STATE OF NEW HAMPSHIRE
INTER-DEPARTMENT COMMUNICATION

DATE: March 22, 2024

FROM:	Joshua Brown Wetlands Program Analyst	**AT (OFFICE):**	Department of Transportation
SUBJECT	Dredge & Fill Application Springfield, 20509		Bureau of Environment
TO	Karl Benedict, Public Works Permitting Officer New Hampshire Wetlands Bureau 29 Hazen Drive, P.O. Box 95 Concord, NH 03302-0095		

Forwarded herewith is the application package prepared by the Bureau of Bridge Design, for the subject major impact project. The project involves the replacement of twin 5' diameter corrugated metal pipes carrying Star Lake Outlet under George's Mills Rd in Springfield, NH. The existing pipes are constructed with masonry headwalls and are considered a bridge. The structural condition is poor due to deterioration of the pipes, failing headwall, and inadequate hydraulic capacity/flood storage potential. The project proposes to replace the current pipes with a 20-foot pre-cast concrete culvert in the same location.

This project was reviewed at the Natural Resource Agency Coordination Meeting on December 18, 2019. A copy of the minutes has been included with this application package. A copy of this application and plans can be accessed on the Departments website via the following link: https://www.dot.nh.gov/projects-plans-and-programs/programs/environmental-management-system/project-management-section-0.

NHDOT anticipates and request that this project be reviewed and permitted by the Army Corp of Engineers through the State Programmatic General Permit process. A copy of the application has been sent to the Army Corp of Engineers.

The lead people to contact for this project are Jennifer Reczek, Bureau of Bridge Design (271-2731 or Jennifer.E.Reczek@dot.nh.gov) or Andrew O'Sullivan, Wetlands Program Manager, Bureau of Environment (271-3226 or Andrew.O'Sullivan@dot.nh.gov).

A payment voucher has been processed for this application (Voucher # 750725) in the amount of $1,190.00.

If and when this application meets with the approval of the Bureau, please send the permit directly to Andrew O'Sullivan, Wetlands Program Manager, Bureau of Environment.

JRB;
cc:
BOE Original
Town of Springfield (4 copies via certified mail)
Mike Dionne & Kevin Newton, NH Fish & Game (via electronic notification)
Maria Tur, US Fish & Wildlife (via electronic notification)
Jeanie Brochi, US Environmental Protection Agency (via electronic notification)
Michael Hicks & Rick Kristoff, US Army Corp of Engineers (via electronic notification)
Kevin Nyhan, BOE (via electronic notification)

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Springfield 20509

Culvert Replacement –

Georges Mills Road - Star Lake Outlet Springfield, NH

FINAL Standard Dredge and Fill Application

March 2024

New Hampshire DOT Department of Transportation

Contents

Attachments

1.0 Project Description

The New Hampshire Department of Transportation (NHDOT) proposes the replacement of twin 5-foot diameter corrugated metal pipes that convey Star Lake Outlet under George's Mills Road in Springfield, NH. Star Lake Outlet is a Tier 3 stream with a 2,240-acre watershed.

The purpose of the project is to replace the inadequate stream crossing under Georges Mills Road with an improved stream crossing structure. This will improve hydrologic connectivity and capacity. The bottom of the culvert will be buried 4 ft underground and stream substrate will be added to allow the stream to function in a more natural state and will prevent undermining of the culvert downstream and will improve stream connectivity.

Several designs options were proposed to replace the existing culvert but it was determined that a 20-foot, precast concrete box culvert was the preferred option. This option would limit impacts to wetlands, reduce cost, and minimize the road closure timeframe during construction.

The total construction area that will be required to complete Project work will extend approximately 250-300 feet on either side of the existing culverts along Georges Mills Road and 175 feet down Fisher Corner Road and Stryker Road (see Wetland Impact Plan). Wetland impact areas are largely restricted to the culverts and around the inlets and outlets.

Impacts associated with the culvert replacement which crosses under Georges Mills Road includes impacts to the stream channel, stream bank, as well as temporary and permanent impacts to vegetated wetlands. These impacts are shown in the impacts table below and can be found on the Wetland Impact Plans.

Wetland Impact Summary Based on Wetland Impact Plan Dated 6/2023

Wetland Impact Summary						
WETLAND NUMBER	WETLAND CLASSIFICATION	LOCATION	PERMANENT N.H.W.B. & A.C.O.E.	BANK	CHANNEL	TEMPORARY IMPACTS
			SF	LF	LF	SF
2	R2UB1,2	A	584	56	23	
2	R2UB1,2	B		12	5	519
3	PFO1E	C				135
3	PFO1E	D	105			
1	R2UB1,2	E		12	5	423
1	R2UB1,2	F	867	99	39	
5	PEM1E	G	65			
1	R2UB1,2	H	185	44	21	
1	R2UB1,2	I		11	5	92
	SUBTOTAL PERMANENT		1806	199	83	
	SUBTOTAL TEMPORARY			35	15	1169

2.0 Requirements for Application Evaluation

The following narrative corresponds to Section 7 of the Standard Dredge and Fill Application under Administrative Rule **Env-Wt 900 – Stream Crossings; Certified Culvert Maintainer Program:**

Env-Wt 903.01 Classification of Stream Crossings and Stream Crossing Projects.

(a) Stream crossings shall be classified as tier 1, tier 2, tier 3, or tier 4 as specified in Env-Wt 904.03(a), Env-Wt 904.04(a), Env-Wt 904.05(a), or Env-Wt 904.06(a), respectively.

Based on the watershed drainage area calculated on the USGS StreamStats website the watershed drainage area is approximately 3.5 square miles. This drainage area exceeds 640 acres; therefore, this stream crossing is classified as Tier 3.

(b) A stream crossing project shall be classified as minimum impact, minor impact, or major impact based on (e) through (g), below.

The project is a replacement of a Tier 3 stream crossing; therefore, the project is classified as a major impact.

Env-Wt 903.02 Application Fees.

(c) The application fee for a stream crossing project that does not qualify as a minimum impact project shall be calculated as specified in RSA 482-A:3, I(c) based upon the sum of the square feet of impacts to the banks and channel bottom and other associated jurisdictional areas.

Total permanent and temporary impacts include 2,975 square feet of impacts to the stream and adjacent wetlands. The calculated fee of $1,190 is required for the project. Please see the Standard Dredge and Fill Wetlands Permit Application form above for more detail on the impacts and calculations.

Env-Wt 903.04 Information Required for All Stream Crossing Standard Permit Applications:

(g) A narrative explaining why the cross-sections identified pursuant to (b)(7), above, are representative;

As noted in the Hydraulic and Hydrologic Report provided in the attachments to this application, the replacement streambed/banks will simulate the existing streambed/banks at the upstream/downstream locations within the project limit of disturbance. Simulated streambed material will be placed immediately upstream and downstream of the proposed culvert as shown on the attached design plans. All efforts will be made to replicate the existing stream channel and banks adjacent to the work area. If the streambed material is not available, the material used will consist of native cobble, boulders and stones from a nearby local gravel pit and mixed with the existing streambed materials. Angular, subangular, or sub-rounded rock (flat bottom) is preferred over round rock.

(h) The design features used to improve aquatic organism passage and the expected distance, in linear feet, of downstream and upstream improvement for aquatic organism passage or fish passage;

The streambed/bank material has been selected with the intent to create a natural stream channel and stream banks upstream/downstream of the culvert that simulates the nearby channel to encourage fish passage and resist scour during larger seasonal rain events.

(i) The hydraulic capacity of the proposed crossing, in terms of flood frequency event, and of the existing crossing, if any;

The proposed stream crossing is not located within a FEMA 100-year flood plain, however, during development of the project the flood frequency was calculated using the Corp of Engineers Hydrologic Engineer Center's (HEC's) HEC-RAS River Analysis System to develop the existing and proposed hydraulic models for this project. The river modeling software GeoHECRAS was utilized to help develop the models. The existing 100-year peak discharge calculated during the simulation was determined to be approximately 510 cubic feet per second (CFS). The estimated bankfull discharge at the crossing was calculated to be approximately 117 CFS. The calculated 100-year peak discharge calculated for the proposed structure is approximately 510 CFS and the 50-year peak discharge is approximately 421 CFS.

Env-Wt 903.05 Information Required for Certain Stream Crossing Standard Permit Applications:

(a) For tier 2 and tier 3 crossings, the following additional channel information at the crossing and for the design reference reach including:

(1) A longitudinal profile that is 7 to 10 bankfull widths long with grade controls, pools, and gradients shown; and

(2) Particle size distribution of the reference reach;

Please see the Stream Crossing Assessment Report attached to this application for the for the longitudinal profile with grade control points and particle size distribution of the reference reach.

(b) For tier 2, tier 3, and tier 4 crossings, streambed details, with figures, that show the following:

(1) The distance from the top of the right bank to the top of the left bank;

(2) The streambed simulation materials and the extent, depth, and length of the streambed within the proposed crossing;

(3) Approximate elevations, spacing, diameters, and locations of structures for steps, bank stabilization, and other channel rocks for roughness; and

Please see the preliminary plans attached to this application for the streambed details including figures showing the information outlined in (1) and (2). The information outlined in (3) will not be provided pursuant to the alternative design.

(c) For tier 2, tier 3, and tier 4 crossings, the following information on the proposed crossing:

(1) The openness ratio, namely the ratio of the area of a cross-section of an individual cell or barrel of a crossing structure, excluding any embedded area, to the length of the structure along the channel;

(2) A narrative assessment of the streambed details provided pursuant to (b), above, channel information of existing crossing metrics relative to the proposed structure, as discussed in the NH stream crossing guidelines, available as noted in Appendix B;
(3) A narrative assessment of the long-term erosion and stability consequences of constructing the proposed stream crossing, and methods and structures to be implemented to minimize any consequences identified;
(4) A narrative assessment of the bed forms and streambed characteristics necessary to cause water depths and velocities within the crossing structure at a variety of flows to be comparable to those found in the natural channel upstream and downstream reaches;
(5) The percent of increase in the hydraulic capacity of the stream crossing;
(6) A narrative analysis of how connectivity considerations were addressed focusing on stream reach, stream type, stream stability, and existing and potential for erosion in siting and modifying or replacing an existing stream crossing;
(7) A narrative explanation of the detrimental geomorphic consequences that have occurred as a result of the existing stream crossing, if any; and
(8) A narrative explanation of the crossing's contribution to flooding that damages the crossing or other human infrastructure;

The crossing structure openness ratio of the proposed concrete box culvert is 1.12. The proposed 20-foot wide 76-foot length box culvert will be buried a minimum of 3 feet and fill based on the streambed assessment will be installed within the culvert to simulate a natural streambed. The fill will be selected and installed as per the stream assessment worksheet in this application. Please see the Hydrologic and Hydraulic Report attached to this application for calculations and a narrative describing the increase of hydraulic capacity at the stream crossing. The failing twin culverts at the existing crossing are eroding along the headwall. The proposed concrete box culvert and headwalls will protect the slopes adjacent to the roadways as well as improve hydrologic capacity during 50 and 100 year storm events.

(d) For tier 3 crossings, structural details of the crossing, including the following:
(1) Structural section, gauge or thickness, and material, minimum and maximum cover limits;
(2) Structures, drawn to scale, on elevation view showing bed material location relative to structure, and special backfill zones; and (3) Structural excavation quantity and total excavation estimate;

Please see the preliminary plan details attached to this application for structural details of the proposed crossing.

(e) For tier 2 and tier 3 crossings, a demonstration that all design and construction considerations outlined in the NH stream crossing guidelines, available as noted in Appendix B, have been addressed;

The proposed installation of the structure is not practicable under the applicable rules; therefore, an alternative design was utilized for the project. The alternative design analysis can be found in the Hydraulic and Hydraulic Report in the attachments to this application.

Env-Wt 903.06 Hydraulic Capacity Report.

(b) A replacement tier 3 or tier 4 stream crossing for which the existing stream crossing cannot accommodate the design storm flow.

Please see the Hydrologic and Hydraulic Report attached to this application for calculations and a narrative describing the design storm flow rate at the existing and proposed culvert.

Env-Wt 904.01 General Design Considerations:

(a) All stream crossings, whether over tidal or non-tidal waters, shall be designed and constructed so as to:

(1) Not be a barrier to sediment transport;
(2) Not restrict high flows and maintain existing low flows;
(3) Not obstruct or otherwise substantially disrupt the movement of aquatic organisms indigenous to the waterbody beyond the actual duration of construction;

The proposed crossing has been designed to not restrict sediment transport, not to impede high flows, to maintain existing flows, and to not disrupt the movement of aquatic organisms. The crossing will improve the hydraulic capacity of the existing crossing to have less flooding potential.

(4) Not cause an increase in the frequency of flooding or overtopping of banks;
(5) Maintain or enhance geomorphic compatibility by:

a. Minimizing the potential for inlet obstruction by sediment, wood, or debris; and

b. Preserving the natural alignment of the stream channel;

(6) Preserve watercourse connectivity where it currently exists;
(7) Restore watercourse connectivity where:

a. Connectivity previously was disrupted as a result of human activity(ies); and

b. Restoration of connectivity will benefit aquatic organisms upstream or downstream of the crossing, or both;

(8) Not cause erosion, aggradation, or scouring upstream or downstream of the crossing; and
(9) Not cause water quality degradation.

The replacement stream crossing will benefit aquatic organisms that utilize both the upstream and downstream stream reach of the crossing by restoring and improving connectivity within the stream channel. A clean water bypass will be utilized to preserve the watercourse connectivity during construction. Appropriate best management practices (BMP’s) including sedimentation and erosion controls will be implemented during the project. Please see the Sediment and Erosion Control Plans attached to this application.

Env-Wt 904.02 Conditions Applicable to All Stream Crossing Work:

(a) In-stream work shall be done only during:

(1) Low flow or dry conditions, in non-tidal areas; or

(2) When the tide is seaward of the work area, in tidal areas; and

(b) Work on stream crossings that requires any work in areas that are subject to flowing water shall maintain normal flows and prevent water quality degradation during the work by using best management practices, such as temporary by-pass pipes, culverts, or cofferdams.

The proposed project will be conducted during low flow and in dry conditions utilizing a clean water bypass to preserve watercourse connectivity.

Env-Wt 904.05 Tier 3 Stream Crossings:

(d) A tier 3 stream crossing shall be a span structure or an open-bottomed culvert with stream simulation, not a closed-bottom culvert or pipe arch.

(e) The applicant may propose an alternative design by submitting a request as specified in Env-Wt 904.10.

(f) Compensatory mitigation shall not be required for:

(1) Any new tier 3 stream crossing that:

a. Meets the general design criteria in Env-Wt 904.01 and the tier-specific criteria of EnvWt 904.07;

b. Is self-mitigating; and

c. Improves aquatic organism passage, connectivity, and hydraulics; or

(2) Any replacement of a crossing that met all applicable requirements when originally installed but is in a location that results in the crossing being classified as tier 3 under these rules, provided the proposed stream crossing meets the requirements of Env-Wt 904.09.

(g) Plans for a tier 3 stream crossing shall be dated and bear the signature and seal of the professional engineer who prepared or had responsibility for and approved them, as required by RSA 310-A:18.

The proposed installation of the structure is not practicable under the applicable rules; therefore, an alternative design was utilized for the project. The alternative design analysis information can be found as an attachment to this application. Please see the Wetland Impacts plans and Hydraulic and Hydraulic Report for further details addressing this section. A mitigation fee for unavoidable permanent impacts to the ARM fund is anticipated for the project. The contract plans will be stamped by a professional engineer and dated.

Env-Wt 904.07 Design Criteria for Tier 2, Tier 3, and Tier 4 Stream Crossings:

(a) Unless otherwise specified, all design criteria in this section shall apply to new and replacement tier 2, tier 3, and tier 4 stream crossings.

(b) Tier 2 and tier 3 stream crossings shall be designed in accordance with the NH stream crossing guidelines, available as noted in Appendix B;

The replacement stream crossing has been designed to avoid and minimize impacts to environmental resources within and downstream of the project area. The crossing has been designed in accordance with the NH stream crossing guidelines to the greatest extent practicable.

(c) Tier 2, tier 3, and tier 4 stream crossings shall be designed:

(1) To meet the general design considerations specified in Env-Wt 904.01;

(2) Of sufficient size to accommodate the greater of:

a. The 100-year 24-hour design storm;

b. Flows sufficient to:

1. Prevent an increase in flooding on upstream and downstream properties; and

2. Not affect flows and sediment transport characteristics in a way that could adversely affect channel stability; or

c. Applicable federal, state, or local requirements;

(3) With the bed forms and streambed characteristics necessary to cause water depths and velocities within the crossing structure at a variety of flows to be comparable to those found in the natural channel upstream and downstream of the stream crossing;

(4) To provide a vegetated bank on both sides of the watercourse or to provide a wildlife shelf of suitable substrate and access to allow for wildlife passage;

(5) To preserve the natural alignment and gradient of the stream channel, so as to accommodate natural flow regimes and the functioning of the natural floodplain;

(6) To simulate a natural stream channel;

(7) So as not to alter sediment transport competence; and

(8) To avoid and minimize impacts to the stream in accordance with Env-Wt 313.03.

(d) In addition to meeting the criteria specified in (c), above, new, repaired, rehabilitated, or replaced tier 4 stream crossing shall be designed:

(1) Based on a hydraulic analysis that accounts for daily fluctuating tides, bidirectional flows, tidal inundation, and coastal storm surge;

(2) To prevent creating a restriction on tidal flows; and

(3) To account for tidal channel morphology and potential impacts due to sea level rise.

The proposed stream crossing was designed in accordance with the NH stream crossing guidelines and the general design considerations of Env-Wt 904.01. The proposed culvert has been hydraulically upsized to improve hydrologic capacity during 50 and 100 year storm events.

Env-Wt 904.09 Repair, Rehabilitation, or Replacement of Tier 3 and Tier 4 Existing Legal Crossings:

(a) The repair, rehabilitation, or replacement of tier 3 stream crossings shall be limited to existing legal crossings where the tier classification is based only on the size of the contributing watershed.

(b) Rehabilitation of a culvert or other closed-bottom stream crossing structure pursuant to this section may be accomplished by concrete repair, slip lining, cured-in place lining, or

concrete invert lining, or any combination thereof, except that slip lining shall not occur more than once.

(c) A project shall qualify under this section only if a professional engineer certifies, and provides supporting analyses to show, that:

(1) The existing crossing does not have a history of causing or contributing to flooding that damages the crossing or other human infrastructure or protected species habitat; and

(2) The proposed stream crossing will:

a. Meet the general criteria specified in Env-Wt 904.01;

b. Maintain or enhance the hydraulic capacity of the stream crossing;

c. Maintain or enhance the capacity of the crossing to accommodate aquatic organism passage;

d. Maintain or enhance the connectivity of the stream reaches upstream or downstream of the crossing; and

e. Not cause or contribute to the increase in the frequency of flooding or overtopping of the banks upstream or downstream of the crossing.

The project as proposed qualifies under this section as a Tier 3 stream crossing based on the contributing watershed size. The proposed stream crossing will replace the existing culvert and has exceeded the general criteria specified in Env-Wt 904.01. The crossing will enhance the hydraulic capacity, improve aquatic organism passage, hydraulic connectivity, and will not increase flood potential at the crossing. To maximize hydraulic capacity and minimize impacts the proposed project does not have bedform and streambed characteristics or a vegetated bank or wildlife shelf as part of the alternative design. This project has been designed to meet these criteria to the maximum extent practicable per 904.10(c)(2)(b).

The proposed work falls under the definition of a replacement provided in Env-Wt 902.26 "Replacement" as applied to a stream crossing means the removal of all or a portion of an existing legal structure and the installation of a new structure or new portion of the structure that does not qualify as a repair or a replacement in-kind." The new structure will be significant improvement to the existing structure and will installed at the same skew of the existing stream channel. Flow capacity and aquatic organism passage of the crossing will be improved following construction.

Env-Wt 904.10 Alternative Designs:

(a) If the applicant can demonstrate that installing the structure specified in the applicable rule is not practicable, as that term is defined in Env-Wt 103, the applicant may propose an alternative design in accordance with this section.

(b) To request approval of an alternative design, the applicant shall submit a written request to the department, accompanied by a technical report that:

(1) Clearly explains how the proposed alternative meets the criteria for approval specified in (c) or (d), below, as applicable; and

(2) Has been prepared by:

a. An environmental scientist or professional engineer for a tier 1 stream crossing; or

b. A professional engineer for a tier 2, tier 3, or tier 4 stream crossing.

(c) The department shall approve an alternative design for a tier 3 or tier 4 stream crossing if:

> ***(1) The report submitted pursuant to (b), above, demonstrates that adhering to the stated requirements is not practicable, by providing:***
>
> > ***a. A detailed financial comparison of the costs of a structure that complies with all applicable design requirements, the proposed structure, and a structure that requires fewer waivers than the proposed structure, with a range of costs estimates for each;***
> >
> > ***b. A detailed description of the physical limitations of the site; and***
> >
> > ***c. A hydraulic analysis to show that the proposed stream crossing can accommodate the applicable design storm or that the crossing, together with the associated roadway and roadway embankment, can safely accommodate overtopping flows; and***
>
> ***(2) The proposed alternative meets:***
>
> > ***a. The general design criteria established in Env-Wt 904.01; and***
> >
> > ***b. The applicable design criteria established in Env-Wt 904.07 to the maximum extent practicable.***
>
> ***(3) A hydraulic analysis shows that the proposed stream crossing can accommodate the applicable design storm or that the crossing, together with the associated roadway and roadway embankment, can safely accommodate overtopping flows.***

As previously described in this application narrative the proposed installation of the structure is not practicable under the applicable rules; therefore, an alternative design utilizing a closed-bottom structure and a 20-foot span that is less than that is required by the stream crossing requirements is proposed for the project. The proposed alternative meets the general design criteria in Env-Wt 904.01 and the applicable design criteria established in Env-Wt 904.07 to the maximum extent practicable. The proposed alternative design can accommodate the applicable design storm events. Please see the Hydrologic and Hydraulic Report in the attachments of this application.

Attachment 1 -

Standard Dredge and Fill Wetlands Permit Application

STANDARD DREDGE AND FILL WETLANDS PERMIT APPLICATION

Water Division/Land Resources Management Wetlands Bureau

Check the Status of your Application

RSA/Rule: RSA 482-A/Env-Wt 100-900

APPLICANT'S NAME: Jennifer E. Reczek **TOWN NAME:** Springfield

Administrative Use Only	Administrative Use Only	Administrative Use Only	File No.:
			Check No.:
			Amount:
			Initials:

A person may request a waiver of the requirements in Rules Env-Wt 100-900 to accommodate situations where strict adherence to the requirements would not be in the best interest of the public or the environment but is still in compliance with RSA 482-A. A person may also request a waiver of the standards for existing dwellings over water pursuant to RSA 482-A:26, III(b). For more information, please consult the Waiver Request Form.

SECTION 1 - REQUIRED PLANNING FOR ALL PROJECTS (Env-Wt 306.05; RSA 482-A:3, I(d)(2)) Please use the Wetland Permit Planning Tool (WPPT), the Natural Heritage Bureau (NHB) DataCheck Tool, the Aquatic Restoration Mapper, or other sources to assist in identifying key features such as: priority resource areas (PRAs), protected species or habitats, coastal areas, designated rivers, or designated prime wetlands.	
Has the required planning been completed?	☒ Yes ☐ No
Does the property contain a PRA? If yes, provide the following information:	☐ Yes ☒ No
• Does the project qualify for an Impact Classification Adjustment (e.g. NH Fish and Game Department (NHF&G) and NHB agreement for a classification downgrade) or a Project-Type Exception (e.g. Maintenance or Statutory Permit-by-Notification (SPN) project)? See Env-Wt 407.02 and Env-Wt 407.04.	☐ Yes ☒ No
• Protected species or habitat? o If yes, species or habitat name(s): None o NHB Project ID #: NHB24-0471	☐ Yes ☒ No
• Bog?	☐ Yes ☒ No
• Floodplain wetland contiguous to a tier 3 or higher watercourse?	☐ Yes ☒ No
• Designated prime wetland or duly-established 100-foot buffer?	☐ Yes ☒ No
• Sand dune, tidal wetland, tidal water, or undeveloped tidal buffer zone?	☐ Yes ☒ No
Is the property within a Designated River corridor? If yes, provide the following information: • Name of Local River Management Advisory Committee (LAC): • A copy of the application was sent to the LAC on Month: Day: Year:	☐ Yes ☒ No

For dredging projects, is the subject property contaminated? • If yes, list contaminant:	☐ Yes ☒ No
Is there potential to impact impaired waters, class A waters, or outstanding resource waters?	☐ Yes ☒ No
For stream crossing projects, provide watershed size (see WPPT or Stream Stats): 3.5 square miles	

SECTION 2 - PROJECT DESCRIPTION (Env-Wt 311.04(i))

Provide a **brief** description of the project and the purpose of the project, outlining the scope of work to be performed and whether impacts are temporary or permanent. DO NOT reply "See attached"; please use the space provided below.

The project involves the replacement of twin 5' diameter corrugated metal pipes carrying Star Lake Outlet under George's Mills Rd in Springfield. Businesses located on Fisher Corner Rd to the south of the project area require large logging trucks to use the intersection frequently throughout the day. The pipes are constructed with masonry headwalls and are considered to be a bridge. The existing condition is poor due to deterioration of the pipes, failing headwall, and inadequate hydraulic capacity/flood storage potential.

The stream crossing location has a contributing watershed measuring 3.5 square miles within the project area, classifies the proposed replacement crossing as a Tier 3 Crossing under Env-Wt 904.05. Project requires a major impact Dredge and Fill permit for the replacement of a Tier 3 stream crossing. All work will be performed in accordance with NHDES Wetland rules effective 12/15/19 as amended through 1/20/20.

Four options were evaluated during project design. The preferred option avoids and minimizes impacts to the perennial stream and adjacent wetlands to the greatest extent practicable while improving the stream skew, flow, and aquatic organism passage.

To meet NHDOT design requirements, the proposed structure must pass the 50-year design flood event with 1' of freeboard and accommodate the 100-year flood event. The recommended structure is the buried 20' span precast concrete box culvert. This option meets the hydraulic criteria, and provides the best possible fit for the site constraints, including the difficult geometry of the Stryker Rd and Fisher Corner intersections. It has the shortest construction duration, which based on local input is very important, and is the most cost effective. Georges Mills Rd will be closed to through traffic during removal and replacement of the structure. The side roads will remain open to traffic throughout. As soon as possible, Georges Mills Rd will be reopened to traffic & temp lane closures will occur.

SECTION 3 - PROJECT LOCATION

Separate wetland permit applications must be submitted for each municipality within which wetland impacts occur.

ADDRESS: Georges Mills Road	
TOWN/CITY: Springfield	
TAX MAP/BLOCK/LOT/UNIT: N/A	
US GEOLOGICAL SURVEY (USGS) TOPO MAP WATERBODY NAME: None ☒ N/A	
(Optional) LATITUDE/LONGITUDE in decimal degrees (to five decimal places):	43.44888° North -72.05384° West

SECTION 4 - APPLICANT (DESIRED PERMIT HOLDER) INFORMATION (Env-Wt 311.04(a)) If the applicant is a trust or a company, then complete with the trust or company information.		
NAME: Jennifer E. Reczek NHDOT		
MAILING ADDRESS: 7 Hazen Drive, P.O. Box 483		
TOWN/CITY: Concord	STATE: NH	ZIP CODE: 03301
EMAIL ADDRESS: Jennifer.E.Reczek@dot.nh.gov		
FAX: N/A	PHONE: 603-271-3401	
ELECTRONIC COMMUNICATION: By initialing here: [initials], I hereby authorize NHDES to communicate all matters relative to this application electronically.		

SECTION 5 - AUTHORIZED AGENT INFORMATION (Env-Wt 311.04(c)) ☐ N/A		
LAST NAME, FIRST NAME, M.I.: Kevin Ferguson		
COMPANY NAME: TRC		
MAILING ADDRESS: 63 Marginal Way, 4th Floor		
TOWN/CITY: Portland	STATE: ME	ZIP CODE: 04101
EMAIL ADDRESS: kferguson@trccompanies.com		
FAX: N/A	PHONE: 603.534.9734	
ELECTRONIC COMMUNICATION: By initialing here KF, I hereby authorize NHDES to communicate all matters relative to this application electronically.		

SECTION 6 - PROPERTY OWNER INFORMATION (IF DIFFERENT THAN APPLICANT) (Env-Wt 311.04(b)) If the owner is a trust or a company, then complete with the trust or company information. ☒ Same as applicant		
NAME:		
MAILING ADDRESS:		
TOWN/CITY:	STATE:	ZIP CODE:
EMAIL ADDRESS:		
FAX:	PHONE:	
ELECTRONIC COMMUNICATION: By initialing here , I hereby authorize NHDES to communicate all matters relative to this application electronically.		

SECTION 7 - RESOURCE-SPECIFIC CRITERIA ESTABLISHED IN Env-Wt 400, Env-Wt 500, Env-Wt 600, Env-Wt 700, OR Env-Wt 900 HAVE BEEN MET (Env-Wt 313.01(a)(3))

Describe how the resource-specific criteria have been met for each chapter listed above (please attach information about stream crossings, coastal resources, prime wetlands, or non-tidal wetlands and surface waters):

Env-Wt 400: Water courses were delineated according to Env-Wt 406.04, wetlands were delineated according to Env-Wt 406.05, and wetlands were classified on the attached Project Plans according to Env-Wt 406.06. The project is classified as a major impact under Env-Wt 407.03.

Env-Wt 500, Env-Wt 600, Env-Wt 700: N/A

Env-Wt 900: The proposed project was designed in accordance with Env-Wt 904.01 and will not cause degradation to the impacted perennial stream. Stream connectivity will be kept during construction with a clean water bypass. The new location and alignment of the culvert will increase flow, sediment transport, aquatic organism passage, and attenuate the 50 year and 100 year flood stages calculated during in the hydrological analysis. Appropriate best management practices including sedimentation and erosion controls will be implemented during the project. The proposed project was designed in accordance with Env-Wt 900 (903.04, 903.05, 904.01, 904.02, 904.04, 904.07, and 904.08) as applied to the stream crossings. Upon completion of the project the stream crossing will allow improved aquatic organism passage, hydraulic capacity, and geomorphic compatibility (for additional details see Standard Dredge and Fill Application Narrative).

SECTION 8 - AVOIDANCE AND MINIMIZATION

Impacts within wetland jurisdiction must be avoided to the maximum extent practicable (Env-Wt 313.03(a)).* Any project with unavoidable jurisdictional impacts must then be minimized as described in the Wetlands Best Management Practice Techniques For Avoidance and Minimization and the Wetlands Permitting: Avoidance, Minimization and Mitigation Fact Sheet. For minor or major projects, a functional assessment of all wetlands on the project site is required (Env-Wt 311.03(b)(10)).*

Please refer to the application checklist to ensure you have attached all documents related to avoidance and minimization, as well as functional assessment (where applicable). Use the Avoidance and Minimization Checklist, the Avoidance and Minimization Narrative, or your own avoidance and minimization narrative.

**See Env-Wt 311.03(b)(6) and Env-Wt 311.03(b)(10) for shoreline structure exemptions.*

SECTION 9 - MITIGATION REQUIREMENT (Env-Wt 311.02)

If unavoidable jurisdictional impacts require mitigation, a mitigation pre-application meeting must occur at least 30 days but not more than 90 days prior to submitting this Standard Dredge and Fill Permit Application.

Mitigation Pre-Application Meeting Date: Month: 12 Day: 18 Year: 2019

(☐ N/A - Mitigation is not required)

SECTION 10 - THE PROJECT MEETS COMPENSATORY MITIGATION REQUIREMENTS (Env-Wt 313.01(a)(1)c)

Confirm that you have submitted a compensatory mitigation proposal that meets the requirements of Env-Wt 800 for all permanent unavoidable impacts that will remain after avoidance and minimization techniques have been exercised to the maximum extent practicable: ☒ I confirm submittal.

(☐ N/A – Compensatory mitigation is not required)

SECTION 11 - IMPACT AREA (Env-Wt 311.04(g))

For each jurisdictional area that will be/has been impacted, provide square feet (SF) and, if applicable, linear feet (LF) of impact, and note whether the impact is after-the-fact (ATF; i.e., work was started or completed without a permit).

For intermittent and ephemeral streams, the linear footage of impact is measured along the thread of the channel. *Please note, installation of a stream crossing in an ephemeral stream may be undertaken without a permit per Rule Env-Wt 309.02(d), however other dredge or fill impacts should be included below.*

For perennial streams/rivers, the linear footage of impact is calculated by summing the lengths of disturbances to the channel and banks.

Permanent impacts are impacts that will remain after the project is complete (e.g., changes in grade or surface materials).

Temporary impacts are impacts not intended to remain (and will be restored to pre-construction conditions) after the project is completed.

JURISDICTIONAL AREA		PERMANENT			TEMPORARY		
		SF	LF	ATF	SF	LF	ATF
Wetlands	Forested Wetland	105		☐	135		☐
	Scrub-shrub Wetland			☐			☐
	Emergent Wetland	65		☐			☐
	Wet Meadow			☐			☐
	Vernal Pool			☐			☐
	Designated Prime Wetland			☐			☐
	Duly-established 100-foot Prime Wetland Buffer			☐			☐
Surface Water	Intermittent / Ephemeral Stream			☐			☐
	Perennial Stream or River	1636	282	☐	1034	50	☐
	Lake / Pond			☐			☐
	Docking - Lake / Pond			☐			☐
	Docking - River			☐			☐
Banks	Bank - Intermittent Stream			☐			☐
	Bank - Perennial Stream / River			☐			☐
	Bank / Shoreline - Lake / Pond			☐			☐
Tidal	Tidal Waters			☐			☐
	Tidal Marsh			☐			☐
	Sand Dune			☐			☐
	Undeveloped Tidal Buffer Zone (TBZ)			☐			☐
	Previously-developed TBZ			☐			☐
	Docking - Tidal Water			☐			☐
TOTAL		1806	282		**1169**	**50**	

SECTION 12 - APPLICATION FEE (RSA 482-A:3, I)

☐ **MINIMUM IMPACT FEE**: Flat fee of $400.

☐ **NON-ENFORCEMENT RELATED, PUBLICLY-FUNDED AND SUPERVISED RESTORATION PROJECTS, REGARDLESS OF IMPACT CLASSIFICATION:** Flat fee of $400 (refer to RSA 482-A:3, 1(c) for restrictions).

☒ **MINOR OR MAJOR IMPACT FEE:** Calculate using the table below:

Permanent and temporary (non-docking):	2975 SF	× $0.40 =	$ 1190
Seasonal docking structure:	SF	× $2.00 =	$
Permanent docking structure:	SF	× $4.00 =	$
Projects proposing shoreline structures (including docks) add $400 =			$
		Total =	$ 1190
The application fee for minor or major impact is the above calculated total or $400, whichever is greater =			$ 1190

SECTION 13 - PROJECT CLASSIFICATION (Env-Wt 306.05) Indicate the project classification.		
☐ Minimum Impact Project	☐ Minor Project	☒ Major Project

SECTION 14 - REQUIRED CERTIFICATIONS (Env-Wt 311.11)	
Initial each box below to certify:	
Initials: KF	To the best of the signer's knowledge and belief, all required notifications have been provided.
Initials: KF	The information submitted on or with the application is true, complete, and not misleading to the best of the signer's knowledge and belief.
Initials: KF	The signer understands that: • The submission of false, incomplete, or misleading information constitutes grounds for NHDES to: 1. Deny the application. 2. Revoke any approval that is granted based on the information. 3. If the signer is a certified wetland scientist, licensed surveyor, or professional engineer licensed to practice in New Hampshire, refer the matter to the joint board of licensure and certification established by RSA 310-A:1. • The signer is subject to the penalties specified in New Hampshire law for falsification in official matters, currently RSA 641. • The signature shall constitute authorization for the municipal conservation commission and the Department to inspect the site of the proposed project, except for minimum impact forestry SPN projects and minimum impact trail projects, where the signature shall authorize only the Department to inspect the site pursuant to RSA 482-A:6, II.
Initials: KF	If the applicant is not the owner of the property, each property owner signature shall constitute certification by the signer that he or she is aware of the application being filed and does not object to the filing.

SECTION 15 - REQUIRED SIGNATURES (Env-Wt 311.04(d); Env-Wt 311.11)		
SIGNATURE (OWNER): Jennifer E. Reczek	PRINT NAME LEGIBLY: Jennifer Reczek	DATE: 3/15/2024
SIGNATURE (APPLICANT, IF DIFFERENT FROM OWNER):	PRINT NAME LEGIBLY:	DATE:
SIGNATURE (AGENT, IF APPLICABLE): Kevin Ferguson	PRINT NAME LEGIBLY: Kevin Ferguson	DATE: 3/14/2024

SECTION 16 - TOWN / CITY CLERK SIGNATURE (Env-Wt 311.04(f))	
As required by RSA 482-A:3, I(a)(1), I hereby certify that the applicant has filed four application forms, four detailed plans, and four USGS location maps with the town/city indicated below.	
TOWN/CITY CLERK SIGNATURE:	PRINT NAME LEGIBLY: N/A EXEMPT - NHDOT
TOWN/CITY:	DATE:

DIRECTIONS FOR TOWN/CITY CLERK:
Per RSA 482-A:3, I(a)(1)

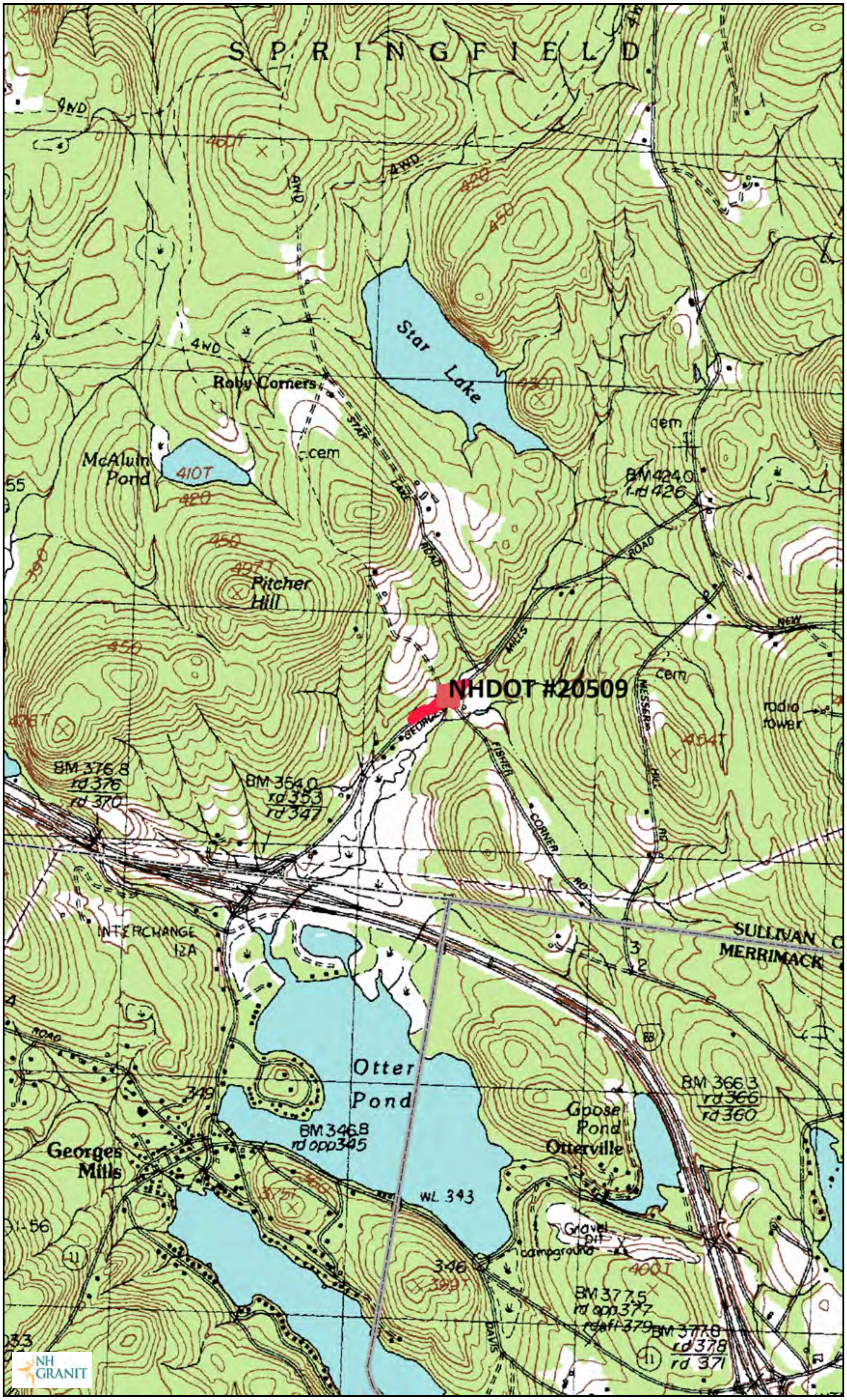
1. IMMEDIATELY sign the original application form and four copies in the signature space provided above.
2. Return the signed original application form and attachments to the applicant so that the applicant may submit the application form and attachments to NHDES by mail or hand delivery.
3. IMMEDIATELY distribute a copy of the application with one complete set of attachments to each of the following bodies: the municipal Conservation Commission, the local governing body (Board of Selectmen or Town/City Council), and the Planning Board.
4. Retain one copy of the application form and one complete set of attachments and make them reasonably accessible for public review.

DIRECTIONS FOR APPLICANT:
Submit the original permit application form bearing the signature of the Town/City Clerk, additional materials, and the application fee to NHDES by mail or hand delivery at the address at the bottom of this page. Make check or money order payable to "Treasurer – State of NH".

Attachment 2 -

USGS Locus Map

Locus Map



Legend

- State
- County
- City/Town

Map Scale

1: 24,000

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Map Generated: 4/27/2023

Notes

NHDES - Standard Wetland Impact Application

Attachment 3 -

Attachment A: Minor and Major Projects

STANDARD DREDGE AND FILL WETLANDS PERMIT APPLICATION ATTACHMENT A: MINOR AND MAJOR PROJECTS

Water Division/Land Resources Management

Wetlands Bureau

Check the Status of your Application

RSA/ Rule: RSA 482-A/ Env-Wt 311.10; Env-Wt 313.01(a)(1); Env-Wt 313.03

APPLICANT'S NAME: Jennifer E. Reczek **TOWN NAME:** Springfield

Attachment A is required for *all minor and major projects*, and must be completed *in addition* to the Avoidance and Minimization Narrative or Checklist that is required by Env-Wt 307.11.

For projects involving construction or modification of non-tidal shoreline structures over areas of surface waters having an absence of wetland vegetation, only Sections I.X through I.XV are required to be completed.

PART I: AVOIDANCE AND MINIMIZATION
In accordance with Env-Wt 313.03(a), the Department shall not approve any alteration of any jurisdictional area unless the applicant demonstrates that the potential impacts to jurisdictional areas have been avoided to the maximum extent practicable and that any unavoidable impacts have been minimized, as described in the Wetlands Best Management Practice Techniques For Avoidance and Minimization.
SECTION I.I - ALTERNATIVES (Env-Wt 313.03(b)(1)) Describe how there is no practicable alternative that would have a less adverse impact on the area and environments under the Department's jurisdiction.
REPLACEMENT OPTIONS EVALUATED CONSISTED OF A 20-FOOT PRECAST CONCRETE CULVERT, A 31-FOOT PRECAST CONCRETE RIGID FRAME AND A 31-FOOT SOLID PRECAST CONCRETE SLAB BRIDGE. THE 20-FOOT CULVERT IS THE PREFERRED OPTION AS IT IS THE MOST COST EFFECTIVE OPTION. ALSO, THE BRIDGE WILL BE CLOSED DURING CONSTRUCTION AND THE PRECAST CULVERT IS THE QUICKEST TO CONSTRUCT THEREBY REDUCING THE IMPACT OF THE BRIDGE CLOSURE TO THE PUBLIC. THE TOWN AGREED TO THE CLOSURE BUT WOULD LIKE THE QUICKEST CLOSURE DURATION POSSIBLE. THE CULVERT DOES NOT MEET THE ENTRENCHMENT RATIO TIMES BANK FULL WIDTH AND DOES NOT HAVE BANKS INSIDE THE STRUCTURE BUT DOES MEET NHDOT HYDRAULIC CRITERIA. THE CULVERT WOULD HAVE STREAM SIMULATION MATERIAL PLACED AT THE BOTTOM AND AT THE INLET AND OUTLET OF THE STRUCTURE. THE DEPARTMENT RECOGNIZES THAT AN ALTERNATE DESIGN WILL NEED TO BE SUBMITTED AS PART OF THE NHDES WETLAND DREDGE AND FILL PERMIT APPLICATION. HOWEVER, THE 20-FOOT CULVERT IS A SIGNIFICANT IMPROVEMENT OVER THE EXISTING CONDITION.

SECTION I.II - MARSHES (Env-Wt 313.03(b)(2)) Describe how the project avoids and minimizes impacts to tidal marshes and non-tidal marshes where documented to provide sources of nutrients for finfish, crustacean, shellfish, and wildlife of significant value.
Not applicable. Tidal and non-tidal marshes are not located within the project area
SECTION I.III - HYDROLOGIC CONNECTION (Env-Wt 313.03(b)(3)) Describe how the project maintains hydrologic connections between adjacent wetland or stream systems.
The replacement of the culverts will improve the hydrologic connection between the upstream and downstream reaches of the stream at the culvert crossing by including simulated streambed material outside and through the new culvert.

SECTION I.IV - JURISDICTIONAL IMPACTS (Env-Wt 313.03(b)(4))

Describe how the project avoids and minimizes impacts to wetlands and other areas of jurisdiction under RSA 482-A, especially those in which there are exemplary natural communities, vernal pools, protected species and habitat, documented fisheries, and habitat and reproduction areas for species of concern, or any combination thereof.

Impacts include temporary and permanent impacts to the stream channel for replacement of the existing crossing. Temporary impact include 1,169 square feet and 50 linear feet and permanent impacts include 1,806 square feet and 282 linear feet of perennial stream channel as part of the proposed project. Two options were evaluated during project design. The preferred option avoids and minimizes impacts to wetlands to the greatest extent practicable while improving the stream skew, flow, and aquatic organism passage. No exemplary natural communities, vernal pools, protected species and habitat, documented fisheries, and habitat and reproduction areas for species of concern exist within or in the vicinity of the project. A natural stream bottom will be constructed along the improved/replaced portion of the stream.

SECTION I.V - PUBLIC COMMERCE, NAVIGATION, OR RECREATION (Env-Wt 313.03(b)(5))

Describe how the project avoids and minimizes impacts that eliminate, depreciate or obstruct public commerce, navigation, or recreation.

Georges Mill Road serves as a roadway providing public commerce into and out of Springfield, NH. The replacement of the culverts for this project will improve the skew and hydraulics of the stream channel thereby protecting Georges Mill Road from potential erosion and flood damage. The project as proposed avoids and minimizes impacts that eliminate, depreciate, or obstruct public commerce. The project will improve safety for the traveling public by providing an adequate stream crossing for traffic along the roadway. The project as proposed will have no effect on navigation or recreation.

SECTION I.VI - FLOODPLAIN WETLANDS (Env-Wt 313.03(b)(6))

Describe how the project avoids and minimizes impacts to floodplain wetlands that provide flood storage.

The project is located on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map, panel number 33019C0210E, effective May 23, 2006. The map indicates the project is located in Zone X which is located outside of the 100-year floodplain. The project as proposed would not impact floodplain wetlands as defined in Env-Wt 103.10.

SECTION I.VII - RIVERINE FORESTED WETLAND SYSTEMS AND SCRUB-SHRUB – MARSH COMPLEXES (Env-Wt 313.03(b)(7))

Describe how the project avoids and minimizes impacts to natural riverine forested wetland systems and scrub-shrub – marsh complexes of high ecological integrity.

The project as proposed will not impact forested wetlands and scrub-shrub marsh complexes.

SECTION I.VIII - DRINKING WATER SUPPLY AND GROUNDWATER AQUIFER LEVELS (Env-Wt 313.03(b)(8))

Describe how the project avoids and minimizes impacts to wetlands that would be detrimental to adjacent drinking water supply and groundwater aquifer levels.

The project as proposed will not impact any drinking water supply or groundwater aquifer levels. The project does not propose any increase to impervious surfaces, will not change recharge levels to the stream within or adjacent to the project area. Adequate sediment and erosion control measures and best management practices will be implemented during the construction of this project.

SECTION I.IX - STREAM CHANNELS (Env-Wt 313.03(b)(9))

Describe how the project avoids and minimizes adverse impacts to stream channels and the ability of such channels to handle runoff of waters.

Replacement of the existing culverts will improve the skew and hydraulics associated with the stream crossing. The project as proposed will improve the flow of the stream and prevent further erosion at the headwalls. The 100 year and 50 year flood stages from the stream simulation were used to design the proposed project.

SECTION I.X - SHORELINE STRUCTURES - CONSTRUCTION SURFACE AREA (Env-Wt 313.03(c)(1))

Describe how the project has been designed to use the minimum construction surface area over surface waters necessary to meet the stated purpose of the structures.

Not applicable. Shoreline is not located within the project area.

SECTION I.XI - SHORELINE STRUCTURES - LEAST INTRUSIVE UPON PUBLIC TRUST (Env-Wt 313.03(c)(2))

Describe how the type of construction proposed is the least intrusive upon the public trust that will ensure safe docking on the frontage.

Not applicable. Shoreline is not located within the project area

SECTION I.XII - SHORELINE STRUCTURES – ABUTTING PROPERTIES (Env-Wt 313.03(c)(3)) Describe how the structures have been designed to avoid and minimize impacts on ability of abutting owners to use and enjoy their properties.
Not applicable. Shoreline is not located within the project area.

SECTION I.XIII - SHORELINE STRUCTURES – COMMERCE AND RECREATION (Env-Wt 313.03(c)(4)) Describe how the structures have been designed to avoid and minimize impacts to the public's right to navigation, passage, and use of the resource for commerce and recreation.
Not applicable. Shoreline is not located within the project area.

SECTION I.XIV - SHORELINE STRUCTURES – WATER QUALITY, AQUATIC VEGETATION, WILDLIFE AND FINFISH HABITAT (Env-Wt 313.03(c)(5)) Describe how the structures have been designed, located, and configured to avoid impacts to water quality, aquatic vegetation, and wildlife and finfish habitat.
Not applicable. Shoreline is not located within the project area.

SECTION I.XV - SHORELINE STRUCTURES – VEGETATION REMOVAL, ACCESS POINTS, AND SHORELINE STABILITY (Env-Wt 313.03(c)(6)) Describe how the structures have been designed to avoid and minimize the removal of vegetation, the number of access points through wetlands or over the bank, and activities that may have an adverse effect on shoreline stability.
Not applicable. Shoreline is not located within the project area.

PART II: FUNCTIONAL ASSESSMENT
REQUIREMENTS Ensure that project meets the requirements of Env-Wt 311.10 regarding functional assessment (Env-Wt 311.04(j); Env-Wt 311.10).
FUNCTIONAL ASSESSMENT METHOD USED: USACE Highway Methodology.
NAME OF CERTIFIED WETLAND SCIENTIST (FOR NON-TIDAL PROJECTS) OR QUALIFIED COASTAL PROFESSIONAL (FOR TIDAL PROJECTS) WHO COMPLETED THE ASSESSMENT: KEVIN FERGUSON
DATE OF ASSESSMENT: 4/26/2023
Check this box to confirm that the application includes a NARRATIVE ON FUNCTIONAL ASSESSMENT: ☒
For minor or major projects requiring a standard permit without mitigation, the applicant shall submit a wetland evaluation report that includes completed checklists and information demonstrating the RELATIVE FUNCTIONS AND VALUES OF EACH WETLAND EVALUATED. Check this box to confirm that the application includes this information, if applicable: ☒ Note: The Wetlands Functional Assessment worksheet can be used to compile the information needed to meet functional assessment requirements.

Attachment 4 -

Natural Resource Agency Coordination Meeting Minutes

BUREAU OF ENVIRONMENT
CONFERENCE REPORT

SUBJECT: NHDOT Monthly Natural Resource Agency Coordination Meeting
DATE OF CONFERENCE: December 18, 2019
LOCATION OF CONFERENCE: John O. Morton Building
ATTENDED BY:

NHDOT
Matt Urban
Sarah Large
Ron Crickard
Andrew O'Sullivan
Marc Laurin
Joseph Adams
Meli Dube
Tim Mallette
Michael Licciardi
Jennifer Reczek

ACOE
Mike Hicks

EPA
Mark Kern
Jeannie Brochi
Beth Alafat

US Coast Guard
*Jeffrey Stieb

US Fish & Wildlife Services
Susi von Oettingen

NHDES
Lori Sommer
Karl Benedict
Eben Lewis

NH Fish & Game
Carol Henderson
Brendan Clifford

NH NHB
Amy Lamb

Consultants/Public Participants
Pete Walker
Lindsey Matras
John Byatt
Kristen Hayden
Chris Fournier
Sarah Barnum
John Stockton
Dan Hageman
Stephanie Dyer-Carroll

*Attendee called in for Seabrook-Hampton, #15904

PRESENTATIONS/ PROJECTS REVIEWED THIS MONTH: *(minutes on subsequent pages)*

(When viewing these minutes online, click on a project to zoom to the minutes for that project.)

NOTES ON CONFERENCE:

Meeting Minutes
Finalized the August 21, 2019 meeting minutes. The group agreed to finalize the October 16, 2019 meeting minutes at the January 15, 2020 meeting. Postponed finalizing the November 20, 2019 meeting minutes.

Keene-Swanzey, #40100 (X-A004(345))
Pete Walker introduced the project, explaining that it seeks to identify an appropriate site to provide compensatory flood storage in Keene to offset four NHDOT construction contracts. These construction projects were completed from 2007-2017. Wetland mitigation was completed, but NHDOT has been unable to find an acceptable floodplain mitigation site. Pete presented the Project Purpose as follows:
Identify an appropriate floodplain mitigation site or sites, in consultation with the City of Keene and state and federal agencies, to provide 19.9 acre-feet of floodplain compensatory storage within the Ashuelot River watershed for four construction contracts:

- Contract 10309A: Base Hill Road Intersections with NH 9 and NH 10 (Completed 2007)
- Contract 10309H: NH 10/Winchester Street Roundabout (Completed 2008)
- Contract 10309O: West Street Improvements (Completed 2008)
- Contract 10309P: Multi-use trail over NH 12/101 (Completed 2017)

VHB is compiling a GIS database, from which a series of filters will be run to identify high priority floodplain mitigation sites in the City of Keene. Initial screening criteria will include:

- Minimum parcel size, most likely a 5-acre minimum parcel size, based on tax parcels;
- Geomorphic position relative to existing floodplain to find sites within or adjacent to the 100-year floodplain;
- Ownership and development status - Publicly-owned site preferred, but private sites not excluded; and
- At least 5 acres undeveloped.

Once the initial screening is completed, VHB will use LiDAR topographic data to estimate the maximum potential compensation flood storage volume for potential mitigation sites – likely up to eight (8) parcels. A total of four sites will be selected for field studies, which will include development of an existing conditions survey, wetland delineations, preliminary cultural resource reviews, rare species coordination, and possibly geotechnical surveys.

P. Walker mentioned to Amy Lamb about establishing a data-sharing agreement for NHB data for the City of Keene.

VHB will be looking for feedback from agencies and the City of Keene during the screening process. Conceptual designs will be developed for all four alternatives (i.e., 30% design - preliminary grading plan). An engineering report will be submitted in the fall, which would serve as an alternatives analysis document, identifying the most feasible floodplain mitigation site. A Categorical Exclusion NEPA document will likely be required. Public Informational Meetings will be held (first one on January 21, 2020), and, if required, a public hearing.

Meeting attendees identified some confusion about whether these four projects requiring floodplain mitigation were complete already or are being proposed for construction. P. Walker confirmed that they have already been constructed. Mark Kern and Tim Mallette asked if the wetlands mitigation has already been completed for the project. P. Walker explained that permits were previously obtained for these projects, most of which were obtained in 1999. Marc Laurin recalled an ARM Fund payment was used for wetlands mitigation for the 10309P project and preservation was identified as mitigation for the other projects at that time, but would look up the supporting information and email to meeting attendees or bring the information to the next meeting.

Lori Sommer asked if floodplain mitigation uses a 1:1 ratio of impact area to mitigation area; P. Walker and Mike Hicks confirmed, per Executive Order. Pete mentioned that the project will consider the Keene Floodplain Ordinance as well, which has some additional criteria.

L. Sommer asked if the selection criteria considered developed sites, since some of the businesses on developed sites are closed. P. Walker clarified that developed sites will not be excluded, but sites that are currently undeveloped or are largely undeveloped will be preferred. L. Sommer asked if wetlands would be constructed as part of the floodplain mitigation. P. Walker explained that wetlands may be developed indirectly but the end goal is to create flood storage areas on the site (excavation would occur to create the storage).

Beth Alafat asked if the floodplain mitigation process would improve existing problems with the City of Keene's stormwater system. P. Walker responded that while stormwater is part of bigger flooding issue in Keene, the City of Keene doesn't have the funding to fully implement all the stormwater retrofits needed to control urban flooding in the City. P. Walker asked if finding a floodplain mitigation site for 20-acre feet of floodplain storage proved difficult, would the agencies be open to stormwater retrofit instead of creation of a specific compensatory storage site? Agency responses for L. Sommer and M. Kern indicated that this would be considered, however it may be difficult to clearly demonstrate the floodplain mitigation benefit of a stormwater project.

Karl Benedict mentioned the new wetland rules require no impacts to stormwater volume, and recommend referring to that rule once the project develops further. If wetlands are impacted during the creation of flood storage, the new stormwater rule would be applied during the permitting process.

A. Lamb requested that the screening process give preference to non-forested areas. There are concerns with using a forested site with a high water table as floodplain mitigation. P. Walker confirmed that it is unlikely that a mature forested site would be used for floodplain storage.

L. Sommer recommended Monadnock Conservancy as an environmental partner in Keene (contacts being Ryan Owens and Anne McBride) to connect with landowners in the area or identify potential mitigation parcels.

P. Walker mentioned that if floodplain excavation was conducted a wetland seed mix would likely be used. L. Sommer expressed concerns about invasive species if excavation occurred; creation of the floodplain mitigation site would therefore require monitoring. Andrew O'Sullivan asked for more details about invasive species monitoring requirements, and if a monitoring component would be required for any site chosen. L. Sommer responded that the monitoring requirement would be established in a permit, likely for any site chosen.

M. Hicks recommended that if a mitigation parcel is chosen within an existing floodplain area, strong justification for choosing the site would be required including a hydraulic analysis, which should include water table considerations.

P. Walker mentioned that NHDOT is considering forming an advisory group for the project. Lori Sommer offered to participate if this group is formed.

This project has not been previously discussed at a Monthly Natural Resource Agency Coordination Meeting.

Springfield, #20509 (X-A002(078))
John Byatt gave an overview of the project which involves the replacement of twin 5' diameter corrugated metal pipes carrying Star Lake Outlet (Otter Brook) under George's Mills Road in Springfield. Construction is complicated by the fact that the pipes cross the intersection with Fisher Corner Road and Stryker Road diagonally. Additionally, businesses located on Fisher Corner Road to the south of the project area require large logging trucks to use the intersection frequently throughout the day. The pipes are constructed with masonry headwalls and are considered to be a bridge (#091/048). The existing condition is poor due to deterioration of the pipes, as well as inadequate hydraulic capacity. The Star Lake Outlet is a Tier 3 stream with a contributing watershed of 2,240 acres, a 25' bankfull width and a suggested stream crossing rules compliant size full span structure of 31'.

Melilotus Dube noted that extensive coordination with the public has occurred and a draft Programmatic Categorical Exclusion has been prepared, however, this will be updated simultaneous with the NHDES Wetlands Bureau permitting process. Relevant natural resources in the area that may be impacted by the project include water quality, federally threatened northern long-eared bat (NLEB) and wetlands/stream impacts affiliated with Star Lake Outlet. The proposed work will increase the impervious surface area in the vicinity of Star Lake Outlet, which is a pH impaired water body. A 180' permanent stormwater treatment swale will be installed in the southwest quadrant of the project area. At this time, there are no adverse impacts to NLEB anticipated with the use of a time-of-year restriction on tree clearing. Impacts to the banks and channel of Star Lake Outlet, and other delineated wetlands, will be permitted appropriately.

J. Byatt provided a summary of the design alternatives that were evaluated. Replacement options included a 20' precast concrete box culvert, a 31' precast concrete rigid frame bridge and a 31' solid precast concrete slab bridge. The 20' concrete culvert is the preferred option due to cost, constructability and public input. The 20' concrete culvert would cost approximately $480,000 less than the next most cost effective option, the rigid frame bridge. Traffic control was a large consideration in analysis of the alternatives. Temporary widening to accommodate traffic flow during construction would have presented significantly increased wetland and stream impacts and posed serious safety concerns for large trucks whereas a road closure would allow for a smaller project footprint and less disturbance. The Town agreed to a road closure with the stipulation that the closure be as short in duration as possible in order to minimize the impact to the public. The 20' culvert allows for the shortest closure, approximately 3 weeks. However, the Department acknowledges that the culvert would not meet criteria of the NHDES Wetlands Bureau stream crossing rules and would require an Alternative Design as part of the Standard Dredge and Fill application package. The 20' culvert would not allow for banks to be constructed inside the structure, however, it would be buried with simulated stream bed material placed inside and at the inlet and outlet. Additionally, the 20' culvert would meet NHDOT hydraulic criteria, which would be an improvement over the existing condition.

J. Byatt summarized the proposed preliminary wetland impacts associated with the 20' concrete box. Permanent wetland impacts would include 2,418 sf and temporary wetland impacts would include 1,370 sf. These impacts include 157 lf impact to the stream along both banks and the centerline of the stream channel. M. Dube pointed out the impacts shown on the wetland plan and noted that there may be a small area of additional impact to a delineated wetland to the west of Star Lake Outlet associated with the proposed replacement of a pipe which would carry the water from the stormwater treatment swale under Georges Mills Road. These impact calculations are preliminary and may change slightly as the design is refined during development of the application package.

Carol Henderson, NHFG, asked how deep the 20' culvert would be buried, and J. Byatt responded that it would be buried 4' deep to allow for a 1' thick concrete bottom and adequate layers of riprap and streambed simulation material. Karl Benedict, NHDES Wetlands Bureau, asked if existing and proposed stream velocities through the structure were calculated and if there would be potential impact to aquatic organism passage. J. Byatt replied that although the numbers were not available at the meeting, a hydraulic analysis was performed including velocities which would be used to size the riprap needed to protect the structure. J. Byatt also noted that the proposed velocities would be lower due to the significantly increased size of the hydraulic opening. K. Benedict indicated that a discussion on existing and proposed velocities at the crossing and the corresponding implications for aquatic organism passage associated with the 20' box culvert would be required as part of the Alternative Design form in the wetland application package. General discussion as to whether the project should be reviewed at another Natural Resource Agency Meeting to verify the hydraulic analysis and velocities occurred, however, K. Benedict suggested that this information could be reviewed via email for pre-approval prior to submission of the full wetland application instead and all in attendance were in agreement. This submission will include a draft of the Alternative Design form, including discussion of hydraulics and velocities from the TS&L study, and minutes from meetings with the Town. The intention of this additional coordination is to seek feedback from DES Wetlands Bureau to allow as complete a Standard Dredge and Fill application package as possible in order to meet project timelines.

Lori Sommer, NHDES Wetlands Bureau, inquired if alternative methods for a terrestrial wildlife crossing had been evaluated since banks could not be constructed inside the 20' culvert alternative, such as replacing either of the existing culverts to the east or west of the crossing with a 4' diameter culvert. Kristin Hayden indicated that a 4' diameter culvert would not fit well as the surrounding area is fairly flat and does not have substantial cover to accommodate an increase in pipe diameter.

L. Sommer asked if the Department intends to pay into the ARM fund to mitigate for wetland and stream impacts. M. Dube confirmed that mitigation for the linear feet of impact to the stream would be required but that the square feet of impact to delineated wetlands is under the 10,000 square foot threshold and would not require mitigation. A preliminary calculation of the ARM fee indicates that mitigation for stream could be approximately $41,000. M. Urban suggested that because simulated stream bed material will be installed for the length of disturbance in the channel at the inlet and outlet that this could be considered self-mitigating and that only the lengths of impacts along each bank should be calculated for the ARM payment. There was general agreement, and this will be confirmed with final numbers via email prior to application submission.

This project has not been previously discussed at a Monthly Natural Resource Agency Coordination Meeting.

Columbia-Colebrook, #42313 (X-A004(814))
Chris Fournier (HEB Engineers) and Sarah Barnum (Normandeau Associates) presented the bridge project consisting of bridge preservation at two locations, Columbia Bridge #108/167, US Route 3 over Simms Stream and Colebrook Bridge #051/098, NH Route 26 over the Mohawk River. The project was previously present at the June 18, 2019 meeting. Since that meeting, the survey, delineation, H&H assessment were completed and impact areas determined.

C. Fournier began by providing and overview of the Columbia location, reiterating the purpose and need to address deterioration and stabilize the bridge structures.
Columbia Location

C. Fournier presented photographs of the existing conditions, specifically identifying the failure of the existing channel protection (riprap), which is sloughing into the channel and opening a void within the spill-through abutments.

Three alternatives were reviewed: do nothing, preserve, or replace. Do nothing does not meet the purpose and need, and replacement exceeds the need, therefore preservation is the preferred option.

C. Fournier review the proposed scope of work including traffic control, "peel and patch" of the bridge deck, sealing substructure, and reconstructing the channel protection. Detail was provided regarding the necessary channel work. To key the channel protection and keep it in place, the banks and entire channel bed under the bridge will be disturbed; riprap will be removed, existing channel materials will be excavated and stockpiled, and then reinstalled at essentially the same elevation and slope as the existing riverbed, on of top of the stabilized channel. Prior to removing and stockpile the existing riverbed material, the existing configuration of materials will be noted, and replacement will mimic that to the extent practicable. A phased "half and half" approach will be used to maintain flows, via water diversion, throughout the construction period. Because the impacted areas will be reconstructed to resemble the existing conditions, no mitigation is proposed. Due to the reconstruction of the channel, a standard NHDES Wetlands Permit Application (NHDES-W-06-012) will be required for this portion of the project.
S. Barnum briefly reviewed the environmental findings. Wetland delineation revealed no wetland resources except for the stream itself and associated banks. The NH NHB data check revealed no rare species or communities within the project footprint, and a survey of the bridge itself revealed no suitable features for roosting by Northern Long Eared Bats (NLEBs). In the vicinity, there are records of Northern Harrier (NOHA) and Round Whitefish from adjacent fields and the confluence of Simms stream and the Connecticut River, respectively. Following BMPs recommended by NHFG will prevent impacts due to construction from occurring to these nearby species.

S. Barnum also noted the existing topography adjacent to and under the bridge provides a suitable pathway for medium- and smaller-sized wildlife to use the bridge for passage under the roadway.
Colebrook Location

C. Fournier presented photographs of the existing conditions, specifically identifying the channel characteristics and deterioration of the center construction joint.

C. Fournier reviewed three alternatives: do nothing, preserve, or replace. Do nothing does not meet the purpose and need, and replacement exceeds the need, therefore preservation is the preferred option.
C. Fournier then described the proposed scope of work including traffic control, "peel and patch" of the bridge deck, sealing substructure, and fully reconstructing the construction joint. This requires under-bridge scaffolding. Access will be from the north due to the configuration of the ROW to the south. Minimal, temporary impacts to the channel and banks will occur due to the access and placing the needed scaffolding in the stream bed, and no mitigation is proposed. It was proposed that the project would be submitted through the new Permit by Notification for Tier 3 bridge repairs (Env-Wt 904.09), as was recommended by NHDES during the June 2019 meeting.

Karl Benedict stated that a Routine Roadway Routine Roadway Maintenance Activities Notification (RR-9) was also applicable to this portion of the project.

S. Barnum briefly reviewed the environment findings. Wetland delineation revealed no wetland resources except for the stream itself and associated banks. The NH NHB data check revealed no rare species or communities within the project footprint, and a survey of the bridge itself revealed no suitable features for roosting by NLEBs. In the vicinity, there is a Round Whitefish record from the area below the confluence of the Mohawk River and the Connecticut River. Following BMPs recommended by NHFG will prevent impacts due to construction from occurring to this nearby species.

The overall project schedule was presented, with intended submission of necessary NHDES applications in February and a Final Environmental Document in March.

This project has been previously discussed at the 6/19/2019 Monthly Natural Resource Agency Coordination Meeting.

Seabrook-Hampton, #15904 (X-A001(026))
The third Natural Resources Agency Coordination Meeting for the Hampton Harbor Bridge Project was held on December 18, 2019 at the offices of the New Hampshire Department of Transportation (NHDOT) in Concord, NH. Jennifer Reczek, NHDOT's Project Manager, opened the meeting by welcoming attendees, facilitating introductions, and outlining the agenda for the meeting. Ms. Reczek also discussed the project status, including the major work completed since the last presentation in January 2019. She explained that a Rehabilitation Study, as well as an Alignment and Profile Study, had been undertaken. She said the public expressed a preference for the western alignment at the January Public Information Meeting.

Dan Hageman with Fitzgerald & Halliday (FHI), a member of the HDR consultant team, then provided a summary of the agency coordination that has taken place since the last presentation in January 2019. The NHDOT met with the US Fish and Wildlife Service (USFWS) and New Hampshire Fish and Game (NHFG) on March 21st, 2019 to discuss federally-listed avian species, especially the Piping Plover. The time-of-year (TOY) restriction (April 1- August 31) and buffer (200-meters) was discussed at this meeting, as well as the Section 7 process. The 200-meter buffer restricts a large portion of the bridge structure. Mr. Hageman explained that the TOY and buffer restrictions could potentially increase the project duration from three to seven years. Formal consultation is likely and the Biological Assessment (BA) is underway. Through coordination with the NHFG, it was determined that the potential softshell clam beds, thought to exist to the west of the bridge in shallow waters, no longer exist due to shifting sediments and storm damage.

Mr. Hageman then explained that the NHDOT also conducted coordination with the New Hampshire Natural Heritage Bureau to confirm the listed plant species and population boundaries. Last summer, some of the listed species within the ROW were relocated by Alyson Eberhardt with the New Hampshire Sea Grant to allow the US Army Corps of Engineers (USACE) temporary access to the beach on the west side of the bridge for the dredging project. Coordination is ongoing with NHNHB to determine what species were relocated and to where. Coordination took place with the National Oceanic and Atmospheric Administration (NOAA) regarding listed aquatic species. Due to the potential presence of listed aquatic species and NOAA Trust Resources, in-water work is restricted by NOAA between March 16 and November 14. A Programmatic Biological Assessment is potentially feasible, depending on the construction methodology. It was also determined that a Programmatic Essential Fish Habitat (EFH) Assessment may not be feasible. Mr. Hageman explained that FHI field-delineated a blue mussel bed located near the northern abutment in support of the EFH Assessment. NOAA has indicated that sediment sampling will not be required in support of the BA and EFH, but that benthic sampling will be necessary. This is likely to be undertaken in early 2020.

Stephanie Dyer-Carroll, a member of the HDR consultant team, then discussed the cultural resources coordination that has taken place since the last presentation in January 2019. The NHDOT undertook a site walk with NHDHR and consulting parties in January 2019 and attended a Cultural Resources Coordination Meeting in February 2019. The NHDOT also completed and submitted five Individual Inventory Forms and one District Area Form in the winter 2019. At the request of the New Hampshire Division of Historical Resources (NHDHR), the NHDOT completed an additional three Individual Inventory Forms, an addendum to the Phase 1A Archaeological Assessment, and a Phase 1B Archaeological Survey for features under the south end of the bridge. Effects evaluations for the Neil R. Underwood Bridge (Hampton Harbor Bridge), the Hampton Beach Cottages District, and 54 River Street were submitted to NHDHR and consulting parties for their review and comments have been received. These historic properties are also subject to Section 4(f).

Ms. Dyer-Carroll explained that NHDOT has also coordinated with the New Hampshire Division of Parks & Recreation regarding 6(f) resources, specifically, the Hampton Beach State Park. It was suggested that the NHDOT minimize 6(f) conversion of the State Park, if feasible, and that the NHDOT further investigate the limits of the right-of-way (ROW). Ms. Dyer-Carroll said that no impacts are anticipated to Harborside Park as a result of any of the alternatives.

John Stockton with HDR then discussed the coordination that has taken place with the US Army Corps of Engineers (USACE) and the US Coast Guard (USCG) since the last presentation. The USACE requested that all bridge alternatives have a vertical under-clearance of 48 feet to facilitate dredge vessels and equipment. Since the last presentation, the western replacement alignments have been shifted closer to the existing bridge to minimize potential impacts to the federal channel to the west. The USCG and NHDOT met with stakeholders to review the proposed navigational clearances. The USCG is currently reviewing the Draft Navigational Study to prepare a Navigational Determination.

Mr. Stockton went on to discuss the four alternatives under consideration. He said the Rehabilitated Bridge (with Widened Bridge) Alternative would widen the bridge to the east in order to maintain the existing operator's house. A temporary bridge would be required to the west to accommodate traffic during construction. Mr. Stockton explained that both the Replacement with Fixed and Replacement with Bascule Alternatives have been pulled in closer to the existing bridge to minimize impacts to the navigational channels, but that there would still be a slight impact to the Hampton Harbor Channel under the Replacement with Bascule Bridge Alternative. Ms. Reczek said that they'd learned through coordination with USACE that the limits of the channel were defined based on an underwater rock ledge. Mr. Stockton said that the Replacement with Bascule Bridge Alternative would increase the vertical under-clearance to 34 feet, and the channel width would be increased to 80 feet. This would allow for passage of the Currituck, the USACE dredge vessel. Mr. Stockton said the increase in profile would reduce the number of lifts required by 50 percent. He explained that the horizontal clearance would be greater with the Replacement with Fixed Bridge because the spans could be longer and that the entrance channel would be widened to 150 feet. He said the vertical under-clearance had been increased from 44 to 48 feet based on input received from USACE. Finally, Mr. Stockton described the Twin Bridge (with Rehabilitated Existing Bridge) Alternative which had been developed since the last meeting. The Twin Bridge Alternative would consist of rehabilitation of the existing bridge to carry only northbound traffic, and the construction of a new bascule bridge to the west which would carry southbound traffic. Ms. Reczek explained that the Twin Bridge Alternative would allow for more of the existing bridge to be maintained. Mr. Stockton said, however, that the superstructure would need to be replaced. Ms. Reczek said that it could be more challenging for boats to pass under the longer channel under the two bridges because of strong cross-currents.

Ms. Dyer-Carroll then began a comparison of the alternatives. She said that all the alternatives would have a potential adverse effect on the National Register-eligible bridge, they all could require the potential use of the Hampton Beach State Park and other Section 4(f) resources, and they could all require the conversion of a portion of the park under Section 6(f). Moreover, all the alternatives could potentially result in a Not Likely to Adversely Affect finding to listed aquatic species and a No Substantial Adverse Effect finding to EFH species if work is undertaken outside the time of year restriction. Finally, all the alternatives could potentially result in an adverse effect to listed avian species if work occurs within the TOY restriction.

Mr. Hageman continued the discussion, focusing on those places where the alternatives differ. He explained that the Rehabilitation (with Widened Bridge) would have the greatest temporary impacts due to the footprint of the temporary bridge, and that the Twin Bridge Alternative would have the least temporary impact because the new bridge would be narrower than the two replacement alternatives. He said the Rehabilitation (with Widened Bridge) would have the smallest overall footprint and the Twin Bridge Alternative would have the greatest overall footprint. Mr. Hageman then discussed the differences in temporary and permanent impacts to different resources including channel bottom habitat, listed plant species/dune habitat, EFH species, and potential impacts to Piping Plover habitat. Regarding navigability, Mr. Stockton stated that the underclearance would stay the same under the two rehabilitation alternatives, but that the vertical clearance would be increased to 34 feet with the Replacement with Bascule Bridge

Alternative, and 48 feet with the Replacement with Fixed Bridge Alternative. Additionally, under the two rehabilitation alternatives, the width of the navigational channel would remain the same. Under the Replacement with Bascule Bridge Alternative, the channel would be widened to 80 feet; under the Replacement with Fixed Bridge Alternative it would be widened to 150 feet.

Ms. Reczek then wrapped up the presentation by discussing the next steps in the project schedule. During the winter of 2019/2020, the NHDOT expects to: undertake benthic sampling and sediment sampling (if required); release the Type, Size and Location (TS&L) Study; hold both a PAC meeting and a public informational meeting; and prepare and submit the BAs and the EFH Assessment. During the Spring/Summer of 2020, the NHDOT expects to execute the Effects Memorandum for cultural resources; release the Draft Environmental Assessment; and hold additional PAC and public meetings.

Mike Hicks with USACE asked when the USCG would complete their Navigational Determination. Jeff Stieb said the USCG plans to have a letter finalized by February 2020. He also said they don't permit submarine cables. Mr. Hicks said USACE will ask the applicant to look at alternatives to the submarine cables. With the activity in the channel, the installation of cables could be very challenging. Mr. Hicks then asked if they'd included the cost of property takings in the estimates. Ms. Reczek said the impacts would primarily be within the ROW or to state lands. Mr. Hicks said that the USACE point-of-contact for Section 408 and navigation items is Wendy Gendron

Carol Henderson with NHFG requested the NHDOT summarize the rational for abandoning the alternative alignments to the east of the existing bridge. Ms. Reczek explained that the western alignment avoids impacts to the homes southeast of the bridge. Susi von Oettingen with the USFWS pointed out that there is no foraging or nesting habitat on the east, only on the west side. Mr. Hageman said the replacement alternatives could allow for the restoration of Piping Plover habitat in the footprint of the existing bridge. Ms. Henderson said it would be beneficial to include an eastern alignment in the alternatives matrix for comparison purposes.

Amy Lamb, with the New Hampshire Natural Heritage Bureau (NHNHB), asked if NHDOT could send the agencies a copy of the alternatives matrix along with any supporting graphics that show the potential impacts of each alternative. NHDOT agreed to send this information. Ms. von Oettingen asked why the NOAA TOY restriction is given more consideration than the USFWS TOY restriction. Ms. Reczek explained that work can often be undertaken during the NOAA TOY restriction with the use of sheet piling. This is not typically the case with the Piping Plover. Lori Sommer with the NH Department of Environmental Services (NHDES) asked if there would be a difference in impact to the Piping Plover between the three-year and seven-year scenarios. Ms. von Oettingen said there would be a loss in productivity and that the USFWS would consider each year of construction within Piping Plover habitat, during the TOY restriction, to constitute the "taking" of one pair of Piping Plover. It may not be a permanent loss, but it would constitute an adverse effect or take. Ms. von Oettingen said there needs to be formal consultation with the USFWS. There must be an inventory of habitat and an assessment of long-term effects to the Piping Plovers. Mr. Hicks asked what the TOY restriction is for the Piping Plover, and Ms. von Oettingen answered from April 1st to August 31st. Ms. von Oettingen then asked if the construction could start at the northern portion of the site, and move south to minimize work near the Plover habitat. Mr. Hicks asked if the birds could be relocated and Ms. von Oettingen answered that they cannot be relocated since they will come right back to the site.

Ms. Sommer asked if the vertical clearance increase is beneficial and how this factors into the project. Would bigger boats be able to enter the harbor? Ms. Reczek responded that the existing channel has an eight-foot design depth, so even if the channel or bridge openings were widened, the channel depth would still be the limiting factor for large vessels. As a result, the NHDOT does not anticipate a substantial change in the size of vessels entering the harbor. She said several party boats dock in the harbor and aren't able to leave the harbor until high tide. Mr. Stockton said mooring locations also restrict the size of boats entering the harbor.

This project has been previously discussed at the 8/15/2018 and 1/16/2019 Monthly Natural Resource Agency Coordination Meetings.

Attachment 5 -

Avoidance and Minimization Checklist and Narrative

AVOIDANCE AND MINIMIZATION CHECKLIST

Water Division/Land Resources Management
Wetlands Bureau

Check the Status of your Application

RSA/Rule: RSA 482-A/ Env-Wt 311.07(c)

This checklist can be used in lieu of the written narrative required by Env-Wt 311.07(a) to demonstrate compliance with requirements for Avoidance and Minimization (A/M), pursuant to RSA 482-A:1 and Env-Wt 311.07(c).

For the construction or modification of non-tidal shoreline structures over areas of surface waters without wetland vegetation, complete only Sections 1, 2, and 4 (or the applicable sections in Attachment A: Minor and Major Projects (NHDES-W-06-013).

The following definitions and abbreviations apply to this worksheet:

- "A/M BMPs" stands for Wetlands Best Management Practice Techniques for Avoidance and Minimization dated 2019, published by the New England Interstate Water Pollution Control Commission (Env-Wt 102.18).
- "Practicable" means available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes (Env-Wt 103.62).

SECTION 1 - CONTACT/LOCATION INFORMATION	
APPLICANT LAST NAME, FIRST NAME, M.I.: Jennifer E. Reczek	
PROJECT STREET ADDRESS: Georges Mill Road and Skyler Road	PROJECT TOWN: Springfield
TAX MAP/LOT NUMBER: N/A - Exempt NHDOT	

SECTION 2 - PRIMARY PURPOSE OF THE PROJECT		
Env-Wt 311.07(b)(1)	Indicate whether the primary purpose of the project is to construct a water-access structure or requires access through wetlands to reach a buildable lot or the buildable portion thereof.	☐ Yes ☒ No

If you answered "no" to this question, describe the purpose of the "non-access" project type you have proposed:

The project includes the replacement of twin culverts carrying a perennial stream under Georges Mill Road and extends several hundred feet along Georges Mill Road east and west of the culverts and approximately 60 feet upstream and 40 feet downstream of the culverts in Springfield, Sullivan County, New Hampshire. The purpose of the project is to replace the existing culverts with a resized replacement culvert, improve the skew and hydraulics of the culverts to provide improved flow, attenuate potential flooding, and prevent further erosion along the headwall of the existing culverts. Impacts include permanent and tempoary impacts to the stream channel and banks for replacement of the existing crossing. Four options were evaluated during project design. The preferred option avoids and minimizes impacts to the perennial stream and adjacent wetlands to the greatest extent practicable while improving the stream skew, flow, and aquatic organism passage.

SECTION 3 - A/M PROJECT DESIGN TECHNIQUES Check the appropriate boxes below in order to demonstrate that these items have been considered in the planning of the project. Use N/A (not applicable) for each technique that is not applicable to your project.		
Env-Wt 311.07(b)(2)	For any project that proposes new permanent impacts of more than one acre or that proposes new permanent impacts to a Priority Resource Area (PRA), or both, whether any other properties reasonably available to the applicant, whether already owned or controlled by the applicant or not, could be used to achieve the project's purpose without altering the functions and values of any jurisdictional area, in particular wetlands, streams, and PRAs.	☐ Check ☒ N/A
Env-Wt 311.07(b)(3)	Whether alternative designs or techniques, such as different layouts, construction sequencing, or alternative technologies could be used to avoid impacts to jurisdictional areas or their functions and values.	☒ Check ☐ N/A
Env-Wt 311.07(b)(4) Env-Wt 311.10(c)(1) Env-Wt 311.10(c)(2)	The results of the functional assessment required by Env-Wt 311.03(b)(10) were used to select the location and design for the proposed project that has the least impact to wetland functions.	☒ Check ☐ N/A
Env-Wt 311.07(b)(4) Env-Wt 311.10(c)(3)	Where impacts to wetland functions are unavoidable, the proposed impacts are limited to the wetlands with the least valuable functions on the site while avoiding and minimizing impacts to the wetlands with the highest and most valuable functions.	☒ Check ☐ N/A
Env-Wt 313.01(c)(1) Env-Wt 313.01(c)(2) Env-Wt 313.03(b)(1)	No practicable alternative would reduce adverse impact on the area and environments under the department's jurisdiction and the project will not cause random or unnecessary destruction of wetlands.	☒ Check ☐ N/A
Env-Wt 313.01(c)(3)	The project would not cause or contribute to the significant degradation of waters of the state or the loss of any PRAs.	☒ Check ☐ N/A
Env-Wt 313.03(b)(3) Env-Wt 904.07(c)(8)	The project maintains hydrologic connectivity between adjacent wetlands or stream systems.	☒ Check ☐ N/A
Env-Wt 311.10 A/M BMPs	Buildings and/or access are positioned away from high function wetlands or surface waters to avoid impact.	☐ Check ☒ N/A
Env-Wt 311.10 A/M BMPs	The project clusters structures to avoid wetland impacts.	☐ Check ☒ N/A
Env-Wt 311.10 A/M BMPs	The placement of roads and utility corridors avoids wetlands and their associated streams.	☐ Check ☒ N/A
A/M BMPs	The width of access roads or driveways is reduced to avoid and minimize impacts. Pullouts are incorporated in the design as needed.	☐ Check ☒ N/A
A/M BMPs	The project proposes bridges or spans instead of roads/driveways/trails with culverts.	☐ Check ☒ N/A

A/M BMPs	The project is designed to minimize the number and size of crossings, and crossings cross wetlands and/or streams at the narrowest point.	☒ Check ☐ N/A
Env-Wt 500 Env-Wt 600 Env-Wt 900	Wetland and stream crossings include features that accommodate aquatic organism and wildlife passage.	☒ Check ☐ N/A
Env-Wt 900	Stream crossings are sized to address hydraulic capacity and geomorphic compatibility.	☒ Check ☐ N/A
A/M BMPs	Disturbed areas are used for crossings wherever practicable, including existing roadways, paths, or trails upgraded with new culverts or bridges.	☐ Check ☒ N/A
SECTION 4 - NON-TIDAL SHORELINE STRUCTURES		
Env-Wt 313.03(c)(1)	The non-tidal shoreline structure has been designed to use the minimum construction surface area over surfaces waters necessary to meet the stated purpose of the structure.	☐ Check ☒ N/A
Env-Wt 313.03(c)(2)	The type of construction proposed for the non-tidal shoreline structure is the least intrusive upon the public trust that will ensure safe navigation and docking on the frontage.	☐ Check ☒ N/A
Env-Wt 313.03(c)(3)	The non-tidal shoreline structure has been designed to avoid and minimize impacts on the ability of abutting owners to use and enjoy their properties.	☐ Check ☒ N/A
Env-Wt 313.03(c)(4)	The non-tidal shoreline structure has been designed to avoid and minimize impacts to the public's right to navigation, passage, and use of the resource for commerce and recreation.	☐ Check ☒ N/A
Env-Wt 313.03(c)(5)	The non-tidal shoreline structure has been designed, located, and configured to avoid impacts to water quality, aquatic vegetation, and wildlife and finfish habitat.	☐ Check ☒ N/A
Env-Wt 313.03(c)(6)	The non-tidal shoreline structure has been designed to avoid and minimize the removal of vegetation, the number of access points through wetlands or over the bank, and activities that may have an adverse effect on shoreline stability.	☐ Check ☒ N/A

AVOIDANCE AND MINIMIZATION WRITTEN NARRATIVE

Water Division/Land Resources Management
Wetlands Bureau
Check the Status of your Application

RSA/ Rule: RSA 482-A/ Env-Wt 311.04(j); Env-Wt 311.07; Env-Wt 313.01(a)(1)b; Env-Wt 313.01(c)

APPLICANT'S NAME: Jennifer E. Reczek **TOWN NAME: Springfield**

An applicant for a standard permit shall submit with the permit application a written narrative that explains how all impacts to functions and values of all jurisdictional areas have been avoided and minimized to the maximum extent practicable. This attachment can be used to guide the narrative (attach additional pages if needed). Alternatively, the applicant may attach a completed Avoidance and Minimization Checklist (NHDES-W-06-050) to the permit application.

SECTION 1 - WATER ACCESS STRUCTURES (Env-Wt 311.07(b)(1)) Is the primary purpose of the proposed project to construct a water access structure?
No - N/A
SECTION 2 - BUILDABLE LOT (Env-Wt 311.07(b)(1)) Does the proposed project require access through wetlands to reach a buildable lot or portion thereof?
No - N/A
SECTION 3 - AVAILABLE PROPERTY (Env-Wt 311.07(b)(2))* For any project that proposes permanent impacts of more than one acre, or that proposes permanent impacts to a PRA, or both, are any other properties reasonably available to the applicant, whether already owned or controlled by the applicant or not, that could be used to achieve the project's purpose without altering the functions and values of any jurisdictional area, in particular wetlands, streams, and PRAs? **Except as provided in any project-specific criteria and except for NH Department of Transportation projects that qualify for a categorical exclusion under the National Environmental Policy Act.*
No PRA within the Project Area - N/A

SECTION 4 - ALTERNATIVES (Env-Wt 311.07(b)(3))

Could alternative designs or techniques, such as different layouts, different construction sequencing, or alternative technologies be used to avoid impacts to jurisdictional areas or their functions and values as described in the Wetlands Best Management Practice Techniques For Avoidance and Minimization?

To meet NHDOT design requirements, the proposed structure must pass the 50-year design flood event with 1 foot of freeboard and accommodate the 100-year check flood event. The following 4 structure alternatives were determined to be acceptable:

· At-grade 20-foot clear span structure with channel banks extending through the structure in front of the abutments.

· Buried 20-foot clear span structure without channel banks extending through the structure.

· Buried 31-foot clear span structure with channel banks extending through the structure in front of the abutments.

· At-grade 31-foot clear span structure with channel banks extending through the structure in front of the abutments.

The recommended structure is the buried 20-foot span precast concrete box culvert. This option meets the hydraulic criteria, and provides the best possible fit for the site constraints, including the difficult geometry of the Stryker Road and Fisher Corner intersections. It has the shortest construction duration, which based on local input is very important, and is the most cost effective. Georges Mills Road will be closed to through traffic during removal and replacement of the structure. The side roads will remain open to traffic throughout. As soon as possible, Georges Mills Road will be reopened to traffic and temporary lane closures will occur to complete the roadway work.

SECTION 5 - CONFORMANCE WITH Env-Wt 311.10(c) (Env-Wt 311.07(b)(4))**

How does the project conform to Env-Wt 311.10(c)?

***Except for projects solely limited to construction or modification of non-tidal shoreline structures only need to complete relevant sections of Attachment A*.

A wetland functional assessment was performed on site, by a wetland scientist and overseeing New Hampshire certified wetland scientist, using the USACE Highway Methodology workbook (1993) and New England District Highway Methodology Workbook Supplement (1999).

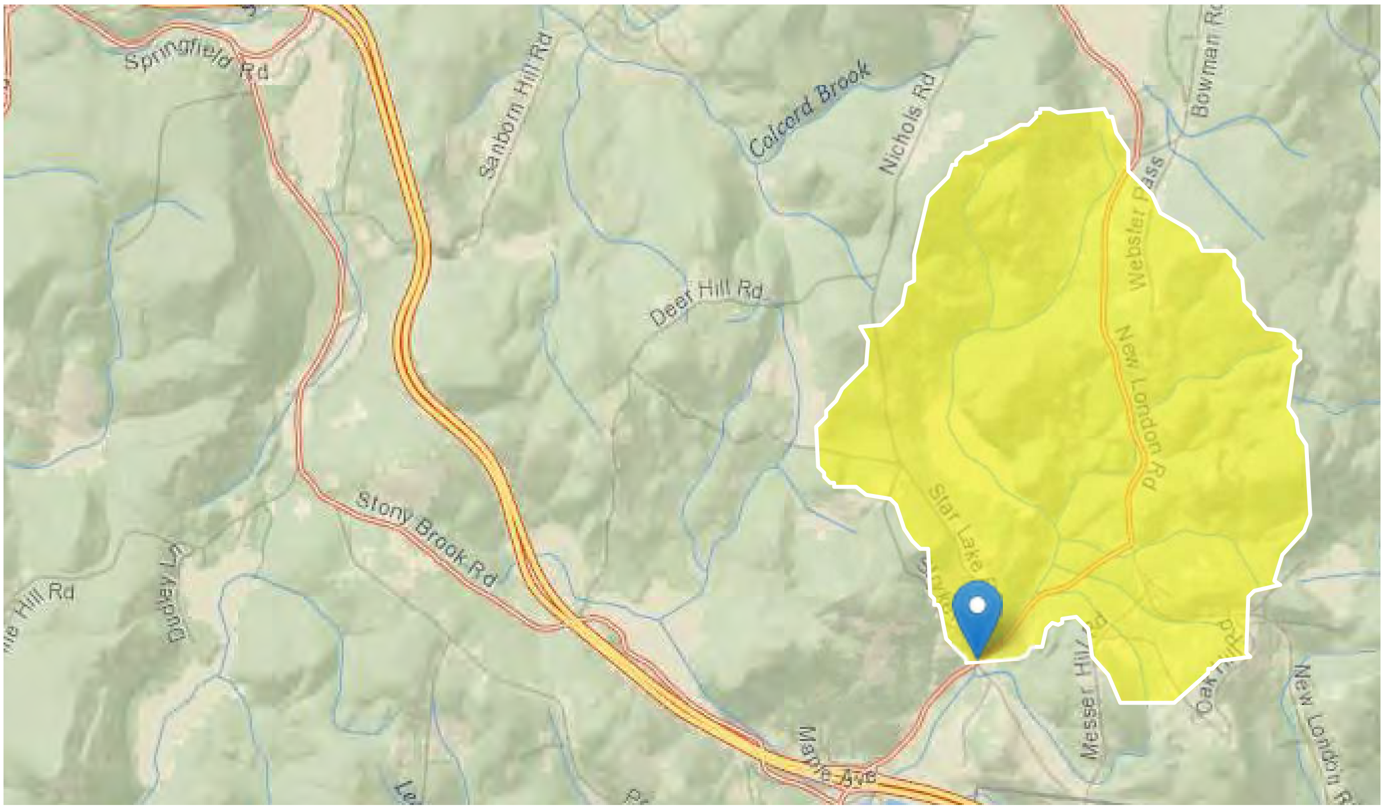
While the results of the assessement were used to select the location of the proposed project, this is a culvert replacement project at a 4-way intersection, therefore the ability to avoid protected natural resources is limited due to the configuration of the existing road infrastructure, and safety requirements of the NHDOT, which have specific design requirements.

The project was designed to improve exising conditions. The proposed box culvert was sized to accommodate required hydraulic capacity.

Attachment 6 -
StreamStats

StreamStats Report

Region ID: NH
Workspace ID: NH20200701201704203000
Clicked Point (Latitude, Longitude): 43.44885, -72.05390
Time: 2020-07-01 16:17:20 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	3.5	square miles

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

Application Version: 4.3.11

Attachment 7 -

Stream Crossing Worksheet

WETLANDS PERMIT APPLICATION
STREAM CROSSING WORKSHEET
Water Division/Land Resources Management
Wetlands Bureau

RSA/Rule RSA 482-A/ Env-Wt-900

This worksheet can be used to accompany Wetlands Permit Applications when proposing stream crossings.

SECTION 1 - TIER CLASSIFICATIONS

Determine the contributing watershed size at USGS StreamStats.

Note: Plans for tier 2 and 3 crossings shall be designed and stamped by a professional engineer who is licensed under RSA 310-A to practice in New Hampshire.

Size of contributing watershed at the crossing location: 2,240 acres

☐ **Tier 1**: A tier 1 stream crossing is a crossing located on a watercourse where the contributing watershed size is less than or equal to 200 acres.

☐ **Tier 2**: A tier 2 stream crossing is a crossing located on a watercourse where the contributing watershed size is greater than 200 acres and less than 640 acres.

☒ **Tier 3**: A tier 3 stream crossing is a crossing that meets **any** of the following criteria:

- ☒ On a watercourse where the contributing watershed is more than 640 acres.
- ☐ Within a designated river corridor unless:
  - a. The crossing would be a tier 1 stream based on contributing watershed size, or
  - b. The structure does not create a direct surface water connection to the designated river as depicted on the national hydrography dataset as found on GRANIT.
- ☐ Within a 100-year floodplain (see Section 2 below).
- ☐ In a jurisdictional area having any protected species or habitat (NHB DataCheck).
- ☐ In a prime wetland or within a duly-established 100-foot buffer, unless a waiver has been granted pursuant to RSA 482-A:11, IV(b) and Env-Wt 706. Review the Wetlands Permit Planning Tool (WPPT) for town prime wetland and prime wetland buffer maps to determine if your project is within these areas.

☐ **Tier 4**: A tier 4 stream crossing is a crossing located on a tidal watercourse.

SECTION 2 - 100-YEAR FLOODPLAIN

Use the FEMA Map Service Center to determine if the crossing is located within a 100-year floodplain. Please answer the questions below:

☒ **No**: The proposed stream crossing *is not* within the FEMA 100-year floodplain.

☐ **Yes**: The proposed project *is* within the FEMA 100-year floodplain. Zone =

Elevation of the 100-year floodplain at the inlet: feet (FEMA El. or Modeled El.)

SECTION 3 - CALCULATING PEAK DISCHARGE

Existing 100-year peak discharge (Q) calculated in cubic feet per second (CFS): 510 CFS	Calculation method: StreamStats
Estimated bankfull discharge at the crossing location: 117 CFS	Calculation method: StreamStats

Note: If tier 1, then skip to Section 10

SECTION 4 - PREDICTED CHANNEL GEOMETRY BASED ON REGIONAL HYDRAULIC CURVES *For **tier 2**, **tier 3** and **tier 4** crossings only.*	
Bankfull Width: 23 feet	Mean Bankfull Depth: 1.8 feet
Bankfull Cross Sectional Area: 41.3 square feet (SF)	

SECTION 5 - CROSS SECTIONAL CHANNEL GEOMETRY: MEASUREMENTS OF THE EXISTING STREAM WITHIN A REFERENCE REACH *For **tier 2**, **tier 3** and **tier 4** crossings only.*
Describe the reference reach location: Upstream, developed,
Reference reach watershed size: 2,240 acres

Parameter	**Cross Section 1** Describe bed form Riffle (*e.g. pool, riffle, glide*)	**Cross Section 2** Describe bed form Riffle (*e.g. pool, riffle, glide*)	**Cross Section 3** Describe bed form Riffle (*e.g. pool, riffle, glide*)	**Range**
Bankfull Width	13 feet	15 feet	15 feet	13-15 feet
Bankfull Cross Sectional Area	10.5 SF	5.9 SF	8.8 SF	5.9-10.5 SF
Mean Bankfull Depth	0.8 feet	0.4 feet	0.6 feet	0.4-0.8 feet
Width to Depth Ratio	16.1	38.1	25.6	16.1-38.1
Max Bankfull Depth	1.1 feet	0.9 feet	1.2 feet	0.9-1.2 feet
Flood Prone Width	18 feet	19 feet	19 feet	18-19 feet
Entrenchment Ratio	1.38	1.27	1.27	1.27-1.38

*Use **Figure 1** below to determine the measurements of the Reference Reach Attributes*

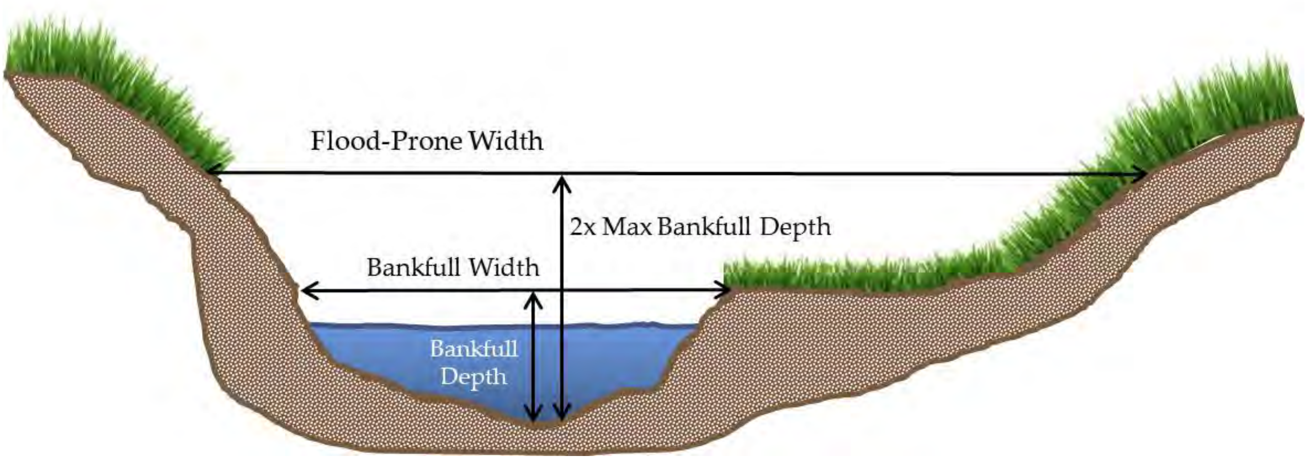


Figure 1: Determining the Reference Reach Attributes.

SECTION 6 - LONGITUDINAL PARAMETERS OF THE REFERENCE REACH AND CROSSING LOCATION *For **tier 2**, **tier 3** and **tier 4** crossings only.*
Average Channel Slope of the Reference Reach: 1%
Average Channel Slope at the Crossing Location: 1%

SECTION 7 - PLAN VIEW GEOMETRY Note: Sinuosity is measured a distance of at least 20 times bankfull width, or 2 meander belt widths. *For **tier 2**, **tier 3** and **tier 4** crossings only.*
Sinuosity of the Reference Reach: 1.37

Sinuosity of the Crossing Location: 1.13	
SECTION 8 - SUBSTRATE CLASSIFICATION BASED ON FIELD OBSERVATIONS *For **tier 2, tier 3** and **tier 4** crossings only.*	
% of reach that is bedrock:	**0** %
% of reach that is boulder:	**1** %
% of reach that is cobble:	**29** %
% of reach that is gravel:	**47** %
% of reach that is sand:	**24** %
% of reach that is silt:	**0** %
SECTION 9 - STREAM TYPE OF REFERENCE REACH *For **tier 2, tier 3** and **tier 4** crossings only.*	
Stream Type of Reference Reach:	Type C

*Refer to Rosgen Classification Chart (**Figure 2**) below:*

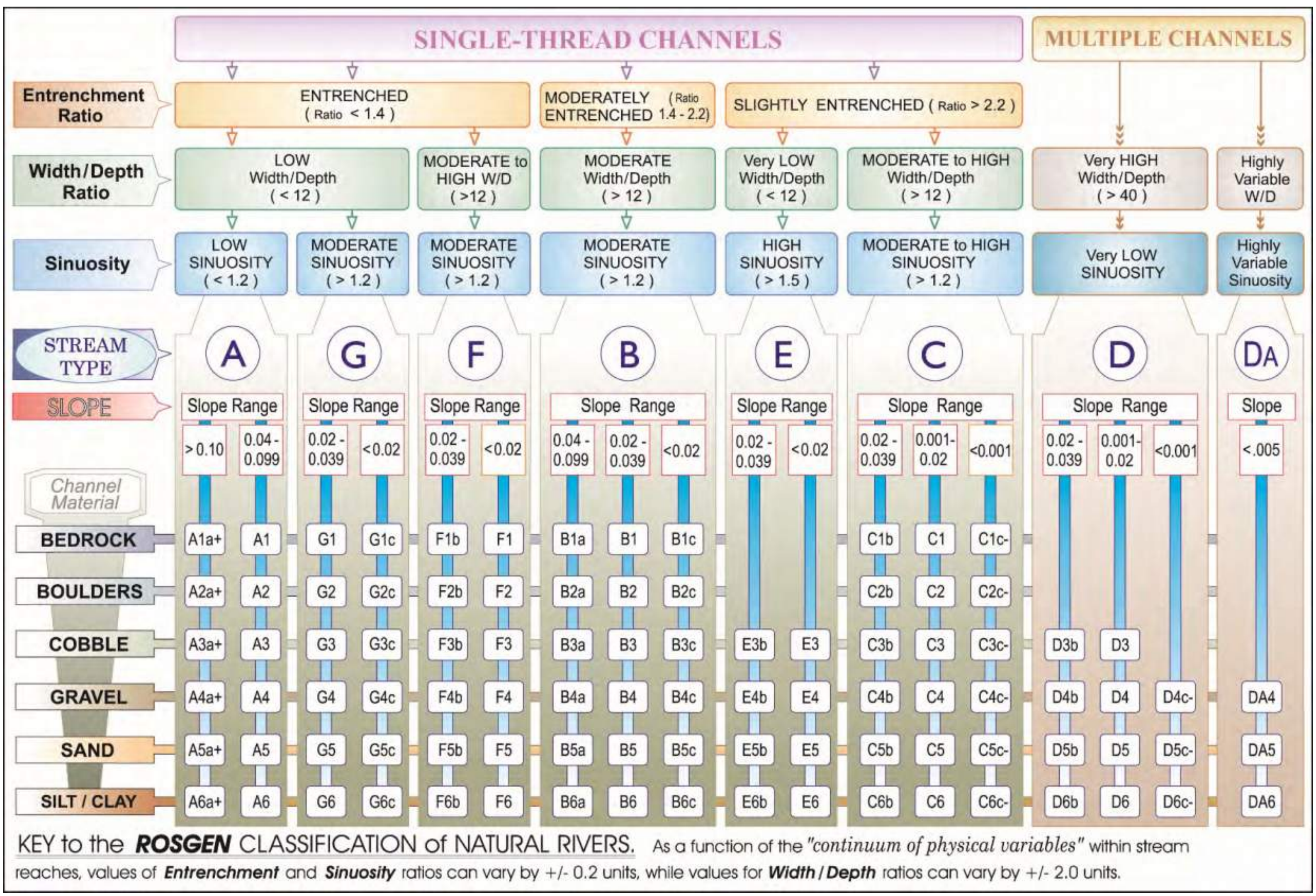


Figure 2: Reference from Applied River Morphology, Rosgen, 1996.

SECTION 10 - CROSSING STRUCTURE METRICS						
Existing Conditions	**Existing Structure Type:**	☐ Bridge span ☐ Pipe arch ☐ Open-bottom culvert ☐ Closed-bottom culvert ☐ Closed-bottom culvert with stream simulation ☒ Other: Twin 5' closed-bottom culverts.				
	Existing Crossing Span: *(perpendicular to flow)*	10 feet	**Culvert Diameter:** 10 feet **Inlet Elevation:** El. 1444 feet			
	Existing Crossing Length: *(parallel to flow)*	66 feet	**Outlet Elevation:** El. 1143.1 feet **Culvert Slope:** 1.5%			
Proposed Conditions	**Proposed Structure Type:**		**Tier 1**	**Tier 2**	**Tier 3**	**Alternative Design**
	Bridge Span		☐	☐	☐	☐
	Pipe Arch		☐	☐		☐
	Closed-bottom Culvert		☐	☐		☐
	Open-bottom Culvert		☐	☐	☐	☐
	Closed-bottom Culvert with stream simulation		☐	☐	☐	☒
	Proposed Structure Span: *(perpendicular to flow)*	20 feet	**Culvert Diameter:** 20 feet **Inlet Elevation:** El. 1144 feet			
	Proposed Structure Length: *(parallel to flow)*	82 feet	**Outlet Elevation:** El. 1143 feet **Culvert Slope:** 1.2%			
	Proposed Entrenchment Ratio:* 2.2 *For **Tier 2**, **Tier 3** and **Tier 4** Crossings Only. To accommodate the entrenchment ratio, floodplain drainage structures may be utilized.*					

** Note: Proposed Entrenchment Ratio must meet the minimum ratio for each stream type listed in **Figure 3**, otherwise the applicant must address the Alternative Design criteria listed in Env-Wt 904.10.*

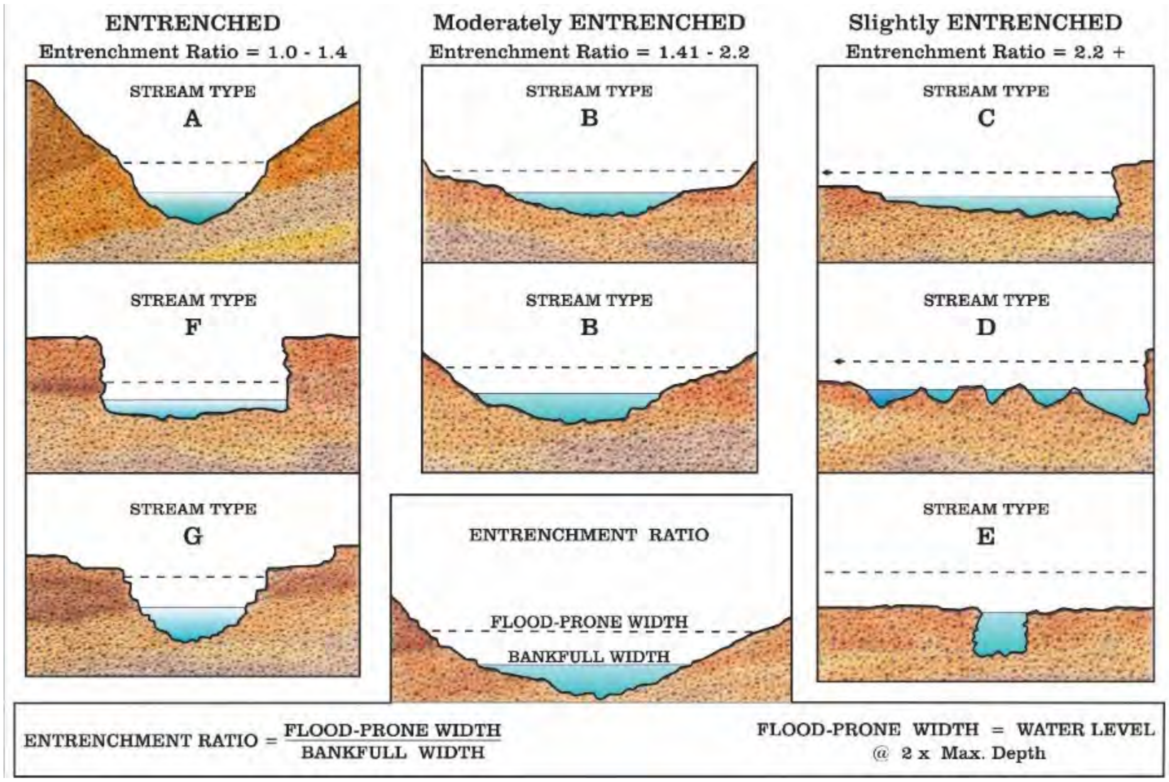


Figure 3: Reference from Applied River Morphology, Rosgen, 1996.

SECTION 11 - CROSSING STRUCTURE HYDRAULICS		
	Existing	**Proposed**
100 year flood stage elevation at inlet:	1152.66	1148.90
Flow velocity at outlet in feet per second (FPS):	11.94	9.16
Calculated 100 year peak discharge (Q) for the *proposed* structure in CFS:		510
Calculated 50 year peak discharge (Q) for the *proposed* structure in CFS:		421

SECTION 12 - CROSSING STRUCTURE OPENNESS RATIO

*For **tier 2**, **tier 3** and **tier 4** crossings only.*

Crossing Structure Openness Ratio* = 1.12

* Openness box culvert = (height x width)/length

Openness round culvert = (3.14 x radius^2)/length

SECTION 13 - GENERAL DESIGN CONSIDERATIONS

Env-Wt 904.01 requires all stream crossings to be designed and constructed according to the following requirements. Check each box if the project meets these general design considerations.

All stream crossings shall be designed and constructed so as to:

☒ Not be a barrier to sediment transport.

☒ Prevent the restriction of high flows and maintain existing low flows.

☒ Not obstruct or otherwise substantially disrupt the movement of aquatic life indigenous to the waterbody beyond the actual duration of construction.

☒ Not cause an increase in the frequency of flooding or overtopping of banks.

☒ Maintain or enhance geomorphic compatibility by:

a. Minimizing the potential for inlet obstruction by sediment, wood, or debris, and

b. Preserving the natural alignment of the stream channel.

☒ Preserve watercourse connectivity where it currently exists.

☒ Restore watercourse connectivity where:

a. Connectivity previously was disrupted as a result of human activity(ies), and

b. Restoration of connectivity will benefit aquatic life upstream or downstream of the crossing, or both.

☒ Not cause erosion, aggradation, or scouring upstream or downstream of the crossing.

☒ Not cause water quality degradation.

SECTION 14 - TIER-SPECIFIC DESIGN CRITERIA

Stream crossings must be designed in accordance with the tier specific design criteria listed in Part Env-Wt 904.

☐ The proposed project meets the tier specific design criteria listed in Part Env-Wt 904 and each requirement has been addressed in the plans and as part of the wetland application.

SECTION 15 - ALTERNATIVE DESIGN

NOTE: If the proposed crossing does not meet all of the general design considerations, the tier specific design criteria, or the minimum entrenchment ratio for each given stream type listed in **Figure 3**, then an alternative design plan and associated requirements must be addressed pursuant to Env-Wt 904.10.

☒ I have submitted an alternative design and addressed each requirement listed in Env-Wt 904.10.

Attachment 8 -

NHB DataCheck Results Letter

New Hampshire Natural Heritage Bureau
NHB DataCheck Results Letter

To: Rhona Thomson
7 Hazen Drive
Concord, NH 03302

From: NH Natural Heritage Bureau

Date: 2/14/2024 (This letter is valid through 2/14/2025)

Re: Review by NH Natural Heritage Bureau of request dated 2/14/2024

Permit Types: Wetland Standard Dredge & Fill - Major
Federal: NEPA Review

NHB ID: NHB24-0471

Applicant: Rhona Thomson

Location: Springfield
Tax Map: N/A, Tax Lot: N/A
Address: Georges Mills Road

Proj. Description: The proposed project will replace existing twin 5'corrugated metal pipes in a masonry headwall carrying Star Lake Outlet under Georges Mill Road with a 20' concrete box culvert.

The NH Natural Heritage database has been checked for records of rare species and exemplary natural communities near the area mapped below. The species considered include those listed as Threatened or Endangered by either the state of New Hampshire or the federal government. We currently have no recorded occurrences for sensitive species near this project area.

A negative result (no record in our database) does not mean that a sensitive species is not present. Our data can only tell you of known occurrences, based on information gathered by qualified biologists and reported to our office. However, many areas have never been surveyed, or have only been surveyed for certain species. An on-site survey would provide better information on what species and communities are indeed present.

Based on the information submitted, no further consultation with the NH Fish and Game Department pursuant to Fis 1004 is required.

MAP OF PROJECT BOUNDARIES FOR: NHB24-0471

Attachment 9 -

USFWS IPaC Results

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
Phone: (603) 223-2541 Fax: (603) 223-0104

In Reply Refer To: February 14, 2024
Project Code: 2023-0061326
Project Name: Springfield 20509

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through IPaC by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at: https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts, see Migratory Bird Permit | What We Do | U.S. Fish & Wildlife Service (fws.gov).

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures, see https://www.fws.gov/library/collections/threats-birds.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/partner/council-conservation-migratory-birds.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
(603) 223-2541

PROJECT SUMMARY

Project Code:	2023-0061326
Project Name:	Springfield 20509
Project Type:	Culvert Repair/Replacement/Maintenance
Project Description:	Replacement of twin 5' corrugated metal pipes in masonry headwall with 20' precast concrete box culvert carrying Star Lake Outlet under Georges Mills Road at the intersection of Stryker Road and Fisher Corner Road.

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@43.448868739765345,-72.05382425758451,14z

Counties: Sullivan County, New Hampshire

ENDANGERED SPECIES ACT SPECIES

There is a total of 2 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Northern Long-eared Bat *Myotis septentrionalis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Endangered

INSECTS

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

IPAC USER CONTACT INFORMATION

Agency: New Hampshire Department of Transportation
Name: Rhona Thomson
Address: 7 Hazen Drive
City: Concord
State: NH
Zip: 03302
Email rhona.c.thomson@dot.nh.gov
Phone: 6032717966

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5094
Phone: (603) 223-2541 Fax: (603) 223-0104

In Reply Refer To:
Project code: 2023-0061326
Project Name: Springfield 20509
IPaC Record Locator: 737-124300255

March 29, 2023

Federal Action Agency (if applicable): New Hampshire Department of Transportation

Subject: Record of project representative's no effect determination for 'Springfield 20509'

Dear Rhona Thomson:

This letter records your determination using the Information for Planning and Consultation (IPaC) system provided to the U.S. Fish and Wildlife Service (Service) on March 29, 2023, for 'Springfield 20509' (here forward, Project). This project has been assigned Project Code 2023-0061326 and all future correspondence should clearly reference this number. **Please carefully review this letter.**

Ensuring Accurate Determinations When Using IPaC

The Service developed the IPaC system and associated species' determination keys in accordance with the Endangered Species Act of 1973 (ESA; 87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) and based on a standing analysis. All information submitted by the Project proponent into the IPaC must accurately represent the full scope and details of the Project. Failure to accurately represent or implement the Project as detailed in IPaC or the Northern Long-eared Bat Rangewide Determination Key (Dkey), invalidates this letter.

Determination for the Northern Long-Eared Bat

Based upon your IPaC submission and a standing analysis, your project has reached the determination of "No Effect" on the northern long-eared bat. To make a no effect determination, the full scope of the proposed project implementation (action) should not have any effects (either positive or negative), to a federally listed species or designated critical habitat. Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action. (See § 402.17).

Under Section 7 of the ESA, if a federal action agency makes a no effect determination, no consultation with the Service is required (ESA §7). If a proposed Federal action may affect a listed species or designated critical habitat, formal consultation is required except when the Service concurs, in writing, that a proposed action "is not likely to adversely affect" listed species or designated critical habitat [50 CFR §402.02, 50 CFR§402.13].

Other Species and Critical Habitat that May be Present in the Action Area

The IPaC-assisted determination for the northern long-eared bat does not apply to the following ESA-protected species and/or critical habitat that also may occur in your Action area:

- Monarch Butterfly *Danaus plexippus* Candidate

You may coordinate with our Office to determine whether the Action may affect the animal species listed above and, if so, how they may be affected.

Next Steps

Based upon your IPaC submission, your project has reached the determination of “No Effect” on the northern long-eared bat. If there are no updates on listed species, no further consultation/ coordination for this project is required with respect to the northern long-eared bat. However, the Service recommends that project proponents re-evaluate the Project in IPaC if: 1) the scope, timing, duration, or location of the Project changes (includes any project changes or amendments); 2) new information reveals the Project may impact (positively or negatively) federally listed species or designated critical habitat; or 3) a new species is listed, or critical habitat designated. If any of the above conditions occurs, additional coordination with the Service should take place to ensure compliance with the Act.

If you have any questions regarding this letter or need further assistance, please contact the New England Ecological Services Field Office and reference Project Code 2023-0061326 associated with this Project.

Action Description
You provided to IPaC the following name and description for the subject Action.

1. Name

Springfield 20509

2. Description

The following description was provided for the project 'Springfield 20509':

> Replacement of twin 5' corrugated metal pipes in masonry headwall with 20' precast concrete box culvert carrying Star Lake Outlet under Georges Mills Road at the intersection of Stryker Road and Fisher Corner Road.

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@43.448845376751706,-72.05386499646396,14z

DETERMINATION KEY RESULT

Based on the information you provided, you have determined that the Proposed Action will have no effect on the Endangered northern long-eared bat (Myotis septentrionalis). Therefore, no consultation with the U.S. Fish and Wildlife Service pursuant to Section 7(a)(2) of the Endangered Species Act of 1973 (87 Stat. 884, as amended 16 U.S.C. 1531 *et seq.*) is required for those species.

QUALIFICATION INTERVIEW

1. Does the proposed project include, or is it reasonably certain to cause, intentional take of the northern long-eared bat or any other listed species?

   Note: Intentional take is defined as take that is the intended result of a project. Intentional take could refer to research, direct species management, surveys, and/or studies that include intentional handling/encountering, harassment, collection, or capturing of any individual of a federally listed threatened, endangered or proposed species?

   No

2. The proposed action does not intersect an area where the northern long-eared bat is likely to occur, based on the information available to U.S. Fish and Wildlife Service as of the most recent update of this key. If you have data that indicates that northern long-eared bats are likely to be present in the action area, answer "NO" and continue through the key.

   Do you want to make a no effect determination?

   Yes

PROJECT QUESTIONNAIRE

IPAC USER CONTACT INFORMATION

Agency: New Hampshire Department of Transportation
Name: Rhona Thomson
Address: 7 Hazen Drive
City: Concord
State: NH
Zip: 03302
Email rhona.c.thomson@dot.nh.gov
Phone: 6032717966

Attachment 10 -

NHDOT Cultural Resource Review

Section 106 Programmatic Agreement – Cultural Resources Review Effect Finding

<u>Appendix B Certification</u> – Activities with Minimal Potential to Cause Effects

Date Reviewed: (Desktop or Field Review Date)	7/20/2020		
Project Name:	Springfield		
State Number:	20509	**FHWA Number:**	X-A002(078)
Environmental Contact: **Email Address:**	Meli Dube Melilotus.Dube@dot.nh.gov	**DOT Project Manager:**	David Scott

Project Description: Replacement of twin 5' x 104' corrugated metal pipe culverts in masonry headwall carrying Star Lake Outlet (also known as Otter Brook) under Georges Mills Road at the intersection of Stryker Road and Fisher Corner Road with a 20' pre-cast concrete box culvert. This will require additional roadwork to accommodate the new crossing including slight realignment and widening at the intersection.

Please select the applicable activity/activities:

Highway and Roadway Improvements	
☒	1. Modernization and general highway maintenance **<u>that may require additional highway right-of-way or easement</u>**, including: h. removal of trees, as part of roadway improvements Choose an item.
☐	2. Installation of rumble strips or rumble stripes
☐	3. Installation or replacement of pole-mounted signs
☒	4. Guardrail replacement, provided any extension does not connect to a bridge older than 50 years old (unless it does already), and there is no change in access associated with the extension
Bridge and Culvert Improvements	
☐	5. Culvert replacement (excluding stone box culverts), when the culvert is less than 60" in diameter and excavation for replacement is limited to previously disturbed areas
☐	6. Bridge deck preservation and replacement, as long as no character defining features are impacted
☒	7. Non-historic bridge and culvert maintenance, renovation, or total replacement, **<u>that may require minor additional right-of-way or easement</u>**, including: a. replacement or maintenance of non-historic bridges Choose an item.
☐	8. Historic bridge maintenance activities within the limits of existing right-of-way, including: Choose an item. Choose an item.
☐	9. Stream and/or slope stabilization and restoration activities (including removal of debris or sediment obstructing the natural waterway, or any non-invasive action to restore natural conditions)
Bicycle and Pedestrian Improvements	
☐	10. Construction of pedestrian walkways, sidewalks, sidewalk tip-downs, small passenger shelters, and alterations to facilities or vehicles in order to make them accessible for elderly and handicapped persons
☐	11. Installation of bicycle racks
☐	12. Recreational trail construction
☐	13. Recreational trail maintenance when done on existing alignment
☐	14. Construction of bicycle lanes and shared use paths and facilities within the existing right-of-way
Railroad Improvements	

☐	15. Modernization, maintenance, and safety improvements of railroad facilities within the existing railroad or highway right-of-way, **provided no historic railroad features are impacted,** including, but not limited to: Choose an item. Choose an item.
☐	16. In-kind replacement of modern railroad features (i.e. those features that are less than 50 years old)
☐	17. Modernization/modification of railroad/roadway crossings provided that all work is undertaken within the limits of the roadway structure (edge of roadway fill to edge of roadway fill) and no associated character defining features are impacted
Other Improvements	
☐	18. Installation of Intelligent Transportation Systems
☐	19. Acquisition or renewal of scenic, conservation, habitat, or other land preservation easements where no construction will occur
☐	20. Rehabilitation or replacement of existing storm drains.
☐	21. Maintenance of stormwater treatment features and related infrastructure

Please describe how this project is applicable under Appendix B of the Programmatic Agreement.

The proposed project meets the intent of Appendix B of the Programmatic Agreement due to the minimal impacts associated with replacing the twin corrugated metal pipes carrying Star Lake Outlet under Georges Mills Road. The crossing itself, including the masonry headwalls, is exempt from further Section 106 review under the Program Comment for Post-1945 Concrete and Steel Bridges. Other work includes widening the roadway slightly to accommodate a new 20' precast concrete box culvert and replacing and updating guardrail and curbing.

Please submit this Certification Form along with the Transportation RPR, including photographs, USGS maps, design plans and as-built plans, if available, for review. Note: The RPR can be waived for in-house projects, please consult Cultural Resources Program Staff.

Coordination Efforts:

Has an RPR been submitted to NHDOT for this project?	No	NHDHR R&C # assigned?	Click here to enter text.
Please identify public outreach effort contacts; method of outreach and date:	Initial contact letters indicating the general scope of work were sent to all Town of Springfield Town Officials, including the Historical Society on January 2016. The project was presented at a Public Informational Meeting/Public Officials Meeting on February 26, 2018.		

Finding: (To be filled out by NHDOT Cultural Resources Staff)

☒	**No Potential to Cause Effects**	☐	**No Historic Properties Affected**
This finding serves as the Section 106 Memorandum of Effect. No further coordination is necessary.			
☐	**This project does *not* comply with Appendix B. Review will continue under Stipulation VII of the Programmatic Agreement. Please contact NHDOT Cultural Resources Staff to determine next steps.**		

NHDOT comments:

Sheila Charles   7/21/2020

NHDOT Cultural Resources Staff   Date

Section 106 Programmatic Agreement – Cultural Resources Review Effect Finding

Appendix B Certification – Activities with Minimal Potential to Cause Effects

Coordination of the Section 106 process should begin as early as possible in the planning phase of the project (undertaking) so as not to cause a delay.

Project sponsors should not predetermine a Section 106 finding under the assumption a project is limited to the activities listed in Appendix B until this form is signed by the NHDOT Bureau of Environment Cultural Resources Program staff.

Every project shall be coordinated with, and reviewed by the NHDOT-BOE Cultural Resources Program in accordance with the *Programmatic Agreement Among the Federal Highway Administration, the New Hampshire State Historic Preservation Office, the Army Corps of Engineers, New England District, the Advisory Council on Historic Preservation, and the New Hampshire Department of Transportation Regarding the Federal Aid Highway Program in New Hampshire*. In accordance with the Advisory Council's regulations, we will continue to consult, as appropriate, as this project proceeds.

If any portion of the project is not entirely limited to any one or a combination of the activities specified in Appendix B (with, or without the inclusion of any activities listed in Appendix A), please continue discussions with NHDOT Cultural Resources staff.

This No Potential to Cause Effect or No Historic Properties Affected project determination is your Section 106 finding, as defined in the Programmatic Agreement.

Should project plans change, please inform the NHDOT Cultural Resources staff in accordance with Stipulation VII of the Programmatic Agreement.

New Hampshire Recordation of Bridges that Apply to the Program Comment for Common Post-1945 Concrete & Steel Bridges

Project Name:	Springfield		
State Number:	20509	**FHWA Number:**	X-A002(078)
Form Completed by:	Meli Dube	**Date:**	January 19, 2017
Email if not NHDOT staff:	Click here to enter text.		

Town	Springfield	**NHDOT Bridge No.**	(091/048)
Year Built (rebuilt)	1951	**Owner**	NHDOT Bridge Design
Road carrying	Georges Mill Road	**Over feature**	Star Lake Outlet (Otter Brook)
Bridge/culvert Type	Metal Pipe	**Number of Spans**	2
Length	104'	**Width**	Twin 5' Pipes
Abutment style	Masonry Headwall	**Pier style**	None
Rail Type	W-Beam Guardrail	**Rail installation date:**	Unknown
Designer/Engineer (if known)	Bill Saffian, John Sargent	**Bridge Plaques or Engravings?**	No

Reviewed by: [signature] NHDOT Cultural Resources Staff **Date Reviewed:** 1/27/2017

Approved ☒ **Not Approved** ☐ **Justification:**

RPR Number:______ Reviewed under PA: X

Please refer to the *NHDOT Guidance on Using the Program Comment for Common Post-1945 Concrete and Steel Bridges*, located on the NHDOT Bureau of Environment Website, for information on using this form: http://www.nh.gov/dot/org/projectdevelopment/environment/units/program-management/cultural.htm

Information on specific bridges can be found on the NHDOT Bureau of Bridge Design **Bridge Summary** Spreadsheet: http://www.nh.gov/dot/org/projectdevelopment/bridgedesign/documents.htm.

(Additional photographs may be attached here if needed).

Attachment 11 -

USACE Section 404 Checklist

US Army Corps of Engineers®
New England District

Appendix B
New Hampshire General Permits
Required Information and USACE Section 404Checklist

USACE Section 404 Checklist

1. Attach any explanations to this checklist. Lack of information could delay a USACE permit determination.
2. All references to "work" include all work associated with the project construction and operation. Work includes filling, clearing, flooding, draining, excavation, dozing, stumping, etc.
3. See GC 3 for information on single and complete projects.
4. Contact USACE at (978) 318-8832 with any questions.
5. The information requested below is generally required in the NHDES Wetland Application. See page 61 for NHDES references and Admin Rules as they relate to the information below.

1. Impaired Waters	Yes	No
1.1 Will any work occur within 1 mile upstream in the watershed of an impaired water? See the following to determine if there is an impaired water in the vicinity of your work area. * https://nhdes-surface-water-quality-assessment-site-nhdes.hub.arcgis.com/ https://www.des.nh.gov/water/rivers-and-lakes/water-quality-assessment https://www4.des.state.nh.us/onestopdatamapper/onestopmapper.aspx		X
2. Wetlands	Yes	No
2.1 Are there are streams, brooks, rivers, ponds, or lakes within 200 feet of any proposed work?	X	
2.2 Are there proposed impacts to tidal SAS, prime wetlands, or priority resource areas? Applicants may obtain information from the NH Department of Resources and Economic Development Natural Heritage Bureau (NHB) DataCheck Tool for information about resources located on the property at https://www4.des.state.nh.us/NHB-DataCheck/.		X
2.3 If wetland crossings are proposed, are they adequately designed to maintain hydrology, sediment transport & wildlife passage?	X	
2.4 Would the project remove part or all of a riparian buffer? (Riparian buffers are lands adjacent to streams where vegetation is strongly influenced by the presence of water. They are often thin lines of vegetation containing native grasses, flowers, shrubs and/or trees that line the stream banks. They are also called vegetated buffer zones.)		X
2.5 The overall project site is more than 40 acres?		X
2.6 What is the area of the previously filled wetlands?	N/A	
2.7 What is the area of the proposed fill in wetlands?	N/A	
2.8 What % of the overall project sire will be previously and proposed filled wetlands?	N/A	
3. Wildlife	Yes	No
3.1 Has the NHB & USFWS determined that there are known occurrences of rare species, exemplary natural communities, Federal and State threatened and endangered species and habitat, in the vicinity of the proposed project? (All projects require an NHB ID number & a USFWS IPAC determination.) NHB DataCheck Tool: https://www4.des.state.nh.us/NHB-DataCheck/. USFWS IPAC website: https://ipac.ecosphere.fws.gov/		X

3.2 Would work occur in any area identified as either "Highest Ranked Habitat in N.H." or "Highest Ranked Habitat in Ecological Region"? (These areas are colored magenta and green, respectively, on NH Fish and Game's map, "2010 Highest Ranked Wildlife Habitat by Ecological Condition.") Map information can be found at: • PDF: https://wildlife.state.nh.us/wildlife/wap-high-rank.html. • Data Mapper: www.granit.unh.edu. • GIS: www.granit.unh.edu/data/downloadfreedata/category/databycategory.html.		X
3.3 Would the project impact more than 20 acres of an undeveloped land block (upland, wetland/waterway) on the entire project site and/or on an adjoining property(s)?		X
3.4 Does the project propose more than a 10-lot residential subdivision, or a commercial or industrial development?		X
3.5 Are stream crossings designed in accordance with the GC 31?	X	
4. Flooding/Floodplain Values	Yes	No
4.1 Is the proposed project within the 100-year floodplain of an adjacent river or stream?		X
4.2 If 4.1 is yes, will compensatory flood storage be provided if the project results in a loss of flood storage?		
5. Historic/Archaeological Resources		
For a minimum, minor or major impact project - a copy of the RPR Form (www.nh.gov/nhdhr/review) with your DES file number shall be sent to the NH Division of Historical Resources as required on Page 37 GC 14(d) of the GP document**	X	
6. Minimal Impact Determination (for projects that exceed 1 acre of permanent impact)	Yes	No
Projects with greater than 1 acre of permanent impact must include the following: • Functional assessment for aquatic resources in the project area. • On and off-site alternative analysis. • Provide additional information and description for how the below criteria are met.		
6.1 Will there be complete loss of aquatic resources on site?		N/A
6.2 Have the impacts to the aquatic resources been avoided and minimized to the greatest extent practicable?	X	N/A
6.3 Will all aquatic resource function be lost?		N/A
6.4 Does the aquatic resource (s) have regional significance (watershed or ecoregion)?		N/A
6.5 Is there an on-site alternative with less impact?		N/A
6.6 Is there an off-site alternative with less impact?		N/A
6.7 Will there be a loss to a resource dependent species?		N/A
6.8 Are indirect impacts greater than 1 acre within and adjacent to the project area?		N/A
6.9 Does the proposed mitigation replace aquatic resource function for direct, indirect, and cumulative impacts?		N/A

*Although this checklist utilizes state information, its submittal to USACE is a federal requirement.

** If your project is not within Federal jurisdiction, coordination with NH DHR is not required under Federal law.

Attachment 12 -

Wetlands Functions and Values Worksheet and Form

WETLANDS FUNCTIONAL ASSESSMENT WORKSHEET

Water Division/Land Resource Management
Wetlands Bureau

Check the Status of your Application

RSA/Rule: RSA 482-A / Env-Wt 311.03(b)(10); Env-Wt 311.10

APPLICANT LAST NAME, FIRST NAME, M.I.: Jennifer E. Reczek

As required by Env-Wt 311.03(b)(10), an application for a standard permit for minor and major projects must include a functional assessment of all wetlands on the project site as specified in Env-Wt 311.10. This worksheet will help you compile data for the functional assessment needed to meet federal (US Army Corps of Engineers (USACE); if applicable) and NHDES requirements. Additional requirements are needed for projects in tidal area; please refer to the Coastal Area Worksheet (NHDES-W-06-079) for more information.

Both a desktop review and a field examination are needed to accurately determine surrounding land use, hydrology, hydroperiod, hydric soils, vegetation, structural complexity of wetland classes, hydrologic connections between wetlands or stream systems or wetland complex, position in the landscape, and physical characteristics of wetlands and associated surface waters. The results of the evaluation are to be used to select the location of the proposed project having the least impact to wetland functions and values (Env-Wt 311.10). This worksheet can be used in conjunction with the Avoidance and Minimization Written Narrative (NHDES-W-06-089) and the Avoidance and Minimization Checklist (NHDES-W-06-050) to address Env-Wt 313.03 (Avoidance and Minimization). If more than one wetland/ stream resource is identified, multiple worksheets can be attached to the application. All wetland, vernal pools, and stream identification (ID) numbers are to be displayed and located on the wetlands delineation of the subject property.

SECTION 1 - LOCATION (USACE HIGHWAY METHODOLOGY)	
ADJACENT LAND USE: Rural residential	
CONTIGUOUS UNDEVELOPED BUFFER ZONE PRESENT? ☒ Yes ☐ No	
DISTANCE TO NEAREST ROADWAY OR OTHER DEVELOPMENT (in feet): 30 Feet	
SECTION 2 - DELINEATION (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)	
CERTIFIED WETLAND SCIENTIST (if in a non-tidal area) or QUALIFIED COASTAL PROFESSIONAL (if in a tidal area) who prepared this assessment: Kevin Ferguson	
DATE(S) OF SITE VISIT(S): 3/23/2023	DELINEATION PER ENV-WT 406 COMPLETED? ☒ Yes ☐ No
CONFIRM THAT THE EVALUATION IS BASED ON: ☒ Office and ☒ Field examination.	
METHOD USED FOR FUNCTIONAL ASSESSMENT (check one and fill in blank if “other”): ☒ USACE Highway Methodology. ☐ Other scientifically supported method (enter name/ title):	

SECTION 3 - WETLAND RESOURCE SUMMARY (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)	
WETLAND ID: Wetland #1, Stream #1	LOCATION: (LAT/ LONG) 43.448881/-72.053933
WETLAND AREA: See Project Plans	DOMINANT WETLAND SYSTEMS PRESENT: PFO
HOW MANY TRIBUTARIES CONTRIBUTE TO THE WETLAND? Several small tributaries located upstream of the project.	COWARDIN CLASS: R2UB1, PFO1E
IS THE WETLAND A SEPARATE HYDRAULIC SYSTEM? ☐ Yes ☒ No if not, where does the wetland lie in the drainage basin? Within the central portion of the drainage basin.	IS THE WETLAND PART OF: ☐ A wildlife corridor or ☐ A habitat island? IS THE WETLAND HUMAN-MADE? ☐ Yes ☒ No
IS THE WETLAND IN A 100-YEAR FLOODPLAIN? ☐ Yes ☒ No	ARE VERNAL POOLS PRESENT? ☐ Yes ☒ No (If yes, complete the Vernal Pool Table)
ARE ANY WETLANDS PART OF A STREAM OR OPEN-WATER SYSTEM? ☒ Yes ☐ No	ARE ANY PUBLIC OR PRIVATE WELLS DOWNSTREAM/ DOWNGRADIENT? ☒ Yes ☐ No
PROPOSED WETLAND IMPACT TYPE: Temporary and Permanent	PROPOSED WETLAND IMPACT AREA: Temporary - 1169 sq ft/50 linear ft; Permanent - 1806sq ft/282 linear ft

SECTION 4 - WETLANDS FUNCTIONS AND VALUES (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)

The following table can be used to compile data on wetlands functions and values. The reference numbers indicated in the "Functions/ Values" column refer to the following functions and values:

1. Ecological Integrity (from RSA 482-A:2, XI)
2. Educational Potential (from USACE Highway Methodology: Educational/Scientific Value)
3. Fish & Aquatic Life Habitat (from USACE Highway Methodology: Fish & Shellfish Habitat)
4. Flood Storage (from USACE Highway Methodology: Floodflow Alteration)
5. Groundwater Recharge (from USACE Highway Methodology: Groundwater Recharge/Discharge)
6. Noteworthiness (from USACE Highway Methodology: Threatened or Endangered Species Habitat)
7. Nutrient Trapping/Retention & Transformation (from USACE Highway Methodology: Nutrient Removal)
8. Production Export (Nutrient) (from USACE Highway Methodology)
9. Scenic Quality (from USACE Highway Methodology: Visual Quality/Aesthetics)
10. Sediment Trapping (from USACE Highway Methodology: Sediment /Toxicant Retention)
11. Shoreline Anchoring (from USACE Highway Methodology: Sediment/Shoreline Stabilization)
12. Uniqueness/Heritage (from USACE Highway Methodology)
13. Wetland-based Recreation (from USACE Highway Methodology: Recreation)
14. Wetland-dependent Wildlife Habitat (from USACE Highway Methodology: Wildlife Habitat)

First, determine if a wetland is suitable for a particular function and value ("Suitability" column) and indicate the rationale behind your determination ("Rationale" column). Please use the rationale reference numbers listed in Appendix A of USACE *The Highway Methodology Workbook Supplement*. Second, indicate which functions and values are principal ("Principal Function/value?" column). As described in *The Highway Methodology Workbook Supplement*, "functions and values can be principal if they are an important physical component of a wetland ecosystem (function only) and/or are considered of special value to society, from a local, regional, and/or national perspective".

"Important Notes" are to include characteristics the evaluator used to determine the principal function and value of the wetland.

FUNCTIONS/ VALUES	SUITABILITY (Y/N)	RATIONALE (Reference #)	PRINCIPAL FUNCTION/VALUE? (Y/N)	IMPORTANT NOTES
1	☒ Yes ☐ No	Functions/Values: 2,5,7	☒ Yes ☐ No	Perennial stream with adjacent forested wetland
2	☐ Yes ☒ No	N/A	☐ Yes ☒ No	None
3	☒ Yes ☐ No	USACE Qualifier: 1,4,7,8,14,16,17	☐ Yes ☒ No	Perennial stream in forested area with potential fish and mollusk habitat
4	☒ Yes ☐ No	USACE Qualifier: 3,5,6,8,9,10,11,13	☒ Yes ☐ No	The wetland located downstream of the project area offers flood attenutation
5	☒ Yes ☐ No	USACE Qualifier: 2,5,7	☐ Yes ☒ No	None
6	☐ Yes ☒ No	N/A	☐ Yes ☒ No	None.
7	☐ Yes ☒ No	3,4	☐ Yes ☒ No	None
8	☐ Yes ☒ No	N/A	☐ Yes ☒ No	None
9	☐ Yes ☒ No	N/A	☐ Yes ☒ No	None
10	☒ Yes ☐ No	USACE Qualifier: 1,2,3,10	☐ Yes ☒ No	Wetland downstream is large and disrupted by biomass plant. Stream located adjacent to roadway
11	☒ Yes ☐ No	USACE Qualifier: 1,2,3,4,6,9,12,14	☒ Yes ☐ No	None
12	☐ Yes ☒ No	N/A	☐ Yes ☒ No	None
13	☐ Yes ☒ No	N/A	☐ Yes ☒ No	None

14	☐ Yes ☒ No	N/A	☐ Yes ☒ No	None

SECTION 5 - VERNAL POOL SUMMARY (Env-Wt 311.10)

Delineations of vernal pools shall be based on the characteristics listed in the definition of “vernal pool” in Env-Wt 104.44. To assist in the delineation, individuals may use either of the following references:

- *Identifying and Documenting Vernal Pools in New Hampshire 3rd Ed.*, 2016, published by the New Hampshire Fish and Game Department; or
- The USACE *Vernal Pool Assessment* draft guidance dated 9-10-2013 and form dated 9-6-2016, Appendix L of the USACE New England District *Compensatory Mitigation Guidance*.

All vernal pool ID numbers are to be displayed and located on the wetland delineation of the subject property.

“Important Notes” are to include documented reproductive and wildlife values, landscape context, and relationship to other vernal pools/wetlands.

Note: For projects seeking federal approval from the USACE, please attach a completed copy of The USACE “Vernal Pool Assessment” form dated 9-6-2016, Appendix L of the USACE New England District *Compensatory Mitigation Guidance*.

VERNAL POOL ID NUMBER	DATE(S) OBSERVED	PRIMARY INDICATORS PRESENT (LIST)	SECONDARY INDICATORS PRESENT (LIST)	LENGTH OF HYDROPERIOD	IMPORTANT NOTES
1					
2					
3					
4					
5					

SECTION 6 - STREAM RESOURCES SUMMARY

DESCRIPTION OF STREAM: Forested area/adjacent to road	STREAM TYPE (ROSGEN): Type C
HAVE FISHERIES BEEN DOCUMENTED? ☐ Yes ☒ No	DOES THE STREAM SYSTEM APPEAR STABLE? ☒ Yes ☐ No

OTHER KEY ON-SITE FUNCTIONS OF NOTE: None.

The following table can be used to compile data on stream resources. "Important Notes" are to include characteristics the evaluator used to determine principal function and value of each stream. The functions and values reference number are defined in Section 4.

FUNCTIONS/ VALUES	SUITABILITY (Y/N)	RATIONALE	PRINCIPAL FUNCTION/VALUE? (Y/N)	IMPORTANT NOTES
1	☒ Yes ☐ No	Functions/Values: 2,5,7	☒ Yes ☐ No	Perennial stream with adjacent forested wetland
2	☐ Yes ☒ No	N/A	☐ Yes ☒ No	None
3	☒ Yes ☐ No	USACE Qualifier: 1,4,7,8,14,16,17	☐ Yes ☒ No	Perennial stream in forested area with potential fish and mollusk habitat
4	☒ Yes ☐ No	USACE Qualifier: 3,5,6,8,9,10,11,13	☒ Yes ☐ No	The wetland located within and adjacent to the project area offers flood attenutation
5	☒ Yes ☐ No	USACE Qualifier: 2,5,7	☐ Yes ☒ No	None
6	☐ Yes ☒ No	N/A	☐ Yes ☒ No	None
7	☐ Yes ☐ No	N/A	☐ Yes ☐ No	None
8	☐ Yes ☒ No	N/A	☐ Yes ☒ No	None
9	☐ Yes ☒ No	N/A	☐ Yes ☒ No	None
10	☒ Yes ☐ No	USACE Qualifier: 1,2,3,10	☐ Yes ☒ No	Stream is located adjacent to roadway
11	☒ Yes ☐ No	USACE Qualifier: 1,2,3,4,6,9,12,14	☒ Yes ☐ No	None
12	☐ Yes ☒ No	N/A	☐ Yes ☒ No	None
13	☐ Yes ☒ No	N/A	☐ Yes ☒ No	None
14	☐ Yes ☒ No	N/A	☐ Yes ☒ No	None

SECTION 7 - ATTACHMENTS (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)

☐ Wildlife and vegetation diversity/abundance list.

☒ Photograph of wetland.

☒ Wetland delineation plans showing wetlands, vernal pools, and streams in relation to the impact area and surrounding landscape. Wetland IDs, vernal pool IDs, and stream IDs must be indicated on the plans.

- [ ] For projects in tidal areas only: additional information required by Env-Wt 603.03/603.04. Please refer to the Coastal Area Worksheet (NHDES-W-06-079) for more information.

Wetland Function-Value Evaluation Form

Total area of wetland See SS Human made? N Is wetland part of a wildlife corridor? N or a "habitat island"? N

Adjacent land use Highway, homes, forested Distance to nearest roadway or other development 1ft

Dominant wetland systems present PFO Contiguous undeveloped buffer zone present Yes, uphill

Is the wetland a separate hydraulic system? N If not, where does the wetland lie in the drainage basin?_____

How many tributaries contribute to the wetland? Mancy Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. Stream 1

Latitude_____ Longitude_____

Prepared by: TRS Date 3/23/23

Wetland Impact:
Type Permanent/Temporary Area_____

Evaluation based on:
Office_____ Field X

Corps manual wetland delineation completed? Y_____ N_____

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	N	2,5,7		
Floodflow Alteration	y	3,5,6,8,9,10,11,13	x	Downstream wetland from project site offers flood attenutation
Fish and Shellfish Habitat	y	1,4,7,8,14,16,17		
Sediment/Toxicant Retention	y	1,2,3,10		Directly adjacent to road. Wetland downstream is large and disrupted by biomass plant.
Nutrient Removal	N	3,4		
Production Export	N			
Sediment/Shoreline Stabilization	Y	1,2,3,4,6,9,12,14	X	Directly adjacent to road. Wetland downstream is large and disrupted by biomass plant.
Wildlife Habitat	N			
Recreation	N			
Educational/Scientific Value	N			
Uniqueness/Heritage	N			
Visual Quality/Aesthetics	N			
ES Endangered Species Habitat	N			
Other				

Notes:

* Refer to backup list of numbered considerations.

Attachment 13 -

Wetland Impact Area Photo Log

Wetland Impact Area Photographs

Photo 1: Upstream photo from culvert location, view is south.

Photo 2: Upstream culvert photo, wetland riparian zone, view is south.

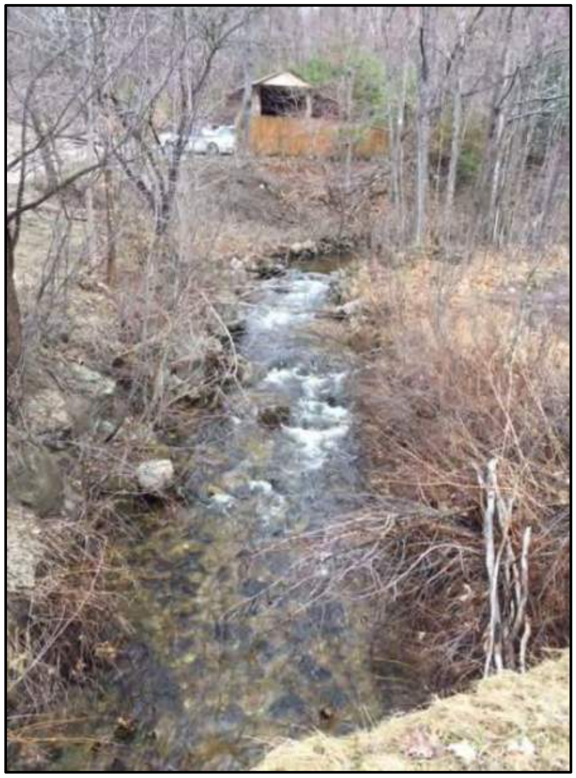
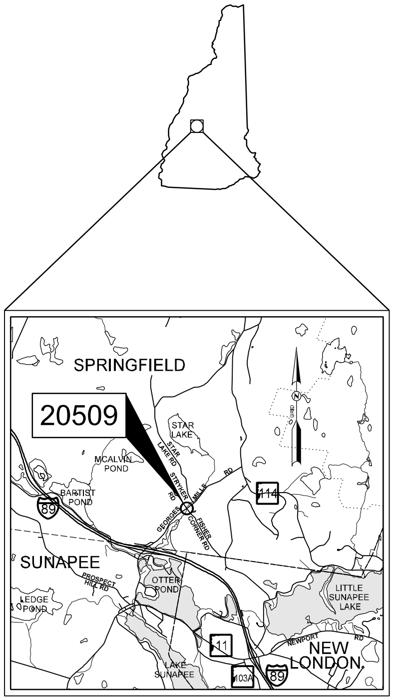


Photo 3: View Upstream of culverts, riparian zone, view is north.

Photo 4: View downstream of culverts, view is north.

Photo 5: View downstream of culverts, view is north.

Photo 6: View downstream of culverts, riparian zone, view is south.



LOCATION MAP

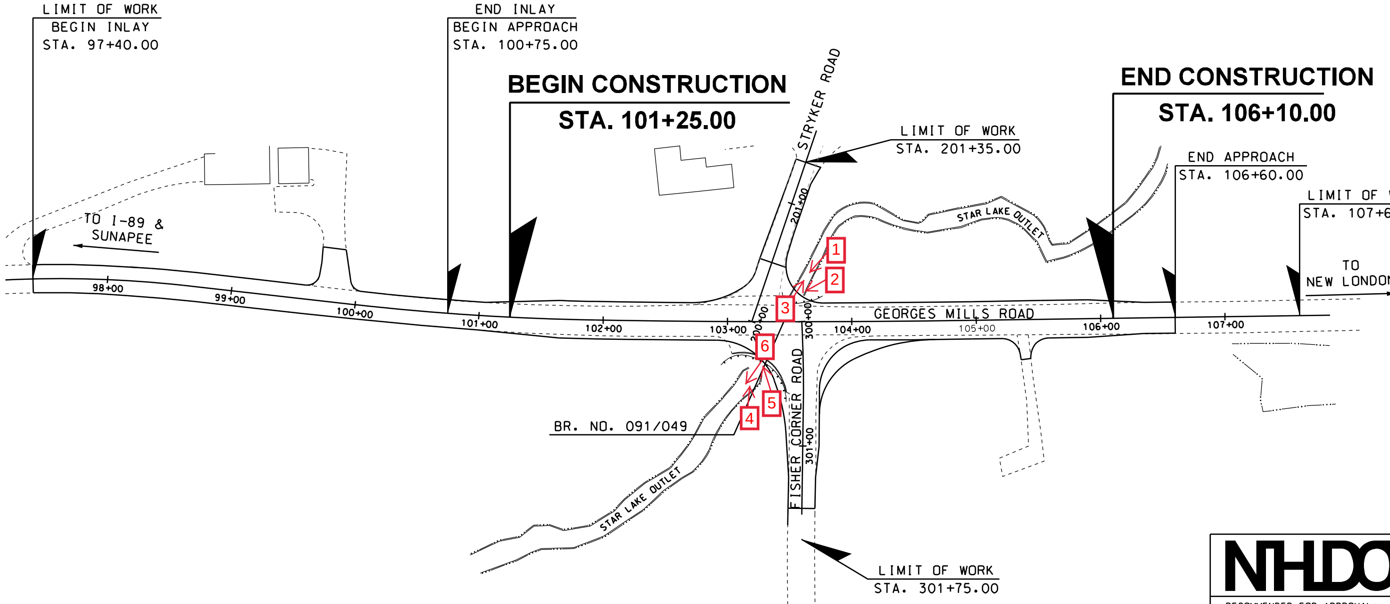
GRAPHIC SCALE

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

WETLANDS PLANS

GEORGES MILLS ROAD OVER STAR LAKE OUTLET BRIDGE REPLACEMENT
FEDERAL NO. X-A002 (078)
N.H. PROJECT NO. 20509

INDEX OF SHEETS



TOWN OF SPRINGFIELD

COUNTY OF SULLIVAN

SCALE: 1" = 50'

FOR CONSTRUCTION DETAILS - SEE CONSTRUCTION PLANS

FUSS & O'NEILL
50 COMMERCIAL STREET
MANCHESTER, NH 03101
603.668.8223
www.fando.com

NHDOT THE STATE OF NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

RECOMMENDED FOR APPROVAL:

DIRECTOR OF PROJECT DEVELOPMENT — DATE

APPROVED:

ASSISTANT COMMISSIONER AND CHIEF ENGINEER — DATE

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED:

DIVISION ADMINISTRATOR — DATE

FEDERAL PROJECT NO.	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
X-A002 (078)	20509	1	10

DRAWN BY EMM	DATE 11/2022
CHECKED BY NCF	DATE 11/2022

Attachment 14 -
Construction Sequence

Construction Sequence Notes

General

1. All construction shall be completed using approved traffic control procedures and in accordance with the traffic control plans. See roadway plans and traffic control plans.

Stage 1:

1. Implement temporary Traffic Control Plan and close Georges Mills Road to through traffic.

2. Install cofferdams (box culvert) and water diversion structure as shown on the Water Diversion Plan. Divert the water around the construction area using the clear water bypass structure.

3. Excavate and remove the existing culverts.

4. Dewater, excavate, and place structural fill.

5. Construct the proposed cast-in-place concrete cut-off walls. Precast concrete box culvert, and wingwalls except for the northwest wingwall.

6. Backfill box culvert and all wingwalls, except northwest wingwall, to the top of the box culvert.

7. Install the riprap, Class III and simulated streambed material inside of the box culvert.

8. Install the geotextile, riprap, Class V, and simulated streambed material outside of the box culvert.

9. Remove upstream sandbags and direct water through precast concrete box culvert.

Stage 2:

1. Remove clean water bypass and cofferdams extending through northwest wingwall.

2. Install sandbags/cofferdams around the proposed northwest wingwall (item 503.202).

3. Dewater, excavate, place structural fill, and construct the proposed northwest cast-in-place cut-off wall and precast concrete northwest wingwall.

4. Backfill northwest wingwall to the top of the box culvert.

5. Remove sandbags/cofferdams around northwest wingwall.

6. Place the precast concrete headwalls and backfill to the bottom of the rail support slabs.

7. Remove the cofferdams and construct the rail support slabs.

8. Complete backfill operations.

9. Construct roadway box and pave.

10. Install mounted bridge rail, approach rail, and guardrail.

11. Remove temporary traffic control measures and reopen Georges Mills Road to through traffic.

Attachment 15 -

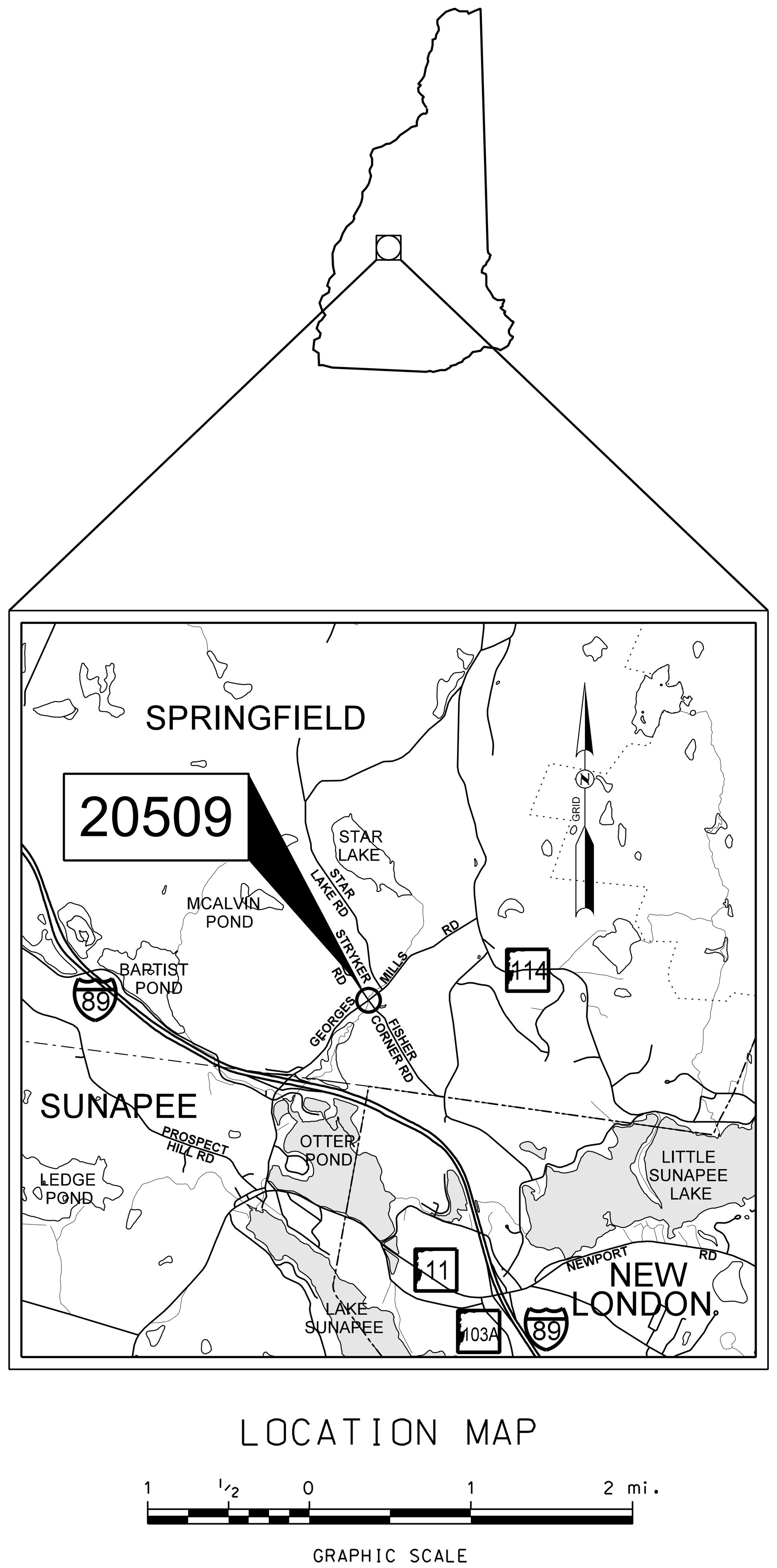
Wetland Impact and Erosion Control Plans

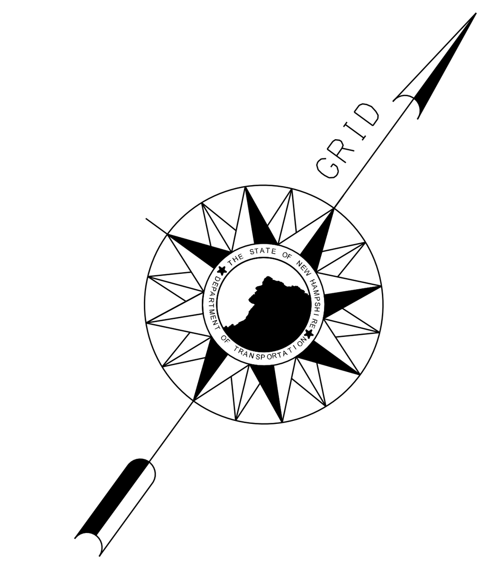
STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

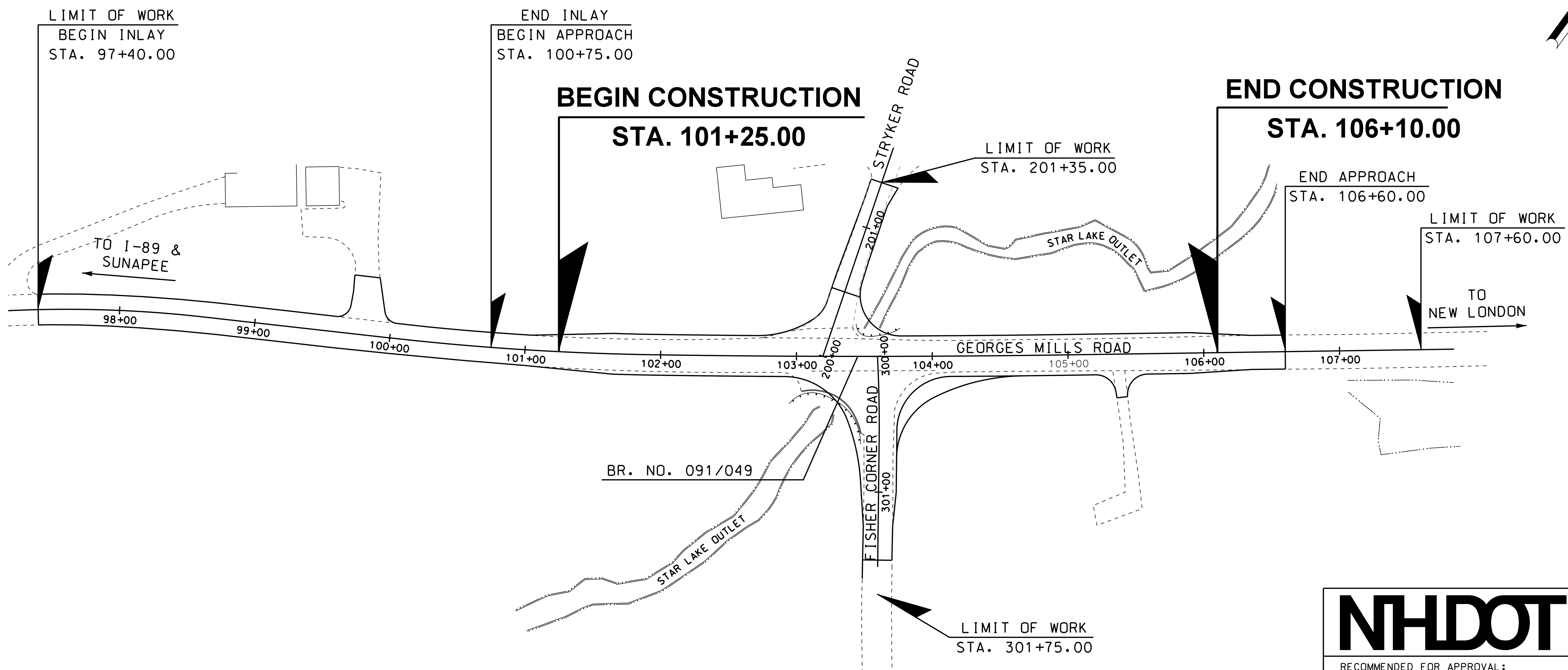
WETLANDS PLANS

GEORGES MILLS ROAD OVER
STAR LAKE OUTLET
BRIDGE REPLACEMENT
FEDERAL NO. X-A002 (078)
N.H. PROJECT NO. 20509

INDEX OF SHEETS







WETLANDS WERE DELINEATED ACCORDING TO ENV-WT 406
ON 7/28/2022 BY DEIDRA BENJAMIN AND MELI DUBE

TOWN OF SPRINGFIELD

COUNTY OF SULLIVAN

SCALE: 1" = 50'

FOR CONSTRUCTION DETAILS - SEE CONSTRUCTION PLANS

STATE OF NEW HAMPSHIRE PROFESSIONAL ENGINEER NICOLE C. FOX No. 13102 LICENSED

FUSS & O'NEILL
50 COMMERCIAL STREET
MANCHESTER, NH 03101
603.668.8223
www.fando.com

NHDOT THE STATE OF NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

RECOMMENDED FOR APPROVAL:

DIRECTOR OF PROJECT DEVELOPMENT DATE

APPROVED:

ASSISTANT COMMISSIONER AND CHIEF ENGINEER DATE

U. S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION

APPROVED:

DIVISION ADMINISTRATOR DATE

FEDERAL PROJECT NO.	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
X-A002 (078)	20509	1	10

DRAWN BY EMM	DATE 06/2023
CHECKED BY NCF	DATE 06/2023

GENERAL

	PROPOSED ROADWAY	existing roadway	(pavement removed outside slope lines)
EDGE OF PAVEMENT			
TRAVELED WAY			

DRIVEWAYS — (label surface type)

BUILDINGS — (building to be removed) — (label house or type of building)

FOUNDATION — (label type)

LEACH FIELD — leach field

BRIDGE CROSSINGS — STREAM — OVERPASS

STEPS AND WALK — (label type)

INTERMITTENT WATER COURSE

SHORE LINE — river/stream — pond — (label name of water body)

POTENTIAL WET AREA SYMBOL

BRUSH OR WOODS LINE

TREES (PLANS) — (deciduous) (coniferous) (stump)

TREE OR STUMP (CROSS-SECTIONS) — (show station, circumference in feet & type)

HEDGE — (label type)

MONITORING WELL — mon

WELL

FLAG POLE — fp

ORIGINAL GROUND (TYPICALS)

ROCK OUTCROP

ROCK LINE (TYPICALS & SECTIONS ONLY)

	existing	PROPOSED
GUARDRAIL (label type)	bgr / cgr	
JERSEY BARRIER		
CURB (LABEL TYPE)		
STONE WALL		
RETAINING WALL (LABEL TYPE)		(points toward retained ground)
FENCE (LABEL TYPE)		

SIGNS — (single post) — (double post)

GAS PUMP — gp

FUEL TANK (ABOVE GROUND) — ft (label size & type)

STORAGE TANK FILLER CAP — fc

SEPTIC TANK — S

GRAVE — gr

MAILBOX — mb

VENT PIPE — vp

SATELLITE DISH ANTENNA — da

PHONE — ph

GROUND LIGHT/LAMP POST — gl lp

BORING LOCATION — B

TEST PIT — TP

INTERSTATE NUMBERED HIGHWAY — 293

UNITED STATES NUMBERED HIGHWAY — 3

STATE NUMBERED HIGHWAY — 102

SHORELAND - WETLAND

WETLAND DESIGNATION AND TYPE	2 PUB2E
DELINEATED WETLAND	DW
ORDINARY HIGH WATER	OHW
TOP OF BANK	TOB
TOP OF BANK & ORDINARY HIGH WATER	TOBOHW
NORMAL HIGH WATER	NHW
WIDTH AT BANK FULL	WBF
PRIME WETLAND	PWET
PRIME WETLAND 100' BUFFER	PWET100
NON-JURISDICTIONAL DRAINAGE AREA	NJDA
COWARDIN DISTINCTION LINE	CDL
TIDAL BUFFER ZONE	TBZ
DEVELOPED TIDAL BUFFER ZONE	DTBZ
HIGHEST OBSERVABLE TIDE LINE	HOTL
MEAN HIGH WATER	MHW
MEAN LOW WATER	MLW
VERNAL POOL	VP
SPECIAL AQUATIC SITE	SAS
REFERENCE LINE	REF
WATER FRONT BUFFER	WB50
NATURAL WOODLAND BUFFER	NWB150
PROTECTED SHORELAND	PS250
INVASIVE SPECIES LABEL	I.S. 1 — I.S. 11
INVASIVE SPECIES	INV

FLOODPLAIN / FLOODWAY

500 YEAR FLOODPLAIN BOUNDARY	FP500
100 YEAR FLOODPLAIN BOUNDARY	FP100
FLOODWAY	FW

ENGINEERING

CONSTRUCTION BASELINE — 30 31 32

PC, PT, POT (ON CONST BASELINE)

PI (IN CONSTRUCTION BASELINES)

INTERSECTION OR EQUATION OF TWO LINES

ORIGINAL GROUND LINE (PROFILES AND CROSS-SECTIONS)

PROFILE GRADE LINE (PROFILES AND CROSS-SECTIONS)

CLEARING LINE — SLOPE LINE — CLEARING LINE

SLOPE LINE

SLOPE LINE (FILL)

SLOPE LINE (CUT)

PROFILES AND CROSS SECTIONS:
ORIGINAL GROUND ELEVATION (LEFT) — 72.5
FINISHED GRADE ELEVATION (RIGHT) — 79.14

SHEET 1 OF 2

STATE OF NEW HAMPSHIRE
SPRINGFIELD
DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

STANDARD SYMBOLS

REVISION DATE	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
11-21-2014	stdsymb1-2	20509	2	10

DRAINAGE

- MANHOLE
- CATCH BASIN — cb — (existing) — (PROPOSED)
- DROP INLET — di
- DRAINAGE PIPE (existing) — (label size & type)
- DRAINAGE PIPE (PROPOSED)
- UNDERDRAIN (existing) W/ FLUSHING BASIN — fb — (label size & type)
- UNDERDRAIN (PROPOSED) W/ FLUSHING BASIN
- show direction of flow
- HEADER (existing & PROPOSED) — (with stone outlet protection)
- END SECTION (existing & PROPOSED) — METAL or PLASTIC — RCP
- OPEN DITCH (PROPOSED)
- EROSION CONTROL/ STONE SLOPE PROTECTION

BOUNDARIES / RIGHT-OF-WAY

- RIGHT-OF-WAY LINE — (label type)
- RR RIGHT-OF-WAY LINE
- PROPERTY LINE — Ꝑ
- PROPERTY LINE (COMMON OWNER) — Z
- TOWN LINE — BOW / CONCORD
- COUNTY LINE — COOS / GRAFTON
- STATE LINE — MAINE / NEW HAMPSHIRE
- NATIONAL FOREST
- CONSERVATION LAND — LC
- BENCH MARK / SURVEY DISK
- BOUND — bnd — (PROPOSED)
- STATE LINE/ TOWN LINE MONUMENT — S/L — T/L
- NHDOT PROJECT MARKER
- IRON PIPE OR PIN — ip
- DRILL HOLE IN ROCK — dh
- TAX MAP AND LOT NUMBER — 156 14 — 1642/341 — 6.80 Ac.±
- PROPERTY PARCEL NUMBER — 12
- HISTORIC PROPERTY — H

UTILITIES

existing — PROPOSED

- TELEPHONE POLE
- POWER POLE
- JOINT OCCUPANCY — (plot point at face not center of symbol)
- MISCELLANEOUS/UNKNOWN POLE
- GUY POLE OR PUSH BRACE
- LIGHT POLE
- LIGHT ON POWER POLE
- LIGHT ON JOINT POLE
- POLE STATUS: REMOVE, LEAVE, PROPOSED, OR TEMPORARY AS APPLICABLE e.g.: — R — L — P+04 25.0' — T+04 25.0'
- RAILROAD — (label ownership)
- RAILROAD SIGN
- RAILROAD SIGNAL
- UTILITY JUNCTION BOX — jb — JB
- OVERHEAD WIRE — OW — (label type)

UNDERGROUND UTILITIES

- WATER (on existing lines label size, type and note if abandoned) — W — PW
- SEWER — S — PS
- TELEPHONE — T — PT
- ELECTRIC — E — PE
- GAS — G — PG
- LIGHTING — L — PL
- INTELLIGENT TRANSPORTATION SYSTEM — ITS
- FIBER OPTIC — FO — PFO
- WATER SHUT OFF — WSO
- GAS SHUT OFF — GSO
- HYDRANT — hyd — HYD

MANHOLES

- SEWER — MHS
- TELEPHONE — MHT
- ELECTRICAL — MHE
- GAS — MHG
- UNKNOWN

TRAFFIC SIGNALS / ITS

existing — PROPOSED

- MAST ARM (existing) — 30' MA (NOTE ANGLE FROM ℄)
- OPTICOM RECEIVER
- OPTICOM STROBE
- TRAFFIC SIGNAL
- PEDESTAL WITH PEDESTRIAN SIGNAL HEADS AND PUSH BUTTON UNIT
- SIGNAL CONDUIT — C — PC
- CONTROLLER CABINET — cc — CC
- METER PEDESTAL — mp — MP
- PULL BOX — pb — PB
- LOOP DETECTOR (QUADRUPOLE) — (label size)
- LOOP DETECTOR (RECTANGULAR) — (label size)
- CAMERA POLE (CCTV)
- FIBER OPTIC DELINEATOR — fod — FOD
- FIBER OPTIC SPLICE VAULT — SVF
- ITS EQUIPMENT CABINET — its — ITS
- VARIABLE SPEED LIMIT SIGN
- DYNAMIC MESSAGE SIGN
- ROAD AND WEATHER INFO SYSTEM

CONSTRUCTION NOTES

CURB MARK NUMBER - BITUMINOUS	B-1
CURB MARK NUMBER - GRANITE	G-1
CLEARING AND GRUBBING AREA	A
DRAINAGE NOTE	1
EROSION CONTROL NOTE	A
FENCING NOTE	A
GUARDRAIL NOTE	1
ITS NOTE	1
LIGHTING NOTE	A
TRAFFIC SIGNAL NOTE	1

SHEET 2 OF 2

STATE OF NEW HAMPSHIRE
SPRINGFIELD
DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF HIGHWAY DESIGN

STANDARD SYMBOLS

REVISION DATE	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
9-1-2016	stdsymb1-2	20509	3	10

EROSION CONTROL STRATEGIES

1. ENVIRONMENTAL COMMITMENTS:
   1.1. THESE GUIDELINES DO NOT RELIEVE THE CONTRACTOR FROM COMPLIANCE WITH ANY CONTRACT PROVISIONS, OR APPLICABLE FEDERAL, STATE, AND LOCAL REGULATIONS.
   1.2. THIS PROJECT WILL BE SUBJECT TO THE US EPA'S NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) STORM WATER CONSTRUCTION GENERAL PERMIT AS ADMINISTERED BY THE ENVIRONMENTAL PROTECTION AGENCY (EPA). THIS PROJECT IS SUBJECT TO REQUIREMENTS IN THE MOST RECENT CONSTRUCTION GENERAL PERMIT (CGP).
   1.3. THE CONTRACTOR'S ATTENTION IS DIRECTED TO THE NHDES WETLAND PERMIT, THE US ARMY CORPS OF ENGINEERS PERMIT, WATER QUALITY CERTIFICATION AND THE SPECIAL ATTENTION ITEMS INCLUDED IN THE CONTRACT DOCUMENTS.
   1.4. ALL STORM WATER, EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSTALLED AND MAINTAINED IN ACCORDANCE WITH THE NEW HAMPSHIRE STORMWATER MANUAL, VOLUME 3, EROSION AND SEDIMENT CONTROLS DURING CONSTRUCTION (DECEMBER 2008) (BMP MANUAL) AVAILABLE FROM THE NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES (NHDES).
   1.5. THE CONTRACTOR SHALL COMPLY WITH RSA 485-A:17, AND ALL PUBLISHED NHDES ALTERATION OF TERRAIN ENV-WQ 1500 REQUIREMENTS (HTTP://DES.NH.GOV/ORGANIZATION/COMMISSIONER/LEGAL/RULES/INDEX.HTM)
   1.6. THE CONTRACTOR IS DIRECTED TO REVIEW AND COMPLY WITH SECTION 107.1 OF THE CONTRACT AS IT REFERS TO SPILLAGE, AND ALSO WITH REGARDS TO EROSION, POLLUTION, AND TURBIDITY PRECAUTIONS.

2. STANDARD EROSION CONTROL SEQUENCING APPLICABLE TO ALL CONSTRUCTION PROJECTS:
   2.1. PERIMETER CONTROLS SHALL BE INSTALLED PRIOR TO EARTH DISTURBING ACTIVITIES. PERIMETER CONTROLS AND STABILIZED CONSTRUCTION EXITS SHALL BE INSTALLED AS SHOWN IN THE BMP MANUAL AND AS DIRECTED BY THE STORMWATER POLLUTION PREVENTION PLAN (SWPPP) PREPARER.
   2.2. EROSION, SEDIMENTATION CONTROL MEASURES AND INFILTRATION BASINS SHALL BE CLEANED, REPLACED AND AUGMENTED AS NECESSARY TO PREVENT SEDIMENTATION BEYOND PROJECT LIMITS THROUGHOUT THE PROJECT DURATION.
   2.3. EROSION AND SEDIMENT CONTROL MEASURES SHALL BE INSPECTED IN ACCORDANCE WITH THE CONSTRUCTION GENERAL PERMIT AND SECTION 645 OF THE NHDOT SPECIFICATIONS FOR ROAD AND BRIDGES CONSTRUCTION.
   2.4. AN AREA SHALL BE CONSIDERED STABLE IF ONE OF THE FOLLOWING HAS OCCURRED:
      (A) BASE COURSE GRAVELS HAVE BEEN INSTALLED IN AREAS TO BE PAVED;
      (B) A MINIMUM OF 85% VEGETATED GROWTH HAS BEEN ESTABLISHED;
      (C) A MINIMUM OF 3" OF NON-EROSIVE MATERIAL SUCH AS STONE OR RIP-RAP HAS BEEN INSTALLED;
      (D) TEMPORARY SLOPE STABILIZATION CONFORMING TO TABLE 1 HAS BEEN PROPERLY INSTALLED
   2.5. ALL STOCKPILES SHALL BE CONTAINED WITH A PERIMETER CONTROL. IF THE STOCKPILE IS TO REMAIN UNDISTURBED FOR MORE THAN 14 DAYS, MULCHING WILL BE REQUIRED.
   2.6. A WATER TRUCK SHALL BE AVAILABLE TO CONTROL EXCESSIVE DUST AT THE DIRECTION OF THE CONTRACT ADMINISTRATOR.
   2.7. TEMPORARY EROSION AND SEDIMENTATION CONTROL MEASURES SHALL REMAIN UNTIL THE AREA HAS BEEN PERMANENTLY STABILIZED.
   2.8. CONSTRUCTION PERFORMED ANY TIME BETWEEN NOVEMBER 30TH AND MAY 1ST OF ANY YEAR SHALL BE CONSIDERED WINTER CONSTRUCTION AND SHALL CONFORM TO THE FOLLOWING REQUIREMENTS.
      (A) ALL PROPOSED VEGETATED AREAS WHICH DO NOT EXHIBIT A MINIMUM OF 85% VEGETATIVE GROWTH BY OCTOBER 15TH, OR WHICH ARE DISTURBED AFTER OCTOBER 15TH, SHALL BE STABILIZED IN ACCORDANCE WITH TABLE 1.
      (B) ALL DITCHES OR SWALES WHICH DO NOT EXHIBIT A MINIMUM OF 85% VEGETATIVE GROWTH BY OCTOBER 15TH, OR WHICH ARE DISTURBED AFTER OCTOBER 15TH, SHALL BE STABILIZED TEMPORARILY WITH STONE OR IN ACCORDANCE WITH TABLE 1.
      (C) AFTER NOVEMBER 30TH INCOMPLETE ROAD SURFACES, WHERE WORK HAS STOPPED FOR THE SEASON, SHALL BE PROTECTED IN ACCORDANCE WITH TABLE 1.
      (D) WINTER EXCAVATION AND EARTHWORK SHALL BE DONE SUCH THAT NO MORE THAN 1 ACRE OF THE PROJECT IS WITHOUT STABILIZATION AT ONE TIME, UNLESS A WINTER CONSTRUCTION PLAN HAS BEEN APPROVED BY NHDOT THAT MEETS THE REQUIREMENTS OF ENV-WQ 1505.02 AND ENV-WQ 1505.05.
      (E) A SWPPP AMENDMENT SHALL BE SUBMITTED TO THE DEPARTMENT, FOR APPROVAL, ADDRESSING COLD WEATHER STABILIZATION (ENV-WQ 1505.05) AND INCLUDING THE REQUIREMENTS OF NO LESS THAN 30 DAYS PRIOR TO THE COMMENCEMENT OF WORK SCHEDULED AFTER NOVEMBER 30TH.

GENERAL CONSTRUCTION PLANNING AND SELECTION OF STRATEGIES TO CONTROL EROSION AND SEDIMENT ON HIGHWAY CONSTRUCTION PROJECTS

3. PLAN ACTIVITIES TO ACCOUNT FOR SENSITIVE SITE CONDITIONS:
   3.1. CLEARLY FLAG AREAS TO BE PROTECTED IN THE FIELD AND PROVIDE CONSTRUCTION BARRIERS TO PREVENT TRAFFICKING OUTSIDE OF WORK AREAS.
   3.2. CONSTRUCTION SHALL BE SEQUENCED TO LIMIT THE DURATION AND AREA OF EXPOSED SOILS.
   3.3. PROTECT AND MAXIMIZE EXISTING NATIVE VEGETATION AND NATURAL FOREST BUFFERS BETWEEN CONSTRUCTION ACTIVITY AND SENSITIVE AREAS.
   3.4. WHEN WORK IS PERFORMED IN AND NEAR WATER COURSES, STREAM FLOW DIVERSION METHODS SHALL BE IMPLEMENTED PRIOR TO ANY EXCAVATION OR FILLING.
   3.5. WHEN WORK IS PERFORMED WITHIN 50 FEET OF SURFACE WATERS (WETLAND, OPEN WATER OR FLOWING WATER), PERIMETER CONTROL SHALL BE ENHANCED CONSISTENT WITH SECTION 2.1.2.1. OF THE 2012 NPDES CONSTRUCTION GENERAL PERMIT.

4. MINIMIZE THE AMOUNT OF EXPOSED SOIL:
   4.1. CONSTRUCTION SHALL BE SEQUENCED TO LIMIT THE DURATION AND AREA OF EXPOSED SOILS. MINIMIZE THE AREA OF EXPOSED SOIL AT ANY ONE TIME. PHASING SHALL BE USED TO REDUCE THE AMOUNT AND DURATION OF SOIL EXPOSED TO THE ELEMENTS AND VEHICLE TRACKING.
   4.2. UTILIZE TEMPORARY MULCHING OR PROVIDE ALTERNATE TEMPORARY STABILIZATION ON EXPOSED SOILS IN ACCORDANCE WITH TABLE 1.
   4.3. THE MAXIMUM AMOUNT OF DISTURBED EARTH SHALL NOT EXCEED A TOTAL OF 5 ACRES FROM MAY 1ST THROUGH NOVEMBER 30TH, OR EXCEED ONE ACRE DURING WINTER MONTHS, UNLESS THE CONTRACTOR DEMONSTRATES TO THE DEPARTMENT THAT THE ADDITIONAL AREA OF DISTURBANCE IS NECESSARY TO MEET THE CONTRACTORS CRITICAL PATH METHOD SCHEDULE (CPM), AND THE CONTRACTOR HAS ADEQUATE RESOURCES AVAILABLE TO ENSURE THAT ENVIRONMENTAL COMMITMENTS WILL BE MET.

5. CONTROL STORMWATER FLOWING ONTO AND THROUGH THE PROJECT:
   5.1. DIVERT OFF SITE RUNOFF OR CLEAN WATER AWAY FROM THE CONSTRUCTION ACTIVITY TO REDUCE THE VOLUME THAT NEEDS TO BE TREATED ON SITE.
   5.2. DIVERT STORM RUNOFF FROM UPSLOPE DRAINAGE AREAS AWAY FROM DISTURBED AREAS, SLOPES, AND AROUND ACTIVE WORK AREAS AND TO A STABILIZED OUTLET LOCATION.
   5.3. CONSTRUCT IMPERMEABLE BARRIERS AS NECESSARY TO COLLECT OR DIVERT CONCENTRATED FLOWS FROM WORK OR DISTURBED AREAS.
   5.4. STABILIZE, TO APPROPRIATE ANTICIPATED VELOCITIES, CONVEYANCE CHANNELS OR PUMPING SYSTEMS NEEDED TO CONVEY CONSTRUCTION STORMWATER TO BASINS AND DISCHARGE LOCATIONS PRIOR TO USE.
   5.5. DIVERT OFF-SITE WATER THROUGH THE PROJECT IN AN APPROPRIATE MANNER SO NOT TO DISTURB THE UPSTREAM OR DOWNSTREAM SOILS, VEGETATION OR HYDROLOGY BEYOND THE PERMITTED AREA.

6. PROTECT SLOPES:
   6.1. INTERCEPT AND DIVERT STORM RUNOFF FROM UPSLOPE DRAINAGE AREAS AWAY FROM UNPROTECTED AND NEWLY ESTABLISHED AREAS AND SLOPES TO A STABILIZED OUTLET OR CONVEYANCE.
   6.2. CONSIDER HOW GROUNDWATER SEEPAGE ON CUT SLOPES MAY IMPACT SLOPE STABILITY AND INCORPORATE APPROPRIATE MEASURES TO MINIMIZE EROSION.
   6.3. CONVEY STORMWATER DOWN THE SLOPE IN A STABILIZED CHANNEL OR SLOPE DRAIN.
   6.4. THE OUTER FACE OF THE FILL SLOPE SHOULD BE IN A LOOSE RUFFLED CONDITION PRIOR TO TURF ESTABLISHMENT. TOPSOIL OR HUMUS LAYERS SHALL BE TRACKED UP AND DOWN THE SLOPE, DISKED, HARROWED, DRAGGED WITH A CHAIN OR MAT, MACHINE-RAKED, OR HAND-WORKED TO PRODUCE A RUFFLED SURFACE.

7. ESTABLISH STABILIZED CONSTRUCTION EXITS:
   7.1. INSTALL AND MAINTAIN CONSTRUCTION EXITS, ANYWHERE TRAFFIC LEAVES A CONSTRUCTION SITE ONTO A PUBLIC RIGHT-OF-WAY.
   7.2. SWEEP ALL CONSTRUCTION RELATED DEBRIS AND SOIL FROM THE ADJACENT PAVED ROADWAYS AS NECESSARY.

8. PROTECT STORM DRAIN INLETS:
   8.1. DIVERT SEDIMENT LADEN WATER AWAY FROM INLET STRUCTURES TO THE EXTENT POSSIBLE.
   8.2. INSTALL SEDIMENT BARRIERS AND SEDIMENT TRAPS AT INLETS TO PREVENT SEDIMENT FROM ENTERING THE DRAINAGE SYSTEM.
   8.3. CLEAN CATCH BASINS, DRAINAGE PIPES, AND CULVERTS IF SIGNIFICANT SEDIMENT IS DEPOSITED.
   8.4. DROP INLET SEDIMENT BARRIERS SHOULD NEVER BE USED AS THE PRIMARY MEANS OF SEDIMENT CONTROL AND SHOULD ONLY BE USED TO PROVIDE AN ADDITIONAL LEVEL OF PROTECTION TO STRUCTURES AND DOWN-GRADIENT SENSITIVE RECEPTORS.

9. SOIL STABILIZATION:
   9.1. WITHIN THREE DAYS OF THE LAST ACTIVITY IN AN AREA, ALL EXPOSED SOIL AREAS, WHERE CONSTRUCTION ACTIVITIES ARE COMPLETE, SHALL BE STABILIZED.
   9.2. IN ALL AREAS, TEMPORARY SOIL STABILIZATION MEASURES SHALL BE APPLIED IN ACCORDANCE WITH THE STABILIZATION REQUIREMENTS (SECTION 2.2) OF THE 2012 CGP. (SEE TABLE 1 FOR GUIDANCE ON THE SELECTION OF TEMPORARY SOIL STABILIZATION MEASURES.)
   9.3. EROSION CONTROL SEED MIX SHALL BE SOWN IN ALL INACTIVE CONSTRUCTION AREAS THAT WILL NOT BE PERMANENTLY SEEDED WITHIN TWO WEEKS OF DISTURBANCE AND PRIOR TO SEPTEMBER 15, OF ANY GIVEN YEAR, IN ORDER TO ACHIEVE VEGETATIVE STABILIZATION PRIOR TO THE END OF THE GROWING SEASON.
   9.4. SOIL TACKIFIERS MAY BE APPLIED IN ACCORDANCE WITH THE MANUFACTURER'S SPECIFICATIONS AND REAPPLIED AS NECESSARY TO MINIMIZE SOIL AND MULCH LOSS UNTIL PERMANENT VEGETATION IS ESTABLISHED.

10. RETAIN SEDIMENT ON-SITE AND CONTROL DEWATERING PRACTICES:
   10.1. TEMPORARY SEDIMENT BASINS (CGP-SECTION 2.1.3.2) OR SEDIMENT TRAPS (ENV-WQ 1506.10) SHALL BE SIZED TO RETAIN, ON SITE, THE VOLUME OF A 2-YEAR 24-HOUR STORM EVENT FOR ANY AREA OF DISTURBANCE OR 3,600 CUBIC FEET OF STORMWATER RUNOFF PER ACRE OF DISTURBANCE, WHICHEVER IS GREATER. TEMPORARY SEDIMENT BASINS USED TO TREAT STORMWATER RUNOFF FROM AREAS GREATER THAN 5-ACRES OF DISTURBANCE SHALL BE SIZED TO ALSO CONTROL STORMWATER RUNOFF FROM A 10-YEAR 24 HOUR STORM EVENT. ON-SITE RETENTION OF THE 10-YEAR 24-HOUR EVENT IS NOT REQUIRED.
   10.2. CONSTRUCT AND STABILIZE DEWATERING INFILTRATION BASINS PRIOR TO ANY EXCAVATION THAT MAY REQUIRE DEWATERING.
   10.3. TEMPORARY SEDIMENT BASINS OR TRAPS SHALL BE PLACED AND STABILIZED AT LOCATIONS WHERE CONCENTRATED FLOW (CHANNELS AND PIPES) DISCHARGE TO THE SURROUNDING ENVIRONMENT FROM AREAS OF UNSTABILIZED EARTH DISTURBING ACTIVITIES.

11. ADDITIONAL EROSION AND SEDIMENT CONTROL GENERAL PRACTICES:
   11.1. USE TEMPORARY MULCHING, PERMANENT MULCHING, TEMPORARY VEGETATIVE COVER, AND PERMANENT VEGETATIVE COVER TO REDUCE THE NEED FOR DUST CONTROL. USE MECHANICAL SWEEPERS ON PAVED SURFACES WHERE NECESSARY TO PREVENT DUST BUILDUP. APPLY WATER, OR OTHER DUST INHIBITING AGENTS OR TACKIFIERS, AS APPROVED BY THE NHDES.
   11.2. ALL STOCKPILES SHALL BE CONTAINED WITH TEMPORARY PERIMETER CONTROLS. INACTIVE SOIL STOCKPILES SHOULD BE PROTECTED WITH SOIL STABILIZATION MEASURES (TEMPORARY EROSION CONTROL SEED MIX AND MULCH, SOIL BINDER) OR COVERED WITH ANCHORED TARPS.
   11.3. EROSION AND SEDIMENT CONTROL MEASURES WILL BE INSPECTED IN ACCORDANCE WITH SECTION 645 OF NHDOT SPECIFICATIONS, WEEKLY AND WITHIN 24 HOURS AFTER ANY STORM EVENT GREATER THAN 0.25 IN. OF RAIN PER 24-HOUR PERIOD. EROSION AND SEDIMENT CONTROL MEASURES WILL ALSO BE INSPECTED IN ACCORDANCE WITH THE GUIDANCE MEMO FROM THE NHDES CONTAINED WITHIN THE CONTRACT PROPOSAL AND THE EPA CONSTRUCTION GENERAL PERMIT.
   11.4. THE CONTRACTOR SHOULD UTILIZE STORM DRAIN INLET PROTECTION TO PREVENT SEDIMENT FROM ENTERING A STORM DRAINAGE SYSTEM PRIOR TO THE PERMANENT STABILIZATION OF THE CONTRIBUTING DISTURBED AREA.
   11.5. PERMANENT STABILIZATION MEASURES WILL BE CONSTRUCTED AND MAINTAINED IN LOCATIONS AS SHOWN ON THE CONSTRUCTION PLANS TO STABILIZE AREAS. VEGETATIVE STABILIZATION SHALL NOT BE CONSIDERED PERMANENTLY STABILIZED UNTIL VEGETATIVE GROWTH COVERS AT LEAST 85% OF THE DISTURBED AREA. THE CONTRACTOR SHALL BE RESPONSIBLE FOR EROSION AND SEDIMENT CONTROL FOR ONE YEAR AFTER PROJECT COMPLETION.
   11.6. CATCH BASINS: CARE SHALL BE TAKEN TO ENSURE THAT SEDIMENTS DO NOT ENTER ANY EXISTING CATCH BASINS DURING CONSTRUCTION. THE CONTRACTOR SHALL PLACE TEMPORARY STONE INLET PROTECTION OVER INLETS IN AREAS OF SOIL DISTURBANCE THAT ARE SUBJECT TO SEDIMENT CONTAMINATION.
   11.7. TEMPORARY AND PERMANENT DITCHES SHALL BE CONSTRUCTED, STABILIZED AND MAINTAINED IN A MANNER THAT WILL MINIMIZE SCOUR. TEMPORARY AND PERMANENT DITCHES SHALL BE DIRECTED TO DRAIN TO SEDIMENT BASINS OR STORM WATER COLLECTION AREAS.
   11.8. WINTER EXCAVATION AND EARTHWORK ACTIVITIES NEED TO BE LIMITED IN EXTENT AND DURATION, TO MINIMIZE POTENTIAL EROSION AND SEDIMENTATION IMPACTS. THE AREA OF EXPOSED SOIL SHALL BE LIMITED TO ONE ACRE, OR THAT WHICH CAN BE STABILIZED AT THE END OF EACH DAY UNLESS A WINTER CONSTRUCTION PLAN, DEVELOPED BY A QUALIFIED ENGINEER OR A CPESC SPECIALIST, IS REVIEWED AND APPROVED BY THE DEPARTMENT.
   11.9. CHANNEL PROTECTION MEASURES SHALL BE SUPPLEMENTED WITH PERIMETER CONTROL MEASURES WHEN THE DITCH LINES OCCUR AT THE BOTTOM OF LONG FILL SLOPES. THE PERIMETER CONTROLS SHALL BE INSTALLED ON THE FILL SLOPE TO MINIMIZE THE POTENTIAL FOR FILL SLOPE SEDIMENT DEPOSITS IN THE DITCH LINE.

BEST MANAGEMENT PRACTICES (BMP) BASED ON AMOUNT OF OPEN CONSTRUCTION AREA

12. STRATEGIES SPECIFIC TO OPEN AREAS LESS THAN 5 ACRES:
   12.1. THE CONTRACTOR SHALL COMPLY WITH RSA 485:A:17 AND ENV-WQ 1500: ALTERATION OF TERRAIN FOR CONSTRUCTION AND USE ALL CONVENTIONAL BMP STRATEGIES.
   12.2. SLOPES STEEPER THAN 3:1 WILL RECEIVE TURF ESTABLISHMENT WITH MATTING.
   12.3. SLOPES 3:1 OR FLATTER WILL RECEIVE TURF ESTABLISHMENT ALONE.
   12.4. AREAS WHERE HAUL ROADS ARE CONSTRUCTED AND STORMWATER CANNOT BE TREATED THE DEPARTMENT WILL CONSIDER INFILTRATION.
   12.5. FOR HAUL ROADS ADJACENT TO SENSITIVE ENVIRONMENTAL AREAS OR STEEPER THAN 5%, THE DEPARTMENT WILL CONSIDER USING EROSION STONE, CRUSHED GRAVEL, OR CRUSHED STONE BASE TO HELP MINIMIZE EROSION ISSUES.
   12.6. ALL AREAS THAT CAN BE STABILIZED SHALL BE STABILIZED PRIOR TO OPENING UP NEW TERRITORY.
   12.7. DETENTION BASINS SHALL BE DESIGNED AND CONSTRUCTED TO ACCOMMODATE A 2 YEAR STORM EVENT.

13. STRATEGIES SPECIFIC TO OPEN AREAS BETWEEN 5 AND 10 ACRES:
   13.1. THE CONTRACTOR SHALL COMPLY WITH RSA 485:A:17 AND ENV-WQ 1500 ALTERATION OF TERRAIN AND SHALL USE CONVENTIONAL BMP STRATEGIES AND ALL TREATMENT OPTIONS USED FOR UNDER 5 ACRES WILL BE UTILIZED.
   13.2. DETENTION BASINS WILL BE CONSTRUCTED TO ACCOMMODATE THE 2-YEAR 24-HOUR STORM EVENT AND CONTROL A 10-YEAR 24-HOUR STORM EVENT.
   13.3. SLOPES STEEPER THAN A 3:1 WILL RECEIVE TURF ESTABLISHMENT WITH MATTING OR OTHER TEMPORARY SOIL STABILIZATION MEASURES DETAILED IN TABLE 1. THE CONTRACTOR MAY ALSO CONSIDER A SOIL BINDER IN ACCORDANCE WITH THE NHDES APPROVALS OR REGULATIONS. OTHER ALTERNATIVE MEASURES, SUCH AS BONDED FIBER MATRIXES (BFMS) OR FLEXIBLE GROWTH MEDIUMS (FGMS) MAY BE UTILIZED, IF MEETING THE NHDES APPROVALS AND REGULATIONS.
   13.4. SLOPES 3:1 OR FLATTER WILL RECEIVE TURF ESTABLISHMENT OR OTHER TEMPORARY SOIL STABILIZATION MEASURES DETAILED IN TABLE 1. THE CONTRACTOR MAY ALSO CONSIDER A SOIL BINDER IN ACCORDANCE WITH THE NHDES APPROVALS OR REGULATIONS.

14. STRATEGIES SPECIFIC TO OPEN AREAS OVER 10 ACRES:
   14.1. THE CONTRACTOR SHALL COMPLY WITH RSA 485:A:17 AND ENV-WQ 1500 ALTERATION OF TERRAIN AND SHALL USE CONVENTIONAL BMP STRATEGIES AND ALL TREATMENT OPTIONS USED FOR UNDER 5 ACRES AND BETWEEN 5 AND 10 ACRES WILL BE UTILIZED.
   14.2. THE DEPARTMENT ANTICIPATES THAT SOIL BINDERS WILL BE NEEDED ON ALL SLOPES STEEPER THAN 3:1, IN ORDER TO MINIMIZE EROSION AND REDUCE THE AMOUNT OF SEDIMENT IN THE STORMWATER TREATMENT BASINS.
   14.3. THE CONTRACTOR WILL BE REQUIRED TO HAVE AN APPROVED DESIGN IN ACCORDANCE WITH ENV-WQ 1506.12 FOR AN ACTIVE FLOCCULANT TREATMENT SYSTEM TO TREAT AND RELEASE WATER CAPTURED IN STORM WATER BASINS. THE CONTRACTOR SHALL ALSO RETAIN THE SERVICES OF AN ENVIRONMENTAL CONSULTANT WHO HAS DEMONSTRATED EXPERIENCE IN THE DESIGN OF FLOCCULANT TREATMENT SYSTEMS. THE CONSULTANT WILL ALSO BE RESPONSIBLE FOR THE IMPLEMENTATION AND MONITORING OF THE SYSTEM.

TABLE 1

GUIDANCE ON SELECTING TEMPORARY SOIL STABILIZATION MEASURES

APPLICATION AREAS	DRY MULCH METHODS				HYDRAULICALLY APPLIED MULCHES[2]				ROLLED EROSION CONTROL BLANKETS[3]			
	HMT	WC	SG	CB	HM	SMM	BFM	FRM	SNSB	DNSB	DNSCB	DNCB
SLOPES[1]												
STEEPER THAN 2:1	NO	NO	YES	NO	NO	NO	NO	YES	NO	NO	NO	YES
2:1 SLOPE	YES'	YES'	YES	YES	NO	NO	YES	YES	NO	YES	YES	YES
3:1 SLOPE	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	NO
4:1 SLOPE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO
WINTER STABILIZATION	4T/AC	YES	YES	YES	NO	NO	YES	YES	YES	YES	YES	YES
CHANNELS												
LOW FLOW CHANNELS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES
HIGH FLOW CHANNELS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES

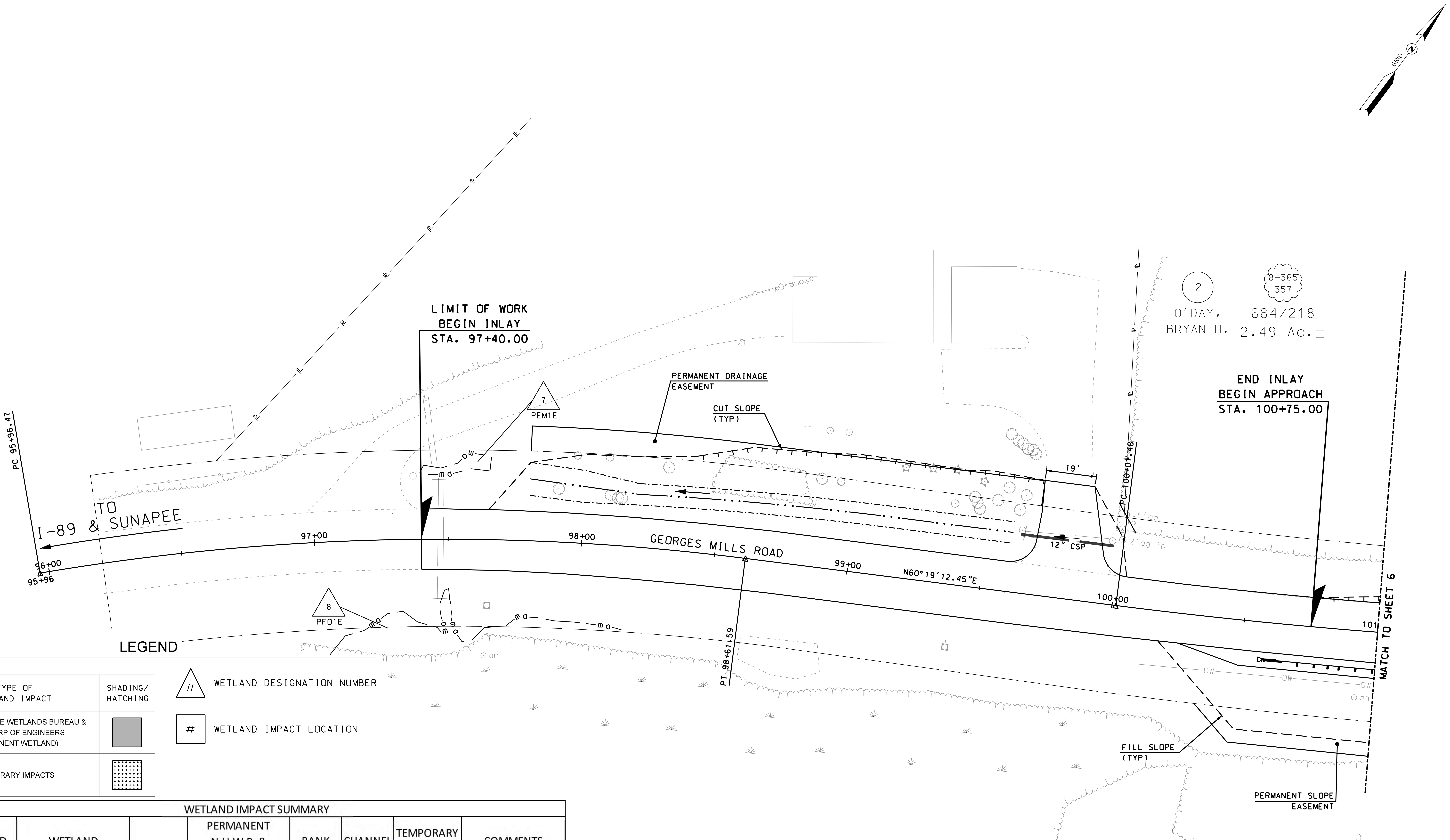
ABBREV.	STABILIZATION MEASURE	ABBREV.	STABILIZATION MEASURE	ABBREV.	STABILIZATION MEASURE
HMT	HAY MULCH & TACK	HM	HYDRAULIC MULCH	SNSB	SINGLE NET STRAW BLANKET
WC	WOOD CHIPS	SMM	STABILIZED MULCH MATRIX	DNSB	DOUBLE NET STRAW BLANKET
SG	STUMP GRINDINGS	BFM	BONDED FIBER MATRIX	DNSCB	2 NET STRAW-COCONUT BLANKET
CB	COMPOST BLANKET	FRM	FIBER REINFORCED MEDIUM	DNCB	2 NET COCONUT BLANKET

NOTES:
1. ALL SLOPE STABILIZATION OPTIONS ASSUME A SLOPE LENGTH ≤10 TIMES THE HORIZONTAL DISTANCE COMPONENT OF THE SLOPE, IN FEET.
2. PRODUCTS CONTAINING POLYACRYLAMIDE (PAM) SHALL NOT BE APPLIED DIRECTLY TO OR WITHIN 100 FEET OF ANY SURFACE WATER WITHOUT PRIOR WRITTEN APPROVAL FROM THE NH DEPARTMENT OF ENVIRONMENTAL SERVICES.
3. ALL EROSION CONTROL BLANKETS SHALL BE MADE WITH WILDLIFE FRIENDLY BIODEGRADABLE NETTING.

STATE OF NEW HAMPSHIRE
SPRINGFIELD
DEPARTMENT OF TRANSPORTATION * BUREAU OF HIGHWAY DESIGN

WETLAND IMPACT PLANS

REVISION DATE	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
12-21-2015	erosstrat	20509	4	10



REVISIONS AFTER PROPOSAL			
NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED	-	DATE -
NEW DESIGN	EMM	DATE 11/2022
SHEET CHECKED	NCF	DATE 11/2022
AS BUILT DETAILS		DATE

LEGEND

TYPE OF WETLAND IMPACT	SHADING/ HATCHING
NEW HAMPSHIRE WETLANDS BUREAU & ARMY CORP OF ENGINEERS (PERMANENT WETLAND)	(grey shading)
TEMPORARY IMPACTS	(dotted hatching)

— WETLAND DESIGNATION NUMBER

— WETLAND IMPACT LOCATION

WETLAND IMPACT SUMMARY							
WETLAND NUMBER	WETLAND CLASSIFICATION	LOCATION	PERMANENT N.H.W.B. & A.C.O.E.	BANK	CHANNEL	TEMPORARY IMPACTS	COMMENTS
			SF	LF	LF	SF	
2	R2UB1,2	A	584	56	23		
2	R2UB1,2	B		12	5	519	
3	PF01E	C				135	
3	PF01E	D	105				
1	R2UB1,2	E		12	5	423	
1	R2UB1,2	F	867	99	39		
5	PEM1E	G	65				
1	R2UB1,2	H	185	44	21		
1	R2UB1,2	I		11	5	92	
	SUBTOTAL PERMANENT		1806	199	83		
	SUBTOTAL TEMPORARY			35	15	1169	

WETLAND CLASSIFICATION CODES	
PEM1E	PALUSTRINE EMERGENT WITH PERSISTENT VEGETATION, SEASONALLY FLOODED/SATURATED
PF01E	PALUSTRINE FORESTED WITH BROAD-LEAVED DECIDUOUS VEGETATION, SEASONALLY FLOODED/SATURATED
R2UB1,2	LOWER PERENNIAL RIVERINE WITH AN UNCONSOLIDATED BOTTOM, COBBLE GRAVEL, SAND

20 0 20 40
SCALE IN FEET

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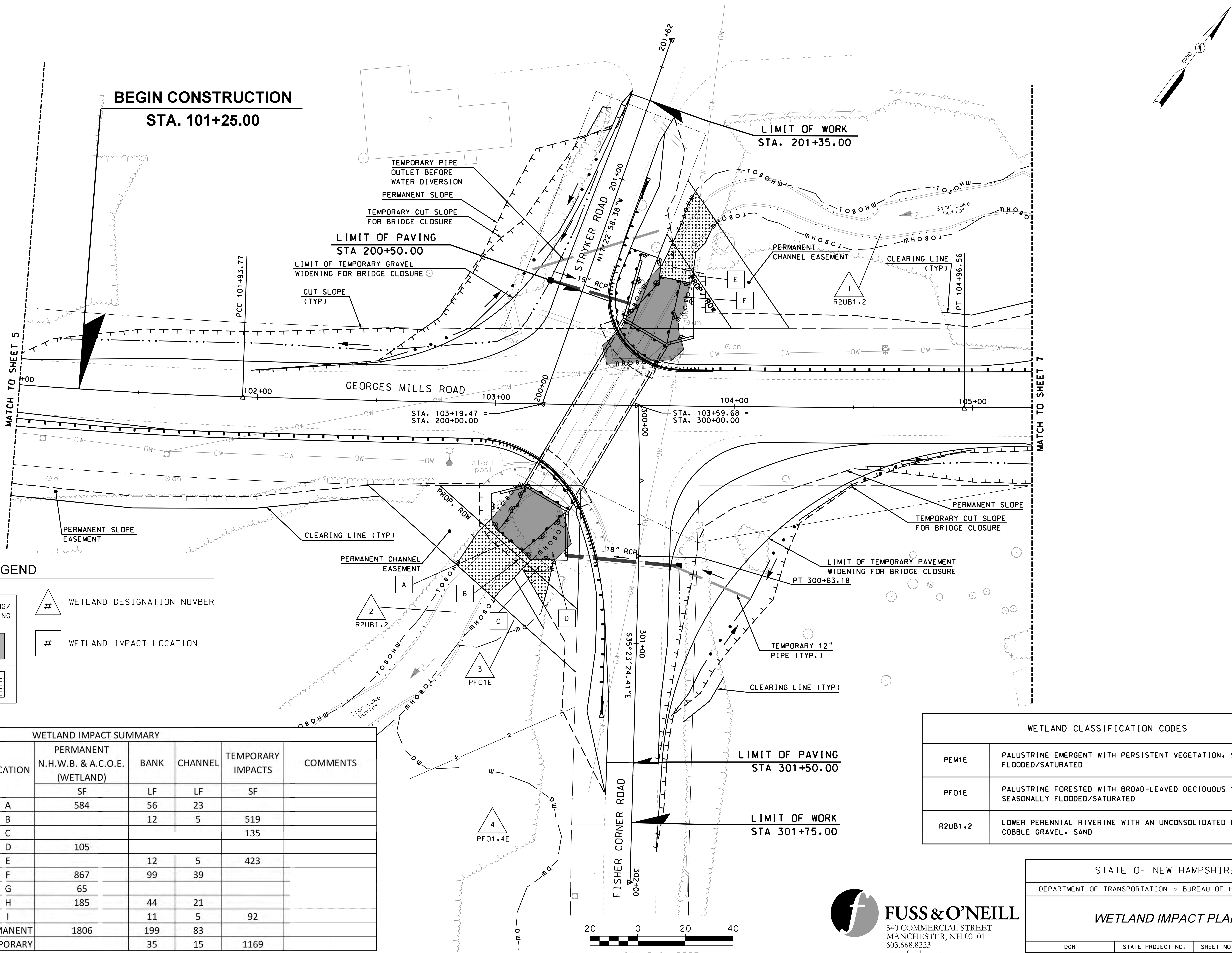
STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

WETLAND IMPACT PLAN

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
20509WET	20509	5	10



LEGEND

TYPE OF WETLAND IMPACT	SHADING/ HATCHING
NEW HAMPSHIRE WETLANDS BUREAU & ARMY CORP OF ENGINEERS (PERMANENT WETLAND)	(solid shading)
TEMPORARY IMPACTS	(dot hatching)

WETLAND DESIGNATION NUMBER (triangle)

WETLAND IMPACT LOCATION (square)

WETLAND IMPACT SUMMARY							
WETLAND NUMBER	WETLAND CLASSIFICATION	LOCATION	PERMANENT N.H.W.B. & A.C.O.E. (WETLAND)	BANK	CHANNEL	TEMPORARY IMPACTS	COMMENTS
			SF	LF	LF	SF	
2	R2UB1,2	A	584	56	23		
2	R2UB1,2	B		12	5	519	
3	PF01E	C				135	
3	PF01E	D	105				
1	R2UB1,2	E		12	5	423	
1	R2UB1,2	F	867	99	39		
5	PEM1E	G	65				
1	R2UB1,2	H	185	44	21		
1	R2UB1,2	I		11	5	92	
	SUBTOTAL PERMANENT		1806	199	83		
	SUBTOTAL TEMPORARY			35	15	1169	

WETLAND CLASSIFICATION CODES	
PEM1E	PALUSTRINE EMERGENT WITH PERSISTENT VEGETATION, SEASONALLY FLOODED/SATURATED
PF01E	PALUSTRINE FORESTED WITH BROAD-LEAVED DECIDUOUS VEGETATION, SEASONALLY FLOODED/SATURATED
R2UB1,2	LOWER PERENNIAL RIVERINE WITH AN UNCONSOLIDATED BOTTOM, COBBLE GRAVEL, SAND

REVISIONS AFTER PROPOSAL			
NUMBER	DATE	STATION	STATION
DESCRIPTION			

SDR PROCESSED	-	DATE -
NEW DESIGN	EMM	DATE 11/2022
SHEET CHECKED	NCF	DATE 11/2022
AS BUILT DETAILS		DATE

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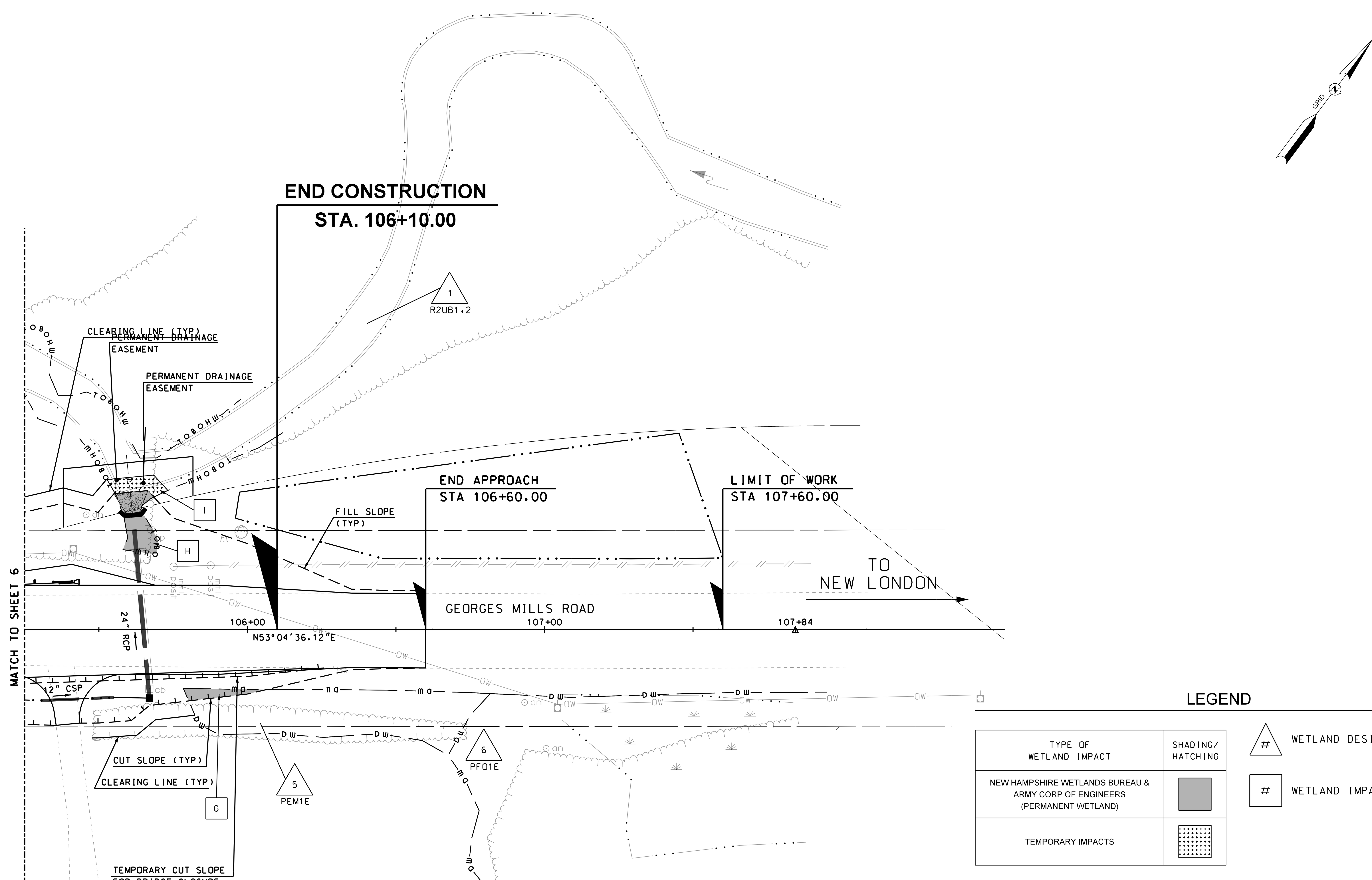
WETLAND IMPACT PLAN

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
20509WET	20509	6	10



LEGEND

TYPE OF WETLAND IMPACT	SHADING/ HATCHING
NEW HAMPSHIRE WETLANDS BUREAU & ARMY CORP OF ENGINEERS (PERMANENT WETLAND)	
TEMPORARY IMPACTS	

WETLAND DESIGNATION NUMBER

WETLAND IMPACT LOCATION

WETLAND CLASSIFICATION CODES	
PEM1E	PALUSTRINE EMERGENT WITH PERSISTENT VEGETATION, SEASONALLY FLOODED/SATURATED
PF01E	PALUSTRINE FORESTED WITH BROAD-LEAVED DECIDUOUS VEGETATION, SEASONALLY FLOODED/SATURATED
R2UB1,2	LOWER PERENNIAL RIVERINE WITH AN UNCONSOLIDATED BOTTOM, COBBLE GRAVEL, SAND

WETLAND IMPACT SUMMARY

WETLAND NUMBER	WETLAND CLASSIFICATION	LOCATION	PERMANENT N.H.W.B. & A.C.O.E.	BANK	CHANNEL	TEMPORARY IMPACTS	COMMENTS
			SF	LF	LF	SF	
2	R2UB1,2	A	584	56	23		
2	R2UB1,2	B		12	5	519	
3	PF01E	C				135	
3	PF01E	D	105				
1	R2UB1,2	E		12	5	423	
1	R2UB1,2	F	867	99	39		
5	PEM1E	G	65				
1	R2UB1,2	H	185	44	21		
1	R2UB1,2	I		11	5	92	
	SUBTOTAL PERMANENT		1806	199	83		
	SUBTOTAL TEMPORARY			35	15	1169	

20 0 20 40
SCALE IN FEET

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DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

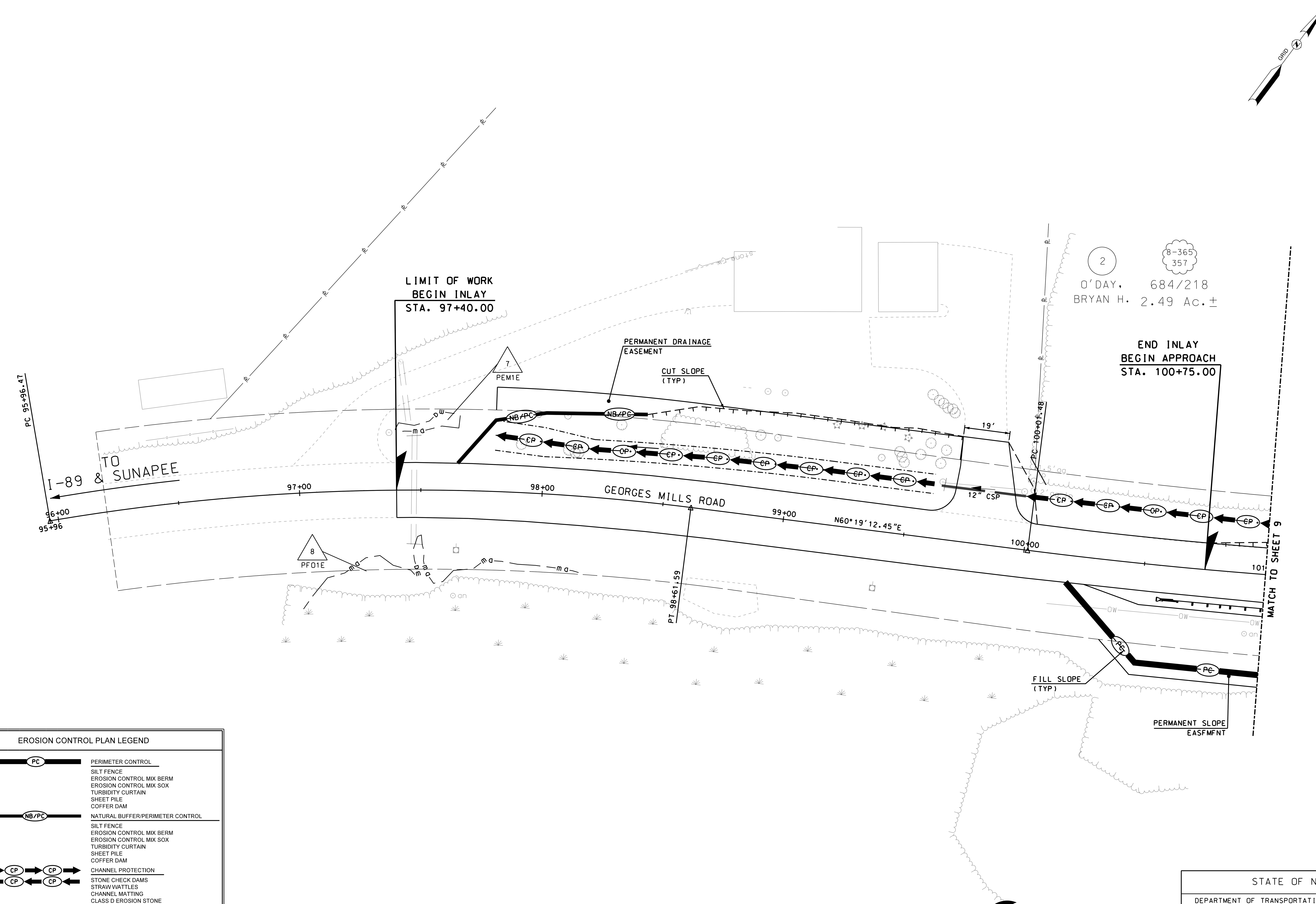
WETLAND IMPACT PLAN

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
20509WET	20509	7	10

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED	-	DATE	-
NEW DESIGN	EMM	DATE	11/2022
SHEET CHECKED	NCF	DATE	11/2022
AS BUILT DETAILS		DATE	



EROSION CONTROL PLAN LEGEND

PC	PERIMETER CONTROL: SILT FENCE, EROSION CONTROL MIX BERM, EROSION CONTROL MIX SOX, TURBIDITY CURTAIN, SHEET PILE, COFFER DAM
NB/PC	NATURAL BUFFER/PERIMETER CONTROL: SILT FENCE, EROSION CONTROL MIX BERM, EROSION CONTROL MIX SOX, TURBIDITY CURTAIN, SHEET PILE, COFFER DAM
CP	CHANNEL PROTECTION: STONE CHECK DAMS, STRAW WATTLES, CHANNEL MATTING, CLASS D EROSION STONE, CLASS C STONE
SD	STREAM DIVERSION: PUMP THROUGH PIPE, DRAIN THROUGH PIPE OR CHANNEL

20 0 20 40
SCALE IN FEET

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DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

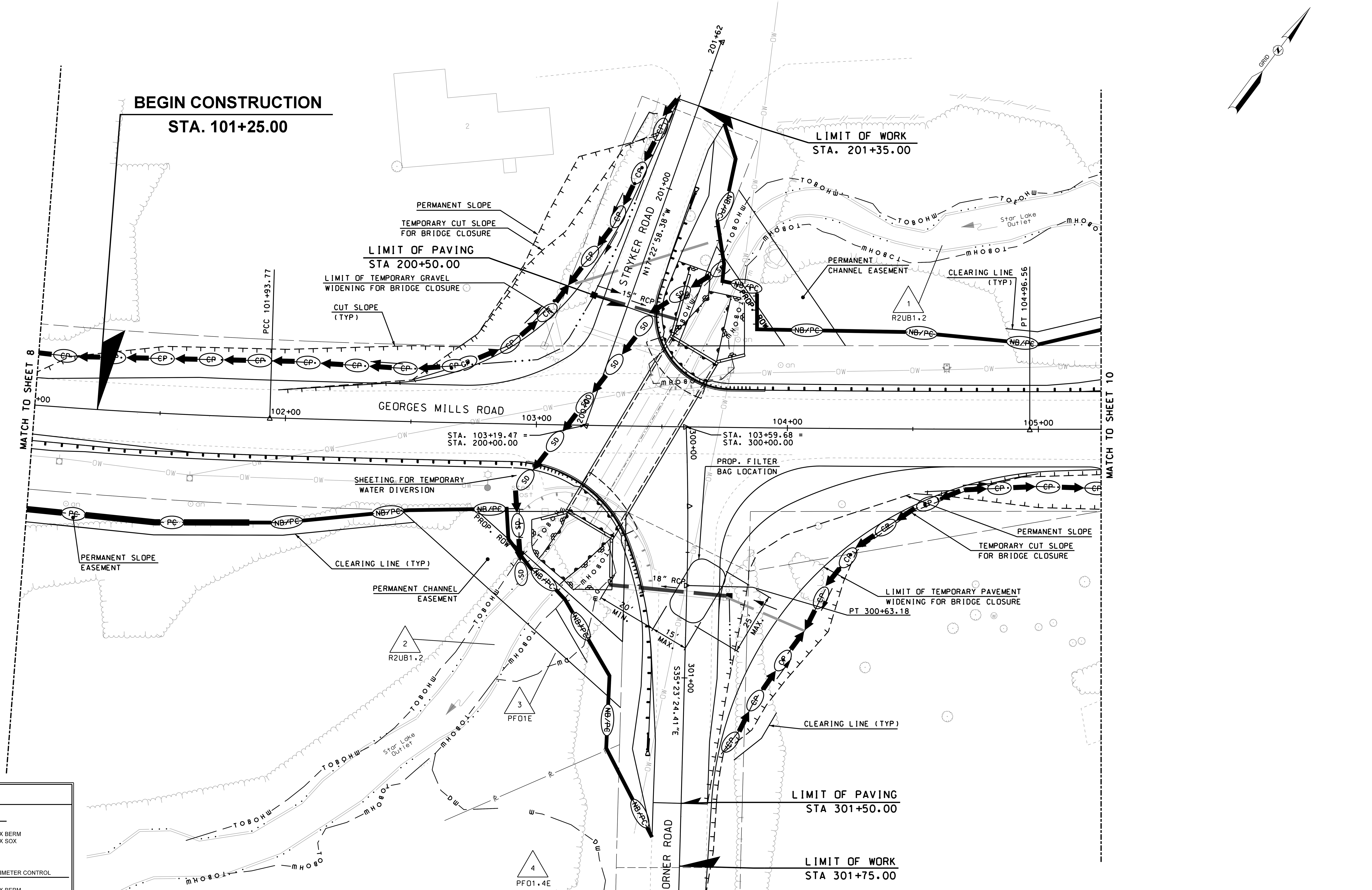
EROSION CONTROL PLAN

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
20509ECP	20509	8	10

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED	-	DATE -
NEW DESIGN	EMM	DATE 11/2022
SHEET CHECKED	AWJ	DATE 11/2022
AS BUILT DETAILS		DATE



EROSION CONTROL PLAN LEGEND

PC	PERIMETER CONTROL SILT FENCE EROSION CONTROL MIX BERM EROSION CONTROL MIX SOX TURBIDITY CURTAIN SHEET PILE COFFER DAM
NB/PC	NATURAL BUFFER/PERIMETER CONTROL SILT FENCE EROSION CONTROL MIX BERM EROSION CONTROL MIX SOX TURBIDITY CURTAIN SHEET PILE COFFER DAM
CP	CHANNEL PROTECTION STONE CHECK DAMS STRAW WATTLES CHANNEL MATTING CLASS D EROSION STONE CLASS C STONE
SD	STREAM DIVERSION PUMP THROUGH PIPE DRAIN THROUGH PIPE OR CHANNEL

REVISIONS AFTER PROPOSAL				
NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED	-	DATE -
NEW DESIGN	EMM	DATE 11/2022
SHEET CHECKED	AWJ	DATE 11/2022
AS BUILT DETAILS		DATE

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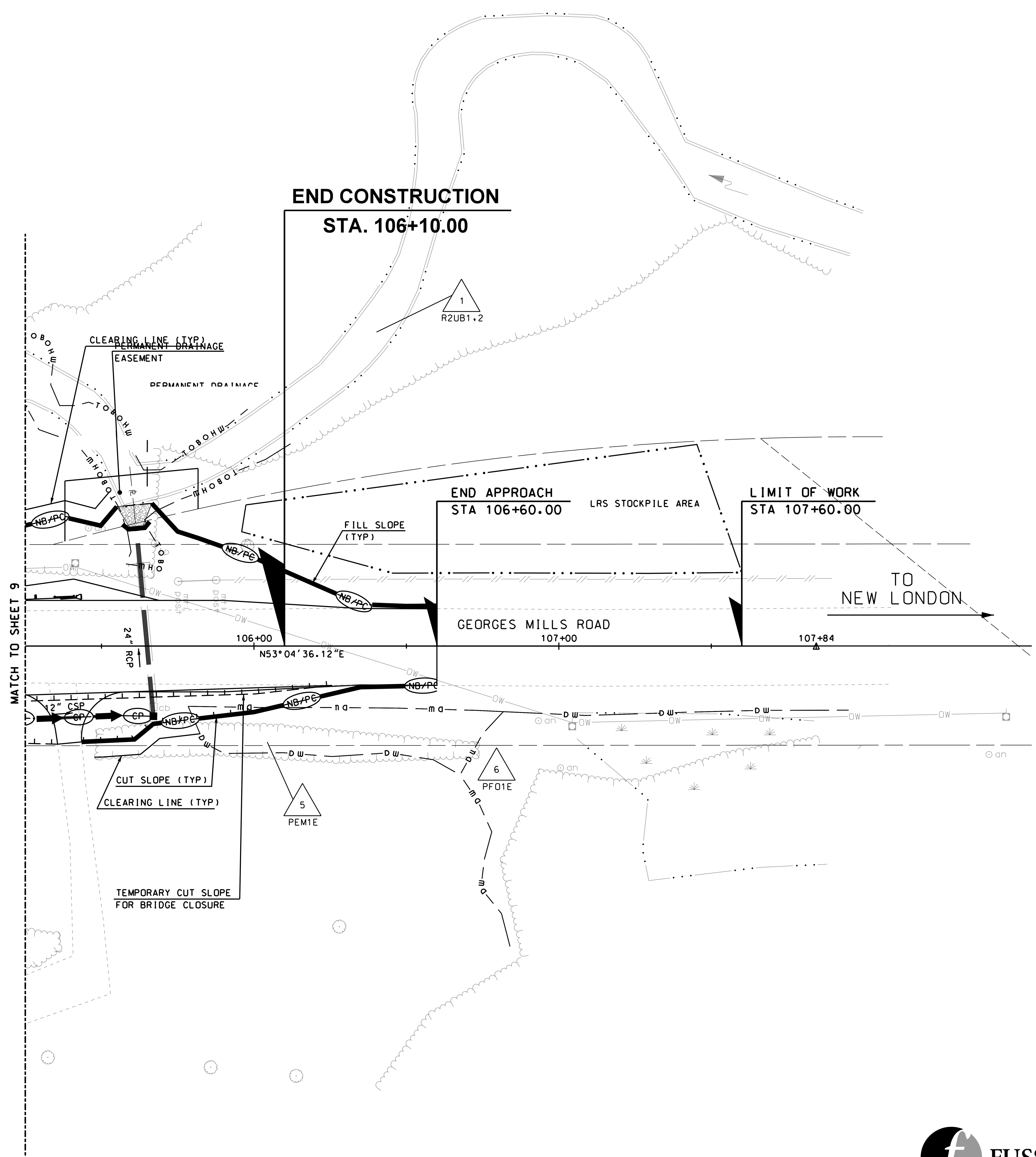
STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

EROSION CONTROL PLAN

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
20509ECP	20509	9	10



SCALE IN FEET: 20 0 20 40

EROSION CONTROL PLAN LEGEND

PC	PERIMETER CONTROL: SILT FENCE, EROSION CONTROL MIX BERM, EROSION CONTROL MIX SOX, TURBIDITY CURTAIN, SHEET PILE, COFFER DAM
NB/PC	NATURAL BUFFER/PERIMETER CONTROL: SILT FENCE, EROSION CONTROL MIX BERM, EROSION CONTROL MIX SOX, TURBIDITY CURTAIN, SHEET PILE, COFFER DAM
CP	CHANNEL PROTECTION: STONE CHECK DAMS, STRAW WATTLES, CHANNEL MATTING, CLASS D EROSION STONE, CLASS C STONE
SD	STREAM DIVERSION: PUMP THROUGH PIPE, DRAIN THROUGH PIPE OR CHANNEL

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED	-	DATE -
NEW DESIGN	EMM	DATE 11/2022
SHEET CHECKED	AWJ	DATE 11/2022
AS BUILT DETAILS		DATE

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STATE OF NEW HAMPSHIRE

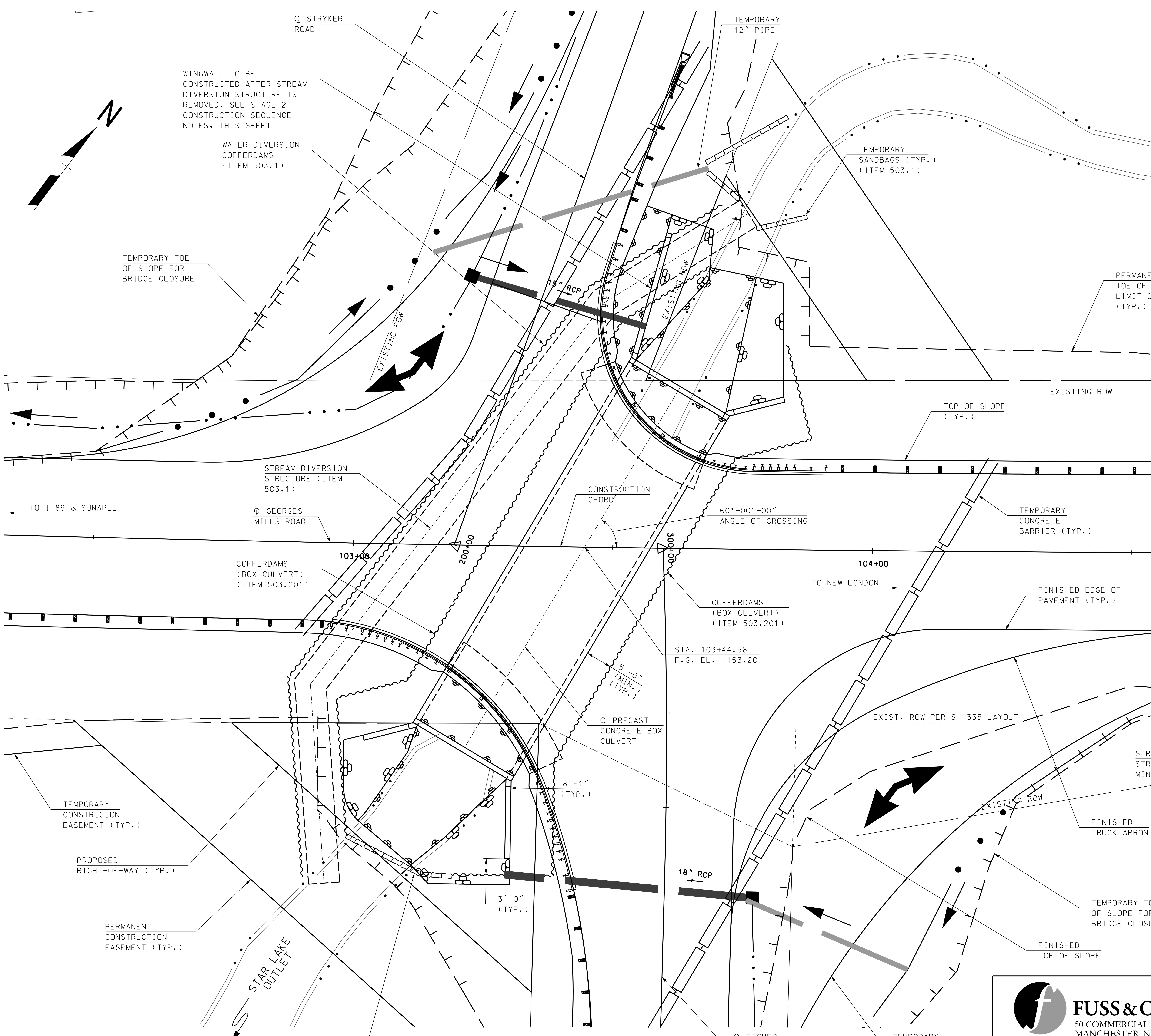
DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

EROSION CONTROL PLAN

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
20509ECP	20509	10	10

Attachment 16 -

Water Diversion Plans



STREAM DIVERSION PLAN

SCALE: 1" = 10'-0"

CONSTRUCTION SEQUENCE NOTES:

GENERAL:

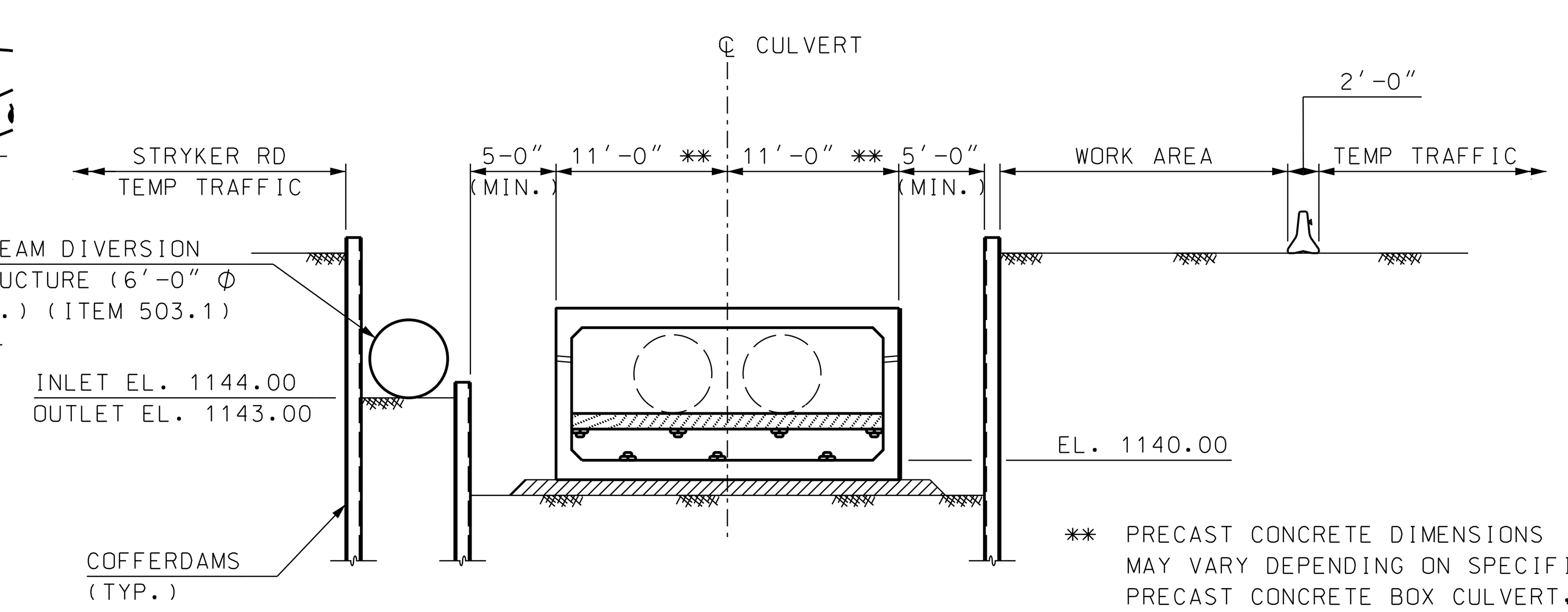
1. ALL CONSTRUCTION SHALL BE COMPLETED USING APPROVED TRAFFIC CONTROL PROCEDURES AND IN ACCORDANCE WITH THE TRAFFIC CONTROL PLANS. SEE ROADWAY PLANS AND TRAFFIC CONTROL PLANS.

STAGE 1:

1. SETUP DETOURS, THEN IMPLEMENT TEMPORARY TRAFFIC CONTROL PLAN (SEE SHEET 25) AND CLOSE GEORGES MILLS ROAD TO THROUGH TRAFFIC.
2. INSTALL COFFERDAMS (BOX CULVERT) (ITEM 503.201) AND STREAM DIVERSION STRUCTURE (ITEM 503.1) AS SHOWN ON THE STREAM DIVERSION PLAN. DIVERT THE WATER AROUND THE CONSTRUCTION AREA USING THE CLEAR WATER STREAM DIVERSION STRUCTURE.
3. EXCAVATE AND REMOVE THE EXISTING CULVERTS.
4. DEWATER, EXCAVATE, AND PLACE STRUCTURAL FILL.
5. CONSTRUCT THE PROPOSED CAST-IN-PLACE CONCRETE CUT-OFF WALLS, PRECAST CONCRETE BOX CULVERT, AND WINGWALLS EXCEPT FOR THE NORTHWEST WINGWALL.
6. BACKFILL BOX CULVERT AND ALL WINGWALLS, EXCEPT NORTHWEST WINGWALL, TO THE TOP OF THE BOX CULVERT.
7. INSTALL THE RIPRAP, CLASS III AND SIMULATED STREAMBED MATERIAL INSIDE OF THE BOX CULVERT.
8. INSTALL THE GEOTEXTILE, RIPRAP, CLASS V, AND SIMULATED STREAMBED MATERIAL OUTSIDE OF THE BOX CULVERT.
9. REMOVE UPSTREAM SANDBAGS AND DIRECT WATER THROUGH PRECAST CONCRETE BOX CULVERT.

STAGE 2:

1. REMOVE STREAM DIVERSION STRUCTURE AND COFFERDAMS EXTENDING THROUGH NORTHWEST WINGWALL.
2. INSTALL SANDBAGS/COFFERDAMS AROUND THE PROPOSED NORTHWEST WINGWALL (ITEM 503.202).
3. DEWATER, EXCAVATE, PLACE STRUCTURAL FILL, AND CONSTRUCT THE PROPOSED NORTHWEST CAST-IN-PLACE CUT-OFF WALL AND PRECAST CONCRETE NORTHWEST WINGWALL.
4. BACKFILL NORTHWEST WINGWALL TO THE TOP OF THE BOX CULVERT.
5. REMOVE SANDBAGS/COFFERDAMS AROUND NORTHWEST WINGWALL.
6. PLACE THE PRECAST CONCRETE HEADWALLS AND BACKFILL TO THE BOTTOM OF THE RAIL SUPPORT SLABS.
7. REMOVE THE COFFERDAMS AND CONSTRUCT THE RAIL SUPPORT SLABS.
8. COMPLETE BACKFILL OPERATIONS.
9. CONSTRUCT ROADWAY BOX AND PAVE.
10. INSTALL MOUNTED BRIDGE RAIL, APPROACH RAIL, AND GUARDRAIL.
11. REMOVE TEMPORARY TRAFFIC CONTROL MEASURES AND REOPEN GEORGES MILLS ROAD TO THROUGH TRAFFIC.



** PRECAST CONCRETE DIMENSIONS MAY VARY DEPENDING ON SPECIFIC PRECAST CONCRETE BOX CULVERT, WINGWALL, AND FOOTING USED.

STREAM DIVERSION SECTION

SCALE: 1" = 10'-0"

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SUBDIRECTORY	.DGN LOCATOR	SHEET SCALE
BRIDGE	20509WtrDivplan	AS NOTED

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION * BUREAU OF BRIDGE DESIGN

TOWN SPRINGFIELD — BRIDGE NO. 091\049 — STATE PROJECT 20509
LOCATION GEORGES MILLS ROAD OVER STAR LAKE OUTLET

STREAM DIVERSION PLAN AND SECTION

BRIDGE SHEET 8 OF 15

FILE NUMBER

REVISIONS AFTER PROPOSAL

	BY	DATE		BY	DATE
DESIGNED	ETC	12/22	CHECKED	SRB	12/22
DRAWN	MWS	12/22	CHECKED	ETC	12/22
QUANTITIES	ETC	12/22	CHECKED	RAT	12/22

	FEDERAL PROJECT NO.	SHEET NO.	TOTAL SHEETS
ISSUE DATE			
REV. DATE	X-A002 (078)	24	69

Attachment 17 -

Stream Crossing Assessment Report

New Hampshire Department of Transportation
Bureau of Environment
Stream Crossing Summary Report

Project: Springfield, 20509
Date of Assessment: 7/28/2022
Names of who completed the assessment: Meli Dube, Deidra Benjamin, & Paul Lovely

Stream Information:

Stream Name: Star Lake Outlet
Watershed Area: 2,240 acres

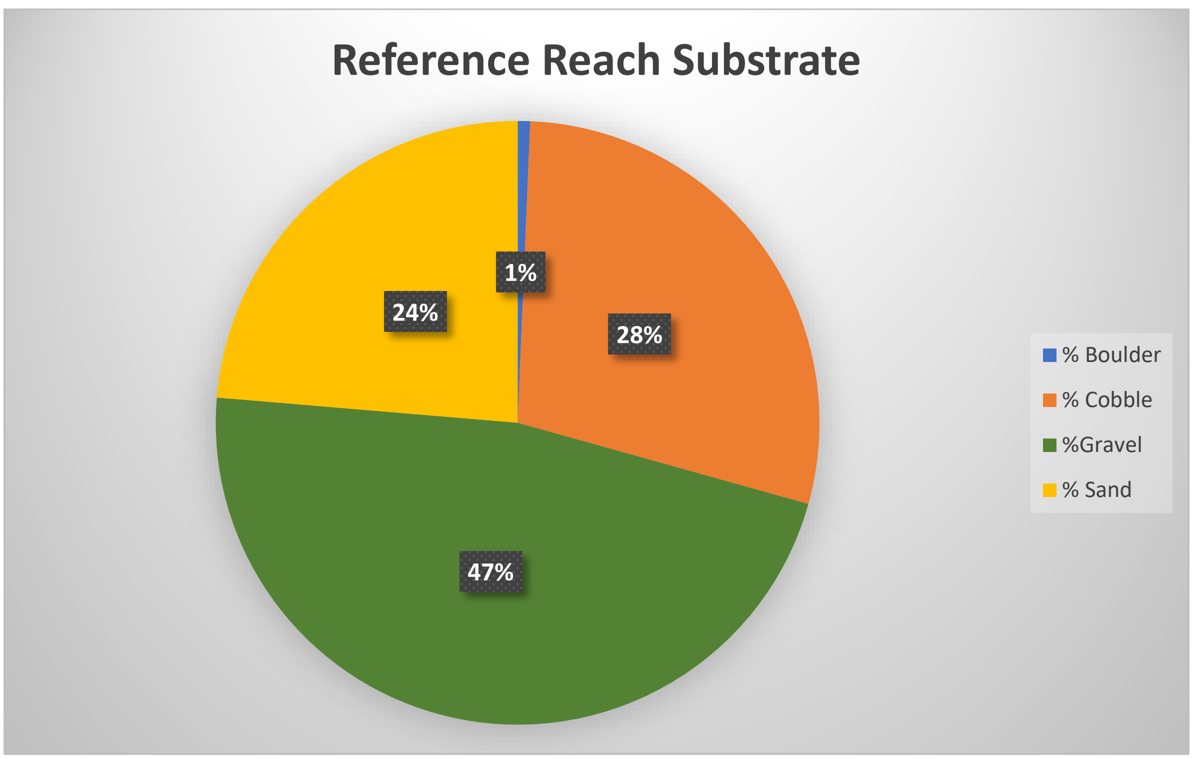
Stream Tier: Tier 3
Wetland Classification: R2UB12

Reference Reach:

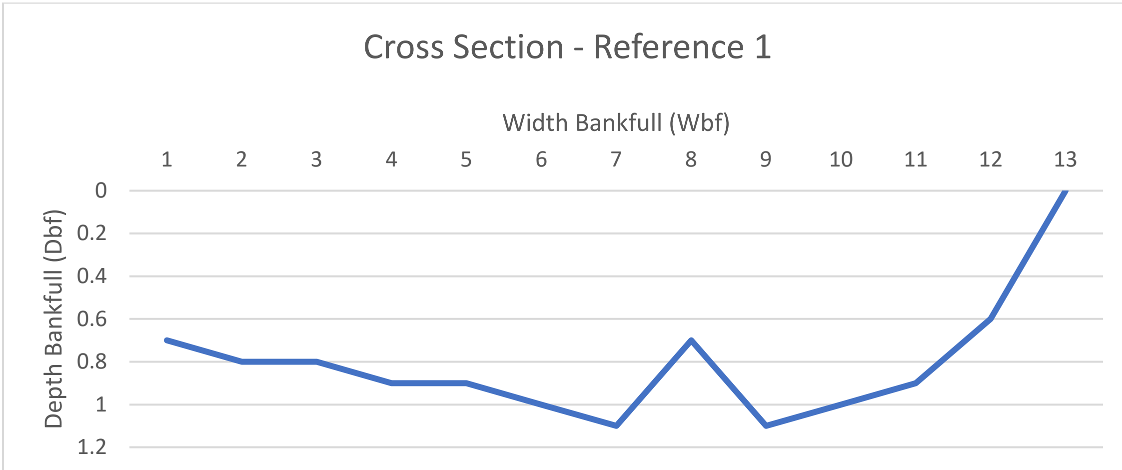
Average Bankfull Width: 14.3'
Average Floodprone Width: 18.7'
Average Depth: 0.6'

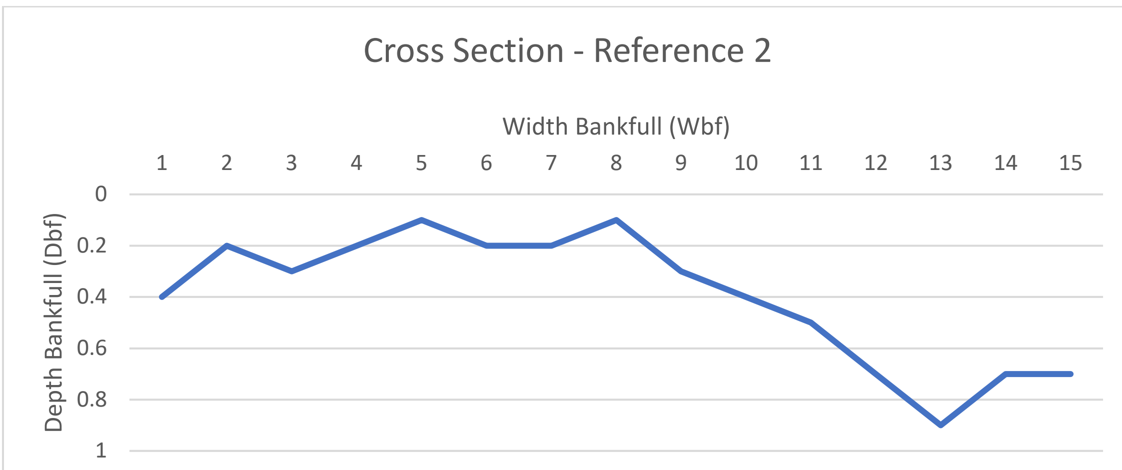
Average Slope: 1%
Entrenchment Ratio: 1.31
Rosgen Classification: Type F

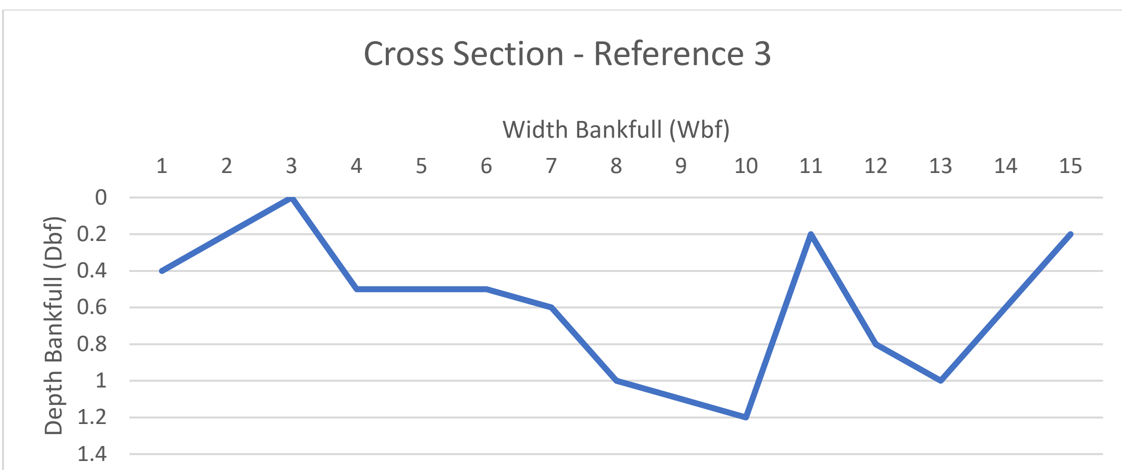
Channel Material (Average Reference Reach):



Cross Sections:







Photos:

Photo 1: Outlet looking upstream

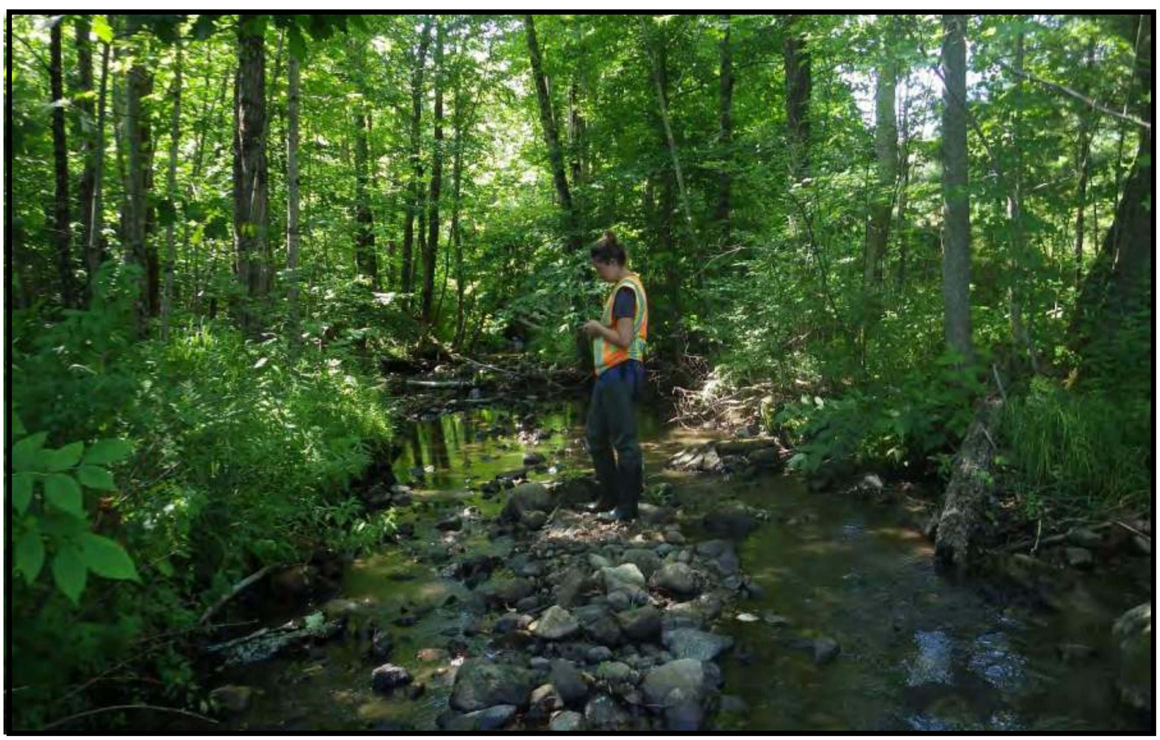


Photo 2: Outlet looking downstream

Photo 3: Inlet looking downstream

Photo 4: Inlet looking upstream

Photo 5: Reference Reach One

Photo 6: Reference Reach Two

Photo 7: Reference Reach Three

Insert PE Certification

Attachment 18-

Hydraulic and Hydrologic Report

HYDROLOGIC AND HYDRAULIC REPORT

GEORGES MILL ROAD
OVER STAR LAKE OUTLET
BRIDGE NO. 091/048
SPRINGFIELD, NEW HAMPSHIRE

Submitted to:
NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

AUGUST 2017 (Revised FEBRUARY 2024)

FUSS & O'NEILL

Prepared by: Shannon Beaumont, P.E.

Checked by: Ethan Carrier

Revised February 13, 2024

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

GEORGES MILL ROAD OVER STAR LAKE OUTLET

HYDROLOGIC AND HYDRAULIC REPORT

AUGUST 2017 (REVISED FEBRUARY 2024)

EXECUTIVE SUMMARY

The existing two 5-foot diameter corrugated metal pipes are located in Springfield, Sullivan County, New Hampshire on Georges Mill Road over Star Lake Outlet. The latest NHDOT inspection report lists the culverts as being in poor condition and on the NHDOT's red list, with light to moderate rust and scale present with some scattered holes. The culverts are also ecologically undersized and are a barrier to aquatic life. The culvert is in a forested location with a relatively shallow channel slope. The brook's drainage basin consists of mostly forested areas with very limited storage and wetlands, with the exception of a large lake. The brook has well-defined channel banks with the channel consisting of a combination of large boulders and stones with smaller gravel and cobbles.

View looking at downstream invert

Roadway above culvert

Four replacement alternatives were evaluated; a 20-foot and a 31-foot span buried structure and a 20-foot and a 31-foot span at-grade structure.

Hydraulic models were created utilizing HEC-RAS to model existing and proposed conditions. The results of the hydraulic model show that the existing culverts only pass up to the 25-year design flood without overtopping. The replacement alternatives pass all design floods, meet freeboard requirements for the 50-year design flood, and accommodate the 100-year design flood.

Bridge substructures are designed per the 100-year scour depth and checked against the 500-year scour depth. Therefore, scour analyses were performed for both storm events.

The 31-foot span buried structure meets both NHDOT requirements (hydraulic and freeboard) and NHDES requirements (bankfull width times the entrenchment ratio with channel banks through the structure). However, the preferred 20-foot span buried box culvert alternative is a compromise that meets all hydraulic requirements, budget, and site constraints. A table showing the lower channel velocities for the preferred alternative as compared to the existing is shown below.

	50-Year Design Flood Event (fps)	100-Year Design Flood Event (fps)
Existing Bridge Model	11.76	11.94
20-Foot Buried (No Banks)	6.56	9.16
Difference	-5.20	-2.78

SUMMARY OF VELOCITIES
PREFERRED ALTERNATIVE 20-FOOT SPAN
BURIED BOX STRUCTURE

The 20-foot buried box structure will require 2-feet of NHDOT Riprap, Class III inside the full width of the box with 1-foot of simulated streambed material over the top and filling in the voids between the larger riprap. Three feet of NHDOT Riprap, Class V will be required across the entire width of the waterway in the upstream and downstream aprons, with 1-foot of simulated streambed material on top and filling in the voids between the larger riprap within the riverbed. The riprap should extend from the face of each abutment (or along the faces of the wingwalls) at least 25 feet to protect the downstream roadway embankment and should extend up the embankments at least to the 100-year event elevation at the bridge. The top of the material should be flush with the existing channel grade.

1. INTRODUCTION

The George's Mill Road Project involves the replacement of two 5-foot diameter corrugated metal pipes at the crossing of Georges Mill Road and Star Lake Outlet.

1.1 Background

The existing culverts are 5-feet in diameter and provide a total waterway opening of approximately 39 square feet. The inlet has a mortared stone headwall and the downstream headwall consists of stacked, dry stone. The latest NHDOT inspection report lists the culverts as being in poor condition, with light to moderate rust and scale present with some scattered holes. There is also undermining at the inlet and water piping under the west pipe. The culverts are located within close proximity of the intersection of Georges Mill Road and Fisher Corner Road, and in the intersection of Georges Mill Road and Stryker Road.

1.2 Site Location

The bridge is located on Georges Mill Road over Star Lake Outlet in the Town of Springfield, Sullivan County, New Hampshire. See Location Map.

Location Map

2. DESIGN CRITERIA

The Hydrologic and Hydraulic Study was completed in accordance with the NHDOT Bridge Design Manual dated January 2015 with current revisions (Reference 1).

2.1 Design Frequency and Freeboard

Georges Mill Road is a paved road in Springfield, not far from Interstate 89. This road would be considered a Highway Tier 4 road, or local connector. Per the NHDOT Bridge Design Manual Table 2.7.4-1 Design Frequencies, for a Tier 4 road, the 50-year event is the design flood, and the 100-year event is the check flood. A new bridge must be designed for the “Design Flood” with the specified freeboard requirement of 1 foot. The bridge must also be checked against the “Check Flood” for high flow damage and is considered an extreme limit state.

2.2 Bridge Scour Analysis Requirements

Bridge substructures must be designed for the 100-year design flood event scour potential, and checked against the 500-year check flood event scour potential. Scour countermeasures and channel protection shall be designed to protect against scour for the design flood.

3. HYDROLOGY

3.1 Drainage Basin Description

The FEMA Flood Insurance Rate Maps (FIRMs) for the project location indicate that the project location is not in an area containing detailed study (Zone X). Therefore, the FEMA Flood Insurance Study (FIS) does not provide drainage areas or flow values for the Star Lake Outlet. The site is in a rural, hilly location. The basin consists of mostly forested areas with one large lake, Star Lake, and limited wetlands. The total contributing drainage area is 3.5 square miles (about 2,240 acres). The maximum basin elevation is 1,947 feet. The maximum elevation at the upper limit of the main channel is 1,476 feet with an elevation at the Georges Mill Road Crossing of 1,144 feet resulting in a 332-foot drop in elevation. The drainage basin has a storage area of 4.4% consisting of Star Lake and a few small wetland areas (Reference 2).

3.2 River Channel and Floodplain

The river channel is lined with trees and consists of a combination of boulders and stones with smaller gravel and cobbles. The channel is sinuous and consists of riffle/pool sequences. The channel banks are well defined due to its forested location and lined with stones. The floodplain consists of heavy stands of timber with flow below the branches. Per a Bureau of Environment Stream Crossing Assessment, the channel has a Rosgen Stream Classification of “C” with an entrenchment ratio of 2.2 and an average bankfull width of 14 feet.

Downstream Reach

Upstream Reach

3.3 Flood History

According to Doug King, District 2 Engineer, there is no history of flooding or overtopping at this location, and there does not appear to be any indications at the project site to indicate previous flooding.

3.4 Hydrologic Study Approach

NHDOT Bridge Design Manual (Reference 1) methodologies indicate that for an ungaged site such as this one, one of the two preferred analysis methods for determining runoff rates/volumes; USGS StreamStats for NH (Reference 4) or the Natural Resources Conservation Service (NRCS) (SCS) Unit Hydrograph Method; should be chosen for analysis. Two of the accepted check methods; Flood Insurance Studies, Runoff Estimates for Small Rural Watersheds and Development of a Sound Method (Reference 5), the New England Hill and Lowlands (NEHL) and Adirondack White Mountains (AWM) Method (Reference 6), and the Index Flood Method; should be chosen to confirm the accuracy of the chosen analysis method.

Based on site conditions with respect to drainage area size and storage area, the USGS StreamStats for NH was chosen for the analysis method. As the project is not located in a FEMA Detailed Study Area, the Flood Insurance Study could not be utilized as a check method. In addition, the Index Flood Method is defined as a check method when other methods are not applicable. The two remaining methods were therefore chosen as the check methods for this project.

CLD established the following design flow rates based on the USGS StreamStats for NH analysis method:

Recurrence Interval in Years	Flow Rate in Cubic Feet per Second (CFS)	
Q2	117	
Q10	259	
Q25	348	
Q50	421	Design Flood
Q100	510	Check Flood
Q500	727	

The design flow rates from the Runoff Estimates for Small Rural Watersheds and Development of a Sound Method (FHWA 5-Parameter Method) was within the allowable prediction errors of the design flow rates from the USGS StreamStats method. The FHWA 7-Parameter Method and the NEHL methods however resulted in design flow rates that substantially exceed the allowable prediction error of the design flow rates for the StreamStats method. The standard error of estimate for the 7-Parameter Method is 83% and uses outdated information. The NEHL Method uses figures from the 1960s and provides design flow values consistently higher that other flow methods for most projects. As there is no known history of flooding at the project location, and one of the check methods falls within the allowable prediction error, the USGS StreamStats for NH method is considered.

4. RIVER HYDRAULIC ANALYSIS

4.1 General Hydraulic Model Approach

The Corp of Engineers Hydrologic Engineer Center's (HEC's) HEC-RAS River Analysis System was utilized to develop the existing and proposed hydraulic models for this project. The river modeling software GeoHECRAS was utilized to help develop the models (Reference 7). This program completely supports HEC-RAS within a 2D and 3D GIS environment. The surface model developed from survey (Reference 8) was imported into the GeoHECRAS program, and the cross sections were cut within the program to allow a seamless transition from the surface model obtained from Survey to the development of the cross sections for the hydraulic model.

The HEC-RAS program utilizes a Step-Backwater Analysis method. The program calculates energy losses through the bridge as a result of friction and either contraction or expansion losses. For this project, the Energy Equation (standard step method) method was utilized for low flows (those that do not come in contact with the low chord of the bridge). High flow (flow that comes in contact with the maximum low chord of the bridge) computations were performed using the Pressure and/or Weir Flow Method.

The upstream and downstream boundary conditions were based on the normal depth slope developed from USGS maps and survey.

HEC-RAS channel sections Station 1238 and Station 1001, the upstream approach station and downstream exit station of the bridge, represent natural unconstricted channel conditions. HEC-RAS channel sections Station 1071, Station 1165, and Station 1182 were chosen to represent the immediate downstream exit location, structure location, and the immediate upstream entrance location, respectively. (See the Cross Section Location Plan in Appendix E.) Characteristic Manning's roughness coefficients of 0.035 for the channel, 0.085 for the overbank areas in wooded areas, and 0.05 for roadway side slope overbank areas were selected. Contraction and expansion coefficients of 0.1 and 0.3, respectively, were used everywhere but in the cross sections immediately upstream and downstream of the existing bridge. Contraction and expansion coefficients of 0.6 and 0.8, respectively, were used at these locations to model the constriction caused by the bridge. Ineffective flow areas were used to model the "dead storage zones" upstream and downstream of the bridge crossing. These areas do not contribute to the conveyance characteristics of the channel. Only the open area underneath the structure contributes to the conveyance computations. The model was run utilizing a subcritical flow regime.

4.2 Existing Bridge

4.2.1 Hydraulic Modeling Approach

The existing structure consists of two 5-foot diameter corrugated metal pipes that are skewed to the road. The existing roadway survey was utilized for the deck surface to develop the roadway profile. The invert elevations of the existing pipes were obtained from the survey and input into HEC-RAS utilizing culvert design methodology.

4.2.2 Hydraulic Performance of Existing Bridge

The results of the existing bridge model indicate that Georges Mill Road is overtopped for all storms greater than the 25-year event.

Although the 25-year event flow does flow through the pipes without overtopping the road, the structures are running full with headwater developing. There is no known flood history at this time to verify the results of the existing model, and there are no indications at the site of previous flooding.

See Appendix F for the existing structure model and output.

4.3 Proposed Bridge

4.3.1 Alternative Selection

Four structure replacement alternatives were considered; 20-foot and 31-foot span buried structures and 20-foot and 31-foot span at-grade structures. The 31-foot span meets stream crossing guidelines of bankfull width times the entrenchment ratio, or 14 feet times 2.2. However, given the location of the site through the intersection, the 20-foot span alternative was proposed due to constructability issues, cost, and public input. It does not meet stream crossing guidelines but could be considered if it meets hydraulic requirements given the additional cost and impacts associated with a larger span. Due to the geometry of the roadway intersection, a buried structure is preferred, but the at-grade alternatives are options if additional rise is required to meet hydraulic requirements.

4.3.2 Proposed Bridge Geometry

Three structures were initially modeled in HEC-RAS; a 20-foot span buried structure with 1.5H:1V channel bank slopes, a 20-foot span at-grade structure with 1.5H:1V channel bank slopes, and a 31-foot span buried structure with 1.5H:1V channel bank slopes. The structures are aligned with the river and skewed to the road approximately 34 degrees.

A fourth structure was modeled; a 20-foot span buried structure with no channel bank slopes, after it was determined that the 20-foot span buried structure with channel banks did not meet the minimum freeboard requirements.

4.3.3 Hydraulic Modeling Approach

The proposed bridge alternatives were modeled using the bridge modeling option identifying the high and low chord of the structure. The existing model was copied, and the proposed bridge section (Section 1165) and immediate upstream and downstream channel cross sections (Stations 1182 and 1071) were revised to show the revised spans. It was assumed that due to the existing constriction at the project location, regrading of the channel upstream and downstream would occur, so the proposed channel banks through the structure were defined in the immediate upstream and downstream sections. The models were run using the subcritical flow regime. For the initial runs, a low chord elevation of 1148.35 feet was approximated for the buried structure alternatives based on the existing roadway profile, a minimum 2 feet of fill over the structure, and an assumed structure depth. A low chord elevation of 1150.60 feet was approximated for the at-grade alternatives based on the existing roadway profile and an assumed structure depth. These low chords were subsequently adjusted to correspond to the calculated minimum low chord elevations.

In addition, the expansion and contraction coefficients were reduced from 0.6 and 0.8 for the existing model to 0.3 and 0.5 for the proposed models since the proposed structure alternatives substantially decrease the constriction at the Georges Mill Road crossing.

4.3.4 Hydraulic Performance of Proposed Conditions

The water profiles of the proposed bridge models for the design flood are significantly lower than the existing model. See Figure 1. Based on a visual inspection of the water surface profile, the 50-year design flow passes through all the proposed alternatives without overtopping the road, however, the 20-foot span buried structure with channel banks results in headwater, and was therefore not evaluated further. Since a buried structure is preferred, the 31-foot at-grade structure was not modeled. This structure alternative would be evaluated only if the 31-foot buried structure did not meet hydraulic requirements.

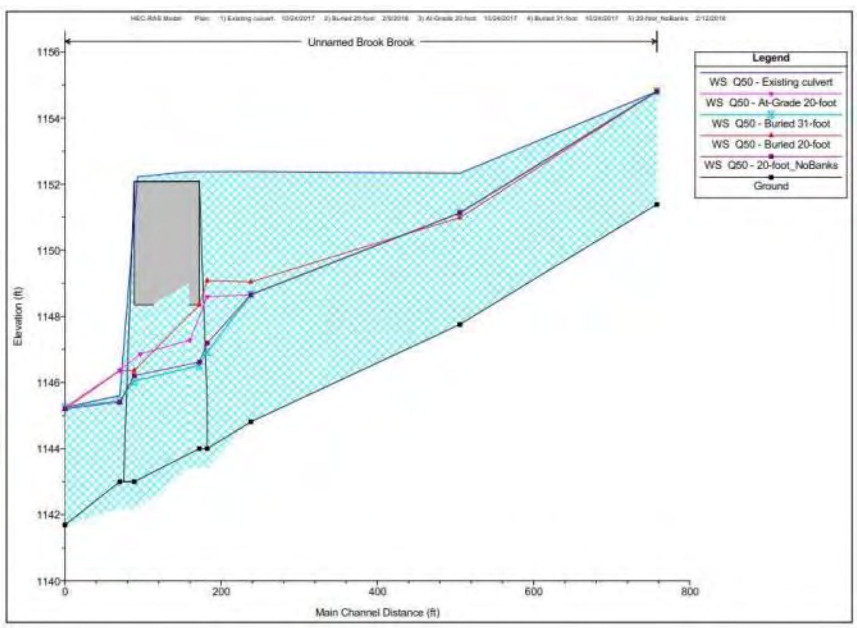


FIGURE 1. – 50-YEAR EVENT WATER SURFACE PROFILE

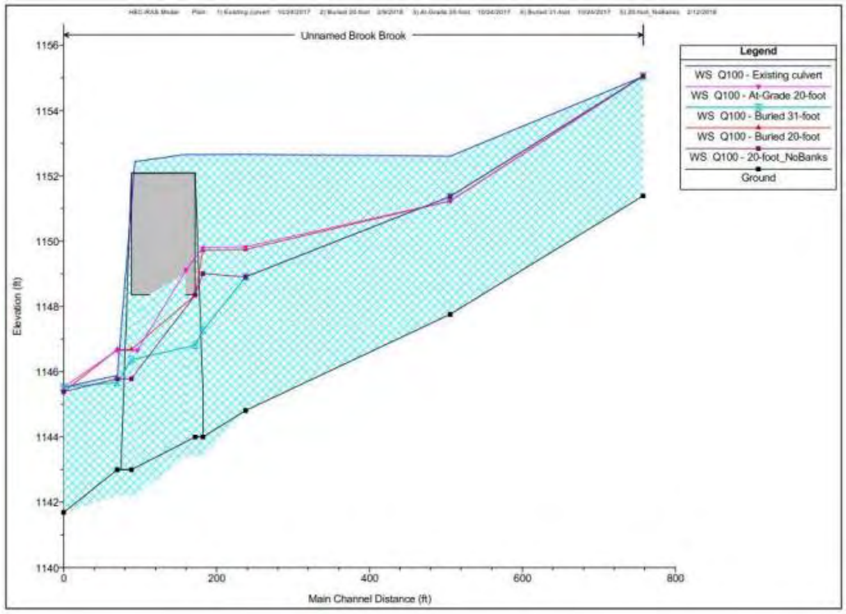


FIGURE 2. – 100-YEAR EVENT WATER SURFACE PROFILE

See Table 1 for a Summary of the Water Surface Elevations at the upstream section (HEC-RAS Station 1238) for the existing model compared to the proposed 31-foot span buried structure model.

HEC-RAS Station 1238	50-Year Design Flood Event (ft.)	100-Year Check Flood Event (ft.)
Existing Bridge Model	1152.38	1152.66
31-Foot Span Buried	1148.66	1148.91
Difference	-3.72	-3.75

TABLE 1. – SUMMARY OF WATER SURFACE ELEVATIONS 31-FOOT SPAN BURIED STRUCTURE

See Table 2 for a Summary of the Water Surface Elevations at the upstream section (HEC-RAS Station 1238) for the existing model compared to the proposed 20-foot span at-grade structure model.

HEC-RAS Station 1238	50-Year Design Flood Event (ft.)	100-Year Check Flood Event (ft.)
Existing Bridge Model	1152.38	1152.66
20-Foot At-Grade	1148.66	1149.83
Difference	-3.57	-3.59

TABLE 2. – SUMMARY OF WATER SURFACE ELEVATIONS
20-FOOT SPAN AT-GRADE STRUCTURE

See Table 3 for a Summary of the Water Surface Elevations at the upstream section (HEC-RAS Station 1238) for the existing model compared to the proposed 20-foot span buried box model with no channel banks.

HEC-RAS Station 1238	50-Year Design Flood Event (ft.)	100-Year Check Flood Event (ft.)
Existing Bridge Model	1152.38	1152.66
20-Foot Buried (No Banks)	1148.66	1148.90
Difference	-3.57	-3.76

TABLE 3. – SUMMARY OF WATER SURFACE ELEVATIONS
20-FOOT SPAN BURIED BOX WITH NO CHANNEL BANKS

Per the NHDOT Bridge Design Manual, the freeboard at the upstream face of the bridge shall be the greater of the flow depth measured at the immediate upstream section (Station 1182) or the flow depth measured at the uncontracted upstream section (Station 1238) applied at the upstream face of the bridge (Station 1165 Br U). Based on the results of the 31-foot span buried structure, the flow depth at HEC-RAS Station 1238 controls resulting in a water surface elevation of 1147.21 feet at the upstream face of the bridge. Based on the results of the 20-foot span at-grade structure, the flow depth at HEC-RAS Station 1182 controls resulting in a water surface elevation of 1148.12 feet at the upstream face of the bridge. Based on the results of the 20-foot span buried box, the flow depth at HEC-RAS Station 1238 controls resulting in a water surface elevation of 1147.21 feet at the upstream face of the bridge. Therefore, the minimum low chord elevation to accommodate 1 foot of freeboard for the 50-year Design Flood event for the 31-foot span buried structure, the 20-foot span at-grade structure, and the 20-foot span buried box is 1148.21 feet, 1149.12 feet, and 1148.21 feet respectively.

The 31-foot span buried structure, the 20-foot span at-grade structure, and the 20-foot span buried box provide 1.23 feet, 1.18 feet, and 1.14 feet of freeboard, respectively, based on the actual low chords for each alternative specified in Section 4.3.3. See Appendix F for freeboard calculations.

The minimum required bridge openings area for the 31-foot span buried structure, the 20-foot span at-grade structure, and the 20-foot span buried box are 111 square feet, 85 square feet, and 87 square feet, respectively. The larger span structure requires a greater opening area than the smaller span structure due to the decrease in low chord for the buried structure.

See Table 4 for a comparison of the velocities between existing and the 31-foot span buried structure at the downstream bridge section (HEC-RAS Station 1165 Br D). It should be noted that the downstream (outlet) velocities for the proposed alternatives are not necessarily the maximum velocities, but were taken at the same location as existing for an accurate comparison.

HEC-RAS Station 1165 BR D	50-Year Design Flood Event (fps)	100-Year Design Flood Event (fps)	500-Year Check Flood Event (fps)
Existing Bridge Model	11.76	11.94	12.21
31-Foot Span Buried	5.81	6.28	9.12
Difference	-5.95	-5.66	-3.90

TABLE 4. – SUMMARY OF VELOCITIES
31-FOOT SPAN BURIED STRUCTURE

See Table 5 for a comparison of the velocities between existing and the 20-foot span at-grade structure at the downstream bridge section (HEC-RAS Station 1165 Br D).

HEC-RAS Station 1165 BR D	50-Year Design Flood Event (fps)	100-Year Design Flood Event (fps)	500-Year Check Flood Event (fps)
Existing Bridge Model	11.76	11.94	12.21
20-Foot Span At-Grade	7.53	9.74	11.04
Difference	-4.23	-2.20	-1.17

TABLE 5. – SUMMARY OF VELOCITIES
20-FOOT SPAN AT-GRADE STRUCTURE

See Table 6 for a comparison of the velocities between existing and the 20-foot span buried box with no channel banks at the downstream bridge section (HEC-RAS Station 1165 Br D).

HEC-RAS Station 1165 BR D	50-Year Design Flood Event (fps)	100-Year Design Flood Event (fps)	500-Year Check Flood Event (fps)
Existing Bridge Model	11.76	11.94	12.21
20-Foot Buried (No Banks)	6.56	9.16	10.20
Difference	-5.20	-2.78	-2.01

TABLE 6. – SUMMARY OF VELOCITIES 20-FOOT SPAN BURIED BOX STRUCTURE

All three structure alternatives result in lower velocities than the existing structure. In addition, all three structure replacement alternatives meet hydraulic requirements. However, due to the differences in span, the 20-foot span structures results in higher velocities than the 31-foot span structure. These higher velocities will also result in greater scour potential as discussed in Section 5 below. It should also be noted that the velocities for the 20-foot span buried box are slightly less that the velocities for the 20-foot at-grade structure. This is due to the elimination of channel banks in the buried structure alternative.

See Appendix F for the proposed bridge model input and output.

5. STABILITY AND SCOUR ASSESSMENT

5.1 Channel Description

As discussed in Section 3.2, the river channel is lined with trees and consists of a combination of boulders and stones with smaller gravel and cobbles. The channel is sinuous and consists of riffle/pool sequences. The channel banks are well defined due to their forested location and lined with stones. Per a Bureau of Environment Stream Crossing Assessment, the channel has a Rosgen Stream Classification of “C”, which “have high entrenchment ratios and commonly access well developed flood plains to accommodate high flow stages”. Channels are typically sinuous with low slopes, less than 2%, and commonly consist of riffle/pool sequences. A concern in designing stream crossing structures for this stream type is channel stability and lateral extension. Channel stability and lateral movement is highly dependent on the adjacent stability of the natural stream bank. If existing stream bank stability is impacted, this channel type can quickly become unstable. To compensate for possible channel instability and wider bankfull flows, larger crossing structures and/or flood plain drainage structures should be considered.”

5.2 Scour Assessment

5.2.1 Degradation and Lateral Migration Potential

As discussed above, a concern for this channel type is channel stability and lateral extension. Given the streams location and geometry at the corner between two roads, it is unlikely to change course at the crossing location. The proposed options for construction are at least double the existing span, which will accommodate some amount of lateral migration. However, new channel banks shall be constructed and stoned through the length of the structure, and stream crossing material shall be utilized in the stream bed. These precautions should minimize stream migration potential.

The channel slope will match existing as closely as possible. Some changes to the up- and downstream channel can be expected due to the increased span; however, as the channel slope is shallow, velocities are low, and the channel banks continue through the proposed structure, channel degradation should be minimized.

5.2.2 Contraction Scour

The D50 values were determined to be 2.5 inches (63.5 mm) upstream and 1 inch (25.4 mm) downstream. The D50 value of 1 inch was utilized for preliminary scour calculations to be conservative. A calculation of critical velocity, which is then compared to the actual approach velocity provided by the HEC-RAS model, shows that the type of contraction scour through the structure in the channel is live bed scour for the 31-foot span alternative, and clear water scour for the 20-foot span alternative. Live bed scour occurs where there is transport of bed material in the upstream reach into the bridge cross section. Clear water scour occurs when there is not bed material transport from the upstream reach into the downstream reach, or the material being transported in the upstream is mostly in suspension and at less than the capacity of the flow (Reference 9). However, the riverbed material inside the structure will be armored. Per Hec-18 (Reference 9), "scour depths with live-bed contraction scour may be limited by coarse sediments in the bed material armoring the bed. Where coarse sediments are present, it is recommended that the scour depths be calculated for live-bed scour conditions using the clear-water scour equation, and that the smaller calculated scour depth be used". Therefore, both methods were utilized to determine the potential scour depths, and the smaller depth of the two methods was used.

The calculations also showed that the type of contraction scour through the structure for both alternatives on the banks is clear-water scour. However, the resulting potential contraction scour is 0.00 for the banks for both proposed structures.

The calculations of the scour depths for the 100-year design flood and the 500-year check flood for the 20-foot span at-grade structure, and the 500-year check flood for the 31-foot span buried structure, were complicated by the existence of pressure flow through the bridge. Additional contraction scour calculations were performed taking pressure flow into account.

Scour calculations were not performed for the 20-foot span buried box as it is a closed bottom structure.

See Table 8 for the results of the contraction scour calculations provided in Appendix G. As shown, the 31-foot span results in less potential contraction scour due to the lower velocities of the flow through the structure.

	100-Year Design Flood Event			500-Year Check Flood Event		
	Left Abutment (ft.)	Channel	Right Abutment (ft.)	Left Abutment (ft.)	Channel	Right Abutment (ft.)
31-Foot Span Buried	0.00	0.45	0.00	0.00	0.97	0.00
20-Foot Span At-Grade	0.00	1.08	0.00	0.00	2.95	0.00
Difference	0.00	+0.63	0.00	0.00	+1.98	0.00

TABLE 8. – SUMMARY OF POTENTIAL CONTRACTION SCOUR DEPTHS

5.2.3 Abutment Scour

Due to the projection of the proposed structure into the floodplain constricting the flow, velocities through a bridge structure increase during larger flood events, resulting in scour occurring at the abutment walls of the structure. An increase in span decreases the flow constriction, decreasing the velocities and the resulting scour. However, scour cannot be evaluated for closed bottom structures such as the existing culverts, so it will not be possible to compare scour from existing to proposed. However, a comparison between existing and proposed velocities can be evaluated.

Appendix G includes all the scour calculations. Hand calculations were performed to verify the results of the HEC-RAS scour reports. Froehlich's Abutment Scour Equation was utilized to estimate the flood event scour depths. The scour depths recorded in Table 9 represent the potential local abutment scour

As with the contraction scour, the local abutment scour potential for the 31-foot span is less than the 20-foot span due to the lower velocity in the channel.

	100-Year Design Flood Event		500-Year Check Flood Event	
	Left(East) Abutment Wall (ft.)	Right(West) Abutment Wall (ft.)	Left(East) Abutment Wall (ft.)	Right(West) Abutment Wall (ft.)
31-Foot Span Buried	5.17	1.47	7.27	2.22
20-Foot Span At-Grade	6.72	2.42	9.33	4.14
Difference	+1.55	+0.95	+2.06	+1.92

TABLE 9. – SUMMARY OF LOCAL ABUTMENT SCOUR DEPTHS

5.2.4 Total Potential Scour

The combined total potential scour is shown in Table 10.

	100-Year Design Flood Event			500-Year Check Flood Event		
	Left(East) Abutment Wall (ft.)	Channel	Right(West) Abutment Wall (ft.)	Left(East) Abutment Wall (ft.)	Channel	Right(West) Abutment Wall (ft.)
31-Foot Span Buried	5.17	0.45	1.47	7.27	0.97	2.22
20-Foot Span At-Grade	6.72	1.08	2.42	9.33	2.95	4.14
Difference	+1.55	+0.63	+0.95	+2.06	+1.98	+1.92

TABLE 10. – SUMMARY OF POTENTIAL TOTAL SCOUR DEPTHS

As discussed previously, the potential scour depths for the 20-foot span are up to 1.55 feet greater than the 31-foot span for the 100-year design flood event, and up to 1.98 feet greater for the 500-year check flood event.

5.3 Foundation and Countermeasure Recommendations

5.3.1 Scour Countermeasures

The depths of estimated scour shown in Table 8 are estimates of the potential scour that would occur during the indicated flood events. The proposed structure should be designed to be stable with minimal damage should that scour occur during the 100-year design flood event. The structure should be designed to be stable during the 500-year check flood event, even if extensive damage occurs, to prevent potential loss of life and property damage.

Riprap is typically used as a scour countermeasure to protect the substructure. Riprap sizing calculations were performed (See Appendix H) to determine the required riprap for the design and check flood events based on the maximum velocity and depth within the contracted section of the bridge for each event. These equations were based on the HEC-23, Design Guideline 14 – Sizing Rock Riprap at Abutments (Reference 11). For the 31-Foot Span Buried Structure, the resulting D50 of the riprap was calculated to be 0.88 feet for the 100-year design flood event and 1.08 feet for 500-year check flood event. NHDOT Riprap, Class III (Reference 1) can be utilized for the 100-year flood event. Although the value for the 500-year check flood event corresponds to NHDOT Riprap, Class V (Reference 1), the required D50 is not significantly greater than that of the Class III riprap, and as the loss to life or property is minimal if the 500-year check flood scour does occur, Class III riprap is acceptable. For the 20-Foot Span At-Grade Structure, the resulting D50 of the riprap was calculated to be 1.15 feet for the 100-year design flood event and 1.46 feet for the 500-year check flood event, which both correspond to NHDOT Riprap, Class V. For the 20-Foot Span Buried Box with no banks, the resulting D50 of the riprap was calculated to be 1.14 feet for the 100-year design flood event and 1.45 feet for the 500-year check flood event, which both correspond to NHDOT Riprap, Class V. However, due to the shallow rise of a 20-foot span buried box structure, the size of the Class V Riprap would be difficult to place inside the box, so 2-feet of NHDOT Riprap, Class III should be utilized inside the box for ease of construction.

31-Foot Span: Both abutment walls should have this riprap extending from the toe of the abutment into the bridge waterway approximately 5 feet for the 100-year design flood event or 6 feet for the 500-year check flood event. For the reasons noted above, 5 feet is recommended. The riprap thickness for Class III Riprap should be 2-feet deep.

20-Foot Span At-Grade: Both abutment walls should have this riprap extending from the toe of the abutment into the bridge waterway approximately 6 feet for the 100-year design flood event and 8 feet for the 500-year check event. The 6 foot value is recommended. The riprap thickness for Class V Riprap should be 3-feet deep.

20-Foot Span Buried: Class III Riprap should be utilized inside the box with a thickness of 2-feet and should extend across the entire width of the channel. In the upstream and downstream aprons, Class V Riprap is required and should extend from the toe of the wingwalls into the channel approximately 6 feet for the 100-year design flood event and 8 feet for the 500-year check event. The

6-foot value is acceptable. The riprap thickness for Class V Riprap should be 3-feet deep.

For all proposed structures, the riprap should extend from the face of each abutment wall back along each downstream roadway approach embankment (or along the faces of the wingwalls) at least 25 feet to protect the downstream roadway approach embankment, and should extend up the embankments at least to the 100-year design flood event elevation at the bridge.

Although riprap is designed as a scour countermeasure for the design flood, there is still some argument for requiring the placement of the bottom of any proposed shallow foundation within the channel below the 100-year design flood event potential scour depths shown in Table 10 for each abutment wall. However, the maximum scour potential is 5.17 feet, which is only slightly deeper than frost depth. Therefore, the bottom of any proposed shallow foundations within the channel shall extend to frost depth.

5.3.2 Channel Protection

The potential contraction scour depths in the channel were calculated to be up to 1 foot for the 31-foot span alternative, and up to 3 feet for the 20-foot span alternative. Therefore, channel protection is required. As the existing structure is being replaced, NHDES Stream Crossing rules will require streambed material through the new structure. It is recommended that the designed riprap extend across the full width of the channel inside and outside the open bottom structures (within the project limits) rather than just that recommended for the local abutment scour discussed previously. One foot of simulated streambed material specified for the channel should be placed over the top of the specified riprap with additional streambed material required to fill in any voids between the riprap. The top of the simulated streambed material should be flush with the existing channel grade.

Inside the 20-foot span buried box structure, 2 feet of Class III Riprap topped with 1 foot of simulated streambed material with additional streambed material required to fill in the voids between the riprap is recommended for ease of construction and shall extend across the full width of the channel inside the structure. Similar to the open bottom structures, the designed riprap with simulated streambed material shall extend across the full width of the channel outside the structure (within the project limits) for channel protection.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

The existing structure is undersized and only passes up to the 25-year flood event without overtopping the road. Four structure replacement alternatives were evaluated; a 20-foot span buried structure with channel banks, a 20-foot span buried box with no channel banks, a 20-foot span at-grade structure with channel banks, and a 31-foot span buried structure with channel banks. The 20-foot span buried structure with channel banks does not meet freeboard requirements and was eliminated from the replacement alternatives. The other three alternatives meet hydraulic requirements. Channel scour protection is required for all alternatives.

6.2 Recommendations

Due to constructability issues, cost, and public input, the 20-foot span buried structure with no channel banks is the preferred alternative. This alternative provides a compromise between the existing structure and the 31-foot span buried structure and meets all hydraulic requirements for the future safety of the crossing for vehicles and pedestrians.

7 REFERENCES

1. NHDOT Bridge Design Manual, January 2015 – V 2.0 (Revised Feb. 2016).
2. Terrain Navigator, TOPO Map, Sunapee, NH Quadrangle 1984.
3. Field reconnaissance by CLD|F&O personnel, April 25, 2017.
4. StreamStats for NH, http://water.usgs.gov/osw/streamstats/new_hampshire.html
5. Drainage Design for Highways, NHDOT, April 1998
6. Runoff Estimates for Small Rural Watersheds and Development of a Sound Design Method, Utah Water Research Lab., Logan, October 1977.
7. GeoHECRAS Version 1.2.0.10916, 2016 CivilGEO Engineering Software.
8. Survey Base Plan.
9. Hydraulic Engineering Circular No. 18, Evaluating Scour at Bridges – Fifth Edition, Federal Highway Administration, April 2012.
10. HEC-RAS River Analysis System Hydraulic Reference Manual, US Army Corps of Engineers Hydrologic Engineering Center, Version 4.1, January 2010
11. Hydraulic Engineering Circular No. 23, Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance – Third Edition, Federal Highway Administration, September 2009.

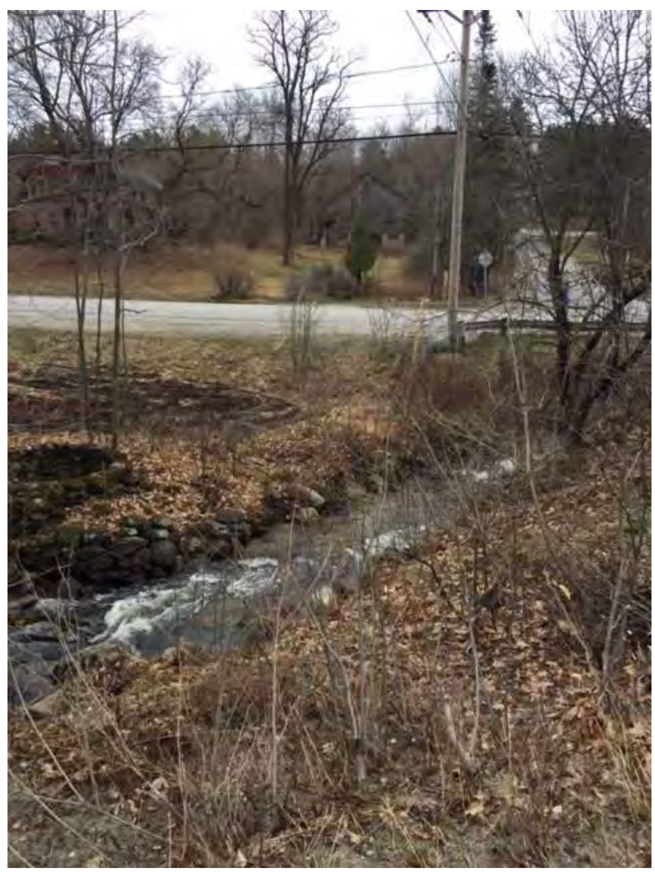
APPENDIX A

PHOTOGRAPHS

Roadway View (Looking West)

Upstream Reach – Looking Upstream

Upstream Reach – Looking Upstream



Upstream Reach – Looking Downstream


Downstream Reach – Looking Downstream


Roadway View – Looking North up Stryker Road

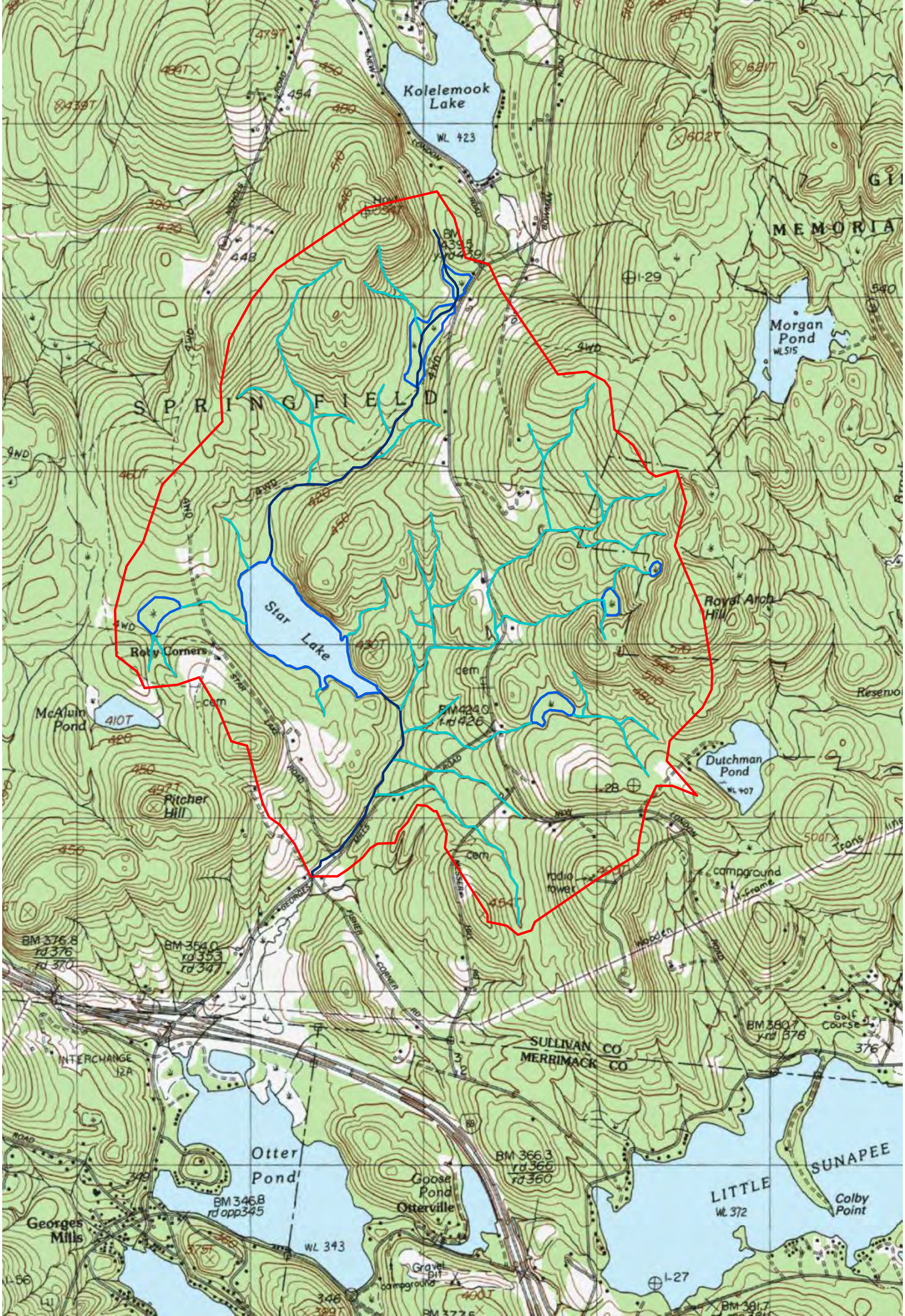
Downstream Outlet

Upstream Inlet

APPENDIX B

WATERSHED AREA MAP

Colcord Brook
Colcord Brook
Hoyt Hill
Leavitt Hill
Star Lake
Royal Arch Hill
Pitcher Hill
Prospect Hill
Morgan Hill
43.44878, -72.05390
SULLIVAN CO
MERRIMACK CO
Otter Pond
Colby Point
Little Sunapee Lake
SPRINGFIELD RD

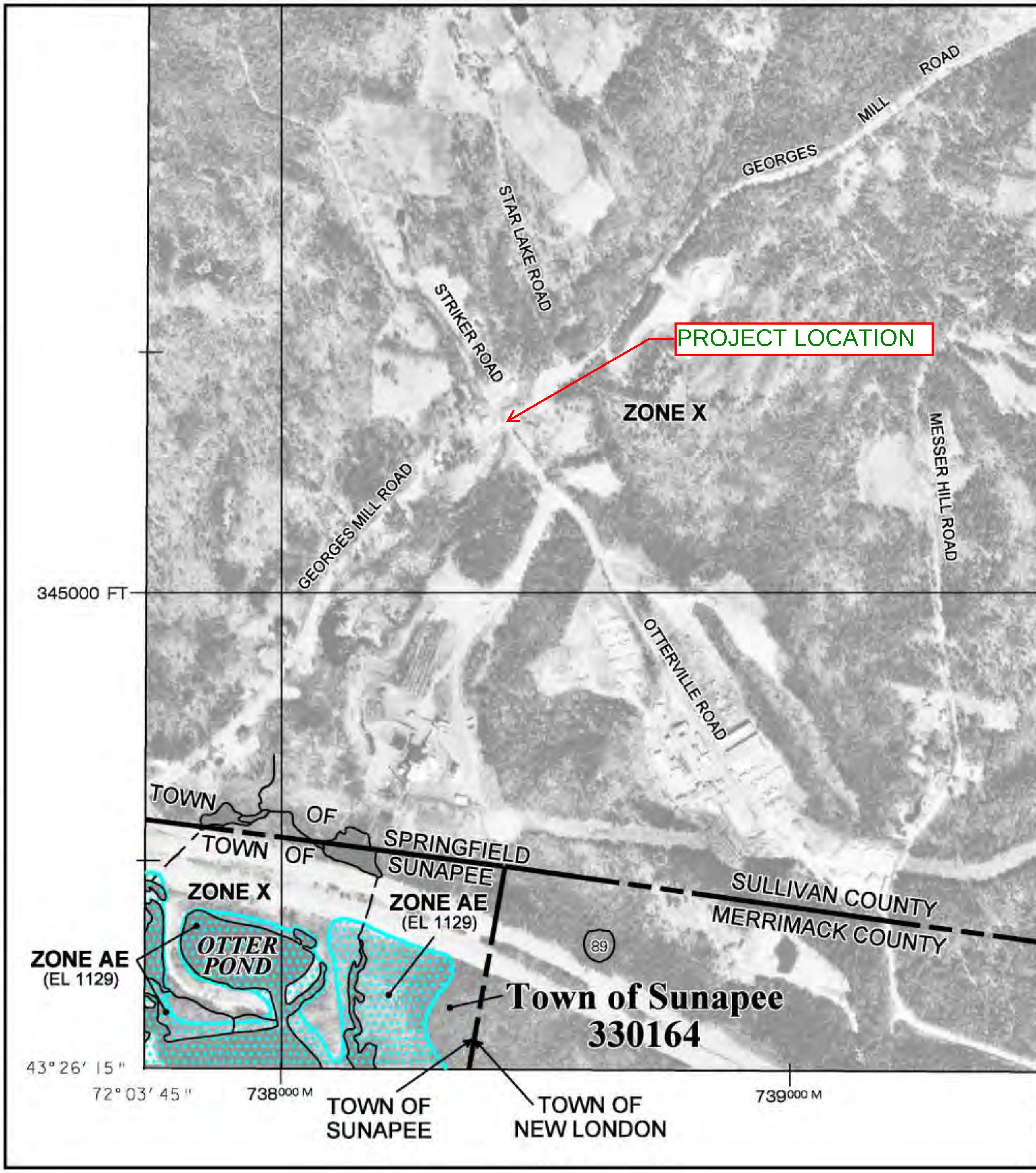


Kolelemook Lake
WL 423
SPRINGFIELD
MEMORIAL
Morgan Pond
WL 515
Star Lake
Roby Corners
McAlvin Pond
410T
Pitcher Hill
Royal Arch Hill
Dutchman Pond
WL 407
cem
BM 424.0
rd 426
radio tower
campground
Wooden
SULLIVAN CO
MERRIMACK CO
INTERCHANGE 12A
Otter Pond
BM 346.8
rd opp 345
WL 343
Goose Pond
Otterville
Georges Mills
LITTLE SUNAPEE
WL 372
Colby Point
Golf Course
BM 380.7
BM 376.8
BM 354.0
BM 366.3
Gravel Pit


SUNAPEE, NEW HAMPSHIRE
7.5 X 15 MINUTE SERIES (TOPOGRAPHIC)
43072-D1-TM-025
Sunapee
NEW HAMPSHIRE
1:25 000-scale metric
topographic map
7.5 X 15 MINUTE QUADRANGLE
SHOWING
Contours and elevations in meters
Highways, roads and other manmade structures
Water features
Woodland areas
Geographic names
GEOLOGICAL SURVEY
PROVISIONAL EDITION 1984
PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY
CONTOUR INTERVAL 5 METERS
THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY
RESTON, VIRGINIA 22092
ROAD LEGEND
PROVISIONAL MAP
Produced from original manuscript drawings. Information shown as of date of field check
SCALE 1:25 000
CONTOUR INTERVAL 5 METERS
SUNAPEE, NEW HAMPSHIRE
PROVISIONAL EDITION 1984
43072-D1-TM-025
GRANTHAM
CROYDON
SUNAPEE
NEW LONDON
NEWPORT
NEWBURY
SUNAPEE LAKE
LITTLE SUNAPEE LAKE
Kolelemook Lake
Stocker Pond
Baptist Pond
Otter Pond
Ledge Pond
Perkins Pond
Gardner Bay
Sunapee Harbor
Herrick Cove
Morgan Pond
Messer Pond
Chalk Pond
Rocky Bound Pond
Red Water Brook
North Newport
Georges Mills
Jackman Ridge
Bald Mtn
Croydon Flat
Pinnacle
Dutchman Pond
Lakeside
Hastings
Deer Hill
Crockett Pond
Crystal
Pleasant Lake
GILE MEMORIAL FOREST
CORNISH
PLAINFIELD
Bark Pond

APPENDIX C

FEMA FIS INFORMATION



onal Flood Insurance Program at 1–800–638–6620.

MAP SCALE 1" = 1000'

0 1000 2000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0210E

FIRM
FLOOD INSURANCE RATE MAP
SULLIVAN COUNTY,
NEW HAMPSHIRE
(ALL JURISDICTIONS)

PANEL 210 OF 445

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SPRINGFIELD, TOWN OF	330163	0210	E
SUNAPEE, TOWN OF	330164	0210	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
33019C0210E

EFFECTIVE DATE
MAY 23, 2006

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

APPENDIX D

HYDROLOGIC DISCHARGE CALCULATIONS

METHODS FOR DETERMINING RUNOFF RATES/VOLUMES	
Preferred Methods for ***Analysis:***	
Methods	Description/Limitations
USGS *StreamStats* for NH (gaged sites)	• Stream Gage Data • 20-years of continuous or synthesized data for 100-yr discharge • Peak discharges affected by dam failure, ice-jam breach, or a similar event are not included in the frequency analyses.
USGS *StreamStats* for NH (ungaged sites)	• Regression Equations • *StreamStats* takes flood characteristics from gaged to ungaged sites through use of watershed characteristics. • The regression equations are applicable only to sites on ungaged, unregulated streams in rural New Hampshire basins. • 0.7 sq. miles < Drainage Area ≤ 1290 sq. miles • 0% ≤ Wetlands ≤ 21.8% • 2.79 in. ≤ Basinwide mean of the average April precipitation ≤ 6.23 in. (3.6) • 5.43 ft/mi ≤ Main Channel Slope ≤ 543 ft/mi
Natural Resources Conservation Service (NRCS) (SCS) Unit Hydrograph Method	• TR-20 • Intended for smaller watersheds • 1 acre ≤ Total Drainage Area ≤ 300 sq. miles • 1 acre ≤ sub-watershed area ≤ 20 sq. miles • Recommended when there is significant storage in the watershed • 0.005 ≤ Manning "n" ≤ 1.00 • 100 ft. maximum length of sheet flow • 30 ≤ Curve Number ≤ 100

Methods for Determining Runoff Rates/Volumes

Table 2.7.4-2

Drainage Area = 3.5 square miles

use USGS streamstats

METHODS FOR CHECKING RUNOFF RATES/VOLUMES	
Accepted Methods for ***Check:***	
Methods	Description/Limitations
Flood Insurance Studies not a detailed study area	• Federal Emergency Management Agency (FEMA) Flood Insurance Studies (FIS) o If the site is located in a floodplain delineated by FEMA, then the peak discharge computed by FEMA shall be used as one of the check methods. o These reports may have outdated datums and outdated information that was used to develop the study. • USGS Flood Reports
Runoff Estimates for Small Rural Watersheds and Development of a Sound Method	• FHWA Report No. FHWA-RD-77-159, 1977. • 5 and 7 Parameter Method (regression equations) • Intended for a drainage area < 50 sq.-mi. ✓ • Use for drainage area < 100 sq.-mi. • May contain outdated information that was used to develop the variables for the equations. • Used as a replacement for Potter's Method
New England Hill and Lowlands (NEHL) and Adirondack White Mountains (AWM) Method	• Use when the drainage area is between 1 sq.-mi. and 1,000 sq.-mi. ✓ • Uses figures dated 1960 (outdated information). • Storage can be estimated • Rainfall Index between 1.5 and 2 inches.
Index Flood Method	• Mean annual floods may vary throughout region • Homogeneity is established at the 10-yr level • Used as a check or where other methods are not applicable.

Methods for Checking Runoff Rates/Volumes

Table 2.7.4-3

StreamStats Version 3.0

Basin Characteristics Ungaged Site Report

Date: Mon June 26, 2017 4:40:20 PM GMT-4
Study Area: New Hampshire
NAD 1983 Latitude: 43.4489 (43 26 56)
NAD 1983 Longitude: -72.0538 (-72 03 14)

Label	Value	Units	Definition
DRNAREA	3.5	square miles	Area that drains to a point on a stream
APRAVPRE	3.599	inches	Mean April Precipitation
WETLAND	4.4137	percent	Percentage of Wetlands
OUTLETX	881415	State plane coordinates	Basin outlet horizontal (x) location in state plane coordinates
OUTLETY	346065	State plane coordinates	Basin outlet vertical (y) location in state plane coordinates
CENTROIDX	883778.2	State plane coordinates	Basin centroid horizontal (x) location in state plane coordinates
CENTROIDY	351627.7	State plane coordinates	Basin centroid vertical (y) location in state plane units
BSLDEM30M	13.498	percent	Mean basin slope computed from 30 m DEM
ELEVMAX	1947.182	feet	Maximum basin elevation
TEMP	43.92	degrees F	Mean Annual Temperature
TEMP_06_10	60.076	degrees F	Basinwide average temperature for June to October summer period
CONIF	29.5029	percent	Percentaqe of land surface covered by coniferous forest
MIXFOR	36.4479	percent	Percentage of land area covered by mixed deciduous and coniferous forest
PREBC0103	7.09	inches	Mean annual precipitation of basin centroid for January 1 to March 15 winter period
PREG_06_10	18.4	inches	Mean precipitation at gaging station location for June to October summer period
PREG_03_05	9	inches	Mean precipitation at gaging station location for March 16 to May 31 spring period
LC11IMP	0.47	percent	Average percentage of impervious area determined from NLCD 2011 impervious dataset
LC11DEV	3.7	percent	Percentage of developed (urban) land from NLCD 2011 classes 21-24
MINTEMP_W	12.819	degrees F	Mean winter minimum air temperature over basin surface area
PREBC_1112	7.56	inches	Mean annual precipitation of basin centroid for November 1 to December 31 period
PRECIPCENT	42.3	inches	Mean Annual Precip at Basin Centroid

PRECIPOUT	41.7	inches	Mean annual precip at the stream outlet (based on annual PRISM precip data in inches from 1971-2000)
SNOFALL	81.158	inches	Mean Annual Snowfall
CSL10_85	97.2	feet per mi	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

StreamStats Version 3.0

Flow Statistics Ungaged Site Report

Date: Mon June 26, 2017 4:37:45 PM GMT-4
Study Area: New Hampshire
NAD 1983 Latitude: 43.4489 (43 26 56)
NAD 1983 Longitude: -72.0538 (-72 03 14)
Drainage Area: 3.5 mi2

Peak Flows Region Grid Basin Characteristics

100% Peak Flow Statewide SIR2008 5206 (3.5 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	3.5	0.7	1290
Mean April Precipitation (inches)	3.599	2.79	6.23
Percent Wetlands (dimensionless)	4.4137	0	21.8
Stream Slope 10 and 85 Method (feet per mi)	97.2	5.43	543

LowFlows Region Grid Basin Characteristics

100% Low Flow Statewide (3.5 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	3.5	3.26	689
Mean Basin Slope from 30m DEM (percent)	13.498	3.19	38.1
Maximum Basin Elevation (feet)	1947.182	260	6290
Percent Coniferous Forest (percent)	29.5029	3.07	56.2
Jan to Mar Basin Centroid Precip (inches)	7.09	5.79	15.1
Mean Annual Temperature (degrees F)	43.920	36	48.7
Jun to Oct Mean Basinwide Temp (degrees F)	60.076	52.9	64.4
Jun to Oct Gage Precipitation (inches)	18.4	16.5	23.1
Percent Mixed Forest (percent)	36.4479	6.21	46.1
Mar to May Gage Precipitation (inches)	9.0	6.83	11.5

Groundwater Recharge Region Grid Basin Characteristics

100% Groundwater Recharge Statewide 2004 5019 (3.5 mi2)

Parameter	Value	Regression Equation Valid Range	
		Min	Max
Drainage Area (square miles)	3.5	3.26	689
Mean Annual Precip at Gage (inches)	41.7	35.83	53.11
Jun to Oct Gage Precipitation (inches)	18.4	16.46	23.11
Mar to May Gage Precipitation (inches)	9.0	6.83	11.54
Mean Annual Precip at Basin Centroid (inches)	42.3	37.44	75.91
Mean Annual Temperature (degrees F)	43.920	36.05	48.69
Mean Winter Min Temperature (degrees F)	12.819	0.8	19.88
Percent Coniferous Forest (percent)	29.5029	3.07	56.18
Percent Mixed Forest (percent)	36.4479	6.21	46.13

Nov to Dec Basin Centroid Precip (inches)	7.56	6.57	15.2
Mean Annual Snowfall (inches)	81.158	54.46	219.07

Peak Flows Region Grid Statistics

Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max
PK2	117	ft3/s	30	3.2	72.3	191
PK5	194	ft3/s	31	4.7	118	320
PK10	259	ft3/s	32	6.2	154	435
PK25	348	ft3/s	34	8	200	603
PK50	421	ft3/s	36	9	236	753
PK100	510	ft3/s	39	9.8	276	942
PK500	727	ft3/s	44	11	363	1460

http://pubs.usgs.gov/sir/2008/5206/ (http://pubs.usgs.gov/sir/2008/5206/)
Olson_ S.A._ 2009_ Estimation of flood discharges at selected recurrence intervals for streams in New Hampshire: U.S.Geological Survey Scientific Investigations Report 2008-5206_ 57 p.

LowFlows Region Grid Statistics

Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max
D60WIN	1.82	dim	21		1.24	2.57
D70WIN	1.52	dim	21		1.05	2.13
D80WIN	1.33	ft3/s	18		0.96	1.8
D90WIN	1.03	dim	19		0.72	1.41
D95WIN	0.82	dim	21		0.56	1.16
D98WIN	0.69	dim	27		0.42	1.07
M7D2Y WIN	1.38	ft3/s	17		1	1.84
M7D10Y WIN	0.76	ft3/s	22		0.5	1.08
D60SPR	8.06	dim	12		6.5	9.85
D70SPR	6.3	dim	11		5.17	7.59
D80SPR	4.63	dim	12		3.72	5.68
D90SPR	3.2	dim	14		2.51	4
D95SPR	2.31	dim	15		1.78	2.95
D98SPR	1.62	dim	18		1.17	2.17
M7D2Y SPR	2.21	ft3/s	15		1.69	2.82
M7D10Y SPR	1.2	ft3/s	16		0.89	1.58
D60SUM	0.53	dim	37		0.27	0.92
D70SUM	0.38	dim	40		0.19	0.69
D80SUM	0.31	dim	45		0.14	0.59
D90SUM	0.19	dim	51		0.0785	0.39
D95SUM	0.13	dim	57		0.048	0.29
D98SUM	0.11	dim	61		0.0362	0.25
M7D2Y SUM	0.22	ft3/s	56		0.0784	0.46

M7D10Y SUM	0.0776	ft3/s	79		0.0187	0.2
D60FALL	3.36	dim	23		2.22	4.85
D70FALL	2.57	dim	26		1.62	3.85
D80FALL	1.96	dim	28		1.19	3.01
D90FALL	1.28	dim	32		0.73	2.06
D95FALL	0.84	dim	38		0.42	1.49
D98FALL	0.54	dim	51		0.22	1.09
M7D2Y FAL	1.93	ft3/s	23		1.27	2.79
M7D10Y FAL	0.82	ft3/s	37		0.42	1.42
D60	1.91	ft3/s	18		1.39	2.55
D70	1.28	ft3/s	21		0.89	1.77
D80	0.73	ft3/s	28		0.45	1.13
D90	0.36	ft3/s	38		0.19	0.64
D95	0.22	ft3/s	44		0.1	0.42
D98	0.14	ft3/s	54		0.0515	0.29
M7D2Y	0.21	ft3/s	56		0.0761	0.44
M7D10Y	0.0734	ft3/s	79		0.0173	0.19

http://pubs.water.usgs.gov/wrir02-4298 (http://pubs.water.usgs.gov/wrir02-4298)
Flynn_ R.H. and Tasker_ G.D._ 2002_ Development of Regression Equations to Estimate Flow Durations and Low-Flow-Frequency Statistics in New Hampshire Streams: U.S.Geological Survey Scientific Investigations Report 02-4298_ 66 p.

Groundwater Recharge Region Grid Statistics						
Statistic	Value	Unit	Prediction Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
					Min	Max
RCHRG WIN	4.13	in	16			
RCHRG SPR	7.65	in	12			
RCHRG SUM	3.05	in	27			
RCHRG FAL	2.72	in	16			
RCHRG ANN	17.8	in	12			

http://pubs.usgs.gov/sir/2004/5019/#StreamStatsDB_2014-11-21 - Copy - Copy.mdb#
(http://pubs.usgs.gov/sir/2004/5019/#StreamStatsDB_2014-11-21 - Copy - Copy.mdb#)
Flynn_ R.H. and Tasker_ G.D._ 2004_ Generalized Estimates from Streamflow Data of Annual and Seasonal Ground-Water-Recharge Rates for Drainage Basins in New Hampshire_ U.S. Geological Survey Scientific Investigations Report 2004-5019_ 67 p.

540 Commercial Street
Manchester, NH 03101
Tel.: (603) 668-8223 Fax: (603) 668-8802
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JOB	Springfield, NH 16-0361
SHEET NO.	OF
CALCULATED BY	AEG DATE 7/17
CHECKED BY	ETC/SRB DATE 8/17

SUBJECT **HYDROLOGY SUMMARY**

DRAINAGE AREA	**97,574,400**	**sq. ft.**
	2240	**acres**
	3.50	**sq. miles (StreamStats)**
	98,566,690	**sq. ft. (USGS Maps - Calculated)**
	2263	**acres**
	3.54	**sq. miles**
USE	**3.50**	**sq. miles**
STORAGE AREA IN DRAINAGE BASIN	**4,303,031**	**sq. ft. (StreamStats)**
	4.41%	**(streamstats)**
	4,328,319	**sq. ft. (USGS Maps - Calculated)**
	0.0439	**sq.ft./sq.ft.**
	4.39%	
USE	**4.41%**	
LENGTH OF RIVER (LONGEST CHANNEL), L1	**16323.95**	**ft. (USGS Map)**
	3.09	**miles**
LENGTH OF OTHER CHANNELS, L2	**60838.92**	**ft. (USGS Map)**
TOTAL LENGTH=	**77162.9**	**ft.**
	14.6	**miles**
APPROX. ELEVATION AT CROSSING	**1144.0**	**ft. (Survey)**
APPROX. ELEVATION AT HIGH POINT OF CHANNEL	**1476.4**	**ft. (USGS)**
CHANGE IN ELEVATION	**332.4**	**ft.**
Estimated Slope	**0.0204**	**ft/ft**
	107.5	**ft/mile**
	97.2	**ft/mile from stream stats (use)**

CONSULTING ENGINEERS
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New Hampshire • Vermont • Maine

JOB Springfield, NH JOB NO. 16-0361
SHEET NO. OF
CALCULATED BY AEG DATE 8/17
CHECKED BY ETC DATE 10/17
SUBJECT elevations in USGS SCALE

elevation where stream starts 450 m/0.3048 m/ft = 1476.4'

CLD CONSULTING ENGINEERS
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Manchester, NH 03101
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Reference: Runoff Estimates for Small Rural Watersheds and Development of a Sound Design Method. Volume I. Research Report, Oct. 1977 and Volume II. Recommendations for Preparing Design Manuals and Appendices B, C, D, E, F, G, and H, Oct. 1977 - U.S. Depatment of Commerce

Design Procedure (Volume II, page 3)

I. Delineate the Watershed

a. *Develop Topographic Map of Area (USGS is 1:24,000 scale)*

b. *Determine Watershed Area feeding Culvert of Bridge Crossing in sq. miles.*

A* = 3.50 *sq. miles

II. Determine the Probable Maximum Runoff Peak, Qp(max)

$$Q_{p(max)} = 10^{\{3.92 + 0.812 (\log A) - 0.0325 (\log A)^2\}}$$

$Q_{p(max)}$ = *the probably maximum runoff in cfs*

log A = *the base 10 logarithm of the watershed area measure in sq. miles.*

$Q_{p(max)}$ = ***22497.76 cfs***

(Note: $Q_{p(max)}$ may also be obtained graphically from Figure 2, page 5)

III. Determine the Required Hydrophysiographic Parameters

a. *Iso-erodent Factor, R: The mean annual rainfall kinetic energy times the annual maximum 30 minute rainfall intensity.*

i. *Determine the centroid of the Watershed and use this location to determine the R Factor from the proper iso-erodent state map in Appendix C.*

For NH, Use Appendix C-33, page 113

***R* = 88**

b. *Elevation Difference, DH: The difference between the elevation of the main channel at its most distant boundary as measured along the channel and the elevation at the culvert of drainage structure site, feet.*

Max Elevation =	*1476.4*	*ft*
Elevation at Crossing =	*1144.0*	*ft*
DH =	***332.4***	***ft***

c. *Percent Surface Water Storage Area, S: The percent of watershed area covered by lakes, ponds, swamps, playas, etc.*

i. *Determine the water storage from topographic map obtained in Step I, then dividing by the watershed area, A, and multiplying by 100.*

Storage Area =	*4303031.0*	*sq. ft.*
A =	*97574400.0*	*sq. ft.*
S =	***4.41***	***%***

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d. *Hydrophysiographic Zone: A less biased and more precise estimate of a dependent variable may be obtained from equations derived from homogeneously grouped data.*
- See Figure 3, page 12 for Zone delineations.
-See Appendix B for zones on a state-by-state basis.
   i. *Use the centroid of the Watershed determined in Step III on the appropriate State Map in Appendix B, and determine the zone in which the centroid of the watershed lies.*

Zone = ***9*** ***(Note: All of NH is in Zone 9.)***

e. *Principal Drainage Channel Length, L: The length in miles of the principal drainage channel from the structure site to the upper boundary of the watershed, miles.*

L = *16323.95* *ft*
L = ***3.09*** ***miles***

f. *10-year, 60-minute rainfall, P_{60}: The value read from the proper state map given in Appendix D at the centroid of the watershed determined in Step III, inches.*
(Note: Value obtained from Map is in hundreths of an inch. Divide value by 100 to obtain rainfall in Inches.

P_{60} = *167.5* *Hundreths of an inch*
P_{60} = ***1.675*** ***inches (See Appendix D-33, page 167, for NH)***

g. Cumulative Channel Lengths, LL: The cumulative length in miles of all drainage channels shown as blue lines within the watershed on a USGS 7 1/2 minute quadrangle (1:24,000 scale) map. If LL is measured from a 1:250,000 scale map it must be corrected by the Equation A below.

$LL = 2.00\ LL_{250}^{\ 1.036}$ *(EQ. A - Correction Eqn. for 1:250,000 scale map)*

LL = ***14.6*** ***miles***

(Note: The corrected LL may also be obtained graphically from Figure 4, page 13)

h. *10-year, 10-minute rainfall intensity, P_{10}: The value read from the proper state map given in Appendix E at the centroid of the watershed determined in Step III in inches per hour.*
(Note: Value obtained from Map is in hundreths of an inch per hour. Divide value by 100 to obtain Rainfall in Inches/Hour.

P_{10} = *468* *Hundreths of an inch per hour*
P_{10} = ***4.68*** ***inches/hour***
(See Appendix E-33, page 221, for NH)

Reference: Runoff Estimates for Small Rural Watersheds and Development of a Sound Design Method. Volume I. Research Report, Oct. 1977 and Volume II. Recommendations for Preparing Design Manuals and Appendices B, C, D, E, F, G, and H, Oct. 1977 - U.S. Depatment of Commerce

IV. Determine the Estimated 10-year Runoff Peak, q_{10}

a. *Pick the appropriate Regression equations from Tables 1-B through 1-D.*

3-Parameter Regression Equation for Zone 9

$q_{10} = 0.50051\, A^{0.69229}\, R^{0.74166}\, DH^{0.39729}$

$q_{10} =$ **331.2** ***cfs***

5-Parameter Regression Equation for Zone 9

$q_{10} = 7.7165\, A^{0.5814}\, R^{0.0547}\, DH^{0.3865}\, L^{0.0990}\, P_{60}^{\;0.8217}$

$q_{10} =$ **329.1** ***cfs***

7-Parameter Regression Equation for Zone 9

$q_{10} = 50.8080\, A^{0.3799}\, R^{-0.1432}\, DH^{0.3401}\, L^{0.0917}\, LL^{0.2879}\, P_{10}^{\;-0.9655}\, P_{60}^{\;1.8748}$

$q_{10} =$ **441.5** ***cfs***

Note: After the 10-year peak flow has been determined from the desired equations, it must be adjusted in the area of the surface water storage, S, determined in Step III-c is greater than 4%.

Is S > 4%? ***YES***

If No, put 1 for Storage Correction Multiplier and Continue to Step V.
If Yes, read the storage correction multiplier from Figure 5, page 15.

Storage Correction Multiplier = ***0.97***

Corrected q10 Values:

3-Parameter Regression Value

$q_{10} =$ **321.2** ***cfs***

5-Parameter Regression Value

$q_{10} =$ **319.2** ***cfs***

7-Parameter Regression Value

$q_{10} =$ **428.3** ***cfs***

V. Determine the Return Period, T_D, for the Design Flow:

If the risk or probability must be considered that one or more flows will exceed the design flow within a specified number of years, usually taken as the usable lifetime of the structure, then the design flood peak must be modified to take this into account.

If the return period for the design flow is specified by agency policy as 50 or 100 or some other number of year, proceed to Step VI with the TD specified by policy.

The Design Flow is specified as Q50 for the Bridge Design Capacity, so skip to Step VI - See page 14 for other state projects if a modified return period for the design flood is necessary.

Reference: Runoff Estimates for Small Rural Watersheds and Development of a Sound Design Method. Volume I. Research Report, Oct. 1977 and Volume II. Recommendations for Preparing Design Manuals and Appendices B, C, D, E, F, G, and H, Oct. 1977 - U.S. Depatment of Commerce

VI. Prepare the Extrapolation Curve for Determining QTD: The below equations are an alternative to obtaining values for Q2.33, Q50, and Q100 graphically from Figure 7, page 18.

$Q_{2.33} = 0.46921\, q_{10}^{\,1.00243}$

$Q_{2.33}$	=	152.8	cfs (3 Parameter Method)
$Q_{2.33}$	=	151.9	cfs (5 Parameter Method)
$Q_{2.33}$	=	203.9	cfs (7 Parameter Method)

$Q_{50} = 1.45962\, q_{10}^{\,1.02342}$

Q_{50}	=	536.7	cfs (3 Parameter Method)
Q_{50}	=	533.3	cfs (5 Parameter Method)
Q_{50}	=	720.4	cfs (7 Parameter Method)

$Q_{100} = 1.64380\, q_{10}^{\,1.02918}$

Q_{100}	=	624.9	cfs (3 Parameter Method)
Q_{100}	=	620.9	cfs (5 Parameter Method)
Q_{100}	=	840.1	cfs (7 Parameter Method)

VII. Determine Q_{DT} from the curve Prepared in Step IV:

This step is only necessary if Step V is used.

Step V was not evaluated - See page 16 for other state projects if a modified design flood is necessary.

VIII. Determine the Confidence Interval about Q_{TD}:

Determine upper and lower values based on a the confidence interval associated with the uncertainty of the estimate of q_{10}.

This Step is unnecessary for this Project.

Reference: Runoff Estimates for Small Rural Watersheds and Development of a Sound Design Method. Volume I. Research Report, Oct. 1977 and Volume II. Recommendations for Preparing Design Manuals and Appendices B, C, D, E, F, G, and H, Oct. 1977 - U.S. Depatment of Commerce

IX. Select Q_{Design} from Q_U, Q_{TD}, and Q_L

If Upper and Lower Values were not calculated, determine the Q_{Design} value from Step VI.

$$Q_{2.33} = 0.46921\, q_{10}^{\,1.00243}$$

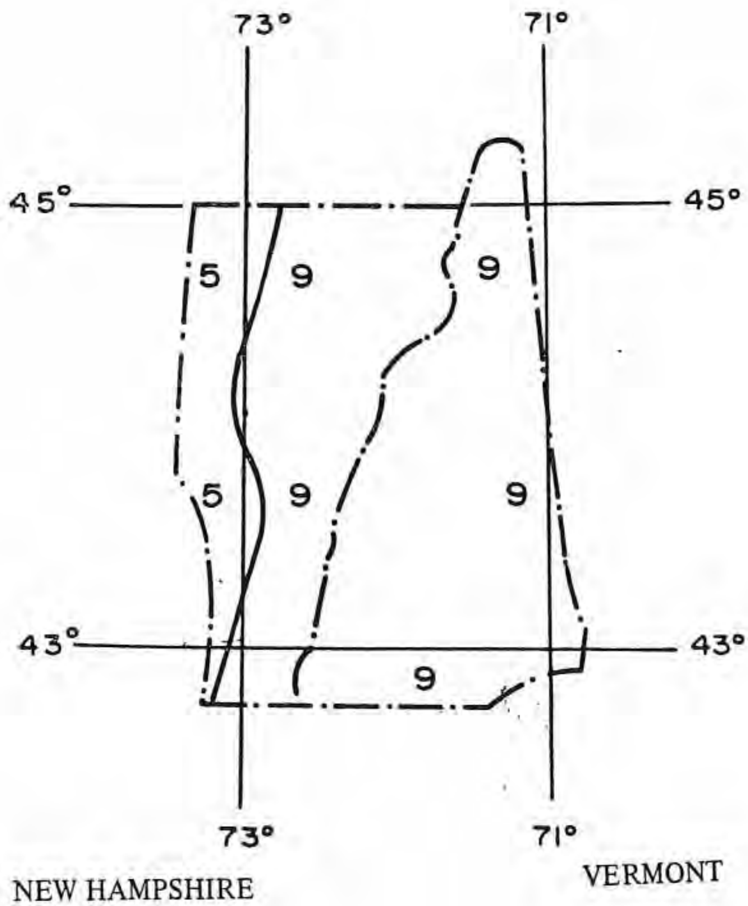
$Q_{2.33}$ =	152.8	cfs (3 Parameter Method)
$Q_{2.33}$ =	151.9	cfs (5 Parameter Method)
$Q_{2.33}$ =	203.9	cfs (7 Parameter Method)

$$Q_{50} = 1.45962\, q_{10}^{\,1.02342}$$

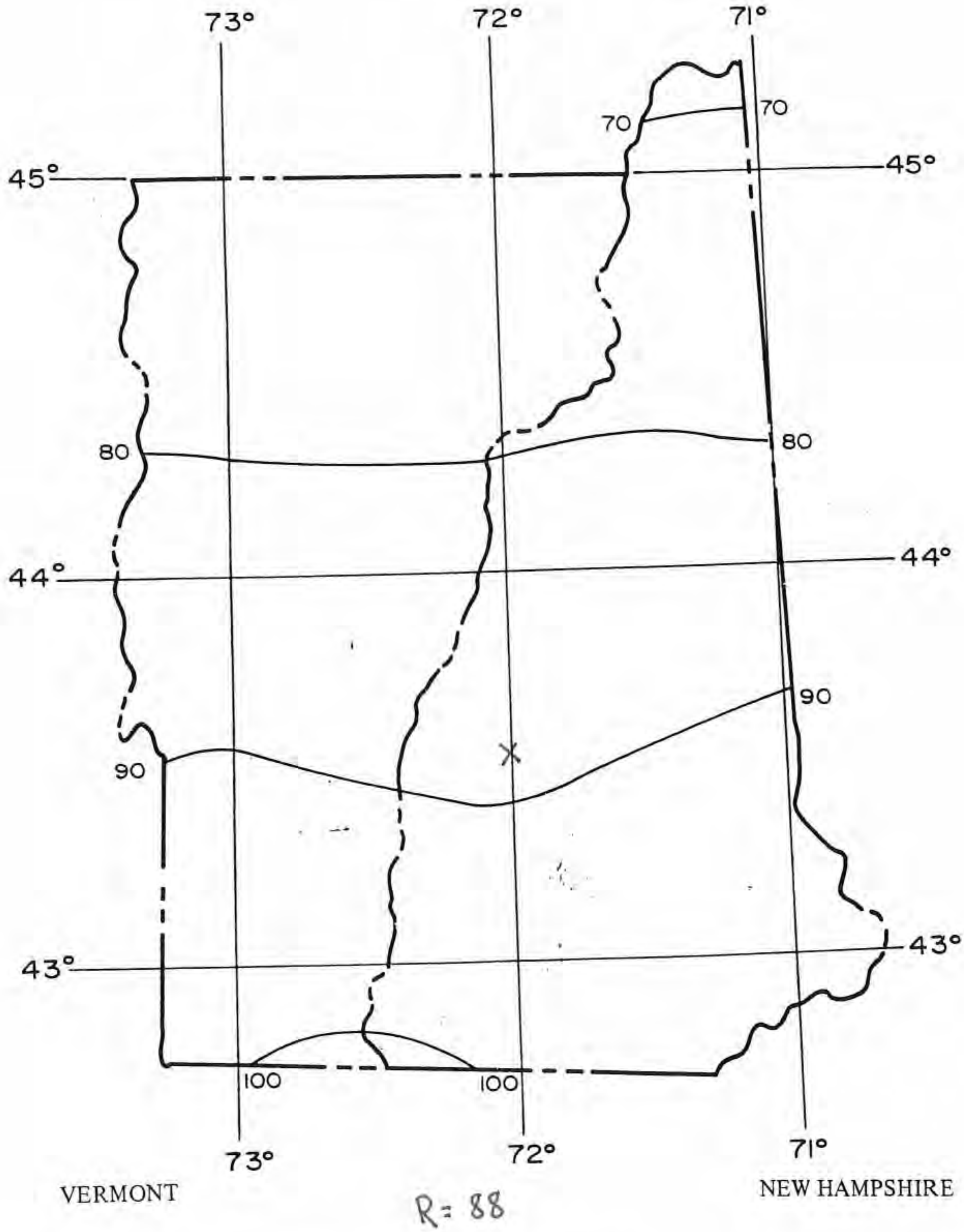
Q_{50} =	536.7	cfs (3 Parameter Method)
Q_{50} =	533.3	cfs (5 Parameter Method)
Q_{50} =	720.4	cfs (7 Parameter Method)

$$Q_{100} = 1.64380\, q_{10}^{\,1.02918}$$

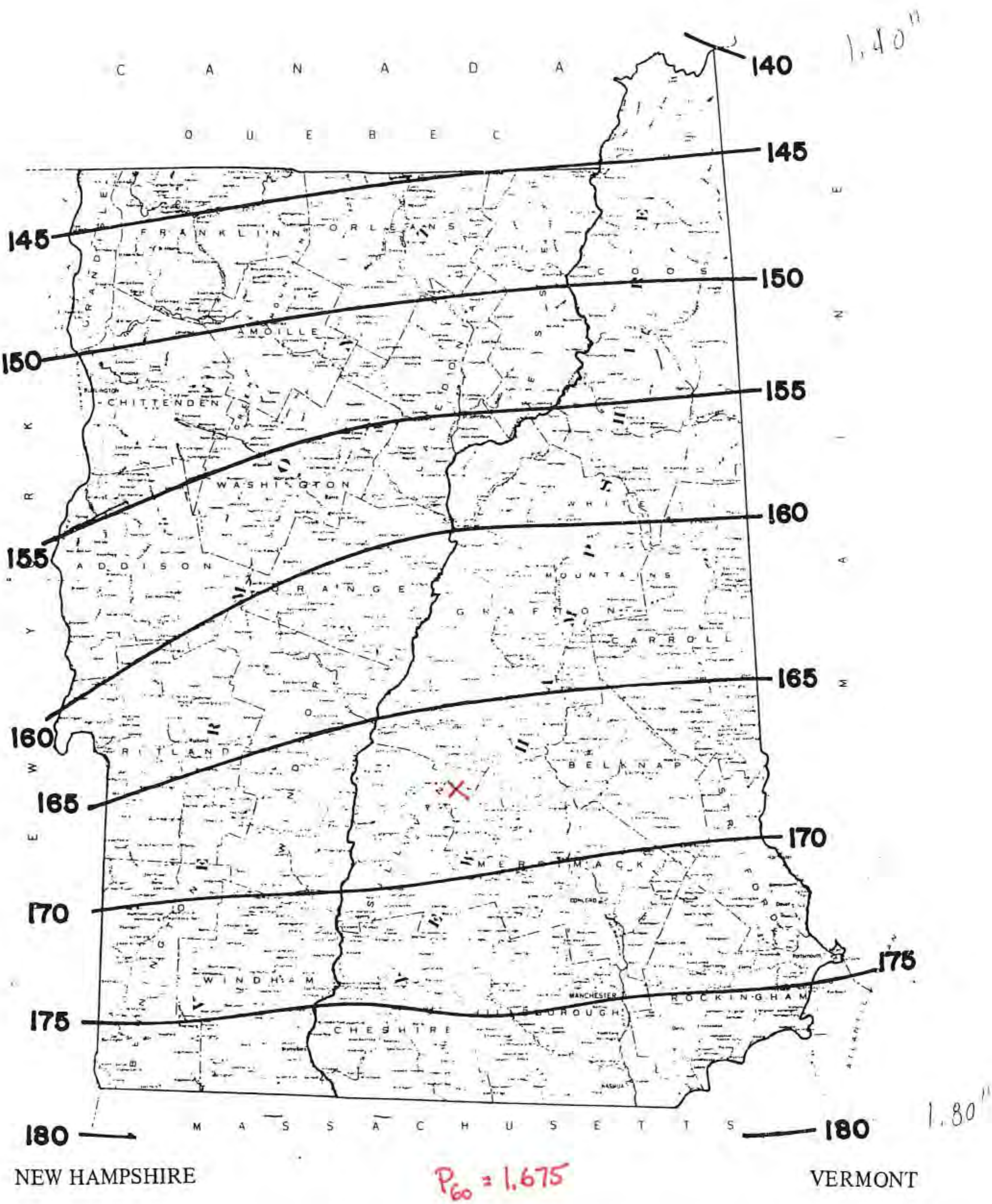
Q_{100} =	624.9	cfs (3 Parameter Method)
Q_{100} =	620.9	cfs (5 Parameter Method)
Q_{100} =	840.1	cfs (7 Parameter Method)



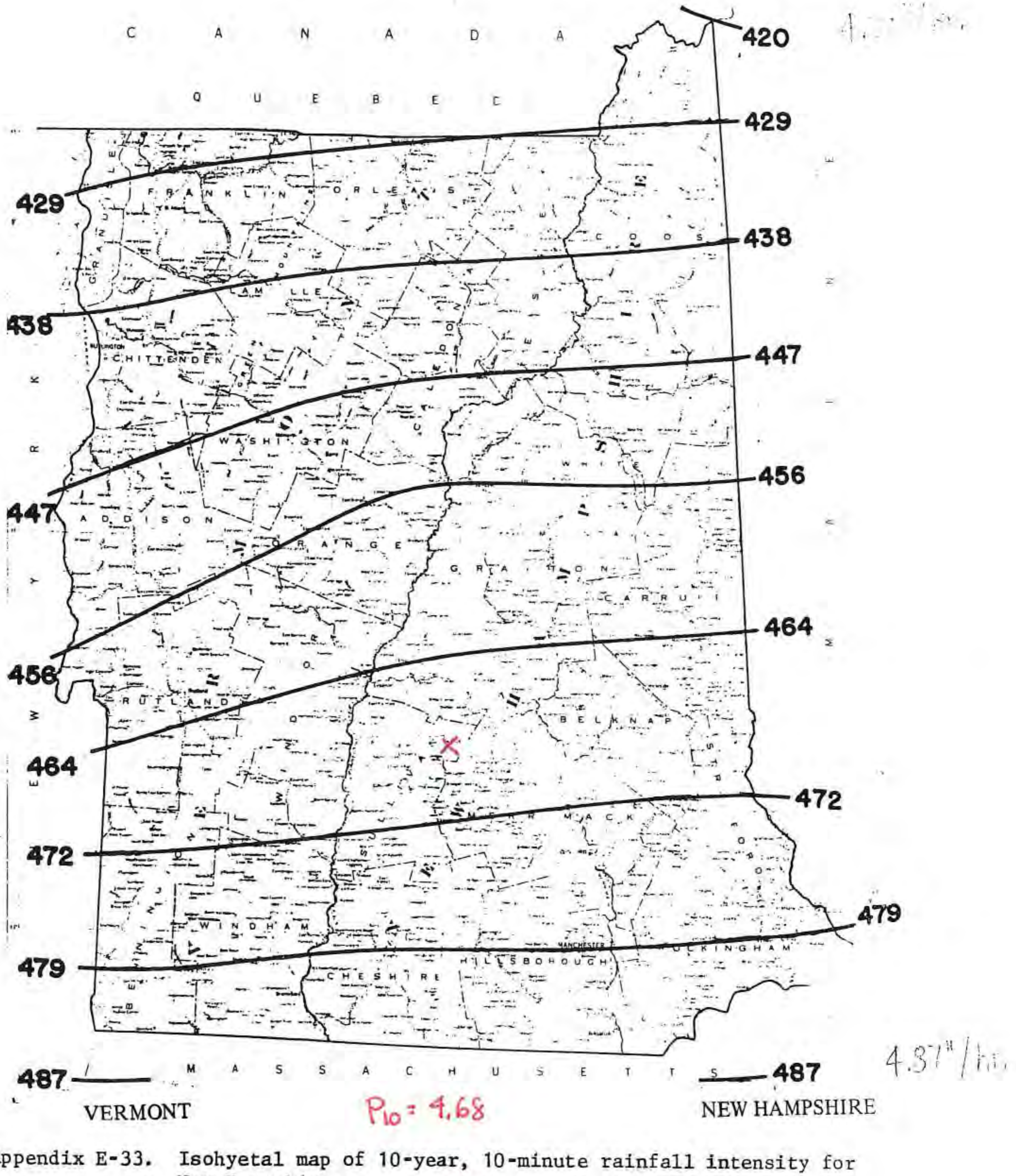
Appendix B-33. Hydrophysiographic zones of New Hampshire.
Appendix B-50. Hydrophysiographic zones of Vermont.



Appendix C-33. Isoerodent, R, map of New Hampshire.
Appendix C-50. Isoerodent, R, map of Vermont.



Appendix D-33. Isohyetal map of 10-year 1-hour rainfall for New Hampshire.
Appendix D-50. Isohyetal map of 10-year 1-hour rainfall for Vermont.



Appendix E-33. Isohyetal map of 10-year, 10-minute rainfall intensity for New Hampshire.

Appendix E-50. Isohyetal map of 10-year, 10-minute rainfall intensity for Vermont.

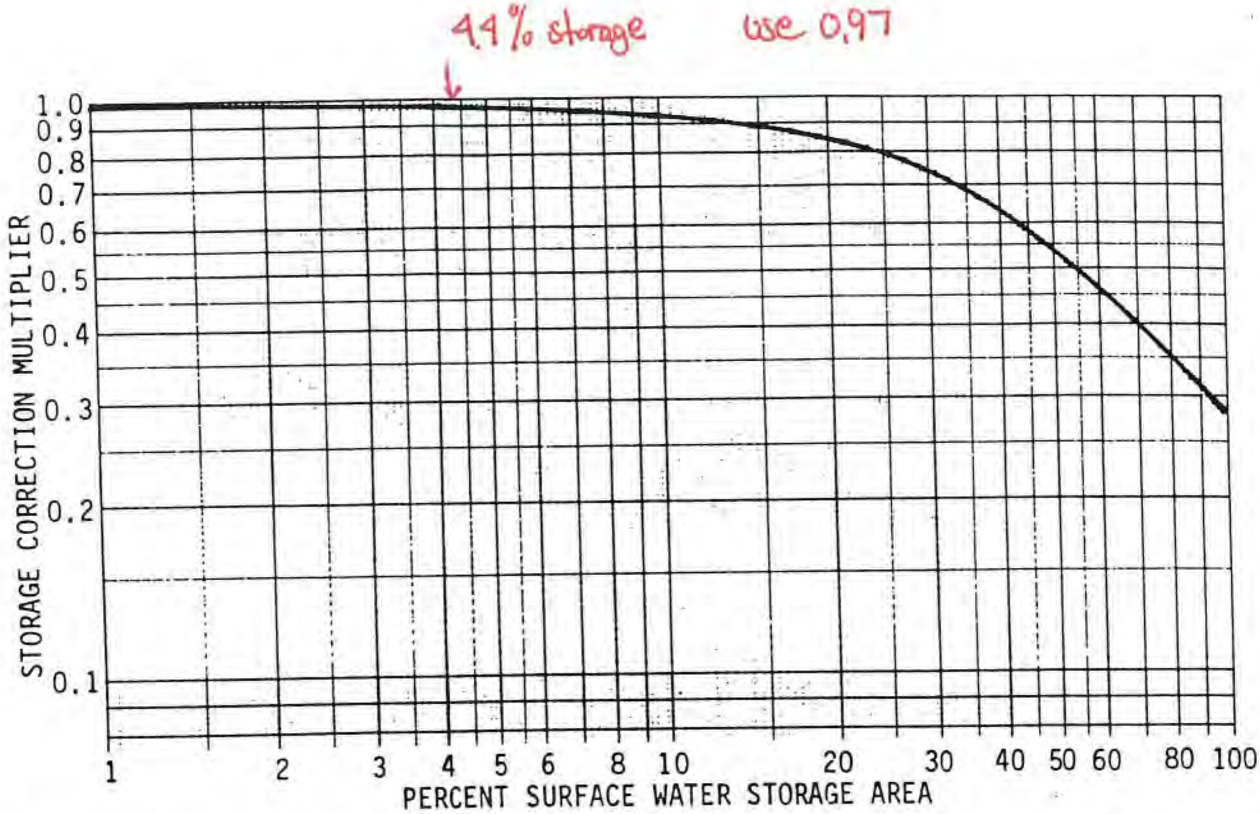


Figure 5. Storage correction curve. (Defines the relationship between the percentage of watershed area covered by lakes, ponds, swamps, playas, etc. and the multiplication factor required to correct a peak runoff estimate for storage.)

in which

- n = the usable lifetime of the structure in years
- k = the number of flood events that exceed the T year flood event
- $\binom{n}{k}$ = the binomial coefficient, $\frac{n!}{k!\,(n-k)!}$
- p = the probability of the nominally specified design flood ($p = 1/T$)
- P_R = the probability that exactly k flood events exceed the T-year flood in n years

If we define the exceedence risk, R_e, as the probability that a T-year flood will be exceeded one or more times in n years,

$$R_e = 1 - P_0 = 1 - \left(1 - \frac{1}{T}\right)^n \quad \ldots\ldots\ldots\ldots \quad (6)$$

in which

- P_0 = the probability of no events exceeding the T-year flood and all other symbols are as previously defined

Equation 6 may be used directly to evaluate the risk of exceedance to ascertain its acceptability for the particular circumstances. If so, then the

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SUBJECT **NEHL / AWM Method**

Reference: VTRANS HYDRAULIC MANUAL

- USUALLY USED FOR DRAINAGE AREAS BETWEEN 1 SQ. MILE AND 1000 SQ. MILES

Location ***NEHL*** *(used streamstats values where needed)*

A =	***3.50***	***sq. miles***
P =	***1.64***	***(Figure 2-7)***
k =	***4.41%***	***(storage percentage)***

Q_{10} =	***520.0***	***cfs***
Q_{50} =	***950.0***	***cfs***

NO. 31,158 LOGARITHMIC 5 BY 5 3-INCH CYCLES (BASE LONG WAY). CODEX BOOK COMPANY, INC. NORWOOD, MASSACHUSETTS. PRINTED IN U.S.A.

A=3,5 sq. mi
K= 4.9
P= 1,64

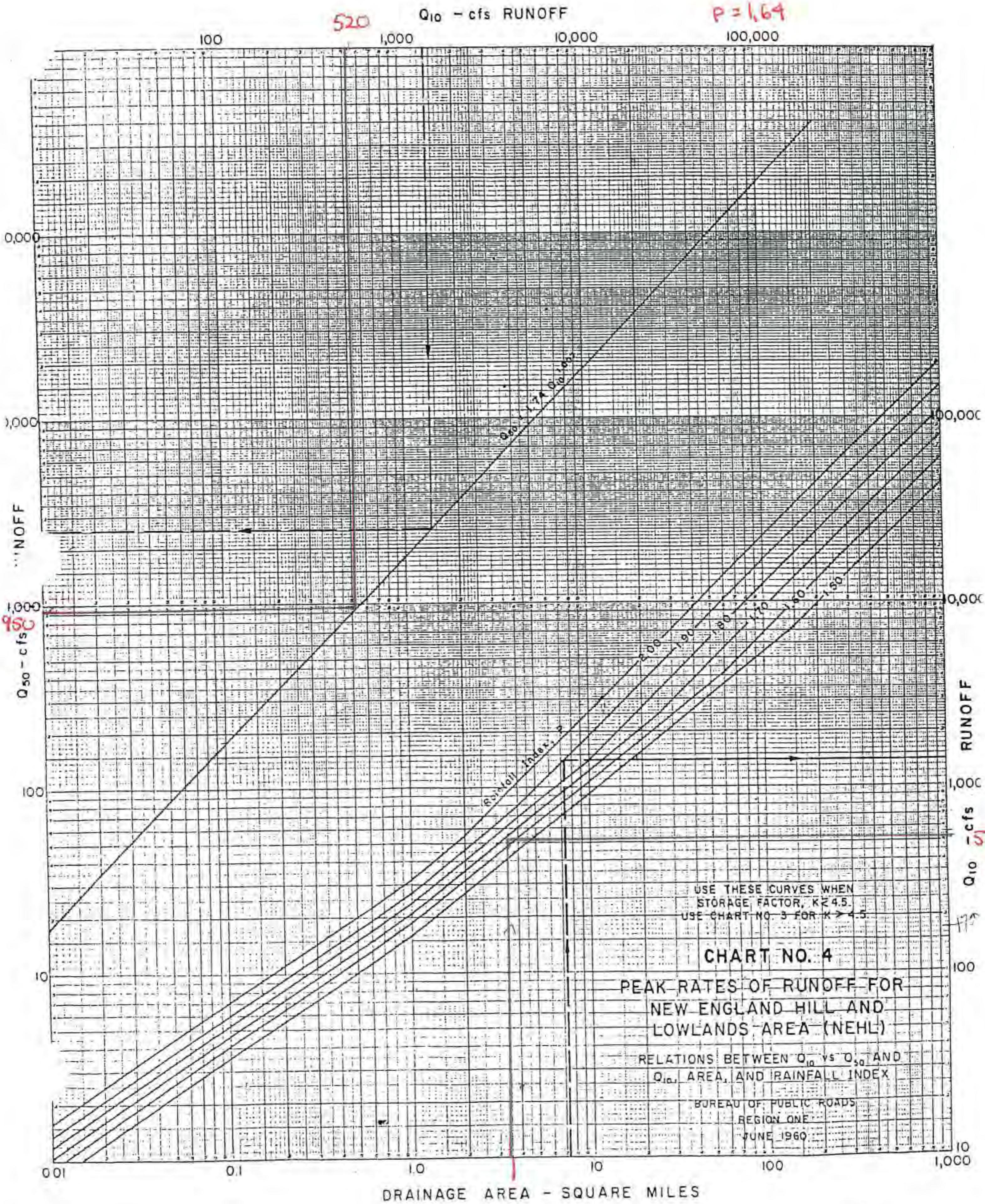
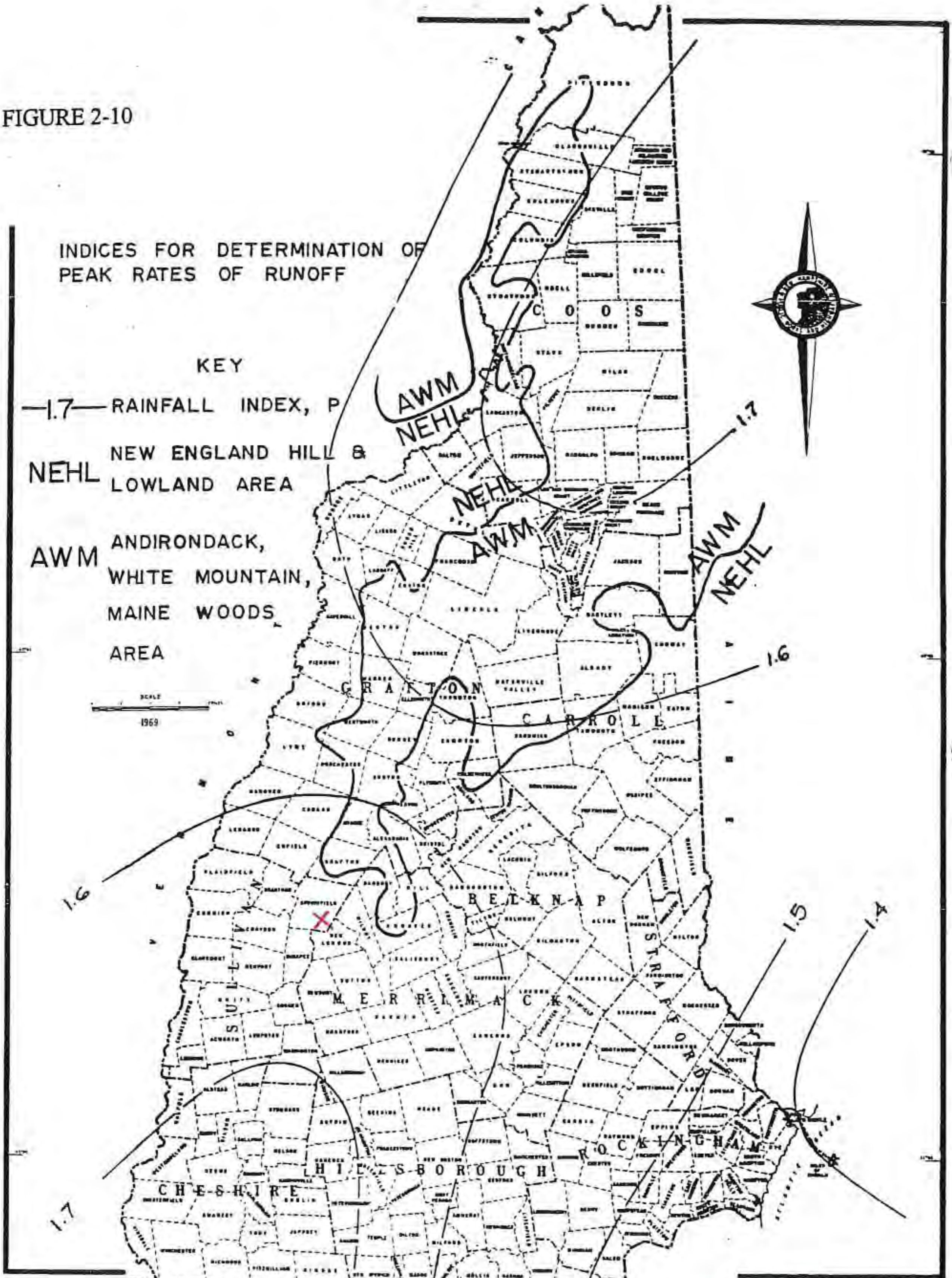


FIGURE 2-10



NOTE: METRIC CONVERSION: 1 INCH = 25.4 mm
1mm = 0.0394 IN.

Use NEHL
P = 1.69

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JOB	Springfield, NH 16-0361		
SHEET NO.		OF	
CALCULATED BY	AEG	DATE	7/17
CHECKED BY	SRB	DATE	8/17

SUBJECT **Design Flood Summary Table**

Figure 4-4. Hydrologic Summary

	Method	Q_2		Q_5		Q_{10}		Q_{25}		Q_{50}		Q_{100}		Q_{500}	
		Flow	*% Difference*	*Flow*	*% Difference*	*Flow*	*% Difference*	*Flow*	*% Difference*	*Flow*	*% Difference*	*Flow*	*% Difference*	*Flow*	*% Difference*
Preferred Method															
1	StreamStats	117.0		194.0		259.0		348.0		421.0		510.0		727.0	
Check Methods															
2	FHWA-5P									533.3	-26.7%	620.9	-21.7%		
3	FHWA-7P									720.4	-71.1%	840.1	-64.7%		
4	NEHL					520.0	-100.8%			950.0	-125.7%				
Allowable Prediction Error			30%		31.0%		32.0%		34.0%		36.0%		39.0%		44.0%
Use Preferred Method		117.0		194.0		259.0		348.0		421.0		510.0		727.0	

Per NHDOT Bridge Manual Section 2.7.5.E(1)_Ungaged Sites; the check methods should come in within the prediction error of the Preferred Method. As shown in the table, the FHWA flow values for the 5-Parameter Method do come in within the allowable prediction error. However, the FHWA 7-Parameter Method and the NEHL Method substantially exceed the allowable prediction error. The standard error of estimate for the 5-Parameter Method is 87%, and the FHWA 7-Parameter Method is 83%. Both methods use outdated information. However, these standard errors could put it well within the StreamStats flow range. In addition, the NEHL Method uses figures from the 1960s, and provided consistently higher flows than other flow predication methods.

Since StreamStats takes flood characteristics from gaged to ungaged sites from water sheds with similar characteristics, and based on the above information, use of the StreamStats flows for design is considered ok. Assume accuracies are acceptable for the Q_2, Q_5, Q_{10}, Q_{25}, and Q_{500} values.

Table H-2. The 5-Parameter regression equations for each of the 24 hydrophysiographic zones with their standard errors of estimate.

Zone	Correction Equation	(1) PS_{EE} %	(2) PS_e %	(3) n	(4) r
All Zone	$\hat{q}_{10} = 1.5102\ A^{0.4707}\ R^{0.8386}\ DH^{0.1718}\ L^{0.1764}\ P_{60}^{0.3476}$	116	13	898	0.856
1	$\hat{q}_{10} = 0.31006\ A^{-0.1672}\ R^{0.1278}\ DH^{0.6261}\ L^{1.1489}\ P_{60}^{3.3884}$	76	11	42	0.844
2	$\hat{q}_{10} = 22.5512\ A^{0.8067}\ R^{0.5364}\ DH^{0.2743}\ L^{-0.4967}\ P_{60}^{-0.7727}$	59	7	28	0.818
3	$\hat{q}_{10} = 13954\ A^{0.9374}\ R^{-0.5560}\ DH^{0.5673}\ L^{-0.7957}\ P_{60}^{-1.6664}$	110	10	14	0.930
4	$\hat{q}_{10} = 43.1724\ A^{0.6940}\ R^{0.1581}\ DH^{0.0566}\ L^{-0.1062}\ P_{60}^{1.1102}$	54	9	62	0.809
5	$\hat{q}_{10} = 1.6364\ A^{1.0337}\ R^{0.6437}\ DH^{0.1830}\ L^{-0.4034}\ P_{60}^{0.2926}$	51	8	35	0.931
6	$\hat{q}_{10} = 10^{-6.2116}\ A^{1.0853}\ R^{5.0977}\ DH^{0.7256}\ L^{-1.2867}\ P_{60}^{-13.5327}$	32	4	12	0.970
7	$\hat{q}_{10} = 324.432\ A^{0.9306}\ R^{-0.3690}\ DH^{0.1133}\ L^{-0.0603}\ P_{60}^{0.7463}$	76	7	33	0.919
8	$\hat{q}_{10} = 53.0874\ A^{0.2186}\ R^{0.1945}\ DH^{0.1319}\ L^{0.6958}\ P_{60}^{0.2225}$	47	6	39	0.964
9	$\hat{q}_{10} = 7.7165\ A^{0.5814}\ R^{0.0547}\ DH^{0.3865}\ L^{0.0990}\ P_{60}^{0.8217}$	87	8	37	0.865
10	$\hat{q}_{10} = 35.8044\ A^{1.6863}\ R^{0.4101}\ DH^{-0.6609}\ L^{-0.6123}\ P_{60}^{5.6323}$	68	13	10	0.905
11	$\hat{q}_{10} = 5518.33\ A^{0.8668}\ R^{-1.4337}\ DH^{0.7315}\ L^{-0.6144}\ P_{60}^{3.3246}$	42	6	32	0.921
12	$\hat{q}_{10} = 0.00404\ A^{-0.1357}\ R^{2.0116}\ DH^{0.2913}\ L^{1.0946}\ P_{60}^{-0.3881}$	115	20	34	0.749
13	$\hat{q}_{10} = 19.0892\ A^{0.7919}\ R^{0.5162}\ DH^{0.0065}\ L^{-0.2461}\ P_{60}^{0.9889}$	82	12	166	0.899
14	$\hat{q}_{10} = 10^{-3.0471}\ A^{0.9278}\ R^{1.9168}\ DH^{1.0534}\ L^{-1.1568}\ P_{60}^{-0.2637}$	134	17	30	0.789
15	$\hat{q}_{10} = 227.5250\ A^{1.0024}\ R^{-0.2697}\ DH^{-0.1703}\ L^{-0.0099}\ P_{60}^{-0.4591}$	91	14	37	0.800
16	$\hat{q}_{10} = 53.9760\ A^{0.2406}\ R^{0.7042}\ DH^{-0.3647}\ L^{0.9690}\ P_{60}^{1.4407}$	73	7	21	0.940
17	$\hat{q}_{10} = 18.0037\ A^{0.8562}\ R^{1.1895}\ DH^{-0.5077}\ L^{0.1432}\ P_{60}^{-1.5285}$	71	14	56	0.809
18	$\hat{q}_{10} = 713.6839\ A^{0.4249}\ R^{0.7032}\ DH^{-0.4949}\ L^{0.6922}\ P_{60}^{-2.8743}$	88	24	14	0.708
19	$\hat{q}_{10} = 0.7227\ A^{0.4635}\ R^{1.2180}\ DH^{0.2569}\ L^{-0.0658}\ P_{60}^{0.2060}$	82	13	40	0.833
20	$\hat{q}_{10} = 1.9367\ A^{0.9351}\ R^{0.8322}\ DH^{0.0042}\ L^{0.00042}\ P_{60}^{1.1826}$	104	9	42	0.936
21	$\hat{q}_{10} = 15.8713\ A^{0.7602}\ R^{0.3027}\ DH^{0.0516}\ L^{0.3632}\ P_{60}^{0.6460}$	68	7	68	0.931
22	$\hat{q}_{10} = 2.3789\ A^{0.5215}\ R^{0.7453}\ DH^{0.0614}\ L^{0.4754}\ P_{60}^{0.4184}$	34	4	22	0.979
23	Insufficient observations for deriving a 5-parameter equation	-	-	6	–
24	$\hat{q}_{10} = 1.4209\ A^{0.6925}\ R^{2.0837}\ DH^{-0.6376}\ L^{0.5060}\ P_{60}^{-1.7726}$	42	4	18	0.917

Notes explaining the column headings:

(1) PS_{EE} is the standard error of estimate expressed as a percent of the zone $\overline{q}_{10}$. It is calculated by the equation:

$$PS_{EE} = \frac{100}{\overline{q}_{10}} \sqrt{\frac{\Sigma (q_{10} - \hat{q}_{10(K)})^2}{n-2}}$$

(2) PS_e is the standard error of the $\log_{10}$ linear equation expressed as a percent of $\log_{10} \overline{q}_{10}$. It is calculated by the equation:

$$PS_e = \frac{100}{\log_{10} \overline{q}_{10}} \sqrt{\frac{\Sigma (\log_{10} q_{10} - \log_{10} \hat{q}_{10(K)})^2}{n-2}}$$

(3) n is the number of watersheds used in deriving the equation.

(4) r is the simple correlation coefficient between q_{10} and $\hat{q}_{10}$. It is calculated by the equation:

$$r = \frac{\Sigma (x - \overline{x})(y - \overline{y})}{\sqrt{\Sigma (x - \overline{x})^2 (y - \overline{y})^2}}$$

where x and y are any two independent and dependent variables respectively.

Table H-3. The 7-Parameter regression equations for each of the 24 hydrophysiographic zones with their standard errors of estimate.

Zone	Correction Equation	(1) PS_{EE} %	(2) PS_e %	(3) n	(4) r
All Zone	$\hat{q}_{10} = 1.8816\ A^{0.3977}\ R^{0.8332}\ DH^{0.1461} L^{-0.0236}\ LL^{0.2613} P_{10}^{-0.1891}\ P_{60}^{0.4668}$	116	12	898	0.860
1	$\hat{q}_{10} = 10^{-9.0593} A^{-0.2759}\ R^{0.7417}\ DH^{0.5174} L^{0.2372}\ LL^{0.7987} P_{10}^{17.7135}\ P_{60}^{-16.1846}$	67	11	42	0.876
2	$\hat{q}_{10} = 10^{-7.1187} A^{0.8277}\ R^{0.3514}\ DH^{0.2184} L^{-0.9688}\ LL^{0.3287}\ P_{10}^{17.2401}\ P_{60}^{-17.3334}$	59	7	28	0.831
3	$\hat{q}_{10} = 10^{-16.2067} A^{0.0416}\ R^{0.1386}\ DH^{0.3787} L^{-0.3301}\ LL^{-0.1630} P_{10}^{34.1201}\ P_{60}^{-31.9517}$	97	11	14	0.934
4	$\hat{q}_{10} = 21.8893\ A^{0.4964}\ R^{0.1096}\ DH^{0.0598}\ L^{-0.1066}\ LL^{-0.0016} P_{10}^{0.8004}\ P_{60}^{1.0040}$	53	9	62	0.809
5	$\hat{q}_{10} = 2.9109\ A^{1.0119}\ R^{-0.3683}\ DH^{0.3164}\ L^{-0.1787}\ LL^{-0.1700}\ P_{10}^{3.5303}\ P_{60}^{-0.0776}$	45	8	35	0.942
6	$\hat{q}_{10} = 10^{-5.1798}\ A^{1.1361}\ R^{6.4283}\ DH^{0.7420}\ L^{-1.3530}\ LL^{-0.0742}\ P_{10}^{-2.4780}\ P_{60}^{-10.9168}$	33	5	12	0.971
7	$\hat{q}_{10} = 10^{6.4029}\ A^{0.7048}\ R^{-0.3011}\ DH^{0.1907}\ L^{-0.8631}\ LL^{0.1642}\ P_{10}^{-0.2787}\ P_{60}^{10.1934}$	79	7	33	0.929
8	$\hat{q}_{10} = 24.1002\ A^{0.0915}\ R^{-0.2570}\ DH^{0.0068}\ L^{0.6322}\ LL^{0.3114}\ P_{10}^{1.5365}\ P_{60}^{0.3177}$	44	6	39	0.968
9	$\hat{q}_{10} = 50.8080\ A^{0.3799}\ R^{-0.1432}\ DH^{0.3401}\ L^{0.0017}\ LL^{0.2879}\ P_{10}^{-0.0665}\ P_{60}^{1.8748}$	83	8	37	0.879
10	$\hat{q}_{10} = 10^{-6.8890}\ A^{0.9409}\ R^{4.1373}\ DH^{-1.0766} L^{-0.4183}\ LL^{0.8684}\ P_{10}^{9.7275}\ P_{60}^{4.2270}$	47	17	10	0.914
11	$\hat{q}_{10} = 5.97844\ A^{0.8616}\ R^{-1.3797}\ DH^{0.4271}\ L^{-0.7836}\ LL^{0.1630}\ P_{10}^{5.9763}\ P_{60}^{-3.6368}$	39	6	32	0.923
12	$\hat{q}_{10} = 807.3722\ A^{-0.5358}\ R^{1.3781}\ DH^{0.1457}\ L^{0.7667}\ LL^{0.0198}\ P_{10}^{-6.7780}\ P_{60}^{9.3097}$	89	19	34	0.793
13	$\hat{q}_{10} = 6.4357\ A^{0.7761}\ R^{0.4431}\ DH^{0.0098}\ L^{-0.4107}\ LL^{0.1434}\ P_{10}^{1.1422}\ P_{60}^{-0.1525}$	85	12	166	0.901
14	$\hat{q}_{10} = 10^{-6.3129}\ A^{1.1471}\ R^{2.3578}\ DH^{1.2258}\ L^{-0.9411}\ LL^{-0.5108} P_{10}^{4.8292}\ P_{60}^{-6.4904}$	133	18	30	0.796
15	$\hat{q}_{10} = 55.3750\ A^{0.5433}\ R^{-0.3586}\ DH^{-0.1705} L^{-0.1117}\ LL^{0.3238}\ P_{10}^{1.1934}\ P_{60}^{1.4425}$	97	14	37	0.808
16	$\hat{q}_{10} = 57.4029\ A^{0.3052}\ R^{0.7521}\ DH^{-0.3972} L^{1.0962}\ LL^{-0.1118}\ P_{10}^{0.4259}\ P_{60}^{1.4146}$	72	7	21	0.941
17	$\hat{q}_{10} = 157.4954\ A^{0.3615}\ R^{1.2801}\ DH^{-0.6240} L^{-0.0429}\ LL^{0.4832}\ P_{10}^{-1.5406}\ P_{60}^{-0.8034}$	76	14	56	0.825
18	$\hat{q}_{10} = 10^{15.0040}\ A^{-0.1026}\ R^{2.0758}\ DH^{0.3302}\ L^{1.3339}\ LL^{-0.0842}\ P_{10}^{-35.7961}\ P_{60}^{16.4781}$	117	20	14	0.857
19	$\hat{q}_{10} = 48.8575\ A^{0.4962}\ R^{1.2346}\ DH^{0.3301}\ L^{0.0945}\ LL^{-0.0067}\ P_{10}^{-3.7300}\ P_{60}^{3.3589}$	82	13	40	0.838
20	$\hat{q}_{10} = 7.8890\ A^{0.8760}\ R^{0.8466}\ DH^{-0.0300} L^{-0.1091}\ LL^{0.1515}\ P_{10}^{-1.1600}\ P_{60}^{1.9846}$	106	10	42	0.937
21	$\hat{q}_{10} = 26.7400\ A^{0.7867}\ R^{0.2968}\ DH^{0.0539}\ L^{0.3939}\ LL^{-0.0486}\ P_{10}^{-0.4269}\ P_{60}^{0.9483}$	69	8	68	0.931
22	$\hat{q}_{10} = 0.00184\ A^{0.1791}\ R^{0.7966}\ DH^{0.0085}\ L^{0.4978}\ LL^{0.3440}\ P_{10}^{6.0977}\ P_{60}^{-4.3433}$	30	4	22	0.986
23	Insufficient observations for deriving a 7-parameter equation	–	–	6	–
24	$\hat{q}_{10} = 101.2426\ A^{0.6478}\ R^{1.7080}\ DH^{-0.7366} L^{0.5271}\ LL^{0.1476}\ P_{10}^{-1.4416}\ P_{60}^{0.0956}$	34	4	18	0.924

Notes explaining the column headings:

(1) PS_{EE} is the standard error of estimate expressed as a percent of the zone $\overline{q}_{10}$. It is calculated by the equation:

$$PS_{EE} = \frac{100}{\overline{q}_{10}} \sqrt{\frac{\Sigma\,(q_{10} - \hat{q}_{10(K)})^2}{n-2}}$$

(2) PS_e is the standard error of the $\log_{10}$ linear equation expressed as a percent of $\log_{10} \overline{q}_{10}$. It is calculated by the equation:

$$PS_e = \frac{100}{\log_{10} \overline{q}_{10}} \sqrt{\frac{\Sigma(\log_{10} q_{10} - \log_{10} \hat{q}_{10(K)})^2}{n-2}}$$

(3) n is the number of watersheds used in deriving the equation.

(4) r is the simple correlation coefficient between q_{10} and $\hat{q}_{10}$. It is calculated by the equation:

$$r = \frac{\Sigma(x-\overline{x})\,(y-\overline{y})}{\sqrt{\Sigma(x-\overline{x})^2\ (y-\overline{y})^2}}$$

where x and y are any two independent and dependent variables respectively.

APPENDIX E

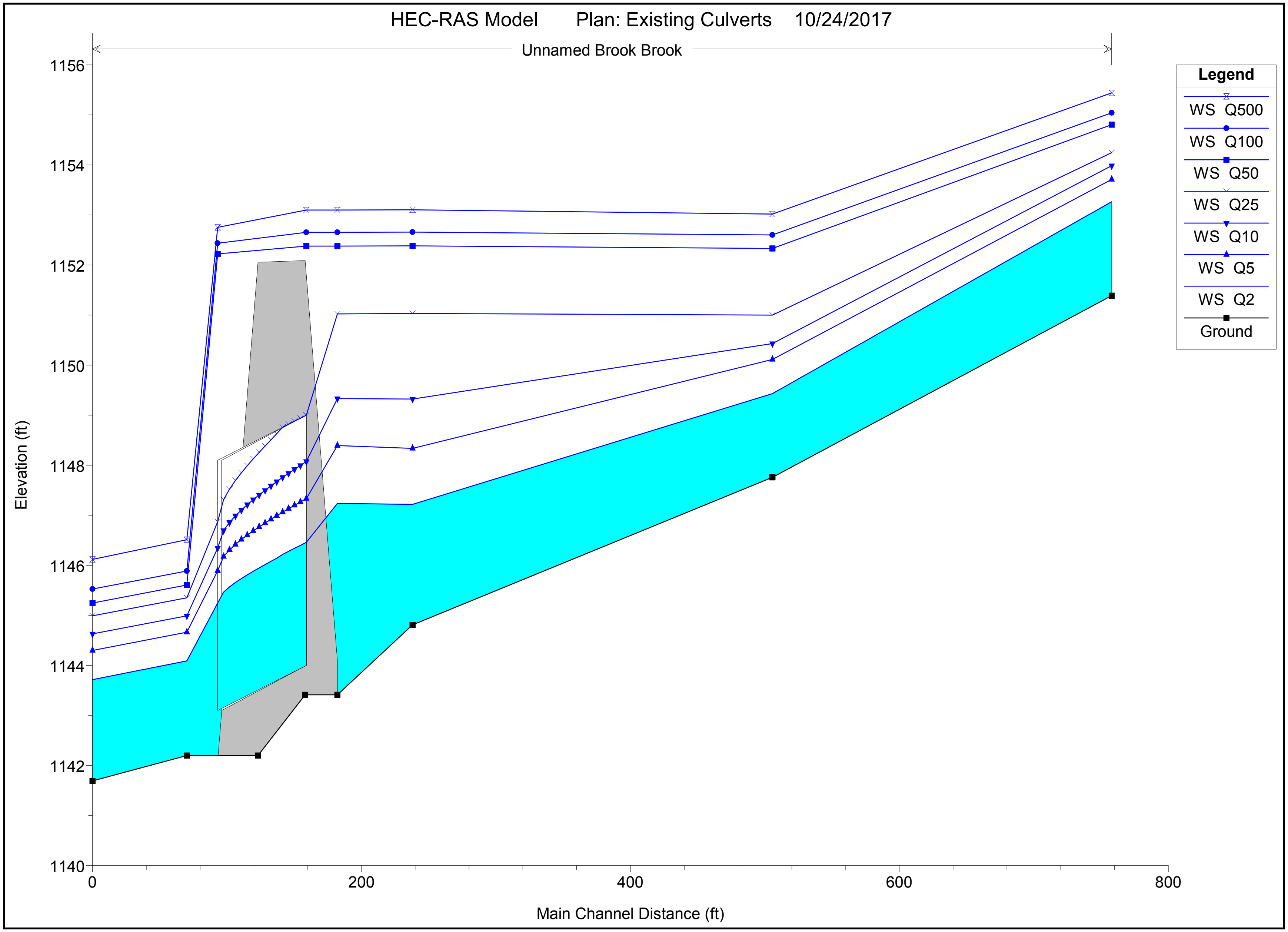
CROSS SECTION LOCATION PLAN

Created with GeoHECRAS v1.4.0.14122

APPENDIX F

HEC-RAS INPUT AND OUTPUT

EXISTING BRIDGE MODEL


HEC-RAS Model Plan: Existing Culverts 10/24/2017
Unnamed Brook Brook
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Elevation (ft)
1156
1154
1152
1150
1148
1146
1144
1142
1140
0
200
400
600
800
Main Channel Distance (ft)

HEC-RAS HEC-RAS 5.0.1 April 2016
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX   XXXX        XXXX      XX     XXXX
X     X  X       X    X       X   X    X  X   X
X     X  X       X            X   X   X    X  X
XXXXXXX  XXXX    X       XXX  XXXX    XXXXXX   XXXX
X     X  X       X            X  X    X    X       X
X     X  X       X    X       X   X   X    X       X
X     X  XXXXXX   XXXX        X    X  X    X  XXXXX
```

PROJECT DATA
Project Title: HEC-RAS Model
Project File : Springfield_Hydraulics.prj
Run Date and Time: 10/24/2017 7:15:19 AM

Project in English units

Project Description:
CRS Info=<SpatialReference> <CoordinateSystem Code="3614"
Unit="US_survey_Foot" /> <Registration OffsetX="0" OffsetY="0" OffsetZ="0"
ScaleX="1" ScaleY="1" ScaleZ="1" /></SpatialReference>

PLAN DATA

Plan Title: Existing Culverts
Plan File : f:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.p01

Geometry Title: Existing Geometry
Geometry File : f:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.g01

Flow Title   : Steady Flow
Flow File   : f:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.f01

Plan Description:
existing culvert

Plan Summary Information:

```
Number of:  Cross Sections =    6    Multiple Openings  =    0
            Culverts       =    1    Inline Structures  =    0
            Bridges        =    0    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.33
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow
```

FLOW DATA

Flow Title: Steady Flow
Flow File : f:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.f01

Flow Data (cfs)

River	Reach	RS	Q2	Q5	Q10	Q25	Q50	Q100	Q500
Unnamed Brook	Brook	1758	117	194	259	348	421	510	727

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Unnamed Brook	Brook	Q2	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q5	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q10	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q25	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q50	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q100	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q500	Normal S = 0.0322	Normal S = 0.0039

GEOMETRY DATA

```
Geometry Title: Existing Geometry
Geometry File : f:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.g01

CROSS SECTION


RIVER: Unnamed Brook
REACH: Brook              RS: 1758

INPUT
Description:
Station Elevation Data    num=      24
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     -10    1157       0    1156   60.03  1154.5   75.66 1154.29   99.99 1154.46
  100.85 1154.47  100.99 1154.48  109.77  1154.9  111.26 1154.74  111.74 1154.64
   112.8 1153.64  114.81 1152.38  121.13 1152.22  121.79 1152.13   122.1 1152.09
  122.32 1152.07  124.12 1151.93  128.32 1151.39  130.04 1151.41  131.07 1151.66
  131.76 1152.02  132.04 1152.35  133.29 1153.46     300    1160

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     -10     .05   112.8    .035  133.29    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         112.8  133.29          252.24  252.24  252.24             .1       .3

CROSS SECTION OUTPUT  Profile #Q2

  E.G. Elev (ft)           1153.64    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.37    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1153.27    Reach Len. (ft)            252.24     252.24     252.24
  Crit W.S. (ft)           1153.07    Flow Area (sq ft)                      23.86
  E.G. Slope (ft/ft)      0.010973    Area (sq ft)                           23.86
  Q Total (cfs)             117.00    Flow (cfs)                            117.00
  Top Width (ft)             19.68    Top Width (ft)                         19.68
  Vel Total (ft/s)            4.90    Avg. Vel. (ft/s)                        4.90
  Max Chl Dpth (ft)           1.88    Hydr. Depth (ft)                        1.21
  Conv. Total (cfs)         1116.9    Conv. (cfs)                           1116.9
  Length Wtd. (ft)          252.24    Wetted Per. (ft)                       20.60
  Min Ch El (ft)           1151.39    Shear (lb/sq ft)                        0.79
  Alpha                       1.00    Stream Power (lb/ft s)                  3.89
  Frctn Loss (ft)             3.54    Cum Volume (acre-ft)         0.01       0.43
  C & E Loss (ft)             0.03    Cum SA (acres)               0.04       0.29


Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
         the need for additional cross sections.

CROSS SECTION OUTPUT  Profile #Q5
```

E.G. Elev (ft)	1154.25	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.54	Wt. n-Val.	0.000	0.035	0.085
W.S. Elev (ft)	1153.71	Reach Len. (ft)	252.24	252.24	252.24
Crit W.S. (ft)	1153.50	Flow Area (sq ft)	0.00	32.80	0.79
E.G. Slope (ft/ft)	0.011076	Area (sq ft)	0.00	32.80	0.79
Q Total (cfs)	194.00	Flow (cfs)	0.00	193.64	0.36
Top Width (ft)	26.92	Top Width (ft)	0.07	20.49	6.36
Vel Total (ft/s)	5.77	Avg. Vel. (ft/s)	0.27	5.90	0.46
Max Chl Dpth (ft)	2.32	Hydr. Depth (ft)	0.03	1.60	0.12
Conv. Total (cfs)	1843.4	Conv. (cfs)	0.0	1839.9	3.5
Length Wtd. (ft)	252.24	Wetted Per. (ft)	0.10	21.60	6.37
Min Ch El (ft)	1151.39	Shear (lb/sq ft)		1.05	0.09
Alpha	1.04	Stream Power (lb/ft s)		6.20	0.04
Frctn Loss (ft)	3.53	Cum Volume (acre-ft)	0.07	0.68	0.01
C & E Loss (ft)	0.01	Cum SA (acres)	0.22	0.37	0.06

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	1154.67	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.68	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1153.99	Reach Len. (ft)	252.24	252.24	252.24
Crit W.S. (ft)	1153.84	Flow Area (sq ft)	0.06	38.48	3.53
E.G. Slope (ft/ft)	0.011394	Area (sq ft)	0.06	38.48	3.53
Q Total (cfs)	259.00	Flow (cfs)	0.05	256.24	2.71
Top Width (ft)	34.28	Top Width (ft)	0.37	20.49	13.42
Vel Total (ft/s)	6.16	Avg. Vel. (ft/s)	0.80	6.66	0.77
Max Chl Dpth (ft)	2.60	Hydr. Depth (ft)	0.17	1.88	0.26
Conv. Total (cfs)	2426.4	Conv. (cfs)	0.5	2400.5	25.4
Length Wtd. (ft)	252.24	Wetted Per. (ft)	0.50	21.60	13.43
Min Ch El (ft)	1151.39	Shear (lb/sq ft)	0.09	1.27	0.19
Alpha	1.16	Stream Power (lb/ft s)	0.07	8.44	0.14
Frctn Loss (ft)	3.59	Cum Volume (acre-ft)	0.32	0.89	0.05
C & E Loss (ft)	0.01	Cum SA (acres)	0.53	0.42	0.11

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q25

E.G. Elev (ft)	1155.16	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.91	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1154.25	Reach Len. (ft)	252.24	252.24	252.24
Crit W.S. (ft)	1154.25	Flow Area (sq ft)	0.20	43.83	7.91
E.G. Slope (ft/ft)	0.012945	Area (sq ft)	0.20	43.83	7.91
Q Total (cfs)	348.00	Flow (cfs)	0.24	339.31	8.44

Top Width (ft)	41.21	Top Width (ft)	0.64	20.49	20.08
Vel Total (ft/s)	6.70	Avg. Vel. (ft/s)	1.24	7.74	1.07
Max Chl Dpth (ft)	2.86	Hydr. Depth (ft)	0.30	2.14	0.39
Conv. Total (cfs)	3058.6	Conv. (cfs)	2.1	2982.3	74.2
Length Wtd. (ft)	252.24	Wetted Per. (ft)	0.89	21.60	20.09
Min Ch El (ft)	1151.39	Shear (lb/sq ft)	0.18	1.64	0.32
Alpha	1.30	Stream Power (lb/ft s)	0.22	12.70	0.34
Frctn Loss (ft)	2.66	Cum Volume (acre-ft)	1.58	1.32	0.20
C & E Loss (ft)	0.13	Cum SA (acres)	1.23	0.42	0.34

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q50

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1155.42	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.61	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1154.80	Reach Len. (ft)	252.24	252.24	252.24
Crit W.S. (ft)	1154.80	Flow Area (sq ft)	20.89	55.23	23.02
E.G. Slope (ft/ft)	0.007112	Area (sq ft)	20.89	55.23	23.02
Q Total (cfs)	421.00	Flow (cfs)	25.23	369.74	26.03
Top Width (ft)	116.78	Top Width (ft)	62.03	20.49	34.26
Vel Total (ft/s)	4.25	Avg. Vel. (ft/s)	1.21	6.70	1.13
Max Chl Dpth (ft)	3.41	Hydr. Depth (ft)	0.34	2.70	0.67
Conv. Total (cfs)	4992.2	Conv. (cfs)	299.2	4384.4	308.6
Length Wtd. (ft)	252.24	Wetted Per. (ft)	62.46	21.60	34.29
Min Ch El (ft)	1151.39	Shear (lb/sq ft)	0.15	1.14	0.30
Alpha	2.19	Stream Power (lb/ft s)	0.18	7.60	0.34
Frctn Loss (ft)	0.69	Cum Volume (acre-ft)	3.20	1.96	0.59
C & E Loss (ft)	0.14	Cum SA (acres)	1.84	0.43	0.46

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	1155.65	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.60	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1155.04	Reach Len. (ft)	252.24	252.24	252.24
Crit W.S. (ft)	1155.04	Flow Area (sq ft)	37.44	60.13	31.95
E.G. Slope (ft/ft)	0.006700	Area (sq ft)	37.44	60.13	31.95
Q Total (cfs)	510.00	Flow (cfs)	57.34	413.55	39.11
Top Width (ft)	135.37	Top Width (ft)	74.51	20.49	40.36
Vel Total (ft/s)	3.94	Avg. Vel. (ft/s)	1.53	6.88	1.22
Max Chl Dpth (ft)	3.65	Hydr. Depth (ft)	0.50	2.93	0.79
Conv. Total (cfs)	6230.7	Conv. (cfs)	700.5	5052.4	477.8
Length Wtd. (ft)	252.24	Wetted Per. (ft)	74.95	21.60	40.39
Min Ch El (ft)	1151.39	Shear (lb/sq ft)	0.21	1.16	0.33
Alpha	2.50	Stream Power (lb/ft s)	0.32	8.01	0.40
Frctn Loss (ft)	0.70	Cum Volume (acre-ft)	3.62	2.18	0.71
C & E Loss (ft)	0.13	Cum SA (acres)	1.98	0.43	0.50

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1156.07	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.63	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1155.44	Reach Len. (ft)	252.24	252.24	252.24
Crit W.S. (ft)	1155.44	Flow Area (sq ft)	70.27	68.29	50.04
E.G. Slope (ft/ft)	0.006712	Area (sq ft)	70.27	68.29	50.04
Q Total (cfs)	727.00	Flow (cfs)	144.14	511.68	71.19
Top Width (ft)	161.44	Top Width (ft)	90.45	20.49	50.51
Vel Total (ft/s)	3.85	Avg. Vel. (ft/s)	2.05	7.49	1.42
Max Chl Dpth (ft)	4.05	Hydr. Depth (ft)	0.78	3.33	0.99
Conv. Total (cfs)	8873.7	Conv. (cfs)	1759.3	6245.5	868.9
Length Wtd. (ft)	252.24	Wetted Per. (ft)	90.89	21.60	50.55
Min Ch El (ft)	1151.39	Shear (lb/sq ft)	0.32	1.32	0.41
Alpha	2.73	Stream Power (lb/ft s)	0.66	9.93	0.59
Frctn Loss (ft)	0.82	Cum Volume (acre-ft)	4.37	2.57	0.91
C & E Loss (ft)	0.12	Cum SA (acres)	2.19	0.44	0.54

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than

```
        1.4.  This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
         the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
         program defaulted to critical depth.

CROSS SECTION


RIVER: Unnamed Brook
REACH: Brook              RS: 1506

INPUT
Description:
Station Elevation Data    num=      40
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1154.44    6.77 1154.44   22.76 1154.44   44.61 1154.11   65.12 1153.75
    82.6 1153.55  106.59  1152.8  116.14 1152.49  127.36 1151.49  131.49 1151.09
  140.43 1151.49  141.14 1151.63   141.9 1151.58  148.14 1151.08   148.9 1150.36
  150.57 1148.79  151.14 1148.06  151.72 1147.99  152.56 1147.76  153.39 1147.78
  154.99 1147.89  156.77 1147.98  158.55 1148.06  159.01 1148.13  162.81 1148.42
  163.61 1148.47  164.55 1149.54  164.72 1149.63  166.56 1149.71  181.79 1150.43
  189.42 1150.57  209.57 1150.66  213.59 1150.82  218.46 1152.95   223.8 1155.73
  227.16 1160.29  227.79  1160.9  306.77  1160.9  418.08  1160.9  631.82  1160.9

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   148.9    .035  181.79    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         148.9  181.79           267.56  267.56  267.56              .1       .3

CROSS SECTION OUTPUT  Profile #Q2

  E.G. Elev (ft)           1150.07    Element                  Left OB    Channel   Right OB
  Vel Head (ft)               0.64    Wt. n-Val.                            0.035
  W.S. Elev (ft)           1149.43    Reach Len. (ft)          267.56     267.56     267.56
  Crit W.S. (ft)           1149.43    Flow Area (sq ft)                     18.26
  E.G. Slope (ft/ft)      0.018600    Area (sq ft)                          18.26
  Q Total (cfs)             117.00    Flow (cfs)                           117.00
  Top Width (ft)             14.57    Top Width (ft)                        14.57
  Vel Total (ft/s)            6.41    Avg. Vel. (ft/s)                       6.41
  Max Chl Dpth (ft)           1.67    Hydr. Depth (ft)                       1.25
  Conv. Total (cfs)          857.9    Conv. (cfs)                           857.9
  Length Wtd. (ft)          267.56    Wetted Per. (ft)                      15.68
  Min Ch El (ft)           1147.76    Shear (lb/sq ft)                       1.35
  Alpha                       1.00    Stream Power (lb/ft s)                 8.67
  Frctn Loss (ft)             2.28    Cum Volume (acre-ft)       0.01        0.30
  C & E Loss (ft)             0.11    Cum SA (acres)             0.04        0.19
```

```
Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical
         depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
         the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
         program defaulted to critical depth.

CROSS SECTION OUTPUT  Profile #Q5

  E.G. Elev (ft)          1150.72    Element                    Left OB    Channel   Right OB
  Vel Head (ft)              0.60    Wt. n-Val.                              0.035
  W.S. Elev (ft)          1150.11    Reach Len. (ft)            267.56     267.56     267.56
  Crit W.S. (ft)          1150.11    Flow Area (sq ft)                       31.08
  E.G. Slope (ft/ft)     0.018245    Area (sq ft)                            31.08
  Q Total (cfs)            194.00    Flow (cfs)                             194.00
  Top Width (ft)            25.92    Top Width (ft)                          25.92
  Vel Total (ft/s)           6.24    Avg. Vel. (ft/s)                         6.24
  Max Chl Dpth (ft)          2.35    Hydr. Depth (ft)                         1.20
  Conv. Total (cfs)        1436.2    Conv. (cfs)                            1436.2
  Length Wtd. (ft)         267.56    Wetted Per. (ft)                        27.38
  Min Ch El (ft)          1147.76    Shear (lb/sq ft)                         1.29
  Alpha                      1.00    Stream Power (lb/ft s)                   8.07
  Frctn Loss (ft)            1.43    Cum Volume (acre-ft)         0.07        0.49       0.01
  C & E Loss (ft)            0.11    Cum SA (acres)               0.22        0.24       0.04


Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical
         depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
         the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
         program defaulted to critical depth.

CROSS SECTION OUTPUT  Profile #Q10

  E.G. Elev (ft)          1151.07    Element                    Left OB    Channel   Right OB
  Vel Head (ft)              0.63    Wt. n-Val.                  0.000       0.035
  W.S. Elev (ft)          1150.43    Reach Len. (ft)            267.56     267.56     267.56
  Crit W.S. (ft)          1150.43    Flow Area (sq ft)            0.00       40.51
  E.G. Slope (ft/ft)     0.018273    Area (sq ft)                 0.00       40.51       0.00
  Q Total (cfs)            259.00    Flow (cfs)                   0.00      259.00
  Top Width (ft)            33.12    Top Width (ft)               0.08       32.89       0.15
```

Vel Total (ft/s)	6.39	Avg. Vel. (ft/s)	0.36	6.39	
Max Chl Dpth (ft)	2.67	Hydr. Depth (ft)	0.04	1.23	
Conv. Total (cfs)	1916.0	Conv. (cfs)	0.0	1916.0	
Length Wtd. (ft)	267.56	Wetted Per. (ft)	0.11	34.45	
Min Ch El (ft)	1147.76	Shear (lb/sq ft)		1.34	
Alpha	1.00	Stream Power (lb/ft s)		8.58	
Frctn Loss (ft)	0.76	Cum Volume (acre-ft)	0.32	0.66	0.04
C & E Loss (ft)	0.15	Cum SA (acres)	0.52	0.26	0.07

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q25

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1151.49	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.49	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1151.00	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1150.79	Flow Area (sq ft)	0.21	59.09	12.58
E.G. Slope (ft/ft)	0.008780	Area (sq ft)	0.21	59.09	12.58
Q Total (cfs)	348.00	Flow (cfs)	0.23	336.77	11.00
Top Width (ft)	65.77	Top Width (ft)	0.67	32.89	32.21
Vel Total (ft/s)	4.84	Avg. Vel. (ft/s)	1.05	5.70	0.87
Max Chl Dpth (ft)	3.24	Hydr. Depth (ft)	0.32	1.80	0.39
Conv. Total (cfs)	3714.0	Conv. (cfs)	2.4	3594.2	117.4
Length Wtd. (ft)	267.56	Wetted Per. (ft)	0.93	34.45	32.25
Min Ch El (ft)	1147.76	Shear (lb/sq ft)	0.13	0.94	0.21
Alpha	1.34	Stream Power (lb/ft s)	0.13	5.36	0.19
Frctn Loss (ft)	0.26	Cum Volume (acre-ft)	1.58	1.03	0.14
C & E Loss (ft)	0.13	Cum SA (acres)	1.23	0.27	0.19

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1152.47	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.14	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1152.33	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)		Flow Area (sq ft)	26.17	102.97	57.58

E.G. Slope (ft/ft)	0.001427	Area (sq ft)	26.17	102.97	57.58
Q Total (cfs)	421.00	Flow (cfs)	26.03	342.56	52.41
Top Width (ft)	99.13	Top Width (ft)	30.98	32.89	35.26
Vel Total (ft/s)	2.25	Avg. Vel. (ft/s)	0.99	3.33	0.91
Max Chl Dpth (ft)	4.57	Hydr. Depth (ft)	0.84	3.13	1.63
Conv. Total (cfs)	11146.5	Conv. (cfs)	689.1	9069.7	1387.6
Length Wtd. (ft)	267.56	Wetted Per. (ft)	31.37	34.45	35.58
Min Ch El (ft)	1147.76	Shear (lb/sq ft)	0.07	0.27	0.14
Alpha	1.80	Stream Power (lb/ft s)	0.07	0.89	0.13
Frctn Loss (ft)	0.04	Cum Volume (acre-ft)	3.06	1.50	0.36
C & E Loss (ft)	0.04	Cum SA (acres)	1.58	0.27	0.25

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	1152.76	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.16	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1152.60	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)		Flow Area (sq ft)	34.99	111.78	67.11
E.G. Slope (ft/ft)	0.001498	Area (sq ft)	34.99	111.78	67.11
Q Total (cfs)	510.00	Flow (cfs)	39.09	402.45	68.45
Top Width (ft)	104.90	Top Width (ft)	36.14	32.89	35.87
Vel Total (ft/s)	2.38	Avg. Vel. (ft/s)	1.12	3.60	1.02
Max Chl Dpth (ft)	4.84	Hydr. Depth (ft)	0.97	3.40	1.87
Conv. Total (cfs)	13178.4	Conv. (cfs)	1010.2	10399.4	1768.8
Length Wtd. (ft)	267.56	Wetted Per. (ft)	36.53	34.45	36.25
Min Ch El (ft)	1147.76	Shear (lb/sq ft)	0.09	0.30	0.17
Alpha	1.84	Stream Power (lb/ft s)	0.10	1.09	0.18
Frctn Loss (ft)	0.05	Cum Volume (acre-ft)	3.41	1.68	0.42
C & E Loss (ft)	0.05	Cum SA (acres)	1.66	0.28	0.28

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1153.25	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.23	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1153.02	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)		Flow Area (sq ft)	52.78	125.50	82.28
E.G. Slope (ft/ft)	0.001898	Area (sq ft)	52.78	125.50	82.28
Q Total (cfs)	727.00	Flow (cfs)	71.18	549.57	106.25
Top Width (ft)	118.94	Top Width (ft)	49.25	32.89	36.80
Vel Total (ft/s)	2.79	Avg. Vel. (ft/s)	1.35	4.38	1.29
Max Chl Dpth (ft)	5.26	Hydr. Depth (ft)	1.07	3.82	2.24
Conv. Total (cfs)	16686.3	Conv. (cfs)	1633.7	12614.0	2438.7

```
  Length Wtd. (ft)          267.56    Wetted Per. (ft)           49.65      34.45      37.27
  Min Ch El (ft)           1147.76    Shear (lb/sq ft)            0.13       0.43       0.26
  Alpha                       1.92    Stream Power (lb/ft s)      0.17       1.89       0.34
  Frctn Loss (ft)             0.07    Cum Volume (acre-ft)        4.01       2.01       0.53
  C & E Loss (ft)             0.07    Cum SA (acres)              1.79       0.28       0.29


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.

CROSS SECTION


RIVER: Unnamed Brook
REACH: Brook              RS: 1238

INPUT
Description:
Station Elevation Data    num=     101
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 -104.69 1154.64   -54.1 1153.89  -51.36 1153.84  -10.64 1153.38    -6.3 1153.24
    -.01 1153.03   25.73 1152.19   29.19  1151.9   30.76 1152.03   36.05 1151.86
   65.48  1151.1   67.99 1150.87   71.33 1150.75   77.55 1150.56   87.32 1150.21
   93.71 1150.13    96.1 1150.32   99.75 1150.14  101.66 1150.05  114.09 1149.98
   116.7 1149.87   120.1 1149.76  125.13 1149.76  129.26 1149.56  137.31 1149.46
  154.45 1149.19  154.62 1149.19  156.69 1149.14  159.13  1149.1  171.98    1150
  175.93 1150.03  183.98 1149.85  188.62 1149.91  197.67  1149.8  207.73 1149.45
   217.4  1149.1   241.6 1148.52  247.27 1148.38  251.41 1148.32   262.4 1148.17
  265.76 1147.87  270.51 1147.78  272.65 1147.73  277.92 1147.92  280.28 1147.68
  280.39 1147.67  280.51 1147.67  280.64 1147.66  280.78 1147.64  282.44 1147.36
  283.99  1145.7  284.38 1145.46  286.17 1144.97  286.28 1144.93  286.52 1144.94
  290.38 1145.04  290.44 1145.03   292.6 1144.82  292.69 1144.81  292.79 1144.83
  295.36 1145.37  298.26 1147.43  299.33 1148.24  300.77 1148.51  302.81 1148.97
  305.15 1149.47  311.45 1153.21  312.36 1153.98  315.59 1154.21  316.32 1154.38
  317.04 1155.12  317.18 1155.39   317.7 1156.42  318.22 1157.35  318.78 1157.34
  328.13 1157.15  329.33 1157.22  334.08 1157.26  345.95 1157.46  346.59 1157.17
  346.92 1157.15  347.33 1156.85  348.19 1156.56  348.61 1156.84   349.7 1157.58
  350.25 1158.12  351.77  1158.9   352.3 1159.29  353.21  1159.6  354.08  1160.7
  354.38 1161.51  355.45 1161.19  355.67 1161.15  356.65 1161.28  358.91 1161.62
  360.45 1161.44  368.32  1161.1  370.28  1160.9   380.7 1161.01  389.36 1161.18
  399.75 1161.18

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
 -104.69     .05  282.44    .035  298.26    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        282.44  298.26             55.99   55.99  55.99             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
```

-104.69	244.68	1152.25	F
352.01	399.75	1152.17	F

CROSS SECTION OUTPUT Profile #Q2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1147.49	Wt. n-Val.		0.035	
Vel Head (ft)	0.27	Reach Len. (ft)	55.99	55.99	55.99
W.S. Elev (ft)	1147.22	Flow Area (sq ft)		28.09	
Crit W.S. (ft)	1146.53	Area (sq ft)		28.09	
E.G. Slope (ft/ft)	0.004871	Flow (cfs)		117.00	
Q Total (cfs)	117.00	Top Width (ft)		15.39	
Top Width (ft)	15.39	Avg. Vel. (ft/s)		4.17	
Vel Total (ft/s)	4.17	Hydr. Depth (ft)		1.83	
Max Chl Dpth (ft)	2.41	Conv. (cfs)		1676.3	
Conv. Total (cfs)	1676.3	Wetted Per. (ft)		16.85	
Length Wtd. (ft)	55.99	Shear (lb/sq ft)		0.51	
Min Ch El (ft)	1144.81	Stream Power (lb/ft s)		2.11	
Alpha	1.00	Cum Volume (acre-ft)	0.01	0.16	
Frctn Loss (ft)	0.11	Cum SA (acres)	0.04	0.10	
C & E Loss (ft)	0.06				

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q5

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1148.58	Wt. n-Val.	0.050	0.035	0.085
Vel Head (ft)	0.24	Reach Len. (ft)	55.99	55.99	55.99
W.S. Elev (ft)	1148.34	Flow Area (sq ft)	11.38	45.71	0.56
Crit W.S. (ft)	1147.08	Area (sq ft)	11.38	45.71	0.56
E.G. Slope (ft/ft)	0.002517	Flow (cfs)	8.50	185.28	0.22
Q Total (cfs)	194.00	Top Width (ft)	32.05	15.82	1.58
Top Width (ft)	49.44	Avg. Vel. (ft/s)	0.75	4.05	0.39
Vel Total (ft/s)	3.37	Hydr. Depth (ft)	0.36	2.89	0.35
Max Chl Dpth (ft)	3.52	Conv. (cfs)	169.4	3693.3	4.4
Conv. Total (cfs)	3867.1	Wetted Per. (ft)	32.11	17.41	1.86
Length Wtd. (ft)	55.99	Shear (lb/sq ft)	0.06	0.41	0.05
Min Ch El (ft)	1144.81	Stream Power (lb/ft s)	0.04	1.67	0.02
Alpha	1.39	Cum Volume (acre-ft)	0.04	0.26	0.01
Frctn Loss (ft)	0.06	Cum SA (acres)	0.12	0.11	0.04
C & E Loss (ft)	0.05				

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	1149.46	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.13	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1149.32	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1147.48	Flow Area (sq ft)	48.47	61.36	4.45
E.G. Slope (ft/ft)	0.001105	Area (sq ft)	65.98	61.36	4.45
Q Total (cfs)	259.00	Flow (cfs)	56.49	200.53	1.99
Top Width (ft)	109.66	Top Width (ft)	87.63	15.82	6.21
Vel Total (ft/s)	2.27	Avg. Vel. (ft/s)	1.17	3.27	0.45
Max Chl Dpth (ft)	4.51	Hydr. Depth (ft)	1.28	3.88	0.72
Conv. Total (cfs)	7792.6	Conv. (cfs)	1699.6	6033.3	59.7
Length Wtd. (ft)	55.99	Wetted Per. (ft)	37.82	17.41	6.59
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.09	0.24	0.05
Alpha	1.67	Stream Power (lb/ft s)	0.10	0.79	0.02
Frctn Loss (ft)	0.04	Cum Volume (acre-ft)	0.12	0.35	0.02
C & E Loss (ft)	0.02	Cum SA (acres)	0.25	0.11	0.05

Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q25

E.G. Elev (ft)	1151.09	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.06	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1151.04	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1148.16	Flow Area (sq ft)	113.07	88.43	18.25
E.G. Slope (ft/ft)	0.000353	Area (sq ft)	358.00	88.43	18.25
Q Total (cfs)	348.00	Flow (cfs)	130.96	208.30	8.74
Top Width (ft)	241.60	Top Width (ft)	216.25	15.82	9.53
Vel Total (ft/s)	1.58	Avg. Vel. (ft/s)	1.16	2.36	0.48
Max Chl Dpth (ft)	6.22	Hydr. Depth (ft)	2.99	5.59	1.92
Conv. Total (cfs)	18531.6	Conv. (cfs)	6973.8	11092.6	465.2
Length Wtd. (ft)	55.99	Wetted Per. (ft)	37.82	17.41	10.36
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.07	0.11	0.04
Alpha	1.53	Stream Power (lb/ft s)	0.08	0.26	0.02
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	0.48	0.57	0.05
C & E Loss (ft)	0.00	Cum SA (acres)	0.56	0.12	0.06

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1152.39	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1152.38	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1148.65	Flow Area (sq ft)	681.73	109.75	32.62

E.G. Slope (ft/ft)	0.000058	Area (sq ft)	681.73	109.75	32.62
Q Total (cfs)	421.00	Flow (cfs)	291.70	121.27	8.03
Top Width (ft)	290.24	Top Width (ft)	262.62	15.82	11.80
Vel Total (ft/s)	0.51	Avg. Vel. (ft/s)	0.43	1.10	0.25
Max Chl Dpth (ft)	7.57	Hydr. Depth (ft)	2.60	6.94	2.76
Conv. Total (cfs)	55201.7	Conv. (cfs)	38248.0	15900.7	1053.0
Length Wtd. (ft)	55.99	Wetted Per. (ft)	262.82	17.41	13.00
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.01	0.02	0.01
Alpha	1.84	Stream Power (lb/ft s)	0.00	0.03	0.00
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	0.89	0.84	0.08
C & E Loss (ft)	0.00	Cum SA (acres)	0.67	0.12	0.11

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1152.67	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1152.66	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1148.92	Flow Area (sq ft)	755.25	114.11	35.93
E.G. Slope (ft/ft)	0.000066	Area (sq ft)	755.25	114.11	35.93
Q Total (cfs)	510.00	Flow (cfs)	361.94	138.25	9.81
Top Width (ft)	299.15	Top Width (ft)	271.06	15.82	12.26
Vel Total (ft/s)	0.56	Avg. Vel. (ft/s)	0.48	1.21	0.27
Max Chl Dpth (ft)	7.85	Hydr. Depth (ft)	2.79	7.21	2.93
Conv. Total (cfs)	62591.3	Conv. (cfs)	44420.2	16967.0	1204.2
Length Wtd. (ft)	55.99	Wetted Per. (ft)	271.27	17.41	13.54
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.01	0.03	0.01
Alpha	1.77	Stream Power (lb/ft s)	0.01	0.03	0.00
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	0.98	0.99	0.10
C & E Loss (ft)	0.00	Cum SA (acres)	0.72	0.13	0.13

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1153.12	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1153.10	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1149.40	Flow Area (sq ft)	878.82	121.15	41.55
E.G. Slope (ft/ft)	0.000093	Area (sq ft)	878.82	121.15	41.55
Q Total (cfs)	727.00	Flow (cfs)	532.50	180.35	14.16
Top Width (ft)	313.47	Top Width (ft)	284.64	15.82	13.01
Vel Total (ft/s)	0.70	Avg. Vel. (ft/s)	0.61	1.49	0.34
Max Chl Dpth (ft)	8.29	Hydr. Depth (ft)	3.09	7.66	3.19
Conv. Total (cfs)	75567.5	Conv. (cfs)	55349.9	18746.0	1471.6
Length Wtd. (ft)	55.99	Wetted Per. (ft)	284.85	17.41	14.41
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.02	0.04	0.02

Alpha	1.68	Stream Power (lb/ft s)	0.01	0.06	0.01
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	1.15	1.26	0.15
C & E Loss (ft)	0.00	Cum SA (acres)	0.77	0.13	0.14

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Unnamed Brook
REACH: Brook RS: 1182

INPUT
Description:
Station Elevation Data num= 94

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1154.85	9.59	1154.85	47.9	1154.33	61.73	1154.18	90.45	1153.8
104.2	1153.67	131.47	1152.71	142.49	1152.63	175.28	1151.57	182.35	1151.47
193.98	1150.76	204.13	1150.39	205.72	1150.36	207.86	1150.53	210.87	1150.92
211.03	1150.52	213.2	1150.1	222.43	1150.15	228.92	1149.87	233.05	1149.69
234.27	1149.6	239.83	1149.33	252.3	1149.19	261.59	1149.06	263.91	1149.8
265.27	1150.24	272.96	1150.59	280.01	1150.37	291.07	1150.15	295.94	1150.23
299.06	1150.39	308.81	1149.83	317.19	1149.54	349.44	1148.38	358.53	1148.13
388.59	1146.97	393.24	1146.84	396.86	1146.66	400.77	1146.51	402.49	1146.5
404.19	1146.48	405.92	1146.01	408.03	1145.74	409.97	1144.24	410.17	1144.1
411.46	1143.71	411.8	1143.54	413.91	1143.45	414.94	1143.41	415.33	1143.76
415.5	1143.73	417.18	1143.78	418.94	1143.97	419.22	1144.05	419.84	1144.66
422.76	1147.58	423.43	1149.31	424.86	1150.8	425.29	1150.92	436.36	1151.84
437.05	1151.9	437.24	1151.93	438.96	1151.99	456.04	1152.67	457.37	1152.39
457.68	1152.37	458.07	1152.2	458.81	1151.95	459.95	1152.7	460.33	1152.96
462.33	1153.92	463.9	1154.73	471.48	1158.35	473.12	1159.16	473.56	1159.28
483.97	1160.82	489.92	1161.16	497.15	1161.29	511.64	1161.53	515.27	1162.17
515.79	1162.23	518.02	1162.22	521.55	1162.47	521.57	1162.48	521.69	1161.93
521.71	1162.68	521.77	1163.91	536.59	1163.91	543.33	1163.91	549.08	1163.91
549.1	1163.29	549.13	1162.14	563.91	1162.14	790.85	1162.14		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	402.49	.035	422.76	.085

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
402.49	422.76	111.86	111.86	111.86	.6	.8

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	383.88	1152.25	F
434.21	790.85	1152.17	F

CROSS SECTION OUTPUT Profile #Q2

E.G. Elev (ft)	1147.32	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.08	Wt. n-Val.	0.050	0.035	
W.S. Elev (ft)	1147.24	Reach Len. (ft)	111.86	111.86	111.86
Crit W.S. (ft)	1145.39	Flow Area (sq ft)	7.93	47.95	
E.G. Slope (ft/ft)	0.001091	Area (sq ft)	8.02	47.95	
Q Total (cfs)	117.00	Flow (cfs)	4.40	112.60	
Top Width (ft)	40.72	Top Width (ft)	20.80	19.93	
Vel Total (ft/s)	2.09	Avg. Vel. (ft/s)	0.56	2.35	
Max Chl Dpth (ft)	3.83	Hydr. Depth (ft)	0.43	2.41	
Conv. Total (cfs)	3541.5	Conv. (cfs)	133.3	3408.2	
Length Wtd. (ft)	111.86	Wetted Per. (ft)	18.62	22.14	
Min Ch El (ft)	1143.41	Shear (lb/sq ft)	0.03	0.15	
Alpha	1.21	Stream Power (lb/ft s)	0.02	0.35	
Frctn Loss (ft)		Cum Volume (acre-ft)		0.11	
C & E Loss (ft)		Cum SA (acres)	0.03	0.08	

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q5

E.G. Elev (ft)	1148.46	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.07	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1148.39	Reach Len. (ft)	111.86	111.86	111.86
Crit W.S. (ft)	1146.06	Flow Area (sq ft)	29.44	71.32	0.13
E.G. Slope (ft/ft)	0.000635	Area (sq ft)	49.72	71.32	0.13
Q Total (cfs)	194.00	Flow (cfs)	29.92	164.07	0.02
Top Width (ft)	73.96	Top Width (ft)	53.38	20.27	0.31
Vel Total (ft/s)	1.92	Avg. Vel. (ft/s)	1.02	2.30	0.12
Max Chl Dpth (ft)	4.98	Hydr. Depth (ft)	1.58	3.52	0.41
Conv. Total (cfs)	7697.5	Conv. (cfs)	1187.1	6509.8	0.6
Length Wtd. (ft)	111.86	Wetted Per. (ft)	18.62	22.62	0.87
Min Ch El (ft)	1143.41	Shear (lb/sq ft)	0.06	0.13	0.01
Alpha	1.25	Stream Power (lb/ft s)	0.06	0.29	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)		0.18	0.01
C & E Loss (ft)		Cum SA (acres)	0.07	0.08	0.03

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	1149.40	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.07	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1149.33	Reach Len. (ft)	111.86	111.86	111.86
Crit W.S. (ft)	1146.54	Flow Area (sq ft)	46.95	90.40	0.60
E.G. Slope (ft/ft)	0.000447	Area (sq ft)	115.22	90.40	0.60
Q Total (cfs)	259.00	Flow (cfs)	54.63	204.27	0.10
Top Width (ft)	123.18	Top Width (ft)	102.22	20.27	0.69
Vel Total (ft/s)	1.88	Avg. Vel. (ft/s)	1.16	2.26	0.17

Max Chl Dpth (ft)	5.92	Hydr. Depth (ft)	2.52	4.46	0.86
Conv. Total (cfs)	12252.5	Conv. (cfs)	2584.5	9663.2	4.8
Length Wtd. (ft)	111.86	Wetted Per. (ft)	18.62	22.62	1.89
Min Ch El (ft)	1143.41	Shear (lb/sq ft)	0.07	0.11	0.01
Alpha	1.22	Stream Power (lb/ft s)	0.08	0.25	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)	0.00	0.25	0.02
C & E Loss (ft)		Cum SA (acres)	0.13	0.09	0.04

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q25

E.G. Elev (ft)	1151.08	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.05	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1151.02	Reach Len. (ft)	111.86	111.86	111.86
Crit W.S. (ft)	1147.08	Flow Area (sq ft)	78.41	124.66	3.25
E.G. Slope (ft/ft)	0.000237	Area (sq ft)	384.15	124.66	3.25
Q Total (cfs)	348.00	Flow (cfs)	93.45	253.94	0.61
Top Width (ft)	236.87	Top Width (ft)	212.83	20.27	3.77
Vel Total (ft/s)	1.69	Avg. Vel. (ft/s)	1.19	2.04	0.19
Max Chl Dpth (ft)	7.61	Hydr. Depth (ft)	4.21	6.15	0.86
Conv. Total (cfs)	22626.3	Conv. (cfs)	6076.0	16510.8	39.4
Length Wtd. (ft)	111.86	Wetted Per. (ft)	18.62	22.62	5.62
Min Ch El (ft)	1143.41	Shear (lb/sq ft)	0.06	0.08	0.01
Alpha	1.20	Stream Power (lb/ft s)	0.07	0.17	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)	0.00	0.44	0.04
C & E Loss (ft)		Cum SA (acres)	0.28	0.09	0.05

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1152.39	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1152.38	Reach Len. (ft)	111.86	111.86	111.86
Crit W.S. (ft)	1147.41	Flow Area (sq ft)	697.51	152.17	21.18
E.G. Slope (ft/ft)	0.000043	Area (sq ft)	697.51	152.17	21.18
Q Total (cfs)	421.00	Flow (cfs)	267.79	151.24	1.97
Top Width (ft)	300.51	Top Width (ft)	252.28	20.27	27.95
Vel Total (ft/s)	0.48	Avg. Vel. (ft/s)	0.38	0.99	0.09
Max Chl Dpth (ft)	8.97	Hydr. Depth (ft)	2.76	7.51	0.76
Conv. Total (cfs)	64079.3	Conv. (cfs)	40759.5	23019.2	300.6
Length Wtd. (ft)	111.86	Wetted Per. (ft)	252.97	22.62	30.05
Min Ch El (ft)	1143.41	Shear (lb/sq ft)	0.01	0.02	0.00
Alpha	1.92	Stream Power (lb/ft s)	0.00	0.02	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)	0.00	0.68	0.05
C & E Loss (ft)		Cum SA (acres)	0.34	0.10	0.08

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	1152.66	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1152.66	Reach Len. (ft)	111.86	111.86	111.86
Crit W.S. (ft)	1147.68	Flow Area (sq ft)	768.06	157.74	30.07
E.G. Slope (ft/ft)	0.000051	Area (sq ft)	768.06	157.74	30.07
Q Total (cfs)	510.00	Flow (cfs)	332.15	174.60	3.25
Top Width (ft)	320.45	Top Width (ft)	263.50	20.27	36.68
Vel Total (ft/s)	0.53	Avg. Vel. (ft/s)	0.43	1.11	0.11
Max Chl Dpth (ft)	9.25	Hydr. Depth (ft)	2.91	7.78	0.82
Conv. Total (cfs)	71391.3	Conv. (cfs)	46495.3	24441.1	454.8
Length Wtd. (ft)	111.86	Wetted Per. (ft)	264.19	22.62	38.90
Min Ch El (ft)	1143.41	Shear (lb/sq ft)	0.01	0.02	0.00
Alpha	1.90	Stream Power (lb/ft s)	0.00	0.02	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)	0.01	0.82	0.06
C & E Loss (ft)		Cum SA (acres)	0.37	0.11	0.10

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1153.11	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1153.10	Reach Len. (ft)	111.86	111.86	111.86
Crit W.S. (ft)	1148.22	Flow Area (sq ft)	890.13	166.73	46.67
E.G. Slope (ft/ft)	0.000074	Area (sq ft)	890.13	166.73	46.67
Q Total (cfs)	727.00	Flow (cfs)	488.70	230.55	7.75
Top Width (ft)	340.19	Top Width (ft)	282.06	20.27	37.86
Vel Total (ft/s)	0.66	Avg. Vel. (ft/s)	0.55	1.38	0.17
Max Chl Dpth (ft)	9.69	Hydr. Depth (ft)	3.16	8.23	1.23
Conv. Total (cfs)	84526.9	Conv. (cfs)	56820.5	26805.0	901.4
Length Wtd. (ft)	111.86	Wetted Per. (ft)	282.76	22.62	40.20
Min Ch El (ft)	1143.41	Shear (lb/sq ft)	0.01	0.03	0.01
Alpha	1.86	Stream Power (lb/ft s)	0.01	0.05	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)	0.02	1.07	0.09
C & E Loss (ft)		Cum SA (acres)	0.40	0.11	0.11

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CULVERT

RIVER: Unnamed Brook
REACH: Brook RS: 1165

INPUT
Description: George's Mills Road
Distance from Upstream XS = 24
Deck/Roadway Width = 35
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 62

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-20.72	1157.54	0	11.03	1157.54	0	12.89	1157.51	0
17.28	1157.42	0	61.95	1156.6	0	63.03	1156.58	0
64.34	1156.56	0	65.45	1156.54	0	65.57	1156.53	0
120.65	1155.56	0	122.43	1155.51	0	125.25	1155.45	0
156.19	1154.9	0	177.76	1154.47	0	180.72	1154.42	0
181.33	1154.41	0	232.7	1153.44	0	233.38	1153.42	0
236.27	1153.38	0	280.75	1152.83	0	285.95	1152.77	0
287.63	1152.75	0	287.96	1152.74	0	340.11	1152.42	0
341.96	1152.41	0	343.81	1152.4	0	393.35	1152.15	0
393.96	1152.15	0	401.39	1152.14	0	439.61	1152.11	0
451.08	1152.1	0	452.2	1152.09	0	452.73	1152.09	0
452.87	1152.09	0	471.27	1152.09	0	517.42	1152.05	0
517.75	1152.05	0	519.11	1152.05	0	520.7	1152.04	0
560.22	1151.91	0	583.5	1151.81	0	584.43	1151.81	0
584.98	1151.81	0	600.39	1151.67	0	613.32	1151.54	0
613.77	1151.54	0	614.64	1151.53	0	636.1	1151.33	0
644.18	1151.25	0	644.47	1151.25	0	656.35	1151.08	0
673.49	1150.84	0	674.65	1150.82	0	674.91	1150.82	0
675.18	1150.81	0	689.81	1150.61	0	705.5	1150.38	0
732.51	1149.99	0	733.71	1149.97	0	733.77	1149.97	0
733.94	1149.97	0	755.59	1149.97	0			

Upstream Bridge Cross Section Data
Station Elevation Data num= 94

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1154.85	9.59	1154.85	47.9	1154.33	61.73	1154.18	90.45	1153.8
104.2	1153.67	131.47	1152.71	142.49	1152.63	175.28	1151.57	182.35	1151.47
193.98	1150.76	204.13	1150.39	205.72	1150.36	207.86	1150.53	210.87	1150.92
211.03	1150.52	213.2	1150.1	222.43	1150.15	228.92	1149.87	233.05	1149.69
234.27	1149.6	239.83	1149.33	252.3	1149.19	261.59	1149.06	263.91	1149.8
265.27	1150.24	272.96	1150.59	280.01	1150.37	291.07	1150.15	295.94	1150.23
299.06	1150.39	308.81	1149.83	317.19	1149.54	349.44	1148.38	358.53	1148.13
388.59	1146.97	393.24	1146.84	396.86	1146.66	400.77	1146.51	402.49	1146.5
404.19	1146.48	405.92	1146.01	408.03	1145.74	409.97	1144.24	410.17	1144.1
411.46	1143.71	411.8	1143.54	413.91	1143.45	414.94	1143.41	415.33	1143.76
415.5	1143.73	417.18	1143.78	418.94	1143.97	419.22	1144.05	419.84	1144.66
422.76	1147.58	423.43	1149.31	424.86	1150.8	425.29	1150.92	436.36	1151.84
437.05	1151.9	437.24	1151.93	438.96	1151.99	456.04	1152.67	457.37	1152.39
457.68	1152.37	458.07	1152.2	458.81	1151.95	459.95	1152.7	460.33	1152.96
462.33	1153.92	463.9	1154.73	471.48	1158.35	473.12	1159.16	473.56	1159.28
483.97	1160.82	489.92	1161.16	497.15	1161.29	511.64	1161.53	515.27	1162.17

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  515.79 1162.23  518.02 1162.22  521.55 1162.47  521.57 1162.48  521.69 1161.93
  521.71 1162.68  521.77 1163.91  536.59 1163.91  543.33 1163.91  549.08 1163.91
   549.1 1163.29  549.13 1162.14  563.91 1162.14  790.85 1162.14

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05  402.49    .035  422.76    .085

Bank Sta: Left   Right    Coeff Contr.   Expan.
        402.49  422.76             .6       .8
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  383.88 1152.25       F
  434.21  790.85 1152.17       F

Downstream  Deck/Roadway Coordinates
    num=      63
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       0 1157.54       0   30.36 1157.54       0   62.11 1157.54       0
   63.97 1157.51       0   68.36 1157.42       0  113.03  1156.6       0
  114.11 1156.58       0  115.42 1156.56       0  116.53 1156.54       0
  116.65 1156.53       0  171.73 1155.56       0  173.51 1155.51       0
  176.33 1155.45       0  207.27  1154.9       0  228.84 1154.47       0
   231.8 1154.42       0  232.41 1154.41       0  283.78 1153.44       0
  284.46 1153.42       0  287.35 1153.38       0  331.83 1152.83       0
  337.03 1152.77       0  338.71 1152.75       0  339.04 1152.74       0
  391.19 1152.42       0  393.04 1152.41       0  394.89  1152.4       0
  444.43 1152.15       0  445.04 1152.15       0  452.47 1152.14       0
  490.69 1152.11       0  502.16  1152.1       0  503.28 1152.09       0
  503.81 1152.09       0  503.95 1152.09       0  522.35 1152.09       0
   568.5 1152.05       0  568.83 1152.05       0  570.19 1152.05       0
  571.78 1152.04       0   611.3 1151.91       0  634.58 1151.81       0
  635.51 1151.81       0  636.06 1151.81       0  651.47 1151.67       0
   664.4 1151.54       0  664.85 1151.54       0  665.72 1151.53       0
  687.18 1151.33       0  695.26 1151.25       0  695.55 1151.25       0
  707.43 1151.08       0  724.57 1150.84       0  725.73 1150.82       0
  725.99 1150.82       0  726.26 1150.81       0  740.89 1150.61       0
  756.58 1150.38       0  783.59 1149.99       0  784.79 1149.97       0
  784.85 1149.97       0  785.02 1149.97       0  806.67 1149.97       0

Downstream Bridge Cross Section Data
Station Elevation Data    num=     128
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1154.86    3.17 1154.86   18.25 1154.54   44.15 1154.46   49.44 1154.39
   64.01 1154.51   87.25  1155.1   91.06 1155.27     102 1154.72  104.46 1154.75
  109.41  1154.7  154.76 1155.19  168.55 1155.15  194.17 1155.07  203.36 1154.97
  220.01 1154.87  223.63 1154.89  229.88 1154.77   231.9 1154.42  236.94 1154.49
  239.49 1154.49  240.01 1154.56  242.26 1154.75  245.96 1154.47  247.98 1154.43
  250.34 1154.39  256.14 1155.31  258.96 1155.72  259.91 1155.81  260.49 1155.82
  260.96 1155.83  278.37 1156.42  283.57  1156.5  288.28 1156.44  290.33 1156.52
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  302.45 1156.68  303.03 1156.66   303.6 1156.64  304.26 1156.61  305.24 1156.53
   316.4 1155.29  319.19 1154.98  324.56 1154.52  331.77 1153.73  336.57 1153.11
  340.34 1152.99  345.08  1152.8  354.89 1152.31  362.26 1152.12  363.93    1152
  369.33 1151.83  374.56 1151.64  383.26 1151.22  389.67 1151.22   398.1 1151.33
  400.27 1151.37  401.99 1151.07   402.1 1151.06  405.15 1151.65  406.95 1151.83
  408.05 1151.76  410.58 1151.76  418.68 1151.97  426.48 1151.65  428.21 1151.59
  429.72 1151.54  430.73 1151.42  432.25 1151.33  432.32 1151.16  433.02 1150.95
  438.91 1148.19  443.07 1145.79  443.77 1145.39  444.41 1144.98  444.73 1144.99
  445.01 1144.99  454.53 1145.88  459.02 1145.79  461.79 1145.38  462.51 1145.25
  463.54 1144.52  463.79 1144.34  464.29 1144.01  464.74 1143.53  465.06 1143.03
  465.57 1142.98  467.55 1142.67  468.97 1142.55  471.05 1142.33  472.17 1142.21
   472.9  1142.2  475.71 1142.44  479.11 1143.07  479.31 1143.08  479.53 1143.23
  480.81 1144.16  484.87  1145.2  487.07 1145.56  490.18 1146.37  492.23 1146.82
  492.62 1147.02  494.12 1147.36  495.13 1147.52  503.18 1148.75  504.05  1149.1
  515.37 1151.64  515.46 1151.68  524.31 1152.02  524.95 1152.06  525.03 1152.07
   525.7 1152.06  530.97 1152.08  537.31 1152.08   544.4 1152.03  551.09 1151.96
  554.21 1151.77  555.12 1151.71  557.63  1151.6  558.15 1151.59  560.34 1152.06
  564.24 1152.81   570.4 1154.62  582.46 1158.25  590.56 1159.62  602.57 1160.47
  604.26 1160.55  604.95 1160.57   616.4 1160.57

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .085  459.02    .035  490.18    .085

Bank Sta: Left   Right    Coeff Contr.   Expan.
        459.02  490.18             .6       .8
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  453.01 1150.85       F
  498.14   616.4 1150.73       F

Upstream Embankment side slope             =       3 horiz. to 1.0 vertical
Downstream Embankment side slope           =       3 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins        =
Energy head used in spillway design        =
Spillway height used in design             =
Weir crest shape                           = Broad Crested

Number of Culverts =  2

Culvert Name     Shape      Rise    Span
Culvert #1      Circular       5
FHWA Chart # 2 - Corrugated Metal Pipe Culvert
FHWA Scale # 1 - Headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                 23      66     .033     .033       0                   .5                 1
Upstream   Elevation =  1144
           Centerline Station =  407
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Downstream Elevation =  1143.1
           Centerline Station =  468

Culvert Name     Shape      Rise    Span
Culvert #2      Circular       5
FHWA Chart # 2 - Corrugated Metal Pipe Culvert
FHWA Scale # 1 - Headwall
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                 23      63     .033     .033        0                    .5                 1
Upstream   Elevation =  1144
           Centerline Station =  415
Downstream Elevation =  1143.1
           Centerline Station =  476

CULVERT OUTPUT  Profile #Q2  Culv Group:  Culvert #1

  Q Culv Group (cfs)         58.23    Culv Full Len (ft)
  # Barrels                      1    Culv Vel US (ft/s)          6.06
  Q Barrel (cfs)             58.23    Culv Vel DS (ft/s)          7.24
  E.G. US. (ft)            1147.32    Culv Inv El Up (ft)      1144.00
  W.S. US. (ft)            1147.24    Culv Inv El Dn (ft)      1143.10
  E.G. DS (ft)             1144.50    Culv Frctn Ls (ft)          0.97
  W.S. DS (ft)             1144.09    Culv Exit Loss (ft)         1.56
  Delta EG (ft)               2.82    Culv Entr Loss (ft)         0.28
  Delta WS (ft)               3.15    Q Weir (cfs)
  E.G. IC (ft)             1146.99    Weir Sta Lft (ft)
  E.G. OC (ft)             1147.31    Weir Sta Rgt (ft)
  Culvert Control           Outlet    Weir Submerg
  Culv WS Inlet (ft)       1146.46    Weir Max Depth (ft)
  Culv WS Outlet (ft)      1145.25    Weir Avg Depth (ft)
  Culv Nml Depth (ft)         2.46    Weir Flow Area (sq ft)
  Culv Crt Depth (ft)         2.14    Min El Weir Flow (ft)    1152.12


Note:    During subcritical analysis, the culvert direct step method, the solution went to normal depth.

CULVERT OUTPUT  Profile #Q5  Culv Group:  Culvert #1

  Q Culv Group (cfs)         96.32    Culv Full Len (ft)
  # Barrels                      1    Culv Vel US (ft/s)          6.93
  Q Barrel (cfs)             96.32    Culv Vel DS (ft/s)          8.55
  E.G. US. (ft)            1148.47    Culv Inv El Up (ft)      1144.00
  W.S. US. (ft)            1148.39    Culv Inv El Dn (ft)      1143.10
  E.G. DS (ft)             1145.20    Culv Frctn Ls (ft)          1.05
  W.S. DS (ft)             1144.66    Culv Exit Loss (ft)         1.83
  Delta EG (ft)               3.27    Culv Entr Loss (ft)         0.37
  Delta WS (ft)               3.73    Q Weir (cfs)
  E.G. IC (ft)             1148.08    Weir Sta Lft (ft)
  E.G. OC (ft)             1148.45    Weir Sta Rgt (ft)
```

Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	1147.33	Weir Max Depth (ft)	
Culv WS Outlet (ft)	1145.89	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	3.39	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	2.79	Min El Weir Flow (ft)	1152.12

CULVERT OUTPUT Profile #Q10 Culv Group: Culvert #1

Q Culv Group (cfs)	128.82	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	7.52
Q Barrel (cfs)	128.82	Culv Vel DS (ft/s)	9.54
E.G. US. (ft)	1149.40	Culv Inv El Up (ft)	1144.00
W.S. US. (ft)	1149.33	Culv Inv El Dn (ft)	1143.10
E.G. DS (ft)	1145.65	Culv Frctn Ls (ft)	1.19
W.S. DS (ft)	1144.99	Culv Exit Loss (ft)	2.11
Delta EG (ft)	3.75	Culv Entr Loss (ft)	0.44
Delta WS (ft)	4.34	Q Weir (cfs)	
E.G. IC (ft)	1148.96	Weir Sta Lft (ft)	
E.G. OC (ft)	1149.39	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	1148.07	Weir Max Depth (ft)	
Culv WS Outlet (ft)	1146.35	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	4.65	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	3.25	Min El Weir Flow (ft)	1152.12

CULVERT OUTPUT Profile #Q25 Culv Group: Culvert #1

Q Culv Group (cfs)	173.10	Culv Full Len (ft)	17.94
# Barrels	1	Culv Vel US (ft/s)	8.82
Q Barrel (cfs)	173.10	Culv Vel DS (ft/s)	10.90
E.G. US. (ft)	1151.08	Culv Inv El Up (ft)	1144.00
W.S. US. (ft)	1151.02	Culv Inv El Dn (ft)	1143.10
E.G. DS (ft)	1146.17	Culv Frctn Ls (ft)	1.76
W.S. DS (ft)	1145.35	Culv Exit Loss (ft)	2.54
Delta EG (ft)	4.90	Culv Entr Loss (ft)	0.60
Delta WS (ft)	5.67	Q Weir (cfs)	
E.G. IC (ft)	1150.34	Weir Sta Lft (ft)	
E.G. OC (ft)	1151.08	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	1149.00	Weir Max Depth (ft)	
Culv WS Outlet (ft)	1146.87	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	5.00	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	3.77	Min El Weir Flow (ft)	1152.12

Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #Q50 Culv Group: Culvert #1

Q Culv Group (cfs)	197.49	Culv Full Len (ft)	43.95
# Barrels	1	Culv Vel US (ft/s)	10.06
Q Barrel (cfs)	197.49	Culv Vel DS (ft/s)	11.69
E.G. US. (ft)	1152.39	Culv Inv El Up (ft)	1144.00
W.S. US. (ft)	1152.38	Culv Inv El Dn (ft)	1143.10
E.G. DS (ft)	1146.54	Culv Frctn Ls (ft)	2.37
W.S. DS (ft)	1145.61	Culv Exit Loss (ft)	2.70
Delta EG (ft)	5.85	Culv Entr Loss (ft)	0.79
Delta WS (ft)	6.77	Q Weir (cfs)	23.87
E.G. IC (ft)	1151.25	Weir Sta Lft (ft)	345.43
E.G. OC (ft)	1152.39	Weir Sta Rgt (ft)	459.48
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	1149.00	Weir Max Depth (ft)	0.30
Culv WS Outlet (ft)	1147.11	Weir Avg Depth (ft)	0.19
Culv Nml Depth (ft)	5.00	Weir Flow Area (sq ft)	20.02
Culv Crt Depth (ft)	4.01	Min El Weir Flow (ft)	1152.12

Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #Q100 Culv Group: Culvert #1

Q Culv Group (cfs)	202.57	Culv Full Len (ft)	46.74
# Barrels	1	Culv Vel US (ft/s)	10.32
Q Barrel (cfs)	202.57	Culv Vel DS (ft/s)	11.86
E.G. US. (ft)	1152.66	Culv Inv El Up (ft)	1144.00
W.S. US. (ft)	1152.66	Culv Inv El Dn (ft)	1143.10
E.G. DS (ft)	1146.93	Culv Frctn Ls (ft)	2.49
W.S. DS (ft)	1145.89	Culv Exit Loss (ft)	2.42
Delta EG (ft)	5.74	Culv Entr Loss (ft)	0.83
Delta WS (ft)	6.77	Q Weir (cfs)	102.72
E.G. IC (ft)	1151.45	Weir Sta Lft (ft)	296.22
E.G. OC (ft)	1152.66	Weir Sta Rgt (ft)	459.93
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	1149.00	Weir Max Depth (ft)	0.60
Culv WS Outlet (ft)	1147.16	Weir Avg Depth (ft)	0.37
Culv Nml Depth (ft)	5.00	Weir Flow Area (sq ft)	60.28
Culv Crt Depth (ft)	4.06	Min El Weir Flow (ft)	1152.12

Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #Q500 Culv Group: Culvert #1

Q Culv Group (cfs)	210.13	Culv Full Len (ft)	50.88
# Barrels	1	Culv Vel US (ft/s)	10.70

Q Barrel (cfs)	210.13	Culv Vel DS (ft/s)	12.12
E.G. US. (ft)	1153.11	Culv Inv El Up (ft)	1144.00
W.S. US. (ft)	1153.10	Culv Inv El Dn (ft)	1143.10
E.G. DS (ft)	1147.72	Culv Frctn Ls (ft)	2.71
W.S. DS (ft)	1146.51	Culv Exit Loss (ft)	1.79
Delta EG (ft)	5.39	Culv Entr Loss (ft)	0.89
Delta WS (ft)	6.59	Q Weir (cfs)	304.38
E.G. IC (ft)	1151.76	Weir Sta Lft (ft)	259.49
E.G. OC (ft)	1153.11	Weir Sta Rgt (ft)	460.61
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	1149.00	Weir Max Depth (ft)	1.00
Culv WS Outlet (ft)	1147.23	Weir Avg Depth (ft)	0.67
Culv Nml Depth (ft)	5.00	Weir Flow Area (sq ft)	134.59
Culv Crt Depth (ft)	4.13	Min El Weir Flow (ft)	1152.12

Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #Q2 Culv Group: Culvert #2

Q Culv Group (cfs)	58.77	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	6.17
Q Barrel (cfs)	58.77	Culv Vel DS (ft/s)	7.26
E.G. US. (ft)	1147.32	Culv Inv El Up (ft)	1144.00
W.S. US. (ft)	1147.24	Culv Inv El Dn (ft)	1143.10
E.G. DS (ft)	1144.50	Culv Frctn Ls (ft)	0.96
W.S. DS (ft)	1144.09	Culv Exit Loss (ft)	1.58
Delta EG (ft)	2.82	Culv Entr Loss (ft)	0.30
Delta WS (ft)	3.15	Q Weir (cfs)	
E.G. IC (ft)	1147.01	Weir Sta Lft (ft)	
E.G. OC (ft)	1147.33	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	1146.44	Weir Max Depth (ft)	
Culv WS Outlet (ft)	1145.26	Weir Avg Depth (ft)	
Culv Nml Depth (ft)	2.44	Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	2.16	Min El Weir Flow (ft)	1152.12

Note: During subcritical analysis, the culvert direct step method, the solution went to normal depth.

CULVERT OUTPUT Profile #Q5 Culv Group: Culvert #2

Q Culv Group (cfs)	97.68	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	7.06
Q Barrel (cfs)	97.68	Culv Vel DS (ft/s)	8.59
E.G. US. (ft)	1148.47	Culv Inv El Up (ft)	1144.00
W.S. US. (ft)	1148.39	Culv Inv El Dn (ft)	1143.10
E.G. DS (ft)	1145.20	Culv Frctn Ls (ft)	1.04
W.S. DS (ft)	1144.66	Culv Exit Loss (ft)	1.86

```
  Delta EG (ft)               3.27    Culv Entr Loss (ft)         0.39
  Delta WS (ft)               3.73    Q Weir (cfs)
  E.G. IC (ft)             1148.12    Weir Sta Lft (ft)
  E.G. OC (ft)             1148.48    Weir Sta Rgt (ft)
  Culvert Control           Outlet    Weir Submerg
  Culv WS Inlet (ft)       1147.32    Weir Max Depth (ft)
  Culv WS Outlet (ft)      1145.91    Weir Avg Depth (ft)
  Culv Nml Depth (ft)         3.38    Weir Flow Area (sq ft)
  Culv Crt Depth (ft)         2.81    Min El Weir Flow (ft)    1152.12

CULVERT OUTPUT  Profile #Q10  Culv Group:  Culvert #2

  Q Culv Group (cfs)        130.18    Culv Full Len (ft)
  # Barrels                      1    Culv Vel US (ft/s)          7.64
  Q Barrel (cfs)            130.18    Culv Vel DS (ft/s)          9.59
  E.G. US. (ft)            1149.40    Culv Inv El Up (ft)      1144.00
  W.S. US. (ft)            1149.33    Culv Inv El Dn (ft)      1143.10
  E.G. DS (ft)             1145.65    Culv Frctn Ls (ft)          1.17
  W.S. DS (ft)             1144.99    Culv Exit Loss (ft)         2.14
  Delta EG (ft)               3.75    Culv Entr Loss (ft)         0.45
  Delta WS (ft)               4.34    Q Weir (cfs)
  E.G. IC (ft)             1149.00    Weir Sta Lft (ft)
  E.G. OC (ft)             1149.41    Weir Sta Rgt (ft)
  Culvert Control           Outlet    Weir Submerg
  Culv WS Inlet (ft)       1148.05    Weir Max Depth (ft)
  Culv WS Outlet (ft)      1146.37    Weir Avg Depth (ft)
  Culv Nml Depth (ft)         4.46    Weir Flow Area (sq ft)
  Culv Crt Depth (ft)         3.26    Min El Weir Flow (ft)    1152.12

CULVERT OUTPUT  Profile #Q25  Culv Group:  Culvert #2

  Q Culv Group (cfs)        174.90    Culv Full Len (ft)         15.49
  # Barrels                      1    Culv Vel US (ft/s)          8.91
  Q Barrel (cfs)            174.90    Culv Vel DS (ft/s)         10.95
  E.G. US. (ft)            1151.08    Culv Inv El Up (ft)      1144.00
  W.S. US. (ft)            1151.02    Culv Inv El Dn (ft)      1143.10
  E.G. DS (ft)             1146.17    Culv Frctn Ls (ft)          1.71
  W.S. DS (ft)             1145.35    Culv Exit Loss (ft)         2.58
  Delta EG (ft)               4.90    Culv Entr Loss (ft)         0.62
  Delta WS (ft)               5.67    Q Weir (cfs)
  E.G. IC (ft)             1150.42    Weir Sta Lft (ft)
  E.G. OC (ft)             1151.08    Weir Sta Rgt (ft)
  Culvert Control           Outlet    Weir Submerg
  Culv WS Inlet (ft)       1149.00    Weir Max Depth (ft)
  Culv WS Outlet (ft)      1146.89    Weir Avg Depth (ft)
  Culv Nml Depth (ft)         5.00    Weir Flow Area (sq ft)
  Culv Crt Depth (ft)         3.79    Min El Weir Flow (ft)    1152.12
```

Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #Q50 Culv Group: Culvert #2

Q Culv Group (cfs)	199.64	Culv Full Len (ft)	41.61
# Barrels	1	Culv Vel US (ft/s)	10.17
Q Barrel (cfs)	199.64	Culv Vel DS (ft/s)	11.76
E.G. US. (ft)	1152.39	Culv Inv El Up (ft)	1144.00
W.S. US. (ft)	1152.38	Culv Inv El Dn (ft)	1143.10
E.G. DS (ft)	1146.54	Culv Frctn Ls (ft)	2.30
W.S. DS (ft)	1145.61	Culv Exit Loss (ft)	2.74
Delta EG (ft)	5.85	Culv Entr Loss (ft)	0.80
Delta WS (ft)	6.77	Q Weir (cfs)	23.87
E.G. IC (ft)	1151.33	Weir Sta Lft (ft)	345.43
E.G. OC (ft)	1152.39	Weir Sta Rgt (ft)	459.48
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	1149.00	Weir Max Depth (ft)	0.30
Culv WS Outlet (ft)	1147.13	Weir Avg Depth (ft)	0.19
Culv Nml Depth (ft)	5.00	Weir Flow Area (sq ft)	20.02
Culv Crt Depth (ft)	4.03	Min El Weir Flow (ft)	1152.12

Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #Q100 Culv Group: Culvert #2

Q Culv Group (cfs)	204.71	Culv Full Len (ft)	44.35
# Barrels	1	Culv Vel US (ft/s)	10.43
Q Barrel (cfs)	204.71	Culv Vel DS (ft/s)	11.94
E.G. US. (ft)	1152.66	Culv Inv El Up (ft)	1144.00
W.S. US. (ft)	1152.66	Culv Inv El Dn (ft)	1143.10
E.G. DS (ft)	1146.93	Culv Frctn Ls (ft)	2.43
W.S. DS (ft)	1145.89	Culv Exit Loss (ft)	2.46
Delta EG (ft)	5.74	Culv Entr Loss (ft)	0.84
Delta WS (ft)	6.77	Q Weir (cfs)	102.72
E.G. IC (ft)	1151.53	Weir Sta Lft (ft)	296.22
E.G. OC (ft)	1152.66	Weir Sta Rgt (ft)	459.93
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	1149.00	Weir Max Depth (ft)	0.60
Culv WS Outlet (ft)	1147.18	Weir Avg Depth (ft)	0.37
Culv Nml Depth (ft)	5.00	Weir Flow Area (sq ft)	60.28
Culv Crt Depth (ft)	4.08	Min El Weir Flow (ft)	1152.12

Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #Q500 Culv Group: Culvert #2

Q Culv Group (cfs)	212.48	Culv Full Len (ft)	48.46
# Barrels	1	Culv Vel US (ft/s)	10.82
Q Barrel (cfs)	212.48	Culv Vel DS (ft/s)	12.21
E.G. US. (ft)	1153.11	Culv Inv El Up (ft)	1144.00
W.S. US. (ft)	1153.10	Culv Inv El Dn (ft)	1143.10
E.G. DS (ft)	1147.72	Culv Frctn Ls (ft)	2.64
W.S. DS (ft)	1146.51	Culv Exit Loss (ft)	1.84
Delta EG (ft)	5.39	Culv Entr Loss (ft)	0.91
Delta WS (ft)	6.59	Q Weir (cfs)	304.38
E.G. IC (ft)	1151.85	Weir Sta Lft (ft)	259.49
E.G. OC (ft)	1153.11	Weir Sta Rgt (ft)	460.61
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	1149.00	Weir Max Depth (ft)	1.00
Culv WS Outlet (ft)	1147.25	Weir Avg Depth (ft)	0.67
Culv Nml Depth (ft)	5.00	Weir Flow Area (sq ft)	134.59
Culv Crt Depth (ft)	4.15	Min El Weir Flow (ft)	1152.12

Note: The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CROSS SECTION

RIVER: Unnamed Brook
REACH: Brook RS: 1071

INPUT
Description:
Station Elevation Data num= 128

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1154.86	3.17	1154.86	18.25	1154.54	44.15	1154.46	49.44	1154.39
64.01	1154.51	87.25	1155.1	91.06	1155.27	102	1154.72	104.46	1154.75
109.41	1154.7	154.76	1155.19	168.55	1155.15	194.17	1155.07	203.36	1154.97
220.01	1154.87	223.63	1154.89	229.88	1154.77	231.9	1154.42	236.94	1154.49
239.49	1154.49	240.01	1154.56	242.26	1154.75	245.96	1154.47	247.98	1154.43
250.34	1154.39	256.14	1155.31	258.96	1155.72	259.91	1155.81	260.49	1155.82
260.96	1155.83	278.37	1156.42	283.57	1156.5	288.28	1156.44	290.33	1156.52
302.45	1156.68	303.03	1156.66	303.6	1156.64	304.26	1156.61	305.24	1156.53
316.4	1155.29	319.19	1154.98	324.56	1154.52	331.77	1153.73	336.57	1153.11
340.34	1152.99	345.08	1152.8	354.89	1152.31	362.26	1152.12	363.93	1152
369.33	1151.83	374.56	1151.64	383.26	1151.22	389.67	1151.22	398.1	1151.33
400.27	1151.37	401.99	1151.07	402.1	1151.06	405.15	1151.65	406.95	1151.83
408.05	1151.76	410.58	1151.76	418.68	1151.97	426.48	1151.65	428.21	1151.59
429.72	1151.54	430.73	1151.42	432.25	1151.33	432.32	1151.16	433.02	1150.95
438.91	1148.19	443.07	1145.79	443.77	1145.39	444.41	1144.98	444.73	1144.99
445.01	1144.99	454.53	1145.88	459.02	1145.79	461.79	1145.38	462.51	1145.25
463.54	1144.52	463.79	1144.34	464.29	1144.01	464.74	1143.53	465.06	1143.03

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  465.57 1142.98  467.55 1142.67  468.97 1142.55  471.05 1142.33  472.17 1142.21
   472.9  1142.2  475.71 1142.44  479.11 1143.07  479.31 1143.08  479.53 1143.23
  480.81 1144.16  484.87  1145.2  487.07 1145.56  490.18 1146.37  492.23 1146.82
  492.62 1147.02  494.12 1147.36  495.13 1147.52  503.18 1148.75  504.05  1149.1
  515.37 1151.64  515.46 1151.68  524.31 1152.02  524.95 1152.06  525.03 1152.07
   525.7 1152.06  530.97 1152.08  537.31 1152.08   544.4 1152.03  551.09 1151.96
  554.21 1151.77  555.12 1151.71  557.63  1151.6  558.15 1151.59  560.34 1152.06
  564.24 1152.81   570.4 1154.62  582.46 1158.25  590.56 1159.62  602.57 1160.47
  604.26 1160.55  604.95 1160.57   616.4 1160.57

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .085  459.02    .035  490.18    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        459.02  490.18             70.2    70.2    70.2             .6       .8
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  453.01 1150.85       F
  498.14   616.4 1150.73       F

CROSS SECTION OUTPUT  Profile #Q2

  E.G. Elev (ft)           1144.50    Element                   Left OB    Channel   Right OB
  Vel Head (ft)               0.41    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1144.09    Reach Len. (ft)             70.20      70.20      70.20
  Crit W.S. (ft)           1143.85    Flow Area (sq ft)                      22.86
  E.G. Slope (ft/ft)      0.010178    Area (sq ft)                           22.86
  Q Total (cfs)             117.00    Flow (cfs)                            117.00
  Top Width (ft)             16.55    Top Width (ft)                         16.55
  Vel Total (ft/s)            5.12    Avg. Vel. (ft/s)                        5.12
  Max Chl Dpth (ft)           1.89    Hydr. Depth (ft)                        1.38
  Conv. Total (cfs)         1159.7    Conv. (cfs)                           1159.7
  Length Wtd. (ft)           70.20    Wetted Per. (ft)                       17.50
  Min Ch El (ft)           1142.20    Shear (lb/sq ft)                        0.83
  Alpha                       1.00    Stream Power (lb/ft s)                  4.25
  Frctn Loss (ft)             0.42    Cum Volume (acre-ft)                    0.05
  C & E Loss (ft)             0.17    Cum SA (acres)                          0.03


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT  Profile #Q5

  E.G. Elev (ft)           1145.20    Element                   Left OB    Channel   Right OB
  Vel Head (ft)               0.53    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1144.66    Reach Len. (ft)             70.20      70.20      70.20
  Crit W.S. (ft)           1144.36    Flow Area (sq ft)                      33.11
```

E.G. Slope (ft/ft)	0.010153	Area (sq ft)		33.11	
Q Total (cfs)	194.00	Flow (cfs)		194.00	
Top Width (ft)	19.43	Top Width (ft)		19.43	
Vel Total (ft/s)	5.86	Avg. Vel. (ft/s)		5.86	
Max Chl Dpth (ft)	2.46	Hydr. Depth (ft)		1.70	
Conv. Total (cfs)	1925.4	Conv. (cfs)		1925.4	
Length Wtd. (ft)	70.20	Wetted Per. (ft)		20.65	
Min Ch El (ft)	1142.20	Shear (lb/sq ft)		1.02	
Alpha	1.00	Stream Power (lb/ft s)		5.96	
Frctn Loss (ft)	0.42	Cum Volume (acre-ft)		0.06	0.01
C & E Loss (ft)	0.22	Cum SA (acres)		0.03	0.03

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	1145.65	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.66	Wt. n-Val.		0.035	
W.S. Elev (ft)	1144.99	Reach Len. (ft)	70.20	70.20	70.20
Crit W.S. (ft)	1144.74	Flow Area (sq ft)		39.74	
E.G. Slope (ft/ft)	0.011058	Area (sq ft)	0.00	39.74	
Q Total (cfs)	259.00	Flow (cfs)		259.00	
Top Width (ft)	21.49	Top Width (ft)	0.32	21.17	
Vel Total (ft/s)	6.52	Avg. Vel. (ft/s)		6.52	
Max Chl Dpth (ft)	2.79	Hydr. Depth (ft)		1.88	
Conv. Total (cfs)	2463.0	Conv. (cfs)		2463.0	
Length Wtd. (ft)	70.20	Wetted Per. (ft)		22.53	
Min Ch El (ft)	1142.20	Shear (lb/sq ft)		1.22	
Alpha	1.00	Stream Power (lb/ft s)		7.94	
Frctn Loss (ft)	0.43	Cum Volume (acre-ft)	0.00	0.07	0.02
C & E Loss (ft)	0.29	Cum SA (acres)	0.00	0.03	0.04

Warning: Divided flow computed for this cross-section.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q25

E.G. Elev (ft)	1146.17	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.82	Wt. n-Val.		0.035	
W.S. Elev (ft)	1145.35	Reach Len. (ft)	70.20	70.20	70.20
Crit W.S. (ft)	1145.17	Flow Area (sq ft)		47.75	
E.G. Slope (ft/ft)	0.012645	Area (sq ft)	1.01	47.75	
Q Total (cfs)	348.00	Flow (cfs)		348.00	
Top Width (ft)	28.84	Top Width (ft)	5.02	23.82	

Vel Total (ft/s)	7.29	Avg. Vel. (ft/s)		7.29	
Max Chl Dpth (ft)	3.15	Hydr. Depth (ft)		2.00	
Conv. Total (cfs)	3094.7	Conv. (cfs)		3094.7	
Length Wtd. (ft)	70.20	Wetted Per. (ft)		25.31	
Min Ch El (ft)	1142.20	Shear (lb/sq ft)		1.49	
Alpha	1.00	Stream Power (lb/ft s)		10.85	
Frctn Loss (ft)	0.45	Cum Volume (acre-ft)	0.00	0.09	0.04
C & E Loss (ft)	0.38	Cum SA (acres)	0.01	0.04	0.05

Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1146.54	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.93	Wt. n-Val.		0.035	
W.S. Elev (ft)	1145.61	Reach Len. (ft)	70.20	70.20	70.20
Crit W.S. (ft)	1145.55	Flow Area (sq ft)		54.29	
E.G. Slope (ft/ft)	0.014144	Area (sq ft)	2.71	54.29	
Q Total (cfs)	421.00	Flow (cfs)		421.00	
Top Width (ft)	35.20	Top Width (ft)	8.21	26.99	
Vel Total (ft/s)	7.75	Avg. Vel. (ft/s)		7.75	
Max Chl Dpth (ft)	3.41	Hydr. Depth (ft)		2.01	
Conv. Total (cfs)	3540.0	Conv. (cfs)		3540.0	
Length Wtd. (ft)	70.20	Wetted Per. (ft)		28.52	
Min Ch El (ft)	1142.20	Shear (lb/sq ft)		1.68	
Alpha	1.00	Stream Power (lb/ft s)		13.03	
Frctn Loss (ft)	0.47	Cum Volume (acre-ft)	0.00	0.10	0.05
C & E Loss (ft)	0.45	Cum SA (acres)	0.01	0.04	0.05

Warning: Divided flow computed for this cross-section.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	1146.93	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.04	Wt. n-Val.	0.085	0.035	
W.S. Elev (ft)	1145.89	Reach Len. (ft)	70.20	70.20	70.20
Crit W.S. (ft)	1145.89	Flow Area (sq ft)	0.34	62.21	
E.G. Slope (ft/ft)	0.014652	Area (sq ft)	5.72	62.21	
Q Total (cfs)	510.00	Flow (cfs)	0.11	509.89	
Top Width (ft)	45.42	Top Width (ft)	16.12	29.30	

Vel Total (ft/s)	8.15	Avg. Vel. (ft/s)	0.31	8.20	
Max Chl Dpth (ft)	3.69	Hydr. Depth (ft)	0.06	2.12	
Conv. Total (cfs)	4213.3	Conv. (cfs)	0.9	4212.4	
Length Wtd. (ft)	70.20	Wetted Per. (ft)	6.02	30.88	
Min Ch El (ft)	1142.20	Shear (lb/sq ft)	0.05	1.84	
Alpha	1.01	Stream Power (lb/ft s)	0.02	15.10	
Frctn Loss (ft)	0.48	Cum Volume (acre-ft)	0.01	0.11	0.06
C & E Loss (ft)	0.51	Cum SA (acres)	0.01	0.04	0.05

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q500

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1147.72	Wt. n-Val.	0.085	0.035	0.085
Vel Head (ft)	1.21	Reach Len. (ft)	70.20	70.20	70.20
W.S. Elev (ft)	1146.51	Flow Area (sq ft)	4.10	81.24	0.05
Crit W.S. (ft)	1146.51	Area (sq ft)	16.14	81.24	0.05
E.G. Slope (ft/ft)	0.013029	Flow (cfs)	6.34	720.64	0.02
Q Total (cfs)	727.00	Top Width (ft)	17.20	31.16	0.64
Top Width (ft)	49.00	Avg. Vel. (ft/s)	1.55	8.87	0.34
Vel Total (ft/s)	8.51	Hydr. Depth (ft)	0.68	2.61	0.07
Max Chl Dpth (ft)	4.31	Conv. (cfs)	55.5	6313.4	0.1
Conv. Total (cfs)	6369.1	Wetted Per. (ft)	6.02	32.80	0.66
Length Wtd. (ft)	70.20	Shear (lb/sq ft)	0.55	2.01	0.06
Min Ch El (ft)	1142.20	Stream Power (lb/ft s)	0.86	17.87	0.02
Alpha	1.08	Cum Volume (acre-ft)	0.02	0.13	0.09
Frctn Loss (ft)	0.46	Cum SA (acres)	0.02	0.04	0.06
C & E Loss (ft)	0.60				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

```
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
         program defaulted to critical depth.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION


RIVER: Unnamed Brook
REACH: Brook              RS: 1001

INPUT
Description:
Station Elevation Data    num=      82
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1163.91   10.93 1163.91   11.76 1163.56   11.77 1163.91   11.85  1161.9
   14.37 1161.82   29.65 1160.54    35.4 1159.97    50.6 1158.18   61.31 1156.29
   69.65    1156   74.83 1155.43   76.38 1155.26   82.96 1154.96  101.08 1154.28
  105.39 1154.25  116.03 1153.28  123.68 1152.73  124.64 1152.44  126.28 1151.79
  126.76 1151.84  127.45 1151.84  128.47 1152.26  129.65 1152.48  130.52 1152.53
  134.62 1152.78  143.06 1152.91     145 1152.96  148.57 1152.81  156.24 1152.59
   158.5 1152.48  159.57 1152.41  160.33 1152.13  164.46 1150.81  168.86  1150.2
  177.51 1149.69  179.58 1149.59   185.1  1149.3  203.94 1148.09   211.2 1147.63
  212.65 1147.59  230.43 1146.51  234.63 1144.34  236.32 1143.38   237.7 1142.32
   237.8 1142.23  241.03 1141.85  241.83 1141.69  243.19 1141.82  243.55 1141.86
  244.98 1141.86  245.56 1141.84  247.41  1141.8   248.1 1141.85  251.38 1142.03
  255.45  1142.2  255.86 1142.76  256.65 1143.89  258.81 1143.99  261.79 1144.12
  270.03 1144.18  276.94 1144.09   284.7 1143.96  288.81 1143.97  309.35 1144.64
  326.88 1146.13  332.27 1146.54  337.83 1147.28  341.91  1147.8  343.95  1147.9
   346.9 1149.03  351.84 1150.42   353.2 1150.97  355.27 1151.62  360.39 1151.89
  362.12 1151.94   362.5 1151.96  362.82 1151.97  368.08    1152  372.71 1152.02
  374.54 1152.03  374.83 1152.03

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .085  234.63    .035  256.65    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        234.63  256.65              .56     .56     .56             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  194.39 1150.85       F
  314.63  374.83 1150.73       F

CROSS SECTION OUTPUT  Profile #Q2

  E.G. Elev (ft)           1143.91    Element                     Left OB    Channel   Right OB
  Vel Head (ft)               0.19    Wt. n-Val.                              0.035
  W.S. Elev (ft)           1143.72    Reach Len. (ft)
  Crit W.S. (ft)           1143.05    Flow Area (sq ft)                       33.47
```

E.G. Slope (ft/ft)	0.003905	Area (sq ft)	33.47
Q Total (cfs)	117.00	Flow (cfs)	117.00
Top Width (ft)	20.80	Top Width (ft)	20.80
Vel Total (ft/s)	3.50	Avg. Vel. (ft/s)	3.50
Max Chl Dpth (ft)	2.03	Hydr. Depth (ft)	1.61
Conv. Total (cfs)	1872.3	Conv. (cfs)	1872.3
Length Wtd. (ft)		Wetted Per. (ft)	22.12
Min Ch El (ft)	1141.69	Shear (lb/sq ft)	0.37
Alpha	1.00	Stream Power (lb/ft s)	1.29
Frctn Loss (ft)		Cum Volume (acre-ft)	
C & E Loss (ft)		Cum SA (acres)	

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q5

E.G. Elev (ft)	1144.56	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.26	Wt. n-Val.		0.035	0.085
W.S. Elev (ft)	1144.30	Reach Len. (ft)			
Crit W.S. (ft)	1143.48	Flow Area (sq ft)		45.96	9.03
E.G. Slope (ft/ft)	0.003901	Area (sq ft)		45.96	9.03
Q Total (cfs)	194.00	Flow (cfs)		190.48	3.52
Top Width (ft)	64.20	Top Width (ft)		21.95	42.25
Vel Total (ft/s)	3.53	Avg. Vel. (ft/s)		4.14	0.39
Max Chl Dpth (ft)	2.61	Hydr. Depth (ft)		2.09	0.21
Conv. Total (cfs)	3106.0	Conv. (cfs)		3049.6	56.4
Length Wtd. (ft)		Wetted Per. (ft)		23.52	42.26
Min Ch El (ft)	1141.69	Shear (lb/sq ft)		0.48	0.05
Alpha	1.36	Stream Power (lb/ft s)		1.97	0.02
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	1144.93	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.30	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1144.63	Reach Len. (ft)			
Crit W.S. (ft)	1143.80	Flow Area (sq ft)	0.08	53.22	24.64
E.G. Slope (ft/ft)	0.003901	Area (sq ft)	0.08	53.22	24.64
Q Total (cfs)	259.00	Flow (cfs)	0.02	242.71	16.27
Top Width (ft)	74.95	Top Width (ft)	0.56	22.02	52.37
Vel Total (ft/s)	3.32	Avg. Vel. (ft/s)	0.28	4.56	0.66
Max Chl Dpth (ft)	2.94	Hydr. Depth (ft)	0.14	2.42	0.47
Conv. Total (cfs)	4146.7	Conv. (cfs)	0.4	3885.9	260.5
Length Wtd. (ft)		Wetted Per. (ft)	0.63	23.60	52.38
Min Ch El (ft)	1141.69	Shear (lb/sq ft)	0.03	0.55	0.11

Alpha	1.77	Stream Power (lb/ft s)	0.01	2.50	0.08
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q25

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1145.34	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1144.99	Reach Len. (ft)			
Crit W.S. (ft)	1144.38	Flow Area (sq ft)	0.41	61.22	44.51
E.G. Slope (ft/ft)	0.003902	Area (sq ft)	0.41	61.22	44.51
Q Total (cfs)	348.00	Flow (cfs)	0.20	306.52	41.28
Top Width (ft)	80.13	Top Width (ft)	1.26	22.02	56.85
Vel Total (ft/s)	3.28	Avg. Vel. (ft/s)	0.48	5.01	0.93
Max Chl Dpth (ft)	3.30	Hydr. Depth (ft)	0.33	2.78	0.78
Conv. Total (cfs)	5571.3	Conv. (cfs)	3.2	4907.3	660.9
Length Wtd. (ft)		Wetted Per. (ft)	1.42	23.60	56.88
Min Ch El (ft)	1141.69	Shear (lb/sq ft)	0.07	0.63	0.19
Alpha	2.06	Stream Power (lb/ft s)	0.03	3.16	0.18
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1145.62	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.37	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1145.25	Reach Len. (ft)			
Crit W.S. (ft)	1144.68	Flow Area (sq ft)	0.80	66.85	59.29
E.G. Slope (ft/ft)	0.003900	Area (sq ft)	0.80	66.85	59.44
Q Total (cfs)	421.00	Flow (cfs)	0.48	354.86	65.66
Top Width (ft)	83.63	Top Width (ft)	1.76	22.02	59.86
Vel Total (ft/s)	3.32	Avg. Vel. (ft/s)	0.60	5.31	1.11
Max Chl Dpth (ft)	3.56	Hydr. Depth (ft)	0.45	3.04	1.02
Conv. Total (cfs)	6741.5	Conv. (cfs)	7.6	5682.4	1051.5
Length Wtd. (ft)		Wetted Per. (ft)	1.98	23.60	58.02
Min Ch El (ft)	1141.69	Shear (lb/sq ft)	0.10	0.69	0.25
Alpha	2.18	Stream Power (lb/ft s)	0.06	3.66	0.28
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	1145.93	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.40	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1145.53	Reach Len. (ft)			
Crit W.S. (ft)	1144.92	Flow Area (sq ft)	1.36	72.99	75.44
E.G. Slope (ft/ft)	0.003902	Area (sq ft)	1.36	72.99	76.57
Q Total (cfs)	510.00	Flow (cfs)	0.97	410.89	98.14
Top Width (ft)	87.45	Top Width (ft)	2.30	22.02	63.13
Vel Total (ft/s)	3.40	Avg. Vel. (ft/s)	0.71	5.63	1.30
Max Chl Dpth (ft)	3.84	Hydr. Depth (ft)	0.59	3.31	1.30
Conv. Total (cfs)	8164.3	Conv. (cfs)	15.5	6577.7	1571.1
Length Wtd. (ft)		Wetted Per. (ft)	2.59	23.60	58.02
Min Ch El (ft)	1141.69	Shear (lb/sq ft)	0.13	0.75	0.32
Alpha	2.23	Stream Power (lb/ft s)	0.09	4.24	0.41
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1146.59	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.47	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1146.12	Reach Len. (ft)			
Crit W.S. (ft)	1145.40	Flow Area (sq ft)	3.07	86.06	109.85
E.G. Slope (ft/ft)	0.003900	Area (sq ft)	3.07	86.06	116.11
Q Total (cfs)	727.00	Flow (cfs)	2.86	540.58	183.55
Top Width (ft)	95.58	Top Width (ft)	3.45	22.02	70.12
Vel Total (ft/s)	3.65	Avg. Vel. (ft/s)	0.93	6.28	1.67
Max Chl Dpth (ft)	4.43	Hydr. Depth (ft)	0.89	3.91	1.89
Conv. Total (cfs)	11640.6	Conv. (cfs)	45.9	8655.7	2939.0
Length Wtd. (ft)		Wetted Per. (ft)	3.88	23.60	58.02
Min Ch El (ft)	1141.69	Shear (lb/sq ft)	0.19	0.89	0.46
Alpha	2.25	Stream Power (lb/ft s)	0.18	5.58	0.77
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

SUMMARY OF MANNING'S N VALUES

River:Unnamed Brook

Reach	River Sta.	n1	n2	n3
Brook	1758	.05	.035	.085

Brook	1506	.05	.035	.085
Brook	1238	.05	.035	.085
Brook	1182	.05	.035	.085
Brook	1165	Culvert		
Brook	1071	.085	.035	.085
Brook	1001	.085	.035	.085

SUMMARY OF REACH LENGTHS

River: Unnamed Brook

Reach	River Sta.	Left	Channel	Right
Brook	1758	252.24	252.24	252.24
Brook	1506	267.56	267.56	267.56
Brook	1238	55.99	55.99	55.99
Brook	1182	111.86	111.86	111.86
Brook	1165	Culvert		
Brook	1071	70.2	70.2	70.2
Brook	1001	.56	.56	.56

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Unnamed Brook

Reach	River Sta.	Contr.	Expan.
Brook	1758	.1	.3
Brook	1506	.1	.3
Brook	1238	.1	.3
Brook	1182	.6	.8
Brook	1165	Culvert	
Brook	1071	.6	.8
Brook	1001	.1	.3

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            the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q5
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q10
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q25
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q50
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q100
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q500
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
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               program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q2
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q5
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q10
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q25
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q50
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q100
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q500
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q2
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q5
     Warning:Divided flow computed for this cross-section.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q10
     Warning:Divided flow computed for this cross-section.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q25
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q50
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
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     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q100
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q500
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q2
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q5
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q10
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q25
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q50
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q100
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q500
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q2     Culv: Culvert #1
     Note:   During subcritical analysis, the culvert direct step method, the solution went to normal depth.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q2     Culv: Culvert #2
     Note:   During subcritical analysis, the culvert direct step method, the solution went to normal depth.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q25     Culv: Culvert #1
     Note:   The normal depth exceeds the height of the culvert.  The program assumes that the normal depth is equal to the height
             of the culvert.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q25     Culv: Culvert #2
     Note:   The normal depth exceeds the height of the culvert.  The program assumes that the normal depth is equal to the height
             of the culvert.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q50     Culv: Culvert #1
     Note:   The normal depth exceeds the height of the culvert.  The program assumes that the normal depth is equal to the height
             of the culvert.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q50     Culv: Culvert #2
     Note:   The normal depth exceeds the height of the culvert.  The program assumes that the normal depth is equal to the height
             of the culvert.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q100     Culv: Culvert #1
     Note:   The normal depth exceeds the height of the culvert.  The program assumes that the normal depth is equal to the height
             of the culvert.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q100     Culv: Culvert #2
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     Note:   The normal depth exceeds the height of the culvert.  The program assumes that the normal depth is equal to the height
             of the culvert.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q500     Culv: Culvert #1
     Note:   The normal depth exceeds the height of the culvert.  The program assumes that the normal depth is equal to the height
             of the culvert.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q500     Culv: Culvert #2
     Note:   The normal depth exceeds the height of the culvert.  The program assumes that the normal depth is equal to the height
             of the culvert.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q2
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q5
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q10
     Warning:Divided flow computed for this cross-section.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q25
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q50
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q100
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
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        for the water surface and continued on with the calculations.
Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
        This may indicate the need for additional cross sections.
Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
        the need for additional cross sections.
Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
        water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
        program defaulted to critical depth.
Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
        used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q500
Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
        for the water surface and continued on with the calculations.
Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
        This may indicate the need for additional cross sections.
Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
        the need for additional cross sections.
Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
        water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
        program defaulted to critical depth.
Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
        used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q2
Warning:Divided flow computed for this cross-section.
Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q5
Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q10
Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q25
Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q50
Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q100
Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q500
Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
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HEC-RAS Plan: Existing culvert River: Unnamed Brook Reach: Brook

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Brook	1758	Q2	117.00	1151.39	1153.27	1153.07	1153.64	0.010973	4.90	23.86	19.68	0.78
Brook	1758	Q5	194.00	1151.39	1153.71	1153.50	1154.25	0.011076	5.90	33.60	26.92	0.82
Brook	1758	Q10	259.00	1151.39	1153.99	1153.84	1154.67	0.011394	6.66	42.07	34.28	0.86
Brook	1758	Q25	348.00	1151.39	1154.25	1154.25	1155.16	0.012945	7.74	51.93	41.21	0.93
Brook	1758	Q50	421.00	1151.39	1154.80	1154.80	1155.42	0.007112	6.70	99.14	116.78	0.72
Brook	1758	Q100	510.00	1151.39	1155.04	1155.04	1155.65	0.006700	6.88	129.52	135.37	0.71
Brook	1758	Q500	727.00	1151.39	1155.44	1155.44	1156.07	0.006712	7.49	188.60	161.44	0.72
Brook	1506	Q2	117.00	1147.76	1149.43	1149.43	1150.07	0.018600	6.41	18.26	14.57	1.01
Brook	1506	Q5	194.00	1147.76	1150.11	1150.11	1150.72	0.018245	6.24	31.08	25.92	1.00
Brook	1506	Q10	259.00	1147.76	1150.43	1150.43	1151.07	0.018273	6.39	40.51	33.12	1.02
Brook	1506	Q25	348.00	1147.76	1151.00	1150.79	1151.49	0.008780	5.70	71.88	65.77	0.75
Brook	1506	Q50	421.00	1147.76	1152.33		1152.47	0.001427	3.33	186.72	99.13	0.33
Brook	1506	Q100	510.00	1147.76	1152.60		1152.76	0.001498	3.60	213.87	104.90	0.34
Brook	1506	Q500	727.00	1147.76	1153.02		1153.25	0.001898	4.38	260.56	118.94	0.40
Brook	1238	Q2	117.00	1144.81	1147.22	1146.53	1147.49	0.004871	4.17	28.09	15.39	0.54
Brook	1238	Q5	194.00	1144.81	1148.34	1147.08	1148.58	0.002517	4.05	57.65	49.44	0.42
Brook	1238	Q10	259.00	1144.81	1149.32	1147.48	1149.46	0.001105	3.27	114.28	109.66	0.29
Brook	1238	Q25	348.00	1144.81	1151.04	1148.16	1151.09	0.000353	2.36	219.74	241.60	0.18
Brook	1238	Q50	421.00	1144.81	1152.38	1148.65	1152.39	0.000058	1.10	824.10	290.24	0.07
Brook	1238	Q100	510.00	1144.81	1152.66	1148.92	1152.67	0.000066	1.21	905.29	299.15	0.08
Brook	1238	Q500	727.00	1144.81	1153.10	1149.40	1153.12	0.000093	1.49	1041.52	313.47	0.09
Brook	1182	Q2	117.00	1143.41	1147.24	1145.39	1147.32	0.001091	2.35	55.88	40.72	0.27
Brook	1182	Q5	194.00	1143.41	1148.39	1146.06	1148.46	0.000635	2.30	100.89	73.96	0.22
Brook	1182	Q10	259.00	1143.41	1149.33	1146.54	1149.40	0.000447	2.26	137.94	123.18	0.19
Brook	1182	Q25	348.00	1143.41	1151.02	1147.08	1151.08	0.000237	2.04	206.32	236.87	0.14
Brook	1182	Q50	421.00	1143.41	1152.38	1147.41	1152.39	0.000043	0.99	870.85	300.51	0.06
Brook	1182	Q100	510.00	1143.41	1152.66	1147.68	1152.66	0.000051	1.11	955.88	320.45	0.07
Brook	1182	Q500	727.00	1143.41	1153.10	1148.22	1153.11	0.000074	1.38	1103.53	340.19	0.08
Brook	1165		Culvert									
Brook	1071	Q2	117.00	1142.20	1144.09	1143.85	1144.50	0.010178	5.12	22.86	16.55	0.77
Brook	1071	Q5	194.00	1142.20	1144.66	1144.36	1145.20	0.010153	5.86	33.11	19.43	0.79
Brook	1071	Q10	259.00	1142.20	1144.99	1144.74	1145.65	0.011058	6.52	39.74	21.49	0.84
Brook	1071	Q25	348.00	1142.20	1145.35	1145.17	1146.17	0.012645	7.29	47.75	28.84	0.91
Brook	1071	Q50	421.00	1142.20	1145.61	1145.55	1146.54	0.014144	7.75	54.29	35.20	0.96
Brook	1071	Q100	510.00	1142.20	1145.89	1145.89	1146.93	0.014652	8.20	62.55	45.42	0.99
Brook	1071	Q500	727.00	1142.20	1146.51	1146.51	1147.72	0.013029	8.87	85.39	49.00	0.97
Brook	1001	Q2	117.00	1141.69	1143.72	1143.05	1143.91	0.003905	3.50	33.47	20.80	0.49
Brook	1001	Q5	194.00	1141.69	1144.30	1143.48	1144.56	0.003901	4.14	54.98	64.20	0.50
Brook	1001	Q10	259.00	1141.69	1144.63	1143.80	1144.93	0.003901	4.56	77.94	74.95	0.52
Brook	1001	Q25	348.00	1141.69	1144.99	1144.38	1145.34	0.003902	5.01	106.15	80.13	0.53
Brook	1001	Q50	421.00	1141.69	1145.25	1144.68	1145.62	0.003900	5.31	126.94	83.63	0.54
Brook	1001	Q100	510.00	1141.69	1145.53	1144.92	1145.93	0.003902	5.63	149.79	87.45	0.54
Brook	1001	Q500	727.00	1141.69	1146.12	1145.40	1146.59	0.003900	6.28	198.97	95.58	0.56

HEC-RAS Plan: Existing culvert River: Unnamed Brook Reach: Brook

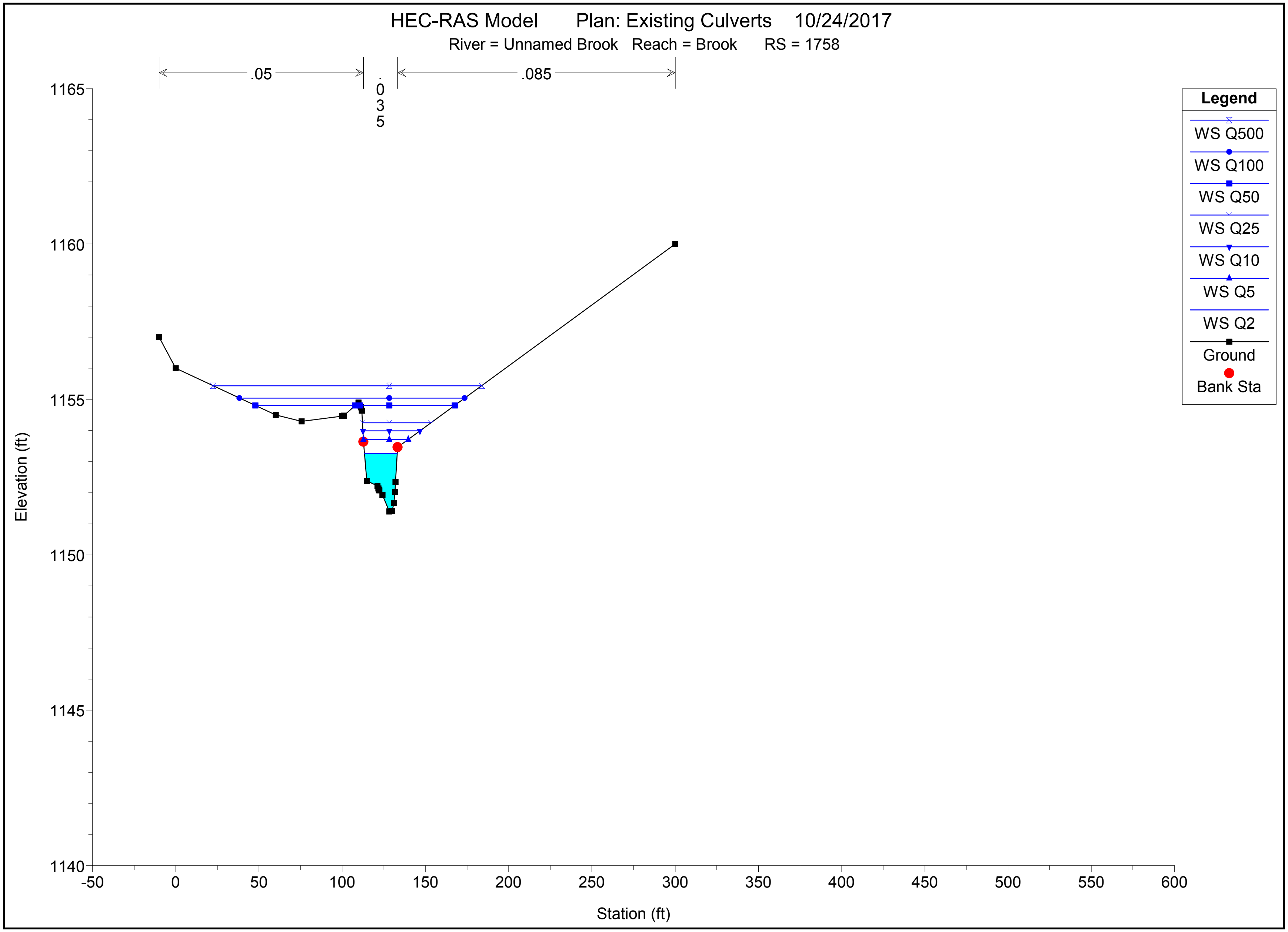
Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Brook	1758	Q2	1153.64	1153.27	0.37	3.54	0.03		117.00		19.68
Brook	1758	Q5	1154.25	1153.71	0.54	3.53	0.01	0.00	193.64	0.36	26.92
Brook	1758	Q10	1154.67	1153.99	0.68	3.59	0.01	0.05	256.24	2.71	34.28
Brook	1758	Q25	1155.16	1154.25	0.91	2.66	0.13	0.24	339.31	8.44	41.21
Brook	1758	Q50	1155.42	1154.80	0.61	0.69	0.14	25.23	369.74	26.03	116.78
Brook	1758	Q100	1155.65	1155.04	0.60	0.70	0.13	57.34	413.55	39.11	135.37
Brook	1758	Q500	1156.07	1155.44	0.63	0.82	0.12	144.14	511.68	71.19	161.44
Brook	1506	Q2	1150.07	1149.43	0.64	2.28	0.11		117.00		14.57
Brook	1506	Q5	1150.72	1150.11	0.60	1.43	0.11		194.00		25.92
Brook	1506	Q10	1151.07	1150.43	0.63	0.76	0.15	0.00	259.00		33.12
Brook	1506	Q25	1151.49	1151.00	0.49	0.26	0.13	0.23	336.77	11.00	65.77
Brook	1506	Q50	1152.47	1152.33	0.14	0.04	0.04	26.03	342.56	52.41	99.13
Brook	1506	Q100	1152.76	1152.60	0.16	0.05	0.05	39.09	402.45	68.45	104.90
Brook	1506	Q500	1153.25	1153.02	0.23	0.07	0.07	71.18	549.57	106.25	118.94
Brook	1238	Q2	1147.49	1147.22	0.27	0.11	0.06		117.00		15.39
Brook	1238	Q5	1148.58	1148.34	0.24	0.06	0.05	8.50	185.28	0.22	49.44
Brook	1238	Q10	1149.46	1149.32	0.13	0.04	0.02	56.49	200.53	1.99	109.66
Brook	1238	Q25	1151.09	1151.04	0.06	0.02	0.00	130.96	208.30	8.74	241.60
Brook	1238	Q50	1152.39	1152.38	0.01	0.00	0.00	291.70	121.27	8.03	290.24
Brook	1238	Q100	1152.67	1152.66	0.01	0.00	0.00	361.94	138.25	9.81	299.15
Brook	1238	Q500	1153.12	1153.10	0.01	0.00	0.00	532.50	180.35	14.16	313.47
Brook	1182	Q2	1147.32	1147.24	0.08			4.40	112.60		40.72
Brook	1182	Q5	1148.46	1148.39	0.07			29.92	164.07	0.02	73.96
Brook	1182	Q10	1149.40	1149.33	0.07			54.63	204.27	0.10	123.18
Brook	1182	Q25	1151.08	1151.02	0.05			93.45	253.94	0.61	236.87
Brook	1182	Q50	1152.39	1152.38	0.01			267.79	151.24	1.97	300.51
Brook	1182	Q100	1152.66	1152.66	0.01			332.15	174.60	3.25	320.45
Brook	1182	Q500	1153.11	1153.10	0.01			488.70	230.55	7.75	340.19
Brook	1165		Culvert								
Brook	1071	Q2	1144.50	1144.09	0.41	0.42	0.17		117.00		16.55
Brook	1071	Q5	1145.20	1144.66	0.53	0.42	0.22		194.00		19.43
Brook	1071	Q10	1145.65	1144.99	0.66	0.43	0.29		259.00		21.49
Brook	1071	Q25	1146.17	1145.35	0.82	0.45	0.38		348.00		28.84
Brook	1071	Q50	1146.54	1145.61	0.93	0.47	0.45		421.00		35.20
Brook	1071	Q100	1146.93	1145.89	1.04	0.48	0.51	0.11	509.89		45.42
Brook	1071	Q500	1147.72	1146.51	1.21	0.46	0.60	6.34	720.64	0.02	49.00
Brook	1001	Q2	1143.91	1143.72	0.19				117.00		20.80
Brook	1001	Q5	1144.56	1144.30	0.26				190.48	3.52	64.20
Brook	1001	Q10	1144.93	1144.63	0.30			0.02	242.71	16.27	74.95
Brook	1001	Q25	1145.34	1144.99	0.34			0.20	306.52	41.28	80.13
Brook	1001	Q50	1145.62	1145.25	0.37			0.48	354.86	65.66	83.63
Brook	1001	Q100	1145.93	1145.53	0.40			0.97	410.89	98.14	87.45
Brook	1001	Q500	1146.59	1146.12	0.47			2.86	540.58	183.55	95.58

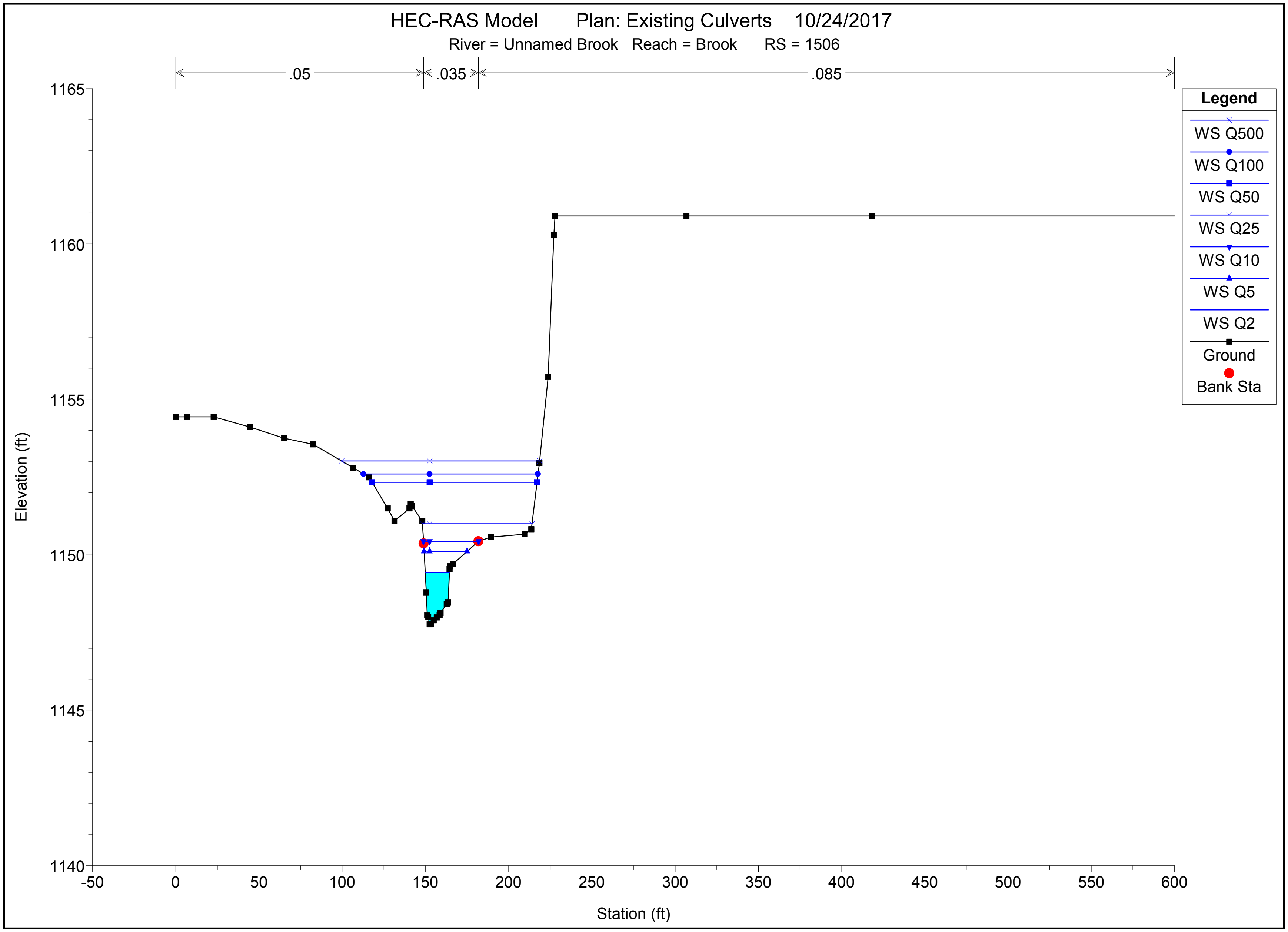
HEC-RAS Plan: Existing culvert River: Unnamed Brook Reach: Brook

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Brook	1238	Q2	1147.49	1147.22	0.27	0.11	0.06		117.00		15.39
Brook	1238	Q5	1148.58	1148.34	0.24	0.06	0.05	8.50	185.28	0.22	49.44
Brook	1238	Q10	1149.46	1149.32	0.13	0.04	0.02	56.49	200.53	1.99	109.66
Brook	1238	Q25	1151.09	1151.04	0.06	0.02	0.00	130.96	208.30	8.74	241.60
Brook	1238	Q50	1152.39	1152.38	0.01	0.00	0.00	291.70	121.27	8.03	290.24
Brook	1238	Q100	1152.67	1152.66	0.01	0.00	0.00	361.94	138.25	9.81	299.15
Brook	1238	Q500	1153.12	1153.10	0.01	0.00	0.00	532.50	180.35	14.16	313.47
Brook	1182	Q2	1147.32	1147.24	0.08			4.40	112.60		40.72
Brook	1182	Q5	1148.46	1148.39	0.07			29.92	164.07	0.02	73.96
Brook	1182	Q10	1149.40	1149.33	0.07			54.63	204.27	0.10	123.18
Brook	1182	Q25	1151.08	1151.02	0.05			93.45	253.94	0.61	236.87
Brook	1182	Q50	1152.39	1152.38	0.01			267.79	151.24	1.97	300.51
Brook	1182	Q100	1152.66	1152.66	0.01			332.15	174.60	3.25	320.45
Brook	1182	Q500	1153.11	1153.10	0.01			488.70	230.55	7.75	340.19
Brook	1165		Culvert								
Brook	1071	Q2	1144.50	1144.09	0.41	0.42	0.17		117.00		16.55
Brook	1071	Q5	1145.20	1144.66	0.53	0.42	0.22		194.00		19.43
Brook	1071	Q10	1145.65	1144.99	0.66	0.43	0.29		259.00		21.49
Brook	1071	Q25	1146.17	1145.35	0.82	0.45	0.38		348.00		28.84
Brook	1071	Q50	1146.54	1145.61	0.93	0.47	0.45		421.00		35.20
Brook	1071	Q100	1146.93	1145.89	1.04	0.48	0.51	0.11	509.89		45.42
Brook	1071	Q500	1147.72	1146.51	1.21	0.46	0.60	6.34	720.64	0.02	49.00
Brook	1001	Q2	1143.91	1143.72	0.19				117.00		20.80
Brook	1001	Q5	1144.56	1144.30	0.26				190.48	3.52	64.20
Brook	1001	Q10	1144.93	1144.63	0.30			0.02	242.71	16.27	74.95
Brook	1001	Q25	1145.34	1144.99	0.34			0.20	306.52	41.28	80.13
Brook	1001	Q50	1145.62	1145.25	0.37			0.48	354.86	65.66	83.63
Brook	1001	Q100	1145.93	1145.53	0.40			0.97	410.89	98.14	87.45
Brook	1001	Q500	1146.59	1146.12	0.47			2.86	540.58	183.55	95.58

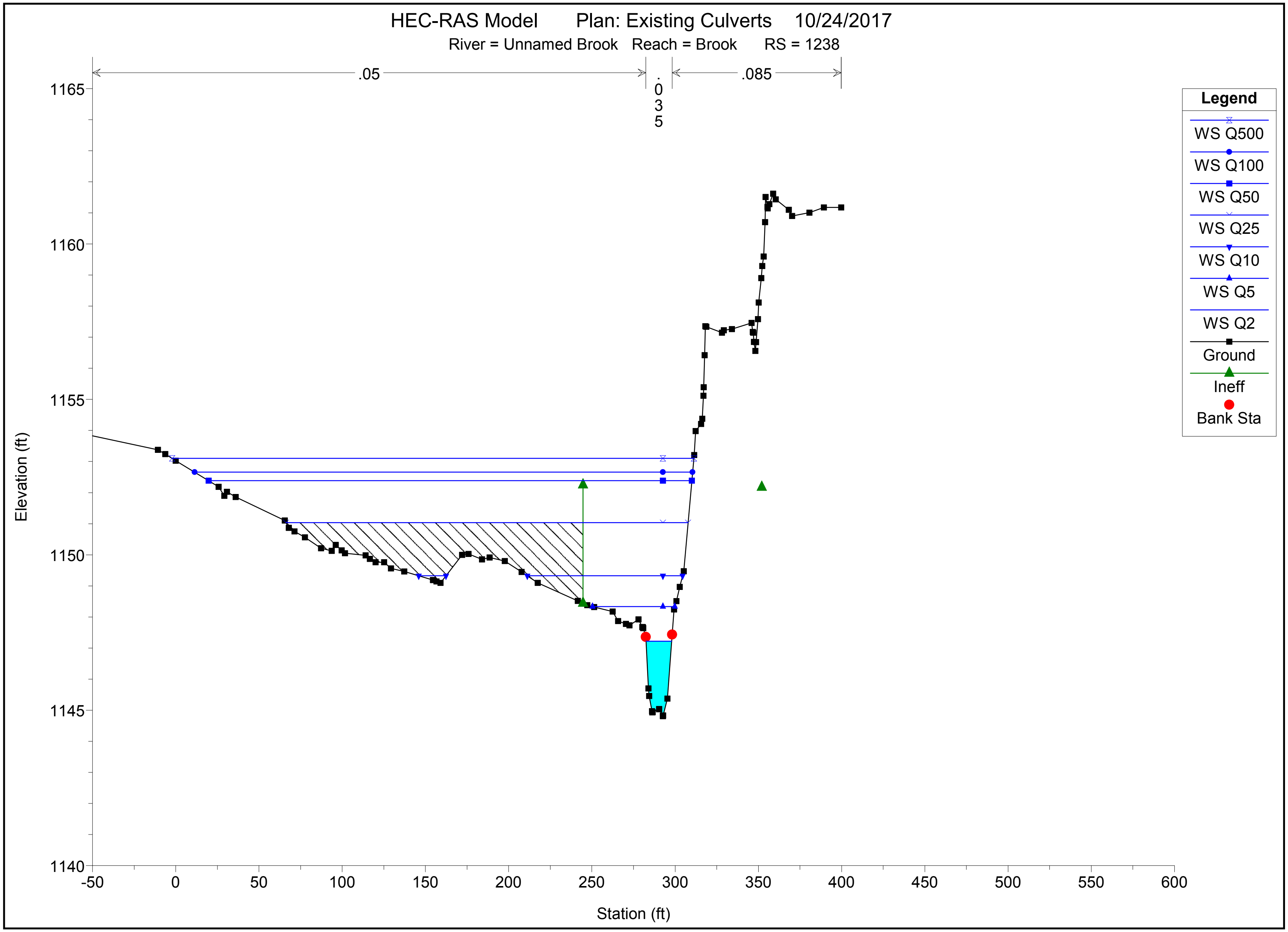
HEC-RAS Plan: Existing culvert River: Unnamed Brook Reach: Brook

Reach	River Sta	Profile	E.G. US.	W.S. US.	E.G. IC	E.G. OC	Min El Weir Flow	Q Culv Group	Q Weir	Delta WS	Culv Vel US	Culv Vel DS
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(ft)	(ft/s)	(ft/s)
Brook	1165 Culvert #1	Q2	1147.32	1147.24	1146.99	1147.31	1152.12	58.23		3.15	6.06	7.24
Brook	1165 Culvert #2	Q2	1147.32	1147.24	1147.01	1147.33	1152.12	58.77		3.15	6.17	7.26
Brook	1165 Culvert #1	Q5	1148.47	1148.39	1148.08	1148.45	1152.12	96.32		3.73	6.93	8.55
Brook	1165 Culvert #2	Q5	1148.47	1148.39	1148.12	1148.48	1152.12	97.68		3.73	7.06	8.59
Brook	1165 Culvert #1	Q10	1149.40	1149.33	1148.96	1149.39	1152.12	128.82		4.34	7.52	9.54
Brook	1165 Culvert #2	Q10	1149.40	1149.33	1149.00	1149.41	1152.12	130.18		4.34	7.64	9.59
Brook	1165 Culvert #1	Q25	1151.08	1151.02	1150.34	1151.08	1152.12	173.10		5.67	8.82	10.90
Brook	1165 Culvert #2	Q25	1151.08	1151.02	1150.42	1151.08	1152.12	174.90		5.67	8.91	10.95
Brook	1165 Culvert #1	Q50	1152.39	1152.38	1151.25	1152.39	1152.12	197.49	23.87	6.77	10.06	11.69
Brook	1165 Culvert #2	Q50	1152.39	1152.38	1151.33	1152.39	1152.12	199.64	23.87	6.77	10.17	11.76
Brook	1165 Culvert #1	Q100	1152.66	1152.66	1151.45	1152.66	1152.12	202.57	102.72	6.77	10.32	11.86
Brook	1165 Culvert #2	Q100	1152.66	1152.66	1151.53	1152.66	1152.12	204.71	102.72	6.77	10.43	11.94
Brook	1165 Culvert #1	Q500	1153.11	1153.10	1151.76	1153.11	1152.12	210.13	304.38	6.59	10.70	12.12
Brook	1165 Culvert #2	Q500	1153.11	1153.10	1151.85	1153.11	1152.12	212.48	304.38	6.59	10.82	12.21


HEC-RAS Model Plan: Existing Culverts 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1758
.05
.035
.085
Elevation (ft)
Station (ft)
1165
1160
1155
1150
1145
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Bank Sta



HEC-RAS Model Plan: Existing Culverts 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1506
.05
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Bank Sta
Elevation (ft)
1165
1160
1155
1150
1145
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
Station (ft)


HEC-RAS Model Plan: Existing Culverts 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1238
.05
.035
.085
Elevation (ft)
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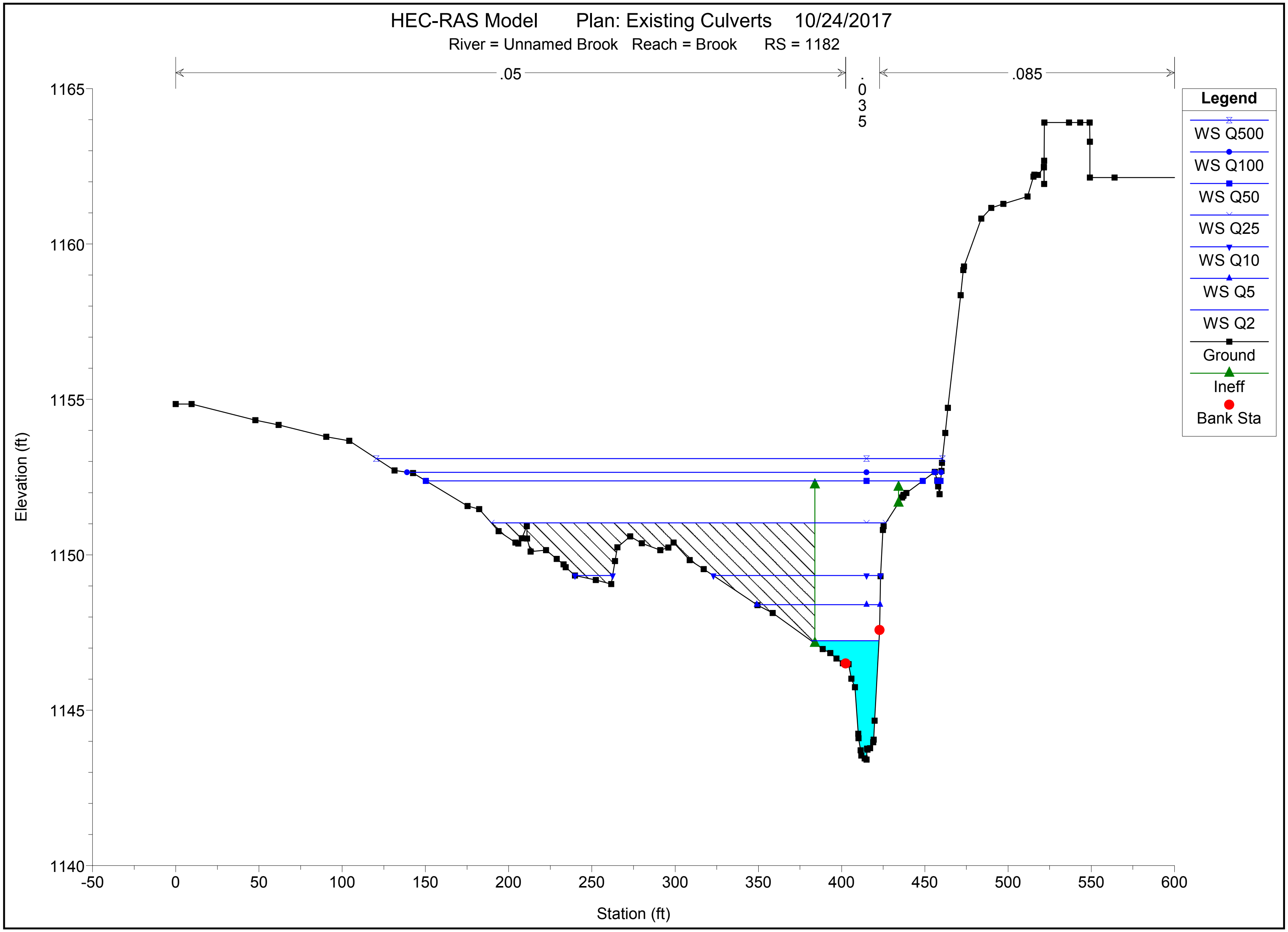
1160
1155
1150
1145
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta



HEC-RAS Model Plan: Existing Culverts 10/24/2017
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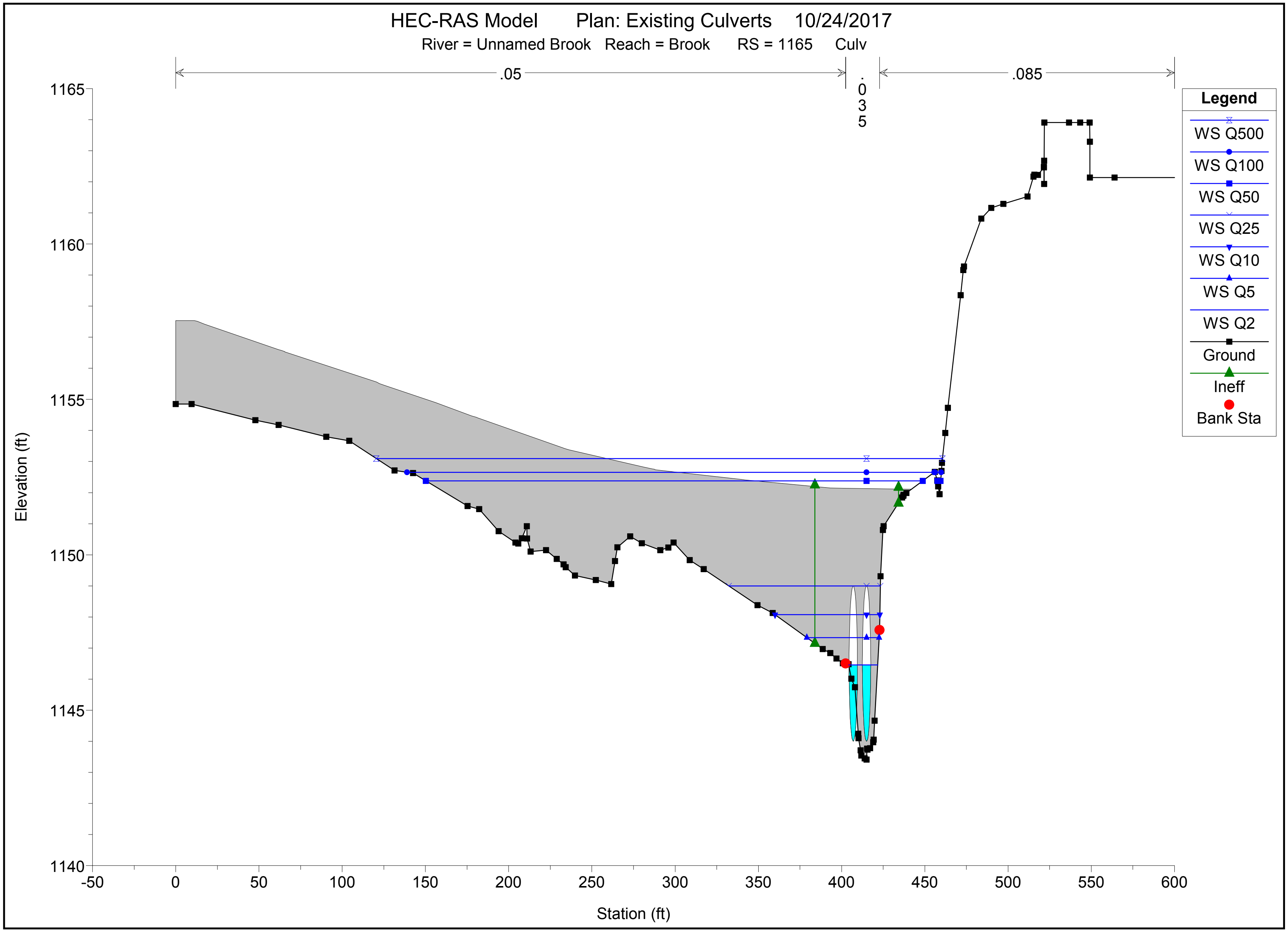
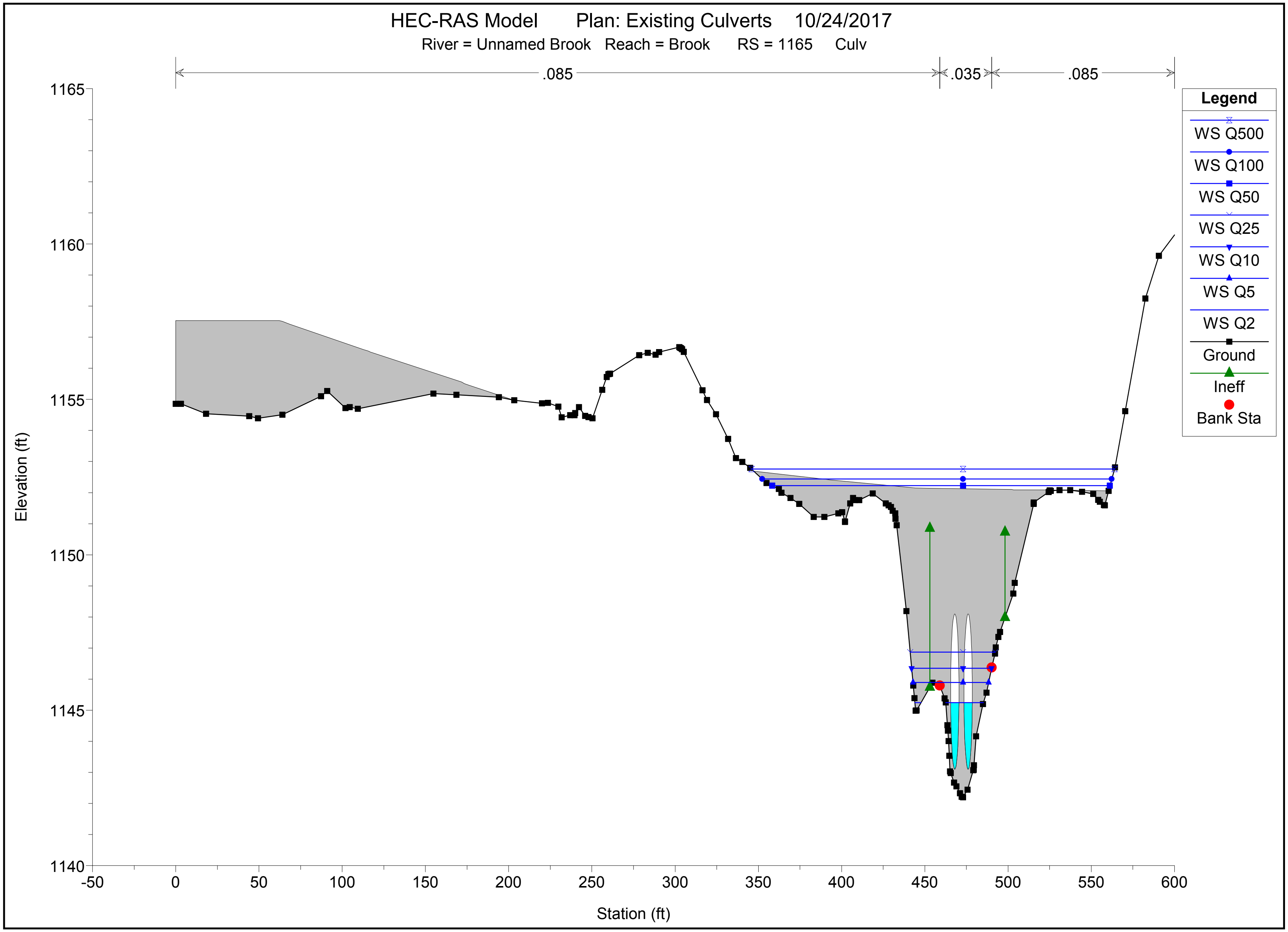
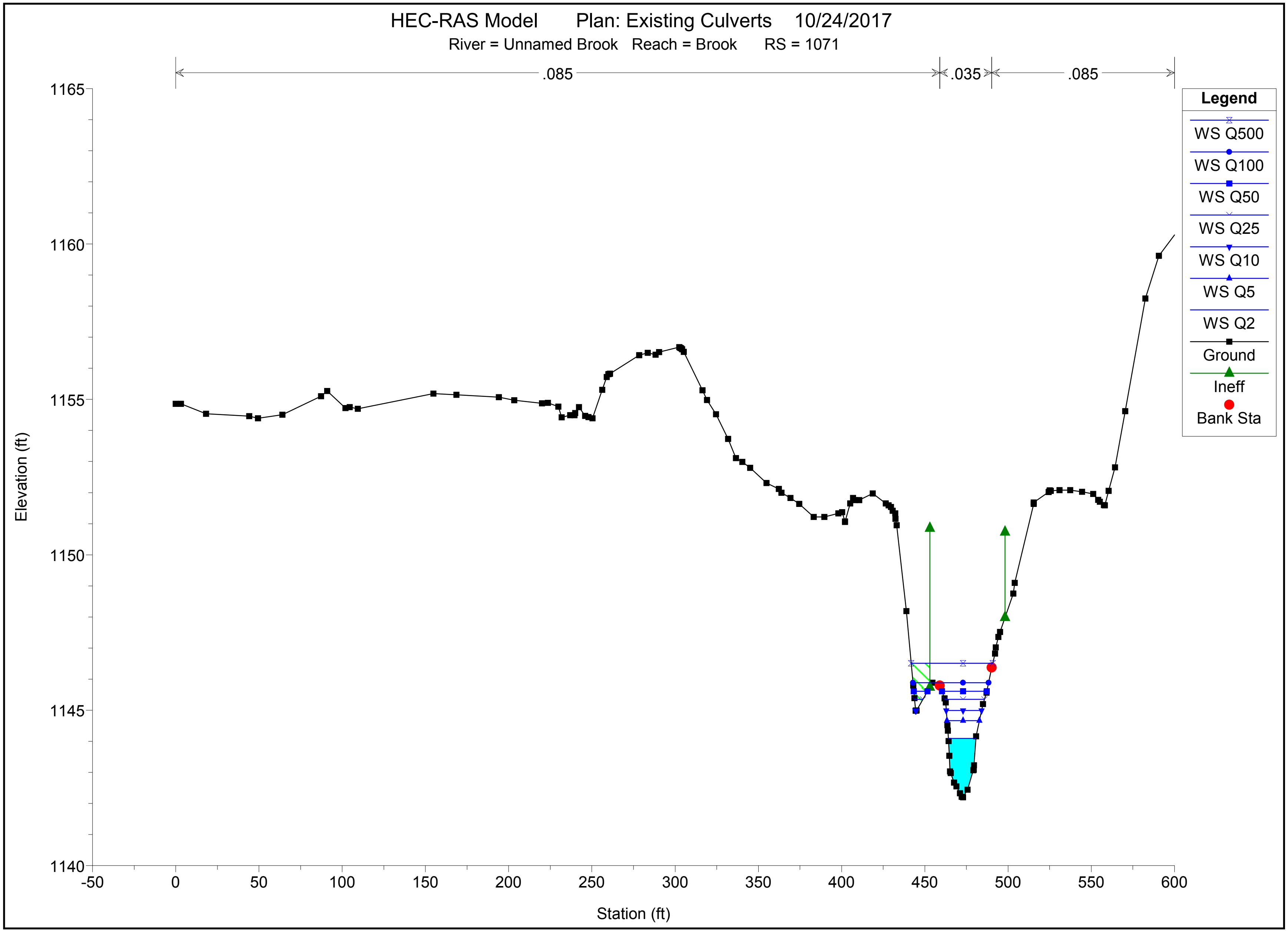
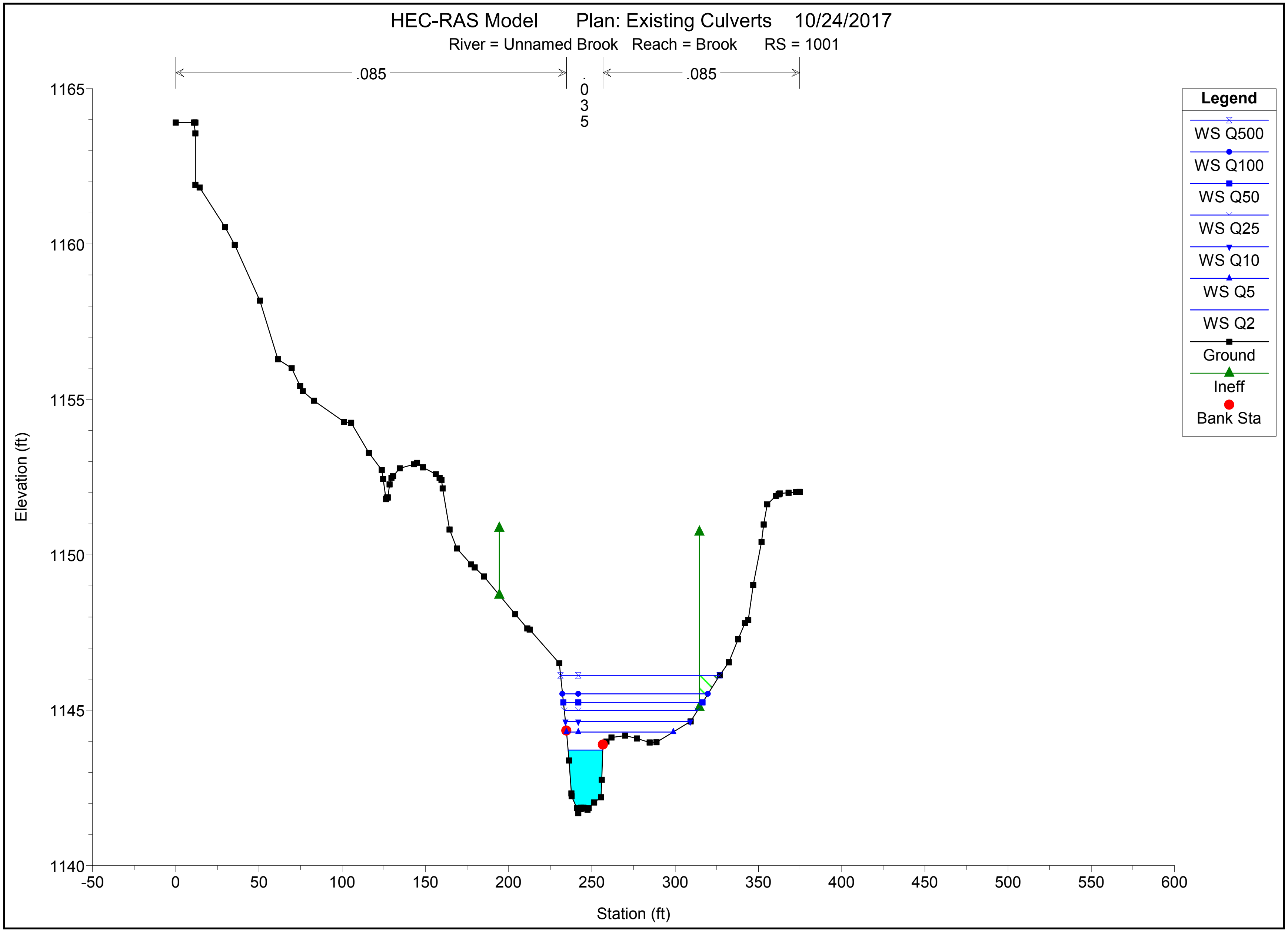
.05
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
1140
1145
1150
1155
1160
1165
Station (ft)
-50
0
50
100
150
200
250
300
350
400
450
500
550
600


HEC-RAS Model Plan: Existing Culverts 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1165 Culv
.05
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
1165
1160
1155
1150
1145
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
Station (ft)



HEC-RAS Model Plan: Existing Culverts 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1165 Culv
.085
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
1165
1160
1155
1150
1145
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
Station (ft)


HEC-RAS Model Plan: Existing Culverts 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1071
.085
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
1165
1160
1155
1150
1145
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
Station (ft)



HEC-RAS Model Plan: Existing Culverts 10/24/2017
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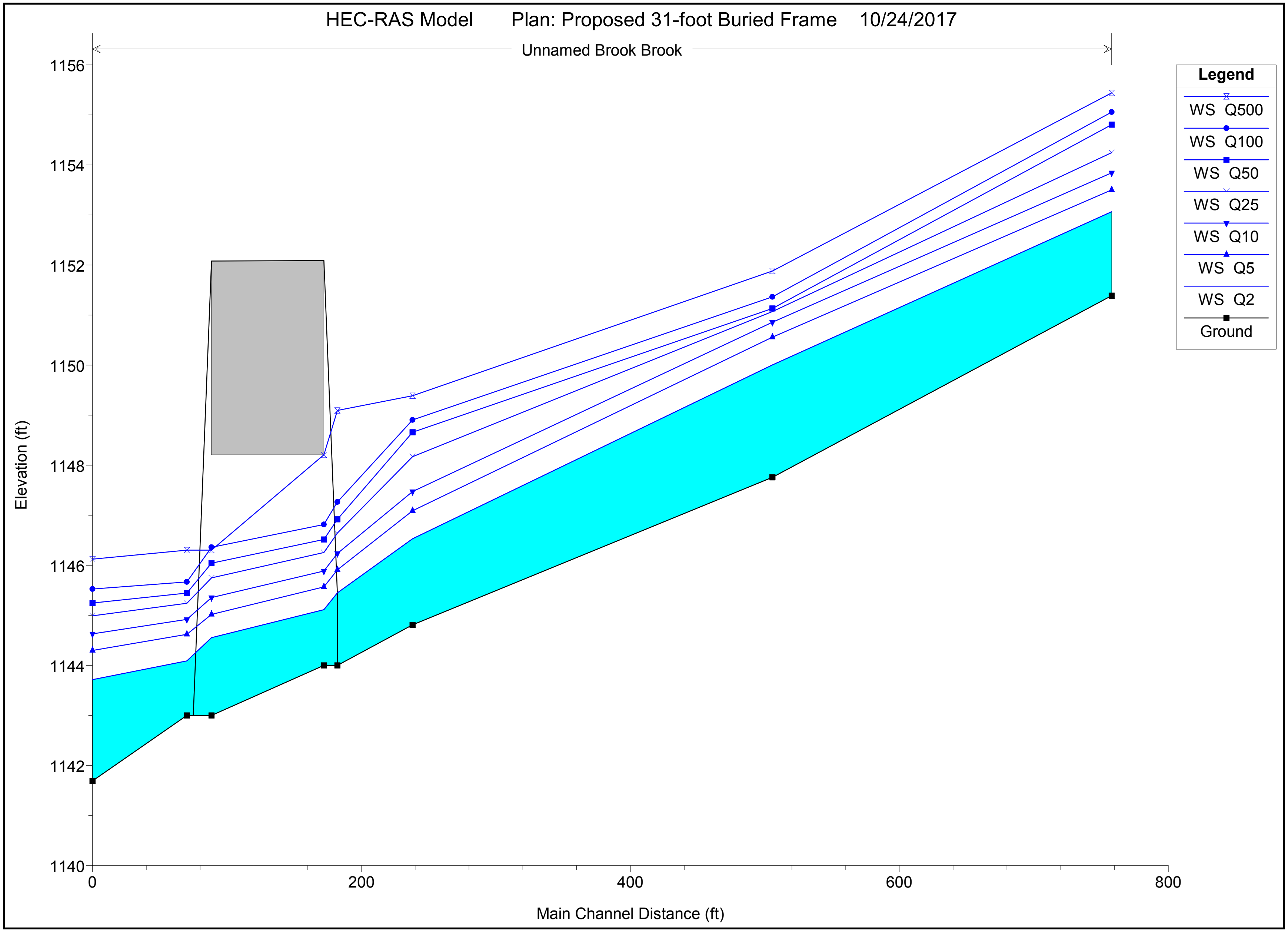
.085
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1165
1160
1155
1150
1145
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600

31 FOOT SPAN BURIED FRAME


HEC-RAS Model Plan: Proposed 31-foot Buried Frame 10/24/2017
Unnamed Brook Brook
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Elevation (ft)
1156
1154
1152
1150
1148
1146
1144
1142
1140
0
200
400
600
800
Main Channel Distance (ft)

```
                    HEC-RAS HEC-RAS 5.0.1 April 2016
                      U.S. Army Corps of Engineers
                     Hydrologic Engineering Center
                           609 Second Street
                           Davis, California

       X     X  XXXXXX   XXXX        XXXX       XX      XXXX
       X     X  X       X    X       X   X     X  X    X
       X     X  X       X            X   X    X    X   X
       XXXXXXX  XXXX    X       XXX  XXXX     XXXXXX    XXXX
       X     X  X       X            X  X     X    X        X
       X     X  X       X    X       X   X    X    X        X
       X     X  XXXXXX   XXXX        X    X   X    X   XXXXX
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PROJECT DATA
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Project File : Springfield_Hydraulics.prj
Run Date and Time: 10/24/2017 1:36:10 PM

Project in English units

Project Description:
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PLAN DATA

Plan Title: Proposed 31-foot Buried Frame
Plan File : f:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.p04

Geometry Title: Buried 31-foot
Geometry File : f:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.g04

Flow Title : Steady Flow
Flow File : f:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.f01

Plan Description:
existing culvert

Plan Summary Information:

```
Number of:  Cross Sections =    6    Multiple Openings  =    0
            Culverts       =    0    Inline Structures  =    0
            Bridges        =    1    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.33
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow
```

FLOW DATA

Flow Title: Steady Flow
Flow File : f:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.f01

Flow Data (cfs)

River	Reach	RS	Q2	Q5	Q10	Q25	Q50	Q100	Q500
Unnamed Brook	Brook	1758	117	194	259	348	421	510	727

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Unnamed Brook	Brook	Q2	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q5	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q10	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q25	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q50	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q100	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q500	Normal S = 0.0322	Normal S = 0.0039

GEOMETRY DATA

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Geometry Title: Buried 31-foot
Geometry File : f:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.g04

CROSS SECTION


RIVER: Unnamed Brook
REACH: Brook              RS: 1758

INPUT
Description:
Station Elevation Data    num=      24
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     -10    1157       0    1156   60.03  1154.5   75.66 1154.29   99.99 1154.46
  100.85 1154.47  100.99 1154.48  109.77  1154.9  111.26 1154.74  111.74 1154.64
   112.8 1153.64  114.81 1152.38  121.13 1152.22  121.79 1152.13   122.1 1152.09
  122.32 1152.07  124.12 1151.93  128.32 1151.39  130.04 1151.41  131.07 1151.66
  131.76 1152.02  132.04 1152.35  133.29 1153.46     300    1160

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     -10     .05   112.8    .035  133.29    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         112.8  133.29           252.24  252.24  252.24             .1       .3

CROSS SECTION OUTPUT  Profile #Q2

  E.G. Elev (ft)           1153.60    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.53    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1153.07    Reach Len. (ft)            252.24     252.24     252.24
  Crit W.S. (ft)           1153.07    Flow Area (sq ft)                      19.94
  E.G. Slope (ft/ft)      0.019079    Area (sq ft)                           19.94
  Q Total (cfs)             117.00    Flow (cfs)                            117.00
  Top Width (ft)             19.13    Top Width (ft)                         19.13
  Vel Total (ft/s)            5.87    Avg. Vel. (ft/s)                        5.87
  Max Chl Dpth (ft)           1.67    Hydr. Depth (ft)                        1.04
  Conv. Total (cfs)          847.0    Conv. (cfs)                            847.0
  Length Wtd. (ft)          252.24    Wetted Per. (ft)                       19.92
  Min Ch El (ft)           1151.39    Shear (lb/sq ft)                        1.19
  Alpha                       1.00    Stream Power (lb/ft s)                  7.00
  Frctn Loss (ft)             2.96    Cum Volume (acre-ft)                    0.43
  C & E Loss (ft)             0.08    Cum SA (acres)                          0.36


Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical
         depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
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the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q5

E.G. Elev (ft)	1154.22	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.72	Wt. n-Val.		0.035	0.085
W.S. Elev (ft)	1153.50	Reach Len. (ft)	252.24	252.24	252.24
Crit W.S. (ft)	1153.50	Flow Area (sq ft)		28.58	0.02
E.G. Slope (ft/ft)	0.017318	Area (sq ft)		28.58	0.02
Q Total (cfs)	194.00	Flow (cfs)		194.00	0.00
Top Width (ft)	21.36	Top Width (ft)		20.27	1.09
Vel Total (ft/s)	6.78	Avg. Vel. (ft/s)		6.79	0.18
Max Chl Dpth (ft)	2.11	Hydr. Depth (ft)		1.41	0.02
Conv. Total (cfs)	1474.2	Conv. (cfs)		1474.2	0.0
Length Wtd. (ft)	252.24	Wetted Per. (ft)		21.34	1.09
Min Ch El (ft)	1151.39	Shear (lb/sq ft)		1.45	0.02
Alpha	1.00	Stream Power (lb/ft s)		9.83	0.00
Frctn Loss (ft)	2.74	Cum Volume (acre-ft)		0.64	0.01
C & E Loss (ft)	0.13	Cum SA (acres)		0.43	0.08

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	1154.66	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.81	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1153.84	Reach Len. (ft)	252.24	252.24	252.24
Crit W.S. (ft)	1153.84	Flow Area (sq ft)	0.02	35.55	1.88
E.G. Slope (ft/ft)	0.014992	Area (sq ft)	0.02	35.55	1.88
Q Total (cfs)	259.00	Flow (cfs)	0.01	257.65	1.34
Top Width (ft)	30.49	Top Width (ft)	0.22	20.49	9.78
Vel Total (ft/s)	6.92	Avg. Vel. (ft/s)	0.64	7.25	0.71
Max Chl Dpth (ft)	2.45	Hydr. Depth (ft)	0.10	1.74	0.19
Conv. Total (cfs)	2115.3	Conv. (cfs)	0.1	2104.2	10.9
Length Wtd. (ft)	252.24	Wetted Per. (ft)	0.30	21.60	9.79
Min Ch El (ft)	1151.39	Shear (lb/sq ft)	0.07	1.54	0.18
Alpha	1.09	Stream Power (lb/ft s)	0.04	11.17	0.13
Frctn Loss (ft)	2.42	Cum Volume (acre-ft)	0.00	0.78	0.07

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  C & E Loss (ft)             0.14    Cum SA (acres)              0.00       0.44       0.26


Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical
         depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
         the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
         program defaulted to critical depth.

CROSS SECTION OUTPUT  Profile #Q25

  E.G. Elev (ft)          1155.16    Element                    Left OB    Channel   Right OB
  Vel Head (ft)              0.91    Wt. n-Val.                  0.050      0.035      0.085
  W.S. Elev (ft)          1154.25    Reach Len. (ft)            252.24     252.24     252.24
  Crit W.S. (ft)          1154.25    Flow Area (sq ft)            0.20      43.83       7.91
  E.G. Slope (ft/ft)     0.012945    Area (sq ft)                 0.20      43.83       7.91
  Q Total (cfs)            348.00    Flow (cfs)                   0.24     339.31       8.44
  Top Width (ft)            41.21    Top Width (ft)               0.64      20.49      20.08
  Vel Total (ft/s)           6.70    Avg. Vel. (ft/s)             1.24       7.74       1.07
  Max Chl Dpth (ft)          2.86    Hydr. Depth (ft)             0.30       2.14       0.39
  Conv. Total (cfs)        3058.6    Conv. (cfs)                   2.1     2982.3       74.2
  Length Wtd. (ft)         252.24    Wetted Per. (ft)             0.89      21.60      20.09
  Min Ch El (ft)          1151.39    Shear (lb/sq ft)             0.18       1.64       0.32
  Alpha                      1.30    Stream Power (lb/ft s)       0.22      12.70       0.34
  Frctn Loss (ft)            2.49    Cum Volume (acre-ft)         0.03       0.93       0.15
  C & E Loss (ft)            0.14    Cum SA (acres)               0.09       0.44       0.31


Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical
         depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
         the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
         program defaulted to critical depth.

CROSS SECTION OUTPUT  Profile #Q50

  E.G. Elev (ft)          1155.42    Element                    Left OB    Channel   Right OB
  Vel Head (ft)              0.61    Wt. n-Val.                  0.050      0.035      0.085
  W.S. Elev (ft)          1154.80    Reach Len. (ft)            252.24     252.24     252.24
  Crit W.S. (ft)          1154.80    Flow Area (sq ft)           20.89      55.23      23.02
  E.G. Slope (ft/ft)     0.007112    Area (sq ft)                20.89      55.23      23.02
  Q Total (cfs)            421.00    Flow (cfs)                  25.23     369.74      26.03
  Top Width (ft)           116.78    Top Width (ft)              62.03      20.49      34.26
  Vel Total (ft/s)           4.25    Avg. Vel. (ft/s)             1.21       6.70       1.13
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Max Chl Dpth (ft)	3.41	Hydr. Depth (ft)	0.34	2.70	0.67
Conv. Total (cfs)	4992.2	Conv. (cfs)	299.2	4384.4	308.6
Length Wtd. (ft)	252.24	Wetted Per. (ft)	62.46	21.60	34.29
Min Ch El (ft)	1151.39	Shear (lb/sq ft)	0.15	1.14	0.30
Alpha	2.19	Stream Power (lb/ft s)	0.18	7.60	0.34
Frctn Loss (ft)	2.12	Cum Volume (acre-ft)	0.16	1.04	0.22
C & E Loss (ft)	0.01	Cum SA (acres)	0.38	0.45	0.36

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q100

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1155.65	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.59	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1155.06	Reach Len. (ft)	252.24	252.24	252.24
Crit W.S. (ft)	1155.06	Flow Area (sq ft)	38.36	60.38	32.45
E.G. Slope (ft/ft)	0.006549	Area (sq ft)	38.36	60.38	32.45
Q Total (cfs)	510.00	Flow (cfs)	58.78	411.75	39.48
Top Width (ft)	136.17	Top Width (ft)	75.01	20.49	40.68
Vel Total (ft/s)	3.89	Avg. Vel. (ft/s)	1.53	6.82	1.22
Max Chl Dpth (ft)	3.67	Hydr. Depth (ft)	0.51	2.95	0.80
Conv. Total (cfs)	6301.9	Conv. (cfs)	726.3	5087.8	487.8
Length Wtd. (ft)	252.24	Wetted Per. (ft)	75.44	21.60	40.71
Min Ch El (ft)	1151.39	Shear (lb/sq ft)	0.21	1.14	0.33
Alpha	2.51	Stream Power (lb/ft s)	0.32	7.80	0.40
Frctn Loss (ft)	1.97	Cum Volume (acre-ft)	0.27	1.15	0.32
C & E Loss (ft)	0.00	Cum SA (acres)	0.54	0.45	0.39

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1156.07	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.63	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1155.44	Reach Len. (ft)	252.24	252.24	252.24

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  Crit W.S. (ft)          1155.44    Flow Area (sq ft)          70.39      68.31      50.11
  E.G. Slope (ft/ft)     0.006697    Area (sq ft)               70.39      68.31      50.11
  Q Total (cfs)            727.00    Flow (cfs)                144.33     511.44      71.23
  Top Width (ft)           161.53    Top Width (ft)             90.50      20.49      50.54
  Vel Total (ft/s)           3.85    Avg. Vel. (ft/s)            2.05       7.49       1.42
  Max Chl Dpth (ft)          4.05    Hydr. Depth (ft)            0.78       3.33       0.99
  Conv. Total (cfs)        8883.9    Conv. (cfs)               1763.7     6249.7      870.5
  Length Wtd. (ft)         252.24    Wetted Per. (ft)           90.94      21.60      50.58
  Min Ch El (ft)          1151.39    Shear (lb/sq ft)            0.32       1.32       0.41
  Alpha                      2.73    Stream Power (lb/ft s)      0.66       9.90       0.59
  Frctn Loss (ft)            1.86    Cum Volume (acre-ft)        0.63       1.41       0.52
  C & E Loss (ft)            0.01    Cum SA (acres)              0.84       0.42       0.44
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Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical
         depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
         the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
         program defaulted to critical depth.

CROSS SECTION


RIVER: Unnamed Brook
REACH: Brook              RS: 1506

INPUT
Description:
Station Elevation Data    num=      39
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1154.44    6.77 1154.44   22.76 1154.44   44.61 1154.11   65.12 1153.75
    82.6 1153.55  106.59  1152.8  116.14 1152.49  127.36 1151.49  131.49 1151.09
  140.43 1151.49  141.14 1151.63   141.9 1151.58  148.14 1151.08  150.57 1148.79
  151.14 1148.06  151.72 1147.99  152.56 1147.76  153.39 1147.78  154.99 1147.89
  156.77 1147.98  158.55 1148.06  159.01 1148.13  162.81 1148.42  163.61 1148.47
  164.55 1149.54  164.72 1149.63  166.56 1149.71  181.79 1150.43  189.42 1150.57
  209.57 1150.66  213.59 1150.82  218.46 1152.95   223.8 1155.73  227.16 1160.29
  227.79  1160.9  306.77  1160.9  418.08  1160.9  631.82  1160.9

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05  148.14    .035  181.79    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        148.14  181.79          267.56  267.56  267.56             .1       .3

CROSS SECTION OUTPUT  Profile #Q2
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			Left OB	Channel	Right OB
E.G. Elev (ft)	1150.27	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.26	Wt. n-Val.		0.035	
W.S. Elev (ft)	1150.00	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1149.44	Flow Area (sq ft)		28.38	
E.G. Slope (ft/ft)	0.007919	Area (sq ft)		28.38	
Q Total (cfs)	117.00	Flow (cfs)		117.00	
Top Width (ft)	23.49	Top Width (ft)		23.49	
Vel Total (ft/s)	4.12	Avg. Vel. (ft/s)		4.12	
Max Chl Dpth (ft)	2.24	Hydr. Depth (ft)		1.21	
Conv. Total (cfs)	1314.8	Conv. (cfs)		1314.8	
Length Wtd. (ft)	267.56	Wetted Per. (ft)		24.90	
Min Ch El (ft)	1147.76	Shear (lb/sq ft)		0.56	
Alpha	1.00	Stream Power (lb/ft s)		2.32	
Frctn Loss (ft)	3.05	Cum Volume (acre-ft)		0.29	
C & E Loss (ft)	0.04	Cum SA (acres)		0.23	

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q5

E.G. Elev (ft)	1150.85	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.29	Wt. n-Val.		0.035	0.085
W.S. Elev (ft)	1150.56	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1150.11	Flow Area (sq ft)		44.71	0.46
E.G. Slope (ft/ft)	0.007453	Area (sq ft)		44.71	0.46
Q Total (cfs)	194.00	Flow (cfs)		193.89	0.11
Top Width (ft)	40.19	Top Width (ft)		33.10	7.09
Vel Total (ft/s)	4.29	Avg. Vel. (ft/s)		4.34	0.24
Max Chl Dpth (ft)	2.80	Hydr. Depth (ft)		1.35	0.07
Conv. Total (cfs)	2247.2	Conv. (cfs)		2245.9	1.3
Length Wtd. (ft)	267.56	Wetted Per. (ft)		34.74	7.09
Min Ch El (ft)	1147.76	Shear (lb/sq ft)		0.60	0.03
Alpha	1.02	Stream Power (lb/ft s)		2.60	0.01
Frctn Loss (ft)	2.86	Cum Volume (acre-ft)		0.43	0.01
C & E Loss (ft)	0.06	Cum SA (acres)		0.28	0.06

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	1151.19	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.		0.035	0.085
W.S. Elev (ft)	1150.86	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1150.43	Flow Area (sq ft)		54.67	8.15
E.G. Slope (ft/ft)	0.006669	Area (sq ft)		54.67	8.15
Q Total (cfs)	259.00	Flow (cfs)		254.31	4.69
Top Width (ft)	65.31	Top Width (ft)		33.42	31.89
Vel Total (ft/s)	4.12	Avg. Vel. (ft/s)		4.65	0.57
Max Chl Dpth (ft)	3.10	Hydr. Depth (ft)		1.64	0.26
Conv. Total (cfs)	3171.4	Conv. (cfs)		3114.0	57.4
Length Wtd. (ft)	267.56	Wetted Per. (ft)		35.18	31.90
Min Ch El (ft)	1147.76	Shear (lb/sq ft)		0.65	0.11
Alpha	1.25	Stream Power (lb/ft s)		3.01	0.06
Frctn Loss (ft)	2.63	Cum Volume (acre-ft)	0.00	0.52	0.04
C & E Loss (ft)	0.07	Cum SA (acres)	0.00	0.28	0.14

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q25

E.G. Elev (ft)	1151.51	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.44	Wt. n-Val.		0.035	0.085
W.S. Elev (ft)	1151.07	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1150.79	Flow Area (sq ft)		61.71	14.90
E.G. Slope (ft/ft)	0.007785	Area (sq ft)		61.71	14.90
Q Total (cfs)	348.00	Flow (cfs)		334.31	13.69
Top Width (ft)	66.01	Top Width (ft)		33.64	32.37
Vel Total (ft/s)	4.54	Avg. Vel. (ft/s)		5.42	0.92
Max Chl Dpth (ft)	3.31	Hydr. Depth (ft)		1.83	0.46
Conv. Total (cfs)	3944.2	Conv. (cfs)		3789.1	155.1
Length Wtd. (ft)	267.56	Wetted Per. (ft)		35.49	32.43
Min Ch El (ft)	1147.76	Shear (lb/sq ft)		0.85	0.22
Alpha	1.37	Stream Power (lb/ft s)		4.58	0.21
Frctn Loss (ft)	2.37	Cum Volume (acre-ft)	0.03	0.63	0.08
C & E Loss (ft)	0.05	Cum SA (acres)	0.09	0.29	0.16

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1151.72	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.59	Wt. n-Val.	0.050	0.035	0.085

W.S. Elev (ft)	1151.13	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1150.99	Flow Area (sq ft)	0.04	63.78	16.90
E.G. Slope (ft/ft)	0.010082	Area (sq ft)	0.04	63.78	16.90
Q Total (cfs)	421.00	Flow (cfs)	0.01	401.84	19.15
Top Width (ft)	68.14	Top Width (ft)	1.98	33.65	32.51
Vel Total (ft/s)	5.22	Avg. Vel. (ft/s)	0.24	6.30	1.13
Max Chl Dpth (ft)	3.37	Hydr. Depth (ft)	0.02	1.90	0.52
Conv. Total (cfs)	4192.9	Conv. (cfs)	0.1	4002.1	190.7
Length Wtd. (ft)	267.56	Wetted Per. (ft)	1.99	35.50	32.58
Min Ch El (ft)	1147.76	Shear (lb/sq ft)	0.01	1.13	0.33
Alpha	1.40	Stream Power (lb/ft s)	0.00	7.12	0.37
Frctn Loss (ft)	2.28	Cum Volume (acre-ft)	0.10	0.69	0.11
C & E Loss (ft)	0.02	Cum SA (acres)	0.20	0.29	0.17

Warning: Divided flow computed for this cross-section.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	1152.00	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.63	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1151.37	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1151.23	Flow Area (sq ft)	1.76	71.70	24.61
E.G. Slope (ft/ft)	0.009508	Area (sq ft)	1.76	71.70	24.61
Q Total (cfs)	510.00	Flow (cfs)	1.37	474.25	34.38
Top Width (ft)	79.30	Top Width (ft)	12.60	33.65	33.05
Vel Total (ft/s)	5.20	Avg. Vel. (ft/s)	0.78	6.61	1.40
Max Chl Dpth (ft)	3.61	Hydr. Depth (ft)	0.14	2.13	0.74
Conv. Total (cfs)	5230.3	Conv. (cfs)	14.1	4863.7	352.6
Length Wtd. (ft)	267.56	Wetted Per. (ft)	12.63	35.50	33.17
Min Ch El (ft)	1147.76	Shear (lb/sq ft)	0.08	1.20	0.44
Alpha	1.51	Stream Power (lb/ft s)	0.06	7.93	0.62
Frctn Loss (ft)	2.25	Cum Volume (acre-ft)	0.16	0.77	0.15
C & E Loss (ft)	0.02	Cum SA (acres)	0.28	0.29	0.18

Warning: Divided flow computed for this cross-section.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1152.56	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.68	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1151.88	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1151.71	Flow Area (sq ft)	12.46	89.02	41.92
E.G. Slope (ft/ft)	0.008171	Area (sq ft)	12.46	89.02	41.92
Q Total (cfs)	727.00	Flow (cfs)	20.91	630.58	75.51

Top Width (ft)	93.04	Top Width (ft)	25.17	33.65	34.23
Vel Total (ft/s)	5.07	Avg. Vel. (ft/s)	1.68	7.08	1.80
Max Chl Dpth (ft)	4.12	Hydr. Depth (ft)	0.50	2.65	1.22
Conv. Total (cfs)	8042.4	Conv. (cfs)	231.3	6975.8	835.4
Length Wtd. (ft)	267.56	Wetted Per. (ft)	25.25	35.50	34.45
Min Ch El (ft)	1147.76	Shear (lb/sq ft)	0.25	1.28	0.62
Alpha	1.71	Stream Power (lb/ft s)	0.42	9.06	1.12
Frctn Loss (ft)	2.17	Cum Volume (acre-ft)	0.39	0.95	0.26
C & E Loss (ft)	0.03	Cum SA (acres)	0.50	0.26	0.20

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION

RIVER: Unnamed Brook
REACH: Brook RS: 1238

INPUT
Description:
Station Elevation Data num= 101

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1154.64	50.59	1153.89	53.33	1153.84	53.34	1153.84	94.44	1153.37
98.25	1153.25	130.83	1152.19	134.01	1151.92	135.47	1152.03	140.41	1151.88
170.3	1151.1	172.75	1150.87	176.02	1150.76	182.19	1150.56	192.01	1150.21
198.4	1150.13	200.79	1150.32	204.45	1150.14	206.36	1150.05	218.78	1149.98
221.4	1149.87	224.79	1149.76	229.82	1149.76	233.95	1149.56	242.01	1149.46
259.14	1149.19	259.31	1149.19	261.38	1149.14	263.82	1149.1	276.67	1150
280.62	1150.03	288.67	1149.85	293.32	1149.91	302.36	1149.8	312.42	1149.45
322.09	1149.1	346.3	1148.52	351.96	1148.38	356.11	1148.32	367.1	1148.17
370.45	1147.87	375.2	1147.78	377.34	1147.73	382.61	1147.92	384.98	1147.68
385.08	1147.67	385.2	1147.67	385.33	1147.66	385.47	1147.64	387.13	1147.36
388.69	1145.7	389.07	1145.46	390.86	1144.97	390.97	1144.93	391.21	1144.94
395.07	1145.04	395.13	1145.03	397.3	1144.82	397.38	1144.81	397.49	1144.83
400.05	1145.37	402.95	1147.43	404.03	1148.24	405.46	1148.51	407.5	1148.97
409.84	1149.47	416.14	1153.21	417.06	1153.98	420.28	1154.21	421.02	1154.38
421.74	1155.13	421.75	1155.14	422.51	1156.57	422.94	1157.35	423.41	1157.34
432.83	1157.15	434.03	1157.21	438.74	1157.25	450.64	1157.45	451.28	1157.17
451.62	1157.15	452.03	1156.85	452.88	1156.55	453.31	1156.84	454.4	1157.57
454.95	1158.12	456.45	1158.89	457	1159.29	457.91	1159.6	458.77	1160.7
459.07	1161.51	460.13	1161.19	460.37	1161.15	461.41	1161.29	463.63	1161.62
465.15	1161.44	473.05	1161.1	475.01	1160.9	485.41	1161.01	494.07	1161.18
504.45	1161.18								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	387.13	.035	402.95	.085

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        387.13  402.95            55.99   55.99   55.99            .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
       0  349.37 1152.13       F

CROSS SECTION OUTPUT  Profile #Q2

  E.G. Elev (ft)           1147.18    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.65    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1146.53    Reach Len. (ft)             55.99      55.99      55.99
  Crit W.S. (ft)           1146.53    Flow Area (sq ft)                      18.06
  E.G. Slope (ft/ft)      0.017733    Area (sq ft)                           18.06
  Q Total (cfs)             117.00    Flow (cfs)                            117.00
  Top Width (ft)             13.78    Top Width (ft)                         13.78
  Vel Total (ft/s)            6.48    Avg. Vel. (ft/s)                        6.48
  Max Chl Dpth (ft)           1.72    Hydr. Depth (ft)                        1.31
  Conv. Total (cfs)          878.6    Conv. (cfs)                            878.6
  Length Wtd. (ft)           55.99    Wetted Per. (ft)                       14.72
  Min Ch El (ft)           1144.81    Shear (lb/sq ft)                        1.36
  Alpha                       1.00    Stream Power (lb/ft s)                  8.80
  Frctn Loss (ft)             0.55    Cum Volume (acre-ft)                    0.15
  C & E Loss (ft)             0.13    Cum SA (acres)                          0.12


Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical
         depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
         the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
         program defaulted to critical depth.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q5

  E.G. Elev (ft)           1147.95    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.86    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1147.09    Reach Len. (ft)             55.99      55.99      55.99
  Crit W.S. (ft)           1147.09    Flow Area (sq ft)                      26.11
  E.G. Slope (ft/ft)      0.016531    Area (sq ft)                           26.11
  Q Total (cfs)             194.00    Flow (cfs)                            194.00
  Top Width (ft)             15.09    Top Width (ft)                         15.09
  Vel Total (ft/s)            7.43    Avg. Vel. (ft/s)                        7.43
  Max Chl Dpth (ft)           2.28    Hydr. Depth (ft)                        1.73
  Conv. Total (cfs)         1508.9    Conv. (cfs)                           1508.9
  Length Wtd. (ft)           55.99    Wetted Per. (ft)                       16.45
  Min Ch El (ft)           1144.81    Shear (lb/sq ft)                        1.64
```

Alpha	1.00	Stream Power (lb/ft s)		12.17	
Frctn Loss (ft)	0.56	Cum Volume (acre-ft)		0.21	0.01
C & E Loss (ft)	0.16	Cum SA (acres)		0.13	0.03

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q10

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1148.49	Wt. n-Val.	0.050	0.035	0.000
Vel Head (ft)	1.01	Reach Len. (ft)	55.99	55.99	55.99
W.S. Elev (ft)	1147.48	Flow Area (sq ft)	0.04	32.11	0.00
Crit W.S. (ft)	1147.48	Area (sq ft)	0.04	32.11	0.00
E.G. Slope (ft/ft)	0.015953	Flow (cfs)	0.02	258.98	0.00
Q Total (cfs)	259.00	Top Width (ft)	0.69	15.82	0.06
Top Width (ft)	16.57	Avg. Vel. (ft/s)	0.56	8.07	0.15
Vel Total (ft/s)	8.06	Hydr. Depth (ft)	0.06	2.03	0.02
Max Chl Dpth (ft)	2.67	Conv. (cfs)	0.2	2050.4	0.0
Conv. Total (cfs)	2050.6	Wetted Per. (ft)	0.69	17.41	0.08
Length Wtd. (ft)	55.99	Shear (lb/sq ft)	0.06	1.84	
Min Ch El (ft)	1144.81	Stream Power (lb/ft s)	0.03	14.82	
Alpha	1.00	Cum Volume (acre-ft)	0.00	0.25	0.02
Frctn Loss (ft)	0.55	Cum SA (acres)	0.00	0.13	0.04
C & E Loss (ft)	0.18				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q25

E.G. Elev (ft)	1149.09	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.92	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1148.17	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1148.17	Flow Area (sq ft)	7.06	43.07	0.36
E.G. Slope (ft/ft)	0.010159	Area (sq ft)	7.06	43.07	0.36
Q Total (cfs)	348.00	Flow (cfs)	10.53	337.19	0.28
Top Width (ft)	36.82	Top Width (ft)	20.01	15.82	0.98
Vel Total (ft/s)	6.89	Avg. Vel. (ft/s)	1.49	7.83	0.78
Max Chl Dpth (ft)	3.36	Hydr. Depth (ft)	0.35	2.72	0.37
Conv. Total (cfs)	3452.6	Conv. (cfs)	104.4	3345.3	2.8
Length Wtd. (ft)	55.99	Wetted Per. (ft)	20.07	17.41	1.23
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.22	1.57	0.19
Alpha	1.25	Stream Power (lb/ft s)	0.33	12.28	0.15
Frctn Loss (ft)	0.44	Cum Volume (acre-ft)	0.01	0.30	0.04
C & E Loss (ft)	0.13	Cum SA (acres)	0.02	0.14	0.05

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1149.43	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.77	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1148.66	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1148.66	Flow Area (sq ft)	23.39	50.85	1.35
E.G. Slope (ft/ft)	0.007296	Area (sq ft)	24.35	50.85	1.35
Q Total (cfs)	421.00	Flow (cfs)	43.12	376.82	1.07
Top Width (ft)	65.68	Top Width (ft)	46.68	15.82	3.18
Vel Total (ft/s)	5.57	Avg. Vel. (ft/s)	1.84	7.41	0.79
Max Chl Dpth (ft)	3.85	Hydr. Depth (ft)	0.62	3.21	0.42
Conv. Total (cfs)	4928.7	Conv. (cfs)	504.8	4411.4	12.5
Length Wtd. (ft)	55.99	Wetted Per. (ft)	37.82	17.41	3.49
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.28	1.33	0.18
Alpha	1.60	Stream Power (lb/ft s)	0.52	9.86	0.14
Frctn Loss (ft)	0.38	Cum Volume (acre-ft)	0.02	0.34	0.05
C & E Loss (ft)	0.06	Cum SA (acres)	0.05	0.14	0.06

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate

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        the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
        water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
        program defaulted to critical depth.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q100

  E.G. Elev (ft)            1149.74    Element                     Left OB    Channel   Right OB
  Vel Head (ft)                0.83    Wt. n-Val.                   0.050      0.035      0.085
  W.S. Elev (ft)            1148.91    Reach Len. (ft)              55.99      55.99      55.99
  Crit W.S. (ft)            1148.91    Flow Area (sq ft)            32.70      54.75       2.27
  E.G. Slope (ft/ft)       0.007483    Area (sq ft)                 37.12      54.75       2.27
  Q Total (cfs)              510.00    Flow (cfs)                   76.28     431.58       2.13
  Top Width (ft)              77.05    Top Width (ft)               56.96      15.82       4.27
  Vel Total (ft/s)             5.68    Avg. Vel. (ft/s)              2.33       7.88       0.94
  Max Chl Dpth (ft)            4.10    Hydr. Depth (ft)              0.87       3.46       0.53
  Conv. Total (cfs)          5895.7    Conv. (cfs)                  881.8     4989.2       24.7
  Length Wtd. (ft)            55.99    Wetted Per. (ft)             37.82      17.41       4.61
  Min Ch El (ft)            1144.81    Shear (lb/sq ft)              0.40       1.47       0.23
  Alpha                        1.65    Stream Power (lb/ft s)        0.94      11.58       0.22
  Frctn Loss (ft)              0.37    Cum Volume (acre-ft)          0.04       0.38       0.07
  C & E Loss (ft)              0.06    Cum SA (acres)                0.07       0.14       0.06


Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical
        depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
        the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
        water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
        program defaulted to critical depth.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q500

  E.G. Elev (ft)            1150.37    Element                     Left OB    Channel   Right OB
  Vel Head (ft)                0.98    Wt. n-Val.                   0.050      0.035      0.085
  W.S. Elev (ft)            1149.39    Reach Len. (ft)              55.99      55.99      55.99
  Crit W.S. (ft)            1149.39    Flow Area (sq ft)            50.93      62.39       4.87
  E.G. Slope (ft/ft)       0.008024    Area (sq ft)                 71.92      62.39       4.87
  Q Total (cfs)              727.00    Flow (cfs)                  165.35     555.62       6.03
  Top Width (ft)             116.84    Top Width (ft)               94.50      15.82       6.51
  Vel Total (ft/s)             6.15    Avg. Vel. (ft/s)              3.25       8.91       1.24
  Max Chl Dpth (ft)            4.58    Hydr. Depth (ft)              1.35       3.94       0.75
  Conv. Total (cfs)          8115.9    Conv. (cfs)                 1845.8     6202.7       67.4
  Length Wtd. (ft)            55.99    Wetted Per. (ft)             37.82      17.41       6.90
  Min Ch El (ft)            1144.81    Shear (lb/sq ft)              0.67       1.80       0.35
  Alpha                        1.67    Stream Power (lb/ft s)        2.19      15.99       0.44
  Frctn Loss (ft)              0.20    Cum Volume (acre-ft)          0.13       0.49       0.11
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  C & E Loss (ft)            0.18    Cum SA (acres)              0.14       0.11       0.07


Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical
         depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross
         sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
         program defaulted to critical depth.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION


RIVER: Unnamed Brook
REACH: Brook              RS: 1182

INPUT
Description:
Station Elevation Data    num=      79
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1154.85    9.59 1154.85    47.9 1154.33   61.73 1154.18   90.45  1153.8
   104.2 1153.67  131.47 1152.71  142.49 1152.63  175.28 1151.57  182.35 1151.47
  193.98 1150.76  204.13 1150.39  205.72 1150.36  207.86 1150.53  210.87 1150.92
  211.03 1150.52   213.2  1150.1  222.43 1150.15  228.92 1149.87  233.05 1149.69
  234.27  1149.6  239.83 1149.33   252.3 1149.19  261.59 1149.06  263.91  1149.8
  265.27 1150.24  272.96 1150.59  280.01 1150.37  291.07 1150.15  295.94 1150.23
  299.06 1150.39  308.81 1149.83  317.19 1149.54  349.44 1148.38  358.53 1148.13
  388.59 1146.97  393.24 1146.84  396.86 1146.66     397 1146.25     399 1146.25
   403.5    1144   421.5    1144     426 1146.25     428 1146.25  436.36 1151.84
  437.05  1151.9  437.24 1151.93  438.96 1151.99  456.04 1152.67  457.37 1152.39
  457.68 1152.37  458.07  1152.2  458.81 1151.95  459.95  1152.7  460.33 1152.96
  462.33 1153.92   463.9 1154.73  471.48 1158.35  473.12 1159.16  473.56 1159.28
  483.97 1160.82  489.92 1161.16  497.15 1161.29  511.64 1161.53  515.27 1162.17
  515.79 1162.23  518.02 1162.22  521.55 1162.47  521.57 1162.48  521.69 1161.93
  521.71 1162.68  521.77 1163.91  536.59 1163.91  543.33 1163.91  549.08 1163.91
   549.1 1163.29  549.13 1162.14  563.91 1162.14  790.85 1162.14

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05     399    .035     426    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
          399     426          111.86  111.86  111.86             .3        .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
```

```
      0  390.62 1152.13       F
  438.87  790.85 1152.13       F
```

CROSS SECTION OUTPUT Profile #Q2

```
  E.G. Elev (ft)           1145.68    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.23    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1145.45    Reach Len. (ft)             10.00      10.00      10.00
  Crit W.S. (ft)           1145.05    Flow Area (sq ft)                      30.26
  E.G. Slope (ft/ft)      0.006253    Area (sq ft)                           30.26
  Q Total (cfs)             117.00    Flow (cfs)                            117.00
  Top Width (ft)             23.79    Top Width (ft)                         23.79
  Vel Total (ft/s)            3.87    Avg. Vel. (ft/s)                        3.87
  Max Chl Dpth (ft)           1.45    Hydr. Depth (ft)                        1.27
  Conv. Total (cfs)         1479.6    Conv. (cfs)                           1479.6
  Length Wtd. (ft)           10.00    Wetted Per. (ft)                       24.48
  Min Ch El (ft)           1144.00    Shear (lb/sq ft)                        0.48
  Alpha                       1.00    Stream Power (lb/ft s)                  1.87
  Frctn Loss (ft)             0.09    Cum Volume (acre-ft)                    0.12
  C & E Loss (ft)             0.06    Cum SA (acres)                          0.09
```

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q5

```
  E.G. Elev (ft)           1146.25    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.34    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1145.91    Reach Len. (ft)             10.00      10.00      10.00
  Crit W.S. (ft)           1145.45    Flow Area (sq ft)                      41.62
  E.G. Slope (ft/ft)      0.006612    Area (sq ft)                           41.62
  Q Total (cfs)             194.00    Flow (cfs)                            194.00
  Top Width (ft)             25.63    Top Width (ft)                         25.63
  Vel Total (ft/s)            4.66    Avg. Vel. (ft/s)                        4.66
  Max Chl Dpth (ft)           1.91    Hydr. Depth (ft)                        1.62
  Conv. Total (cfs)         2385.9    Conv. (cfs)                           2385.9
  Length Wtd. (ft)           10.00    Wetted Per. (ft)                       26.53
  Min Ch El (ft)           1144.00    Shear (lb/sq ft)                        0.65
  Alpha                       1.00    Stream Power (lb/ft s)                  3.02
  Frctn Loss (ft)             0.09    Cum Volume (acre-ft)                    0.16       0.01
  C & E Loss (ft)             0.06    Cum SA (acres)                          0.10       0.03
```

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q10

			Left OB	Channel	Right OB
E.G. Elev (ft)	1146.65	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.41	Wt. n-Val.		0.035	
W.S. Elev (ft)	1146.24	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)	1145.74	Flow Area (sq ft)		50.29	
E.G. Slope (ft/ft)	0.006743	Area (sq ft)		50.29	
Q Total (cfs)	259.00	Flow (cfs)		259.00	
Top Width (ft)	26.95	Top Width (ft)		26.95	
Vel Total (ft/s)	5.15	Avg. Vel. (ft/s)		5.15	
Max Chl Dpth (ft)	2.24	Hydr. Depth (ft)		1.87	
Conv. Total (cfs)	3154.1	Conv. (cfs)		3154.1	
Length Wtd. (ft)	10.00	Wetted Per. (ft)		28.01	
Min Ch El (ft)	1144.00	Shear (lb/sq ft)		0.76	
Alpha	1.00	Stream Power (lb/ft s)		3.89	
Frctn Loss (ft)	0.09	Cum Volume (acre-ft)	0.00	0.20	0.02
C & E Loss (ft)	0.06	Cum SA (acres)	0.00	0.11	0.04

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q25

E.G. Elev (ft)	1147.14	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.49	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1146.64	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)	1146.09	Flow Area (sq ft)	0.81	61.26	0.90
E.G. Slope (ft/ft)	0.006268	Area (sq ft)	0.81	61.26	0.90
Q Total (cfs)	348.00	Flow (cfs)	0.93	346.47	0.60
Top Width (ft)	31.72	Top Width (ft)	2.13	27.00	2.59
Vel Total (ft/s)	5.53	Avg. Vel. (ft/s)	1.14	5.66	0.67
Max Chl Dpth (ft)	2.64	Hydr. Depth (ft)	0.38	2.27	0.35
Conv. Total (cfs)	4395.7	Conv. (cfs)	11.7	4376.3	7.6
Length Wtd. (ft)	10.00	Wetted Per. (ft)	2.42	28.06	2.71
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.13	0.85	0.13
Alpha	1.04	Stream Power (lb/ft s)	0.15	4.83	0.09
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)	0.00	0.24	0.04
C & E Loss (ft)	0.07	Cum SA (acres)	0.01	0.11	0.05

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1147.49	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.57	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1146.92	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)	1146.35	Flow Area (sq ft)	2.12	68.68	1.67
E.G. Slope (ft/ft)	0.006218	Area (sq ft)	2.12	68.68	1.67
Q Total (cfs)	421.00	Flow (cfs)	1.95	417.56	1.49
Top Width (ft)	38.58	Top Width (ft)	8.58	27.00	3.00

Vel Total (ft/s)	5.81	Avg. Vel. (ft/s)	0.92	6.08	0.89
Max Chl Dpth (ft)	2.92	Hydr. Depth (ft)	0.25	2.54	0.56
Conv. Total (cfs)	5339.0	Conv. (cfs)	24.7	5295.4	18.9
Length Wtd. (ft)	10.00	Wetted Per. (ft)	8.68	28.06	3.20
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.09	0.95	0.20
Alpha	1.09	Stream Power (lb/ft s)	0.09	5.78	0.18
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)	0.00	0.26	0.05
C & E Loss (ft)	0.07	Cum SA (acres)	0.01	0.11	0.05

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q100

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1147.89	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.62	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1147.26	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)	1146.64	Flow Area (sq ft)	5.02	78.00	2.80
E.G. Slope (ft/ft)	0.005812	Area (sq ft)	6.79	78.00	2.80
Q Total (cfs)	510.00	Flow (cfs)	7.89	499.09	3.03
Top Width (ft)	48.54	Top Width (ft)	18.03	27.00	3.52
Vel Total (ft/s)	5.94	Avg. Vel. (ft/s)	1.57	6.40	1.08
Max Chl Dpth (ft)	3.26	Hydr. Depth (ft)	0.60	2.89	0.80
Conv. Total (cfs)	6689.6	Conv. (cfs)	103.4	6546.5	39.7
Length Wtd. (ft)	10.00	Wetted Per. (ft)	8.68	28.06	3.82
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.21	1.01	0.27
Alpha	1.14	Stream Power (lb/ft s)	0.33	6.45	0.29
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)	0.01	0.30	0.07
C & E Loss (ft)	0.09	Cum SA (acres)	0.02	0.11	0.06

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1149.49	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.39	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1149.10	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)	1147.29	Flow Area (sq ft)	20.37	127.48	11.75
E.G. Slope (ft/ft)	0.002013	Area (sq ft)	86.07	127.48	11.75
Q Total (cfs)	727.00	Flow (cfs)	47.99	666.14	12.87
Top Width (ft)	105.46	Top Width (ft)	72.21	27.00	6.26
Vel Total (ft/s)	4.55	Avg. Vel. (ft/s)	2.36	5.23	1.10
Max Chl Dpth (ft)	5.10	Hydr. Depth (ft)	2.43	4.72	1.88
Conv. Total (cfs)	16201.8	Conv. (cfs)	1069.5	14845.5	286.9
Length Wtd. (ft)	10.00	Wetted Per. (ft)	8.68	28.06	7.12
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.30	0.57	0.21
Alpha	1.22	Stream Power (lb/ft s)	0.70	2.98	0.23
Frctn Loss (ft)		Cum Volume (acre-ft)	0.03	0.37	0.10
C & E Loss (ft)		Cum SA (acres)	0.03	0.08	0.06

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE

RIVER: Unnamed Brook
REACH: Brook RS: 1165

INPUT
Description: George's Mills Road
Distance from Upstream XS = 10
Deck/Roadway Width = 83.5
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 64

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-20.72	1157.54	0	11.02	1157.54	0	12.89	1157.51	0
17.29	1157.42	0	61.95	1156.6	0	63.02	1156.58	0
64.34	1156.56	0	65.45	1156.54	0	65.57	1156.53	0
120.65	1155.56	0	122.43	1155.51	0	125.25	1155.45	0
156.19	1154.9	0	177.76	1154.47	0	180.72	1154.42	0
181.33	1154.41	0	232.7	1153.44	0	233.38	1153.42	0
236.27	1153.38	0	280.75	1152.83	0	285.95	1152.77	0
287.63	1152.75	0	287.96	1152.74	0	340.11	1152.42	0
341.96	1152.41	0	343.81	1152.4	0	393.35	1152.15	0
397	1152.15	0	397	1152.13	1148.21	428	1152.12	1148.21
428	1152.12	0	439.61	1152.11	0	451.08	1152.1	0
452.2	1152.09	0	452.73	1152.09	0	452.87	1152.09	0
471.27	1152.09	0	517.42	1152.05	0	517.74	1152.05	0
519.11	1152.05	0	520.7	1152.04	0	560.22	1151.91	0
583.5	1151.81	0	584.42	1151.81	0	584.98	1151.81	0
600.39	1151.67	0	613.33	1151.54	0	613.77	1151.54	0
614.64	1151.53	0	636.1	1151.33	0	644.18	1151.25	0
644.47	1151.25	0	656.35	1151.08	0	673.49	1150.84	0
674.65	1150.82	0	674.92	1150.82	0	675.18	1150.81	0
689.81	1150.61	0	705.5	1150.38	0	732.51	1149.99	0
733.71	1149.97	0	733.77	1149.97	0	733.94	1149.97	0
755.59	1149.97	0						

Upstream Bridge Cross Section Data
Station Elevation Data num= 79

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1154.85	9.59	1154.85	47.9	1154.33	61.73	1154.18	90.45	1153.8
104.2	1153.67	131.47	1152.71	142.49	1152.63	175.28	1151.57	182.35	1151.47
193.98	1150.76	204.13	1150.39	205.72	1150.36	207.86	1150.53	210.87	1150.92
211.03	1150.52	213.2	1150.1	222.43	1150.15	228.92	1149.87	233.05	1149.69
234.27	1149.6	239.83	1149.33	252.3	1149.19	261.59	1149.06	263.91	1149.8
265.27	1150.24	272.96	1150.59	280.01	1150.37	291.07	1150.15	295.94	1150.23

299.06	1150.39	308.81	1149.83	317.19	1149.54	349.44	1148.38	358.53	1148.13
388.59	1146.97	393.24	1146.84	396.86	1146.66	397	1146.25	399	1146.25
403.5	1144	421.5	1144	426	1146.25	428	1146.25	436.36	1151.84
437.05	1151.9	437.24	1151.93	438.96	1151.99	456.04	1152.67	457.37	1152.39
457.68	1152.37	458.07	1152.2	458.81	1151.95	459.95	1152.7	460.33	1152.96
462.33	1153.92	463.9	1154.73	471.48	1158.35	473.12	1159.16	473.56	1159.28
483.97	1160.82	489.92	1161.16	497.15	1161.29	511.64	1161.53	515.27	1162.17
515.79	1162.23	518.02	1162.22	521.55	1162.47	521.57	1162.48	521.69	1161.93
521.71	1162.68	521.77	1163.91	536.59	1163.91	543.33	1163.91	549.08	1163.91
549.1	1163.29	549.13	1162.14	563.91	1162.14	790.85	1162.14		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	399	.035	426	.085

Bank Sta: Left	Right	Coeff Contr.	Expan.
399	426	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	390.62	1152.13	F
438.87	790.85	1152.13	F

Downstream Deck/Roadway Coordinates
num= 66

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	1157.54	0	30.36	1157.54	0	62.11	1157.54	0
63.97	1157.51	0	68.36	1157.42	0	113.03	1156.6	0
114.11	1156.58	0	115.42	1156.56	0	116.53	1156.54	0
116.65	1156.53	0	171.73	1155.56	0	173.51	1155.51	0
176.32	1155.45	0	207.26	1154.9	0	228.84	1154.47	0
231.8	1154.42	0	232.41	1154.41	0	283.77	1153.44	0
284.46	1153.42	0	287.35	1153.38	0	331.83	1152.83	0
337.03	1152.77	0	338.71	1152.75	0	339.04	1152.74	0
391.19	1152.42	0	393.03	1152.41	0	394.89	1152.4	0
444.43	1152.15	0	445.03	1152.15	0	452.46	1152.14	0
456.5	1152.13	0	456.5	1152.13	1148.21	487.5	1152.11	1148.21
487.5	1152.11	0	502.16	1152.1	0	503.28	1152.09	0
503.81	1152.09	0	503.95	1152.09	0	522.35	1152.09	0
568.5	1152.05	0	568.83	1152.05	0	570.19	1152.05	0
571.78	1152.04	0	611.3	1151.91	0	634.58	1151.81	0
635.51	1151.81	0	636.06	1151.81	0	651.47	1151.67	0
664.4	1151.54	0	664.86	1151.54	0	665.72	1151.53	0
687.18	1151.33	0	695.26	1151.25	0	695.55	1151.25	0
707.43	1151.08	0	724.58	1150.84	0	725.73	1150.82	0
725.99	1150.82	0	726.26	1150.81	0	740.9	1150.61	0
756.58	1150.38	0	783.6	1149.99	0	784.79	1149.97	0
784.85	1149.97	0	785.02	1149.97	0	806.67	1149.97	0

Downstream Bridge Cross Section Data
Station Elevation Data num= 36

```
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
  418.68 1151.97  426.48 1151.65  428.21 1151.59  429.72 1151.54  430.73 1151.42
  432.25 1151.33  432.32 1151.16  433.02 1150.95  438.91 1148.19  443.07 1145.79
  443.77 1145.39   444.4 1144.98  444.73 1144.99  445.01 1144.99  454.53 1145.88
   458.5 1145.25     463    1143     481    1143   485.5 1145.25  487.06 1145.56
  490.17 1146.37  492.23 1146.82  492.62 1147.02  494.11 1147.36  495.13 1147.52
  503.18 1148.75  504.05  1149.1  515.37 1151.64  515.46 1151.68   524.3 1152.02
  524.95 1152.06  525.02 1152.07   525.7 1152.06  530.96 1152.08  537.29 1152.08
   537.3 1152.08

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
  418.68    .085   458.5    .035   485.5    .085

Bank Sta: Left   Right    Coeff Contr.   Expan.
         458.5   485.5             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
  418.68  442.28 1150.13       F
  496.87   537.3 1150.13       F

Upstream Embankment side slope             =     1.5 horiz. to 1.0 vertical
Downstream Embankment side slope           =     1.5 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins        =
Energy head used in spillway design        =
Spillway height used in design             =
Weir crest shape                           = Broad Crested

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Pressure and Weir flow
           Submerged Inlet Cd          =
           Submerged Inlet + Outlet Cd =      .8
           Max Low Cord                =

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT  Profile #Q2
```

E.G. US. (ft)	1145.68	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	1145.45	E.G. Elev (ft)	1145.53	1144.75
Q Total (cfs)	117.00	W.S. Elev (ft)	1145.11	1144.56
Q Bridge (cfs)	117.00	Crit W.S. (ft)	1145.05	1144.05
Q Weir (cfs)		Max Chl Dpth (ft)	1.11	1.56
Weir Sta Lft (ft)		Vel Total (ft/s)	5.20	3.56
Weir Sta Rgt (ft)		Flow Area (sq ft)	22.51	32.85
Weir Submerg		Froude # Chl	0.91	0.54
Weir Max Depth (ft)		Specif Force (cu ft)	30.95	37.24
Min El Weir Flow (ft)	1152.12	Hydr Depth (ft)	1.00	1.36
Min El Prs (ft)	1148.21	W.P. Total (ft)	22.98	24.96
Delta EG (ft)	1.15	Conv. Total (cfs)	942.6	1674.8
Delta WS (ft)	1.36	Top Width (ft)	22.45	24.22
BR Open Area (sq ft)	111.38	Frctn Loss (ft)	0.67	0.15
BR Open Vel (ft/s)	5.20	C & E Loss (ft)	0.11	0.07
BR Sluice Coef	0.00	Shear Total (lb/sq ft)	0.94	0.40
BR Sel Method	Energy only	Power Total (lb/ft s)	4.90	1.43

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #Q5

E.G. US. (ft)	1146.25	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	1145.91	E.G. Elev (ft)	1146.10	1145.31
Q Total (cfs)	194.00	W.S. Elev (ft)	1145.57	1145.02
Q Bridge (cfs)	194.00	Crit W.S. (ft)	1145.45	1144.45
Q Weir (cfs)		Max Chl Dpth (ft)	1.57	2.02
Weir Sta Lft (ft)		Vel Total (ft/s)	5.85	4.36
Weir Sta Rgt (ft)		Flow Area (sq ft)	33.19	44.46
Weir Submerg		Froude # Chl	0.88	0.59
Weir Max Depth (ft)		Specif Force (cu ft)	59.98	68.41
Min El Weir Flow (ft)	1152.12	Hydr Depth (ft)	1.37	1.71
Min El Prs (ft)	1148.21	W.P. Total (ft)	25.02	27.02
Delta EG (ft)	1.13	Conv. Total (cfs)	1700.8	2630.9
Delta WS (ft)	1.29	Top Width (ft)	24.28	26.07
BR Open Area (sq ft)	111.38	Frctn Loss (ft)	0.67	0.14
BR Open Vel (ft/s)	5.85	C & E Loss (ft)	0.12	0.06
BR Sluice Coef	0.00	Shear Total (lb/sq ft)	1.08	0.56
BR Sel Method	Energy only	Power Total (lb/ft s)	6.30	2.44

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

```
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT  Profile #Q10

  E.G. US. (ft)              1146.65    Element                Inside BR US  Inside BR DS
  W.S. US. (ft)              1146.24    E.G. Elev (ft)             1146.50       1145.72
  Q Total (cfs)               259.00    W.S. Elev (ft)             1145.89       1145.36
  Q Bridge (cfs)              259.00    Crit W.S. (ft)             1145.74       1144.74
  Q Weir (cfs)                          Max Chl Dpth (ft)             1.89          2.36
  Weir Sta Lft (ft)                     Vel Total (ft/s)              6.30          4.83
  Weir Sta Rgt (ft)                     Flow Area (sq ft)            41.11         53.57
  Weir Submerg                          Froude # Chl                  0.88          0.61
  Weir Max Depth (ft)                   Specif Force (cu ft)         87.24         97.65
  Min El Weir Flow (ft)      1152.12    Hydr Depth (ft)               1.61          1.90
  Min El Prs (ft)            1148.21    W.P. Total (ft)              26.44         29.29
  Delta EG (ft)                 1.14    Conv. Total (cfs)           2342.1        3493.3
  Delta WS (ft)                 1.32    Top Width (ft)               25.55         28.21
  BR Open Area (sq ft)        111.38    Frctn Loss (ft)               0.66          0.14
  BR Open Vel (ft/s)            6.30    C & E Loss (ft)               0.13          0.07
  BR Sluice Coef                0.00    Shear Total (lb/sq ft)        1.19          0.63
  BR Sel Method          Energy only    Power Total (lb/ft s)         7.48          3.03


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT  Profile #Q25

  E.G. US. (ft)              1147.14    Element                Inside BR US  Inside BR DS
  W.S. US. (ft)              1146.64    E.G. Elev (ft)             1146.99       1146.21
  Q Total (cfs)               348.00    W.S. Elev (ft)             1146.26       1145.75
  Q Bridge (cfs)              348.00    Crit W.S. (ft)             1146.09       1145.09
  Q Weir (cfs)                          Max Chl Dpth (ft)             2.26          2.75
  Weir Sta Lft (ft)                     Vel Total (ft/s)              6.85          5.32
  Weir Sta Rgt (ft)                     Flow Area (sq ft)            50.78         65.43
  Weir Submerg                          Froude # Chl                  0.88          0.57
  Weir Max Depth (ft)                   Specif Force (cu ft)        127.50        140.51
  Min El Weir Flow (ft)      1152.12    Hydr Depth (ft)               1.64          2.11
  Min El Prs (ft)            1148.21    W.P. Total (ft)              32.06         32.13
  Delta EG (ft)                 1.16    Conv. Total (cfs)           3199.6        4736.3
  Delta WS (ft)                 1.40    Top Width (ft)               31.00         31.00
  BR Open Area (sq ft)        111.38    Frctn Loss (ft)               0.64          0.14
  BR Open Vel (ft/s)            6.85    C & E Loss (ft)               0.14          0.09
  BR Sluice Coef                0.00    Shear Total (lb/sq ft)        1.17          0.69
```

BR Sel Method	Energy only	Power Total (lb/ft s)	8.02	3.65

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #Q50

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	1147.49	E.G. Elev (ft)	1147.33	1146.57
W.S. US. (ft)	1146.92	W.S. Elev (ft)	1146.52	1146.04
Q Total (cfs)	421.00	Crit W.S. (ft)	1146.36	1145.33
Q Bridge (cfs)	421.00	Max Chl Dpth (ft)	2.52	3.04
Q Weir (cfs)		Vel Total (ft/s)	7.14	5.65
Weir Sta Lft (ft)		Flow Area (sq ft)	58.95	74.51
Weir Sta Rgt (ft)		Froude # Chl	0.80	0.59
Weir Submerg		Specif Force (cu ft)	162.51	178.26
Weir Max Depth (ft)		Hydr Depth (ft)	1.90	2.40
Min El Weir Flow (ft)	1152.12	W.P. Total (ft)	32.06	32.13
Min El Prs (ft)	1148.21	Conv. Total (cfs)	3991.7	5766.3
Delta EG (ft)	1.17	Top Width (ft)	31.00	31.00
Delta WS (ft)	1.47	Frctn Loss (ft)	0.62	0.14
BR Open Area (sq ft)	111.38	C & E Loss (ft)	0.15	0.10
BR Open Vel (ft/s)	7.14	Shear Total (lb/sq ft)	1.28	0.77
BR Sluice Coef	0.00	Power Total (lb/ft s)	9.12	4.36
BR Sel Method	Energy only			

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #Q100

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	1147.89	E.G. Elev (ft)	1147.73	1146.97
W.S. US. (ft)	1147.26	W.S. Elev (ft)	1146.82	1146.36
Q Total (cfs)	510.00	Crit W.S. (ft)	1146.63	1145.63
Q Bridge (cfs)	510.00	Max Chl Dpth (ft)	2.82	3.36
Q Weir (cfs)		Vel Total (ft/s)	7.48	6.05
Weir Sta Lft (ft)		Flow Area (sq ft)	68.16	84.28
Weir Sta Rgt (ft)		Froude # Chl	0.80	0.60
Weir Submerg		Specif Force (cu ft)	207.74	226.32
Weir Max Depth (ft)		Hydr Depth (ft)	2.20	2.72
Min El Weir Flow (ft)	1152.12			

Min El Prs (ft)	1148.21	W.P. Total (ft)	32.06	32.13
Delta EG (ft)	1.19	Conv. Total (cfs)	4978.8	6969.8
Delta WS (ft)	1.59	Top Width (ft)	31.00	31.00
BR Open Area (sq ft)	111.38	Frctn Loss (ft)	0.61	0.15
BR Open Vel (ft/s)	7.48	C & E Loss (ft)	0.15	0.13
BR Sluice Coef	0.00	Shear Total (lb/sq ft)	1.39	0.88
BR Sel Method	Energy only	Power Total (lb/ft s)	10.42	5.31

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #Q500

E.G. US. (ft)	1149.49	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	1149.10	E.G. Elev (ft)	1149.49	1147.58
Q Total (cfs)	727.00	W.S. Elev (ft)	1148.21	1146.30
Q Bridge (cfs)	727.00	Crit W.S. (ft)	1147.22	1146.22
Q Weir (cfs)		Max Chl Dpth (ft)	4.21	3.30
Weir Sta Lft (ft)		Vel Total (ft/s)	6.53	8.81
Weir Sta Rgt (ft)		Flow Area (sq ft)	111.38	82.52
Weir Submerg		Froude # Chl	0.59	0.88
Weir Max Depth (ft)		Specif Force (cu ft)	365.28	327.53
Min El Weir Flow (ft)	1152.12	Hydr Depth (ft)		2.66
Min El Prs (ft)	1148.21	W.P. Total (ft)	68.94	32.13
Delta EG (ft)	2.00	Conv. Total (cfs)	6828.3	6746.0
Delta WS (ft)	2.79	Top Width (ft)		31.00
BR Open Area (sq ft)	111.38	Frctn Loss (ft)		
BR Open Vel (ft/s)	6.53	C & E Loss (ft)		
BR Sluice Coef	0.00	Shear Total (lb/sq ft)	1.14	1.86
BR Sel Method	Press Only	Power Total (lb/ft s)	7.46	16.40

Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir flow. The momentum answer has been disregarded.
Note: The downstream water surface is below the minimum elevation for pressure flow. The sluice gate equations were used for pressure flow.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION

RIVER: Unnamed Brook
REACH: Brook RS: 1071

INPUT
Description:

```
Station Elevation Data    num=      36
     Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
  418.68 1151.97  426.48 1151.65  428.21 1151.59  429.72 1151.54  430.73 1151.42
  432.25 1151.33  432.32 1151.16  433.02 1150.95  438.91 1148.19  443.07 1145.79
  443.77 1145.39   444.4 1144.98  444.73 1144.99  445.01 1144.99  454.53 1145.88
   458.5 1145.25     463    1143     481    1143   485.5 1145.25  487.06 1145.56
  490.17 1146.37  492.23 1146.82  492.62 1147.02  494.11 1147.36  495.13 1147.52
  503.18 1148.75  504.05  1149.1  515.37 1151.64  515.46 1151.68   524.3 1152.02
  524.95 1152.06  525.02 1152.07   525.7 1152.06  530.96 1152.08  537.29 1152.08
   537.3 1152.08

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
  418.68    .085   458.5    .035   485.5    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         458.5   485.5              70.2    70.2    70.2             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
  418.68  442.28 1150.13       F
  496.87   537.3 1150.13       F

CROSS SECTION OUTPUT  Profile #Q2

  E.G. Elev (ft)           1144.53    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.44    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1144.09    Reach Len. (ft)             70.20      70.20      70.20
  Crit W.S. (ft)           1144.05    Flow Area (sq ft)                      21.95
  E.G. Slope (ft/ft)      0.016648    Area (sq ft)                           21.95
  Q Total (cfs)             117.00    Flow (cfs)                            117.00
  Top Width (ft)             22.35    Top Width (ft)                         22.35
  Vel Total (ft/s)            5.33    Avg. Vel. (ft/s)                        5.33
  Max Chl Dpth (ft)           1.09    Hydr. Depth (ft)                        0.98
  Conv. Total (cfs)          906.8    Conv. (cfs)                            906.8
  Length Wtd. (ft)           70.20    Wetted Per. (ft)                       22.87
  Min Ch El (ft)           1143.00    Shear (lb/sq ft)                        1.00
  Alpha                       1.00    Stream Power (lb/ft s)                  5.32
  Frctn Loss (ft)             0.50    Cum Volume (acre-ft)                    0.04
  C & E Loss (ft)             0.13    Cum SA (acres)                          0.03


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT  Profile #Q5

  E.G. Elev (ft)           1145.11    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.49    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1144.62    Reach Len. (ft)             70.20      70.20      70.20
```

Crit W.S. (ft)	1144.45	Flow Area (sq ft)		34.47	
E.G. Slope (ft/ft)	0.011607	Area (sq ft)		34.47	
Q Total (cfs)	194.00	Flow (cfs)		194.00	
Top Width (ft)	24.49	Top Width (ft)		24.49	
Vel Total (ft/s)	5.63	Avg. Vel. (ft/s)		5.63	
Max Chl Dpth (ft)	1.62	Hydr. Depth (ft)		1.41	
Conv. Total (cfs)	1800.7	Conv. (cfs)		1800.7	
Length Wtd. (ft)	70.20	Wetted Per. (ft)		25.26	
Min Ch El (ft)	1143.00	Shear (lb/sq ft)		0.99	
Alpha	1.00	Stream Power (lb/ft s)		5.57	
Frctn Loss (ft)	0.44	Cum Volume (acre-ft)		0.06	0.01
C & E Loss (ft)	0.11	Cum SA (acres)		0.04	0.03

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q10

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1145.51	Wt. n-Val.		0.035	
Vel Head (ft)	0.59	Reach Len. (ft)	70.20	70.20	70.20
W.S. Elev (ft)	1144.92	Flow Area (sq ft)		41.97	
Crit W.S. (ft)	1144.74	Area (sq ft)		41.97	
E.G. Slope (ft/ft)	0.011502	Flow (cfs)		259.00	
Q Total (cfs)	259.00	Top Width (ft)		25.69	
Top Width (ft)	25.69	Avg. Vel. (ft/s)		6.17	
Vel Total (ft/s)	6.17	Hydr. Depth (ft)		1.63	
Max Chl Dpth (ft)	1.92	Conv. (cfs)		2415.0	
Conv. Total (cfs)	2415.0	Wetted Per. (ft)		26.59	
Length Wtd. (ft)	70.20	Shear (lb/sq ft)		1.13	
Min Ch El (ft)	1143.00	Stream Power (lb/ft s)		6.99	
Alpha	1.00	Cum Volume (acre-ft)	0.00	0.08	0.02
Frctn Loss (ft)	0.44	Cum SA (acres)	0.00	0.04	0.04
C & E Loss (ft)	0.14				

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q25

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1145.98	Wt. n-Val.	0.085	0.035	
Vel Head (ft)	0.74	Reach Len. (ft)	70.20	70.20	70.20
W.S. Elev (ft)	1145.24	Flow Area (sq ft)	0.54	50.34	
Crit W.S. (ft)	1145.09	Area (sq ft)	0.54	50.34	
E.G. Slope (ft/ft)	0.012118	Flow (cfs)	0.28	347.72	
Q Total (cfs)	348.00	Top Width (ft)	3.68	26.96	
Top Width (ft)	30.63				

Vel Total (ft/s)	6.84	Avg. Vel. (ft/s)	0.53	6.91	
Max Chl Dpth (ft)	2.24	Hydr. Depth (ft)	0.15	1.87	
Conv. Total (cfs)	3161.2	Conv. (cfs)	2.6	3158.7	
Length Wtd. (ft)	70.20	Wetted Per. (ft)	3.76	28.01	
Min Ch El (ft)	1143.00	Shear (lb/sq ft)	0.11	1.36	
Alpha	1.02	Stream Power (lb/ft s)	0.06	9.39	
Frctn Loss (ft)	0.45	Cum Volume (acre-ft)	0.00	0.09	0.04
C & E Loss (ft)	0.20	Cum SA (acres)	0.00	0.04	0.05

Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1146.32	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.87	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1145.45	Reach Len. (ft)	70.20	70.20	70.20
Crit W.S. (ft)	1145.35	Flow Area (sq ft)	1.69	55.96	0.10
E.G. Slope (ft/ft)	0.012433	Area (sq ft)	1.69	55.96	0.10
Q Total (cfs)	421.00	Flow (cfs)	1.25	419.71	0.04
Top Width (ft)	35.48	Top Width (ft)	7.48	27.00	0.99
Vel Total (ft/s)	7.29	Avg. Vel. (ft/s)	0.74	7.50	0.41
Max Chl Dpth (ft)	2.45	Hydr. Depth (ft)	0.23	2.07	0.10
Conv. Total (cfs)	3775.6	Conv. (cfs)	11.2	3764.0	0.4
Length Wtd. (ft)	70.20	Wetted Per. (ft)	7.66	28.06	1.01
Min Ch El (ft)	1143.00	Shear (lb/sq ft)	0.17	1.55	0.08
Alpha	1.06	Stream Power (lb/ft s)	0.13	11.61	0.03
Frctn Loss (ft)	0.45	Cum Volume (acre-ft)	0.00	0.10	0.05
C & E Loss (ft)	0.25	Cum SA (acres)	0.01	0.04	0.05

Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	1146.70	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.03	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1145.67	Reach Len. (ft)	70.20	70.20	70.20
Crit W.S. (ft)	1145.66	Flow Area (sq ft)	3.82	61.97	0.44
E.G. Slope (ft/ft)	0.012864	Area (sq ft)	3.82	61.97	0.44
Q Total (cfs)	510.00	Flow (cfs)	3.63	506.06	0.31
Top Width (ft)	40.64	Top Width (ft)	11.66	27.00	1.98
Vel Total (ft/s)	7.70	Avg. Vel. (ft/s)	0.95	8.17	0.71
Max Chl Dpth (ft)	2.67	Hydr. Depth (ft)	0.33	2.30	0.22

```
  Conv. Total (cfs)         4496.5    Conv. (cfs)                 32.0     4461.8        2.7
  Length Wtd. (ft)           70.20    Wetted Per. (ft)           11.92      28.06       2.03
  Min Ch El (ft)           1143.00    Shear (lb/sq ft)            0.26       1.77       0.17
  Alpha                       1.12    Stream Power (lb/ft s)      0.24      14.48       0.12
  Frctn Loss (ft)             0.46    Cum Volume (acre-ft)        0.00       0.11       0.06
  C & E Loss (ft)             0.31    Cum SA (acres)              0.01       0.04       0.05


Warning: Divided flow computed for this cross-section.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross
         sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT  Profile #Q500

  E.G. Elev (ft)           1147.49    Element                   Left OB    Channel   Right OB
  Vel Head (ft)               1.19    Wt. n-Val.                 0.085      0.035      0.085
  W.S. Elev (ft)           1146.30    Reach Len. (ft)            70.20      70.20      70.20
  Crit W.S. (ft)           1146.30    Flow Area (sq ft)          13.41      79.03       2.46
  E.G. Slope (ft/ft)      0.011030    Area (sq ft)               13.41      79.03       2.46
  Q Total (cfs)             727.00    Flow (cfs)                 21.30     702.71       3.00
  Top Width (ft)             47.73    Top Width (ft)             16.32      27.00       4.41
  Vel Total (ft/s)            7.66    Avg. Vel. (ft/s)            1.59       8.89       1.22
  Max Chl Dpth (ft)           3.30    Hydr. Depth (ft)            0.83       2.93       0.56
  Conv. Total (cfs)         6922.3    Conv. (cfs)                202.8     6691.0       28.5
  Length Wtd. (ft)           70.20    Wetted Per. (ft)           16.66      28.06       4.53
  Min Ch El (ft)           1143.00    Shear (lb/sq ft)            0.55       1.94       0.37
  Alpha                       1.30    Stream Power (lb/ft s)      0.88      17.24       0.46
  Frctn Loss (ft)             0.43    Cum Volume (acre-ft)        0.01       0.13       0.10
  C & E Loss (ft)             0.36    Cum SA (acres)              0.02       0.04       0.06


Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical
         depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross
         sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
         program defaulted to critical depth.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION


RIVER: Unnamed Brook
REACH: Brook              RS: 1001
```

```
INPUT
Description:
Station Elevation Data    num=      55
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
  145.18 1152.95  148.55 1152.81  156.23 1152.59  158.48 1152.48  159.55 1152.41
  160.31 1152.13  164.44 1150.81  168.84  1150.2   177.5 1149.69  179.56 1149.59
  185.08  1149.3  203.92 1148.09  211.18 1147.63  212.63 1147.59  230.41 1146.51
  234.61 1144.34   236.3 1143.38  237.68 1142.32  237.78 1142.23  241.01 1141.85
  241.81 1141.69  243.18 1141.82  243.53 1141.86  244.96 1141.86  245.55 1141.84
  247.39  1141.8  248.08 1141.85  251.36 1142.03  255.43  1142.2  255.85 1142.76
  256.63 1143.89  258.79 1143.99  261.77 1144.12  270.01 1144.18  276.92 1144.09
  284.68 1143.96  288.79 1143.97  309.33 1144.64  326.86 1146.13  332.25 1146.54
  337.82 1147.28  341.89  1147.8  343.93  1147.9  346.89 1149.03  351.83 1150.42
  353.19 1150.97  355.25 1151.62  360.37 1151.89  362.11 1151.94  362.48 1151.96
   362.8 1151.97  368.06    1152  372.69 1152.02  374.52 1152.03  374.81 1152.03

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
  145.18    .085  234.61    .035  256.63    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       234.61  256.63              .56     .56     .56             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
  145.18  187.58 1150.13       F
  313.72  374.81 1150.13       F

CROSS SECTION OUTPUT  Profile #Q2

  E.G. Elev (ft)           1143.91    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.19    Wt. n-Val.                              0.035
  W.S. Elev (ft)           1143.72    Reach Len. (ft)
  Crit W.S. (ft)           1143.06    Flow Area (sq ft)                       33.48
  E.G. Slope (ft/ft)      0.003902    Area (sq ft)                            33.48
  Q Total (cfs)             117.00    Flow (cfs)                             117.00
  Top Width (ft)             20.80    Top Width (ft)                          20.80
  Vel Total (ft/s)            3.50    Avg. Vel. (ft/s)                         3.50
  Max Chl Dpth (ft)           2.03    Hydr. Depth (ft)                         1.61
  Conv. Total (cfs)         1873.1    Conv. (cfs)                            1873.1
  Length Wtd. (ft)                    Wetted Per. (ft)                        22.12
  Min Ch El (ft)           1141.69    Shear (lb/sq ft)                         0.37
  Alpha                       1.00    Stream Power (lb/ft s)                   1.29
  Frctn Loss (ft)                     Cum Volume (acre-ft)
  C & E Loss (ft)                     Cum SA (acres)

Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q5
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E.G. Elev (ft)	1144.56	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.26	Wt. n-Val.		0.035	0.085
W.S. Elev (ft)	1144.30	Reach Len. (ft)			
Crit W.S. (ft)	1143.48	Flow Area (sq ft)		45.95	8.99
E.G. Slope (ft/ft)	0.003904	Area (sq ft)		45.95	8.99
Q Total (cfs)	194.00	Flow (cfs)		190.50	3.50
Top Width (ft)	64.17	Top Width (ft)		21.95	42.23
Vel Total (ft/s)	3.53	Avg. Vel. (ft/s)		4.15	0.39
Max Chl Dpth (ft)	2.61	Hydr. Depth (ft)		2.09	0.21
Conv. Total (cfs)	3105.0	Conv. (cfs)		3048.9	56.1
Length Wtd. (ft)		Wetted Per. (ft)		23.51	42.24
Min Ch El (ft)	1141.69	Shear (lb/sq ft)		0.48	0.05
Alpha	1.35	Stream Power (lb/ft s)		1.97	0.02
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	1144.93	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.30	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1144.63	Reach Len. (ft)			
Crit W.S. (ft)	1143.80	Flow Area (sq ft)	0.08	53.21	24.58
E.G. Slope (ft/ft)	0.003906	Area (sq ft)	0.08	53.21	24.58
Q Total (cfs)	259.00	Flow (cfs)	0.02	242.75	16.23
Top Width (ft)	74.91	Top Width (ft)	0.56	22.02	52.33
Vel Total (ft/s)	3.33	Avg. Vel. (ft/s)	0.28	4.56	0.66
Max Chl Dpth (ft)	2.94	Hydr. Depth (ft)	0.14	2.42	0.47
Conv. Total (cfs)	4144.0	Conv. (cfs)	0.4	3884.0	259.6
Length Wtd. (ft)		Wetted Per. (ft)	0.63	23.60	52.35
Min Ch El (ft)	1141.69	Shear (lb/sq ft)	0.03	0.55	0.11
Alpha	1.77	Stream Power (lb/ft s)	0.01	2.51	0.08
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q25

E.G. Elev (ft)	1145.34	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1144.99	Reach Len. (ft)			
Crit W.S. (ft)	1144.37	Flow Area (sq ft)	0.41	61.21	44.47
E.G. Slope (ft/ft)	0.003905	Area (sq ft)	0.41	61.21	44.47
Q Total (cfs)	348.00	Flow (cfs)	0.20	306.58	41.23
Top Width (ft)	80.12	Top Width (ft)	1.26	22.02	56.84

Vel Total (ft/s)	3.28	Avg. Vel. (ft/s)	0.48	5.01	0.93
Max Chl Dpth (ft)	3.30	Hydr. Depth (ft)	0.33	2.78	0.78
Conv. Total (cfs)	5568.8	Conv. (cfs)	3.1	4905.9	659.7
Length Wtd. (ft)		Wetted Per. (ft)	1.42	23.60	56.87
Min Ch El (ft)	1141.69	Shear (lb/sq ft)	0.07	0.63	0.19
Alpha	2.06	Stream Power (lb/ft s)	0.03	3.17	0.18
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1145.62	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.37	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1145.25	Reach Len. (ft)			
Crit W.S. (ft)	1144.67	Flow Area (sq ft)	0.79	66.82	59.01
E.G. Slope (ft/ft)	0.003902	Area (sq ft)	0.79	66.82	59.33
Q Total (cfs)	421.00	Flow (cfs)	0.47	354.68	65.84
Top Width (ft)	83.61	Top Width (ft)	1.75	22.02	59.83
Vel Total (ft/s)	3.32	Avg. Vel. (ft/s)	0.60	5.31	1.12
Max Chl Dpth (ft)	3.56	Hydr. Depth (ft)	0.45	3.03	1.03
Conv. Total (cfs)	6739.6	Conv. (cfs)	7.6	5678.0	1054.1
Length Wtd. (ft)		Wetted Per. (ft)	1.97	23.60	57.12
Min Ch El (ft)	1141.69	Shear (lb/sq ft)	0.10	0.69	0.25
Alpha	2.16	Stream Power (lb/ft s)	0.06	3.66	0.28
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	1145.93	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.40	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1145.53	Reach Len. (ft)			
Crit W.S. (ft)	1144.92	Flow Area (sq ft)	1.36	72.99	75.00
E.G. Slope (ft/ft)	0.003901	Area (sq ft)	1.36	72.99	76.55
Q Total (cfs)	510.00	Flow (cfs)	0.97	410.84	98.18
Top Width (ft)	87.45	Top Width (ft)	2.30	22.02	63.13
Vel Total (ft/s)	3.41	Avg. Vel. (ft/s)	0.71	5.63	1.31
Max Chl Dpth (ft)	3.84	Hydr. Depth (ft)	0.59	3.31	1.31
Conv. Total (cfs)	8165.8	Conv. (cfs)	15.5	6578.2	1572.1
Length Wtd. (ft)		Wetted Per. (ft)	2.58	23.60	57.12
Min Ch El (ft)	1141.69	Shear (lb/sq ft)	0.13	0.75	0.32
Alpha	2.22	Stream Power (lb/ft s)	0.09	4.24	0.42
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1146.59	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.47	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1146.12	Reach Len. (ft)			
Crit W.S. (ft)	1145.41	Flow Area (sq ft)	3.07	86.09	108.97
E.G. Slope (ft/ft)	0.003903	Area (sq ft)	3.07	86.09	116.19
Q Total (cfs)	727.00	Flow (cfs)	2.87	541.10	183.04
Top Width (ft)	95.60	Top Width (ft)	3.45	22.02	70.13
Vel Total (ft/s)	3.67	Avg. Vel. (ft/s)	0.93	6.29	1.68
Max Chl Dpth (ft)	4.43	Hydr. Depth (ft)	0.89	3.91	1.91
Conv. Total (cfs)	11637.5	Conv. (cfs)	45.9	8661.6	2930.0
Length Wtd. (ft)		Wetted Per. (ft)	3.88	23.60	57.12
Min Ch El (ft)	1141.69	Shear (lb/sq ft)	0.19	0.89	0.46
Alpha	2.24	Stream Power (lb/ft s)	0.18	5.59	0.78
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

SUMMARY OF MANNING'S N VALUES

River:Unnamed Brook

Reach	River Sta.	n1	n2	n3
Brook	1758	.05	.035	.085
Brook	1506	.05	.035	.085
Brook	1238	.05	.035	.085
Brook	1182	.05	.035	.085
Brook	1165	Bridge		
Brook	1071	.085	.035	.085
Brook	1001	.085	.035	.085

SUMMARY OF REACH LENGTHS

River: Unnamed Brook

Reach	River Sta.	Left	Channel	Right

Brook	1758	252.24	252.24	252.24
Brook	1506	267.56	267.56	267.56
Brook	1238	55.99	55.99	55.99
Brook	1182	111.86	111.86	111.86
Brook	1165	Bridge		
Brook	1071	70.2	70.2	70.2
Brook	1001	.56	.56	.56

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Unnamed Brook

Reach	River Sta.	Contr.	Expan.
Brook	1758	.1	.3
Brook	1506	.1	.3
Brook	1238	.1	.3
Brook	1182	.3	.5
Brook	1165	Bridge	
Brook	1071	.3	.5
Brook	1001	.1	.3

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 Brook                1071            .3        .5
 Brook                1001            .1        .3



ERRORS WARNINGS AND NOTES
Errors Warnings and Notes for Plan : Buried 31-foot

River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q2
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q5
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q10
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q25
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q50
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
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          for the water surface and continued on with the calculations.
  Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
          the need for additional cross sections.
  Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
          water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
          program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q100
  Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
          for the water surface and continued on with the calculations.
  Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
          the need for additional cross sections.
  Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
          water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
          program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q500
  Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
          for the water surface and continued on with the calculations.
  Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
          the need for additional cross sections.
  Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
          water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
          program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q2
  Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
  Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
          the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q5
  Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
  Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
  Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
          the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q10
  Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
  Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
  Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
          the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q25
  Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
          the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q50
  Warning:Divided flow computed for this cross-section.
  Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
          the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q100
  Warning:Divided flow computed for this cross-section.
  Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
          the need for additional cross sections.
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River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q500
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q2
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q5
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q10
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q25
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q50
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     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q100
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q500
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q2
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q5
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q10
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q25
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
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River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q50
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q100
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q500
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q2 Upstream
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q2 Downstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q5 Upstream
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q5 Downstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q10 Upstream
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
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          water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
          program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q10 Downstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q25 Upstream
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
          for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
          water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
          program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q25 Downstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q50 Upstream
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
          for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q50 Downstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q100 Upstream
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q100 Downstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q500
     Note:   Momentum answer is not valid if the water surface is above the low chord or if there is weir flow.  The momentum
          answer has been disregarded.
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     Note:   The downstream water surface is below the minimum elevation for pressure flow.  The sluice gate equations were used
             for pressure flow.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q500 Upstream
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q500 Downstream
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q2
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q5
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q10
     Warning:Divided flow computed for this cross-section.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q25
     Warning:Divided flow computed for this cross-section.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q50
     Warning:Divided flow computed for this cross-section.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q100
     Warning:Divided flow computed for this cross-section.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q500
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q2
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     Warning:Divided flow computed for this cross-section.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q5
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q10
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q25
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q50
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q100
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q500
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
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HEC-RAS Plan: Buried 31-foot River: Unnamed Brook Reach: Brook

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Brook	1758	Q2	117.00	1151.39	1153.07	1153.07	1153.60	0.019079	5.87	19.94	19.13	1.01
Brook	1758	Q5	194.00	1151.39	1153.50	1153.50	1154.22	0.017318	6.79	28.60	21.36	1.01
Brook	1758	Q10	259.00	1151.39	1153.84	1153.84	1154.66	0.014992	7.25	37.45	30.49	0.97
Brook	1758	Q25	348.00	1151.39	1154.25	1154.25	1155.16	0.012945	7.74	51.93	41.21	0.93
Brook	1758	Q50	421.00	1151.39	1154.80	1154.80	1155.42	0.007112	6.70	99.14	116.78	0.72
Brook	1758	Q100	510.00	1151.39	1155.06	1155.06	1155.65	0.006549	6.82	131.20	136.17	0.70
Brook	1758	Q500	727.00	1151.39	1155.44	1155.44	1156.07	0.006697	7.49	188.82	161.53	0.72
Brook	1506	Q2	117.00	1147.76	1150.00	1149.44	1150.27	0.007919	4.12	28.38	23.49	0.66
Brook	1506	Q5	194.00	1147.76	1150.56	1150.11	1150.85	0.007453	4.34	45.17	40.19	0.66
Brook	1506	Q10	259.00	1147.76	1150.86	1150.43	1151.19	0.006669	4.65	62.82	65.31	0.64
Brook	1506	Q25	348.00	1147.76	1151.07	1150.79	1151.51	0.007785	5.42	76.62	66.01	0.70
Brook	1506	Q50	421.00	1147.76	1151.13	1150.99	1151.72	0.010082	6.30	80.73	68.14	0.81
Brook	1506	Q100	510.00	1147.76	1151.37	1151.23	1152.00	0.009508	6.61	98.07	79.30	0.80
Brook	1506	Q500	727.00	1147.76	1151.88	1151.71	1152.56	0.008171	7.08	143.41	93.04	0.77
Brook	1238	Q2	117.00	1144.81	1146.53	1146.53	1147.18	0.017733	6.48	18.06	13.78	1.00
Brook	1238	Q5	194.00	1144.81	1147.09	1147.09	1147.95	0.016531	7.43	26.11	15.09	1.00
Brook	1238	Q10	259.00	1144.81	1147.48	1147.48	1148.49	0.015953	8.07	32.15	16.57	1.00
Brook	1238	Q25	348.00	1144.81	1148.17	1148.17	1149.09	0.010159	7.83	50.49	36.82	0.84
Brook	1238	Q50	421.00	1144.81	1148.66	1148.66	1149.43	0.007296	7.41	75.59	65.68	0.73
Brook	1238	Q100	510.00	1144.81	1148.91	1148.91	1149.74	0.007483	7.88	89.71	77.05	0.75
Brook	1238	Q500	727.00	1144.81	1149.39	1149.39	1150.37	0.008024	8.91	118.18	116.84	0.79
Brook	1182	Q2	117.00	1144.00	1145.45	1145.05	1145.68	0.006253	3.87	30.26	23.79	0.60
Brook	1182	Q5	194.00	1144.00	1145.91	1145.45	1146.25	0.006612	4.66	41.62	25.63	0.64
Brook	1182	Q10	259.00	1144.00	1146.24	1145.74	1146.65	0.006743	5.15	50.29	26.95	0.66
Brook	1182	Q25	348.00	1144.00	1146.64	1146.09	1147.14	0.006268	5.66	62.98	31.72	0.66
Brook	1182	Q50	421.00	1144.00	1146.92	1146.35	1147.49	0.006218	6.08	72.48	38.58	0.67
Brook	1182	Q100	510.00	1144.00	1147.26	1146.64	1147.89	0.005812	6.40	85.81	48.54	0.66
Brook	1182	Q500	727.00	1144.00	1149.10	1147.29	1149.49	0.002013	5.23	159.61	105.46	0.42
Brook	1165		Bridge									
Brook	1071	Q2	117.00	1143.00	1144.09	1144.05	1144.53	0.016648	5.33	21.95	22.35	0.95
Brook	1071	Q5	194.00	1143.00	1144.62	1144.45	1145.11	0.011607	5.63	34.47	24.49	0.84
Brook	1071	Q10	259.00	1143.00	1144.92	1144.74	1145.51	0.011502	6.17	41.97	25.69	0.85
Brook	1071	Q25	348.00	1143.00	1145.24	1145.09	1145.98	0.012118	6.91	50.88	30.63	0.89
Brook	1071	Q50	421.00	1143.00	1145.45	1145.35	1146.32	0.012433	7.50	57.75	35.48	0.92
Brook	1071	Q100	510.00	1143.00	1145.67	1145.66	1146.70	0.012864	8.17	66.23	40.64	0.95
Brook	1071	Q500	727.00	1143.00	1146.30	1146.30	1147.49	0.011030	8.89	94.89	47.73	0.92
Brook	1001	Q2	117.00	1141.69	1143.72	1143.06	1143.91	0.003902	3.50	33.48	20.80	0.49
Brook	1001	Q5	194.00	1141.69	1144.30	1143.48	1144.56	0.003904	4.15	54.94	64.17	0.50
Brook	1001	Q10	259.00	1141.69	1144.63	1143.80	1144.93	0.003906	4.56	77.87	74.91	0.52
Brook	1001	Q25	348.00	1141.69	1144.99	1144.37	1145.34	0.003905	5.01	106.09	80.12	0.53
Brook	1001	Q50	421.00	1141.69	1145.25	1144.67	1145.62	0.003902	5.31	126.62	83.61	0.54
Brook	1001	Q100	510.00	1141.69	1145.53	1144.92	1145.93	0.003901	5.63	149.35	87.45	0.54
Brook	1001	Q500	727.00	1141.69	1146.12	1145.41	1146.59	0.003903	6.29	198.13	95.60	0.56

HEC-RAS Plan: Buried 31-foot River: Unnamed Brook Reach: Brook

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Brook	1758	Q2	1153.60	1153.07	0.53	2.96	0.08		117.00		19.13
Brook	1758	Q5	1154.22	1153.50	0.72	2.74	0.13		194.00	0.00	21.36
Brook	1758	Q10	1154.66	1153.84	0.81	2.42	0.14	0.01	257.65	1.34	30.49
Brook	1758	Q25	1155.16	1154.25	0.91	2.49	0.14	0.24	339.31	8.44	41.21
Brook	1758	Q50	1155.42	1154.80	0.61	2.12	0.01	25.23	369.74	26.03	116.78
Brook	1758	Q100	1155.65	1155.06	0.59	1.97	0.00	58.78	411.75	39.48	136.17
Brook	1758	Q500	1156.07	1155.44	0.63	1.86	0.01	144.33	511.44	71.23	161.53
Brook	1506	Q2	1150.27	1150.00	0.26	3.05	0.04		117.00		23.49
Brook	1506	Q5	1150.85	1150.56	0.29	2.86	0.06		193.89	0.11	40.19
Brook	1506	Q10	1151.19	1150.86	0.33	2.63	0.07		254.31	4.69	65.31
Brook	1506	Q25	1151.51	1151.07	0.44	2.37	0.05		334.31	13.69	66.01
Brook	1506	Q50	1151.72	1151.13	0.59	2.28	0.02	0.01	401.84	19.15	68.14
Brook	1506	Q100	1152.00	1151.37	0.63	2.25	0.02	1.37	474.25	34.38	79.30
Brook	1506	Q500	1152.56	1151.88	0.68	2.17	0.03	20.91	630.58	75.51	93.04
Brook	1238	Q2	1147.18	1146.53	0.65	0.55	0.13		117.00		13.78
Brook	1238	Q5	1147.95	1147.09	0.86	0.56	0.16		194.00		15.09
Brook	1238	Q10	1148.49	1147.48	1.01	0.55	0.18	0.02	258.98	0.00	16.57
Brook	1238	Q25	1149.09	1148.17	0.92	0.44	0.13	10.53	337.19	0.28	36.82
Brook	1238	Q50	1149.43	1148.66	0.77	0.38	0.06	43.12	376.82	1.07	65.68
Brook	1238	Q100	1149.74	1148.91	0.83	0.37	0.06	76.28	431.58	2.13	77.05
Brook	1238	Q500	1150.37	1149.39	0.98	0.20	0.18	165.35	555.62	6.03	116.84
Brook	1182	Q2	1145.68	1145.45	0.23	0.09	0.06		117.00		23.79
Brook	1182	Q5	1146.25	1145.91	0.34	0.09	0.06		194.00		25.63
Brook	1182	Q10	1146.65	1146.24	0.41	0.09	0.06		259.00		26.95
Brook	1182	Q25	1147.14	1146.64	0.49	0.08	0.07	0.93	346.47	0.60	31.72
Brook	1182	Q50	1147.49	1146.92	0.57	0.08	0.07	1.95	417.56	1.49	38.58
Brook	1182	Q100	1147.89	1147.26	0.62	0.08	0.09	7.89	499.09	3.03	48.54
Brook	1182	Q500	1149.49	1149.10	0.39			47.99	666.14	12.87	105.46
Brook	1165		Bridge								
Brook	1071	Q2	1144.53	1144.09	0.44	0.50	0.13		117.00		22.35
Brook	1071	Q5	1145.11	1144.62	0.49	0.44	0.11		194.00		24.49
Brook	1071	Q10	1145.51	1144.92	0.59	0.44	0.14		259.00		25.69
Brook	1071	Q25	1145.98	1145.24	0.74	0.45	0.20	0.28	347.72		30.63
Brook	1071	Q50	1146.32	1145.45	0.87	0.45	0.25	1.25	419.71	0.04	35.48
Brook	1071	Q100	1146.70	1145.67	1.03	0.46	0.31	3.63	506.06	0.31	40.64
Brook	1071	Q500	1147.49	1146.30	1.19	0.43	0.36	21.30	702.71	3.00	47.73
Brook	1001	Q2	1143.91	1143.72	0.19				117.00		20.80
Brook	1001	Q5	1144.56	1144.30	0.26				190.50	3.50	64.17
Brook	1001	Q10	1144.93	1144.63	0.30			0.02	242.75	16.23	74.91
Brook	1001	Q25	1145.34	1144.99	0.34			0.20	306.58	41.23	80.12
Brook	1001	Q50	1145.62	1145.25	0.37			0.47	354.68	65.84	83.61
Brook	1001	Q100	1145.93	1145.53	0.40			0.97	410.84	98.18	87.45
Brook	1001	Q500	1146.59	1146.12	0.47			2.87	541.10	183.04	95.60

HEC-RAS Plan: Buried 31-foot River: Unnamed Brook Reach: Brook

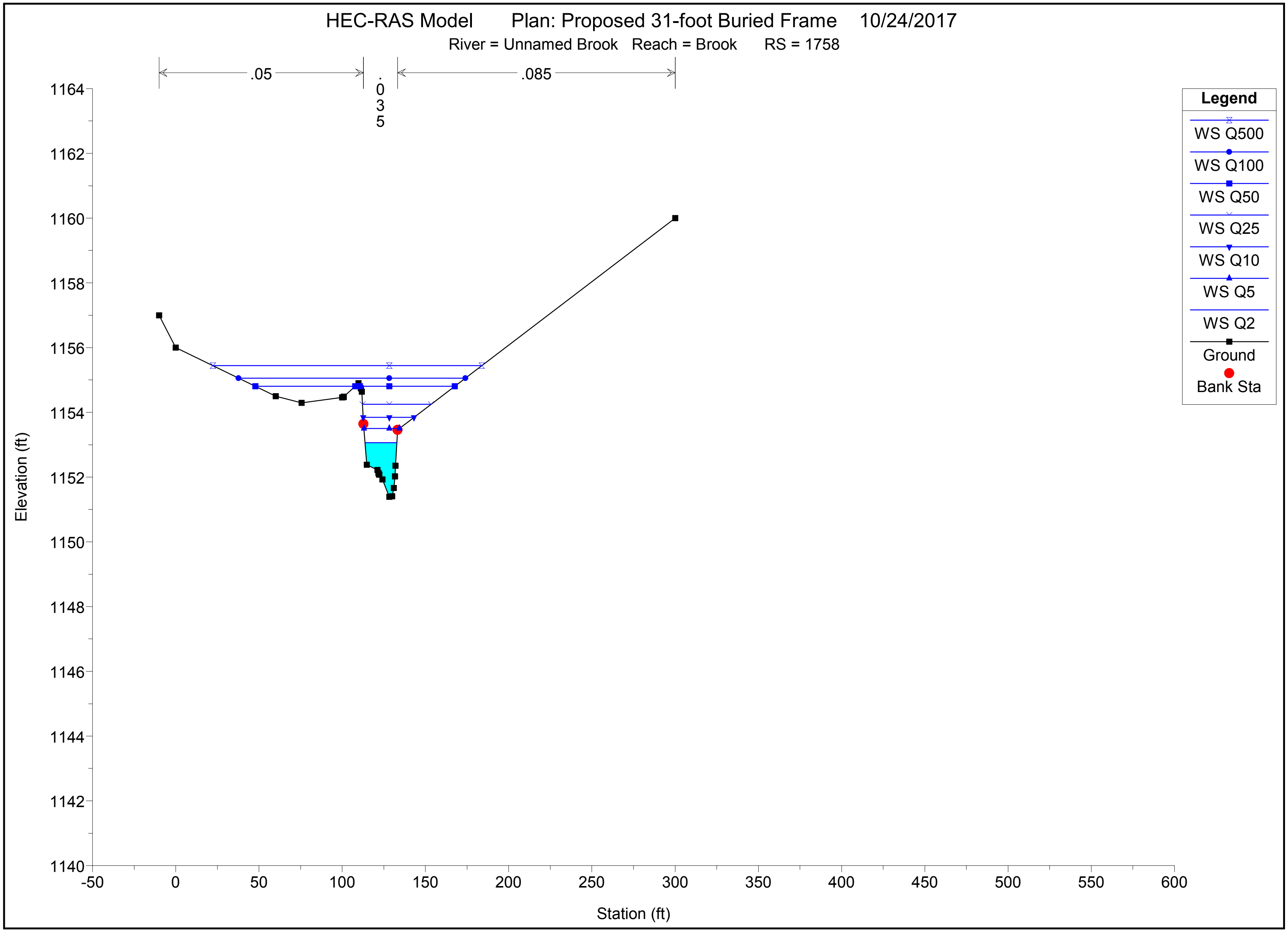
Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Brook	1238	Q2	1147.18	1146.53	1146.53	0.55	0.13	13.78		117.00		6.48
Brook	1238	Q5	1147.95	1147.09	1147.09	0.56	0.16	15.09		194.00		7.43
Brook	1238	Q10	1148.49	1147.48	1147.48	0.55	0.18	16.57	0.02	258.98	0.00	8.07
Brook	1238	Q25	1149.09	1148.17	1148.17	0.44	0.13	36.82	10.53	337.19	0.28	7.83
Brook	1238	Q50	1149.43	1148.66	1148.66	0.38	0.06	65.68	43.12	376.82	1.07	7.41
Brook	1238	Q100	1149.74	1148.91	1148.91	0.37	0.06	77.05	76.28	431.58	2.13	7.88
Brook	1238	Q500	1150.37	1149.39	1149.39	0.20	0.18	116.84	165.35	555.62	6.03	8.91
Brook	1182	Q2	1145.68	1145.45	1145.05	0.09	0.06	23.79		117.00		3.87
Brook	1182	Q5	1146.25	1145.91	1145.45	0.09	0.06	25.63		194.00		4.66
Brook	1182	Q10	1146.65	1146.24	1145.74	0.09	0.06	26.95		259.00		5.15
Brook	1182	Q25	1147.14	1146.64	1146.09	0.08	0.07	31.72	0.93	346.47	0.60	5.66
Brook	1182	Q50	1147.49	1146.92	1146.35	0.08	0.07	38.58	1.95	417.56	1.49	6.08
Brook	1182	Q100	1147.89	1147.26	1146.64	0.08	0.09	48.54	7.89	499.09	3.03	6.40
Brook	1182	Q500	1149.49	1149.10	1147.29			105.46	47.99	666.14	12.87	5.23
Brook	1165 BR U	Q2	1145.53	1145.11	1145.05	0.67	0.11	22.45		117.00		5.20
Brook	1165 BR U	Q5	1146.10	1145.57	1145.45	0.67	0.12	24.28		194.00		5.85
Brook	1165 BR U	Q10	1146.50	1145.89	1145.74	0.66	0.13	25.55		259.00		6.30
Brook	1165 BR U	Q25	1146.99	1146.26	1146.09	0.64	0.14	31.00	0.00	348.00	0.00	6.86
Brook	1165 BR U	Q50	1147.33	1146.52	1146.36	0.62	0.15	31.00	0.70	419.89	0.41	7.25
Brook	1165 BR U	Q100	1147.73	1146.82	1146.63	0.61	0.15	31.00	2.35	506.26	1.39	7.68
Brook	1165 BR U	Q500	1149.49	1148.21	1147.22				9.38	713.05	4.57	6.89
Brook	1165 BR D	Q2	1144.75	1144.56	1144.05	0.15	0.07	24.22		117.00		3.56
Brook	1165 BR D	Q5	1145.31	1145.02	1144.45	0.14	0.06	26.07		194.00		4.36
Brook	1165 BR D	Q10	1145.72	1145.36	1144.74	0.14	0.07	28.21	0.01	258.99	0.01	4.84
Brook	1165 BR D	Q25	1146.21	1145.75	1145.09	0.14	0.09	31.00	0.43	347.23	0.34	5.41
Brook	1165 BR D	Q50	1146.57	1146.04	1145.33	0.14	0.10	31.00	1.19	418.76	1.05	5.81
Brook	1165 BR D	Q100	1146.97	1146.36	1145.63	0.15	0.13	31.00	2.33	505.53	2.14	6.28
Brook	1165 BR D	Q500	1147.58	1146.30	1146.22			31.00	3.10	721.07	2.83	9.12
Brook	1071	Q2	1144.53	1144.09	1144.05	0.50	0.13	22.35		117.00		5.33
Brook	1071	Q5	1145.11	1144.62	1144.45	0.44	0.11	24.49		194.00		5.63
Brook	1071	Q10	1145.51	1144.92	1144.74	0.44	0.14	25.69		259.00		6.17
Brook	1071	Q25	1145.98	1145.24	1145.09	0.45	0.20	30.63	0.28	347.72		6.91
Brook	1071	Q50	1146.32	1145.45	1145.35	0.45	0.25	35.48	1.25	419.71	0.04	7.50
Brook	1071	Q100	1146.70	1145.67	1145.66	0.46	0.31	40.64	3.63	506.06	0.31	8.17
Brook	1071	Q500	1147.49	1146.30	1146.30	0.43	0.36	47.73	21.30	702.71	3.00	8.89
Brook	1001	Q2	1143.91	1143.72	1143.06			20.80		117.00		3.50
Brook	1001	Q5	1144.56	1144.30	1143.48			64.17		190.50	3.50	4.15
Brook	1001	Q10	1144.93	1144.63	1143.80			74.91	0.02	242.75	16.23	4.56
Brook	1001	Q25	1145.34	1144.99	1144.37			80.12	0.20	306.58	41.23	5.01
Brook	1001	Q50	1145.62	1145.25	1144.67			83.61	0.47	354.68	65.84	5.31
Brook	1001	Q100	1145.93	1145.53	1144.92			87.45	0.97	410.84	98.18	5.63
Brook	1001	Q500	1146.59	1146.12	1145.41			95.60	2.87	541.10	183.04	6.29

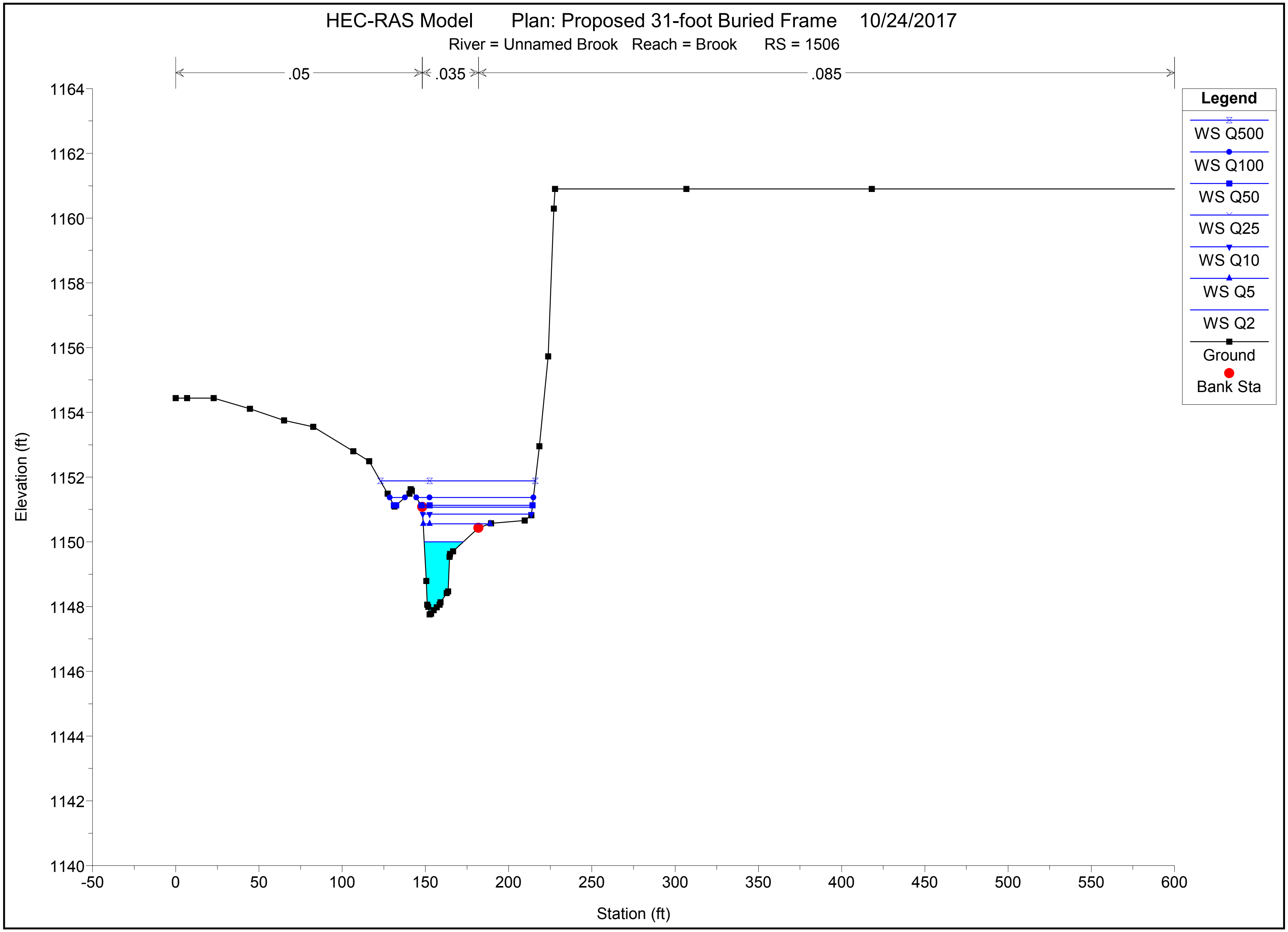
HEC-RAS Plan: Buried 31-foot River: Unnamed Brook Reach: Brook

Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG	BR Sluice Coef
			(ft)	(ft)	(sq ft)	(ft)	(cfs)	(ft)	(cfs)	(ft)	
Brook	1165	Q2	1145.68	1148.21	111.38		117.00	1152.12		1.15	0.00
Brook	1165	Q5	1146.25	1148.21	111.38		194.00	1152.12		1.13	0.00
Brook	1165	Q10	1146.65	1148.21	111.38		259.00	1152.12		1.14	0.00
Brook	1165	Q25	1147.14	1148.21	111.38		348.00	1152.12		1.16	0.00
Brook	1165	Q50	1147.49	1148.21	111.38		421.00	1152.12		1.17	0.00
Brook	1165	Q100	1147.89	1148.21	111.38		510.00	1152.12		1.19	0.00
Brook	1165	Q500	1149.49	1148.21	111.38	1149.10	727.00	1152.12		2.00	0.00

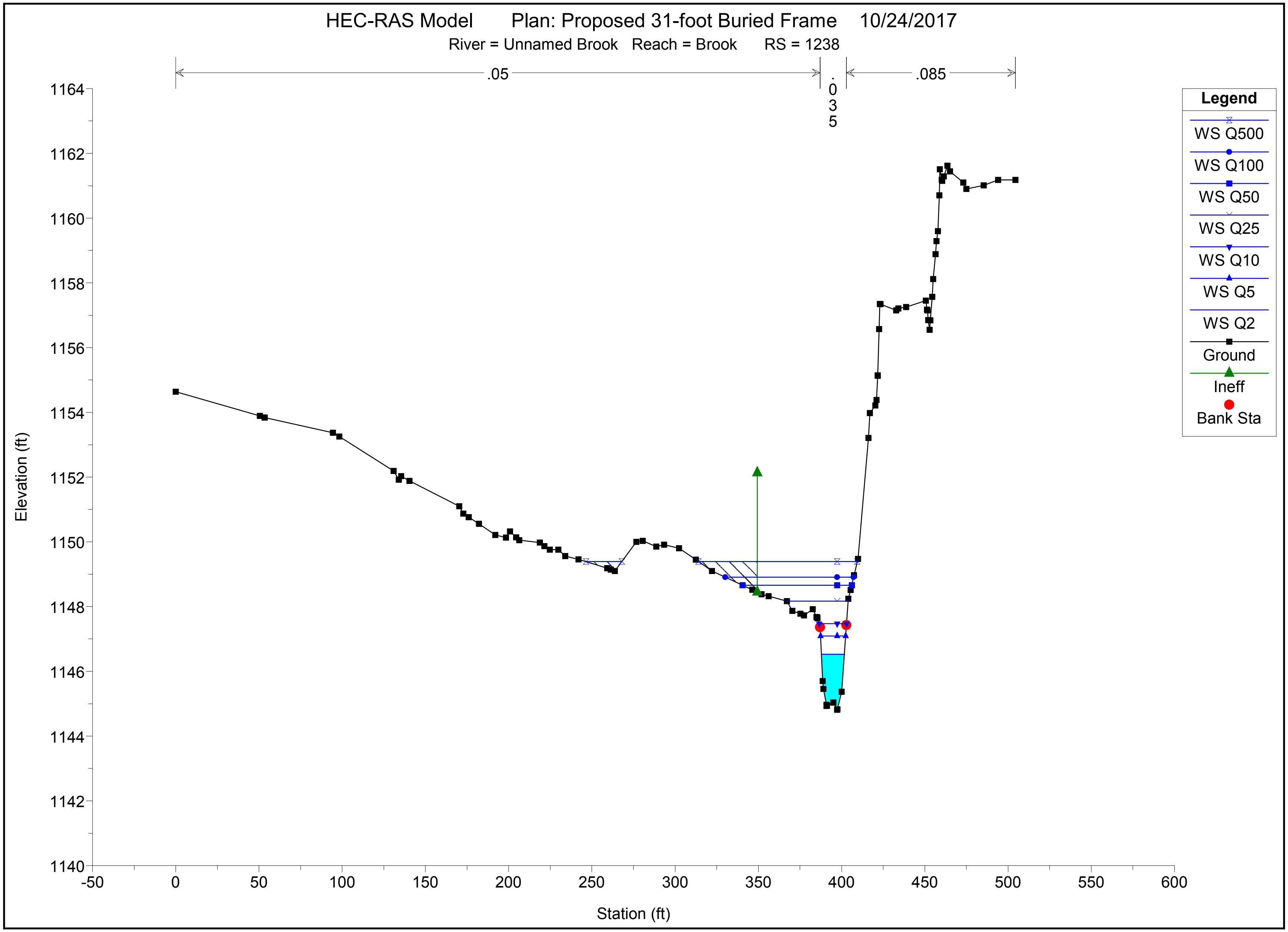
HEC-RAS Plan: Buried 31-foot   River: Unnamed Brook   Reach: Brook

Reach	River Sta	Profile	E.G. US.	W.S. US.	BR Sel Method	Energy EG	Momen. EG	Yarnell EG	WSPRO EG	Prs O EG	Prs/Wr EG	Energy/Wr EG
			(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Brook	1165	Q2	1145.68	1145.45	Energy only	1145.68	1146.03					
Brook	1165	Q5	1146.25	1145.91	Energy only	1146.25	1146.63					
Brook	1165	Q10	1146.65	1146.24	Energy only	1146.65	1147.04					
Brook	1165	Q25	1147.14	1146.64	Energy only	1147.14	1147.51					
Brook	1165	Q50	1147.49	1146.92	Energy only	1147.49	1147.87					
Brook	1165	Q100	1147.89	1147.26	Energy only	1147.89	1148.26					
Brook	1165	Q500	1149.49	1149.10	Press Only	1148.79				1149.49		

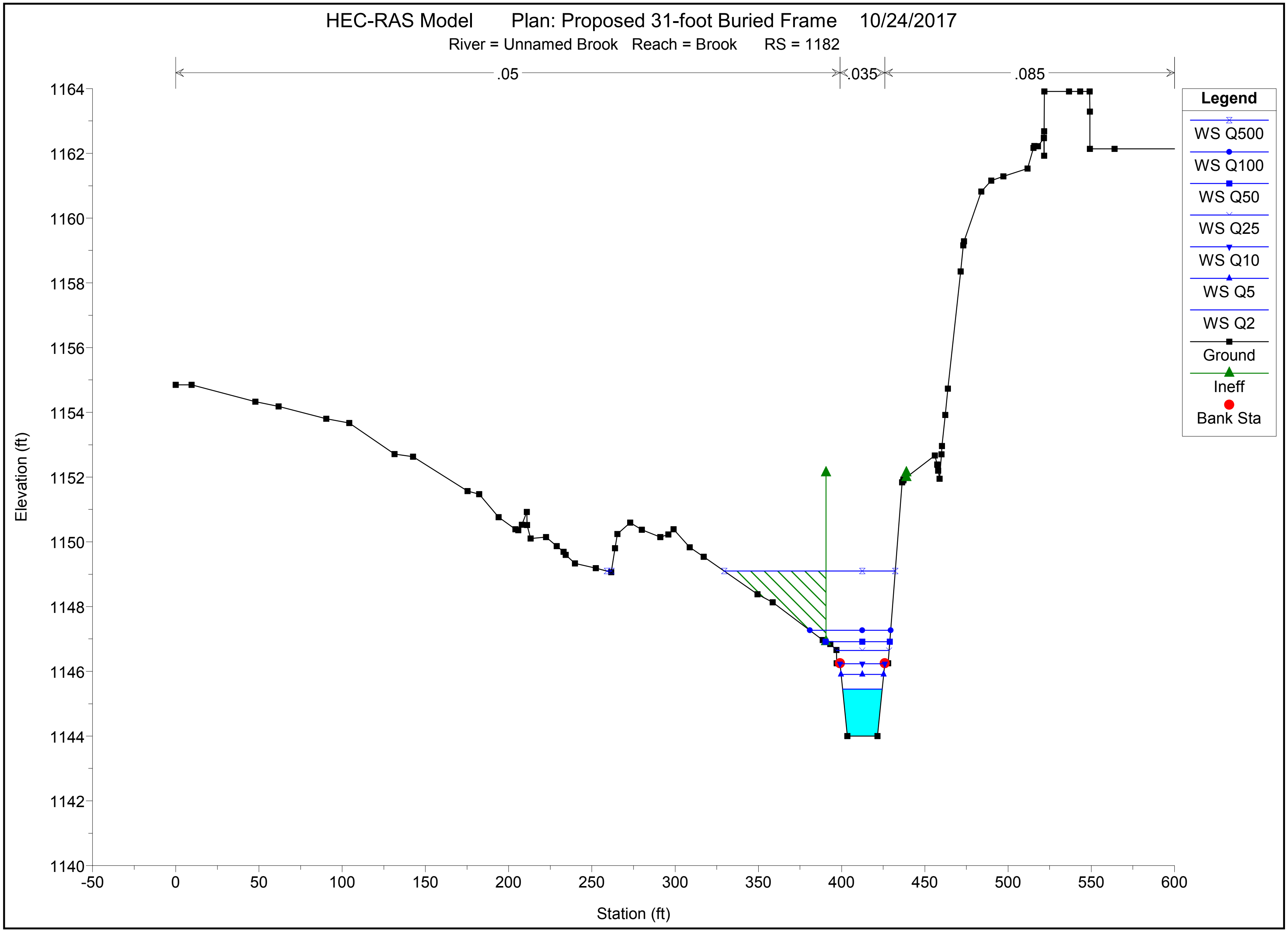

HEC-RAS Model Plan: Proposed 31-foot Buried Frame 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1758
.05
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Bank Sta
Elevation (ft)
Station (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600



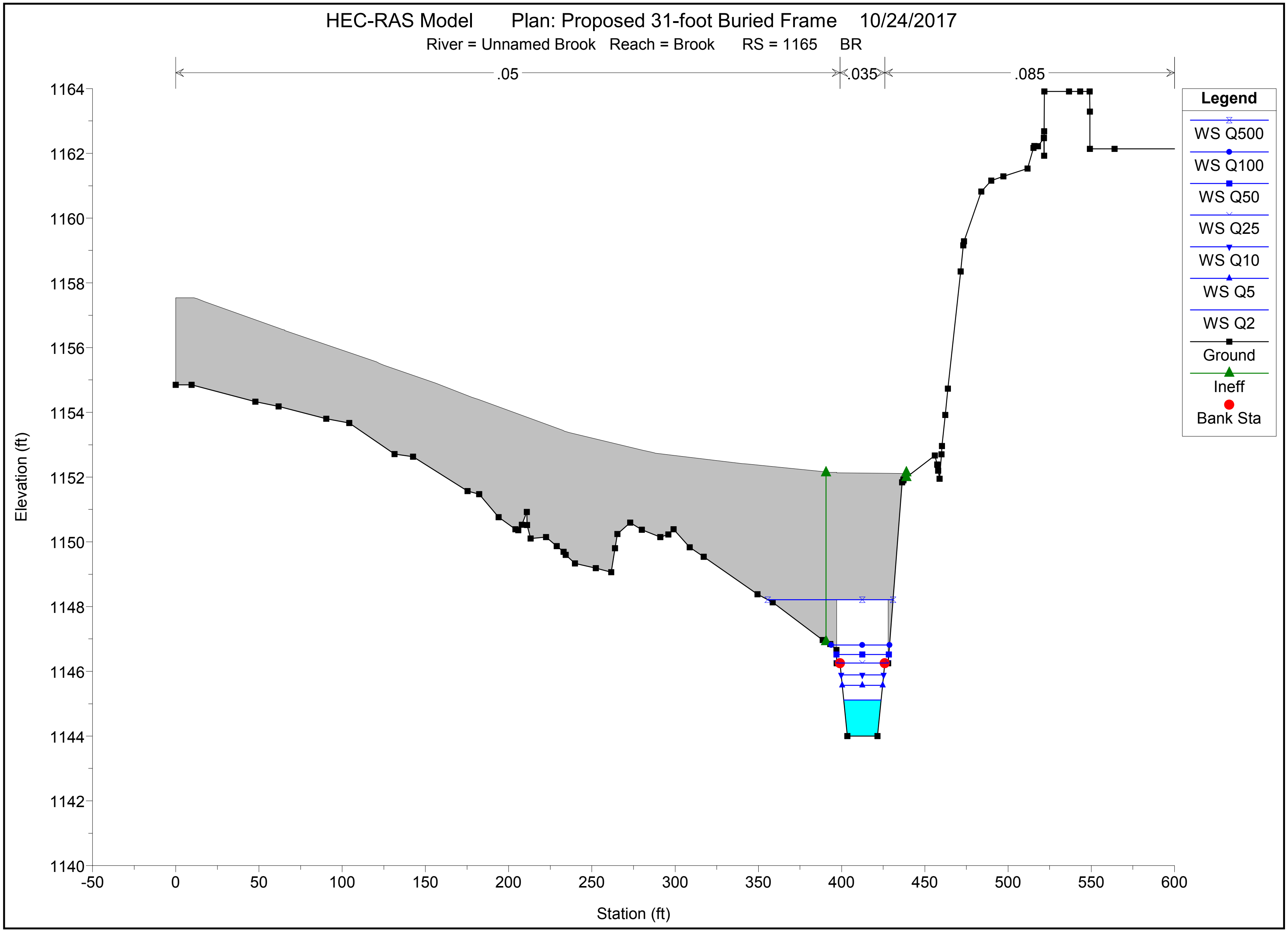
HEC-RAS Model Plan: Proposed 31-foot Buried Frame 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1506
.05
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Bank Sta
Elevation (ft)
Station (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600

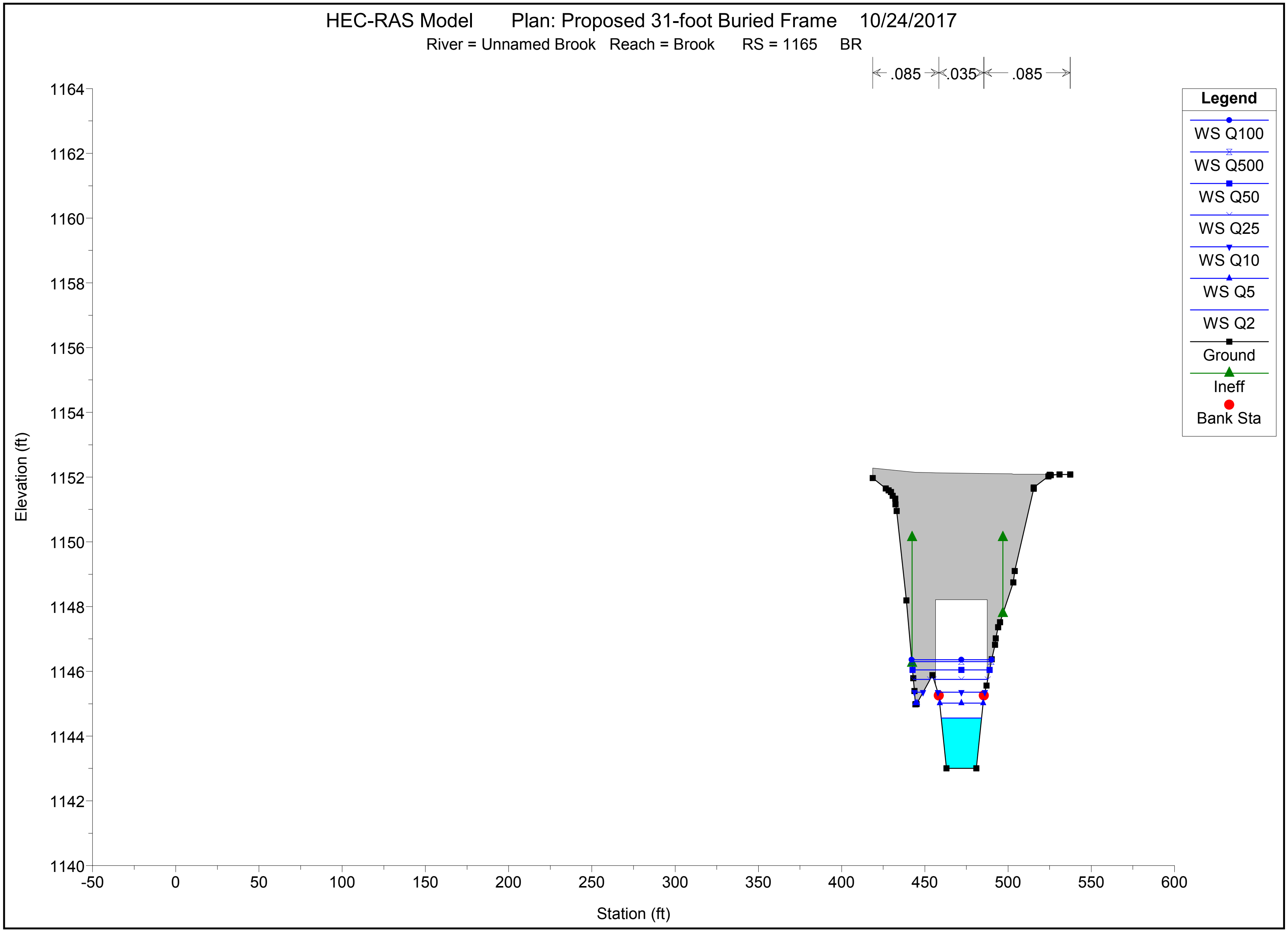


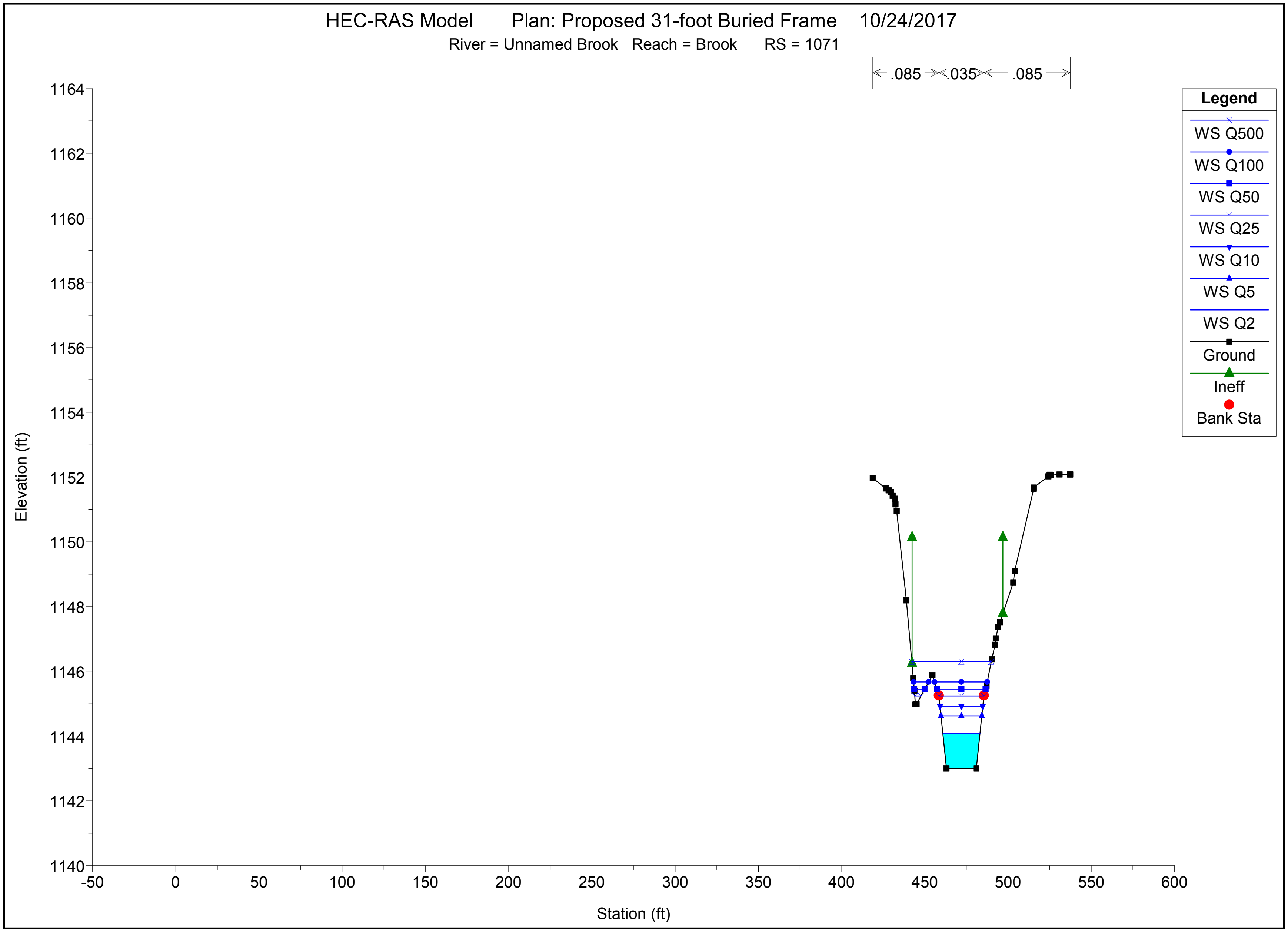
HEC-RAS Model Plan: Proposed 31-foot Buried Frame 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1238
.05
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1140
1142
1144
1146
1148
1150
1152
1154
1156
1158
1160
1162
1164
-50
0
50
100
150
200
250
300
350
400
450
500
550
600

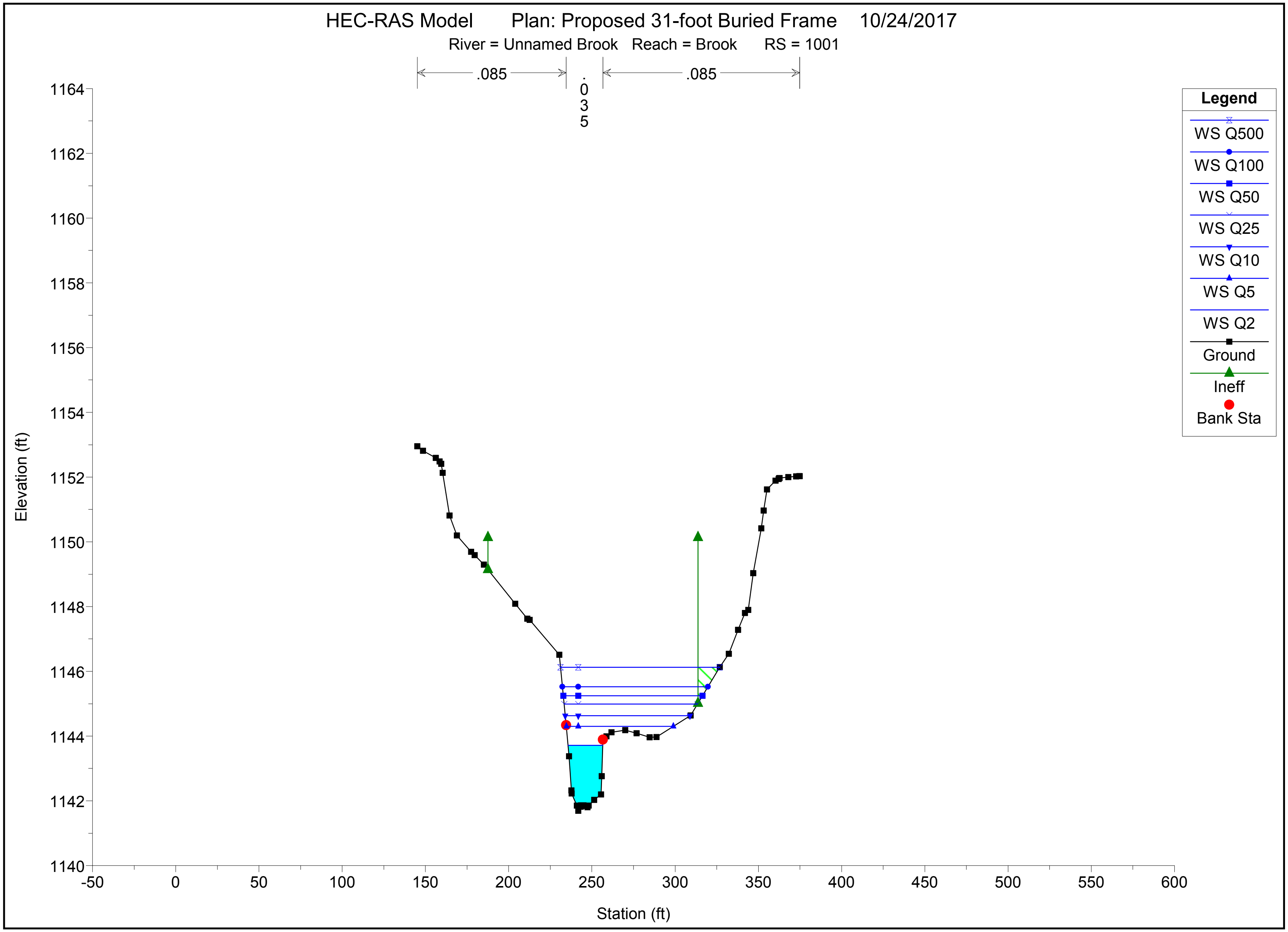


HEC-RAS Model Plan: Proposed 31-foot Buried Frame 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1182
.05
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1140
1142
1144
1146
1148
1150
1152
1154
1156
1158
1160
1162
1164
-50
0
50
100
150
200
250
300
350
400
450
500
550
600

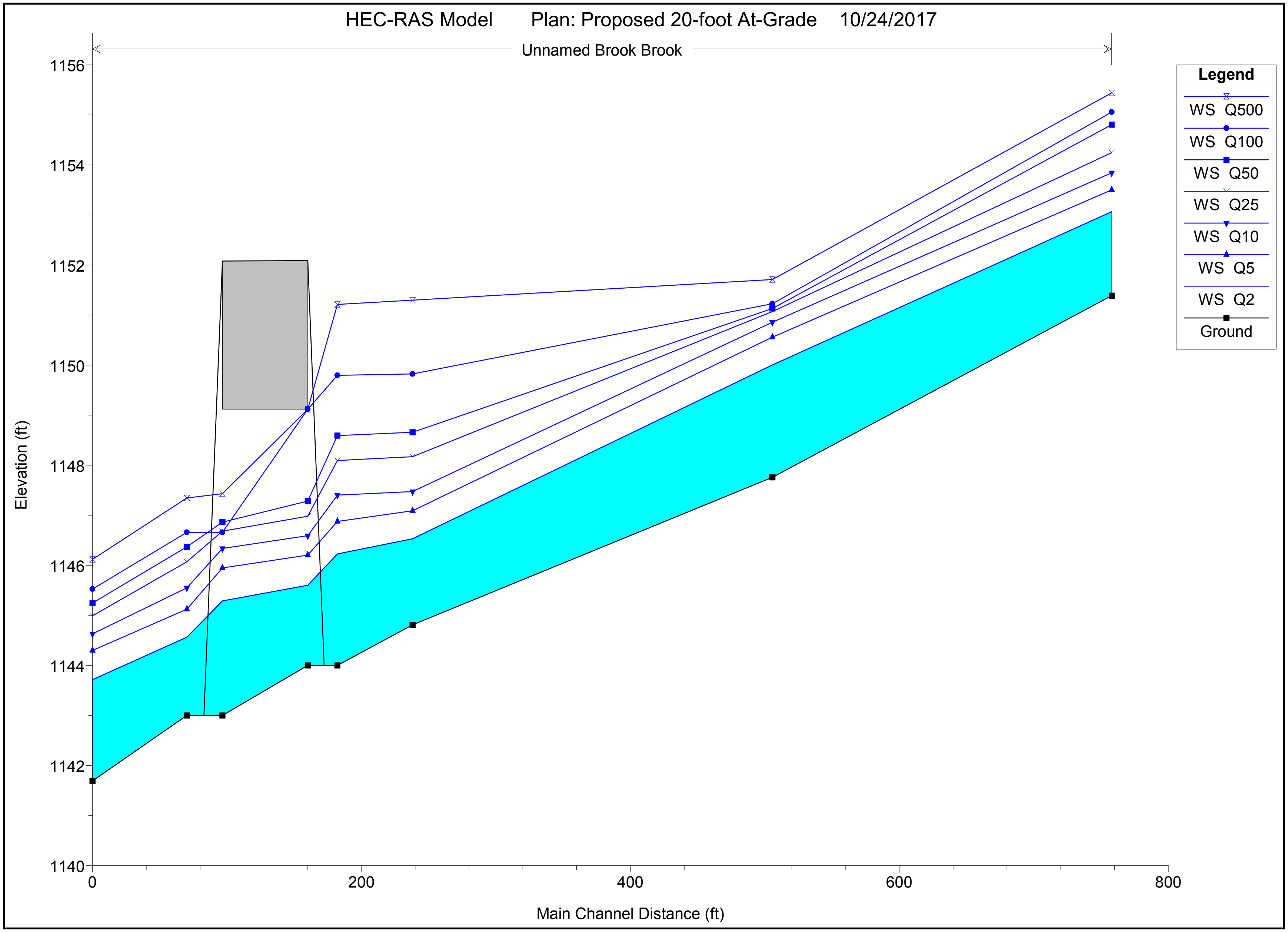

HEC-RAS Model Plan: Proposed 31-foot Buried Frame 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1165 BR
.05
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600


HEC-RAS Model Plan: Proposed 31-foot Buried Frame 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1165 BR
.085
.035
.085
Legend
WS Q100
WS Q500
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600


HEC-RAS Model Plan: Proposed 31-foot Buried Frame 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1071
.085
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
Station (ft)


HEC-RAS Model Plan: Proposed 31-foot Buried Frame 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1001
.085
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
Station (ft)

20-FOOT SPAN AT-GRADE FRAME



HEC-RAS Model Plan: Proposed 20-foot At-Grade 10/24/2017
Unnamed Brook Brook
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Elevation (ft)
1156
1154
1152
1150
1148
1146
1144
1142
1140
0
200
400
600
800
Main Channel Distance (ft)

```
                    HEC-RAS HEC-RAS 5.0.1 April 2016
                      U.S. Army Corps of Engineers
                     Hydrologic Engineering Center
                           609 Second Street
                           Davis, California

            X     X  XXXXXX    XXXX        XXXX       XX      XXXX
            X     X  X        X    X       X   X     X  X    X
            X     X  X        X            X   X    X    X   X
            XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
            X     X  X        X            X  X     X    X        X
            X     X  X        X    X       X   X    X    X        X
            X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
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PROJECT DATA
Project Title: HEC-RAS Model
Project File : Springfield_Hydraulics.prj
Run Date and Time: 10/24/2017 1:59:38 PM

Project in English units

Project Description:
CRS Info=<SpatialReference> <CoordinateSystem Code="3614"
Unit="US_survey_Foot" /> <Registration OffsetX="0" OffsetY="0" OffsetZ="0"
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PLAN DATA

Plan Title: Proposed 20-foot At-Grade
Plan File : f:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.p03

Geometry Title: At-Grade 20-foot
Geometry File : f:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.g03

Flow Title   : Steady Flow
Flow File   : f:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.f01

Plan Description:
existing culvert

Plan Summary Information:

```
Number of:  Cross Sections =    6    Multiple Openings  =    0
            Culverts       =    0    Inline Structures  =    0
            Bridges        =    1    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.33
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow
```

FLOW DATA

Flow Title: Steady Flow
Flow File : f:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.f01

Flow Data (cfs)

River	Reach	RS	Q2	Q5	Q10	Q25	Q50	Q100	Q500
Unnamed Brook	Brook	1758	117	194	259	348	421	510	727

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Unnamed Brook	Brook	Q2	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q5	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q10	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q25	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q50	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q100	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q500	Normal S = 0.0322	Normal S = 0.0039

GEOMETRY DATA

```
Geometry Title: At-Grade 20-foot
Geometry File : f:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.g03

CROSS SECTION


RIVER: Unnamed Brook
REACH: Brook              RS: 1758

INPUT
Description:
Station Elevation Data    num=      24
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     -10    1157       0    1156   60.03  1154.5   75.66 1154.29   99.99 1154.46
  100.85 1154.47  100.99 1154.48  109.77  1154.9  111.26 1154.74  111.74 1154.64
   112.8 1153.64  114.81 1152.38  121.13 1152.22  121.79 1152.13   122.1 1152.09
  122.32 1152.07  124.12 1151.93  128.32 1151.39  130.04 1151.41  131.07 1151.66
  131.76 1152.02  132.04 1152.35  133.29 1153.46     300    1160

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     -10     .05   112.8    .035  133.29    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         112.8  133.29           252.24  252.24  252.24             .1       .3

CROSS SECTION OUTPUT  Profile #Q2

  E.G. Elev (ft)           1153.60    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.53    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1153.07    Reach Len. (ft)            252.24     252.24     252.24
  Crit W.S. (ft)           1153.07    Flow Area (sq ft)                      19.94
  E.G. Slope (ft/ft)      0.019079    Area (sq ft)                           19.94
  Q Total (cfs)             117.00    Flow (cfs)                            117.00
  Top Width (ft)             19.13    Top Width (ft)                         19.13
  Vel Total (ft/s)            5.87    Avg. Vel. (ft/s)                        5.87
  Max Chl Dpth (ft)           1.67    Hydr. Depth (ft)                        1.04
  Conv. Total (cfs)          847.0    Conv. (cfs)                            847.0
  Length Wtd. (ft)          252.24    Wetted Per. (ft)                       19.92
  Min Ch El (ft)           1151.39    Shear (lb/sq ft)                        1.19
  Alpha                       1.00    Stream Power (lb/ft s)                  7.00
  Frctn Loss (ft)             2.96    Cum Volume (acre-ft)         0.00       0.41       0.00
  C & E Loss (ft)             0.08    Cum SA (acres)               0.00       0.32       0.00


Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical
         depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
```

the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q5

E.G. Elev (ft)	1154.22	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.72	Wt. n-Val.		0.035	0.085
W.S. Elev (ft)	1153.50	Reach Len. (ft)	252.24	252.24	252.24
Crit W.S. (ft)	1153.50	Flow Area (sq ft)		28.58	0.02
E.G. Slope (ft/ft)	0.017318	Area (sq ft)		28.58	0.02
Q Total (cfs)	194.00	Flow (cfs)		194.00	0.00
Top Width (ft)	21.36	Top Width (ft)		20.27	1.09
Vel Total (ft/s)	6.78	Avg. Vel. (ft/s)		6.79	0.18
Max Chl Dpth (ft)	2.11	Hydr. Depth (ft)		1.41	0.02
Conv. Total (cfs)	1474.2	Conv. (cfs)		1474.2	0.0
Length Wtd. (ft)	252.24	Wetted Per. (ft)		21.34	1.09
Min Ch El (ft)	1151.39	Shear (lb/sq ft)		1.45	0.02
Alpha	1.00	Stream Power (lb/ft s)		9.83	0.00
Frctn Loss (ft)	2.74	Cum Volume (acre-ft)	0.00	0.62	0.01
C & E Loss (ft)	0.13	Cum SA (acres)	0.02	0.39	0.08

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	1154.66	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.81	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1153.84	Reach Len. (ft)	252.24	252.24	252.24
Crit W.S. (ft)	1153.84	Flow Area (sq ft)	0.02	35.55	1.88
E.G. Slope (ft/ft)	0.014992	Area (sq ft)	0.02	35.55	1.88
Q Total (cfs)	259.00	Flow (cfs)	0.01	257.65	1.34
Top Width (ft)	30.49	Top Width (ft)	0.22	20.49	9.78
Vel Total (ft/s)	6.92	Avg. Vel. (ft/s)	0.64	7.25	0.71
Max Chl Dpth (ft)	2.45	Hydr. Depth (ft)	0.10	1.74	0.19
Conv. Total (cfs)	2115.3	Conv. (cfs)	0.1	2104.2	10.9
Length Wtd. (ft)	252.24	Wetted Per. (ft)	0.30	21.60	9.79
Min Ch El (ft)	1151.39	Shear (lb/sq ft)	0.07	1.54	0.18
Alpha	1.09	Stream Power (lb/ft s)	0.04	11.17	0.13
Frctn Loss (ft)	2.42	Cum Volume (acre-ft)	0.02	0.75	0.08

C & E Loss (ft)	0.14	Cum SA (acres)	0.04	0.40	0.27

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q25

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1155.16	Wt. n-Val.	0.050	0.035	0.085
Vel Head (ft)	0.91	Reach Len. (ft)	252.24	252.24	252.24
W.S. Elev (ft)	1154.25	Flow Area (sq ft)	0.20	43.83	7.91
Crit W.S. (ft)	1154.25	Area (sq ft)	0.20	43.83	7.91
E.G. Slope (ft/ft)	0.012945	Flow (cfs)	0.24	339.31	8.44
Q Total (cfs)	348.00	Top Width (ft)	0.64	20.49	20.08
Top Width (ft)	41.21	Avg. Vel. (ft/s)	1.24	7.74	1.07
Vel Total (ft/s)	6.70	Hydr. Depth (ft)	0.30	2.14	0.39
Max Chl Dpth (ft)	2.86	Conv. (cfs)	2.1	2982.3	74.2
Conv. Total (cfs)	3058.6	Wetted Per. (ft)	0.89	21.60	20.09
Length Wtd. (ft)	252.24	Shear (lb/sq ft)	0.18	1.64	0.32
Min Ch El (ft)	1151.39	Stream Power (lb/ft s)	0.22	12.70	0.34
Alpha	1.30	Cum Volume (acre-ft)	0.08	0.89	0.16
Frctn Loss (ft)	2.49	Cum SA (acres)	0.15	0.40	0.32
C & E Loss (ft)	0.14				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q50

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1155.42	Wt. n-Val.	0.050	0.035	0.085
Vel Head (ft)	0.61	Reach Len. (ft)	252.24	252.24	252.24
W.S. Elev (ft)	1154.80	Flow Area (sq ft)	20.89	55.23	23.02
Crit W.S. (ft)	1154.80	Area (sq ft)	20.89	55.23	23.02
E.G. Slope (ft/ft)	0.007112	Flow (cfs)	25.23	369.74	26.03
Q Total (cfs)	421.00	Top Width (ft)	62.03	20.49	34.26
Top Width (ft)	116.78	Avg. Vel. (ft/s)	1.21	6.70	1.13
Vel Total (ft/s)	4.25				

Max Chl Dpth (ft)	3.41	Hydr. Depth (ft)	0.34	2.70	0.67
Conv. Total (cfs)	4992.2	Conv. (cfs)	299.2	4384.4	308.6
Length Wtd. (ft)	252.24	Wetted Per. (ft)	62.46	21.60	34.29
Min Ch El (ft)	1151.39	Shear (lb/sq ft)	0.15	1.14	0.30
Alpha	2.19	Stream Power (lb/ft s)	0.18	7.60	0.34
Frctn Loss (ft)	2.12	Cum Volume (acre-ft)	0.24	0.99	0.24
C & E Loss (ft)	0.01	Cum SA (acres)	0.45	0.40	0.37

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	1155.65	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.59	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1155.06	Reach Len. (ft)	252.24	252.24	252.24
Crit W.S. (ft)	1155.06	Flow Area (sq ft)	38.36	60.38	32.45
E.G. Slope (ft/ft)	0.006549	Area (sq ft)	38.36	60.38	32.45
Q Total (cfs)	510.00	Flow (cfs)	58.78	411.75	39.48
Top Width (ft)	136.17	Top Width (ft)	75.01	20.49	40.68
Vel Total (ft/s)	3.89	Avg. Vel. (ft/s)	1.53	6.82	1.22
Max Chl Dpth (ft)	3.67	Hydr. Depth (ft)	0.51	2.95	0.80
Conv. Total (cfs)	6301.9	Conv. (cfs)	726.3	5087.8	487.8
Length Wtd. (ft)	252.24	Wetted Per. (ft)	75.44	21.60	40.71
Min Ch El (ft)	1151.39	Shear (lb/sq ft)	0.21	1.14	0.33
Alpha	2.51	Stream Power (lb/ft s)	0.32	7.80	0.40
Frctn Loss (ft)	2.21	Cum Volume (acre-ft)	0.76	1.15	0.33
C & E Loss (ft)	0.02	Cum SA (acres)	0.91	0.39	0.41

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1156.07	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.63	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1155.44	Reach Len. (ft)	252.24	252.24	252.24

Crit W.S. (ft)	1155.44	Flow Area (sq ft)	70.39	68.31	50.11
E.G. Slope (ft/ft)	0.006697	Area (sq ft)	70.39	68.31	50.11
Q Total (cfs)	727.00	Flow (cfs)	144.33	511.44	71.23
Top Width (ft)	161.53	Top Width (ft)	90.50	20.49	50.54
Vel Total (ft/s)	3.85	Avg. Vel. (ft/s)	2.05	7.49	1.42
Max Chl Dpth (ft)	4.05	Hydr. Depth (ft)	0.78	3.33	0.99
Conv. Total (cfs)	8883.9	Conv. (cfs)	1763.7	6249.7	870.5
Length Wtd. (ft)	252.24	Wetted Per. (ft)	90.94	21.60	50.58
Min Ch El (ft)	1151.39	Shear (lb/sq ft)	0.32	1.32	0.41
Alpha	2.73	Stream Power (lb/ft s)	0.66	9.90	0.59
Frctn Loss (ft)	2.11	Cum Volume (acre-ft)	2.24	1.41	0.58
C & E Loss (ft)	0.02	Cum SA (acres)	1.46	0.39	0.47

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Unnamed Brook
REACH: Brook RS: 1506

INPUT
Description:
Station Elevation Data num= 39

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1154.44	6.77	1154.44	22.76	1154.44	44.61	1154.11	65.12	1153.75
82.6	1153.55	106.59	1152.8	116.14	1152.49	127.36	1151.49	131.49	1151.09
140.43	1151.49	141.14	1151.63	141.9	1151.58	148.14	1151.08	150.57	1148.79
151.14	1148.06	151.72	1147.99	152.56	1147.76	153.39	1147.78	154.99	1147.89
156.77	1147.98	158.55	1148.06	159.01	1148.13	162.81	1148.42	163.61	1148.47
164.55	1149.54	164.72	1149.63	166.56	1149.71	181.79	1150.43	189.42	1150.57
209.57	1150.66	213.59	1150.82	218.46	1152.95	223.8	1155.73	227.16	1160.29
227.79	1160.9	306.77	1160.9	418.08	1160.9	631.82	1160.9		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	148.14	.035	181.79	.085

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
148.14	181.79	267.56	267.56	267.56	.1	.3

CROSS SECTION OUTPUT Profile #Q2

			Left OB	Channel	Right OB
E.G. Elev (ft)	1150.27	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.26	Wt. n-Val.		0.035	
W.S. Elev (ft)	1150.00	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1149.44	Flow Area (sq ft)		28.38	
E.G. Slope (ft/ft)	0.007919	Area (sq ft)		28.38	
Q Total (cfs)	117.00	Flow (cfs)		117.00	
Top Width (ft)	23.49	Top Width (ft)		23.49	
Vel Total (ft/s)	4.12	Avg. Vel. (ft/s)		4.12	
Max Chl Dpth (ft)	2.24	Hydr. Depth (ft)		1.21	
Conv. Total (cfs)	1314.8	Conv. (cfs)		1314.8	
Length Wtd. (ft)	267.56	Wetted Per. (ft)		24.90	
Min Ch El (ft)	1147.76	Shear (lb/sq ft)		0.56	
Alpha	1.00	Stream Power (lb/ft s)		2.32	
Frctn Loss (ft)	3.05	Cum Volume (acre-ft)	0.00	0.27	0.00
C & E Loss (ft)	0.04	Cum SA (acres)	0.00	0.20	0.00

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q5

E.G. Elev (ft)	1150.85	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.29	Wt. n-Val.		0.035	0.085
W.S. Elev (ft)	1150.56	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1150.11	Flow Area (sq ft)		44.71	0.46
E.G. Slope (ft/ft)	0.007453	Area (sq ft)		44.71	0.46
Q Total (cfs)	194.00	Flow (cfs)		193.89	0.11
Top Width (ft)	40.19	Top Width (ft)		33.10	7.09
Vel Total (ft/s)	4.29	Avg. Vel. (ft/s)		4.34	0.24
Max Chl Dpth (ft)	2.80	Hydr. Depth (ft)		1.35	0.07
Conv. Total (cfs)	2247.2	Conv. (cfs)		2245.9	1.3
Length Wtd. (ft)	267.56	Wetted Per. (ft)		34.74	7.09
Min Ch El (ft)	1147.76	Shear (lb/sq ft)		0.60	0.03
Alpha	1.02	Stream Power (lb/ft s)		2.60	0.01
Frctn Loss (ft)	2.86	Cum Volume (acre-ft)	0.00	0.40	0.01
C & E Loss (ft)	0.06	Cum SA (acres)	0.02	0.24	0.06

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	1151.19	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.		0.035	0.085
W.S. Elev (ft)	1150.86	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1150.43	Flow Area (sq ft)		54.67	8.15
E.G. Slope (ft/ft)	0.006669	Area (sq ft)		54.67	8.15
Q Total (cfs)	259.00	Flow (cfs)		254.31	4.69
Top Width (ft)	65.31	Top Width (ft)		33.42	31.89
Vel Total (ft/s)	4.12	Avg. Vel. (ft/s)		4.65	0.57
Max Chl Dpth (ft)	3.10	Hydr. Depth (ft)		1.64	0.26
Conv. Total (cfs)	3171.4	Conv. (cfs)		3114.0	57.4
Length Wtd. (ft)	267.56	Wetted Per. (ft)		35.18	31.90
Min Ch El (ft)	1147.76	Shear (lb/sq ft)		0.65	0.11
Alpha	1.25	Stream Power (lb/ft s)		3.01	0.06
Frctn Loss (ft)	2.63	Cum Volume (acre-ft)	0.02	0.49	0.05
C & E Loss (ft)	0.07	Cum SA (acres)	0.04	0.24	0.15

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q25

E.G. Elev (ft)	1151.51	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.44	Wt. n-Val.		0.035	0.085
W.S. Elev (ft)	1151.07	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1150.79	Flow Area (sq ft)		61.71	14.90
E.G. Slope (ft/ft)	0.007785	Area (sq ft)		61.71	14.90
Q Total (cfs)	348.00	Flow (cfs)		334.31	13.69
Top Width (ft)	66.01	Top Width (ft)		33.64	32.37
Vel Total (ft/s)	4.54	Avg. Vel. (ft/s)		5.42	0.92
Max Chl Dpth (ft)	3.31	Hydr. Depth (ft)		1.83	0.46
Conv. Total (cfs)	3944.2	Conv. (cfs)		3789.1	155.1
Length Wtd. (ft)	267.56	Wetted Per. (ft)		35.49	32.43
Min Ch El (ft)	1147.76	Shear (lb/sq ft)		0.85	0.22
Alpha	1.37	Stream Power (lb/ft s)		4.58	0.21
Frctn Loss (ft)	2.37	Cum Volume (acre-ft)	0.08	0.59	0.10
C & E Loss (ft)	0.05	Cum SA (acres)	0.14	0.24	0.17

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1151.72	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.59	Wt. n-Val.	0.050	0.035	0.085

W.S. Elev (ft)	1151.13	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1150.99	Flow Area (sq ft)	0.04	63.78	16.90
E.G. Slope (ft/ft)	0.010082	Area (sq ft)	0.04	63.78	16.90
Q Total (cfs)	421.00	Flow (cfs)	0.01	401.84	19.15
Top Width (ft)	68.14	Top Width (ft)	1.98	33.65	32.51
Vel Total (ft/s)	5.22	Avg. Vel. (ft/s)	0.24	6.30	1.13
Max Chl Dpth (ft)	3.37	Hydr. Depth (ft)	0.02	1.90	0.52
Conv. Total (cfs)	4192.9	Conv. (cfs)	0.1	4002.1	190.7
Length Wtd. (ft)	267.56	Wetted Per. (ft)	1.99	35.50	32.58
Min Ch El (ft)	1147.76	Shear (lb/sq ft)	0.01	1.13	0.33
Alpha	1.40	Stream Power (lb/ft s)	0.00	7.12	0.37
Frctn Loss (ft)	2.28	Cum Volume (acre-ft)	0.18	0.65	0.12
C & E Loss (ft)	0.02	Cum SA (acres)	0.26	0.24	0.18

Warning: Divided flow computed for this cross-section.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	1151.99	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.76	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1151.23	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1151.23	Flow Area (sq ft)	0.44	66.98	19.99
E.G. Slope (ft/ft)	0.012320	Area (sq ft)	0.44	66.98	19.99
Q Total (cfs)	510.00	Flow (cfs)	0.24	481.88	27.88
Top Width (ft)	72.64	Top Width (ft)	6.27	33.65	32.73
Vel Total (ft/s)	5.84	Avg. Vel. (ft/s)	0.56	7.19	1.39
Max Chl Dpth (ft)	3.47	Hydr. Depth (ft)	0.07	1.99	0.61
Conv. Total (cfs)	4594.7	Conv. (cfs)	2.2	4341.4	251.1
Length Wtd. (ft)	267.56	Wetted Per. (ft)	6.28	35.50	32.82
Min Ch El (ft)	1147.76	Shear (lb/sq ft)	0.05	1.45	0.47
Alpha	1.44	Stream Power (lb/ft s)	0.03	10.44	0.65
Frctn Loss (ft)	1.23	Cum Volume (acre-ft)	0.65	0.78	0.18
C & E Loss (ft)	0.13	Cum SA (acres)	0.68	0.23	0.20

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1152.55	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.84	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1151.71	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1151.71	Flow Area (sq ft)	8.30	83.24	36.08
E.G. Slope (ft/ft)	0.010733	Area (sq ft)	8.30	83.24	36.08
Q Total (cfs)	727.00	Flow (cfs)	12.85	646.20	67.95
Top Width (ft)	90.72	Top Width (ft)	23.24	33.65	33.83
Vel Total (ft/s)	5.70	Avg. Vel. (ft/s)	1.55	7.76	1.88
Max Chl Dpth (ft)	3.95	Hydr. Depth (ft)	0.36	2.47	1.07
Conv. Total (cfs)	7017.3	Conv. (cfs)	124.0	6237.4	655.9
Length Wtd. (ft)	267.56	Wetted Per. (ft)	23.31	35.50	34.02
Min Ch El (ft)	1147.76	Shear (lb/sq ft)	0.24	1.57	0.71
Alpha	1.66	Stream Power (lb/ft s)	0.37	12.20	1.34
Frctn Loss (ft)	0.74	Cum Volume (acre-ft)	2.01	0.97	0.33
C & E Loss (ft)	0.18	Cum SA (acres)	1.13	0.23	0.22

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Unnamed Brook
REACH: Brook RS: 1238

INPUT
Description:
Station Elevation Data num= 101

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1154.64	50.59	1153.89	53.33	1153.84	53.34	1153.84	94.44	1153.37
98.25	1153.25	130.83	1152.19	134.01	1151.92	135.47	1152.03	140.41	1151.88
170.3	1151.1	172.75	1150.87	176.02	1150.76	182.19	1150.56	192.01	1150.21
198.4	1150.13	200.79	1150.32	204.45	1150.14	206.36	1150.05	218.78	1149.98
221.4	1149.87	224.79	1149.76	229.82	1149.76	233.95	1149.56	242.01	1149.46
259.14	1149.19	259.31	1149.19	261.38	1149.14	263.82	1149.1	276.67	1150
280.62	1150.03	288.67	1149.85	293.32	1149.91	302.36	1149.8	312.42	1149.45
322.09	1149.1	346.3	1148.52	351.96	1148.38	356.11	1148.32	367.1	1148.17
370.45	1147.87	375.2	1147.78	377.34	1147.73	382.61	1147.92	384.98	1147.68
385.08	1147.67	385.2	1147.67	385.33	1147.66	385.47	1147.64	387.13	1147.36

```
  388.69  1145.7  389.07 1145.46  390.86 1144.97  390.97 1144.93  391.21 1144.94
  395.07 1145.04  395.13 1145.03   397.3 1144.82  397.38 1144.81  397.49 1144.83
  400.05 1145.37  402.95 1147.43  404.03 1148.24  405.46 1148.51   407.5 1148.97
  409.84 1149.47  416.14 1153.21  417.06 1153.98  420.28 1154.21  421.02 1154.38
  421.74 1155.13  421.75 1155.14  422.51 1156.57  422.94 1157.35  423.41 1157.34
  432.83 1157.15  434.03 1157.21  438.74 1157.25  450.64 1157.45  451.28 1157.17
  451.62 1157.15  452.03 1156.85  452.88 1156.55  453.31 1156.84   454.4 1157.57
  454.95 1158.12  456.45 1158.89     457 1159.29  457.91  1159.6  458.77  1160.7
  459.07 1161.51  460.13 1161.19  460.37 1161.15  461.41 1161.29  463.63 1161.62
  465.15 1161.44  473.05  1161.1  475.01  1160.9  485.41 1161.01  494.07 1161.18
  504.45 1161.18

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05  387.13    .035  402.95    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        387.13  402.95            55.99   55.99   55.99             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  349.37 1152.13       F
  456.67  504.45 1152.13       F

CROSS SECTION OUTPUT  Profile #Q2

  E.G. Elev (ft)           1147.18    Element                   Left OB    Channel   Right OB
  Vel Head (ft)               0.65    Wt. n-Val.                            0.035
  W.S. Elev (ft)           1146.53    Reach Len. (ft)            55.99      55.99      55.99
  Crit W.S. (ft)           1146.53    Flow Area (sq ft)                     18.06
  E.G. Slope (ft/ft)      0.017733    Area (sq ft)                          18.06
  Q Total (cfs)             117.00    Flow (cfs)                           117.00
  Top Width (ft)             13.78    Top Width (ft)                        13.78
  Vel Total (ft/s)            6.48    Avg. Vel. (ft/s)                       6.48
  Max Chl Dpth (ft)           1.72    Hydr. Depth (ft)                       1.31
  Conv. Total (cfs)          878.6    Conv. (cfs)                           878.6
  Length Wtd. (ft)           55.99    Wetted Per. (ft)                      14.72
  Min Ch El (ft)           1144.81    Shear (lb/sq ft)                       1.36
  Alpha                       1.00    Stream Power (lb/ft s)                 8.80
  Frctn Loss (ft)             0.48    Cum Volume (acre-ft)        0.00       0.13       0.00
  C & E Loss (ft)             0.11    Cum SA (acres)              0.00       0.09       0.00


Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical
          depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
         program defaulted to critical depth.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
```

CROSS SECTION OUTPUT Profile #Q5

E.G. Elev (ft)	1147.95	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.86	Wt. n-Val.		0.035	
W.S. Elev (ft)	1147.09	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1147.09	Flow Area (sq ft)		26.11	
E.G. Slope (ft/ft)	0.016531	Area (sq ft)		26.11	
Q Total (cfs)	194.00	Flow (cfs)		194.00	
Top Width (ft)	15.09	Top Width (ft)		15.09	
Vel Total (ft/s)	7.43	Avg. Vel. (ft/s)		7.43	
Max Chl Dpth (ft)	2.28	Hydr. Depth (ft)		1.73	
Conv. Total (cfs)	1508.9	Conv. (cfs)		1508.9	
Length Wtd. (ft)	55.99	Wetted Per. (ft)		16.45	
Min Ch El (ft)	1144.81	Shear (lb/sq ft)		1.64	
Alpha	1.00	Stream Power (lb/ft s)		12.17	
Frctn Loss (ft)	0.45	Cum Volume (acre-ft)	0.00	0.19	0.01
C & E Loss (ft)	0.15	Cum SA (acres)	0.02	0.09	0.04

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	1148.49	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.01	Wt. n-Val.	0.050	0.035	0.000
W.S. Elev (ft)	1147.48	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1147.48	Flow Area (sq ft)	0.04	32.11	0.00
E.G. Slope (ft/ft)	0.015953	Area (sq ft)	0.04	32.11	0.00
Q Total (cfs)	259.00	Flow (cfs)	0.02	258.98	0.00
Top Width (ft)	16.57	Top Width (ft)	0.69	15.82	0.06
Vel Total (ft/s)	8.06	Avg. Vel. (ft/s)	0.56	8.07	0.15
Max Chl Dpth (ft)	2.67	Hydr. Depth (ft)	0.06	2.03	0.02
Conv. Total (cfs)	2050.6	Conv. (cfs)	0.2	2050.4	0.0
Length Wtd. (ft)	55.99	Wetted Per. (ft)	0.69	17.41	0.08
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.06	1.84	
Alpha	1.00	Stream Power (lb/ft s)	0.03	14.82	
Frctn Loss (ft)	0.39	Cum Volume (acre-ft)	0.02	0.22	0.03
C & E Loss (ft)	0.19	Cum SA (acres)	0.04	0.09	0.06

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q25

E.G. Elev (ft)	1149.09	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.92	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1148.17	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1148.17	Flow Area (sq ft)	7.06	43.07	0.36
E.G. Slope (ft/ft)	0.010159	Area (sq ft)	7.06	43.07	0.36
Q Total (cfs)	348.00	Flow (cfs)	10.53	337.19	0.28
Top Width (ft)	36.82	Top Width (ft)	20.01	15.82	0.98
Vel Total (ft/s)	6.89	Avg. Vel. (ft/s)	1.49	7.83	0.78
Max Chl Dpth (ft)	3.36	Hydr. Depth (ft)	0.35	2.72	0.37
Conv. Total (cfs)	3452.6	Conv. (cfs)	104.4	3345.3	2.8
Length Wtd. (ft)	55.99	Wetted Per. (ft)	20.07	17.41	1.23
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.22	1.57	0.19
Alpha	1.25	Stream Power (lb/ft s)	0.33	12.28	0.15
Frctn Loss (ft)	0.27	Cum Volume (acre-ft)	0.06	0.27	0.05
C & E Loss (ft)	0.18	Cum SA (acres)	0.08	0.09	0.06

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1149.43	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.77	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1148.66	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1148.66	Flow Area (sq ft)	23.39	50.85	1.35
E.G. Slope (ft/ft)	0.007296	Area (sq ft)	24.35	50.85	1.35
Q Total (cfs)	421.00	Flow (cfs)	43.12	376.82	1.07
Top Width (ft)	65.68	Top Width (ft)	46.68	15.82	3.18
Vel Total (ft/s)	5.57	Avg. Vel. (ft/s)	1.84	7.41	0.79
Max Chl Dpth (ft)	3.85	Hydr. Depth (ft)	0.62	3.21	0.42

Conv. Total (cfs)	4928.7	Conv. (cfs)	504.8	4411.4	12.5
Length Wtd. (ft)	55.99	Wetted Per. (ft)	37.82	17.41	3.49
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.28	1.33	0.18
Alpha	1.60	Stream Power (lb/ft s)	0.52	9.86	0.14
Frctn Loss (ft)	0.22	Cum Volume (acre-ft)	0.10	0.30	0.07
C & E Loss (ft)	0.13	Cum SA (acres)	0.11	0.09	0.07

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1150.14	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.32	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1149.83	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1148.91	Flow Area (sq ft)	67.43	69.30	7.97
E.G. Slope (ft/ft)	0.002370	Area (sq ft)	122.74	69.30	7.97
Q Total (cfs)	510.00	Flow (cfs)	143.45	359.78	6.77
Top Width (ft)	161.68	Top Width (ft)	138.37	15.82	7.49
Vel Total (ft/s)	3.52	Avg. Vel. (ft/s)	2.13	5.19	0.85
Max Chl Dpth (ft)	5.02	Hydr. Depth (ft)	1.79	4.38	1.06
Conv. Total (cfs)	10475.2	Conv. (cfs)	2946.4	7389.7	139.1
Length Wtd. (ft)	55.99	Wetted Per. (ft)	37.82	17.41	7.99
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.26	0.59	0.15
Alpha	1.63	Stream Power (lb/ft s)	0.56	3.06	0.13
Frctn Loss (ft)	0.09	Cum Volume (acre-ft)	0.27	0.36	0.10
C & E Loss (ft)	0.03	Cum SA (acres)	0.23	0.08	0.07

Warning: Divided flow computed for this cross-section.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1151.52	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.22	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1151.30	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1149.39	Flow Area (sq ft)	122.95	92.56	20.80
E.G. Slope (ft/ft)	0.001252	Area (sq ft)	415.40	92.56	20.80
Q Total (cfs)	727.00	Flow (cfs)	283.67	423.49	19.83
Top Width (ft)	250.15	Top Width (ft)	224.37	15.82	9.97
Vel Total (ft/s)	3.08	Avg. Vel. (ft/s)	2.31	4.58	0.95
Max Chl Dpth (ft)	6.49	Hydr. Depth (ft)	3.26	5.85	2.09

```
  Conv. Total (cfs)         20549.8    Conv. (cfs)              8018.5    11970.7      560.6
  Length Wtd. (ft)            55.99    Wetted Per. (ft)          37.82      17.41      10.87
  Min Ch El (ft)            1144.81    Shear (lb/sq ft)           0.25       0.42       0.15
  Alpha                        1.51    Stream Power (lb/ft s)     0.59       1.90       0.14
  Frctn Loss (ft)              0.06    Cum Volume (acre-ft)       0.71       0.43       0.15
  C & E Loss (ft)              0.00    Cum SA (acres)             0.37       0.08       0.09


Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION


RIVER: Unnamed Brook
REACH: Brook              RS: 1182

INPUT
Description:
Station Elevation Data    num=      85
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1154.85    9.59 1154.85    47.9 1154.33   61.73 1154.18   90.45  1153.8
   104.2 1153.67  131.47 1152.71  142.49 1152.63  175.28 1151.57  182.35 1151.47
  193.98 1150.76  204.13 1150.39  205.72 1150.36  207.86 1150.53  210.87 1150.92
  211.03 1150.52   213.2  1150.1  222.43 1150.15  228.92 1149.87  233.05 1149.69
  234.27  1149.6  239.83 1149.33   252.3 1149.19  261.59 1149.06  263.91  1149.8
  265.27 1150.24  272.96 1150.59  280.01 1150.37  291.07 1150.15  295.94 1150.23
  299.06 1150.39  308.81 1149.83  317.19 1149.54  349.44 1148.38  358.53 1148.13
  388.59 1146.97  393.24 1146.84  396.86 1146.66  400.77 1146.51  402.49  1146.5
   402.5 1146.25   404.5 1146.25 407.875    1144 417.125    1144   420.5 1146.25
   422.5 1146.25  422.76 1147.58  423.43 1149.31  424.86  1150.8  425.29 1150.92
  436.36 1151.84  437.05  1151.9  437.24 1151.93  438.96 1151.99  456.04 1152.67
  457.37 1152.39  457.68 1152.37  458.07  1152.2  458.81 1151.95  459.95  1152.7
  460.33 1152.96  462.33 1153.92   463.9 1154.73  471.48 1158.35  473.12 1159.16
  473.56 1159.28  483.97 1160.82  489.92 1161.16  497.15 1161.29  511.64 1161.53
  515.27 1162.17  515.79 1162.23  518.02 1162.22  521.55 1162.47  521.57 1162.48
  521.69 1161.93  521.71 1162.68  521.77 1163.91  536.59 1163.91  543.33 1163.91
  549.08 1163.91   549.1 1163.29  549.13 1162.14  563.91 1162.14  790.85 1162.14

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05   404.5    .035   420.5    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         404.5   420.5           111.86  111.86  111.86             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  383.88  1152.2       F
  434.21  790.85 1152.12       F

CROSS SECTION OUTPUT  Profile #Q2
```

E.G. Elev (ft)	1146.50	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.27	Wt. n-Val.		0.035	
W.S. Elev (ft)	1146.23	Reach Len. (ft)	22.00	22.00	22.00
Crit W.S. (ft)	1145.56	Flow Area (sq ft)		28.01	
E.G. Slope (ft/ft)	0.005080	Area (sq ft)		28.01	
Q Total (cfs)	117.00	Flow (cfs)		117.00	
Top Width (ft)	15.93	Top Width (ft)		15.93	
Vel Total (ft/s)	4.18	Avg. Vel. (ft/s)		4.18	
Max Chl Dpth (ft)	2.23	Hydr. Depth (ft)		1.76	
Conv. Total (cfs)	1641.6	Conv. (cfs)		1641.6	
Length Wtd. (ft)	22.00	Wetted Per. (ft)		17.27	
Min Ch El (ft)	1144.00	Shear (lb/sq ft)		0.51	
Alpha	1.00	Stream Power (lb/ft s)		2.15	
Frctn Loss (ft)	0.18	Cum Volume (acre-ft)	0.00	0.10	0.00
C & E Loss (ft)	0.10	Cum SA (acres)	0.00	0.07	0.00

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q5

E.G. Elev (ft)	1147.25	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.37	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1146.88	Reach Len. (ft)	22.00	22.00	22.00
Crit W.S. (ft)	1146.12	Flow Area (sq ft)	3.53	38.45	1.29
E.G. Slope (ft/ft)	0.004693	Area (sq ft)	3.53	38.45	1.29
Q Total (cfs)	194.00	Flow (cfs)	3.04	189.99	0.96
Top Width (ft)	30.74	Top Width (ft)	12.61	16.00	2.12
Vel Total (ft/s)	4.48	Avg. Vel. (ft/s)	0.86	4.94	0.74
Max Chl Dpth (ft)	2.88	Hydr. Depth (ft)	0.28	2.40	0.61
Conv. Total (cfs)	2832.0	Conv. (cfs)	44.4	2773.5	14.1
Length Wtd. (ft)	22.00	Wetted Per. (ft)	12.86	17.36	2.64
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.08	0.65	0.14
Alpha	1.19	Stream Power (lb/ft s)	0.07	3.21	0.11
Frctn Loss (ft)	0.17	Cum Volume (acre-ft)	0.00	0.14	0.01
C & E Loss (ft)	0.12	Cum SA (acres)	0.01	0.07	0.04

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	1147.78	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.37	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1147.40	Reach Len. (ft)	22.00	22.00	22.00

Crit W.S. (ft)	1146.49	Flow Area (sq ft)	13.33	46.84	2.43
E.G. Slope (ft/ft)	0.003833	Area (sq ft)	14.15	46.84	2.43
Q Total (cfs)	259.00	Flow (cfs)	18.20	238.60	2.21
Top Width (ft)	45.34	Top Width (ft)	27.11	16.00	2.23
Vel Total (ft/s)	4.14	Avg. Vel. (ft/s)	1.36	5.09	0.91
Max Chl Dpth (ft)	3.40	Hydr. Depth (ft)	0.65	2.93	1.09
Conv. Total (cfs)	4183.6	Conv. (cfs)	293.9	3854.0	35.7
Length Wtd. (ft)	22.00	Wetted Per. (ft)	20.87	17.36	3.17
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.15	0.65	0.18
Alpha	1.40	Stream Power (lb/ft s)	0.21	3.29	0.17
Frctn Loss (ft)	0.14	Cum Volume (acre-ft)	0.01	0.17	0.03
C & E Loss (ft)	0.15	Cum SA (acres)	0.02	0.07	0.05

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q25

E.G. Elev (ft)	1148.44	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1148.10	Reach Len. (ft)	22.00	22.00	22.00
Crit W.S. (ft)	1147.13	Flow Area (sq ft)	27.65	57.95	4.05
E.G. Slope (ft/ft)	0.002815	Area (sq ft)	39.22	57.95	4.05
Q Total (cfs)	348.00	Flow (cfs)	52.60	291.55	3.85
Top Width (ft)	63.57	Top Width (ft)	45.11	16.00	2.46
Vel Total (ft/s)	3.88	Avg. Vel. (ft/s)	1.90	5.03	0.95
Max Chl Dpth (ft)	4.10	Hydr. Depth (ft)	1.34	3.62	1.65
Conv. Total (cfs)	6559.1	Conv. (cfs)	991.4	5495.2	72.6
Length Wtd. (ft)	22.00	Wetted Per. (ft)	20.87	17.36	3.91
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.23	0.59	0.18
Alpha	1.44	Stream Power (lb/ft s)	0.44	2.95	0.17
Frctn Loss (ft)	0.12	Cum Volume (acre-ft)	0.03	0.20	0.05
C & E Loss (ft)	0.23	Cum SA (acres)	0.04	0.07	0.06

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1148.92	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1148.59	Reach Len. (ft)	22.00	22.00	22.00

Crit W.S. (ft)	1147.48	Flow Area (sq ft)	37.86	65.87	5.32
E.G. Slope (ft/ft)	0.002408	Area (sq ft)	65.63	65.87	5.32
Q Total (cfs)	421.00	Flow (cfs)	82.09	333.76	5.14
Top Width (ft)	79.59	Top Width (ft)	60.94	16.00	2.65
Vel Total (ft/s)	3.86	Avg. Vel. (ft/s)	2.17	5.07	0.97
Max Chl Dpth (ft)	4.59	Hydr. Depth (ft)	1.84	4.12	2.01
Conv. Total (cfs)	8580.2	Conv. (cfs)	1673.1	6802.3	104.8
Length Wtd. (ft)	22.00	Wetted Per. (ft)	20.87	17.36	4.44
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.27	0.57	0.18
Alpha	1.43	Stream Power (lb/ft s)	0.59	2.89	0.17
Frctn Loss (ft)	0.10	Cum Volume (acre-ft)	0.04	0.22	0.06
C & E Loss (ft)	0.28	Cum SA (acres)	0.05	0.07	0.06

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	1150.02	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.23	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1149.80	Reach Len. (ft)	22.00	22.00	22.00
Crit W.S. (ft)	1147.76	Flow Area (sq ft)	62.67	85.12	8.86
E.G. Slope (ft/ft)	0.001236	Area (sq ft)	174.99	85.12	8.86
Q Total (cfs)	510.00	Flow (cfs)	136.24	366.61	7.15
Top Width (ft)	147.31	Top Width (ft)	127.92	16.00	3.40
Vel Total (ft/s)	3.26	Avg. Vel. (ft/s)	2.17	4.31	0.81
Max Chl Dpth (ft)	5.79	Hydr. Depth (ft)	3.04	5.32	2.61
Conv. Total (cfs)	14508.3	Conv. (cfs)	3875.8	10429.1	203.3
Length Wtd. (ft)	22.00	Wetted Per. (ft)	20.87	17.36	5.88
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.23	0.38	0.12
Alpha	1.38	Stream Power (lb/ft s)	0.50	1.63	0.09
Frctn Loss (ft)		Cum Volume (acre-ft)	0.08	0.26	0.09
C & E Loss (ft)		Cum SA (acres)	0.06	0.06	0.07

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1151.45	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.24	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1151.21	Reach Len. (ft)	22.00	22.00	22.00
Crit W.S. (ft)	1148.33	Flow Area (sq ft)	91.88	107.79	15.21
E.G. Slope (ft/ft)	0.000989	Area (sq ft)	434.40	107.79	15.21
Q Total (cfs)	727.00	Flow (cfs)	230.64	486.13	10.23
Top Width (ft)	242.21	Top Width (ft)	217.91	16.00	8.29

Vel Total (ft/s)	3.38	Avg. Vel. (ft/s)	2.51	4.51	0.67
Max Chl Dpth (ft)	7.21	Hydr. Depth (ft)	4.46	6.74	1.83
Conv. Total (cfs)	23116.1	Conv. (cfs)	7333.6	15457.2	325.2
Length Wtd. (ft)	22.00	Wetted Per. (ft)	20.87	17.36	11.24
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.27	0.38	0.08
Alpha	1.36	Stream Power (lb/ft s)	0.68	1.73	0.06
Frctn Loss (ft)		Cum Volume (acre-ft)	0.17	0.30	0.13
C & E Loss (ft)		Cum SA (acres)	0.09	0.06	0.08

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE

RIVER: Unnamed Brook
REACH: Brook RS: 1165

INPUT
Description: George's Mills Road
Distance from Upstream XS = 22
Deck/Roadway Width = 63.5
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 65

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-20.72	1157.54	0	11.03	1157.54	0	12.89	1157.51	0
17.28	1157.42	0	61.95	1156.6	0	63.03	1156.58	0
64.34	1156.56	0	65.45	1156.54	0	65.57	1156.53	0
120.65	1155.56	0	122.43	1155.51	0	125.25	1155.45	0
156.19	1154.9	0	177.76	1154.47	0	180.72	1154.42	0
181.33	1154.41	0	232.7	1153.44	0	233.38	1153.42	0
236.27	1153.38	0	280.75	1152.83	0	285.95	1152.77	0
287.63	1152.75	0	287.96	1152.74	0	340.11	1152.42	0
341.96	1152.41	0	343.81	1152.4	0	393.35	1152.15	0
393.96	1152.15	0	402.5	1152.13	0	402.5	1152.13	1149.12
422.5	1152.12	1149.12	422.5	1152.12	0	439.61	1152.11	0
451.08	1152.1	0	452.2	1152.09	0	452.73	1152.09	0
452.87	1152.09	0	471.27	1152.09	0	517.42	1152.05	0
517.75	1152.05	0	519.11	1152.05	0	520.7	1152.04	0
560.22	1151.91	0	583.5	1151.81	0	584.43	1151.81	0
584.98	1151.81	0	600.39	1151.67	0	613.32	1151.54	0
613.77	1151.54	0	614.64	1151.53	0	636.1	1151.33	0
644.18	1151.25	0	644.47	1151.25	0	656.35	1151.08	0
673.49	1150.84	0	674.65	1150.82	0	674.91	1150.82	0
675.18	1150.81	0	689.81	1150.61	0	705.5	1150.38	0
732.51	1149.99	0	733.71	1149.97	0	733.77	1149.97	0
733.94	1149.97	0	755.59	1149.97	0			

Upstream Bridge Cross Section Data

```
Station Elevation Data    num=      85
     Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev      Sta    Elev
       0 1154.85     9.59 1154.85     47.9 1154.33    61.73 1154.18    90.45  1153.8
   104.2 1153.67   131.47 1152.71   142.49 1152.63   175.28 1151.57   182.35 1151.47
  193.98 1150.76   204.13 1150.39   205.72 1150.36   207.86 1150.53   210.87 1150.92
  211.03 1150.52    213.2  1150.1   222.43 1150.15   228.92 1149.87   233.05 1149.69
  234.27  1149.6   239.83 1149.33    252.3 1149.19   261.59 1149.06   263.91  1149.8
  265.27 1150.24   272.96 1150.59   280.01 1150.37   291.07 1150.15   295.94 1150.23
  299.06 1150.39   308.81 1149.83   317.19 1149.54   349.44 1148.38   358.53 1148.13
  388.59 1146.97   393.24 1146.84   396.86 1146.66   400.77 1146.51   402.49  1146.5
   402.5 1146.25    404.5 1146.25  407.875    1144  417.125    1144    420.5 1146.25
   422.5 1146.25   422.76 1147.58   423.43 1149.31   424.86  1150.8   425.29 1150.92
  436.36 1151.84   437.05  1151.9   437.24 1151.93   438.96 1151.99   456.04 1152.67
  457.37 1152.39   457.68 1152.37   458.07  1152.2   458.81 1151.95   459.95  1152.7
  460.33 1152.96   462.33 1153.92    463.9 1154.73   471.48 1158.35   473.12 1159.16
  473.56 1159.28   483.97 1160.82   489.92 1161.16   497.15 1161.29   511.64 1161.53
  515.27 1162.17   515.79 1162.23   518.02 1162.22   521.55 1162.47   521.57 1162.48
  521.69 1161.93   521.71 1162.68   521.77 1163.91   536.59 1163.91   543.33 1163.91
  549.08 1163.91    549.1 1163.29   549.13 1162.14   563.91 1162.14   790.85 1162.14

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0     .05    404.5    .035    420.5    .085

Bank Sta: Left   Right    Coeff Contr.   Expan.
         404.5   420.5             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  383.88  1152.2       F
  434.21  790.85 1152.12       F

Downstream  Deck/Roadway Coordinates
    num=      67
     Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord      Sta Hi Cord Lo Cord
       0 1157.54       0    30.36 1157.54       0    62.11 1157.54       0
   63.97 1157.51       0    68.36 1157.42       0   113.03  1156.6       0
  114.11 1156.58       0   115.42 1156.56       0   116.53 1156.54       0
  116.65 1156.53       0   171.73 1155.56       0   173.51 1155.51       0
  176.33 1155.45       0   207.27  1154.9       0   228.84 1154.47       0
   231.8 1154.42       0   232.41 1154.41       0   283.78 1153.44       0
  284.46 1153.42       0   287.35 1153.38       0   331.83 1152.83       0
  337.03 1152.77       0   338.71 1152.75       0   339.04 1152.74       0
  391.19 1152.42       0   393.04 1152.41       0   394.89  1152.4       0
  444.43 1152.15       0   445.04 1152.15       0   452.47 1152.14       0
     462 1152.13       0      462 1152.13 1149.12      482 1152.12 1149.12
     482 1152.12       0   490.69 1152.11       0   502.16  1152.1       0
  503.28 1152.09       0   503.81 1152.09       0   503.95 1152.09       0
  522.35 1152.09       0    568.5 1152.05       0   568.83 1152.05       0
  570.19 1152.05       0   571.78 1152.04       0    611.3 1151.91       0
  634.58 1151.81       0   635.51 1151.81       0   636.06 1151.81       0
```

651.47	1151.67	0	664.4	1151.54	0	664.85	1151.54	0
665.72	1151.53	0	687.18	1151.33	0	695.26	1151.25	0
695.55	1151.25	0	707.43	1151.08	0	724.57	1150.84	0
725.73	1150.82	0	725.99	1150.82	0	726.26	1150.81	0
740.89	1150.61	0	756.58	1150.38	0	783.59	1149.99	0
784.79	1149.97	0	784.85	1149.97	0	785.02	1149.97	0
806.67	1149.97	0						

Downstream Bridge Cross Section Data
Station Elevation Data num= 102

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1154.86	3.17	1154.86	18.25	1154.54	44.15	1154.46	49.44	1154.39
64.01	1154.51	87.25	1155.1	91.06	1155.27	102	1154.72	104.46	1154.75
109.41	1154.7	154.76	1155.19	168.55	1155.15	194.17	1155.07	203.36	1154.97
220.01	1154.87	223.63	1154.89	229.88	1154.77	231.9	1154.42	236.94	1154.49
237.3	1154.49	239.49	1154.49	240.01	1154.56	242.26	1154.75	245.96	1154.47
247.98	1154.43	250.34	1154.39	256.14	1155.31	258.96	1155.72	259.91	1155.81
260.49	1155.82	260.96	1155.83	278.37	1156.42	283.57	1156.5	288.28	1156.44
290.33	1156.52	302.45	1156.68	303.03	1156.66	303.6	1156.64	304.26	1156.61
305.24	1156.53	319.19	1154.98	324.56	1154.52	331.77	1153.73	336.57	1153.11
340.34	1152.99	345.08	1152.8	354.89	1152.31	362.26	1152.12	363.93	1152
369.33	1151.83	374.56	1151.64	383.26	1151.22	389.67	1151.22	398.1	1151.33
400.27	1151.37	401.99	1151.07	402.1	1151.06	405.15	1151.65	406.95	1151.83
408.05	1151.76	410.58	1151.76	418.68	1151.97	426.48	1151.65	428.21	1151.59
429.72	1151.54	430.73	1151.42	432.25	1151.33	432.32	1151.16	433.02	1150.95
438.91	1148.19	443.07	1145.79	443.77	1145.39	444.41	1144.98	444.73	1144.99
445.01	1144.99	454.53	1145.88	459.02	1145.79	461.79	1145.38	462	1145.25
464	1145.25	467.375	1143	476.625	1143	480	1145.25	482	1145.25
484.87	1145.2	487.07	1145.56	490.18	1146.37	492.23	1146.82	492.62	1147.02
494.12	1147.36	495.13	1147.52	503.18	1148.75	504.05	1149.1	515.37	1151.64
515.46	1151.68	524.31	1152.02	524.95	1152.06	525.03	1152.07	525.7	1152.06
530.97	1152.08	537.3	1152.08						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.085	464	.035	480	.085

Bank Sta: Left	Right	Coeff Contr.	Expan.
464	480	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	453.01	1151.33	F
498.14	537.3	1151.29	F

Upstream Embankment side slope = 1.5 horiz. to 1.0 vertical
Downstream Embankment side slope = 1.5 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow = .98
Elevation at which weir flow begins =
Energy head used in spillway design =
Spillway height used in design =

```
Weir crest shape                          = Broad Crested

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Pressure and Weir flow
           Submerged Inlet Cd          =
           Submerged Inlet + Outlet Cd =      .8
           Max Low Cord                =

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT  Profile #Q2

  E.G. US. (ft)              1146.50    Element                 Inside BR US  Inside BR DS
  W.S. US. (ft)              1146.23    E.G. Elev (ft)              1146.21       1145.54
  Q Total (cfs)               117.00    W.S. Elev (ft)              1145.60       1145.29
  Q Bridge (cfs)              117.00    Crit W.S. (ft)              1145.56       1144.56
  Q Weir (cfs)                          Max Chl Dpth (ft)              1.60          2.29
  Weir Sta Lft (ft)                     Vel Total (ft/s)               6.26          4.01
  Weir Sta Rgt (ft)                     Flow Area (sq ft)             18.70         29.14
  Weir Submerg                          Froude # Chl                   0.96          0.47
  Weir Max Depth (ft)                   Specif Force (cu ft)          36.70         44.82
  Min El Weir Flow (ft)      1152.12    Hydr Depth (ft)                1.33          1.46
  Min El Prs (ft)            1149.12    W.P. Total (ft)               15.03         21.36
  Delta EG (ft)                 1.29    Conv. Total (cfs)             917.9        1732.9
  Delta WS (ft)                 1.66    Top Width (ft)                14.06         20.00
  BR Open Area (sq ft)         85.81    Frctn Loss (ft)                0.49          0.21
  BR Open Vel (ft/s)            6.26    C & E Loss (ft)                0.18          0.12
  BR Sluice Coef                0.00    Shear Total (lb/sq ft)         1.26          0.39
  BR Sel Method          Energy only    Power Total (lb/ft s)          7.89          1.56


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT  Profile #Q5
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```
  E.G. US. (ft)              1147.25    Element                Inside BR US  Inside BR DS
  W.S. US. (ft)              1146.88    E.G. Elev (ft)             1146.97       1146.31
  Q Total (cfs)               194.00    W.S. Elev (ft)             1146.21       1145.95
  Q Bridge (cfs)              194.00    Crit W.S. (ft)             1146.12       1145.12
  Q Weir (cfs)                          Max Chl Dpth (ft)             2.21          2.95
  Weir Sta Lft (ft)                     Vel Total (ft/s)              7.01          4.58
  Weir Sta Rgt (ft)                     Flow Area (sq ft)            27.69         42.33
  Weir Submerg                          Froude # Chl                  0.93          0.49
  Weir Max Depth (ft)                   Specif Force (cu ft)         70.06         82.60
  Min El Weir Flow (ft)      1152.12    Hydr Depth (ft)               1.75          2.12
  Min El Prs (ft)            1149.12    W.P. Total (ft)              17.20         21.36
  Delta EG (ft)                 1.29    Conv. Total (cfs)           1615.0        2944.8
  Delta WS (ft)                 1.76    Top Width (ft)               15.87         20.00
  BR Open Area (sq ft)         85.81    Frctn Loss (ft)               0.46          0.20
  BR Open Vel (ft/s)            7.01    C & E Loss (ft)               0.20          0.14
  BR Sluice Coef                0.00    Shear Total (lb/sq ft)        1.45          0.54
  BR Sel Method          Energy only    Power Total (lb/ft s)        10.16          2.46
```

```
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.
```

BRIDGE OUTPUT Profile #Q10

```
  E.G. US. (ft)              1147.78    Element                Inside BR US  Inside BR DS
  W.S. US. (ft)              1147.40    E.G. Elev (ft)             1147.48       1146.80
  Q Total (cfs)               259.00    W.S. Elev (ft)             1146.59       1146.34
  Q Bridge (cfs)              259.00    Crit W.S. (ft)             1146.53       1145.52
  Q Weir (cfs)                          Max Chl Dpth (ft)             2.59          3.34
  Weir Sta Lft (ft)                     Vel Total (ft/s)              7.35          5.16
  Weir Sta Rgt (ft)                     Flow Area (sq ft)            35.23         50.18
  Weir Submerg                          Froude # Chl                  0.83          0.53
  Weir Max Depth (ft)                   Specif Force (cu ft)        100.71        115.65
  Min El Weir Flow (ft)      1152.12    Hydr Depth (ft)               1.76          2.51
  Min El Prs (ft)            1149.12    W.P. Total (ft)              21.36         21.36
  Delta EG (ft)                 1.30    Conv. Total (cfs)           2260.6        3796.0
  Delta WS (ft)                 1.85    Top Width (ft)               20.00         20.00
  BR Open Area (sq ft)         85.81    Frctn Loss (ft)               0.46          0.20
  BR Open Vel (ft/s)            7.35    C & E Loss (ft)               0.21          0.14
  BR Sluice Coef                0.00    Shear Total (lb/sq ft)        1.35          0.68
  BR Sel Method          Energy only    Power Total (lb/ft s)         9.94          3.52
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Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
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Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #Q25

E.G. US. (ft)	1148.44	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	1148.10	E.G. Elev (ft)	1148.09	1147.34
Q Total (cfs)	348.00	W.S. Elev (ft)	1146.98	1146.68
Q Bridge (cfs)	348.00	Crit W.S. (ft)	1146.97	1145.95
Q Weir (cfs)		Max Chl Dpth (ft)	2.98	3.68
Weir Sta Lft (ft)		Vel Total (ft/s)	8.08	6.10
Weir Sta Rgt (ft)		Flow Area (sq ft)	43.07	57.01
Weir Submerg		Froude # Chl	0.86	0.60
Weir Max Depth (ft)		Specif Force (cu ft)	146.04	160.03
Min El Weir Flow (ft)	1152.12	Hydr Depth (ft)	2.15	2.85
Min El Prs (ft)	1149.12	W.P. Total (ft)	21.36	21.36
Delta EG (ft)	1.39	Conv. Total (cfs)	3035.4	4609.9
Delta WS (ft)	2.03	Top Width (ft)	20.00	20.00
BR Open Area (sq ft)	85.81	Frctn Loss (ft)	0.53	0.21
BR Open Vel (ft/s)	8.08	C & E Loss (ft)	0.22	0.09
BR Sluice Coef	0.00	Shear Total (lb/sq ft)	1.65	0.95
BR Sel Method	Energy only	Power Total (lb/ft s)	13.37	5.80

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #Q50

E.G. US. (ft)	1148.92	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	1148.59	E.G. Elev (ft)	1148.54	1147.72
Q Total (cfs)	421.00	W.S. Elev (ft)	1147.29	1146.86
Q Bridge (cfs)	421.00	Crit W.S. (ft)	1147.29	1146.29
Q Weir (cfs)		Max Chl Dpth (ft)	3.29	3.86
Weir Sta Lft (ft)		Vel Total (ft/s)	8.57	6.94
Weir Sta Rgt (ft)		Flow Area (sq ft)	49.12	60.65
Weir Submerg		Froude # Chl	0.87	0.67
Weir Max Depth (ft)		Specif Force (cu ft)	186.15	197.14
Min El Weir Flow (ft)	1152.12	Hydr Depth (ft)	2.46	3.03
Min El Prs (ft)	1149.12	W.P. Total (ft)	21.36	21.36
Delta EG (ft)	1.49	Conv. Total (cfs)	3702.2	5070.7
Delta WS (ft)	2.22	Top Width (ft)	20.00	20.00
BR Open Area (sq ft)	85.81	Frctn Loss (ft)	0.58	0.23
BR Open Vel (ft/s)	8.57	C & E Loss (ft)	0.20	0.06

BR Sluice Coef	0.00	Shear Total (lb/sq ft)	1.86	1.22
BR Sel Method	Energy only	Power Total (lb/ft s)	15.91	8.48

Warning: For the final momentum answer at the bridge, the upstream energy was computed lower than the energy inside of the bridge deck. This is not physically possible. Please review your bridge data and results for reasonableness.
Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #Q100

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	1150.02	E.G. Elev (ft)	1150.02	1148.09
W.S. US. (ft)	1149.80	W.S. Elev (ft)	1149.12	1146.66
Q Total (cfs)	510.00	Crit W.S. (ft)	1147.62	1146.63
Q Bridge (cfs)	510.00	Max Chl Dpth (ft)	5.12	3.66
Q Weir (cfs)		Vel Total (ft/s)	5.94	9.01
Weir Sta Lft (ft)		Flow Area (sq ft)	85.81	56.59
Weir Sta Rgt (ft)		Froude # Chl	0.50	0.89
Weir Submerg		Specif Force (cu ft)	294.50	240.09
Weir Max Depth (ft)		Hydr Depth (ft)		2.83
Min El Weir Flow (ft)	1152.12	W.P. Total (ft)	49.97	21.36
Min El Prs (ft)	1149.12	Conv. Total (cfs)	5604.4	4558.5
Delta EG (ft)	2.16	Top Width (ft)		20.00
Delta WS (ft)	3.14	Frctn Loss (ft)		
BR Open Area (sq ft)	85.81	C & E Loss (ft)		
BR Open Vel (ft/s)	5.94	Shear Total (lb/sq ft)	0.89	2.07
BR Sluice Coef	0.00	Power Total (lb/ft s)	5.28	18.66
BR Sel Method	Press Only			

Warning: For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum answer has been disregarded.
Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir flow. The momentum answer has been disregarded.
Note: The downstream water surface is below the minimum elevation for pressure flow. The sluice gate equations were used for pressure flow.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #Q500

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	1151.45	E.G. Elev (ft)	1151.45	1149.26
W.S. US. (ft)	1151.21	W.S. Elev (ft)	1149.12	1147.43
Q Total (cfs)	727.00	Crit W.S. (ft)	1148.40	1147.43
Q Bridge (cfs)	727.00			

Q Weir (cfs)		Max Chl Dpth (ft)	5.12	4.43
Weir Sta Lft (ft)		Vel Total (ft/s)	8.47	10.10
Weir Sta Rgt (ft)		Flow Area (sq ft)	85.81	72.01
Weir Submerg		Froude # Chl	0.72	0.91
Weir Max Depth (ft)		Specif Force (cu ft)	399.24	381.05
Min El Weir Flow (ft)	1152.12	Hydr Depth (ft)		3.60
Min El Prs (ft)	1149.12	W.P. Total (ft)	49.97	21.36
Delta EG (ft)	2.69	Conv. Total (cfs)	5604.4	6621.1
Delta WS (ft)	3.87	Top Width (ft)		20.00
BR Open Area (sq ft)	85.81	Frctn Loss (ft)		
BR Open Vel (ft/s)	8.47	C & E Loss (ft)		
BR Sluice Coef	0.00	Shear Total (lb/sq ft)	1.80	2.54
BR Sel Method	Press Only	Power Total (lb/ft s)	15.28	25.61

Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir flow. The momentum answer has been disregarded.
Note: The downstream water surface is below the minimum elevation for pressure flow. The sluice gate equations were used for pressure flow.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION

RIVER: Unnamed Brook
REACH: Brook RS: 1071

INPUT
Description:
Station Elevation Data num= 102

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1154.86	3.17	1154.86	18.25	1154.54	44.15	1154.46	49.44	1154.39
64.01	1154.51	87.25	1155.1	91.06	1155.27	102	1154.72	104.46	1154.75
109.41	1154.7	154.76	1155.19	168.55	1155.15	194.17	1155.07	203.36	1154.97
220.01	1154.87	223.63	1154.89	229.88	1154.77	231.9	1154.42	236.94	1154.49
237.3	1154.49	239.49	1154.49	240.01	1154.56	242.26	1154.75	245.96	1154.47
247.98	1154.43	250.34	1154.39	256.14	1155.31	258.96	1155.72	259.91	1155.81
260.49	1155.82	260.96	1155.83	278.37	1156.42	283.57	1156.5	288.28	1156.44
290.33	1156.52	302.45	1156.68	303.03	1156.66	303.6	1156.64	304.26	1156.61
305.24	1156.53	319.19	1154.98	324.56	1154.52	331.77	1153.73	336.57	1153.11
340.34	1152.99	345.08	1152.8	354.89	1152.31	362.26	1152.12	363.93	1152
369.33	1151.83	374.56	1151.64	383.26	1151.22	389.67	1151.22	398.1	1151.33
400.27	1151.37	401.99	1151.07	402.1	1151.06	405.15	1151.65	406.95	1151.83
408.05	1151.76	410.58	1151.76	418.68	1151.97	426.48	1151.65	428.21	1151.59
429.72	1151.54	430.73	1151.42	432.25	1151.33	432.32	1151.16	433.02	1150.95
438.91	1148.19	443.07	1145.79	443.77	1145.39	444.41	1144.98	444.73	1144.99
445.01	1144.99	454.53	1145.88	459.02	1145.79	461.79	1145.38	462	1145.25
464	1145.25	467.375	1143	476.625	1143	480	1145.25	482	1145.25
484.87	1145.2	487.07	1145.56	490.18	1146.37	492.23	1146.82	492.62	1147.02

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  494.12 1147.36  495.13 1147.52  503.18 1148.75  504.05  1149.1  515.37 1151.64
  515.46 1151.68  524.31 1152.02  524.95 1152.06  525.03 1152.07   525.7 1152.06
  530.97 1152.08   537.3 1152.08

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .085     464    .035     480    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           464     480             70.2    70.2    70.2             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  453.01 1151.33       F
  498.14   537.3 1151.29       F

CROSS SECTION OUTPUT  Profile #Q2

  E.G. Elev (ft)           1145.21    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.65    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1144.56    Reach Len. (ft)             70.20      70.20      70.20
  Crit W.S. (ft)           1144.56    Flow Area (sq ft)                      18.13
  E.G. Slope (ft/ft)      0.017766    Area (sq ft)                           18.13
  Q Total (cfs)             117.00    Flow (cfs)                            117.00
  Top Width (ft)             13.94    Top Width (ft)                         13.94
  Vel Total (ft/s)            6.45    Avg. Vel. (ft/s)                        6.45
  Max Chl Dpth (ft)           1.56    Hydr. Depth (ft)                        1.30
  Conv. Total (cfs)          877.8    Conv. (cfs)                            877.8
  Length Wtd. (ft)           70.20    Wetted Per. (ft)                       14.89
  Min Ch El (ft)           1143.00    Shear (lb/sq ft)                        1.35
  Alpha                       1.00    Stream Power (lb/ft s)                  8.72
  Frctn Loss (ft)             0.51    Cum Volume (acre-ft)                    0.04
  C & E Loss (ft)             0.23    Cum SA (acres)                          0.03


Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical
         depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
         the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
         program defaulted to critical depth.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT  Profile #Q5

  E.G. Elev (ft)           1145.96    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.84    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1145.12    Reach Len. (ft)             70.20      70.20      70.20
```

Crit W.S. (ft)	1145.12	Flow Area (sq ft)		26.38	
E.G. Slope (ft/ft)	0.016568	Area (sq ft)	0.19	26.38	
Q Total (cfs)	194.00	Flow (cfs)		194.00	
Top Width (ft)	17.85	Top Width (ft)	2.23	15.62	
Vel Total (ft/s)	7.35	Avg. Vel. (ft/s)		7.35	
Max Chl Dpth (ft)	2.12	Hydr. Depth (ft)		1.69	
Conv. Total (cfs)	1507.2	Conv. (cfs)		1507.2	
Length Wtd. (ft)	70.20	Wetted Per. (ft)		16.90	
Min Ch El (ft)	1143.00	Shear (lb/sq ft)		1.61	
Alpha	1.00	Stream Power (lb/ft s)		11.87	
Frctn Loss (ft)	0.50	Cum Volume (acre-ft)	0.00	0.06	0.01
C & E Loss (ft)	0.29	Cum SA (acres)	0.00	0.03	0.03

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	1146.47	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.92	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1145.55	Reach Len. (ft)	70.20	70.20	70.20
Crit W.S. (ft)	1145.55	Flow Area (sq ft)	0.75	33.21	1.91
E.G. Slope (ft/ft)	0.013972	Area (sq ft)	3.02	33.21	1.91
Q Total (cfs)	259.00	Flow (cfs)	0.56	256.79	1.65
Top Width (ft)	33.88	Top Width (ft)	10.87	16.00	7.01
Vel Total (ft/s)	7.22	Avg. Vel. (ft/s)	0.75	7.73	0.87
Max Chl Dpth (ft)	2.55	Hydr. Depth (ft)	0.22	2.08	0.27
Conv. Total (cfs)	2191.2	Conv. (cfs)	4.8	2172.4	14.0
Length Wtd. (ft)	70.20	Wetted Per. (ft)	3.41	17.36	7.04
Min Ch El (ft)	1143.00	Shear (lb/sq ft)	0.19	1.67	0.24
Alpha	1.14	Stream Power (lb/ft s)	0.14	12.90	0.20
Frctn Loss (ft)	0.47	Cum Volume (acre-ft)	0.00	0.07	0.02
C & E Loss (ft)	0.31	Cum SA (acres)	0.01	0.03	0.05

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.

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Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross
         sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
         the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
         program defaulted to critical depth.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT  Profile #Q25

  E.G. Elev (ft)          1147.04    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.97    Wt. n-Val.                0.085      0.035      0.085
  W.S. Elev (ft)          1146.07    Reach Len. (ft)           70.20      70.20      70.20
  Crit W.S. (ft)          1146.07    Flow Area (sq ft)          4.60      41.53       6.09
  E.G. Slope (ft/ft)     0.011258    Area (sq ft)              11.87      41.53       6.09
  Q Total (cfs)            348.00    Flow (cfs)                 4.75     334.63       8.62
  Top Width (ft)            46.45    Top Width (ft)            21.42      16.00       9.03
  Vel Total (ft/s)           6.66    Avg. Vel. (ft/s)           1.03       8.06       1.42
  Max Chl Dpth (ft)          3.07    Hydr. Depth (ft)           0.42       2.60       0.67
  Conv. Total (cfs)        3279.9    Conv. (cfs)                44.8     3153.9       81.2
  Length Wtd. (ft)          70.20    Wetted Per. (ft)          11.06      17.36       9.12
  Min Ch El (ft)          1143.00    Shear (lb/sq ft)           0.29       1.68       0.47
  Alpha                      1.41    Stream Power (lb/ft s)     0.30      13.55       0.66
  Frctn Loss (ft)            0.43    Cum Volume (acre-ft)       0.01       0.08       0.04
  C & E Loss (ft)            0.31    Cum SA (acres)             0.02       0.03       0.05


Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical
         depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross
         sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
         the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
         program defaulted to critical depth.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT  Profile #Q50

  E.G. Elev (ft)          1147.43    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              1.06    Wt. n-Val.                0.085      0.035      0.085
  W.S. Elev (ft)          1146.37    Reach Len. (ft)           70.20      70.20      70.20
  Crit W.S. (ft)          1146.37    Flow Area (sq ft)          7.89      46.33       8.96
  E.G. Slope (ft/ft)     0.010879    Area (sq ft)              18.36      46.33       8.96
```

Q Total (cfs)	421.00	Flow (cfs)	11.48	394.63	14.88
Top Width (ft)	48.12	Top Width (ft)	21.94	16.00	10.18
Vel Total (ft/s)	6.66	Avg. Vel. (ft/s)	1.46	8.52	1.66
Max Chl Dpth (ft)	3.37	Hydr. Depth (ft)	0.72	2.90	0.88
Conv. Total (cfs)	4036.3	Conv. (cfs)	110.1	3783.5	142.7
Length Wtd. (ft)	70.20	Wetted Per. (ft)	11.06	17.36	10.31
Min Ch El (ft)	1143.00	Shear (lb/sq ft)	0.48	1.81	0.59
Alpha	1.54	Stream Power (lb/ft s)	0.70	15.44	0.98
Frctn Loss (ft)	0.43	Cum Volume (acre-ft)	0.02	0.09	0.06
C & E Loss (ft)	0.34	Cum SA (acres)	0.02	0.03	0.06

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	1147.86	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.20	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1146.66	Reach Len. (ft)	70.20	70.20	70.20
Crit W.S. (ft)	1146.66	Flow Area (sq ft)	11.07	50.96	12.10
E.G. Slope (ft/ft)	0.011080	Area (sq ft)	24.79	50.96	12.10
Q Total (cfs)	510.00	Flow (cfs)	20.38	466.80	22.82
Top Width (ft)	49.94	Top Width (ft)	22.44	16.00	11.50
Vel Total (ft/s)	6.88	Avg. Vel. (ft/s)	1.84	9.16	1.89
Max Chl Dpth (ft)	3.66	Hydr. Depth (ft)	1.01	3.18	1.05
Conv. Total (cfs)	4845.1	Conv. (cfs)	193.6	4434.6	216.8
Length Wtd. (ft)	70.20	Wetted Per. (ft)	11.06	17.36	11.66
Min Ch El (ft)	1143.00	Shear (lb/sq ft)	0.69	2.03	0.72
Alpha	1.63	Stream Power (lb/ft s)	1.27	18.60	1.35
Frctn Loss (ft)	0.43	Cum Volume (acre-ft)	0.02	0.10	0.07
C & E Loss (ft)	0.40	Cum SA (acres)	0.02	0.03	0.06

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q500

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1148.76	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.42	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1147.34	Reach Len. (ft)	70.20	70.20	70.20
Crit W.S. (ft)	1147.34	Flow Area (sq ft)	18.60	61.92	20.82
E.G. Slope (ft/ft)	0.010597	Area (sq ft)	40.56	61.92	20.82
Q Total (cfs)	727.00	Flow (cfs)	47.32	631.61	48.08
Top Width (ft)	53.68	Top Width (ft)	23.62	16.00	14.05
Vel Total (ft/s)	7.17	Avg. Vel. (ft/s)	2.54	10.20	2.31
Max Chl Dpth (ft)	4.34	Hydr. Depth (ft)	1.69	3.87	1.48
Conv. Total (cfs)	7062.3	Conv. (cfs)	459.7	6135.6	467.0
Length Wtd. (ft)	70.20	Wetted Per. (ft)	11.06	17.36	14.32
Min Ch El (ft)	1143.00	Shear (lb/sq ft)	1.11	2.36	0.96
Alpha	1.77	Stream Power (lb/ft s)	2.83	24.07	2.22
Frctn Loss (ft)	0.42	Cum Volume (acre-ft)	0.04	0.12	0.11
C & E Loss (ft)	0.47	Cum SA (acres)	0.02	0.03	0.07

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION

RIVER: Unnamed Brook
REACH: Brook RS: 1001

INPUT
Description:
Station Elevation Data num= 82

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1163.91	10.93	1163.91	11.76	1163.56	11.77	1163.91	11.85	1161.9

```
   14.37 1161.82   29.65 1160.54    35.4 1159.97    50.6 1158.18   61.31 1156.29
   69.65    1156   74.83 1155.43   76.38 1155.26   82.96 1154.96  101.08 1154.28
  105.39 1154.25  116.03 1153.28  123.68 1152.73  124.64 1152.44  126.28 1151.79
  126.76 1151.84  127.45 1151.84  128.47 1152.26  129.65 1152.48  130.52 1152.53
  134.62 1152.78  143.06 1152.91     145 1152.96  148.57 1152.81  156.24 1152.59
   158.5 1152.48  159.57 1152.41  160.33 1152.13  164.46 1150.81  168.86  1150.2
  177.51 1149.69  179.58 1149.59   185.1  1149.3  203.94 1148.09   211.2 1147.63
  212.65 1147.59  230.43 1146.51  234.63 1144.34  236.32 1143.38   237.7 1142.32
   237.8 1142.23  241.03 1141.85  241.83 1141.69  243.19 1141.82  243.55 1141.86
  244.98 1141.86  245.56 1141.84  247.41  1141.8   248.1 1141.85  251.38 1142.03
  255.45  1142.2  255.86 1142.76  256.65 1143.89  258.81 1143.99  261.79 1144.12
  270.03 1144.18  276.94 1144.09   284.7 1143.96  288.81 1143.97  309.35 1144.64
  326.88 1146.13  332.27 1146.54  337.83 1147.28  341.91  1147.8  343.95  1147.9
   346.9 1149.03  351.84 1150.42   353.2 1150.97  355.27 1151.62  360.39 1151.89
  362.12 1151.94   362.5 1151.96  362.82 1151.97  368.08    1152  372.71 1152.02
  374.54 1152.03  374.83 1152.03

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .085  234.63    .035  256.65    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        234.63  256.65              .56     .56     .56             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  194.39 1151.33       F
  314.63  374.83 1151.29       F

CROSS SECTION OUTPUT  Profile #Q2

  E.G. Elev (ft)           1143.91    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.19    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1143.72    Reach Len. (ft)
  Crit W.S. (ft)           1143.05    Flow Area (sq ft)                      33.47
  E.G. Slope (ft/ft)      0.003905    Area (sq ft)                           33.47
  Q Total (cfs)             117.00    Flow (cfs)                            117.00
  Top Width (ft)             20.80    Top Width (ft)                         20.80
  Vel Total (ft/s)            3.50    Avg. Vel. (ft/s)                        3.50
  Max Chl Dpth (ft)           2.03    Hydr. Depth (ft)                        1.61
  Conv. Total (cfs)         1872.3    Conv. (cfs)                           1872.3
  Length Wtd. (ft)                    Wetted Per. (ft)                       22.12
  Min Ch El (ft)           1141.69    Shear (lb/sq ft)                        0.37
  Alpha                       1.00    Stream Power (lb/ft s)                  1.29
  Frctn Loss (ft)                     Cum Volume (acre-ft)
  C & E Loss (ft)                     Cum SA (acres)

Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q5
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E.G. Elev (ft)	1144.56	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.26	Wt. n-Val.		0.035	0.085
W.S. Elev (ft)	1144.30	Reach Len. (ft)			
Crit W.S. (ft)	1143.48	Flow Area (sq ft)		45.96	9.03
E.G. Slope (ft/ft)	0.003901	Area (sq ft)		45.96	9.03
Q Total (cfs)	194.00	Flow (cfs)		190.48	3.52
Top Width (ft)	64.20	Top Width (ft)		21.95	42.25
Vel Total (ft/s)	3.53	Avg. Vel. (ft/s)		4.14	0.39
Max Chl Dpth (ft)	2.61	Hydr. Depth (ft)		2.09	0.21
Conv. Total (cfs)	3106.0	Conv. (cfs)		3049.6	56.4
Length Wtd. (ft)		Wetted Per. (ft)		23.52	42.26
Min Ch El (ft)	1141.69	Shear (lb/sq ft)		0.48	0.05
Alpha	1.36	Stream Power (lb/ft s)		1.97	0.02
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	1144.93	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.30	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1144.63	Reach Len. (ft)			
Crit W.S. (ft)	1143.80	Flow Area (sq ft)	0.08	53.22	24.64
E.G. Slope (ft/ft)	0.003901	Area (sq ft)	0.08	53.22	24.64
Q Total (cfs)	259.00	Flow (cfs)	0.02	242.71	16.27
Top Width (ft)	74.95	Top Width (ft)	0.56	22.02	52.37
Vel Total (ft/s)	3.32	Avg. Vel. (ft/s)	0.28	4.56	0.66
Max Chl Dpth (ft)	2.94	Hydr. Depth (ft)	0.14	2.42	0.47
Conv. Total (cfs)	4146.7	Conv. (cfs)	0.4	3885.9	260.5
Length Wtd. (ft)		Wetted Per. (ft)	0.63	23.60	52.38
Min Ch El (ft)	1141.69	Shear (lb/sq ft)	0.03	0.55	0.11
Alpha	1.77	Stream Power (lb/ft s)	0.01	2.50	0.08
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q25

E.G. Elev (ft)	1145.34	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1144.99	Reach Len. (ft)			
Crit W.S. (ft)	1144.38	Flow Area (sq ft)	0.41	61.22	44.51
E.G. Slope (ft/ft)	0.003902	Area (sq ft)	0.41	61.22	44.51
Q Total (cfs)	348.00	Flow (cfs)	0.20	306.52	41.28
Top Width (ft)	80.13	Top Width (ft)	1.26	22.02	56.85

Vel Total (ft/s)	3.28	Avg. Vel. (ft/s)	0.48	5.01	0.93
Max Chl Dpth (ft)	3.30	Hydr. Depth (ft)	0.33	2.78	0.78
Conv. Total (cfs)	5571.3	Conv. (cfs)	3.2	4907.3	660.9
Length Wtd. (ft)		Wetted Per. (ft)	1.42	23.60	56.88
Min Ch El (ft)	1141.69	Shear (lb/sq ft)	0.07	0.63	0.19
Alpha	2.06	Stream Power (lb/ft s)	0.03	3.16	0.18
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1145.62	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.37	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1145.25	Reach Len. (ft)			
Crit W.S. (ft)	1144.68	Flow Area (sq ft)	0.80	66.85	59.29
E.G. Slope (ft/ft)	0.003900	Area (sq ft)	0.80	66.85	59.44
Q Total (cfs)	421.00	Flow (cfs)	0.48	354.86	65.66
Top Width (ft)	83.63	Top Width (ft)	1.76	22.02	59.86
Vel Total (ft/s)	3.32	Avg. Vel. (ft/s)	0.60	5.31	1.11
Max Chl Dpth (ft)	3.56	Hydr. Depth (ft)	0.45	3.04	1.02
Conv. Total (cfs)	6741.5	Conv. (cfs)	7.6	5682.4	1051.5
Length Wtd. (ft)		Wetted Per. (ft)	1.98	23.60	58.02
Min Ch El (ft)	1141.69	Shear (lb/sq ft)	0.10	0.69	0.25
Alpha	2.18	Stream Power (lb/ft s)	0.06	3.66	0.28
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	1145.93	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.40	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1145.53	Reach Len. (ft)			
Crit W.S. (ft)	1144.92	Flow Area (sq ft)	1.36	72.99	75.44
E.G. Slope (ft/ft)	0.003902	Area (sq ft)	1.36	72.99	76.57
Q Total (cfs)	510.00	Flow (cfs)	0.97	410.89	98.14
Top Width (ft)	87.45	Top Width (ft)	2.30	22.02	63.13
Vel Total (ft/s)	3.40	Avg. Vel. (ft/s)	0.71	5.63	1.30
Max Chl Dpth (ft)	3.84	Hydr. Depth (ft)	0.59	3.31	1.30
Conv. Total (cfs)	8164.3	Conv. (cfs)	15.5	6577.7	1571.1
Length Wtd. (ft)		Wetted Per. (ft)	2.59	23.60	58.02
Min Ch El (ft)	1141.69	Shear (lb/sq ft)	0.13	0.75	0.32
Alpha	2.23	Stream Power (lb/ft s)	0.09	4.24	0.41
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1146.59	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.47	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1146.12	Reach Len. (ft)			
Crit W.S. (ft)	1145.40	Flow Area (sq ft)	3.07	86.06	109.85
E.G. Slope (ft/ft)	0.003900	Area (sq ft)	3.07	86.06	116.11
Q Total (cfs)	727.00	Flow (cfs)	2.86	540.58	183.55
Top Width (ft)	95.58	Top Width (ft)	3.45	22.02	70.12
Vel Total (ft/s)	3.65	Avg. Vel. (ft/s)	0.93	6.28	1.67
Max Chl Dpth (ft)	4.43	Hydr. Depth (ft)	0.89	3.91	1.89
Conv. Total (cfs)	11640.6	Conv. (cfs)	45.9	8655.7	2939.0
Length Wtd. (ft)		Wetted Per. (ft)	3.88	23.60	58.02
Min Ch El (ft)	1141.69	Shear (lb/sq ft)	0.19	0.89	0.46
Alpha	2.25	Stream Power (lb/ft s)	0.18	5.58	0.77
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

SUMMARY OF MANNING'S N VALUES

River:Unnamed Brook

Reach	River Sta.	n1	n2	n3
Brook	1758	.05	.035	.085
Brook	1506	.05	.035	.085
Brook	1238	.05	.035	.085
Brook	1182	.05	.035	.085
Brook	1165	Bridge		
Brook	1071	.085	.035	.085
Brook	1001	.085	.035	.085

SUMMARY OF REACH LENGTHS

River: Unnamed Brook

Reach	River Sta.	Left	Channel	Right

Brook	1758	252.24	252.24	252.24
Brook	1506	267.56	267.56	267.56
Brook	1238	55.99	55.99	55.99
Brook	1182	111.86	111.86	111.86
Brook	1165	Bridge		
Brook	1071	70.2	70.2	70.2
Brook	1001	.56	.56	.56

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Unnamed Brook

Reach	River Sta.	Contr.	Expan.
Brook	1758	.1	.3
Brook	1506	.1	.3
Brook	1238	.1	.3
Brook	1182	.3	.5
Brook	1165	Bridge	
Brook	1071	.3	.5
Brook	1001	.1	.3

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            program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q25
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q50
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q100
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q500
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q2
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q5
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q10
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
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               the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q25
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q50
     Warning:Divided flow computed for this cross-section.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q100
     Warning:Divided flow computed for this cross-section.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q500
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q2
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q5
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q10
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
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          program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q25
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
          for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
          water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
          program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q50
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
          for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
          water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
          program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q100
     Warning:Divided flow computed for this cross-section.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q500
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q2
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q5
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q10
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q25
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
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          used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q50
     Warning:Divided flow computed for this cross-section.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q100
     Warning:Divided flow computed for this cross-section.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q500
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q2 Upstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q2 Downstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q5 Upstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q5 Downstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q10 Upstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q10 Downstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q25 Upstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
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          This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q25 Downstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q50
     Warning:For the final momentum answer at the bridge, the upstream energy was computed lower than the energy inside of the
          bridge deck.  This is not physically possible.  Please review your bridge data and results for reasonableness.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q50 Upstream
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
          for the water surface and continued on with the calculations.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
          water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
          program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q50 Downstream
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q100
     Warning:For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy.  This
          is not physically possible, the momentum answer has been disregarded.
     Note:   Momentum answer is not valid if the water surface is above the low chord or if there is weir flow.  The momentum
          answer has been disregarded.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q100 Upstream
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
          for the water surface and continued on with the calculations.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
          water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
          program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q100 Downstream
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q500
     Note:   Momentum answer is not valid if the water surface is above the low chord or if there is weir flow.  The momentum
          answer has been disregarded.
     Note:   The downstream water surface is below the minimum elevation for pressure flow.  The sluice gate equations were used
          for pressure flow.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q500 Upstream
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q500 Downstream
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
          used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q2
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     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q5
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q10
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q25
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
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     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q50
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q100
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q500
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q2
     Warning:Divided flow computed for this cross-section.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q5
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q10
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q25
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
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River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q50
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q100
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q500
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
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HEC-RAS Plan: At-Grade 20-foot River: Unnamed Brook Reach: Brook

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Brook	1758	Q2	117.00	1151.39	1153.07	1153.07	1153.60	0.019079	5.87	19.94	19.13	1.01
Brook	1758	Q5	194.00	1151.39	1153.50	1153.50	1154.22	0.017318	6.79	28.60	21.36	1.01
Brook	1758	Q10	259.00	1151.39	1153.84	1153.84	1154.66	0.014992	7.25	37.45	30.49	0.97
Brook	1758	Q25	348.00	1151.39	1154.25	1154.25	1155.16	0.012945	7.74	51.93	41.21	0.93
Brook	1758	Q50	421.00	1151.39	1154.80	1154.80	1155.42	0.007112	6.70	99.14	116.78	0.72
Brook	1758	Q100	510.00	1151.39	1155.06	1155.06	1155.65	0.006549	6.82	131.20	136.17	0.70
Brook	1758	Q500	727.00	1151.39	1155.44	1155.44	1156.07	0.006697	7.49	188.82	161.53	0.72
Brook	1506	Q2	117.00	1147.76	1150.00	1149.44	1150.27	0.007919	4.12	28.38	23.49	0.66
Brook	1506	Q5	194.00	1147.76	1150.56	1150.11	1150.85	0.007453	4.34	45.17	40.19	0.66
Brook	1506	Q10	259.00	1147.76	1150.86	1150.43	1151.19	0.006669	4.65	62.82	65.31	0.64
Brook	1506	Q25	348.00	1147.76	1151.07	1150.79	1151.51	0.007785	5.42	76.62	66.01	0.70
Brook	1506	Q50	421.00	1147.76	1151.13	1150.99	1151.72	0.010082	6.30	80.73	68.14	0.81
Brook	1506	Q100	510.00	1147.76	1151.23	1151.23	1151.99	0.012320	7.19	87.40	72.64	0.90
Brook	1506	Q500	727.00	1147.76	1151.71	1151.71	1152.55	0.010733	7.76	127.63	90.72	0.87
Brook	1238	Q2	117.00	1144.81	1146.53	1146.53	1147.18	0.017733	6.48	18.06	13.78	1.00
Brook	1238	Q5	194.00	1144.81	1147.09	1147.09	1147.95	0.016531	7.43	26.11	15.09	1.00
Brook	1238	Q10	259.00	1144.81	1147.48	1147.48	1148.49	0.015953	8.07	32.15	16.57	1.00
Brook	1238	Q25	348.00	1144.81	1148.17	1148.17	1149.09	0.010159	7.83	50.49	36.82	0.84
Brook	1238	Q50	421.00	1144.81	1148.66	1148.66	1149.43	0.007296	7.41	75.59	65.68	0.73
Brook	1238	Q100	510.00	1144.81	1149.83	1148.91	1150.14	0.002370	5.19	144.69	161.68	0.44
Brook	1238	Q500	727.00	1144.81	1151.30	1149.39	1151.52	0.001252	4.58	236.31	250.15	0.33
Brook	1182	Q2	117.00	1144.00	1146.23	1145.56	1146.50	0.005080	4.18	28.01	15.93	0.55
Brook	1182	Q5	194.00	1144.00	1146.88	1146.12	1147.25	0.004693	4.94	43.28	30.74	0.56
Brook	1182	Q10	259.00	1144.00	1147.40	1146.49	1147.78	0.003833	5.09	62.61	45.34	0.52
Brook	1182	Q25	348.00	1144.00	1148.10	1147.13	1148.44	0.002815	5.03	89.66	63.57	0.47
Brook	1182	Q50	421.00	1144.00	1148.59	1147.48	1148.92	0.002408	5.07	109.04	79.59	0.44
Brook	1182	Q100	510.00	1144.00	1149.80	1147.76	1150.02	0.001236	4.31	156.64	147.31	0.33
Brook	1182	Q500	727.00	1144.00	1151.21	1148.33	1151.45	0.000989	4.51	214.87	242.21	0.31
Brook	1165		Bridge									
Brook	1071	Q2	117.00	1143.00	1144.56	1144.56	1145.21	0.017766	6.45	18.13	13.94	1.00
Brook	1071	Q5	194.00	1143.00	1145.12	1145.12	1145.96	0.016568	7.35	26.38	17.85	1.00
Brook	1071	Q10	259.00	1143.00	1145.55	1145.55	1146.47	0.013972	7.73	35.86	33.88	0.95
Brook	1071	Q25	348.00	1143.00	1146.07	1146.07	1147.04	0.011258	8.06	52.22	46.45	0.88
Brook	1071	Q50	421.00	1143.00	1146.37	1146.37	1147.43	0.010879	8.52	63.18	48.12	0.88
Brook	1071	Q100	510.00	1143.00	1146.66	1146.66	1147.86	0.011080	9.16	74.13	49.94	0.90
Brook	1071	Q500	727.00	1143.00	1147.34	1147.34	1148.76	0.010597	10.20	101.33	53.68	0.91
Brook	1001	Q2	117.00	1141.69	1143.72	1143.05	1143.91	0.003905	3.50	33.47	20.80	0.49
Brook	1001	Q5	194.00	1141.69	1144.30	1143.48	1144.56	0.003901	4.14	54.98	64.20	0.50
Brook	1001	Q10	259.00	1141.69	1144.63	1143.80	1144.93	0.003901	4.56	77.94	74.95	0.52
Brook	1001	Q25	348.00	1141.69	1144.99	1144.38	1145.34	0.003902	5.01	106.15	80.13	0.53
Brook	1001	Q50	421.00	1141.69	1145.25	1144.68	1145.62	0.003900	5.31	126.94	83.63	0.54
Brook	1001	Q100	510.00	1141.69	1145.53	1144.92	1145.93	0.003902	5.63	149.79	87.45	0.54
Brook	1001	Q500	727.00	1141.69	1146.12	1145.40	1146.59	0.003900	6.28	198.97	95.58	0.56

HEC-RAS Plan: At-Grade 20-foot   River: Unnamed Brook   Reach: Brook

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Brook	1758	Q2	1153.60	1153.07	0.53	2.96	0.08		117.00		19.13
Brook	1758	Q5	1154.22	1153.50	0.72	2.74	0.13		194.00	0.00	21.36
Brook	1758	Q10	1154.66	1153.84	0.81	2.42	0.14	0.01	257.65	1.34	30.49
Brook	1758	Q25	1155.16	1154.25	0.91	2.49	0.14	0.24	339.31	8.44	41.21
Brook	1758	Q50	1155.42	1154.80	0.61	2.12	0.01	25.23	369.74	26.03	116.78
Brook	1758	Q100	1155.65	1155.06	0.59	2.21	0.02	58.78	411.75	39.48	136.17
Brook	1758	Q500	1156.07	1155.44	0.63	2.11	0.02	144.33	511.44	71.23	161.53
Brook	1506	Q2	1150.27	1150.00	0.26	3.05	0.04		117.00		23.49
Brook	1506	Q5	1150.85	1150.56	0.29	2.86	0.06		193.89	0.11	40.19
Brook	1506	Q10	1151.19	1150.86	0.33	2.63	0.07		254.31	4.69	65.31
Brook	1506	Q25	1151.51	1151.07	0.44	2.37	0.05		334.31	13.69	66.01
Brook	1506	Q50	1151.72	1151.13	0.59	2.28	0.02	0.01	401.84	19.15	68.14
Brook	1506	Q100	1151.99	1151.23	0.76	1.23	0.13	0.24	481.88	27.88	72.64
Brook	1506	Q500	1152.55	1151.71	0.84	0.74	0.18	12.85	646.20	67.95	90.72
Brook	1238	Q2	1147.18	1146.53	0.65	0.48	0.11		117.00		13.78
Brook	1238	Q5	1147.95	1147.09	0.86	0.45	0.15		194.00		15.09
Brook	1238	Q10	1148.49	1147.48	1.01	0.39	0.19	0.02	258.98	0.00	16.57
Brook	1238	Q25	1149.09	1148.17	0.92	0.27	0.18	10.53	337.19	0.28	36.82
Brook	1238	Q50	1149.43	1148.66	0.77	0.22	0.13	43.12	376.82	1.07	65.68
Brook	1238	Q100	1150.14	1149.83	0.32	0.09	0.03	143.45	359.78	6.77	161.68
Brook	1238	Q500	1151.52	1151.30	0.22	0.06	0.00	283.67	423.49	19.83	250.15
Brook	1182	Q2	1146.50	1146.23	0.27	0.18	0.10		117.00		15.93
Brook	1182	Q5	1147.25	1146.88	0.37	0.17	0.12	3.04	189.99	0.96	30.74
Brook	1182	Q10	1147.78	1147.40	0.37	0.14	0.15	18.20	238.60	2.21	45.34
Brook	1182	Q25	1148.44	1148.10	0.34	0.12	0.23	52.60	291.55	3.85	63.57
Brook	1182	Q50	1148.92	1148.59	0.33	0.10	0.28	82.09	333.76	5.14	79.59
Brook	1182	Q100	1150.02	1149.80	0.23			136.24	366.61	7.15	147.31
Brook	1182	Q500	1151.45	1151.21	0.24			230.64	486.13	10.23	242.21
Brook	1165		Bridge								
Brook	1071	Q2	1145.21	1144.56	0.65	0.51	0.23		117.00		13.94
Brook	1071	Q5	1145.96	1145.12	0.84	0.50	0.29		194.00		17.85
Brook	1071	Q10	1146.47	1145.55	0.92	0.47	0.31	0.56	256.79	1.65	33.88
Brook	1071	Q25	1147.04	1146.07	0.97	0.43	0.31	4.75	334.63	8.62	46.45
Brook	1071	Q50	1147.43	1146.37	1.06	0.43	0.34	11.48	394.63	14.88	48.12
Brook	1071	Q100	1147.86	1146.66	1.20	0.43	0.40	20.38	466.80	22.82	49.94
Brook	1071	Q500	1148.76	1147.34	1.42	0.42	0.47	47.32	631.61	48.08	53.68
Brook	1001	Q2	1143.91	1143.72	0.19				117.00		20.80
Brook	1001	Q5	1144.56	1144.30	0.26				190.48	3.52	64.20
Brook	1001	Q10	1144.93	1144.63	0.30			0.02	242.71	16.27	74.95
Brook	1001	Q25	1145.34	1144.99	0.34			0.20	306.52	41.28	80.13
Brook	1001	Q50	1145.62	1145.25	0.37			0.48	354.86	65.66	83.63
Brook	1001	Q100	1145.93	1145.53	0.40			0.97	410.89	98.14	87.45
Brook	1001	Q500	1146.59	1146.12	0.47			2.86	540.58	183.55	95.58

HEC-RAS Plan: At-Grade 20-foot River: Unnamed Brook Reach: Brook

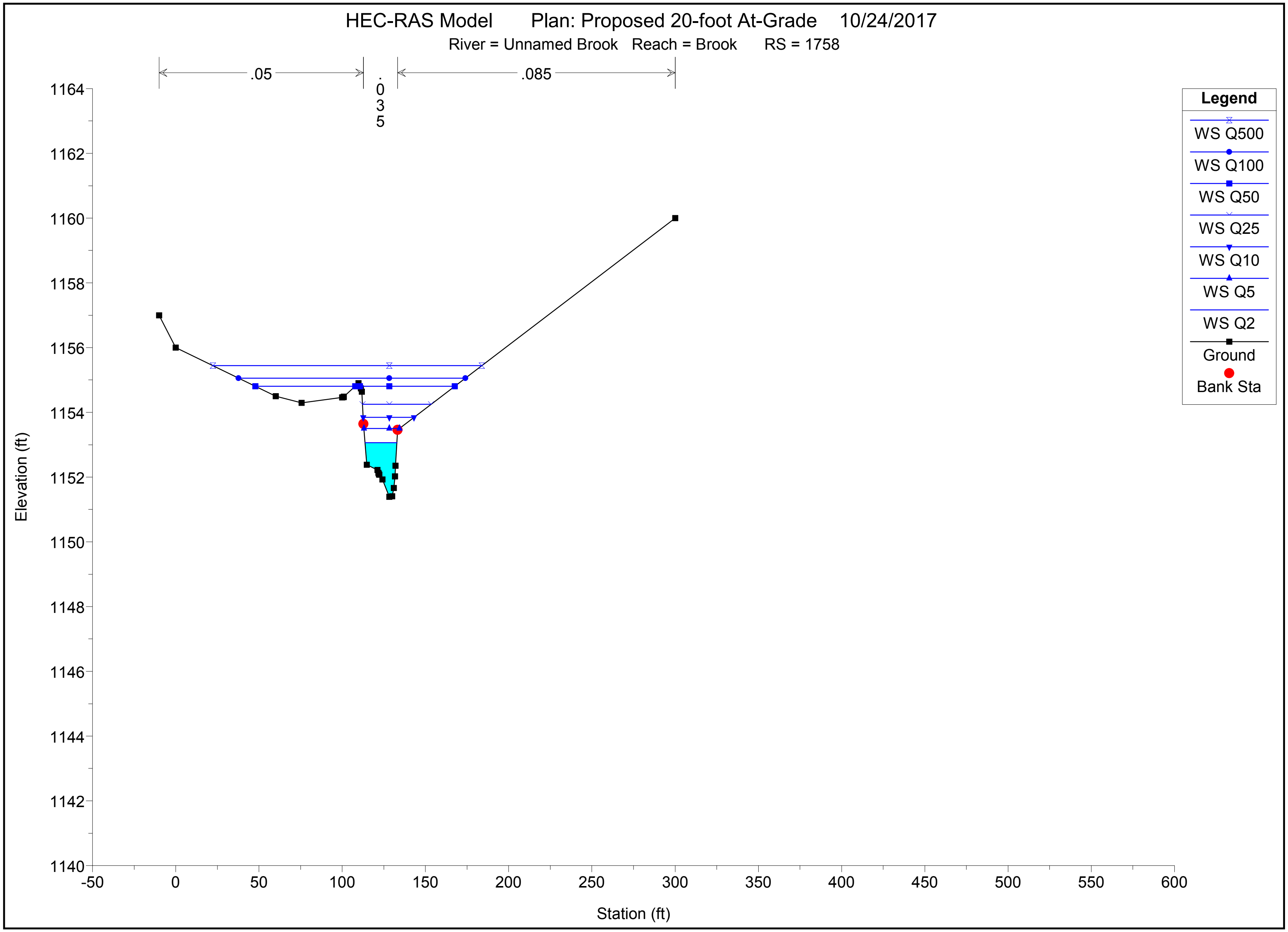
Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Brook	1238	Q2	1147.18	1146.53	1146.53	0.48	0.11	13.78		117.00		6.48
Brook	1238	Q5	1147.95	1147.09	1147.09	0.45	0.15	15.09		194.00		7.43
Brook	1238	Q10	1148.49	1147.48	1147.48	0.39	0.19	16.57	0.02	258.98	0.00	8.07
Brook	1238	Q25	1149.09	1148.17	1148.17	0.27	0.18	36.82	10.53	337.19	0.28	7.83
Brook	1238	Q50	1149.43	1148.66	1148.66	0.22	0.13	65.68	43.12	376.82	1.07	7.41
Brook	1238	Q100	1150.14	1149.83	1148.91	0.09	0.03	161.68	143.45	359.78	6.77	5.19
Brook	1238	Q500	1151.52	1151.30	1149.39	0.06	0.00	250.15	283.67	423.49	19.83	4.58
Brook	1182	Q2	1146.50	1146.23	1145.56	0.18	0.10	15.93		117.00		4.18
Brook	1182	Q5	1147.25	1146.88	1146.12	0.17	0.12	30.74	3.04	189.99	0.96	4.94
Brook	1182	Q10	1147.78	1147.40	1146.49	0.14	0.15	45.34	18.20	238.60	2.21	5.09
Brook	1182	Q25	1148.44	1148.10	1147.13	0.12	0.23	63.57	52.60	291.55	3.85	5.03
Brook	1182	Q50	1148.92	1148.59	1147.48	0.10	0.28	79.59	82.09	333.76	5.14	5.07
Brook	1182	Q100	1150.02	1149.80	1147.76			147.31	136.24	366.61	7.15	4.31
Brook	1182	Q500	1151.45	1151.21	1148.33			242.21	230.64	486.13	10.23	4.51
Brook	1165 BR U	Q2	1146.21	1145.60	1145.56	0.49	0.18	14.06		117.00		6.26
Brook	1165 BR U	Q5	1146.97	1146.21	1146.12	0.46	0.20	15.87		194.00		7.01
Brook	1165 BR U	Q10	1147.48	1146.59	1146.53	0.46	0.21	20.00	1.14	257.20	0.67	7.59
Brook	1165 BR U	Q25	1148.09	1146.98	1146.97	0.53	0.22	20.00	4.06	341.55	2.39	8.51
Brook	1165 BR U	Q50	1148.54	1147.29	1147.29	0.58	0.20	20.00	7.17	409.62	4.22	9.11
Brook	1165 BR U	Q100	1150.02	1149.12	1147.62				13.77	489.81	6.42	6.59
Brook	1165 BR U	Q500	1151.45	1149.12	1148.40				19.63	698.22	9.15	9.39
Brook	1165 BR D	Q2	1145.54	1145.29	1144.56	0.21	0.12	20.00	0.01	116.98	0.01	4.03
Brook	1165 BR D	Q5	1146.31	1145.95	1145.12	0.20	0.14	20.00	1.26	191.48	1.26	4.84
Brook	1165 BR D	Q10	1146.80	1146.34	1145.52	0.20	0.14	20.00	2.75	253.50	2.75	5.53
Brook	1165 BR D	Q25	1147.34	1146.68	1145.95	0.21	0.09	20.00	4.79	338.42	4.79	6.60
Brook	1165 BR D	Q50	1147.72	1146.86	1146.29	0.23	0.06	20.00	6.44	408.13	6.44	7.53
Brook	1165 BR D	Q100	1148.09	1146.66	1146.63			20.00	6.93	496.14	6.93	9.74
Brook	1165 BR D	Q500	1149.26	1147.43	1147.43			20.00	14.07	698.85	14.07	11.04
Brook	1071	Q2	1145.21	1144.56	1144.56	0.51	0.23	13.94		117.00		6.45
Brook	1071	Q5	1145.96	1145.12	1145.12	0.50	0.29	17.85		194.00		7.35
Brook	1071	Q10	1146.47	1145.55	1145.55	0.47	0.31	33.88	0.56	256.79	1.65	7.73
Brook	1071	Q25	1147.04	1146.07	1146.07	0.43	0.31	46.45	4.75	334.63	8.62	8.06
Brook	1071	Q50	1147.43	1146.37	1146.37	0.43	0.34	48.12	11.48	394.63	14.88	8.52
Brook	1071	Q100	1147.86	1146.66	1146.66	0.43	0.40	49.94	20.38	466.80	22.82	9.16
Brook	1071	Q500	1148.76	1147.34	1147.34	0.42	0.47	53.68	47.32	631.61	48.08	10.20
Brook	1001	Q2	1143.91	1143.72	1143.05			20.80		117.00		3.50
Brook	1001	Q5	1144.56	1144.30	1143.48			64.20		190.48	3.52	4.14
Brook	1001	Q10	1144.93	1144.63	1143.80			74.95	0.02	242.71	16.27	4.56
Brook	1001	Q25	1145.34	1144.99	1144.38			80.13	0.20	306.52	41.28	5.01
Brook	1001	Q50	1145.62	1145.25	1144.68			83.63	0.48	354.86	65.66	5.31
Brook	1001	Q100	1145.93	1145.53	1144.92			87.45	0.97	410.89	98.14	5.63
Brook	1001	Q500	1146.59	1146.12	1145.40			95.58	2.86	540.58	183.55	6.28

HEC-RAS Plan: At-Grade 20-foot River: Unnamed Brook Reach: Brook

Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG	BR Sluice Coef
			(ft)	(ft)	(sq ft)	(ft)	(cfs)	(ft)	(cfs)	(ft)	
Brook	1165	Q2	1146.50	1149.12	85.81		117.00	1152.12		1.29	0.00
Brook	1165	Q5	1147.25	1149.12	85.81		194.00	1152.12		1.29	0.00
Brook	1165	Q10	1147.78	1149.12	85.81		259.00	1152.12		1.30	0.00
Brook	1165	Q25	1148.44	1149.12	85.81		348.00	1152.12		1.39	0.00
Brook	1165	Q50	1148.92	1149.12	85.81		421.00	1152.12		1.49	0.00
Brook	1165	Q100	1150.02	1149.12	85.81	1149.80	510.00	1152.12		2.16	0.00
Brook	1165	Q500	1151.45	1149.12	85.81	1151.21	727.00	1152.12		2.69	0.00

HEC-RAS Plan: At-Grade 20-foot River: Unnamed Brook Reach: Brook

Reach	River Sta	Profile	E.G. US.	W.S. US.	BR Sel Method	Energy EG	Momen. EG	Yarnell EG	WSPRO EG	Prs O EG	Prs/Wr EG	Energy/Wr EG
			(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Brook	1165	Q2	1146.50	1146.23	Energy only	1146.50	1146.77					
Brook	1165	Q5	1147.25	1146.88	Energy only	1147.25	1147.51					
Brook	1165	Q10	1147.78	1147.40	Energy only	1147.78	1148.00					
Brook	1165	Q25	1148.44	1148.10	Energy only	1148.44	1148.57					
Brook	1165	Q50	1148.92	1148.59	Energy only	1148.92	1148.98					
Brook	1165	Q100	1150.02	1149.80	Press Only	1149.49				1150.02		
Brook	1165	Q500	1151.45	1151.21	Press Only	1150.71				1151.45		



HEC-RAS Model Plan: Proposed 20-foot At-Grade 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1758
.05
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Bank Sta
Elevation (ft)
Station (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
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50
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250
300
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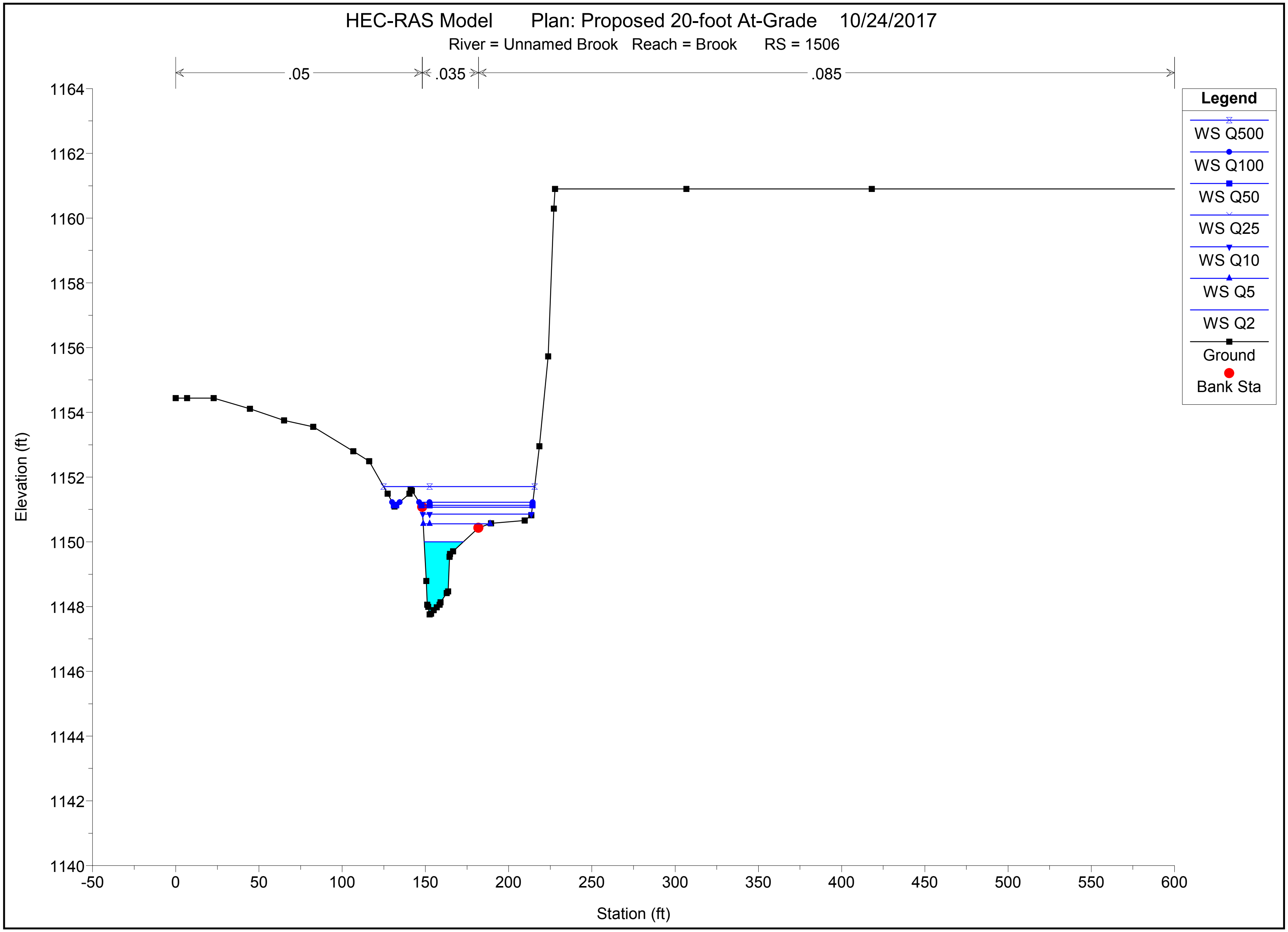
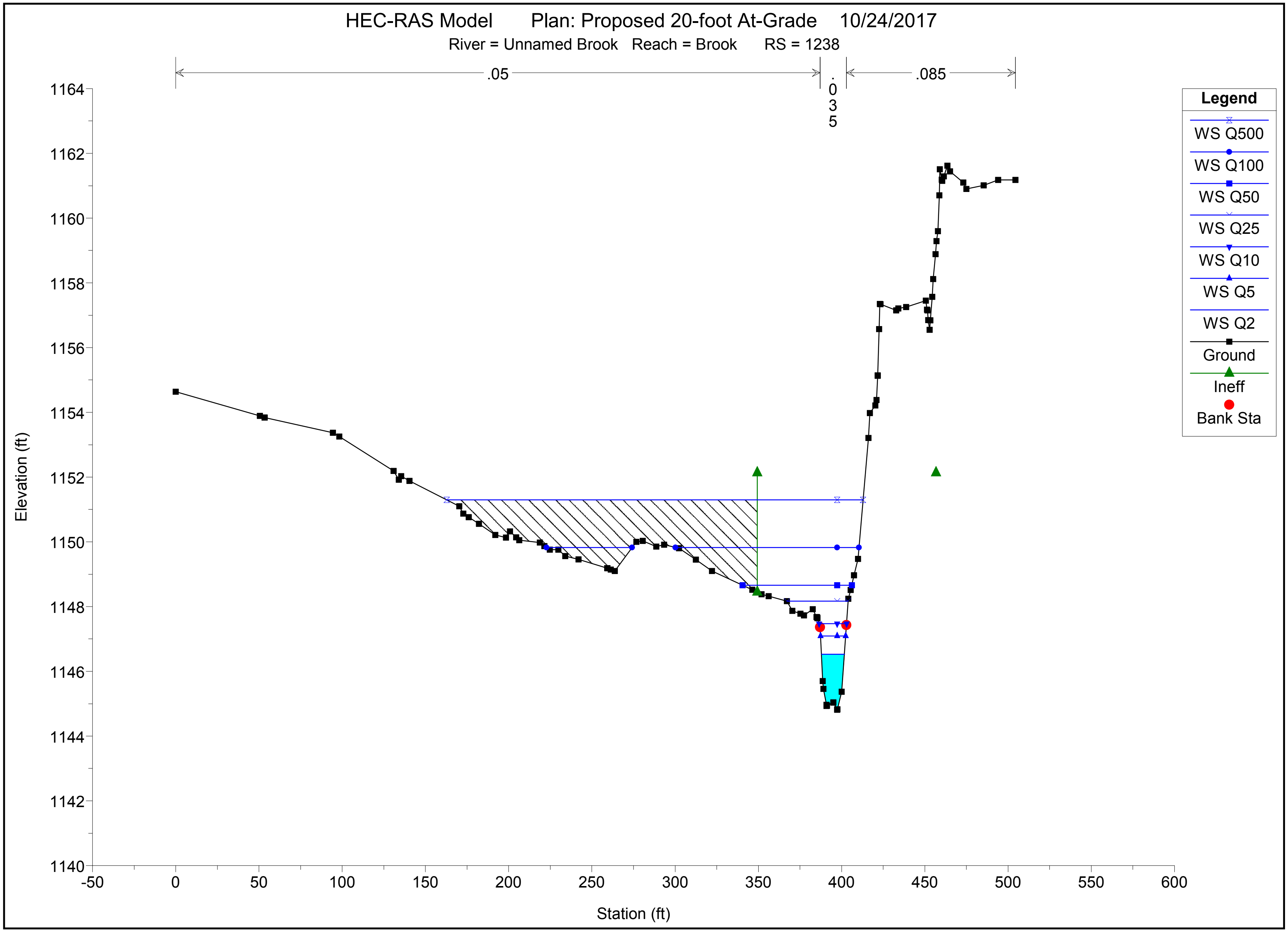
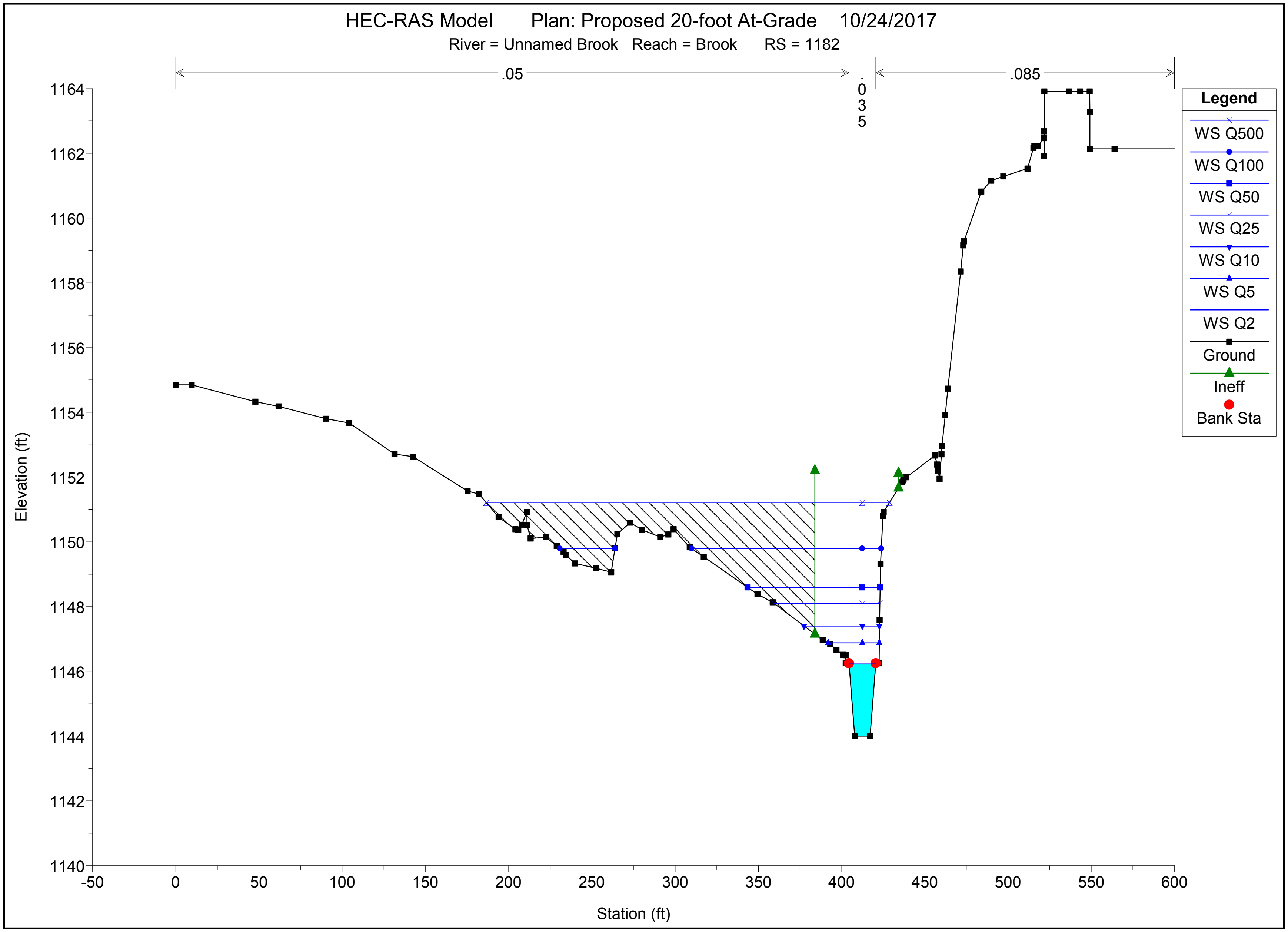
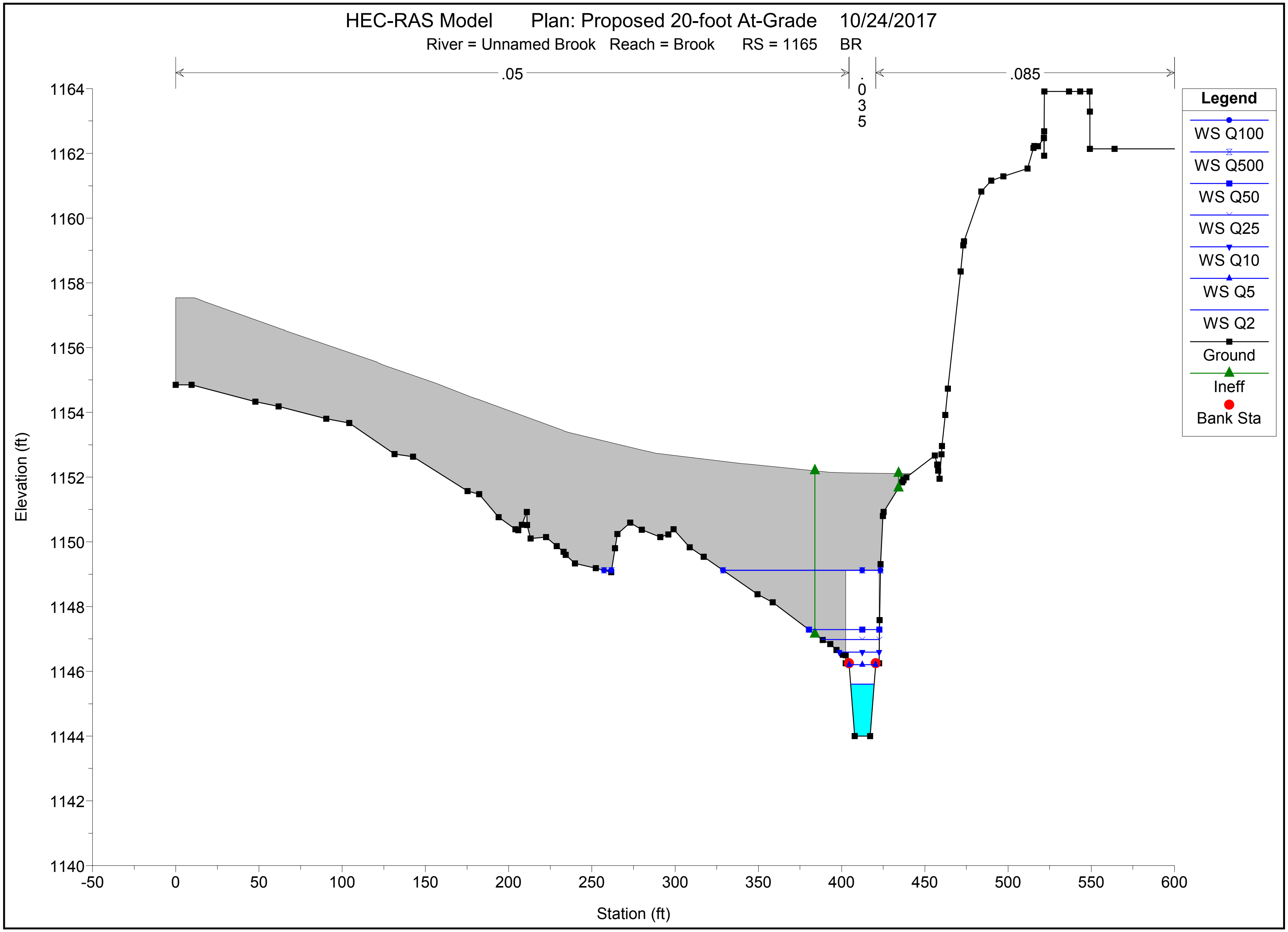
450
500
550
600


HEC-RAS Model Plan: Proposed 20-foot At-Grade 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1506
.05
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Bank Sta
Elevation (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
Station (ft)


HEC-RAS Model Plan: Proposed 20-foot At-Grade 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1238
.05
.035
.085
Elevation (ft)
Station (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta



HEC-RAS Model Plan: Proposed 20-foot At-Grade 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1182
.05
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
Station (ft)


HEC-RAS Model Plan: Proposed 20-foot At-Grade 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1165 BR
.05
.035
.085
Legend
WS Q100
WS Q500
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1140
1142
1144
1146
1148
1150
1152
1154
1156
1158
1160
1162
1164
-50
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150
200
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300
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450
500
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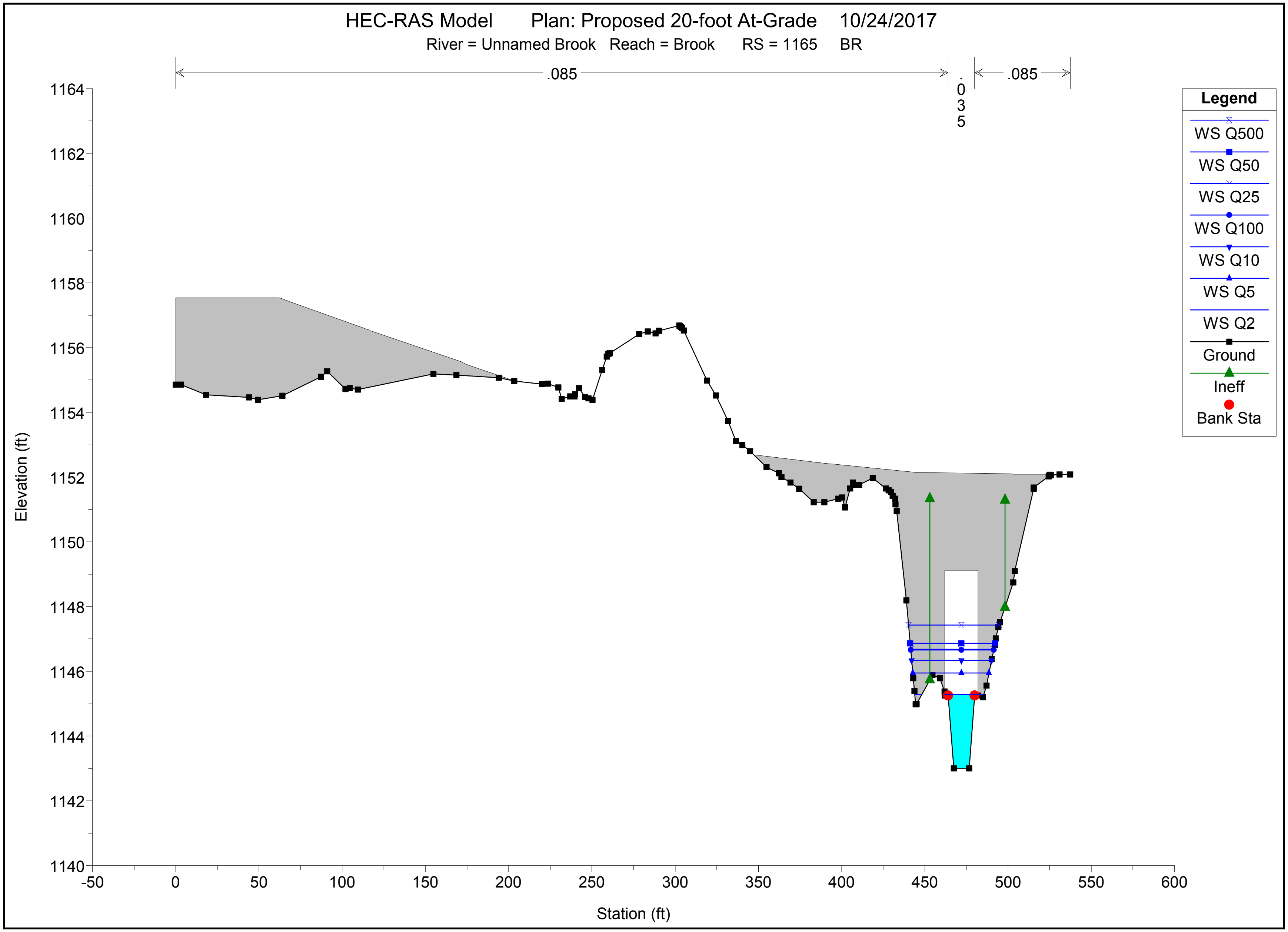
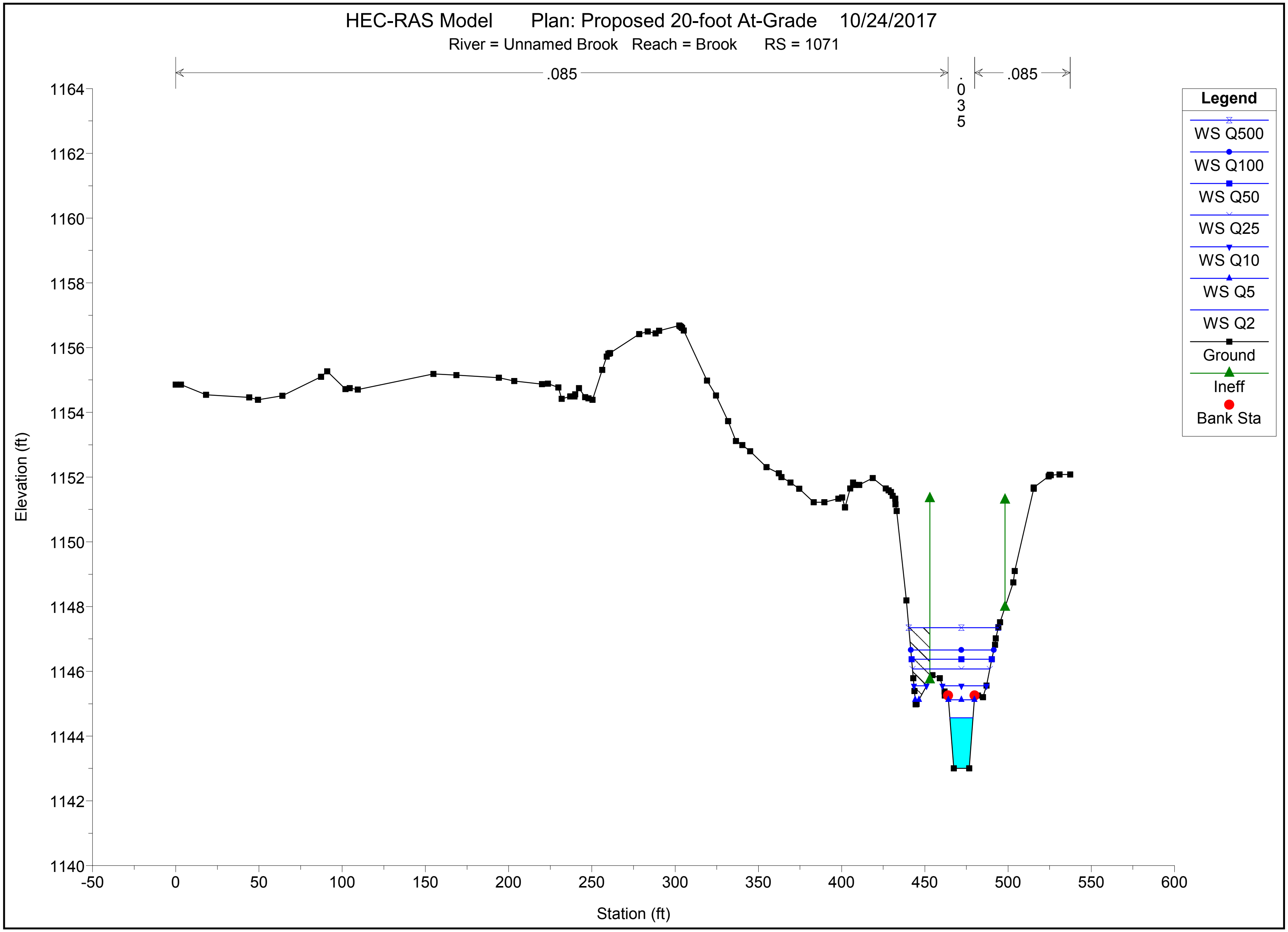


HEC-RAS Model Plan: Proposed 20-foot At-Grade 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1165 BR
.085
.035
.085
Legend
WS Q500
WS Q50
WS Q25
WS Q100
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600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River = Unnamed Brook Reach = Brook RS = 1071
.085
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
0
50
100
150
200
250
300
350
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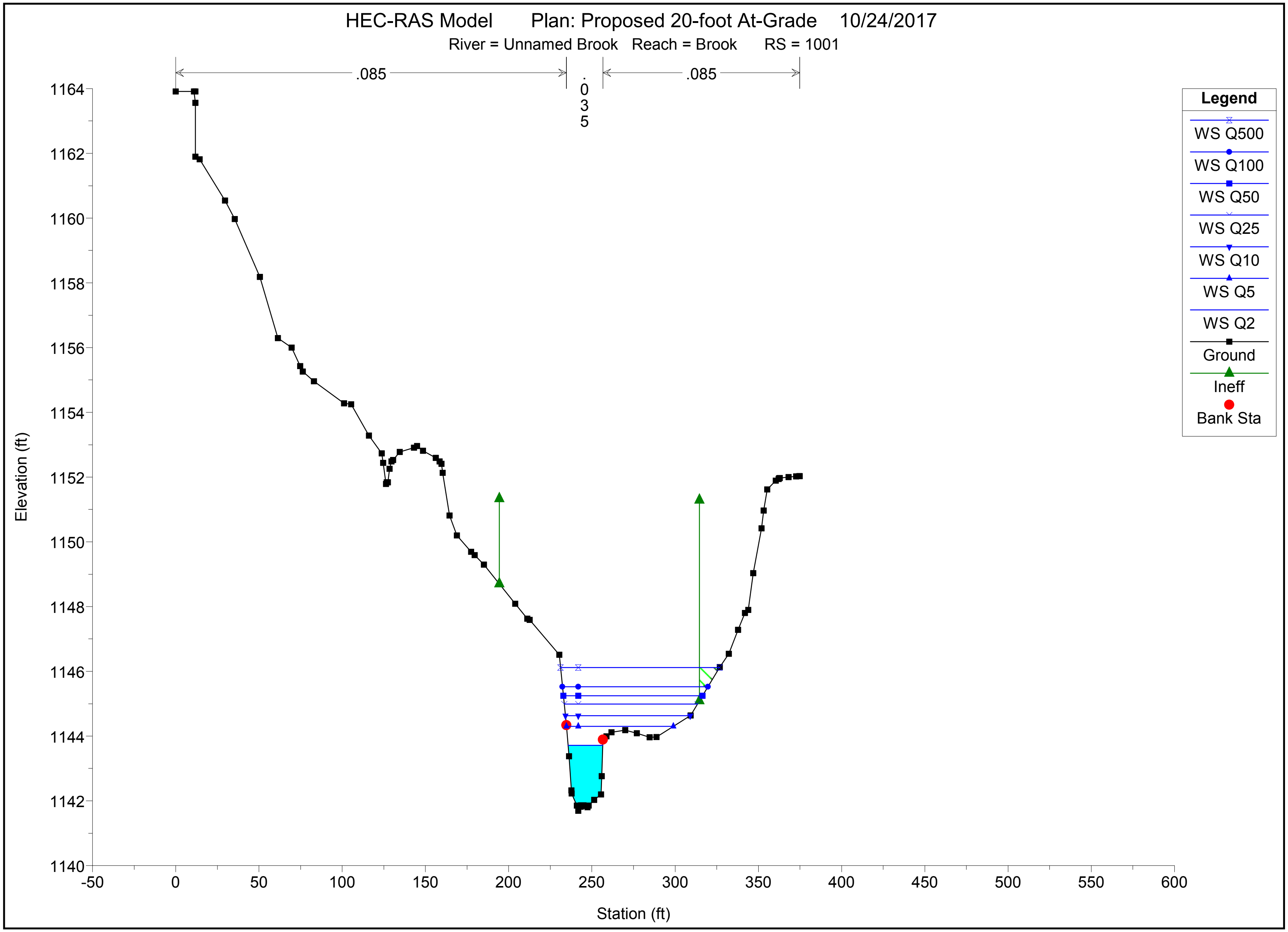
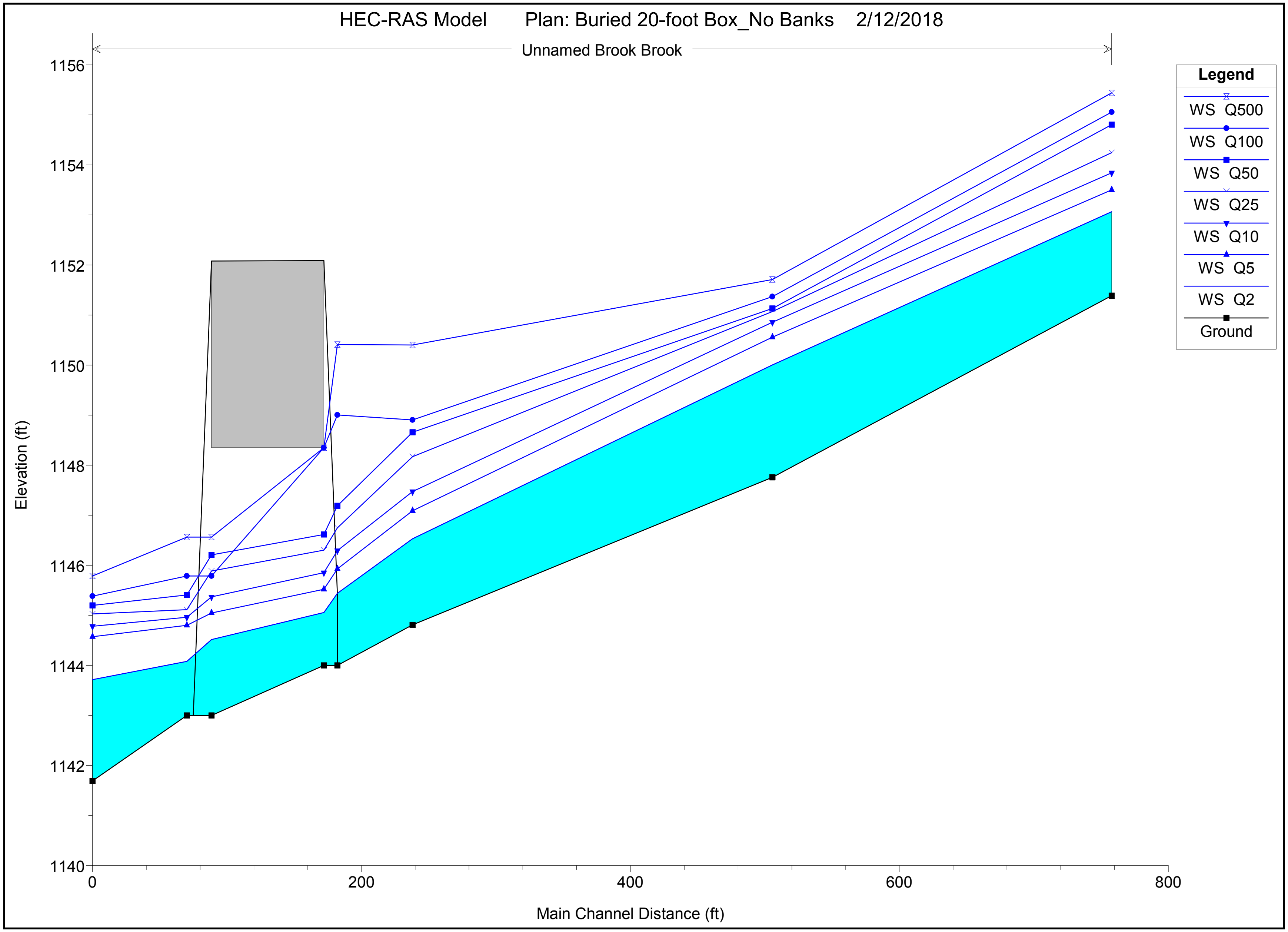
500
550
600



HEC-RAS Model Plan: Proposed 20-foot At-Grade 10/24/2017
River = Unnamed Brook Reach = Brook RS = 1001
.085
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
Station (ft)

20-FOOT SPAN BURIED FRAME WITHOUT CHANNEL BANKS



HEC-RAS Model Plan: Buried 20-foot Box_No Banks 2/12/2018
Unnamed Brook Brook
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Elevation (ft)
1156
1154
1152
1150
1148
1146
1144
1142
1140
0
200
400
600
800
Main Channel Distance (ft)

HEC-RAS Version 4.1.0 Jan 2010
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```
X     X  XXXXXX    XXXX        XXXX       XX      XXXX
X     X  X        X    X       X   X     X  X    X
X     X  X        X            X   X    X    X   X
XXXXXXX  XXXX     X      XXX   XXXX     XXXXXX    XXXX
X     X  X        X            X  X     X    X        X
X     X  X        X    X       X   X    X    X        X
X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
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PROJECT DATA
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Project File : Springfield_Hydraulics.prj
Run Date and Time: 2/12/2018 9:56:49 AM

Project in English units

Project Description:
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Unit="US_survey_Foot" /> <Registration OffsetX="0" OffsetY="0" OffsetZ="0"
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PLAN DATA

Plan Title: Buried 20-foot Box_No Banks
Plan File : F:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.p05

Geometry Title: Buried 20-foot_No Banks
Geometry File : F:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.g05

Flow Title   : Steady Flow
Flow File   : F:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.f01

Plan Description:
Buried 20-foot box with no bank lines

Plan Summary Information:

```
Number of:  Cross Sections =    6    Multiple Openings  =    0
            Culverts       =    0    Inline Structures  =    0
            Bridges        =    1    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.33
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Subcritical Flow
```

FLOW DATA

Flow Title: Steady Flow
Flow File : F:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.f01

Flow Data (cfs)

River	Reach	RS	Q2	Q5	Q10	Q25	Q50	Q100	Q500
Unnamed Brook	Brook	1758	117	194	259	348	421	510	727

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Unnamed Brook	Brook	Q2	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q5	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q10	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q25	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q50	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q100	Normal S = 0.0322	Normal S = 0.0039
Unnamed Brook	Brook	Q500	Normal S = 0.0322	Normal S = 0.0039

GEOMETRY DATA

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Geometry Title: Buried 20-foot_No Banks
Geometry File : F:\Proj2016\160361 Springfield NH Bridge\Struct\Calcs\Hydraulics\GeoHECRAS\Springfield_Hydraulics.g05

CROSS SECTION


RIVER: Unnamed Brook
REACH: Brook              RS: 1758

INPUT
Description:
Station Elevation Data    num=      24
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     -10    1157       0    1156   60.03  1154.5   75.66 1154.29   99.99 1154.46
  100.85 1154.47  100.99 1154.48  109.77  1154.9  111.26 1154.74  111.74 1154.64
   112.8 1153.64  114.81 1152.38  121.13 1152.22  121.79 1152.13   122.1 1152.09
  122.32 1152.07  124.12 1151.93  128.32 1151.39  130.04 1151.41  131.07 1151.66
  131.76 1152.02  132.04 1152.35  133.29 1153.46     300    1160

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     -10     .05   112.8    .035  133.29    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         112.8  133.29          252.24  252.24  252.24             .1       .3

CROSS SECTION OUTPUT  Profile #Q2

  E.G. Elev (ft)           1153.60    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.53    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1153.07    Reach Len. (ft)            252.24     252.24     252.24
  Crit W.S. (ft)           1153.07    Flow Area (sq ft)                      19.94
  E.G. Slope (ft/ft)      0.019079    Area (sq ft)                           19.94
  Q Total (cfs)             117.00    Flow (cfs)                            117.00
  Top Width (ft)             19.13    Top Width (ft)                         19.13
  Vel Total (ft/s)            5.87    Avg. Vel. (ft/s)                        5.87
  Max Chl Dpth (ft)           1.67    Hydr. Depth (ft)                        1.04
  Conv. Total (cfs)          847.0    Conv. (cfs)                            847.0
  Length Wtd. (ft)          252.24    Wetted Per. (ft)                       19.92
  Min Ch El (ft)           1151.39    Shear (lb/sq ft)                        1.19
  Alpha                       1.00    Stream Power (lb/ft s)     300.00       0.00       0.00
  Frctn Loss (ft)             2.96    Cum Volume (acre-ft)                    0.42
  C & E Loss (ft)             0.08    Cum SA (acres)                          0.34


Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
         for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate the
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need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q5

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1154.22	Wt. n-Val.		0.035	0.085
Vel Head (ft)	0.72	Reach Len. (ft)	252.24	252.24	252.24
W.S. Elev (ft)	1153.50	Flow Area (sq ft)		28.58	0.02
Crit W.S. (ft)	1153.50	Area (sq ft)		28.58	0.02
E.G. Slope (ft/ft)	0.017318	Flow (cfs)		194.00	0.00
Q Total (cfs)	194.00	Top Width (ft)		20.27	1.09
Top Width (ft)	21.36	Avg. Vel. (ft/s)		6.79	0.18
Vel Total (ft/s)	6.78	Hydr. Depth (ft)		1.41	0.02
Max Chl Dpth (ft)	2.11	Conv. (cfs)		1474.2	0.0
Conv. Total (cfs)	1474.2	Wetted Per. (ft)		21.34	1.09
Length Wtd. (ft)	252.24	Shear (lb/sq ft)		1.45	0.02
Min Ch El (ft)	1151.39	Stream Power (lb/ft s)	300.00	0.00	0.00
Alpha	1.00	Cum Volume (acre-ft)		0.65	0.00
Frctn Loss (ft)	2.74	Cum SA (acres)		0.45	0.05
C & E Loss (ft)	0.13				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q10

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1154.66	Wt. n-Val.	0.050	0.035	0.085
Vel Head (ft)	0.81	Reach Len. (ft)	252.24	252.24	252.24
W.S. Elev (ft)	1153.84	Flow Area (sq ft)	0.02	35.55	1.88
Crit W.S. (ft)	1153.84	Area (sq ft)	0.02	35.55	1.88
E.G. Slope (ft/ft)	0.014992	Flow (cfs)	0.01	257.65	1.34
Q Total (cfs)	259.00	Top Width (ft)	0.22	20.49	9.78
Top Width (ft)	30.49	Avg. Vel. (ft/s)	0.64	7.25	0.71
Vel Total (ft/s)	6.92	Hydr. Depth (ft)	0.10	1.74	0.19
Max Chl Dpth (ft)	2.45	Conv. (cfs)	0.1	2104.2	10.9
Conv. Total (cfs)	2115.3	Wetted Per. (ft)	0.30	21.60	9.79
Length Wtd. (ft)	252.24	Shear (lb/sq ft)	0.07	1.54	0.18
Min Ch El (ft)	1151.39	Stream Power (lb/ft s)	300.00	0.00	0.00
Alpha	1.09	Cum Volume (acre-ft)	0.00	0.79	0.05
Frctn Loss (ft)	2.42				

C & E Loss (ft)	0.14	Cum SA (acres)	0.00	0.46	0.22

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q25

E.G. Elev (ft)	1155.16	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.91	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1154.25	Reach Len. (ft)	252.24	252.24	252.24
Crit W.S. (ft)	1154.25	Flow Area (sq ft)	0.20	43.83	7.91
E.G. Slope (ft/ft)	0.012945	Area (sq ft)	0.20	43.83	7.91
Q Total (cfs)	348.00	Flow (cfs)	0.24	339.31	8.44
Top Width (ft)	41.21	Top Width (ft)	0.64	20.49	20.08
Vel Total (ft/s)	6.70	Avg. Vel. (ft/s)	1.24	7.74	1.07
Max Chl Dpth (ft)	2.86	Hydr. Depth (ft)	0.30	2.14	0.39
Conv. Total (cfs)	3058.6	Conv. (cfs)	2.1	2982.3	74.2
Length Wtd. (ft)	252.24	Wetted Per. (ft)	0.89	21.60	20.09
Min Ch El (ft)	1151.39	Shear (lb/sq ft)	0.18	1.64	0.32
Alpha	1.30	Stream Power (lb/ft s)	300.00	0.00	0.00
Frctn Loss (ft)	2.49	Cum Volume (acre-ft)	0.03	0.94	0.11
C & E Loss (ft)	0.14	Cum SA (acres)	0.08	0.46	0.26

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1155.42	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.61	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1154.80	Reach Len. (ft)	252.24	252.24	252.24
Crit W.S. (ft)	1154.80	Flow Area (sq ft)	20.89	55.23	23.02
E.G. Slope (ft/ft)	0.007112	Area (sq ft)	20.89	55.23	23.02
Q Total (cfs)	421.00	Flow (cfs)	25.23	369.74	26.03
Top Width (ft)	116.78	Top Width (ft)	62.03	20.49	34.26
Vel Total (ft/s)	4.25	Avg. Vel. (ft/s)	1.21	6.70	1.13

Max Chl Dpth (ft)	3.41	Hydr. Depth (ft)	0.34	2.70	0.67
Conv. Total (cfs)	4992.2	Conv. (cfs)	299.2	4384.4	308.6
Length Wtd. (ft)	252.24	Wetted Per. (ft)	62.46	21.60	34.29
Min Ch El (ft)	1151.39	Shear (lb/sq ft)	0.15	1.14	0.30
Alpha	2.19	Stream Power (lb/ft s)	300.00	0.00	0.00
Frctn Loss (ft)	2.12	Cum Volume (acre-ft)	0.16	1.06	0.17
C & E Loss (ft)	0.01	Cum SA (acres)	0.39	0.47	0.31

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q100

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1155.65	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.59	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1155.06	Reach Len. (ft)	252.24	252.24	252.24
Crit W.S. (ft)	1155.06	Flow Area (sq ft)	38.36	60.38	32.45
E.G. Slope (ft/ft)	0.006549	Area (sq ft)	38.36	60.38	32.45
Q Total (cfs)	510.00	Flow (cfs)	58.78	411.75	39.48
Top Width (ft)	136.17	Top Width (ft)	75.01	20.49	40.68
Vel Total (ft/s)	3.89	Avg. Vel. (ft/s)	1.53	6.82	1.22
Max Chl Dpth (ft)	3.67	Hydr. Depth (ft)	0.51	2.95	0.80
Conv. Total (cfs)	6301.9	Conv. (cfs)	726.3	5087.8	487.8
Length Wtd. (ft)	252.24	Wetted Per. (ft)	75.44	21.60	40.71
Min Ch El (ft)	1151.39	Shear (lb/sq ft)	0.21	1.14	0.33
Alpha	2.51	Stream Power (lb/ft s)	300.00	0.00	0.00
Frctn Loss (ft)	1.97	Cum Volume (acre-ft)	0.33	1.21	0.25
C & E Loss (ft)	0.00	Cum SA (acres)	0.57	0.45	0.34

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1156.07	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.63	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1155.44	Reach Len. (ft)	252.24	252.24	252.24

Crit W.S. (ft)	1155.44	Flow Area (sq ft)	70.39	68.31	50.11
E.G. Slope (ft/ft)	0.006697	Area (sq ft)	70.39	68.31	50.11
Q Total (cfs)	727.00	Flow (cfs)	144.33	511.44	71.23
Top Width (ft)	161.53	Top Width (ft)	90.50	20.49	50.54
Vel Total (ft/s)	3.85	Avg. Vel. (ft/s)	2.05	7.49	1.42
Max Chl Dpth (ft)	4.05	Hydr. Depth (ft)	0.78	3.33	0.99
Conv. Total (cfs)	8883.9	Conv. (cfs)	1763.7	6249.7	870.5
Length Wtd. (ft)	252.24	Wetted Per. (ft)	90.94	21.60	50.58
Min Ch El (ft)	1151.39	Shear (lb/sq ft)	0.32	1.32	0.41
Alpha	2.73	Stream Power (lb/ft s)	300.00	0.00	0.00
Frctn Loss (ft)	2.11	Cum Volume (acre-ft)	1.31	1.47	0.42
C & E Loss (ft)	0.02	Cum SA (acres)	1.31	0.45	0.39

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Unnamed Brook
REACH: Brook RS: 1506

INPUT
Description:
Station Elevation Data num= 39

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1154.44	6.77	1154.44	22.76	1154.44	44.61	1154.11	65.12	1153.75
82.6	1153.55	106.59	1152.8	116.14	1152.49	127.36	1151.49	131.49	1151.09
140.43	1151.49	141.14	1151.63	141.9	1151.58	148.14	1151.08	150.57	1148.79
151.14	1148.06	151.72	1147.99	152.56	1147.76	153.39	1147.78	154.99	1147.89
156.77	1147.98	158.55	1148.06	159.01	1148.13	162.81	1148.42	163.61	1148.47
164.55	1149.54	164.72	1149.63	166.56	1149.71	181.79	1150.43	189.42	1150.57
209.57	1150.66	213.59	1150.82	218.46	1152.95	223.8	1155.73	227.16	1160.29
227.79	1160.9	306.77	1160.9	418.08	1160.9	631.82	1160.9		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	148.14	.035	181.79	.085

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
148.14	181.79	267.56	267.56	267.56	.1	.3

CROSS SECTION OUTPUT Profile #Q2

E.G. Elev (ft)	1150.27	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.26	Wt. n-Val.		0.035	
W.S. Elev (ft)	1150.00	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1149.44	Flow Area (sq ft)		28.38	
E.G. Slope (ft/ft)	0.007919	Area (sq ft)		28.38	
Q Total (cfs)	117.00	Flow (cfs)		117.00	
Top Width (ft)	23.49	Top Width (ft)		23.49	
Vel Total (ft/s)	4.12	Avg. Vel. (ft/s)		4.12	
Max Chl Dpth (ft)	2.24	Hydr. Depth (ft)		1.21	
Conv. Total (cfs)	1314.8	Conv. (cfs)		1314.8	
Length Wtd. (ft)	267.56	Wetted Per. (ft)		24.90	
Min Ch El (ft)	1147.76	Shear (lb/sq ft)		0.56	
Alpha	1.00	Stream Power (lb/ft s)	631.82	0.00	0.00
Frctn Loss (ft)	3.05	Cum Volume (acre-ft)		0.28	
C & E Loss (ft)	0.04	Cum SA (acres)		0.22	

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q5

E.G. Elev (ft)	1150.85	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.29	Wt. n-Val.		0.035	0.085
W.S. Elev (ft)	1150.56	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1150.11	Flow Area (sq ft)		44.71	0.46
E.G. Slope (ft/ft)	0.007453	Area (sq ft)		44.71	0.46
Q Total (cfs)	194.00	Flow (cfs)		193.89	0.11
Top Width (ft)	40.19	Top Width (ft)		33.10	7.09
Vel Total (ft/s)	4.29	Avg. Vel. (ft/s)		4.34	0.24
Max Chl Dpth (ft)	2.80	Hydr. Depth (ft)		1.35	0.07
Conv. Total (cfs)	2247.2	Conv. (cfs)		2245.9	1.3
Length Wtd. (ft)	267.56	Wetted Per. (ft)		34.74	7.09
Min Ch El (ft)	1147.76	Shear (lb/sq ft)		0.60	0.03
Alpha	1.02	Stream Power (lb/ft s)	631.82	0.00	0.00
Frctn Loss (ft)	2.86	Cum Volume (acre-ft)		0.44	0.00
C & E Loss (ft)	0.06	Cum SA (acres)		0.30	0.02

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	1151.19	Element	Left OB	Channel	Right OB

Vel Head (ft)	0.33	Wt. n-Val.		0.035	0.085
W.S. Elev (ft)	1150.86	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1150.43	Flow Area (sq ft)		54.67	8.15
E.G. Slope (ft/ft)	0.006669	Area (sq ft)		54.67	8.15
Q Total (cfs)	259.00	Flow (cfs)		254.31	4.69
Top Width (ft)	65.31	Top Width (ft)		33.42	31.89
Vel Total (ft/s)	4.12	Avg. Vel. (ft/s)		4.65	0.57
Max Chl Dpth (ft)	3.10	Hydr. Depth (ft)		1.64	0.26
Conv. Total (cfs)	3171.4	Conv. (cfs)		3114.0	57.4
Length Wtd. (ft)	267.56	Wetted Per. (ft)		35.18	31.90
Min Ch El (ft)	1147.76	Shear (lb/sq ft)		0.65	0.11
Alpha	1.25	Stream Power (lb/ft s)	631.82	0.00	0.00
Frctn Loss (ft)	2.63	Cum Volume (acre-ft)	0.00	0.53	0.03
C & E Loss (ft)	0.07	Cum SA (acres)	0.00	0.30	0.10

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q25

E.G. Elev (ft)	1151.51	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.44	Wt. n-Val.		0.035	0.085
W.S. Elev (ft)	1151.07	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1150.79	Flow Area (sq ft)		61.71	14.90
E.G. Slope (ft/ft)	0.007785	Area (sq ft)		61.71	14.90
Q Total (cfs)	348.00	Flow (cfs)		334.31	13.69
Top Width (ft)	66.01	Top Width (ft)		33.64	32.37
Vel Total (ft/s)	4.54	Avg. Vel. (ft/s)		5.42	0.92
Max Chl Dpth (ft)	3.31	Hydr. Depth (ft)		1.83	0.46
Conv. Total (cfs)	3944.2	Conv. (cfs)		3789.1	155.1
Length Wtd. (ft)	267.56	Wetted Per. (ft)		35.49	32.43
Min Ch El (ft)	1147.76	Shear (lb/sq ft)		0.85	0.22
Alpha	1.37	Stream Power (lb/ft s)	631.82	0.00	0.00
Frctn Loss (ft)	2.37	Cum Volume (acre-ft)	0.03	0.64	0.05
C & E Loss (ft)	0.05	Cum SA (acres)	0.08	0.31	0.10

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1151.72	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.59	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1151.13	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1150.99	Flow Area (sq ft)	0.04	63.78	16.90

E.G. Slope (ft/ft)	0.010082	Area (sq ft)	0.04	63.78	16.90
Q Total (cfs)	421.00	Flow (cfs)	0.01	401.84	19.15
Top Width (ft)	68.14	Top Width (ft)	1.98	33.65	32.51
Vel Total (ft/s)	5.22	Avg. Vel. (ft/s)	0.24	6.30	1.13
Max Chl Dpth (ft)	3.37	Hydr. Depth (ft)	0.02	1.90	0.52
Conv. Total (cfs)	4192.9	Conv. (cfs)	0.1	4002.1	190.7
Length Wtd. (ft)	267.56	Wetted Per. (ft)	1.99	35.50	32.58
Min Ch El (ft)	1147.76	Shear (lb/sq ft)	0.01	1.13	0.33
Alpha	1.40	Stream Power (lb/ft s)	631.82	0.00	0.00
Frctn Loss (ft)	2.28	Cum Volume (acre-ft)	0.10	0.71	0.06
C & E Loss (ft)	0.02	Cum SA (acres)	0.20	0.31	0.12

Warning: Divided flow computed for this cross-section.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q100

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1152.00	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.63	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1151.37	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1151.23	Flow Area (sq ft)	1.79	71.78	24.69
E.G. Slope (ft/ft)	0.009466	Area (sq ft)	1.79	71.78	24.69
Q Total (cfs)	510.00	Flow (cfs)	1.40	474.11	34.49
Top Width (ft)	79.42	Top Width (ft)	12.71	33.65	33.05
Vel Total (ft/s)	5.19	Avg. Vel. (ft/s)	0.78	6.60	1.40
Max Chl Dpth (ft)	3.61	Hydr. Depth (ft)	0.14	2.13	0.75
Conv. Total (cfs)	5241.8	Conv. (cfs)	14.4	4872.9	354.5
Length Wtd. (ft)	267.56	Wetted Per. (ft)	12.75	35.50	33.17
Min Ch El (ft)	1147.76	Shear (lb/sq ft)	0.08	1.19	0.44
Alpha	1.51	Stream Power (lb/ft s)	631.82	0.00	0.00
Frctn Loss (ft)	2.25	Cum Volume (acre-ft)	0.21	0.83	0.09
C & E Loss (ft)	0.02	Cum SA (acres)	0.32	0.29	0.12

Warning: Divided flow computed for this cross-section.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1152.55	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.84	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1151.71	Reach Len. (ft)	267.56	267.56	267.56
Crit W.S. (ft)	1151.71	Flow Area (sq ft)	8.30	83.24	36.08
E.G. Slope (ft/ft)	0.010733	Area (sq ft)	8.30	83.24	36.08
Q Total (cfs)	727.00	Flow (cfs)	12.85	646.20	67.95
Top Width (ft)	90.72	Top Width (ft)	23.24	33.65	33.83
Vel Total (ft/s)	5.70	Avg. Vel. (ft/s)	1.55	7.76	1.88

Max Chl Dpth (ft)	3.95	Hydr. Depth (ft)	0.36	2.47	1.07
Conv. Total (cfs)	7017.3	Conv. (cfs)	124.0	6237.4	655.9
Length Wtd. (ft)	267.56	Wetted Per. (ft)	23.31	35.50	34.02
Min Ch El (ft)	1147.76	Shear (lb/sq ft)	0.24	1.57	0.71
Alpha	1.66	Stream Power (lb/ft s)	631.82	0.00	0.00
Frctn Loss (ft)	1.27	Cum Volume (acre-ft)	1.08	1.04	0.17
C & E Loss (ft)	0.13	Cum SA (acres)	0.98	0.29	0.15

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

CROSS SECTION

RIVER: Unnamed Brook
REACH: Brook RS: 1238

INPUT
Description:
Station Elevation Data num= 101

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1154.64	50.59	1153.89	53.33	1153.84	53.34	1153.84	94.44	1153.37
98.25	1153.25	130.83	1152.19	134.01	1151.92	135.47	1152.03	140.41	1151.88
170.3	1151.1	172.75	1150.87	176.02	1150.76	182.19	1150.56	192.01	1150.21
198.4	1150.13	200.79	1150.32	204.45	1150.14	206.36	1150.05	218.78	1149.98
221.4	1149.87	224.79	1149.76	229.82	1149.76	233.95	1149.56	242.01	1149.46
259.14	1149.19	259.31	1149.19	261.38	1149.14	263.82	1149.1	276.67	1150
280.62	1150.03	288.67	1149.85	293.32	1149.91	302.36	1149.8	312.42	1149.45
322.09	1149.1	346.3	1148.52	351.96	1148.38	356.11	1148.32	367.1	1148.17
370.45	1147.87	375.2	1147.78	377.34	1147.73	382.61	1147.92	384.98	1147.68
385.08	1147.67	385.2	1147.67	385.33	1147.66	385.47	1147.64	387.13	1147.36
388.69	1145.7	389.07	1145.46	390.86	1144.97	390.97	1144.93	391.21	1144.94
395.07	1145.04	395.13	1145.03	397.3	1144.82	397.38	1144.81	397.49	1144.83
400.05	1145.37	402.95	1147.43	404.03	1148.24	405.46	1148.51	407.5	1148.97
409.84	1149.47	416.14	1153.21	417.06	1153.98	420.28	1154.21	421.02	1154.38
421.74	1155.13	421.75	1155.14	422.51	1156.57	422.94	1157.35	423.41	1157.34
432.83	1157.15	434.03	1157.21	438.74	1157.25	450.64	1157.45	451.28	1157.17
451.62	1157.15	452.03	1156.85	452.88	1156.55	453.31	1156.84	454.4	1157.57
454.95	1158.12	456.45	1158.89	457	1159.29	457.91	1159.6	458.77	1160.7
459.07	1161.51	460.13	1161.19	460.37	1161.15	461.41	1161.29	463.63	1161.62
465.15	1161.44	473.05	1161.1	475.01	1160.9	485.41	1161.01	494.07	1161.18
504.45	1161.18								

```
Manning's n Values          num=        3
     Sta    n Val      Sta    n Val      Sta    n Val
       0      .05  387.13     .035  402.95     .085

Bank Sta: Left    Right     Lengths: Left Channel    Right      Coeff Contr.    Expan.
        387.13  402.95              55.99    55.99    55.99               .1        .3
Ineffective Flow     num=        2
   Sta L    Sta R     Elev  Permanent
       0  349.37  1152.2        F
  456.67  504.45 1152.15        F

CROSS SECTION OUTPUT  Profile #Q2

  E.G. Elev (ft)           1147.18    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.65    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1146.53    Reach Len. (ft)             55.99      55.99      55.99
  Crit W.S. (ft)           1146.53    Flow Area (sq ft)                      18.06
  E.G. Slope (ft/ft)      0.017733    Area (sq ft)                           18.06
  Q Total (cfs)             117.00    Flow (cfs)                            117.00
  Top Width (ft)             13.78    Top Width (ft)                         13.78
  Vel Total (ft/s)            6.48    Avg. Vel. (ft/s)                        6.48
  Max Chl Dpth (ft)           1.72    Hydr. Depth (ft)                        1.31
  Conv. Total (cfs)          878.6    Conv. (cfs)                            878.6
  Length Wtd. (ft)           55.99    Wetted Per. (ft)                       14.72
  Min Ch El (ft)           1144.81    Shear (lb/sq ft)                        1.36
  Alpha                       1.00    Stream Power (lb/ft s)    504.45        0.00       0.00
  Frctn Loss (ft)             0.58    Cum Volume (acre-ft)                    0.14
  C & E Loss (ft)             0.12    Cum SA (acres)                          0.11


Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
         for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate the
         need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The program
         defaulted to critical depth.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q5

  E.G. Elev (ft)           1147.95    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.86    Wt. n-Val.                             0.035
  W.S. Elev (ft)           1147.09    Reach Len. (ft)             55.99      55.99      55.99
  Crit W.S. (ft)           1147.09    Flow Area (sq ft)                      26.11
  E.G. Slope (ft/ft)      0.016531    Area (sq ft)                           26.11
  Q Total (cfs)             194.00    Flow (cfs)                            194.00
```

Top Width (ft)	15.09	Top Width (ft)		15.09	
Vel Total (ft/s)	7.43	Avg. Vel. (ft/s)		7.43	
Max Chl Dpth (ft)	2.28	Hydr. Depth (ft)		1.73	
Conv. Total (cfs)	1508.9	Conv. (cfs)		1508.9	
Length Wtd. (ft)	55.99	Wetted Per. (ft)		16.45	
Min Ch El (ft)	1144.81	Shear (lb/sq ft)		1.64	
Alpha	1.00	Stream Power (lb/ft s)	504.45	0.00	0.00
Frctn Loss (ft)	0.59	Cum Volume (acre-ft)		0.22	
C & E Loss (ft)	0.14	Cum SA (acres)		0.15	

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	1148.49	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.01	Wt. n-Val.	0.050	0.035	0.000
W.S. Elev (ft)	1147.48	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1147.48	Flow Area (sq ft)	0.04	32.11	0.00
E.G. Slope (ft/ft)	0.015953	Area (sq ft)	0.04	32.11	0.00
Q Total (cfs)	259.00	Flow (cfs)	0.02	258.98	0.00
Top Width (ft)	16.57	Top Width (ft)	0.69	15.82	0.06
Vel Total (ft/s)	8.06	Avg. Vel. (ft/s)	0.56	8.07	0.15
Max Chl Dpth (ft)	2.67	Hydr. Depth (ft)	0.06	2.03	0.02
Conv. Total (cfs)	2050.6	Conv. (cfs)	0.2	2050.4	0.0
Length Wtd. (ft)	55.99	Wetted Per. (ft)	0.69	17.41	0.08
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.06	1.84	
Alpha	1.00	Stream Power (lb/ft s)	504.45	0.00	0.00
Frctn Loss (ft)	0.60	Cum Volume (acre-ft)	0.00	0.26	0.00
C & E Loss (ft)	0.16	Cum SA (acres)	0.00	0.15	0.00

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program

defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q25

E.G. Elev (ft)	1149.09	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.92	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1148.17	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1148.17	Flow Area (sq ft)	7.06	43.07	0.36
E.G. Slope (ft/ft)	0.010159	Area (sq ft)	7.06	43.07	0.36
Q Total (cfs)	348.00	Flow (cfs)	10.53	337.19	0.28
Top Width (ft)	36.82	Top Width (ft)	20.01	15.82	0.98
Vel Total (ft/s)	6.89	Avg. Vel. (ft/s)	1.49	7.83	0.78
Max Chl Dpth (ft)	3.36	Hydr. Depth (ft)	0.35	2.72	0.37
Conv. Total (cfs)	3452.6	Conv. (cfs)	104.4	3345.3	2.8
Length Wtd. (ft)	55.99	Wetted Per. (ft)	20.07	17.41	1.23
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.22	1.57	0.19
Alpha	1.25	Stream Power (lb/ft s)	504.45	0.00	0.00
Frctn Loss (ft)	0.49	Cum Volume (acre-ft)	0.01	0.32	0.00
C & E Loss (ft)	0.09	Cum SA (acres)	0.02	0.16	0.00

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1149.43	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.77	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1148.66	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1148.66	Flow Area (sq ft)	23.39	50.85	1.35
E.G. Slope (ft/ft)	0.007296	Area (sq ft)	24.35	50.85	1.35
Q Total (cfs)	421.00	Flow (cfs)	43.12	376.82	1.07
Top Width (ft)	65.68	Top Width (ft)	46.68	15.82	3.18
Vel Total (ft/s)	5.57	Avg. Vel. (ft/s)	1.84	7.41	0.79
Max Chl Dpth (ft)	3.85	Hydr. Depth (ft)	0.62	3.21	0.42
Conv. Total (cfs)	4928.7	Conv. (cfs)	504.8	4411.4	12.5
Length Wtd. (ft)	55.99	Wetted Per. (ft)	37.82	17.41	3.49
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.28	1.33	0.18
Alpha	1.60	Stream Power (lb/ft s)	504.45	0.00	0.00
Frctn Loss (ft)	0.39	Cum Volume (acre-ft)	0.02	0.36	0.00
C & E Loss (ft)	0.04	Cum SA (acres)	0.05	0.16	0.01

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	1149.74	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.83	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1148.90	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1148.90	Flow Area (sq ft)	32.59	54.70	2.25
E.G. Slope (ft/ft)	0.007513	Area (sq ft)	36.96	54.70	2.25
Q Total (cfs)	510.00	Flow (cfs)	76.02	431.86	2.12
Top Width (ft)	76.92	Top Width (ft)	56.85	15.82	4.26
Vel Total (ft/s)	5.70	Avg. Vel. (ft/s)	2.33	7.89	0.94
Max Chl Dpth (ft)	4.09	Hydr. Depth (ft)	0.86	3.46	0.53
Conv. Total (cfs)	5884.0	Conv. (cfs)	877.1	4982.4	24.5
Length Wtd. (ft)	55.99	Wetted Per. (ft)	37.82	17.41	4.60
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.40	1.47	0.23
Alpha	1.65	Stream Power (lb/ft s)	504.45	0.00	0.00
Frctn Loss (ft)	0.17	Cum Volume (acre-ft)	0.10	0.44	0.00
C & E Loss (ft)	0.18	Cum SA (acres)	0.10	0.14	0.01

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1150.80	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.40	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1150.41	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1149.40	Flow Area (sq ft)	89.26	78.45	12.58
E.G. Slope (ft/ft)	0.002673	Area (sq ft)	225.91	78.45	12.58
Q Total (cfs)	727.00	Flow (cfs)	243.14	469.77	14.09
Top Width (ft)	224.86	Top Width (ft)	200.58	15.82	8.46
Vel Total (ft/s)	4.03	Avg. Vel. (ft/s)	2.72	5.99	1.12
Max Chl Dpth (ft)	5.59	Hydr. Depth (ft)	2.36	4.96	1.49
Conv. Total (cfs)	14061.2	Conv. (cfs)	4702.6	9086.1	272.5

Length Wtd. (ft)	55.99	Wetted Per. (ft)	37.82	17.41	9.12
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.39	0.75	0.23
Alpha	1.58	Stream Power (lb/ft s)	504.45	0.00	0.00
Frctn Loss (ft)	0.10	Cum Volume (acre-ft)	0.36	0.54	0.02
C & E Loss (ft)	0.05	Cum SA (acres)	0.29	0.14	0.02

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: Unnamed Brook
REACH: Brook RS: 1182

INPUT
Description:
Station Elevation Data num= 85

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1154.85	9.59	1154.85	47.9	1154.33	61.73	1154.18	90.45	1153.8
104.2	1153.67	131.47	1152.71	142.49	1152.63	175.29	1151.57	182.35	1151.47
193.98	1150.76	204.13	1150.38	205.72	1150.36	207.86	1150.53	210.87	1150.92
211.03	1150.52	213.2	1150.1	222.43	1150.15	228.92	1149.87	233.05	1149.68
234.27	1149.6	239.83	1149.33	252.3	1149.19	261.59	1149.06	263.91	1149.8
265.27	1150.24	272.96	1150.59	280.01	1150.37	291.07	1150.15	295.94	1150.23
299.06	1150.39	308.81	1149.83	317.19	1149.54	349.44	1148.38	358.53	1148.13
388.59	1146.97	393.24	1146.84	396.86	1146.66	400.77	1146.51	402.49	1146.5
402.5	1144	404.5	1144	407.875	1144	417.125	1144	420.5	1144
422.5	1144	422.76	1147.58	423.43	1149.31	424.86	1150.8	425.29	1150.92
436.36	1151.84	437.05	1151.9	437.24	1151.93	438.96	1151.99	456.04	1152.67
457.37	1152.39	457.68	1152.37	458.07	1152.2	458.81	1151.95	459.95	1152.7
460.33	1152.96	462.33	1153.92	463.9	1154.73	471.48	1158.35	473.12	1159.16
473.56	1159.28	483.97	1160.82	489.92	1161.16	497.15	1161.29	511.64	1161.53
515.27	1162.17	515.79	1162.23	518.02	1162.22	521.55	1162.47	521.57	1162.48
521.69	1161.93	521.71	1162.68	521.77	1163.91	536.59	1163.91	543.33	1163.91
549.08	1163.91	549.1	1163.29	549.13	1162.14	563.91	1162.14	790.85	1162.14

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.05	402.49	.035	422.76	.085

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
402.49	422.76	111.86	111.86	111.86	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	383.88	1152.2	F
434.21	790.85	1152.15	F

```
CROSS SECTION OUTPUT  Profile #Q2

  E.G. Elev (ft)           1145.69    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.26    Wt. n-Val.                              0.035
  W.S. Elev (ft)           1145.44    Reach Len. (ft)             10.00      10.00      10.00
  Crit W.S. (ft)           1145.02    Flow Area (sq ft)                      28.86
  E.G. Slope (ft/ft)      0.006694    Area (sq ft)                           28.86
  Q Total (cfs)             117.00    Flow (cfs)                            117.00
  Top Width (ft)             20.11    Top Width (ft)                         20.11
  Vel Total (ft/s)            4.05    Avg. Vel. (ft/s)                        4.05
  Max Chl Dpth (ft)           1.44    Hydr. Depth (ft)                        1.43
  Conv. Total (cfs)         1430.0    Conv. (cfs)                           1430.0
  Length Wtd. (ft)           10.00    Wetted Per. (ft)                       22.88
  Min Ch El (ft)           1144.00    Shear (lb/sq ft)                        0.53
  Alpha                       1.00    Stream Power (lb/ft s)     790.85       0.00       0.00
  Frctn Loss (ft)             0.10    Cum Volume (acre-ft)                    0.11
  C & E Loss (ft)             0.07    Cum SA (acres)                          0.08


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT  Profile #Q5

  E.G. Elev (ft)           1146.32    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.39    Wt. n-Val.                              0.035
  W.S. Elev (ft)           1145.93    Reach Len. (ft)             10.00      10.00      10.00
  Crit W.S. (ft)           1145.44    Flow Area (sq ft)                      38.74
  E.G. Slope (ft/ft)      0.007293    Area (sq ft)                           38.74
  Q Total (cfs)             194.00    Flow (cfs)                            194.00
  Top Width (ft)             20.15    Top Width (ft)                         20.15
  Vel Total (ft/s)            5.01    Avg. Vel. (ft/s)                        5.01
  Max Chl Dpth (ft)           1.93    Hydr. Depth (ft)                        1.92
  Conv. Total (cfs)         2271.7    Conv. (cfs)                           2271.7
  Length Wtd. (ft)           10.00    Wetted Per. (ft)                       23.86
  Min Ch El (ft)           1144.00    Shear (lb/sq ft)                        0.74
  Alpha                       1.00    Stream Power (lb/ft s)     790.85       0.00       0.00
  Frctn Loss (ft)             0.09    Cum Volume (acre-ft)                    0.18
  C & E Loss (ft)             0.07    Cum SA (acres)                          0.13


Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT  Profile #Q10

  E.G. Elev (ft)           1146.78    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               0.49    Wt. n-Val.                              0.035
  W.S. Elev (ft)           1146.29    Reach Len. (ft)             10.00      10.00      10.00
  Crit W.S. (ft)           1145.74    Flow Area (sq ft)                      46.06
```

E.G. Slope (ft/ft)	0.007600	Area (sq ft)		46.06	
Q Total (cfs)	259.00	Flow (cfs)		259.00	
Top Width (ft)	20.18	Top Width (ft)		20.18	
Vel Total (ft/s)	5.62	Avg. Vel. (ft/s)		5.62	
Max Chl Dpth (ft)	2.29	Hydr. Depth (ft)		2.28	
Conv. Total (cfs)	2970.9	Conv. (cfs)		2970.9	
Length Wtd. (ft)	10.00	Wetted Per. (ft)		24.59	
Min Ch El (ft)	1144.00	Shear (lb/sq ft)		0.89	
Alpha	1.00	Stream Power (lb/ft s)	790.85	0.00	0.00
Frctn Loss (ft)	0.09	Cum Volume (acre-ft)		0.21	
C & E Loss (ft)	0.08	Cum SA (acres)		0.13	

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q25

E.G. Elev (ft)	1147.36	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.61	Wt. n-Val.	0.050	0.035	
W.S. Elev (ft)	1146.75	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)	1146.11	Flow Area (sq ft)	1.14	55.27	
E.G. Slope (ft/ft)	0.007704	Area (sq ft)	1.14	55.27	
Q Total (cfs)	348.00	Flow (cfs)	0.85	347.15	
Top Width (ft)	27.63	Top Width (ft)	7.42	20.21	
Vel Total (ft/s)	6.17	Avg. Vel. (ft/s)	0.75	6.28	
Max Chl Dpth (ft)	2.75	Hydr. Depth (ft)	0.15	2.73	
Conv. Total (cfs)	3964.9	Conv. (cfs)	9.7	3955.2	
Length Wtd. (ft)	10.00	Wetted Per. (ft)	7.43	25.26	
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.07	1.05	
Alpha	1.03	Stream Power (lb/ft s)	790.85	0.00	0.00
Frctn Loss (ft)	0.09	Cum Volume (acre-ft)	0.00	0.25	0.00
C & E Loss (ft)	0.08	Cum SA (acres)	0.00	0.13	0.00

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	1147.82	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.63	Wt. n-Val.	0.050	0.035	
W.S. Elev (ft)	1147.19	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)	1146.40	Flow Area (sq ft)	7.06	64.18	
E.G. Slope (ft/ft)	0.006747	Area (sq ft)	7.08	64.18	
Q Total (cfs)	421.00	Flow (cfs)	9.03	411.97	
Top Width (ft)	39.83	Top Width (ft)	19.59	20.24	
Vel Total (ft/s)	5.91	Avg. Vel. (ft/s)	1.28	6.42	
Max Chl Dpth (ft)	3.19	Hydr. Depth (ft)	0.38	3.17	
Conv. Total (cfs)	5125.3	Conv. (cfs)	109.9	5015.4	
Length Wtd. (ft)	10.00	Wetted Per. (ft)	18.62	25.70	
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.16	1.05	

Alpha	1.16	Stream Power (lb/ft s)	790.85	0.00	0.00
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)	0.00	0.29	0.00
C & E Loss (ft)	0.11	Cum SA (acres)	0.01	0.13	0.00

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	1149.25	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.24	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1149.01	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)	1146.81	Flow Area (sq ft)	40.88	101.01	0.39
E.G. Slope (ft/ft)	0.001631	Area (sq ft)	87.80	101.01	0.39
Q Total (cfs)	510.00	Flow (cfs)	82.87	427.02	0.11
Top Width (ft)	91.30	Top Width (ft)	70.47	20.27	0.55
Vel Total (ft/s)	3.58	Avg. Vel. (ft/s)	2.03	4.23	0.29
Max Chl Dpth (ft)	5.01	Hydr. Depth (ft)	2.20	4.98	0.71
Conv. Total (cfs)	12628.1	Conv. (cfs)	2052.0	10573.4	2.8
Length Wtd. (ft)	10.00	Wetted Per. (ft)	18.62	26.09	1.53
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.22	0.39	0.03
Alpha	1.22	Stream Power (lb/ft s)	790.85	0.00	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)	0.02	0.34	0.00
C & E Loss (ft)		Cum SA (acres)	0.02	0.12	0.01

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1150.66	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.25	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1150.41	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)	1147.68	Flow Area (sq ft)	67.05	129.51	1.90
E.G. Slope (ft/ft)	0.001233	Area (sq ft)	259.92	129.51	1.90
Q Total (cfs)	727.00	Flow (cfs)	164.36	561.85	0.80
Top Width (ft)	206.47	Top Width (ft)	184.47	20.27	1.73
Vel Total (ft/s)	3.66	Avg. Vel. (ft/s)	2.45	4.34	0.42
Max Chl Dpth (ft)	6.41	Hydr. Depth (ft)	3.60	6.39	1.10
Conv. Total (cfs)	20703.4	Conv. (cfs)	4680.6	16000.2	22.6
Length Wtd. (ft)	10.00	Wetted Per. (ft)	18.62	26.09	3.38
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.28	0.38	0.04
Alpha	1.19	Stream Power (lb/ft s)	790.85	0.00	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)	0.05	0.41	0.01
C & E Loss (ft)		Cum SA (acres)	0.04	0.12	0.01

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE

RIVER: Unnamed Brook
REACH: Brook RS: 1165

INPUT
Description: George's Mills Road
Distance from Upstream XS = 10
Deck/Roadway Width = 83.5
Weir Coefficient = 2.6
Upstream Deck/Roadway Coordinates
num= 65

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-20.72	1157.54	0	11.03	1157.54	0	12.89	1157.51	0
17.28	1157.42	0	61.95	1156.6	0	63.03	1156.58	0
64.34	1156.56	0	65.45	1156.54	0	65.57	1156.53	0
120.65	1155.56	0	122.43	1155.51	0	125.25	1155.45	0
156.19	1154.9	0	177.76	1154.47	0	180.72	1154.42	0
181.33	1154.41	0	232.7	1153.44	0	233.38	1153.42	0
236.27	1153.38	0	280.75	1152.83	0	285.95	1152.77	0
287.63	1152.75	0	287.96	1152.74	0	340.11	1152.42	0
341.96	1152.41	0	343.81	1152.4	0	393.35	1152.15	0
393.96	1152.15	0	402.5	1152.13	0	402.5	1152.13	1148.35
422.5	1152.12	1148.35	422.5	1152.12	0	439.61	1152.11	0
451.08	1152.1	0	452.2	1152.09	0	452.73	1152.09	0
452.87	1152.09	0	471.27	1152.09	0	517.42	1152.05	0
517.75	1152.05	0	519.11	1152.05	0	520.7	1152.04	0
560.22	1151.91	0	583.5	1151.81	0	584.43	1151.81	0
584.98	1151.81	0	600.39	1151.67	0	613.32	1151.54	0
613.77	1151.54	0	614.64	1151.53	0	636.1	1151.33	0
644.18	1151.25	0	644.47	1151.25	0	656.35	1151.08	0
673.49	1150.84	0	674.65	1150.82	0	674.91	1150.82	0
675.18	1150.81	0	689.81	1150.61	0	705.5	1150.38	0
732.51	1149.99	0	733.71	1149.97	0	733.77	1149.97	0
733.94	1149.97	0	755.59	1149.97	0			

Upstream Bridge Cross Section Data
Station Elevation Data num= 85

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1154.85	9.59	1154.85	47.9	1154.33	61.73	1154.18	90.45	1153.8
104.2	1153.67	131.47	1152.71	142.49	1152.63	175.29	1151.57	182.35	1151.47
193.98	1150.76	204.13	1150.38	205.72	1150.36	207.86	1150.53	210.87	1150.92
211.03	1150.52	213.2	1150.1	222.43	1150.15	228.92	1149.87	233.05	1149.68
234.27	1149.6	239.83	1149.33	252.3	1149.19	261.59	1149.06	263.91	1149.8
265.27	1150.24	272.96	1150.59	280.01	1150.37	291.07	1150.15	295.94	1150.23
299.06	1150.39	308.81	1149.83	317.19	1149.54	349.44	1148.38	358.53	1148.13
388.59	1146.97	393.24	1146.84	396.86	1146.66	400.77	1146.51	402.49	1146.5
402.5	1144	404.5	1144	407.875	1144	417.125	1144	420.5	1144
422.5	1144	422.76	1147.58	423.43	1149.31	424.86	1150.8	425.29	1150.92
436.36	1151.84	437.05	1151.9	437.24	1151.93	438.96	1151.99	456.04	1152.67

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  457.37 1152.39  457.68 1152.37  458.07  1152.2  458.81 1151.95  459.95  1152.7
  460.33 1152.96  462.33 1153.92   463.9 1154.73  471.48 1158.35  473.12 1159.16
  473.56 1159.28  483.97 1160.82  489.92 1161.16  497.15 1161.29  511.64 1161.53
  515.27 1162.17  515.79 1162.23  518.02 1162.22  521.55 1162.47  521.57 1162.48
  521.69 1161.93  521.71 1162.68  521.77 1163.91  536.59 1163.91  543.33 1163.91
  549.08 1163.91   549.1 1163.29  549.13 1162.14  563.91 1162.14  790.85 1162.14

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .05  402.49    .035  422.76    .085

Bank Sta: Left   Right    Coeff Contr.   Expan.
        402.49  422.76             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  383.88  1152.2       F
  434.21  790.85 1152.15       F

Downstream  Deck/Roadway Coordinates
    num=      67
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       0 1157.54       0   30.36 1157.54       0   62.11 1157.54       0
   63.97 1157.51       0   68.36 1157.42       0  113.03  1156.6       0
  114.11 1156.58       0  115.42 1156.56       0  116.53 1156.54       0
  116.65 1156.53       0  171.73 1155.56       0  173.51 1155.51       0
  176.33 1155.45       0  207.27  1154.9       0  228.84 1154.47       0
   231.8 1154.42       0  232.41 1154.41       0  283.78 1153.44       0
  284.46 1153.42       0  287.35 1153.38       0  331.83 1152.83       0
  337.03 1152.77       0  338.71 1152.75       0  339.04 1152.74       0
  391.19 1152.42       0  393.04 1152.41       0  394.89  1152.4       0
  444.43 1152.15       0  445.04 1152.15       0  452.47 1152.14       0
     462 1152.13       0     462 1152.13 1148.35     482 1152.12 1148.35
     482 1152.12       0  490.69 1152.11       0  502.16  1152.1       0
  503.28 1152.09       0  503.81 1152.09       0  503.95 1152.09       0
  522.35 1152.09       0   568.5 1152.05       0  568.83 1152.05       0
  570.19 1152.05       0  571.78 1152.04       0   611.3 1151.91       0
  634.58 1151.81       0  635.51 1151.81       0  636.06 1151.81       0
  651.47 1151.67       0   664.4 1151.54       0  664.85 1151.54       0
  665.72 1151.53       0  687.18 1151.33       0  695.26 1151.25       0
  695.55 1151.25       0  707.43 1151.08       0  724.57 1150.84       0
  725.73 1150.82       0  725.99 1150.82       0  726.26 1150.81       0
  740.89 1150.61       0  756.58 1150.38       0  783.59 1149.99       0
  784.79 1149.97       0  784.85 1149.97       0  785.02 1149.97       0
  806.67 1149.97       0

Downstream Bridge Cross Section Data
Station Elevation Data    num=     103
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1154.86    3.17 1154.86   18.25 1154.54   44.15 1154.46   49.44 1154.39
   64.01 1154.51   87.25  1155.1   91.06 1155.27     102 1154.72  104.46 1154.75
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  109.41  1154.7  154.76 1155.19  168.55 1155.15  194.17 1155.07  203.36 1154.97
  220.01 1154.87  223.63 1154.89  229.88 1154.77   231.9 1154.42  236.94 1154.49
  239.49 1154.49  240.01 1154.56  242.26 1154.75  245.96 1154.47  247.98 1154.43
  250.34 1154.39  256.13 1155.31  258.96 1155.72  259.91 1155.81  260.49 1155.82
  260.96 1155.83  278.37 1156.42  283.57  1156.5  288.28 1156.44  290.33 1156.52
  302.45 1156.68  303.03 1156.66   303.6 1156.64  304.26 1156.61  305.24 1156.53
  319.19 1154.98  321.05 1154.82  324.56 1154.52  331.77 1153.73  336.58 1153.11
  340.34 1152.99  345.08  1152.8  354.89 1152.31  362.26 1152.12  363.93    1152
  369.33 1151.83  374.56 1151.64  383.26 1151.22  389.67 1151.22   398.1 1151.33
  400.27 1151.37  401.99 1151.07  402.11 1151.06  405.15 1151.65  406.95 1151.83
  408.05 1151.76  410.57 1151.76  418.68 1151.97  426.48 1151.65  428.21 1151.59
  429.72 1151.54  430.73 1151.42  432.25 1151.33  432.32 1151.16  433.02 1150.95
  438.91 1148.18  443.07 1145.79  443.77 1145.39  444.41 1144.98  444.73 1144.99
  445.01 1144.99  454.53 1145.88  459.02 1145.79  461.79 1145.37     462    1143
     464    1143 467.375    1143 476.625    1143     480    1143     482    1143
  482.01    1145  484.87  1145.2  487.07 1145.56  490.18 1146.37  492.23 1146.82
  492.62 1147.02  494.12 1147.36  495.13 1147.52  503.18 1148.75  504.05  1149.1
  515.37 1151.64  515.46 1151.68  524.31 1152.03  524.95 1152.06  525.03 1152.07
   525.7 1152.06  530.97 1152.08   537.3 1152.08

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .085  461.79    .035  482.01    .085

Bank Sta: Left   Right    Coeff Contr.   Expan.
        461.79  482.01             .3       .5
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  453.01 1151.22       F
  498.14   537.3 1151.25       F

Upstream Embankment side slope             =     1.5 horiz. to 1.0 vertical
Downstream Embankment side slope           =     1.5 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins        =
Energy head used in spillway design        =
Spillway height used in design             =
Weir crest shape                           = Broad Crested

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Pressure and Weir flow
           Submerged Inlet Cd          =
           Submerged Inlet + Outlet Cd =      .8
           Max Low Cord                =
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Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT  Profile #Q2

  E.G. US. (ft)              1145.69    Element                Inside BR US  Inside BR DS
  W.S. US. (ft)              1145.44    E.G. Elev (ft)             1145.53      1144.75
  Q Total (cfs)               117.00    W.S. Elev (ft)             1145.06      1144.52
  Q Bridge (cfs)              117.00    Crit W.S. (ft)             1145.02      1144.02
  Q Weir (cfs)                          Max Chl Dpth (ft)             1.06         1.52
  Weir Sta Lft (ft)                     Vel Total (ft/s)              5.54         3.86
  Weir Sta Rgt (ft)                     Flow Area (sq ft)            21.12        30.32
  Weir Submerg                          Froude # Chl                  0.95         0.55
  Weir Max Depth (ft)                   Specif Force (cu ft)         31.28        37.01
  Min El Weir Flow (ft)      1152.12    Hydr Depth (ft)               1.06         1.52
  Min El Prs (ft)            1148.35    W.P. Total (ft)              20.00        20.00
  Delta EG (ft)                 1.16    Conv. Total (cfs)            929.9       1698.9
  Delta WS (ft)                 1.36    Top Width (ft)               20.00        20.00
  BR Open Area (sq ft)         87.00    Frctn Loss (ft)               0.66         0.15
  BR Open Vel (ft/s)            5.54    C & E Loss (ft)               0.12         0.07
  Coef of Q                             Shear Total (lb/sq ft)        1.04         0.45
  Br Sel Method          Energy only    Power Total (lb/ft s)         0.00         0.00


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT  Profile #Q5

  E.G. US. (ft)              1146.32    Element                Inside BR US  Inside BR DS
  W.S. US. (ft)              1145.93    E.G. Elev (ft)             1146.15      1145.40
  Q Total (cfs)               194.00    W.S. Elev (ft)             1145.52      1145.05
  Q Bridge (cfs)              194.00    Crit W.S. (ft)             1145.43      1144.44
  Q Weir (cfs)                          Max Chl Dpth (ft)             1.52         2.05
  Weir Sta Lft (ft)                     Vel Total (ft/s)              6.37         4.74
  Weir Sta Rgt (ft)                     Flow Area (sq ft)            30.46        40.96
  Weir Submerg                          Froude # Chl                  0.91         0.58
  Weir Max Depth (ft)                   Specif Force (cu ft)         61.57        70.48
  Min El Weir Flow (ft)      1152.12    Hydr Depth (ft)               1.52         2.05
  Min El Prs (ft)            1148.35    W.P. Total (ft)              20.00        20.00
  Delta EG (ft)                 1.07    Conv. Total (cfs)           1711.7       2804.9
```

Delta WS (ft)	1.13	Top Width (ft)	20.00	20.00
BR Open Area (sq ft)	87.00	Frctn Loss (ft)	0.62	0.12
BR Open Vel (ft/s)	6.37	C & E Loss (ft)	0.14	0.03
Coef of Q		Shear Total (lb/sq ft)	1.22	0.61
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #Q10

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	1146.78	E.G. Elev (ft)	1146.61	1145.83
W.S. US. (ft)	1146.29	W.S. Elev (ft)	1145.86	1145.37
Q Total (cfs)	259.00	Crit W.S. (ft)	1145.74	1144.74
Q Bridge (cfs)	259.00	Max Chl Dpth (ft)	1.86	2.37
Q Weir (cfs)		Vel Total (ft/s)	6.98	5.46
Weir Sta Lft (ft)		Flow Area (sq ft)	37.10	47.42
Weir Sta Rgt (ft)		Froude # Chl	0.90	0.63
Weir Submerg		Specif Force (cu ft)	90.56	100.15
Weir Max Depth (ft)		Hydr Depth (ft)	1.86	2.37
Min El Weir Flow (ft)	1152.12	W.P. Total (ft)	20.00	20.00
Min El Prs (ft)	1148.35	Conv. Total (cfs)	2378.4	3580.2
Delta EG (ft)	1.15	Top Width (ft)	20.00	20.00
Delta WS (ft)	1.33	Frctn Loss (ft)	0.63	0.14
BR Open Area (sq ft)	87.00	C & E Loss (ft)	0.15	0.06
BR Open Vel (ft/s)	6.98	Shear Total (lb/sq ft)	1.37	0.77
Coef of Q		Power Total (lb/ft s)	0.00	0.00
Br Sel Method	Energy only			

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #Q25

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	1147.36	E.G. Elev (ft)	1147.19	1146.45
W.S. US. (ft)	1146.75	W.S. Elev (ft)	1146.30	1145.89
Q Total (cfs)	348.00	Crit W.S. (ft)	1146.12	1145.12
Q Bridge (cfs)	348.00	Max Chl Dpth (ft)	2.30	2.89
Q Weir (cfs)		Vel Total (ft/s)	7.56	6.03
Weir Sta Lft (ft)		Flow Area (sq ft)	46.04	57.74
Weir Sta Rgt (ft)		Froude # Chl	0.88	0.63
Weir Submerg				

```
  Weir Max Depth (ft)                      Specif Force (cu ft)        134.68        148.49
  Min El Weir Flow (ft)       1152.12    Hydr Depth (ft)               2.30          2.89
  Min El Prs (ft)             1148.35    W.P. Total (ft)              20.00         20.00
  Delta EG (ft)                  1.20    Conv. Total (cfs)           3407.7        4970.4
  Delta WS (ft)                  1.64    Top Width (ft)              20.00         20.00
  BR Open Area (sq ft)          87.00    Frctn Loss (ft)              0.58          0.15
  BR Open Vel (ft/s)             7.56    C & E Loss (ft)              0.16          0.14
  Coef of Q                              Shear Total (lb/sq ft)       1.50          0.88
  Br Sel Method           Energy only    Power Total (lb/ft s)        0.00          0.00


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT  Profile #Q50

  E.G. US. (ft)               1147.82    Element                 Inside BR US  Inside BR DS
  W.S. US. (ft)               1147.19    E.G. Elev (ft)             1147.62       1146.88
  Q Total (cfs)                421.00    W.S. Elev (ft)             1146.62       1146.21
  Q Bridge (cfs)               421.00    Crit W.S. (ft)             1146.40       1145.40
  Q Weir (cfs)                           Max Chl Dpth (ft)             2.62          3.21
  Weir Sta Lft (ft)                      Vel Total (ft/s)              8.05          6.56
  Weir Sta Rgt (ft)                      Flow Area (sq ft)            52.33         64.19
  Weir Submerg                           Froude # Chl                  0.88          0.65
  Weir Max Depth (ft)                    Specif Force (cu ft)        173.65        188.76
  Min El Weir Flow (ft)       1152.12    Hydr Depth (ft)               2.62          3.21
  Min El Prs (ft)             1148.35    W.P. Total (ft)              20.00         20.00
  Delta EG (ft)                  1.24    Conv. Total (cfs)           4218.4        5929.4
  Delta WS (ft)                  1.78    Top Width (ft)              20.00         20.00
  BR Open Area (sq ft)          87.00    Frctn Loss (ft)              0.57          0.15
  BR Open Vel (ft/s)             8.05    C & E Loss (ft)              0.17          0.15
  Coef of Q                              Shear Total (lb/sq ft)       1.63          1.01
  Br Sel Method           Energy only    Power Total (lb/ft s)        0.00          0.00


Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT  Profile #Q100

  E.G. US. (ft)               1149.25    Element                 Inside BR US  Inside BR DS
  W.S. US. (ft)               1149.01    E.G. Elev (ft)             1149.25       1147.09
  Q Total (cfs)                510.00    W.S. Elev (ft)             1148.35       1145.79
  Q Bridge (cfs)               510.00    Crit W.S. (ft)             1146.73       1145.72
```

Q Weir (cfs)		Max Chl Dpth (ft)	4.35	2.78
Weir Sta Lft (ft)		Vel Total (ft/s)	5.86	9.16
Weir Sta Rgt (ft)		Flow Area (sq ft)	87.00	55.70
Weir Submerg		Froude # Chl	0.50	0.97
Weir Max Depth (ft)		Specif Force (cu ft)	282.07	222.58
Min El Weir Flow (ft)	1152.12	Hydr Depth (ft)		2.78
Min El Prs (ft)	1148.35	W.P. Total (ft)	48.70	20.00
Delta EG (ft)	2.21	Conv. Total (cfs)	5438.0	4680.7
Delta WS (ft)	3.22	Top Width (ft)		20.00
BR Open Area (sq ft)	87.00	Frctn Loss (ft)		
BR Open Vel (ft/s)	5.86	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)	0.98	2.06
Br Sel Method	Press Only	Power Total (lb/ft s)	0.00	0.00

Note: The downstream water surface is below the minimum elevation for pressure flow. The sluice gate equations were used for pressure flow.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #Q500

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	1150.66	E.G. Elev (ft)	1150.66	1148.17
W.S. US. (ft)	1150.41	W.S. Elev (ft)	1148.35	1146.57
Q Total (cfs)	727.00	Crit W.S. (ft)	1147.46	1146.46
Q Bridge (cfs)	727.00	Max Chl Dpth (ft)	4.35	3.56
Q Weir (cfs)		Vel Total (ft/s)	8.36	10.20
Weir Sta Lft (ft)		Flow Area (sq ft)	87.00	71.30
Weir Sta Rgt (ft)		Froude # Chl	0.71	0.95
Weir Submerg		Specif Force (cu ft)	377.89	357.30
Weir Max Depth (ft)		Hydr Depth (ft)		3.56
Min El Weir Flow (ft)	1152.12	W.P. Total (ft)	48.70	20.00
Min El Prs (ft)	1148.35	Conv. Total (cfs)	5438.0	7063.9
Delta EG (ft)	2.68	Top Width (ft)		20.00
Delta WS (ft)	3.85	Frctn Loss (ft)		
BR Open Area (sq ft)	87.00	C & E Loss (ft)		
BR Open Vel (ft/s)	8.36	Shear Total (lb/sq ft)	1.99	2.36
Coef of Q		Power Total (lb/ft s)	0.00	0.00
Br Sel Method	Press Only			

Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir flow. The momentum answer has been disregarded.
Note: The downstream water surface is below the minimum elevation for pressure flow. The sluice gate equations were used for pressure flow.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION

RIVER: Unnamed Brook
REACH: Brook RS: 1071

INPUT
Description:
Station Elevation Data num= 103

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	1154.86	3.17	1154.86	18.25	1154.54	44.15	1154.46	49.44	1154.39
64.01	1154.51	87.25	1155.1	91.06	1155.27	102	1154.72	104.46	1154.75
109.41	1154.7	154.76	1155.19	168.55	1155.15	194.17	1155.07	203.36	1154.97
220.01	1154.87	223.63	1154.89	229.88	1154.77	231.9	1154.42	236.94	1154.49
239.49	1154.49	240.01	1154.56	242.26	1154.75	245.96	1154.47	247.98	1154.43
250.34	1154.39	256.13	1155.31	258.96	1155.72	259.91	1155.81	260.49	1155.82
260.96	1155.83	278.37	1156.42	283.57	1156.5	288.28	1156.44	290.33	1156.52
302.45	1156.68	303.03	1156.66	303.6	1156.64	304.26	1156.61	305.24	1156.53
319.19	1154.98	321.05	1154.82	324.56	1154.52	331.77	1153.73	336.58	1153.11
340.34	1152.99	345.08	1152.8	354.89	1152.31	362.26	1152.12	363.93	1152
369.33	1151.83	374.56	1151.64	383.26	1151.22	389.67	1151.22	398.1	1151.33
400.27	1151.37	401.99	1151.07	402.11	1151.06	405.15	1151.65	406.95	1151.83
408.05	1151.76	410.57	1151.76	418.68	1151.97	426.48	1151.65	428.21	1151.59
429.72	1151.54	430.73	1151.42	432.25	1151.33	432.32	1151.16	433.02	1150.95
438.91	1148.18	443.07	1145.79	443.77	1145.39	444.41	1144.98	444.73	1144.99
445.01	1144.99	454.53	1145.88	459.02	1145.79	461.79	1145.37	462	1143
464	1143	467.375	1143	476.625	1143	480	1143	482	1143
482.01	1145	484.87	1145.2	487.07	1145.56	490.18	1146.37	492.23	1146.82
492.62	1147.02	494.12	1147.36	495.13	1147.52	503.18	1148.75	504.05	1149.1
515.37	1151.64	515.46	1151.68	524.31	1152.03	524.95	1152.06	525.03	1152.07
525.7	1152.06	530.97	1152.08	537.3	1152.08				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.085	461.79	.035	482.01	.085

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
461.79	482.01	70.2	70.2	70.2	.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
0	453.01	1151.22	F
498.14	537.3	1151.25	F

CROSS SECTION OUTPUT Profile #Q2

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1144.53	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.45	Wt. n-Val.		0.035	
W.S. Elev (ft)	1144.08	Reach Len. (ft)	70.20	70.20	70.20
Crit W.S. (ft)	1144.02	Flow Area (sq ft)		21.71	
E.G. Slope (ft/ft)	0.016573	Area (sq ft)		21.71	
Q Total (cfs)	117.00	Flow (cfs)		117.00	
Top Width (ft)	20.10	Top Width (ft)		20.10	

```
  Vel Total (ft/s)           5.39    Avg. Vel. (ft/s)                      5.39
  Max Chl Dpth (ft)          1.08    Hydr. Depth (ft)                      1.08
  Conv. Total (cfs)         908.8    Conv. (cfs)                          908.8
  Length Wtd. (ft)          70.20    Wetted Per. (ft)                     22.17
  Min Ch El (ft)          1143.00    Shear (lb/sq ft)                      1.01
  Alpha                      1.00    Stream Power (lb/ft s)    537.30      0.00       0.00
  Frctn Loss (ft)            0.50    Cum Volume (acre-ft)                  0.04
  C & E Loss (ft)            0.13    Cum SA (acres)                        0.03


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT  Profile #Q5

  E.G. Elev (ft)          1145.25    Element                   Left OB    Channel   Right OB
  Vel Head (ft)              0.45    Wt. n-Val.                           0.035
  W.S. Elev (ft)          1144.80    Reach Len. (ft)            70.20      70.20      70.20
  Crit W.S. (ft)          1144.44    Flow Area (sq ft)                    36.20
  E.G. Slope (ft/ft)     0.009017    Area (sq ft)                         36.20
  Q Total (cfs)            194.00    Flow (cfs)                          194.00
  Top Width (ft)            20.17    Top Width (ft)                       20.17
  Vel Total (ft/s)           5.36    Avg. Vel. (ft/s)                      5.36
  Max Chl Dpth (ft)          1.80    Hydr. Depth (ft)                      1.79
  Conv. Total (cfs)        2043.0    Conv. (cfs)                         2043.0
  Length Wtd. (ft)          70.20    Wetted Per. (ft)                     23.61
  Min Ch El (ft)          1143.00    Shear (lb/sq ft)                      0.86
  Alpha                      1.00    Stream Power (lb/ft s)    537.30      0.00       0.00
  Frctn Loss (ft)            0.40    Cum Volume (acre-ft)                  0.09
  C & E Loss (ft)            0.17    Cum SA (acres)                        0.08


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT  Profile #Q10

  E.G. Elev (ft)          1145.63    Element                   Left OB    Channel   Right OB
  Vel Head (ft)              0.67    Wt. n-Val.                           0.035
  W.S. Elev (ft)          1144.96    Reach Len. (ft)            70.20      70.20      70.20
  Crit W.S. (ft)          1144.74    Flow Area (sq ft)                    39.41
  E.G. Slope (ft/ft)     0.012319    Area (sq ft)                         39.41
  Q Total (cfs)            259.00    Flow (cfs)                          259.00
  Top Width (ft)            20.18    Top Width (ft)                       20.18
  Vel Total (ft/s)           6.57    Avg. Vel. (ft/s)                      6.57
  Max Chl Dpth (ft)          1.96    Hydr. Depth (ft)                      1.95
  Conv. Total (cfs)        2333.5    Conv. (cfs)                         2333.5
  Length Wtd. (ft)          70.20    Wetted Per. (ft)                     23.93
```

```
  Min Ch El (ft)          1143.00    Shear (lb/sq ft)                        1.27
  Alpha                      1.00    Stream Power (lb/ft s)    537.30       0.00        0.00
  Frctn Loss (ft)            0.45    Cum Volume (acre-ft)                   0.10
  C & E Loss (ft)            0.27    Cum SA (acres)                         0.08
```

Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q25

```
  E.G. Elev (ft)          1146.16    Element                   Left OB    Channel   Right OB
  Vel Head (ft)              1.04    Wt. n-Val.                            0.035      0.085
  W.S. Elev (ft)          1145.11    Reach Len. (ft)            70.20      70.20      70.20
  Crit W.S. (ft)          1145.11    Flow Area (sq ft)                     42.44       0.09
  E.G. Slope (ft/ft)     0.017561    Area (sq ft)                0.17      42.44       0.09
  Q Total (cfs)            348.00    Flow (cfs)                           347.97       0.03
  Top Width (ft)            23.90    Top Width (ft)              2.10      20.20       1.59
  Vel Total (ft/s)           8.18    Avg. Vel. (ft/s)                       8.20       0.34
  Max Chl Dpth (ft)          2.11    Hydr. Depth (ft)                       2.10       0.06
  Conv. Total (cfs)        2626.0    Conv. (cfs)                          2625.8        0.2
  Length Wtd. (ft)          70.20    Wetted Per. (ft)                      24.12       1.60
  Min Ch El (ft)          1143.00    Shear (lb/sq ft)                       1.93       0.06
  Alpha                      1.00    Stream Power (lb/ft s)    537.30       0.00       0.00
  Frctn Loss (ft)            0.51    Cum Volume (acre-ft)        0.00       0.12       0.00
  C & E Loss (ft)            0.44    Cum SA (acres)              0.00       0.08       0.00
```

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q50

```
  E.G. Elev (ft)          1146.57    Element                   Left OB    Channel   Right OB
  Vel Head (ft)              1.16    Wt. n-Val.                 0.001      0.035      0.085
  W.S. Elev (ft)          1145.41    Reach Len. (ft)            70.20      70.20      70.20
  Crit W.S. (ft)          1145.41    Flow Area (sq ft)           0.01      48.45       1.02
  E.G. Slope (ft/ft)     0.016692    Area (sq ft)                1.34      48.45       1.02
  Q Total (cfs)            421.00    Flow (cfs)                  0.00     420.10       0.90
  Top Width (ft)            30.37    Top Width (ft)              6.01      20.22       4.14
```

Vel Total (ft/s)	8.51	Avg. Vel. (ft/s)	0.16	8.67	0.88
Max Chl Dpth (ft)	2.41	Hydr. Depth (ft)	0.02	2.40	0.25
Conv. Total (cfs)	3258.6	Conv. (cfs)	0.0	3251.6	7.0
Length Wtd. (ft)	70.20	Wetted Per. (ft)	0.26	24.38	4.16
Min Ch El (ft)	1143.00	Shear (lb/sq ft)		2.07	0.25
Alpha	1.04	Stream Power (lb/ft s)	537.30	0.00	0.00
Frctn Loss (ft)	0.50	Cum Volume (acre-ft)	0.00	0.14	0.00
C & E Loss (ft)	0.49	Cum SA (acres)	0.00	0.08	0.00

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q100

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	1147.04	Wt. n-Val.	0.085	0.035	0.085
Vel Head (ft)	1.25	Reach Len. (ft)	70.20	70.20	70.20
W.S. Elev (ft)	1145.79	Flow Area (sq ft)	0.58	56.05	2.95
Crit W.S. (ft)	1145.79	Area (sq ft)	4.95	56.05	2.95
E.G. Slope (ft/ft)	0.014879	Flow (cfs)	0.42	505.66	3.92
Q Total (cfs)	510.00	Top Width (ft)	13.17	20.22	5.92
Top Width (ft)	39.31	Avg. Vel. (ft/s)	0.73	9.02	1.33
Vel Total (ft/s)	8.56	Hydr. Depth (ft)	0.18	2.77	0.50
Max Chl Dpth (ft)	2.78	Conv. (cfs)	3.5	4145.4	32.1
Conv. Total (cfs)	4181.0	Wetted Per. (ft)	3.27	24.38	5.99
Length Wtd. (ft)	70.20	Shear (lb/sq ft)	0.16	2.14	0.46
Min Ch El (ft)	1143.00	Stream Power (lb/ft s)	537.30	0.00	0.00
Alpha	1.10	Cum Volume (acre-ft)	0.00	0.16	0.00
Frctn Loss (ft)	0.48	Cum SA (acres)	0.01	0.09	0.00
C & E Loss (ft)	0.52				

Warning: The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning: Divided flow computed for this cross-section.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m). This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

```
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The program
         defaulted to critical depth.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT  Profile #Q500

  E.G. Elev (ft)           1147.98    Element                    Left OB    Channel   Right OB
  Vel Head (ft)               1.41    Wt. n-Val.                  0.085      0.035      0.085
  W.S. Elev (ft)           1146.57    Reach Len. (ft)             70.20      70.20      70.20
  Crit W.S. (ft)           1146.57    Flow Area (sq ft)            7.15      71.82       8.75
  E.G. Slope (ft/ft)      0.012421    Area (sq ft)                19.80      71.82       8.75
  Q Total (cfs)             727.00    Flow (cfs)                  12.13     698.41      16.46
  Top Width (ft)             49.35    Top Width (ft)              20.07      20.22       9.06
  Vel Total (ft/s)            8.29    Avg. Vel. (ft/s)             1.69       9.72       1.88
  Max Chl Dpth (ft)           3.56    Hydr. Depth (ft)             0.81       3.55       0.97
  Conv. Total (cfs)         6523.1    Conv. (cfs)                 108.8     6266.6      147.7
  Length Wtd. (ft)           70.20    Wetted Per. (ft)             8.82      24.38       9.22
  Min Ch El (ft)           1143.00    Shear (lb/sq ft)             0.63       2.28       0.74
  Alpha                       1.32    Stream Power (lb/ft s)     537.30       0.00       0.00
  Frctn Loss (ft)             0.45    Cum Volume (acre-ft)         0.02       0.20       0.01
  C & E Loss (ft)             0.57    Cum SA (acres)               0.02       0.09       0.01


Warning: The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
         for the water surface and continued on with the calculations.
Warning: The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
          This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate the
         need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
         water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The program
         defaulted to critical depth.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION


RIVER: Unnamed Brook
REACH: Brook              RS: 1001

INPUT
Description:
Station Elevation Data    num=      82
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0 1163.91   10.93 1163.91   11.76 1163.56   11.77 1163.91   11.85  1161.9
   14.37 1161.82   29.65 1160.54    35.4 1159.97    50.6 1158.18   61.31 1156.29
   69.65    1156   74.83 1155.43   76.38 1155.26   82.96 1154.96  101.08 1154.28
  105.39 1154.25  116.03 1153.28  123.68 1152.73  124.64 1152.44  126.28 1151.79
```

```
  126.76 1151.84  127.45 1151.84  128.47 1152.26  129.65 1152.48  130.52 1152.53
  134.62 1152.78  143.06 1152.91     145 1152.96  148.57 1152.81  156.24 1152.59
   158.5 1152.48  159.57 1152.41  160.33 1152.13  164.46 1150.81  168.86  1150.2
  177.51 1149.69  179.58 1149.59   185.1  1149.3  203.94 1148.09   211.2 1147.63
  212.65 1147.59  230.43 1146.51  234.63 1144.34  236.32 1143.38   237.7 1142.32
   237.8 1142.23  241.03 1141.85  241.83 1141.69  243.19 1141.82  243.55 1141.86
  244.98 1141.86  245.56 1141.84  247.41  1141.8   248.1 1141.85  251.38 1142.03
  255.45  1142.2  255.86 1142.76  256.65 1143.89  258.81 1143.99  261.79 1144.12
  270.03 1144.18  276.94 1144.09   284.7 1143.96  288.81 1143.97  309.35 1144.64
  326.88 1146.13  332.27 1146.54  337.83 1147.28  341.91  1147.8  343.95  1147.9
   346.9 1149.03  351.84 1150.42   353.2 1150.97  355.27 1151.62  360.39 1151.89
  362.12 1151.94   362.5 1151.96  362.82 1151.97  368.08    1152  372.71 1152.02
  374.54 1152.03  374.83 1152.03

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .085   74.83    .035  374.83    .085

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         74.83  374.83             .56     .56     .56             .1       .3
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  194.39 1151.22       F
  314.63  374.83 1151.25       F

CROSS SECTION OUTPUT  Profile #Q2

  E.G. Elev (ft)          1143.91    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.19    Wt. n-Val.                           0.035
  W.S. Elev (ft)          1143.72    Reach Len. (ft)
  Crit W.S. (ft)          1143.06    Flow Area (sq ft)                    33.49
  E.G. Slope (ft/ft)     0.003895    Area (sq ft)                         33.49
  Q Total (cfs)            117.00    Flow (cfs)                          117.00
  Top Width (ft)            20.80    Top Width (ft)                       20.80
  Vel Total (ft/s)           3.49    Avg. Vel. (ft/s)                      3.49
  Max Chl Dpth (ft)          2.03    Hydr. Depth (ft)                      1.61
  Conv. Total (cfs)        1874.7    Conv. (cfs)                         1874.7
  Length Wtd. (ft)                   Wetted Per. (ft)                     22.13
  Min Ch El (ft)          1141.69    Shear (lb/sq ft)                      0.37
  Alpha                      1.00    Stream Power (lb/ft s)   374.83       0.00       0.00
  Frctn Loss (ft)                    Cum Volume (acre-ft)
  C & E Loss (ft)                    Cum SA (acres)

Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q5

  E.G. Elev (ft)          1144.68    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.11    Wt. n-Val.                           0.035
```

```
  W.S. Elev (ft)          1144.57    Reach Len. (ft)
  Crit W.S. (ft)          1143.49    Flow Area (sq ft)                       73.77
  E.G. Slope (ft/ft)     0.003906    Area (sq ft)                            73.77
  Q Total (cfs)            194.00    Flow (cfs)                             194.00
  Top Width (ft)            73.11    Top Width (ft)                          73.11
  Vel Total (ft/s)           2.63    Avg. Vel. (ft/s)                         2.63
  Max Chl Dpth (ft)          2.88    Hydr. Depth (ft)                         1.01
  Conv. Total (cfs)        3104.0    Conv. (cfs)                            3104.0
  Length Wtd. (ft)                   Wetted Per. (ft)                        74.76
  Min Ch El (ft)          1141.69    Shear (lb/sq ft)                         0.24
  Alpha                      1.00    Stream Power (lb/ft s)    374.83         0.00        0.00
  Frctn Loss (ft)                    Cum Volume (acre-ft)
  C & E Loss (ft)                    Cum SA (acres)
```

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q10

```
  E.G. Elev (ft)          1144.91    Element                   Left OB    Channel   Right OB
  Vel Head (ft)              0.13    Wt. n-Val.                            0.035
  W.S. Elev (ft)          1144.78    Reach Len. (ft)
  Crit W.S. (ft)          1144.23    Flow Area (sq ft)                       89.70
  E.G. Slope (ft/ft)     0.003903    Area (sq ft)                            89.70
  Q Total (cfs)            259.00    Flow (cfs)                             259.00
  Top Width (ft)            77.27    Top Width (ft)                          77.27
  Vel Total (ft/s)           2.89    Avg. Vel. (ft/s)                         2.89
  Max Chl Dpth (ft)          3.09    Hydr. Depth (ft)                         1.16
  Conv. Total (cfs)        4145.6    Conv. (cfs)                            4145.6
  Length Wtd. (ft)                   Wetted Per. (ft)                        78.98
  Min Ch El (ft)          1141.69    Shear (lb/sq ft)                         0.28
  Alpha                      1.00    Stream Power (lb/ft s)    374.83         0.00        0.00
  Frctn Loss (ft)                    Cum Volume (acre-ft)
  C & E Loss (ft)                    Cum SA (acres)
```

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q25

```
  E.G. Elev (ft)          1145.19    Element                   Left OB    Channel   Right OB
  Vel Head (ft)              0.16    Wt. n-Val.                            0.035
  W.S. Elev (ft)          1145.03    Reach Len. (ft)
  Crit W.S. (ft)          1144.43    Flow Area (sq ft)                      108.94
  E.G. Slope (ft/ft)     0.003900    Area (sq ft)                           108.94
  Q Total (cfs)            348.00    Flow (cfs)                             348.00
  Top Width (ft)            80.61    Top Width (ft)                          80.61
  Vel Total (ft/s)           3.19    Avg. Vel. (ft/s)                         3.19
  Max Chl Dpth (ft)          3.34    Hydr. Depth (ft)                         1.35
  Conv. Total (cfs)        5572.2    Conv. (cfs)                            5572.2
```

```
  Length Wtd. (ft)                   Wetted Per. (ft)                     82.39
  Min Ch El (ft)          1141.69    Shear (lb/sq ft)                      0.32
  Alpha                      1.00    Stream Power (lb/ft s)    374.83      0.00       0.00
  Frctn Loss (ft)                    Cum Volume (acre-ft)
  C & E Loss (ft)                    Cum SA (acres)
```

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

```
  E.G. Elev (ft)          1145.38    Element                   Left OB    Channel   Right OB
  Vel Head (ft)              0.18    Wt. n-Val.                            0.035
  W.S. Elev (ft)          1145.20    Reach Len. (ft)
  Crit W.S. (ft)          1144.57    Flow Area (sq ft)                    122.76
  E.G. Slope (ft/ft)     0.003902    Area (sq ft)                         122.83
  Q Total (cfs)            421.00    Flow (cfs)                           421.00
  Top Width (ft)            82.93    Top Width (ft)                        82.93
  Vel Total (ft/s)           3.43    Avg. Vel. (ft/s)                       3.43
  Max Chl Dpth (ft)          3.51    Hydr. Depth (ft)                       1.50
  Conv. Total (cfs)        6739.4    Conv. (cfs)                          6739.4
  Length Wtd. (ft)                   Wetted Per. (ft)                      83.48
  Min Ch El (ft)          1141.69    Shear (lb/sq ft)                       0.36
  Alpha                      1.00    Stream Power (lb/ft s)    374.83       0.00       0.00
  Frctn Loss (ft)                    Cum Volume (acre-ft)
  C & E Loss (ft)                    Cum SA (acres)
```

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

```
  E.G. Elev (ft)          1145.60    Element                   Left OB    Channel   Right OB
  Vel Head (ft)              0.21    Wt. n-Val.                            0.035
  W.S. Elev (ft)          1145.38    Reach Len. (ft)
  Crit W.S. (ft)          1144.72    Flow Area (sq ft)                    137.98
  E.G. Slope (ft/ft)     0.003904    Area (sq ft)                         138.49
  Q Total (cfs)            510.00    Flow (cfs)                           510.00
  Top Width (ft)            85.48    Top Width (ft)                        85.48
  Vel Total (ft/s)           3.70    Avg. Vel. (ft/s)                       3.70
  Max Chl Dpth (ft)          3.69    Hydr. Depth (ft)                       1.68
  Conv. Total (cfs)        8162.8    Conv. (cfs)                          8162.8
  Length Wtd. (ft)                   Wetted Per. (ft)                      83.89
  Min Ch El (ft)          1141.69    Shear (lb/sq ft)                       0.40
  Alpha                      1.00    Stream Power (lb/ft s)    374.83       0.00       0.00
  Frctn Loss (ft)                    Cum Volume (acre-ft)
  C & E Loss (ft)                    Cum SA (acres)
```

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	1146.07	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.28	Wt. n-Val.		0.035	
W.S. Elev (ft)	1145.79	Reach Len. (ft)			
Crit W.S. (ft)	1145.05	Flow Area (sq ft)		171.43	
E.G. Slope (ft/ft)	0.003902	Area (sq ft)		174.32	
Q Total (cfs)	727.00	Flow (cfs)		727.00	
Top Width (ft)	91.04	Top Width (ft)		91.04	
Vel Total (ft/s)	4.24	Avg. Vel. (ft/s)		4.24	
Max Chl Dpth (ft)	4.10	Hydr. Depth (ft)		2.07	
Conv. Total (cfs)	11639.0	Conv. (cfs)		11639.0	
Length Wtd. (ft)		Wetted Per. (ft)		84.77	
Min Ch El (ft)	1141.69	Shear (lb/sq ft)		0.49	
Alpha	1.00	Stream Power (lb/ft s)	374.83	0.00	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

SUMMARY OF MANNING'S N VALUES

River:Unnamed Brook

Reach	River Sta.	n1	n2	n3
Brook	1758	.05	.035	.085
Brook	1506	.05	.035	.085
Brook	1238	.05	.035	.085
Brook	1182	.05	.035	.085
Brook	1165	Bridge		
Brook	1071	.085	.035	.085
Brook	1001	.085	.035	.085

SUMMARY OF REACH LENGTHS

River: Unnamed Brook

Reach	River Sta.	Left	Channel	Right
Brook	1758	252.24	252.24	252.24
Brook	1506	267.56	267.56	267.56
Brook	1238	55.99	55.99	55.99

Brook	1182	111.86	111.86	111.86
Brook	1165	Bridge		
Brook	1071	70.2	70.2	70.2
Brook	1001	.56	.56	.56

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Unnamed Brook

Reach	River Sta.	Contr.	Expan.
Brook	1758	.1	.3
Brook	1506	.1	.3
Brook	1238	.1	.3
Brook	1182	.3	.5
Brook	1165	Bridge	
Brook	1071	.3	.5
Brook	1001	.1	.3

ERRORS WARNINGS AND NOTES
Errors Warnings and Notes for Plan : 20-foot_NoBanks

River: Unnamed Brook Reach: Brook RS: 1758 Profile: Q2
Warning:The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
River: Unnamed Brook Reach: Brook RS: 1758 Profile: Q5
Warning:The energy equation could not be balanced within the specified number of iterations. The program used critical depth for the water surface and continued on with the calculations.
Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.
Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.
River: Unnamed Brook Reach: Brook RS: 1758 Profile: Q10
Warning:The energy equation could not be balanced within the specified number of iterations. The program used critical depth

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                for the water surface and continued on with the calculations.
        Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
                This may indicate the need for additional cross sections.
        Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
                the need for additional cross sections.
        Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
                water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
                program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q25
        Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
                for the water surface and continued on with the calculations.
        Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
                the need for additional cross sections.
        Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
                water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
                program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q50
        Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
                for the water surface and continued on with the calculations.
        Warning:Divided flow computed for this cross-section.
        Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
                the need for additional cross sections.
        Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
                water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
                program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q100
        Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
                for the water surface and continued on with the calculations.
        Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
                the need for additional cross sections.
        Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
                water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
                program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1758     Profile: Q500
        Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
                for the water surface and continued on with the calculations.
        Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
                the need for additional cross sections.
        Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
                water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
                program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q2
        Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
                This may indicate the need for additional cross sections.
        Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
                the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q5
        Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
        Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
                This may indicate the need for additional cross sections.
```

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     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q10
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q25
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q50
     Warning:Divided flow computed for this cross-section.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q100
     Warning:Divided flow computed for this cross-section.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
River: Unnamed Brook  Reach: Brook     RS: 1506     Profile: Q500
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q2
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q5
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
```

```
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q10
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q25
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q50
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q100
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1238     Profile: Q500
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q2
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
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River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q5
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q10
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q25
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q50
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q100
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1182     Profile: Q500
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q2 Upstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q2 Downstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q5 Upstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q5 Downstream
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q10 Upstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q10 Downstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q25 Upstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
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             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q25 Downstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q50 Upstream
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q50 Downstream
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q100
     Note:   The downstream water surface is below the minimum elevation for pressure flow.  The sluice gate equations were used
             for pressure flow.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q100 Upstream
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q100 Downstream
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q500
     Note:   Momentum answer is not valid if the water surface is above the low chord or if there is weir flow.  The momentum
             answer has been disregarded.
     Note:   The downstream water surface is below the minimum elevation for pressure flow.  The sluice gate equations were used
             for pressure flow.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q500 Upstream
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1165     Profile: Q500 Downstream
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q2
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q5
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q10
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
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River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q25
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q50
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q100
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:Divided flow computed for this cross-section.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1071     Profile: Q500
     Warning:The energy equation could not be balanced within the specified number of iterations.  The program used critical depth
             for the water surface and continued on with the calculations.
     Warning:The velocity head has changed by more than 0.5 ft (0.15 m).  This may indicate the need for additional cross sections.
     Warning:The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4.
             This may indicate the need for additional cross sections.
     Warning:The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section.  This may indicate
             the need for additional cross sections.
     Warning:During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated
             water surface came back below critical depth.  This indicates that there is not a valid subcritical answer.  The
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             program defaulted to critical depth.
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was
             used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q2
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q5
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q10
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q25
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q50
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q100
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
River: Unnamed Brook  Reach: Brook     RS: 1001     Profile: Q500
     Note:   Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.
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HEC-RAS Plan: 20-foot_NoBanks River: Unnamed Brook Reach: Brook

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Brook	1758	Q2	117.00	1151.39	1153.07	1153.07	1153.60	0.019079	5.87	19.94	19.13	1.01
Brook	1758	Q5	194.00	1151.39	1153.50	1153.50	1154.22	0.017318	6.79	28.60	21.36	1.01
Brook	1758	Q10	259.00	1151.39	1153.84	1153.84	1154.66	0.014992	7.25	37.45	30.49	0.97
Brook	1758	Q25	348.00	1151.39	1154.25	1154.25	1155.16	0.012945	7.74	51.93	41.21	0.93
Brook	1758	Q50	421.00	1151.39	1154.80	1154.80	1155.42	0.007112	6.70	99.14	116.78	0.72
Brook	1758	Q100	510.00	1151.39	1155.06	1155.06	1155.65	0.006549	6.82	131.20	136.17	0.70
Brook	1758	Q500	727.00	1151.39	1155.44	1155.44	1156.07	0.006697	7.49	188.82	161.53	0.72
Brook	1506	Q2	117.00	1147.76	1150.00	1149.44	1150.27	0.007919	4.12	28.38	23.49	0.66
Brook	1506	Q5	194.00	1147.76	1150.56	1150.11	1150.85	0.007453	4.34	45.17	40.19	0.66
Brook	1506	Q10	259.00	1147.76	1150.86	1150.43	1151.19	0.006669	4.65	62.82	65.31	0.64
Brook	1506	Q25	348.00	1147.76	1151.07	1150.79	1151.51	0.007785	5.42	76.62	66.01	0.70
Brook	1506	Q50	421.00	1147.76	1151.13	1150.99	1151.72	0.010082	6.30	80.73	68.14	0.81
Brook	1506	Q100	510.00	1147.76	1151.37	1151.23	1152.00	0.009466	6.60	98.26	79.42	0.80
Brook	1506	Q500	727.00	1147.76	1151.71	1151.71	1152.55	0.010733	7.76	127.63	90.72	0.87
Brook	1238	Q2	117.00	1144.81	1146.53	1146.53	1147.18	0.017733	6.48	18.06	13.78	1.00
Brook	1238	Q5	194.00	1144.81	1147.09	1147.09	1147.95	0.016531	7.43	26.11	15.09	1.00
Brook	1238	Q10	259.00	1144.81	1147.48	1147.48	1148.49	0.015953	8.07	32.15	16.57	1.00
Brook	1238	Q25	348.00	1144.81	1148.17	1148.17	1149.09	0.010159	7.83	50.49	36.82	0.84
Brook	1238	Q50	421.00	1144.81	1148.66	1148.66	1149.43	0.007296	7.41	75.59	65.68	0.73
Brook	1238	Q100	510.00	1144.81	1148.90	1148.90	1149.74	0.007513	7.89	89.55	76.92	0.75
Brook	1238	Q500	727.00	1144.81	1150.41	1149.40	1150.80	0.002673	5.99	180.29	224.86	0.47
Brook	1182	Q2	117.00	1144.00	1145.44	1145.02	1145.69	0.006694	4.05	28.86	20.11	0.60
Brook	1182	Q5	194.00	1144.00	1145.93	1145.44	1146.32	0.007293	5.01	38.74	20.15	0.64
Brook	1182	Q10	259.00	1144.00	1146.29	1145.74	1146.78	0.007600	5.62	46.06	20.18	0.66
Brook	1182	Q25	348.00	1144.00	1146.75	1146.11	1147.36	0.007704	6.28	56.41	27.63	0.67
Brook	1182	Q50	421.00	1144.00	1147.19	1146.40	1147.82	0.006747	6.42	71.24	39.83	0.64
Brook	1182	Q100	510.00	1144.00	1149.01	1146.81	1149.25	0.001631	4.23	142.28	91.30	0.33
Brook	1182	Q500	727.00	1144.00	1150.41	1147.68	1150.66	0.001233	4.34	198.46	206.47	0.30
Brook	1165		Bridge									
Brook	1071	Q2	117.00	1143.00	1144.08	1144.02	1144.53	0.016573	5.39	21.71	20.10	0.91
Brook	1071	Q5	194.00	1143.00	1144.80	1144.44	1145.25	0.009017	5.36	36.20	20.17	0.71
Brook	1071	Q10	259.00	1143.00	1144.96	1144.74	1145.63	0.012319	6.57	39.41	20.18	0.83
Brook	1071	Q25	348.00	1143.00	1145.11	1145.11	1146.16	0.017561	8.20	42.53	23.90	1.00
Brook	1071	Q50	421.00	1143.00	1145.41	1145.41	1146.57	0.016692	8.67	49.47	30.37	0.99
Brook	1071	Q100	510.00	1143.00	1145.79	1145.79	1147.04	0.014879	9.02	59.58	39.31	0.95
Brook	1071	Q500	727.00	1143.00	1146.57	1146.57	1147.98	0.012421	9.72	87.73	49.35	0.91
Brook	1001	Q2	117.00	1141.69	1143.72	1143.06	1143.91	0.003895	3.49	33.49	20.80	0.49
Brook	1001	Q5	194.00	1141.69	1144.57	1143.49	1144.68	0.003906	2.63	73.77	73.11	0.46
Brook	1001	Q10	259.00	1141.69	1144.78	1144.23	1144.91	0.003903	2.89	89.70	77.27	0.47
Brook	1001	Q25	348.00	1141.69	1145.03	1144.43	1145.19	0.003900	3.19	108.94	80.61	0.48
Brook	1001	Q50	421.00	1141.69	1145.20	1144.57	1145.38	0.003902	3.43	122.76	82.93	0.49
Brook	1001	Q100	510.00	1141.69	1145.38	1144.72	1145.60	0.003904	3.70	137.98	85.48	0.50
Brook	1001	Q500	727.00	1141.69	1145.79	1145.05	1146.07	0.003902	4.24	171.43	91.04	0.52

HEC-RAS Plan: 20-foot_NoBanks River: Unnamed Brook Reach: Brook

Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Vel Head	Frctn Loss	C & E Loss	Q Left	Q Channel	Q Right	Top Width
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)
Brook	1758	Q2	1153.60	1153.07	0.53	2.96	0.08		117.00		19.13
Brook	1758	Q5	1154.22	1153.50	0.72	2.74	0.13		194.00	0.00	21.36
Brook	1758	Q10	1154.66	1153.84	0.81	2.42	0.14	0.01	257.65	1.34	30.49
Brook	1758	Q25	1155.16	1154.25	0.91	2.49	0.14	0.24	339.31	8.44	41.21
Brook	1758	Q50	1155.42	1154.80	0.61	2.12	0.01	25.23	369.74	26.03	116.78
Brook	1758	Q100	1155.65	1155.06	0.59	1.97	0.00	58.78	411.75	39.48	136.17
Brook	1758	Q500	1156.07	1155.44	0.63	2.11	0.02	144.33	511.44	71.23	161.53
Brook	1506	Q2	1150.27	1150.00	0.26	3.05	0.04		117.00		23.49
Brook	1506	Q5	1150.85	1150.56	0.29	2.86	0.06		193.89	0.11	40.19
Brook	1506	Q10	1151.19	1150.86	0.33	2.63	0.07		254.31	4.69	65.31
Brook	1506	Q25	1151.51	1151.07	0.44	2.37	0.05		334.31	13.69	66.01
Brook	1506	Q50	1151.72	1151.13	0.59	2.28	0.02	0.01	401.84	19.15	68.14
Brook	1506	Q100	1152.00	1151.37	0.63	2.25	0.02	1.40	474.11	34.49	79.42
Brook	1506	Q500	1152.55	1151.71	0.84	1.27	0.13	12.85	646.20	67.95	90.72
Brook	1238	Q2	1147.18	1146.53	0.65	0.58	0.12		117.00		13.78
Brook	1238	Q5	1147.95	1147.09	0.86	0.59	0.14		194.00		15.09
Brook	1238	Q10	1148.49	1147.48	1.01	0.60	0.16	0.02	258.98	0.00	16.57
Brook	1238	Q25	1149.09	1148.17	0.92	0.49	0.09	10.53	337.19	0.28	36.82
Brook	1238	Q50	1149.43	1148.66	0.77	0.39	0.04	43.12	376.82	1.07	65.68
Brook	1238	Q100	1149.74	1148.90	0.83	0.17	0.18	76.02	431.86	2.12	76.92
Brook	1238	Q500	1150.80	1150.41	0.40	0.10	0.05	243.14	469.77	14.09	224.86
Brook	1182	Q2	1145.69	1145.44	0.26	0.10	0.07		117.00		20.11
Brook	1182	Q5	1146.32	1145.93	0.39	0.09	0.07		194.00		20.15
Brook	1182	Q10	1146.78	1146.29	0.49	0.09	0.08		259.00		20.18
Brook	1182	Q25	1147.36	1146.75	0.61	0.09	0.08	0.85	347.15		27.63
Brook	1182	Q50	1147.82	1147.19	0.63	0.08	0.11	9.03	411.97		39.83
Brook	1182	Q100	1149.25	1149.01	0.24			82.87	427.02	0.11	91.30
Brook	1182	Q500	1150.66	1150.41	0.25			164.36	561.85	0.80	206.47
Brook	1165		Bridge								
Brook	1071	Q2	1144.53	1144.08	0.45	0.50	0.13		117.00		20.10
Brook	1071	Q5	1145.25	1144.80	0.45	0.40	0.17		194.00		20.17
Brook	1071	Q10	1145.63	1144.96	0.67	0.45	0.27		259.00		20.18
Brook	1071	Q25	1146.16	1145.11	1.04	0.51	0.44		347.97	0.03	23.90
Brook	1071	Q50	1146.57	1145.41	1.16	0.50	0.49	0.00	420.10	0.90	30.37
Brook	1071	Q100	1147.04	1145.79	1.25	0.48	0.52	0.42	505.66	3.92	39.31
Brook	1071	Q500	1147.98	1146.57	1.41	0.45	0.57	12.13	698.41	16.46	49.35
Brook	1001	Q2	1143.91	1143.72	0.19				117.00		20.80
Brook	1001	Q5	1144.68	1144.57	0.11				194.00		73.11
Brook	1001	Q10	1144.91	1144.78	0.13				259.00		77.27
Brook	1001	Q25	1145.19	1145.03	0.16				348.00		80.61
Brook	1001	Q50	1145.38	1145.20	0.18				421.00		82.93
Brook	1001	Q100	1145.60	1145.38	0.21				510.00		85.48
Brook	1001	Q500	1146.07	1145.79	0.28				727.00		91.04

HEC-RAS Plan: 20-foot_NoBanks   River: Unnamed Brook   Reach: Brook

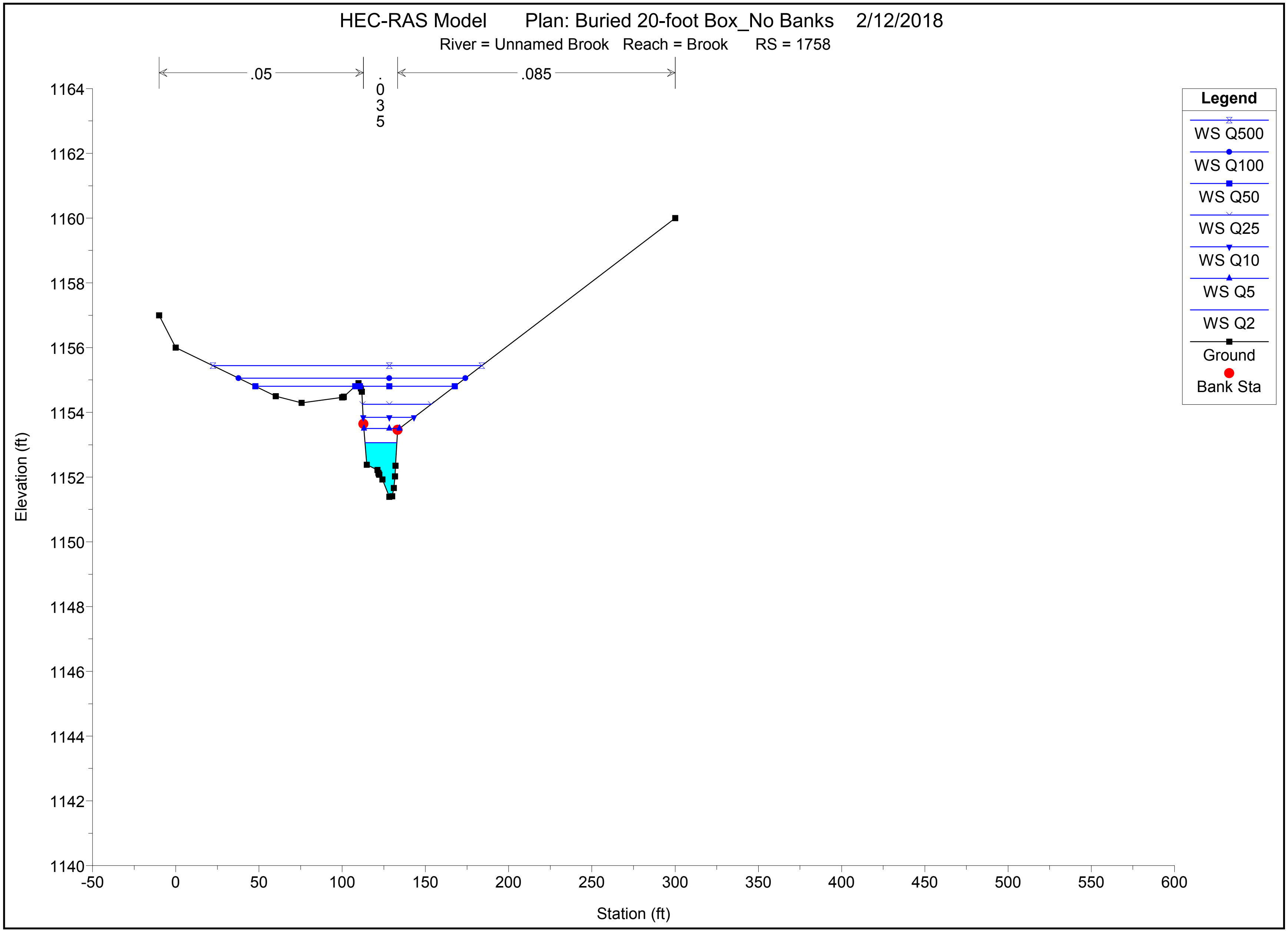
Reach	River Sta	Profile	E.G. Elev	W.S. Elev	Crit W.S.	Frctn Loss	C & E Loss	Top Width	Q Left	Q Channel	Q Right	Vel Chnl
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)
Brook	1238	Q2	1147.18	1146.53	1146.53	0.58	0.12	13.78		117.00		6.48
Brook	1238	Q5	1147.95	1147.09	1147.09	0.59	0.14	15.09		194.00		7.43
Brook	1238	Q10	1148.49	1147.48	1147.48	0.60	0.16	16.57	0.02	258.98	0.00	8.07
Brook	1238	Q25	1149.09	1148.17	1148.17	0.49	0.09	36.82	10.53	337.19	0.28	7.83
Brook	1238	Q50	1149.43	1148.66	1148.66	0.39	0.04	65.68	43.12	376.82	1.07	7.41
Brook	1238	Q100	1149.74	1148.90	1148.90	0.17	0.18	76.92	76.02	431.86	2.12	7.89
Brook	1238	Q500	1150.80	1150.41	1149.40	0.10	0.05	224.86	243.14	469.77	14.09	5.99
Brook	1182	Q2	1145.69	1145.44	1145.02	0.10	0.07	20.11		117.00		4.05
Brook	1182	Q5	1146.32	1145.93	1145.44	0.09	0.07	20.15		194.00		5.01
Brook	1182	Q10	1146.78	1146.29	1145.74	0.09	0.08	20.18		259.00		5.62
Brook	1182	Q25	1147.36	1146.75	1146.11	0.09	0.08	27.63	0.85	347.15		6.28
Brook	1182	Q50	1147.82	1147.19	1146.40	0.08	0.11	39.83	9.03	411.97		6.42
Brook	1182	Q100	1149.25	1149.01	1146.81			91.30	82.87	427.02	0.11	4.23
Brook	1182	Q500	1150.66	1150.41	1147.68			206.47	164.36	561.85	0.80	4.34
Brook	1165 BR U	Q2	1145.53	1145.06	1145.02	0.66	0.12	20.00		117.00		5.54
Brook	1165 BR U	Q5	1146.15	1145.52	1145.43	0.62	0.14	20.00		194.00		6.37
Brook	1165 BR U	Q10	1146.61	1145.86	1145.74	0.63	0.15	20.00		259.00		6.98
Brook	1165 BR U	Q25	1147.19	1146.30	1146.12	0.58	0.16	20.00		348.00		7.56
Brook	1165 BR U	Q50	1147.62	1146.62	1146.40	0.57	0.17	20.00		421.00		8.05
Brook	1165 BR U	Q100	1149.25	1148.35	1146.73					510.00		5.86
Brook	1165 BR U	Q500	1150.66	1148.35	1147.46					727.00		8.36
Brook	1165 BR D	Q2	1144.75	1144.52	1144.02	0.15	0.07	20.00		117.00		3.86
Brook	1165 BR D	Q5	1145.40	1145.05	1144.44	0.12	0.03	20.00		194.00		4.74
Brook	1165 BR D	Q10	1145.83	1145.37	1144.74	0.14	0.06	20.00		259.00		5.46
Brook	1165 BR D	Q25	1146.45	1145.89	1145.12	0.15	0.14	20.00		348.00		6.03
Brook	1165 BR D	Q50	1146.88	1146.21	1145.40	0.15	0.15	20.00		421.00		6.56
Brook	1165 BR D	Q100	1147.09	1145.79	1145.72			20.00		510.00		9.16
Brook	1165 BR D	Q500	1148.17	1146.57	1146.46			20.00		727.00		10.20
Brook	1071	Q2	1144.53	1144.08	1144.02	0.50	0.13	20.10		117.00		5.39
Brook	1071	Q5	1145.25	1144.80	1144.44	0.40	0.17	20.17		194.00		5.36
Brook	1071	Q10	1145.63	1144.96	1144.74	0.45	0.27	20.18		259.00		6.57
Brook	1071	Q25	1146.16	1145.11	1145.11	0.51	0.44	23.90		347.97	0.03	8.20
Brook	1071	Q50	1146.57	1145.41	1145.41	0.50	0.49	30.37	0.00	420.10	0.90	8.67
Brook	1071	Q100	1147.04	1145.79	1145.79	0.48	0.52	39.31	0.42	505.66	3.92	9.02
Brook	1071	Q500	1147.98	1146.57	1146.57	0.45	0.57	49.35	12.13	698.41	16.46	9.72
Brook	1001	Q2	1143.91	1143.72	1143.06			20.80		117.00		3.49
Brook	1001	Q5	1144.68	1144.57	1143.49			73.11		194.00		2.63
Brook	1001	Q10	1144.91	1144.78	1144.23			77.27		259.00		2.89
Brook	1001	Q25	1145.19	1145.03	1144.43			80.61		348.00		3.19
Brook	1001	Q50	1145.38	1145.20	1144.57			82.93		421.00		3.43
Brook	1001	Q100	1145.60	1145.38	1144.72			85.48		510.00		3.70
Brook	1001	Q500	1146.07	1145.79	1145.05			91.04		727.00		4.24

HEC-RAS Plan: 20-foot_NoBanks   River: Unnamed Brook   Reach: Brook

Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG
			(ft)	(ft)	(sq ft)	(ft)	(cfs)	(ft)	(cfs)	(ft)
Brook	1165	Q2	1145.69	1148.35	87.00		117.00	1152.12		1.16
Brook	1165	Q5	1146.32	1148.35	87.00		194.00	1152.12		1.07
Brook	1165	Q10	1146.78	1148.35	87.00		259.00	1152.12		1.15
Brook	1165	Q25	1147.36	1148.35	87.00		348.00	1152.12		1.20
Brook	1165	Q50	1147.82	1148.35	87.00		421.00	1152.12		1.24
Brook	1165	Q100	1149.25	1148.35	87.00	1149.01	510.00	1152.12		2.21
Brook	1165	Q500	1150.66	1148.35	87.00	1150.41	727.00	1152.12		2.68

HEC-RAS Plan: 20-foot_NoBanks River: Unnamed Brook Reach: Brook

Reach	River Sta	Profile	E.G. US.	W.S. US.	Br Sel Method	Energy EG	Momen. EG	Yarnell EG	WSPRO EG	Prs O EG	Prs/Wr EG	Energy/Wr EG
			(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Brook	1165	Q2	1145.69	1145.44	Energy only	1145.69	1146.02					
Brook	1165	Q5	1146.32	1145.93	Energy only	1146.32	1146.70					
Brook	1165	Q10	1146.78	1146.29	Energy only	1146.78	1147.16					
Brook	1165	Q25	1147.36	1146.75	Energy only	1147.36	1147.73					
Brook	1165	Q50	1147.82	1147.19	Energy only	1147.82	1148.16					
Brook	1165	Q100	1149.25	1149.01	Press Only	1148.37	1148.63			1149.25		
Brook	1165	Q500	1150.66	1150.41	Press Only	1149.60				1150.66		


HEC-RAS Model Plan: Buried 20-foot Box_No Banks 2/12/2018
River = Unnamed Brook Reach = Brook RS = 1758
.05
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Bank Sta
Elevation (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
0
50
100
150
200
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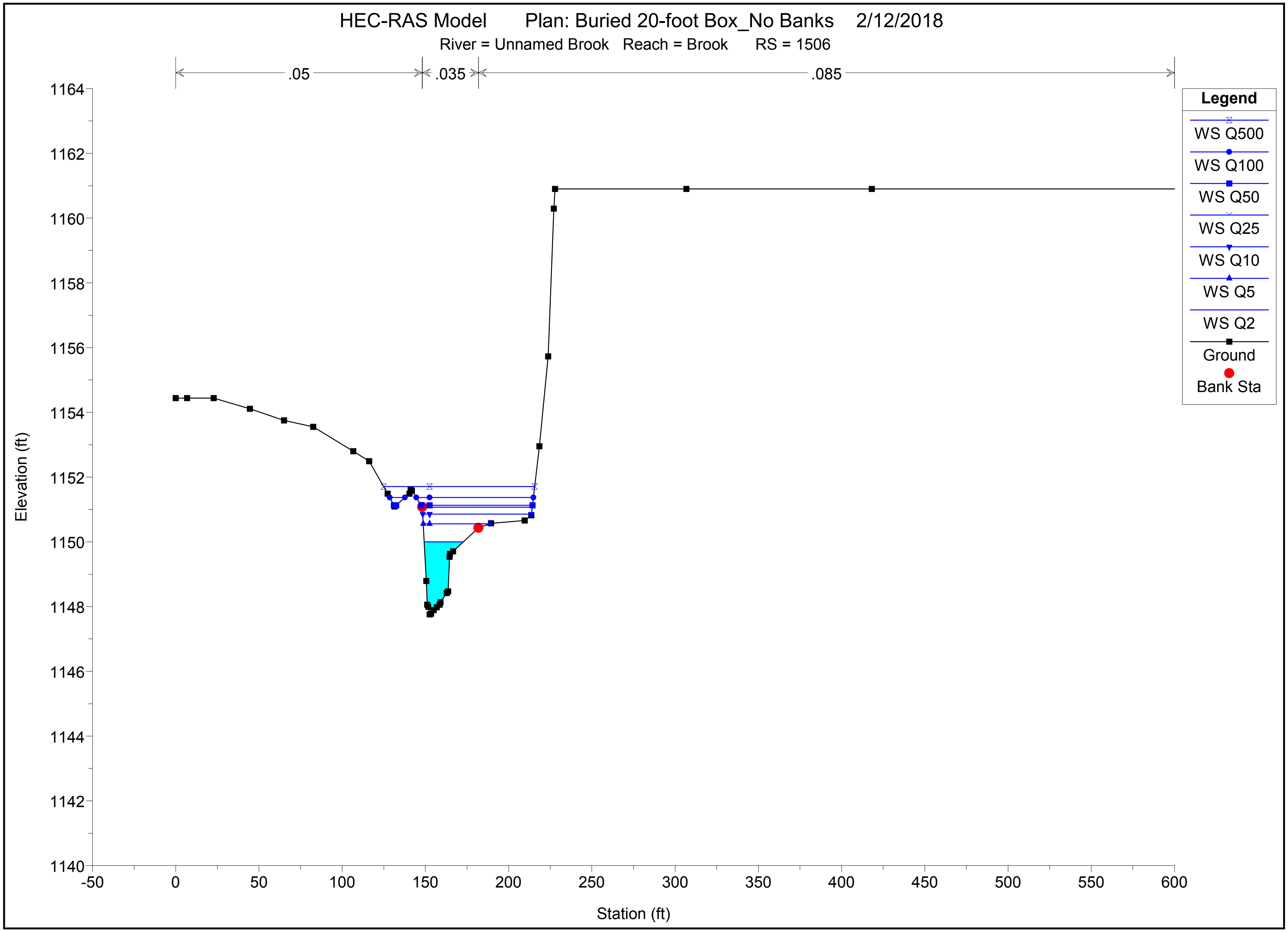
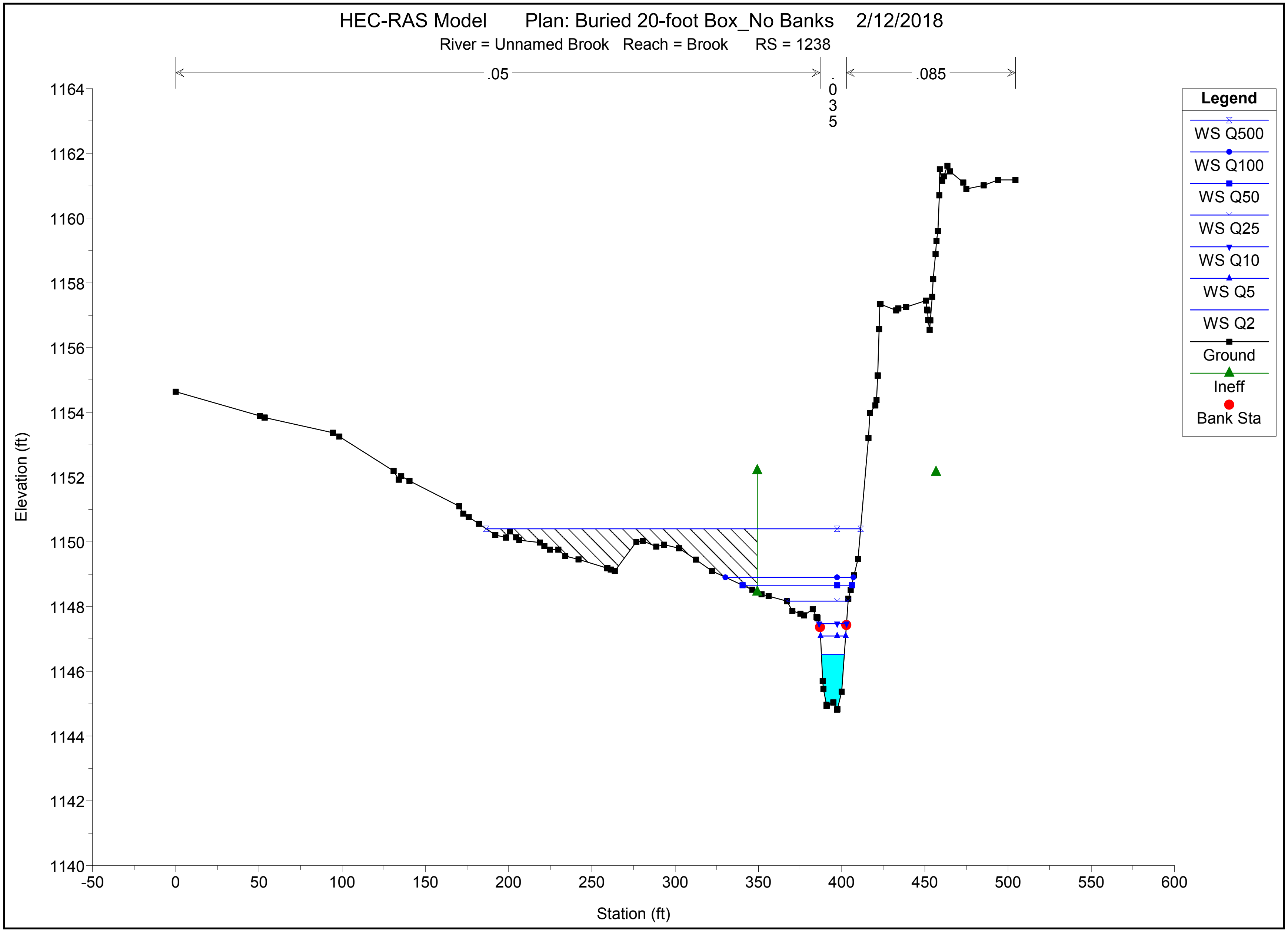
350
400
450
500
550
600
Station (ft)



HEC-RAS Model Plan: Buried 20-foot Box_No Banks 2/12/2018
River = Unnamed Brook Reach = Brook RS = 1506
.05
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Bank Sta
Elevation (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
Station (ft)


HEC-RAS Model Plan: Buried 20-foot Box_No Banks 2/12/2018
River = Unnamed Brook Reach = Brook RS = 1238
.05
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
0
50
100
150
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250
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350
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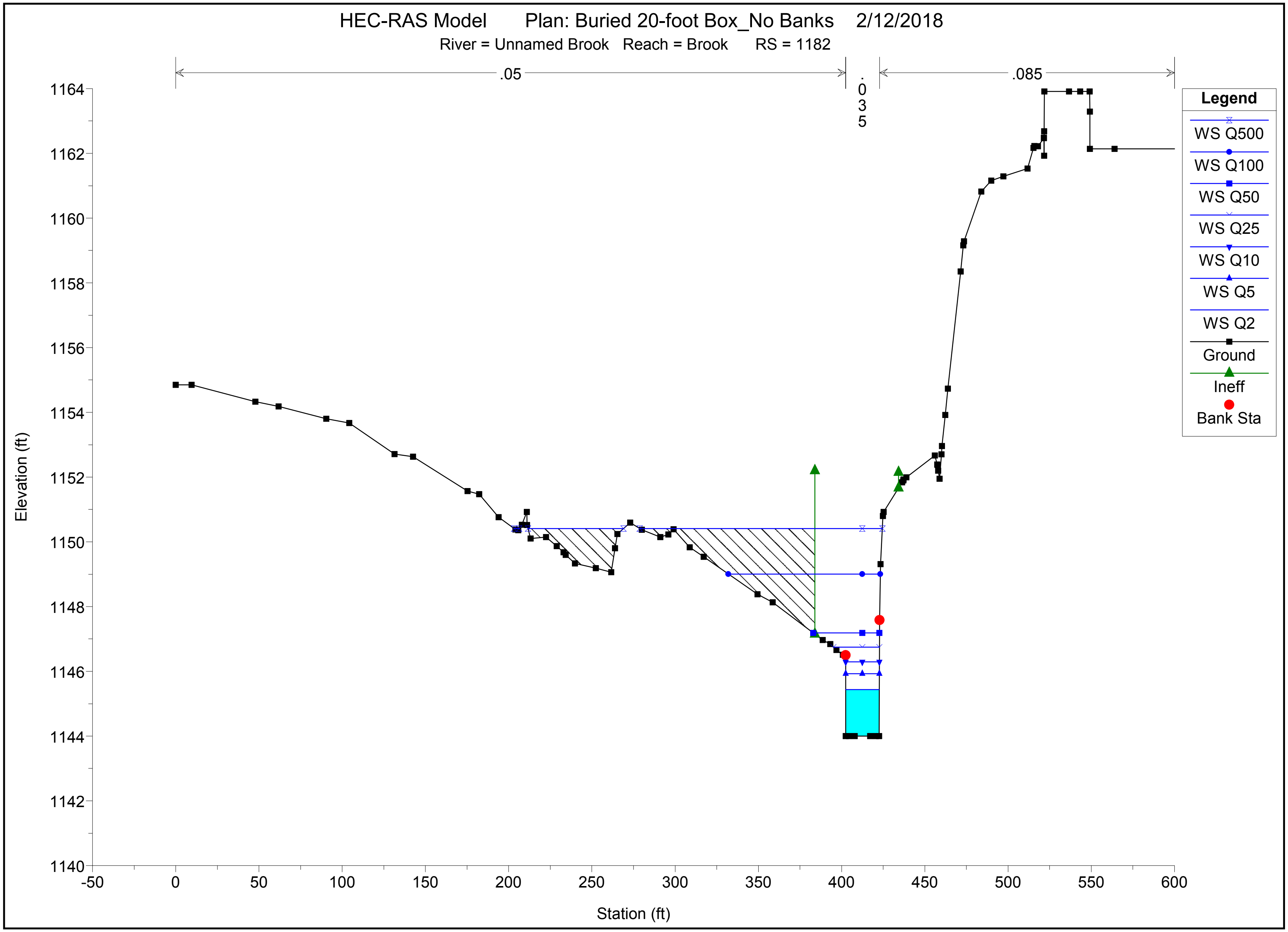
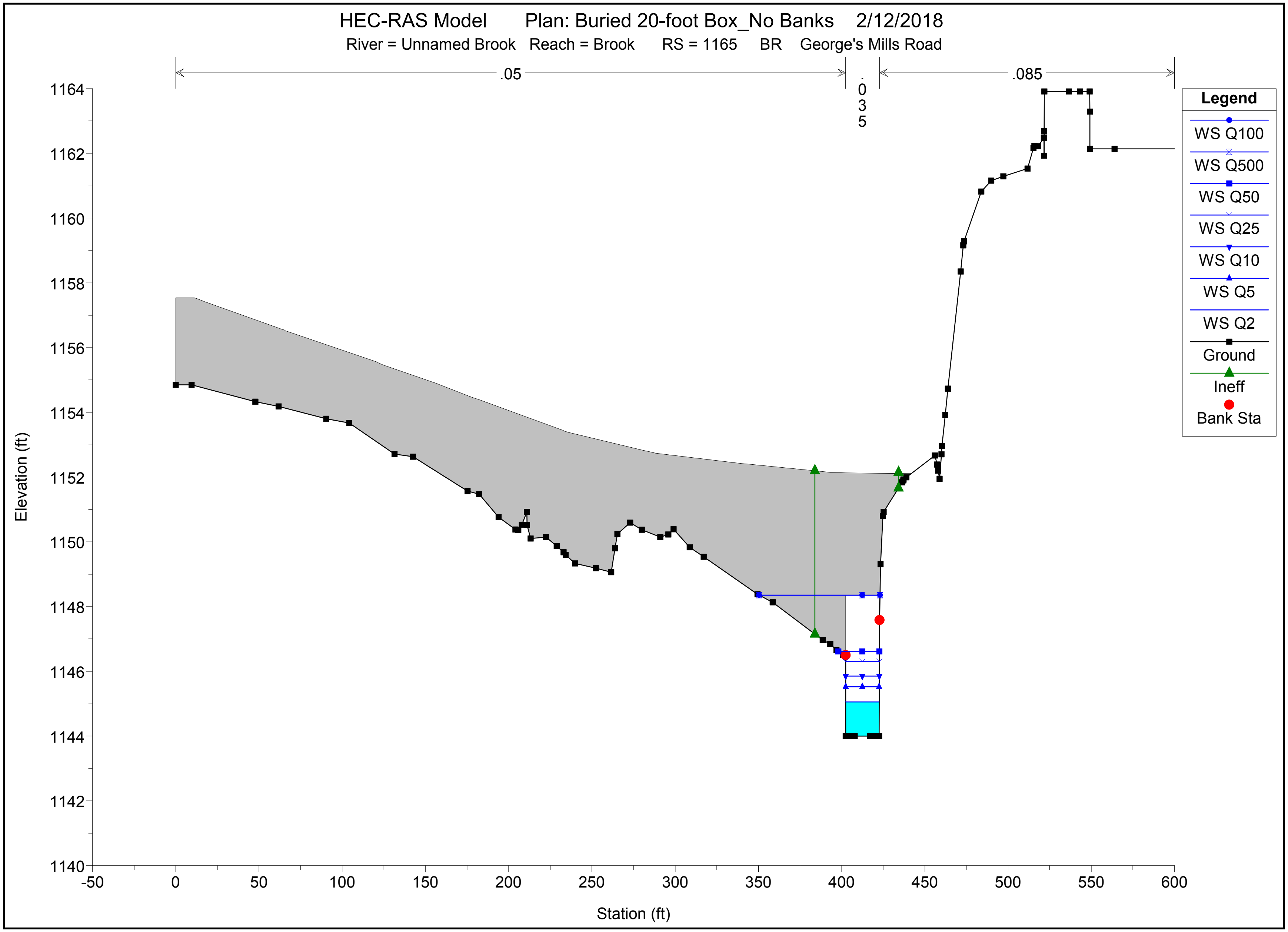
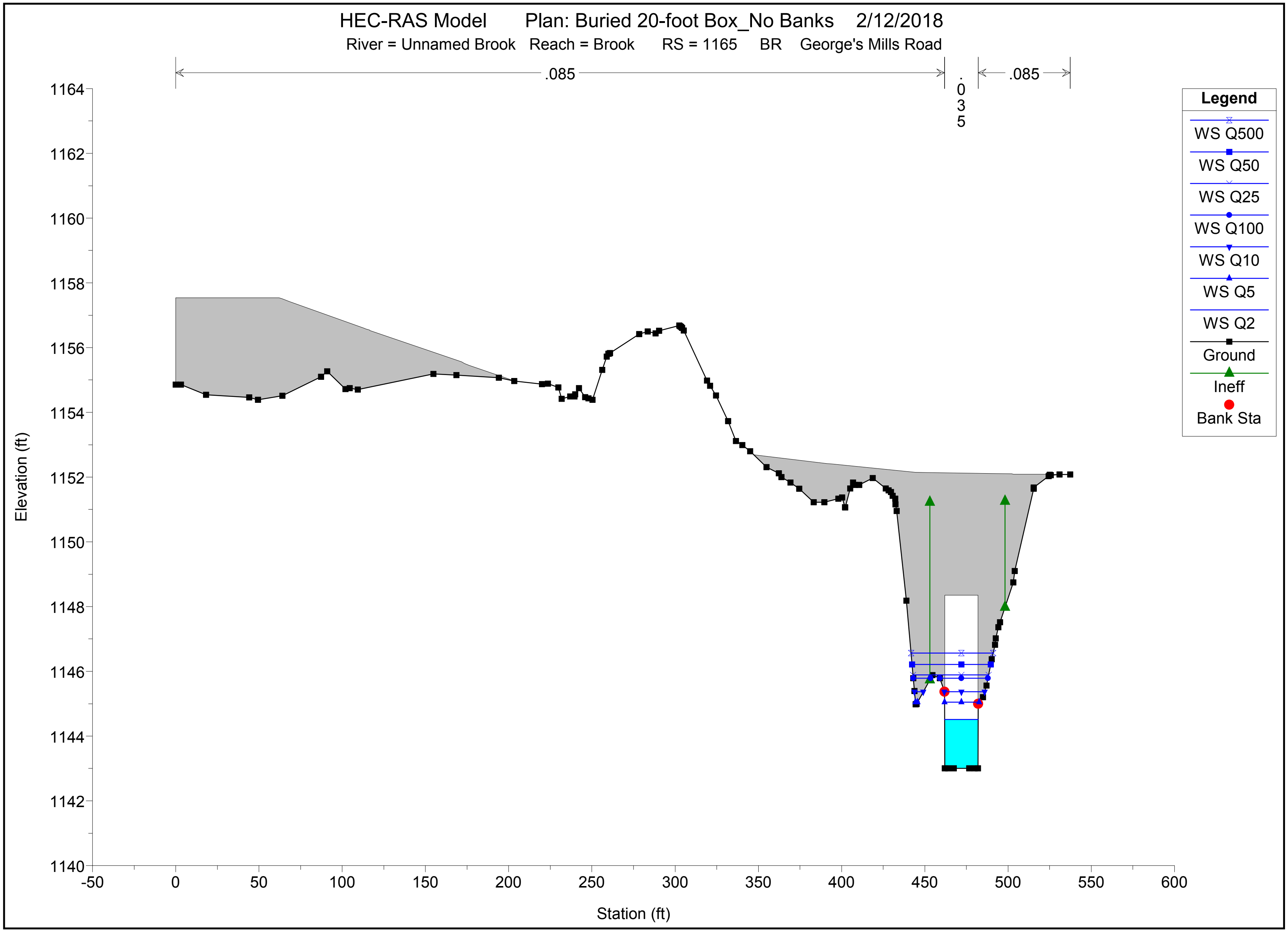
600



HEC-RAS Model Plan: Buried 20-foot Box_No Banks 2/12/2018
River = Unnamed Brook Reach = Brook RS = 1182
.05
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
1140
1142
1144
1146
1148
1150
1152
1154
1156
1158
1160
1162
1164
Station (ft)
-50
0
50
100
150
200
250
300
350
400
450
500
550
600



HEC-RAS Model Plan: Buried 20-foot Box_No Banks 2/12/2018
River = Unnamed Brook Reach = Brook RS = 1165 BR George's Mills Road
.05
.035
.085
Elevation (ft)
Station (ft)
Legend
WS Q100
WS Q500
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta



HEC-RAS Model Plan: Buried 20-foot Box_No Banks 2/12/2018
River = Unnamed Brook Reach = Brook RS = 1165 BR George's Mills Road
.085
.035
.085
Legend
WS Q500
WS Q50
WS Q25
WS Q100
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
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-50
0
50
100
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200
250
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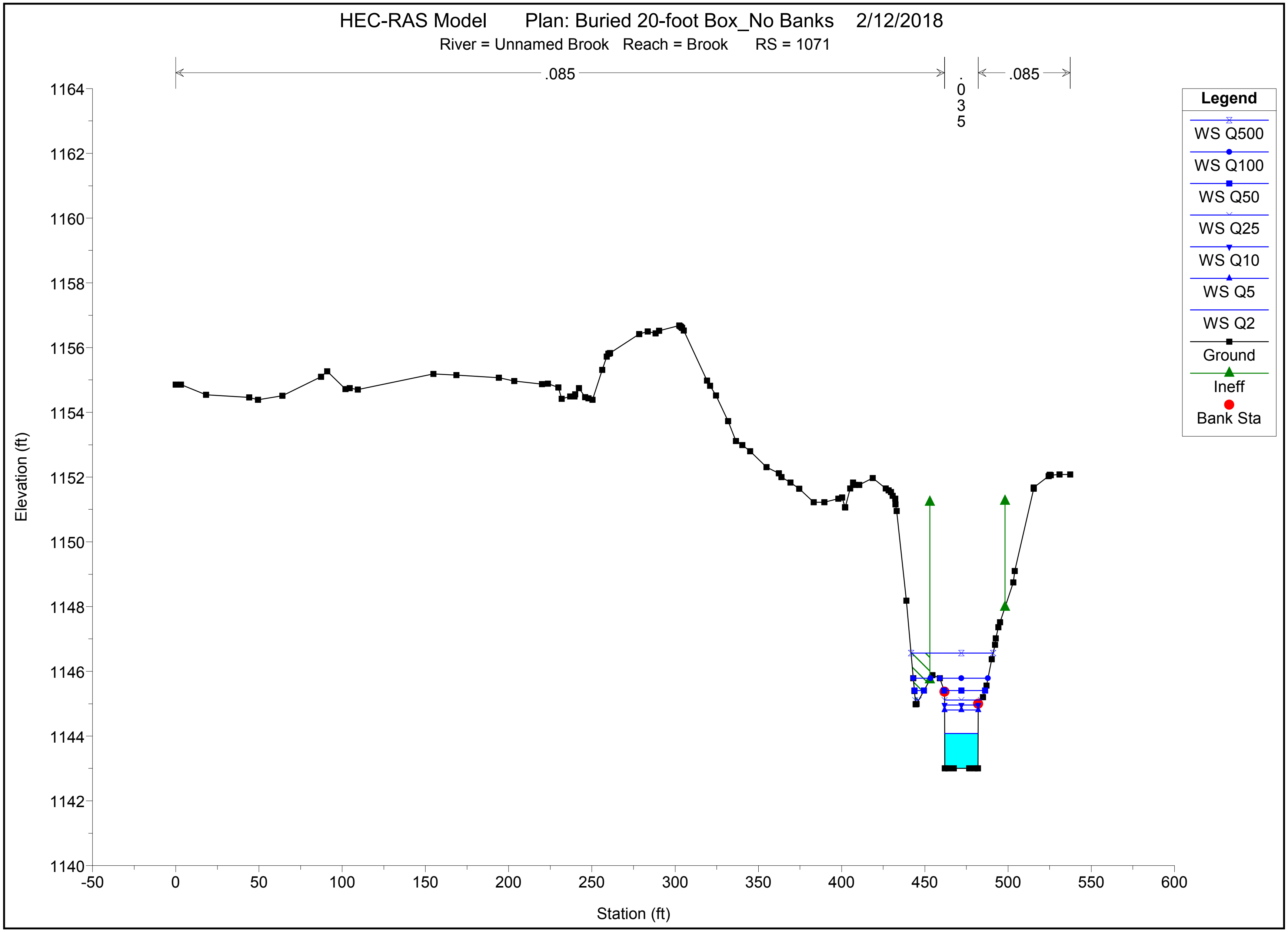
350
400
450
500
550
600
Station (ft)



HEC-RAS Model Plan: Buried 20-foot Box_No Banks 2/12/2018
River = Unnamed Brook Reach = Brook RS = 1071
.085
.035
.085
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
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50
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150
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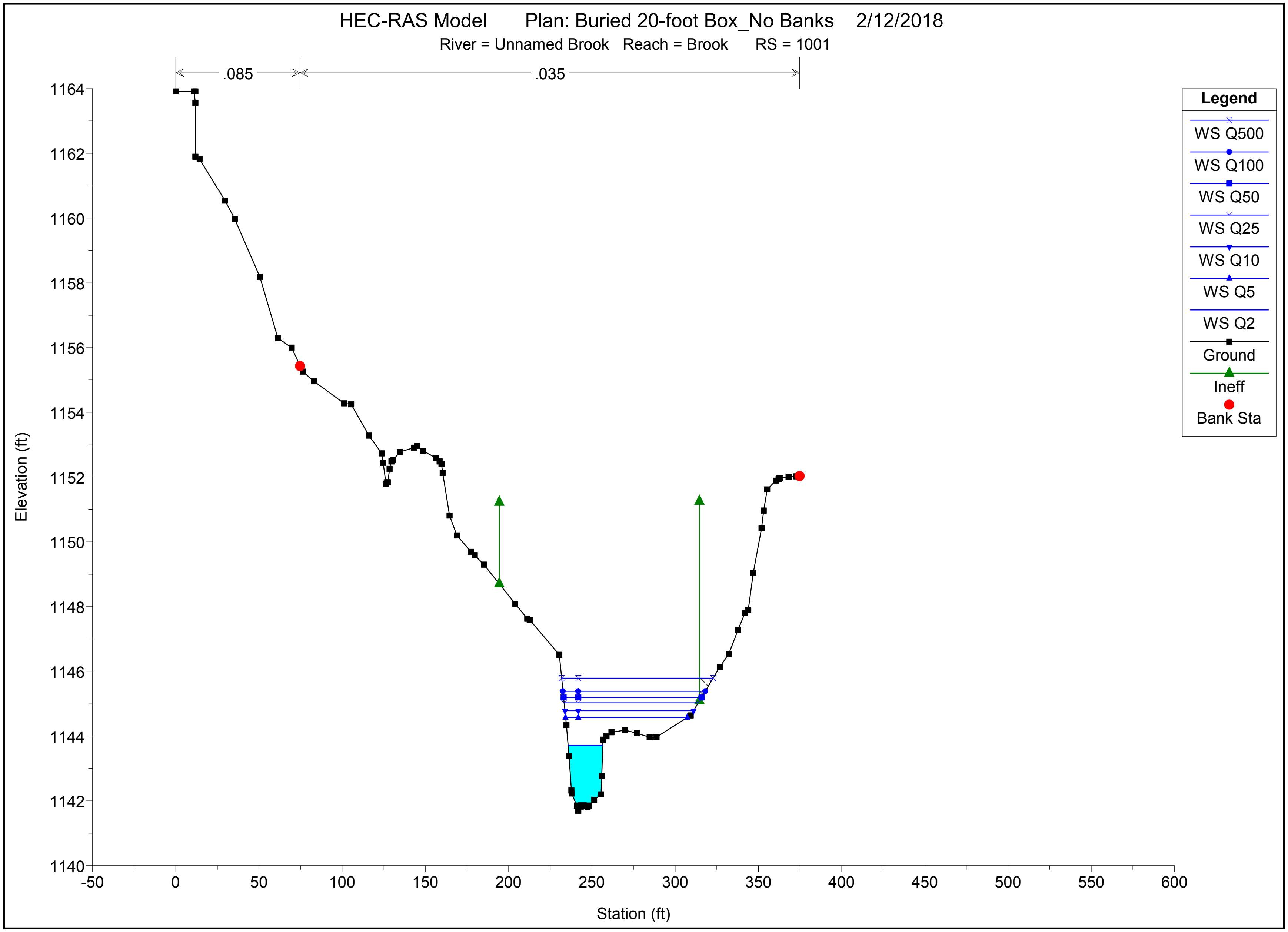
250
300
350
400
450
500
550
600


HEC-RAS Model Plan: Buried 20-foot Box_No Banks 2/12/2018
River = Unnamed Brook Reach = Brook RS = 1001
.085
.035
Elevation (ft)
Station (ft)
1164
1162
1160
1158
1156
1154
1152
1150
1148
1146
1144
1142
1140
-50
0
50
100
150
200
250
300
350
400
450
500
550
600
Legend
WS Q500
WS Q100
WS Q50
WS Q25
WS Q10
WS Q5
WS Q2
Ground
Ineff
Bank Sta

MODEL DEVELOPMENT BACKUP

CONSULTING ENGINEERS
Commercial Street, Manchester, NH 03101
(603) 668-8223 • Fax. (603) 668-8802
cld@cldengineers.com • www.cldengineers.com
New Hampshire • Vermont • Maine

JOB Springfield, NH JOB NO. 16-0361
SHEET NO. OF
CALCULATED BY AEG DATE 8/17
CHECKED BY ETC DATE 8/17
SUBJECT Stream slopes SCALE

using USGS maps to get the slopes over a larger distance

Upstream

USGS (metric) → survey

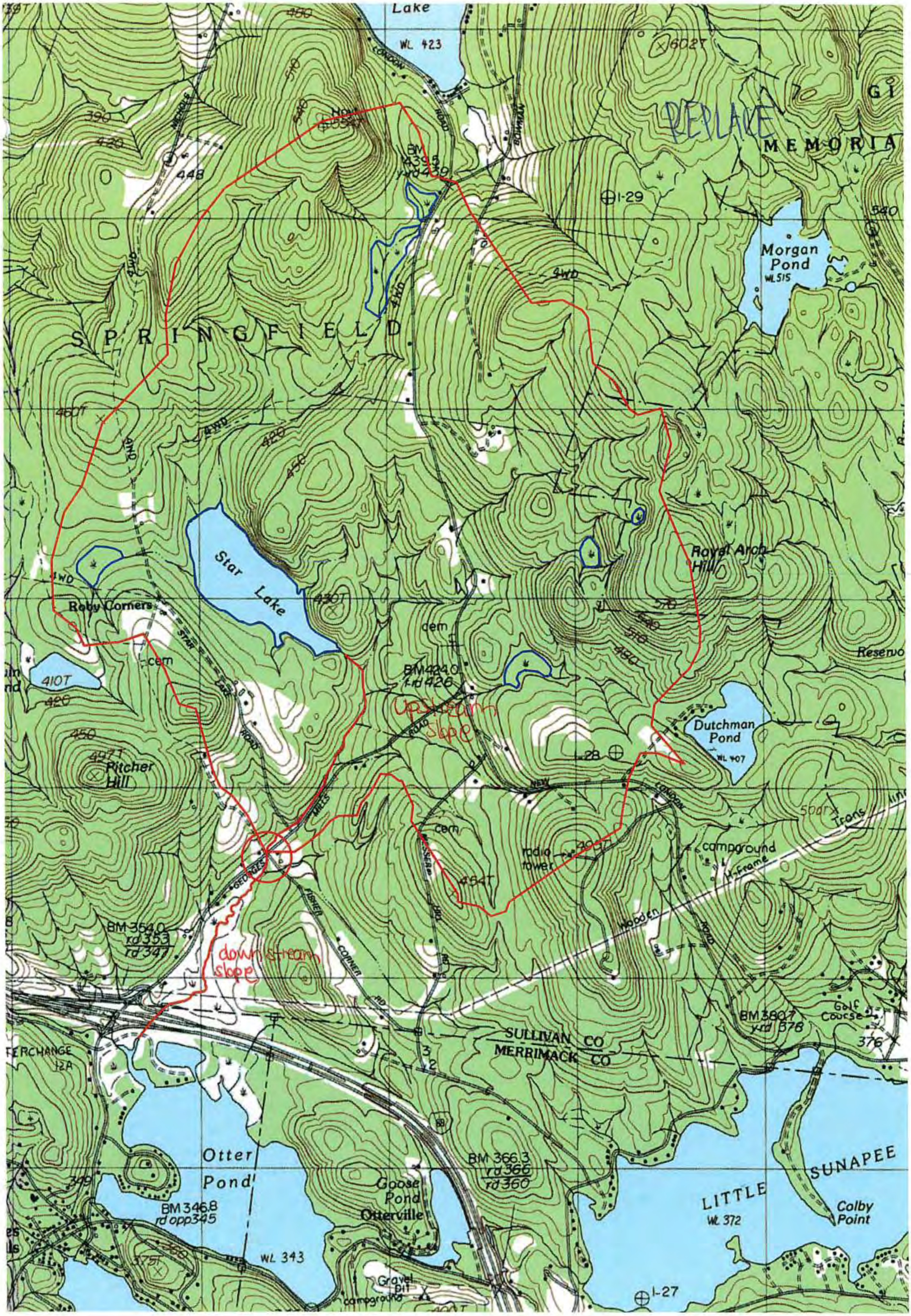
$$S = \frac{390/0.3048 - 1144.08'}{4205'} = \frac{135.45'}{4205'} = 0.0322$$

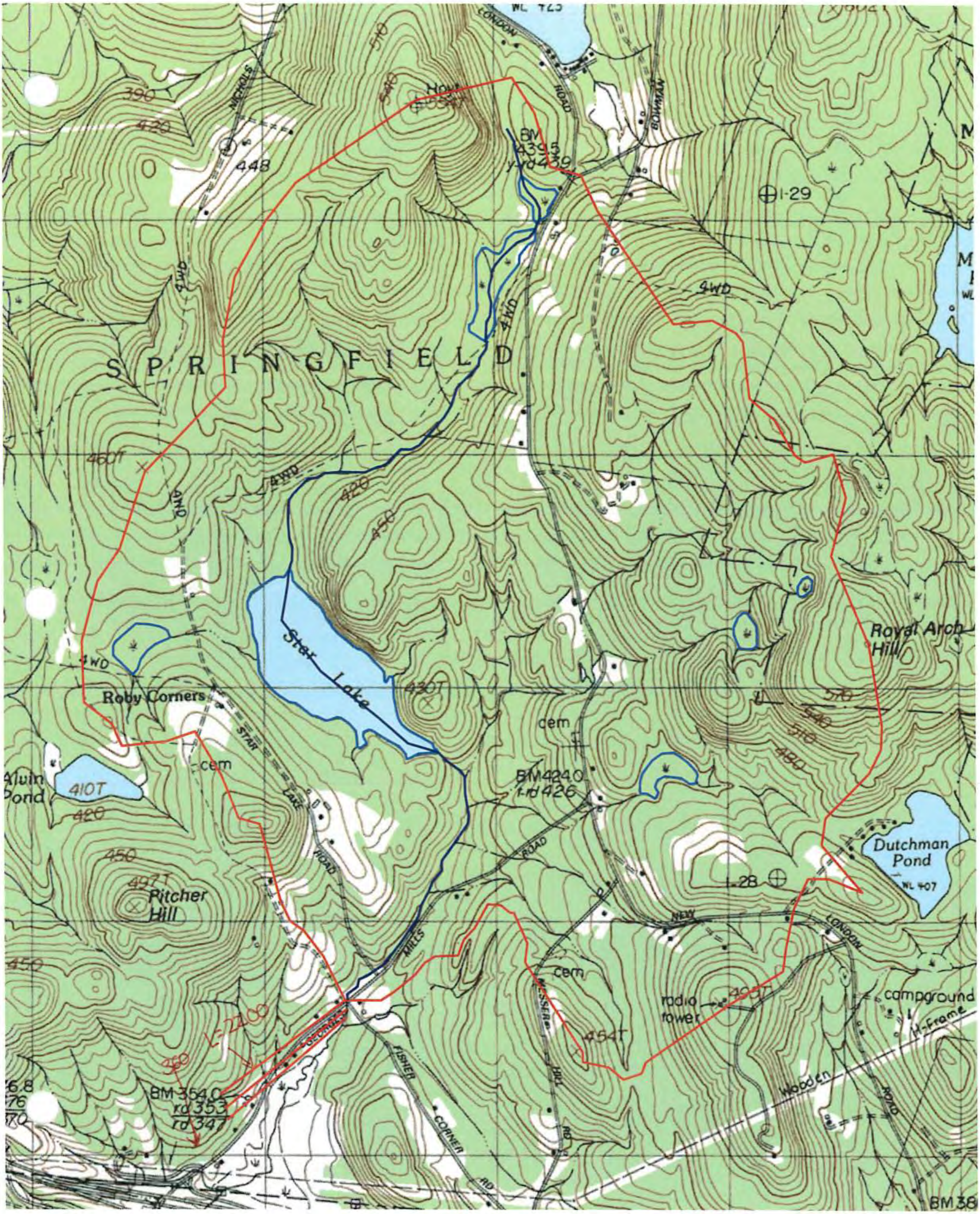
Downstream

survey → WL USGS (metric) (other pond)

$$S = \frac{1143.13 - 343/0.3048}{4533} = \frac{17.80'}{4533} = 0.0039$$

see microstation in Struct\calcs\Hydraulics\Hydrology.dgn


Lake
WL 423
REPLACE
MEMORIA
Morgan
Pond
WL515
S P R I N G F I E L D
Star
Lake
Roby Corners
cem
Pitcher
Hill
Royal Arch
Hill
Dutchman
Pond
WL 407
Reservo
BM 424.0
upstream
slope
downstream
slope
BM 354.0
radio
tower
campground
SULLIVAN CO
MERRIMACK CO
BM 380.7
Golf
Course
Otter
Pond
Goose
Pond
Otterville
BM 346.8
BM 366.3
LITTLE
SUNAPEE
WL 372
Colby
Point
WL 343
Gravel
pit
campground
INTERCHANGE
12A


SPRINGFIELD
Star Lake
Roby Corners
Pitcher Hill
Royal Arch Hill
Dutchman Pond
Aluin Pond
cem
radio tower
campground
H-Frame
Wooden
NEW LONDON
STAR LAKE ROAD
MILLS ROAD
FISHER CORNER RD
NICHOLS
BOWMAN
MESSER HILL RD
4WD
BM 4395
BM 4240
BM 354.0
1-29
1-28
448
460T
430T
497T
454T
410T
WL 407
WL 425

Questions concerning the VERTCON process may be mailed to NGS

Latitude: 43.44878

Longitude: 072.05390

NGVD 29 height:

Datum shift(NAVD 88 minus NGVD 29): -0.105 meter = 0,34 ft
this is insignificant in slope calculations and
extrapolation of x-sections,

PRODUCED BY THE UNITED STATES GEOLOGICAL SURVEY

CONTROL BY . . . . USGS, NOS/NOAA, AND STATE OF NEW HAMPSHIRE AGENCIES

COMPILED FROM AERIAL PHOTOGRAPHS TAKEN 1977

FIELD CHECKED . . . . 1980. MAP EDITED 1984

PROJECTION . . . . UNIVERSAL TRANSVERSE MERCATOR

GRID: 1000-METER UNIVERSAL TRANSVERSE MERCATOR . . . . ZONE 18

10,000-FOOT STATE GRID TICKS . . . . NEW HAMPSHIRE

UTM GRID DECLINATION . . . . 1°59′ EAST

1984 MAGNETIC NORTH DECLINATION . . . . 15°30′ WEST

VERTICAL DATUM . . . . NATIONAL GEODETIC VERTICAL DATUM OF 1929 NGVD1929

HORIZONTAL DATUM . . . . 1927 NORTH AMERICAN DATUM

To place on the predicted North American Datum of 1983, move the projection lines as shown by dashed corner ticks (4 meters south and 38 meters west)

There may be private inholdings within the boundaries of any National or State reservations shown on this map

Gray tint indicates area in which selected buildings are shown

CONTOUR INTERVAL 6 METERS

CONTROL ELEVATIONS SHOWN TO THE NEAREST 0.1 METER

OTHER ELEVATIONS SHOWN TO THE NEAREST METER

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS

Culvert Entrance Loss Coefficients

Culvert Type and Entrance Design	Loss Coefficient
Pipe, Concrete	
Projecting from fill, socket end (groove-end)	0.2
Projecting from fill, square cut end	0.5
Headwall or headwall with wingwalls	
Socket end of pipe (groove-end)	0.2
Square-edge	0.5
Rounded (radius = 1/12 barrel diameter)	0.2
Mitered to conform to fill slope	0.7
End section conforming to fill slope[1]	0.5
Beveled edges, 33.7° or 45° angle	0.2
Side-tapered or slope-tapered inlet	0.2
Pipe or Pipe Arch, Corrugated Metal	
Project from fill (no headwall)	0.9
Headwall or headwall with wingwalls square edge	0.5 *
Mitered to conform to fill slope, paved or unpaved slope	0.7
End section conforming to fill slope[1]	0.5
Beveled edges, 33.7° or 45° angle	0.2
Side-tapered or slope-tapered inlet	0.2
Box, Reinforced Concrete	
Headwall parallel to embankment (no wingwalls)	
Square-edged on 3 edges	0.5
Rounded on 3 edges (radius = 1/12 barrel diameter)	0.2
Beveled edges on 3 sides	0.2
Wingwalls at 30° or 75° angle to barrel	
Square-edged at crown	0.4
Crown edge rounded (radius = 1/12 barrel diameter)	0.2
Beveled top edge	0.2
Wingwalls at 10° or 25° angle to barrel	
Square-edged at crown	0.5
Wingwalls parallel (extension of sides)	
Square-edged at crown	0.7
Side-tapered or slope-tapered inlet	0.2

Source: Normann, J. M., Houghtalen, R. J., and Johnston, W. J., 1985, "Hydraulic Design of Highway Culverts," Hydraulic Design Series No. 5, FHWA Federal Highway Administration, McLean, VA

1. *"End-section conforming to fill slope," made of either metal or concrete, are the sections commonly available from manufacturers. From limited hydraulic tests they are equivalent in operation to a headwall in both "inlet" and "outlet" control. Some end sections, incorporating a "closed" tape in their design, have a superior hydraulic performance.*

Contraction & Expansion Coefficients

Flow Type	Contraction	Expansion
No transition loss computed	0.0	0.0
Gradual transitions	0.1	0.3
Typical bridge cross sections	0.3	0.5
Abrupt transitions and culverts	0.6	0.8

*

Source: Chow, Ven Te. Open-Channel Hydraulics, McGraw Hill, 1959.

Culvert Manning's Roughness n

Type of Pipe and Description	Minimum	Normal	Maximum
A. Manning's "n" for Closed Conduits Flowing Partly Full [1]			
1. Corrugated Metal			
a. Subdrain	0.017	0.019	0.021
b. Storm Drain	0.021	0.024	0.030
2. Cement			
a. Neat, suface	0.010	0.011	0.013
b. Mortar	0.011	0.013	0.015
3. Concrete			
a. Culvert, straight and free of debris	0.010	0.011	0.013
b. Culvert with bends, connections, and some debris	0.011	0.013	0.014
c. Finished	0.011	0.012	0.014
d. Sewer with manholes, inlet, etc., straight	0.013	0.015	0.017
e. Unfinished, steel form	0.012	0.013	0.014
f. Unfinished, smooth wood form	0.012	0.014	0.016
g. Unfinished, rough wood form	0.015	0.017	0.020
4. Brickwork			
a. Glazed	0.011	0.013	0.015
b. Lined with cement mortar	0.012	0.015	0.017
c. Sanitary sewers coated with sewage slime with bends and connections	0.012	0.013	0.016
d. Paved invert, sewer, smooth bottom	0.016	0.019	0.020
e. Rubble masonry, cemented	0.018	0.025	0.030

Type of Pipe and Diameter	Unpaved	25% Paved	Fully Paved
B. Manning's "n" for Corrugated Metal Pipe [2]			
1. Annular 2.67 x 2 in. (all diameters)	0.024	0.021	0.021
2. Helical 1.50 x 1/4 in.			
a. 8 inch diameter	0.012		
b. 10 inch diameter	0.014		
3. Helical 2.67 x 2 in.			
a. 12 inch diameter	0.011		
b. 18 inch diameter	0.014		
c. 24 inch diameter	0.016	0.015	0.022
d. 36 inch diameter	0.019	0.017	0.012
e. 48 inch diameter	0.020	0.020	0.012
f. 60 inch diameter	0.021	0.019	0.012
g. Annular 3 x 1 in. (all diameters)	0.027	0.023	0.012
4. Helical 3 x 1 in.			
a. 48 inch diameter	0.023	0.020	0.012
b. 54 inch diameter	0.023	0.020	0.012
c. 60 inch diameter	0.024	0.021	0.012
d. 66 inch diameter	0.025	0.022	0.012
e. 72 inch diameter	0.026	0.022	0.012
f. 78 inch & larger	0.027	0.023	0.012
5. Corrugations 6 x 2 in.			
a. 60 inch diameter	* 0.033	0.028	
b. 72 inch diameter	0.032	0.027	
c. 120 inch diameter	0.030	0.026	
d. 180 inch diameter	0.028	0.024	

Sources:
(1) Chow, 1959
(2) AISI, 1980

Table 3-1 Manning's 'n' Values

Type of Channel and Description	Minimum	Normal	Maximum
A. *Natural Streams*			
1. Main Channels			
a. Clean, straight, full, no rifts or deep pools	0.025	0.030	0.033
b. Same as above, but more stones and weeds	0.030	0.035 *	0.040
c. Clean, winding, some pools and shoals	0.033	0.040	0.045
d. Same as above, but some weeds and stones	0.035	0.045	0.050
e. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
f. Same as "d" but more stones	0.045	0.050	0.060
g. Sluggish reaches, weedy. deep pools	0.050	0.070	0.080
h. Very weedy reaches, deep pools, or floodways with heavy stands of timber and brush	0.070	0.100	0.150
2. Flood Plains			
a. Pasture no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated areas			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050 *	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
2. Same as above, but heavy sprouts	0.050	0.060	0.080
3. Heavy stand of timber, few down trees, little undergrowth, flow below branches	0.080	0.100	0.120 Say 0.085
4. Same as above, but with flow into branches	0.100	0.120	0.160
5. Dense willows, summer, straight	0.110	0.150	0.200
3. Mountain Streams, no vegetation in channel, banks usually steep, with trees and brush on banks submerged			
a. Bottom: gravels, cobbles, and few boulders	0.030	0.040	0.050
b. Bottom: cobbles with large boulders	0.040	0.050	0.070

HEC-RAS 4.1 Reference Manual

Table 5-2 Subcritical Flow Contraction and Expansion Coefficients

	Contraction	Expansion
No transition loss computed	0.0	0.0
Gradual transitions	0.1	0.3
Typical Bridge sections	0.3	0.5
Abrupt transitions	0.6	0.8

The maximum value for the contraction and expansion coefficient is 1.0. As mentioned previously, a detailed study was completed by the Hydrologic Engineering Center entitled "Flow Transitions in Bridge Backwater Analysis" (HEC, 1995). A summary of this research, as well as recommendations for contraction and expansion coefficients, can be found in Appendix B.

In general, contraction and expansion coefficients for supercritical flow should be lower than subcritical flow. For typical bridges that are under class C flow conditions (totally supercritical flow), the contraction and expansion coefficients should be around 0.03 and 0.05 respectively. For abrupt bridge transitions under class C flow, values of 0.05 and 0.1 may be more appropriate.

Hydraulic Computations Through the Bridge

The bridge routines in HEC-RAS allow the modeler to analyze a bridge with several different methods without changing the bridge geometry. The bridge routines have the ability to model low flow (Class A, B, and C), low flow and weir flow (with adjustments for submergence on the weir), pressure flow (orifice and sluice gate equations), pressure and weir flow, and highly submerged flows (the program will automatically switch to the energy equation when the flow over the road is highly submerged). This portion of the manual describes in detail how the program models each of these different flow types.

Low Flow Computations

Low flow exists when the flow going through the bridge opening is open channel flow (water surface below the highest point on the low chord of the bridge opening). For low flow computations, the program first uses the momentum equation to identify the class of flow. This is accomplished by first calculating the momentum at critical depth inside the bridge at the upstream and downstream ends. The end with the higher momentum (therefore most constricted section) will be the controlling section in the bridge. If the two sections are identical, the program selects the upstream bridge section as the controlling section.

HEC-RAS 4.1 Reference Manual

FUSS & O'NEILL	Prepared By SRB	Date 10/17	Checked By ETC	Date 10/17	Project No 160361
FREEBOARD - 31' SPAN					Sheet No of

Upstream Section (XS4)
STA. 1238

Q_{50} Hydraulic Depth = 3.21' ← CONTROLS

Immediate Upstream Section (XS3)
STA. 1182

Q_{50} Hydraulic Depth = 2.54

Riverbed Elevation @ Immediate Upstream Section = 1144'

MIN. Low Chord = 1144' + 3.21' + 1' = 1148.21'

FREEBOARD - 20' AT-GRADE

Upstream Section (XS4)
STA 1238

Q_{50} Hydraulic Depth = 3.21'

Immediate Upstream Section (XS3)

Q_{50} Hydraulic Depth = 4.12' ← Controls

Riverbed Elevation @ Immediate Upstream Section = 1144'

Min. Low Chord = 1144' + 4.12' + 1' = 1149.12'

FUSS & O'NEILL

Prepared By	Date	Checked By	Date	Project No
SRB	01/18	ETC	1/15/18	1603161 - SPRINGFIELD

FREEBOARD - BURIED 20' BOX - NO BANKS

Sheet No of

Upstream Section (XS4)
STA 1238

Q50 Hydraulic Depth = 3.21' ← Controls

Immediate Upstream Section (XS3)
STA 1182

Q50 Hydraulic Depth = 3.17'

RIVERBED ELEVATION @ IMMEDIATE Upstream Section
= 1144

Low Chord = 1148.35

Freeboard = 1148.35' - 1' - 3.21' - 1144' = 0.14'

FLOW DEPTH = 1144 + 3.21 = 1147.21'
MIN. LOW CHORD = 1147.21' + 1' = 1148.21'

Plan: Buried 31-foot Unnamed Brook Brook RS: 1238 Profile: Q50

E.G. Elev (ft)	1149.43	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.77	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1148.66	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1148.66	Flow Area (sq ft)	23.39	50.85	1.35
E.G. Slope (ft/ft)	0.007296	Area (sq ft)	24.35	50.85	1.35
Q Total (cfs)	421.00	Flow (cfs)	43.12	376.82	1.07
Top Width (ft)	65.68	Top Width (ft)	46.68	15.82	3.18
Vel Total (ft/s)	5.57	Avg. Vel. (ft/s)	1.84	7.41	0.79
Max Chl Dpth (ft)	3.85	Hydr. Depth (ft)	0.62	3.21	0.42
Conv. Total (cfs)	4928.7	Conv. (cfs)	504.8	4411.4	12.5
Length Wtd. (ft)	55.99	Wetted Per. (ft)	37.82	17.41	3.49
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.28	1.33	0.18
Alpha	1.60	Stream Power (lb/ft s)	0.52	9.86	0.14
Frctn Loss (ft)	0.38	Cum Volume (acre-ft)	0.02	0.34	0.05
C & E Loss (ft)	0.06	Cum SA (acres)	0.05	0.14	0.06

Plan: Buried 31-foot Unnamed Brook Brook RS: 1182 Profile: Q50

E.G. Elev (ft)	1147.49	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.57	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1146.92	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)	1146.35	Flow Area (sq ft)	2.12	68.68	1.67
E.G. Slope (ft/ft)	0.006218	Area (sq ft)	2.12	68.68	1.67
Q Total (cfs)	421.00	Flow (cfs)	1.95	417.56	1.49
Top Width (ft)	38.58	Top Width (ft)	8.58	27.00	3.00
Vel Total (ft/s)	5.81	Avg. Vel. (ft/s)	0.92	6.08	0.89
Max Chl Dpth (ft)	2.92	Hydr. Depth (ft)	0.25	2.54	0.56
Conv. Total (cfs)	5339.0	Conv. (cfs)	24.7	5295.4	18.9
Length Wtd. (ft)	10.00	Wetted Per. (ft)	8.68	28.06	3.20
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.09	0.95	0.20
Alpha	1.09	Stream Power (lb/ft s)	0.09	5.78	0.18
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)	0.00	0.26	0.05
C & E Loss (ft)	0.07	Cum SA (acres)	0.01	0.11	0.05

Plan: At-Grade 20-foot   Unnamed Brook   Brook RS: 1238   Profile: Q50

E.G. Elev (ft)	1149.43	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.77	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1148.66	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1148.66	Flow Area (sq ft)	23.39	50.85	1.35
E.G. Slope (ft/ft)	0.007296	Area (sq ft)	24.35	50.85	1.35
Q Total (cfs)	421.00	Flow (cfs)	43.12	376.82	1.07
Top Width (ft)	65.68	Top Width (ft)	46.68	15.82	3.18
Vel Total (ft/s)	5.57	Avg. Vel. (ft/s)	1.84	7.41	0.79
Max Chl Dpth (ft)	3.85	Hydr. Depth (ft)	0.62	3.21	0.42
Conv. Total (cfs)	4928.7	Conv. (cfs)	504.8	4411.4	12.5
Length Wtd. (ft)	55.99	Wetted Per. (ft)	37.82	17.41	3.49
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.28	1.33	0.18
Alpha	1.60	Stream Power (lb/ft s)	0.52	9.86	0.14
Frctn Loss (ft)	0.22	Cum Volume (acre-ft)	0.10	0.30	0.07
C & E Loss (ft)	0.13	Cum SA (acres)	0.11	0.09	0.07

Plan: At-Grade 20-foot   Unnamed Brook   Brook RS: 1182   Profile: Q50

E.G. Elev (ft)	1148.92	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1148.59	Reach Len. (ft)	22.00	22.00	22.00
Crit W.S. (ft)	1147.48	Flow Area (sq ft)	37.86	65.87	5.32
E.G. Slope (ft/ft)	0.002408	Area (sq ft)	65.63	65.87	5.32
Q Total (cfs)	421.00	Flow (cfs)	82.09	333.76	5.14
Top Width (ft)	79.59	Top Width (ft)	60.94	16.00	2.65
Vel Total (ft/s)	3.86	Avg. Vel. (ft/s)	2.17	5.07	0.97
Max Chl Dpth (ft)	4.59	Hydr. Depth (ft)	1.84	4.12	2.01
Conv. Total (cfs)	8580.2	Conv. (cfs)	1673.1	6802.3	104.8
Length Wtd. (ft)	22.00	Wetted Per. (ft)	20.87	17.36	4.44
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.27	0.57	0.18
Alpha	1.43	Stream Power (lb/ft s)	0.59	2.89	0.17
Frctn Loss (ft)	0.10	Cum Volume (acre-ft)	0.04	0.22	0.06
C & E Loss (ft)	0.28	Cum SA (acres)	0.05	0.07	0.06

Plan: 20-foot_NoBanks Unnamed Brook Brook RS: 1238 Profile: Q50

E.G. Elev (ft)	1149.43	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.77	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1148.66	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1148.66	Flow Area (sq ft)	23.39	50.85	1.35
E.G. Slope (ft/ft)	0.007296	Area (sq ft)	24.35	50.85	1.35
Q Total (cfs)	421.00	Flow (cfs)	43.12	376.82	1.07
Top Width (ft)	65.68	Top Width (ft)	46.68	15.82	3.18
Vel Total (ft/s)	5.57	Avg. Vel. (ft/s)	1.84	7.41	0.79
Max Chl Dpth (ft)	3.85	Hydr. Depth (ft)	0.62	3.21	0.42
Conv. Total (cfs)	4928.7	Conv. (cfs)	504.8	4411.4	12.5
Length Wtd. (ft)	55.99	Wetted Per. (ft)	37.82	17.41	3.49
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.28	1.33	0.18
Alpha	1.60	Stream Power (lb/ft s)	504.45	0.00	0.00
Frctn Loss (ft)	0.39	Cum Volume (acre-ft)	0.02	0.36	0.00
C & E Loss (ft)	0.04	Cum SA (acres)	0.05	0.16	0.01

Plan: 20-foot_NoBanks Unnamed Brook Brook RS: 1182 Profile: Q50

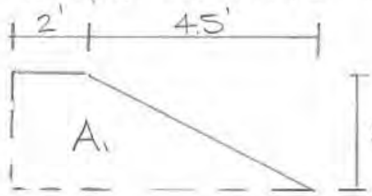
E.G. Elev (ft)	1147.82	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.63	Wt. n-Val.	0.050	0.035	
W.S. Elev (ft)	1147.19	Reach Len. (ft)	10.00	10.00	10.00
Crit W.S. (ft)	1146.40	Flow Area (sq ft)	7.06	64.18	
E.G. Slope (ft/ft)	0.006747	Area (sq ft)	7.08	64.18	
Q Total (cfs)	421.00	Flow (cfs)	9.03	411.97	
Top Width (ft)	39.83	Top Width (ft)	19.59	20.24	
Vel Total (ft/s)	5.91	Avg. Vel. (ft/s)	1.28	6.42	
Max Chl Dpth (ft)	3.19	Hydr. Depth (ft)	0.38	3.17	
Conv. Total (cfs)	5125.3	Conv. (cfs)	109.9	5015.4	
Length Wtd. (ft)	10.00	Wetted Per. (ft)	18.62	25.70	
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.16	1.05	
Alpha	1.16	Stream Power (lb/ft s)	790.85	0.00	0.00
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)	0.00	0.29	0.00
C & E Loss (ft)	0.11	Cum SA (acres)	0.01	0.13	0.00

FUSS & O'NEILL	Prepared By	Date	Checked By	Date	Project No
	SRB	10/17	ETC	10/17	160361 Springfield

MIN. REQUIRED OPENING AREAS	Sheet No of

31-ft Span Buried

Min Low Chord = 1148.21'
Riverbed = 1144
Slope Width = 1146.25' − 1144 = 2.25' x 2' = 4.5'



$A_1 = 2(2.25) + \frac{1}{2}(4.5)(2.25)$
$= 9.5625$ SF

MIN. REQD AREA = (1148.21 − 1144)(31) − 2(9.5625 SF)
= 111.385 SF
HEC-RAS OPENING = 111.38 SF <u>OK</u>

20-ft Span At-Grade

Min Low Chord = 1149.12'
Riverbed = 1144'
Slope Width = 1146.25 − 1144 = 2.25' x 1.5 = 3.375'

$A_2 = 2(2.25) + \frac{1}{2}(3.375)(2.25)$
$= 8.2969$ SF

MIN REQD AREA = (1149.12 − 1144)(20) − 2(8.2969 SF)
= 85.806 SF
HEC-RAS OPENING = 85.81 SF <u>OK</u>

FUSS & O'NEILL	Prepared By. SRB	Date 02/18	Checked By ETC	Date 02/18	Project No 1160361-SPRINGFIELD

MIN. REQ'D OPENING AREAS

Sheet No
of

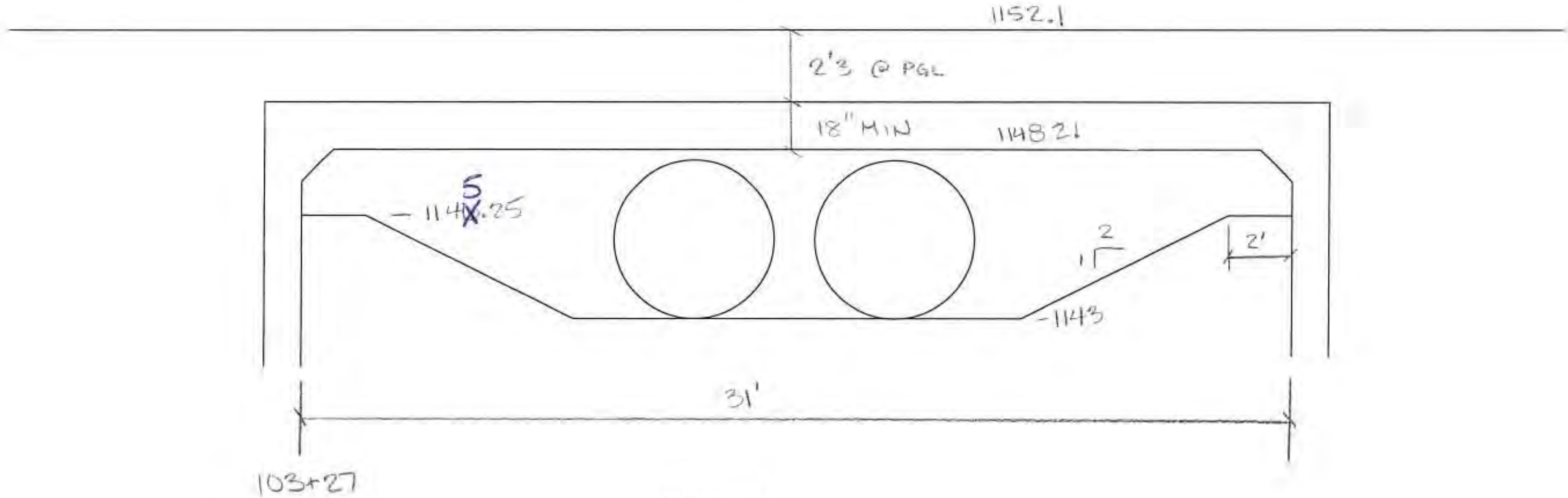
20-ft Span Buried - No Banks

Min Low Chord = 1148.35'
Riverbed = 1144

MIN. REQ'D AREA = 20' (1148.35-1144') = 87 Sq. Ft.

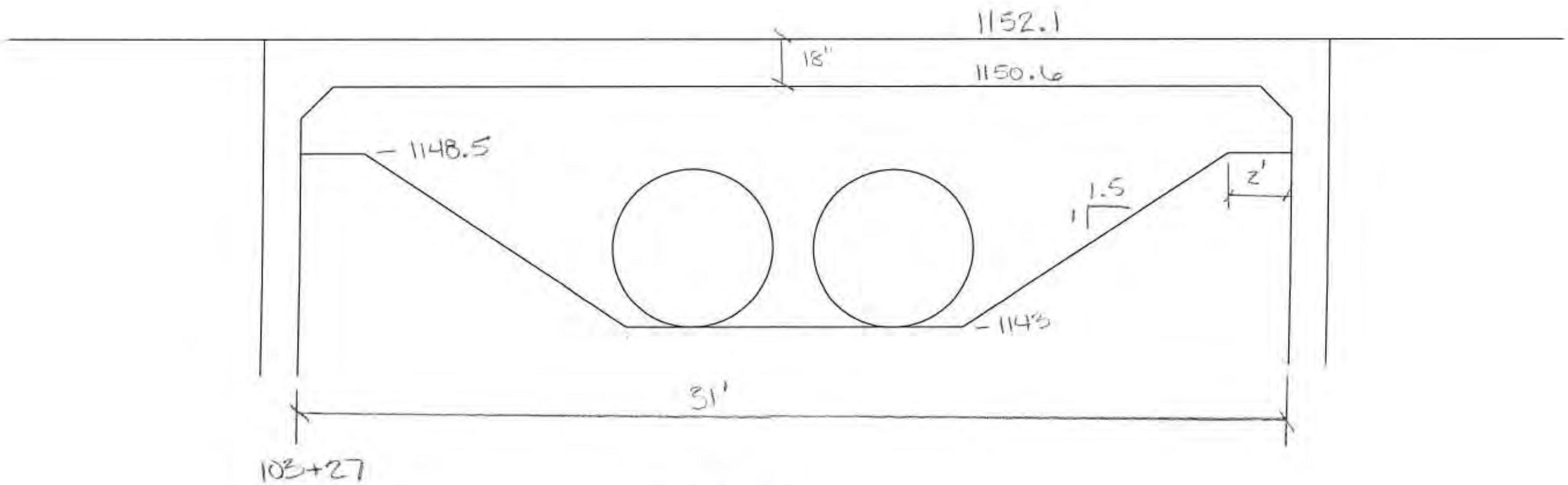
HEC-RAS OPENING = 87 Sq. ft. ✓ Ok

31' FRAME



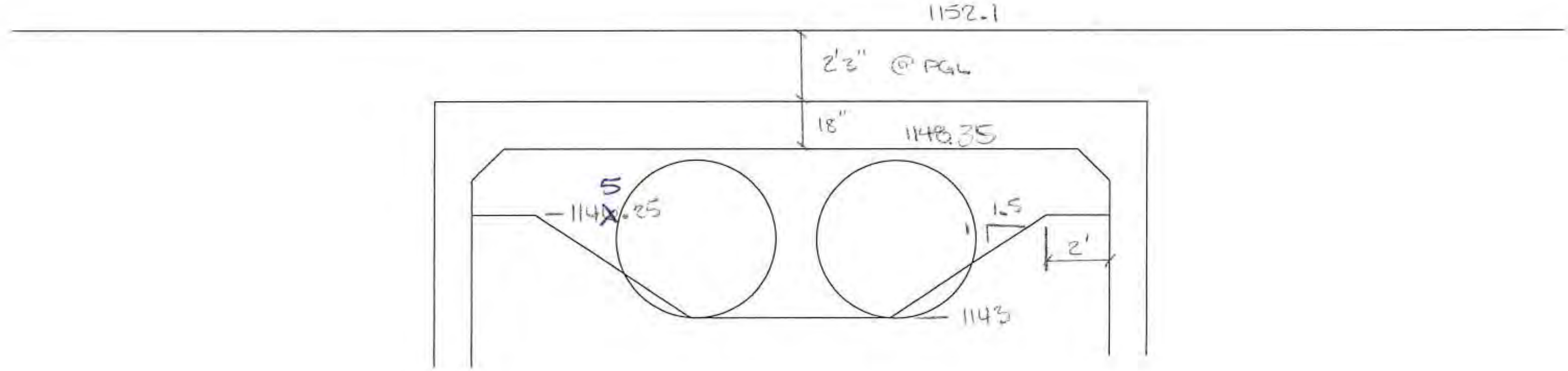
BURIED

Downstream

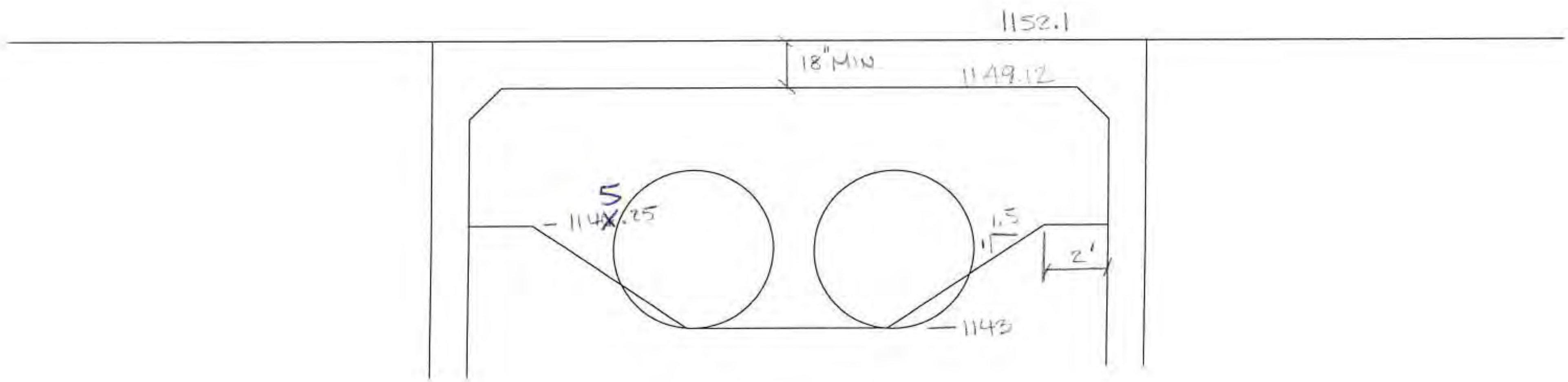


@ GRADE

20 FRAME



BURIED
Downstream



@ GRADE
Downstream

SPRINGFIELD 1L0361

Plan: Buried 31-foot Unnamed Brook Brook RS: 1165 BR U Profile: Q50

E.G. Elev (ft)	1147.33	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.82	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1146.52	Reach Len. (ft)	83.50	83.50	83.50
Crit W.S. (ft)	1146.36	Flow Area (sq ft)	0.54	57.88	0.54
E.G. Slope (ft/ft)	0.011124	Area (sq ft)	0.54	57.88	0.54
Q Total (cfs)	421.00	Flow (cfs)	0.70	419.89	0.41
Top Width (ft)	31.00	Top Width (ft)	2.00	27.00	2.00
Vel Total (ft/s)	7.14	Avg. Vel. (ft/s)	1.30	7.25	0.77
Max Chl Dpth (ft)	2.52	Hydr. Depth (ft)	0.27	2.14	0.27
Conv. Total (cfs)	3991.7	Conv. (cfs)	6.6	3981.2	3.9
Length Wtd. (ft)	83.50	Wetted Per. (ft)	2.00	28.06	2.00
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.19	1.43	0.19
Alpha	1.03	Stream Power (lb/ft s)	0.24	10.39	0.14
Frctn Loss (ft)	0.62	Cum Volume (acre-ft)	0.00	0.25	0.05
C & E Loss (ft)	0.15	Cum SA (acres)	0.01	0.10	0.05

HEC-RAS Plan: Buried 31-foot   River: Unnamed Brook   Reach: Brook   Profile: Q50

Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG	BR Sluice Coef
			(ft)	(ft)	(sq ft)	(ft)	(cfs)	(ft)	(cfs)	(ft)	
Brook	1165	Q50	1147.49	1148.21	111.38		421.00	1152.12		1.17	0.00

Plan: At-Grade 20-foot   Unnamed Brook   Brook RS: 1165   BR U   Profile: Q50

E.G. Elev (ft)	1148.54	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.26	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1147.29	Reach Len. (ft)	63.50	63.50	63.50
Crit W.S. (ft)	1147.29	Flow Area (sq ft)	2.07	44.98	2.07
E.G. Slope (ft/ft)	0.012931	Area (sq ft)	2.07	44.98	2.07
Q Total (cfs)	421.00	Flow (cfs)	7.17	409.62	4.22
Top Width (ft)	20.00	Top Width (ft)	2.00	16.00	2.00
Vel Total (ft/s)	8.57	Avg. Vel. (ft/s)	3.46	9.11	2.04
Max Chl Dpth (ft)	3.29	Hydr. Depth (ft)	1.04	2.81	1.04
Conv. Total (cfs)	3702.2	Conv. (cfs)	63.0	3602.1	37.1
Length Wtd. (ft)	63.50	Wetted Per. (ft)	2.00	17.36	2.00
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.84	2.09	0.84
Alpha	1.10	Stream Power (lb/ft s)	2.89	19.05	1.70
Frctn Loss (ft)	0.58	Cum Volume (acre-ft)	0.03	0.19	0.06
C & E Loss (ft)	0.20	Cum SA (acres)	0.03	0.06	0.06

HEC-RAS Plan: At-Grade 20-foot River: Unnamed Brook Reach: Brook Profile: Q50

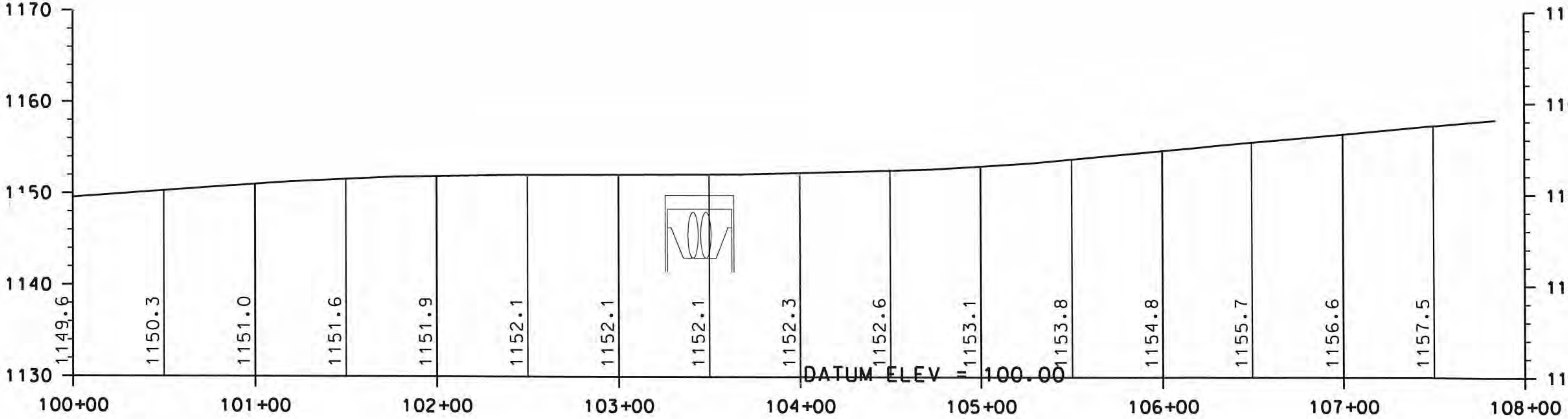
Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG	BR Sluice Coef
			(ft)	(ft)	(sq ft)	(ft)	(cfs)	(ft)	(cfs)	(ft)	
Brook	1165	Q50	1148.92	1149.12	85.81		421.00	1152.12		1.49	0.00

Plan: 20-foot_NoBanks   Unnamed Brook   Brook RS: 1165   BR U   Profile: Q50

E.G. Elev (ft)	1147.62	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.01	Wt. n-Val.		0.035	
W.S. Elev (ft)	1146.62	Reach Len. (ft)	83.50	83.50	83.50
Crit W.S. (ft)	1146.40	Flow Area (sq ft)		52.33	
E.G. Slope (ft/ft)	0.009960	Area (sq ft)		52.33	
Q Total (cfs)	421.00	Flow (cfs)		421.00	
Top Width (ft)	20.00	Top Width (ft)		20.00	
Vel Total (ft/s)	8.05	Avg. Vel. (ft/s)		8.05	
Max Chl Dpth (ft)	2.62	Hydr. Depth (ft)		2.62	
Conv. Total (cfs)	4218.4	Conv. (cfs)		4218.4	
Length Wtd. (ft)	83.50	Wetted Per. (ft)		20.00	
Min Ch El (ft)	1144.00	Shear (lb/sq ft)		1.63	
Alpha	1.00	Stream Power (lb/ft s)	790.85	0.00	0.00
Frctn Loss (ft)	0.57	Cum Volume (acre-ft)	0.00	0.27	0.00
C & E Loss (ft)	0.17	Cum SA (acres)	0.01	0.13	0.00

HEC-RAS Plan: 20-foot_NoBanks River: Unnamed Brook Reach: Brook Profile: Q50

Reach	River Sta	Profile	E.G. US.	Min El Prs	BR Open Area	Prs O WS	Q Total	Min El Weir Flow	Q Weir	Delta EG
			(ft)	(ft)	(sq ft)	(ft)	(cfs)	(ft)	(cfs)	(ft)
Brook	1165	Q50	1147.82	1148.35	87.00		421.00	1152.12		1.24



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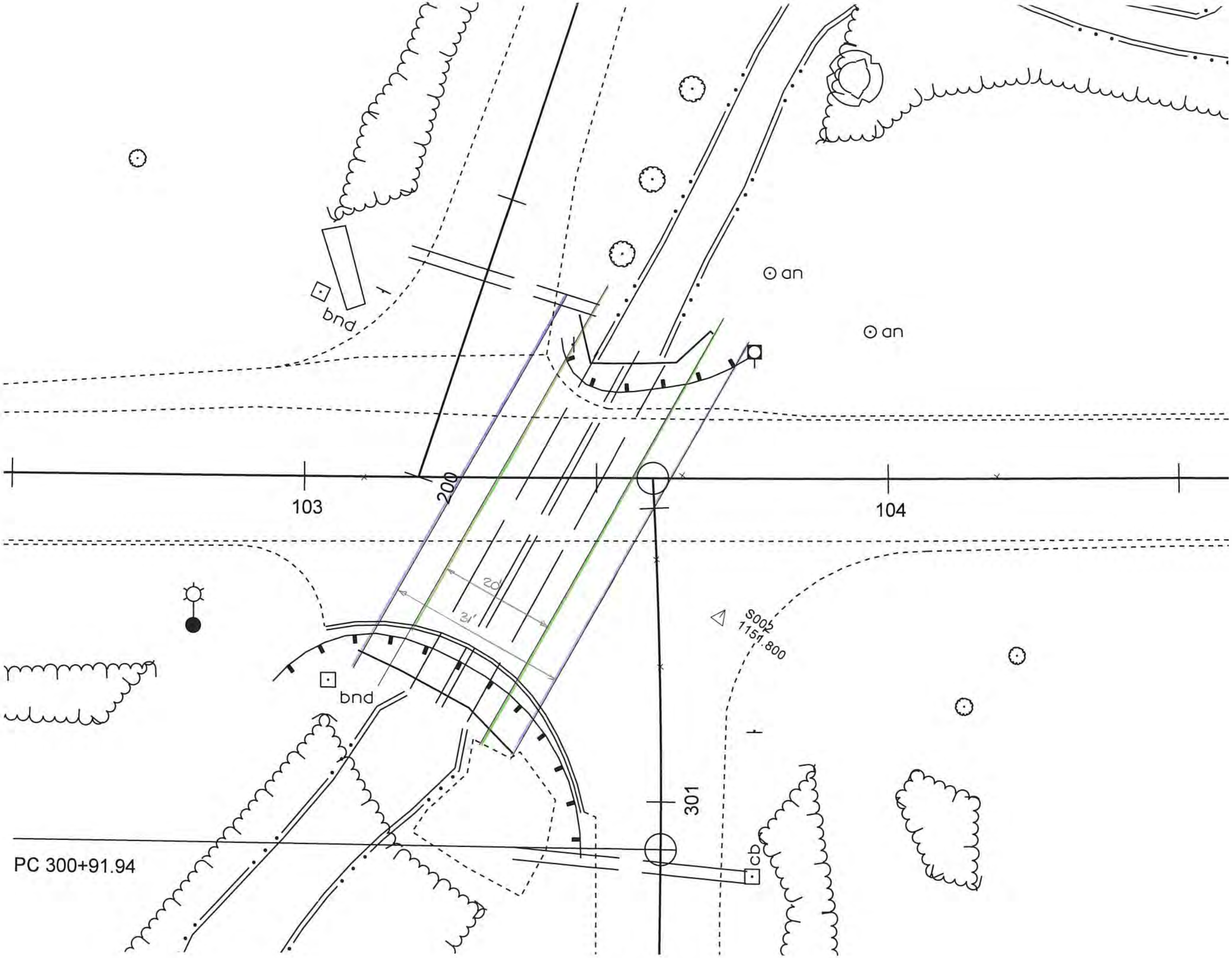

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APPENDIX G

DETAILED SCOUR CALCULATIONS

31-FOOT SPAN BURIED FRAME

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SHEET NO.		OF	
CALCULATED BY	ETC	DATE	10/17
CHECKED BY	SRB	DATE	10/17

SUBJECT Proposed 31' Span Scour (Verification of HEC-RAS Scour Report)

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

Contraction Scour:

Q100 - Left of Bank

Critical Velocity: $V_c = K_u Y_1^{1/6} D_{50}^{1/3}$ *(HEC 18, Eqn. 6.1)*

K_u =	11.17		(English Conversion Value)	*(HEC 18 Eqn. 6.1)*
Y_1 =	0.87	ft	(depth of flow in upstream section)	*(HEC-RAS)*
D_{50} =	1.00	in	(bed material particle size in a mixture of which 50% are smaller)	
	0.0833	ft		
V_c =	4.77	fps	(Critical Velocity above which material of size D50 and smaller will be transported)	
V =	2.33	fps	(Approach Velocity)	*(HEC-RAS)*

Method to Use: **Clear Water Scour**

Per Hec-18, scour depths with live-bed contraction scour may be limited by coarse sediments in the bed material armoring the bed. Where coarse sediments are present, it is recommended that scour depths be calculated for live-bed scour conditions using the clear-water scour equation in addition to the live-bed equation, and that the smaller calculated scour depth be used.

Live Bed Scour:

$Y_2 = Y_1 (Q_2 / Q_1)^{6/7} (W_1 / W_2)^{k1}$ *(HEC 18 Eqn. 6.4)*

$Y_s = Y_2 - Y_o$ *(HEC 18 Eqn. 6.5)*

$V* = (32.2\ Y_1\ S_1)^{1/2}$

Clear Water Scour:

$Y_{2\_cw} = [(K_u Q_2^2) / (D_m^{2/3} W_2^2)]^{3/7}$ *(HEC 18 Eqn. 6.4)*

$Y_{s\_cw} = Y_{2\_cw} - Y_o$ *(HEC 18 Eqn. 6.5)*

$D_m = 1.25\ D_{50}$

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SUBJECT Proposed 31' Span Scour (Verification of HEC-RAS Scour Report)

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

$D_s = D_{50}$ =	1.00	in	(bed material particle size in a mixture of which 50% are smaller)	
D_m =	0.1042	ft		*(HEC 18 Eqn. 6.4)*
T =	0.650	m/s	(fall velocity of bed material)	*(HEC 18 Fig. 6.8)*
	2.1320	ft/s		
S_1 =	0.0075	ft/ft	(slope of energy grade line)	*(HEC-RAS)*
V* =	0.46	ft/s	(shear velocity in the upstream section)	*(HEC 18 Section 6.3)*
V* / T =	0.21			
k_1 =	0.59			*(HEC 18 Section 6.3)*
K_u =	0.0077	ft	(English Conversion Value)	*(HEC 18 Eqn. 6.4)*
Q_2 =	2.35	cfs	(flow in contracted section)	*(HEC-RAS)*
W_2 =	2.00	ft	(bottom width in contracted channel)	*(HEC-RAS)*
Q_1 =	76.28	cfs	(flow in upstream channel)	*(HEC-RAS)*
W_1 =	56.96	ft	(bottom width in upstream channel)	*(HEC-RAS)*
Y_o =	0.57	ft	(depth of flow in contracted section before scour)	*(HEC-RAS)*
Y_{2_lb} =	0.32	ft	(depth of flow in contracted section)	
Y_{2_cw} =	0.27	ft	(depth of flow in contracted section)	
Y_{s_lb} =	-0.25	ft		
Y_{s_cw} =	-0.30	ft		
Y_s =	**0.00**	**ft**	***Therefore, no Contraction Scour***	

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SUBJECT Proposed 31' Span Scour (Verification of HEC-RAS Scour Report)

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

Contraction Scour:

Q100 - Channel

Critical Velocity: $V_c = K_u Y_1^{1/6} D_{50}^{1/3}$ *(HEC 18, Eqn. 6.1)*

K_u =	11.17		(English Conversion Value)	*(HEC 18 Eqn. 6.1)*
Y_1 =	3.46	ft	(depth of flow in upstream section)	*(HEC-RAS)*
D_{50} =	1.00	in	(bed material particle size in a mixture of which 50% are smaller)	
	0.0833	ft		
V_c =	6.00	fps	(Critical Velocity above which material of size D50 and smaller will be transported)	
V =	7.88	fps	(Approach Velocity)	*(HEC-RAS)*

Method to Use: **Live Bed Scour**

Live Bed Scour:

$Y_{2\_lb} = Y_1 (Q_2 / Q_1)^{6/7} (W_1 / W_2)^{k1}$ *(HEC 18 Eqn. 6.4)*

$Y_{s\_lb} = Y_{2\_lb} - Y_o$ *(HEC 18 Eqn. 6.5)*

$V^* = (32.2\ Y_1\ S_1)^{1/2}$

Clear Water Scour:

$Y_{2\_cw} = [(K_u Q_2^2) / (D_m^{2/3} W_2^2)]^{3/7}$ *(HEC 18 Eqn. 6.4)*

$Y_{s\_cw} = Y_{2\_cw} - Y_o$ *(HEC 18 Eqn. 6.5)*

$D_m = 1.25\ D_{50}$

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SUBJECT Proposed 31' Span Scour (Verification of HEC-RAS Scour Report)

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

$D_s = D_{50}$ =	1.00	in	(bed material particle size in a mixture of which 50% are smaller)	
D_m =	0.1042	ft		*(HEC 18 Eqn. 6.4)*
T =	0.650	m/s	(fall velocity of bed material)	*(HEC 18 Fig. 6.8)*
	2.1320	ft/s		
S_1 =	0.0075	ft/ft	(slope of energy grade line)	*(HEC-RAS)*
V* =	0.91	ft/s	(shear velocity in the upstream section)	*(HEC 18 Section 6.3)*
V* / T =	0.43			
k_1 =	0.59			*(HEC 18 Section 6.3)*
K_u =	0.0077	ft		*(HEC 18 Eqn. 6.4)*
Q_2 =	506.26	cfs	(flow in contracted section)	*(HEC-RAS)*
W_2 =	27.00	ft	(bottom width in contracted channel)	*(HEC-RAS)*
Q_1 =	431.58	cfs	(flow in upstream channel)	*(HEC-RAS)*
W_1 =	15.82	ft	(bottom width in upstream channel)	*(HEC-RAS)*
Y_o =	2.44	ft	(depth of flow in contracted section before scour)	*(HEC-RAS)*
Y_{2_lb} =	2.89	ft	(depth of flow in contracted section)	
Y_{2_cw} =	2.92	ft	(depth of flow in contracted section)	
Y_{s_lb} =	0.45	ft		
Y_{s_cw} =	0.48	ft		
Y_s =	**0.45**	**ft**		

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SUBJECT Proposed 31' Span Scour (Verification of HEC-RAS Scour Report)

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

Contraction Scour:

Q100 - Right of Bank

Critical Velocity: $V_c = K_u Y_1^{1/6} D_{50}^{1/3}$ *(HEC 18, Eqn. 6.1)*

K_u =	11.17		(English Conversion Value)	*(HEC 18 Eqn. 6.1)*
Y_1 =	0.53	ft	(depth of flow in upstream section)	*(HEC-RAS)*
D_{50} =	1.00	mm	(bed material particle size in a mixture of which 50% are smaller)	
	0.0833	ft		
V_c =	4.39	fps	(Critical Velocity above which material of size D50 and smaller will be transported)	
V =	0.94	fps	(Approach Velocity)	*(HEC-RAS)*

Method to Use: **Clear Water Scour**

Live Bed Scour:

$Y_2 = Y_1 (Q_2 / Q_1)^{6/7} (W_1 / W_2)^{k1}$ *(HEC 18 Eqn. 6.4)*

$Y_s = Y_2 - Y_o$ *(HEC 18 Eqn. 6.5)*

$V^* = (32.2\ Y_1\ S_1)^{1/2}$

Clear Water Scour:

$Y_{2\_cw} = [(K_u Q_2^2) / (D_m^{2/3} W_2^2)]^{3/7}$ *(HEC 18 Eqn. 6.4)*

$Y_{s\_cw} = Y_{2\_cw} - Y_o$ *(HEC 18 Eqn. 6.5)*

$D_m = 1.25\ D_{50}$

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SUBJECT Proposed 31' Span Scour (Verification of HEC-RAS Scour Report)

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

$D_s = D_{50} =$	1.00	in	(bed material particle size in a mixture of which 50% are smaller)	
$D_m =$	0.1042	ft		*(HEC 18 Eqn. 6.4)*
$T =$	0.650	m/s	(fall velocity of bed material)	*(HEC 18 Fig. 6.8)*
	2.1320	ft/s		
$S_1 =$	0.0075	ft/ft	(slope of energy grade line)	*(HEC-RAS)*
$V^* =$	0.36	ft/s	(shear velocity in the upstream section)	*(HEC 18 Section 6.3)*
$V^* / T =$	0.17			
$k_1 =$	0.59			*(HEC 18 Section 6.3)*
$K_u =$	0.0077	ft		*(HEC 18 Eqn. 6.4)*
$Q_2 =$	1.39	cfs	(flow in contracted section)	*(HEC-RAS)*
$W_2 =$	2.00	ft	(bottom width in contracted channel)	*(HEC-RAS)*
$Q_1 =$	2.13	cfs	(flow in upstream channel)	*(HEC-RAS)*
$W_1 =$	4.27	ft	(bottom width in upstream channel)	*(HEC-RAS)*
$Y_o =$	0.57	ft	(depth of flow in contracted section before scour)	*(HEC-RAS)*
$Y_{2\_lb} =$	0.58	ft	(depth of flow in contracted section)	
$Y_{2\_cw} =$	0.17	ft	(depth of flow in contracted section)	
$Y_{s\_lb} =$	0.01	ft		
$Y_{s\_cw} =$	-0.40	ft		
$Y_s =$	**0.00**	**ft**	***Therefore, no Contraction Scour***	

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SUBJECT Proposed Scour (31' Buried Span)

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

Contraction Scour - Pressure Flow Situation (No Overtopping):

Q500 - Left of Bank

Critical Velocity: $V_c = K_u Y_1^{1/6} D_{50}^{1/3}$ *(HEC 18, Eqn. 6.1)*

$K_u =$ 11.17 (English Conversion Value) *(HEC 18 Eqn. 6.1)*

$Y_1 =$ 1.35 ft (depth of flow in upstream section) *(HEC-RAS)*

$D_{50} =$ 1.00 in (bed material particle size in a mixture of which 50% are smaller)

0.0833 ft

$V_c =$ 5.13 fps (Critical Velocity above which material of size D50 and smaller will be transported)

$V =$ 3.25 fps (Approach Velocity) *(HEC-RAS)*

Method to Use: **Clear Water Scour**

Per Hec-18, scour depths with live-bed contraction scour may be limited by coarse sediments in the bed material armoring the bed. Where coarse sediments are present, it is recommended that scour depths be calculated for live-bed scour conditions using the clear-water scour equation in addition to the live-bed equation, and that the smaller calculated scour depth be used.

Live Bed Scour: $Y_{2\_lb} = Y_1 (Q_2 / Q_1)^{6/7} (W_1 / W_2)^{k1}$ *(HEC 18 Eqn. 6.4)*

$V^* = (32.2\ Y_1\ S_1)^{1/2}$

$Y_{s\_lb} = Y_{2\_lb} + t - h_b$ *(HEC 18 Eqn. 6.14)*

Clear Water Scour: $Y_{2\_cw} = [(K_u Q_2^2) / (D_m^{2/3} W_2^2)]^{3/7}$ *(HEC 18 Eqn. 6.4)*

$D_m = 1.25\ D_{50}$

$Y_{s\_cw} = Y_{2\_cw} + t - h_b$ *(HEC 18 Eqn. 6.14)*

$t = 0.5\ h_b\ ((h_b\ h_t) / h_u^2)^{0.2} (1 - h_w / h_t)^{-0.1}$ *(HEC 18 Eqn. 6.16)*

h_b = Avg. Low Chord El. - Min. Channel El.

h_t = Pressure Only Water Surface Elevation - Avg. Low Chord

T = Avg. Deck El. - Avg. Low Chord

h_w = if $h_t > T$, $h_w = h_t - T$; if $h_t <= T$, $h_w = 0$

$D_s = D_{50} =$ 1.00 in (bed material particle size in a mixture of which 50% are smaller)

$D_m =$ 0.1042 ft *(HEC 18 Eqn. 6.4)*

T = 0.650 m/s (fall velocity of bed material) *(HEC 18 Fig. 6.8)*

2.1320 ft/s

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SUBJECT Proposed Scour (31' Buried Span)

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

S_1 =	0.0080	ft/ft	(slope of energy grade line)	*(HEC-RAS)*
V* =	0.59	ft/s	(shear velocity in the upstream section)	*(HEC 18 Section 6.3)*
V* / T =	0.28			
k_1 =	0.59			*(HEC 18 Section 6.3)*
K_u =	0.0077	ft		*(HEC 18 Eqn. 6.4)*
Q_2 =	9.38	cfs	(flow in contracted section)	*(HEC-RAS)*
W_2 =	2.00	ft	(bottom width in contracted channel)	*(HEC-RAS)*
Q_1 =	165.35	cfs	(flow in upstream channel)	*(HEC-RAS)*
W_1 =	94.50	ft	(bottom width in upstream channel)	*(HEC-RAS)*
Y_{2_lb} =	1.12	ft	(depth of flow in contracted section)	
Y_{2_cw} =	0.89	ft	(depth of flow in contracted section)	
Low Chord El. 1 =	1148.21	ft		*(HEC-RAS)*
Low Chord El. 2 =	1148.21	ft		*(HEC-RAS)*
Avg. Low Chord =	1148.21	ft		
Approx. Channel El. =	1146.25	ft	(use lowest elev. closest to abut. face)	*(HEC-RAS)*
$h_b = y_o$ =	1.96	ft	(vertical size of bridge opening prior to scour)	
Pressure Only WSE =	1149.10	ft		*(HEC-RAS)*
h_t =	0.89	ft	(water surface to avg. low chord	
$h_u = Y_1$ =	1.35	ft	(depth of flow in upstream section)	*(HEC-RAS)*
Deck El. 1 =	1152.13	ft		*(HEC-RAS)*
Deck El. 2 =	1152.12	ft		*(HEC-RAS)*
Avg. Deck El. =	1152.13	ft		
T =	3.91	ft	(structure depth - height of obstruction)	
h_w =	0.00	ft	(weir flow height - if no overtopping, 0)	*(HEC-RAS)*
t =	0.97	ft		
Y_{s_lb} =	0.13	ft		
Y_{s_cw} =	-0.10	ft		
Y_s =	**0.00**	**ft**	***Therefore, no Contraction Scour***	

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SUBJECT Proposed Scour (31' Buried Span)

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

Contraction Scour - Pressure Flow Situation (No Overtopping):

Q500 - Channel:

Critical Velocity: $V_c = K_u Y_1^{1/6} D_{50}^{1/3}$ *(HEC 18, Eqn. 6.1)*

K_u =	11.17		(English Conversion Value)	*(HEC 18 Eqn. 6.1)*
Y_1 =	3.94	ft	(depth of flow in upstream section)	*(HEC-RAS)*
D_{50} =	1.00	in	(bed material particle size in a mixture of which 50% are smaller)	
	0.0833	ft		
V_c =	6.13	fps	(Critical Velocity above which material of size D50 and smaller will be transported)	
V =	8.91	fps	(Approach Velocity)	*(HEC-RAS)*

Method to Use: **Live Bed Scour**

Live Bed Scour: $Y_{2\_lb} = Y_1 (Q_2 / Q_1)^{6/7} (W_1 / W_2)^{k1}$ *(HEC 18 Eqn. 6.4)*

$V^* = (32.2\ Y_1\ S_1)^{1/2}$

$Y_{s\_lb} = Y_{2\_lb} + t - h_b$ *(HEC 18 Eqn. 6.14)*

Clear Water Scour: $Y_{2\_cw} = [(K_u Q_2^2) / (D_m^{2/3} W_2^2)]^{3/7}$ *(HEC 18 Eqn. 6.4)*

$D_m = 1.25\ D_{50}$

$Y_{s\_cw} = Y_{2\_cw} + t - h_b$ *(HEC 18 Eqn. 6.14)*

$t = 0.5\ h_b\ ((h_b\ h_t) / h_u^2)^{0.2} (1 - h_w / h_t)^{-0.1}$ *(HEC 18 Eqn. 6.16)*

h_b = Avg. Low Chord El. - Min. Channel El.

h_t = Pressure Only Water Surface Elevation - Avg. Low Chord

T = Avg. Deck El. - Avg. Low Chord

h_w = if $h_t > T$, $h_w = h_t - T$; if $h_t <= T$, $h_w = 0$

$D_s = D_{50}$ =	1.00	in	(bed material particle size in a mixture of which 50% are smaller)	
D_m =	0.1042	ft		*(HEC 18 Eqn. 6.4)*
T =	0.650	m/s	(fall velocity of bed material)	*(HEC 18 Fig. 6.8)*
	2.1320	ft/s		

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SUBJECT Proposed Scour (31' Buried Span)

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

S_1 =	0.0080	ft/ft	(slope of energy grade line)	*(HEC-RAS)*
V* =	1.01	ft/s	(shear velocity in the upstream section)	*(HEC 18 Section 6.3)*
V* / T =	0.47			
k_1 =	0.59			*(HEC 18 Section 6.3)*
K_u =	0.0077	ft		*(HEC 18 Eqn. 6.4)*
Q_2 =	721.07	cfs	(flow in contracted section)	*(HEC-RAS)*
W_2 =	27.00	ft	(bottom width in contracted channel)	*(HEC-RAS)*
Q_1 =	555.62	cfs	(flow in upstream channel)	*(HEC-RAS)*
W_1 =	15.82	ft	(bottom width in upstream channel)	*(HEC-RAS)*
Y_{2_lb} =	3.59	ft	(depth of flow in contracted section)	
Y_{2_cw} =	3.96	ft	(depth of flow in contracted section)	
Low Chord El. 1 =	1148.21	ft		*(HEC-RAS)*
Low Chord El. 2 =	1148.21	ft		*(HEC-RAS)*
Avg. Low Chord =	1148.21	ft		
Min. Channel El. =	1144.00	ft		*(HEC-RAS)*
$h_b = y_o$ =	4.21	ft	(vertical size of bridge opening prior to scour)	
Pressure Only WSE =	1149.10	ft		*(HEC-RAS)*
h_t =	0.89	ft	(water surface to avg. low chord	
$h_u = Y_1$ =	3.94	ft	(depth of flow in upstream section)	*(HEC-RAS)*
Deck El. 1 =	1152.13	ft		*(HEC-RAS)*
Deck El. 2 =	1152.12	ft		*(HEC-RAS)*
Avg. Deck El. =	1152.13	ft		
T =	3.91	ft	(structure depth - height of obstruction)	
h_w =	0.00	ft	(weir flow height - if no overtopping, 0)	*(HEC-RAS)*
t =	1.58	ft		
Y_{s_lb} =	0.97	ft		
Y_{s_cw} =	1.33	ft		
Y_s =	**0.97**	**ft**		

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JOB	Springfield, NH 16-0361		
SHEET NO.		OF	
CALCULATED BY	ETC	DATE	10/17
CHECKED BY	SRB	DATE	10/17

SUBJECT Proposed Scour (31' Buried Span)

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

Contraction Scour - Pressure Flow Situation (No Overtopping):

Q500 - Right of Bank

Critical Velocity: $V_c = K_u\ Y_1^{1/6}\ D_{50}^{1/3}$ *(HEC 18, Eqn. 6.1)*

K_u =	11.17		(English Conversion Value)	*(HEC 18 Eqn. 6.1)*
Y_1 =	0.75	ft	(depth of flow in upstream section)	*(HEC-RAS)*
D_{50} =	1.00	in	(bed material particle size in a mixture of which 50% are smaller)	
	0.0833	ft		
V_c =	4.65	fps	(Critical Velocity above which material of size D50 and smaller will be transported)	
V =	1.24	fps	(Approach Velocity)	*(HEC-RAS)*

Method to Use: **Clear Water Scour**

Live Bed Scour: $Y_{2\_lb} = Y_1\ (Q_2 / Q_1)^{6/7}\ (W_1 / W_2)^{k1}$ *(HEC 18 Eqn. 6.4)*

$V^* = (32.2\ Y_1\ S_1)^{1/2}$

$Y_{s\_lb} = Y_{2\_lb} + t - h_b$ *(HEC 18 Eqn. 6.14)*

Clear Water Scour: $Y_{2\_cw} = [(K_u\ Q_2^2) / (D_m^{2/3}\ W_2^2)]^{3/7}$ *(HEC 18 Eqn. 6.4)*

$D_m = 1.25\ D_{50}$

$Y_{s\_cw} = Y_{2\_cw} + t - h_b$ *(HEC 18 Eqn. 6.14)*

$t = 0.5\ h_b\ ((h_b\ h_t) / h_u^2)^{0.2}\ (1 - h_w / h_t)^{-0.1}$ *(HEC 18 Eqn. 6.16)*

h_b = Avg. Low Chord El. - Min. Channel El.

h_t = Pressure Only Water Surface Elevation - Avg. Low Chord

T = Avg. Deck El. - Avg. Low Chord

h_w = if $h_t > T$, $h_w = h_t - T$; if $h_t <= T$, $h_w = 0$

$D_s = D_{50}$ =	1.00	in	(bed material particle size in a mixture of which 50% are smaller)	
D_m =	0.1042	ft		*(HEC 18 Eqn. 6.4)*
T =	0.650	m/s	(fall velocity of bed material)	*(HEC 18 Fig. 6.8)*
	2.1320	ft/s		

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JOB	Springfield, NH 16-0361		
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CALCULATED BY	ETC	DATE	10/17
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SUBJECT Proposed Scour (31' Buried Span)

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

S_1 =	0.0080	ft/ft	(slope of energy grade line)	*(HEC-RAS)*
V* =	0.44	ft/s	(shear velocity in the upstream section)	*(HEC 18 Section 6.3)*
V* / T =	0.21			
k_1 =	0.59			*(HEC 18 Section 6.3)*
K_u =	0.0077	ft		*(HEC 18 Eqn. 6.4)*
Q_2 =	4.57	cfs	(flow in contracted section)	*(HEC-RAS)*
W_2 =	2.00	ft	(bottom width in contracted channel)	*(HEC-RAS)*
Q_1 =	6.03	cfs	(flow in upstream channel)	*(HEC-RAS)*
W_1 =	6.51	ft	(bottom width in upstream channel)	*(HEC-RAS)*
Y_{2_lb} =	1.19	ft	(depth of flow in contracted section)	
Y_{2_cw} =	0.48	ft	(depth of flow in contracted section)	
Low Chord El. 1 =	1148.21	ft		*(HEC-RAS)*
Low Chord El. 2 =	1148.21	ft		*(HEC-RAS)*
Avg. Low Chord =	1148.21	ft		
Approx. Channel El. =	1146.25	ft	(use lowest elev. closest to abut. face)	*(HEC-RAS)*
$h_b = y_o$ =	1.96	ft	(vertical size of bridge opening prior to scour)	
Pressure Only WSE =	1149.10	ft		*(HEC-RAS)*
h_t =	0.89	ft	(water surface to avg. low chord	
$h_u = Y_1$ =	0.75	ft	(depth of flow in upstream section)	*(HEC-RAS)*
Deck El. 1 =	1152.13	ft		*(HEC-RAS)*
Deck El. 2 =	1152.12	ft		*(HEC-RAS)*
Avg. Deck El. =	1152.13	ft		
T =	3.91	ft	(structure depth - height of obstruction)	
h_w =	0.00	ft	(weir flow height - if no overtopping, 0)	*(HEC-RAS)*
t =	1.23	ft		
Y_{s_lb} =	0.46	ft		
Y_{s_cw} =	-0.25	ft		
Y_s =	**0.00**	**ft**	***Therefore, no Contraction Scour***	

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JOB	Springfield, NH 16-0361		
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CALCULATED BY	ETC	DATE	10/17
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SUBJECT Proposed Scour (31' Buried Span)

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

Local Abutment Scour:

Froehlich's Eqn:	$Y_s/Y_a = 2.27\ K_1\ K_2\ (L'/Y_a)^{0.43}\ FR^{0.61} + 1$		*(HEC 18, Eqn. 8.1)*
	$K2 = (\theta/90)^{0.13}$		*(HEC 18, Eqn. 8.1)*
	$V_e = Q_e / A_e$		*(HEC 18, Eqn. 8.1)*
	$L = A_e / Y_a$		*(HEC 18, Eqn. 8.1)*
	$L' = L \sin\theta$	(if $\theta <= 90$)	*(See Backup Sheet)*
	$L' = L \sin(180 - \theta)$	(if $\theta > 90$)	*(See Backup Sheet)*
	$FR = V_e / (32.2\ Y_a)^{1/2}$		*(HEC 18, Eqn. 8.1)*

Left Abutment:

K_1 =	0.82	(coefficient for abutment shape)	*(HEC 18, Table 8.1)*
θ =	56.00	(embankment angle to flow)	*(See Backup Sheet)*
K_2 =	0.94	(coefficient for embankment angle to flow)	

	Q100	Q500		
Y_a (ft) =	0.87	1.35	(depth of flow at abutment face)	*(HEC-RAS)*
A_e (sq ft) =	32.70	50.93	(flow area obstructed by embankment)	*(HEC-RAS)*
Q_e (cfs) =	76.28	165.35	(flow in flow area, Ae)	*(HEC-RAS)*
V_e (fps) =	2.33	3.25	(velocity in flow area)	
L (ft) =	37.59	37.73	(abut. length normal to flow)	
L' (ft) =	31.16	31.28	(adjusted abut. length normal to flow)	
FR =	0.44	0.49	(Froude number)	
Y_s (ft) =	**5.17**	**7.27**	**(avg. scour depth)**	

Assumes all overbank flow is blocked by bridge - Conservative.

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JOB	Springfield, NH 16-0361		
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CALCULATED BY	ETC	DATE	10/17
CHECKED BY	SRB	DATE	10/17

SUBJECT Proposed Scour (31' Buried Span)

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

Local Abutment Scour:

Froehlich's Eqn:	$Y_s/Y_a = 2.27\ K_1\ K_2\ (L'/Y_a)^{0.43}\ FR^{0.61} + 1$		*(HEC 18, Eqn. 8.1)*
	$K2 = (\theta/90)^{0.13}$		*(HEC 18, Eqn. 8.1)*
	$V_e = Q_e / A_e$		*(HEC 18, Eqn. 8.1)*
	$L = A_e / Y_a$		*(HEC 18, Eqn. 8.1)*
	$L' = L \sin\theta$	(if $\theta <= 90$)	*(See Backup Sheet)*
	$L' = L \sin(180 - \theta)$	(if $\theta > 90$)	*(See Backup Sheet)*
	$FR = V_e / (32.2\ Y_a)^{1/2}$		*(HEC 18, Eqn. 8.1)*

Right Abutment:

K_1 =	0.82	(coefficient for abutment shape)	*(HEC 18, Table 8.1)*
θ =	124.00	(embankment angle to flow)	*(See Backup Sheet)*
K_2 =	1.04	(coefficient for embankment angle to flow)	

	Q100	Q500		
Y_a (ft) =	0.53	0.75	(depth of flow at abutment face)	*(HEC-RAS)*
A_e (sq ft) =	2.27	4.87	(flow area obstructed by embankment)	*(HEC-RAS)*
Q_e (cfs) =	2.13	6.03	(flow in flow area, Ae)	*(HEC-RAS)*
V_e (fps) =	0.94	1.24	(velocity in flow area)	
L (ft) =	4.28	6.49	(abut. length normal to flow)	
L' (ft) =	3.55	5.38	(adjusted abut. length normal to flow)	
FR =	0.23	0.25	(Froude number)	
Y_s (ft) =	**1.47**	**2.22**	**(avg. scour depth)**	

Assumes all overbank flow is blocked by bridge - Conservative.

PROPOSED 31' BURIED SPAN SCOUR SUMMARY TABLE

LOCATION	FLOOD EVENT	CONTRACTION SCOUR			LOCAL SCOUR
		LIVE BED	CLEAR WATER	CONTROLLING	FROEHLICH
		(feet)			(feet)
LEFT OF BANK	**Q100**	-0.25	-0.30	0.00	5.17
	Q500	0.13	-0.10	0.00	7.27
CHANNEL	**Q100**	0.45	0.48	0.45	N/A
	Q500	0.97	1.33	0.97	N/A
RIGHT OF BANK	**Q100**	0.01	-0.40	0.00	1.47
	Q500	0.46	-0.25	0.00	2.22

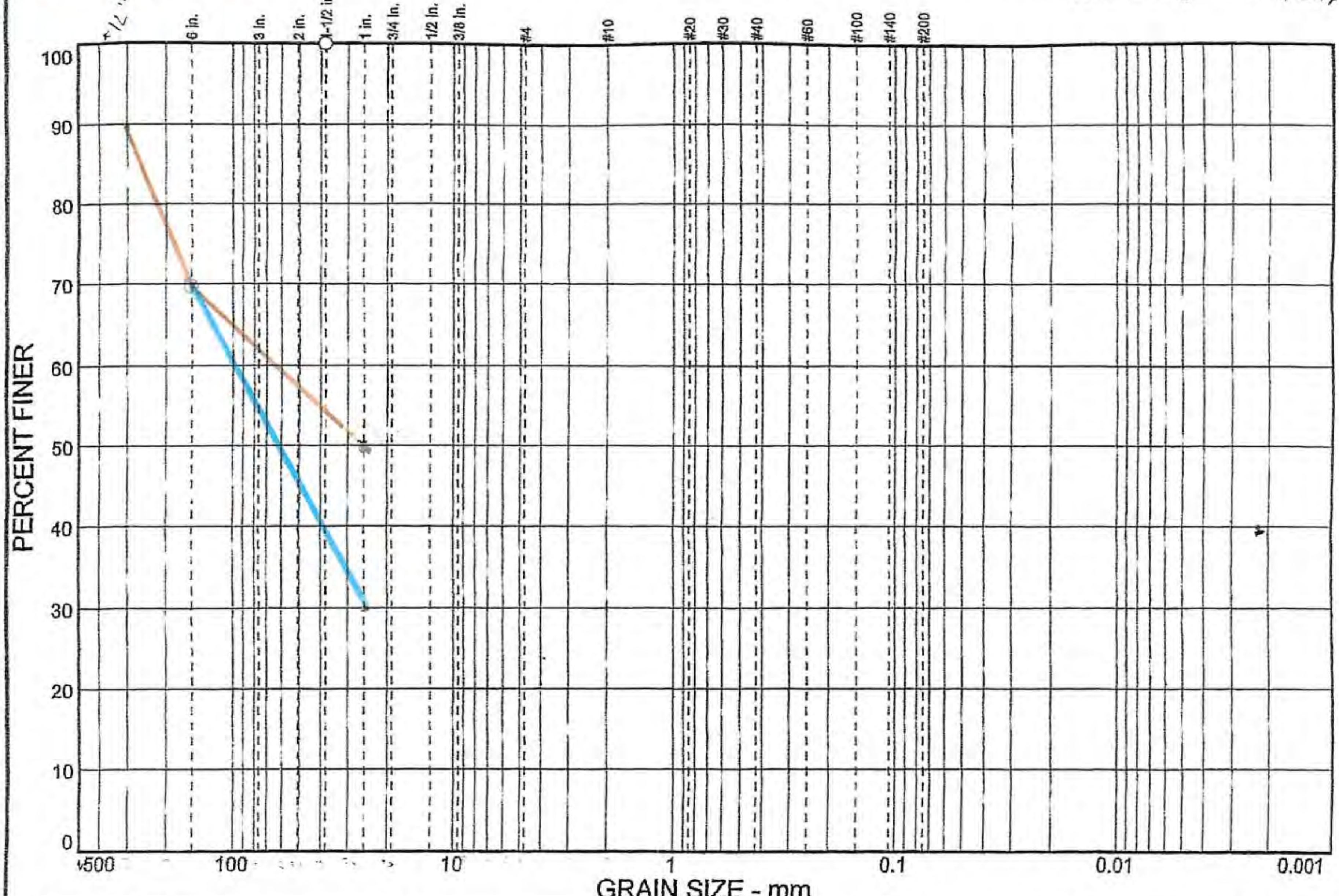
PROPOSED 31' BURIED SPAN SCOUR SUMMARY OF TOTALS TABLE

LOCATION	FLOOD EVENT	CONTRACTION SCOUR	LOCAL SCOUR	TOTAL SCOUR
		(feet)		
LEFT OF BANK	**Q100**	0.00	5.17	5.17
	Q500	0.00	7.27	7.27
CHANNEL	**Q100**	0.45	N/A	0.45
	Q500	0.97	N/A	0.97
RIGHT OF BANK	**Q100**	0.00	1.47	1.47
	Q500	0.00	2.22	2.22

Sf g field 20509

Particle Size Distribution Report

*Field estimate by US Chinburg on 8/4/2017



% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY

correctly account for the increase in transport that will occur as the result of the bed planing out (which decreases resistance to flow, increases the velocity and the transport of bed material at the bridge). That is, Laursen's equation indicates a decrease in scour for this case, whereas in reality, there would be an increase in scour depth. In addition, at flood flows, a plane bedform will usually exist upstream and through the bridge waterway, and the values of Manning n will be equal. Consequently, the n value ratio is not recommended or presented in Equation 6.2.

4. W_1 and W_2 are not always easily defined. In some cases, it is acceptable to use the topwidth of the main channel to define these widths. Whether topwidth or bottom width is used, it is important to be consistent so that W_1 and W_2 refer to either bottom widths or top widths.

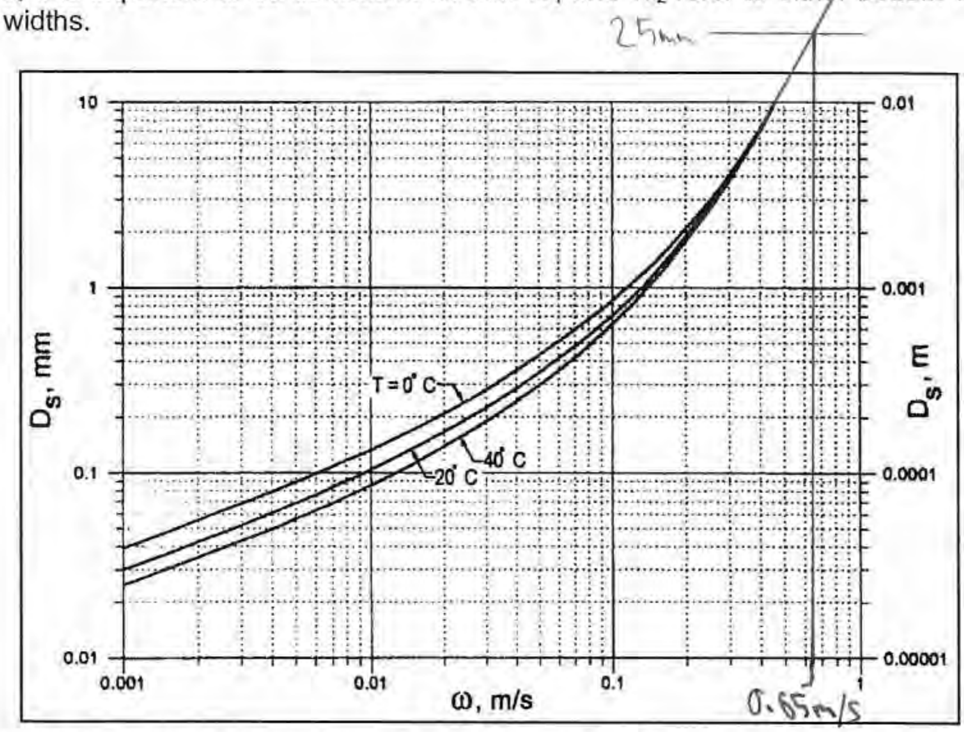


Figure 6.8. Fall velocity of sand-sized particles with specific gravity of 2.65 in metric units.

5. The average width of the bridge opening (W_2) is normally taken as the bottom width, with the width of the piers subtracted.

6. Laursen's equation will overestimate the depth of scour at the bridge if the bridge is located at the upstream end of a natural contraction or if the contraction is the result of the bridge abutments and piers. At this time, however, it is the best equation available.

7. In sand channel streams where the contraction scour hole is filled in on the falling stage, the y_0 depth may be approximated by y_1. Sketches or surveys through the bridge can help in determining the existing bed elevation.

8. **Scour depths with live-bed contraction scour may be limited by coarse sediments in the bed material armoring the bed. Where coarse sediments are present, it is recommended that scour depths be calculated for live-bed scour conditions using the clear-water scour equation (given in the next section) in addition to the live-bed equation, and that the smaller calculated scour depth be used.**

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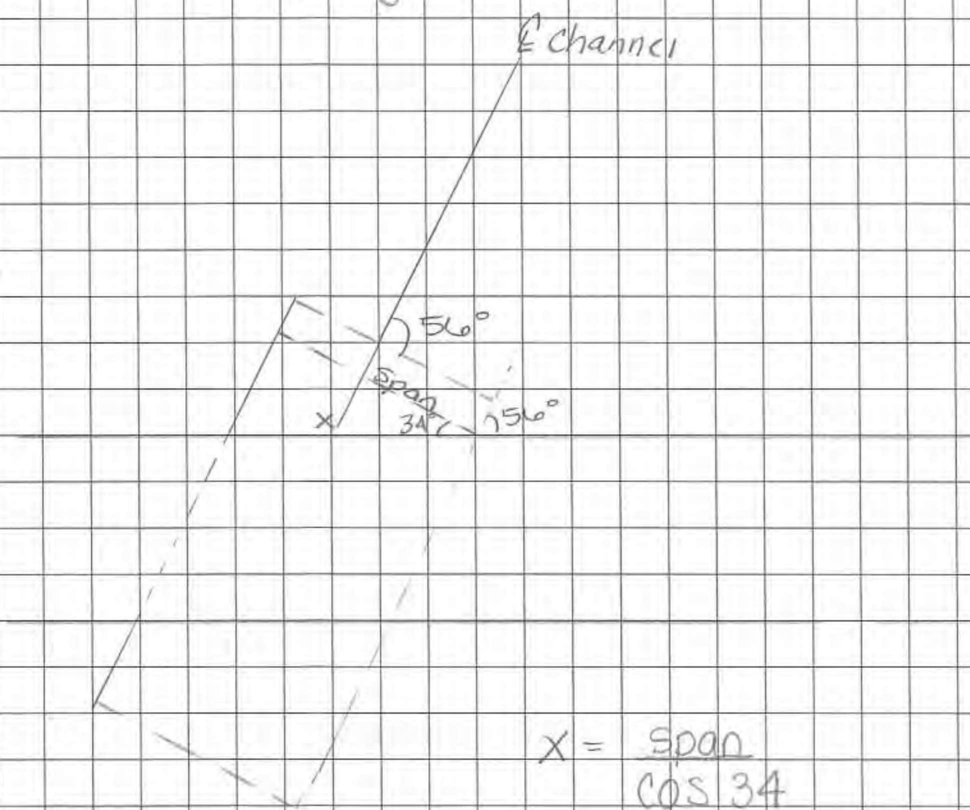
JOB Springfield, NH JOB NO. 1603161
SHEET NO. OF
CALCULATED BY SRB DATE 8/23/17
CHECKED BY FTC DATE 8/17
SUBJECT SCALE

Adjust structure opening for skewed stream to road.



$X = \frac{Span}{\cos 34}$

Span = 20' X = 24.12' 24.12' − 20' = 4.12/2 = 2.06'
Span = 31' X = 37.39' 37.39' − 31' = 6.39/2 = 3.20'

Plan: Buried 31-foot Unnamed Brook Brook RS: 1238 Profile: Q100

E.G. Elev (ft)	1149.74	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.83	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1148.91	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1148.91	Flow Area (sq ft)	32.70	54.75	2.27
E.G. Slope (ft/ft)	0.007483	Area (sq ft)	37.12	54.75	2.27
Q Total (cfs)	510.00	Flow (cfs)	76.28	431.58	2.13
Top Width (ft)	77.05	Top Width (ft)	56.96	15.82	4.27
Vel Total (ft/s)	5.68	Avg. Vel. (ft/s)	2.33	7.88	0.94
Max Chl Dpth (ft)	4.10	Hydr. Depth (ft)	0.87	3.46	0.53
Conv. Total (cfs)	5895.7	Conv. (cfs)	881.8	4989.2	24.7
Length Wtd. (ft)	55.99	Wetted Per. (ft)	37.82	17.41	4.61
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.40	1.47	0.23
Alpha	1.65	Stream Power (lb/ft s)	0.94	11.58	0.22
Frctn Loss (ft)	0.37	Cum Volume (acre-ft)	0.04	0.38	0.07
C & E Loss (ft)	0.06	Cum SA (acres)	0.07	0.14	0.06

Plan: Buried 31-foot Unnamed Brook Brook RS: 1238 Profile: Q500

E.G. Elev (ft)	1150.37	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.98	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1149.39	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1149.39	Flow Area (sq ft)	50.93	62.39	4.87
E.G. Slope (ft/ft)	0.008024	Area (sq ft)	71.92	62.39	4.87
Q Total (cfs)	727.00	Flow (cfs)	165.35	555.62	6.03
Top Width (ft)	116.84	Top Width (ft)	94.50	15.82	6.51
Vel Total (ft/s)	6.15	Avg. Vel. (ft/s)	3.25	8.91	1.24
Max Chl Dpth (ft)	4.58	Hydr. Depth (ft)	1.35	3.94	0.75
Conv. Total (cfs)	8115.9	Conv. (cfs)	1845.8	6202.7	67.4
Length Wtd. (ft)	55.99	Wetted Per. (ft)	37.82	17.41	6.90
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.67	1.80	0.35
Alpha	1.67	Stream Power (lb/ft s)	2.19	15.99	0.44
Frctn Loss (ft)	0.20	Cum Volume (acre-ft)	0.13	0.49	0.11
C & E Loss (ft)	0.18	Cum SA (acres)	0.14	0.11	0.07

Plan: Buried 31-foot Unnamed Brook Brook RS: 1165 BR U Profile: Q100

E.G. Elev (ft)	1147.73	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.91	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1146.82	Reach Len. (ft)	83.50	83.50	83.50
Crit W.S. (ft)	1146.63	Flow Area (sq ft)	1.13	65.89	1.13
E.G. Slope (ft/ft)	0.010493	Area (sq ft)	1.13	65.89	1.13
Q Total (cfs)	510.00	Flow (cfs)	2.35	506.26	1.39
Top Width (ft)	31.00	Top Width (ft)	2.00	27.00	2.00
Vel Total (ft/s)	7.48	Avg. Vel. (ft/s)	2.08	7.68	1.22
Max Chl Dpth (ft)	2.82	Hydr. Depth (ft)	0.57	2.44	0.57
Conv. Total (cfs)	4978.8	Conv. (cfs)	23.0	4942.3	13.5
Length Wtd. (ft)	83.50	Wetted Per. (ft)	2.00	28.06	2.00
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.37	1.54	0.37
Alpha	1.05	Stream Power (lb/ft s)	0.77	11.82	0.45
Frctn Loss (ft)	0.61	Cum Volume (acre-ft)	0.01	0.28	0.07
C & E Loss (ft)	0.15	Cum SA (acres)	0.02	0.10	0.06

Plan: Buried 31-foot Unnamed Brook Brook RS: 1165 BR U Profile: Q500

E.G. Elev (ft)	1149.49	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.72	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1148.21	Reach Len. (ft)	83.50	83.50	83.50
Crit W.S. (ft)	1147.22	Flow Area (sq ft)	3.92	103.54	3.92
E.G. Slope (ft/ft)	0.011336	Area (sq ft)	3.92	103.54	3.92
Q Total (cfs)	727.00	Flow (cfs)	9.38	713.05	4.57
Top Width (ft)		Top Width (ft)			
Vel Total (ft/s)	6.53	Avg. Vel. (ft/s)	2.39	6.89	1.16
Max Chl Dpth (ft)	4.21	Hydr. Depth (ft)			
Conv. Total (cfs)	6828.3	Conv. (cfs)	88.1	6697.3	42.9
Length Wtd. (ft)	83.50	Wetted Per. (ft)	5.96	55.06	7.92
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.47	1.33	0.35
Alpha	1.09	Stream Power (lb/ft s)	1.11	9.16	0.41
Frctn Loss (ft)		Cum Volume (acre-ft)	0.02	0.34	0.10
C & E Loss (ft)		Cum SA (acres)	0.02	0.08	0.06

Plan: Buried 31-foot Unnamed Brook Brook RS: 1165 BR D Profile: Q100

E.G. Elev (ft)	1146.97	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.61	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1146.36	Reach Len. (ft)	18.36	18.36	18.36
Crit W.S. (ft)	1145.63	Flow Area (sq ft)	1.90	80.56	1.81
E.G. Slope (ft/ft)	0.005354	Area (sq ft)	1.90	80.56	1.81
Q Total (cfs)	510.00	Flow (cfs)	2.33	505.53	2.14
Top Width (ft)	31.00	Top Width (ft)	2.00	27.00	2.00
Vel Total (ft/s)	6.05	Avg. Vel. (ft/s)	1.23	6.28	1.18
Max Chl Dpth (ft)	3.36	Hydr. Depth (ft)	0.95	2.98	0.91
Conv. Total (cfs)	6969.8	Conv. (cfs)	31.8	6908.6	29.3
Length Wtd. (ft)	18.36	Wetted Per. (ft)	2.02	28.06	2.05
Min Ch El (ft)	1143.00	Shear (lb/sq ft)	0.31	0.96	0.30
Alpha	1.07	Stream Power (lb/ft s)	0.38	6.02	0.35
Frctn Loss (ft)	0.15	Cum Volume (acre-ft)	0.01	0.14	0.06
C & E Loss (ft)	0.13	Cum SA (acres)	0.01	0.05	0.05

Plan: Buried 31-foot Unnamed Brook Brook RS: 1165 BR D Profile: Q500

E.G. Elev (ft)	1147.58	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.28	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1146.30	Reach Len. (ft)	18.36	18.36	18.36
Crit W.S. (ft)	1146.22	Flow Area (sq ft)	1.79	79.03	1.70
E.G. Slope (ft/ft)	0.011614	Area (sq ft)	1.79	79.03	1.70
Q Total (cfs)	727.00	Flow (cfs)	3.10	721.07	2.83
Top Width (ft)	31.00	Top Width (ft)	2.00	27.00	2.00
Vel Total (ft/s)	8.81	Avg. Vel. (ft/s)	1.73	9.12	1.67
Max Chl Dpth (ft)	3.30	Hydr. Depth (ft)	0.89	2.93	0.85
Conv. Total (cfs)	6746.0	Conv. (cfs)	28.7	6691.0	26.3
Length Wtd. (ft)	18.36	Wetted Per. (ft)	2.02	28.06	2.05
Min Ch El (ft)	1143.00	Shear (lb/sq ft)	0.64	2.04	0.60
Alpha	1.06	Stream Power (lb/ft s)	1.11	18.63	1.00
Frctn Loss (ft)		Cum Volume (acre-ft)	0.02	0.17	0.10
C & E Loss (ft)		Cum SA (acres)	0.02	0.05	0.06

HEC-RAS Plan: Buried 31-foot River: Unnamed Brook Reach: Brook

Reach	River Sta	Profile	E.G. US.	W.S. US.	BR Sel Method	Energy EG	Momen. EG	Yarnell EG	WSPRO EG	Prs O EG	Prs/Wr EG	Energy/Wr EG
			(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Brook	1165	Q2	1145.68	1145.45	Energy only	1145.68	1146.03					
Brook	1165	Q5	1146.25	1145.91	Energy only	1146.25	1146.63					
Brook	1165	Q10	1146.65	1146.24	Energy only	1146.65	1147.04					
Brook	1165	Q25	1147.14	1146.64	Energy only	1147.14	1147.51					
Brook	1165	Q50	1147.49	1146.92	Energy only	1147.49	1147.87					
Brook	1165	Q100	1147.89	1147.26	Energy only	1147.89	1148.26					
Brook	1165	Q500	1149.49	1149.10	Press Only	1148.79				1149.49		

20-FOOT SPAN AT-GRADE FRAME

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SUBJECT Proposed Scour (20' @ Grade Span))

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

Contraction Scour - Pressure Flow Situation (No Overtopping):

Q100 - Left of Bank

Critical Velocity: $V_c = K_u\ Y_1^{1/6}\ D_{50}^{1/3}$ *(HEC 18, Eqn. 6.1)*

$K_u =$ 11.17 (English Conversion Value) *(HEC 18 Eqn. 6.1)*

$Y_1 =$ 1.79 ft (depth of flow in upstream section) *(HEC-RAS)*

$D_{50} =$ 1.00 in (bed material particle size in a mixture of which 50% are smaller)

0.0833 ft

$V_c =$ 5.38 fps (Critical Velocity above which material of size D50 and smaller will be transported)

$V =$ 2.13 fps (Approach Velocity) *(HEC-RAS)*

Method to Use: **Clear Water Scour**

Per Hec-18, scour depths with live-bed contraction scour may be limited by coarse sediments in the bed material armoring the bed. Where coarse sediments are present, it is recommended that scour depths be calculated for live-bed scour conditions using the clear-water scour equation in addition to the live-bed equation, and that the smaller calculated scour depth be used.

Live Bed Scour: $Y_{2\_lb} = Y_1\ (Q_2 / Q_1)^{6/7}\ (W_1 / W_2)^{k1}$ *(HEC 18 Eqn. 6.4)*

$V^* = (32.2\ Y_1\ S_1)^{1/2}$

$Y_{s\_lb} = Y_{2\_lb} + t - h_b$ *(HEC 18 Eqn. 6.14)*

Clear Water Scour: $Y_{2\_cw} = [(K_u\ Q_2^2) / (D_m^{2/3}\ W_2^2)]^{3/7}$ *(HEC 18 Eqn. 6.4)*

$D_m = 1.25\ D_{50}$

$Y_{s\_cw} = Y_{2\_cw} + t - h_b$ *(HEC 18 Eqn. 6.14)*

$t = 0.5\ h_b\ ((h_b\ h_t) / h_u^2)^{0.2}\ (1 - h_w / h_t)^{-0.1}$ *(HEC 18 Eqn. 6.16)*

h_b = Avg. Low Chord El. - Min. Channel El.

h_t = Pressure Only Water Surface Elevation - Avg. Low Chord

T = Avg. Deck El. - Avg. Low Chord

h_w = if $h_t > T$, $h_w = h_t - T$; if $h_t \le T$, $h_w = 0$

$D_s = D_{50} =$ 1.00 in (bed material particle size in a mixture of which 50% are smaller)

$D_m =$ 0.1042 ft *(HEC 18 Eqn. 6.4)*

$T =$ 0.650 m/s (fall velocity of bed material) *(HEC 18 Fig. 6.8)*

2.1320 ft/s

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JOB	Springfield, NH 16-0361		
SHEET NO.		OF	
CALCULATED BY	ETC	DATE	10/17
CHECKED BY	SRB	DATE	10/17

SUBJECT Proposed Scour (20' @ Grade Span))

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

S_1 =	0.0024	ft/ft	(slope of energy grade line)	*(HEC-RAS)*
V* =	0.37	ft/s	(shear velocity in the upstream section)	*(HEC 18 Section 6.3)*
V* / T =	0.17			
k_1 =	0.59			*(HEC 18 Section 6.3)*
K_u =	0.0077	ft		*(HEC 18 Eqn. 6.4)*
Q_2 =	13.77	cfs	(flow in contracted section)	*(HEC-RAS)*
W_2 =	2.00	ft	(bottom width in contracted channel)	*(HEC-RAS)*
Q_1 =	143.45	cfs	(flow in upstream channel)	*(HEC-RAS)*
W_1 =	138.37	ft	(bottom width in upstream channel)	*(HEC-RAS)*
Y_{2_lb} =	2.92	ft	(depth of flow in contracted section)	
Y_{2_cw} =	1.24	ft	(depth of flow in contracted section)	
Low Chord El. 1 =	1149.12	ft		*(HEC-RAS)*
Low Chord El. 2 =	1149.12	ft		*(HEC-RAS)*
Avg. Low Chord =	1149.12	ft		
Approx. Channel El. =	1145.25	ft	(use lowest elev. closest to abut. face)	*(HEC-RAS)*
$h_b = y_o$ =	3.87	ft	(vertical size of bridge opening prior to scour)	
Pressure Only WSE =	1149.80	ft		*(HEC-RAS)*
h_t =	0.68	ft	(water surface to avg. low chord	
$h_u = Y_1$ =	1.79	ft	(depth of flow in upstream section)	*(HEC-RAS)*
Deck El. 1 =	1152.13	ft		*(HEC-RAS)*
Deck El. 2 =	1152.12	ft		*(HEC-RAS)*
Avg. Deck El. =	1152.13	ft		
T =	3.01	ft	(structure depth - height of obstruction)	
h_w =	0.00	ft	(weir flow height - if no overtopping, 0)	*(HEC-RAS)*
t =	1.86	ft		
Y_{s_lb} =	0.92	ft		
Y_{s_cw} =	-0.77	ft		
Y_s =	**0.00**	**ft**	***Therefore, no Contraction Scour***	

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SUBJECT Proposed Scour (20' @ Grade Span))

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

Contraction Scour - Pressure Flow Situation (No Overtopping):

Q100 - Channel:

Critical Velocity: $V_c = K_u\, Y_1^{1/6}\, D_{50}^{1/3}$ *(HEC 18, Eqn. 6.1)*

$K_u =$ 11.17 (English Conversion Value) *(HEC 18 Eqn. 6.1)*
$Y_1 =$ 5.19 ft (depth of flow in upstream section) *(HEC-RAS)*
$D_{50} =$ 1.00 in (bed material particle size in a mixture of which 50% are smaller)
0.0833 ft

$V_c =$ 6.42 fps (Critical Velocity above which material of size D50 and smaller will be transported)
$V =$ 4.38 fps (Approach Velocity) *(HEC-RAS)*

Method to Use: **Clear Water Scour**

Live Bed Scour: $Y_{2\_lb} = Y_1\,(Q_2 / Q_1)^{6/7}\,(W_1 / W_2)^{k1}$ *(HEC 18 Eqn. 6.4)*
$V^* = (32.2\, Y_1\, S_1)^{1/2}$
$Y_{s\_lb} = Y_{2\_lb} + t - h_b$ *(HEC 18 Eqn. 6.14)*

Clear Water Scour: $Y_{2\_cw} = [(K_u\, Q_2^{2}) / (D_m^{2/3}\, W_2^{2})]^{3/7}$ *(HEC 18 Eqn. 6.4)*
$D_m = 1.25\, D_{50}$
$Y_{s\_cw} = Y_{2\_cw} + t - h_b$ *(HEC 18 Eqn. 6.14)*

$t = 0.5\, h_b\, ((h_b\, h_t) / h_u^{2})^{0.2}\, (1 - h_w / h_t)^{-0.1}$ *(HEC 18 Eqn. 6.16)*
h_b = Avg. Low Chord El. - Min. Channel El.
h_t = Pressure Only Water Surface Elevation - Avg. Low Chord
T = Avg. Deck El. - Avg. Low Chord
h_w = if $h_t > T$, $h_w = h_t - T$; if $h_t <= T$, $h_w = 0$

$D_s = D_{50} =$ 1.00 in (bed material particle size in a mixture of which 50% are smaller)
$D_m =$ 0.1042 ft *(HEC 18 Eqn. 6.4)*
T = 0.650 m/s (fall velocity of bed material) *(HEC 18 Fig. 6.8)*
2.1320 ft/s

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SUBJECT Proposed Scour (20' @ Grade Span))

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

S_1 =	0.0024	ft/ft	(slope of energy grade line)	*(HEC-RAS)*
V* =	0.63	ft/s	(shear velocity in the upstream section)	*(HEC 18 Section 6.3)*
V* / T =	0.30			
k_1 =	0.59			*(HEC 18 Section 6.3)*
K_u =	0.0077	ft		*(HEC 18 Eqn. 6.4)*
Q_2 =	496.14	cfs	(flow in contracted section)	*(HEC-RAS)*
W_2 =	16.00	ft	(bottom width in contracted channel)	*(HEC-RAS)*
Q_1 =	359.78	cfs	(flow in upstream channel)	*(HEC-RAS)*
W_1 =	15.82	ft	(bottom width in upstream channel)	*(HEC-RAS)*
Y_{2_lb} =	6.79	ft	(depth of flow in contracted section)	
Y_{2_cw} =	4.50	ft	(depth of flow in contracted section)	
Low Chord El. 1 =	1149.12	ft		*(HEC-RAS)*
Low Chord El. 2 =	1149.12	ft		*(HEC-RAS)*
Avg. Low Chord =	1149.12	ft		
Min. Channel El. =	1144.00	ft		*(HEC-RAS)*
$h_b = y_o$ =	5.12	ft	(vertical size of bridge opening prior to scour)	
Pressure Only WSE =	1149.80	ft		*(HEC-RAS)*
h_t =	0.68	ft	(water surface to avg. low chord	
$h_u = Y_1$ =	5.19	ft	(depth of flow in upstream section)	*(HEC-RAS)*
Deck El. 1 =	1152.13	ft		*(HEC-RAS)*
Deck El. 2 =	1152.12	ft		*(HEC-RAS)*
Avg. Deck El. =	1152.13	ft		
T =	3.01	ft	(structure depth - height of obstruction)	
h_w =	0.00	ft	(weir flow height - if no overtopping, 0)	*(HEC-RAS)*
t =	1.70	ft		
Y_{s_lb} =	3.37	ft		
Y_{s_cw} =	1.08	ft		
Y_s =	**1.08**	**ft**		

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SUBJECT Proposed Scour (20' @ Grade Span))

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

Contraction Scour - Pressure Flow Situation (No Overtopping):

Q100 - Right of Bank

Critical Velocity: $V_c = K_u\ Y_1^{1/6}\ D_{50}^{1/3}$ *(HEC 18, Eqn. 6.1)*

K_u = 11.17 (English Conversion Value) *(HEC 18 Eqn. 6.1)*
Y_1 = 1.06 ft (depth of flow in upstream section) *(HEC-RAS)*
D_{50} = 1.00 in (bed material particle size in a mixture of which 50% are smaller)
0.0833 ft

V_c = 4.93 fps (Critical Velocity above which material of size D50 and smaller will be transported)
V = 0.85 fps (Approach Velocity) *(HEC-RAS)*

Method to Use: **Clear Water Scour**

Live Bed Scour: $Y_{2\_lb} = Y_1\ (Q_2 / Q_1)^{6/7}\ (W_1 / W_2)^{k1}$ *(HEC 18 Eqn. 6.4)*
$V^* = (32.2\ Y_1\ S_1)^{1/2}$
$Y_{s\_lb} = Y_{2\_lb} + t - h_b$ *(HEC 18 Eqn. 6.14)*

Clear Water Scour: $Y_{2\_cw} = [(K_u\ Q_2^2) / (D_m^{2/3}\ W_2^2)]^{3/7}$ *(HEC 18 Eqn. 6.4)*
$D_m = 1.25\ D_{50}$
$Y_{s\_cw} = Y_{2\_cw} + t - h_b$ *(HEC 18 Eqn. 6.14)*

$t = 0.5\ h_b\ ((h_b\ h_t) / h_u^2)^{0.2}\ (1 - h_w / h_t)^{-0.1}$ *(HEC 18 Eqn. 6.16)*
h_b = Avg. Low Chord El. - Min. Channel El.
h_t = Pressure Only Water Surface Elevation - Avg. Low Chord
T = Avg. Deck El. - Avg. Low Chord
h_w = if $h_t > T$, $h_w = h_t - T$; if $h_t \le T$, $h_w = 0$

$D_s = D_{50}$ = 1.00 in (bed material particle size in a mixture of which 50% are smaller)
D_m = 0.1042 ft *(HEC 18 Eqn. 6.4)*
T = 0.650 m/s (fall velocity of bed material) *(HEC 18 Fig. 6.8)*
2.1320 ft/s

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SUBJECT Proposed Scour (20' @ Grade Span))

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

S_1 =	0.0024	ft/ft	(slope of energy grade line)	*(HEC-RAS)*
V* =	0.28	ft/s	(shear velocity in the upstream section)	*(HEC 18 Section 6.3)*
V* / T =	0.13			
k_1 =	0.59			*(HEC 18 Section 6.3)*
K_u =	0.0077	ft		*(HEC 18 Eqn. 6.4)*
Q_2 =	6.93	cfs	(flow in contracted section)	*(HEC-RAS)*
W_2 =	2.00	ft	(bottom width in contracted channel)	*(HEC-RAS)*
Q_1 =	6.77	cfs	(flow in upstream channel)	*(HEC-RAS)*
W_1 =	7.49	ft	(bottom width in upstream channel)	*(HEC-RAS)*
Y_{2_lb} =	2.36	ft	(depth of flow in contracted section)	
Y_{2_cw} =	0.69	ft	(depth of flow in contracted section)	
Low Chord El. 1 =	1149.12	ft		*(HEC-RAS)*
Low Chord El. 2 =	1149.12	ft		*(HEC-RAS)*
Avg. Low Chord =	1149.12	ft		
Approx. Channel El. =	1145.25	ft	(use lowest elev. closest to abut. face)	*(HEC-RAS)*
$h_b = y_o$ =	3.87	ft	(vertical size of bridge opening prior to scour)	
Pressure Only WSE =	1149.80	ft		*(HEC-RAS)*
h_t =	0.68	ft	(water surface to avg. low chord	
$h_u = Y_1$ =	1.06	ft	(depth of flow in upstream section)	*(HEC-RAS)*
Deck El. 1 =	1152.13	ft		*(HEC-RAS)*
Deck El. 2 =	1152.12	ft		*(HEC-RAS)*
Avg. Deck El. =	1152.13	ft		
T =	3.01	ft	(structure depth - height of obstruction)	
h_w =	0.00	ft	(weir flow height - if no overtopping, 0)	*(HEC-RAS)*
t =	2.29	ft		
Y_{s_lb} =	0.78	ft		
Y_{s_cw} =	-0.89	ft		
Y_s =	**0.00**	**ft**	***Therefore, no Contraction Scour***	

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SUBJECT Proposed Scour (20' @ Grade Span))

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

Contraction Scour - Pressure Flow Situation (No Overtopping):

Q500 - Left of Bank

Critical Velocity: $V_c = K_u\, Y_1^{1/6}\, D_{50}^{1/3}$ *(HEC 18, Eqn. 6.1)*

K_u = 11.17 (English Conversion Value) *(HEC 18 Eqn. 6.1)*
Y_1 = 3.26 ft (depth of flow in upstream section) *(HEC-RAS)*
D_{50} = 1.00 in (bed material particle size in a mixture of which 50% are smaller)
0.0833 ft

V_c = 5.94 fps (Critical Velocity above which material of size D50 and smaller will be transported)
V = 2.31 fps (Approach Velocity) *(HEC-RAS)*

Method to Use: **Clear Water Scour**

Per Hec-18, scour depths with live-bed contraction scour may be limited by coarse sediments in the bed material armoring the bed. Where coarse sediments are present, it is recommended that scour depths be calculated for live-bed scour conditions using the clear-water scour equation in addition to the live-bed equation, and that the smaller calculated scour depth be used.

Live Bed Scour: $Y_{2\_lb} = Y_1\, (Q_2 / Q_1)^{6/7}\, (W_1 / W_2)^{k1}$ *(HEC 18 Eqn. 6.4)*
$V^* = (32.2\, Y_1\, S_1)^{1/2}$
$Y_{s\_lb} = Y_{2\_lb} + t - h_b$ *(HEC 18 Eqn. 6.14)*

Clear Water Scour: $Y_{2\_cw} = [(K_u\, Q_2^2) / (D_m^{2/3}\, W_2^2)]^{3/7}$ *(HEC 18 Eqn. 6.4)*
$D_m = 1.25\, D_{50}$
$Y_{s\_cw} = Y_{2\_cw} + t - h_b$ *(HEC 18 Eqn. 6.14)*

$t = 0.5\, h_b\, ((h_b\, h_t) / h_u^2)^{0.2}\, (1 - h_w / h_t)^{-0.1}$ *(HEC 18 Eqn. 6.16)*
h_b = Avg. Low Chord El. - Min. Channel El.
h_t = Pressure Only Water Surface Elevation - Avg. Low Chord
T = Avg. Deck El. - Avg. Low Chord
h_w = if $h_t > T$, $h_w = h_t - T$; if $h_t <= T$, $h_w = 0$

$D_s = D_{50}$ = 1.00 in (bed material particle size in a mixture of which 50% are smaller)
D_m = 0.1042 ft *(HEC 18 Eqn. 6.4)*
T = 0.650 m/s (fall velocity of bed material) *(HEC 18 Fig. 6.8)*
2.1320 ft/s

SUBJECT Proposed Scour (20' @ Grade Span))

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

S_1 =	0.0013	ft/ft	(slope of energy grade line)	*(HEC-RAS)*
V* =	0.36	ft/s	(shear velocity in the upstream section)	*(HEC 18 Section 6.3)*
V* / T =	0.17			
k_1 =	0.59			*(HEC 18 Section 6.3)*
K_u =	0.0077	ft		*(HEC 18 Eqn. 6.4)*
Q_2 =	19.63	cfs	(flow in contracted section)	*(HEC-RAS)*
W_2 =	2.00	ft	(bottom width in contracted channel)	*(HEC-RAS)*
Q_1 =	283.67	cfs	(flow in upstream channel)	*(HEC-RAS)*
W_1 =	224.37	ft	(bottom width in upstream channel)	*(HEC-RAS)*
Y_{2_lb} =	5.35	ft	(depth of flow in contracted section)	
Y_{2_cw} =	1.68	ft	(depth of flow in contracted section)	
Low Chord El. 1 =	1149.12	ft		*(HEC-RAS)*
Low Chord El. 2 =	1149.12	ft		*(HEC-RAS)*
Avg. Low Chord =	1149.12	ft		
Approx. Channel El. =	1145.25	ft	(use lowest elev. closest to abut. face)	*(HEC-RAS)*
$h_b = y_o$ =	3.87	ft	(vertical size of bridge opening prior to scour)	
Pressure Only WSE =	1151.21	ft		*(HEC-RAS)*
h_t =	2.09	ft	(water surface to avg. low chord	
$h_u = Y_1$ =	3.26	ft	(depth of flow in upstream section)	*(HEC-RAS)*
Deck El. 1 =	1152.13	ft		*(HEC-RAS)*
Deck El. 2 =	1152.12	ft		*(HEC-RAS)*
Avg. Deck El. =	1152.13	ft		
T =	3.01	ft	(structure depth - height of obstruction)	
h_w =	0.00	ft	(weir flow height - if no overtopping, 0)	*(HEC-RAS)*
t =	1.83	ft		
Y_{s_lb} =	3.31	ft		
Y_{s_cw} =	-0.36	ft		
Y_s =	**0.00**	**ft**	***Therefore, no Contraction Scour***	

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SUBJECT Proposed Scour (20' @ Grade Span))

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

Contraction Scour - Pressure Flow Situation (No Overtopping):

Q500 - Channel:

Critical Velocity: $V_c = K_u\, Y_1^{1/6}\, D_{50}^{1/3}$ *(HEC 18, Eqn. 6.1)*

K_u =	11.17		(English Conversion Value)	*(HEC 18 Eqn. 6.1)*
Y_1 =	5.85	ft	(depth of flow in upstream section)	*(HEC-RAS)*
D_{50} =	1.00	in	(bed material particle size in a mixture of which 50% are smaller)	
	0.0833	ft		
V_c =	6.55	fps	(Critical Velocity above which material of size D50 and smaller will be transported)	
V =	4.58	fps	(Approach Velocity)	*(HEC-RAS)*

Method to Use: **Clear Water Scour**

Live Bed Scour: $Y_{2\_lb} = Y_1\,(Q_2 / Q_1)^{6/7}\,(W_1 / W_2)^{k1}$ *(HEC 18 Eqn. 6.4)*

$V^* = (32.2\, Y_1\, S_1)^{1/2}$

$Y_{s\_lb} = Y_{2\_lb} + t - h_b$ *(HEC 18 Eqn. 6.14)*

Clear Water Scour: $Y_{2\_cw} = [(K_u\, Q_2^{\,2}) / (D_m^{\,2/3}\, W_2^{\,2})]^{3/7}$ *(HEC 18 Eqn. 6.4)*

$D_m = 1.25\, D_{50}$

$Y_{s\_cw} = Y_{2\_cw} + t - h_b$ *(HEC 18 Eqn. 6.14)*

$t = 0.5\, h_b\, ((h_b\, h_t) / h_u^{\,2})^{0.2}\, (1 - h_w / h_t)^{-0.1}$ *(HEC 18 Eqn. 6.16)*

h_b = Avg. Low Chord El. - Min. Channel El.

h_t = Pressure Only Water Surface Elevation - Avg. Low Chord

T = Avg. Deck El. - Avg. Low Chord

h_w = if $h_t > T$, $h_w = h_t - T$; if $h_t <= T$, $h_w = 0$

$D_s = D_{50}$ =	1.00	in	(bed material particle size in a mixture of which 50% are smaller)	
D_m =	0.1042	ft		*(HEC 18 Eqn. 6.4)*
T =	0.650	m/s	(fall velocity of bed material)	*(HEC 18 Fig. 6.8)*
	2.1320	ft/s		

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SUBJECT Proposed Scour (20' @ Grade Span))

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

S_1 =	0.0013	ft/ft	(slope of energy grade line)	*(HEC-RAS)*
V* =	0.49	ft/s	(shear velocity in the upstream section)	*(HEC 18 Section 6.3)*
V* / T =	0.23			
k_1 =	0.59			*(HEC 18 Section 6.3)*
K_u =	0.0077	ft		*(HEC 18 Eqn. 6.4)*
Q_2 =	698.85	cfs	(flow in contracted section)	*(HEC-RAS)*
W_2 =	16.00	ft	(bottom width in contracted channel)	*(HEC-RAS)*
Q_1 =	423.49	cfs	(flow in upstream channel)	*(HEC-RAS)*
W_1 =	15.82	ft	(bottom width in upstream channel)	*(HEC-RAS)*
Y_{2_lb} =	8.93	ft	(depth of flow in contracted section)	
Y_{2_cw} =	6.04	ft	(depth of flow in contracted section)	
Low Chord El. 1 =	1149.12	ft		*(HEC-RAS)*
Low Chord El. 2 =	1149.12	ft		*(HEC-RAS)*
Avg. Low Chord =	1149.12	ft		
Min. Channel El. =	1144.00	ft		*(HEC-RAS)*
$h_b = y_o$ =	5.12	ft	(vertical size of bridge opening prior to scour)	
Pressure Only WSE =	1151.21	ft		*(HEC-RAS)*
h_t =	2.09	ft	(water surface to avg. low chord	
$h_u = Y_1$ =	5.85	ft	(depth of flow in upstream section)	*(HEC-RAS)*
Deck El. 1 =	1152.13	ft		*(HEC-RAS)*
Deck El. 2 =	1152.12	ft		*(HEC-RAS)*
Avg. Deck El. =	1152.13	ft		
T =	3.01	ft	(structure depth - height of obstruction)	
h_w =	0.00	ft	(weir flow height - if no overtopping, 0)	*(HEC-RAS)*
t =	2.03	ft		
Y_{s_lb} =	5.84	ft		
Y_{s_cw} =	2.95	ft		
Y_s =	**2.95**	**ft**		

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JOB	Springfield, NH 16-0361		
SHEET NO.		OF	
CALCULATED BY	ETC	DATE	10/17
CHECKED BY	SRB	DATE	10/17

SUBJECT Proposed Scour (20' @ Grade Span))

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

Contraction Scour - Pressure Flow Situation (No Overtopping):

Q500 - Right of Bank

Critical Velocity: $V_c = K_u\ Y_1^{1/6}\ D_{50}^{1/3}$ *(HEC 18, Eqn. 6.1)*

K_u =	11.17		(English Conversion Value)	*(HEC 18 Eqn. 6.1)*
Y_1 =	2.09	ft	(depth of flow in upstream section)	*(HEC-RAS)*
D_{50} =	1.00	in	(bed material particle size in a mixture of which 50% are smaller)	
	0.0833	ft		
V_c =	5.52	fps	(Critical Velocity above which material of size D50 and smaller will be transported)	
V =	0.95	fps	(Approach Velocity)	*(HEC-RAS)*

Method to Use: **Clear Water Scour**

Live Bed Scour: $Y_{2\_lb} = Y_1\ (Q_2 / Q_1)^{6/7}\ (W_1 / W_2)^{k1}$ *(HEC 18 Eqn. 6.4)*

$V^* = (32.2\ Y_1\ S_1)^{1/2}$

$Y_{s\_lb} = Y_{2\_lb} + t - h_b$ *(HEC 18 Eqn. 6.14)*

Clear Water Scour: $Y_{2\_cw} = [(K_u\ Q_2^2) / (D_m^{2/3}\ W_2^2)]^{3/7}$ *(HEC 18 Eqn. 6.4)*

$D_m = 1.25\ D_{50}$

$Y_{s\_cw} = Y_{2\_cw} + t - h_b$ *(HEC 18 Eqn. 6.14)*

$t = 0.5\ h_b\ ((h_b\ h_t) / h_u^2)^{0.2}\ (1 - h_w / h_t)^{-0.1}$ *(HEC 18 Eqn. 6.16)*

h_b = Avg. Low Chord El. - Min. Channel El.

h_t = Pressure Only Water Surface Elevation - Avg. Low Chord

T = Avg. Deck El. - Avg. Low Chord

h_w = if $h_t > T$, $h_w = h_t - T$; if $h_t <= T$, $h_w = 0$

$D_s = D_{50}$ =	1.00	in	(bed material particle size in a mixture of which 50% are smaller)	
D_m =	0.1042	ft		*(HEC 18 Eqn. 6.4)*
T =	0.650	m/s	(fall velocity of bed material)	*(HEC 18 Fig. 6.8)*
	2.1320	ft/s		

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JOB	Springfield, NH 16-0361		
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SUBJECT Proposed Scour (20' @ Grade Span))

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

S_1 =	0.0013	ft/ft	(slope of energy grade line)	*(HEC-RAS)*
V* =	0.29	ft/s	(shear velocity in the upstream section)	*(HEC 18 Section 6.3)*
V* / T =	0.14			
k_1 =	0.59			*(HEC 18 Section 6.3)*
K_u =	0.0077	ft		*(HEC 18 Eqn. 6.4)*
Q_2 =	14.07	cfs	(flow in contracted section)	*(HEC-RAS)*
W_2 =	2.00	ft	(bottom width in contracted channel)	*(HEC-RAS)*
Q_1 =	19.83	cfs	(flow in upstream channel)	*(HEC-RAS)*
W_1 =	9.97	ft	(bottom width in upstream channel)	*(HEC-RAS)*
Y_{2_lb} =	4.02	ft	(depth of flow in contracted section)	
Y_{2_cw} =	1.26	ft	(depth of flow in contracted section)	
Low Chord El. 1 =	1149.12	ft		*(HEC-RAS)*
Low Chord El. 2 =	1149.12	ft		*(HEC-RAS)*
Avg. Low Chord =	1149.12	ft		
Approx. Channel El. =	1145.25	ft	(use lowest elev. closest to abut. face)	*(HEC-RAS)*
$h_b = y_o$ =	3.87	ft	(vertical size of bridge opening prior to scour)	
Pressure Only WSE =	1151.21	ft		*(HEC-RAS)*
h_t =	2.09	ft	(water surface to avg. low chord	
$h_u = Y_1$ =	2.09	ft	(depth of flow in upstream section)	*(HEC-RAS)*
Deck El. 1 =	1152.13	ft		*(HEC-RAS)*
Deck El. 2 =	1152.12	ft		*(HEC-RAS)*
Avg. Deck El. =	1152.13	ft		
T =	3.01	ft	(structure depth - height of obstruction)	
h_w =	0.00	ft	(weir flow height - if no overtopping, 0)	*(HEC-RAS)*
t =	2.19	ft		
Y_{s_lb} =	2.34	ft		
Y_{s_cw} =	-0.42	ft		
Y_s =	**0.00**	**ft**	***Therefore, no Contraction Scour***	

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JOB	Springfield, NH 16-0361		
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SUBJECT Proposed Scour (20' @ Grade Span))

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

Local Abutment Scour:

Froehlich's Eqn:

$Y_s/Y_a = 2.27\ K_1\ K_2\ (L'/Y_a)^{0.43}\ FR^{0.61} + 1$		*(HEC 18, Eqn. 8.1)*
$K2 = (\theta/90)^{0.13}$		*(HEC 18, Eqn. 8.1)*
$V_e = Q_e / A_e$		*(HEC 18, Eqn. 8.1)*
$L = A_e / Y_a$		*(HEC 18, Eqn. 8.1)*
$L' = L \sin\theta$	(if $\theta <= 90$)	*(See Backup Sheet)*
$L' = L \sin(180 - \theta)$	(if $\theta > 90$)	*(See Backup Sheet)*
$FR = V_e / (32.2\ Y_a)^{1/2}$		*(HEC 18, Eqn. 8.1)*

Left Abutment:

K_1 =	0.82	(coefficient for abutment shape)	*(HEC 18, Table 8.1)*
θ =	56.00	(embankment angle to flow)	*(See Backup Sheet)*
K_2 =	0.94	(coefficient for embankment angle to flow)	

	Q100	Q500		
Y_a (ft) =	1.79	3.26	(depth of flow at abutment face)	*(HEC-RAS)*
A_e (sq ft) =	67.43	122.95	(flow area obstructed by embankment)	*(HEC-RAS)*
Q_e (cfs) =	143.45	283.67	(flow in flow area, Ae)	*(HEC-RAS)*
V_e (fps) =	2.13	2.31	(velocity in flow area)	
L (ft) =	37.67	37.71	(abut. length normal to flow)	
L' (ft) =	31.23	31.27	(adjusted abut. length normal to flow)	
FR =	0.28	0.23	(Froude number)	
Y_s (ft) =	**6.72**	**9.33**	**(avg. scour depth)**	

Assumes all overbank flow is blocked by bridge - Conservative.

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SUBJECT Proposed Scour (20' @ Grade Span))

References: "Evaluating Scour at Bridges", HEC-18, 4/2012

Local Abutment Scour:

Froehlich's Eqn:	$Y_s/Y_a = 2.27\ K_1\ K_2\ (L'/Y_a)^{0.43}\ FR^{0.61} + 1$		*(HEC 18, Eqn. 8.1)*
	$K2 = (\theta/90)^{0.13}$		*(HEC 18, Eqn. 8.1)*
	$V_e = Q_e / A_e$		*(HEC 18, Eqn. 8.1)*
	$L = A_e / Y_a$		*(HEC 18, Eqn. 8.1)*
	$L' = L \sin\theta$	(if $\theta <= 90$)	*(See Backup Sheet)*
	$L' = L \sin(180 - \theta)$	(if $\theta > 90$)	*(See Backup Sheet)*
	$FR = V_e / (32.2\ Y_a)^{1/2}$		*(HEC 18, Eqn. 8.1)*

Right Abutment:

K_1 =	0.82	(coefficient for abutment shape)	*(HEC 18, Table 8.1)*
θ =	124.00	(embankment angle to flow)	*(See Backup Sheet)*
K_2 =	1.04	(coefficient for embankment angle to flow)	

	Q100	Q500		
Y_a (ft) =	1.06	2.09	(depth of flow at abutment face)	*(HEC-RAS)*
A_e (sq ft) =	7.97	19.83	(flow area obstructed by embankment)	*(HEC-RAS)*
Q_e (cfs) =	6.77	20.80	(flow in flow area, Ae)	*(HEC-RAS)*
V_e (fps) =	0.85	1.05	(velocity in flow area)	
L (ft) =	7.52	9.49	(abut. length normal to flow)	
L' (ft) =	6.23	7.87	(adjusted abut. length normal to flow)	
FR =	0.15	0.13	(Froude number)	
Y_s (ft) =	**2.42**	**4.14**	**(avg. scour depth)**	

Assumes all overbank flow is blocked by bridge - Conservative.

PROPOSED 20' SPAN AT GRADE SCOUR SUMMARY TABLE

LOCATION	FLOOD EVENT	CONTRACTION SCOUR			LOCAL SCOUR
		LIVE BED	CLEAR WATER	CONTROLLING	FROEHLICH
		(feet)			(feet)
LEFT OF BANK	Q100	0.92	-0.77	0.00	6.72
	Q500	3.31	-0.36	0.00	9.33
CHANNEL	Q100	3.37	1.08	1.08	N/A
	Q500	5.84	2.95	2.95	N/A
RIGHT OF BANK	Q100	0.78	-0.89	0.00	2.42
	Q500	2.34	-0.42	0.00	4.14

PROPOSED 20' SPAN AT GRADE SCOUR SUMMARY OF TOTALS TABLE

LOCATION	FLOOD EVENT	CONTRACTION SCOUR	LOCAL SCOUR	TOTAL SCOUR
		(feet)		
LEFT OF BANK	Q100	0.00	6.72	6.72
	Q500	0.00	9.33	9.33
CHANNEL	Q100	1.08	N/A	1.08
	Q500	2.95	N/A	2.95
RIGHT OF BANK	Q100	0.00	2.42	2.42
	Q500	0.00	4.14	4.14

Plan: At-Grade 20-foot Unnamed Brook Brook RS: 1238 Profile: Q100

E.G. Elev (ft)	1150.14	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.32	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1149.83	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1148.91	Flow Area (sq ft)	67.43	69.30	7.97
E.G. Slope (ft/ft)	0.002370	Area (sq ft)	122.74	69.30	7.97
Q Total (cfs)	510.00	Flow (cfs)	143.45	359.78	6.77
Top Width (ft)	161.68	Top Width (ft)	138.37	15.82	7.49
Vel Total (ft/s)	3.52	Avg. Vel. (ft/s)	2.13	5.19	0.85
Max Chl Dpth (ft)	5.02	Hydr. Depth (ft)	1.79	4.38	1.06
Conv. Total (cfs)	10475.2	Conv. (cfs)	2946.4	7389.7	139.1
Length Wtd. (ft)	55.99	Wetted Per. (ft)	37.82	17.41	7.99
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.26	0.59	0.15
Alpha	1.63	Stream Power (lb/ft s)	0.56	3.06	0.13
Frctn Loss (ft)	0.09	Cum Volume (acre-ft)	0.27	0.36	0.10
C & E Loss (ft)	0.03	Cum SA (acres)	0.23	0.08	0.07

Plan: At-Grade 20-foot Unnamed Brook Brook RS: 1238 Profile: Q500

E.G. Elev (ft)	1151.52	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.22	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1151.30	Reach Len. (ft)	55.99	55.99	55.99
Crit W.S. (ft)	1149.39	Flow Area (sq ft)	122.95	92.56	20.80
E.G. Slope (ft/ft)	0.001252	Area (sq ft)	415.40	92.56	20.80
Q Total (cfs)	727.00	Flow (cfs)	283.67	423.49	19.83
Top Width (ft)	250.15	Top Width (ft)	224.37	15.82	9.97
Vel Total (ft/s)	3.08	Avg. Vel. (ft/s)	2.31	4.58	0.95
Max Chl Dpth (ft)	6.49	Hydr. Depth (ft)	3.26	5.85	2.09
Conv. Total (cfs)	20549.8	Conv. (cfs)	8018.5	11970.7	560.6
Length Wtd. (ft)	55.99	Wetted Per. (ft)	37.82	17.41	10.87
Min Ch El (ft)	1144.81	Shear (lb/sq ft)	0.25	0.42	0.15
Alpha	1.51	Stream Power (lb/ft s)	0.59	1.90	0.14
Frctn Loss (ft)	0.06	Cum Volume (acre-ft)	0.71	0.43	0.15
C & E Loss (ft)	0.00	Cum SA (acres)	0.37	0.08	0.09

Plan: At-Grade 20-foot Unnamed Brook Brook RS: 1165 BR U Profile: Q100

E.G. Elev (ft)	1150.02	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.65	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1149.12	Reach Len. (ft)	63.50	63.50	63.50
Crit W.S. (ft)	1147.62	Flow Area (sq ft)	5.74	74.33	5.74
E.G. Slope (ft/ft)	0.008281	Area (sq ft)	5.74	74.33	5.74
Q Total (cfs)	510.00	Flow (cfs)	13.77	489.81	6.42
Top Width (ft)		Top Width (ft)			
Vel Total (ft/s)	5.94	Avg. Vel. (ft/s)	2.40	6.59	1.12
Max Chl Dpth (ft)	5.12	Hydr. Depth (ft)			
Conv. Total (cfs)	5604.4	Conv. (cfs)	151.3	5382.6	70.5
Length Wtd. (ft)	63.50	Wetted Per. (ft)	6.87	33.36	9.74
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.43	1.15	0.30
Alpha	1.19	Stream Power (lb/ft s)	1.04	7.59	0.34
Frctn Loss (ft)		Cum Volume (acre-ft)	0.04	0.22	0.08
C & E Loss (ft)		Cum SA (acres)	0.03	0.05	0.07

Plan: At-Grade 20-foot Unnamed Brook Brook RS: 1165 BR U Profile: Q500

E.G. Elev (ft)	1151.45	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.32	Wt. n-Val.	0.050	0.035	0.085
W.S. Elev (ft)	1149.12	Reach Len. (ft)	63.50	63.50	63.50
Crit W.S. (ft)	1148.40	Flow Area (sq ft)	5.74	74.33	5.74
E.G. Slope (ft/ft)	0.016827	Area (sq ft)	5.74	74.33	5.74
Q Total (cfs)	727.00	Flow (cfs)	19.63	698.22	9.15
Top Width (ft)		Top Width (ft)			
Vel Total (ft/s)	8.47	Avg. Vel. (ft/s)	3.42	9.39	1.59
Max Chl Dpth (ft)	5.12	Hydr. Depth (ft)			
Conv. Total (cfs)	5604.4	Conv. (cfs)	151.3	5382.6	70.5
Length Wtd. (ft)	63.50	Wetted Per. (ft)	6.87	33.36	9.74
Min Ch El (ft)	1144.00	Shear (lb/sq ft)	0.88	2.34	0.62
Alpha	1.19	Stream Power (lb/ft s)	3.00	21.99	0.99
Frctn Loss (ft)		Cum Volume (acre-ft)	0.06	0.26	0.13
C & E Loss (ft)		Cum SA (acres)	0.03	0.05	0.07

Plan: At-Grade 20-foot Unnamed Brook Brook RS: 1165 BR D Profile: Q100

E.G. Elev (ft)	1148.09	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.43	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1146.66	Reach Len. (ft)	26.36	26.36	26.36
Crit W.S. (ft)	1146.63	Flow Area (sq ft)	2.82	50.96	2.82
E.G. Slope (ft/ft)	0.012517	Area (sq ft)	2.82	50.96	2.82
Q Total (cfs)	510.00	Flow (cfs)	6.93	496.14	6.93
Top Width (ft)	20.00	Top Width (ft)	2.00	16.00	2.00
Vel Total (ft/s)	9.01	Avg. Vel. (ft/s)	2.46	9.74	2.46
Max Chl Dpth (ft)	3.66	Hydr. Depth (ft)	1.41	3.18	1.41
Conv. Total (cfs)	4558.5	Conv. (cfs)	61.9	4434.6	61.9
Length Wtd. (ft)	26.36	Wetted Per. (ft)	2.00	17.36	2.00
Min Ch El (ft)	1143.00	Shear (lb/sq ft)	1.10	2.29	1.10
Alpha	1.14	Stream Power (lb/ft s)	2.71	22.33	2.71
Frctn Loss (ft)		Cum Volume (acre-ft)	0.03	0.13	0.08
C & E Loss (ft)		Cum SA (acres)	0.03	0.04	0.06

Plan: At-Grade 20-foot Unnamed Brook Brook RS: 1165 BR D Profile: Q500

E.G. Elev (ft)	1149.26	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.83	Wt. n-Val.	0.085	0.035	0.085
W.S. Elev (ft)	1147.43	Reach Len. (ft)	26.36	26.36	26.36
Crit W.S. (ft)	1147.43	Flow Area (sq ft)	4.36	63.29	4.36
E.G. Slope (ft/ft)	0.012056	Area (sq ft)	4.36	63.29	4.36
Q Total (cfs)	727.00	Flow (cfs)	14.07	698.85	14.07
Top Width (ft)	20.00	Top Width (ft)	2.00	16.00	2.00
Vel Total (ft/s)	10.10	Avg. Vel. (ft/s)	3.23	11.04	3.23
Max Chl Dpth (ft)	4.43	Hydr. Depth (ft)	2.18	3.96	2.18
Conv. Total (cfs)	6621.1	Conv. (cfs)	128.2	6364.7	128.2
Length Wtd. (ft)	26.36	Wetted Per. (ft)	2.00	17.36	2.00
Min Ch El (ft)	1143.00	Shear (lb/sq ft)	1.64	2.74	1.64
Alpha	1.15	Stream Power (lb/ft s)	5.30	30.30	5.30
Frctn Loss (ft)		Cum Volume (acre-ft)	0.05	0.16	0.12
C & E Loss (ft)		Cum SA (acres)	0.03	0.04	0.07

HEC-RAS Plan: At-Grade 20-foot River: Unnamed Brook Reach: Brook

Reach	River Sta	Profile	E.G. US.	W.S. US.	BR Sel Method	Energy EG	Momen. EG	Yarnell EG	WSPRO EG	Prs O EG	Prs/Wr EG	Energy/Wr EG
			(ft)	(ft)		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)
Brook	1165	Q2	1146.50	1146.23	Energy only	1146.50	1146.77					
Brook	1165	Q5	1147.25	1146.88	Energy only	1147.25	1147.51					
Brook	1165	Q10	1147.78	1147.40	Energy only	1147.78	1148.00					
Brook	1165	Q25	1148.44	1148.10	Energy only	1148.44	1148.57					
Brook	1165	Q50	1148.92	1148.59	Energy only	1148.92	1148.98					
Brook	1165	Q100	1150.02	1149.80	Press Only	1149.49				1150.02		
Brook	1165	Q500	1151.45	1151.21	Press Only	1150.71				1151.45		

APPENDIX H

COUNTERMEASURE DESIGN

31-FOOT SPAN BURIED FRAME

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JOB	Springfield 16-0361		
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SUBJECT **STONE FILL SIZING - 100-Year Flood Event (31' span buried)**

Reference:
HEC-23, DGN 14.3 Sizing Rock Riprap at Abutments

STONE SIZE - For Froude Numbers $V/(gy)^{1/2}$ </= 0.80, $D_{50} = y K / (S_s - 1) \times [V^2 / (gy)]$
STONE SIZE - For Froude Numbers $V/(gy)^{1/2}$ > 0.80, $D_{50} = y K / (S_s - 1) \times [V^2 / (gy)]^{0.14}$

FROUDE NUMBER
$F = V/(gy)^{1/2}$ =

V =	*Velocity in Channel in contracted section=*	7.48	**ft/s (see attached)**
y =	*Average Flow Depth in contracted section =*	2.20	**ft (see attached)**
g =	*Gravitational Acceleration =*	**32.20**	**ft/s^2**
F =		**0.89**	> **0.80**

THEREFORE, REQUIRED STONE SIZE IS
$1.5D_{50}$ is the minimum stone size to use in the channel for scour protection.
D50 = y K / (Ss - 1) x [V^2 / (gy)]^0.14 = **0.88** **ft**

Spill-through or Vertical Wall Abutments?		**V**	**(V/ST)**
K =	*Constant for Froude Number </= 0.80*	**0.89**	**Spill-through Abutment**
		1.02	**Vertical Wall Abutment**
K =	*Constant for Froude Number > 0.80*	**0.61**	**Spill-through Abutment**
		0.69	**Vertical Wall Abutment**
S_s =	*Specific Gravity of Rip Rap =*	2.67	**(NHDOT BDM, Section 2.7.7C)**

Determine approximate D_{50} of NHDOT Riprap, Item 583:

Class V Riprap
15% - 85% of Mass has Volume > 3.5 ft^3 *(See NHDOT Standard Specs for Road and Bridge Construction)*
Assume Cubic = r^3 = 3.5 ft^3
$d_{50} = [3.5]^{1/3}$ = **1.52** **ft**

Class III Riprap
15% - 85% of Mass has Volume > 1 ft^3 *(See NHDOT Standard Specs for Road and Bridge Construction)*
Assume Cubic = r^3 = 1 ft^3
$d_{50} = [1]^{1/3}$ = **1.00** **ft**

Therefore, Use Riprap Class III for Scour Protection - Class III Item 583.5

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JOB	Springfield 16-0361		
SHEET NO.		OF	
CALCULATED BY	ETC	DATE	10/17
CHECKED BY	SRB	DATE	10/17

SUBJECT **STONE FILL SIZING - 100-Year Flood Event (31' span buried)**

Reference:
HEC-23, DGN 14.3 Sizing Rock Riprap at Abutments

Riprap Extents

Extent of Riprap from Toe of Abutment into Channel

Flow Depth=		2.20	ft
Apron Extent=	2 x 2.2=	4.4	ft from toe of abutment < 25ft
Use		**5**	**ft from toe of abutment (each face)**

Extent of Riprap extending Parallel to the Approach Embankment at Downstream End

›ownstream Coverage	2 x 2.2=	4.4	ft back from abutment downstream
Minimum Coverage=		25	ft back from abutment downstream
Use		**25**	**ft back from abutment downstream**

Riprap Thickness

Required D50=	0.88	ft
1.5D50=	1.32	ft
D100=	2	*ft (Max Size of Riprap Class III in NHDOT Standard Specs)*
Max=	**2**	**ft (max of 1.5D50 and D100)**

SUBJECT **STONE FILL SIZING - 500-Year Flood Event (31' span buried)**

Reference:
HEC-23, DGN 14.3 Sizing Rock Riprap at Abutments

STONE SIZE - For Froude Numbers $V/(gy)^{1/2}$ </= 0.80, $D_{50} = y K / (S_s - 1) \times [V^2 / (gy)]$
STONE SIZE - For Froude Numbers $V/(gy)^{1/2} > 0.80$, $D_{50} = y K / (S_s - 1) \times [V^2 / (gy)]^{0.14}$

FROUDE NUMBER
$F = V/(gy)^{1/2}$ =

V =	*Velocity in Channel in contracted section=*	8.81	**ft/s (see attached)**
y =	*Average Flow Depth in contracted section =*	2.66	**ft (see attached)**
g =	*Gravitational Acceleration =*	32.20	**ft/s^2**
F =		**0.95**	> **0.80**

THEREFORE, REQUIRED STONE SIZE IS
$1.5D_{50}$ is the minimum stone size to use in the channel for scour protection.
D50 = y K / (Ss - 1) x [V^2 / (gy)]^0.14 = **1.08** **ft**

Spill-through or Vertical Wall Abutments? **V** **(V/ST)**

K =	*Constant for Froude Number </= 0.80*	0.89	**Spill-through Abutment**
		1.02	**Vertical Wall Abutment**
K =	*Constant for Froude Number > 0.80*	0.61	**Spill-through Abutment**
		0.69	**Vertical Wall Abutment**
S_s =	*Specific Gravity of Rip Rap =*	2.67	**(NHDOT BDM, Section 2.7.7C)**

Determine approximate D_{50} of NHDOT Riprap, Item 583:

Class V Riprap
15% - 85% of Mass has Volume > 3.5 ft^3 *(See NHDOT Standard Specs for Road and Bridge Construction)*
Assume Cubic = $r^3 = 3.5\ ft^3$
$d_{50} = [3.5]^{1/3}$ = **1.52** **ft**

Class III Riprap
15% - 85% of Mass has Volume > 1 ft^3 *(See NHDOT Standard Specs for Road and Bridge Construction)*
Assume Cubic = $r^3 = 1\ ft^3$
$d_{50} = [1]^{1/3}$ = **1.00** **ft**

Therefore, Use Riprap Class V for Scour Protection - Class V Item 583.7

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JOB	Springfield 16-0361		
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SUBJECT **STONE FILL SIZING - 500-Year Flood Event (31' span buried)**

Reference:
HEC-23, DGN 14.3 Sizing Rock Riprap at Abutments

Riprap Extents

Extent of Riprap from Toe of Abutment into Channel

Flow Depth=		2.66	ft
Apron Extent=	2 x 2.66=	5.32	ft from toe of abutment < 25ft
Use		**6**	**ft from toe of abutment (each face)**

Extent of Riprap extending Parallel to the Approach Embankment at Downstream End

›ownstream Coverage	2 x 2.66=	5.32	ft back from abutment downstream
Minimum Coverage=		25	ft back from abutment downstream
Use		**25**	**ft back from abutment downstream**

Riprap Thickness

Required D50=	1.08	ft
1.5D50=	1.63	ft
D100=	3	*ft (Max Size of Riprap Class V in NHDOT Standard Specs)*
Max=	**3**	**ft (max of 1.5D50 and D100)**

BRIDGE OUTPUT Profile #Q100

E.G. US. (ft)	1147.89	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	1147.26	E.G. Elev (ft)	1147.73	1146.97
Q Total (cfs)	510.00	W.S. Elev (ft)	1146.82	1146.36
Q Bridge (cfs)	510.00	Crit W.S. (ft)	1146.63	1145.63
Q Weir (cfs)		Max Chl Dpth (ft)	2.82	3.36
Weir Sta Lft (ft)		Vel Total (ft/s)	7.48	6.05
Weir Sta Rgt (ft)		Flow Area (sq ft)	68.16	84.28
Weir Submerg		Froude # Chl	0.80	0.60
Weir Max Depth (ft)		Specif Force (cu ft)	207.74	226.32
Min El Weir Flow (ft)	1152.12	Hydr Depth (ft)	2.20	2.72
Min El Prs (ft)	1148.21	W.P. Total (ft)	32.06	32.13
Delta EG (ft)	1.19	Conv. Total (cfs)	4978.8	6969.8
Delta WS (ft)	1.59	Top Width (ft)	31.00	31.00
BR Open Area (sq ft)	111.38	Frctn Loss (ft)	0.61	0.15
BR Open Vel (ft/s)	7.48	C & E Loss (ft)	0.15	0.13
BR Sluice Coef	0.00	Shear Total (lb/sq ft)	1.39	0.88
BR Sel Method	Energy only	Power Total (lb/ft s)	10.42	5.31

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #Q500

E.G. US. (ft)	1149.49	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	1149.10	E.G. Elev (ft)	1149.49	1147.58
Q Total (cfs)	727.00	W.S. Elev (ft)	1148.21	1146.30
Q Bridge (cfs)	727.00	Crit W.S. (ft)	1147.22	1146.22
Q Weir (cfs)		Max Chl Dpth (ft)	4.21	3.30
Weir Sta Lft (ft)		Vel Total (ft/s)	6.53	8.81
Weir Sta Rgt (ft)		Flow Area (sq ft)	111.38	82.52
Weir Submerg		Froude # Chl	0.59	0.88
Weir Max Depth (ft)		Specif Force (cu ft)	365.28	327.53
Min El Weir Flow (ft)	1152.12	Hydr Depth (ft)		2.66
Min El Prs (ft)	1148.21	W.P. Total (ft)	68.94	32.13
Delta EG (ft)	2.00	Conv. Total (cfs)	6828.3	6746.0
Delta WS (ft)	2.79	Top Width (ft)		31.00
BR Open Area (sq ft)	111.38	Frctn Loss (ft)		
BR Open Vel (ft/s)	6.53	C & E Loss (ft)		
BR Sluice Coef	0.00	Shear Total (lb/sq ft)	1.14	1.86
BR Sel Method	Press Only	Power Total (lb/ft s)	7.46	16.40

20-FOOT SPAN AT-GRADE FRAME

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SUBJECT **STONE FILL SIZING - 100-Year Flood Event (20' span @ grade)**

Reference:
HEC-23, DGN 14.3 Sizing Rock Riprap at Abutments

STONE SIZE - For Froude Numbers $V/(gy)^{1/2}$ </= 0.80, D_{50} =y K / (S_s - 1) x [V^2 / (gy)]
STONE SIZE - For Froude Numbers $V/(gy)^{1/2}$ > 0.80, D_{50} =y K / (S_s - 1) x [V^2 / (gy)]$^{0.14}$

FROUDE NUMBER
$F = V/(gy)^{1/2}$ =

V =	*Velocity in Channel in contracted section=*	9.01	**ft/s (see attached)**
y =	*Average Flow Depth in contracted section =*	2.83	**ft (see attached)**
g =	*Gravitational Acceleration =*	**32.20**	**ft/s^2**
F =		**0.94**	**> 0.80**

THEREFORE, REQUIRED STONE SIZE IS
1.5D_{50} is the minimum stone size to use in the channel for scour protection.
D50 = y K / (Ss - 1) x [V^2 / (gy)]^0.14 = 1.15 ft

Spill-through or Vertical Wall Abutments? V (V/ST)

K =	*Constant for Froude Number </= 0.80*	**0.89**	**Spill-through Abutment**
		1.02	**Vertical Wall Abutment**
K =	*Constant for Froude Number > 0.80*	**0.61**	**Spill-through Abutment**
		0.69	**Vertical Wall Abutment**
S_s =	*Specific Gravity of Rip Rap =*	2.67	**(NHDOT BDM, Section 2.7.7C)**

Determine approximate D_{50} of NHDOT Riprap, Item 583:

Class V Riprap
15% - 85% of Mass has Volume > 3.5 ft^3 *(See NHDOT Standard Specs for Road and Bridge Construction)*
Assume Cubic = r^3 = 3.5 ft^3
$d_{50} = [3.5]^{1/3}$ = **1.52 ft**

Class III Riprap
15% - 85% of Mass has Volume > 1 ft^3 *(See NHDOT Standard Specs for Road and Bridge Construction)*
Assume Cubic = r^3 = 1 ft^3
$d_{50} = [1]^{1/3}$ = **1.00 ft**

Therefore, Use Riprap Class V for Scour Protection - Class V Item 583.7

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SUBJECT **STONE FILL SIZING - 100-Year Flood Event (20' span @ grade)**

Reference:
HEC-23, DGN 14.3 Sizing Rock Riprap at Abutments

Riprap Extents

Extent of Riprap from Toe of Abutment into Channel

Flow Depth=		2.83	ft
Apron Extent=	2 x 2.83=	5.66	ft from toe of abutment < 25ft
Use		**6**	**ft from toe of abutment (each face)**

Extent of Riprap extending Parallel to the Approach Embankment at Downstream End

ownstream Coverage	2 x 2.83=	5.66	ft back from abutment downstream
Minimum Coverage=		25	ft back from abutment downstream
Use		**25**	**ft back from abutment downstream**

Riprap Thickness

Required D50=	1.15	ft
1.5D50=	1.73	ft
D100=	3	*ft (Max Size of Riprap Class V in NHDOT Standard Specs)*
Max=	**3**	**ft (max of 1.5D50 and D100)**

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SUBJECT **STONE FILL SIZING - 500-Year Flood Event (20' span @ grade)**

Reference:
HEC-23, DGN 14.3 Sizing Rock Riprap at Abutments

STONE SIZE - For Froude Numbers $V/(gy)^{1/2}$ </= 0.80, $D_{50} = y K / (S_s - 1) \times [V^2 / (gy)]$
STONE SIZE - For Froude Numbers $V/(gy)^{1/2}$ > 0.80, $D_{50} = y K / (S_s - 1) \times [V^2 / (gy)]^{0.14}$

FROUDE NUMBER
$F = V/(gy)^{1/2}$ =

V =	*Velocity in Channel in contracted section=*	10.10	**ft/s (see attached)**
y =	*Average Flow Depth in contracted section =*	3.60	**ft (see attached)**
g =	*Gravitational Acceleration =*	32.20	**ft/s^2**
F =		**0.94**	> **0.80**

THEREFORE, REQUIRED STONE SIZE IS
$1.5D_{50}$ is the minimum stone size to use in the channel for scour protection.
D50 = y K / (Ss - 1) x [V^2 / (gy)]^0.14 = **1.46** **ft**

Spill-through or Vertical Wall Abutments? **V** **(V/ST)**

K =	*Constant for Froude Number </= 0.80*	0.89	**Spill-through Abutment**
		1.02	**Vertical Wall Abutment**
K =	*Constant for Froude Number > 0.80*	0.61	**Spill-through Abutment**
		0.69	**Vertical Wall Abutment**
S_s =	*Specific Gravity of Rip Rap =*	2.67	**(NHDOT BDM, Section 2.7.7C)**

Determine approximate D_{50} of NHDOT Riprap, Item 583:

Class V Riprap
15% - 85% of Mass has Volume > 3.5 ft^3 *(See NHDOT Standard Specs for Road and Bridge Construction)*
Assume Cubic = r^3 = 3.5 ft^3
$d_{50} = [3.5]^{1/3}$ = **1.52** **ft**

Class III Riprap
15% - 85% of Mass has Volume > 1 ft^3 *(See NHDOT Standard Specs for Road and Bridge Construction)*
Assume Cubic = r^3 = 1 ft^3
$d_{50} = [1]^{1/3}$ = **1.00** **ft**

Therefore, Use Riprap Class V for Scour Protection - Class V Item 583.7

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SUBJECT **STONE FILL SIZING - 500-Year Flood Event (20' span @ grade)**

Reference:
HEC-23, DGN 14.3 Sizing Rock Riprap at Abutments

Riprap Extents

Extent of Riprap from Toe of Abutment into Channel

Flow Depth=		3.60	ft
Apron Extent=	2 x 3.6=	7.2	ft from toe of abutment < 25ft
Use		**8**	**ft from toe of abutment (each face)**

Extent of Riprap extending Parallel to the Approach Embankment at Downstream End

ownstream Coverage	2 x 3.6=	7.2	ft back from abutment downstream
Minimum Coverage=		25	ft back from abutment downstream
Use		**25**	**ft back from abutment downstream**

Riprap Thickness

Required D50=	1.46	ft
1.5D50=	2.19	ft
D100=	4	*ft (Max Siz of Riprap Class VII in NHDOT Standard Specs)*
Max=	**4**	**ft (max of 1.5D50 and D100)**

BRIDGE OUTPUT Profile #Q100

E.G. US. (ft)	1150.02	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	1149.80	E.G. Elev (ft)	1150.02	1148.09
Q Total (cfs)	510.00	W.S. Elev (ft)	1149.12	1146.66
Q Bridge (cfs)	510.00	Crit W.S. (ft)	1147.62	1146.63
Q Weir (cfs)		Max Chl Dpth (ft)	5.12	3.66
Weir Sta Lft (ft)		Vel Total (ft/s)	5.94	9.01
Weir Sta Rgt (ft)		Flow Area (sq ft)	85.81	56.59
Weir Submerg		Froude # Chl	0.50	0.89
Weir Max Depth (ft)		Specif Force (cu ft)	294.50	240.09
Min El Weir Flow (ft)	1152.12	Hydr Depth (ft)		2.83
Min El Prs (ft)	1149.12	W.P. Total (ft)	49.97	21.36
Delta EG (ft)	2.16	Conv. Total (cfs)	5604.4	4558.5
Delta WS (ft)	3.14	Top Width (ft)		20.00
BR Open Area (sq ft)	85.81	Frctn Loss (ft)		
BR Open Vel (ft/s)	5.94	C & E Loss (ft)		
BR Sluice Coef	0.00	Shear Total (lb/sq ft)	0.89	2.07
BR Sel Method	Press Only	Power Total (lb/ft s)	5.28	18.66

Warning: For the final momentum answer at the bridge, the upstream energy was computed lower than the downstream energy. This is not physically possible, the momentum answer has been disregarded.

Note: Momentum answer is not valid if the water surface is above the low chord or if there is weir flow. The momentum answer has been disregarded.

Note: The downstream water surface is below the minimum elevation for pressure flow. The sluice gate equations were used for pressure flow.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #Q500

E.G. US. (ft)	1151.45	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	1151.21	E.G. Elev (ft)	1151.45	1149.26
Q Total (cfs)	727.00	W.S. Elev (ft)	1149.12	1147.43
Q Bridge (cfs)	727.00	Crit W.S. (ft)	1148.40	1147.43
Q Weir (cfs)		Max Chl Dpth (ft)	5.12	4.43
Weir Sta Lft (ft)		Vel Total (ft/s)	8.47	10.10
Weir Sta Rgt (ft)		Flow Area (sq ft)	85.81	72.01
Weir Submerg		Froude # Chl	0.72	0.91
Weir Max Depth (ft)		Specif Force (cu ft)	399.24	381.05
Min El Weir Flow (ft)	1152.12	Hydr Depth (ft)		3.60
Min El Prs (ft)	1149.12	W.P. Total (ft)	49.97	21.36
Delta EG (ft)	2.69	Conv. Total (cfs)	5604.4	6621.1
Delta WS (ft)	3.87	Top Width (ft)		20.00
BR Open Area (sq ft)	85.81	Frctn Loss (ft)		
BR Open Vel (ft/s)	8.47	C & E Loss (ft)		
BR Sluice Coef	0.00	Shear Total (lb/sq ft)	1.80	2.54
BR Sel Method	Press Only	Power Total (lb/ft s)	15.28	25.61

Attachment 19 -
Public Meeting Transcript

In the Matter Of:

DOT BUREAU OF RIGHT-OF-WAY PUBLIC HEARING

SPRINGFIELD PROJECT 20509

August 10, 2022

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STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION

BUREAU OF RIGHT-OF-WAY

PUBLIC HEARING and FINDING OF NECESSITY MEETING

SPRINGFIELD, PROJECT 20509

PROPOSAL TO REPLACE EXISTING BRIDGE

THAT CARRIES GEORGES MILL ROAD OVER STAR LAKE OUTLET

Public Hearing held at Springfield Town Hall, 2750 Main Street, in accordance with RSA 230:14 and the Surface Transportation and Uniform Relocation Assistance Act of 1987 to discuss the proposal to replace the existing red list, twin-pipe bridge that carries Georges Mills Road over Star Lake Outlet, in the town of Springfield, New Hampshire, commencing at 6:01 p.m.

PUBLIC HEARING THUS HELD BEFORE THE COMMISSION MEMBERS APPOINTED BY THE GOVERNOR AND EXECUTIVE COUNCIL:

COMMISSION OF THREE PERSONS MEMBERS:
Bruce Temple, Chairperson
Jessica Hatch, Member
John Simon, Member

SPEAKERS PRESENTING:
Stephanie Beaumont, Project Manager, Fuss & O'Neill
Jonathan Evans, Bureau of Environment, NHDOT
Stephen LaBonte, Administrator, Bureau of Right-of-Way, NHDOT

OTHER ATTENDEES FROM NHDOT:
Paul Coddington, Chief of Administration, Bureau of Right-of Way, NHDOT
Jennifer Reczek, P.E., Bureau of Bridge Design, NHDOT

MR. PAUL CODDINGTON: Good evening. Welcome to Springfield, New Hampshire. My name is Paul Coddington. I'm with the Department of Transportation. My team planned this meeting, and I'm glad the chairs are full. If you are not familiar with this building, the restroom is downstairs -- down here and down the hall downstairs.

Ken, you would know better than I do -- exit. So, if we are in trouble, go out the way you came in or go out that door. I wouldn't go all the way down the stairs. That's about it. We have no fire alarms.

We have a presentation for you this evening, and I'm going to turn the meeting over to the chairperson of our commission.

MR. BRUCE TEMPLE: Good evening. I appreciate everyone coming out this evening. Thank you. This hearing for Springfield Project Number 20509 is called to order at -- 6:01?

MR. STEPHEN LABONTE: 6:0l.

MR. BRUCE TEMPLE: 6:01 p.m., Wednesday, August 10, 2022. I'm Bruce Temple, chairman of this commission appointed by the governor and executive council. Jessica Hatch and John Simon are also members of this commission.

This hearing is being held pursuant to RSA 230:14 and the Surface Transportation and Uniform Relocation Assistance Act of 1987, and is being recorded. The purpose of the hearing is to gather comments from the public, hear evidence of the economic, environmental, and sociological effects of the project, and its consistency with the goals and objectives of the Department of Transportation.

It is the commission's responsibility to determine, based on all information provided, if the project should go forward as proposed. It is, therefore, important that all individuals who want to make requests or suggestions do so during the hearing.

At this time, I would like to ask Jennifer Reczek, the project manager from New Hampshire DOT, to speak. She will introduce the rest of the DOT team. Then Steve LaBonte, administrator for the Bureau of Right-of-Way, will speak about the process that the DOT follows after the hearing. After this, I'll open up the floor to those that wish to address the commission.

Jennifer...

MS. JENNIFER RECZEK: Thank you, Chairman, and members of the commission. Good evening, ladies and gentlemen. It's my pleasure to be here this evening on behalf of the Department. As Chairman mentioned, this is a public hearing to present the Department's layout for the bridge replacement project on Georges Mills Road here in Springfield. I would first like to introduce the other people here this evening representing the Department.

John Evans, to my direct left, is with our Bureau of Environment. Steve LaBonte, two down, is with our Bureau of Right-of-Way. I also have Shannon Beaumont, who is sitting on the far side. She works with Fuss & O'Neill, who's our consultant partner on this project. I also have John Stockton in the back in green, as well as a whole crew from our Bureau of Right-of-Way in the back corner. And they'll be working with people to acquire the property rights and have worked hard to organize the hearing tonight.

The project that we're presenting proposes to replace the existing poor-condition bridge that carries Georges Mills Road over Star Lake Outlet. The bridge has been on the Department's red list since 2008, and is currently ranked 104 on the Draft 2021 Replacement and Rehabilitation Priority List. The project has previously been included in the State's ten-year transportation plan, and, sort of by error, got omitted in the most recent version because we thought it had already advertised -- well, not -- but we really didn't think -- but, administratively, it appeared to have already advertised.

But it is still planned to be constructed with funding in Fiscal Year 2024. The project plans were presented at a public informational meeting in February of 2018, and reviewed again with the Springfield Select Board in February of 2022. The feedback that we received at those meetings has been used to inform the design and traffic control that is being presented here this evening.

Once we've completed this presentation, I will turn the meeting back to the commission chairman, and receive any questions or comments from those in attendance. I will now ask Shannon Beaumont to explain what you see on the plans over along the wall and to provide the details of the proposed layout.

MS. SHANNON BEAUMONT: Thank you, Jennifer. I'm here tonight to present the Department's selected alternative for the bridge replacement, the Georges Mills over Star Lake Outlet. It's right here in Springfield. I'm going to start by giving you a little bit of information about the plan that we have here.

The top of the page up here is north, more or less. The Georges Mills Road runs west to east across the page. Stryker Road is at the top of the intersection in the north. And Fisher Corner Road is here to the south.

Star Lake Outlet flows north to south. The red boxes here are existing buildings. The dark green are wooded areas. The light brown and the light gray is existing road and existing driveways. The dark gray is gravel or stone-fill areas. The yellow is proposed pavement. And the dark brown areas here are new shoulder areas. The light green is proposed roadway embankment slopes.

And, then, you can kind of see here from a distance -- these dashed blue lines are the existing right-of-way lines on both sides of the road here, and up each of the side roads. There's two dark blue lines here. Those are proposed right-of-way lines. And then there's two orange lines here and here, and then one over there. Those are proposed easements.

To elaborate on what Jennifer said, the existing structure was constructed in 1951. It consists of two 5-foot-diameter corrugated metal pipes. The upstream headwall up here is stone, and the downstream consists of dry stone -- also dry stone. It runs diagonally across the intersection, which makes the geometry quite interesting. And, as Jennifer noted, it is on the State's red list due to its poor condition. It has light to moderate rust throughout, scattered holes.

The upstream invert is undermined, and there is water that flows underneath the pipe rather than through it. To our knowledge, there isn't a history of flooding at this intersection. Our hydraulic analysis indicated that the road would be overtopped for a storm event greater than the 25-year storm. The proposed structure -- you can kind of see -- this here is a typical section of the proposed structure -- it is a 20-foot span by 76-foot-long precast concrete box culvert. It runs in the same configuration as the existing structures.

The larger span -- so it's pretty much double the span, and that will increase, substantially, the hydraulic capacity of the structure, which is the ability of the structure to convey the flow. This will help to minimize any potential future overtopping of Georges Mill Road.

It was designed to accommodate the 50-year design storm, with one foot of free ~~three~~-board. Free ~~Three~~-board is defined as the distance between the water surface elevation for the design event and the very top of the inside of the box.

It is a closed-bottom structure, which isn't ideal from an environmental perspective. So we are proposing a simulated streambed material overlaying a stone fill that is designed to prevent scour. This material runs the full length of the box here and into the channel upstream and downstream to protect the channel from scour in those areas. There's also designed stone fill on each of the stream embankments to protect the proposed wing walls from scour and to provide slope stabilization.

There are existing overhead utility lines that run along the south side of Georges Mills Road, west of the intersection, diagonally across the intersection, and along the north side of Georges Mills Road. There's also some additional overhead electric that run along Stryker Road and down across Fisher Corner Road. And right about here, there's a junction pole where they all intersect. There's also an existing light pole right here. The lines that run across the intersection and meet the connecting poles will need to be relocated for the construction of the new structure.

The existing Georges Mills Road is two lanes, 11 feet wide, with 1- to 2-foot-wide shoulders. We are proposing to widen those shoulders to be 4 feet in these areas. The road is posted for 40 miles an hour. The horizontal alignment is not proposed to be changed at all; however, this intersection is quite flat and it doesn't drain properly. So we are proposing to raise the profile, or raise the grade of the road, at that point, approximately a foot. That will improve the drainage there, add some additional cover over the top of that box, and accommodate some bridge ~~curve~~ curb that is being proposed along the face of the proposed guardrail on those tripwires.

Stryker Road and Fisher Corner Road alignments are not changing either. However, their profiles will adjust a little bit to match into the higher Georges Mills Road. That will improve slightly the alignment on Stryker Road, which is currently quite steep.

Stryker Road is currently 16 to 18 feet wide, gravel. That will be maintained at approximately 18 feet. And Fisher Corner Road is currently 22 feet wide with no shoulders. And we are adding 2-foot shoulders on either side of that road.

Those roads are posted for 25 miles an hour. They have been designed for something slightly less than that because of the stop position at the intersection. However, Georges Mills Road is designed for a 45-mile-per-hour design speed.

The intersection is designed to accommodate turning movements for the size of vehicles anticipated to be going down the side roads. So the corner here of Georges Mills Road and Stryker Road is designed to accommodate a larger vehicle intended to access the existing garage up on Stryker Road. And the corner here on Georges Mills Road and Fisher Corner Road has been designed for the much larger trucks that are anticipated to access the sawmill and the power plant at that location.

There is proposed guardrail running along the south side of Georges Mills Road here and wrapping around onto Fisher Corner Road, and another line running here along the north side of Georges Mills Road and on Stryker Road. This stretch of guardrail was minimized as much as possible to maintain access to this area between Star Lake Outlet and the roadway.

Because we're raising the profile of

Georges Mills Road, there's going to be some regrading of some existing ditches. And we are replacing five drainage pipes in these areas across driveways on Stryker Road and Fisher Corner Road. We are also proposing the construction of a stormwater treatment swale on the western limits of the project. This swale is required for permitting because we are adding approximately 4,000 square feet of impervious area. So pavement, gravel, things that water cannot soak through.

Now, the part of project that is always the most impactful to the public, of course, is traffic control. And I'm going to move over down here so I can better show what's gone on. Based on input from two previous public informational meetings, the Town made the decision to go with a four-week closure and accelerated bridge construction of the box culvert. That closure would occur during the summer months to not impact bus routes.

And access would still be maintained in this area down to Fisher Corner Road and up here -- I'm going to try so everybody can see -- up here to Stryker Road. So temporary widening will be required. You can see here, these are barriers -- and here. And this would be the area the contractor would be working in. And that closure would be the removal of the existing structure, the construction of the new box culvert, and backfilling that box culvert back up to the road.

Then the road would be opened and temporary road closures -- lane closures would be used to complete the rest of the construction. This temporary widening would be required during construction to allow access to Fisher Corner Road to and from the west, and widening here temporarily to allow access to Stryker Road to and from the west.

During the closure, there are two proposed regional detours for through traffic. That's these two over here. Southbound traffic coming down 89 would take Exit 13 and travel down Routes 10 and 114 to get down to Georges Mills Road over here. And then northbound traffic would take Exit 11 and Routes 11 and 114 to get out to Georges Mills Road here.

There will be some temporary easements in this corner and this corner to accommodate that work from these two property owners here. And we will have approximately five slope easements along the length of the project to do the work, along with those two temporary easements.

As I said before, this dashed blue line here is the existing right-of-way. If you look really close in these corners, you can see that that blue line goes though the existing structure and road, which means the existing roadway is not actually, entirely within the State right-of-way now.

So, to fix that, these solid blue lines are proposed to get the road and the entirety of the proposed structure inside the State's right-of-way so that they can be maintained. And these orange lines are construction easements which allow the contractor access to that area to do the work -- construction, as well as over here to do the construction of the headwall for this drainage pipe and the stone-fill outlet there.

And I think that concludes my part of the presentation. So I'm going to hand it back to Jennifer; right?

MS. JENNIFER RECZEK: Thank you, Shannon.

As she's mentioned, the design of this project has been very challenging because of the existing previous location across the intersection. And as she mentioned, we are planning to do this work during the four-week closure. This would be done in the summer to avoid impacts to the school bus routes as well as corresponding to the period of low flow in the water course itself.

And that exact timing will be coordinated between the contractor, and the Department, and the Town when that time comes. We'll set a range of closure periods in the contract, and then they'll select the appropriate time as they get closer.

As part of our evaluation on any project, the Department has to consider and document the environmental impacts of our proposed actions. At this time, I'm going to ask Jon Evans to provide a summary of the environmental aspects of the project.

MR. JONATHAN EVANS: Thank you, Jennifer.

Good evening, members of the commission, ladies and gentlemen. Pursuant to the National Environmental Policy Act, the New Hampshire

Department of Transportation has evaluated alternatives to the proposed project and the potential impacts this project will have upon the surrounding social, economic, and natural environments.

Coordination was established and input received from federal and state agencies, including the U.S. Federal Highway Administration, the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, the New Hampshire Division of Historical Resources, New Hampshire Department of Natural and Cultural Resources, and the New Hampshire Natural Heritage Bureau. In addition, input was received from town officials as well as concerned citizens.

After evaluation of the information gathered, a draft environmental document was prepared. This document is available for review after tonight's hearing or upon request. The following is a brief summary of some of the information contained in this document:

Completion of the proposed project is not expected to noticeably increase the noise levels or impact air quality or any -- at any of the adjacent residences. Temporary increases in noise and dust levels are anticipated during construction of the project. These temporary increases are expected to return to normal after construction.

The proposed project will require impacts to wetlands under the jurisdiction of the New Hampshire Department of Environmental Services and the U.S. Army Corps of Engineers, including impacts to the bank and channel of the Star Lake Outlet. The Department will continue to coordinate with the appropriate agencies to ensure that all wetland impacts are minimized, appropriate mitigation is provided, if necessary, and all permits are secured prior to construction.

In order to protect the water quality during construction, the contractor will be required to prepare a stormwater pollution prevention plan prior to the start of construction activities. Additionally, permanent stormwater treatment will be incorporated into the design of the project to treat all new stormwater runoff due to the proposed increase in impervious surface area.

An endangered species review has indicated that the Northern long-eared bat, a federally listed endangered species, may be present within this region of the state. U.S. Fish and Wildlife Service has concurred with the Department's conclusions that the project may affect the Northern long-eared bat due to proposed tree clearing. However, it is not likely to jeopardize the continued existence of the species.

No other federal or state listed threatened or endangered species concerns were identified in association with the proposed project. No publicly owned or federally funded conservation lands were identified within the project area.

Pursuant to Section 106 of the National Historic Preservation Act, the Department, in coordination with the U.S. Federal Highway Administration and the New Hampshire Division of Historical Resources, must consider the impacts of the project on historic resources. The project area has been evaluated and reviewed for historic properties and areas of archaeological sensitivity.

The project, as proposed, is not anticipated to result in any adverse impacts to historic resources. The project as proposed would result in a finding of no potential to cause effect in accordance with Appendix B of the Section 106 Programmatic Agreement.

If there are any natural, cultural, or socioeconomic resource concerns associated with this project, please bring them to our attention tonight or within the comment period following the public hearing.

Thank you.

MS. JENNIFER RECZEK: Thank you, Jon.

As we've mentioned, the Department is required to provide stormwater treatment in order to comply with NHDES' alteration of terrain rules. This treatment location must be outside of the existing wetlands in a place where there is space to collect and treat the roadway runoff. We have done our best to minimize the impacts to private property while complying with this regulation and maintaining access to all of the properties in the project area while construction occurs.

The proposed improvements as explained by

Shannon will require acquisition of property rights in the form of easements and minor permanent acquisitions, one at each end of the new culvert. No complete acquisitions are required.

I'd like to ask Steve with the Bureau of Right-of-Way now to describe the process for acquiring the necessary property rights.

MR. STEPHEN LABONTE: Thank you, Jennifer.

Members of the commission, ladies and gentlemen, before I go into the right-of-way procedures for this project, I would like to mention that we have with us tonight copies of a booklet entitled "Public Projects and Your Property." It's this booklet here. I see most of you already them have, but, if you don't, they're located at the back of the room. These booklets are helpful especially for those of you who will have impacts to your property, and it will explain the whole right-of-way process. Again, these are available at the back.

If, after reviewing the information and testimony presented at this hearing, the commission finds necessity for this layout, several things will happen. First, with approval to proceed with design of this project, the Department will be preparing appraisals for each of the properties impacted by the proposed construction you see on the plans. A staff appraiser from the Department or a fee appraiser hired from private industry will contact each impacted property owner to appraise their property.

And by "property," I mean they'll appraise the impact to your property. The appraisals will reflect the fair market value of the property rights needed to complete construction. Prior to starting negotiations, the appraisals are reviewed separately to see that all appraisals are accurate and have taken into account all applicable approaches to value.

The value in the reviewed and finalized appraisal will be the offer of compensation used by the Department as a basis for negotiations. A right-of-way agent from the Department will visit each property owner and discuss each acquisition separately. This is an opportunity for owners to ask questions or bring up concerns. If the property owner accepts the offer, deeds are prepared, ownership is transferred to the State, and compensation is provided to the property owner.

If negotiations between the Department fail -- between the owner and the Department fail, the matter will be filed with the New Hampshire Board of Tax and Land Appeals, where the owner will have the opportunity to argue for additional compensation. Please understand this can be done with or without an attorney. After the board issues its ruling on just compensation, either party can appeal the board's decision to the superior court if they are unsatisfied.

Any time after this hearing or before the design approval, all information in support of this hearing is available at the Department's headquarters in Concord for your inspection and copying. That's all I have.

MS. JENNIFER RECZEK: Thank you, Steve.

So following this hearing, a transcript will be prepared that will include all testimony heard tonight, as well as any written statements that are received within the ten-day comment period, and those will also be posted on the website.

Are the handouts in the back -- the maps?

MR. STEPHEN LABONTE: Yep.

MS. JENNIFER RECZEK: So if you want to provide a written comment after this evening, please make sure to pick up one of the handout maps that has the physical address -- mailing address and email address for where comments can be forwarded. We will also be posting the plans from this evening on the Department's website, so you can check that for the plans as well as the transcript.

If there is support of the proposal and the special committee for the -- yeah, special committee finds in favor of the layout, and we meet Federal Highway's approval, we will move forward with the final design. Final design includes the development of the detailed contract plans, the rights -- the property rights that we need, environmental permitting, and then putting the project out for contractors to bid on.

If all goes well throughout this hearing process, the contract should be ready to advertise in the summer of 2024. This allows time for utility relocation in the fall of 2024, which is anticipated to take up to 24 weeks. And then construction of the precast elements would also be happening during that winter period. And the road closure is anticipated to occur in the summer of 2025 outside of the school year.

The preliminary cost estimate for construction is $1.6 million. Given the current inflation and escalation that we've seen in prices lately, we do anticipate that this cost will increase. With the recent federal infrastructure bill, that has provided additional funding specifically to address poor-condition bridges such as this one. So we don't have any concerns without -- or with lack of funds to carry the project forward.

It is funded 80 percent from federal funds, 20 percent from state funds. And there's no reason, at this time, that the Town would need to contribute any sort of funding for the construction.

Chairman Temple, this concludes the Department's formal presentation for the Georges Mills Road bridge replacement. I'd like to thank all of you for your time this evening. And, at this time, I respectfully ask that the special commission find in favor of the necessity for the layout of the project as presented here this evening.

Thank you.

MR. BRUCE TEMPLE: Thank you, Jennifer, and the rest of your team, for explaining all of this to us this evening.

I'd like to open this hearing for testimony. Before we begin hearing comments, concerns, or questions from the public, I'd like to know if we have any elected officials here this evening that would like to be heard first.

MR. POUL HEILMANN: I'm Poul Heilmann. I'm a selectman here. I have no questions for the board.

MS. AMY LEWIS: Amy Lewis, also a selectman. And just one curiosity more than anything.

You had mentioned that traffic from the south would be diverted from Exit 11, assuming through New London down 114. What's the reason behind not diverting from Exit 12 going down into Georges Mills Road?

MS. JENNIFER RECZEK: So we divert traffic on state roadways, and the roadway from Exit 12 is a municipal roadway. So we don't, like, put that kind of traffic on roads that we don't own and maintain.

MS. AMY LEWIS: Okay. Thank you.

MR. BRUCE TEMPLE: Thank you.

Are you a municipal --

MEMBER OF THE PUBLIC: No, I'm not.

MR. BRUCE TEMPLE: Okay. Is there anybody else that's a municipal --

MEMBER OF THE PUBLIC: No, just the two of them.

MR. BRUCE TEMPLE: Okay. Now let's open this meeting up to anybody else that would like to speak. And if you could please state your name, your address. Make your statement. We are doing some recording, so there's a little mark here in front of the machine here on the floor. I'd ask that you come up and speak; okay? Yes, sir.

MR. JAMES CARTER: My name is James Carter, and I just have one question in pursuance of your comment.

What kind of provisions are there for making any signage for people coming in off of 89 or 114? What kind of turns are they going to have to make and, you know, that kind of information? Are there provisions?

MR. BRUCE TEMPLE: Sure. Yeah, I'll briefly answer that. Typically, under New Hampshire DOT, there is a full-blown detour that's posted and part of the contract plans. There will be signage.

And, Jennifer, if you'd like to expand upon that...

MS. JENNIFER RECZEK: No, I think that answers the question.

But, yeah, we'll have, like, an entire detour package that will be located on 89, on 114, and some of the other roads that Shannon has mentioned. So that as travelers are approaching, they would know that they wouldn't be able to get beyond --

MS. JESSICA HATCH: It does say on those how many signs there will be located here --

MS. SHANNON BEAUMONT: Yes. This legend here has the sizes, and the signs, and locations, and what they say.

MR. BRUCE TEMPLE: So it's clear, the proposed signage for detours is available for public review?

MS. SHANNON BEAUMONT: Yes.

MR. BRUCE TEMPLE: Thank you.

Would there be anyone else that would like to speak this evening? Questions? Please feel free to share any thoughts or concerns, questions you might have.

MEMBER OF THE PUBLIC: Just a quick question just to confirm.

So this will be the summer of 2025, Fiscal Year 2024?

MS. SHANNON BEAUMONT: Correct.

MS. JESSICA HATCH: I would just like to ask, are there any abutters? Okay.

Did you have any thoughts or --

MR. BRYAN O'DAY: I've already been to all the meetings before. I don't really have any other questions, per se.

MR. BRUCE TEMPLE: And who are you, for the record?

MR. BRYAN O'DAY: Bryan O'Day.

MR. BRUCE TEMPLE: Thank you. Looking out in the audience.

Any other concerns? Abutters?

MS. JESSICA HATCH: You've got one in the back.

MR. BRUCE TEMPLE: Okay.

Yes, sir. Please come forward.

MR. TIMOTHY JULIAN: Tim Julian, 2750 Main Street. So, like Bryan, I've been to every meeting also. What's going to move this beyond summer of 2025? Because we were supposed to have this done quite a while ago.

MR. BRUCE TEMPLE: I'll refer that to the DOT.

MEMBER OF THE PUBLIC: Have you got a new team, or...

MS. JENNIFER RECZEK: We've got a new team. I'm not planning on going anywhere anytime soon. We have had quite a bit of turnover at the Department. Every time you have a new team, it takes some time and transition. So I'd say that's primarily what's caused most of this delay. But we are committed to getting this out and making this project happen.

MR. TIMOTHY JULIAN: Thank you.

MR. POUL HEILMANN: As a follow-up to

that, when will we, the town, know specifically what the plan is? Will we hear six months ahead of time, or three weeks before?

MS. JENNIFER RECZEK: In terms of the closure or the project itself?

MR. POUL HEILMANN: The closure is the most important thing. I mean, the project itself you've communicated earlier.

MS. JENNIFER RECZEK: So when the project gets advertised, we typically will send a set of ~~hands~~ plans out to the town at that point. And then we will put provisions in the contract as to how much advance notice that the Town needs to be able to coordinate that, and advertise that, and send it out. Some towns have, like, Listservs that they'll email.

What type of a time frame -- like a month? What type of a time frame might you be looking for?

MR. POUL HEILMANN: Oh, I'm not certain. Just in follow-up to his question, it's been dragging for a long time. So, at some point as we get closer (inaudible)...

MS. JENNIFER RECZEK: And if the select board was to discuss and get -- I mean, I think you have my card. You can certainly get in touch with us, either during the comment period or --

MS. AMY LEWIS: I just don't want it to be one of those things -- you wake up on a Tuesday and the road's closed.

MS. JENNIFER RECZEK: No, we would typically give a couple weeks' -- at least a couple weeks' notice that that is coming.

MS. AMY LEWIS: Okay.

MR. BRUCE TEMPLE: Okay. Anybody else care to speak this evening? I'd like to say going once, twice, three times.

Do the members of the commission have any questions?

MS. JESSICA HATCH: I do not. All of my things are answered.

MR. BRUCE TEMPLE: Good. It looks to me like it'll be a nice project replacing, what, a seventy-year -- over seventy-year bridge? Culvert, excuse me.

(Inaudible crosstalk.)

MR. BRYAN O'DAY: You are replacing the culvert off of the road towards Star Lake too? You said you were working on the headwall or something there.

MS. JENNIFER RECZEK: I can see Paul getting antsy. So, for the record, that's Bryan O'Day.

MS. SHANNON BEAUMONT: Yes, this culvert is being replaced.

MR. BRYAN O'DAY: Right. You're replacing that -- the drainage from the other side of the road across?

MS. SHANNON BEAUMONT: Yes. And, I believe, it's actually getting a little bit bigger.

MR. BRYAN O'DAY: Yeah.

MR. BRUCE TEMPLE: Okay. Hearing nothing else, I'll take a motion to adjourn.

MS. SHANNON BEAUMONT: I motion to adjourn at 6:36.

MR. BRUCE TEMPLE: And I'll second that.

And all in favor?

MS. SHANNON BEAUMONT: Aye.

MR. BRUCE TEMPLE: All right. Thank you, everybody, for coming out this evening. Adjourned.

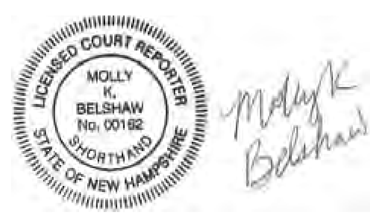
(The finding of necessity meeting was adjourned at 6:36 p.m.)

C E R T I F I C A T E

I, Molly K. Belshaw, a Licensed Shorthand Reporter for the State of New Hampshire and Registered Professional Reporter, do hereby certify that the foregoing is a true and accurate transcript of my stenographic notes of the proceeding taken at the place and on the date hereinbefore set forth to the best of my skill and ability under the conditions present at the time.

I further certify that I am neither attorney or counsel for, nor related to or employed by any of the parties to the action in which this proceeding was taken, and further, that I am not a relative or employee of any attorney or counsel employed in this case, nor am I financially interested in this action.

The foregoing certification of this transcript does not apply to any reproduction of the same by any means unless under the direct control and/ or direction of the certifying reporter.



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