STATE OF NEW HAMPSHIRE
INTER-DEPARTMENT COMMUNICATION

DATE: May 12, 2021

FROM: Andrew O'Sullivan
Wetlands Program Manager

AT (OFFICE): Department of Transportation
Bureau of Environment

SUBJECT Dredge & Fill Application
Bennington, 29486

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 NH DOT Bureau of Bridge Design for the subject major impact project. This project is classified as major per Env-Wt 903.03(g)(3)b. The project is located on South Bennington Road over Russel Brook in the Town of Bennington, NH. The proposed work consists of replacing an existing 10ft wide box culvert with a 22 ft wide embedded box culvert.

This project was reviewed at the Natural Resource Agency Coordination Meetings on November 21, 2018 and March 17, 2021. 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: http://www.nh.gov/dot/org/projectdevelopment/environment/units/program-management/wetland-applications.htm

NHDOT anticipates and requests 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.

Mitigation includes a one-time in lieu fee payment of $21,873.76 to the NHDES ARM fund. Details regarding the mitigation proposal and coordination can be found within the application.

The lead people to contact for this project are David Scott, Bureau of Bridge Maintenance (271-2731 or David.Scott@dot.nh.gov) or Sarah Large, Wetlands Program Analyst, Bureau of Environment (271-3226 or Sarah.Large@dot.nh.gov).

A payment voucher has been processed for this application (Voucher #645737) in the amount of $1,456.

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.

AMO:sel
Enclosures

cc:
BOE Original
Town of Bennington (4 copies via certified mail)
Contoocook & N. Branch Rivers Local Advisory Committee (via certified mail)
David Trubey, NH Division of Historic Resources (Cultural Review Within)
Bureau of Construction (via electronic notification)
Carol Henderson, NH Fish & Game (via electronic notification)
Maria Tur, US Fish & Wildlife (via electronic notification)
Mark Kern, US Environmental Protection Agency (via electronic notification)
Michael Hicks, US Army Corp of Engineers (via electronic notification)
Kevin Nyhan, BOE (via electronic notification)

Wetlands Permit Application

For

South Bennington Road Bridge Replacement over Russell Brook

South Bennington Road and Tax Map 7 Lots 47, 46, 50, & 51 – Bennington, NH

NHDOT Project - Bennington 29486

Applicant and Owner:

New Hampshire DOT Department of Transportation

May 2021

Stantec

Wetlands Permit Application
South Bennington Road Bridge Replacement over Russell Brook – Bennington, NH
NHDOT Project - Bennington 29486

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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: New Hampshire Department of Transportation **TOWN NAME:** Bennington

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): Blandings turtles o NHB Project ID #: NHB20-2016	☒ 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): Contoocook & N. Branch Rivers 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): 2.34 Sq. 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 proposes to replace an existing 10 ft. wide NHDOT red list box culvert bridge along south Bennington Road over Russell Brook (Carkin Brook) - a tier 3 stream - with a 22 ft wide embedded box culvert. The bridge location is approximately 500 feet upstream of the Russell Brook connection to the Contoocook River and is backwatered by and within the 100-year elevation of the Monadnock Power Station Dam that is along the Contoocook River. The project proposes temporary impacts for construction and permanent impacts to Russell Brook and its adjacent wetlands including the installation of the larger replacement box culvert, headwalls with associated riprap embankments and stream improvements totaling to 3,640 SF (2,099 SF Perm. & 1,541 SF Temp.). The enlargement of the stream crossing bridge structure and associated stream and stream bank improvements propose to maintain and improve hydraulic conductivity and will create additional flood storage volume for the watershed area adjacent to the new bridge structure. The proposed bridge structure will pass the contributing upstream 100-year storm event flow along Russell Brook and intended to provide approximately nine inches of freeboard at the crossing consistent with NHDES design guidelines.

The project also includes impacts to Shoreland area as defined under the Surface Water Quality Protection Act (SWQPA) associated with the Monadnock Power Station Dam with the reference elevation of 664. The reference elevation is located along Russell Brook and extends upstream beyond the project limits. Under the project, additional temporary and permanent impacts within the upland portions of the SWQPA will occur during construction. A separate Shoreland Permit application is to be submitted for the impacts within SWQPA that are not wetlands.

The attached application information provides supporting information on the proposed project.

SECTION 3 - PROJECT LOCATION

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

ADDRESS: South Bennington Road

TOWN/CITY: Bennington

TAX MAP/BLOCK/LOT/UNIT: Tax Map 7 Adjacent to Lots 46, 47, 50 & 51

US GEOLOGICAL SURVEY (USGS) TOPO MAP WATERBODY NAME: Contoocook River
☐ N/A

(Optional) LATITUDE/LONGITUDE in decimal degrees (to five decimal places): 42.99687° North
71.92138° 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: New Hampshire Department of Transportation		
MAILING ADDRESS: 7 Hazen Drive		
TOWN/CITY: Concord	STATE: NH	ZIP CODE: 03301
EMAIL ADDRESS: David.L.Scott@dot.nh.gov		
FAX:	PHONE: 603-271-2731	
ELECTRONIC COMMUNICATION: By initialing here: DLS, 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.: Michael Leach		
COMPANY NAME: Stantec Consulting Services, Inc.		
MAILING ADDRESS: 5 Dartmouth Drive - Suite 200		
TOWN/CITY: Auburn	STATE: NH	ZIP CODE: 03032
EMAIL ADDRESS: michael.leach@stantec.com		
FAX: 603-669-7636	PHONE: 603-206-7538	
ELECTRONIC COMMUNICATION: By initialing here ml, 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: Andrew.M.OSullivan@dot.nh.gov		
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):

A wetland delineation report (Exhibit O) and stream assessment (Exhibit M) per Env-Wt. 400 are attached; Env-Wt. 527 – Public Highways and Env-Wt. 514 – Bank Stabilization worksheets are attached; Env-Wt. 700 does not apply to this project.

The following are the project specific general design considerations per Env-Wt. 900:

- The project is not a barrier to sediment transport;
- Does not restrict high flows and maintain existing low flows;
- Does not obstruct or otherwise substantially disrupt the movement of aquatic organisms indigenous to the waterbody beyond the actual duration of construction;
- Does not cause an increase in the frequency of flooding and does not overtop the roadway at the crossing at the 100 year storm event for Russell Brook;
- Intended to enhance geomorphic compatibility by minimizing the potential for inlet obstruction by sediment, wood, or debris; and is placed to preserve the natural alignment of the stream channel and provide a natural stream bottom;
- Intended to preserve and maintain watercourse connectivity where it currently exists;
- Intended to restore watercourse connectivity where the connectivity was previously was disrupted as a result of prior bridge abutment and to provide some connectivity to benefit aquatic organisms. The stream reconstruction includes placement of streambed materials along the stream and through the culvert;
- Intended to not cause erosion, aggradation, or scouring upstream or downstream of the crossing. Erosion stone is proposed along the stream bank to the 100-year stream elevation. Humus intermixed with stone is proposed for the stream embankments above the 100-year stream elevation of Russell Brook for establishment of a vegetated slope;
- Intended to not cause water quality degradation.

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: March Day: 17 Year: 2021

(☐ 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			☐			☐
	Scrub-shrub Wetland	54		☐	220		☐
	Emergent Wetland			☐	44		☐
	Wet Meadow			☐			☐
	Vernal Pool			☐			☐
	Designated Prime Wetland			☐			☐
	Duly-established 100-foot Prime Wetland Buffer			☐			☐
Surface Water	Intermittent / Ephemeral Stream			☐			☐
	Perennial Stream or River	2045	84	☐	1277	34	☐
	Lake / Pond			☐			☐
	Docking - Lake / Pond			☐			☐
	Docking - River			☐			☐
Banks	Bank - Intermittent Stream			☐			☐
	Bank - Perennial Stream / River		79	☐			☐
	Bank / Shoreline - Lake / Pond			☐			☐
Tidal	Tidal Waters			☐			☐
	Tidal Marsh			☐			☐
	Sand Dune			☐			☐
	Undeveloped Tidal Buffer Zone (TBZ)			☐			☐
	Previously-developed TBZ			☐			☐
	Docking - Tidal Water			☐			☐
TOTAL		2099	163		1541	34	

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):	3,640	SF	× $0.40 =	$ 1,456.00
Seasonal docking structure:	0	SF	× $2.00 =	$ 0
Permanent docking structure:	0	SF	× $4.00 =	$ 0
Projects proposing shoreline structures (including docks) add $400 =				
			Total =	$ 1,456.00

The application fee for minor or major impact is the above calculated total or $400, whichever is greater = $ 1,456.00

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: DLS	To the best of the signer's knowledge and belief, all required notifications have been provided.
Initials: DLS	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: DLS	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:	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.

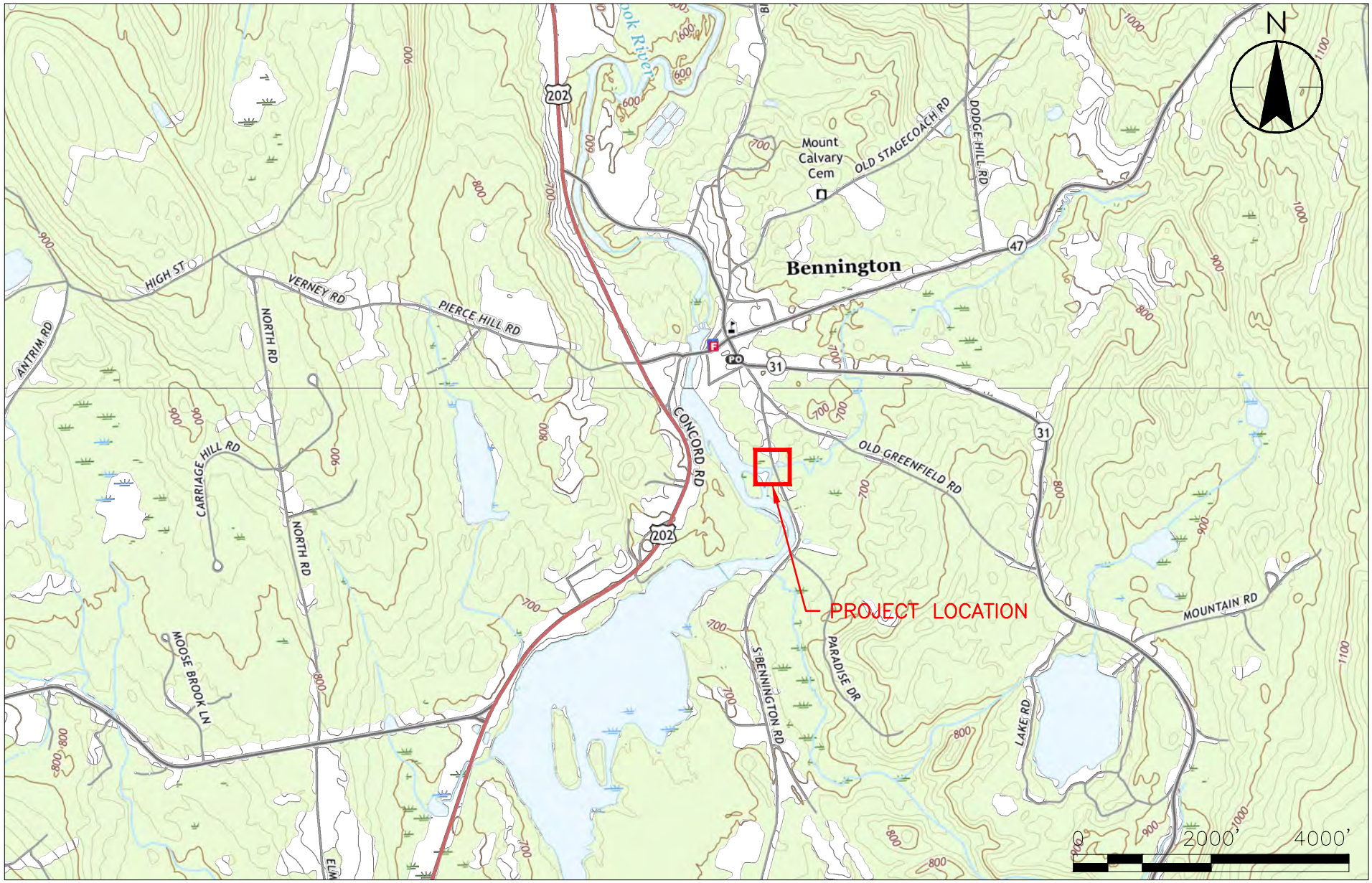
SECTION 15 - REQUIRED SIGNATURES (Env-Wt 311.04(d); Env-Wt 311.11)		
SIGNATURE (OWNER): David L Scott	PRINT NAME LEGIBLY:	DATE:
SIGNATURE (APPLICANT, IF DIFFERENT FROM OWNER):	PRINT NAME LEGIBLY:	DATE:
SIGNATURE (AGENT, IF APPLICABLE):	PRINT NAME LEGIBLY: Michael Leach	DATE:

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: State Agency Exempt Per RSA 482-A:3,I(a)
TOWN/CITY: 4 Copies via Certified Mail	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".



Stantec

Stantec Consulting Services Inc.
5 Dartmouth Drive Suite 200
Auburn NH 03032-3984
Tel: (603) 669-8672
www.stantec.com

Notes

Client/Project
NHDOT

BENNINGTON, NH

Project No.
29486

Title
USGS MAP

Revision
-

Date
02/2021

Reference Sheet
-

Figure No.
1

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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: New Hampshire Department of Transportation **TOWN NAME:** Bennington

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.

The project proposes to replace a NHDOT red listed bridge along South Bennington Road over Russell Brook (Carkin Brook). The existing bridge falls within the floodplain of the Contoocook River and the FEMA mapped floodplain elevation near the Russell Brook crossing is controlled by backwater on the Contoocook River from the Monadnock Power Station Dam. The proposed box culvert design is the preferred alternative and most practicable design to ensure longevity of the current stream crossing location. The bridge project will utilize the existing disturbed stream crossing location of the existing bridge which is the most practicable and least adverse impact on the NHDES jurisdictional areas. The embedded box culvert bridge is placed along the existing disturbed stream channel to minimize wetland and stream impacts to the area previously disturbed by the existing bridge. The design intent is to maintain the existing functions and values at the stream crossing. The proposed crossing maintains existing elevations to reduce disturbance and side slope fill. The project proposes to enlarge the current stream channel crossing and provide a natural streambed conditions due to the unavoidable disturbance of the channel. The design avoids impounding water up-gradient of the crossing and maintains hydrologic conductivity of the stream. The design is intended to maintain existing side slope grades, as much as possible, to minimize fill and wetland loss.

The preferred alternative selected by the Town requires temporary road closure and avoids additional temporary wetland impacts that would be necessary for roadway widening to create suitable travel lanes to maintain traffic flow.

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.

There are no tidal marshes documented in the project area and none will be impacted.

There a small marsh areas located in the floodway adjacent to the stream and the project design intent minimizes impacts to these areas to the extend practical.

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 selected alternate design is an embedded box culvert bridge centered along the existing stream alignment and hydraulic connection and proposes a wider bridge (22') than the existing crossing (10') to enhance the current hydrologic stream crossing capacity. The current and proposed crossing will remain in a backwatered condition created by the Monadnock Power Station Dam located on the Contoocook River and thus would not alter the hydraulic condition of the crossing or adjacent wetlands with the proposed larger opening under the existing roadway.

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.

Based upon the Natural Heritage Report – NHB20-2016, Wood Turtle (Glyptemys insculpta) is identified as a species of concern in the project area. The selected alternative involves closing the road during construction to limit impacts to Russell Brook and replacing the existing culvert with a precast 22' box culvert which will be embedded with simulated streambed materials. Previous coordination indicated that records of wood turtles are in the vicinity, and NHFG concurred that the backwatered conditions of the site would support turtle passage aquatically and that a dry critter crossing shelf would not be feasible or beneficial for this site. It was noted that there was no suitable area to connect the dry critter shelf to beyond the culvert.

There are no known exemplary natural communities, vernal pools, documented fisheries and habitat and reproductive areas for species of concern in the project area. The project design is intended to minimize impact to wetlands and other areas of jurisdiction to the extent practicable.

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.

The selected alternative involves temporary closure the road during construction of approximately 2-4 weeks to allow for quicker construction of the crossing and limit impacts relative to emergency access, public commerce, navigation, and recreation in this area. The proposed culvert will reduce flooding in this location and is intended to enhance public access, public commerce, navigation, and recreation in the project area upon completion of the bridge construction.

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 existing bridge falls within the floodplain of the Contoocook River and the FEMA mapped floodplain elevation near the Russell Brook (Carkin Brook) crossing is controlled by backwater on the Contoocook River from the Monadnock Power Station Dam. The FEMA 50-year event backwater elevation is approximately 672.8. The 100-year elevation is approximately 673.1. The FEMA data is included in the project Hydraulic Report as Appendix A attached to the Application as Exhibit R. The proposed project will expand the Russell Brook stream crossing cross sectional area underneath the existing roadway and allow the 100-year storm event of Russell Brook to flow through the proposed box culvert with approximately 9 inches of freeboard. The design analysis for the box culvert is intended to minimize additional impacts to the resource area. Upon project completion, there would be a slight increase in available flood volume in the project area due to the excavation and dredging required within the FEMA 100-year floodplain to install the wider culvert and roadway improvements resulting in an increase in available flood storage volume to elevation 664 of approximately 87 CY. The project does not increase flood stages off-site and will not cause an increase to the Base Flood Elevation.

The Monadnock Power Station Dam along the Contoocook River creates the FEMA 100-year floodplain pond along the river with an established reference line at elevation of 664 noted in the CONSOLIDATED LIST OF WATER BODIES SUBJECT TO RSA 483-B that is subject to the Shoreland Water Quality Protection Act (SWQPA). Elevation 664 extends along Russell Brook through the project site and upstream along Russell Brook beyond the project area. A separate permit application will be submitted relative to the project impacts related to the SWQPA.

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 bridge project design intent utilizes the existing disturbed stream crossing location that is the most practicable and least adverse impact to the NHDES jurisdictional areas.

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 location does not appear to be adjacent to a drinking water supply or designated groundwater aquifer. The bridge project will utilize the existing disturbed stream crossing location and therefore is intended to have the least adverse impact on the NHDES jurisdictional areas.

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.

The following are the project specific general design considerations :

- The project is not a barrier to sediment transport; Does not restrict high flows and maintain existing low flows while enhancing stream hydraulic capacity;
- Does not obstruct or otherwise substantially disrupt the movement of aquatic organisms indigenous to the waterbody beyond the actual duration of construction and enhances aquatic passage with the increased width;
- Does not cause an increase in the frequency of flooding and sized to pass the 100-year 24-hour storm event for Russell Brook with freeboard in the structure that prevents overtopping the roadway during the 100-year storm event for Russell Brook;
- Maintains current backwater conditions within then the 100-year floodplain;
- Intended to enhance geomorphic compatibility by minimizing the potential for inlet obstruction by sediment, wood, or debris; and is placed to preserve the natural alignment of the stream channel; Intended to preserve, maintain, and increase watercourse connectivity where it currently exists;
- Intended to restore watercourse connectivity where the connectivity was previously was disrupted as a result of prior bridge abutment and to provide some connectivity to benefit aquatic organisms. The stream reconstruction includes placement of simulated streambed materials along the stream and through the culvert;
- Intended to not cause erosion, aggradation, or scouring upstream or downstream of the crossing. Erosion stone is proposed along the stream bank to the 100-year stream elevation. Humus intermixed with stone is proposed for the stream embankments above the 100-year stream elevation of Russell Brook for establishment of a vegetated slope;
- Intended to not cause water quality degradation.

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.

Although the project is within the jurisdictional area of the shoreland as defined by "reference line" at elevation 664 associated with the Monadnock Power Station Dam along the Contoocook River listed in the Consolidated List of Water Bodies Subject to RSA 483-B, the selected alternative is located along Russell Brook (Carkin Brook) and is intended to be a stream crossing structure and not a shoreline structure. The proposed box culvert structure has been designed to meet the intent of the stream crossing rules to the extent practical.

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.

Although the project is within the jurisdictional area of the shoreland associated with the Monadnock Power Station Dam along the Contoocook River, the selected alternative is located along Russell Brook (Carkin Brook)and is intended to be a stream crossing structure and not a shoreline structure. The project does not propose any docks or docking on the frontage relative to Env-Wt. 313.03(c)(2).

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.

Although the project is within the jurisdictional area of the shoreland associated with the Monadnock Power Station Dam along the Contoocook River, the selected alternative is located along Russell Brook (Carkin Brook) and is intended to be a stream crossing structure and not a shoreline structure. The selected stream crossing alternative is located in the same location as the existing structure does not propose to impact the ability of abutting owners to use and enjoy their properties relative to Env-Wt. 313.03(c)(3) upon completion. As part of the project, the Department will acquire temporary and permanent easements from abutting property owners that are necessary for construction and maintenance of the proposed improvements.

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.

Although the project is within the jurisdictional area of the shoreland associated with the Monadnock Power Station Dam along the Contoocook River, the selected alternative is located along Russell Brook (Carkin Brook) and is intended to be a stream crossing structure and not a shoreline structure. The selected alternative involves temporary closure the road during construction to allow for quicker construction of the crossing and limit impacts relative to emergency access, public commerce, navigation, and recreation in this area. The proposed wider box culvert will reduce flooding in this location and is intended to enhance public access, public commerce, navigation, and recreation in the project area upon completion of the bridge construction.

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.

Although the project is within the jurisdictional area of the shoreland associated with the Monadnock Power Station Dam along the Contoocook River, the selected alternative is located along Russell Brook (Carkin Brook) and is intended to be a stream crossing structure and not a shoreline structure. The selected stream crossing alternative is located in the same location as the existing structure to minimize impacts aquatic vegetation, and wildlife and finfish habitat. The proposed wider embedded box culvert and associated stream channel improvements will provide greater flow conductivity along Russell Brook that are anticipated to improve water quality upon completion. All disturbed areas along the roadway and stream banks will be restored and stabilized with riprap and vegetated where appropriate.

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.

Although the project is within the jurisdictional area of the shoreland associated with the Monadnock Power Station Dam along the Contoocook River, the selected alternative is located along Russell Brook (Carkin Brook) and is intended to be a stream crossing structure and not a shoreline structure. The selected stream crossing alternative is located in the same location as the existing structure to minimize impacts to the stream and associated vegetation. This project does not propose access points along the stream or shoreline. During construction, the vegetation within the project limits will be removed. Upon completion of construction, all disturbed areas along the roadway and stream banks will be restored and stabilized with riprap and vegetated where appropriate. In addition, guardrail will be installed along the edge of the roadway that will prevent access to the stream and associated shoreland 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: ACOE: See attached Wetlands Functional Assessment Report - Exhibit P and Worksheet - Exhibit Q
NAME OF CERTIFIED WETLAND SCIENTIST (FOR NON-TIDAL PROJECTS) OR QUALIFIED COASTAL PROFESSIONAL (FOR TIDAL PROJECTS) WHO COMPLETED THE ASSESSMENT: Matt Arsenault
DATE OF ASSESSMENT: February 18, 2021
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.

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.: New Hampshire Department of Transportation	
PROJECT STREET ADDRESS: 45 South Bennington Road	PROJECT TOWN: Bennington
TAX MAP/LOT NUMBER: Map 7	

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 primary purpose is to replace a NHDOT red listed bridge located along South Bennington Road over Russell Brook (Carkin Brook).

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

BUREAU OF ENVIRONMENT
CONFERENCE REPORT

SUBJECT: NHDOT Monthly Natural Resource Agency Coordination Meeting
DATE OF CONFERENCE: November 21, 2018
LOCATION OF CONFERENCE: John O. Morton Building
ATTENDED BY:

NHDOT
Matt Urban
Sarah Large
Ron Crickard
Tim Boodey
James McMahon III
Rebecca Martin
Meli Dube
Chris Carucci
Julius Nemeth
Don Lyford
Bill Saffian
Tony King
Trent Zanes
Wendy Johnson
Marc Laurin
Jason Tremblay
Jon Hebert
Kevin Nyhan
Hans Weber
Ron Kleiner

ACOE
Mike Hicks

EPA
Mark Kern

NHDES
Gino Infascelli
Lori Sommer
Dale Keirstead

NHF&G
Carol Henderson
John Magee

NHB
Amy Lamb

The Nature Conservancy
Pete Steckler

Consultants/Public Participants
Christine Perron
Pete Walker
Lindsay Matras
Jason Hilton
Chris Fournier

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

Finalize August 15, 2018 and September 19, 2018 Meeting Minutes 2
Berlin, #42385 2
Dixville, #42398 2
Stratford, #41788 3
Gilford, #42249 (X-A004(796)) 5
Hinsdale-Brattleboro, #12210C (A004(152)) 6
Salem-Manchester, #13933A (A004(435)) 9
Bennington, #29486 (X-A004(156)) 10
Danbury, #16303 (X-A001(230)) 11
Laconia, #40656 12
Haverhill, #41734 13
Canaan, #41399 14
Laconia, #26706 15

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

D. Keirstead asked if there would be wetland impacts near the northbound off-ramp of the Salem Rest Area. P. Walker explained that no wetlands within the vicinity of the Salem Rest Area will be impacted. Work planned within this area includes minor paving/striping. The SEIS included work around the Salem Rest Area, however this work has been removed from the project. Matt Urban noted that NHDOT is planning to perform maintenance work on the on- and off-ramps of the rest area's Policy Brook culverts, but that work is unrelated to Contract A.
P. Walker concluded the meeting noting that the draft wetlands permit application and shoreland permit application are under review by NHDOT and should be ready for submittal to NHDES soon.

This project has been previously discussed at the 7/18/2018 Monthly Natural Resource Agency Coordination Meeting.

Bennington, #29486 (X-A004(156))
Meli Dube (NHDOT Bureau of Environment) introduced the proposed project, which will rehabilitate or replace the existing concrete box bridge carrying South Bennington Road over Russell Brook in the Town of Bennington. The intent of review by the Natural Resource Agencies at this time is for initial feedback to help inform design decisions moving forward, including consultation with the public. Jason Tremblay (NHDOT Bureau of Bridge Design) explained that the existing bridge is on the State red list due to the poor condition of the deck, superstructure and substructure. The current structure measures 10' wide by 7' tall and was built in 1925 and widened in 1975 but has not received any other major repairs or reconstructions. J. Tremblay explained that rehabilitation is still being considered at this time due to the Section 106 consultation process, however, replacement is more likely due to the deteriorated condition of the bridge. At this time, the replacement options include a 22' wide 4 sided buried structure with simulated streambed material or a 22' wide open-bottomed structure built on either a spread footing or piles. Geotechnical information is being requested to determine what kind of foundation will be required if an open-bottomed structure is proposed. The Town will be consulted in the coming months regarding which option they prefer, as well as to gather input regarding traffic control to determine if the bridge can be closed and construction streamlined or if the bridge must remain open and therefore require temporary widening for either alternative.

M. Dube gave a summary of the environmental review up to this point. There are no conservation lands in the project area and the State National Flood Insurance Program Coordinator has confirmed that the work is located outside of regulatory floodways and that no further coordination is necessary. The NH Natural Heritage Bureau has been consulted and indicated that there are records of wood turtle in the area and the US Fish and Wildlife Service Information for Planning and Conservation tool was used to determine that the project area is located in the range of the northern long-eared bat. The project area is located within ¼ of the designated Contoocook River. The Contoocook River Local Advisory Committee has been contacted and indicated that their preference is a three sided structure with natural stream bottom.

Michael Hicks, US Army Corps of Engineers, asked if the proposed alternatives would impact wetland impacts. J. Tremblay replied that the alternatives will affect whether temporary widening is necessary to keep the bridge open or if it can be closed, the alternatives will affect the length of time the closure is in place. Potential temporary widening will increase the wetland impacts in the project area. Gino Infascelli, NHDES Wetlands Bureau, asked if the wetlands have been delineated and noted that the option to close the road is preferred as there are lots of wetlands surrounding the bridge. M. Dube explained that delineations were completed by a consultant in November 2013, a new delineation will be completed in the spring of 2019. Lori Sommer, NHDES Wetlands Bureau, asked if the crossing has been evaluated in SADES and Sarah Large, NHDOT Bureau of Environment, indicated that she does not believe it has. Carol Henderson,

NH Fish and Game, asked if the crossing had been evaluated for brook trout usage, M. Dube confirmed that it has not. L. Sommer asked if the existing crossing has a perch. J. Tremblay explained that the current crossing acts like an equalizer pipe and is frequently filled with water and does not have an existing perch. L. Sommer asked if the 22' width of both proposed alternative would allow room for a wildlife shelf and if not, requested that design proposals consider creating room for one moving forward. Amy Lamb, NH Natural Heritage Bureau, inquired if it is likely for wood turtle to use this habitat and C. Henderson responded that it is unlikely.

J. Tremblay explained that the next step is to present the proposed alternatives to the town to collected feedback on their preferences and then return to the Natural Resource Agencies with a proposed preferred alternatives and draft wetland impacts.

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

Danbury, #16303 (X-A001(230))

Jon Hebert provided an overview of the project to replace the Route 4 bridge over the Northern Rail Trail. He mentioned that the evaluation of at-grade or rehab alternatives were determined to not be viable options. The proposed action is to replace the existing bridge. US Route 4 will be realigned to the northwest to alleviate the sight issues with the intersection of Spear Hill Road and improve the geometry of the existing roadway. The project limits are about one-third of mile in length. The roadway will be designed for 50 mph and will consist of two 12 foot lanes with 5 foot shoulders added to increase safety of the crossing. Existing drainage will be maintained and DOT is evaluating treatment options to accommodate the additional 12,000 square feet of impervious pavement. Treatment measures will likely be through swales or a small detention pond. There are about 18,000 square feet of wetland impacts.

Marc Laurin described the adjacent wetland system that were delineated by Stoney Ridge Environmental. The impacts are to a Forested/Shrub-Scrub/Emergent system located along the existing rail trail. The main function and value of the wetlands are for sediment and toxin removal. The wetland impacts are proposed to be mitigated through an in-lieu fee payment to the ARM fund.

The project will likely have a hearing at the end of January 2019. The wetland permit application is anticipated to be submitted in May 2019. The advertising date for the project is June 2020.

Matt Urban inquired if the slopes could be pulled in tighter to reduce impacts to the delineated wetlands. Jon H. responded that the slopes are already at 1½ to 1 in those locations. Lori Sommer inquired if Danbury has a Conservation Commission, if they do, coordination with them on mitigation options must be made and documentation from conversation on mitigation must be provided. Marc L. stated that he would pursue coordination as needed (*a subsequent review of the Town's web site indicates that the Town has no Conservation Commission).*

Dale Keirstead asked about the historic nature of the bridge. Marc L. replied that the rail corridor is historic and the bridge contributes to the corridor. The project impacts to the historic resources have been reviewed with FHWA and DHR. A MOA will be developed to address the historic concerns and mitigation. A Section 4(f) Evaluation will be completed as part of the environmental documentation.

Amy Lamb stated that there are no hits on the NHB database for species or natural communities of concern.

BUREAU OF ENVIRONMENT
CONFERENCE REPORT

SUBJECT: NHDOT Monthly Natural Resource Agency Coordination Meeting
DATE OF CONFERENCE: March 17, 2021
LOCATION OF CONFERENCE: Virtual meeting held via Zoom

ATTENDED BY:

NHDOT
Sarah Large
Andrew O'Sullivan
Mark Hemmerlein
Deidra Benjamin
Marc Laurin
Jason Tremblay
David Scott
Tom Jameson
Tobey Reynolds
Meli Dube
Andrew Czachor
Corey Spetelunas
Bill Saffian
Kirk Mudgett
Kerry Ryan
Roger Appleton
Ralph Sanders

ME DOT
Eric Ham
Kristen Chamberlain
Jeff Folsom

ACOE
Mike Hicks

EPA
Jeanie Brochi

NHDES
Lori Sommer
Karl Benedict
Chris Williams
David Price

NHB
Amy Lamb

NH Fish & Game
Carol Henderson
Mike Dionne
Cheri Patterson

The Nature Conservancy
Pete Steckler

Consultants/ Public Participants
Christine Perron
Jim Foley, Lamprey River LAC
David McNamara
Mike Leach
Jerry Fortin
Pete Walker
Greg Bakos
Greg Goodrich
Nicole Martin
Frank Koczalka
KC Moran, City of Manchester
Owen Friend-Gray, City of Manchester
Stephen Hoffmann
Samuel White
Brian Colburn
Vicki Chase
Kevin Ferguson
Keith Snow
Tim Higginson

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

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Bennington, #29486 (X-A004(156))....3
Jefferson, #42558 (X-A004(910))....5
Sutton, #42419 (X-A004(839))....9
Sutton-New London #40511 (X-A004(421))....11
Manchester, #29811 (X-A004(311))....14
Candia-Raymond, #43221 (X-A0005(058))....16
Portsmouth-Kittery, #15731 (A000(909))....17

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

Karl Benedict, NHDES– Tier 2 Stream crossings have to follow 904.04 [design criteria in 904.07] and the proposed crossings aren't meeting the requirements. The crossing needs stream simulation. Understanding that there is a downstream constraint, has there been an effort to coordinate on the downstream crossing? Likely will require mitigation. Suggests that it should be self-mitigating by meeting rules or mitigation will be required. **T. Higginson**, WSP has discussed with the District, the downstream structure is town-owned and they would have to have further discussions. **S. Large**, since it is a town-owned structure the most DOT will likely do is let the town know that the state is planning to replace the subject culvert. K. Benedict agrees, but thinks it would be helpful to get the town on board.

Lori Sommer, **NHDES**– A plate arch might provide the stream simulation. As designed the length of scour stone plus the pipe itself would have to be included in mitigation. **V. Chase** said that as depicted there are about 80 linear feet of impact [does not include the pipe itself]. **S. Large** said that DOT would want to discuss if the impacts through the pipe itself would require mitigation since it is not currently a natural channel. Lori agreed that it could be discussed.

S. Large asked if the watershed was able to be refined, and if the Tier 2 watershed size was certain. **V. Chase** said that according to WSP's analysis most of the stream goes through the subject culvert. **T. Higginson** said there is a flow splitter, some flow goes toward the old channel during higher storm events but under low flow it goes toward the subject culvert.

Carol Henderson, NHFG – no perches? What is the timeframe for construction? T. Higginson – no perches on either end. District hopes to replace the culvert in late summer of 2021.

Amy Lamb, NHNHB – No comments.

Mike Hicks, USACE – No comments**.**

Pete Steckler, Nature Conservancy – agrees that a pipe arch would be more compatible, of the three presented the elliptical culvert comes closer to meeting the rules.

Jean Brochi, USEPA – No additional comments.

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

Bennington, #29486 (X-A004(156))

D. McNamara presented the project, history, and existing conditions of the site, as well as potential impacts and mitigation requirements. The project involves the replacement of an existing 10' x 7' x 30' precast concrete box culvert carrying Russell Brook under South Bennington Road, in Bennington, NH. The need for the project is based on the deteriorated condition of the culvert and the inclusion on the NH State red list, as well as the fact that existing crossing is undersized. The project was previously discussed on November 21, 2018. Since that time, the project was presented to the Town, and Alternative 1A was determined to be preferred, due to the short term closure. Wetlands delineation and the Stream Crossing Assessment were conducted in June and April of 2018, respectively. The NHB coordination was updated in 2020 and is current. It was also determined through e-mail correspondence that a wildlife shelf was not practical at this location.

The existing precast concrete box culvert is 10' wide by 7' high with a length of 30' under the roadway. The wingwalls extend parallel to the brook at the inlet and outlet which adds an additional 7.5' of

channelization. The existing box culvert has no natural bed material, and the concrete bottom extends through the ends of the wingwalls with a total length of 37.5'. The new configuration will remove a total of 37.5' of concrete stream bed. The existing straight wingwalls will be replaced with 45 degree wingwalls, reducing approximately 7.5' of existing channelization.

The preferred alternative is to replace the 10' wide box culvert with a 22' wide precast concrete box culvert, 8' deep and 30' long. A 2' bed of simulated stream material will be placed in the culvert and over a 2' deep layer of riprap at the inlet and outlet of the culvert. The roadway width will be maintained, with riprap slope protection added.

This project falls into a category noted by DOT as one of the few remaining projects where the field work was completed prior to the current rules. The proposed culvert was sized prior to the current Stream Crossing Rules adopted in 2019. The 22' width is reflective of a bankful width of 16.2' x 1.2 + 2'.

To comply with current rules, due to the crossing's slight entrenchment, the opening would need to be 38' wide. This is not practical at the site. It would require a bridge structure, which would raise the roadway profile within the floodplain. The wider opening would lead to additional property and resource impacts as well, including wetland, stream, Shoreland and floodplain impacts. Additionally, it would require a significantly longer roadway closure to install, and the costs would also significantly increase to construct the full bridge.

The project will be constructed during a full roadway closure and detour of South Bennington Road. Water diversion structures will be installed on both the upstream and downstream ends of the culvert, and a 48" temporary pipe will convey the brook during construction. Once the existing culvert has been removed and the new culvert installed, the temporary diversion and structures will be removed, and the stream restored to the culvert. The project is scheduled to advertise in the fall of 2021 with anticipated construction during the summer of 2022.

There are approximately 2,000 sf of permanent impacts to the stream anticipated, as well as 3 sf of permanent wetland impacts. 84 lf of permanent channel impacts are proposed. Additional temporary impacts of 1,150 sf and 85 lf of stream and 175 sf of wetlands are also anticipated.
Stantec proposed the project as self-mitigating, based on the following project elements:

- The project complies with the Stream Crossing rules as they existed at the time of design.
- Simulated streambed material will be placed within the stream where impacted by the project and replace the existing concrete bed through the culvert.
- The structure will pass the 100-year storm for the Russell Brook with 1 foot of freeboard.
- The project will add 125 cy of flood storage.

Karl Benedict, NHDES Wetlands Bureau, noted the improvements to hydraulics and aquatic passage. It is not fully accommodating per the current guidelines, but good as is. He asked about adding a mix of humus and vegetation in the bank riprap. Stantec noted stone intermixed with humus is proposed above the 100-year elevation associated with Russell Brook. He agreed that the stream crossing was self-mitigating. He noted that 904.10 (Alternative Design) does need to be submitted as part of the application as the crossing is not fully compliant.

Lori Sommer, NHDES Wetlands Bureau, noted that the bank riprap shown on the plans impacts the stream and will require mitigation. She asked about leaving the 48" bypass pipe permanently due to the entrenchment of the crossing. Due to use of plastic pipe and long-term maintenance concerns this was not supported by DOT. S. Large also clarified that the proposed crossing does meet the Q100 with 1' of freeboard, so accommodation for additional flow is not necessary from a hydraulic standpoint in the design.

It was asked if the simulated stream material could be intermixed with the riprap below the 100-year elevation. This could allow the riprap to be self-mitigating. It was suggested that this be reviewed. Otherwise, linear foot of riprap along the channel for each bank will need to be counted as part of an ARM fund calculation. Lori noted the bank impact is measured parallel to the brook. The channel is considered self-mitigating. Lori noted the 3 sf in the PRA wetland would require mitigation under the new rules since the entire project is within the floodplain (of the Contoocook River).

Carol Henderson, NHFG, asked about the construction timeline. It is planned for the summer of 2022, during low flow season. Wildlife friendly erosion control will be necessary due to the presence of the wood turtle. She noted that silt fence and similar barriers need to be installed early. Also, the duration of bank impacts should be minimized, and leaflets provided to the contractor due to the wood turtle's presence.

Peter Steckler, TNC, noted he has seen erosion issues with simulated streambed materials in these types of bottleneck crossings. Suggested a coarser simulated material that might be less likely to wash out of the culvert, and utilizing larger stones at theoutlet to help lock the simulated stream bed material in.
Melilotus Dube, NHDOT Bureau of Environment, noted that the project wetland permit application is anticipated to be submitted in the near future and the application and plans would be updated based upon the meeting discussion, including to show self-mitigation for the banks, if possible, or provide an arm fund calculation for the banks if unable to be self-mitigating, and would coordinate with staff. The intent was not to have to return to the Natural Resources meeting for the project to discuss mitigation. L. Sommer agreed that follow up via email is acceptable.

This project has been previously discussed at the 11/21/2018 Monthly Natural Resource Agency Coordination Meeting.

Jefferson, #42558 (X-A004(910))
Stephen Hoffmann introduced the Jefferson 42558 project involving the replacement of the US Route 2 Bridge over Priscilla Brook (Bridge No. 140/097) and the replacement of a culvert located 200' to the southeast that carries an unnamed stream under US Route 2 in Jefferson, New Hampshire. The majority of the resource identification has been completed and an alternative analysis has evaluated potential replacement structures. A public meeting is scheduled for April 2021. The project is currently scheduled to advertise in August 2022.

Bridge 140/097
Bridge 140/097 consists of a 10' jack-arch bridge founded on stone masonry abutments and was originally constructed in 1900. A roadway/bridge rehabilitation and widening project in 1979 extended the bridge on the upstream and downstream sides by installing a concrete slab superstructure founded on concrete abutments. Priscilla Brook is a perennial stream with a 2.05 square mile watershed, making this a Tier 3 stream crossing. A stream assessment was completed in November 2020 and the average Bankfull width was determined to be 11'. There are wetlands located adjacent to the bridge and roadway. Based on the results of the stream assessment and the Rosgen Stream Classification System the channel is a Type E channel. Additional resources in the vicinity of the proposed project (both the bridge and culvert) include 2015 New Hampshire Wildlife Action Plan mapped 'Highest Ranked Habitat in NH' and the project is located within the range of the federally threatened northern long-eared bat and Canada lynx.

The purpose of the proposed project is to address the deterioration of the existing bridge and the hydraulic opening. The project is needed because the bridge deck, superstructure, and substructure are Condition State 4 (Poor) and the bridge is included on the State Red List.

From: Dube, Melilotus
To: Fortin, Gerard; McNamara, David; Leach, Michael
Cc: Tremblay, Jason
Subject: RE: Bennington - 29486 Mitigation Coordination
Date: Monday, April 26, 2021 8:02:26 AM

Hi Dave,
Please see Lori's concurrence with our proposed mitigation. Please include this correspondence in the application package and follow up on other mitigation requirements as noted in previous emails in order to complete the application package for submittal to BOE.
Thanks,
Meli

From: Sommer, Lori <LORI.L.SOMMER@des.nh.gov>
Sent: Sunday, April 25, 2021 11:20 AM
To: Dube, Melilotus <Melilotus.M.Dube@dot.nh.gov>; Benedict, Karl <Karl.D.Benedict@des.nh.gov>
Cc: Large, Sarah <Sarah.E.Large@dot.nh.gov>; OSullivan, Andrew <Andrew.M.OSullivan@dot.nh.gov>; Tremblay, Jason <Jason.A.Tremblay@dot.nh.gov>
Subject: RE: Bennington - 29486 Mitigation Coordination

Hi Meli,
This looks acceptable for the project. Thanks for your attention to detail and follow-up. The ARM calculator sheets should be submitted for the record along with the complete submittal. Take care,

Lori

From: Dube, Melilotus <Melilotus.M.Dube@dot.nh.gov>
Sent: Monday, April 19, 2021 3:11 PM
To: Sommer, Lori <LORI.L.SOMMER@des.nh.gov>; Benedict, Karl <Karl.D.Benedict@des.nh.gov>
Cc: Large, Sarah <Sarah.E.Large@dot.nh.gov>; OSullivan, Andrew <Andrew.M.OSullivan@dot.nh.gov>; Tremblay, Jason <Jason.A.Tremblay@dot.nh.gov>
Subject: FW: Bennington - 29486 Mitigation Coordination

Hello Lori,
I hope you are well and enjoying the early spring! I am following up with you on mitigation for the Bennington 29486 project that was discussed at the March 17, 2021 NRAC Meeting. I am attaching the draft minutes as a reminder of the discussion. Ultimately, we agreed on an approach for making final calculations for mitigation but did not have a number at that meeting and agreed to follow up via email. As David McNamara discusses in his email below, Stantec did explore the suggestion of placing simulated stream bed material further up the bank than normal in an attempt to mitigate some of the impacts due to placement of riprap for armoring but this was considered infeasible and may destabilize the bank in the long run. We have included those areas in the attached ARM fund calculator. At this time, we are proposing to pay $225.23 in mitigation for 0.0012 acres of permanent PSS/PEM wetland and $21,648.53 in mitigation for permanent impacts to the left and right bank of Russel Brook for a total of $21,873.76. Please let us know if you agree with this mitigation plan. A response as soon as possible this week will help us stay on schedule for submitting the application in

time to advertise this fiscal year and would be greatly appreciated!
Thank you!
Meli

From: McNamara, David <David.McNamara@stantec.com>
Sent: Tuesday, April 13, 2021 1:18 PM
To: Dube, Melilotus <Melilotus.M.Dube@dot.nh.gov>; Tremblay, Jason <Jason.A.Tremblay@dot.nh.gov>
Cc: Leach, Michael <Michael.Leach@stantec.com>; Fortin, Gerard <Gerard.Fortin@stantec.com>
Subject: Bennington - 29640

EXTERNAL: Do not open attachments or click on links unless you recognize and trust the sender.

Meli,

See attached for our proposed mitigation lengths and the corresponding calculator. As we discussed, we don't recommend the simulated material in the embankment stone. This is for a couple of reasons. First there is no way to ensure it stays there, it would likely wash out within the stream, and anything above the normal water elevation would be susceptible to rainwater washing it out. The other is a concern that having the smaller material intermixed in the rip rap could cause some gaps between the rip rap stones as the simulated material washes away. Ultimately this could create risk to destabilize the embankment or sections of it if the rip rap moves around over time. For that reason, we'd recommend moving forward with the in-lieu payment for the bank impacts as shown above. We will intermix humus and seed in above the 100-year elevation, where it can grow in.

We are just finishing up the plan and application changes. Will send those later today for your review before finalizing for next Monday.

Thanks,

David McNamara
Senior Associate

Direct: 603 263-4653
Mobile: 617 968-3133
Fax: 603 668-2670
David.McNamara@stantec.com

Stantec
5 Dartmouth Drive Suite 200
Auburn NH 03032-3984

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2020 LAND VALUES

TOWN	Equalized Value per Acre
ACWORTH	1434
ALBANY	852
ALEXANDRIA	2562
ALLENSTOWN	8503
ALSTEAD	2370
ALTON	20491
AMHERST	29292
ANDOVER	4240
ANTRIM	4071
ASHLAND	12219
ATKINSON	40318
AUBURN	20934
BARNSTEAD	7961
BARRINGTON	11631
BARTLETT	7782
BATH	1594
BEAN'S GRANT	426
BEAN'S PURCHASE	426
BEDFORD	40318
BELMONT	12360
BENNINGTON	4259
BENTON	426
BERLIN	1169
BETHLEHEM	930
BOSCAWEN	6870
BOW	18821
BRADFORD	3898
BRENTWOOD	19505
BRIDGEWATER	13926
BRISTOL	12862
BROOKFIELD	2500
BROOKLINE	19304
CAMBRIDGE	426
CAMPTON	4203
CANAAN	4399
CANDIA	10683
CANTERBURY	3880
CARROLL	2492
CENTER HARBOR	31222
CHANDLER'S PURCHASE	426
CHARLESTOWN	2560
CHATHAM	586

NHDES AQUATIC RESOURCE MITIGATION FUND
WETLAND PAYMENT CALCULATION
*****INSERT AMOUNTS IN YELLOW CELLS*****

1	**Convert square feet of impact to acres:**		
INSERT SQ FT OF IMPACT	Square feet of impact	54.00	
		43560.00	
	Acres of impact =	0.0012	
2	**Determine acreage of wetland construction:**		
	Forested wetlands:	0.0019	
	Tidal wetlands:	0.0037	
	All other areas:	0.0019	
3	**Wetland construction cost:**		
	Forested wetlands:	$179.77	
	Tidal Wetlands:	$359.54	
	All other areas:	$179.77	
4	**Land acquisition cost (See land value table):**		
INSERT LAND VALUE FROM TABLE WHICH APPEARS TO THE LEFT. (Insert the amount do not copy and paste.)	Town land value:	4259	
	Forested wetlands:	$7.92	
	Tidal wetlands:	$15.84	
	All other areas:	$7.92	
5	**Construction + land costs:**		
	Forested wetland:	$187.69	
	Tidal wetlands:	$375.38	
	All other areas:	$187.69	
6	**DES Administrative cost:**		
	Forested wetlands:	$37.54	
	Tidal wetlands:	$75.08	
	All other areas:	$37.54	
**********	**TOTAL ARM PAYMENT************		
	Forested wetlands:	$225.23	
	Tidal wetlands:	$450.45	
	All other areas:	$225.23	

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

NHDES AQUATIC RESOURCE MITIGATION FUND STREAM PAYMENT CALCULATION		
INSERT LINEAR FEET OF IMPACT on BOTH BANKS AND CHANNEL	**Right Bank**	36.00
	Left Bank	43.0000
	Channel	0.0000
	TOTAL IMPACT	79.0000
	Stream Impact Cost:	$18,040.44
	DES Administrative cost:	
		$3,608.09
********* **TOTAL ARM FUND STREAM PAYMENT********		
		$21,648.53

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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.: New Hampshire Department of Transportation

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: Forested, rural residential	
CONTIGUOUS UNDEVELOPED BUFFER ZONE PRESENT? ☐ Yes ☒ No	
DISTANCE TO NEAREST ROADWAY OR OTHER DEVELOPMENT (in feet): 0	
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: Matthew Arsenault (#278)	
DATE(S) OF SITE VISIT(S): May 4, 2018	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: W1 , W2, W3, W4, W5	LOCATION: (LAT/ LONG) /
WETLAND AREA:	DOMINANT WETLAND SYSTEMS PRESENT: Emergent, Scrub-shrub
HOW MANY TRIBUTARIES CONTRIBUTE TO THE WETLAND? 2	COWARDIN CLASS: PEM, PSS
IS THE WETLAND A SEPARATE HYDRAULIC SYSTEM? ☒ Yes ☐ No if not, where does the wetland lie in 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:	PROPOSED WETLAND IMPACT AREA:

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	Scoring of 5.8	☐ Yes ☒ No	
2	☐ Yes ☒ No		☐ Yes ☒ No	Site has limited potential for educational value due to limited roadside access (e.g., lack of parking); wetland consists of common community types
3	☒ Yes ☐ No	1, 2, 3, 4, 5, 8, 10, 12, 14, 15, 16, 17	☒ Yes ☐ No	Russell Brook is perennial tributary with established fish population
4	☒ Yes ☐ No	5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18	☒ Yes ☐ No	Wetlands are adjacent to Russell Brook with dense vegetation and deep soils to attenuate floodwaters, mapped FEMA floodplain
5	☒ Yes ☐ No	2, 7, 13	☒ Yes ☐ No	The unnamed intermittent tributary is fed by groundwater seepage from the adjacent wetland. The slow-flowing nature of Russell Brook allows for groundwater interchange
6	☒ Yes ☐ No	1	☐ Yes ☒ No	Wood turtle (state Special Concern) has been documented from Russell Brook.
7	☒ Yes ☐ No	2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14	☒ Yes ☐ No	Wetlands adjacent to stream are able to retain and remove nutrients from surface water runoff.
8	☒ Yes ☐ No	1, 2, 4, 6, 7, 10, 11	☒ Yes ☐ No	Wetland provides flushing of detritus, habitat for wildlife food sources (e.g., invertebrates)
9	☒ Yes ☐ No	1, 2, 9, 11	☐ Yes ☒ No	Wetland is publicly visible from road but consists of common community types
10	☒ Yes ☐ No	1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 16	☒ Yes ☐ No	Wetlands adjacent to stream are able to retain sediments and toxicants from roadway and neighboring lands
11	☒ Yes ☐ No	1, 3, 5, 6, 7, 9, 12, 13, 14, 15	☒ Yes ☐ No	Wetland provides shoreline stabilization of Russell Brook.
12	☐ Yes ☒ No		☐ Yes ☒ No	Wetland consists of common community types and vegetation
13	☒ Yes ☐ No	2, 8	☐ Yes ☒ No	Wetland and aquatic system is publicly accessible and may be used for fishing by local residents

14	☒ Yes ☐ No	5, 6, 7, 8, 9, 13, 16, 19, 20	☒ Yes ☐ No	Wetland provides habitat for fish, invertebrates, small birds and mammals, reptiles, and amphibians

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: Russell Brook - perennial	STREAM TYPE (ROSGEN): E5
HAVE FISHERIES BEEN DOCUMENTED? ☒ Yes ☐ No	DOES THE STREAM SYSTEM APPEAR STABLE? ☒ Yes ☐ No
OTHER KEY ON-SITE FUNCTIONS OF NOTE: Hydrology of stream is partially impounded	

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	Scoring of 5.8	☐ Yes ☒ No	
2	☐ Yes ☒ No		☐ Yes ☒ No	Site has limited potential for educational value due to limited roadside access (e.g., lack of parking); wetland consists of common community types
3	☒ Yes ☐ No	1, 2, 3, 4, 5, 8, 10, 12, 14, 15, 16, 17	☒ Yes ☐ No	Russell Brook is perennial tributary with established fish population
4	☒ Yes ☐ No	5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18	☒ Yes ☐ No	Wetlands are adjacent to Russell Brook with dense vegetation and deep soils to attenuate floodwaters, mapped FEMA floodplain
5	☒ Yes ☐ No	2, 7, 13	☒ Yes ☐ No	The unnamed intermittent tributary is fed by groundwater seepage from the adjacent wetland. The slow-flowing nature of Russell Brook allows for groundwater interchange
6	☒ Yes ☐ No	1	☐ Yes ☒ No	Wood turtle (state Special Concern) has been documented from Russell Brook. d
7	☒ Yes ☐ No	2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14	☒ Yes ☐ No	Wetlands adjacent to stream are able to retain and remove nutrients from surface water runoff.
8	☒ Yes ☐ No	1, 2, 4, 6, 7, 10, 11	☒ Yes ☐ No	Wetland and aquatic system provides flushing of detritus, habitat for wildlife food sources (e.g., invertebrates)
9	☒ Yes ☐ No	1, 2, 9, 11	☐ Yes ☒ No	Wetland and aquatic system is publicly visible from road but consists of common community types
10	☒ Yes ☐ No	1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 16	☒ Yes ☐ No	Stream and wetlands adjacent to stream are able to retain sediments and toxicants from roadway and neighboring lands
11	☒ Yes ☐ No	1, 3, 5, 6, 7, 9, 12, 13, 14, 15	☒ Yes ☐ No	Wetland provides shoreline stabilization of Russell Brook.

12	☐ Yes ☒ No		☐ Yes ☒ No	Wetland and aquatic system consists of common community types and vegetation
13	☒ Yes ☐ No	2, 8	☐ Yes ☒ No	Wetland and aquatic system is publicly accessible and may be used for fishing by local residents
14	☒ Yes ☐ No	5, 6, 7, 8, 9, 13, 16, 19, 20	☒ Yes ☐ No	Wetland and aquatic system provides habitat for fish, invertebrates, small birds and mammals, reptiles, and amphibians

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 and Watercourse Functional Assessment Report: South Bennington Road Bridge Replacement Project

Bennington, New Hampshire

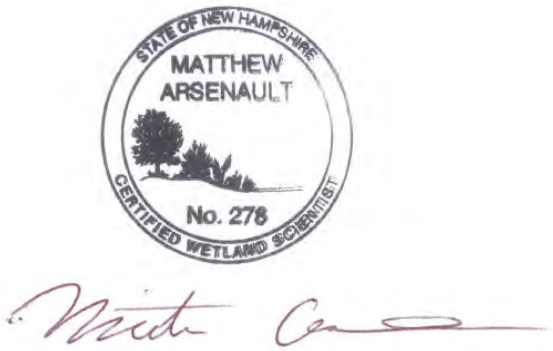
February 18, 2021

Prepared for:

New Hampshire Department of Transportation
7 Hazen Drive
Concord, NH 03302

Prepared by:

Stantec Consulting Services Inc.
5 Dartmouth Drive Suite 101
Auburn, NH 03032



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1.0 INTRODUCTION

The New Hampshire Department of Transportation proposes to replace the existing bridge on South Bennington Road over Russell Brook in Bennington, New Hampshire (hereafter, project). Stantec Consulting Services Inc. (Stantec) conducted wetland and watercourse delineations in May 2018 to facilitate project design and permitting efforts.[1] A follow-up functional assessment of the delineated wetlands and watercourses was conducted in 2021 to address the current permitting requirements. This report summarizes the results of the wetland and watercourse functional assessment.

2.0 PROJECT SITE DESCRIPTION

The project site is located in a rural landscape along South Bennington Road. Residential homes and undeveloped woodlands are present in the vicinity of the bridge location. The undeveloped uplands consist of early successional woodlands dominated by eastern white pine (*Pinus strobus*) and black cherry (*Prunus serotina*) trees and an understory dominated by invasive shrub species such as glossy buckthorn (*Frangula alnus*) and winged euonymus (*Euonymus alatus*). Soil mapping data available from the Natural Resources Conservation Service (NRCS) identifies the predominant soils within the project site as Monadnock fine sandy loam, Rumney fine sandy loam, and Colton loamy sand. Figure 1 illustrates the locations of the delineated wetlands and watercourses within the project site. Representative photographs are provided in Appendix A.

2.1 WATERCOURSE DESCRIPTIONS

Russell Brook (S-1) is a perennial watercourse (R2UB3), per Cowardin et al. (1979)[2], that flows westerly through the project site and converges with the Contoocook River approximately 500 feet to the west. It is a slow-flowing stream with a silt-dominated substrate. Flow has been partially impounded within the project site due to downstream impoundments on the Contoocook River by the Monadnock Power Station Dam. The existing hydraulic opening of the bridge over Russell Brook has also partially contributed to impounding of flow upstream of the bridge. Bankfull widths coincide with the ordinary high water mark (OHWM) widths along Russell Brook and the widths vary from approximately 15 feet to over 30 feet wide due to impoundment. Several unidentified fish species were observed within Russell Brook at the time of the 2018 delineation. Russell Brook is bordered by emergent and scrub shrub wetlands in its floodplain.

A small unnamed intermittent tributary (S-2) of Russell Brook (R4SB4/5) flows southerly through wetland W-2 and intersects the north bank of Russell Brook upstream of the bridge crossing. It has a sand and silt

[1] The results of the wetland and watercourse delineation are provided in Stantec. 2018. *Wetland and Watercourse Delineation Report: South Bennington Road Bridge Replacement* Project. June 8.
[2] Cowardin, L.M., V. Carter V., F.C. Golet, and E.T. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service Report No. FWS/OBS/-79/31.Washington, D.C.

substrate with a bankfull / OHWM width of approximately 3 feet. Due to its shallow depth and narrow channel, flow likely becomes intermittent during seasonal low-flow periods.

2.2 WETLAND DESCRIPTIONS

Five wetlands were delineated along Russell Brook and are summarized in Table 1 and illustrated on Figure 1. All the delineated wetlands are effectively contiguous and associated with a floodplain wetland complex of Russell Brook. According to the New Hampshire Department of Environmental Services (NHDES) Wetlands Permit Planning Tool (WPPT), Russell Brook and the associated wetlands are identified as a Priority Resource Area and are mapped as “Flood Plain Wetlands Adjacent to Tier 3 Streams”.[3]

[3] New Hampshire Department of Environmental Services Wetlands Permit Planning Tool. Available online: https://nhdeswppt.unh.edu/Html5Viewer/index.html?viewer=WPPT.gvh. Accessed February 12, 2021.

Table 1. Summary of Delineated Wetlands

Wetland Identifier	Wetland Classification[1]	Dominant and Characteristic Vegetation	Hydric Soil Criteria	Evidence of Hydrology	Additional Comments
W-1	PEM	Shrubs: glossy buckthorn (*Frangula alnus*) Herbs: bluejoint (*Calamagrostis canadensis*), uptight sedge (*Carex stricta*), broad-leaf meadowsweet (*Spiraea latifolia*)	Depleted Matrix	Water marks, saturation, high water table	In floodplain of Russell Brook
W-2	PEM	Herbs: bluejoint, uptight sedge	Histosol	Water marks, saturation, surface water	Includes narrow stream flowing southerly into floodplain wetland along Russell Brook.
W-3	PEM	Herbs: bluejoint, uptight sedge	Histosol	Water marks, saturation, surface water	In floodplain of Russell Brook
W-4	PSS	Trees: red maple (*Acer rubrum*) Shrubs: glossy buckthorn, silky dogwood (*Cornus amomum*) Herbs: bluejoint	Depleted Below Dark Surface	Water marks, drift deposits	In floodplain of Russell Brook
W-5	PSS/PEM	Shrubs: speckled alder (*Alnus incana*), glossy buckthorn, red maple Herbs: bluejoint, uptight sedge, northern territory sedge (*Carex utriculata*)	Depleted Below Dark Surface	Water marks, saturation, high water table	In floodplain of Russell Brook

[1] Wetland classification follows Cowardin et al. (1979):
PEM = Palustrine (freshwater) Emergent
PSS = Palustrine (freshwater) Scrub-shrub

3.0 METHODOLOGY

Stantec performed a wetland functional assessment of the delineated wetlands in accordance with New Hampshire Wetland Rules (Env-Wt 311.10). Wetland functions and values were evaluated through direct field observation and a review of existing public data resources following the Corps *Highway Methodology Workbook Supplement*[4] and the New Hampshire Method (NH Method) for evaluating the Ecological Integrity of the wetland (RSA 482-A:2, XI). Information was collected to prepare Corps Wetland Functional Assessment Worksheet and a NH Method scoring sheet for ecological integrity (Appendix B). The functional assessment was conducted by Matt Arsenault (New Hampshire Certified Wetland Scientist #278).

The criteria are assessed through direct field observations and a review of existing public data sources. As part of the evaluation, the "principal" (i.e., most important) functions and values associated with the subject wetland are identified and described. In addition, the ecological integrity of the wetland is evaluated based on the existing and past levels of disturbance and the overall significance of that wetland within the local watershed. This descriptive and qualitative approach integrates wetland science with subjective value judgments made by wetland professionals.

Following are the 14 wetland functions and values considered in the assessment.

Groundwater Recharge/Discharge

This function considers the potential for a wetland to serve as groundwater recharge and/or discharge areas. It refers to the fundamental interaction between wetlands and aquifers, regardless of the size or importance of either.

Floodwater Alteration

This function considers the effectiveness of the wetlands in reducing flood damage by water retention for prolonged periods following precipitation and the gradual release of floodwaters.

Fish and Shellfish Habitat

This function considers the effectiveness of seasonal or permanent waterbodies associated with the wetland in question for fish and shellfish habitat.

Sediment/Toxicant Retention

This function relates to a wetland's ability to reduce or prevent degradation of surface water and ground water quality by trapping sediments, toxicants, or pathogens that may enter the wetland. A wetland's

[4] U.S. Army Corps of Engineers. 1999. The Highway Methodology Workbook Supplement, Wetland Functions and Values: A Descriptive Approach. U.S. Army Corps of Engineers. New England Division. 32pp. NAEEP-360-1-30a.

effectiveness in performing this function is typically related to factors such as soil type, vegetation type and density, and the position in the landscape.

Nutrient Removal/

This wetland function relates to the effectiveness of the wetland to assimilate nutrients and prevent or reduce the adverse effects of excess nutrients on aquifers or surface waters such as ponds, lakes, streams, rivers, or estuaries.

Production Export

This function relates to the effectiveness of the wetland to produce and export food or usable products for humans or other living organisms.

Sediment/Shoreline Stabilization

This function considers the effectiveness of a wetland to stabilize stream banks and shorelines against erosion, primarily through the presence of persistent, well-rooted vegetation.

Wildlife Habitat

This function considers the effectiveness of the wetland to provide habitat for various types and populations of animals typically associated with wetlands and the wetland edge. Both resident and migrating species are considered.

Recreation

This value considers the suitability of the wetland and associated watercourses to provide recreational opportunities such as hiking, canoeing, boating, fishing, hunting, and other active or passive recreational activities.

Educational/Scientific Value

This value considers the effectiveness of the wetland as a site for an “outdoor classroom” or as a location for scientific study or research.

Uniqueness/Heritage

This value relates to the effectiveness of the wetland or its associated water bodies to provide certain special values such as archaeological sites, unusual aesthetic quality, historical events, or unique plants, animals, or geologic features.

Visual Quality/Aesthetics

This value relates to the visual and aesthetic qualities of the wetland.

Endangered Species Habitat

This value considers the suitability of the wetland to support threatened or endangered species.

Ecological Integrity

This category evaluates the overall health and stability of the wetland ecosystem.

4.0 RESULTS

The five delineated wetlands and two delineated streams are contiguous, and part of the same floodplain wetland system associated with Russell Brook. Therefore, these delineated resource areas were evaluated collectively as one wetland system. A Corps Wetland Function – Value Evaluation Form and a NH Method Ecological Integrity assessment form are provided in Appendix B.

The wetlands and aquatic habitats associated with the project site support several principal functions including Groundwater Recharge/Discharge, Floodwater Alteration, Fish and Shellfish Habitat, Sediment/Toxicant Retention, Nutrient Removal, Production Export, Sediment and Shoreline Stabilization, and Wildlife Habitat. Additional secondary functions provided include Recreation, Visual Quality / Aesthetics, Endangered Species Habitat, and Ecological Integrity.

Groundwater Recharge / Discharge

The intermittent tributary to Russell Brook (stream S-2) is bordered by narrow seepy wetlands with groundwater discharging from the bottom of the slope. In addition, the partially impounded nature of Russell Brook and the bordering low marsh floodplain wetlands allow for discharge and recharge of groundwater. Groundwater Recharge / Discharge is considered a principal function of the wetland complex.

Floodwater Alteration

The wetland complex is mapped as Special Flood Hazard Area by the Federal Emergency Management Agency. The associated wetlands are within the floodplain of Russell Brook and the dense vegetation and slow-flowing and partially impounded stream geomorphology have the capacity to retain and attenuate floodwaters and protect downstream resources from flooding. Floodwater Alteration is a principal function of the wetland complex. The wetlands are also mapped as Flood Plain Wetlands Adjacent to Tier 3 Streams on the NHDES WPPT and considered Priority Resource Areas.

Fish and Shellfish Habitat

Russell Brook is a perennial watercourse and sustains a population of fish. Several fish were observed at the time of the wetland delineation. Fish passage is also provided between Russell Brook and the Contoocook River downstream of the site. Fish and Shellfish Habitat is a principal function of the wetland complex.

Sediment / Toxicant Retention

The emergent and scrub-shrub wetlands are able to capture and retain sediments from adjacent sources such as roadways and residential properties, thereby limiting their discharge into aquatic habitats. The slow-flowing and impounded nature of Russell Brook also allows for additional retention of sediments and toxicants. Sediment / Toxicant Retention is a principal function of the wetland complex.

Nutrient Removal

Like Sediment / Toxicant Retention, the wetland complex is able to capture and retain excessive nutrients from adjacent sources such as roadways and residential properties, thereby limiting their discharge into aquatic habitats. Nutrient Removal is a principal function of the wetland complex.

Sediment / Shoreline Stabilization

The dense vegetation along the banks of Russell Brook function to stabilize the shoreline from erosion during high flow events. Sediment / Shoreline Stabilization is a principal function of the wetland complex.

Wildlife Habitat

The wetland complex includes multiple wetland classes including open water, emergent marsh, and scrub-shrub. These provide suitable habitat for several wildlife groups including aquatic and terrestrial species such as fish, freshwater mussels, macroinvertebrate insects, amphibians, reptiles, small mammals such as beaver (*Castor canadensis*), and several species of birds. The New Hampshire Wildlife Action Plan 2020 identifies the habitat as “Highest Ranked Habitat in Region” and Supporting Landscape” based on data available through the WPPT. Wildlife Habitat is a principal function of the wetland complex.

Recreation

The wetland complex provides limited recreation opportunities. It is likely used on occasion for fishing by local residents and possibly use by small personal watercraft such as canoe or kayak. However, given the presumed limited use and comparatively small size to that of nearby recreational areas, Recreation is not considered a principal function.

Education / Scientific Value

Limited opportunity for scientific or educational value is provided by the wetland due to is relatively small size, presence of common and widespread wetland community types, and limited access opportunities beyond the public road right-of-way.

Uniqueness / Heritage

The wetland complex is not unique or otherwise noteworthy as it consists of common wetland community types with alterations as a result of past human activity (e.g., road and bridge construction).

Visual Quality / Aesthetics

The wetland complex provides some visual quality and aesthetics as open water and emergent marshes are visible from the road. However, this is not considered a principal function of the wetland.

Endangered Species Habitat

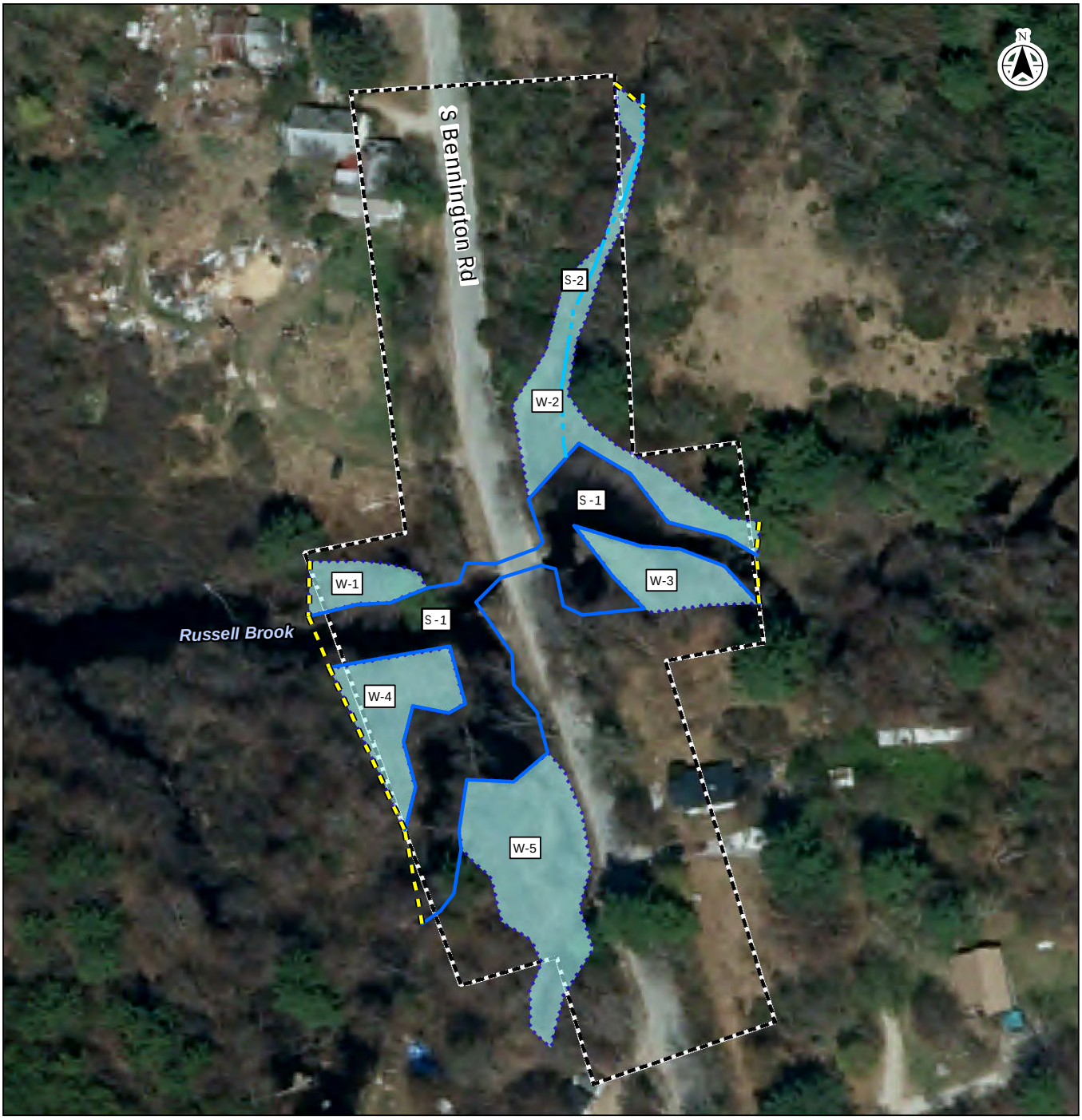
Based on a July 13, 2020, New Hampshire Natural Heritage Bureau Data Check Results Letter, wood turtle (*Glyptemys insculpta*), a species listed as Special Concern by NHB, has been documented previously from Russell Brook at the bridge crossing.

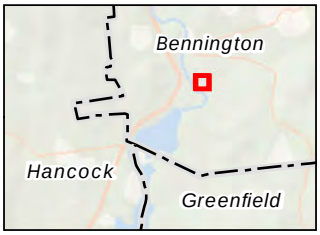
Ecological Integrity

The Ecological Integrity of the wetland is moderate as the associated watershed is relatively intact and not substantially degraded and lack of recent land use activities such as forestry and agriculture within the wetland. However, the presence of the existing roadway and bridge as well as neighboring residential properties and presence of invasive species reduces the overall ecological integrity of the wetland.

FIGURES

V:\1956\active_Task Owner and other Non-BC\1956 Jobs\193511574\03_data\gis_cad\GIS\mxds\193511574_WetlandDelineation_20180523.mxd Revised: 2018-05-29 By: rmack





Legend

- Approximate Survey Limit
- Delineated Intermittent Stream Centerline — S1 Stream ID
- Delineated Perennial Stream Edge
- Open Wetland/Stream (Continues Off Site)
- Delineated Wetland — W1 Wetland ID

0 100 Feet

1:1,237 (at original document size of 8.5x11)

Stantec

Project Location
Bennington, NH

Wetland Delineation Map REVA
Prepared by REM on 2018-05-25
Technical Review by EAC on 2018-05-25
Independent Review by MPA on 2018-05-29

Client/Project
New Hampshire Department of Transportation
Wetland Delineation
South Bennington Road Bridge Replacement

Figure No.
1

Title
Wetland and Watercourse Delineation Map

Notes
1. Wetland boundaries delineated in accordance with USACE Wetland Delineation Manual (1987) or subsequent versions.
2. Wetland boundaries were located utilizing a Trimble GeoExplorer Series Receiver. Expected accuracy of GPS data is within 1 meter of actual position.

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants, and agents, from any and all claims arising in any way from the content or provision of the data.

APPENDICES

Appendix A REPRESENTATIVE PHOTOGRAPHS

Photo 1. Wetland W-1 looking east. Stantec. May 4, 2018.

Photo 2. Wetland W-2 looking north. Stantec. May 4, 2018.

Photo 3. Wetland W-3 along Russell Brook, looking east. Stantec. May 4, 2018.

Photo 4. Wetland W-4 on west side of Russell Brook, looking west. Stantec. May 4, 2018.

Photo 5. Wetland W-5 looking northwest. Stantec. May 4, 2018.

Photo 6. Russell Brook looking upstream to bridge. Stantec. May 4, 2018.

Photo 7. Watercourse S-2 through Wetland W-2, looking upstream. Stantec. May 4, 2018.

Appendix B FUNCTIONAL ASSESSMENT FORMS

Wetland Function – Value Evaluation Form

Wetland Description: palustrine emergent and scrub-shrub wetland complex within floodplain of Russell Brook and associated unnamed intermittent.	File number: 195311574	
tributary. Wetlands dominated by *Alnus incana*, *Frangula alnus*, *Cornus amomum*, *Calamagrostis canadensis*, and *Carex stricta*.	Wetland identifier: Russell Brook wetland complex	
Russell Brook is a slow-flowing perennial stream with a silt substrate. The stream is partially impounded due to limited hydraulic opening of bridge and	Latitude: 42.996906	Longitude: -71.921750
downstream impoundments on Contoocook River by Monadnock Power Station Dam. The unnamed intermittent tributary is shallow with a sand and silt	Preparer(s): Matt Arsenault (CWS #278)	
Substrate. NHB Data Check Results Letter NHB20-2016 (7/13/2020) indicate wood turtle has been documented previously at bridge crossing.		
	Date: 2/11/2021	

Function/Value	Capability Y	Capability N	Summary	Principal Yes/No
Groundwater Recharge/Discharge	X		The unnamed intermittent tributary is fed by groundwater seepage from the adjacent wetland. The slow-flowing nature of Russell Brook allows for groundwater interchange. Qualifiers: 2, 7, 13	Y
Floodwater Alteration	X		Wetlands are adjacent to Russell Brook with dense vegetation and deep soils to attenuate floodwaters, mapped FEMA floodplain. Qualifiers: 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18	Y
Fish and Shellfish Habitat	X		Russell Brook is perennial tributary with established fish population. Qualifiers: 1, 2, 3, 4, 5, 8, 10, 12, 14, 15, 16, 17	Y
Sediment/Toxicant Retention	Y		Wetlands adjacent to stream are able to retain sediments and toxicants from roadway and neighboring lands. Qualifiers: 1, 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 16	Y
Nutrient Removal	Y		Wetlands adjacent to stream are able to retain and remove nutrients from surface water runoff. Qualifiers: 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14	Y
Production Export	Y		Wetland provides flushing of detritus, habitat for wildlife food sources (e.g., invertebrates). Qualifiers: 1, 2, 4, 6, 7, 10, 11	Y
Sediment/Shoreline Stabilization	Y		Wetland provides shoreline stabilization of Russell Brook. Qualifiers: 1, 3, 5, 6, 7, 9, 12, 13, 14, 15	Y
Wildlife Habitat	Y		Wetland provides habitat for fish, invertebrates, small birds and mammals, reptiles, and amphibians. Qualifiers: 5, 6, 7, 8, 9, 13, 16, 19, 20	Y
Recreation	Y		Wetland is publicly accessible and may be used for fishing by local residents. Qualifiers: 2, 8	N
Education/Scientific Value		X	Site has limited potential for educational value due to limited roadside access (e.g., lack of parking); wetland consists of common community types	
Uniqueness/Heritage		X	Wetland consists of common community types and vegetation	
Visual Quality/Aesthetics	X		Wetland is publicly visible from road but consists of common community types. Qualifiers: 1, 2, 9, 11	N
ES Endangered Species Habitat	X		Wood turtle (state Special Concern) has been documented from Russell Brook. Qualifiers: 1	N
Ecological Integrity	X		See attached scoring sheet. Moderate ecological integrity (score 5.8)	N

Notes:

* Attach list of considerations.

NH METHOD FOR THE EVALUATION OF FRESHWATER WETLANDS *(revised December, 2015)*

Wetland Name/Code: Russell Brook Wetland Complex Evaluation Date: 2/11/2021 Evaluator: Matt Arsenault (CWS #278)

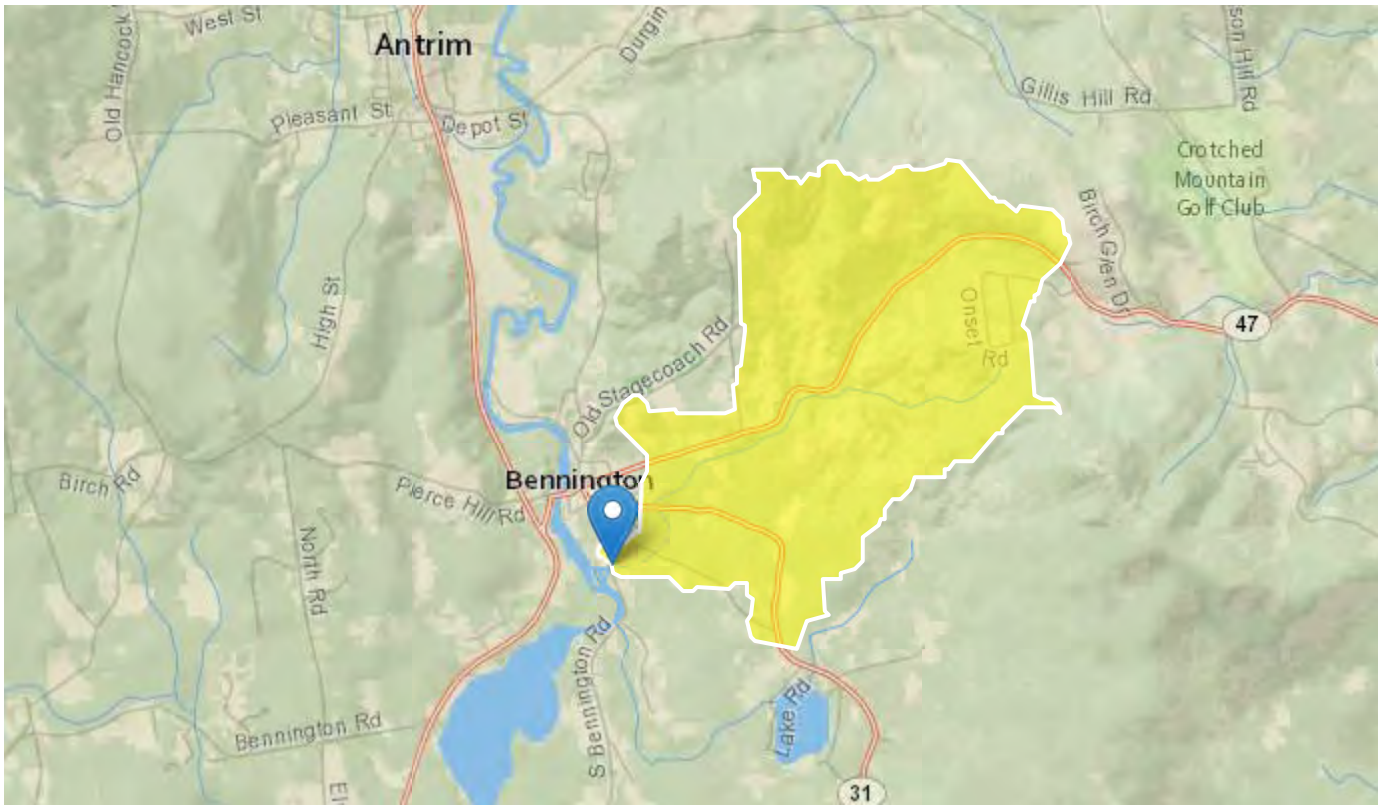
1 – ECOLOGICAL INTEGRITY

Evaluation Questions	Observations & Notes	Answers	Score
1. Are there land uses in the wetland's watershed that could degrade water quality in the wetland?	Trash and debris in residential yards neighboring site	a. Less than 5% of the watershed has land uses that could degrade water quality. b. 5-10% of the watershed has land uses that could degrade water quality. c. > 10% of the watershed has land uses that could degrade water quality.	10 5 1
2. Is there evidence of fill in the wetland?	Fill from bridge abutments and roadway has historically altered hydrology	a. Less than 1 % b. From 1-3 % c. More than 3 %	10 5 1
3. What percentage of the wetland has been altered by agricultural activities?	Historic agricultural clearing in wetland NE of bridge	a. Less than 5 % b. From 5 to 25 % c. More than 25 %	10 5 1
4. What percentage of the wetland has been adversely impacted by logging activity within the last 10 years?	Minimal logging in wetland	a. Less than 1% b. From 1 to 10 % c. More than 10 %	10 5 1
5. How much human activity is taking place in the wetland (e.g. ATV use, trails, cars, dumping of brush and garbage, etc.)?	Minimal evidence of human degradation	a. Low: Few trails in use, little or no traffic, and little or no litter. b. Moderate: Some used trails, roads, litter c. High: Many trails, roads, and/or litter	10 5 1
6. What percentage of the wetland is occupied by invasive plant species?	Frangula alnus present in several areas	a. None b. 1-5% of the wetland has invasive species c. > 5% of the wetland has invasive species	10 5 1
7. Are there roads, driveways and/or railroads crossing or adjacent to the wetland or come within 500 ft. of the wetland?	Wetland is crossed by S. Bennington Road	a. No roads, driveways or railroads. within 500 ft. of, or in the wetland b. Roads, driveways, railroads are within 500 ft of the wetland c. Roads, driveways, railroads cross, or are adjacent to, the wetland	10 5 1
8. How much human activity is taking place in the upland within 500 feet of the wetland edge?	3 residences in proximity to wetland	a. Less than 5% or no activity b. Human activity evident in up to 25% of the 500 ft zone c. Human activity evident in more than 25% of the 500 ft zone	10 5 1
9. What is the percent of impervious surface within 500 feet of the wetland edge?	South Bennington Rd. traverses wetland	a. Less than 3% impervious area within 500 ft of the wetland edge b. 3-10% impervious area within 500 ft of the wetland edge c. Greater than 10% impervious area within 500 ft of the wetland edge	10 5 1
10. Is there a human-made structure that regulates the flow of water through the wetland?	S. Bennington Rd bridge constricts flow	a. No human made structures present **upstream of, or in** the wetland. b. One or more human made structures present **upstream of, or** in the wetland but hydrologic modification is slight c. One or more human made structures present **upstream of, or** in the wetland that severely block or alter surface water hydrology	10 5 1

AVERAGE SCORE FOR ECOLOGICAL INTEGRITY 5.8
(Add scores for each question and divide by 10)

South Bennington Road Culvert StreamStats Report

Region ID: NH
Workspace ID: NH20180821183428104000
Clicked Point (Latitude, Longitude): 42.99693, -71.92137
Time: 2018-08-21 14:34:43 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
APRAVPRE	Mean April Precipitation	3.993	inches
BSLDEM30M	Mean basin slope computed from 30 m DEM	10.898	percent
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	921441.2	feet
CENTROIDY	Basin centroid vertical (y) location in state plane units	185418	feet
CONIF	Percentaqe of land surface covered by coniferous forest	26.9717	percent

Parameter Code	Parameter Description	Value	Unit
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	151	feet per mi
DRNAREA	Area that drains to a point on a stream	2.34	square miles
ELEVMAX	Maximum basin elevation	1424.344	feet
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	7.98	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	1.79	percent
MINTEMP_W	Mean winter minimum air temperature over basin surface area	15.635	degrees F
MIXFOR	Percentage of land area covered by mixed deciduous and coniferous forest	34.6283	percent
OUTLETX	Basin outlet horizontal (x) location in state plane coordinates	916125	feet
OUTLETY	Basin outlet vertical (y) location in state plane coordinates	181215	feet
PREBC0103	Mean annual precipitation of basin centroid for January 1 to March 15 winter period	8.62	inches
PREBC_1112	Mean annual precipitation of basin centroid for November 1 to December 31 period	8.46	inches
PRECIPCENT	Mean Annual Precip at Basin Centroid	44.8	inches
PRECIPOUT	Mean annual precip at the stream outlet (based on annual PRISM precip data in inches from 1971-2000)	43.9	inches
PREG_03_05	Mean precipitation at gaging station location for March 16 to May 31 spring period	9.3	inches
PREG_06_10	Mean precipitation at gaging station location for June to October summer period	18	inches
SNOFALL	Mean Annual Snowfall	77.55	inches
TEMP	Mean Annual Temperature	45.345	degrees F
TEMP_06_10	Basinwide average temperature for June to October summer period	61.238	degrees F
WETLAND	Percentage of Wetlands	2.4493	percent

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.

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Application Version: 4.2.1

Stantec

Memo

To:	Mike Leach Auburn, NH	From:	David Huntress Topsham, ME
File:	195311574	Date:	July 9, 2018

Reference: **Geomorphic Investigation, Russell Brook at South Bennington Road Stream Crossing, Bennington, New Hampshire**

Stantec performed a geomorphic investigation of Russell Brook adjacent to South Bennington Road in Bennington, NH. This memo summarizes observations and findings of the geomorphic field reconnaissance site visit performed on April 11, 2018, and includes discussion of relative parameters for design of a replacement stream crossing. Descriptions of the project watershed, localized land use, and geomorphology are included.

Russell Brook is a 3rd order stream[1], mainly forested, rural drainage flowing through Bennington, New Hampshire. The watershed area at the South Bennington Road crossing is approximately 2.34 square miles[2] and is largely dominated by wetland cover, upland areas, and rural residential development. A drainage basin map is provided as Attachment A and photographs from the April 11, 2018, site visit are provided in Attachment B.

SITE OBSERVATIONS

The South Bennington Road stream crossing was backwatered by a dam-controlled reach of the Contoocook River during the site visit. However, observations during the site visit and review of aerial photographs suggest that a drawdown at the downstream dam on the Contoocook River could result in a perched culvert condition. Observations during the site visit included indicators of lateral and vertical stability, such as established herbaceous ground cover, lack of recent depositional features, and limited evidence of bank erosion or other signs of instability.

Stantec performed a Level 2 geomorphic characterization[3] along approximately 285 feet of the channel of the brook adjacent to the South Bennington Road stream crossing. Based on observations and field measurements during the site visit, Stantec characterized Russell Brook at South Bennington Road is a stable E5 stream-type with identified geomorphic characteristics presented in Table 1. There is an abrupt turn to the left[4] in the channel of the brook immediately upstream from the South Bennington Road stream crossing. This turn, and other observed conditions in the channel upstream from the culvert, may have resulted from historical realignment of the channel through the existing, cast-in-place box culvert. The poor alignment of the upstream channel may be exacerbated by deposition of sediment upstream from the South Bennington Road culvert due to the apparent backwater associated with the downstream dam and impoundment.

Channel bed material consisted of fine sand with some silt and organic detritus. A representative sample rubbed between the observer's fingers indicated the channel bed material was generally between 1 to 2 mm in diameter. Due to the limited variation in bed material size fraction, a Wolman pebble count was not performed. Water surface slope between the downstream beaver debris and downstream side of a beaver dam located upstream from the culvert was visually estimated as 6-inches per 300 feet of channel.

[1] Strahler, A.N., 1957, Quantitative analysis of watershed geomorphology, *Transactions of the American Geophysical Union*, 38 (6): 913-920.

[2] Watershed area estimated using the United States Geological Survey's *StreamStats v4.0* online application for the State of New Hampshire.

[3] A Classification of Natural Rivers. *David L. Rosgen. Wildland Hydrology, 157649 U. S. Highway 160, Pagosa Springs, CO 81147*

[4] Directionals 'left' and 'right' in this document refer to the viewer's left and right when facing downstream.

Table 1: Bankfull Channel Data

Bankfull Width	17.6 ft
Bankfull Mean Depth	1.7 ft
Bankfull Maximum Depth	2.5 ft
Flood-Prone Width	47 ft
Channel Materials D50	1 mm
Channel Materials D84	2 mm
Estimated Water Surface Slope	0.0017
Sinuosity	2.1
Estimated Bankfull Discharge	74 cfs
Estimated Bankfull Velocity	2.5 ft/s
Bankfull Cross Sectional Area	30 ft^2
Entrenchment Ratio	2. 7
Width to Depth Ratio	10.5

DESKTOP ANALYSIS

The measured geomorphic parameters, when normalized to drainage area, are similar to values for discharge and bankfull cross-sectional area predicted by New Hampshire regional hydraulic geometry curves[5]. The parameters that can be estimated from the regional curves are bankfull flow (Q_{BF}), bankfull cross sectional area (A_{BF}), bankfull width (W_{BF}), bankfull mean depth (D_{BF}), and average bankfull velocity (V_{BF}), derived by the following formulas:

$$Q_{BF} = 44.159*(\text{Drainage Area})^{0.9114}$$

$$A_{BF} = 16.024*(\text{Drainage Area})^{0.7552}$$

$$W_{BF} = 12.469*(\text{Drainage Area})^{0.4892}$$

$$D_{BF} = 1.2952*(\text{Drainage Area})^{0.2645}$$

$$V_{BF} = Q_{BF}/A_{BF}$$

The results of these calculations, using a drainage area of 2.34 square miles are provided in Table 2 below.

Table 2: Estimated Bankfull Channel Data Using New Hampshire Regional Hydraulic Geometry Curves

Bankfull Discharge	96 cfs
Bankfull Cross Sectional Area	31 ft^2
Bankfull Width	19 ft
Bankfull Mean Depth	1.6 ft
Bankfull Velocity	3.1 ft/s

[5] Schiff, R., J.G. MacBroom, and J. Armstrong Bonin, 2006, River Restoration and Fluvial Geomorphology White Paper. NHDES-R-WD-06-27. Prepared by Milone & MacBroom, Inc. for the New Hampshire Department of Environmental Services and the New Hampshire Department of Transportation, Concord, NH.

Reference: **Geomorphic Investigation, Russell Brook at South Bennington Road Stream Crossing, Bennington, New Hampshire**

DISCUSSION

The apparent stability of the adjacent sections of stream channel indicate that using the data collection during the geomorphic assessment (provided in Table 1 above) is appropriate for stream crossing design purposes, however, it is noted that the existing culvert is located within an area affected by downstream hydropower operations. Therefore, a bankfull width of 16.2 feet was determined at a representative cross section on Russell Brook located approximately 150 feet downstream from the Old Greenfield Road culvert, which is approximately 1,350 feet upstream from the South Bennington Road stream crossing. Based on the similarity between the measured bankfull width at the two measured cross sections on Russell Brook and information obtained using the regional regression equation, the geomorphic parameters presented in Table 1 are recommended for use for design of the replacement crossing on South Bennington Road.

STANTEC CONSULTING SERVICES INC.

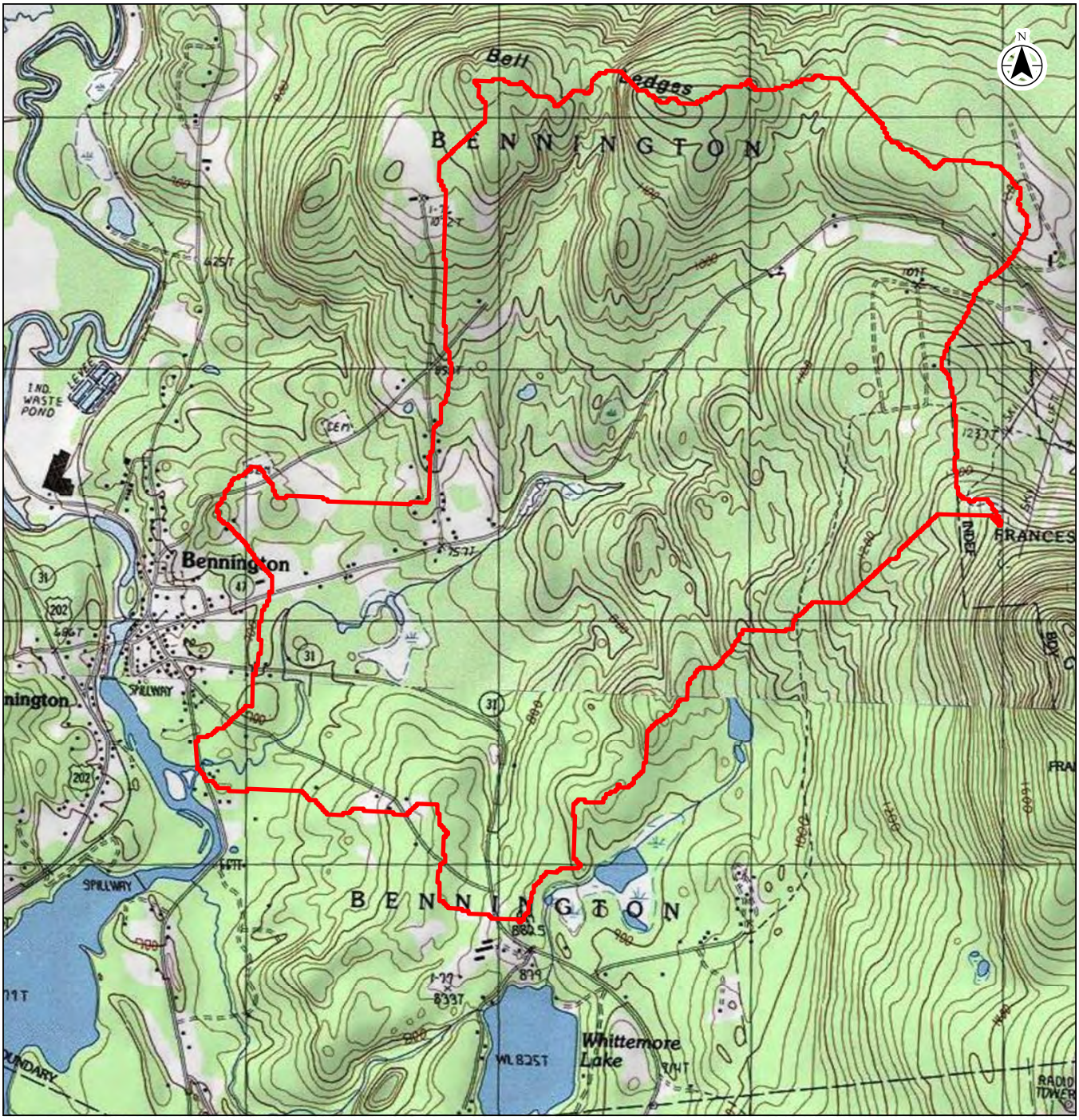
David Huntress
Geomorphologist, Ecological Restoration Services

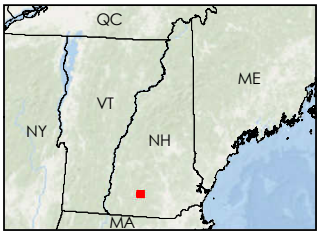
Phone: (207) 406-5468
Fax: (207) 729-2715
David.Huntress@stantec.com

Attachment: Attachment A: Contributing Watershed Map
Attachment B: Site Photographs

c. Michael Chelminski, P.E. (Stantec)

V:\1956\active_Task Owner and other Non-BC\1956 Jobs\193111574\03_data\gis_cad\GIS\mxds\195611574_Watershed.mxd Revised: 2018-07-06 By: rmack





Legend

Contributing Watershed (2.34 sq. mi.)

0 2,000 Feet

1:24,000 (at original document size of 8.5x11)

Stantec

Project Location
Bennington, NH

195311574

Prepared by REM on 2018-07-06
Technical Review by KWH on 2018-07-06
Independent Review by MRC on 2018-07-06

Client/Project
New Hampshire Department of Transportation
Geomorphic Assessment
South Bennington Road Bridge Replacement

Figure No.
Attachment A

Title
Contributing Watershed Map

Notes
1. Coordinate System: NAD 1983 UTM Zone 19N
2. Watershed area estimated using the USGS's StreamStats v4.2.1 online application (https://streamstats.usgs.gov/ss/).
3. USGS Imagery/Topo provided by The National Map Mapping Service (http://basemap.nationalmap.gov/arcgis/services/USGSImageryTopo).

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants, and agents, from any and all claims arising in any way from the content or provision of the data.

Reference: **Geomorphic Investigation, Russell Brook at South Bennington Road Stream Crossing, Bennington, New Hampshire**

Attachment B: Site Photographs

Photo 1:View looking downstream from left culvert approach.

Photo 2: View looking upstream from right culvert approach.

Reference: **Geomorphic Investigation, Russell Brook at South Bennington Road Stream Crossing, Bennington, New Hampshire**

Photo 3. View looking upstream at representative cross section near upstream limit of the backwatered reach.

Photo 4. View across channel at representative cross section near upstream limit of the backwatered reach. Flow is from top to bottom.

Reference: **Geomorphic Investigation, Russell Brook at South Bennington Road Stream Crossing, Bennington, New Hampshire**

Photo 5. View looking downstream towards upstream cross section. This cross section is approximately 150 feet downstream from Old Greenfield Road.

Photo 6. View across channel at representative cross section below Old Greenfield Road (flow is from bottom to top in this image).

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: 1497 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 = AE

Elevation of the 100-year floodplain at the inlet: 673 feet (FEMA El. or Modeled El.)

SECTION 3 - CALCULATING PEAK DISCHARGE

Existing 100-year peak discharge (Q) calculated in cubic feet per second (CFS): 540 CFS	Calculation method: StreamStats
Estimated bankfull discharge at the crossing location: CFS	Calculation method:

➡ ***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: 19 feet	Mean Bankfull Depth: 1.6 feet
Bankfull Cross Sectional Area: 31 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: Along 285' of Russel Brook at South Bennington Rd
Reference reach watershed size: 1497 acres

Parameter	**Cross Section 1** Describe bed form (*e.g. pool, riffle, glide*)	**Cross Section 2** Describe bed form (*e.g. pool, riffle, glide*)	**Cross Section 3** Describe bed form (*e.g. pool, riffle, glide*)	**Range**
Bankfull Width	17.6 feet	feet	feet	feet
Bankfull Cross Sectional Area	30 SF	SF	SF	SF
Mean Bankfull Depth	1.7 feet	feet	feet	feet
Width to Depth Ratio	10.5			
Max Bankfull Depth	2.5 feet	feet	feet	feet
Flood Prone Width	47 feet	feet	feet	feet
Entrenchment Ratio	2.7			

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

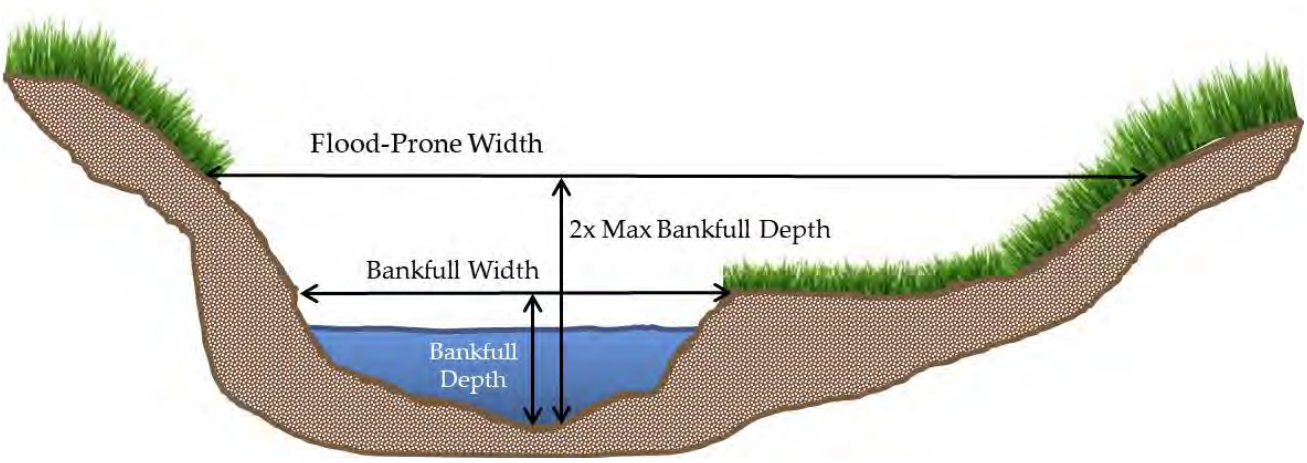


Figure 1: Determining the Reference Reach Attributes.

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: 0.0017
Average Channel Slope at the Crossing Location: 0.003

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: 2.1
Sinuosity of the Crossing Location: 1.1

SECTION 8 - SUBSTRATE CLASSIFICATION BASED ON FIELD OBSERVATIONS *For **tier 2, tier 3** and **tier 4** crossings only.*	
% of reach that is bedrock:	%
% of reach that is boulder:	%
% of reach that is cobble:	%
% of reach that is gravel:	%
% of reach that is sand:	**85** %
% of reach that is silt:	**10** %
SECTION 9 - STREAM TYPE OF REFERENCE REACH *For **tier 2, tier 3** and **tier 4** crossings only.*	
Stream Type of Reference Reach:	E5

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

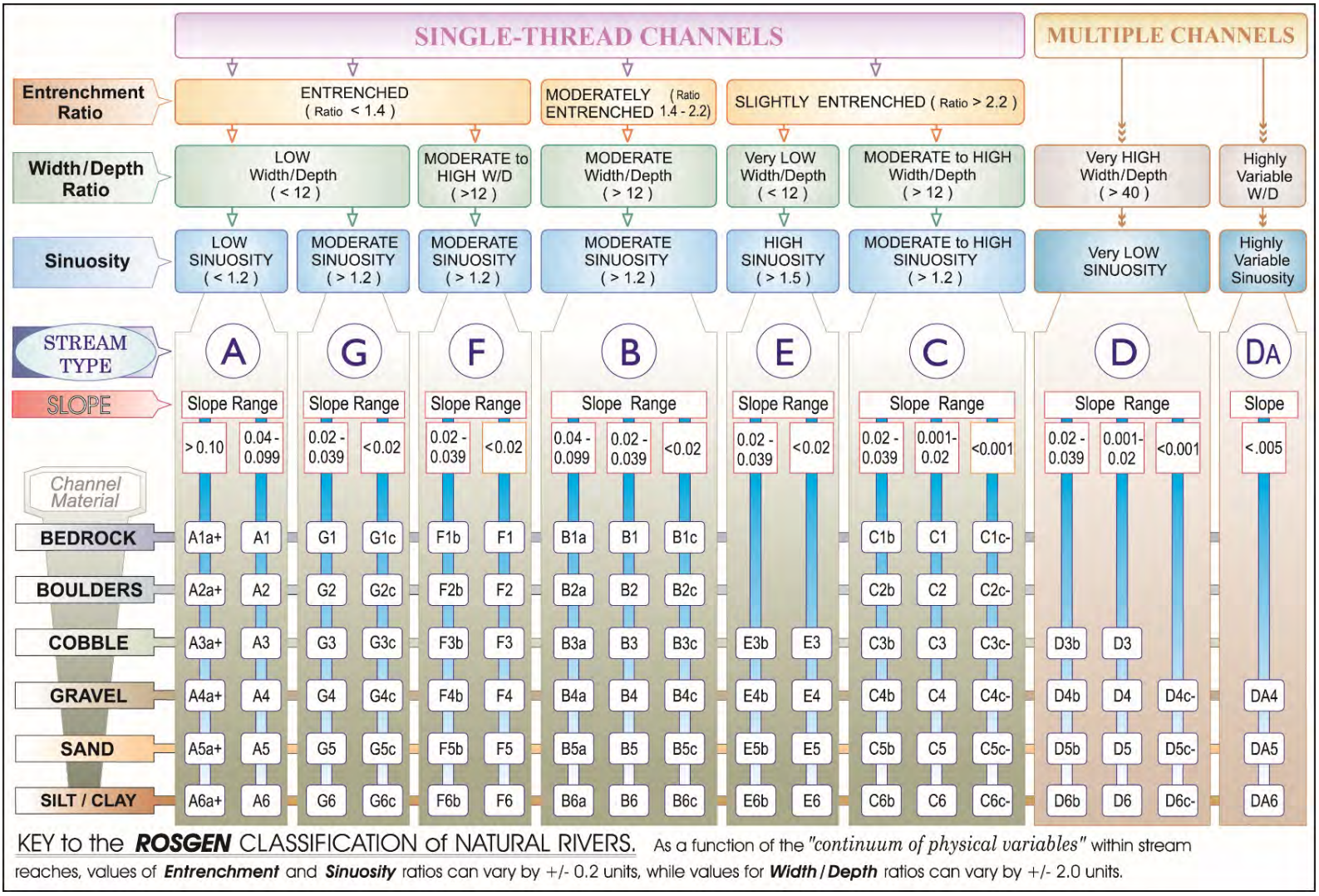


Figure 2: Reference from Applied River Morphology, Rosgen, 1996.

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:			
	Existing Crossing Span: *(perpendicular to flow)* 10 feet	**Culvert Diameter:** feet **Inlet Elevation:** El. feet			
	Existing Crossing Length: *(parallel to flow)* 30 feet	**Outlet Elevation:** El. feet **Culvert Slope:**			
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)* 22 feet	**Culvert Diameter:** feet **Inlet Elevation:** El. feet			
	Proposed Structure Length: *(parallel to flow)* 30 feet	**Outlet Elevation:** El. feet **Culvert Slope:**			
	Proposed Entrenchment Ratio:* 1.0 *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.*

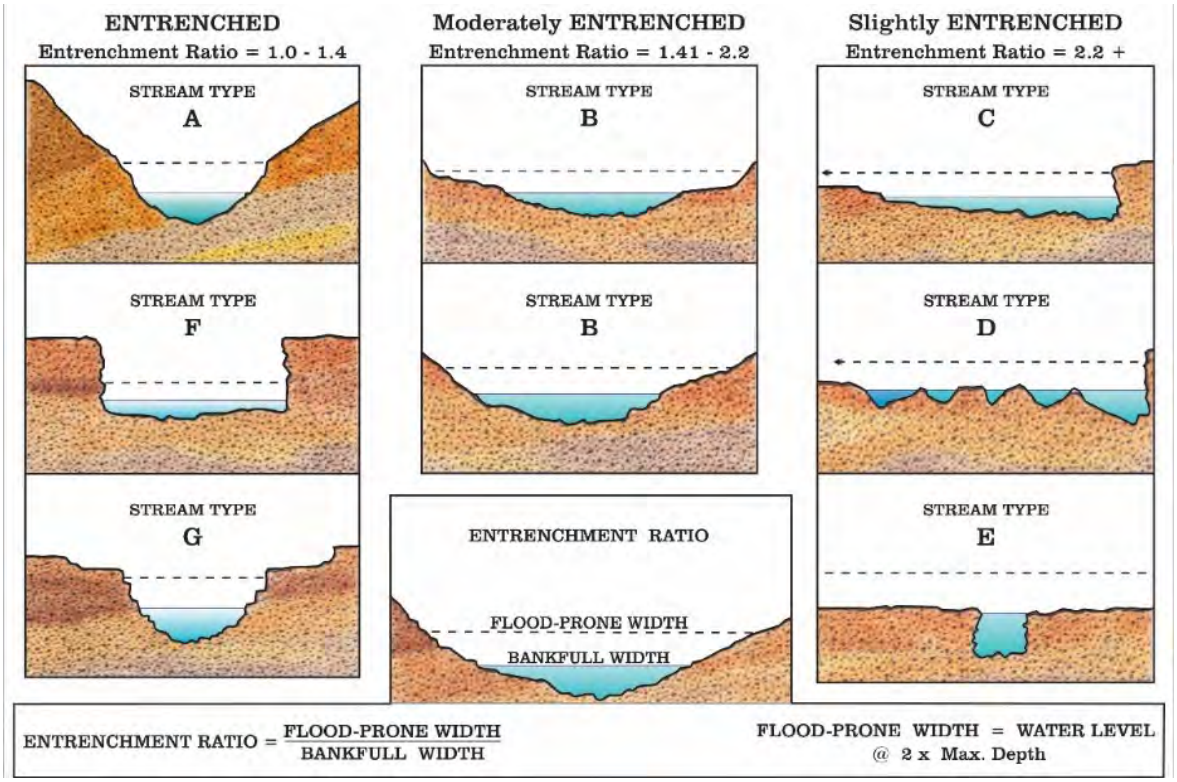


Figure 3: Reference from Applied River Morphology, Rosgen, 1996.

SECTION 11 - CROSSING STRUCTURE HYDRAULICS		
	Existing	**Proposed**
100 year flood stage elevation at inlet:	670.2	667.5
Flow velocity at outlet in feet per second (FPS):	6.2	6.9
Calculated 100 year peak discharge (Q) for the *proposed* structure in CFS:		540
Calculated 50 year peak discharge (Q) for the *proposed* structure in CFS:		443

SECTION 12 - CROSSING STRUCTURE OPENNESS RATIO

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

Crossing Structure Openness Ratio* = Proposed 4.55

* 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.

Hydrologic, Hydraulic and Scour Protection Report
Bennington 29486 - Bridge No. 099/080
South Bennington Road over Russell Brook

August 21, 2018

Prepared for:

NH Department of Transportation

Prepared by:

Stantec Consulting Services Inc.
5 Dartmouth Dr, Suite 101
Auburn, New Hampshire

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Prepared by _____

Thomas E. Knight, PE

Reviewed by _____

Gerard Fortin, PE

Approved by _____

George A. Bogue, PE

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B.2 RURAL 7 PARAMETER ANALYSIS
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1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this report is to evaluate the hydraulic capacity of the existing bridge and potential replacement options for Bridge No. 099/080 which carries South Bennington Road over Russell Brook. This report was prepared using procedures and analyses consistent with the American Association of State Highway Officials (AASHTO), the Federal Highway Administration (FHWA) and the New Hampshire Department of Transportation (NHDOT) Bridge Design Manual.

The hydrologic and hydraulic investigation reported herein contains pertinent information as typically required by the NHDOT for bridge replacement projects.

1.2 LOCATION MAP

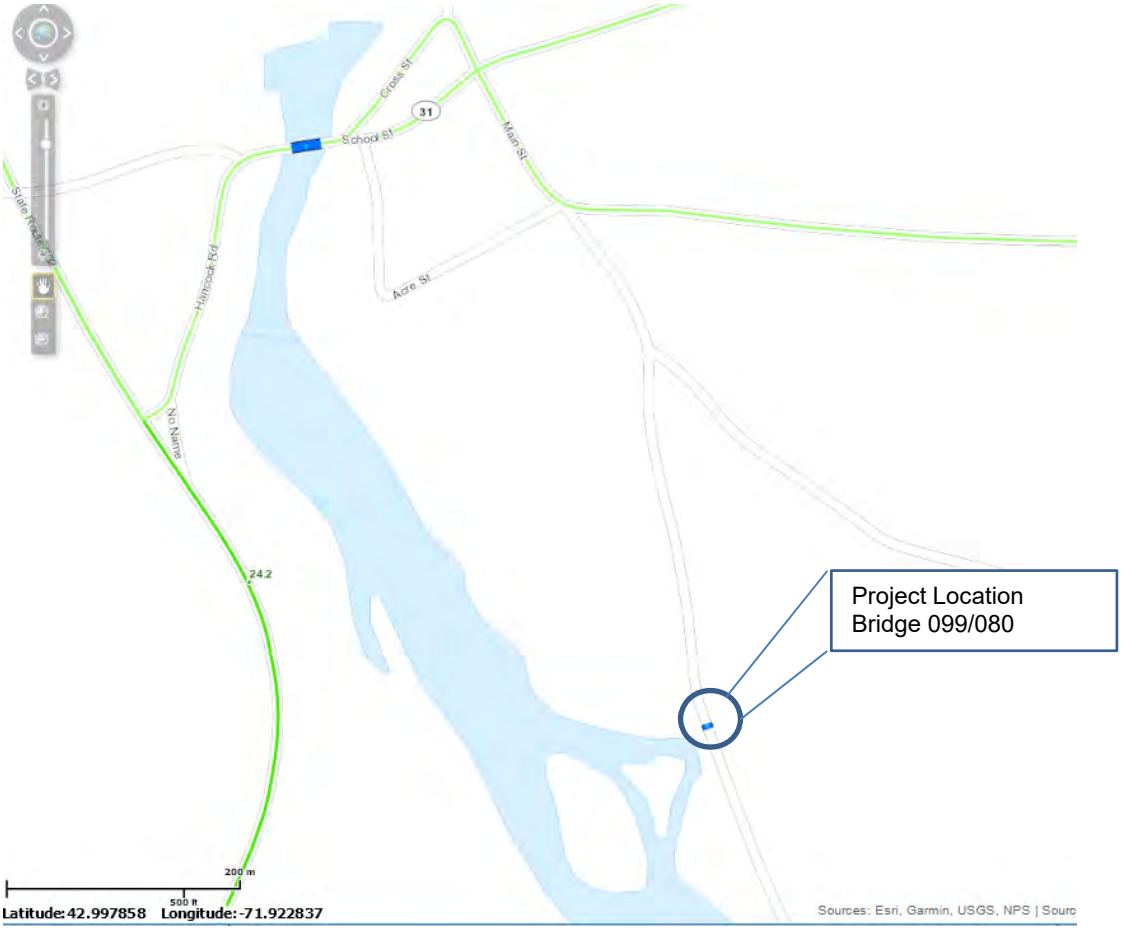


Figure 1 Project Location Map

1.3 SCOPE

The project consists of replacement or rehabilitation of the existing bridge. Any replacement bridge will be located over the approximate "foot print" of the existing bridge, however some widening of the bridge may be necessary on both sides to accommodate the proposed roadway cross section associated with the roadway and bridge improvements.

The design objectives of this report include evaluation of the hydraulic capacity of the existing bridge; evaluation of the hydraulic capacity of a replacement bridge; design of a waterway opening to maximize flow carrying capacity in the channel beneath the bridge; and provide no increase in backwater elevations for the 100-year storm.

The scope of work performed for this investigation included a site field survey, review of all available information for Russel Brook, and detailed hydraulic analysis.

1.4 EXISTING BRIDGE

The existing bridge is a concrete box culvert. The bridge has a clear span on 10 feet. The existing internal height from the bottom of the streambed to the bottom of the wide-section beams is approximately 7 ft. The travel lane width of the bridge and roadway over Russell Brook is 26 ft. curb to curb with two 1 ft. – 10 inch wide curbs, and the hydraulic opening is approximately 70 sq. ft. An existing bridge carrying Old Greenfield Road over the Russell Brook is approximately 1350 ft. upstream from the South Bennington Road crossing.

A field survey of the bridge and roadway was performed to develop a project plan depicting existing conditions. A topographic plan of the existing stream crossing and adjacent area was prepared by NHDOT. Information presented on this plan was used in the development of the hydraulic model that is described subsequently in this report. The stream topography includes a beaver lodge downstream of the crossing. A copy of the topographic survey plan is included in Appendix C.

1.5 RECONNAISSANCE

The Flood Insurance Rate Map for Hillsborough County, New Hampshire was obtained from the Federal Emergency Management Agency (FEMA). The study's effective date is September 25, 2009. The study provides detailed backwater analysis for the Contoocook River for the 10-, 50-, 100-, and 500-year storms. The existing bridge falls within the floodplain of the Contoocook River and the FEMA mapped floodplain elevation near the Russell Brook crossing is controlled by backwater on the Contoocook River. The 50-year backwater elevation is approximately 672.8. The 100-year elevation is approximately 673.1. The FEMA data is included in Appendix A.

1.6 DESIGN CRITERIA

South Bennington Road is a Tier 4 highway, therefore the following design criteria were used evaluate the hydraulics alternatives:

		Freeboard Required
Bridge Superstructure:		
Design flood	50-year event	1 foot
Check flood for high flow damage, extreme limit state	100-year event	-
Bridge Substructures:		
Design flood for scour	100-year event	-
Check flood for scour, extreme limit state	500-year event	-

2.0 HYDROLOGIC ANALYSIS

Russell Brook has a tributary watershed area of approximately 2.34 square miles. The brook passes through forested hillside, fields, sparse development, and scattered wetlands upstream of the crossing and discharges to the Contoocook, approximately 500 feet downstream from South Bennington Road.

The drainage basin for Russell Brook starts with headwater (elev. 1425 ft) and flows under various roads including Old Greenfield Road and NH Route 31 before passing under South Bennington road at the study site. Elevations range from approximately 660 ft at the subject bridge to over 1425 ft. NGVD in the upstream areas of the watershed. The stream slope is approximately 150 ft./mile by the 10% and 85% method determined using NH StreamStats.

Estimates of the peak flow were developed using the USGS program, StreamStats, the New England Hill and Lowlands Method (NEHL), and the Rural 7 Parameter EST. (FHWA-RD-77-159). Input parameters were obtained from the New Hampshire StreamStats (StreamStats) software system and estimates based on review of aerial photography. Estimated peak flows for return-interval events (years) are provided in cubic feet per second (cfs).

A summary of discharge estimates can be seen in Table 1 and the backup is provided in Appendix B.

Table 1 Discharge Estimates

Return-Interval Event/Peak Discharge (CFS)				
Return-Interval (Year)	StreamStats Olsen (2008)	Rural 7 Parameter EST. (FHWA-RD-77-159)	NEHL	Design Flows
2 Year	114	-	-	114
10 Year	266	236	375	266
50 Year	443	391	680	443
100 Year	540	455	-	540
500 Year	778	-	-	778

The peak discharges obtained using the StreamStats estimate were adopted for subsequent analyses as part of this study.

Based on the identified Roadway Classification, the design return-interval event is the 50-year storm.

3.0 GEOMORPHIC INVESTIGATION

Stantec performed a geomorphic characterization along approximately 285 feet of the channel of the brook adjacent to the South Bennington Road stream crossing. Based on observations and field measurements during the site visit, Stantec characterized Russell Brook at South Bennington Road as having the characteristics as outlined in the following table.

Table 2 Bankfull Channel Data

Bankfull Width	17.6 ft
Bankfull Mean Depth	1.7 ft
Bankfull Maximum Depth	2.5 ft
Flood-Prone Width	47 ft
Channel Materials D50	1 mm
Channel Materials D84	2 mm
Estimated Water Surface Slope Z(ft/ft)	0.0017
Sinuosity	2.1
Estimated Bankfull Discharge	74 cfs
Estimated Bankfull Velocity	2.5 ft/s
Bankfull Cross Sectional Area	30 ft^2
Entrenchment Ratio	2. 7
Width to Depth Ratio	10.5

3.1 NHDES WETLAND PERMIT REQUIREMENTS

- Crossing would be considered Tier 3 since the contributing watershed is greater than 640 acres (1 sq-mi.) per Env.Wt. 904.04(a) and would be classified as a major impact project.
- Tier 3 Design Requirements:
    - shall be a span structure or an open-bottomed culvert with stream simulation, not a closed-bottom culvert or pipe arch;
    - In accordance with the NH Stream Crossing Guidelines, University of New Hampshire, May 2009;
    - 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;

- To provide a vegetated bank on both sides of the watercourse to allow for wildlife passage;
- To simulate a natural stream channel including preservation of alignment, gradient and functioning of the natural floodplain;
- To accommodate the 100-year flood frequency to ensure no increase in flood stages to abutting properties and characteristics that will not adversely affect channel stability;
- So as not to alter sediment transport competence.

If the applicant believes that installing the structure or providing information specified in the applicable rule is not practicable (meaning available and capable of being done after taking into consideration cost, existing technology, and logistics considering overall project purposes), the applicant may propose an alternative design per Env.Wt. 904.09.

4.0 HYDRAULIC ANALYSIS

Hydraulic analyses of the existing and proposed stream crossings were performed using a one-dimensional numerical model developed using the U.S. Army Corps of Engineers Hydrologic Engineer Center River Analysis System (HEC-RAS) software.

4.1 GENERAL

Backwater analyses were performed for the 2-,10-, 50-, 100-, and 500-year floods. Backwater profiles were calculated for the existing condition as well as for the alternative bridge replacement concept designs.

Cross-sections were developed based upon the field survey conducted for this report supplemented with Light Detection and Ranging data (LIDAR). The backwater analyses utilized cross sections starting approximately 300 feet downstream of the existing structure and extended approximately 300 feet upstream of the existing structure. Cross sections were located at a spacing of approximately 50 feet with some variation in spacing for placement of cross sections adjacent to the structure.

As noted previously, the existing bridge falls within the floodplain of the Contoocook River and the FEMA mapped floodway elevation near the Russell Brook. The 50-year backwater elevation on the Contoocook is approximately 672.8 and the 100-year elevation is approximately 673.1. The top of South Bennington road is at elevation 670.1 +/-, therefore the structure would be backwatered by 2.7 and 3.0 feet at the 50-year and 100-year flood stages respectively on the Contoocook River.

Stantec developed the hydraulic model for analyzing the South Bennington Road bridge opening assuming normal depth at the downstream boundary to estimate the conveyance requirements and stream velocities of the existing and proposed crossings independent of the tailwater condition.

4.2 HEC-RAS MODELS

This section presents information on the results of the HEC-RAS model for the existing and proposed bridge geometries.

4.2.1 Existing Bridge

The HEC-RAS backwater analysis for this report was performed using cross-sections based upon the field survey conducted near the South Bennington Road bridge. The cross-section location plan is provided in appendix C.

The HEC-RAS analysis for the existing bridge is provided in Appendix C.

4.2.2 Bridge Repair and Replacement Alternatives

Stantec evaluated three potential construction alternatives as well as a do nothing alternative. The alternatives considered are as follows:

Alternative 1: Do Nothing – Given the poor condition of the existing bridge, this is not considered a viable alternative. The hydraulics of this alternative are the same as the existing bridge.

Alternative 2: Rehabilitate Existing - This alternative may not be the most cost-effective construction alternative due to the poor condition of the existing structure. The following is an excerpt from the Bridge inspection report: *"Underside of slab- rust stains, delamination, spalls and rebar exposed…abutments- large areas of delamination, spalls and exposed rebar above and below the water line. Wings- exteriors spalled, delamination and exposed rebar at bases of all four corners."*

For the purposes of this study, the waterway opening would not be appreciably changed by rehabilitation and this alternative is hydraulically the same as the existing condition.

Alternative 3: Bridge Replacement with a 22 foot span Box Culvert embedded with stream simulation material. This alternative mitigates concerns about abutment scour, minimizes environmental impacts by allowing installation within a short construction duration, thus eliminating the need for a temporary bridge. The crossing is sized to accommodate 1.2 x the bank-full-width and the invert of the culvert could be set below the anticipated long term stream profile to allow for stream material to naturally fill in the box, or the box could be filled with stream simulation material to create a low flow channel and allow for some natural sediment transport and deposition within the box.

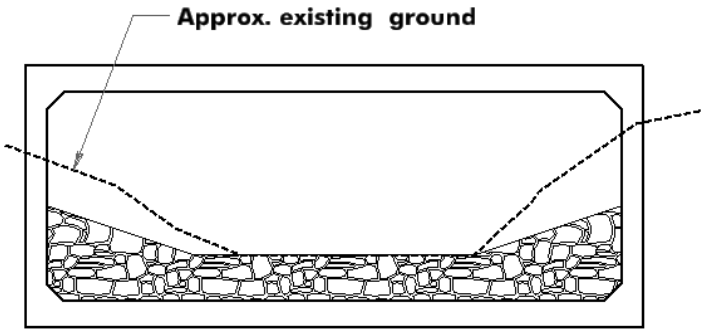


Figure 2 Embedded Box Culvert with Stream simulation material

Alternative 4: Bridge Replacement with Precast Rigid Frame supported on spread footings, or pile supported foundations. This alternative is likely to have a much higher construction cost than alternative 3 and will also have a much longer construction duration and may have greater traffic maintenance considerations. The hydraulic analysis of this alternative is the same as alternative 3.

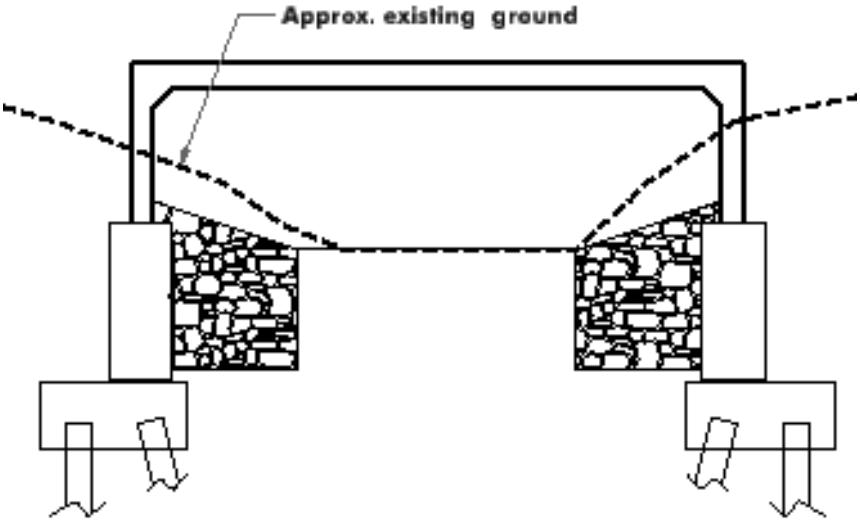


Figure 3 Precast Rigid Frame on Stem Wall and Footing

4.2.3 Analysis Results

Existing Conditions (Alternatives 1 and 2): The analysis shows the existing bridge at South Bennington Road can pass the 2-,10- and 50- year floods, however the 100-, and 500-year floods overtop the roadway. The velocities in the existing channel are in the range of 11.2 – 12.6 fps for the 50-year storm within the constriction of the existing bridge and just downstream of the structure.

Alternatives 3 and 4: Alternatives 3 and 4 both pass the 2-,10-, 50-, 100-floods. The 500 year flood impacts the upstream fascia of the structure. Both alternatives provide greater than 1 foot of freeboard above the 50-year flood elevation. The velocities in are in the range of 6.5 - 7.8 fps for the 50-year storm within the constriction of the bridge and just downstream of the structure.

The existing low chord elevation of the bridge will be similar to the existing, and the roadway profile will depend upon the span length and construction depth of the proposed structure. The complete review of the alternatives will be described in more detail in the Engineering Study.

Table 3 summarizes the flood elevations at the bridge at South Bennington based upon the analyses conducted for this report:

Table 3 Flood Elevations

	Elevation (NGVD 1929) Immediately Upstream of Bridge			
At upstream side bridge at South Bennington Rd. (River Sta. 411 Upstream Bridge Section)	10-Year	50-Year	100-Year	500-Year
FEMA – Flood Insurance Study Based on Backwater from Contoocook River (unaffected by bridge span)	669.7	672.8	673.1	675.1
Alternative 1: Do nothing	667.14	665.94	670.17	670.60
Alternative 2: Rehabilitate Existing Bridge	667.14	665.94	670.17	670.60
Alternative 3: Bridge Replacement with 22 foot span culvert (embedded with simulated stream bottom)	666.02	666.99	667.48	669.00
Alternative 4: Bridge Replacement with 22 foot span Precast Rigid Frame	666.02	666.99	667.48	669.00

Note: The existing low bridge chord is elevation 668.6 and the top of road elevation at the crossing is elevation 670.0.

All HEC-RAS results are provided in Appendices C and D for each alternative.

4.2.4 Proposed Bridge

Replacement of the existing structure with a 22 foot span Box Culvert, embedded with stream simulation is recommended for final Design.

The HEC-RAS analysis for the proposed bridge is provided in Appendix D.

4.3 SCOUR PROTECTION

From Chapter 2.7.7 Stability Analysis and Countermeasures of NHDOT Bridge Design Manual "Since any bridge placed within a waterway can be vulnerable to scour, an analysis is required for all new and existing bridges, to determine the necessary protective measures. The minimum requirements for a scour analysis are set by the FHWA Technical Advisory T5140.23, which requires that all bridges be designed to resist scour from a 100-year event and be checked against a 500-year event."

Similar to the hydraulic analysis, the scour analysis neglects the tailwater condition imposed by the water surface elevation on the Contoocook River. While it is valid that the peak flow on Russell Brook will likely occur prior to peak flow on the Contoocook, it is conservative to completely neglect the reduction in scour velocities due to the Contoocook tailwater. If the design of the chosen alterative is scour sensitive, the Department may wish to refine this assumption during final design.

Three components make up total scour: long-term aggradation and degradation, contraction scour and local scour. Long-term aggradation and degradation involves the deposition or removal of bed material. Contraction scour is the result of a "contraction of flow area or change in the downstream control of the Water Surface Elevation (WSE)". A contraction causes an increase in the water velocity and added shear stress on the river bed, resulting in scour. Local scour is defined as "Removal of material from around piers, abutments, spurs, and embankments caused by an acceleration of flow and resulting vortices induced by obstructions to the flow".

Long-term aggradation and degradation: Scour Computations were computed using the HEC-RAS computer model. The scour equations for each of the components are based upon methods outlined in Hydraulic Engineering Circular No. 18 (HEC-18 - FHWA 2012). The program does not have capability to estimate Long-term aggradation and degradation.

Russell Brook appears to be experiencing slight aggradation adjacent at the existing crossing. The is likely due to the backwater effects of the Contoocook River during high flows, which we have assumed will remain. Widening the provided stream corridor from 10 feet to 22 feet will not increase the effects of long-term stream degradation, therefore it is assumed that long-term degradation will not be a contributor to the total scour.

Contraction Scour: A predicted contraction scour depth of 4.7 feet (100-yr.) was estimated based upon assumed soil properties. The D50 grain size of the existing soil was estimated at 1 millimeter (.04 inches) from the Geomorphic Field Evaluation Conducted by Stantec.

Local Scour: Local scour at abutments is based on predictions about turbulent flow caused by the projection of the abutment into the flood plain of the stream. The estimated local abutment scour depth

for the proposed 22 foot span structure in alternative 4 was 9.8 feet (100-yr). While the accuracy of these estimates is debatable, the estimates do provide a good sense of the potential for local scour.

Total Scour: Total scour is a combination of long-term aggradation and degradation, local and contraction scour. The total predicted scour depth is 14.5 feet (100-yr.). While it may not be practical to set the bottom off footing below these elevations, there are assorted options for designing the foundation to mitigate this scour, including setting the foundation below the anticipated contraction scour depth and using scour countermeasures to mitigate the local scour at the abutments, or in the case of a pile foundation, the piling can be designed as unsupported for the estimated depth of scour. These design considerations would apply to Alternative 4, the Precast Rigid Frame option. If alternative 4 is pursued, a detail scour design including countermeasures should be conducted during final design.

The 500-year scour magnitude was also computed as a check. Results are included in Table 4 below.

Box Culvert Scour: Scour potential for a box culvert is less of an issue because of the culvert bottom. Generally, scour at the inlet and outlet of the structure is mitigated with a stone apron, and it is common to embed the culvert 1 to 3 feet depending upon the anticipated variability in the channel profile to avoid the channel degrading below the culvert bottom and creating a perched culvert. It is recommended that the culvert include a cut-off wall that extends 5 feet below the channel profile at the inlet and outlet of the box to prevent undermining of the structure and to limit hydraulic connectivity in the engineered fill beneath the box. In some cases, the permit agency may prefer the culvert be filled with material to mimic the natural channel bottom in an adjacent reach of stream, and sometimes the preference is to simply set the invert of the culvert below grade and allow natural deposition of material to mimic the adjacent channel. Refer to appendix E for the scour analysis.

The recommended scour apron is Class III riprap revetments along the channel slopes with a minimum thickness of 24 inches. Depending on the preferences of the permit agency, this riprap apron could either be constructed with a mixed gradation mimicking the natural channel material, or the apron could be set below the channel grade with the simulated material over the top of the apron. The recommended riprap layout is to extend to 25 feet on the upstream and downstream ends of the box culvert.

4.4 HYDRAULIC DATA

Table 4 summarizes the hydraulic data for the bridge replacement of the South Bennington Road with a 22 foot clear span structure (box culvert or open bottom bridge).

Table 4 Hydraulic Data

HYDRAULIC DATA			
Drainage Area (Square Miles)	2.34		
Return Interval (yr.)	50 years	100 Year	500 Year
Discharge (CFS)	443	540	778
Water Surface Elevation (NGVD 1929)	666.99 ft	667.48 ft	669.00 ft
Velocity (within bridge) fps	6.5	6.9	10.5
Anticipated Depth of Long-term Scour (ft)	not used	-	-
Anticipated Depth of Contraction Scour (ft)	not used	4.7	5.7
Anticipated Depth of Local Scour (ft)	not used	9.8	10.0
Anticipated Depth of Total Scour (ft)	not used	14.5	15.7
Minimum Low Chord Elevation 50 year + 1 ft (NGVD 1929)	667.99 ft		
Bridge full waterway opening	130 SF		

5.0 CONCLUSIONS

The recommended structure for South Bennington Road from a Hydraulic standpoint is Alternative 3, Bridge Replacement with a 22 foot span Box Culvert embedded with stream simulation material. The hydraulic analysis indicates that this option provides for an adequate hydraulic opening to pass the design flow with the required 1 foot freeboard. The alternative also passes the 100-yr. check flow.

Ultimately, the structure type may be governed by permit requirements, in particular the NH-DES Wetland Permit and Stream Crossing Requirements (Wetland Permit). Under the Wetland Permit rules, the stream would be considered a Tier 3 stream and therefore the preferred crossing type would be an open bottomed structure. In this case, the closed bottom structure has several advantages over the open bottom version which are outlined as follows:

- The open bottom structure would be more costly to construct.
- The duration of construction for a box culvert is much shorter than for an open bottom structure.
- The box culvert option is less scour susceptible than the open bottom structure.

APPENDICES

Appendix A EXCERPTS FROM FEMA – FLOOD INSURANCE STUDY (SEPTEMBER 25, 2009)

drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was New Hampshire State Plane (FIPSZONE 2800). The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of the FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum.** For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC- 3, #9202
1315 East- West Highway
Silver Spring, MD 20910- 3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242,** or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was derived from U.S. Geological Survey Digital Orthophoto Quadrangles produced at a scale of 1:12,000 from photography dated 1998 or later. These images were recast by NH GRANIT onto the NH State Plane coordinate system.

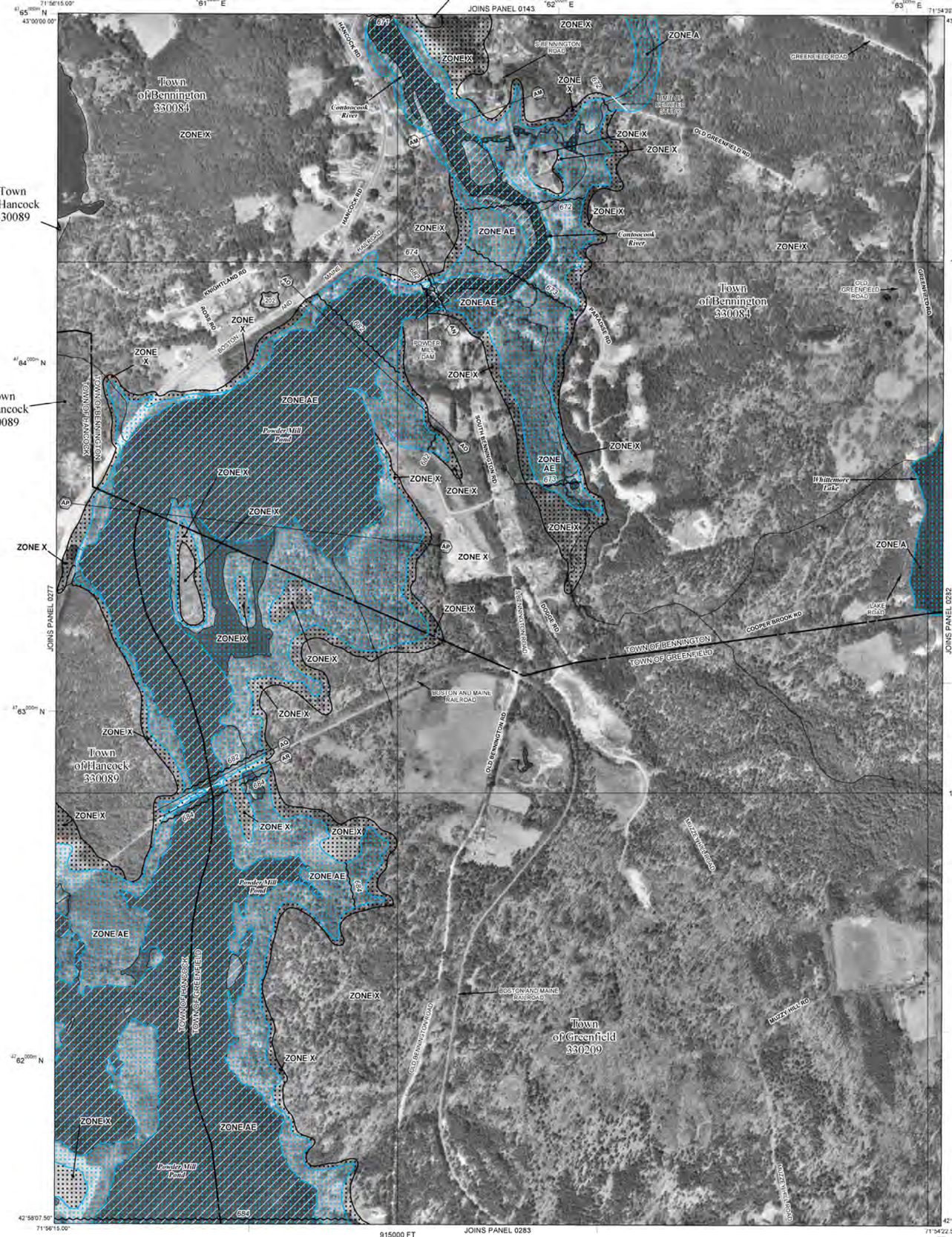
This map reflects more detailed and up- to- date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables *in the Flood Insurance Study report (which contains authoritative hydraulic data)* may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de- annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1- 800- 358- 9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, *a Flood Insurance Study report,* and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1- 800- 358- 9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1- 877- FEMA MAP** (1- 877- 336- 2627) or visit the FEMA website at http://www.fema.gov/.



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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

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

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 - - - - 23	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN	1000-meter Universal Transverse Mercator grid ticks, zone 19
6000000 FT	5000-foot grid values: New Hampshire State Plane coordinate system, (FIPSZONE 2800), Transverse Mercator
DX5510	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index.

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 25, 2009
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1- 800- 638- 6620.

N

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0281D

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

PANEL 281 OF 701
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

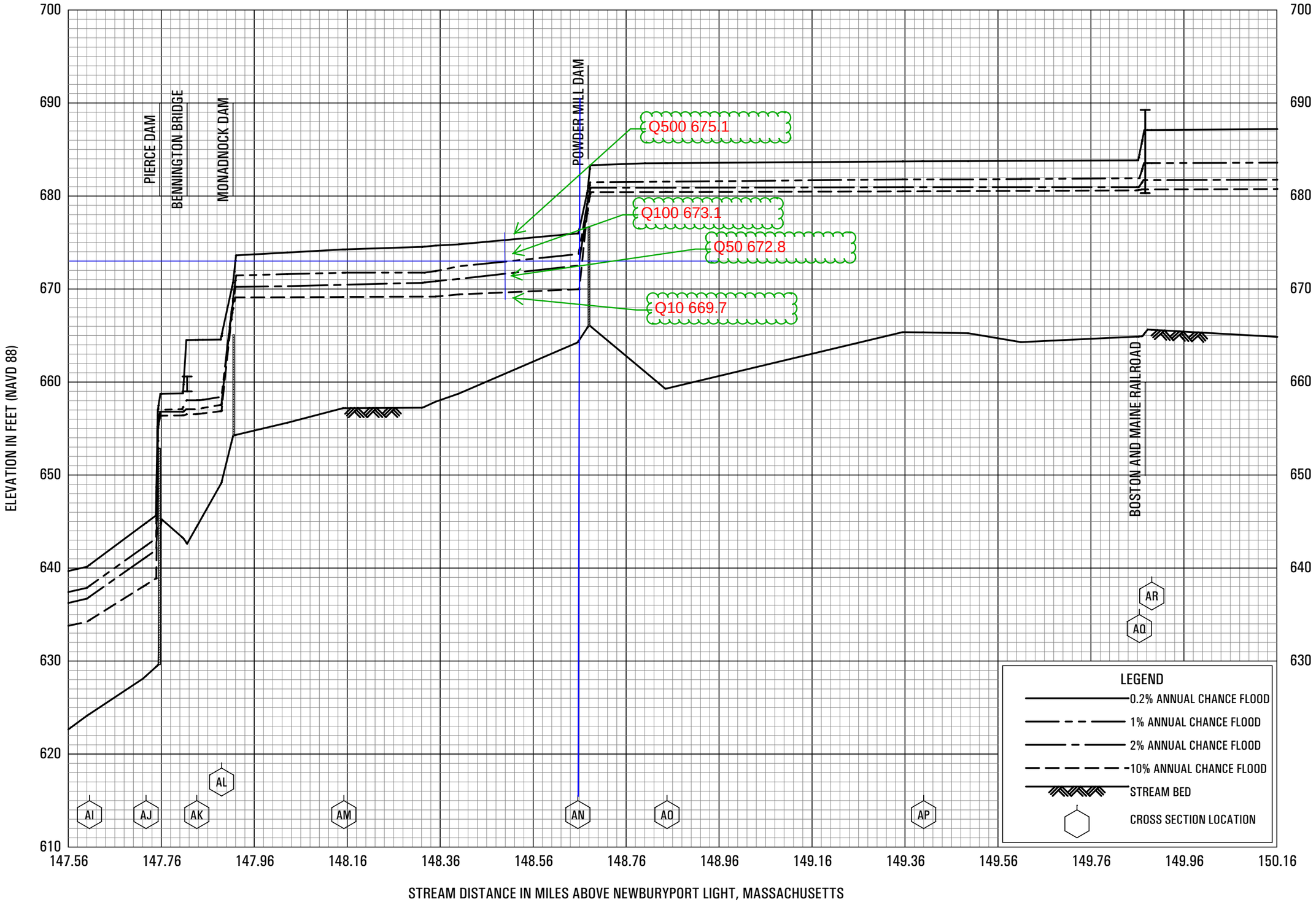
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BENNINGTON, TOWN OF	330084	0281	D
GREENFIELD, TOWN OF	330209	0281	D
HANCOCK, TOWN OF	330089	0281	D

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
33011C0281D

EFFECTIVE DATE



FLOOD PROFILES

CONTOOCOOK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

HILLSBOROUGH COUNTY, NH

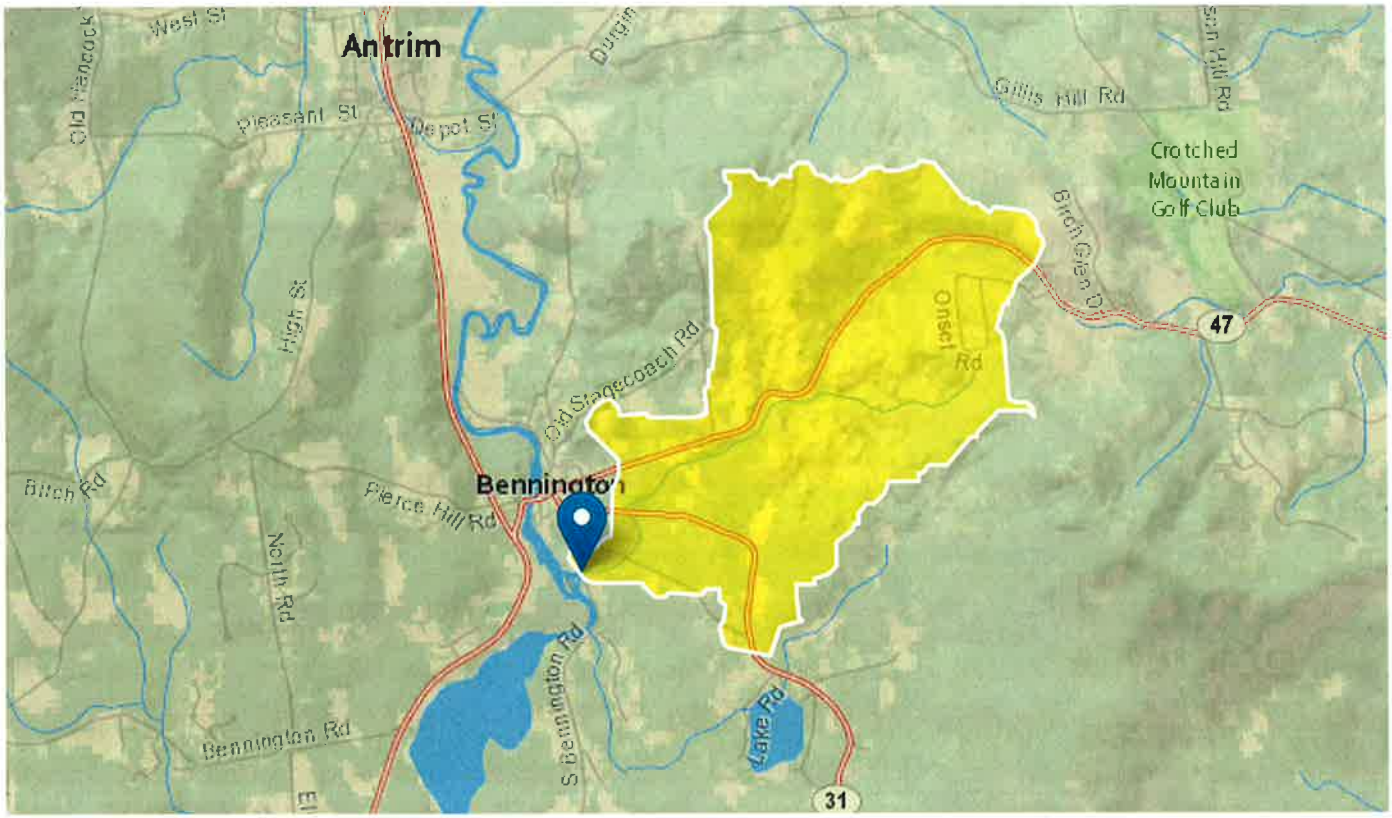
(ALL JURISDICTIONS)

Appendix B HYDROLOGIC ANALYSES

B.1 STREAMSTATS ANALYSIS

StreamStats Report

Region ID: NH
Workspace ID: NH20170731112034701000
Clicked Point (Latitude, Longitude): 42.99688, -71.92144
Time: 2017-07-31 11:21:27 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	2.34	square miles
APRAVPRE	Mean April Precipitation	3.993	inches
WETLAND	Percentage of Wetlands	2.4543	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	150	feet per mi
TEMP	Mean Annual Temperature	45.345	degrees F
PREG_06_10	Mean precipitation at gaging station location for June to October summer period	18	inches
CONIF	Percentage of land surface covered by coniferous forest	26.9657	percent
PREBC0103	Mean annual precipitation of basin centroid for January 1 to March 15 winter period	8.62	inches
BSLDEM30M	Mean basin slope computed from 30 m DEM	10.897	percent

Parameter Code	Parameter Description	Value	Unit
MIXFOR	Percentage of land area covered by mixed deciduous and coniferous forest	34.6206	percent
PREG_03_05	Mean precipitation at gaging station location for March 16 to May 31 spring period	9.3	inches
TEMP_06_10	Basinwide average temperature for June to October summer period	61.238	degrees F
ELEVMAX	Maximum basin elevation	1424.344	feet

Peak-Flow Statistics Parameters [Peak Flow Statewide SIR2008 5206]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.34	square miles	0.7	1290
APRAVPRE	Mean April Precipitation	3.993	inches	2.79	6.23
WETLAND	Percent Wetlands	2.4543	percent	0	21.8
CSL10_85	Stream Slope 10 and 85 Method	150	feet per mi	5.43	543

Peak-Flow Statistics Flow Report [Peak Flow Statewide SIR2008 5206]

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

Statistic	Value	Unit	PII	PIu	SEp	Equiv. Yrs.
2 Year Peak Flood	114	ft^3/s	70	185	30.1	3.2
5 Year Peak Flood	196	ft^3/s	119	323	31.1	4.7
10 Year Peak Flood	266	ft^3/s	158	447	32.3	6.2
25 Year Peak Flood	362	ft^3/s	208	630	34.3	8
50 Year Peak Flood	443	ft^3/s	247	793	36.4	9
100 Year Peak Flood	540	ft^3/s	291	1000	38.6	9.8
500 Year Peak Flood	778	ft^3/s	387	1560	44.1	11

Peak-Flow Statistics Citations

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. (http://pubs.usgs.gov/sir/2008/5206/)

Low-Flow Statistics Parameters [Low Flow Statewide]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.34	square miles	3.26	689
TEMP	Mean Annual Temperature	45.345	degrees F	36	48.7
PREG_06_10	Jun to Oct Gage Precipitation	18	inches	16.5	23.1

Low-Flow Statistics Disclaimers [Low Flow Statewide]

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

Low-Flow Statistics Flow Report [Low Flow Statewide]

Statistic	Value	Unit
7 Day 2 Year Low Flow	0.0981	ft^3/s
7 Day 10 Year Low Flow	0.0299	ft^3/s

Low-Flow Statistics Citations

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. (http://pubs.water.usgs.gov/wrir02-4298)

Seasonal Flow Statistics Parameters [Low Flow Statewide]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	2.34	square miles	3.26	689
CONIF	Percent Coniferous Forest	26.9657	percent	3.07	56.2
PREBC0103	Jan to Mar Basin Centroid Precip	8.62	inches	5.79	15.1
BSLDEM30M	Mean Basin Slope from 30m DEM	10.897	percent	3.19	38.1
MIXFOR	Percent Mixed Forest	34.6206	percent	6.21	46.1
PREG_03_05	Mar to May Gage Precipitation	9.3	inches	6.83	11.5
TEMP	Mean Annual Temperature	45.345	degrees F	36	48.7
TEMP_06_10	Jun to Oct Mean Basinwide Temp	61.238	degrees F	52.9	64.4
PREG_06_10	Jun to Oct Gage Precipitation	18	inches	16.5	23.1
ELEVMAX	Maximum Basin Elevation	1424.344	feet	260	6290

Seasonal Flow Statistics Disclaimers [Low Flow Statewide]

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

Seasonal Flow Statistics Flow Report [Low Flow Statewide]

Statistic	Value	Unit
Jan to Mar15 60 Percent Flow	1.5	ft^3/s
Jan to Mar15 70 Percent Flow	1.26	ft^3/s

Statistic	Value	Unit
Jan to Mar15 80 Percent Flow	1.09	ft^3/s
Jan to Mar15 90 Percent Flow	0.825	ft^3/s
Jan to Mar15 95 Percent Flow	0.657	ft^3/s
Jan to Mar15 98 Percent Flow	0.541	ft^3/s
Jan to Mar15 7 Day 2 Year Low Flow	1.09	ft^3/s
Jan to Mar15 7 Day 10 Year Low Flow	0.602	ft^3/s
Mar16 to May 60 Percent Flow	5.01	ft^3/s
Mar16 to May 70 Percent Flow	3.94	ft^3/s
Mar16 to May 80 Percent Flow	2.94	ft^3/s
Mar16 to May 90 Percent Flow	2.07	ft^3/s
Mar16 to May 95 Percent Flow	1.52	ft^3/s
Mar16 to May 98 Percent Flow	1.06	ft^3/s
Mar16 to May 7 Day 2 Year Low Flow	1.51	ft^3/s
Mar16 to May 7 Day 10 Year Low Flow	0.821	ft^3/s
Jun to Oct 60 Percent Flow	0.263	ft^3/s
Jun to Oct 70 Percent Flow	0.185	ft^3/s
Jun to Oct 80 Percent Flow	0.146	ft^3/s
Jun to Oct 90 Percent Flow	0.0868	ft^3/s
Jun to Oct 95 Percent Flow	0.0568	ft^3/s
Jun to Oct 98 Percent Flow	0.0457	ft^3/s
Jun to Oct 7 Day 2 Year Low Flow	0.102	ft^3/s
Jun to Oct 7 Day 10 Year Low Flow	0.0316	ft^3/s
Nov to Dec 60 Percent Flow	2.14	ft^3/s
Nov to Dec 70 Percent Flow	1.6	ft^3/s
Nov to Dec 80 Percent Flow	1.18	ft^3/s
Nov to Dec 90 Percent Flow	0.748	ft^3/s
Nov to Dec 95 Percent Flow	0.476	ft^3/s
Nov to Dec 98 Percent Flow	0.289	ft^3/s
Oct to Nov 7 Day 2 Year Low Flow	1.17	ft^3/s
Oct to Nov 7 Day 10 Year Low Flow	0.457	ft^3/s

Seasonal Flow Statistics Citations

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. (http://pubs.water.usgs.gov/wrir02-4298)

B.2 RURAL 7 PARAMETER ANALYSIS

Stantec

Russell Brook
S. Bennington Rd
Bennington, NH

FHWA-RD-77-159 - 7 PARAMETER

DRAINAGE AREA = 2.34 sq mi

ZONE 9

$$\hat{q}_{10} = 50.808\, A^{0.3799}\, R^{-0.1432}\, DH^{0.3401}\, L^{0.0917}\, LL^{0.2879}\, P_{10}^{-0.9655}\, P_{60}^{1.8748}$$

$$= 50.808 (2.34)^{0.3799}\, 94^{-0.1432}\, 516^{0.3401}\, 2.717^{0.0917}\, 1.653^{0.2879}\, 4.74^{-0.9655}\, 1.72^{1.8748}$$

$$= 50.808 (1.38)(0.52)(8.37)(1.10)(1.16)(0.22)(2.76)$$

$$Q_{10} = 236 \text{ cfs}$$

$$Q_{2.33} = 0.46921 (236)^{1.00243} = 112 \text{ cfs}$$

$$Q_{50} = 1.45962 (236)^{1.02342} = 391 \text{ cfs}$$

$$Q_{100} = 1.64380 (236)^{1.02918} = 455 \text{ cfs}$$

A, drainage area

94 R, Iso-erodent factor

1180 − 664 = 516 DH, Δ elevation (full length main path)

6.9" = 2.717 mi L, main channel length (total)

4.2" = 1.653 mi *LL, cumulative channels in watershed

4.74 P_{10}, 10-year 10 min rainfall

1.72 P_{60}, 10-year 60 min rainfall

* as measured on QUAD sheet (blue lines)

6.9" ÷ 2.54"/mile = 2.717 miles = 14,343 feet

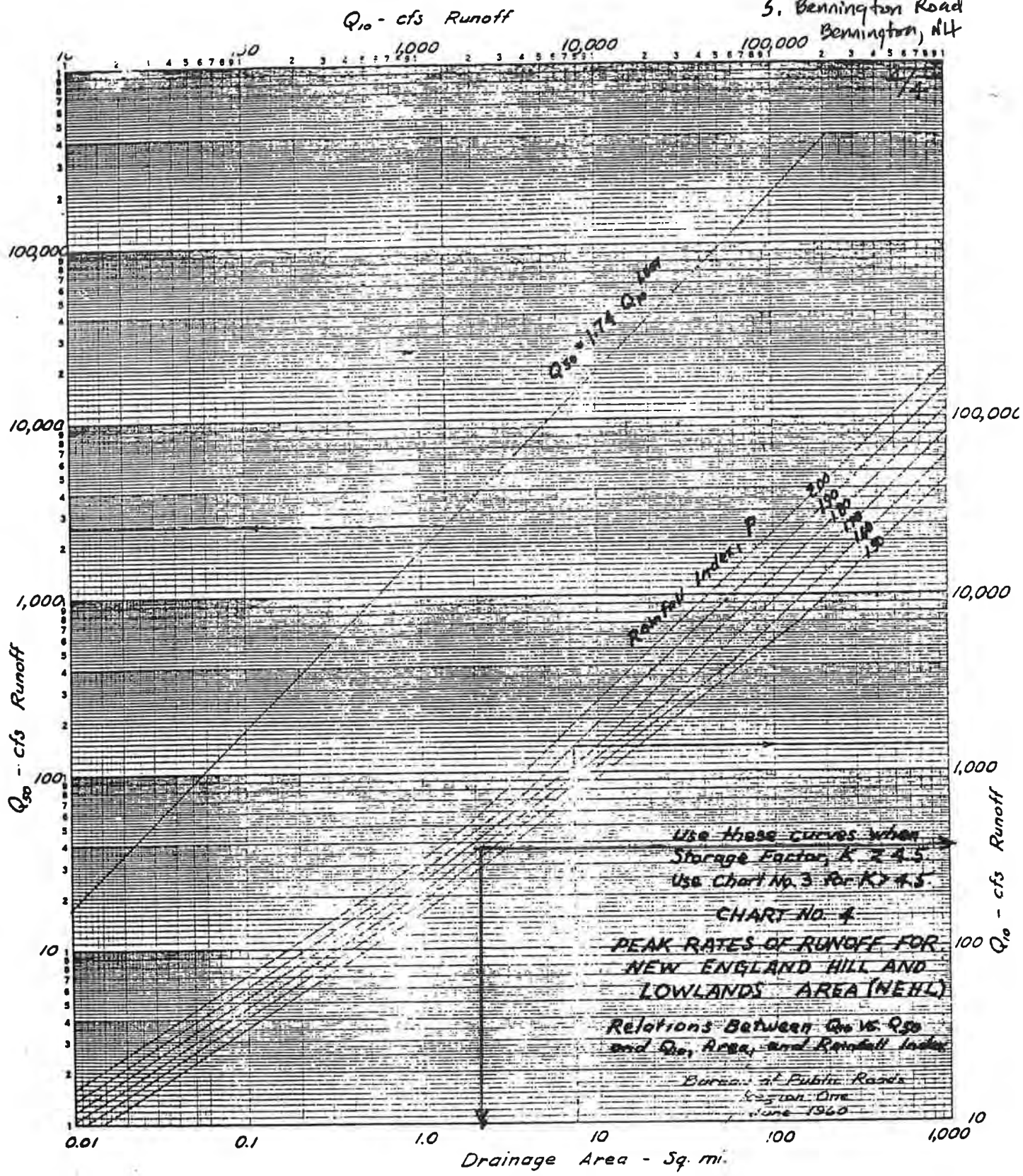
4.2" ÷ 2.54"/mile = 1.653 = 8731 feet

QC-Tim Adams, See email 6/1/15

Designed by: Checked by:

B.3 NEW ENGLAND HILL AND LOWLAND METHOD (NEHL)

Russell Brook
S. Bennington Road
Bennington, NH



GPO 888836

DA = 2.3 sqmi Q_{10} = 375 cfs P = 1.7

$Q_{50} = 1.75(375)^{1.007}$

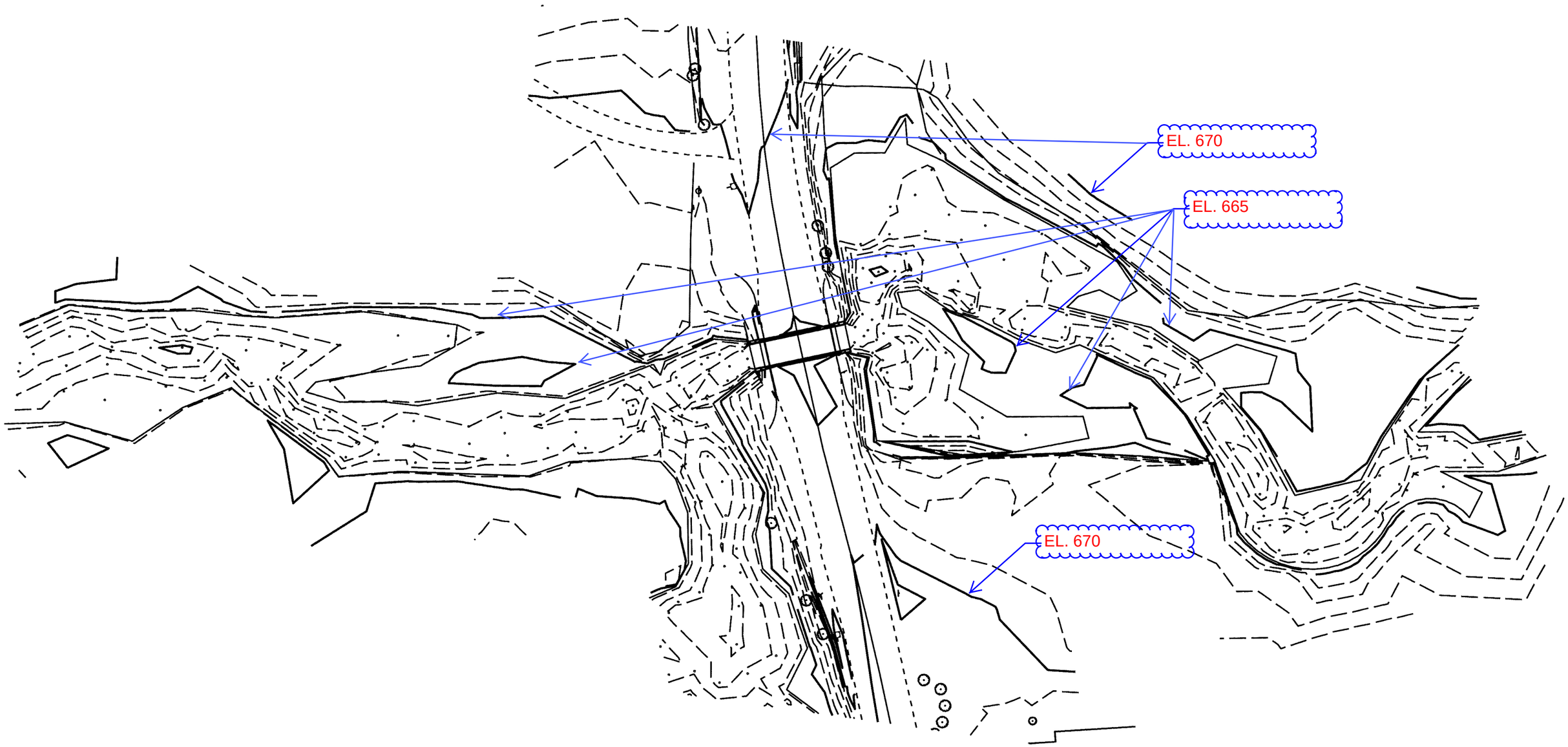
$= 680$ cfs

QC-Tim Adams, See email 6/1/15

FIGURE 2-9

Appendix C HEC-RAS MODEL - EXISTING CONDITIONS

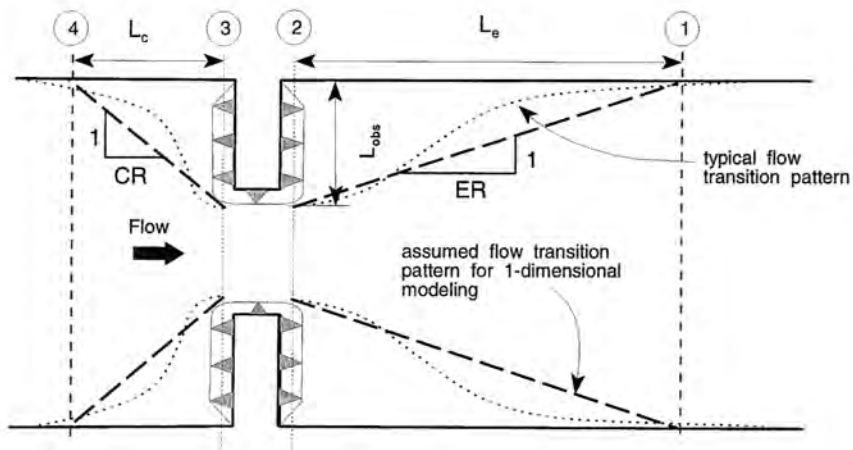
Hydraulics Analysis
Model of Existing Conditions



EXISTING TOPOGRAPHY FROM NHDOT SURVEY

Stantec	Project	Bennington NH	
	Sheet No.	of	
Authored by TEK	Date 4/18	Checked by	Date 3/18

Subject **Hydraulic Model - Existing Conditions**



Stream Stationing to determine Approx. Splope

	begin	end						
Elev.	661	663	Dy=	2	Slope	0.003	Ft/ft	18 ft/mile
Sta.	110.8	693.7	Dx=	583				

			b	10	width of bridge opening
n ob	0.07	mannings for overbank	B	100	width of flood plain
n channel	0.05	mannings for channel	b/B	0.1	
nob/nc	1.4		Lobs=	45	

Table 2. Ranges of Contraction Ratios

	$n_{ob} / n_c = 1$	$n_{ob} / n_c = 2$	$n_{ob} / n_c = 4$
S = 1 ft/mile	1.0 - 2.3	0.8 - 1.7	0.7 - 1.3
5 ft/mile	1.0 - 1.9	0.8 - 1.5	0.7 - 1.2
10 ft/mile	1.0 - 1.9	0.8 - 1.4	0.7 - 1.2

Lc= 0+50
Lobs= 45

Cr= 1.1

Table 1. Ranges of Expansion Ratios

b/B = 0.10	Slope:	$n_{ob} / n_c = 1$	$n_{ob} / n_c = 2$	$n_{ob} / n_c = 4$
	1 ft/mile	1.4 - 3.6	1.3 - 3.0	1.2 - 2.1
	5 ft/mile	1.0 - 2.5	0.8 - 2.0	0.8 - 2.0
	10 ft/mile	1.0 - 2.2	0.8 - 2.0	0.8 - 2.0
b/B = 0.25	1 ft/mile	1.6 - 3.0	1.4 - 2.5	1.2 - 2.0
	5 ft/mile	1.5 - 2.5	1.3 - 2.0	1.3 - 2.0
	10 ft/mile	1.5 - 2.0	1.3 - 2.0	1.3 - 2.0
b/B = 0.50	1 ft/mile	1.4 - 2.6	1.3 - 1.9	1.2 - 1.4
	5 ft/mile	1.3 - 2.1	1.2 - 1.6	1.0 - 1.4
	10 ft/ mile	1.3 - 2.0	1.2 - 1.5	1.0 - 1.4

Stations	US to DS
4	4+85
3	4+35
2	3+85
1	3+50

L exp 0+35
Lobs 45

Er= 0.8

Manning's n for Channels (Chow, 1959).

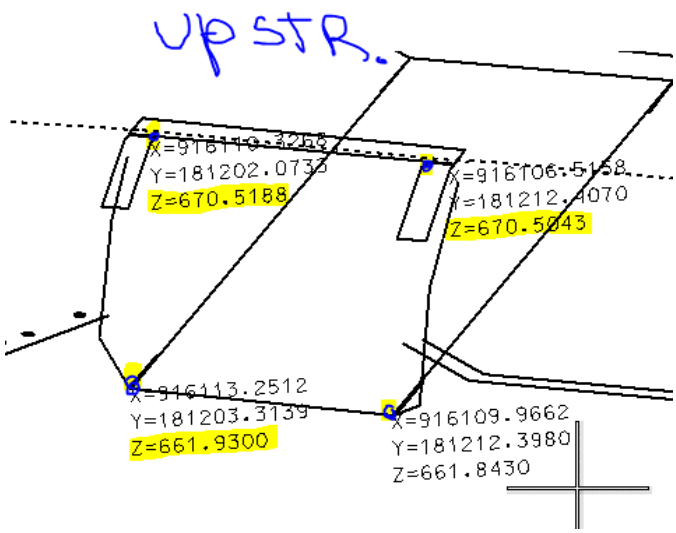
Type of Channel and Description	Minimum	Normal	Maximum
Natural streams - minor streams (top width at floodstage < 100 ft)			
1. Main Channels			
a. clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
b. same as above, but more stones and weeds	0.030	0.035	0.040
c. clean, winding, some 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" with 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 stand of timber and underbrush	0.075	0.100	0.150

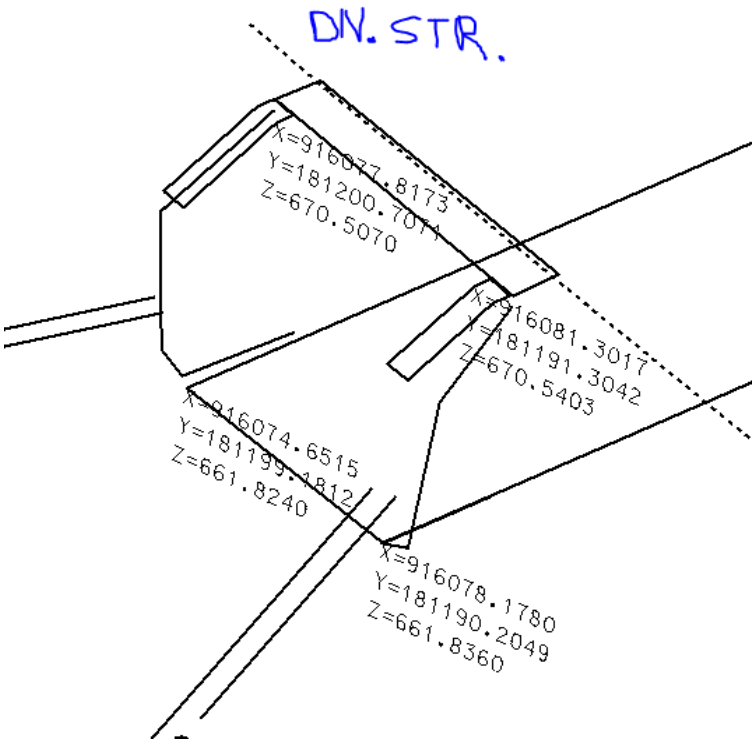
http://www.fsl.orst.edu/geowater/FX3/help/8_Hydraulic_Reference/Mannings_n_Tables.htm

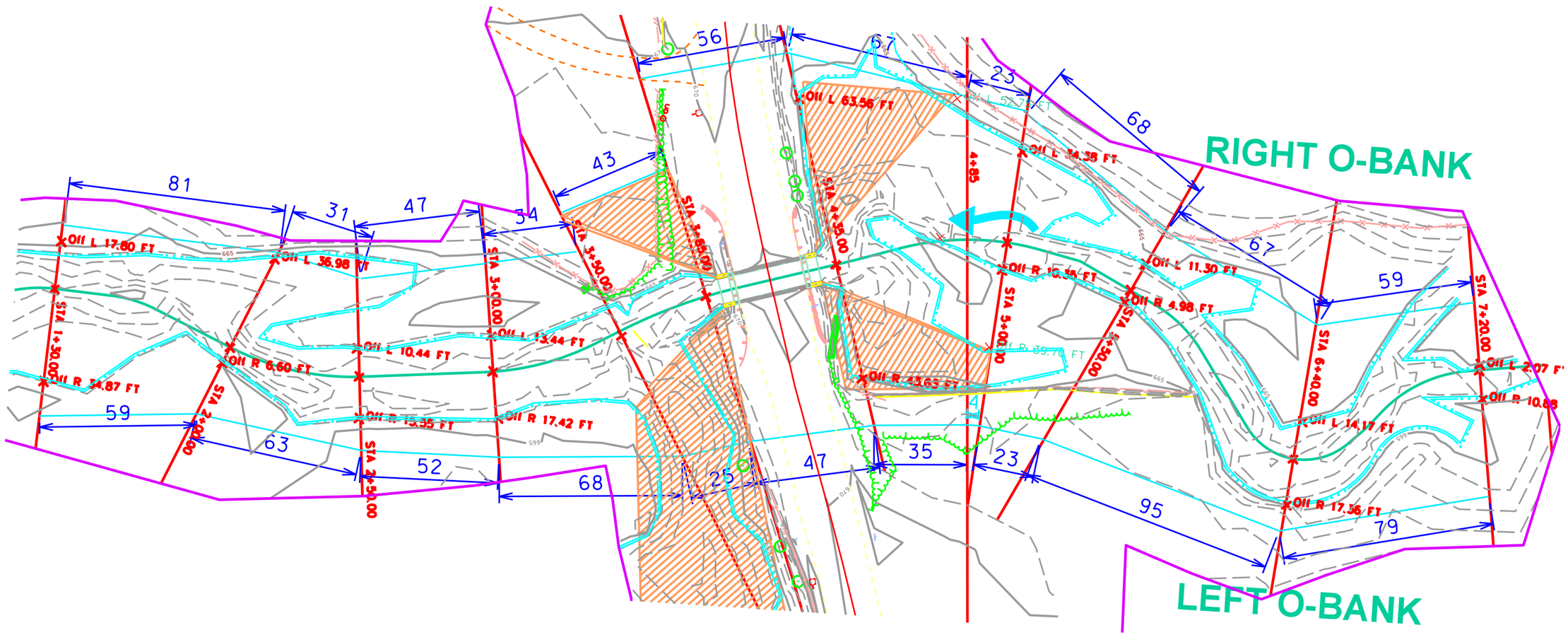
3. Floodplains			
a. Pasture, no brush			
1.short grass	0.025	0.030	0.035
2. high grass	0.030	0.035	0.050
b. Cultivated areas			
1. no crop	0.020	0.030	0.040
2. mature row crops	0.025	0.035	0.045
3. mature field crops	0.030	0.040	0.050
c. Brush			
1. scattered brush, heavy weeds	0.035	0.050	0.070
2. 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

Upstream Boundary conditions.
Assume normal depth with a relatively flat slope due to beaver dam

Existing bridge elevations





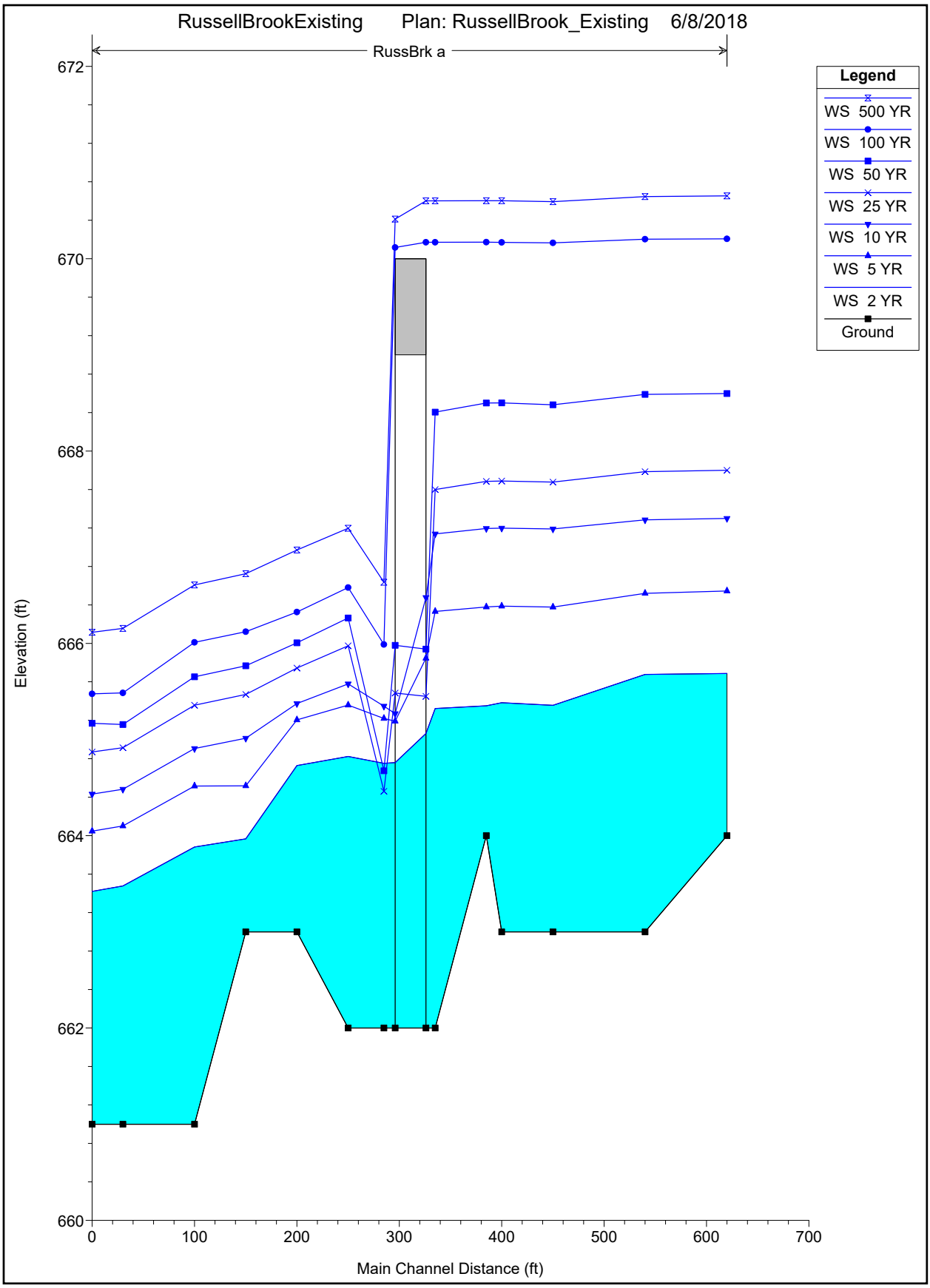


RUSSELL BROOK CHANNEL CROSS SECTION LAYOUT

OVERLAYED ON EXISTING TOPOGRAPHY

HEC-RAS Plan: RussBrookExisting River: RussBrk Reach: a

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)
a	485	2 YR	665.39	665.35		0.04	0.00	103.00	12.24	101.44	0.31	1.55
a	485	5 YR	666.40	666.38		0.02	0.00	109.94	44.87	148.06	3.07	1.22
a	485	10 YR	667.21	667.19		0.02	0.00	117.17	69.99	189.51	6.50	1.15
a	485	25 YR	667.71	667.68		0.02	0.01	124.47	99.03	252.36	10.61	1.32
a	485	50 YR	668.52	668.50		0.02	0.01	161.03	116.47	308.99	17.54	1.31
a	485	100 YR	670.18	670.17		0.00	0.00	398.14	163.02	307.94	69.04	0.94
a	485	500 YR	670.62	670.60		0.00	0.00	434.61	218.21	432.33	127.46	1.23
a	435	2 YR	665.35	665.32	662.85	0.01	0.06	120.17	0.75	113.25		1.23
a	435	5 YR	666.37	666.33	663.22	0.01	0.11	140.98	2.09	193.91		1.60
a	435	10 YR	667.19	667.14	663.49	0.01	0.15	167.66	3.46	262.54		1.81
a	435	25 YR	667.68	667.60	663.82	0.02	0.49	182.80	5.11	356.89		2.26
a	435	50 YR	668.49	668.40	664.07	0.02	0.56	212.59	6.95	436.05		2.41
a	435	100 YR	670.18	670.17	664.35			325.43	136.20	287.79	116.01	0.81
a	435	500 YR	670.61	670.60	664.96			341.23	214.85	393.95	169.20	1.05
a	411 BR U	2 YR	665.28	665.06	663.61	0.23	0.02	10.00		114.00		3.73
a	411 BR U	5 YR	666.25	665.85	664.28	0.40	0.06	10.00		196.00		5.11
a	411 BR U	10 YR	667.03	666.48	664.81	0.55	0.15	10.00		266.00		5.95
a	411 BR U	25 YR	667.17	665.45	665.45			10.00		362.00		10.52
a	411 BR U	50 YR	667.91	665.94	665.94			10.00		443.00		11.26
a	411 BR U	100 YR	670.18	670.17	666.50			235.47	20.43	518.01	2.10	7.09
a	411 BR U	500 YR	670.61	670.60	667.75			328.72	151.32	577.76	48.46	6.50
a	411 BR D	2 YR	665.03	664.76	663.63	0.07	0.06	10.00		114.00		4.19
a	411 BR D	5 YR	665.79	665.19	664.32	0.12	0.15	10.00		196.00		6.22
a	411 BR D	10 YR	666.32	665.27	664.85	0.20	0.28	10.00		266.00		8.23
a	411 BR D	25 YR	667.20	665.48	665.48	1.42	0.00	10.00		362.00		10.51
a	411 BR D	50 YR	667.94	665.98	665.98	1.46	0.00	10.00		443.00		11.24
a	411 BR D	100 YR	670.16	670.12	666.52			149.24	20.43	518.01	2.10	7.13
a	411 BR D	500 YR	670.61	670.41	667.77			200.61	151.32	577.76	48.46	6.88
a	385	2 YR	664.90	664.75	663.53	0.00	0.08	17.01		114.00		3.12
a	385	5 YR	665.52	665.22	664.12	0.01	0.15	18.98		196.00		4.37
a	385	10 YR	665.84	665.35	664.54	0.01	0.24	19.52		266.00		5.62
a	385	25 YR	666.49	664.46	665.07	0.01	0.36	16.04		362.00		11.42
a	385	50 YR	667.14	664.67	665.47	0.02	0.47	16.68		443.00		12.60
a	385	100 YR	667.23	665.99	665.84	0.02	0.61	22.21		540.00		8.93
a	385	500 YR	668.33	666.64	666.64	0.03	0.84	24.94		778.00		10.45
a	350	2 YR	664.83	664.82		0.01	0.01	141.99	79.16	34.71	0.13	0.36
a	350	5 YR	665.36	665.36		0.01	0.01	149.70	133.10	62.45	0.44	0.53
a	350	10 YR	665.58	665.58		0.02	0.02	151.80	179.72	85.55	0.74	0.68
a	350	25 YR	665.98	665.97	662.40	0.02	0.02	155.58	242.71	117.93	1.36	0.83
a	350	50 YR	666.27	666.26	662.51	0.03	0.02	158.33	295.68	145.32	2.00	0.95
a	350	100 YR	666.59	666.58		0.03	0.02	161.35	358.93	178.17	2.90	1.08
a	350	500 YR	667.22	667.20	662.88	0.04	0.02	187.27	499.39	272.79	5.82	1.44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RussBrk a
Legend
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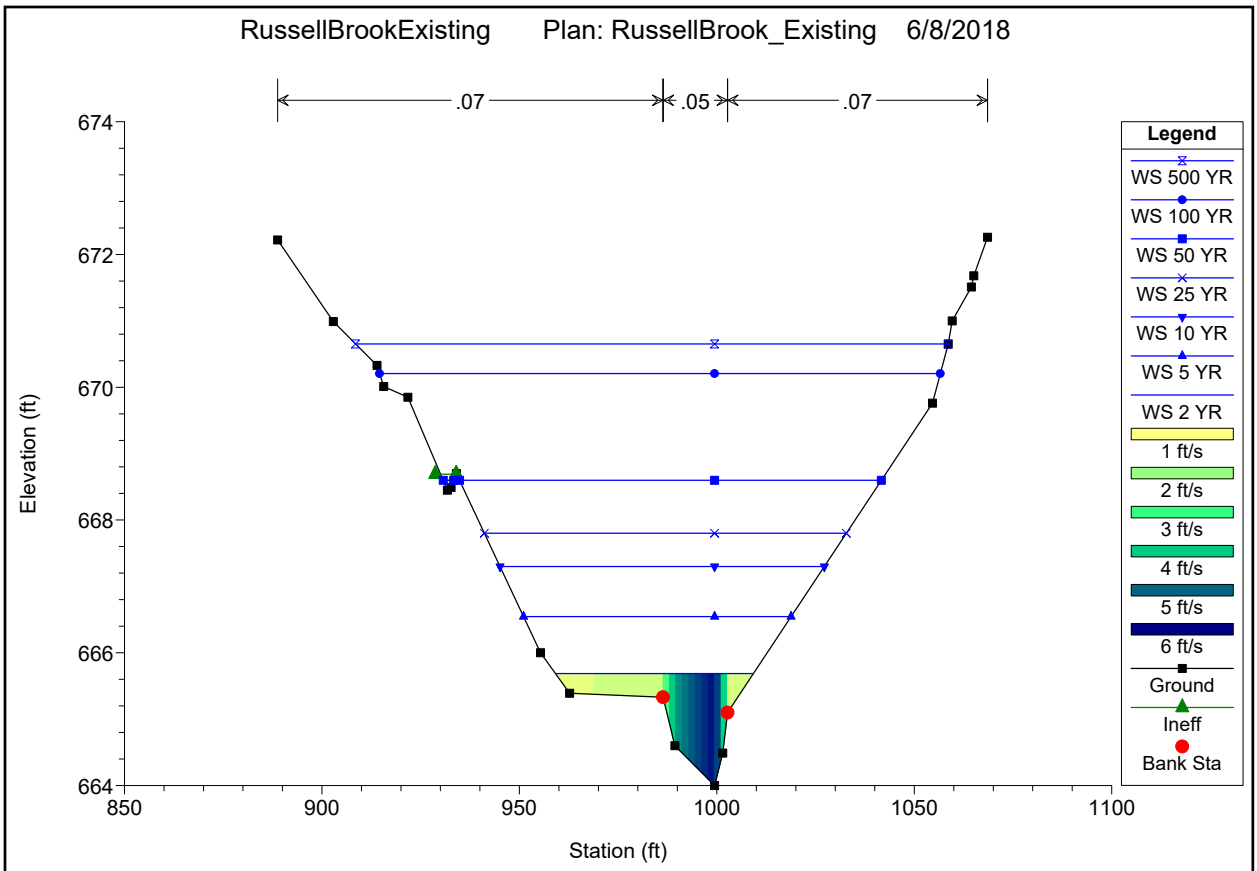
WS 100 YR
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
Ground
Elevation (ft)
672
670
668
666
664
662
660
0
100
200
300
400
500
600
700
Main Channel Distance (ft)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.07
Elevation (ft)
Station (ft)
Legend
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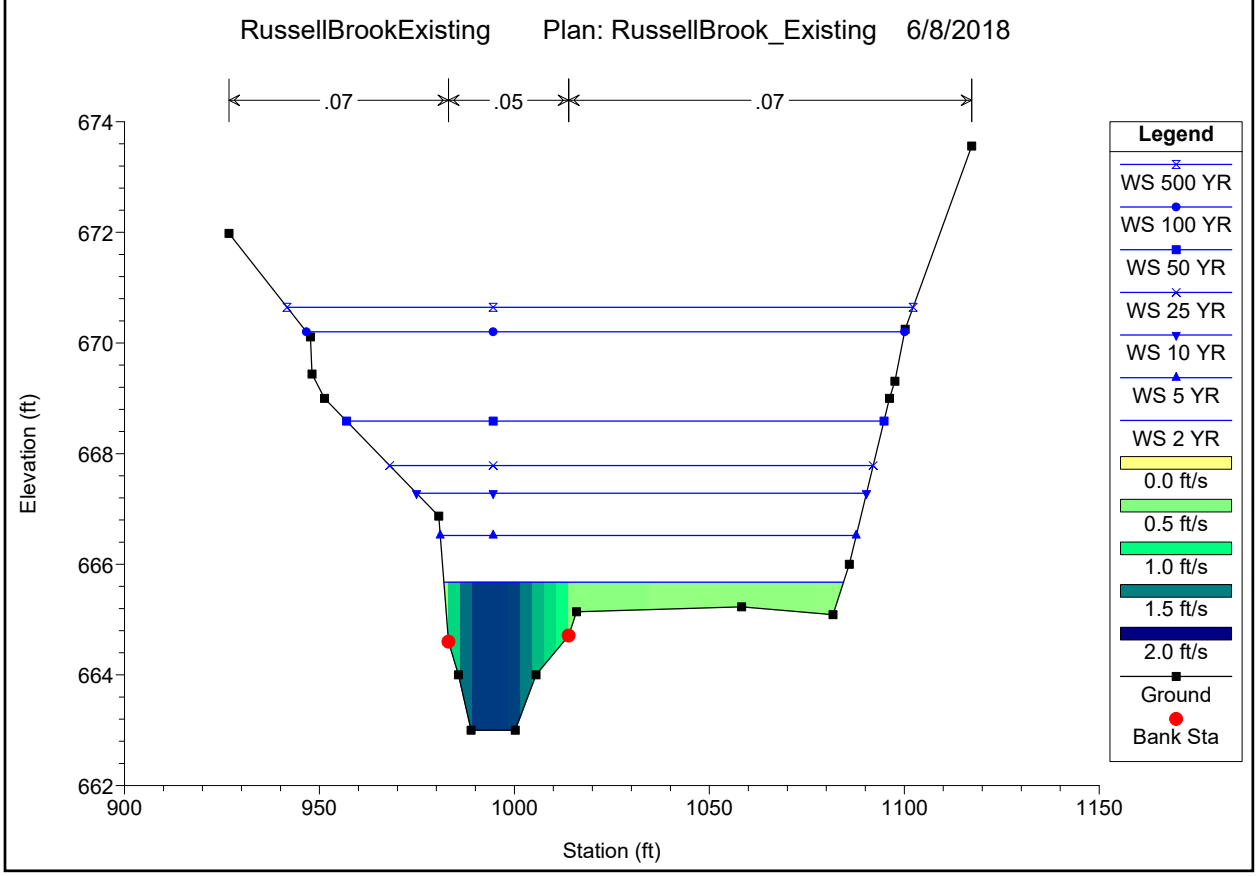
WS 100 YR
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Ineff
Bank Sta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Elevation (ft)
Station (ft)
Legend
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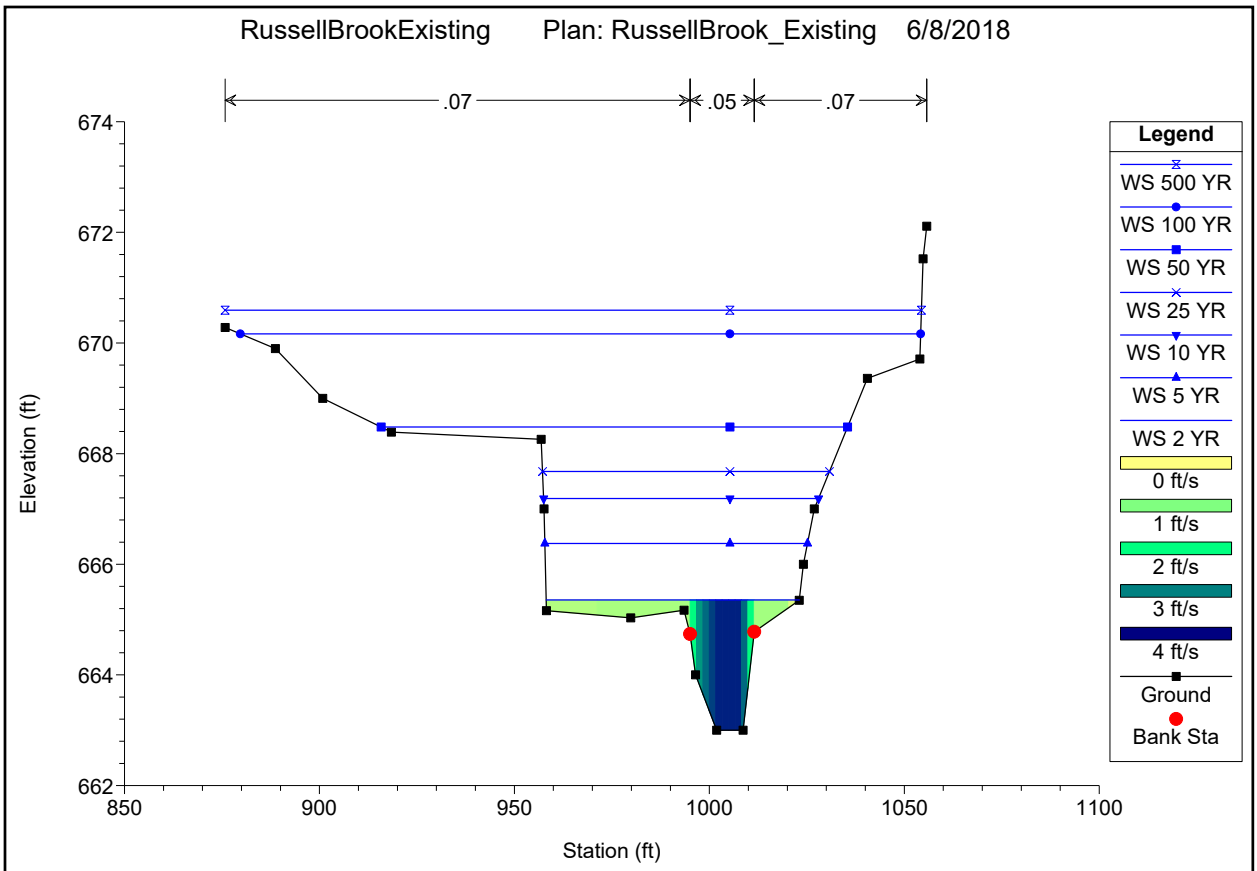
WS 100 YR
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
Ground
Bank Sta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Station (ft)
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WS 100 YR
WS 50 YR
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WS 5 YR
WS 2 YR
0 ft/s
1 ft/s
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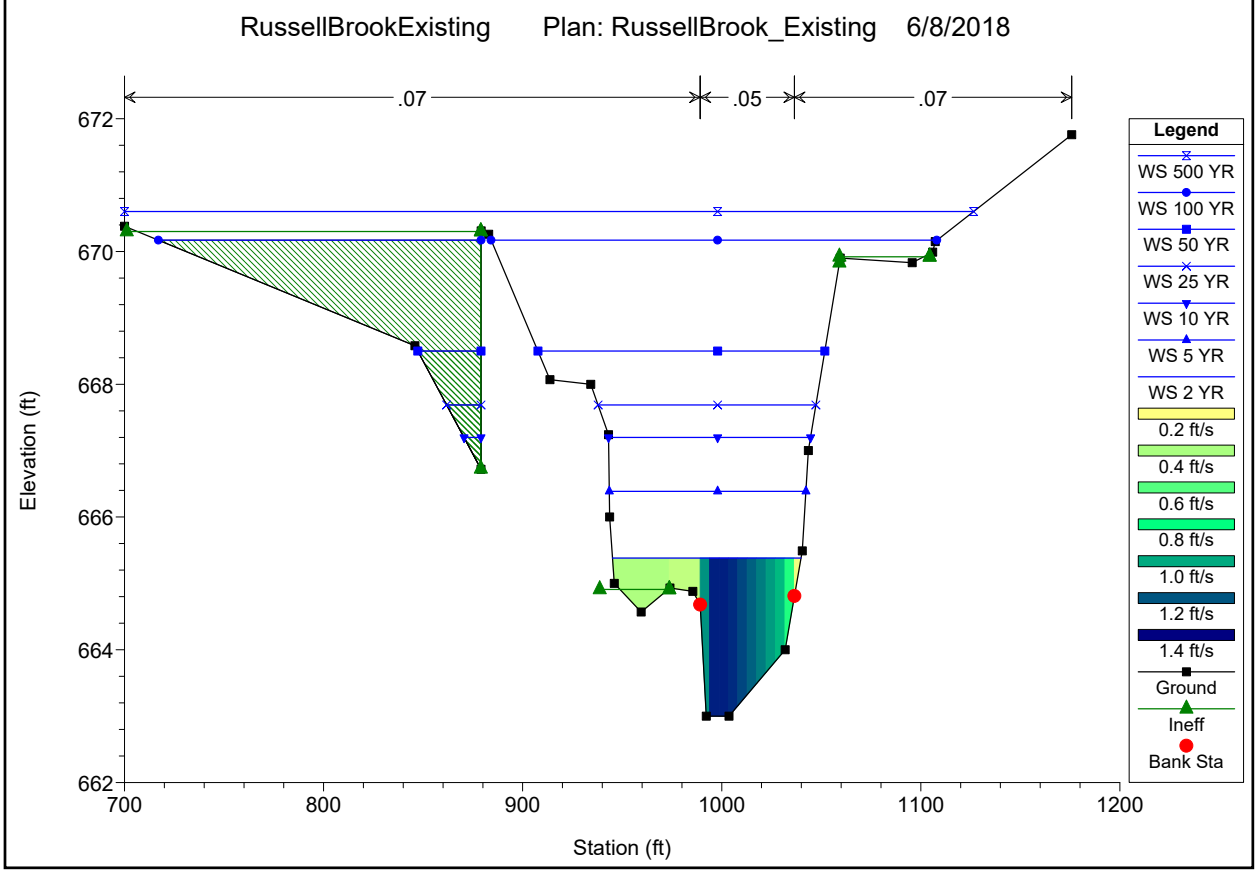
3 ft/s
4 ft/s
Ground
Bank Sta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Station (ft)
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WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
0.2 ft/s
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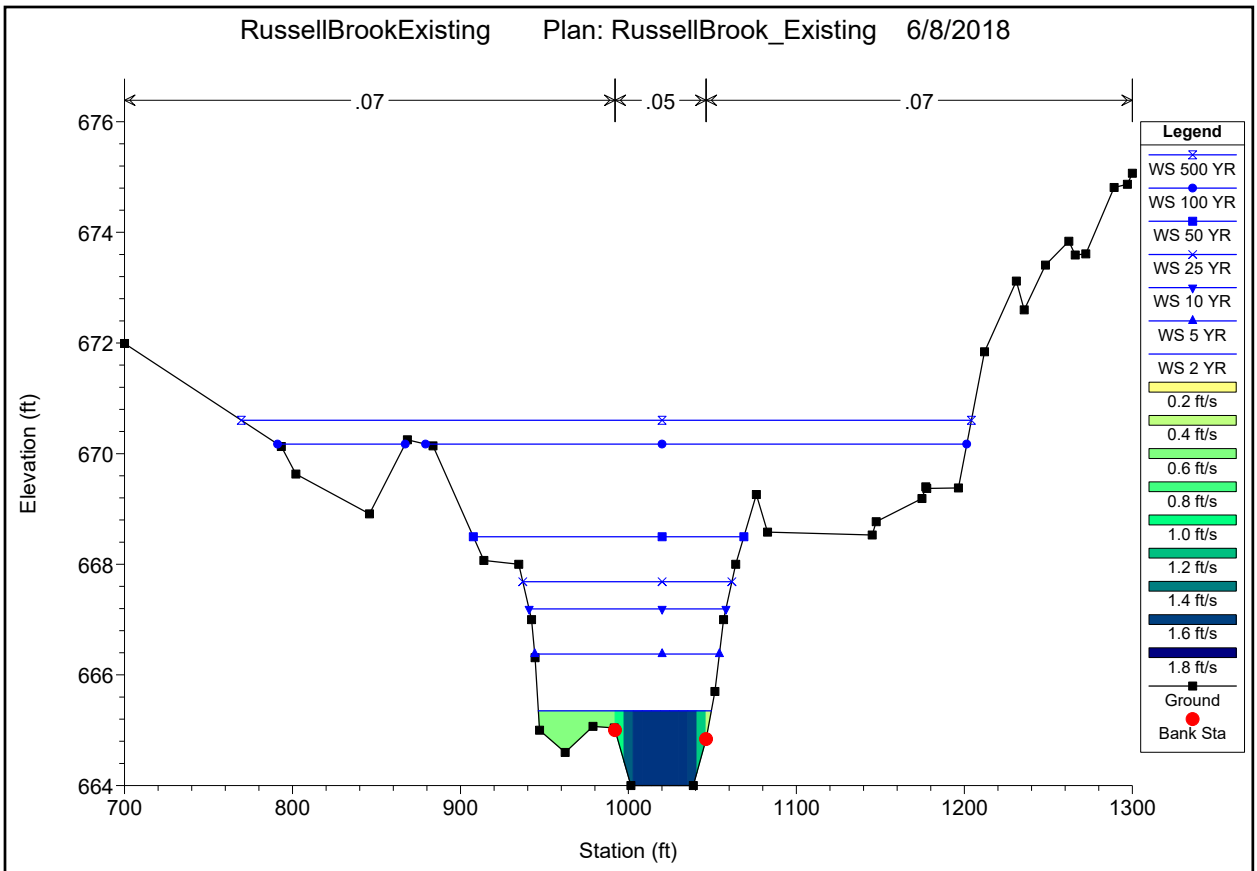
1.2 ft/s
1.4 ft/s
Ground
Ineff
Bank Sta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Station (ft)
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WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
0.2 ft/s
0.4 ft/s
0.6 ft/s
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1.4 ft/s
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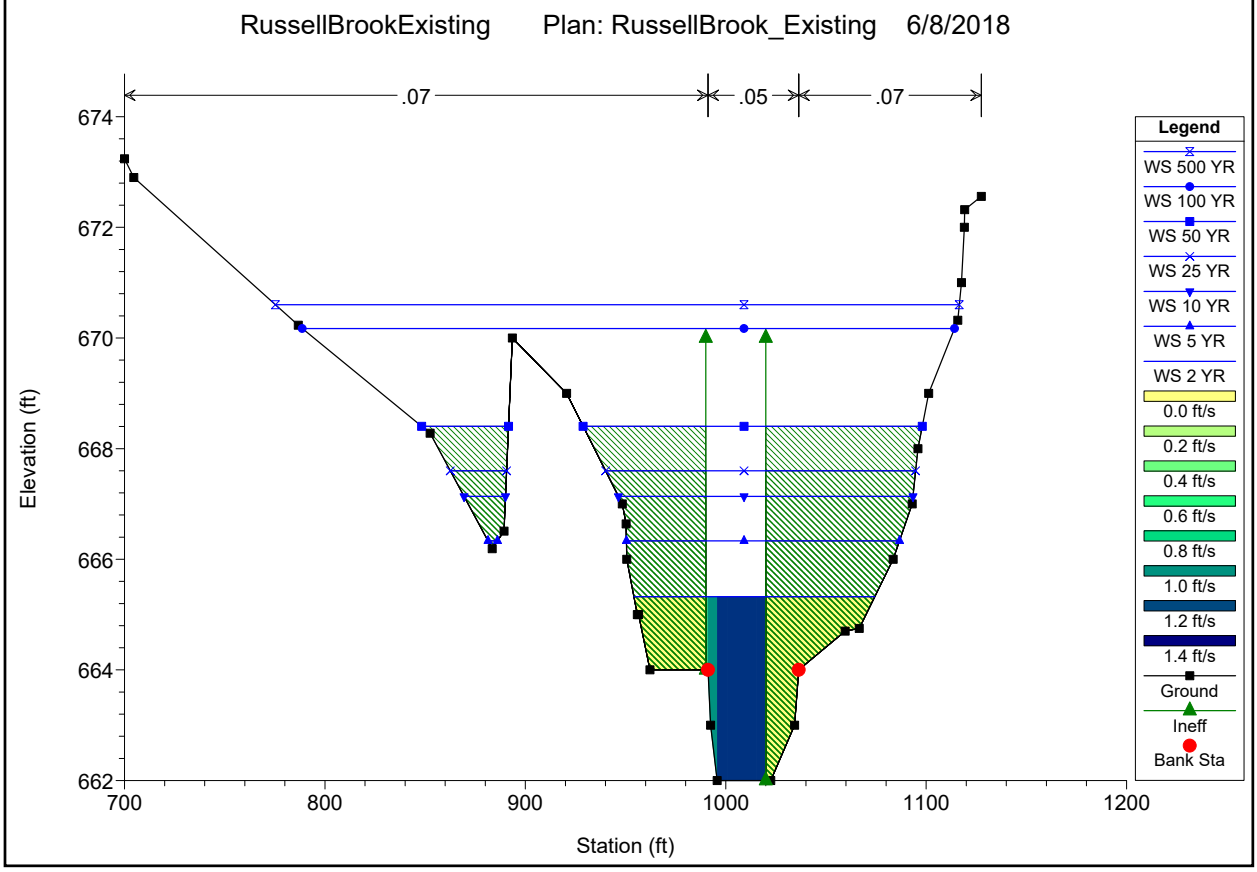
1.8 ft/s
Ground
Bank Sta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Elevation (ft)
Station (ft)
Legend
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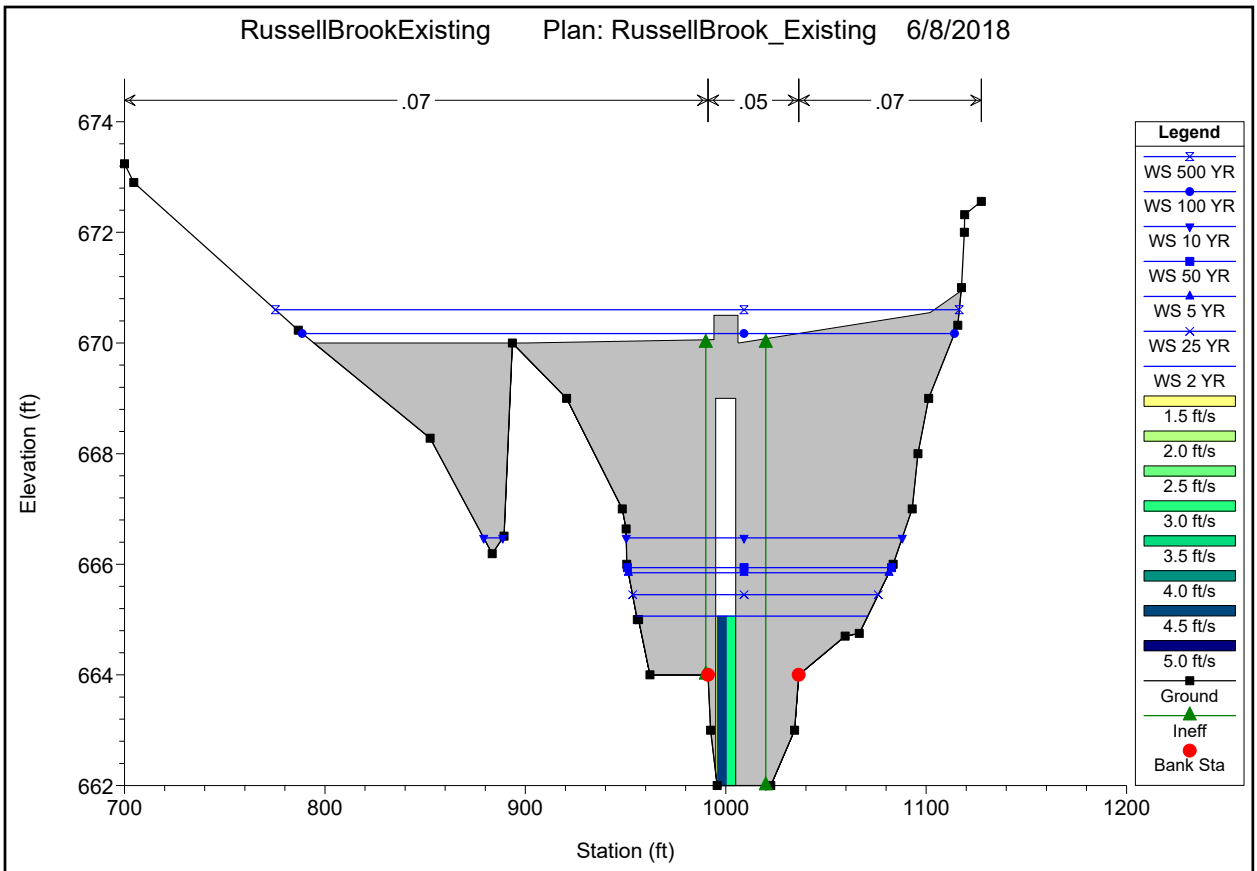
WS 100 YR
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
0.0 ft/s
0.2 ft/s
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
Ground
Ineff
Bank Sta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Elevation (ft)
Station (ft)
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WS 100 YR
WS 10 YR
WS 50 YR
WS 5 YR
WS 25 YR
WS 2 YR
1.5 ft/s
2.0 ft/s
2.5 ft/s
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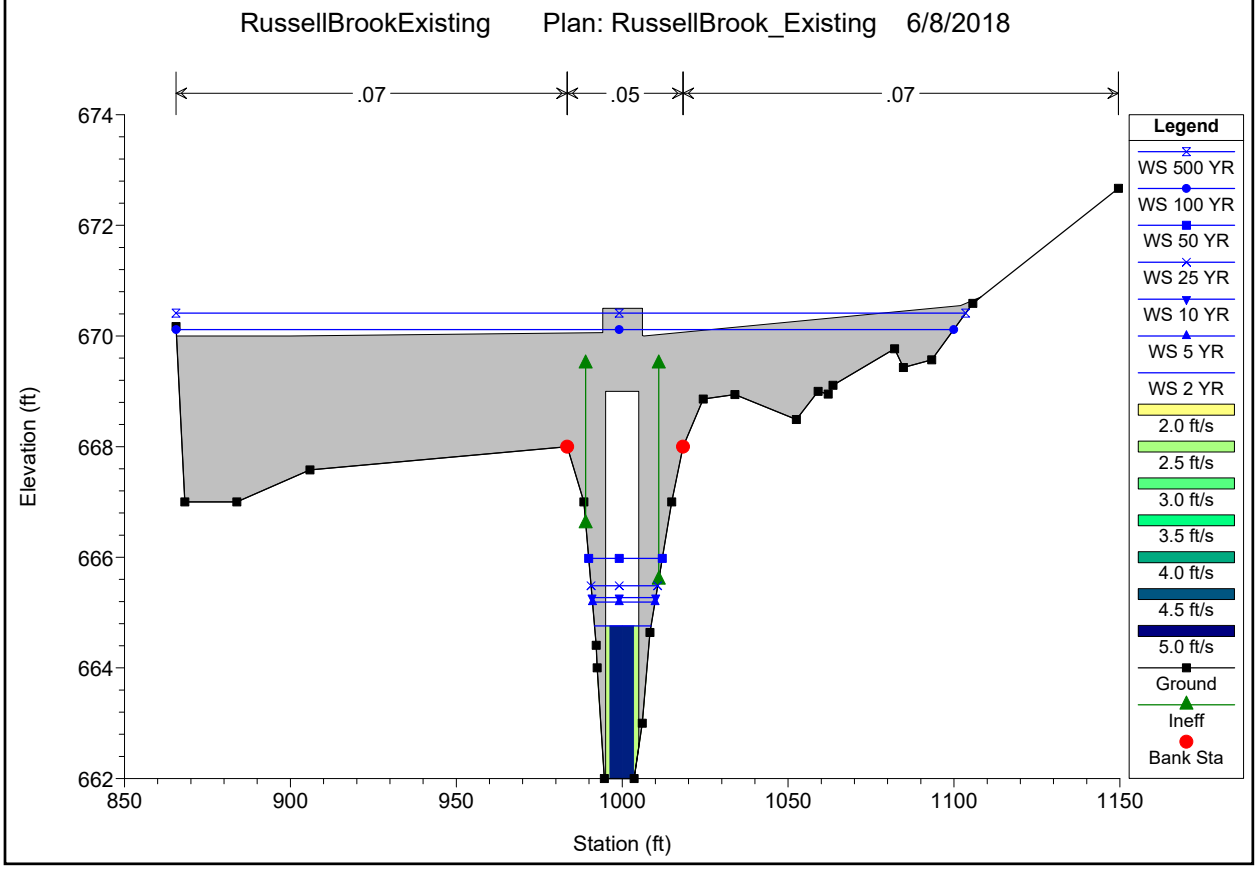
3.5 ft/s
4.0 ft/s
4.5 ft/s
5.0 ft/s
Ground
Ineff
Bank Sta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Elevation (ft)
Station (ft)
Legend
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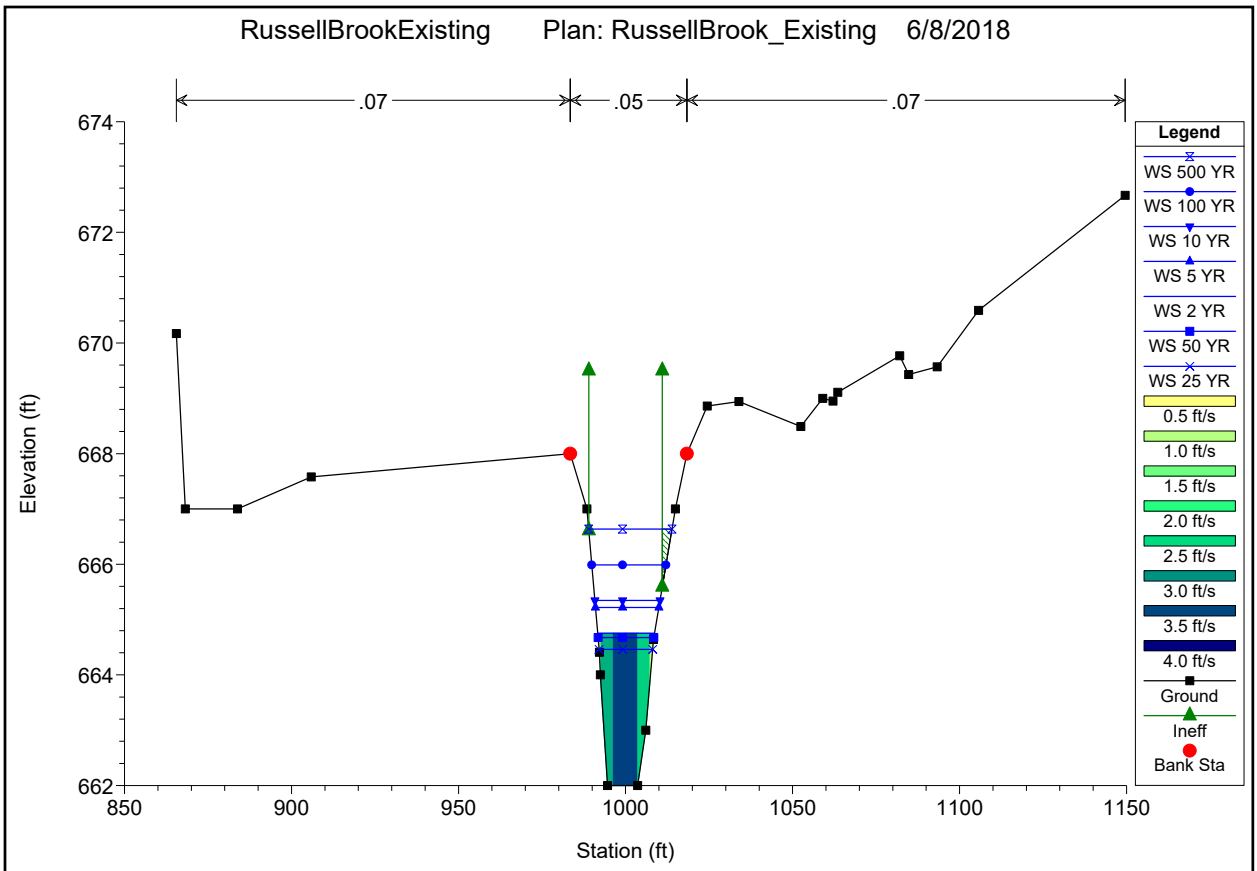
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
2.0 ft/s
2.5 ft/s
3.0 ft/s
3.5 ft/s
4.0 ft/s
4.5 ft/s
5.0 ft/s
Ground
Ineff
Bank Sta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Station (ft)
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WS 2 YR
WS 50 YR
WS 25 YR
0.5 ft/s
1.0 ft/s
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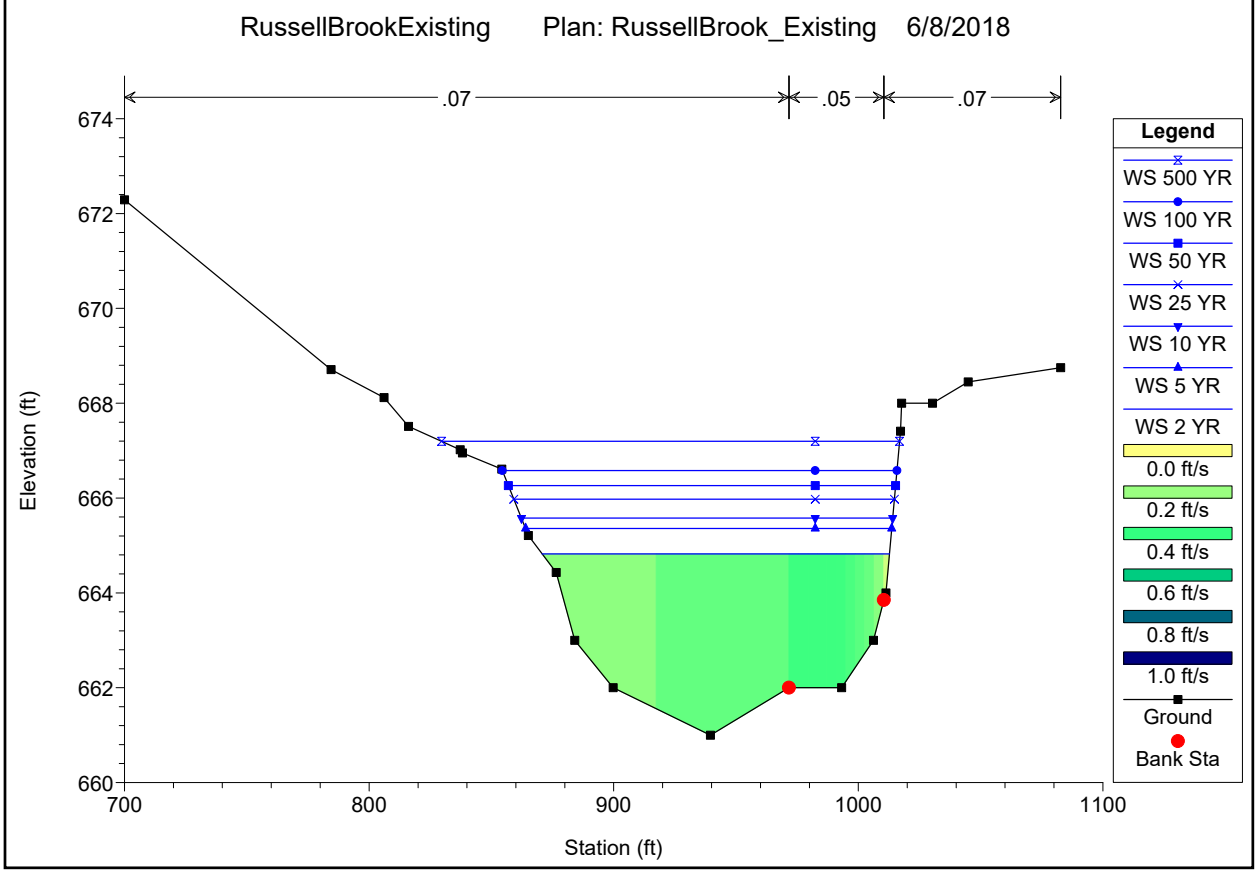
Ground
Ineff
Bank Sta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Elevation (ft)
Station (ft)
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WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
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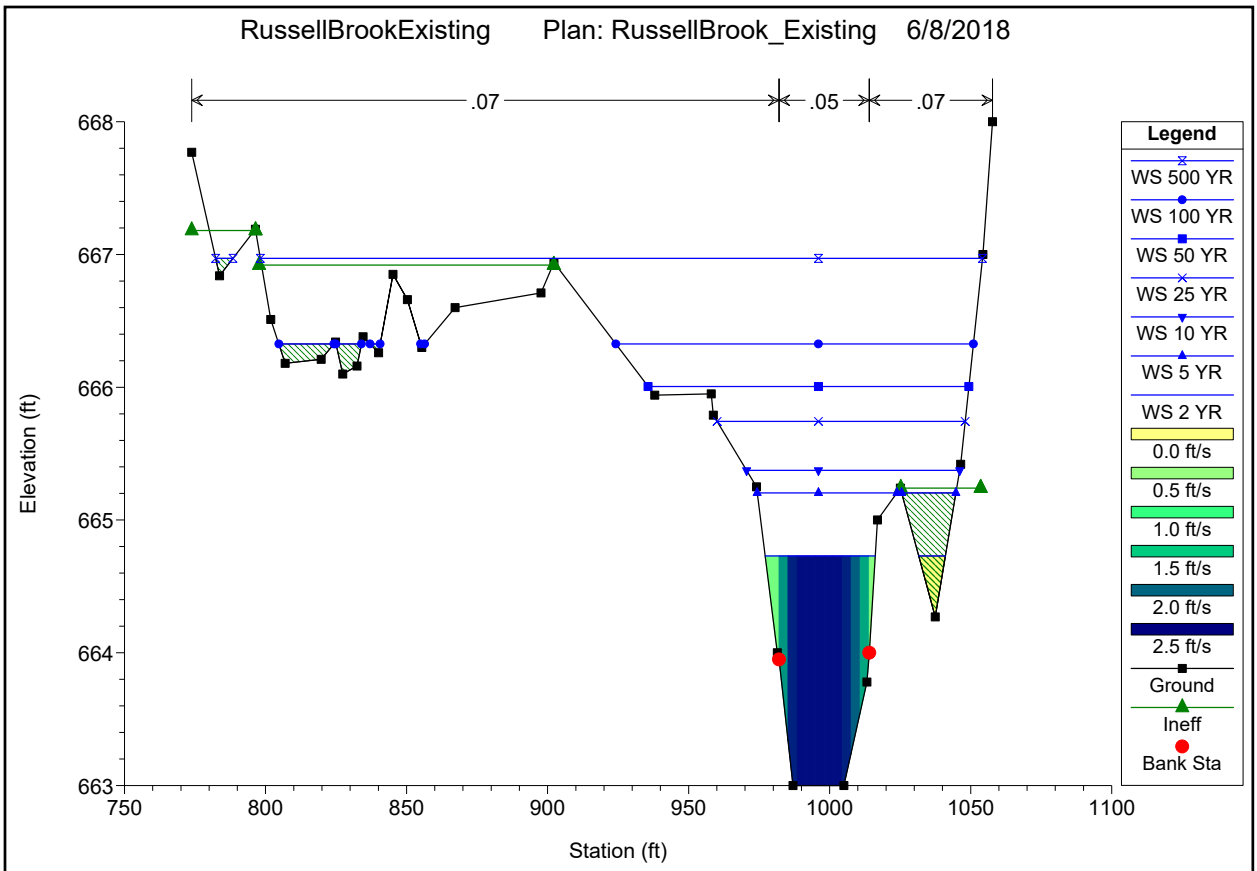
Ground
Bank Sta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Elevation (ft)
Station (ft)
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WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
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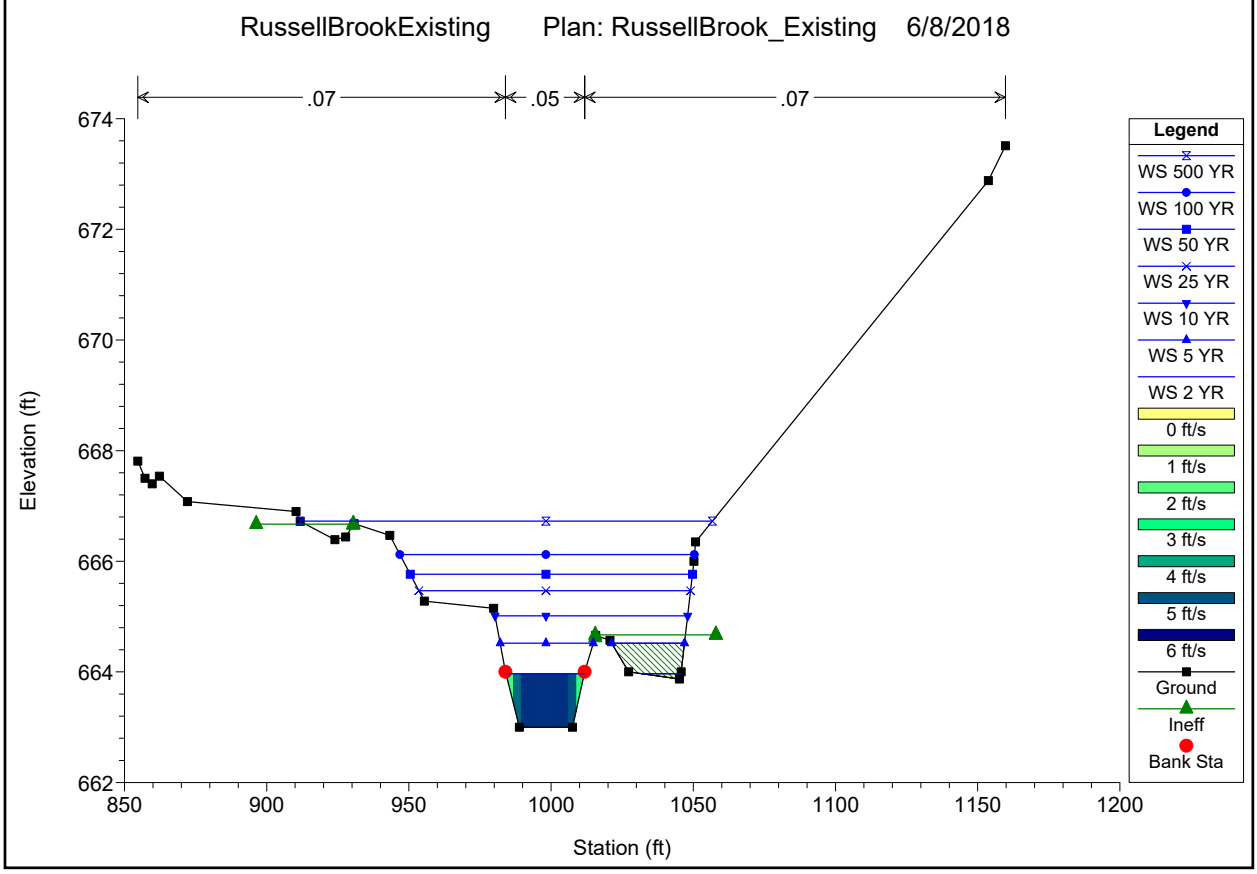
2.0 ft/s
2.5 ft/s
Ground
Ineff
Bank Sta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Elevation (ft)
Station (ft)
Legend
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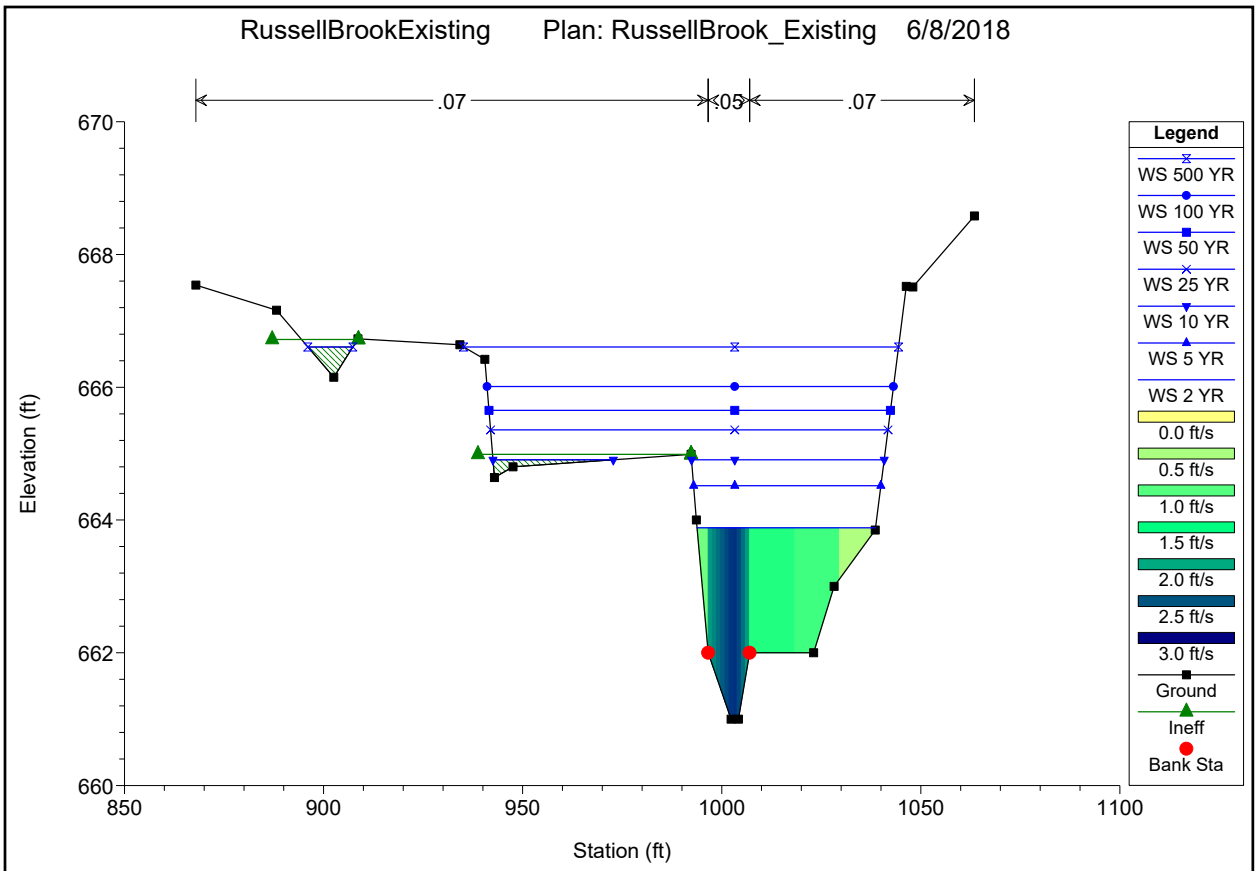
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Ineff
Bank Sta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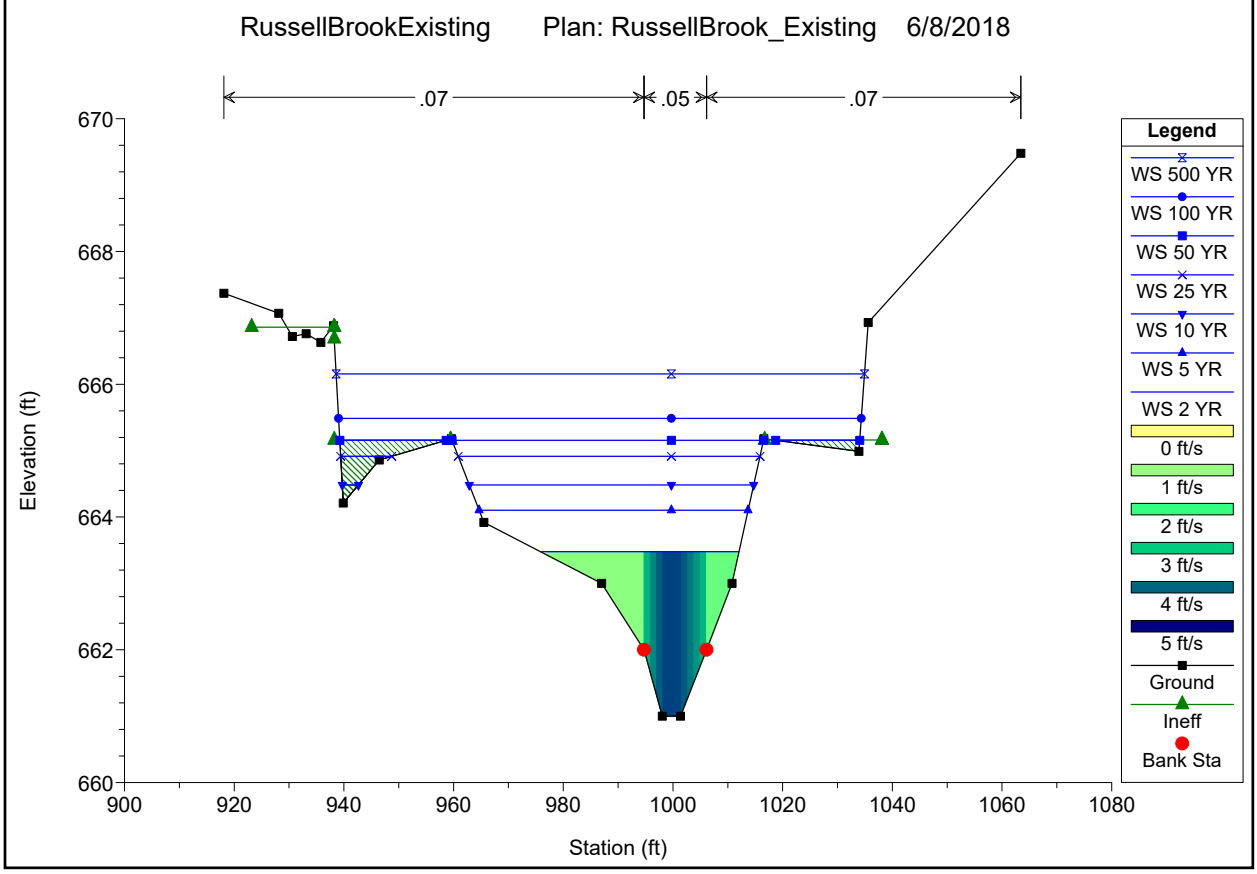
.07
.05
.07
Elevation (ft)
Station (ft)
Legend
WS 500 YR
WS 100 YR
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
2.5 ft/s
3.0 ft/s
Ground
Ineff
Bank Sta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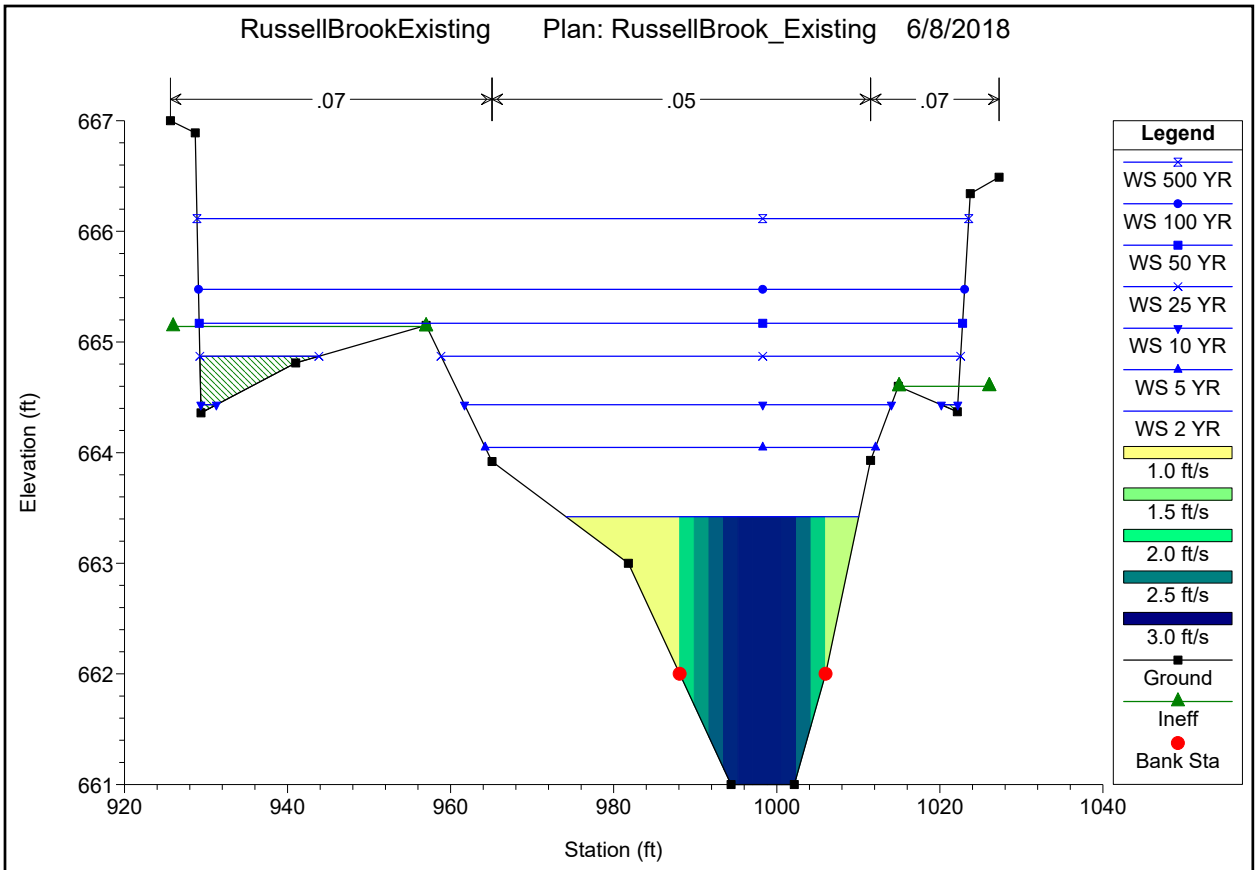
Elevation (ft)
Station (ft)
Legend
WS 500 YR
WS 100 YR
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
Ground
Ineff
Bank Sta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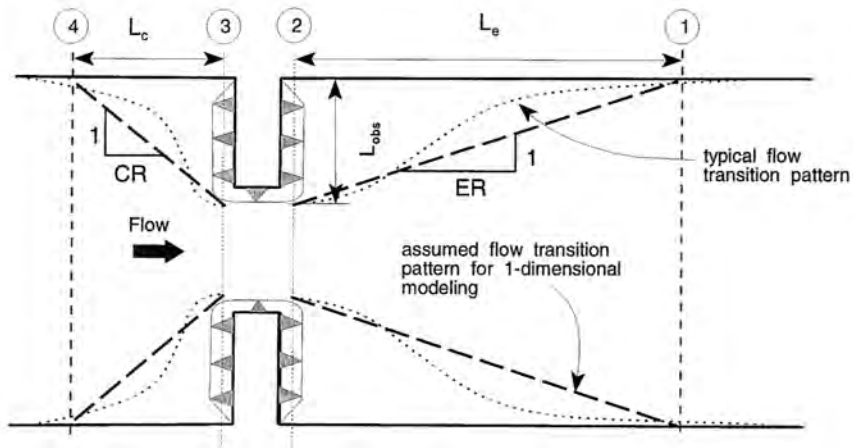
666
665
664
663
662
661
920
940
960
980
1000
1020
1040
Station (ft)
Legend
WS 500 YR
WS 100 YR
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
1.0 ft/s
1.5 ft/s
2.0 ft/s
2.5 ft/s
3.0 ft/s
Ground
Ineff
Bank Sta

Appendix D HEC-RAS ANALYSES

Hydraulics Analysis
Model of 22 foot Box Culvert

Stantec			Project	Bennington NH	
			Sheet No.	of	
Authored TEK	Date	4/18	Checked by	Date	3/18

Subject **Hydraulic Model**



Stream Stationing to determine Approx. Splope

	begin	end						
Elev.	661	663	Dy=	2	Slope	0.003	Ft/ft	18 ft/mile
Sta.	110.8	693.7	Dx=	583				

			b	22	width of bridge opening
n ob	0.07	mannings for overbank	B	100	width of flood plain
n channel	0.05	mannings for channel	b/B	0.2	
nob/nc	1.4		Lobs=	39	

Table 2. Ranges of Contraction Ratios

	$n_{ob} / n_c = 1$	$n_{ob} / n_c = 2$	$n_{ob} / n_c = 4$
S = 1 ft/mile	1.0 - 2.3	0.8 - 1.7	0.7 - 1.3
5 ft/mile	1.0 - 1.9	0.8 - 1.5	0.7 - 1.2
10 ft/mile	1.0 - 1.9	0.8 - 1.4	0.7 - 1.2

Lc= 0+50
Lobs= 39

Cr= 1.3

Table 1. Ranges of Expansion Ratios

b/B = 0.10	Slope:	$n_{ob} / n_c = 1$	$n_{ob} / n_c = 2$	$n_{ob} / n_c = 4$
	1 ft/mile	1.4 - 3.6	1.3 - 3.0	1.2 - 2.1
	5 ft/mile	1.0 - 2.5	0.8 - 2.0	0.8 - 2.0
	10 ft/mile	1.0 - 2.2	0.8 - 2.0	0.8 - 2.0
b/B = 0.25	1 ft/mile	1.6 - 3.0	1.4 - 2.5	1.2 - 2.0
	5 ft/mile	1.5 - 2.5	1.3 - 2.0	1.3 - 2.0
	10 ft/mile	1.5 - 2.0	1.3 - 2.0	1.3 - 2.0
b/B = 0.50	1 ft/mile	1.4 - 2.6	1.3 - 1.9	1.2 - 1.4
	5 ft/mile	1.3 - 2.1	1.2 - 1.6	1.0 - 1.4
	10 ft/ mile	1.3 - 2.0	1.2 - 1.5	1.0 - 1.4

Stations	US to DS
4	4+85
3	4+35
2	3+90
1	3+50

L exp 0+40
Lobs 39

Er= 1.0

Manning's n for Channels (Chow, 1959).

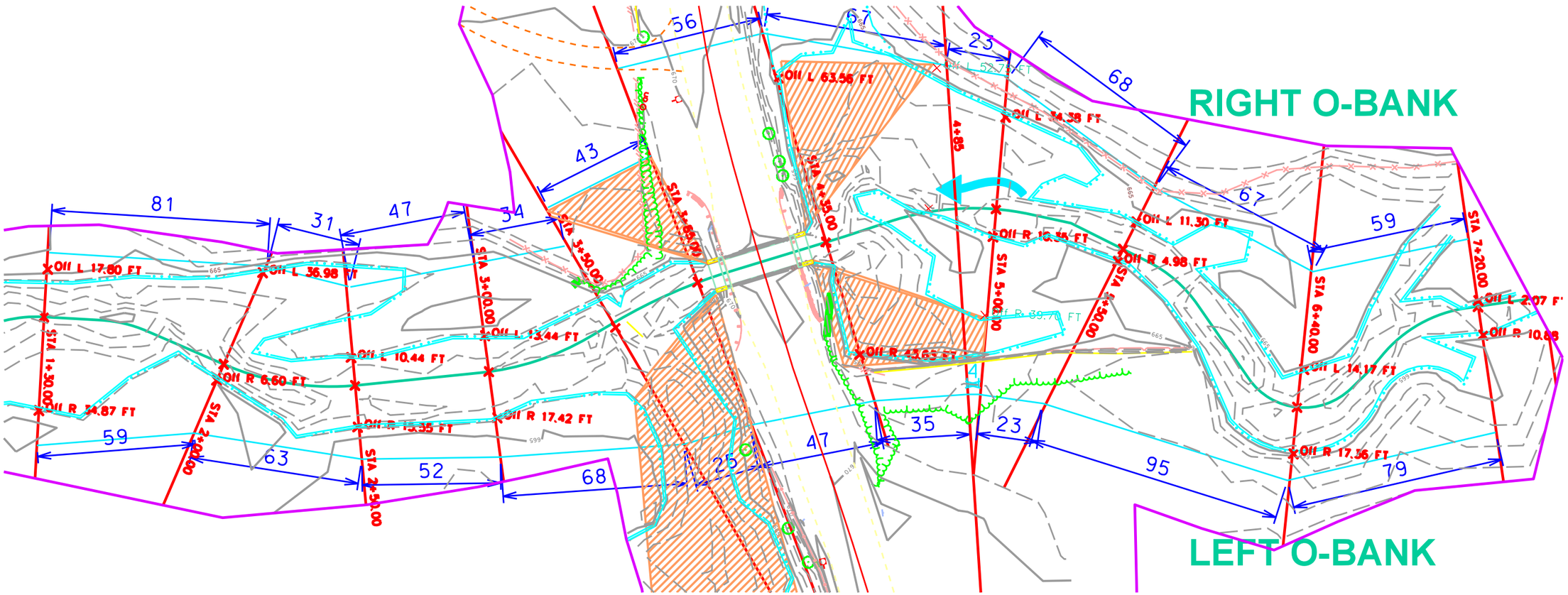
Type of Channel and Description	Minimum	Normal	Maximum
Natural streams - minor streams (top width at floodstage < 100 ft)			
1. Main Channels			
a. clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
b. same as above, but more stones and weeds	0.030	0.035	0.040
c. clean, winding, some 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" with 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 stand of timber and underbrush	0.075	0.100	0.150

http://www.fsl.orst.edu/geowater/FX3/help/8_Hydraulic_Reference/Mannings_n_Tables.htm

3. Floodplains			
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

Upstream Boundary conditions.

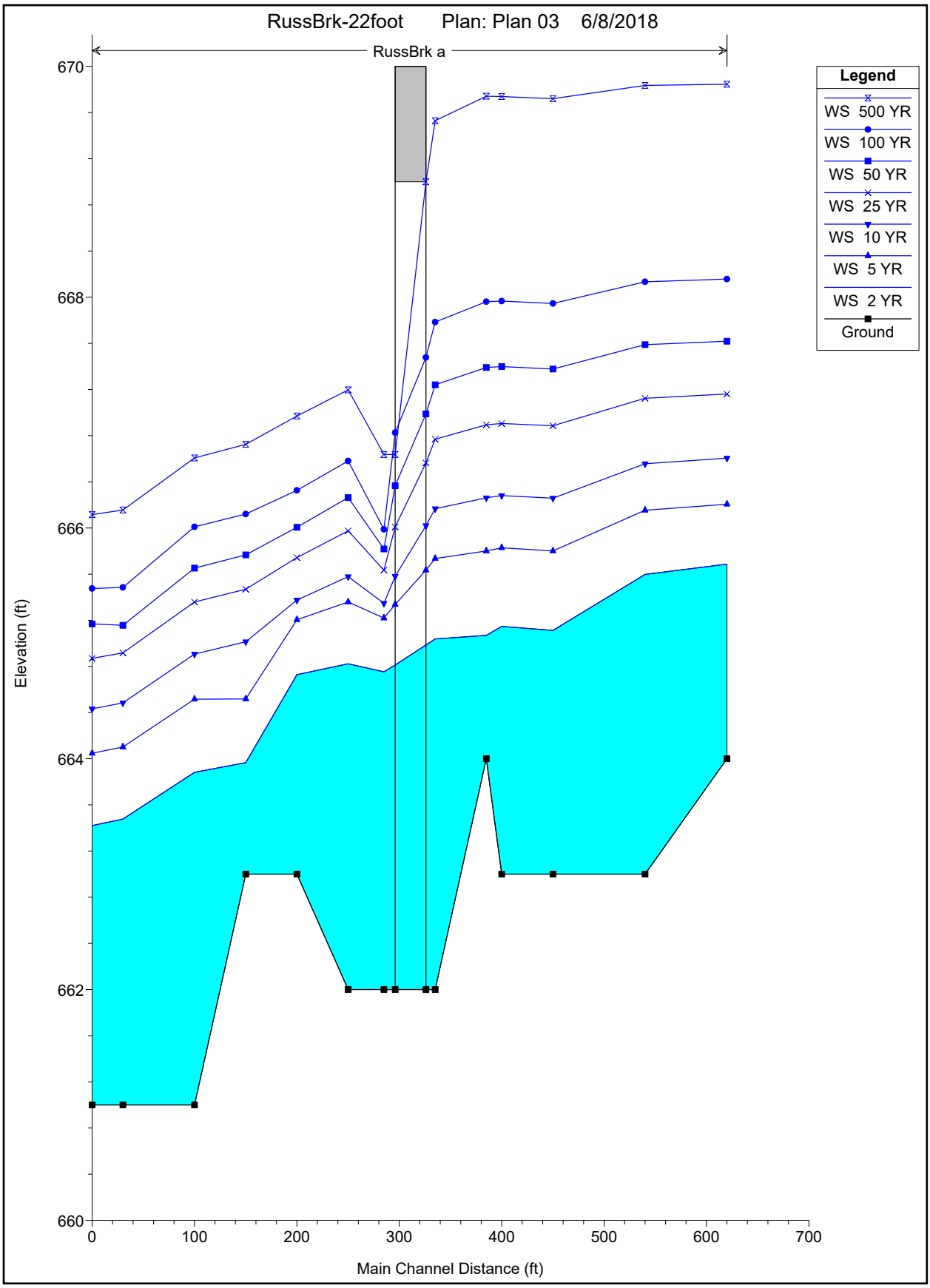
Assume normal depth with a relatively flat slope due to beaver dam



RUSSELL BROOK CHANNEL CROSS SECTION LAYOUT

HEC-RAS Plan: Plan 03 River: RussBrk Reach: a

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)
a	485	2 YR	665.14	665.07		0.06	0.01	100.46	5.23	108.71	0.06	2.17
a	485	5 YR	665.84	665.80		0.05	0.00	106.44	35.09	159.31	1.60	1.78
a	485	10 YR	666.30	666.26		0.05	0.00	109.17	58.86	203.36	3.78	1.77
a	485	25 YR	666.93	666.89		0.05	0.01	113.54	92.05	262.08	7.87	1.76
a	485	50 YR	667.43	667.39		0.04	0.01	120.09	118.53	312.84	11.63	1.78
a	485	100 YR	668.00	667.96		0.04	0.01	128.57	150.45	372.00	17.54	1.80
a	485	500 YR	669.77	669.74		0.02	0.02	369.03	232.11	473.45	72.44	1.56
a	435	2 YR	665.07	665.04	662.85	0.01	0.01	114.83	0.58	113.42		1.35
a	435	5 YR	665.79	665.73	663.22	0.01	0.02	127.94	1.65	194.35		1.86
a	435	10 YR	666.25	666.17	663.49	0.01	0.03	134.61	2.68	263.32		2.26
a	435	25 YR	666.88	666.77	663.82	0.02	0.04	156.02	4.35	357.65		2.67
a	435	50 YR	667.38	667.24	664.07	0.02	0.05	171.04	5.88	437.12		2.96
a	435	100 YR	667.95	667.78	664.35	0.02	0.07	188.85	7.83	532.17		3.26
a	435	500 YR	669.73	669.53	664.96			283.49	13.53	764.47		3.58
a	411 BR U	2 YR	665.05	664.99	663.14	0.07	0.02	22.00	0.91	113.09		2.03
a	411 BR U	5 YR	665.76	665.63	663.61	0.11	0.04	22.00	2.60	193.40		2.82
a	411 BR U	10 YR	666.20	666.02	663.95	0.15	0.07	22.00	4.24	261.76		3.43
a	411 BR U	25 YR	666.82	666.56	664.38	0.17	0.09	22.00	6.95	355.05		4.08
a	411 BR U	50 YR	667.30	666.99	664.69	0.19	0.10	22.00	9.50	433.50		4.54
a	411 BR U	100 YR	667.86	667.48	665.04	0.20	0.10	22.00	12.88	527.12		5.01
a	411 BR U	500 YR	669.73	669.00	665.80				18.87	759.13		5.61
a	411 BR D	2 YR	664.96	664.81	663.53	0.05	0.00	17.26		114.00		3.04
a	411 BR D	5 YR	665.61	665.34	664.12	0.08	0.01	19.47		196.00		4.16
a	411 BR D	10 YR	665.99	665.58	664.54	0.12	0.03	20.50		266.00		5.11
a	411 BR D	25 YR	666.56	666.01	665.07	0.15	0.05	21.14		362.00		5.94
a	411 BR D	50 YR	667.01	666.37	665.47	0.17	0.09	21.65		443.00		6.46
a	411 BR D	100 YR	667.56	666.83	665.84	0.18	0.15	22.00		540.00		6.87
a	411 BR D	500 YR	668.33	666.64	666.63			22.00		778.00		10.45
a	385	2 YR	664.90	664.75	663.53	0.00	0.08	17.01		114.00		3.12
a	385	5 YR	665.52	665.22	664.12	0.01	0.15	18.98		196.00		4.37
a	385	10 YR	665.84	665.35	664.54	0.01	0.24	19.52		266.00		5.62
a	385	25 YR	666.36	665.63	665.07	0.01	0.36	20.72		362.00		6.82
a	385	50 YR	666.76	665.82	665.47	0.02	0.47	21.50		443.00		7.78
a	385	100 YR	667.23	665.99	665.84	0.02	0.61	22.21		540.00		8.93
a	385	500 YR	668.33	666.64	666.64	0.03	0.84	24.94		778.00		10.45
a	350	2 YR	664.83	664.82		0.01	0.01	141.99	79.16	34.71	0.13	0.36
a	350	5 YR	665.36	665.36		0.01	0.01	149.70	133.10	62.45	0.44	0.53
a	350	10 YR	665.58	665.58		0.02	0.02	151.80	179.71	85.55	0.74	0.68
a	350	25 YR	665.98	665.98		0.02	0.02	155.58	242.71	117.93	1.36	0.83
a	350	50 YR	666.27	666.26		0.03	0.02	158.33	295.68	145.32	2.00	0.95
a	350	100 YR	666.59	666.58		0.03	0.02	161.35	358.93	178.17	2.90	1.08
a	350	500 YR	667.22	667.20	662.88	0.04	0.02	187.26	499.40	272.79	5.82	1.44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RussBrk a
Legend
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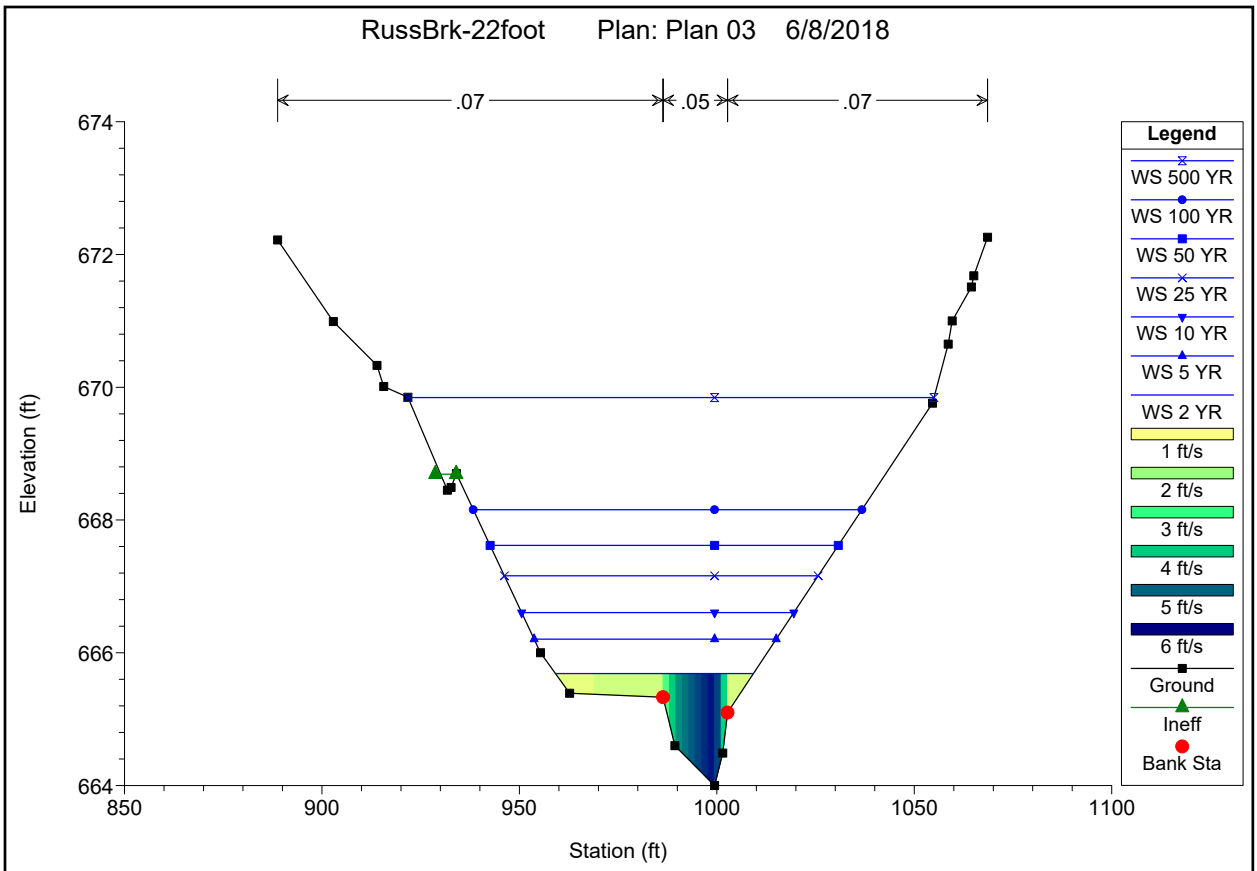
WS 100 YR
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
Ground
Elevation (ft)
670
668
666
664
662
660
0
100
200
300
400
500
600
700
Main Channel Distance (ft)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.07
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Elevation (ft)
Station (ft)
Legend
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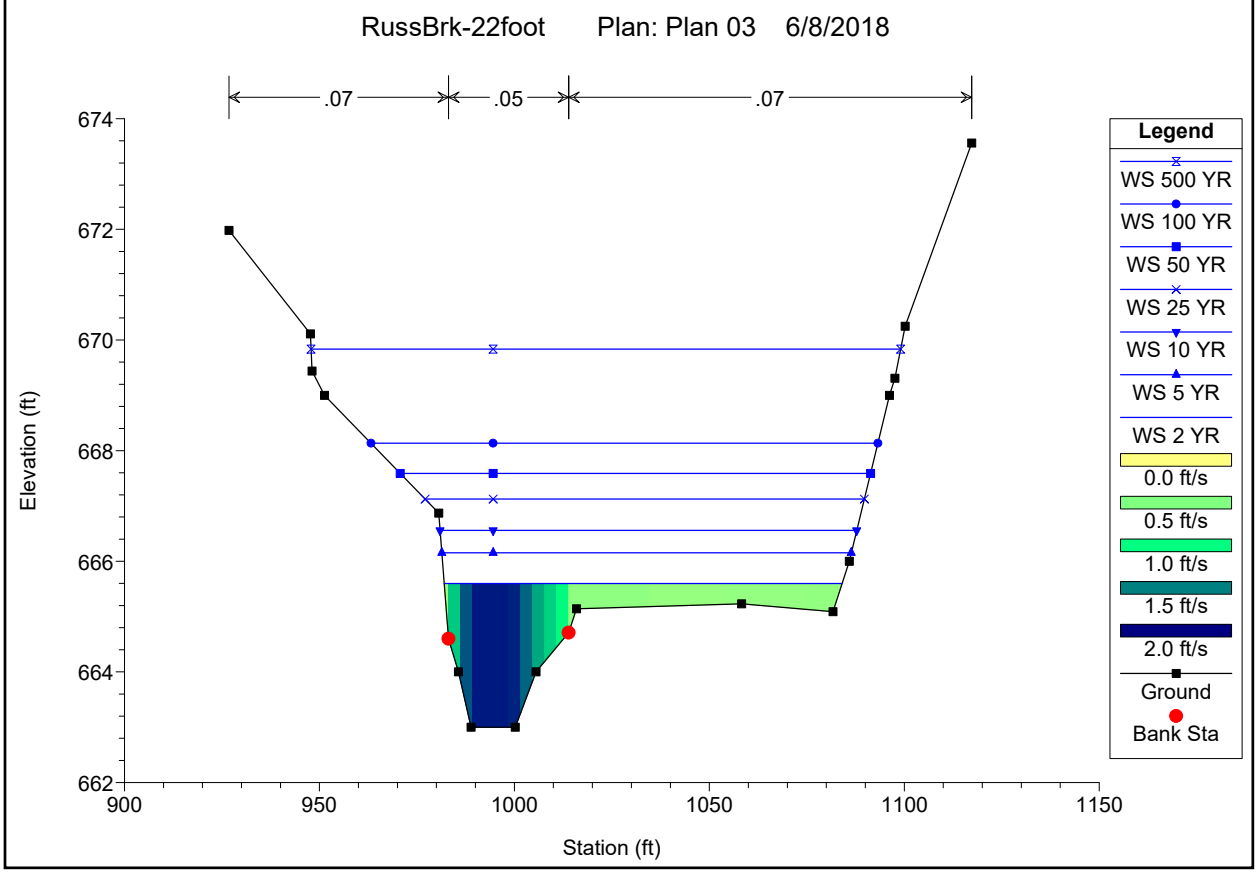
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
6 ft/s
Ground
Ineff
Bank Sta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Elevation (ft)
Station (ft)
Legend
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WS 25 YR
WS 10 YR
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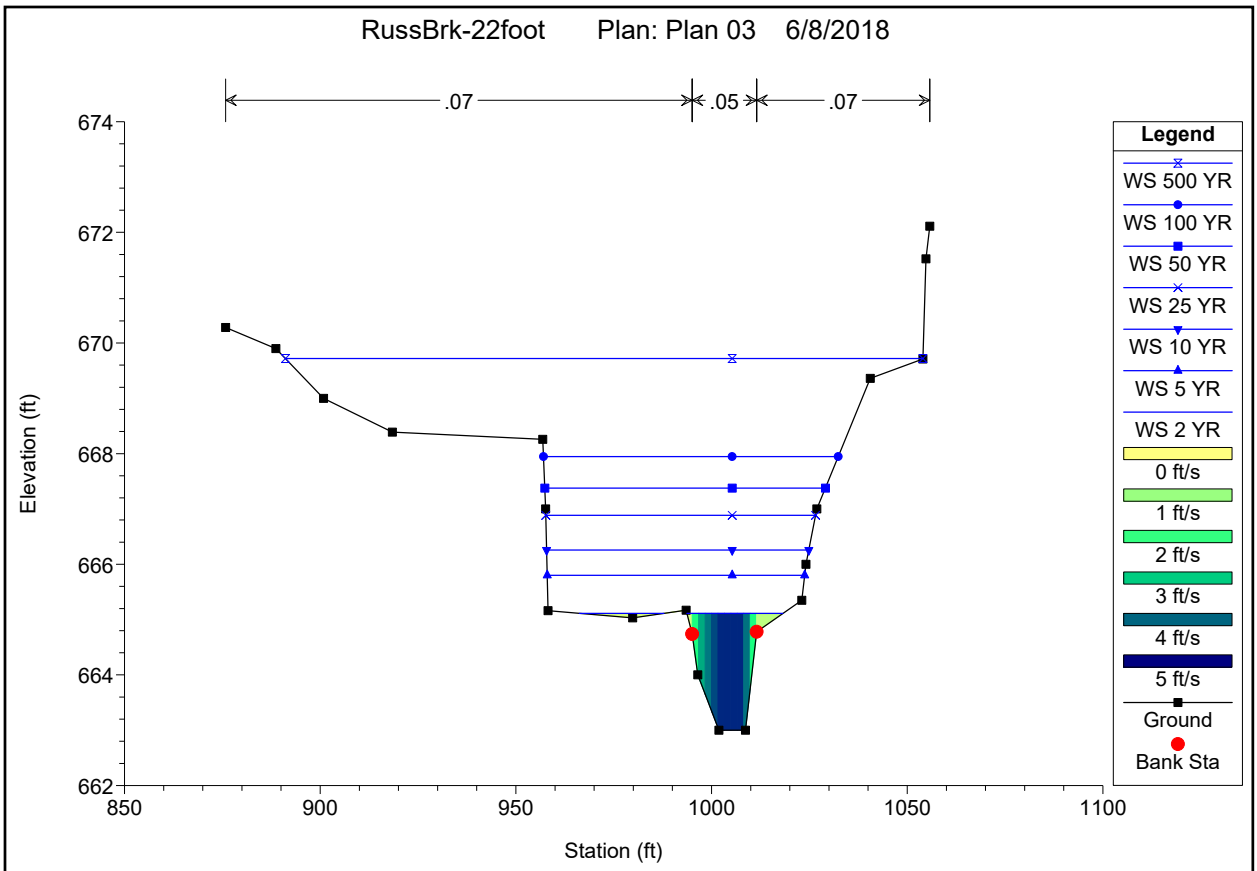
Ground
Bank Sta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Station (ft)
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WS 50 YR
WS 25 YR
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1 ft/s
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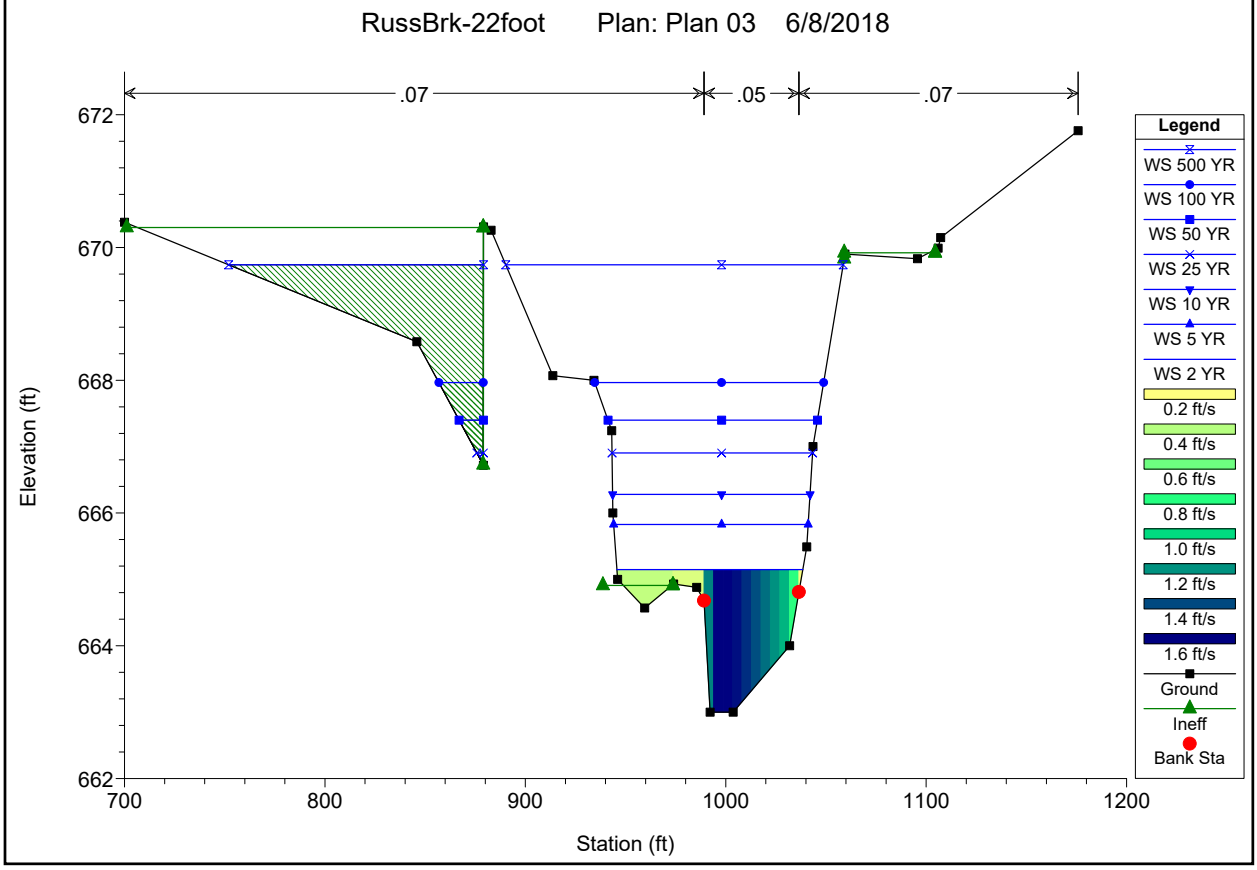
4 ft/s
5 ft/s
Ground
Bank Sta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Station (ft)
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WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
0.2 ft/s
0.4 ft/s
0.6 ft/s
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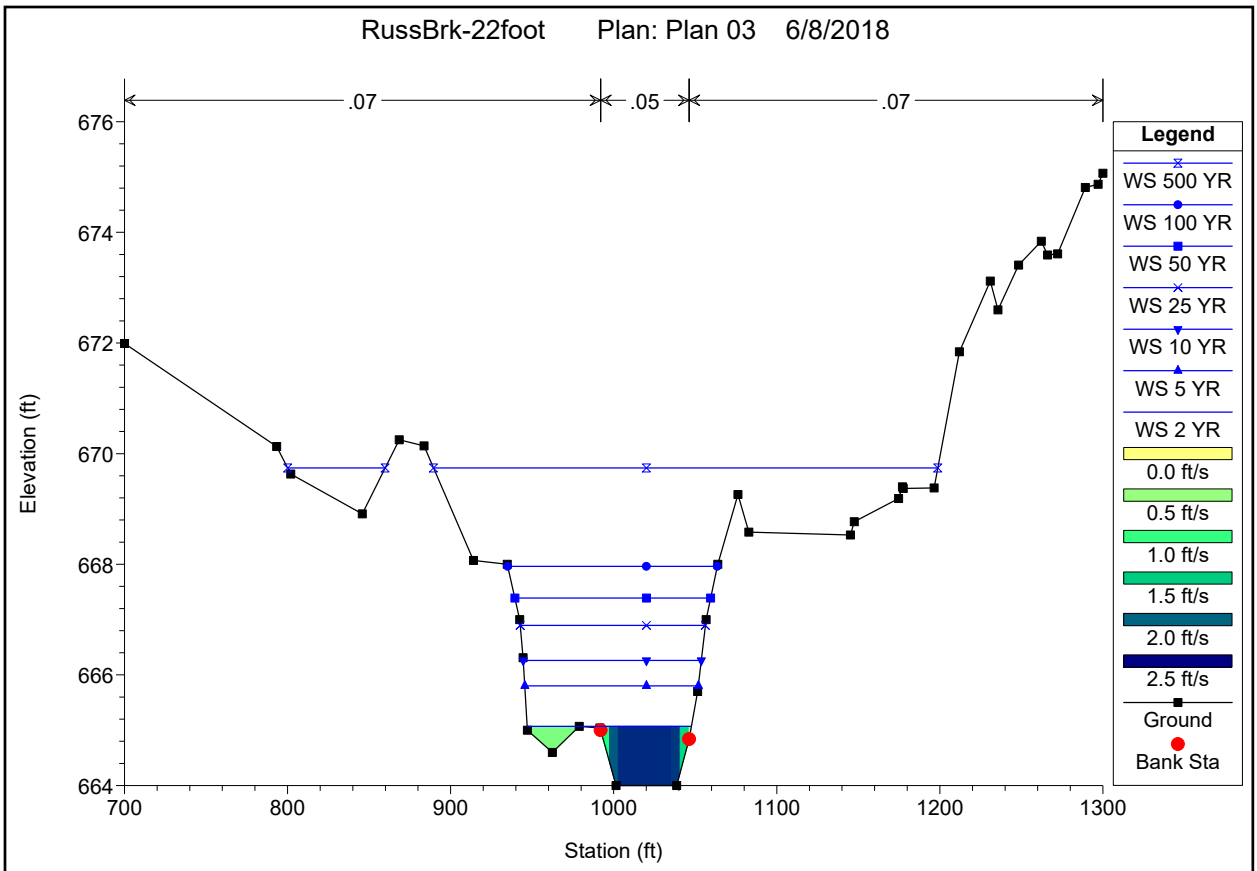
1.2 ft/s
1.4 ft/s
1.6 ft/s
Ground
Ineff
Bank Sta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WS 5 YR
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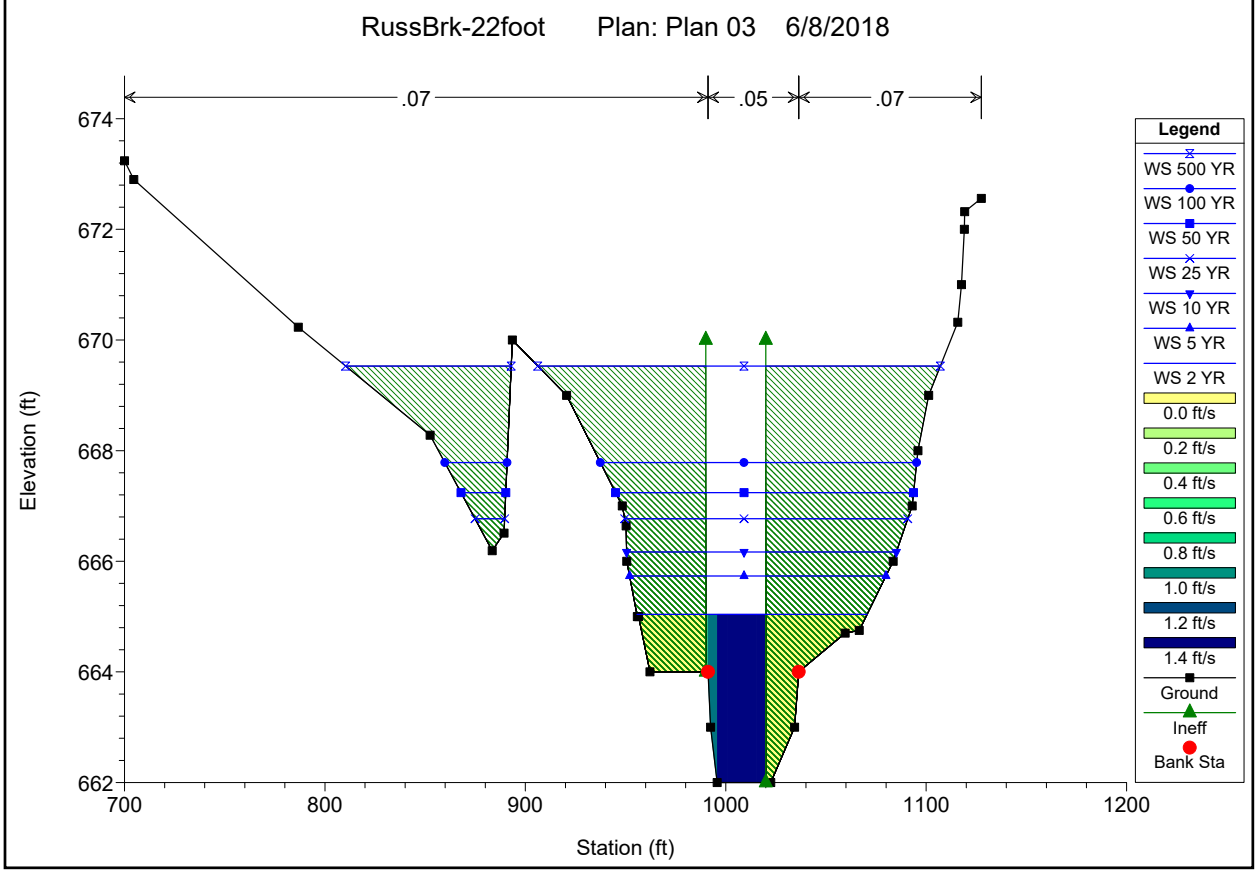
2.5 ft/s
Ground
Bank Sta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WS 10 YR
WS 5 YR
WS 2 YR
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1.4 ft/s
Ground
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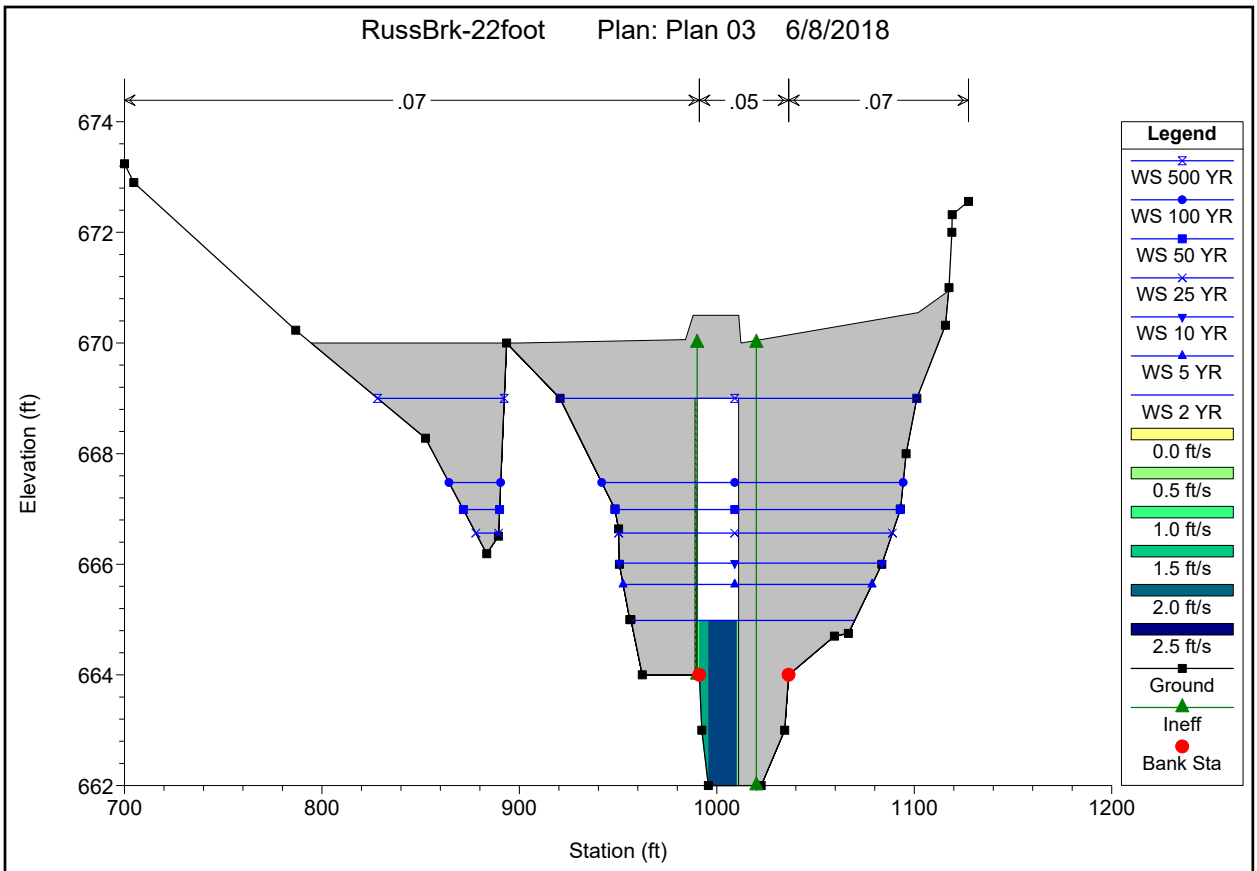
Bank Sta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Elevation (ft)
Station (ft)
Legend
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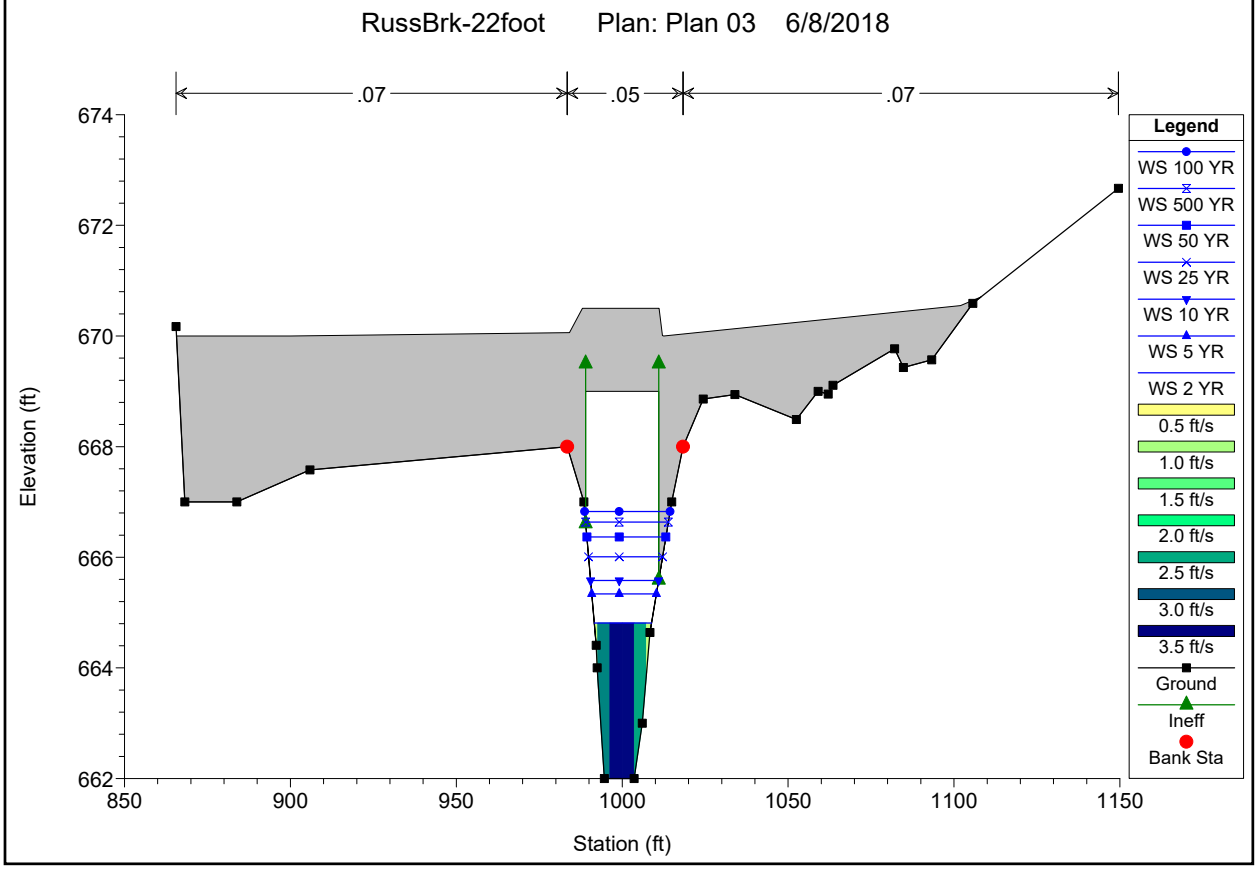
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
2.5 ft/s
Ground
Ineff
Bank Sta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.05
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Station (ft)
Legend
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WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
0.5 ft/s
1.0 ft/s
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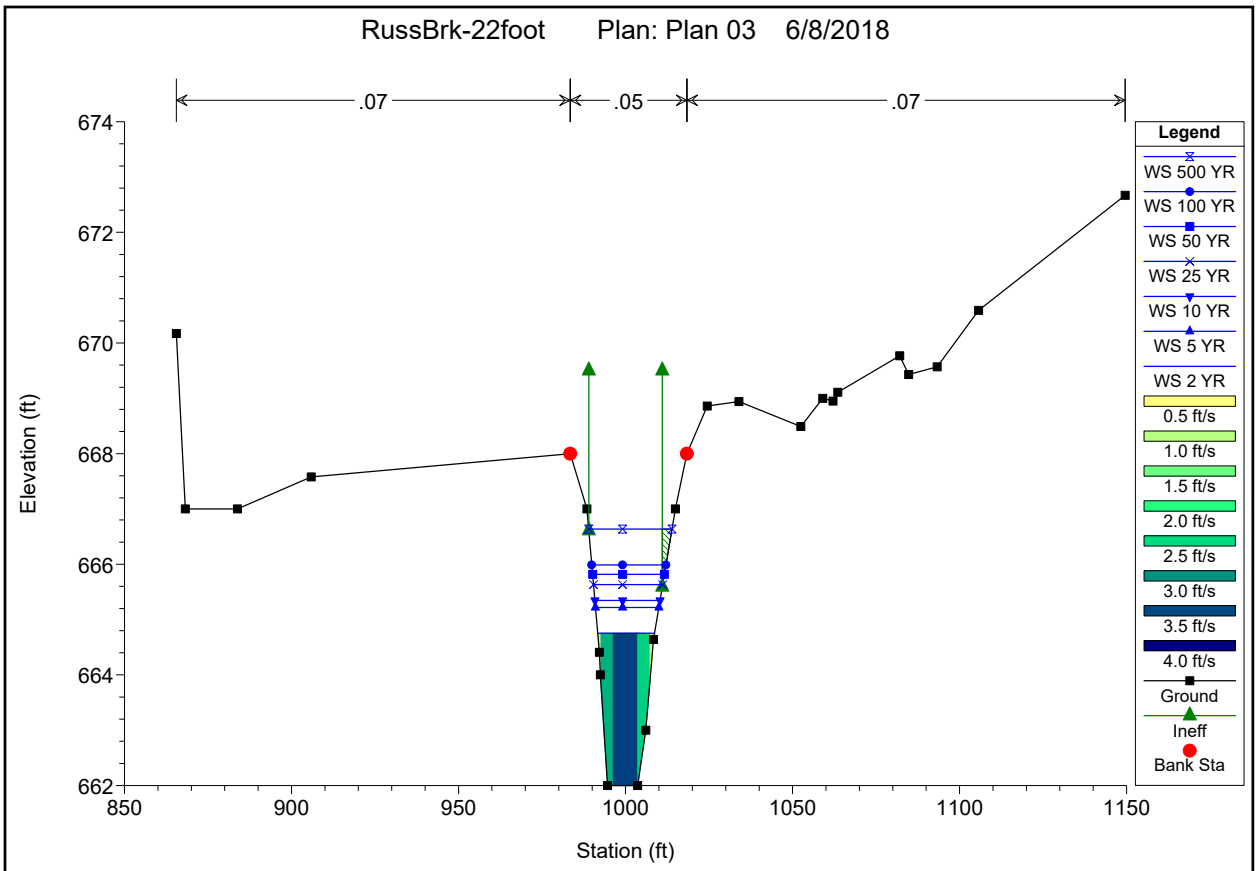
2.0 ft/s
2.5 ft/s
3.0 ft/s
3.5 ft/s
Ground
Ineff
Bank Sta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WS 5 YR
WS 2 YR
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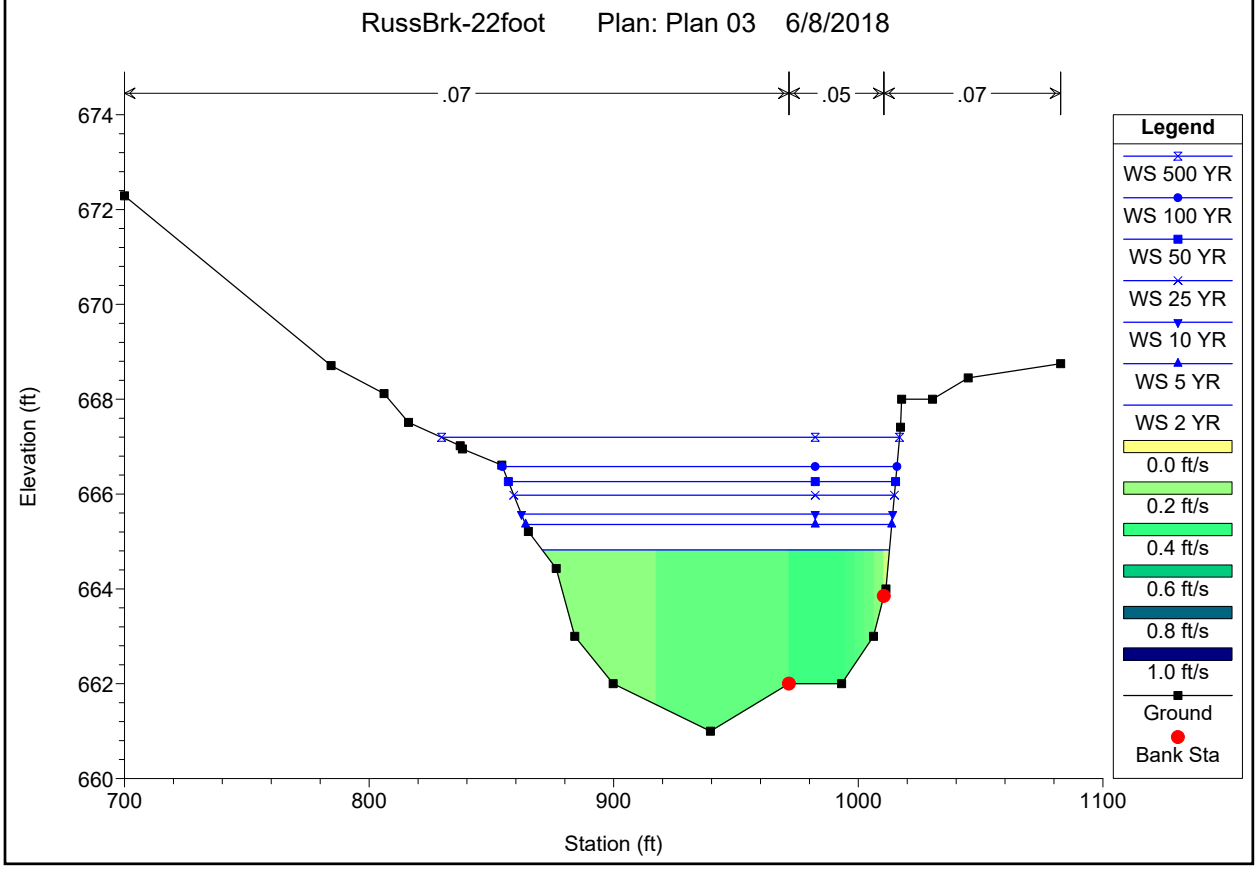
Ground
Ineff
Bank Sta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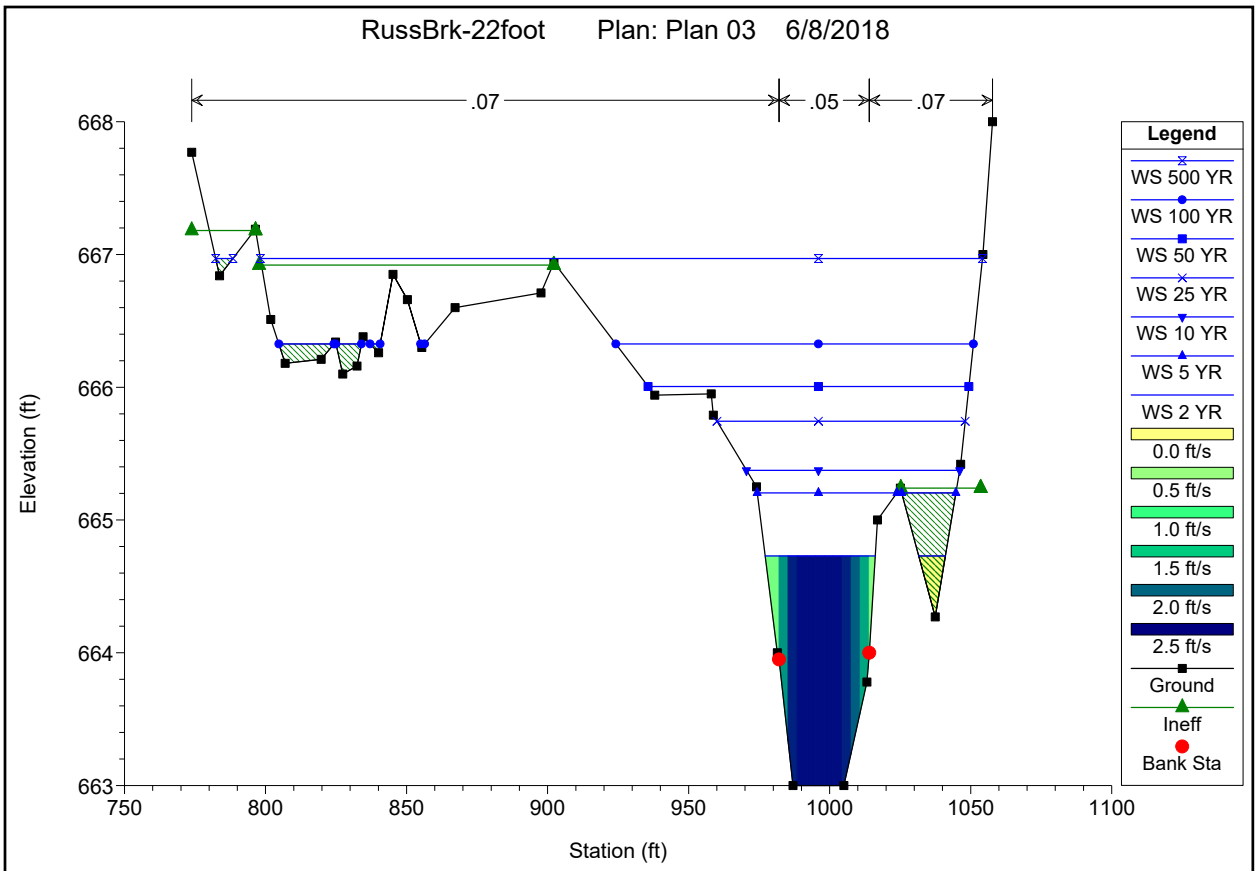
Ground
Bank Sta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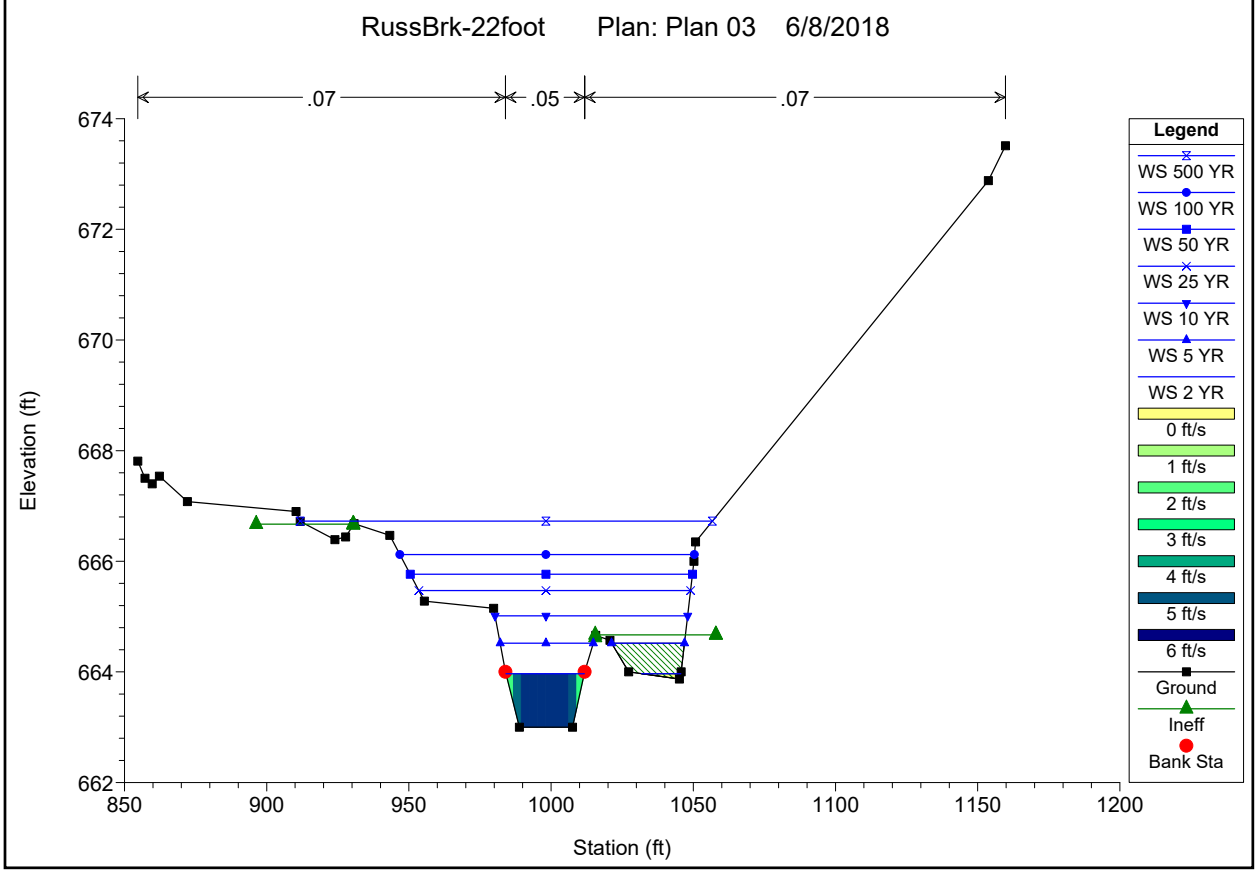
Ground
Ineff
Bank Sta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Station (ft)
Legend
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WS 10 YR
WS 5 YR
WS 2 YR
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2 ft/s
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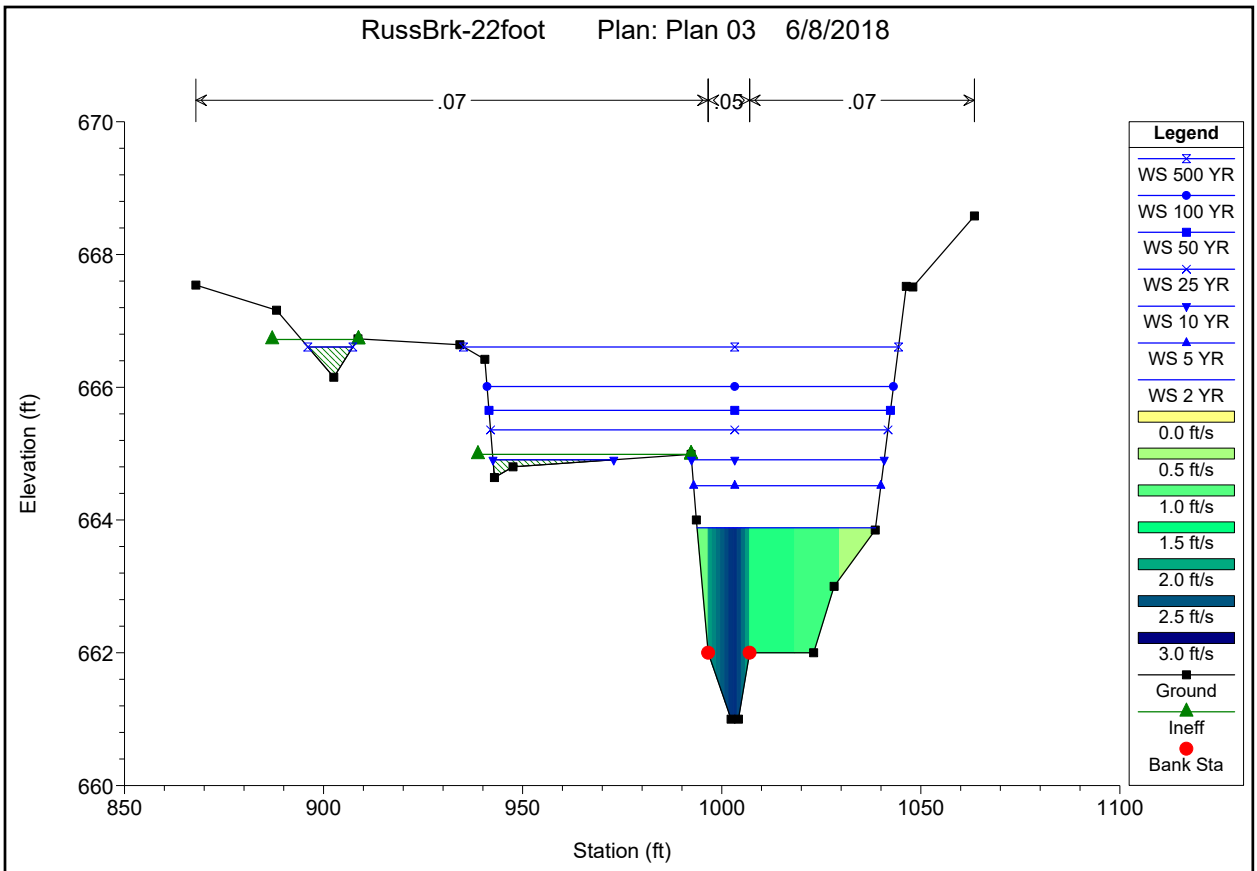
5 ft/s
6 ft/s
Ground
Ineff
Bank Sta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Elevation (ft)
Station (ft)
Legend
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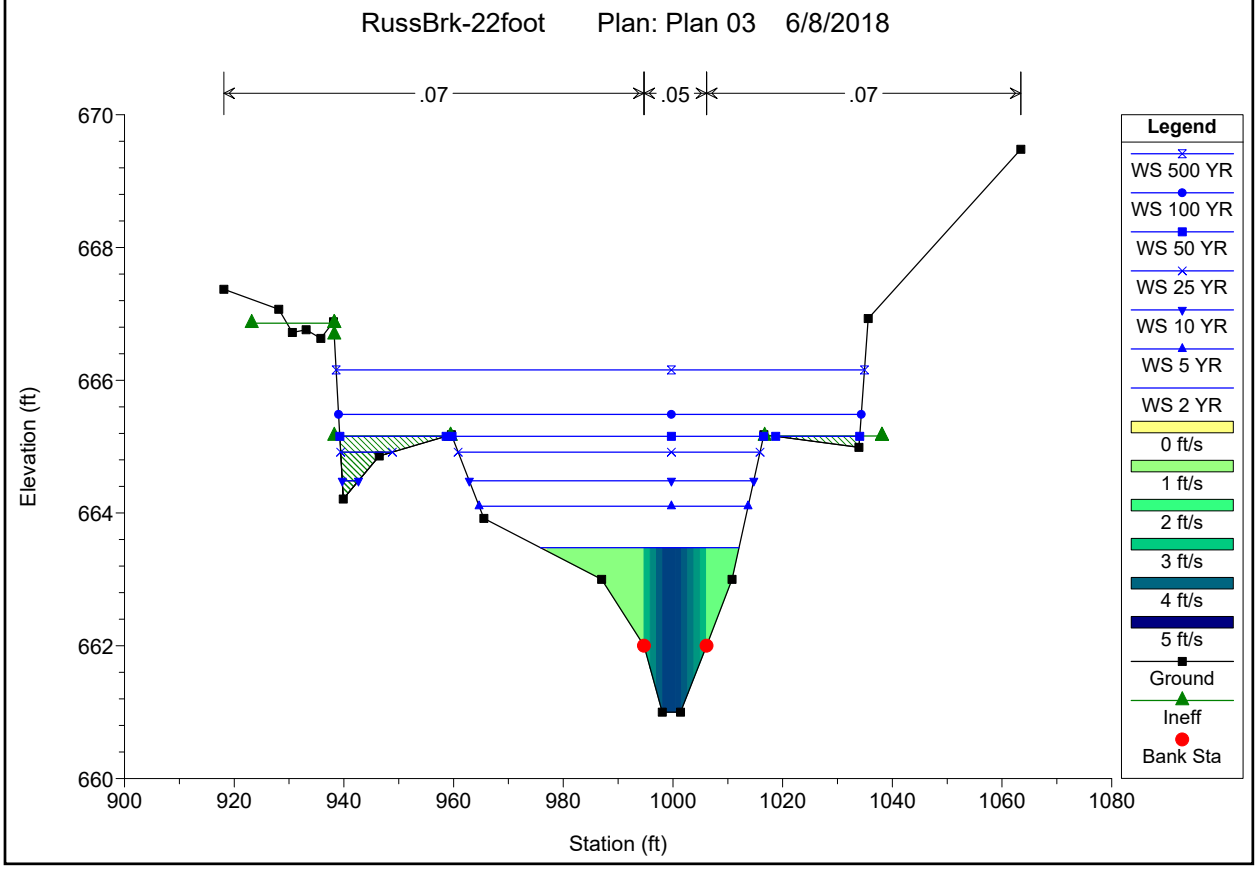
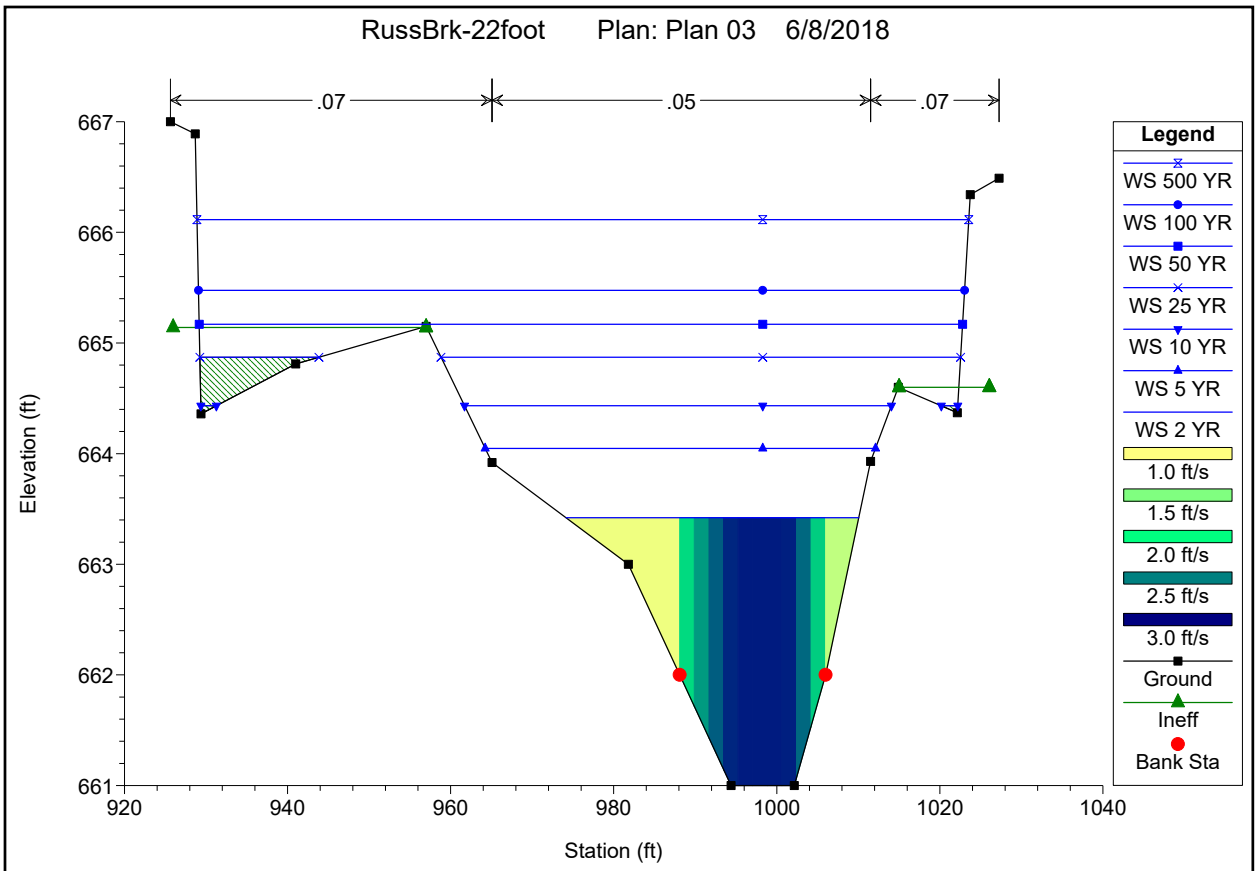
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
0.0 ft/s
0.5 ft/s
1.0 ft/s
1.5 ft/s
2.0 ft/s
2.5 ft/s
3.0 ft/s
Ground
Ineff
Bank Sta


RussBrk-22foot Plan: Plan 03 6/8/2018
.07
.05
.07
Elevation (ft)
Station (ft)
Legend
WS 500 YR
WS 100 YR
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
0 ft/s
1 ft/s
2 ft/s
3 ft/s
4 ft/s
5 ft/s
Ground
Ineff
Bank Sta


RussBrk-22foot Plan: Plan 03 6/8/2018
.07
.05
.07
Elevation (ft)
667
666
665
664
663
662
661
920
940
960
980
1000
1020
1040
Station (ft)
Legend
WS 500 YR
WS 100 YR
WS 50 YR
WS 25 YR
WS 10 YR
WS 5 YR
WS 2 YR
1.0 ft/s
1.5 ft/s
2.0 ft/s
2.5 ft/s
3.0 ft/s
Ground
Ineff
Bank Sta

Appendix E SCOUR ANALYSES

Contraction Scour

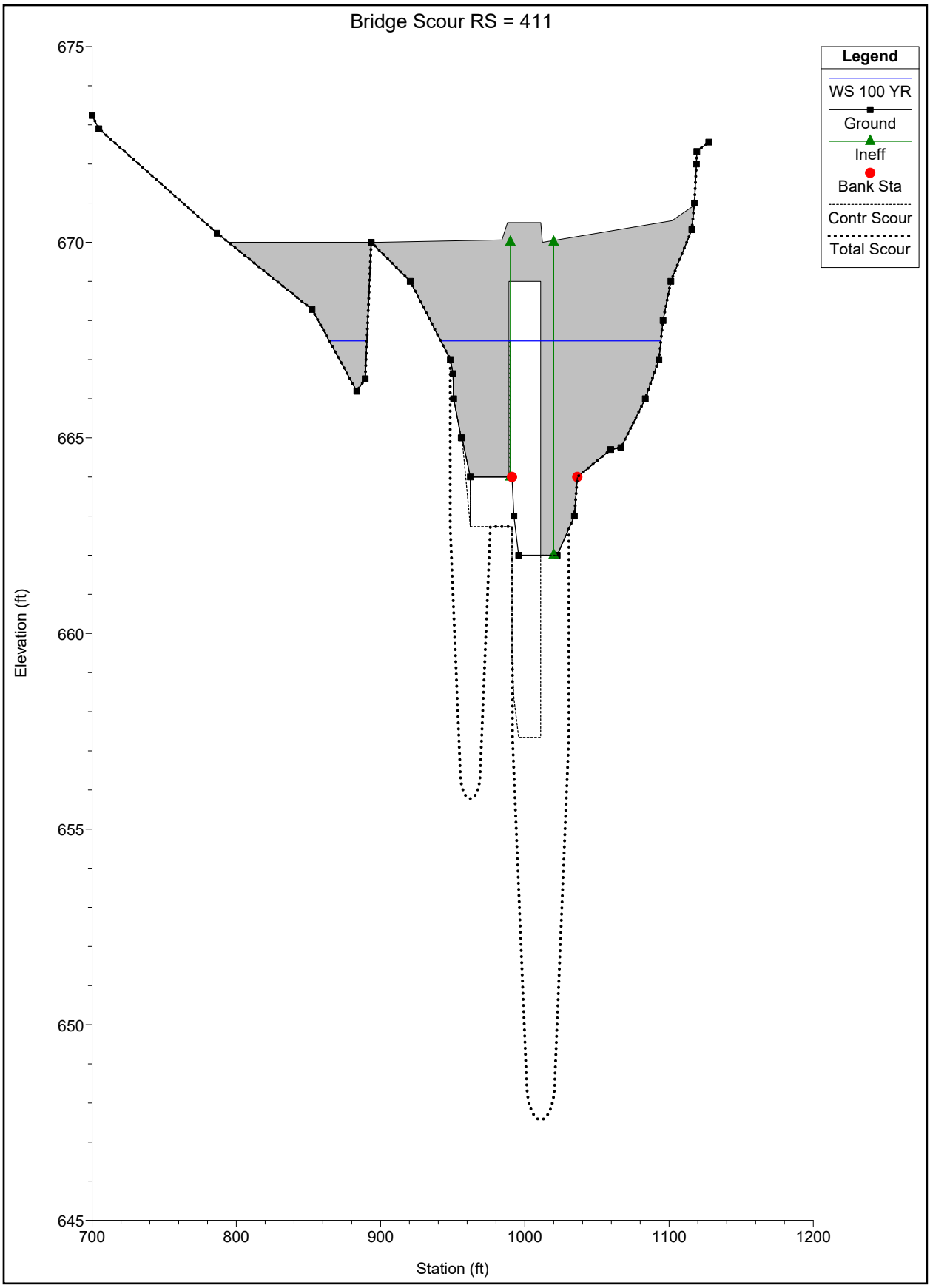
		Left	Channel	Right
Input Data				
	Average Depth (ft):	2.64	3.81	1.49
	Approach Velocity (ft/s):	1.00	1.80	0.68
	Br Average Depth (ft):	3.48	5.30	
	BR Opening Flow (cfs):	12.88	527.12	
	BR Top WD (ft):	1.15	19.85	
	Grain Size D50 (mm):	1.00	1.00	1.00
	Approach Flow (cfs):	150.45	372.00	17.54
	Approach Top WD (ft):	57.01	54.22	17.34
	K1 Coefficient:	0.640	0.640	0.590
Results				
	Scour Depth Ys (ft):	1.27	4.66	
	Critical Velocity (ft/s):	1.96	2.08	
	Equation:	Clear	Clear	

Abutment Scour

		Left	Right
Input Data			
	Station at Toe (ft):	962.20	1011.00
	Toe Sta at appr (ft):	963.05	1020.80
	Abutment Length (ft):	28.75	42.76
	Depth at Toe (ft):	3.78	5.78
	K1 Shape Coef:	1.00 - Vertical abutment	
	Degree of Skew (degrees):	90.00	90.00
	K2 Skew Coef:	1.00	1.00
	Projected Length L' (ft):	28.75	42.76
	Avg Depth Obstructed Ya (ft):	2.64	2.88
	Flow Obstructed Qe (cfs):	75.87	193.40
	Area Obstructed Ae (sq ft):	75.86	123.32
Results			
	Scour Depth Ys (ft):	6.96	9.77
	Qe/Ae = Ve:	1.00	1.57
	Froude #:	0.11	0.16
	Equation:	Froehlich	Froehlich

Combined Scour Depths

Left abutment scour + contraction scour (ft):	8.22
Right abutment scour + contraction scour (ft):	14.43


Bridge Scour RS = 411
Legend
WS 100 YR
Ground
Ineff
Bank Sta
Contr Scour
Total Scour
Elevation (ft)
675
670
665
660
655
650
645
700
800
900
1000
1100
1200
Station (ft)

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Project **Bennington NH**
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Subject **Hydraulic Model**

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RIPRAP APRON CHECK

TW < 0.5 Rp Connicut Eq from GranDOT

Rp = 7', culvert rise
Sp = 22', culvert span

2YR = 114 cfs
10YR = 266 cfs
25YR = 362 cfs
50YR = 443 cfs

$$L_a(2) = \frac{1.8\,(Q-5)}{Sp^{1.5}} + 10$$

$$= \frac{1.8\,(109)}{22^{1.5}} + 10 = \frac{196.2}{103.2} + 10 = 11.9'$$

say 12'

$$L_a(10) = \frac{1.8\,(261)}{22^{1.5}} + 10 = \frac{469.8}{103.2} + 10 = 14.6'$$

say 15'

Estimated Tailwater (22' span)

Crit INV	662
2YR	664.8
10YR	665.3
25YR	665.6
50YR	665.8

From HEC-RAS for Proposed 22' SPAN.

TW > 0.5 Rp > 2' Connicut Eq from GranDOT

$$L_a(25) = \frac{3.0\,(Q-5)}{Sp^{1.5}} + 10$$

$$= \frac{3.0\,(357)}{22^{1.5}} + 10 = \frac{1071}{103.2} + 10 = 24.3$$

say 25'

$$L_a(50) = \frac{3.0\,(438)}{22^{1.5}} + 10 \quad \frac{1314}{103.2} + 10 = 22.7$$

say 25'

From NHDES

$$D_{50} = 0.02\,Q^{1.3} / TW \times D_o$$

50YR = TW = 3.8' $D_o = Sp = 22'$

$$= 0.02\,(443)^{1.3} / 3.8 \times 22 = 55.1/83.6 = 0.66 \sim 8''$$

BENNINGTON 29486
South Bennington Road over Russell Brook

Designed by: GF 6-8-18 Check Checked by:

Stantec

Project **Bennington NH**
Sheet No. of
Authored **TEK** Date **6/18** Checked by Date

Subject **Hydraulic Model**

RIP-RAP SIZE USING Q500

Calculate D50 for a Stable Bed
Refer to HEC 18 Equation 5.1

Vc	6.9	ft/s	critical velocity above which bed material size D and smaller is transported
Ku	11.17		constant
y	5.5	ft	average depth of Flow
D 50	0.10	ft	=(Vc/(Ku*y^0.166666))^3
D 50	**1**	in	

Calculate D50 for a Stable Bed - USGS Method
D50 = 0.01 V^2.44
Where D50 = Median Stone Diameter (ft)
V = Average Velocity (ft/s)

V (ft/s)	6.9
D50 (ft)	1.11
D50(in)	**13**

Based on the 3 methods, use class III Riprap with a nominal diameter of 12 inches for the channel, If using riprap for slope protection or abutment scour mitiation, a larger size should be considered. DES may have additional requirements for simluated streambed material. (SEE ALSO Q50 DESIGN)

Isbash Method

Vc	6.9	ft/s critical velocity
C	0.86	(0.86 High tubulance, 1.2 for low trubulance)
g	32	ft/s^2
γs	168	stone density (lb/ft3)
γw	62.4	water density (lb/ft3)
D50		ft
Z=(γs-γw)/γw	1.69	
D50^.5=Vc/(C*(2g*Z)^.5)	0.77	
D50=	0.59	ft
D50=	**7**	**inches**

$$V_c = C \times \left(2 \times g \times \frac{\gamma_s - \gamma_w}{\gamma_w}\right)^{0.50} \times (D_{50})^{0.50}$$

where:

Plan: Plan 03 RussBrk a RS: 411 BR D Profile: 500 YR

E.G. Elev (ft)	**668.74**	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.94	Wt. n-Val.		0.05	
W.S. Elev (ft)	**667.8**	Reach Len. (ft)	11	11	11
Crit W.S. (ft)	**666.63**	Flow Area (sq ft)		100.02	
E.G. Slope (ft/ft)	**0.010539**	Area (sq ft)		100.02	
Q Total (cfs)	**778**	Flow (cfs)		778	
Top Width (ft)	**22**	Top Width (ft)		22	
Vel Total (ft/s)	**7.78**	Avg. Vel. (ft/s)		7.78	
Max Chl Dpth (ft)	**5.8**	Hydr. Depth (ft)		4.55	
Conv. Total (cfs)	**7578.5**	Conv. (cfs)		7578.5	
Length Wtd. (ft)	**11**	Wetted Per. (ft)		24.57	
Min Ch El (ft)	**662**	Shear (lb/sq ft)		2.68	
Alpha	**1**	Stream Power (lb/ft s)		20.83	
Frctn Loss (ft)	**0.18**	Cum Volume (acre-ft)	1.16	0.63	0.41
C & E Loss (ft)	**0.23**	Cum SA (acres)	0.68	0.15	0.17

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Project **Bennington NH**
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Authored **TEK** Date **6/18** Checked by Date

Subject **Hydraulic Model**

RIP-RAP SIZE USING Q100

Calculate D50 for a Stable Bed
Refer to HEC 18 Equation 5.1

Vc	6.5	ft/s	critical velocity above which bed material size D and smaller is transported
Ku	11.17		constant
y	5	ft	average depth of Flow
D 50	0.09	ft	=(Vc/(Ku*y^0.166666))^3
D 50	**1**	in	

Calculate D50 for a Stable Bed - USGS Method
D50 = 0.01 V^2.44
Where D50 = Median Stone Diameter (ft)
V = Average Velocity (ft/s)

V (ft/s)	6.5
D50 (ft)	0.96
D50(in)	**12**

Based on the 3 methods, use class III Riprap with a nominal diameter of 12 inches for the channel, If using riprap for slope protection or abutment scour mitiation, a larger size should be considered. DES may have additional requirements for simluated streambed material. (SEE ALSO, Q500 DESIGN)

Isbash Method

Vc	6.5	ft/s critical velocity
C	0.86	(0.86 High tubulance, 1.2 for low trubulance)
g	32	ft/s^2
γs	168	stone density (lb/ft3)
γw	62.4	water density (lb/ft3)
D50		ft
Z=(γs-γw)/γw	1.69	
D50^.5=Vc/(C*(2g*Z)^.5)	0.72	
D50=	0.52	ft
D50=	**6**	**inches**

$$V_c = C \times \left(2 \times g \times \frac{\gamma_s - \gamma_w}{\gamma_w}\right)^{0.50} \times (D_{50})^{0.50}$$

where:

Plan: Plan 03 RussBrk a RS: 411 BR D Profile: 50 YR

		Element	Left OB	Channe	Right OB
E.G. Elev (ft)	667.01				
Vel Head (ft)	0.65	Wt. n-Val.		0.05	
W.S. Elev (ft)	666.37	**Reach Len. (ft)**	11	11	11
Crit W.S. (ft)	665.47	**Flow Area (sq ft)**		68.56	
E.G. Slope (ft/ft)	0.011759	**Area (sq ft)**		68.56	
Q Total (cfs)	443	**Flow (cfs)**		443	
Top Width (ft)	21.65	**Top Width (ft)**		21.65	
Vel Total (ft/s)	6.46	**Avg. Vel. (ft/s)**		6.46	
Max Chl Dpth (ft)	4.37	**Hydr. Depth (ft)**		3.17	
Conv. Total (cfs)	4085.3	**Conv. (cfs)**		4085	
Length Wtd. (ft)	11	**Wetted Per. (ft)**		24.14	
Min Ch El (ft)	662	**Shear (lb/sq ft)**		2.08	
Alpha	1	**Stream Power (lb/ft s)**		13.47	
Frctn Loss (ft)	0.17	**Cum Volume (acre-ft)**	0.68	0.49	0.25
C & E Loss (ft)	0.09	**Cum SA (acres)**	0.38	0.15	0.15

Appendix F GEOMORPHIC ASSESSMENT

Stantec

Memo

To:	Mike Leach	From:	David Huntress
	Auburn, NH		Topsham, ME
File:	195311574	Date:	April 17, 2018

Reference: **Geomorphic Investigation, Russell Brook at South Bennington Road Stream Crossing, Bennington, New Hampshire**

Stantec performed a geomorphic investigation of Russell Brook adjacent to South Bennington Road in Bennington, NH. This memo summarizes observations and findings of the geomorphic field reconnaissance site visit performed on April 11, 2018, and includes discussion of relative parameters for design of a replacement stream crossing. Descriptions of the project watershed, localized land use, and geomorphology are included.

Russell Brook is a 3rd order stream[1], mainly forested, rural drainage flowing through Bennington, New Hampshire. The watershed area at the South Bennington Road crossing is approximately 2.34 square miles[2] and is largely dominated by wetland cover, upland areas, and rural residential development (refer to Hydrology / StreamStats analysis).

SITE OBSERVATIONS

The South Bennington Road stream crossing was backwatered by a dam-controlled reach of the Contoocook River during the site visit. However, observations during the site visit and review of aerial photographs suggest that a drawdown at the downstream dam on the Contoocook River could result in a perched culvert condition. Observations during the site visit included indicators of lateral and vertical stability, such as established herbaceous ground cover, lack of recent depositional features, and limited evidence of bank erosion or other signs of instability.

Stantec performed a Level 2 geomorphic characterization[3] along approximately 285 feet of the channel of the brook adjacent to the South Bennington Road stream crossing. Based on observations and field measurements during the site visit, Stantec characterized Russell Brook at South Bennington Road is a stable E5 stream-type with identified geomorphic characteristics presented in Table 1. There is an abrupt turn to the left[4] in the channel of the brook immediately upstream from the South Bennington Road stream crossing. This turn, and other observed conditions in the channel upstream from the culvert, may have resulted from historical realignment of the channel through the existing, cast-in-place box culvert. The poor alignment of the upstream channel may be exacerbated by deposition of sediment upstream from the South Bennington Road culvert due to the apparent backwater associated with the downstream dam and impoundment.

Channel bed material consisted of fine sand with some silt and organic detritus. A representative sample rubbed between the observer's fingers indicated the channel bed material was generally between 1 to 2 mm in diameter. Due to the limited variation in bed material size fraction, a Wolman pebble count was not performed. Water surface slope between the downstream beaver debris and downstream side of a beaver dam located upstream from the culvert was visually estimated as 6-inches per 300 feet of channel.

[1] Strahler, A.N., 1957, Quantitative analysis of watershed geomorphology, *Transactions of the American Geophysical Union*, 38 (6): 913-920.

[2] Watershed area estimated using the United States Geological Survey's *StreamStats v4.0* online application for the State of New Hampshire.

[3] A Classification of Natural Rivers. *David L. Rosgen. Wildland Hydrology, 157649 U. S. Highway 160, Pagosa Springs, CO 81147*

[4] Directionals 'left' and 'right' in this document refer to the viewer's left and right when facing downstream.

Table 1: Bankfull Channel Data

Bankfull Width	17.6 ft
Bankfull Mean Depth	1.7 ft
Bankfull Maximum Depth	2.5 ft
Flood-Prone Width	47 ft
Channel Materials D50	1 mm
Channel Materials D84	2 mm
Estimated Water Surface Slope	0.0017
Sinuosity	2.1
Estimated Bankfull Discharge	74 cfs
Estimated Bankfull Velocity	2.5 ft/s
Bankfull Cross Sectional Area	30 ft^2
Entrenchment Ratio	2. 7
Width to Depth Ratio	10.5

DESKTOP ANALYSIS

The measured geomorphic parameters, when normalized to drainage area, are similar to values for discharge and bankfull cross-sectional area predicted by New Hampshire regional hydraulic geometry curves[5]. The parameters that can be estimated from the regional curves are bankfull flow (Q_{BF}), bankfull cross sectional area (A_{BF}), bankfull width (W_{BF}), bankfull mean depth (D_{BF}), and average bankfull velocity (V_{BF}), derived by the following formulas:

$$Q_{BF} = 44.159*(\text{Drainage Area})^{0.9114}$$

$$A_{BF} = 16.024*(\text{Drainage Area})^{0.7552}$$

$$W_{BF} = 12.469*(\text{Drainage Area})^{0.4892}$$

$$D_{BF} = 1.2952*(\text{Drainage Area})^{0.2645}$$

$$V_{BF} = Q_{BF}/A_{BF}$$

The results of these calculations, using a drainage area of 2.34 square miles are provided in Table 2 below.

Table 2: Estimated Bankfull Channel Data Using New Hampshire Regional Hydraulic Geometry Curves

Bankfull Discharge	96 cfs
Bankfull Cross Sectional Area	31 ft^2
Bankfull Width	19 ft
Bankfull Mean Depth	1.6 ft
Bankfull Velocity	3.1 ft/s

[5] Schiff, R., J.G. MacBroom, and J. Armstrong Bonin, 2006, River Restoration and Fluvial Geomorphology White Paper. NHDES-R-WD-06-27. Prepared by Milone & MacBroom, Inc. for the New Hampshire Department of Environmental Services and the New Hampshire Department of Transportation, Concord, NH.

Reference: **Geomorphic Investigation, Russell Brook at South Bennington Road Stream Crossing, Bennington, New Hampshire**

DISCUSSION

The apparent stability of the adjacent sections of stream channel indicate that using the data collection during the geomorphic assessment (provided in Table 1 above) is appropriate for stream crossing design purposes, however, it is noted that the existing culvert is located within an area affected by downstream hydropower operations. Therefore, a bankfull width of 16.2 feet was determined at a representative cross section on Russell Brook located approximately 150 feet downstream from the Old Greenfield Road culvert, which is approximately 1,350 feet upstream from the South Bennington Road stream crossing. Based on the similarity between the measured bankfull width at the two measured cross sections on Russell Brook and information obtained using the regional regression equation, the geomorphic parameters presented in Table 1 are recommended for use for design of the replacement crossing on South Bennington Road.

STANTEC CONSULTING SERVICES INC.

David Huntress
Geomorphologist, Ecological Restoration Services

Phone: (207) 406-5468
Fax: (207) 729-2715
David.Huntress@stantec.com

Attachment: Appendix A: Contributing Watershed Map
Appendix B: Site Photographs

c. Michael Chelminski, P.E. (Stantec)

Reference: **Geomorphic Investigation, Russell Brook at South Bennington Road Stream Crossing, Bennington, New Hampshire**

Site Photographs

Photo 1:View looking downstream from left culvert approach.

Photo 2: View looking upstream from right culvert approach.

Reference: **Geomorphic Investigation, Russell Brook at South Bennington Road Stream Crossing, Bennington, New Hampshire**

Photo 3. View looking upstream at representative cross section near upstream limit of the backwatered reach.

Photo 4. View across channel at representative cross section near upstream limit of the backwatered reach. Flow is from top to bottom.

Photo 5. View looking downstream towards upstream cross section. This cross section is approximately 150 feet downstream from Old Greenfield Road.

Photo 6. View across channel at representative cross section below Old Greenfield Road (flow is from bottom to top in this image).

NH Department of Transportation
Bureau of Bridge Design
Project Bennington**, #**29486
Env-Wt 904.10 Alternative Design
TECHNICAL REPORT
Prepared by: Stantec Consulting Services, Inc.

Env-Wt 904.10(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.

Please explain why the structure specified in the applicable rule *(a compliant structure)* is not practicable. (Env-Wt 103.62 defines practicable as *available and capable of being done after taking into consideration costs, existing technology, and logistics in light of overall project purposes.)*

The project involves replacing an existing 10 foot wide by 37.5 feet long concrete box culvert along Russell Brook that is on the NHDOT Red List for bridges. Russell Brook is a Tier 3 stream crossing. This project falls into a category noted by DOT as one of the few remaining projects where the field work was completed prior to the current rules. The proposed culvert was sized prior to the current Stream Crossing Rules adopted in 2019. The 22' width is reflective of a bankfull width of 16.2' x 1.2 + 2'.

The current Stream Crossing Guidelines would require a 38 foot opening. This is not practical for the location as it would be too large to utilize a precast culvert and would require a full bridge structure to span that distance. This would increase the bank impacts as well as resulting in an increase of the profile to account for the span length and deck thickness. The wider opening would lead to additional property and resource impacts as well, including wetland, stream, Shoreland and floodplain impacts. Additionally, it would require a significantly longer roadway closure to install, and the costs would also significantly increase to construct the full bridge structure that would not meet the Town's requirements. This would have an adverse impact on the floodplain storage as well. A Summary of Meeting Minutes for the March 17, 2021 Natural Resource meeting has been provided with the wetland permit application which includes discussion on this issue.

The replacement of the existing culvert was determined to be the most appropriate action to remedy the failing existing culvert at this location. It allows for improved hydraulics and aquatic passage at the location, as well as removing a failing bridge from the State's red list. The Department did consider rehabilitation as well as other full replacement alternatives. Rehabilitation alternatives would not provide the hydraulic and aquatic passage improvements of the replacement. In addition, staged full replacement option impacts would be significant, requiring a widened crossing with additional temporary wetland impacts to maintain traffic through construction, as well as an extended construction period. The Town's preference was the full replacement option, with a short term full roadway closure.

The no build alternative will not address the existing culvert, which is in poor condition, and without any improvements its condition will continue to decline, eventually forcing the roadway to be closed. Therefore, this alternative was rejected.

Env-Wt 904.10(c)(1) Explain how the proposed alternative meets the criteria for approval specified as applicable: *(answer within this form and/or include attachments while referencing attachments as answer to this form.)*

Env-Wt. 904.10 Alternative Design
TECHNICAL REPORT

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 estimated for each;
The project, a proposed box culvert structure, has a construction cost estimate of $900,000. In order to construct a structure that would meet a 38-foot opening, a full bridge would be required. A bridge of this size would cost between $1.2 and $1.5 million to construct, an increase in cost of 33% to almost 50%. At this particular location, there are no viable alternatives that would provide additional benefits while decreasing the number of waivers. A bridge spanning less than the 38-foot minimum width, or a larger culvert than proposed would not decrease the number of waivers required, while also potentially creating additional impacts, as the structure depths will be increased, raising the proposed roadway profile. As the currently proposed culvert accommodates the necessary site hydraulics and improves aquatic passage, a widened opening does not provide any quantifiable improvements over the proposed.

b. A detailed description of the physical limitations of the site; and
The project on South Bennington Road involves replacing an existing 10 foot wide by 37.5 feet long concrete box culvert bridge located along Russell Brook that is on the NHDOT Red List for bridges. The bridge location is approximately 500 feet upstream of the Russell Brook confluence with the Contoocook River and is backwatered by and within the 100-year elevation of the Monadnock Power Station Dam that is along the Contoocook River. The 100-year flood elevation of the Contoocook River at 673.1 is above the entire project area at elevation ~670 including the roadway and proposed box culvert. Russell Brook (Carkin Brook) is a tier 3 stream. South Bennington Road has a narrow roadway section with guardrail at the crossing location. The existing adjacent floodplain and wetland areas, and steep stream banks are located approximately 10-20 feet from the roadway pavement, and alternatives considering larger structures would result in additional impacts to the resources. The adjacent resources are identified as Prime Resources Areas (PRA) under the new rules that requires more diligence to minimize impacts.
The project also includes impacts to Shoreland area as defined under the Surface Water Quality Protection Act (SWQPA) associated with the Monadnock Power Station Dam with the reference elevation of 664. The reference elevation is located along Russell Brook and extends upstream beyond the project limits.

c. A hydraulic analysis to show the proposed stream crossing can accommodate the applicable design storm that the crossing, together with the associated roadway and roadway embankment, can safely accommodate overtopping flows;
A hydraulic analysis is provided with the wetland permit application under Exhibit I. The analysis indicates the 100-year storm flows associated with Russell Brook will pass through the proposed box culvert with approximately 9 inches of freeboard. We note the entire project area is located within the 100-year backwater elevation of the Contoocook River.

Env-Wt 904.10(c)(2)a – The proposed alternative design must meet the general design criteria established in Env-Wt 904.01:

Env-Wt. 904.10 Alternative Design
TECHNICAL REPORT

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;
Sediment transport is accommodated by the existing culvert and will continue to be accommodated at this crossing with the new culvert.

2) Not restrict high flows and maintain existing low flows;
High and low flows are accommodated at this crossing and will continue to be accommodated with the culvert improvements. The improvements to the culvert will result in a slight decrease in the velocities of flow through the structure for storms under 100-year event and match the 100-year velocity. A more detailed discussion of this can be found in the Hydraulic Study Report dated \August 2018 which has been provided with the wetland application

3) Not obstruct or otherwise substantially disrupt the movement of aquatic life indigenous to the waterbody beyond the actual duration of construction;
There will be no obstructions or disruptions to the movement of aquatic life indigenous to the waterbody beyond the duration of construction. The existing slope and profile of the culvert is being maintained with the improvements. The wider structure is anticipated to be more accommodating to aquatic species.

4) Not cause an increase in the frequency of flooding or overtopping of banks;
The hydraulic study performed for this project demonstrates that the culvert improvements will not cause an increase in the frequency of flooding or overtopping of banks and will pass the Russell Brook 100-year storm event with freeboard within the culvert. The study demonstrates the Russell Brook 100-year storm elevation would be lower at this location with the culvert improvement.

5) Maintain or enhance geomorphic compatibility by:
    a. Minimizing the potential for inlet obstruction by sediment, wood, or debris; and
    The proposed culvert improvement is wider and shorter in length and will minimize the potential of inlet obstructions and improve geomorphic compatibility.
    b. Preserving the natural alignment of the stream channel;
    The proposed culvert improvement is located at the same location as the existing stream crossing and intended to preserve the natural alignment.

6) Preserve watercourse connectivity where it currently exists;
Watercourse connectivity exists today and will continue to exist with the culvert improvements placed at the same location.

7) Restore watercourse connectivity where:
    a. Connectivity previously was disrupted as a result of human activity(ies); and
    The proposed culvert improvement is wider and shorter in length and will improve watercourse conductivity.

b. Restoration of connectivity will benefit aquatic life upstream or downstream of the crossing, or both;
The proposed culvert improvement is wider and shorter in length and will benefit and improve aquatic life upstream and downstream of the crossing.

8) Not cause erosion, aggradation, or scouring upstream or downstream of the crossing; and
The proposed culvert inlet and outlet will be protected with Class B stonefill sized to resist erosion and scour, and be topped with streambed aggregate upstream and downstream of the crossing

9) Not cause water quality degradation.
The proposed culvert improvements will not cause water quality degradation. Erosion and sediment controls will be utilized during construction to protect water quality in Russell Brook.

(b) For stream crossing over tidal waters, the stream crossing shall be designed to:
1) Match the velocity, depth, cross-sectional area, and substrate of the natural stream: and
Not Applicable to this project

2) Be of sufficient size to not restrict bi-directional tidal flow over the natural tide range above, below, and through the crossing.
Not Applicable to this project

Env-Wt 904.10(c)(2)b - The proposed alternative design meets the applicable design criteria established in Env-Wt 904.07 for Tier 2, Tier 3, and Tier 4 stream crossings to the *maximum extent practicable,* as specified below.

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 crossings, new and replacement Tier 3 crossings, as well as new and replacement Tier 4 tidal crossings that do not meet the requirements of Env-Wt 904.07:

(b) Tier 2 and tier 3 stream crossings shall be designed in accordance with the NH Stream Crossing Guidelines.
This project falls into a category noted by DOT as one of the few remaining projects where the field work was completed prior to the current rules. At the time the design was developed in 2018, the NH Stream Crossing Guidelines recommended that the crossing should be a span structure with a width of 1.2 x Bankfull Width + 2 feet. A Stream Crossing Assessment performed by Stantec determined the bankfull width to be 16 feet beyond the backwater effect of the Contoocook River. The proposed culvert was sized prior to the current Stream Crossing Rules adopted in 2019. This results in a minimum structure width of 22 feet to comply with the guidelines that was designed for the project. The 22' width is reflective of a bankfull width of 16.2' x 1.2 + 2'. This criteria will be met under those guidelines.

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

1) To meet the general design considerations specific in Env-Wt 904.01;
The proposed culvert improvements meet the general design considerations under Env-Wt 904.01 to the extent practicable.

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 would adversely affect channel stability; or
   c. Applicable federal, state, or local requirements;

   The hydraulic study performed for the culvert indicates that the improvements will result in a slight decrease in flood elevations from existing for larger storm events and continue to pass the 100-year storm event associated with Russell Brook. A more detailed discussion of the hydrologic and hydraulic analyses can be found in the Hydraulic Study Report dated August 2018 which has been provided with the wetland application.

3) With 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.
The bed forms and streambed characteristics will remain the same as they are today and are comparable to those found upstream and downstream of the stream crossing. The current and future conditions at this location are backwatered by the Monadnock Power Station Dam.

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.
There will not be an opportunity to provide vegetated banks along the watercourse banks due to the stream velocities and site condition restrains. Proposed riprap banks at 1.5H:1V minimize resources impacts to the extent practical. Site conditions do not provide for opportunities for "dry" wildlife passage along the banks. Riprap installed above the 100-year storm elevation will be intermixed with Humus and vegetated. ***This criteria will not be met under the guidelines.***

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.
The culvert is being widened on the existing alignment and gradient. The proposed work will not impact the natural flow regimes of the brook, since the area is backwatered by the Monadnock Power Station Dam. There will be a net gain in floodplain storage due to the larger structure.

6) To simulate a natural stream channel.
Designed simulated stream bed material will be placed within the proposed box culvert and channel in any locations where the existing stream bed is impacted.

7) So as not to alter sediment transport competence.
   Sediment transport competence will not be altered under the project.

8) To avoid and minimize impacts to the stream in accordance with Env-Wt 313.03
   The wetland permit application includes Attachment A (NHDES form W-06-013) and the NHDES Avoidance and Minimization checklist (NHDES form W-06-050) to address Env-Wt.313.03.

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

1) Based on a hydraulic analysis that accounts for daily fluctuating tides, bidirectional flows, tidal inundation, and coastal storm surge;
   Not Applicable to this project

2) To prevent creating a restriction on tidal flows; and
   Not Applicable to this project

3) To account for tidal channel morphology and potential impacts due to sea level rise.
   Not Applicable to this project

BANK/SHORELINE STABILIZATION PROJECT-SPECIFIC WORKSHEET FOR STANDARD APPLICATION

Water Division/Land Resources Management
Wetlands Bureau

Check the Status of your Application

RSA/Rule: RSA 482/ Env-Wt 514

This worksheet summarizes the criteria and requirements for a Standard Permit for all types of "bank/shoreline stabilization" projects, one of the 18 specific project types in Chapter Env-Wt 500. In addition to the project-specific criteria and requirements on this worksheet, all Standard Applications must meet the criteria and requirements listed in the Standard Application form (NHDES-W-06-012).

Do **not** use this worksheet if the project is located in a coastal (tidal) area (Env-Wt 509.02(b)).

SECTION 1 - APPROVAL CRITERIA (Env-Wt 514.02)

An application for bank/shoreline stabilization must meet the following approval criteria:

☒ The project must meet the applicable conditions established in Env-Wt 300;

☒ For a hard-scape stabilization proposal, such as rip-rap or a retaining wall, the applicant must demonstrate that the bank or shoreline in that location cannot be stabilized by preserving natural vegetation, landscaping, or bioengineering;

☐ Bank/shoreline stabilization must be designed to be the least intrusive practicable method in accordance with Chapter 8 of the Wetlands Best Management Practice Techniques for Avoidance and Minimization (A/M BMPs);

☒ Bank/shoreline stabilization must conform to the natural alignment of the bank/shoreline;

☒ Bank/shoreline stabilization must not adversely affect the stream course such that water flow will be transported by the stream channel in a manner that the stream maintains it dimensions, general pattern, and slope with no unnatural raising or lowering of the channel bed elevation along the stream bed profile;

☒ Bank/shoreline stabilization must not adversely affect the physical stream forms or alter the local channel hydraulics, natural stream bank stability, or floodplain connectivity;

☒ Bank/shoreline stabilization must avoid and minimize impacts to shoreline resource functions as described in Env-Wt 514.01 and Chapter 8 of the A/M BMPs;

☐ If the project is a wall on a great pond or other surface water where the state holds fee simple ownership of the bed, bank/shoreline stabilization must locate the wall on the shoreward side of the normal high water line;

☒ If the project is to install rip-rap, bank/shoreline stabilization must locate the rip-rap shoreward of the normal high water line, where practicable, and extend it not more than 2 feet lakeward of that line at any point;

☒ The hierarchy of bank stabilization practices must be as follows:

(1) Soft vegetative bank stabilization, including regrading and replanting of slopes, in which all work occurs above ordinary high water or normal high water;

(2) Bioengineered bank stabilization or naturalized design techniques that uses a combination of live vegetation, woody material, or geotextile matting and may include regrading and replanting of slopes;

(3) Semi-natural form design shall be allowed only where the applicant demonstrates that anticipated turbulence, flows, restricted space, or similar factors, render vegetative or soft stabilization methods, bioengineering, and natural process design stabilization methods are physically impractical;

(4) Hard-scape or rip-rap design shall be allowed only where anticipated turbulence, flows, restricted space, or similar factors render vegetative, bio-engineering, semi-natural form design and diversion methods physically impractical and where necessary to protect existing infrastructure; and

(5) Wall construction shall be allowed as the last available option, only where lack of space or other limitations of the site make alternative stabilization methods of bioengineering, seminatural, and rip-rap impractical. Wherever sufficient room exists, slopes shall be cut back to eliminate the requirement for a wall; and

☒ Stream bank-stabilization project plan, must be developed in accordance with the following techniques, as applicable:

- Naturalized and semi-natural design techniques where practicable in accordance with "Guidelines for Naturalized River Channel Design and Bank Stabilization" dated February 2007; R. Schiff, J.G. MacBroom, and J. Armstrong Bonin;
- For bioengineering projects, National Engineering Handbook Part 654 (NEH 654), "Technical Supplement 141, Streambank Soil Bioengineering", dated August 2007, USDA NRCS; and
- For stream restoration projects, NEH 654, "Stream Restoration Design", dated August 2007, USDA NRCS.

SECTION 2 - APPLICATION REQUIREMENTS FOR ALL BANK/SHORELINE STABILIZATION PROJECTS (Env-Wt 514.03)

An application for any bank/shoreline stabilization project must include:

☒ A narrative and photos that:

- Describe and illustrate existing conditions and locations where shoreline vegetation currently exists;

  See photos under Exhibit L that show the exising conditions and location where vegetation currently exists.

- Identify all known causes of erosion to the bank/shoreline in that location;

  Erosion in the area is due high stream flows

- Identify information and, for minor and major projects, engineering standards used to determine the appropriateness of the proposed bank stabilization treatment or practice;

  Project hydraulic analysis indicates stream velocities for 50-year storm event at 6.3 fps and for the 100-year storm event at 6.8 fps that are excessive for any type of vegetative or bioengineered bank stabilization and therfore riprap bank stabilization is proposed.

- Explain the design elements that have been incorporated to address erosion, by eliminating or minimizing the causes therefor; and

  Project hydraulic analysis included scour analysis that is incorporated in the design for the propsoed structure.

- For minor and major bank/shoreline stabilization projects or minimum impact bioengineering stream bank projects, identify the flood risk tolerance of the proposed treatment or practice using the appropriate technical guidance or national engineering handbook;

  Riprap bank stabilization based upon 100-year storm event - see project hydraulic analysis

☒ A cross-section plan that shows:

- ☒ The difference in elevation between the lowest point of the bank/shoreline slope to be impacted by the construction and the highest point of the bank/shoreline slope to be impacted;
- ☐ The linear distance across the proposed project area as measured along a straight line between the highest and lowest point of the bank/shoreline slope to be impacted;
- ☒ The existing and proposed slope of the bank/shoreline; and
- ☒ The normal high water line or ordinary high water mark, as applicable;

☒ Hard-scape, rip-rap, or unnatural design plans that must include:

- ☒ Designation of minimum and maximum stone size;
- ☒ Gradation;
- ☒ Minimum rip-rap thickness;
- ☒ Type of bedding for stone;
- ☒ Cross-section and plan views of the proposed installation;
- ☒ A description of anticipated turbulence, flows, restricted space, or similar factors that would render vegetation and bioengineering stabilization methods physically impracticable;
- ☐ Engineering plans for rip-rap in excess of 100 linear feet along the bank or bed of a stream or river, including in-stream revetments, stamped by a professional engineer; and
- ☐ If the project proposes rip-rap adjacent to great ponds or other surface waters where the state holds fee simple ownership to the bed, a stamped surveyed plan showing the location of the normal high water line and the footprint of the proposed project; and

☐ Design plans for a wall in non-tidal waters must include:

- ☐ Cross-section and plan views of the proposed installation and sufficient plans to clearly indicate the relationship of the project to fixed points of reference, abutting properties, and features of the natural shoreline; and
- ☐ If the application is for a wall adjacent to a great pond or other surface water where the state holds fee simple ownership to the bed, a surveyed plan, stamped by a licensed land surveyor, showing the location of the normal high water line and the footprint of the proposed project.

SECTION 3 - DESIGN REQUIREMENTS FOR ALL BANK/SHORELINE STABILIZATION PROJECTS (Env-Wt 514.04)

In addition to meeting all applicable requirements in Env-Wt 300, bank/shoreline stabilization must be designed to:

☐ Incorporate stormwater diversion and retention to minimize erosion;

☒ Retain natural vegetation to the maximum extent possible;

☐ If space and soil conditions allow, cut back unstable banks to a flatter slope and then plant with native, non-invasive trees, shrubs, and groundcover;

☒ Avoid and minimize impacts to adjacent properties and infrastructure;

☒ Avoid and minimize impacts to water quality;

☒ Avoid and minimize impacts to priority resource areas, avian nesting areas, fish spawning locations, and other wildlife habitat to meet the requirements of Env-Wt 514.02;

☐ Incorporate naturalized and semi-natural design techniques where practicable in accordance with Guidelines for Naturalized River Channel Design and Bank Stabilization" dated February 2007, R. Schiff, J.G. MacBroom, and J. Armstrong Bonin;

☐ For bioengineering projects, be in accordance with NEH 654, "Technical Supplement 141, Streambank Soil Bioengineering", dated August 2007, USDA NRCS; and

☐ For stream restoration projects, be in accordance with NEH 654, "Stream Restoration Design", dated August, 2007, USDA NRCS.

SECTION 4 - CONSTRUCTION REQUIREMENTS FOR ALL BANK/SHORELINE STABILIZATION PROJECTS (Env-Wt 514.05)

In addition to all applicable construction standards specified in Env-Wt 300, the following apply to all bank/ shoreline stabilization projects:

☒ Materials used to emulate a natural channel bottom must:

- Be consistent with materials identified in the reference reach; and
- Not include any angular rip-rap or gravel unless specifically identified on the approved plan;

☒ Bank restoration must be constructed, landscaped, and monitored in a manner that will create a healthy riparian or lacustrine shoreline system;

☒ Bank/shoreline stabilization areas must:

(1) Have at least 75% successful establishment of vegetation after 2 growing seasons; or

(2) Be replanted and re-established until a functional lacustrine, wetland, or riparian system has been reestablished in accordance with the approved plans;

☒ Unless otherwise approved, construction must be performed during low flow or dry conditions;

☐ Where there is documented occurrence of a cold water fishery or protected species or habitat, unless a waiver of this condition is issued in writing by the department in consultation with New Hampshire Fish and Game, work must occur:

- During low-flow or dry conditions during the growing season; and
- Prior to October 1;

☒ Work authorized must be carried out in accordance with Env-Wt 307 such that there are no discharges in or to spawning or nursery areas during spawning seasons;

☒ Work authorized must be carried out in accordance with Env-Wt 307 such that controls are in place to protect water quality and appropriate turbidity controls such that no turbidity escape the immediate dredge area and must remain until suspended particles have settled and water at the work site has returned to normal clarity; and

☒ Within 60 days of completion of construction, the applicant must submit a post-construction report that:

- Has been prepared by a professional engineer, certified wetland scientist, or qualified professional, as applicable, and
- Contains a narrative, exhibits, and photographs, as necessary to report the status of the project area and restored jurisdictional area.

SECTION 5 - ON-GOING REQUIREMENTS FOR ALL BANK/SHORELINE STABILIZATION PROJECTS (Env-Wt 514.06)

The owner must monitor the project and take corrective measures if the area is inadequately stabilized or restored by:

(a) Replacing fallen or displaced materials without a permit, where no machinery in the channel is required;

(b) Identifying corrective actions and follow-up plans in accordance with Env-Wt 307; and

(c) Filing appropriate application and plans where work exceeds (a), above.

SECTION 6 - BANK STABILIZATION CONSTRUCTION PROJECT CLASSIFICATION (Env-Wt 514.07)

(a) The following projects are classified as minimum impact:

(1) Any bank stabilization project of less than 50 linear feet, at low flow, and no in-channel work, if designed by a certified wetland scientist or a professional engineer;

(2) Any soft vegetative bank stabilization, bioengineered bank stabilization, or semi-natural form of less than 200 LF designed by a professional engineer on any size watercourse, when the applicant participates in a pre-design submittal meeting with department wetland bureau staff and the application is submitted through the minimum impact expedited review process; and

(3) Repair of an existing retaining wall that:

a. Is done in the dry;

b. Results in no change in height, length, location, or configuration; and

c. Adds no more than 6 inches of width.

(b) The following projects are classified as a minor impact:

(1) Any project less than 50 linear feet that exceeds the minimum impact criteria;

(2) A bioengineering project that is 200 linear feet or greater when designed by a professional engineer;

(3) Any other bank stabilization project that is 50 linear feet or more to less than 200 linear feet in length; and

(4) Any semi-natural design bank stabilization project of less than 200 linear feet in length, where greater than 75 percent of the project is designed using soft bank stabilization components that includes natural plants, dormant stakes, fiber rolls, and native wood logs.

(c) The following projects are classified as a major project:

(1) A semi-natural design bank stabilization project of 200 linear feet or greater or where greater than 25 percent of the project is using hard scape components; and

(2) Any other project that exceeds the minor bank stabilization criteria.

CONFIDENTIAL – NH Dept. of Environmental Services review

Memo

NH Natural Heritage Bureau
HB Datacheck Results Letter

To: Melilotus Dube, New Hampshire Department of Transportation
7 Hazen Drive
Concord, NH 03301

From: Amy Lamb, NH Natural Heritage Bureau
Date: 7/13/2020 (valid for one year from this date)
Re: Review by NH Natural Heritage Bureau
NHB File ID: NHB20-2016 Town: Bennington Location: South Bennington Road over Russell Brook

Description: NHDOT Bennington 29486. Previous NHB17-2846. The proposed project will replace the existing box culvert carrying South Bennington Road over Russell Brook in the Town of Bennington. The selected alternative involves closing the road during construction to limit impacts to Russell Brook and replacing the existing culvert with a precast 22' box culvert which will be embedded with simulated streambed materials. Previous coordination indicated that records of wood turtles are in the vicinity, however, NHFG concurred that it is not likely that wood turtles would use this crossing. A wildlife shelf concept was thoroughly vetted and determined to be infeasible at the project location.

cc: Kim Tuttle

As requested, I have searched our database for records of rare species and exemplary natural communities, with the following results.

Comments: Please contact Kim Tuttle.

Vertebrate species	State[1]	Federal	Notes
Wood Turtle (*Glyptemys insculpta*)	SC	--	Contact the NH Fish & Game Dept (see below).

[1]Codes: "E" = Endangered, "T" = Threatened, "SC" = Special Concern, "--" = an exemplary natural community, or a rare species tracked by NH Natural Heritage that has not yet been added to the official state list. An asterisk (*) indicates that the most recent report for that occurrence was more than 20 years ago.

Contact for all animal reviews: Kim Tuttle, NH F&G, (603) 271-6544.

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.

Department of Natural and Cultural Resources
Division of Forests and Lands
(603) 271-2214 fax: 271-6488

DNCR/NHB
172 Pembroke Rd.
Concord, NH 03301

2020 NH WILDLIFE HABITAT LAND COVER

- Coastal Island/Rocky coast
- Dune
- Salt marsh
- Peatland
- Marsh and Shrub wetland
- Northern or Temperate Swamp
- Floodplain Forest
- Grassland
- Pine barren
- Cliff or Talus slope
- Rocky ridge
- Alpine
- High-elevation Spruce-fir
- Low-elevation Spruce-fir
- Northern hardwood-conifer
- Appalachian oak-pine
- Hemlock-hardwood-pine
- Open Water
- Sand/Gravel
- Developed Impervious
- Developed or Barren
- Conservation or public land

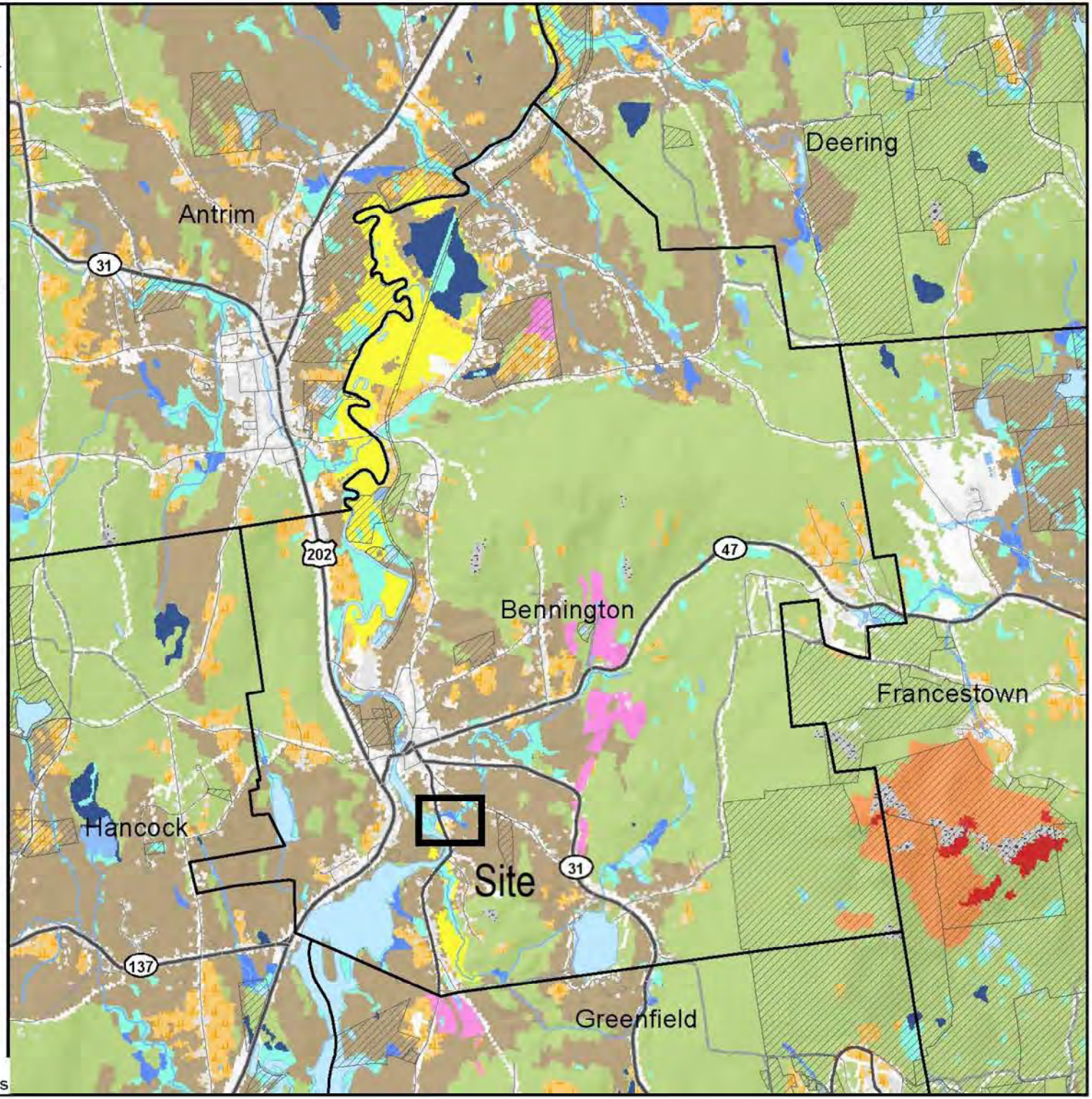
Base map data provided by NH GRANIT at UNH May 2020. Intended for planning use only.

NEW HAMPSHIRE Wildlife Action Plan

Sept. 2015, spatial data Apr. 2020

0 1 2 Kilometers

0 0.8 1.6 Miles



Dube, Melilotus

From: Dube, Melilotus
Sent: Tuesday, July 16, 2019 9:03 AM
To: Sommer, Lori; Lamb, Amy; Henderson, Carol
Cc: Tremblay, Jason
Subject: RE: NHDOT Bennington 29486 Wildlife Shelf Discussion

Good morning all,

I'm hoping to close the loop on this and address some of Carol's comments below. A 4-sided structure was selected as the chosen alternative. Due to the nature of the crossing which is located in an area that serves as backwater for the Contoocook River, the structure is full of water year round so I don't think it would be possible to have just a flattened area for turtle crossing which is why we explored the concrete/constructed shelf option instead. At this time, the Design team intends to move forward with the design without incorporating a wildlife shelf. Thank you all for your help and consideration of this issue, it's definitely a tricky spot!

If any other questions or concerns come up, please let me know!
Meli

From: Sommer, Lori
Sent: Monday, June 24, 2019 10:13 AM
To: Lamb, Amy; Henderson, Carol; Dube, Melilotus
Cc: Tremblay, Jason
Subject: RE: NHDOT Bennington 29486 Wildlife Shelf Discussion

Thanks for keeping me in the loop. What has been decided with the shelf on this one?

Lori

From: Lamb, Amy
Sent: Friday, June 21, 2019 2:40 PM
To: Henderson, Carol ; Dube, Melilotus ; Sommer, Lori
Cc: Tremblay, Jason
Subject: RE: NHDOT Bennington 29486 Wildlife Shelf Discussion

Thanks Meli and Carol. No comments from NHB.

Amy Lamb
Ecological Information Specialist
(603) 271-2834
amy.lamb@dncr.nh.gov

NH Natural Heritage Bureau
DNCR - Forests & Lands
172 Pembroke Rd
Concord, NH 03301

From: Henderson, Carol <Carol.Henderson@wildlife.nh.gov>
Sent: Monday, June 17, 2019 3:16 PM
To: Dube, Melilotus <Melilotus.Dube@dot.nh.gov>; Sommer, Lori <Lori.Sommer@des.nh.gov>; Lamb, Amy <Amy.Lamb@dncr.nh.gov>
Cc: Tremblay, Jason <Jason.Tremblay@dot.nh.gov>
Subject: RE: NHDOT Bennington 29486 Wildlife Shelf Discussion

Hi Mel:

Thank you for the update and photos; however, what was the final proposal after you discussed with the town? 4 sided box or open bottom and is it still proposed as 22 ft. box? A wildlife shelf was suggested as a potential option if the conditions were favorable for its installation. Considering that the shelf would impact additional wetland areas of Russell Brook and impact additional flood storage, as well as, the fact that it's effectiveness would be questionable as an actual shelf, then I think that a concrete shelf at this location is not feasible. It is difficult to tell from the photos or plan detail (can't really see the bank due to snow covered) but if it were possible to just have a flattened area within the box if there is any room before the steep slopes, then that could suffice as an area for turtles and wildlife to walk on. It doesn't have to necessarily be a concrete platform for passage. I do appreciate your attempts at trying to complete a wildlife shelf for this project. I hope this information helps. Thanks, Carol Henderson, NH Fish and Game Dept.

From: Dube, Melilotus
Sent: Monday, June 17, 2019 8:52 AM
To: Sommer, Lori; Henderson, Carol; Lamb, Amy
Cc: Tremblay, Jason
Subject: NHDOT Bennington 29486 Wildlife Shelf Discussion

Good morning Lori, Carol and Amy:

This project was presented at the November 2018 Natural Resource Agency Meeting and proposes the rehabilitation or replacement of the bridge carrying South Bennington Road over Russell Brook in the Town of Bennington. The Department has continued investigating design alternatives, including the possible incorporation of a wildlife shelf to allow for wood turtle passage through the crossing. The Department's Consultant, Stantec Consulting Services, Inc., has created an alternative which includes a 3' wildlife shelf through the crossing but the topography of the area makes it difficult to tie the shelf back in to the bank. Please see the attached plans with some preliminary options sketched in. You'll notice that on the eastern side of the crossing Russell Brook widens and serves as a backwater for the Contoocook River so the banks are actually very steeply sloped and run basically adjacent to the roadway. Creating an appropriate tie-in would require filling in the river along the bank of the inlet side to create what would essentially be a raised continuation of the shelf that would curve and follow the roadway to the north. This would increase our impacts to Russell Brook as well as increase the impacts to properties outside of the existing ROW.

The Consultant provided the following remarks regarding this design alternative:

> "It doesn't look *any* grading can tie back to existing within the existing ROW without going steeper than 1.5:1. Rough grading around the current wingwalls and a U-Back wingwall layout are attached.
>
> On the upstream side, the ROW line is approximately at EL. 665.5, which is very close to the water surface. The existing ground at all four corners of the existing culvert are nearly vertical, and since we're maintaining the existing roadway width and top of slope, a "designed" slope of 1.5:1 will extend outside the ROW and/or into the proposed 22' channel.
>
> On the downstream side, the existing ground is at higher elevations, and the southerly side has similar issues to the upstream end. The northerly side provides the best tie-in back to existing with the ROW.

The shelf will require a separate retaining wall of some kind, or it would be necessary to fill within the proposed channel. We've considered a couple of options for creating this wall. Large stones (with voids filled with small stones and gravel) placed outside the culvert ends could be incorporated into the scour protection. Alternatively, prefabricated concrete modular wall block could be used for this purpose as well. Top course blocks that allow backfill to be placed over the concrete (such as the Redi-Rock typical top row blocks) could be filled with the natural material of the shelf to avoid a concrete shelf surface. Inside the box, a vertical bulkhead attached to the bottom slab (as shown in the attached sketch) would probably be easiest for construction."

I reviewed the notes from the Natural Resource Agency Meeting at which the need for this shelf was discussed (attached). At the time, Lori inquired as to whether the proposed design alternatives had room for a shelf and if one could be considered moving forward. Amy acknowledged that the NHB search did come up with records of wood turtles in the area but inquired if they would use the specific habitat at the crossing (steep banks, constantly backwatered structure, etc) and Carol responded that it is unlikely. At this point, my concern is that while it is possible to install a shelf through the crossing, the terrain in this area does not allow for a tie-in that would make it effective for use by turtles or other wildlife as they would essentially have to enter the shelf far away from the actual crossing and follow the artificially constructed bank along the roadway. Given that this would also increase our impacts to Russell Brook by requiring the construction of a retaining wall or placing fill in the river and therefore potentially impacting the flood storage capacity of this backwatering area, I am concerned with justifying the cost and impact of installing the shelf without a corresponding and obviously effective benefit.

At this time, I am requesting input from DES Wetlands Bureau, NHFG and NHB regarding this shelf in relation to the design complications and cost/benefit concerns raised above. We are open to any suggestions! I have attached a picture looking at the crossing along the area where the river would have to be filled in for quite a distance to the bridge (IMGP4537), as well as one of the existing steep bank at the existing structure (PB010005). These pictures demonstrate why fill and/or a retaining wall would be necessary to create a shelved bank that would have to travel along the roadway and then curve around the new wingwall to connect to the proposed 3' shelf inside the structure.

Thank you!
Meli

Melilotus M. Dube
Environmental Manager
NHDOT Bureau of Environment
7 Hazen Drive
Concord, NH 03301
(603) 271-1612
NEW EMAIL: Melilotus.Dube@dot.nh.gov

Dube, Melilotus

From: Tuttle, Kim
Sent: Thursday, July 16, 2020 1:17 PM
To: Dube, Melilotus
Subject: RE: NHB20-2016 replace the existing box culvert carrying South Bennington Road over Russell Brook, Bennington.

Thank you. Kim

From: Dube, Melilotus <Melilotus.Dube@dot.nh.gov>
Sent: Thursday, July 16, 2020 12:39 PM
To: Tuttle, Kim <Kim.Tuttle@wildlife.nh.gov>
Cc: Doperalski, Melissa <Melissa.Doperalski@wildlife.nh.gov>; Megyesy, Joshua <Joshua.Megyesy@wildlife.nh.gov>; Magee, John <john.magee@wildlife.nh.gov>; Lamb, Amy <Amy.Lamb@dncr.nh.gov>; Henderson, Carol <Carol.Henderson@wildlife.nh.gov>; Sommer, Lori <Lori.Sommer@des.nh.gov>; Tremblay, Jason <Jason.Tremblay@dot.nh.gov>
Subject: RE: NHB20-2016 replace the existing box culvert carrying South Bennington Road over Russell Brook, Bennington.

Kim,
Thank you for the review of the crossing, we will move forward with the NEPA review, permitting and design as proposed without the shelf. We will include requirements to use wildlife friendly erosion control BMPs in the contract proposal package. I am looping Amy, Lori and Carol back in just so that everyone is up to date on the most recent discussion for documentation purposes.
Meli

From: Tuttle, Kim <Kim.Tuttle@wildlife.nh.gov>
Sent: Thursday, July 16, 2020 12:34 PM
To: Dube, Melilotus <Melilotus.Dube@dot.nh.gov>
Cc: Doperalski, Melissa <Melissa.Doperalski@wildlife.nh.gov>; Megyesy, Joshua <Joshua.Megyesy@wildlife.nh.gov>; Magee, John <john.magee@wildlife.nh.gov>
Subject: RE: NHB20-2016 replace the existing box culvert carrying South Bennington Road over Russell Brook, Bennington.

Hi Meli,

Thanks for the additional information. I don't think a wildlife streambank or concrete shelf is critical at the Russell Brook crossing. We do agree that the larger proposed width (22') box with natural streambed simulation will provide additional passage opportunities for wood turtle and other aquatic wildlife. Please avoid the use of welded plastic or 'biodegradable plastic' netting (e.g. polypropylene) or thread in erosion control matting. There are numerous documented cases of snakes and other wildlife being trapped and killed in erosion control matting with synthetic netting and thread. The use of erosion control berm, white Filtrexx Degradable Woven Silt Sock, or several 'wildlife friendly' options such as woven organic material (e.g. coco or jute matting such as North American Green SC150BN or equivalent) are readily available.

Thanks,

Kim Tuttle
Wildlife Biologist

NH Fish and Game
11 Hazen Drive
Concord, NH 03301
603-271-6544

From: Dube, Melilotus <Melilotus.Dube@dot.nh.gov>
Sent: Thursday, July 16, 2020 12:08 PM
To: Magee, John <john.magee@wildlife.nh.gov>; Tuttle, Kim <Kim.Tuttle@wildlife.nh.gov>
Cc: Doperalski, Melissa <Melissa.Doperalski@wildlife.nh.gov>; Megyesy, Joshua <Joshua.Megyesy@wildlife.nh.gov>
Subject: RE: NHB20-2016 replace the existing box culvert carrying South Bennington Road over Russell Brook, Bennington.

John,
Yes, that is correct.
Meli

From: Magee, John <john.magee@wildlife.nh.gov>
Sent: Thursday, July 16, 2020 12:04 PM
To: Dube, Melilotus <Melilotus.Dube@dot.nh.gov>; Tuttle, Kim <Kim.Tuttle@wildlife.nh.gov>
Cc: Doperalski, Melissa <Melissa.Doperalski@wildlife.nh.gov>; Megyesy, Joshua <Joshua.Megyesy@wildlife.nh.gov>
Subject: Re: NHB20-2016 replace the existing box culvert carrying South Bennington Road over Russell Brook, Bennington.

HI Meli. I want to make sure I understand the existing conditions. Is it completely backwatered its entire length, 365 days/year with a water depth of a few feet?

Thanks,

John

John Magee, M.S., Certified Fisheries Professional
Past President, Northeastern Division of the American Fisheries Society
Fisheries Habitat Research and Management Programs Coordinator
New Hampshire Fish and Game Department
11 Hazen Drive
Concord, NH 03301
p 603-271-2744
f 603-271-5829

From: Dube, Melilotus
Sent: Thursday, July 16, 2020 11:36 AM
To: Tuttle, Kim
Cc: Doperalski, Melissa; Megyesy, Joshua; Magee, John
Subject: RE: NHB20-2016 replace the existing box culvert carrying South Bennington Road over Russell Brook, Bennington.

All,

I am attaching location maps and photos of the inlet and outlet of the box culvert (accidently wrote "pipe" in the email below). Image 4537 shows that the overflow of the Contoocook River runs along the length of the roadway for several hundred feet, which is why widening the box or raising the road to accommodate a naturally dry shelf is infeasible as the roadway itself would have to be raised for an impractically long length and would have correspondingly huge impacts to abutting properties and the wetlands.
Meli

From: Dube, Melilotus
Sent: Thursday, July 16, 2020 11:25 AM
To: Tuttle, Kim <Kim.Tuttle@wildlife.nh.gov>
Cc: Doperalski, Melissa <Melissa.Doperalski@wildlife.nh.gov>; Megyesy, Joshua <Joshua.Megyesy@wildlife.nh.gov>; Magee, John <john.magee@wildlife.nh.gov>
Subject: RE: NHB20-2016 replace the existing box culvert carrying South Bennington Road over Russell Brook, Bennington.

Hi Kim,
This pipe serves as an equalizer and is full of several feet of water year round, it would require a significant alteration to the roadway and crossing which would cause substantially increased impacts to the wetlands and private ROW (with historic houses) in the area in order to raise the crossing such that a naturally dry area could be installed. This was investigated first and deemed infeasible and outside the scope of the project which is why a concrete shelf was then explored.
Meli

From: Tuttle, Kim <Kim.Tuttle@wildlife.nh.gov>
Sent: Thursday, July 16, 2020 8:50 AM
To: Dube, Melilotus <Melilotus.Dube@dot.nh.gov>
Cc: Doperalski, Melissa <Melissa.Doperalski@wildlife.nh.gov>; Megyesy, Joshua <Joshua.Megyesy@wildlife.nh.gov>; Magee, John <john.magee@wildlife.nh.gov>
Subject: NHB20-2016 replace the existing box culvert carrying South Bennington Road over Russell Brook, Bennington.

Hi Meli,

I have to disagree with Carol Henderson on this one. I think it likely that wood turtles could be using this tributary stream to the South Branch of the Contoocook River. I do agree that a wildlife shelf, if made of concrete, would not be helpful to provide passage for most wildlife including turtles. A 22 ft. box culvert with a natural stream simulated bottom would be very attractive to wood turtles to use as well as for most other terrestrial wildlife. A better alternative than a concrete shelf in almost all stream crossings would be to construct a shallow bank on one side of the brook that remains 'dry' in most water conditions but again this would not be a deal breaker. John Magee could give you advice on which side makes sense given the stream characteristics if there is room in this crossing to go this way.

Thanks,

Kim Tuttle
Wildlife Biologist
NH Fish and Game
11 Hazen Drive
Concord, NH 03301
603-271-6544

From: Dube, Melilotus <Melilotus.Dube@dot.nh.gov>
Sent: Thursday, July 16, 2020 8:36 AM
To: Tuttle, Kim <Kim.Tuttle@wildlife.nh.gov>
Subject: RE: NHB review: NHB20-2016

Kim,
I am attaching the Natural Resource Agency Minutes from November 2018 during which the wood turtle records were discussed and Carol Henderson indicated that it did not seem likely that they would use the habitat present at this site. At that time, it was also requested that the Department investigate the potential to install a wildlife shelf for critter crossing. This was thoroughly vetted through design and determined to be infeasible, see the attached PDF of an email chain with Lori Sommer, Amy Lamb and Carol Henderson which discusses the various options and challenges for the shelf. I am hoping to finalize the environmental review for this project and am requesting confirmation from you that no additional coordination regarding the wood turtle records noted in the attached NHB memo is necessary.

Thank you,
Meli

Melilotus M. Dube
Environmental Manager
NHDOT Bureau of Environment
7 Hazen Drive
Concord, NH 03301
(603) 271-1612
NEW EMAIL: Melilotus.Dube@dot.nh.gov

From: Lamb, Amy <Amy.Lamb@dncr.nh.gov>
Sent: Wednesday, July 15, 2020 1:38 PM
To: Dube, Melilotus <Melilotus.Dube@dot.nh.gov>
Cc: Tuttle, Kim <Kim.Tuttle@wildlife.nh.gov>
Subject: NHB review: NHB20-2016

Attached, please find the review we have completed. If your review memo includes potential impacts to plants or natural communities please contact me for further information. If your project had potential impacts to wildlife, please contact NH Fish and Game at the phone number listed on the review.
Best,
Amy
Amy Lamb
Ecological Information Specialist
NH Natural Heritage Bureau
DNCR - Forests & Lands
172 Pembroke Rd
Concord, NH 03301
603-271-2834

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
http://www.fws.gov/newengland

In Reply Refer To: July 07, 2020
Consultation Code: 05E1NE00-2017-SLI-2668
Event Code: 05E1NE00-2020-E-09698
Project Name: Bennington 29486

Subject: Updated list of threatened and endangered species that may occur in your proposed project location, and/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 ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system 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:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

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 Tracking Number 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

Consultation Code: 05E1NE00-2017-SLI-2668

Event Code: 05E1NE00-2020-E-09698

Project Name: Bennington 29486

Project Type: TRANSPORTATION

Project Description: Proposed replacement of existing box culvert carrying South Bennington Road over Russell Brook, including guardrail and approach work.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/42.99678493997392N71.92120856578826W

Counties: Hillsborough, NH

Endangered Species Act Species

There is a total of 1 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	Threatened

Critical habitats

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

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Ecological Services Field Office
70 Commercial Street, Suite 300
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Phone: (603) 223-2541 Fax: (603) 223-0104
http://www.fws.gov/newengland

IPaC Record Locator: 806-22450691 July 07, 2020

Subject: Consistency letter for the 'Bennington 29486' project (TAILS 05E1NE00-2017-R-2668) under the revised February 5, 2018, FHWA, FRA, FTA Programmatic Biological Opinion for Transportation Projects within the Range of the Indiana Bat and Northern Long-eared Bat.

To whom it may concern:

The U.S. Fish and Wildlife Service (Service) has received your request to verify that the **Bennington 29486** (Proposed Action) may rely on the revised February 5, 2018, FHWA, FRA, FTA Programmatic Biological Opinion for Transportation Projects within the Range of the Indiana Bat and Northern Long-eared Bat (PBO) to satisfy requirements under Section 7(a)(2) of the Endangered Species Act of 1973 (ESA) (87 Stat.884, as amended; 16 U.S.C. 1531 *et seq.*).

Based on the information you provided (Project Description shown below), you have determined that the Proposed Action is within the scope and adheres to the criteria of the PBO, including the adoption of applicable avoidance and minimization measures, and may affect, and is likely to adversely affect the endangered Indiana bat (*Myotis sodalis*) and/or the threatened Northern long-eared bat (*Myotis septentrionalis*). Consultation with the Service pursuant to Section 7(a)(2) of the Endangered Species Act of 1973 (ESA) (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) is required.

This "may affect - likely to adversely affect" determination becomes effective when the lead Federal action agency or designated non-federal representative requests the Service rely on the PBO to satisfy the agency's consultation requirements for this project. Please provide this consistency letter to the lead Federal action agency or its designated non-federal representative for review, and as the agency deems appropriate, transmit to this Service Office for verification that the project is consistent with the PBO.

This Service Office will respond by letter to the requesting Federal action agency or designated non-federal representative within 30 calendar days to:

- verify that the Proposed Action is consistent with the scope of actions covered under the PBO;

- verify that all applicable avoidance, minimization, and compensation measures are included in the action proposal;
- identify any action-specific monitoring and reporting requirements, consistent with the monitoring and reporting requirements of the PBO, and
- identify anticipated incidental take.

ESA Section 7 compliance for this Proposed Action is not complete until the Federal action agency or its designated non-federal representative receives a verification letter from the Service.

For Proposed Actions that include bridge/structure removal, replacement, and/or maintenance activities: If your initial bridge/structure assessments failed to detect Indiana bats, but you later detect bats during construction, please submit the Post Assessment Discovery of Bats at Bridge/Structure Form (User Guide Appendix E) to this Service Office. In these instances, potential incidental take of Indiana bats may be exempted provided that the take is reported to the Service.

If the Proposed Action may affect any other federally-listed or proposed species and/or designated critical habitat, additional consultation between the lead Federal action agency and this Service Office is required. If the proposed action has the potential to take bald or golden eagles, additional coordination with the Service under the Bald and Golden Eagle Protection Act may also be required. In either of these circumstances, please advise the lead Federal action agency accordingly.

Project Description

The following project name and description was collected in IPaC as part of the endangered species review process.

Name

Bennington 29486

Description

Proposed replacement of existing box culvert carrying South Bennington Road over Russell Brook, including guardrail and approach work.

Determination Key Result

Based on your answers provided, this project is likely to adversely affect the endangered Indiana bat and/or the threatened Northern long-eared bat. Therefore, consultation with the U.S. Fish and Wildlife Service pursuant to Section 7(a)(2) of the Endangered Species Act of 1973 (ESA) (87 Stat. 884, as amended 16 U.S.C. 1531 *et seq.*) is required. However, also based on your answers provided, this project may rely on the conclusion and Incidental Take Statement provided in the revised February 5, 2018, FHWA, FRA, FTA Programmatic Biological Opinion for Transportation Projects within the Range of the Indiana Bat and Northern Long-eared Bat.

Qualification Interview

1. Is the project within the range of the Indiana bat[1]?

   [1] See Indiana bat species profile

   Automatically answered
   No

2. Is the project within the range of the Northern long-eared bat[1]?

   [1] See Northern long-eared bat species profile

   Automatically answered
   Yes

3. Which Federal Agency is the lead for the action?

   A) Federal Highway Administration (FHWA)

4. Are *all* project activities limited to non-construction[1] activities only? (examples of non-construction activities include: bridge/abandoned structure assessments, surveys, planning and technical studies, property inspections, and property sales)

   [1] Construction refers to activities involving ground disturbance, percussive noise, and/or lighting.

   No

5. Does the project include *any* activities that are **greater than** 300 feet from existing road/rail surfaces[1]?

   [1] Road surface is defined as the actively used [e.g. motorized vehicles] driving surface and shoulders [may be pavement, gravel, etc.] and rail surface is defined as the edge of the actively used rail ballast.

   No

6. Does the project include *any* activities **within** 0.5 miles of a known Indiana bat and/or NLEB hibernaculum[1]?

   [1] For the purpose of this consultation, a hibernaculum is a site, most often a cave or mine, where bats hibernate during the winter (see suitable habitat), but could also include bridges and structures if bats are found to be hibernating there during the winter.

   No

7. Is the project located **within** a karst area?

   No

8. Is there *any* suitable[1] summer habitat for Indiana Bat or NLEB **within** the project action area[2]? (includes any trees suitable for maternity, roosting, foraging, or travelling habitat)

   [1] See the Service's summer survey guidance for our current definitions of suitable habitat.

   [2] The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR Section 402.02). Further clarification is provided by the national consultation FAQs.

   Yes

9. Will the project remove *any* suitable summer habitat[1] and/or remove/trim any existing trees **within** suitable summer habitat?

   [1] See the Service's summer survey guidance for our current definitions of suitable habitat.

   Yes

10. Will the project clear more than 20 acres of suitable habitat per 5-mile section of road/rail?

    No

11. Have presence/probable absence (P/A) summer surveys[1][2] been conducted[3][4] **within** the suitable habitat located within your project action area?

    [1] See the Service's summer survey guidance for our current definitions of suitable habitat.

    [2] Presence/probable absence summer surveys conducted within the fall swarming/spring emergence home range of a documented Indiana bat hibernaculum (contact local Service Field Office for appropriate distance from hibernacula) that result in a negative finding requires additional consultation with the local Service Field Office to determine if clearing of forested habitat is appropriate and/or if seasonal clearing restrictions are needed to avoid and minimize potential adverse effects on fall swarming and spring emerging Indiana bats.

    [3] For projects within the range of either the Indiana bat or NLEB in which suitable habitat is present, and no bat surveys have been conducted, the transportation agency will assume presence of the appropriate species. This assumption of presence should be based upon the presence of suitable habitat and the capability of bats to occupy it because of their mobility.

    [4] Negative presence/probable absence survey results obtained using the summer survey guidance are valid for a minimum of two years from the completion of the survey unless new information (e.g., other nearby surveys) suggest otherwise.

    No

12. Does the project include activities **within documented NLEB habitat**[1][2]?

    [1] Documented roosting or foraging habitat – for the purposes of this consultation, we are considering documented habitat as that where Indiana bats and/or NLEB have actually been captured and tracked using (1) radio telemetry to roosts; (2) radio telemetry biangulation/triangulation to estimate foraging areas; or (3) foraging areas with repeated use documented using acoustics. Documented roosting habitat is also considered as suitable summer habitat within 0.25 miles of documented roosts.)

    [2] For the purposes of this key, we are considering documented corridors as that where Indiana bats and/or NLEB have actually been captured and tracked to using (1) radio telemetry; or (2) treed corridors located directly between documented roosting and foraging habitat.

    No

13. Will the removal or trimming of habitat or trees occur **within** suitable but **undocumented NLEB** roosting/foraging habitat or travel corridors?

    Yes

14. What time of year will the removal or trimming of habitat or trees **within** suitable but **undocumented NLEB** roosting/foraging habitat or travel corridors occur?

    A) During the active season

15. Will *any* tree trimming or removal occur **within** 100 feet of existing road/rail surfaces?

    Yes

16. Will **more than** 10 trees be removed **between** 0-100 feet of the road/rail surface *during* the active season[1]?

    [1] Areas containing more than 10 trees will be assessed by the local Service Field Office on a case-by-case basis with the project proponent.

    Yes

17. Will *any* tree trimming or removal occur **between** 100-300 feet of existing road/rail surfaces?

    No

18. Are *all* trees that are being removed clearly demarcated?

    Yes

19. Will the removal of habitat or the removal/trimming of trees involve the use of **temporary** lighting?

    No

20. Will the removal of habitat or the removal/trimming of trees include installing new or replacing existing **permanent** lighting?

    No

21. Does the project include wetland or stream protection activities associated with compensatory wetland mitigation?

    No

22. Does the project include slash pile burning?

    No

23. Does the project include *any* bridge removal, replacement, and/or maintenance activities (e.g., any bridge repair, retrofit, maintenance, and/or rehabilitation work)?

    No

24. Does the project include the removal, replacement, and/or maintenance of *any* structure other than a bridge? (e.g., rest areas, offices, sheds, outbuildings, barns, parking garages, etc.)

    No

25. Will the project involve the use of **temporary** lighting *during* the active season?

    Yes

26. Is there *any* suitable habitat **within** 1,000 feet of the location(s) where **temporary** lighting will be used?

    Yes

27. Will the project install new or replace existing **permanent** lighting?

    No

28. Does the project include percussives or other activities (**not including tree removal/ trimming or bridge/structure work**) that will increase noise levels above existing traffic/ background levels?

    Yes

29. Will the activities that use percussives (**not including tree removal/trimming or bridge/ structure work**) and/or increase noise levels above existing traffic/background levels be conducted *during* the active season[1]?

    [1] Coordinate with the local Service Field Office for appropriate dates.

    Yes

30. Will *any* activities that use percussives (**not including tree removal/trimming or bridge/ structure work**) and/or increase noise levels above existing traffic/background levels be conducted *during* the inactive season[1]?

    [1] Coordinate with the local Service Field Office for appropriate dates.

    No

31. Are *all* project activities that are **not associated with** habitat removal, tree removal/ trimming, bridge and/or structure activities, temporary or permanent lighting, or use of percussives, limited to actions that DO NOT cause any additional stressors to the bat species?

    Examples: lining roadways, unlighted signage , rail road crossing signals, signal lighting, and minor road repair such as asphalt fill of potholes, etc.

    Yes

32. Will the project raise the road profile **above the tree canopy**?

    No

33. Are the project activities that use percussives (not including tree removal/trimming or bridge/structure work) consistent with a Not Likely to Adversely Affect determination in this key?

    Automatically answered
    Yes, because the activities are within 300 feet of the existing road/rail surface, greater than 0.5 miles from a hibernacula, and conducted during the active season within undocumented habitat.

34. Are the project activities that are not associated with habitat removal, tree removal/ trimming, bridge and/or structure activities, temporary or permanent lighting, or use of percussives consistent with a No Effect determination in this key?

    Automatically answered
    Yes, other project activities are limited to actions that DO NOT cause any additional stressors to the bat species as described in the BA/BO

35. Is the habitat removal portion of this project consistent with a Likely to Adversely Affect determination in this key?

    Automatically answered
    Yes, because tree removal that occurs within the NLEB's active season occurs greater than 0.5 miles from the nearest hibernaculum, is less than 100 feet from the existing road/rail surface, and is not in documented NLEB roosting/foraging habitat or travel corridors, and a visual emergence survey has not been conducted

36. **General AMM 1**
    Will the project ensure *all* operators, employees, and contractors working in areas of known or presumed bat habitat are aware of *all* FHWA/FRA/FTA (Transportation Agencies) environmental commitments, including all applicable Avoidance and Minimization Measures?

    Yes

37. **Tree Removal AMM 1**
    Can *all* phases/aspects of the project (e.g., temporary work areas, alignments) be modified, to the extent practicable, to avoid tree removal[1] in excess of what is required to implement the project safely?

    Note: Tree Removal AMM 1 is a minimization measure, the full implementation of which may not always be practicable. Projects may still be NLAA as long as Tree Removal AMMs 2, 3, and 4 are implemented and LAA as long as Tree Removal AMMs 3, 5, 6, and 7 are implemented.

    [1] The word “trees” as used in the AMMs refers to trees that are suitable habitat for each species within their range. See the USFWS’ current summer survey guidance for our latest definitions of suitable habitat.

    Yes

38. **Tree Removal AMM 3**
    Can tree removal be limited to that specified in project plans and ensure that contractors understand clearing limits and how they are marked in the field (e.g., install bright colored flagging/fencing prior to any tree clearing to ensure contractors stay within clearing limits)?

    Yes

39. **Lighting AMM 1**
    Will *all* **temporary** lighting be directed away from suitable habitat during the active season?

    Yes

40. For Indiana bat, if applicable, compensatory mitigation measures are required to offset adverse effects on the species (see Section 2.10 of the BA). Please select the mechanism in which compensatory mitigation will be implemented:

    6. Not Applicable

Project Questionnaire

1. Have you made a No Effect determination for *all* other species indicated on the FWS IPaC generated species list?

   N/A

2. Have you made a May Affect determination for *any* other species on the FWS IPaC generated species list?

   N/A

3. How many acres[1] of trees are proposed for removal between 0-100 feet of the existing road/rail surface?

   [1] If described as number of trees, multiply by 0.09 to convert to acreage and enter that number.

   .25

4. **Please verify:**
   All tree removal will occur greater than 0.5 mile from any hibernaculum.

   No, this is not the case.

5. Is the project location 0-100 feet from the edge of existing road/rail surface?

   Yes

6. Is the project location 100-300 feet from the edge of existing road/rail surface?
   No

7. **Please verify:**
   No documented NLEB roosts or surrounding summer habitat within 150 feet of documented roosts will be impacted between June 1 and July 31.

   Yes, I verify that no documented NLEB roosts or surrounding summer habitat within 150 feet of documented roosts will be impacted during this period.

8. You have indicated that the following Avoidance and Minimization Measures (AMMs) will be implemented as part of the proposed project:
   - *General AMM 1*
   - *Lighting AMM 1*
   - *Tree Removal AMM 1*
   - *Tree Removal AMM 3*

Avoidance And Minimization Measures (AMMs)

This determination key result includes the committment to implement the following Avoidance and Minimization Measures (AMMs):

GENERAL AMM 1

Ensure all operators, employees, and contractors working in areas of known or presumed bat habitat are aware of all FHWA/FRA/FTA (Transportation Agencies) environmental commitments, including all applicable AMMs.

LIGHTING AMM 1

Direct temporary lighting away from suitable habitat during the active season.

TREE REMOVAL AMM 1

Modify all phases/aspects of the project (e.g., temporary work areas, alignments) to avoid tree removal.

TREE REMOVAL AMM 3

Ensure tree removal is limited to that specified in project plans and ensure that contractors understand clearing limits and how they are marked in the field (e.g., install bright colored flagging/fencing prior to any tree clearing to ensure contractors stay within clearing limits).

Determination Key Description: FHWA, FRA, FTA Programmatic Consultation For Transportation Projects Affecting NLEB Or Indiana Bat

This key was last updated in IPaC on December 02, 2019. Keys are subject to periodic revision.

This decision key is intended for projects/activities funded or authorized by the Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), and/or Federal Transit Administration (FTA), which may require consultation with the U.S. Fish and Wildlife Service (Service) under Section 7 of the Endangered Species Act (ESA) for the endangered **Indiana bat** (*Myotis sodalis*) and the threatened **Northern long-eared bat** (NLEB) (*Myotis septentrionalis*).

This decision key should only be used to verify project applicability with the Service's February 5, 2018, FHWA, FRA, FTA Programmatic Biological Opinion for Transportation Projects. The programmatic biological opinion covers limited transportation activities that may affect either bat species, and addresses situations that are both likely and not likely to adversely affect either bat species. This decision key will assist in identifying the effect of a specific project/activity and applicability of the programmatic consultation. The programmatic biological opinion is not intended to cover all types of transportation actions. Activities outside the scope of the programmatic biological opinion, or that may affect ESA-listed species other than the Indiana bat or NLEB, or any designated critical habitat, may require additional ESA Section 7 consultation.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5087
http://www.fws.gov/newengland

July 16, 2020

Melilotus M. Dube
Bureau of Environment
NH Department of Transportation
7 Hazen Drive, P.O. Box 483
Concord, New Hampshire 03302-0483

Re: NH DOT Project 29486, Box Culvert Replacement, Bennington, NH
TAILS: 05E1NE00-2017-F-2668

Dear Ms. Dube:

The U.S. Fish and Wildlife Service (Service) is responding to your request, dated July 9, 2020, and received the same day via electronic mail, to verify that the New Hampshire Department of Transportation (NHDOT) Project 29486 (Project), the proposed replacement of a box culvert in Bennington, New Hampshire, may rely on the December 15, 2016, Programmatic Biological Opinion (BO) for federally funded or approved transportation projects that may affect the northern long-eared bat (*Myotis septentrionalis*) (NLEB). This letter provides the Service's response as to whether the Federal Highway Administration may rely on the BO to comply with section 7(a)(2) of the Endangered Species Act of 1973 (ESA) (87 Stat. 884, as amended; U.S.C. 1531 *et seq.*) for the Project's effects to the NLEB.

The NHDOT, as the non-Federal agency representative for the Federal Transportation Agency, has determined that the Project may affect, and is likely to adversely affect the NLEB. The Project consists of the replacement of the existing culvert carrying South Bennington Road over Russell Brook. Approximately one-quarter acre of tree clearing will occur, which may be implemented during the bat active season.

NHDOT also determined the Project may rely on the programmatic BO to comply with section 7(a)(2) of the ESA, because the Project meets the conditions outlined in the BO and all tree clearing related to the proposed work will occur farther than 0.25 mile from documented roosts and farther than 0.5 mile from any known hibernacula. The Service reviewed the LAA Consistency Letter and concurs with NHDOT's determination. This concurrence concludes your ESA section 7 responsibilities relative to this species for this Project, subject to the Reinitiation Notice below.

Conclusion

The Service has reviewed the effects of the proposed Project, which include the NHDOT's commitment to implement the impact avoidance, minimization, and compensation measures as indicated on the LAA Consistency Letter. We confirm that the proposed Project's effects are consistent with those analyzed in the BO. The Service has determined that the Project is consistent with the BO's conservation measures, and the scope of the program analyzed in the BO is not likely to jeopardize the continued existence of the NLEB. In coordination with your agency, the Federal Highway Administration, and the other sponsoring Federal Transportation Agencies, the Service will reevaluate this conclusion annually in light of any new pertinent information under the adaptive management provisions of the BO.

Incidental Take of the Northern Long-eared Bat

The Service anticipates that tree removal associated with the proposed Project will cause incidental take of the NLEB. However, the Project is consistent with the BO, and such projects will not cause take of NLEBs that is prohibited under the final 4(d) rule for this species (50 CFR §17.40(o)). Therefore, this taking does not require exemption from the Service.

Reporting Dead or Injured Bats

The NHDOT, the Federal Highway Administration, its State/local cooperators, and any contractors must take care when handling dead or injured NLEBs that are found at the project site, in order to preserve biological material in the best possible condition and to protect the handler from exposure to diseases, such as rabies. Project personnel are responsible for ensuring that any evidence about determining the cause of death or injury is not unnecessarily disturbed. Reporting the discovery of dead or injured listed species is required in all cases to enable the Service to determine whether the level of incidental take exempted by this BO is exceeded, and to ensure that the terms and conditions are appropriate and effective. Parties finding a dead, injured, or sick specimen of any endangered or threatened species must promptly notify the Service's New England Field Office.

Reinitiation Notice

This letter concludes consultation for the proposed Project, which qualifies for inclusion in the BO issued to the Federal Transportation Agencies. To maintain this inclusion, a reinitiation of this project-level consultation is required where the Federal Highway Administration's discretionary involvement or control over the Project has been retained (or is authorized by law) and if:

1. new information reveals that the Project may affect listed species or critical habitat in a manner or to an extent not considered in the BO;
2. the Project is subsequently modified in a manner that causes an effect to listed species or designated critical habitat not considered in the BO; or
3. a new species is listed or critical habitat designated that the Project may affect.

In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease, pending reinitiation.

We appreciate your continued efforts to ensure that this Project is fully consistent with all applicable provisions of the BO. If you have any questions regarding our response, or if you need additional information, please contact Susi von Oettingen of this office at 603-227-6418.

Sincerely yours,

Thomas R. Chapman
Supervisor
New England Field Office

cc: Reading file
Melilotus Dube/NHDOT, via email
ES: SvonOettingen:jd:7-16-20:603-227-6418

10406

New Hampshire DOT
Department of Transportation

Victoria F. Sheehan
Commissioner

THE STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

RECEIVED
BUREAU OF ENVIRONMENT
JUL 10 2020
NH DEPARTMENT
OF TRANSPORTATION

William Cass, P.E.
Assistant Commissioner

BENNINGTON
X-A004(156)
29486

No Historic Properties Affected Memo

Pursuant to discussions and the responses to the Request for Project Reviews signed on1/25/2019 and 5/18/2020, and for the purpose of compliance with regulations of the National Historic Preservation Act and the Advisory Council on Historic Preservation's *Procedures for the Protection of Historic Properties* (36 CFR 800), the NH Division of Historical Resources (NHDHR) and the NH Division of the Federal Highway Administration (FHWA) have coordinated the identification and evaluation of historical and archaeological resources with plans to correct structural deficiencies of the buried concrete box bridge carrying South Bennington Road over Russell Brook in the Town of Bennington and address safety concerns associated with the bridge approach rail and end units.

Project Description
The proposed project includes replacing the existing concrete box culvert with a pre-cast 22' span three-sided concrete box culvert with simulated stream bed interior. The Town is in agreement with the replacement and agreed to road closure, which eliminates the need for a temporary widening. The APE includes all properties immediately adjacent to the roadway for the length of the project area (approx. 250' north and south of the crossing, 500' total).

Identification - Above-Ground
The existing buried concrete box bridge (099/080) was constructed in 1925, and widened in 1975. BNN0339 was determined not eligible for listing on the National Register.

The APE also includes two parcels with structures over 50 years old, neither structures will be impacted by the project. The two parcels include:

- 1790 Colonial, at 43 South Bennington Road (Map 7, Lot 51, Byam parcel) – proposed impacts are limited to the SE corner of parcel to clear trees and place fill in order to help stabilize the bank of Russel Brook (NW bridge quadrant) and tie into the slope.
- 1939 Ranch, at 68 South Bennington Road (Map 7, Lot 47, Martel parcel) – proposed impacts are limited to the area of the SE bridge quadrant.

Impacts will be limited to landscape elements along the road and to the parcel corners, which are some distance removed from the structures on the parcels. There will also be permanent channel (stone placement) easements and permanent slope easements. The DOT and NHDHR reviewed the project activities in detail and determined survey was not warranted. Based on a review pursuant to 36 CFR 800.4 of the architectural significance of resources in the APE, we agree that there are no significant impacts to above ground resources within the APE.

Identification -Archaeology
Based on a review pursuant to 36 CFR 800.4 of the archaeological potential in the APE, it was determined that there are no known archaeological sites within the corridor alignment and no historic structures are depicted in the vicinity on historic maps. There are no archaeological concerns as temporary widening to accommodate traffic will not be necessary and the project will remain within the disturbed footprint associated with the road and bridge crossing.

Public Consultation
Initial Contact Letters were sent to Town Officials on September 13, 2017, however, no response was received at that time. A joint Public Officials and Public Informational Meeting was held on January 30, 2019. Residents and Town

Officials were invited post card, DOT notices and certified letter, if appropriate. There were eleven attendees including members of the Bennington Board of Selectmen, NH House, Contoocook River North Branch Local Advisory Committee, Bennington Water and Sewer Commission, Monadnock Paper Mills and residents in the area. There are no consulting parties.

The Byams were invited via post card and certified letter to the Public Information meeting of January 2019, however, they did not attend.

Determination of Effect

Based on a review pursuant to 36 CFR 800.4, we agree that no historic or archaeological resources are affected in the project area and that no further survey work is needed. Should project plans change, NHDOT will notify FHWA and NHDHR to resume further coordination.

Section 4(f) *(to be completed by FHWA)*	*There Will Be:*	☒ **No 4(f);**	☐ **Programmatic 4(f);**	☐ **Full 4 (f);** or
	☐ **A finding of *de minimis* 4(f) impact as stated:** In addition, with NHDHR concurrence of no historic properties affected or no adverse effect for the above undertaking, and in accordance with 23 CFR 774.3, FHWA intends to, and by signature below, does make a finding of *de minimis* impact. NHDHR's signature represents concurrence with either the no historic properties affected or no adverse effect determination, as well as the *de minimis* findings. Parties to the Section 106 process have been consulted and their concerns have been taken into account. Therefore, the requirements of Section 4(f) have been satisfied.			

In accordance with the Advisory Council's regulations, we will continue to consult, as appropriate, as this project proceeds.

no signature req'd

Sheila Charles 6/25/2020

Patrick Bauer, Administrator — Date
Federal Highway Administration

Jill Edelmann — Date
Cultural Resources Manager

Concurred with by the NH State Historic Preservation Officer:

Nadine Miller, DSHPO 6/29/2020

Nadine Miller — Date
Deputy State Historic Preservation Officer
NH Division of Historical Resources

c.c. Marika Labash, NHDHR
Laura Black, NHDHR
David Trubey, NHDHR
Jamie Sikora, FHWA
Meli Dube, DOT
David Scott, DOT

S:\Environment\PROJECTS\BENNINGTON\29486\Cultural\No Historic Properties Affected Memo\Bennington 29486 No Historic or Archaeological Properties Affected needs SHPO signature .docx

US Army Corps of Engineers®
New England District

New Hampshire General Permits (GPs)
Appendix B - Corps Secondary Impacts Checklist
(for inland wetland/waterway fill projects in New Hampshire)

1. Attach any explanations to this checklist. Lack of information could delay a Corps 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 5, regarding single and complete projects.
4. Contact the Corps at (978) 318-8832 with any questions.

1. Impaired Waters	Yes	No
1.1 Will any work occur within 1 mile upstream in the watershed of an impaired water? See http://des.nh.gov/organization/divisions/water/wmb/section401/impaired_waters.htm to determine if there is an impaired water in the vicinity of your work area.*	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 SAS, special wetlands. 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://www2.des.state.nh.us/nhb_datacheck/. The book Natural Community Systems of New Hampshire also contains specific information about the natural communities found in NH.	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?	UNKNOWN	
2.7 What is the area of the proposed fill in wetlands?	2,099 SF Perm	
2.8 What is the % of previously and proposed fill in wetlands to the overall project site?	UNKNOWN	
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://www2.des.state.nh.us/nhb_datacheck/ USFWS IPAC website: https://ecos.fws.gov/ipac/location/index	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: www.wildlife.state.nh.us/Wildlife/Wildlife_Plan/highest_ranking_habitat.htm. • 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 21?	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?	YES	
5. Historic/Archaeological Resources		
For a minimum, minor or major impact project - a copy of the Request for Project Review (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 11 GC 8(d) of the GP document**	X	

*Although this checklist utilizes state information, its submittal to the Corps is a Federal requirement.
** If your project is not within Federal jurisdiction, coordination with NH DHR is not required under Federal law.
`

Stantec

Wetland and Watercourse Delineation Report: South Bennington Road Bridge Replacement Project

Bennington, New Hampshire

June 8, 2018

Prepared for:

New Hampshire Department of Transportation
7 Hazen Drive
Concord, NH 03302

Prepared by:

Stantec Consulting Services Inc
5 Dartmouth Drive Suite 101
Auburn, NH 03032

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WETLAND AND WATERCOURSE DELINEATION REPORT: SOUTH BENNINGTON ROAD BRIDGE REPLACEMENT PROJECT, BENNINGTON, NEW HAMPSHIRE

June 8, 2018

1.0 INTRODUCTION

The New Hampshire Department of Transportation proposes to replace the existing bridge on South Bennington Road over Russell Brook in Bennington, New Hampshire (hereafter, project). Stantec Consulting Services Inc. (Stantec) conducted wetland and watercourse delineations in May 2018 to facilitate project design and permitting efforts. This report summarizes the results of the wetland and watercourse delineation.

2.0 PROJECT SITE DESCRIPTION

The project site is located in a rural landscape along South Bennington Road. Residential homes and undeveloped woodlands are present in the vicinity of the bridge location. The undeveloped uplands consist of early successional woodlands dominated by eastern white pine (*Pinus strobus*) and black cherry (*Prunus serotina*) trees and an understory dominated by invasive shrub species such as glossy buckthorn (*Frangula alnus*) and winged euonymus (*Euonymus alatus*). Soil mapping data available from the Natural Resources Conservation Service (NRCS) identifies the predominant soils within the project site as Monadnock fine sandy loam, Rumney fine sandy loam, and Colton loamy sand.

Russell Brook flows westerly through the project site and converges with the Contoocook River approximately 500 feet to the west. Russel Brook is bordered by emergent and scrub-shrub wetlands within its floodplain.

The approximate survey area extended approximately 350 feet north and south of the existing bridge over Russell Brook on South Bennington Road and approximately 50 feet perpendicular from the edge of the pavement. The survey area was extended to approximately 100 feet upstream and downstream (perpendicular to edge of pavement) along Russell Brook and its active floodplain.

3.0 METHODOLOGY

3.1 WETLAND AND WATERCOURSE DELINEATIONS

Wetland and watercourse delineations were completed on May 4, 2018 by Matt Arsenault of Stantec, a New Hampshire Certified Wetland Scientist (#278). Wetland boundaries under federal and state jurisdiction were determined using the technical criteria described in the U.S. Army Corps of Engineers (Corps) *Wetlands Delineation Manual*[1] and the *Regional Supplement to the Corps of Engineers Wetland*

[1] Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS.

Delineation Manual: Northcentral and Northeast Regional Supplement (Version 2.0)[2]. Wetland boundaries were demarcated with pink "WETLAND DELINEATION" flagging labeled with a unique sequential alpha-numeric code and located using Trimble® Global Positioning System (GPS) receiver. Data were collected on dominant vegetation, evidence of wetland hydrology, and hydric soil criteria. Corps Wetland Determination Forms were completed during the delineation. Representative photographs were taken as appropriate.

Concurrent with the wetland delineation, streams and other potential Waters of the United States were demarcated with blue alpha-numeric labeled flagging and located with the GPS receiver. These resources were identified using the regulatory criteria established by the New Hampshire Department of Environmental Services (NHDES) and the Corps. Data were recorded on apparent flow regime, substrate, bankfull widths, ordinary high-water mark widths, water depths, and presence of aquatic organisms and vegetation. Representative photographs were taken as appropriate.

3.2 INVASIVE SPECIES

Invasive species were noted at the time of the delineation and populations were located through a combination of GPS survey and field sketches on aerial imagery. Target invasive species included those identified in Appendix K of the Corps *New England District Compensatory Mitigation Guidance* (September 7, 2016) and the N*ew Hampshire Department of Agriculture's Prohibited Invasive Plant Species List* (January 31, 2017).

4.0 RESULTS

4.1 WETLAND AND WATERCOURSE DELINEATION

4.1.1 Wetlands

Five wetlands were delineated along Russell Brook and are summarized in Table 1 and illustrated on Figure 1. Representative photographs are included in Appendix A. Completed Corps Wetland Determination Data Forms are included in Appendix B. None of the wetlands are designated Prime Wetlands by NHDES or the Town of Bennington.

[2] U.S. Army Corps of Engineers. 2012. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0)*, ed. J. S. Wakeley, R. W. Lichvar, and C. V. Noble. ERDC/EL TR-12-1. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Table 1. Summary of Delineated Wetlands

Wetland Identifier	Wetland Classification[1]	Dominant Vegetation	Hydric Soil Criteria	Evidence of Hydrology	Additional Comments
W-1	PEM	Shrubs: glossy buckthorn Herbs: bluejoint (*Calamagrostis canadensis*), uptight sedge (*Carex stricta*), broad-leaf meadowsweet (*Spiraea latifolia*)	Depleted Matrix	Water marks, saturation, high water table	In floodplain of Russell Brook
W-2	PEM	Herbs: bluejoint, uptight sedge	Histosol	Water marks, saturation, surface water	Includes narrow stream flowing southerly into floodplain wetland along Russell Brook.
W-3	PEM	Herbs: bluejoint, uptight sedge	Histosol	Water marks, saturation, surface water	In floodplain of Russell Brook
W-4	PSS	Trees: red maple (*Acer rubrum*) Shrubs: glossy buckthorn, silky dogwood (*Cornus amomum*) Herbs: bluejoint	Depleted Below Dark Surface	Water marks, drift deposits	In floodplain of Russell Brook
W-5	PSS/PEM	Shrubs: speckled alder (*Alnus incana*), glossy buckthorn, red maple Herbs: bluejoint, uptight sedge, northern territory sedge (*Carex utriculata*)	Depleted Below Dark Surface	Water marks, saturation, high water table	In floodplain of Russell Brook

[1] Wetland classification follows Cowardin et al. (1979):
PEM = Palustrine (freshwater) Emergent
PSS = Palustrine (freshwater) Scrub-shrub

4.1.2 Watercourses

Two watercourses were delineated at the project site including Russell Brook (S-1) and a small tributary of Russell Brook (S-2) (Figure 1). Representative photographs are included in Appendix A. Each are further discussed below.

Russell Brook (S-1)

Russell Brook is a perennial watercourse (R2UB3)[3] that flows westerly into the Contoocook River. It is a slow-flowing stream with a silt-dominated substrate. Flow has been partially impounded within the project site due to downstream impoundments on the Contoocook River. The existing hydraulic opening of the bridge over Russell Brook has also partially contributed to impounding of flow upstream of the bridge. Bankfull widths coincide with the ordinary high water mark (OHWM) widths along Russell Brook and the widths vary from approximately 15 feet to over 30 feet wide due to impoundment. Several unidentified fish species were observed within Russell Brook.

Watercourse S-2

Watercourse S-2 is a small unnamed intermittent tributary (R4SB4/5) of Russell Brook. It flows southerly through wetland W-2 and intersects the north bank of Russell Brook upstream of the bridge crossing. It has a sand and silt substrate with a bankful / OHWM width of approximately 3 feet. Due to its shallow depth and narrow channel, flow likely becomes intermittent during seasonal low-flow periods.

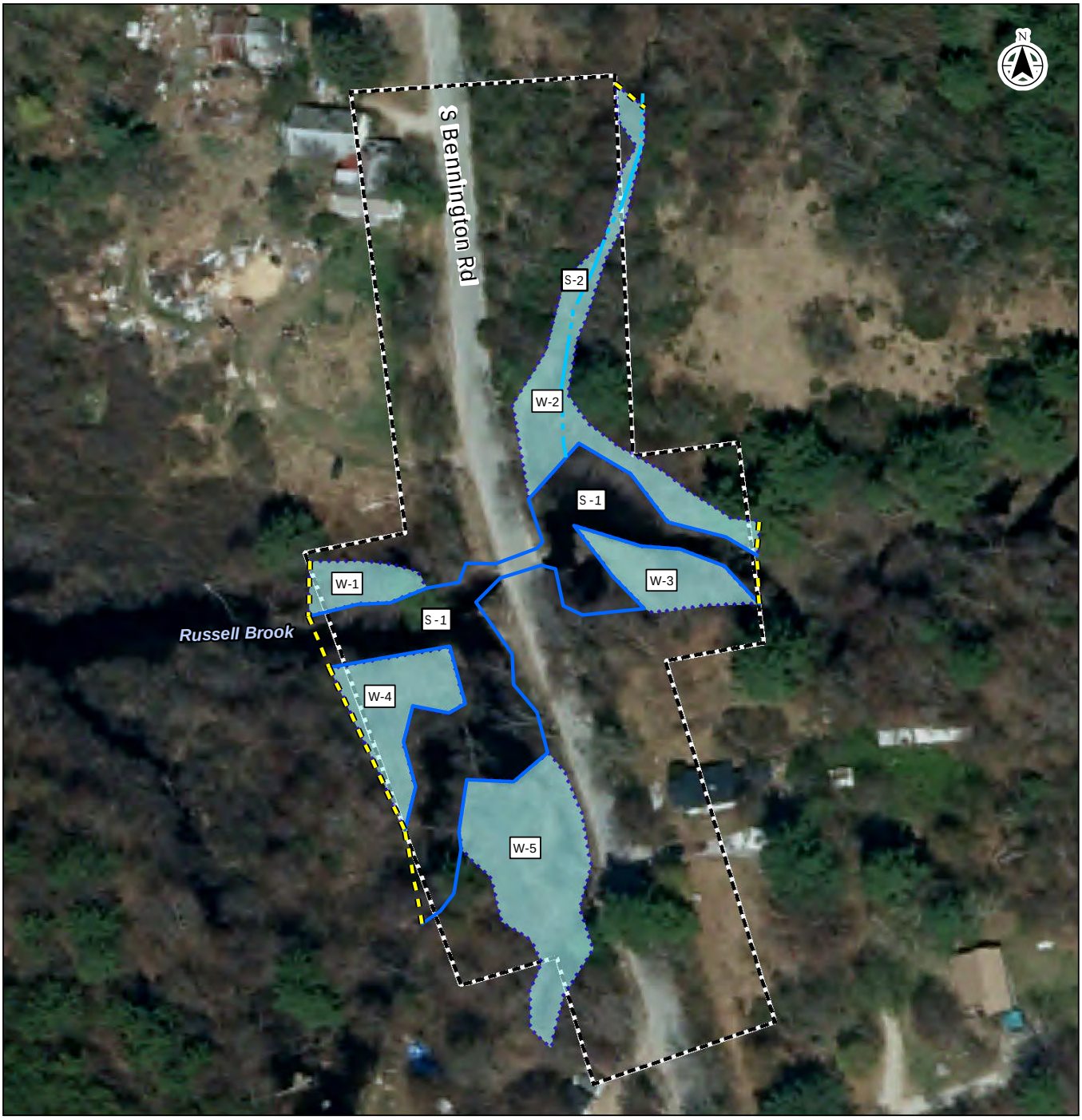
4.2 INVASIVE SPECIES

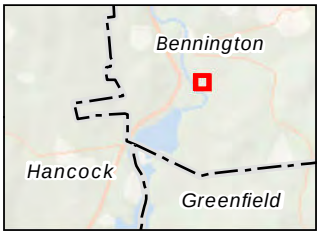
Invasive plant species are ubiquitous in terrestrial areas along South Bennington Road (Figure 2). Glossy buckthorn is present throughout upland and shrub-dominated wetland areas. Winged euonymus is dominant north and east of South Bennington Road. Morrow's honeysuckle (*Lonicera morrowii*) is scattered throughout the project site but concentrated near existing residences. Rambler rose (*Rosa multiflora*), Japanese barberry (*Berberis thunbergii*), and Asian bittersweet (*Celastrus orbiculatus*) are scattered throughout upland areas within the project site. Japanese knotweed (*Reynoutria japonica*) is located to the south and east of Russell Brook. Note that this list only includes those species that were readily identifiable during the May 4, 2018 field survey. Additional species may be present but were not identifiable due to the early seasonal timing of the field surveys.

[3] Stream classification follows Cowardin et al. (1979)

Figures

V:\1956\active_Task Owner and other Non-BC\1956 Jobs\193511574\03_data\gis_cad\GIS\mxds\193511574_WetlandDelineation_20180523.mxd Revised: 2018-05-29 By: rmack





Legend

- Approximate Survey Limit
- Delineated Intermittent Stream Centerline — S1 Stream ID
- Delineated Perennial Stream Edge
- Open Wetland/Stream (Continues Off Site)
- Delineated Wetland — W1 Wetland ID

0 100 Feet

1:1,237 (at original document size of 8.5x11)

Stantec

Project Location
Bennington, NH

Wetland Delineation Map REVA
Prepared by REM on 2018-05-25
Technical Review by EAC on 2018-05-25
Independent Review by MPA on 2015-05-29

Client/Project
New Hampshire Department of Transportation
Wetland Delineation
South Bennington Road Bridge Replacement

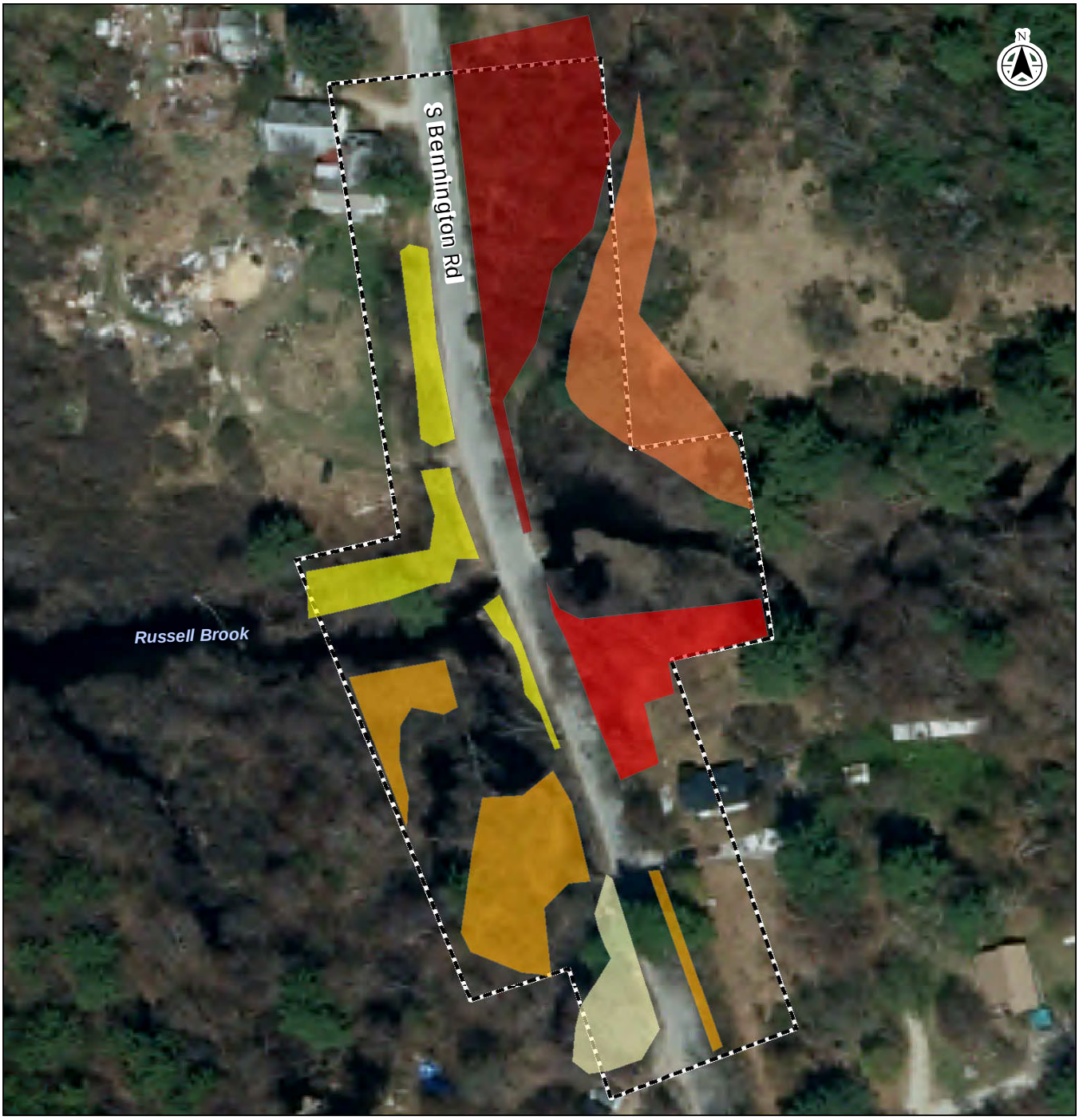
Figure No.
1

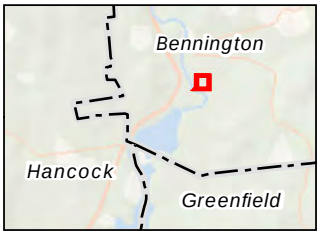
Title
Wetland and Watercourse Delineation Map

Notes
1. Wetland boundaries delineated in accordance with USACE Wetland Delineation Manual (1987) or subsequent versions.
2. Wetland boundaries were located utilizing a Trimble GeoExplorer Series Receiver. Expected accuracy of GPS data is within 1 meter of actual position.

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants, and agents, from any and all claims arising in any way from the content or provision of the data.

V:\1956\active_Task Owner and other Non-BC1956\Jobs\195311574\03_data\gis_cad\GIS\mxds\195311574_Invasives.mxd Revised: 2018-05-25 By: rmack





Legend

Approximate Cover by Invasive Species

- 70-90% abundance
- 50-70% abundance
- 50-70% abundnace
- 30-50% abundance
- 10-30% abundance
- 5-10% abundance
- Approximate Survey Limit

Surveys for invasive species were performed on 5/4/2018. Invasive species observed within the survey area include (in decreasing order of approximate overall abundance):

Glossy buckthorn (*Frangula alnus*)
Winged euonymus (*Euonymus alatus*)
Morrow's honeysuckle (*Lonicera morrowii*)
Japanese barberry (*Berberis thunbergii*)
Rambler rose (*Rosa multiflora*)
Japanese knotweed (*Reynoutria japonica*)
Asian bittersweet (*Celastrus orbiculatus*)

0 100 Feet
1:1,200 (at original document size of 8.5x11)

Stantec

Project Location
Bennington, NH

Invasive Species Map REVA
Prepared by REM on 2018-05-25
Technical Review by EAC on 2018-05-25
Independent Review by MPA on 2015-05-29

Client/Project
New Hampshire Department of Transportation
Wetland Delineation
South Bennington Road Bridge Replacement

Figure No.
2

Title
Invasive Species Map

Notes
1. Coordinate System: NAD 1983 StatePlane New Hampshire FIPS 2800 Feet
2. 2015 New Hampshire aerial orthoimagery provided by the New Hampshire Department of Transportation and New Hampshire GRANIT GIS Clearinghouse.

Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants, and agents, from any and all claims arising in any way from the content or provision of the data.

Appendix A REPRESENTATIVE PHOTOGRAPHS

Photo 1. Wetland W-1 looking east. Stantec. May 4, 2018.

Photo 2. Wetland W-2 looking north. Stantec. May 4, 2018.

Photo 3. Wetland W-3 along Russell Brook, looking east. Stantec. May 4, 2018.

Photo 4. Wetland W-4 on west side of Russell Brook, looking west. Stantec. May 4, 2018.

Photo 5. Wetland W-5 looking northwest. Stantec. May 4, 2018.

Photo 6. Russell Brook looking upstream to bridge. Stantec. May 4, 2018.

Photo 7. Watercourse S-2 through Wetland W-2, looking upstream. Stantec. May 4, 2018.

Appendix B CORPS WETLAND DETERMINATION DATA FORMS

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site:	South Bennington Road	Stantec Project #:	195311574
Applicant:	New Hampshire Department of Transportation		
Investigator #1:	Matt Arsenault (CWS #278)	Investigator #2:	
Soil Unit:	Rumney fine sandy loam	NWI/WWI Classification:	PEM
Landform:	Floodplain	Local Relief:	Linear
Slope (%):	0	Latitude: 42.996863	Longitude: -71.921825
Datum:	NAD 1983		

Date:	05/04/18
County:	Hillsborough
State:	New Hampshire
Wetland ID:	W-1
Sample Point:	**W-1**
Community ID:	Wetland

Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No

Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed?
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic?

Are normal circumstances present? ☑ Yes ☐ No

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☑ Yes ☐ No
Wetland Hydrology Present? ☑ Yes ☐ No
Hydric Soils Present? ☑ Yes ☐ No
Is This Sampling Point Within A Wetland? ☑ **Yes** ☐ **No**

Remarks: Floodplain of Russell Brook

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☐ A1 - Surface Water
- ☑ A2 - High Water Table
- ☑ A3 - Saturation
- ☑ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☑ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☑ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☑ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:	(in.)
Water Table Present?	☑ Yes	☐ No	Depth: 1	(in.)
Saturation Present?	☑ Yes	☐ No	Depth: 0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Map Unit Name: Rumney fine sandy loam — Series Drainage Class: Poorly drained

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)	Matrix	Matrix %	Mottles Color (Moist)	Mottles	Mottles %	Mottles Type	Mottles Location	Texture (e.g. clay, sand, loam)
0	6	1	2.5Y	3/1	85	2.5Y	4/1	15	D	M	silt loam
6	10	2	2.5Y	4/1	100	--	--	--	--	--	sandy loam
10	20	3	2.5Y	5/1	100	--	--	--	--	--	sandy loam
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):
- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☑ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (**LRR K, L, R**)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (**LRR K, L**)
- ☐ S9 - Thin Dark Surface (**LRR K, L**)
- ☐ F12 - Iron-Manganese Masses (**LRR K, L, R**)
- ☐ F19 - Piedmont Floodplain Soils (**MLRA 149B**)
- ☐ TA6 - Mesic Spodic (**MLRA 144A, 145, 149B**)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Depth:

Hydric Soil Present? ☑ Yes ☐ No

Remarks:

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site:	South Bennington Road	Wetland ID:	W-1	Sample Point	W-1

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	0		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

1.	*Frangula alnus*	15	Y	FAC
2.	*Cornus amomum*	3	N	FACW
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	18		

Herb Stratum (Plot size: 2 meter radius)

1.	*Calamagrostis canadensis*	35	Y	OBL
2.	*Carex stricta*	30	Y	OBL
3.	*Spiraea latifolia*	2	N	FACW
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	67		

Woody Vine Stratum (Plot size: 10 meter radius)

1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Remarks:

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***100.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	65	x 1 =	65
FACW spp.	5	x 2 =	10
FAC spp.	15	x 3 =	45
FACU spp.	0	x 4 =	0
UPL spp.	0	x 5 =	0
Total	85 (A)		120 (B)

Prevalence Index = B/A = ***1.412***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☐ No Dominance Test is > 50%
- ☑ Yes ☐ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Additional Remarks:

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site:	South Bennington Road	Stantec Project #:	195311574
Applicant:	New Hampshire Department of Transportation		
Investigator #1:	Matt Arsenault (CWS #278)	Investigator #2:	
Soil Unit:	Rumney fine sandy loam	NWI/WWI Classification:	PEM
Landform:	Floodplain	Local Relief:	Linear
Slope (%):	0	Latitude: 42.997187	Longitude: -71.921351
Datum:	NAD 1983		

Date:	05/04/18
County:	Hillsborough
State:	New Hampshire
Wetland ID:	W-2 / W-3
Sample Point:	**W-2 / W-3**
Community ID:	Wetland

Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No

Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ significantly disturbed?
Are Vegetation ☐ , Soil ☐ , or Hydrology ☐ naturally problematic?

Are normal circumstances present? ☑ Yes ☐ No

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☑ Yes ☐ No
Wetland Hydrology Present? ☑ Yes ☐ No
Hydric Soils Present? ☑ Yes ☐ No
Is This Sampling Point Within A Wetland? ☑ Yes ☐ No

Remarks: Floodplain of Russell Brook

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☑ A1 - Surface Water
- ☑ A2 - High Water Table
- ☑ A3 - Saturation
- ☑ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☑ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☑ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☑ Yes	☐ No	Depth:	1	(in.)
Water Table Present?	☑ Yes	☐ No	Depth:	1	(in.)
Saturation Present?	☑ Yes	☐ No	Depth:	0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Map Unit Name: Rumney fine sandy loam Series Drainage Class: Poorly drained

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)		Matrix %	Mottles Color (Moist)		Mottles %	Mottles Type	Mottles Location	Texture (e.g. clay, sand, loam)
18	0	1	2.5Y	2/1	100	--	--	--	--	--	mucky peat
0	2	2	10YR	4/2	100	--	--	--	--	--	loamy sand
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):
- ☑ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (**LRR K, L, R**)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (**LRR K, L**)
- ☐ S9 - Thin Dark Surface (**LRR K, L**)
- ☐ F12 - Iron-Manganese Masses (**LRR K, L, R**)
- ☐ F19 - Piedmont Floodplain Soils (**MLRA 149B**)
- ☐ TA6 - Mesic Spodic (**MLRA 144A, 145, 149B**)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Depth:

Hydric Soil Present? ☑ Yes ☐ No

Remarks:

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: South Bennington Road | Wetland ID: W-2 / W-3 | Sample Point W-2 / W-3

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	0		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	0		

Herb Stratum (Plot size: 2 meter radius)

1.	*Calamagrostis canadensis*	60	Y	OBL
2.	*Carex stricta*	15	Y	OBL
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	75		

Woody Vine Stratum (Plot size: 10 meter radius)

1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Remarks:

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***100.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	75	x 1 =	75
FACW spp.	0	x 2 =	0
FAC spp.	0	x 3 =	0
FACU spp.	0	x 4 =	0
UPL spp.	0	x 5 =	0
Total	75 (A)		75 (B)

Prevalence Index = B/A = ***1.000***

Hydrophytic Vegetation Indicators:

- ☑ Yes ☐ No Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☐ No Dominance Test is > 50%
- ☑ Yes ☐ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Additional Remarks:

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site:	South Bennington Road	Stantec Project #:	195311574
Applicant:	New Hampshire Department of Transportation		
Investigator #1:	Matt Arsenault (CWS #278)	Investigator #2:	
Soil Unit:	Rumney fine sandy loam	NWI/WWI Classification:	PSS
Landform:	Floodplain	Local Relief:	Linear
Slope (%):	0	Latitude: 42.996710	Longitude: -71.921667
Datum:	NAD 1983		

Date:	05/04/18
County:	Hillsborough
State:	New Hampshire
Wetland ID:	W-4
Sample Point:	**W-4**
Community ID:	Wetland

Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No

Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed?
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic?

Are normal circumstances present? ☑ Yes ☐ No

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☑ Yes ☐ No
Wetland Hydrology Present? ☑ Yes ☐ No
Hydric Soils Present? ☑ Yes ☐ No
Is This Sampling Point Within A Wetland? ☑ **Yes** ☐ **No**

Remarks: Floodplain of Russell Brook

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☐ A3 - Saturation
- ☑ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☑ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☑ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☑ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:	(in.)
Water Table Present?	☐ Yes	☑ No	Depth:	(in.)
Saturation Present?	☐ Yes	☑ No	Depth:	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Map Unit Name: Rumney fine sandy loam Series Drainage Class: Poorly drained

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)	Matrix	Matrix %	Mottles Color (Moist)	Mottles	Mottles %	Mottles Type	Mottles Location	Texture (e.g. clay, sand, loam)
0	8	1	10YR	3/1	85	10YR	5/6	5	C	M	sandy loam
--	--	--	--	--	--	10YR	5/1	10	D	M	--
8	20	2	2.5Y	5/1	92	2.5Y	5/6	8	C	M	loamy sand
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):
- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☑ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (**LRR K, L, R**)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (**LRR K, L**)
- ☐ S9 - Thin Dark Surface (**LRR K, L**)
- ☐ F12 - Iron-Manganese Masses (**LRR K, L, R**)
- ☐ F19 - Piedmont Floodplain Soils (**MLRA 149B**)
- ☐ TA6 - Mesic Spodic (**MLRA 144A, 145, 149B**)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Depth:

Hydric Soil Present? ☑ Yes ☐ No

Remarks:

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site: South Bennington Road | Wetland ID: W-4 | Sample Point W-4

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Acer rubrum*	15	Y	FAC
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	15		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

1.	*Frangula alnus*	70	Y	FAC
2.	*Cornus amomum*	3	N	FACW
3.	*Rosa multiflora*	1	N	FACU
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	74		

Herb Stratum (Plot size: 2 meter radius)

1.	*Calamagrostis canadensis*	60	Y	OBL
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	60		

Woody Vine Stratum (Plot size: 10 meter radius)

1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***100.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	60	x 1 =	60
FACW spp.	3	x 2 =	6
FAC spp.	85	x 3 =	255
FACU spp.	1	x 4 =	4
UPL spp.	0	x 5 =	0
Total	149 (A)		325 (B)

Prevalence Index = B/A = ***2.181***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☐ No Dominance Test is > 50%
- ☑ Yes ☐ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Remarks:

Additional Remarks:

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site:	South Bennington Road	Stantec Project #:	195311574
Applicant:	New Hampshire Department of Transportation		
Investigator #1:	Matt Arsenault (CWS #278)	Investigator #2:	
Soil Unit:	Rumney fine sandy loam	NWI/WWI Classification:	PSS
Landform:	Floodplain	Local Relief:	Linear
Slope (%):	0	Latitude: 42.996336	Longitude: -71.921326
Datum:	NAD 1983		

Date:	05/04/18
County:	Hillsborough
State:	New Hampshire
Wetland ID:	W-5
Sample Point:	**W-5**
Community ID:	Wetland

Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No

Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed?
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic?

Are normal circumstances present? ☑ Yes ☐ No

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present? ☑ Yes ☐ No
Wetland Hydrology Present? ☑ Yes ☐ No
Hydric Soils Present? ☑ Yes ☐ No
Is This Sampling Point Within A Wetland? ☑ **Yes** ☐ **No**

Remarks: Floodplain of Russell Brook

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☐):

Primary:
- ☑ A1 - Surface Water
- ☑ A2 - High Water Table
- ☑ A3 - Saturation
- ☑ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☑ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☑ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☑ Yes	☐ No	Depth:	1	(in.)
Water Table Present?	☑ Yes	☐ No	Depth:	1	(in.)
Saturation Present?	☑ Yes	☐ No	Depth:	0	(in.)

Wetland Hydrology Present? ☑ Yes ☐ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Map Unit Name: Rumney fine sandy loam Series Drainage Class: Poorly drained

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)	Matrix %	Mottles Color (Moist)	Mottles %	Mottles Type	Mottles Location	Texture (e.g. clay, sand, loam)
0	8	1	10YR 3/1	85	10YR 5/6	5	C	M	sandy loam
--	--	--	--	--	10YR 5/1	10	D	M	--
8	20	2	2.5Y 5/1	92	2.5Y 5/6	8	C	M	loamy sand
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☐):
- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☑ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (**LRR K, L, R**)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (**LRR K, L**)
- ☐ S9 - Thin Dark Surface (**LRR K, L**)
- ☐ F12 - Iron-Manganese Masses (**LRR K, L, R**)
- ☐ F19 - Piedmont Floodplain Soils (**MLRA 149B**)
- ☐ TA6 - Mesic Spodic (**MLRA 144A, 145, 149B**)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Depth:

Hydric Soil Present? ☑ Yes ☐ No

Remarks:

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site:	South Bennington Road	Wetland ID:	W-5	Sample Point	W-5

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	0		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

1.	*Alnus incana*	15	Y	FACW
2.	*Acer rubrum*	8	Y	FAC
3.	*Frangula alnus*	5	N	FAC
4.	*Cornus amomum*	1	N	FACW
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	29		

Herb Stratum (Plot size: 2 meter radius)

1.	*Carex stricta*	25	Y	OBL
2.	*Calamagrostis canadensis*	5	N	OBL
3.	*Carex utriculata*	3	N	OBL
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	33		

Woody Vine Stratum (Plot size: 10 meter radius)

1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***100.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	33	x 1 =	33
FACW spp.	16	x 2 =	32
FAC spp.	13	x 3 =	39
FACU spp.	0	x 4 =	0
UPL spp.	0	x 5 =	0
Total	62 (A)		104 (B)

Prevalence Index = B/A = ***1.677***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
- ☑ Yes ☐ No Dominance Test is > 50%
- ☑ Yes ☐ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☑ Yes ☐ No

Remarks:

Additional Remarks:

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site:	South Bennington Road	Stantec Project #:	195311574
Applicant:	New Hampshire Department of Transportation		
Investigator #1:	Matt Arsenault (CWS #278)	Investigator #2:	
Soil Unit:	Rumney fine sandy loam	NWI/WWI Classification:	Upland
Landform:	Floodplain	Local Relief:	Linear
Slope (%):	0	Latitude: 42.997236	Longitude: -71.921248
Datum:	NAD 1983		

Date:	05/04/18
County:	Hillsborough
State:	New Hampshire
Wetland ID:	W-2
Sample Point:	**Upland**
Community ID:	Upland

Are climatic/hydrologic conditions on the site typical for this time of year? (If no, explain in remarks) ☑ Yes ☐ No

Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed?
Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic?

Are normal circumstances present? ☑ Yes ☐ No

SUMMARY OF FINDINGS

Hydrophytic Vegetation Present?	☐ Yes ☑ No	Hydric Soils Present?	☐ Yes ☑ No
Wetland Hydrology Present?	☐ Yes ☑ No	Is This Sampling Point Within A Wetland?	☐ **Yes** ☑ **No**

Remarks: Floodplain of Russell Brook

HYDROLOGY

Wetland Hydrology Indicators (Check here if indicators are not present ☑):

Primary:
- ☐ A1 - Surface Water
- ☐ A2 - High Water Table
- ☐ A3 - Saturation
- ☐ B1 - Water Marks
- ☐ B2 - Sediment Deposits
- ☐ B3 - Drift Deposits
- ☐ B4 - Algal Mat or Crust
- ☐ B5 - Iron Deposits
- ☐ B7 - Inundation Visible on Aerial Imagery
- ☐ B8 - Sparsely Vegetated Concave Surface
- ☐ B9 - Water-Stained Leaves
- ☐ B13 - Aquatic Fauna
- ☐ B15 - Marl Deposits
- ☐ C1 - Hydrogen Sulfide Odor
- ☐ C3 - Oxidized Rhizospheres on Living Roots
- ☐ C4 - Presence of Reduced Iron
- ☐ C6 - Recent Iron Reduction in Tilled Soils
- ☐ C7 - Thin Muck Surface
- ☐ Other (Explain in Remarks)

Secondary:
- ☐ B6 - Surface Soil Cracks
- ☐ B10 - Drainage Patterns
- ☐ B16 - Moss Trim Lines
- ☐ C2 - Dry-Season Water Table
- ☐ C8 - Crayfish Burrows
- ☐ C9 - Saturation Visible on Aerial Imagery
- ☐ D1 - Stunted or Stressed Plants
- ☐ D2 - Geomorphic Position
- ☐ D3 - Shallow Aquitard
- ☐ D4 - Microtopographic Relief
- ☐ D5 - FAC-Neutral Test

Field Observations:

Surface Water Present?	☐ Yes	☑ No	Depth:	(in.)
Water Table Present?	☐ Yes	☑ No	Depth:	(in.)
Saturation Present?	☐ Yes	☑ No	Depth:	(in.)

Wetland Hydrology Present? ☐ Yes ☑ No

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available: N/A

Remarks:

SOILS

Map Unit Name: Rumney fine sandy loam — Series Drainage Class: Poorly drained

Profile Description (Describe to the depth needed to document the indicator or confirm the absence of indicators.) (Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered/Coated Sand Grains; Location: PL=Pore Lining, M=Matrix)

Top Depth	Bottom Depth	Horizon	Matrix Color (Moist)	Matrix %	Mottles Color (Moist)	Mottles %	Mottles Type	Mottles Location	Texture (e.g. clay, sand, loam)
0	2	1	10YR 3/3	--	--	--	--	--	sandy loam
2	5	2	2.5Y 4/3	--	--	--	--	--	silt loam
5	12	3	10YR 4/4	--	--	--	--	--	fine sandy loam
12	20	4	2.5Y 5/6	--	--	--	--	--	fine sandy loam
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--

NRCS Hydric Soil Field Indicators (check here if indicators are not present ☑):
- ☐ A1- Histosol
- ☐ A2 - Histic Epipedon
- ☐ A3 - Black Histic
- ☐ A4 - Hydrogen Sulfide
- ☐ A5 - Stratified Layers
- ☐ A11 - Depleted Below Dark Surface
- ☐ A12 - Thick Dark Surface
- ☐ S1 - Sandy Muck Mineral
- ☐ S4 - Sandy Gleyed Matrix
- ☐ S5 - Sandy Redox
- ☐ S6 - Stripped Matrix
- ☐ S7 - Dark Surface (LRR R, MLRA 149B)
- ☐ S8 - Polyvalue Below Surface (LRR R, MLRA 149B)
- ☐ S9 - Thin Dark Surface (LRR R, MLRA 149B)
- ☐ F1 - Loamy Mucky Mineral (LRR K, L)
- ☐ F2 - Loamy Gleyed Matrix
- ☐ F3 - Depleted Matrix
- ☐ F6 - Redox Dark Surface
- ☐ F7 - Depleted Dark Surface
- ☐ F8 - Redox Depressions

Indicators for Problematic Soils [1]
- ☐ A10 - 2 cm Muck (LRR K, L, MLRA 149B)
- ☐ A16 - Coast Prairie Redox (LRR K, L, R)
- ☐ S3 - 5cm Mucky Peat of Peat (**LRR K, L, R**)
- ☐ S7 - Dark Surface (LRR K, L, M)
- ☐ S8 - Polyvalue Below Surface (**LRR K, L**)
- ☐ S9 - Thin Dark Surface (**LRR K, L**)
- ☐ F12 - Iron-Manganese Masses (**LRR K, L, R**)
- ☐ F19 - Piedmont Floodplain Soils (**MLRA 149B**)
- ☐ TA6 - Mesic Spodic (**MLRA 144A, 145, 149B**)
- ☐ TF2 - Red Parent Material
- ☐ TF12 - Very Shallow Dark Surface
- ☐ Other (Explain in Remarks)

[1] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (If Observed) Type: Depth:

Hydric Soil Present? ☐ Yes ☑ No

Remarks:

WETLAND DETERMINATION DATA FORM
Northeast and Northcentral Region

Project/Site:	South Bennington Road	Wetland ID:	W-2	Sample Point	Upland

VEGETATION (Species identified in all uppercase are non-native species.)

Tree Stratum (Plot size: 10 meter radius)

	Species Name	% Cover	Dominant	Ind.Status
1.	*Pinus strobus*	40	Y	FACU
2.	*Prunus serotina*	30	Y	FACU
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	70		

Sapling/Shrub Stratum (Plot size: 5 meter radius)

1.	*Frangula alnus*	60	Y	FAC
2.	*Juniperus communis*	15	N	FACU
3.	*Vaccinium corymbosum*	5	N	FACW
4.	--	--	--	--
5.	--	--	--	--
6.	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
	Total Cover =	80		

Herb Stratum (Plot size: 2 meter radius)

1.	*Maianthemum canadense*	5	Y	FACU
2.	*Dichanthelium acuminatum*	5	Y	FAC
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
6	--	--	--	--
7.	--	--	--	--
8.	--	--	--	--
9.	--	--	--	--
10.	--	--	--	--
11.	--	--	--	--
12.	--	--	--	--
13.	--	--	--	--
14.	--	--	--	--
15.	--	--	--	--
	Total Cover =	10		

Woody Vine Stratum (Plot size: 10 meter radius)

1.	--	--	--	--
2.	--	--	--	--
3.	--	--	--	--
4.	--	--	--	--
5.	--	--	--	--
	Total Cover =	0		

Remarks:

Dominance Test Worksheet

Number of Dominant Species that are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: ***40.0%*** (A/B)

Prevalence Index Worksheet

Total % Cover of:		Multiply by:	
OBL spp.	0	x 1 =	0
FACW spp.	5	x 2 =	10
FAC spp.	65	x 3 =	195
FACU spp.	90	x 4 =	360
UPL spp.	0	x 5 =	0
Total	160 (A)		565 (B)

Prevalence Index = B/A = ***3.531***

Hydrophytic Vegetation Indicators:

- ☐ Yes ☑ No Rapid Test for Hydrophytic Vegetation
- ☐ Yes ☑ No Dominance Test is > 50%
- ☐ Yes ☑ No Prevalence Index is ≤ 3.0 *
- ☐ Yes ☑ No Morphological Adaptations (Explain) *
- ☐ Yes ☑ No Problem Hydrophytic Vegetation (Explain) *

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree - Woody plants 3 in. (7.6cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub - Woody plants less than 3 in. DBH and greater than 3.28 ft. tall.

Herb - All herbaceous (non-woody) plants, regardless of size, and woody plants less than 3.28 ft. tall.

Woody Vines - All woody vines greater than 3.28 ft. in height.

Hydrophytic Vegetation Present ☐ Yes ☑ No

Additional Remarks:

Wetland Permit Application for Replacement of South Bennington Road Bridge over Russell Brook
South Bennington Road and Tax Map 7 Lots 47, 46, 50, and 51 – Bennington, NH
NHDOT Project - Bennington 29486
Applicant: New Hampshire Department of Transportation

Photo 1 – View northerly along the easterly side of South Bennington Road of the easterly portion of the existing guardrail and box culvert along the upstream portion of Russell Brook. Taken 5-23-18.

Photo 2 – View northwesterly along the westerly side of South Bennington Road of the westerly portion of the existing guardrail and box culvert along the downstream portion of Russell Brook. Taken 5-23-18.

Photo 3 – View east - northeast along the center of the existing bridge from the travel lane of South Bennington Road in the upstream direction of Russell Brook. Taken 5-23-18.

Photo 4 – View easterly from the center of the bridge at the edge of the South Bennington Road travel lane in the upstream direction of Russell Brook floodplain area. Taken 5-23-18.

Photo 5 – View east- northeast from the center of the bridge at the edge of the South Bennington Road travel lane in the upstream direction of Russell Brook floodplain area. Taken 5-23-18.

Photo 6 – View northeasterly from the center of the bridge at the edge of the South Bennington Road travel lane in the upstream direction of Russell Brook floodplain area. Taken 5-23-18.

Photo 7 – View from the upstream northerly edge of Russell Brook and the floodplain area downstream towards the upstream bridge opening at South Bennington Road. Taken 5-04-18.

Photo 8 – View westerly along the center of the existing bridge from the travel lane of South Bennington Road in the downstream direction of Russell Brook. Taken 5-23-18.

Photo 9 – View northwesterly from the center of the bridge at the edge of the South Bennington Road travel lane in the downstream direction of Russell Brook floodplain area. Taken 5-23-18.

Photo 10 – View west-southwest from the center of the bridge at the edge of the South Bennington Road travel lane in the downstream direction of Russell Brook floodplain area. Taken 5-23-18.

Photo 11 – View southwesterly from the center of the bridge at the edge of the South Bennington Road travel lane in the downstream direction of Russell Brook floodplain area. Taken 5-23-18.

Photo 12 – View from the downstream southerly edge of Russell Brook and the floodplain area upstream towards the downstream bridge opening at South Bennington Road. Taken 5-04-18.

Construction Sequence:

1. CONSTRUCTION SURVEY AND LAYOUT.
2. INSTALL PERIMETER CONTROLS ALONG LIMITS OF WORK.
3. COMPLETE CLEARING AND GRUBBING.
4. ESTABLISH DETOUR AND CLOSE SOUTH BENNINGTON ROAD IN THE VICINITY OF THE CULVERT.
5. CONSTRUCT TEMPORARY STAGING AREAS.
6. INSTALL SEDIMENT CONTROL MEASURES AS APPROPRIATE AT STAGING AREAS.
7. INSTALL IN-WATER SEDIMENT CONTROL MEASURE AROUND THE BRIDGE,
8. ESTABLISH DEWATERING AREA.
9. CONSTRUCT WATER DIVERSION STRUCTURE.
10. REDIRECT FLOW TO WATER DIVERSION STRUCTURE.
11. REMOVE EXISTING CULVERT AND WING WALLS.
12. INSTALL NEW CULVERT FOUNDATION, WING WALLS, AND RIPRAP PROTECTION.
13. RESTORE STREAM BED. THIS WORK TO BE PHASED AND COMPLETED IN THE DRY.
14. CONSTRUCT APPROACH SLABS.
15. GRADE AND CONSTRUCT ROADWAY APPROACHES.
16. REMOVE ACCUMULATED SEDIMENTS FROM SEDIMENT CONTROL DEVICES.
17. APPLY EROSION CONTROLS.
18. REMOVE TEMPORARY SEDIMENT CONTROLS.

WRITTEN NOTIFICATION LIST FOR WETLANDS PERMIT

Map 7 Lot 39
Horn, Robert C.
59 Old Greenfield Rd
Bennington, NH 03442

Map 7 Lot 40
Mctague, Nycole L.
39 Old Greenfield Rd
Bennington, NH 03442

Map 7 Lot 44
Vergato, Dennis P.
26 South Bennington Rd
Bennington, NH 03442

Map 7 Lot 46
Franggos, Talitha
390 Harrison Street
Manchester, NH 03104

Map 7 Lot 47
Martel, Peter K.
68 South Bennington Rd
Bennington, NH 03442

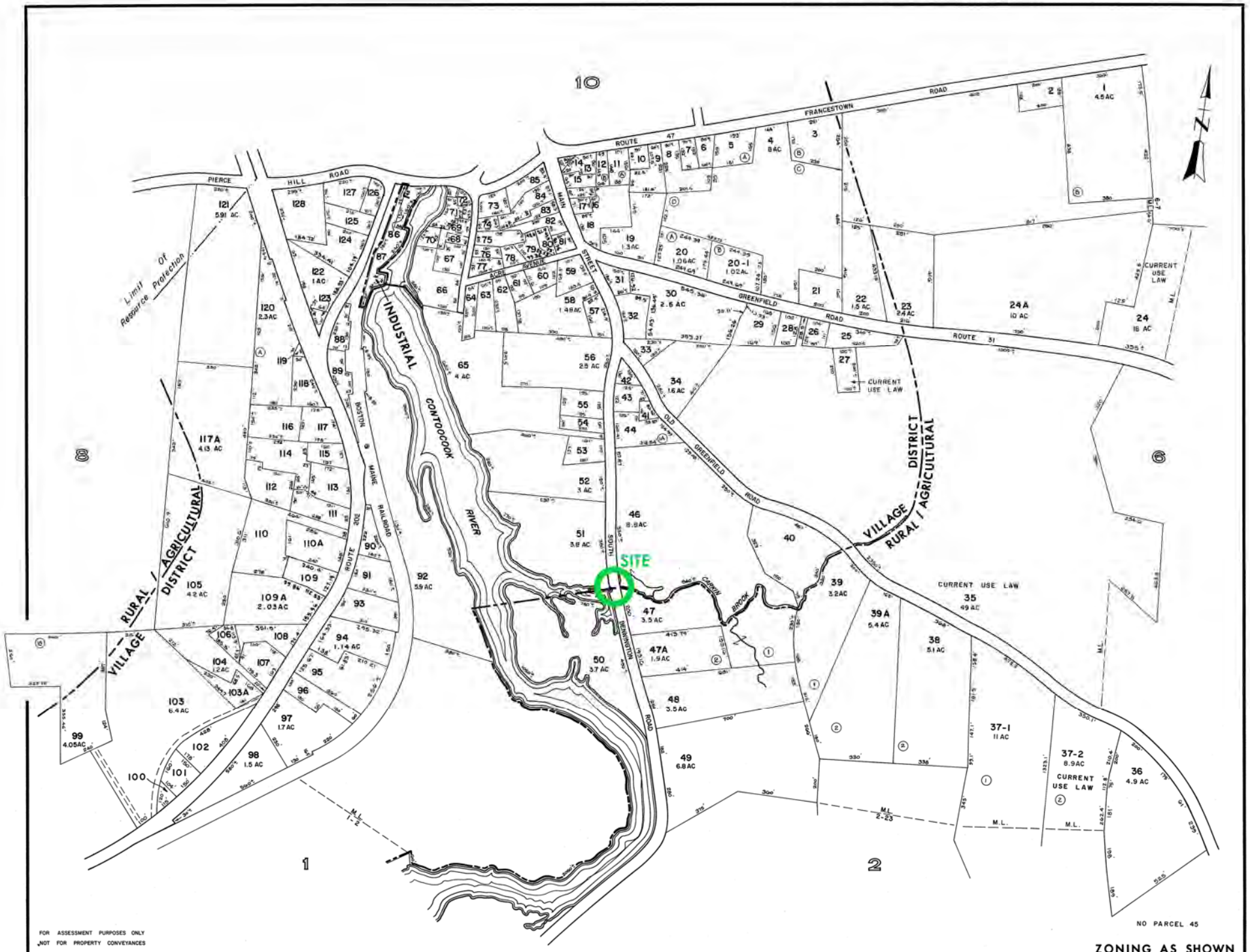
Map 7 Lot 47A
Count, Trevor A.
78 South Bennington Rd
Bennington, NH 03442

Map 7 Lot 48
Knight, Meraya A.
84 South Bennington Rd
Bennington, NH 03442

Map 7 Lot 50
Rosa, Manuel
77 South Bennington Rd
Bennington, NH 03442

Map 7 Lot 51
Byam, John
42 South Bennington Rd
Bennington, NH 03442

Map 7 Lot 52
Putnam, James D.
35 South Bennington Rd
Bennington, NH 03442



PREPARED BY PHOTOGRAMMETRIC METHODS BY

JOHN E. O'DONNELL & ASSOCIATES
AUBURN, MAINE
1979

LEGEND

ADJACENT SHEET NO.	12
COMMON OWNERSHIP	OR ✓
DEVELOPMENT LOT NO.	②
SCALED DIMENSION	±

PROPERTY MAP

BENNINGTON

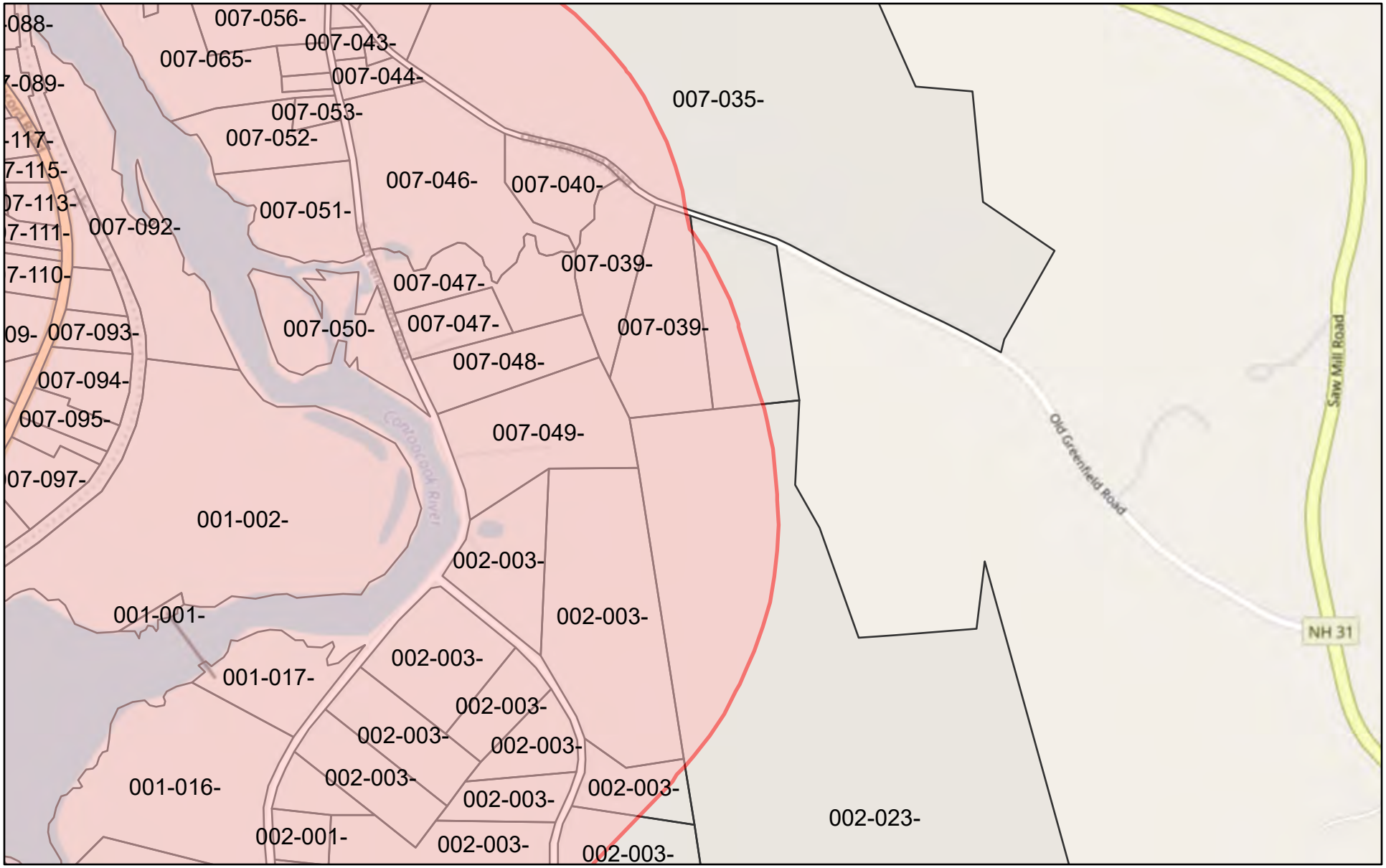
NEW HAMPSHIRE

SCALE IN FEET
0 200 400

7

MAKEPEACE P-3113

ArcGIS Web Map



2/8/2021, 2:33:08 PM

Designated_Rivers_Web - Designated_Rivers_24k_Buffer_Quartermile

Subject to SWQPA

Designated_Rivers_Web - Parcels_Along_Corridors

Municipalities (borders)

1:9,028

0 0.05 0.1 0.2 mi

0 0.07 0.15 0.3 km

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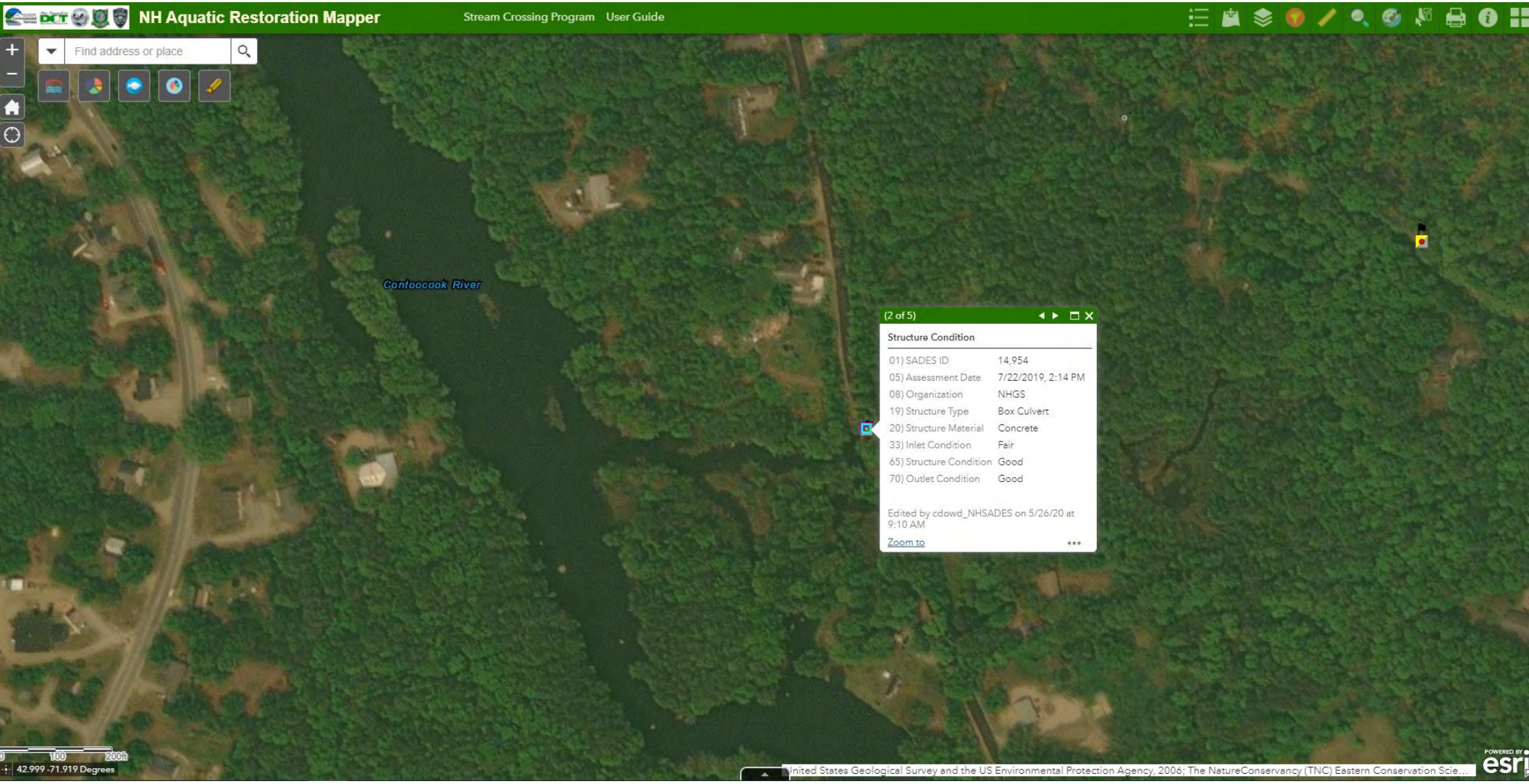
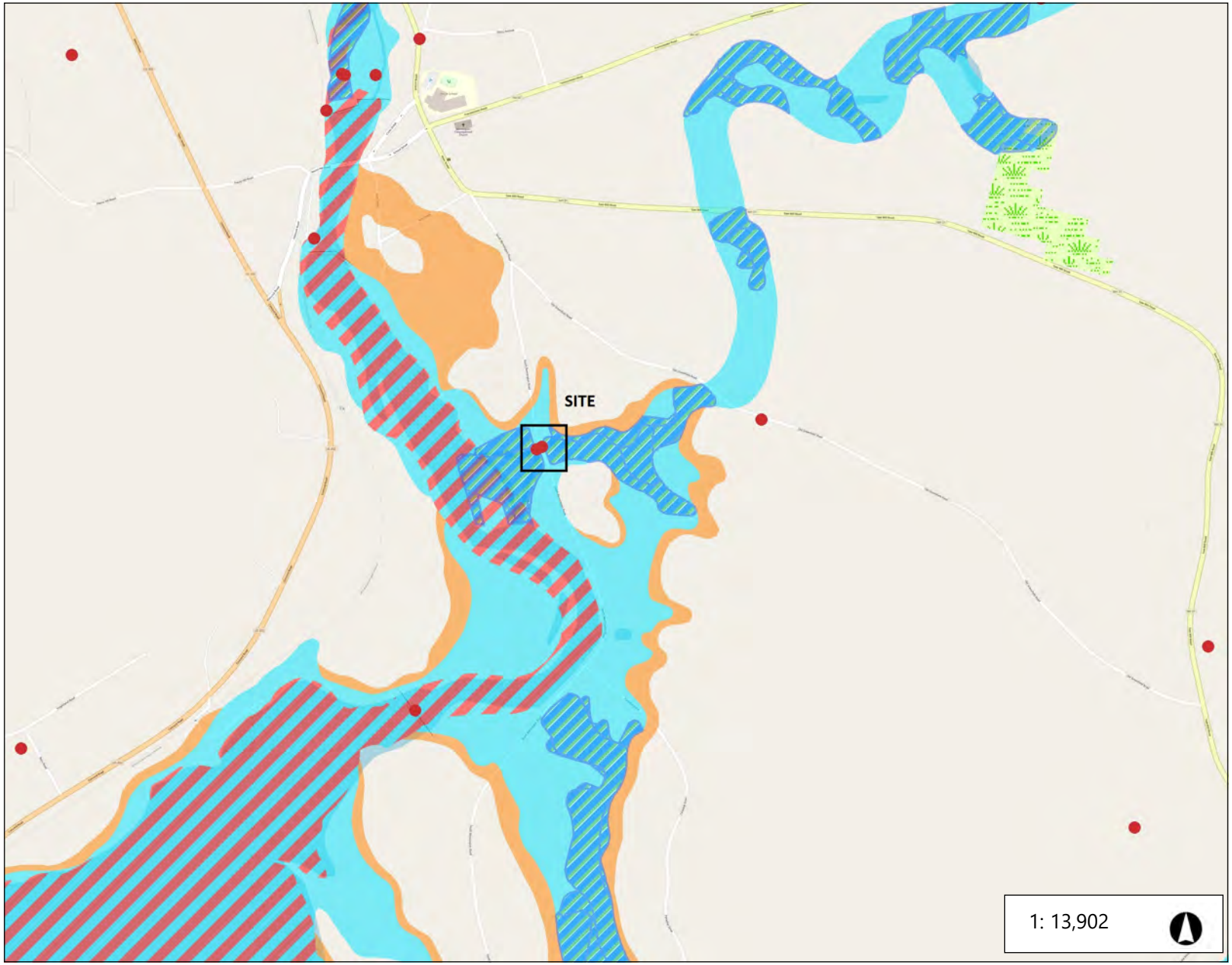
ArcGIS Web AppBuilder

Map data © OpenStreetMap contributors, CC-BY-SA |


NH Aquatic Restoration Mapper
Stream Crossing Program
User Guide
Find address or place
Contoocook River
(2 of 5)
Structure Condition
01) SADES ID 14,954
05) Assessment Date 7/22/2019, 2:14 PM
08) Organization NHGS
19) Structure Type Box Culvert
20) Structure Material Concrete
33) Inlet Condition Fair
65) Structure Condition Good
70) Outlet Condition Good
Edited by cdowd_NHSADES on 5/26/20 at 9:10 AM
Zoom to
100
200ft
42.999 -71.919 Degrees
United States Geological Survey and the US Environmental Protection Agency, 2006; The NatureConservancy (TNC) Eastern Conservation Scie...
esri

NHDES WPPT FEMA Floodplain Map - South Bennington Road



0.4 0 0.22 0.4 Miles

WGS_1984_Web_Mercator_Auxiliary_Sphere

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This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Legend

- NHDES Wetland and Shorelan
- Flood Plain Wetlands Adjacent
- Prime Wetlands with 100 ft Buf
- Prime Wetlands
- Peatlands

FEMA Floodplains

- 1 pct. Annual Chance Flood Hazard
- Floodway
- 0.2 pct. Annual Chance Flood Haza
- Area of Undetermined Flood Hazar
- Area Protected by Levee

Sand Dunes

- backdune
- foredune
- interdune
- other

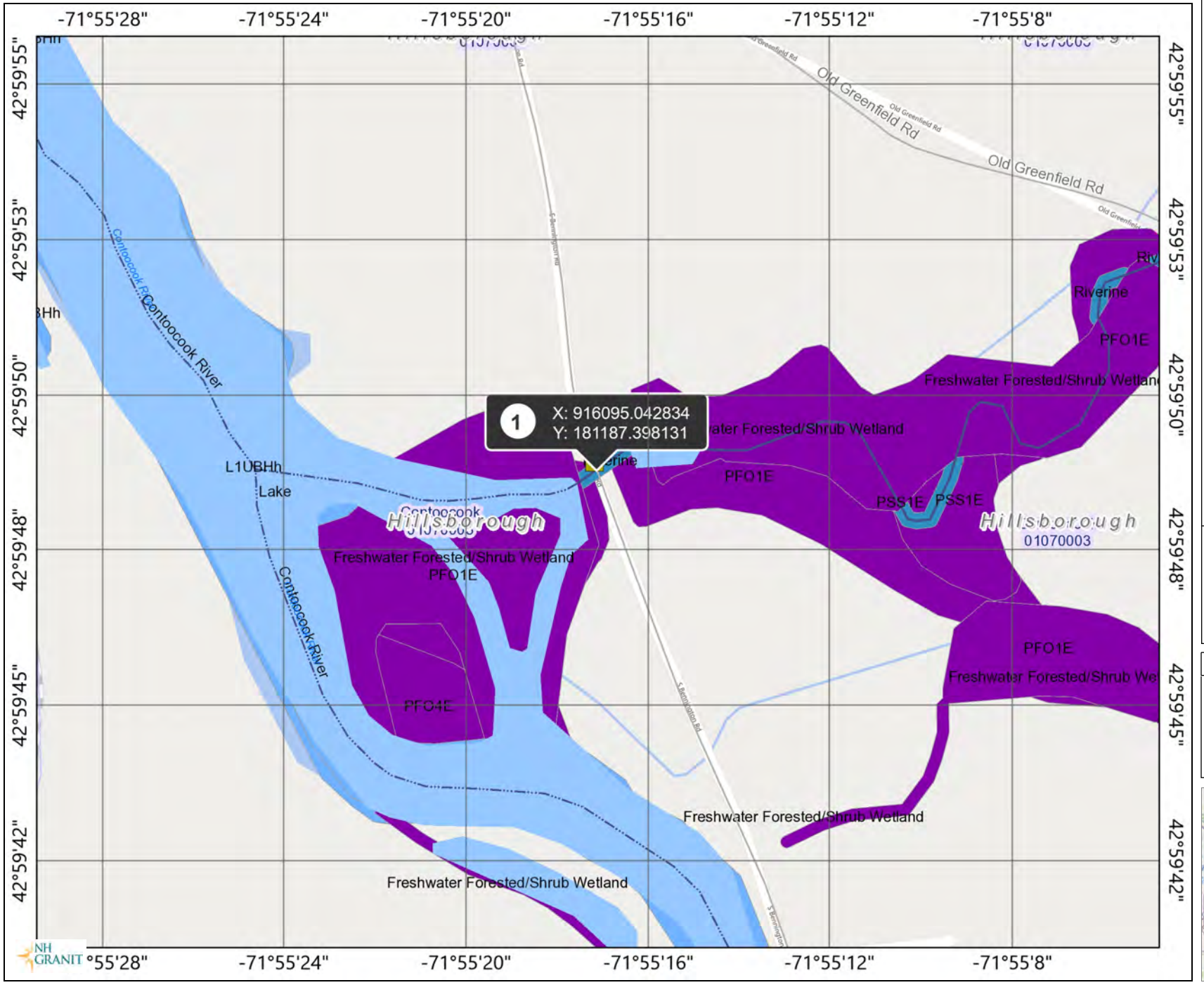
Tidal Waters / Tidal Wetlands

- Tidal wetland
- Transitional salt marsh
- Salt marsh
- Mud flat
- Tidal water

Notes

Bennington - 29486

South Bennington Road **Bridge over Russell Brook - Bennington - 29486**



Legend

- Dam Inventory
- State
- County
- City/Town
- Bridges
- Railroads
  - Active
  - Abandoned
  - Inactive
  - Out of State
- Turnpikes
- Interstates
- US Routes
- State Routes
- Local Roads
- Conservation and Public Lar
- Watersheds - HUC 8
- Stream Centerlines
  - Perennial Stream
  - Intermittent Stream
- Artificial Paths
- Water Bodies
  - Lake/Pond
  - Reservoir
  - Estuary
  - Swamp/Marsh
- Other Water Features
  - River

Map Scale

1: 2,591

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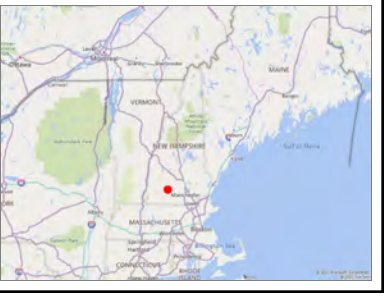
Map Generated: 2/5/2021

Notes

NHDES-WPPT Wetlands Map