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: NH Dept of Transportation **TOWN NAME:** Bedford

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

A person may request a waiver to 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. 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 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? ○ If yes, species or habitat name(s): Blanding's Turtle (NHFG pers. com.) ○ NHB Project ID #: NHB20-2146	☒ Yes ☐ No
• Bog?	☐ Yes ☒ No
• Floodplain wetland contiguous to a tier 3 or higher watercourse?	☒ Yes ☐ No
• Designated prime wetland or duly-established 100-foot buffer?	☐ Yes ☒ No
• Sand dune, tidal wetland, tidal water, or undeveloped tidal buffer zone?	☐ Yes ☒ No
Is the property within a Designated River corridor? If yes, provide the following information: • Name of Local River Management Advisory Committee (LAC): • A copy of the application was sent to the LAC on Month: Day: Year:	☐ Yes ☒ No

For dredging projects, is the subject property contaminated? • If yes, list contaminant:	☐ Yes ☒ No
Is there potential to impact impaired waters, class A waters, or outstanding resource waters?	☐ Yes ☒ No
For stream crossing projects, provide watershed size (se Wetland Permit Planning Tool or Stream Stats): 5.29 sq mi	

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 NHDOT proposes to replace a structurally deficient stream crossing structure on NH Route 101 over Pulpit Brook in Bedford, NH. Built in the early 1950's, Bridge No. 090/065 consists of buried, twin 60" RCP culverts. The upstream headwall was reconstructed in 2011. This bridge is currently on the NHDOT red list due to settling and separating of culvert sections, and tipping failure on the downstream headwall. It will be replaced with a 50'-6" clear span, precast concrete, butted box-beam bridge with composite concrete overlay. The project includes roadway approach work on Route 101 extending approximately 1,200 feet southwest and 800 feet northeast of the bridge. The project will construct two 12-foot travel lanes with 8-foot shoulders, and adds a 12-foot left turn lane at Twin Brook Lane for westbound Route 101 traffic. Total roadway width at the new bridge is 52 feet. The centerline of the road will be raised by approximately 6 inches to reclaim existing pavement. Guardrail will be installed for safety, and stormwater treatment BMPs will be added to treat runnoff. Approximately 6,562 square feet of permanent wetland/bank impact is associated with wingwalls and fill slopes for drainage and road safety improvements. There will be 2,186 sf of permanent (self mitigating) impact to the streambed above and below the culverts, to improve the streambed, and approximately 1,000 sf of new functional streambed will be created where the culverts are currently located, thereby increasing aquatic habitat, enhancing connectivity, and reducing flood risk. The 1,882 sf of temporary impacts, including resetting two culvert sections on an intermittent stream and necessary traffic diversions during bridge construction, will be graded and restored with appropriate materials. The impacted wetland under the temporary traffic diversion will also be graded and seeded with wetland seed mix, even though this is considered permanent impact due to significant soil alterations.

SECTION 3 - PROJECT LOCATION

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

ADDRESS: Route 101

TOWN/CITY: Bedford

TAX MAP/BLOCK/LOT/UNIT: N/A

US GEOLOGICAL SURVEY (USGS) TOPO MAP WATERBODY NAME: Pulpit Brook
☐ N/A

(Optional) LATITUDE/LONGITUDE in decimal degrees (to five decimal places): 42.905920° North
-71.569745° 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: NH Department of Transportation, C/C Jennifer Reczek, P.E.		
MAILING ADDRESS: 7 Hazen Drive		
TOWN/CITY: Concord	STATE: NH	ZIP CODE: 03302
EMAIL ADDRESS: jennifer.reczek@dot.nh.gov		
FAX:	PHONE: 603 271-3401	

ELECTRONIC COMMUNICATION: By initialing here: JCR, 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.: Carbonneau, Lee, E.		
COMPANY NAME: Normandeau Associates, Inc.		
MAILING ADDRESS: 25 Nashua Road		
TOWN/CITY: Bedford	STATE: NH	ZIP CODE: 03110
EMAIL ADDRESS: lcarbonneau@normandeau.com		
FAX:	PHONE: 603 637-1150	

ELECTRONIC COMMUNICATION: By initialing here LEC, I hereby authorize NHDES to communicate all matters relative to this application electronically.

SECTION 6 - PROPERTY OWNER INFORMATION (IF DIFFERENT THAN APPLICANT) (Env-Wt 311.04(b))
If the owner is a trust or a company, then complete with the trust or company information.
☒ Same as applicant

NAME:		
MAILING ADDRESS:		
TOWN/CITY:	STATE:	ZIP CODE:
EMAIL ADDRESS:		
FAX:	PHONE:	

ELECTRONIC COMMUNICATION: By initialing here , I hereby authorize NHDES to communicate all matters relative to this application electronically.

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

Describe how the resource-specific criteria have been met for each chapter listed above (please attach information about stream crossings, coastal resources, prime wetlands, or non-tidal wetlands and surface waters):
In compliance with Env-Wt 400, Wetlands were delineated by Normandeau Certified Wetland Scientists in 2016, 2018 and 2020 in accordance with the USACE delineation manual and regional supplement; the 2016 Regional Wetland Plant List published by the USACE; and the New England Hydric Soils Technical Committee's "Field Indicators for Identifying Hydric Soils in New England", Versions 3 (2004) and 4 (2017). Vernal pools were identified based on "Identifying and Documenting Vernal Pools in New Hampshire" by NHFG, and assessed using the USACE Vernal Pool Assessment method in the 2016 Mitigation Guidance. The ordinary high water and banks of Pulpit Brook were also flagged and GPS located. As defined in Env-Wt 400 and 900, the wetlands around Pulpit Brook (tier 3 stream with a mapped floodplain) are Priority Resource Areas (PRA), and the project was classified as major impact. As required in Env-Wt 527, this project is designed to improve public safety and will not divert stream flow or increase flood stages off site. Mitigation in the form of an ARM fund payment has been approved by NHDES. This project is not a coastal project or located in Prime wetlands, so Env-Wt 600 and 700 do not apply. As required by Env-Wt 900, stream survey, hydrologic and hydraulic analysis, narrative assessment, span structure design standards for passing the 100-year storm, stream connectivity, channel simulation, and wildlife passage have been completed (see attached Headwaters Hydrology report, wetland report, and design plans). Construction of this self-mitigating crossing will be scheduled during low flow conditions, as possible.

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 that you have attached all documents related to avoidance and minimization, as well as functional assessment (where applicable). You can 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: 01 Day: 20 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	5879		☐	567		☐
	Scrub-shrub Wetland			☐	869		☐
	Emergent Wetland			☐			☐
	Wet Meadow			☐			☐
	Vernal Pool			☐			☐
	Designated Prime Wetland			☐			☐
	Duly-established 100-foot Prime Wetland Buffer			☐			☐
Surface Water	Intermittent / Ephemeral Stream			☐	91	19	☐
	Perennial Stream or River	2186	87	☐			☐
	Lake / Pond			☐	213		☐
	Docking - Lake / Pond			☐			☐
	Docking - River			☐			☐
Banks	Bank - Intermittent Stream			☐			☐
	Bank - Perennial Stream / River	683	161	☐	142	75	☐
	Bank / Shoreline - Lake / Pond			☐			☐
Tidal	Tidal Waters			☐			☐
	Tidal Marsh			☐			☐
	Sand Dune			☐			☐
	Undeveloped Tidal Buffer Zone (TBZ)			☐			☐
	Previously-developed TBZ			☐			☐
	Docking - Tidal Water			☐			☐
TOTAL		8748	248		**1882**	**94**	

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):	10630 SF	×	$0.40 =	$ 4252
Seasonal docking structure:	SF	×	$2.00 =	$
Permanent docking structure:	SF	×	$4.00 =	$
Projects proposing shoreline structures (including docks) add $400			=	$
			Total =	$ 4252
The application fee for minor or major impact is the above calculated total or $400, whichever is greater =				$ 4252

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: JER	To the best of the signer's knowledge and belief, all required notifications have been provided.
Initials: JER	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: JER	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): Jennifer E. Reczek	PRINT NAME LEGIBLY: Jennifer E. Reczek	DATE: 6/17/21
SIGNATURE (APPLICANT, IF DIFFERENT FROM OWNER):	PRINT NAME LEGIBLY:	DATE:
SIGNATURE (AGENT, IF APPLICABLE): Lee E. Carbonneau	PRINT NAME LEGIBLY: Lee. E. Carbonneau	DATE: 6/11/21

SECTION 16 - TOWN / CITY CLERK SIGNATURE (Env-Wt 311.04(f))

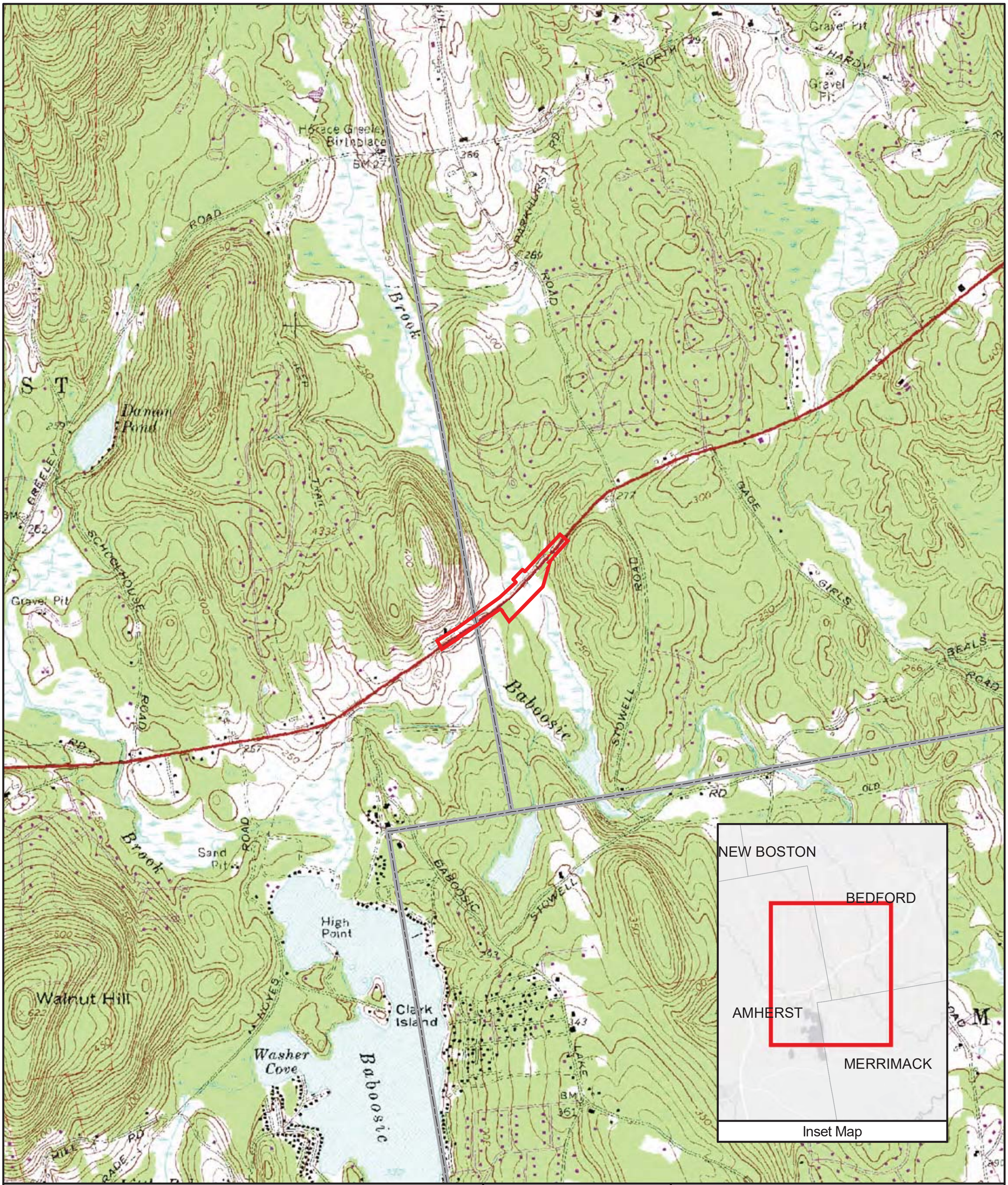
As required by RSA 482-A:3, I(a),(1), I hereby certify that the applicant has filed four application forms, four detailed plans, and four USGS location maps with the town/city indicated below.

TOWN/CITY CLERK SIGNATURE: Exempt per RSA 482-A:3, I(a), (1), copies sent via certified mail	PRINT NAME LEGIBLY:
TOWN/CITY:	DATE:

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

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

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



N

Project Location

Town Boundary

0 0.25 0.5 1 Miles

NORMANDEAU ASSOCIATES
Environmental Consultants

Date:
1/06/2021

NHDOT
BEDFORD 13692C
NH ROUTE 101 OVER PULPIT BROOK
Exhibit A

25 Nashua Road Bedford, NH 03110

Prepared For: LEC Project: 23741.008 Prepared By: JOP

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: **NH Department of Transportation** **TOWN NAME:** Bedford

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.

SEVERAL ALTERNATIVE DESIGNS WERE EVALUATED TO FIND THE PRACTICABLE ALTERNATIVE WITH THE LEAST IMPACTS TO WETLAND RESOURCES. THE NO-BUILD ALTERNATIVE WOULD HAVE NO IMPACTS, BUT WAS REJECTED AS IT WOULD NOT SOLVE THE SAFETY ISSUES OF THIS RED-LISTED BRIDGE OR IMPROVE THE HYDRAULIC DEFICIENCIES THAT RESULT IN ROAD FLOODING IN THE 50-YEAR STORM. REHABILITATION OF THE EXISTING CULVERTS WOULD REDUCE IMPACTS BUT NOT ADDRESS THE HYDRAULIC DEFICIENCIES OF THIS ROAD CROSSING. ACCELERATED BRIDGE CONSTRUCTION WOULD AVOID THE TEMPORARY IMPACTS ASSOCIATED WITH THE TEMPORARY TRAFFIC DIVERSION AND MINIMIZE THE DURATION OF CONSTRUCTION (THEREBY REDUCING TEMPORAL IMPACTS), BUT WOULD REQUIRE A 34-MILE TRAFFIC DETOUR ON NEIGHBORHOOD ROADS, WHICH IS CONSIDERED AN UNNACCEPTABLE IMPACT TO RESIDENTS AND THE NUMEROUS ROUTE 101 TRAVELLERS. REPLACEMENT OF THE BRIDGE WITHOUT A LEFT TURNING LANE INTO TWIN BROOK LANE WAS CONSIDERED. THIS WOULD REDUCE TEMPORARY AND PERMANENT WETLAND IMPACTS, BUT WOULD NOT ALLEVIATE THE LEFT TURN SAFETY ISSUES. REDUCED TEMPORARY LANE WIDTHS (26-0' RATHER THAN 32-0') WERE ALSO CONSIDERED, BUT WOULD NOT PROVIDE ADEQUATE SAFETY MARGINS FOR BICYCLISTS AND CONTRACTORS DURING CONSTRUCTION ON THIS BUSY ROAD.

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.

Permanent impacts to the emergent marsh north of the existing road crossing of Pulpit Brook have been largely avoided by widening the roadway to the south. There will be a small impact at the stream edge to stabilize the banks. The remainder of the project impacts are to forested and shrub wetlands, and the forested edge of a pond.

SECTION I.III - HYDROLOGIC CONNECTION (Env-Wt 313.03(b)(3))

Describe how the project maintains hydrologic connections between adjacent wetland or stream systems.

Undersized twin culverts (both 60 inch RCP) will be replaced by with a 50'-6" clear span precast concrete butted box-beam bridge. This project will actually improve hydrologic connections between upstream and downstream wetlands, and along the stream channel itself by providing continuous stream channel and bank habitat instead of culverts, and allowing more natural flow. A relatively flat shelf approximately 4 ft wide on either side of the stream channel will restore passage for riparian/semi-aquatic wildlife. In addition, two 8-ft end sections of a small culvert that carries intermittent flow from Wetland 11 on the north side of Route 101 to Wetland 4 on the south side of Route 101 that have settled will be reset to preserve flow under Route 101.

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.

Two undersized twin culverts will be replaced with one clear span bridge, allowing the stream to flow freely in a recreated streambed, with a shelf on either side for wildlife passage, including for Blandings Turtle, a state endangered species reported in the vicinity of the project by NHFG. The road side slopes will be 1.5:1 in this area, to reduce the lateral extent of fill. Fill associated with the temporary traffic diversion will be removed and the impacted area restored, although this was quantified as a permanent wetland impact.

Wildlife-friendly sediment and erosion controls will be used around the work area to minimize impacts to wildlife and water quality during construction.

The stream banks and temporarily impacted wetlands will be restored with humus and wetland seed mixes.

Although NHF&G did not suggest work restriction dates for aquatic life protection, NHDOT plans to undertake stream channel work during low-flow conditions as much as possible.

Work will take place in two primary phases. Phase 1 will construct the northern portion of the proposed bridge and roadway, and detour traffic along a two-way temporary traffic diversion south of the existing crossing. Phase 2 will shift the two-way traffic north onto the newly constructed portion of the bridge, remove the temporary traffic diversion, and construct the remaining portions of the bridge. A construction sequence is attached to the wetland application.

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.

No commercial properties will be impacted by the proposed construction project, and traffic flow to and from commercial areas to the east will be maintained throughout the construction period with no road closures. NHDOT has worked with the Town of Amherst to make sure access to the Town-owned conservation lands that are actively managed for hay and public recreation (sliding hill, hiking and X-country skiing) is maintained throughout construction (and after). Other conservation land near the project includes a 5-acre parcel downstream of the crossing owned by the Town of Bedford -the “DeNicola Land”, which will not be impacted by the project. Pulpit Brook is not navigable, but access to the stream will not be restricted by this project.

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 replacement of the existing stream channel fill/culverts with an open bridge entails the removal of fill within the Pulpit Brook floodway, thereby improving natural flow, improving connectivity between the floodplain wetlands above and below the road crossing, and relieving flooding issues along Route 101. A HEC-RAS hydraulic analysis was conducted by Headwaters Hydrology, PLLC which concluded that 100-year flood stages (a.k.a. base flood levels) would decrease for the proposed action; therefore, the design would comply with applicable federal floodplain management regulations. Further, the stormwater BMPs were redesigned to minimize additional impacts to the floodplain wetlands along Pulpit Brook.

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.

Permanent impacts to the forested wetlands along Pulpit Brook will take place in the vicinity of the widened road, which is necessary to complete the safety improvements of Route 101 (the addition of a left turning lane). These impacts have been minimized to the extent possible with 1.5:1 roadbank slopes in the vicinity of the brook, and 2:1 slopes elsewhere. The impacts to the wetland edges will not substantially reduce the ecological value of the emergent/shrub/forested wetland complex. Temporary wetland and bank impacts and the permanently impacted traffic diversion area will be restored with humus and wetland seed mix, so over time, some wetland functions should return. The replacement of the culverts with a bridge and floodplain shelves will improve natural flow and aquatic/semiaquatic fauna passage throughout this riverine wetland complex, thereby preserving ecological integrity of this locally important riverine/wetland system.

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 small quantity of wetland impacts will not have a detrimental effect on drinking water supplies or groundwater aquifer levels or quality. The project complies with NPDES, MS4, and Alteration of Terrain standards for surface water protection. Stormwater BMPs, which include new curbing and several grassed swales, have been designed to collect and treat stormwater where it was not previously treated, providing a net water quality improvement in the watershed. The restoration of natural stream flows under Route 101 is also a positive effect on local hydrology within the riverine valley. The closest public water wells are approximately 1,170 feet to the northeast of the bridge project. There is a 200 ft deep, private bedrock well 415 feet southwest of the bridge, and within 100 feet of Route 101, which should not be adversely affected by the Project.

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

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

Two undersized twin culverts (with no natural streambed materials inside) under Route 101 will be replaced with one open span bridge, with natural substrate materials within the channel for stream simulation and unimpeded flow. This new crossing has been designed to accommodate the 100-year storm. In addition, two 8-ft end sections of a small culvert that carries intermittent flow from Wetland 11 on the north side of Route 101 to Wetland 4 on the south side of Route 101 have settled and will be reset to preserve surface flow along this drainage path.

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.
N/A

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.
N/A

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.
N/A
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.
N/A

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.
N/A

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.
N/A

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: Wetlands, streams and vernal pools were assessed using the Highway Methodology.
NAME OF CERTIFIED WETLAND SCIENTIST (FOR NON-TIDAL PROJECTS) OR QUALIFIED COASTAL PROFESSIONAL (FOR TIDAL PROJECTS) WHO COMPLETED THE ASSESSMENT: LEE CARBONNEAU (CWS# 123)
DATE OF ASSESSMENT: 7/28/20
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 WRITTEN NARRATIVE

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

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

APPLICANT'S NAME: **NH Department of Transportation** **TOWN NAME:** **Bedford and Amherst**

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

SECTION 1 - WATER ACCESS STRUCTURES (Env-Wt 311.07(b)(1))
Is the primary purpose of the proposed project to construct a water access structure?

No, the primary project purpose is to replace a red-listed bridge for public safety purposes.

SECTION 2 - BUILDABLE LOT (Env-Wt 311.07(b)(1))
Does the proposed project require access through wetlands to reach a buildable lot or portion thereof?

No, this is a replacement of an existing highway stream/wetland crossing and a temporary traffic diversion next to the existing stream crossing.

SECTION 3 - AVAILABLE PROPERTY (Env-Wt 311.07(b)(2))*
For any project that proposes permanent impacts of more than one acre, or that proposes permanent impacts to a PRA, or both, are any other properties reasonably available to the applicant, whether already owned or controlled by the applicant or not, that could be used to achieve the project's purpose without altering the functions and values of any jurisdictional area, in particular wetlands, streams, and PRAs?

**Except as provided in any project-specific criteria and except for NH Department of Transportation projects that qualify for a categorical exclusion under the National Environmental Policy Act.*

This is a NHDOT project that qualifies for a Categorical Exclusion under NEPA. Wetland impacts will be less than one acre, but occur to a PRA. The project cannot be relocated, as it involves the replacement of a red-listed bridge within an existing highway ROW. Permanent relocation of the highway and culvert would result in more significant environmental and residential impacts.

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

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

Several alternative designs were evaluated to find the practicable alternative with the least impacts to wetlands and their functions. the no-build alternative would have no impacts, but was rejected as it would not solve the safety issues of the red-listed bridge or improve the hydraulic deficiencies that result in road flooding at the 50-year storm. Rehabilitation of the existing culverts would reduce impacts to wetlands, but not address the hydraulic deficiencies of this road crossing. Accelerated bridge construction would avoid the impacts associated with a temporary traffic diversion and minimize temporal impacts to wetlands, but would require a 34-mile traffic detour on neighborhood roads, which is considered an unacceptable impact to those neighborhoods and the numerous travellers on busy Route 101.   Replacement of the bridge without a left turning lane into Twin Brook Lane was considered. This alternative would reduce both temporary and permanent wetland impacts, but would not alleviate the left turn safety issues. Reduced temporary lane widths (26-0' rather than 32-0') were also considered, but would not provide adequate safety margins for bicyclists and contractors during construction on this busy roadway. Stormwater BMPs were designed to minimize direct impacts to the floodplain wetland along Pulpit Brook.

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

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

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

The principal functions and values of the floodplain wetland adjacent to the undersized bridge (PBW5) are groundwater recharge/discharge, sediment/toxicant retention, nutrient removal and retention, and wildlife habitat. this wetland is also suitable for floodflow alteration, fish/shellfish habitat, sediment/shoreline stabilization and production export. The replacement of the undersized culverts with a new bridge span designed in accordance with stream rules will improve hydrologic functions and fisheries habitat, alleviate a floodplain constriction, and provide safe passage for small widlife along the new constructed streambank shelves. Fill along the road margin will not adversly affect shoreline stabilization or nutrient retention functions. Proposed roadway embankment slopes of 1.5:1 are proposed at some locations to minimize vernal pool, wetland and conservation land impacts and preserve their habitat functions. Slopes steeper than 2:1 will have erosion control protection as needed to prevent slope failure. An assessment of vernal pool functional loss (USACE method) indicates that these medium value pools will not become low value due to the project. The funcitonal benefits of improved stream flow and wetland connectivity will outweigh the small loss of habitat associated with the permanent impacts along the existing road margin. The other minor wetland impacts are either temporary or very small, with minimal function and service impacts.

Erosion and sedimentation controls will be wildlife-friendly, per the recommendations of NHFG. The wildlife shelves through the bridge were also recommended by NHFG. The addition of stormwater BMPs to this section of Route 101 will have a net benefit to water quality in Pulpit Brook and its wetland system. The temporarily impacted wetlands will be restored with wetland humus and wetland seed mix to re-establish habitat and shoreline stabilization functions.

Natural Resource Agency Coordination
Meeting Minutes

BUREAU OF ENVIRONMENT
CONFERENCE REPORT

SUBJECT: NHDOT Monthly Natural Resource Agency Coordination Meeting
DATE OF CONFERENCE: January 20, 2021
LOCATION OF CONFERENCE: Virtual meeting held via Zoom

ATTENDED BY:

NHDOT
Sarah Large
Matt Urban
Andrew O'Sullivan
Ron Crickard
Mark Hemmerlein
Arin Mills
Rebecca Martin
James McMahon
Ralph Sanders
Toney Weatherbee
Jason Tremblay
Chuck Corliss
Tim Boodey
Marc Laurin
Jennifer Reczek
Tobey Reynolds
Dan Prehemo
Gerry Bedard

ACOE
Mike Hicks

EPA
Beth Alafat
Jeanie Brochi

NHDES
Lori Sommer
Karl Benedict
Ann-Elizabeth Pelonzi

The Nature Conservancy
Pete Steckler

Consultants/ Public Participants
Jennifer Riordan
Tom Levins
Lee Carbonneau
Thomas Marshall
Gene McCarthy

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

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

received. Section 106 review for cultural resources determined no concerns provided no excavations for staging or access.

Sarah asked for confirmation that project would fall under Env-Wt 523 for dredging, and no stream crossing rules would be needed. Karl B concurred no stream crossing rules need to be addressed in the wetlands permit application because this is a dredging activity, although he did have questions on the change in velocities as it relates to scour protection. Karl asked if the Department had considered just removing the beaver dam to restore flow and allow material to move naturally. Karl mentioned he would like to understand the scour potential at the crossing by way of the velocities that lead to the need for the riprap scour protection along the streambed. He also mentioned the surrounding wetlands would be a PRA-"floodplain wetland contiguous to a tier 3 watercourse" and impacts to the PRA's would need to be addressed. Karl expressed that the PRA is identified by the FEMA 100-year floodplain overlapping the adjacent delineated wetlands along a tier 3 watercourse. Karl also asked if bioengineering was evaluated for the bank stabilization needs. In summary, he asked impacts be justified by discussing the velocities, identify alternatives such as removing the beaver dam and letting the stream naturally correct itself, identify PRA impacts and address hierarchy of bank stabilization rules. Tim mentioned that maintenance forces do address the beaver dams. Tim also commented that the rip rap placed within the stream will be similar to natural streambed material and feels it would address potential undermining of the structure. Tim stated the expectation is that installation of more natural streambed material at the inlet will also allow for more natural streamflow and lessen the aggregation of material. The Department is open to the idea of a more natural bank armoring away from area immediately adjacent to the structure, and encourage vegetation growth.

Lori Sommer believes mitigation may be required due to impacts within the PRA, but is not clear on amounts at this time. She suggested a possible future discussion to address mitigation requirements. Mike Hicks did mention although trees are not cut, impacts to the bats may require additional USFWS coordination for bridge work. Arin mentioned this is a corrugated metal pipe and does not anticipate bat concerns and Mike agreed. Jeanie Brochi and Pete Steckler had no comments. Sarah stated Amy L had provided an email and that she had no additional comments. Tim's lastly stated he will develop a more finalized plan and send impact totals to DES after meeting with the adjacent landowners.

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

Bedford, #13692-C (X-004(254))

Thom Marshall provided an overview of the project, which has been presented at the Natural Resource Agency meeting twice before, in 2017 and 2019. The existing bridge was built in the 1950's and red-listed in 2008. It is comprised of twin 5' diameter concrete pipes with a mortar rubble masonry headwall downstream and a concrete headwall on the upstream side, added in 2011. As presented in 2019, the project will replace the twin culverts with a 48' clear span bridge, and adds a left turn lane for Twin Brook Lane, added in response to strong urging by local residents during a public meeting. The project is subject to MS4 permit conditions. A temporary bypass will be constructed and bridge construction will be phased to minimize site impacts. The stream will be considered self-mitigating. Thom shared slides showing the hearing plan presented at the November 7, 2019 public hearing and the construction phasing details with cross sections of the road and bypass. Approximately 2,000 ft. of road work will take place. There are two primary phases of traffic control, which includes a downstream bypass bridge located tight to the existing road to minimize impacts. This bypass location also avoids the Bragdon Farm conservation land to the north. In Phase I, traffic will be diverted to the bypass while bridge work takes place on the northern portion of the bridge. In Phase II, traffic will return to the northern portion of the new bridge while the remaining southern bridge work is completed.

Thom then presented the expected project schedule:

- Permit Application Submitted – March 2021
- Final Design – July 30, 2021
- Advertising – September 7, 2021
- Construction Start – Winter 2021/22
- Construction Completion – Spring 2023

Lee Carbonneau provided a recap of the natural resources present in the project area. Pulpit Brook is a Tier 3 stream, which was surveyed by Headwaters Hydrology. The wetlands along the brook are now classified as a Priority Resource Area (PRA). The current NH Natural Heritage Bureau report does not list Blanding's turtles, although earlier reports do, but project commitments still include streambank shelves under the bridge, use of wildlife friendly erosion and sedimentation controls, and providing turtle information sheets to the contractors. The US Fish and Wildlife Service consultation through IPaC was completed and a programmatic compliance letter on the Northern Long-eared Bat received. Vernal pools were surveyed, and there are two medium value pools within the project limits, classified using the USACE 2016 guidance. There are conservation lands owned by the Town of Amherst adjacent to the project, the Bragdon Farm mentioned by Thom, and shown in purple on the map inset. ROW agreements are in progress.

Lee described the additional work that took place in 2020, including wetland delineation extensions east and west of the project area, as well as around the stormwater BMPs, and geotechnical studies and recommendations. Wetland boundaries for floodplain wetlands along Pulpit Brook, originally delineated in 2016, were shifted in 2020. While the delineations were conducted by different wetland scientists, and likely in different seasons, the wetland extension upgradient is due at least in part to a clogged bridge along the old road alignment just downstream of the project area, which has increased water levels throughout the wetland by at least 1 ft.

Gerry Bedard then discussed the geotechnical engineering report that recommended flattening both the permanent and temporary road embankments from 1.5:1 to 1.75:1 for approximately 250 feet, which pushes out the toe of slope approximately 5 ft. into the wetlands. The report indicated that the slope change was necessary to meet the desired safety factor for stability of the slope. In addition, the report recommended the removal of muck soils below the embankments, as shown on the plan view and cross sections. The temporary embankment will be removed, and the area regraded to pre-construction elevations.

Lee identified the permanent and temporary wetland, stream and bank impact areas. The wetlands under the temporary bypass are now considered permanent impacts, as the muck soils will be excavated and not replaced. Small impacts related to vegetated swales #2 and #3, which were modified to minimize wetland impacts that would have occurred due to the 2020 delineation, are included. Lee provided a slide with the previous resource impacts as presented to this group in 2019 and the current resource impacts based on design changes. Permanent impacts of 8,995 sf include 2,187 sf of stream channel impacts and 683 sf of bank impacts. Temporary impact to wetlands, streams and banks is 1,583 sf. There are no direct vernal pool impacts, and impacts to the vernal pool envelope and critical terrestrial habitat are not expected to be significant enough to drop the pools from medium to low value, which would be a secondary impact. However, the GIS analysis has not yet been conducted. A recent adjacent private development located to the northeast of the project will be a factor in the analysis. Stream impacts are considered self-mitigating, as the project will replace undersized culverts with open channel and natural streambed materials, and restore hydraulic compatibility, geomorphic compatibility, and aquatic organism passage. The permanent wetland impacts are less than 10,000 sf, so no compensatory mitigation is planned.

Sarah Large then went through a roll call for comments:

Karl Benedict: Karl appreciated the summary and agreed that the wetlands impacted by the temporary bypass should be considered permanently impacted due to the removal of muck. He wanted additional information regarding how temporary impacts to banks and wetlands are defined. He also suggested we confirm the extent of the floodplain, noting that impacts to floodplain wetlands adjacent to a Tier 3 stream are PRA and would require mitigation, regardless of the size of the overall total impacts. Karl also asked if the project will meet the NH Alteration of Terrain stormwater guidelines.

> Thom referred to a cross section showing the 100-year storm flow at elevation 235', which may be the floodplain elevation. Lee noted that FEMA mapped a fairly wide floodplain along Pulpit Brook. It was concluded that the majority of wetlands impacted will likely be considered PRA.

Lori Sommer: Lori confirmed that the new wetland rules require mitigation for PRA wetland impacts regardless of size, and suggested we tease out the impacts based on overlap with the 100-year floodplain. She indicated NHDES would be looking for mitigation for these permanent wetland impacts. Lori also asked that we advise NHDES and USACE of the results of the GIS analysis for possible secondary vernal pool impacts, as that may also require mitigation. This can be coordinated directly with NHDES and USACE, rather than in a full agency meeting. Lori also asked if the project has held meetings with the towns.

> Lee concurred that the vernal pool impact analysis would be completed and shared with the agencies, and noted that she attended a meeting with Amherst officials. Jennifer Reczek confirmed that several meetings have been held with Bedford and Amherst.

Mike Hicks: Mike indicated that he can pull in Taylor Bell if needed to address vernal pools, which for the Exit 4A project were addressed on a case-by-case basis. Mike also asked whether the project coordinated with the State Historic Preservation Office (SHPO) and if the existing bridge is eligible for listing on the National Register.

> Jennifer confirmed that coordination with SHPO is complete and the existing structure is not eligible.

Jean Brochi: Jean had no additional comments.

Pete Steckler: Pete noted that this stream corridor is likely an important wildlife corridor, and asked if the bridge design included a wildlife shelf at bankfull elevation.

> Thom returned to the bridge cross section slide which shows a wildlife shelf below the riprap embankment, which will be approximately 4' 8" wide on both sides of the stream channel and made of natural materials.

Andy O'Sullivan: Andy asked for more clarification regarding Lori's concern with the vernal pools, and if this was related to changes in water levels.

> Lori indicated that her concern was with impacts to the vernal pool buffer zones.

This project was previously discussed at the 9/20/2017 and 6/19/2019 Monthly Natural Resource Agency Coordination Meetings.

BUREAU OF ENVIRONMENT
CONFERENCE REPORT

SUBJECT: NHDOT Monthly Natural Resource Agency Coordination Meeting
DATE OF CONFERENCE: June 19, 2019
LOCATION OF CONFERENCE: John O. Morton Building
ATTENDED BY:

NHDOT
Matt Urban
Sarah Large
Andrew O'Sullivan
Doug Locker
Tim Boodey
Arin Mills
Chris Carucci
Julius Nemeth
Jennifer Reczek
Anthony Weatherbee
Maggie Baldwin
Jason Abdulla
Marc Laurin
Ralph Sanders
Tim Mallette
Jon Evans
Wendy Johnson
Tom Jameson
Chelsea Noyes

ACOE
Mike Hicks

NHDES
Collis Adams
Karl Benedict
Andrew Madison

NHF&G
Carol Henderson

NH NHB
Amy Lamb

LCHIP
Paula Bellemore

NH DNCR
Tracey Boisvert

Consultants/Public Participants
Lee Carbonneau
Thomas Marshall
Sarah Barnum
Chris Fournier
Christine Perron
Burr Phillips
Greg Howard
Jed Merrow

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

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

Karl Benedict asked for clarification that the Q100 showed an increase in capacity and Chris Carucci confirmed that the proposed culvert will pass the Q100 with headwater elevation just below the adjacent garage elevation.

Matt Urban clarified that since the new culvert will be shorter and there is existing riprap the project would be considered self-mitigating. Matt Urban clarified that since the new culvert will be shorter and there is existing riprap the project may be considered self-mitigating.

Karl Benedict noted additional discussion about addressing stormwater treatment and the limited areas to provide treatment. My additional notes on this one were that abutter permissions would be required and provision of a stream diversion plan.

Karl Benedict asked if there was a specification sheet for the streambed material. Chris said the material would be a mixture of material designed to match the existing stream bed material, along with a placement specification. Colis Adams asked if an open bottom culvert was considered. Chris Carucci said this was not evaluated as a possible alternative for concerns for potential scour at the footing which could lead to deeper embedment.

Mike Hicks asked about the IPaC and 4(d) rule, Arin said both were done, and Northern long eared bat was the only species resulting from the USFWS species list. Mike also asked about floodplain impacts and Arin stated there were no anticipated impacts. Chris determined the hydraulic model shows no change in flow rate or depth in the channel immediately downstream of the culvert.

Collis Adams asked if treatment from the 12" cmp outlet was considered. Chris Carucci said that was not considered due to space constraints within the project area. The catch basin and associated pipe are within the private land and treatment would require work in the front lawn. Chris Carucci said catch basins typically have a sump which provides sediment retention and that treatment options would be further investigated.

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

Bedford, #13962-C (X-004(254))

Thom Marshall described the existing bridge and changes to the replacement design since the Project was presented in this venue in September of 2017. The two five-foot diameter culverts will be replaced by a 48-ft clear span precast box-beam bridge. Stormwater treatment swales have been added, and a left turning lane into Twin Brook Road was added based on input at the public meeting. The bankfull channel is 22' wide. A 4-ft 8-inch wide wildlife corridor will be constructed adjacent to each side of the stream channel below the riprap. A temporary bypass will be constructed as close to the south side of the existing road as possible, and construction work on the bridge will be phased.

L. Carbonneau reviewed natural resources. The Aquatic Restoration Mapper shows a flood hazard flag and notes that the existing culvert is undersized, has reduced passage and is in poor condition. Pulpit Brook is a Tier 3 stream with a 5.3 square mile watershed. There is a 100-year floodplain and floodway, but a hydraulic analysis shows that the new crossing decreases flood levels significantly upstream and results in no changes downstream. Fill will be removed around the culverts. There are forested and scrub-shrub wetlands on both sides of Route 101, and two vernal pools on the south side of Route 101.

State listed Blanding's turtles have been recorded as being present within the project limits by NH NHB, and NHF&G requested that no plastic netting be used, and timing restrictions and protective fencing should be incorporated to avoid nesting turtle impacts. Northern long-eared bats will be reviewed under FHWA's range-wide programmatic consultation with the USFWS.

Preliminary impact estimates are 5,615 sf permanent wetland impacts, which includes 3,000 sf of stream channel grading to tie the restored stream in with the rest of the channel and fill in scour holes. We believed this might be more akin to a temporary impact as it is part of the stream restoration. There will also be 2,240 sf of temporary impacts mostly near the stream crossing for siltation devices and water handling structures. These areas will be restored.

Normandeau conducted a vernal pool survey, and found two vernal pools in the forested wetland to the south of the road. No fill will be placed in the pools. The USACE value assessment indicates that these are Medium value pools. A GIS analysis of the post-construction condition revealed that impacts to the vernal pool envelopes and 750-ft buffers were not sufficient to drop the value of either pool from Medium to Low, so it is expected that mitigating for indirect vernal pool impacts will not be required. Sufficient information on stream morphology was collected for the bridge design so that the stream channel can be restored, so we assumed that to be self-mitigating. Indirect edge impacts to wetlands have not been quantified, but given the permanent impact area is 5,615 sf, the project should be below the 10,000 sf mitigation threshold, and no compensatory mitigation is proposed.

Conservation lands are present on the north and south sides of Route 101. The Bragdon Farm is approximately 111 acres, and is owned by the Town of Amherst. The south side is a local sledding hill, and the north side has a former ski area and hiking trails. The project will require Permanent slope/drainage easements (5,489 sf) as well as a temporary construction easement (1,904 sf) near the bridge on this conservation parcel. The potential for 4(f) impacts are still being investigated, but are not anticipated.

C. Henderson asked for details regarding the wildlife shelf under the bridge, and stated that it should be flat/level. T. Marshall stated that it will be level, and will likely consist of regraded channel material. He noted the difficulty of growing vegetation in the center of a bridge span due to shade.

M. Hicks asked when the bridge was constructed. J. Reczek replied that it was constructed in the 1950's. M. Hicks stated that FHWA would be the lead agency, and asked about Section 6(f) coordination. J. Reczek provided an overview of the archeological and historical determinations, confirming no adverse effects. M. Hicks noted that coordination with the Coast Guard would be required. S. Large stated that the Coast Guard has provided email confirmation that Pulpit Brook was not considered navigable and no further coordination was required. She will forward this information to L. Carbonneau.

K. Benedict stated that the work in the stream channel would be considered a permanent impact. He asked for the stream channel linear impact length, which T. Marshall estimated to be approximately 50 feet X 3, or 150-200 feet. K. Benedict asked how the temporary bypass would be handled after construction and if there would be downstream impacts. T. Marshall and L. Carbonneau stated that the temporary culverts and fill would be removed and the stream would be restored. K. Benedict noted that a restoration plan and longitudinal profile for the restores streambed would be necessary. L. Carbonneau stated that sufficient information was collected during the hydraulic analysis to restore the stream channel and confirm that no downstream impacts would occur, including to the old bridge just below the Project area.

L. Carbonneau asked if there was concurrence that mitigation will not be required. It was noted that further coordination with Lori Sommer and Mark Kern will be necessary, as they were not present at today's meeting.

M. Hicks asked when the Project would be built. J. Reczek replied that construction was expected to take place in 2021 and 2022. C. Henderson asked if construction would be coordinated with the F.E. Everett Turnpike Project also in Bedford and neighboring towns, and J. Reczek replied that there was no plan to coordinate the two projects.

Follow-up: L Carbonneau spoke with Lori Sommer by phone on June 27, 2019 regarding the Pulpit Brook project wetland impacts. The discussion included permanent wetland impact quantities, the "self-mitigating" stream crossing, and the assessment of vernal pool buffer impacts. L. Sommer said that she had also discussed the project with K. Benedict, who attended the Natural Resource Coordination meeting on June 19th. They both concur that compensatory mitigation does not appear to be necessary.

This project was previously discussed at the 9/20/2017 Monthly Natural Resource Agency Coordination Meeting.

Deerfield, #42279

Tim Mallette started the meeting describing the severe scour issue at several different locations on both abutments of the three sided concrete box culvert. The boulders deposited at the outlet of the culvert was also evidence of the high flows the culvert was subjected to. Tim Boodey explained that the footings will be underpinned with concrete to fill voids and class III Rip Rap will be placed in front of the footings 1' wide. Tim Mallette recommends the simulated stream bed material, 585.3401 extend several feet beyond the inlet and outlet of the box culvert.

Tim Boodey and Tim Mallette discussed placing simulated stream bed material, Item 585.3401. Carol Henderson from NHF & G was agreeable with this proposal.

Karl Benedict NH DES asked how much hydraulic reduction will there be after placing the materials, 585.3401, Class III Rip Rap and concrete in the culvert? Tim explained the culvert will pass the 100 year event at 400 CFS.

Tim Mallette and Ralph Sanders will obtain more survey data to determine the pre and post analysis flow rates.

BUREAU OF ENVIRONMENT
CONFERENCE REPORT

SUBJECT: NHDOT Monthly Natural Resource Agency Coordination Meeting
DATE OF CONFERENCE: September 20, 2017
LOCATION OF CONFERENCE: John O. Morton Building
ATTENDED BY:

NHDOT
Matt Urban
Sarah Large
Ron Crickard
Mark Hemmerlein
Marc Laurin
Meli Dube
Josh Lafond
Kathy Corliss
Jennifer Reczek
Joseph Adams
Charles Willeke
Jason Trembley
John Butler
Tobey Reynolds
Jim Kirouac
Tim Mallette
James Bowles

ACOE
Mike Hicks

EPA
Mark Kern

NHDES
Gino Infascelli
Chris Williams

NHF&G
Carol Henderson

NH Natural Heritage Bureau
Amy Lamb

Consultants/Public Participants
Joshua McAllister
Vicki Chase
Thomas Marshal
Darren Blood
Kim Smith
Christine Perron

(When viewing these minutes online, click on an attendee to send an e-mail)

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

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

The Connecticut River and all its tributaries are mapped as Essential Fish Habitat for Atlantic Salmon but the National Marine Fisheries Service has recently determined that because they are no longer present, consultation for projects on the Connecticut or its tributaries is no longer needed, as long as impacts are avoided and minimized.

Invasive Species – Japanese knotweed on the northwest bank.

Permanent impacts (~ 400 square feet) are associated with infrastructure protection so no compensatory mitigation is proposed.

T. Marshall reviewed potential water diversion methods. Temporary impacts would depend on the type of diversion structure to be used. A portadam, a framed structure with a membrane would be lain on the streambed (approximately 2,800 square feet of impact) or if sheetpile or sandbag cofferdams were used would result 1,600 square feet of impact. There is a desire to keep costs as low as possible. A third option would be to run a row of sheetpiles or sandbags across the entire channel width both upstream and down to create temporary headwalls so that the water could be channeled through pipes near the center of the river.

Mike Hicks commented that sheetpile diversions would not be counted as ACOE impacts but sandbags would.

M. Hicks asked if an IPaC form had been submitted, it has and only Northern Long-Eared Bats were identified. A 4d informal consultation form will be submitted to USACE.
M. Hicks asked if floodplain impacts were anticipated and said that floodplain compensation would be required if so.

M. Hicks asked if Section 106 had been started. The bridge falls under the 2014 Programmatic Agreement between FHWA, ACHP, NHSHPO and NHDOT, and the recordation form has been submitted to NHDHR.

Carol Henderson commented that her preference would be for the work to be undertaken so there was always flow in the river and was not in support of an option that would block the entire stream and bypass water through pipes.

Gino Infascelli indicated that riprap extended past its current location would require mitigation.

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

Bedford, #13692-C (X-004(254))
Vicki Chase introduced the project. The project is a federally funded bridge rehabilitation / replacement project. Pulpit Brook is a relatively small stream with extensive wetlands on both the north and south sides. The setting is rural with scattered residential with conservation land abutting the bridge right of way to the north.

Thom Marshall described the existing bridge, which was built in the 1950's and consists of two five-foot diameter culverts. The bridge was red-listed in 2008. The downstream end has a mortared rubble wall and the upstream end headwall was rebuilt in 2011. Engineering study is currently being developed. Based on preliminary hydraulics a 48-foot span is proposed, which would meet the stream crossing guidelines. The bankfull channel is 22' wide with wildlife corridors on each side.

Two alternatives are under consideration. A Conventional precast superstructure on cast-in-place abutments matching existing geometry of the roadway. A temporary bypass will be required (traffic volumes 20,000 vehicles per day) for this conventional alternative. Second alternative is accelerated bridge construction which would require a short term detour and no temporary bypass. Geotechnical information is not yet available.

V. Chase reviewed natural resources. There are forested wetlands to the south that would be affected by a temporary bypass. These will be reviewed in the spring to determine whether they are functioning as vernal pools. Pulpit Brook is a 2nd order stream, crossing is a Tier 3 stream with a 5.29 square mile watershed and no impairments.

There are state listed Blanding's turtles in the vicinity of the project. NHF&G has requested that sufficient aquatic organism passage be provided and that no plastic netting be used.

Carol Henderson noted that she spoke to Kim Tuttle who says the Blanding's turtles are nesting in the direct vicinity of the bridge and suggested that timing of construction, fencing to isolate construction, and reporting to NHF&G of any observed nesting activities will be required. No fisheries recommendations were noted by NHF&G.

There is a FEMA mapped floodway.

Currently no additional mitigation is proposed. There would be under 1,000 square feet of impact and the result would be a huge improvement. If the temporary detour were utilized there would be approximately 25,000 square feet of temporary impact.

C. Henderson asked for additional details about the wildlife platform under the bridge. There will be a 4.8' platform (made of riprap) on either side of the bridge. The proposed abutments are outside of the existing pipes.

Mike Hicks asked about northern long-eared bat coordination and Section 106 coordination. Bat coordination would be handled under FHWA's range-wide programmatic agreement.
M. Hicks asked about impacts to the 100-year floodplain. There will be a net removal of material from the floodplain.

Mark Hemmerlein noted that the project was within the urbanized area regulated under the NPDES Phase II MS4 permit.

Gino Infascelli asked about stormwater treatment. T. Marshall said design is in progress. If the bypass is pursued stormwater treatment can be constructed as part of the site restoration.

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

Newport, #16109 (X-A001)
Vicki Chase introduced the project. The project is a federally-funded, municipally managed project. The Sugar River is a 4th order stream with a 210 square mile watershed. The bridge is set in a rural location with a recreational trail to the west of the bridge. NEPA is not yet complete for the project as the Memorandum of Agreement for Section 106 has not been completed.

Thom Marshall described the existing conditions of the bridge. The existing bridge is a 1937 108' clear span Warren Truss that has been previously rehabilitated and was red-listed due to the superstructure, with the substructure also rated as poor. The deck is in satisfactory condition.

Several alternatives were studied, with the selected alternative being a complete replacement with a 120'-6" single-span. The western abutment will be moved to the west, but the eastern abutment will remain at the same location because of a National Register eligible structure (currently occupied) that lies directly next to the bridge abutment. Wetland impacts total ~1,300 square feet permanent and ~2,700 square feet of temporary impact. Wetland impacts associated with the project are mostly related to opening up the stream channel and reconstructing the banks. A bridge that would be fully compliant with the NH Stream Crossing rules would have required excavation into the bank to create a wider opening, which was deemed to be more impacting than the proposed condition. The low chord of the proposed bridge will be slightly higher than the existing bridge and will pass the Q100 flood.

Drainage - There is little space to provide treatment on the east side of the bridge because of existing structures. Drainage will flow from catch basins through the NE wingwall and through an existing pipe that flows to the north. On the west side there is an existing drainage swale. A relocated drainage swale will be provided for the outlet of the pipe beneath Greenwood Road that is to be replaced as part of the project.

Natural Resources – The Sugar River is a 4th order stream or larger [6th order], and a Tier 3 stream crossing. It will require a Major Impact wetland permit and a Shoreland permit. The northwest parcel adjacent to the project was funded in part with LWCF funding, but project will not impact the trail.

Rare Species – State-listed Brook Floaters were identified as occurring nearby but NHF&G indicated that they were not in the vicinity of the project. Wood Turtles were also identified, and NHF&G provided guidance for using biodegradable netting and for watching out for wood turtles during construction.

Brook Trout – the river is stocked with brook trout, and the bridge is used as a stocking site. There is an environmental commitment that access will be maintained during construction.
The Connecticut River and all its tributaries are mapped as Essential Fish Habitat for Atlantic Salmon but the National Marine Fisheries Service has recently determined that because they are no longer present, consultation for projects on the Connecticut or its tributaries is no longer needed, as long as impacts are avoided and minimized.

Carol Henderson inquired is wildlife shelves were proposed. T. Marshall responded that a shelf would be constructed along the western bank of the river, but it would be made of riprap. The eastern side has a retaining wall south of the project (outside of the project area) that would prohibit passage of terrestrial wildlife, so no attempt is being made to provide a shelf on the eastern side but a shelf already exists during ordinary high water.

Mitigation – NHDOT proposes that the project is self-mitigating since it is an improvement over the existing condition.

Mike Hicks asked about the status of the Section 106 MOA. T. Marshall indicated that it has been executed by DHR and the town, but not yet by NHDOT. The MOA is a critical path item.
M. Hicks asked about floodplain impacts. T. Marshall indicated that he was not sure and would double check. Due to the significant amount of fill being removed to create the larger span opening it is anticipated that there will not be a decrease in floodplain storage. This will be confirmed prior to submitting the permit application.

The Sugar River is impaired by pH and Aluminum but the project proposes a decrease of impervious of about ~2,000 square feet.

Gino Infascelli asked about the road width. The existing width is 19', but is being widened to 24'. G. Infascelli asked where the decrease in impervious was from. V. Chase stated that the bridge was not included in this calculation. Mark Hemmerlein indicated that the deck should be included as impervious. [The net increase in impervious including the bridge deck is 1,145 square feet.] M. Hemmerlein said that options for treatment should be evaluated. T. Marshall explained that coordination with AoT had occurred and it had been determined that the thresholds for requiring an AoT permit were not met. [As an LPA project it is not subject to the memorandum of Agreement between NHDOT and NHDES.]

This project has been previously discussed at the 1/20/2017 Monthly Natural Resource Agency Coordination Meeting.

Durham, #16236 (X-A0001(202)
Darren Blood introduced the project. The current crossing is a 15-foot slab bridge on the east side of the causeway, underlain by marine clay. The bridge was updated in the 1970's. The project has been to a public hearing and as a result the alignment has been shifted 7-10 feet northward to minimize private property impacts on the south side. This also required a modification to the profile, but the bridge is still being raised by four feet. The sight distance from Morgan Way west is substandard, and raising the bridge will fix the geometric deficiencies.

At the February 2015 meeting a 61-foot clear span bridge was presented, but the proposed action is a 76-foot span bridge. There are existing wood piles from the previous structure buried in the causeway, extending back on either side of the crossing, and in order to utilize rapid construction techniques conflicts with these subsurface wooden piles have to be avoided. Proposed traffic control is a detour for 14 days. The roadway section is 12' lanes with 5' shoulders and design speed is 45 mph.

Mike Hicks asked if a hydraulic study has been done to study the effects of a wider opening. A hydraulic study has been done and velocities are actually reduced resulting in less scour. Mike asked if this would

Mitigation Narrative, Worksheet
and
Aquatic Resource Mitigation Fund
Calculation

Compensatory Mitigation

The unavoidable, permanent wetland impacts to a PRA (after avoidance and minimization efforts), regardless of impact size, requires mitigation under the NHDES Wetland Rules as modified in 2019 (Env-Wt 311.01(c)(2)). Permanent impacts to the PRA requiring mitigation is 5,879 sf (this area does not include the self-mitigating stream impacts). In addition, the project was evaluated for secondary effects per Part 230—Section 404(b)(1) Guidelines. Secondary effects are defined in § 230.11 (H) as "…effects on an aquatic ecosystem that are associated with a discharge of dredged or fill materials, but do not result from the actual placement of the dredged or fill material." The New England Division of the US Army Corps of Engineers' 2016 Mitigation Guidance identifies and provides mitigation ratios for several types of secondary wetland impacts.

One type of secondary impact that was evaluated for this project is the reduction in value of a vernal pool due to impacts in the vernal pool buffer area. An assessment of the potential secondary impacts to vernal pools was conducted, using the USACE vernal pool evaluation method in the 2016 Mitigation Guidance. This method provides values for the pool itself and the landscape within the 100-ft vernal pool envelope and the 100-750-ft critical terrestrial habitat. Pre- and post-construction conditions were evaluated to determine if the value of these medium value vernal pools would drop to Low value as a result of the project. As the pools themselves are not directly filled, only the landscape portion of the assessment is altered for the post-construction assessment. Land use change in the vernal pool buffer zones was measured using GIS. For this evaluation, plans for the adjacent residential development, now under construction, were obtained and used in the measurements of existing landscape condition. For post-construction conditions, the Bedford 13692C Pulpit Brook project was added, and the landscape scores reevaluated based on additional loss of accessible forested habitat. The assessment shows no drop in vernal pool value from the replacement of the Pulpit Brook culvert.

The USACE also recognizes temporary impacts and "edge effects" beyond the fill placed in a wetlands as potential secondary impacts. For this project, impacts to the edge of Wetland PBW5 adjacent to the permanent fill slope from the temporary bypass fill is already categorized as a permanent impact due to the removal of the muck soils necessary for safety reasons. Nevertheless, the temporarily filled wetlands will be restored to pre-construction grades and seeded with native wetland seed mix. , pre-construction conditions will be difficult to re-establish without replacement of in-kind organic wetland soils. Further, the edge effects north of Route 101 in Wetland PBW_ will be minimal, because:

- Best Management Practices, including erosion and sedimentation controls along the toe of slopes will prevent wetland soil rutting and sedimentation during construction;

- Stormwater BMPs will improve water quality in the general watershed area;
- Wetland vegetation more than 5-feet beyond the impact area will not be altered.

For this reason, no additional secondary effects are anticipated, and no additional secondary impact mitigation is proposed.

As required by wetland rules Env-Wt 801.03, the Town of Bedford Conservation Commission Chairman and Community Planner were contacted several times for information on local mitigation project priorities that might match the impacted resource functions/types that would occur for this Project, but no responses were received. As no projects were identified by Bedford officials, a payment to the Aquatic Resource Mitigation (ARM) Fund will provide mitigation for natural resource impacts of 5,879 sf. This approach was agreed to by Lori Sommer of NHDES in the January 20, 2021 Natural Resource Agency Meeting.

The ARM fund estimate for this project is $33,280 and the ARM fund calculator printout is included in the NHDES Wetland Permit application package, and is not duplicated here. The ARM fund calculations are provided for direct, permanent impacts to wetlands. Impacts to the bank and channel of Pulpit Brook are considered self-mitigating, as replacing undersized culverts with an open channel and natural streambed materials will restore hydraulic compatibility, geomorphic compatibility, and aquatic organism passage.

Wetland or Stream ID	**Cowardin Wetland Class/ or Stream Type**	**Functions & Values (**Principal in **Bold)***	**Table 2. Project Impacts For Mitigation**						**Vernal Pool Present? ID or #**	**Other Comments**
			Permanent Wetland Impact (sq. ft.)	**Permanent Stream Impact** (linear ft)			**Temporary** (sq. ft.)	**Secondary** (sq. ft.)		
				Left Bank	Right Bank	Channel				
Stream 2	R2UB2	GW,**FF**,FS, PE,WH		77	84	87		N/A		Self-mitigating
Wetland 4	PUB3H	GW,**FF**,FS,SS, **ST**,**NR**,PE,WH					213	N/A		
Wetland 5	PFO1E	**GW,FF**,FS,**ST**, SS,**NR**,PE,**WH**	5,879					N/A	VP1, VP2	VPs not impacted
Wetland 6	PSS1C	GW,**FF**,FS,ST, **NR**,**SS**,PE,WH					184	N/A		
Wetland 8	PSS1C	**GW**,**FF**,FS,**ST**, **NR**,SS,PE,**WH**					181	N/A		
Stream 1	R4UB	GW					91	N/A		

*GW=Groundwater Recharge/Discharge; FS=Fish/Shellfish Habitat; FF=Floodflow Alteration; ST=Sediment/Toxicant Retention; NR=Nutrient Retention/Transformation; SS=Shoreline Stabilization; PE=Production Export; WH=Wildlife Habitat

Note: this table identifies impacts that will be mitigated (through ARM fund payment), and does not include the self-mitigating stream impacts that are included in the wetland permit application form.

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

PERMITTEE RESPONSIBLE MITIGATION PROJECT WORKSHEET

Water Division/ Wetlands Bureau/ Mitigation Program
Land Resources Management

RSA 482-A: / Env-Wt 800

1. PROPOSED PERMITTEE RESPONSIBLE MITIGATION PROJECT TYPE		
Upland Buffer Preservation:	Aquatic Resource Restoration:	Mitigation Payment: X
2. PROPOSED MITIGATION PROJECT LOCATION INFORMATION (if applicable)		
Street/Road:	Town/City:	Tax Map/Lot #:

3. APPLICANT INFORMATION	
Applicant Name: NH Department of Transportation	
Applicant Mailing Address: 7 Hazen Drive, Concord, NH 03302	
Contact Individual: Jennifer Reczek, P.E.	
Daytime Telephone: 603 271-3401	Email (if any): jennifer.reczek@dot.nh.gov
4. RESOURCE WORKSHEET SUMMARY	
Aquatic Resources Involved in Project: See Table Below.	
Total preservation proposed: Upland: Acres Wetland: Acres	
Total length of stream on property: Linear Feet % having 100-ft wooded zone: in direction % upland: in direction	
# confirmed vernal pools:	# potential vernal pools:
Area of wetland restoration proposed: acres	Area of wetland creation proposed: acres
Area of wetland enhancement proposed: acres	Area of upland enhancement proposed: acres
5. BRIEF NARRATIVE DESCRIBING PROPOSED PERMITTEE RESPONSIBLE MITIGATION	
NHDOT will make an ARM fund payment	
6. SIGNATURE AND CERTIFICATION	

- I hereby certify that:

▪ The information contained in or otherwise submitted with this application is true, complete, and not misleading to the best of my knowledge and belief;

▪ I understand that:

- Submitting false, incomplete, or misleading information is grounds for denying the application or revoking any award of ARM Funds that is made based on such information; and
- I am subject to the penalties for making unsworn false statements specified RSA 641:3 or any successor New Hampshire statute.

SIGNATURE: ____	**DATE:** _____ / _____/ _____

Lori.Sommer@des.nh.gov or (603) 271-4059
NHDES Wetlands Bureau, Concord, NH 03303-0095
www.des.nh.gov

Summary of Aquatic Resource(s) Involved in Project

The following information is required to be provided about the aquatic resources found on the proposed impact site and the mitigation site. New Hampshire RSA 482-A:3 requires a wetland permit for any proposed project that involves dredging and filling wetlands or impacts to the bed or bank surface waters such as rivers and streams. Before NHDES will issue a permit, applicants must demonstrate that their project proposal will avoid adverse impacts to aquatic resources and will minimize and mitigate those impacts that are unavoidable. When impacts to aquatic resources are unavoidable, applicants must identify the wetland and stream(s) resource types that will be lost during the development of the project. Identifying the functions and values of the aquatic resource that will be lost at the project site better ensures that they can be recreated and transferred to the proposed mitigation site. Please use the table formats provided below to document all aquatic resources types on the impact site and the mitigation site. A separate table should be prepared for each site. *Additional rows may be required for projects proposing impacts to multiple resource types.*

Wetland Resources: Wetlands shall be classified by US Fish and Wildlife Service Manual WS/OBS-79/31 Classification of Wetlands and Deepwater Habitats of the United States, Cowardin et al, 1979, reprinted 1992.

Stream Resources: For permittee responsible mitigation projects to restore or improve stream systems, the streams on the project site shall be reviewed and the following information collected to the best extent possible:

Stream order according to New Hampshire Hydrography Dataset (NHHD)	Geomorphology including degradation
Rosgen stream type	Position within the surrounding landscape
Impacts to upstream and downstream flooding	Connectivity improvement for aquatic organism passage
Stream bed materials	Fisheries presence
Sediment Transport capacity	Characterization of the adjacent buffers in terms of vegetative coverage
Channel form	Floodplain connectivity

These general principals are described within the New Hampshire Stream Crossing Guidelines, University of New Hampshire, May 2009.

Wetland Functions & Values: A wetland evaluation is the process of determining the values of a wetland based on an assessment of the functions it performs. The evaluation of wetland functions and values should be determined through use of the Method for Inventorying and Evaluating Freshwater Wetlands in New Hampshire, 2015 edition (2015 NH Method), available at http://nhmethod.org *–OR–* U.S. Army Corps of Engineers New England District highway methodology workbook supplement, 1999 edition (1999 US ACE Highway Workbook Supplement). The evaluation should focus on the following: Ecological Integrity (EI), Wetland-Dependent Wildlife Habitat (WH), Fish and Aquatic Habitat (FH), Scenic Quality (SQ), Educational Potential (EP), Wetland-based Recreation (WR), Flood Storage (FS), Groundwater (GW), Sediment Trapping (ST), Nutrient Trapping/Retention/Transformation (NT), Shoreline Anchoring (SA), Noteworthiness (NW).

Secondary Impacts: The Army Corps of Engineers federal mitigation guidance should be consulted if the project involves conversion of forested wetlands to scrub-shrub or emergent wetlands, cutting of riparian buffer and impacts within the buffer to vernal pools. The guidance can be found at: http://www.nae.usace.army.mil/Portals/74/docs/regulatory/Mitigation/CompensatoryMitigationGuidance.pdf.

WETLAND/STREAM RESOURCE SUMMARY

Wetland ID or Stream Number	**Cowardin Wetland Class** (list all that apply) **or Stream Type**	**Principal Functions & Values**	**Project Impacts**						**Vernal Pool Present? ID or Number**	**Other Comments**
			Permanent Wetland (sq.ft.)	**Permanent Stream Bank** (lin.ft.)			**Temporary** (sq.ft.)	**Secondary** (sq.ft.)		
				Bank Left	Bank Right	Channel				
			See Wetland Report for table of Project Impacts							

MITIGATION RESOURCE SUMMARY

Wetland ID or Stream Number	**Cowardin Wetland Class** (list all that apply) **or Stream Type**	**Principal Functions & Values**	**Wetland/Stream Resources**			**Vernal Pool Present? ID or Number**	**Other Comments**
			Area of Wetland (sq.ft. or acres)	**Streams** (lin.ft.)			
				Length on Property	% having 100 foot wooded zone		

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 =	5879.00
		43560.00
	Acres of impact =	0.1350
2	**Determine acreage of wetland construction:**	
	Forested wetlands:	0.2024
	Tidal wetlands:	0.4049
	All other areas:	0.2024
3	**Wetland construction cost:**	
	Forested wetlands:	$19,571.40
	Tidal Wetlands:	$39,142.80
	All other areas:	$19,571.40
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:	40318
	Forested wetlands:	$8,162.17
	Tidal wetlands:	$16,324.35
	All other areas:	$8,162.17
5	**Construction + land costs:**	
	Forested wetland:	$27,733.58
	Tidal wetlands:	$55,467.15
	All other areas:	$27,733.58
6	**NHDES Administrative cost:**	
	Forested wetlands:	$5,546.72
	Tidal wetlands:	$11,093.43
	All other areas:	$5,546.72
****************	**TOTAL ARM PAYMENT*************	
	Forested wetlands:	$33,280.29
	Tidal wetlands:	$66,560.58
	All other areas:	$33,280.29

Wetland Functional Assessment Worksheets

(Non-applicable assessment pages omitted)

Wetland 1

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.: NH 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 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 Written Narrative (NHDES-W-06-089) or 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 with 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: Field, highway (NH Route 101)	
CONTIGUOUS UNDEVELOPED BUFFER ZONE PRESENT? ☐ Yes ☒ No	
DISTANCE TO NEAREST ROADWAY OR OTHER DEVELOPMENT (in feet): < 10 feet	
SECTION 2 - DELINEATION (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)	
CERTIFIED WETLAND SCIENTIST (if in a non-tidal area) or QUALIFIED COASTAL PROFESSIONAL (if in a tidal area) who prepared this assessment: Lee Carbonneau (NH Certified Wetland Scientist #123)	
DATE(S) OF SITE VISIT(S): 7/28/2020	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 field 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: 1	LOCATION: (LAT/ LONG) 42.902947/-71.575378
WETLAND AREA: 700+ SqFt	DOMINANT WETLAND SYSTEMS PRESENT: PFO
HOW MANY TRIBUTARIES CONTRIBUTE TO THE WETLAND? 0	COWARDIN CLASS: PFO1
IS THE WETLAND A SEPARATE HYDRAULIC SYSTEM? ☐ Yes ☒ No if not, where does the wetland lie in the drainage basin? upper edge	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: 0 sf

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 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		☐ Yes ☒ No	Very small, adjacent to road
2	☐ Yes ☒ No		☐ Yes ☒ No	Parking nearby
3	☐ Yes ☒ No		☐ Yes ☒ No	No open water component or watercourse
4	☒ Yes ☐ No	5, 9	☐ Yes ☒ No	limted but basin shape
5	☒ Yes ☐ No	15	☐ Yes ☒ No	limited recharge
6	☐ Yes ☒ No		☐ Yes ☒ No	
7	☒ Yes ☐ No	3, 4	☐ Yes ☒ No	road runnoff
8	☐ Yes ☒ No		☐ Yes ☒ No	
9	☐ Yes ☒ No		☐ Yes ☒ No	
10	☒ Yes ☐ No	2, 3	☐ Yes ☒ No	road runnoff
11	☐ Yes ☒ No		☐ Yes ☒ No	
12	☐ Yes ☒ No		☐ Yes ☒ No	
13	☐ Yes ☒ No		☐ Yes ☒ No	
14	☐ Yes ☒ No		☐ Yes ☒ No	

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

☒ Wildlife and vegetation diversity/abundance list.

☒ Photograph of wetland attached.

☒ 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 for more information)

Wetland Functions and Values Data Sheet

Pulpit Brook

Amherst

Wetland ID:	Wetland 1	**Delineator(s):**	Jamie O'Brien
Cowardin Classification:	PFO1, 100%		
Number of Flags:	9	**Open Water:**	No
Wetland Open/Closed	Open	**Wetland Open Details**	6, 7
Associated Stream:	No	**Stream ID:**	N/A
Vernal Pool/Potential	No	**VP/PVP ID:**	N/A
Vernal Pool Identified:			
Wetland Description:	Road swale tied to culverts at toe of slope		

Functions and Values:

Groundwater Recharge/Discharge	Suitable
Floodflow Alteration	Suitable
Fish/Shellfish Habitat	No
Sediment/Toxicant Retention	Suitable
Nutrient Removal/Retention	Suitable
Sediment/Shoreline Stabilization	No
Production Export	No
Wildlife Habitat	No
Recreation	No
Education/Scientific Value	No
Uniqueness/Heritage	No
Visual Quality/Aesthetics	No
Rare/Threatened and Endangered Species	No
Other	No

Dominant Plants:

Tree
Acer rubrum

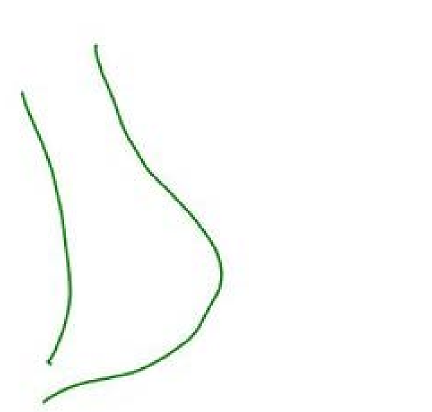
Sapling/ Shrub
Cornus amomum, Rosa multiflora

Herb/Seedling
Impatiens capensis, Solidago rugosa
Toxicodendron radicans, Phalaris arundinacea

Woody Vine

Invasives
Rosa multiflora, Phalaris arundinacea

Sketch:

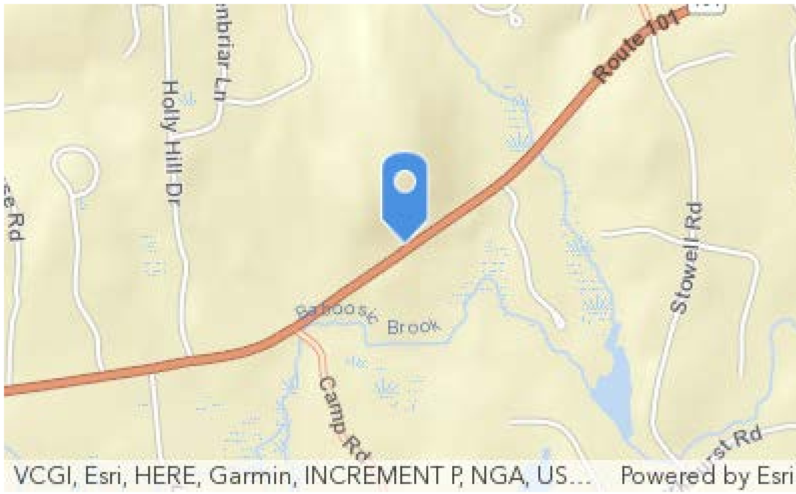


Soils:

Texture: Sandy Loam
Parent Material: Alluvium
Restrictive Layer: No
Hydric Soil Indicator(s):
Soil Notes:

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

Location:



Photos:

From culvert facing flag 3 (7/28/2020)

Near flag 3 facing open end of wetland (7/28/2020)

Wetland 2

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.: NH 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 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 Written Narrative (NHDES-W-06-089) or 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 with 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: Field, Highway (NH Route 101)	
CONTIGUOUS UNDEVELOPED BUFFER ZONE PRESENT? ☐ Yes ☒ No	
DISTANCE TO NEAREST ROADWAY OR OTHER DEVELOPMENT (in feet): 30 feet	
SECTION 2 - DELINEATION (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)	
CERTIFIED WETLAND SCIENTIST (if in a non-tidal area) or QUALIFIED COASTAL PROFESSIONAL (if in a tidal area) who prepared this assessment: Lee Carbonneau (NH Certified Wetland Scientist #123)	
DATE(S) OF SITE VISIT(S): 7/28/2020	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 field 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: 2	LOCATION: (LAT/ LONG) 42.903515/-71.573501
WETLAND AREA: 2,835+ SqFt	DOMINANT WETLAND SYSTEMS PRESENT: PEM
HOW MANY TRIBUTARIES CONTRIBUTE TO THE WETLAND? 0	COWARDIN CLASS: PEM/PFO1 (80/20)
IS THE WETLAND A SEPARATE HYDRAULIC SYSTEM? ☐ Yes ☒ No if not, where does the wetland lie in the drainage basin? High on edge of Baboosic Brook watershed	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: 0 sf

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 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		☐ Yes ☒ No	Mowed hayfield
2	☐ Yes ☒ No		☐ Yes ☐ No	Parking nearby
3	☐ Yes ☒ No		☐ Yes ☐ No	No open water component or watercourse
4	☐ Yes ☒ No		☐ Yes ☒ No	
5	☐ Yes ☒ No		☐ Yes ☒ No	groundwater discharge, no recharge
6	☐ Yes ☒ No		☐ Yes ☒ No	
7	☒ Yes ☐ No	3, 4, 8, 9	☒ Yes ☐ No	Road runoff - Wetland opens up into hay field
8	☐ Yes ☒ No		☐ Yes ☒ No	
9	☐ Yes ☒ No		☐ Yes ☒ No	
10	☒ Yes ☐ No	1, 2, 9	☒ Yes ☐ No	Road runoff
11	☐ Yes ☒ No		☐ Yes ☒ No	
12	☐ Yes ☒ No		☐ Yes ☒ No	
13	☐ Yes ☒ No	1, 10	☐ Yes ☒ No	Sledding hill in winter -not wetland dependent
14	☒ Yes ☐ No		☐ Yes ☒ No	wet meadow habitat

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

- [x] Wildlife and vegetation diversity/abundance list.
- [x] Photograph of wetland attached.
- [x] 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 for more information)

Wetland Functions and Values Data Sheet

Pulpit Brook

Amherst

Wetland ID:	Wetland 2	**Delineator(s):**	Jamie O'Brien
Cowardin Classification:	PEM/PFO1, 80/20%	**Date:**	7/28/2020
Number of Flags:	11	**Open Water:**	No
Wetland Open/Closed	Open	**Wetland Open Details**	3, 8x
Associated Stream:	No	**Stream ID:**	N/A
Vernal Pool/Potential	No	**VP/PVP ID:**	N/A
Vernal Pool Identified:			
Wetland Description:	Wetland at toe of slope thst runs into open field		

Functions and Values:

Groundwater Recharge/Discharge	Suitable
Floodflow Alteration	No
Fish/Shellfish Habitat	No
Sediment/Toxicant Retention	Principal
Nutrient Removal/Retention	Principal
Sediment/Shoreline Stabilization	No
Production Export	No
Wildlife Habitat	Suitable
Recreation	No
Education/Scientific Value	No
Uniqueness/Heritage	No
Visual Quality/Aesthetics	No
Rare/Threatened and Endangered Species	No
Other	No

Dominant Plants:

Tree

Sapling/ Shrub
Spiraea latifolia, Rosa multiflora

Herb/Seedling
Phalaris arundinacea, Onoclea sensibilis, Solidago rugose, Bromus sp.

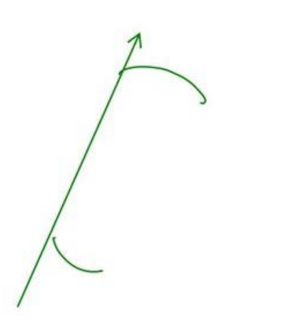
Woody Vine

Invasives
Black swallowwort, Rosa multiflora, oriental bittersweet, Phalaris arundinacea

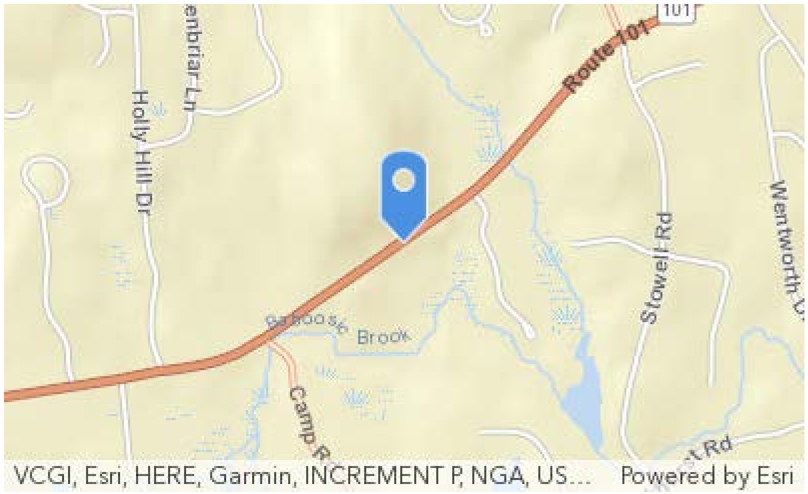
Soils:

Texture: Fine Sandy Loam
Parent Material: Alluvium
Restrictive Layer: Yes 6”
Hydric Soil Indicator(s): Depleted below dark surface
Soil Notes: None

Sketch:



Location:



Photos:

Facing flag 1 from open field edge (7/28/2020)

Wetland 3

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.: NH 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 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 Written Narrative (NHDES-W-06-089) or 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 with 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: Field, Highway (NH Route 101)	
CONTIGUOUS UNDEVELOPED BUFFER ZONE PRESENT? ☐ Yes ☒ No	
DISTANCE TO NEAREST ROADWAY OR OTHER DEVELOPMENT (in feet): 35 feet	
SECTION 2 - DELINEATION (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)	
CERTIFIED WETLAND SCIENTIST (if in a non-tidal area) or QUALIFIED COASTAL PROFESSIONAL (if in a tidal area) who prepared this assessment: Lee Carbonneau (NH Certified Wetland Scientist #123)	
DATE(S) OF SITE VISIT(S): 7/28/2020	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 field 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: 3	LOCATION: (LAT/ LONG) 42.902944/-71.574594
WETLAND AREA: 3,474+ SqFt	DOMINANT WETLAND SYSTEMS PRESENT: PEM
HOW MANY TRIBUTARIES CONTRIBUTE TO THE WETLAND? 0	COWARDIN CLASS: PEM/PFO1 (80/20)
IS THE WETLAND A SEPARATE HYDRAULIC SYSTEM? ☐ Yes ☒ No if not, where does the wetland lie in the drainage basin? High at edge of Baboosic Brook watershed	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: 0 sf

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 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		☐ Yes ☒ No	managed hayfield
2	☐ Yes ☒ No		☐ Yes ☐ No	Parking nearby
3	☐ Yes ☒ No		☐ Yes ☒ No	No open water component or watercourse
4	☐ Yes ☒ No		☐ Yes ☒ No	
5	☐ Yes ☒ No		☐ Yes ☒ No	
6	☐ Yes ☒ No		☐ Yes ☒ No	
7	☒ Yes ☐ No	3, 4, 8, 9	☒ Yes ☐ No	road runnoff treatment, wetland opens up into hay field
8	☐ Yes ☒ No		☐ Yes ☒ No	
9	☐ Yes ☒ No		☐ Yes ☒ No	
10	☒ Yes ☐ No	1, 2, 9	☒ Yes ☐ No	road runnoff treatment
11	☐ Yes ☒ No		☐ Yes ☒ No	
12	☐ Yes ☒ No		☐ Yes ☒ No	
13	☐ Yes ☒ No	1, 10	☐ Yes ☒ No	Sledding hill in winter, not wetland dependent
14	☒ Yes ☐ No	23	☐ Yes ☒ No	Bird house present, wet meadow

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

- [x] Wildlife and vegetation diversity/abundance list.
- [x] Photograph of wetland attached.
- [x] 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 for more information)

Wetland Functions and Values Data Sheet

Pulpit Brook

Amherst

Wetland ID:	Wetland 3	**Delineator(s):**	Jamie O'Brien
Cowardin Classification:	PEM1/PFO1, 80/20%	**Date:**	7/28/2020
Number of Flags:		**Open Water:**	No
Wetland Open/Closed	Open	**Wetland Open Details**	3, 4
Associated Stream:	No	**Stream ID:**	N/A
Vernal Pool/Potential	No	**VP/PVP ID:**	N/A
Vernal Pool Identified:			
Wetland Description:	Wetland at toe of slope extending into open field		

Functions and Values:

Groundwater Recharge/Discharge	Suitable
Floodflow Alteration	No
Fish/Shellfish Habitat	No
Sediment/Toxicant Retention	Principal
Nutrient Removal/Retention	Principal
Sediment/Shoreline Stabilization	No
Production Export	No
Wildlife Habitat	Suitable
Recreation	No
Education/Scientific Value	No
Uniqueness/Heritage	No
Visual Quality/Aesthetics	No
Rare/Threatened and Endangered Species	No
Other	No

Dominant Plants:

Tree
Acer rubrum

Sapling/ Shrub
Viburnum dentatum

Herb/Seedling
Toxicodendron radicans, persicaria sagitata, phalaris arundinacea, parthenosissus quinquefolia, solidago rugose, onoclea sensibilis, impatiens capensis, spotted joe-pye weed

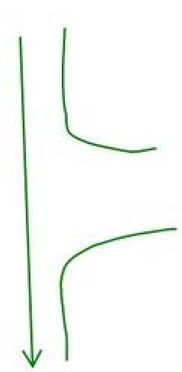
Woody Vine

Invasives
Rosa multifolora, lythrum salicaria, black swallowwort, oriental bittersweet, phalaris arundinacea

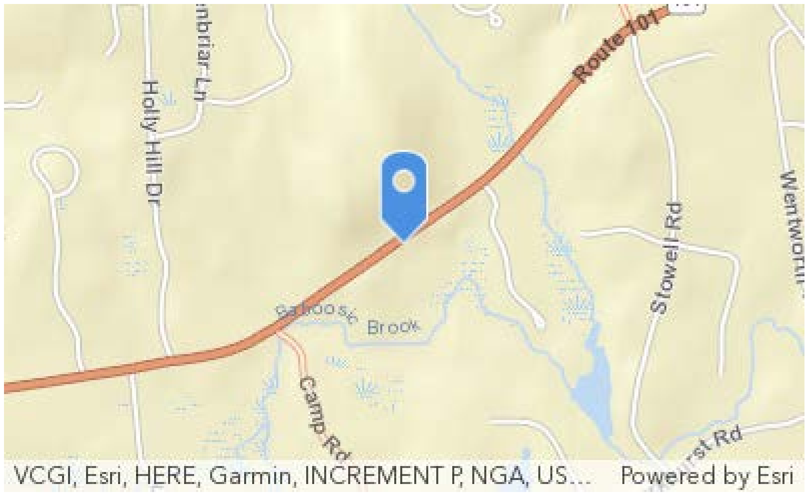
Soils:

Texture: Sandy Loam
Parent Material: Alluvium
Restrictive Layer: No
Hydric Soil Indicator(s):
Soil Notes:

Sketch:



Location:



Photos:

Looking north from open field edge to treeline/PFO portion of wetland (7/28/2020)

Wetland 4

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.: NH 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 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 Written Narrative (NHDES-W-06-089) or 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 with 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, Residential development, Highway (NH Route 101)	
CONTIGUOUS UNDEVELOPED BUFFER ZONE PRESENT? ☐ Yes ☒ No	
DISTANCE TO NEAREST ROADWAY OR OTHER DEVELOPMENT (in feet): 15 feet	
SECTION 2 - DELINEATION (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)	
CERTIFIED WETLAND SCIENTIST (if in a non-tidal area) or QUALIFIED COASTAL PROFESSIONAL (if in a tidal area) who prepared this assessment: Lee Carbonneau (NH Certified Wetland Scientist #123)	
DATE(S) OF SITE VISIT(S): 7/30/2020	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 field 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: 4	LOCATION: (LAT/ LONG) 42.904498/-71.570818
WETLAND AREA: 7,259+ SqFt	DOMINANT WETLAND SYSTEMS PRESENT: PUB
HOW MANY TRIBUTARIES CONTRIBUTE TO THE WETLAND? 0	COWARDIN CLASS: PSS/PUB (80/20)
IS THE WETLAND A SEPARATE HYDRAULIC SYSTEM? ☐ Yes ☒ No if not, where does the wetland lie in the drainage basin? At the edge of the Pulpit Brook watershed	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: temp disturb.	PROPOSED WETLAND IMPACT AREA: 213sf

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 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		☐ Yes ☒ No	Functional but man-made ponds near road and development
2	☐ Yes ☒ No		☐ Yes ☒ No	
3	☒ Yes ☐ No	10	☐ Yes ☒ No	No evidence of fish observed, but pond most likely does not freeze solid in winter
4	☒ Yes ☐ No	3, 5, 7, 8, 9	☒ Yes ☐ No	pond acts as detention basin
5	☒ Yes ☐ No	15	☐ Yes ☒ No	pond recharge possible
6	☐ Yes ☒ No		☐ Yes ☒ No	
7	☒ Yes ☐ No	2, 3, 4, 5	☒ Yes ☐ No	Stormwater detention, lawns
8	☒ Yes ☐ No	1, 12	☐ Yes ☒ No	detritus
9	☐ Yes ☒ No		☐ Yes ☒ No	very small
10	☒ Yes ☐ No	1, 2, 3, 5, 9	☒ Yes ☐ No	stormwater detention
11	☒ Yes ☐ No	3	☐ Yes ☒ No	pond shore is stable
12	☐ Yes ☒ No		☐ Yes ☒ No	
13	☐ Yes ☒ No		☐ Yes ☒ No	
14	☒ Yes ☐ No	8, 19, 20	☐ Yes ☒ No	

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

☒ Wildlife and vegetation diversity/abundance list.

☒ Photograph of wetland attached.

☒ 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 for more information)

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

Wetland Functions and Values Data Sheet

Pulpit Brook

Amherst

Wetland ID:	Wetland 4	**Delineator(s):**	Lee Carbonneau
Cowardin Classification:	PUB, 100		
Number of Flags:	13	**Open Water:**	Yes
Wetland Open/Closed	Open	**Wetland Open Details**	1, 13
Associated Stream:	No	**Stream ID:**	N/A
Vernal Pool/Potential	No	**VP/PVP ID:**	N/A
Vernal Pool Identified:			
Wetland Description:	Constructed pond		

Functions and Values:

Groundwater Recharge/Discharge	Suitable
Floodflow Alteration	Principal
Fish/Shellfish Habitat	Suitable
Sediment/Toxicant Retention	Principal
Nutrient Removal/Retention	Principal
Sediment/Shoreline Stabilization	Suitable
Production Export	Suitable
Wildlife Habitat	Suitable
Recreation	No
Education/Scientific Value	No
Uniqueness/Heritage	No
Visual Quality/Aesthetics	No
Rare/Threatened and Endangered Species	No
Other	No

Dominant Plants:

Tree

Sapling/ Shrub
Vaccinium corymbosum, Acer rubrum, Spiraea latifolia

Herb/Seedling
Typha latifolia, Lythrum salicaria, Impatiens capensis, Onoclea sensibilis, Juncus effusus Solidago rugose, Phalaris arundinacea, Rubus hispidus, Eutrochium maculatum, Carex scoparia, Elymus virginicus

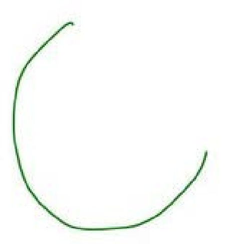
Woody Vine
Celastrus orbiculatus

Invasives
Lythrum salicaria, Celastrus orbiculatus, Phalaris arundinacea

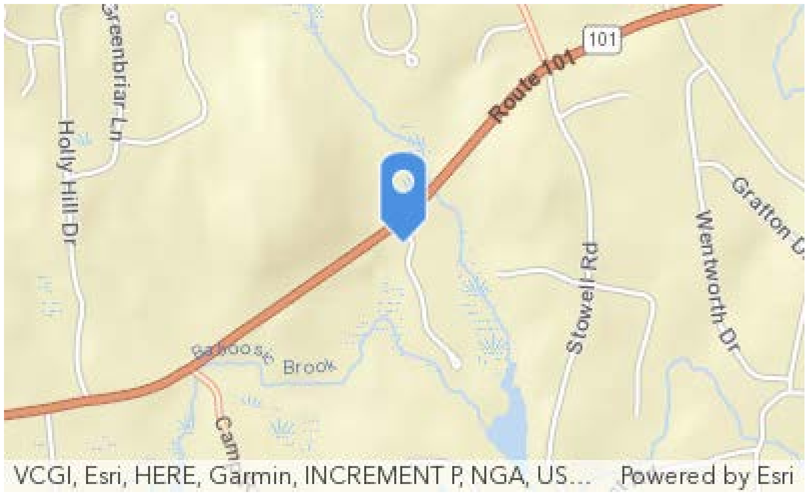
Soils:

Texture:	Sandy loam
Parent Material:	Alluvium
Restrictive Layer:	No
Hydric Soil Indicator(s):	
Soil Notes:	

Sketch:



Location:



Photos:

From road culvert facing open (7/30/2020)

Wetland 5

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.: NH 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 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 Written Narrative (NHDES-W-06-089) or 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 with 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, Residential development, Highway (NH Route 101)	
CONTIGUOUS UNDEVELOPED BUFFER ZONE PRESENT? ☐ Yes ☒ No	
DISTANCE TO NEAREST ROADWAY OR OTHER DEVELOPMENT (in feet): 20 feet	
SECTION 2 - DELINEATION (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)	
CERTIFIED WETLAND SCIENTIST (if in a non-tidal area) or QUALIFIED COASTAL PROFESSIONAL (if in a tidal area) who prepared this assessment: Lee Carbonneau (NH Certified Wetland Scientist #123)	
DATE(S) OF SITE VISIT(S): 7/30/2020	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 field 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: 5	LOCATION: (LAT/ LONG) 42.906036/-71.569063
WETLAND AREA: 32,128+ SqFt	DOMINANT WETLAND SYSTEMS PRESENT: PFO1, Riverine
HOW MANY TRIBUTARIES CONTRIBUTE TO THE WETLAND? 0	COWARDIN CLASS: PFO/PUB (80/20)
IS THE WETLAND A SEPARATE HYDRAULIC SYSTEM? ☐ Yes ☒ No if not, where does the wetland lie in the drainage basin? Low in the Pulpit Brook watershed, just above confluence with Baboosic Brook	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: Fill and restoration	PROPOSED WETLAND IMPACT AREA: 8748 sf P

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 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		☐ Yes ☒ No	Functional but disturbed
2	☐ Yes ☒ No		☐ Yes ☒ No	
3	☒ Yes ☐ No	1, 4, 7, 8, 10, 12, 14, 17	☐ Yes ☒ No	Tier 3 perennial stream
4	☒ Yes ☐ No	5, 7, 8, 9, 10, 13	☒ Yes ☐ No	FEMA floodplain
5	☒ Yes ☐ No	7, 9, 15	☒ Yes ☐ No	Constricted culvert;
6	☐ Yes ☒ No		☐ Yes ☒ No	
7	☒ Yes ☐ No	2, 3, 4, 5, 13	☒ Yes ☐ No	Constricted culvert,
8	☒ Yes ☐ No	1, 4	☐ Yes ☒ No	Vernal pools within wetland
9	☐ Yes ☒ No		☐ Yes ☒ No	
10	☒ Yes ☐ No	1, 2, 3, 5, 9, 10, 12	☒ Yes ☐ No	road runnoff, perennial stream, vegetation
11	☒ Yes ☐ No	3	☐ Yes ☒ No	stable streambanks
12	☐ Yes ☒ No		☐ Yes ☒ No	
13	☐ Yes ☒ No		☐ Yes ☒ No	

14	☒ Yes ☐ No	4, 5, 6, 8, 19, 20	☒ Yes ☐ No	Vernal pool species present

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 NHF&G; 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	5/9/2018	spotted salamander	caddisfly larvae, orb snail, mayfly larvae, water mites		5 egg masses present (mature); Route 101 is landscape barrier
2	5/9/2018	spotted salamander	fingernail clam, mayfly larvae, caddisfy larvae		2 egg masses present (mature); Route 101 is landscape barrier
3					
4					
5					
6					
7					

8					

SECTION 6 - STREAM RESOURCES SUMMARY

DESCRIPTION OF STREAM: Stream 2 - Tier 3, Pulpit Brook

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: FEMA Floodplain

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		☐ Yes ☐ No	
2	☐ Yes ☒ No		☐ Yes ☒ No	
3	☒ Yes ☐ No	1,4,8,10,14,16	☐ Yes ☒ No	Aquatic habitat, maybe fish
4	☒ Yes ☐ No	6,7,8,10,13,14,15	☒ Yes ☐ No	FEMA floodway; downstream culvert
5	☒ Yes ☐ No	2,7,9,15	☐ Yes ☒ No	Likely discharge and recharge
6	☐ Yes ☒ No		☐ Yes ☒ No	possible Blandings turtles but stream is not habitat
7	☐ Yes ☒ No	10,11	☐ Yes ☒ No	
8	☒ Yes ☐ No	10	☐ Yes ☒ No	
9	☐ Yes ☒ No		☐ Yes ☒ No	Noisy inaccessible
10	☐ Yes ☒ No	1,10	☐ Yes ☒ No	
11	☒ Yes ☐ No	3,4,6,9,12	☐ Yes ☒ No	really the adjacent wetland is the stablizing feature
12	☐ Yes ☒ No		☐ Yes ☒ No	Blandings turtles possible, stream is not habitat

13	☐ Yes ☒ No		☐ Yes ☒ No	
14	☒ Yes ☐ No	5,6,7,19	☐ Yes ☒ No	poor WQ for fish

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

☒ Wildlife and vegetation diversity/abundance list.

☒ Photograph of wetland attached.

☒ 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 for more information)

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

Wetland Functions and Values Data Sheet

Pulpit Brook

Amherst

Wetland ID:	Wetland 5	**Delineator(s):**	Lee Carbonneau
Cowardin Classification:	PFO/PUB, 80/20%		
Number of Flags:		**Open Water:**	Yes
Wetland Open/Closed	Open	**Wetland Open Details**	1
Associated Stream:	No	**Stream ID:**	N/A
Vernal Pool/Potential	Yes	**VP/PVP ID:**	VP1, VP2
Vernal Pool Identified:			
Wetland Description:	Forested wetland with open water component		

Functions and Values:

Groundwater Recharge/Discharge	Principal
Floodflow Alteration	Principal
Fish/Shellfish Habitat	Suitable
Sediment/Toxicant Retention	Principal
Nutrient Removal/Retention	Principal
Sediment/Shoreline Stabilization	Suitable
Production Export	Suitable
Wildlife Habitat	Principal
Recreation	No
Education/Scientific Value	No
Uniqueness/Heritage	No
Visual Quality/Aesthetics	No
Rare/Threatened and Endangered Species	No
Other	No

Dominant Plants:

Tree
Acer rubrum

Sapling/ Shrub
Cephalanthus occidentalis, Sambucus nigra, Spiraea latifolia, Alnus incana, Vaccinium corymbosum

Herb/Seedling
Solidago rugose, Rubus hispidus, Onoclea sensibilis, Carex stricta, Phalaris arundinacea, Impatiens capensis, royal fern

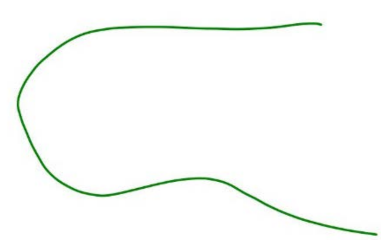
Woody Vine
Parthenocissus quinquefolia, Clematis virginiana, Celastrus orbiculatus

Invasives
Phalaris arundinacea, Celastrus orbiculatus, Cuscuta japonica

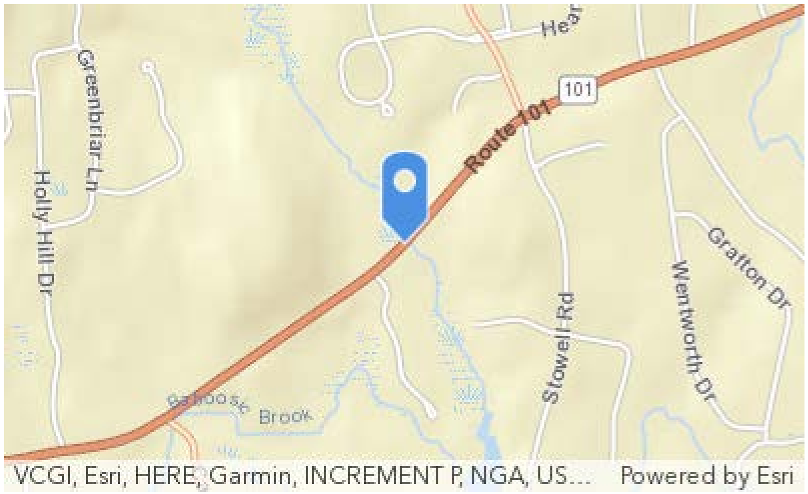
Soils:

Texture:	Sandy loam
Parent Material:	Alluvium
Restrictive Layer:	No
Hydric Soil Indicator(s):	
Soil Notes:	

Sketch:



Location:



Photos:

Between flags 7 and 8 facing headwall (7/30/2020)

From flag 16 facing culvert (7/30/2020)

From flag 5x near headwall (7/30/2020)

Wetland 6

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.: NH 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 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 Written Narrative (NHDES-W-06-089) or 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 with 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, Residential development, Highway (NH Route 101)	
CONTIGUOUS UNDEVELOPED BUFFER ZONE PRESENT? ☐ Yes ☒ No	
DISTANCE TO NEAREST ROADWAY OR OTHER DEVELOPMENT (in feet): 15 feet	
SECTION 2 - DELINEATION (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)	
CERTIFIED WETLAND SCIENTIST (if in a non-tidal area) or QUALIFIED COASTAL PROFESSIONAL (if in a tidal area) who prepared this assessment: Lee Carbonneau (NH Certified Wetland Scientist #123)	
DATE(S) OF SITE VISIT(S): 7/30/2020	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 field 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: 6	LOCATION: (LAT/ LONG) 42.904827/-71.570145
WETLAND AREA: 28,279+ SqFt	DOMINANT WETLAND SYSTEMS PRESENT: PUB/PFO
HOW MANY TRIBUTARIES CONTRIBUTE TO THE WETLAND? 0	COWARDIN CLASS: PUB/PFO (70/30)
IS THE WETLAND A SEPARATE HYDRAULIC SYSTEM? ☐ Yes ☒ No if not, where does the wetland lie in the drainage basin? edge of Pulpit Brook watershed	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: Temp dist.	PROPOSED WETLAND IMPACT AREA: 184 sf

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 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		☐ Yes ☒ No	man made, adjacent to development
2	☐ Yes ☒ No		☐ Yes ☒ No	
3	☒ Yes ☐ No	10	☐ Yes ☒ No	No evidence of fish observed, but pond most likely does not freeze solid in winter
4	☒ Yes ☐ No	3, 5, 7, 8, 9	☒ Yes ☐ No	Pond and adjacent wetland are in floodplain, have capacity
5	☒ Yes ☐ No	15	☐ Yes ☒ No	recharge and discharge
6	☐ Yes ☒ No		☐ Yes ☒ No	
7	☒ Yes ☐ No	2, 3, 4, 5	☒ Yes ☐ No	pond sediments and dense wetland vegetation
8	☒ Yes ☐ No	1, 12	☐ Yes ☒ No	
9	☐ Yes ☒ No	2,9	☐ Yes ☒ No	accessible but noisy, small
10	☒ Yes ☐ No	1, 2, 3, 5, 9	☐ Yes ☒ No	pond acts as detention basin
11	☒ Yes ☐ No	3,6,12,15	☒ Yes ☐ No	Dense pond shoreline vegetation
12	☐ Yes ☒ No		☐ Yes ☒ No	
13	☐ Yes ☒ No		☐ Yes ☒ No	
14	☒ Yes ☐ No	8, 19, 20	☐ Yes ☒ No	small pond, for amphibians,

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

- [x] Wildlife and vegetation diversity/abundance list.
- [x] Photograph of wetland attached.
- [x] 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 for more information)

Wetland Functions and Values Data Sheet

Pulpit Brook

Amherst

Wetland ID:	Wetland 6	**Delineator(s):**	Lee Carbonneau
Cowardin Classification:	PUB/PFO, 80/20%		
Number of Flags:	27	**Open Water:**	Yes
Wetland Open/Closed	Open	**Wetland Open Details**	1
Associated Stream:	No	**Stream ID:**	N/A
Vernal Pool/Potential	No	**VP/PVP ID:**	N/A
Vernal Pool Identified:			
Wetland Description:	Pond extending into woods		

Functions and Values:

Groundwater Recharge/Discharge	Suitable
Floodflow Alteration	Principal
Fish/Shellfish Habitat	Suitable
Sediment/Toxicant Retention	Suitable
Nutrient Removal/Retention	Principal
Sediment/Shoreline Stabilization	Principal
Production Export	Suitable
Wildlife Habitat	Suitable
Recreation	No
Education/Scientific Value	No
Uniqueness/Heritage	No
Visual Quality/Aesthetics	No
Rare/Threatened and Endangered Species	No
Other	No

Dominant Plants:

Tree
acer rubrum

Sapling/ Shrub
silky dogwood, speckled alder, winterberry, high bush blueberry, maleberry, spirae latifolia, spiraea tomentosa

Herb/Seedling
Royal fern, typha latifolia, carex stricta, interrupted fern, rubus hispidus, solidago rugosa, impatiens capensis, stinging nettle, sensitive fern

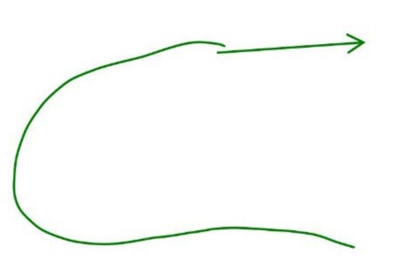
Woody Vine

Invasives

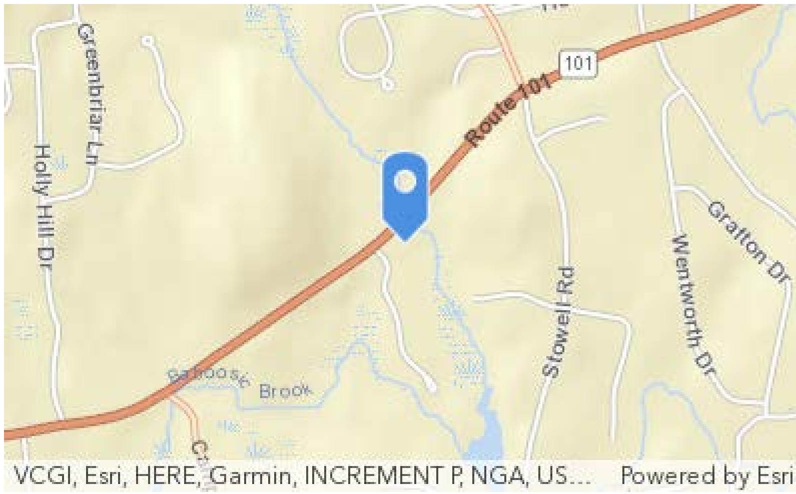
Soils:

Texture:	Sandy loam
Parent Material:	Alluvium
Restrictive Layer:	No
Hydric Soil Indicator(s):	
Soil Notes:	

Sketch:



Location:



Photos:

Flag 10 facing entrance road (7/30/2020)

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

Near open flag facing woods (7/30/2020)

Wetland 7

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.: NH 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 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 Written Narrative (NHDES-W-06-089) or 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 with 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, Recent construction to east	
CONTIGUOUS UNDEVELOPED BUFFER ZONE PRESENT? ☐ Yes ☒ No	
DISTANCE TO NEAREST ROADWAY OR OTHER DEVELOPMENT (in feet): 185 feet	
SECTION 2 - DELINEATION (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)	
CERTIFIED WETLAND SCIENTIST (if in a non-tidal area) or QUALIFIED COASTAL PROFESSIONAL (if in a tidal area) who prepared this assessment: Lee Carbonneau (NH Certified Wetland Scientist #123)	
DATE(S) OF SITE VISIT(S): 7/30/2020	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 field 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: 7	LOCATION: (LAT/ LONG) 42.906185/-71.568385
WETLAND AREA: 486+ SqFt	DOMINANT WETLAND SYSTEMS PRESENT: PFO
HOW MANY TRIBUTARIES CONTRIBUTE TO THE WETLAND? 0	COWARDIN CLASS: PFO1
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: 0 sf

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 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		☐ Yes ☐ No	
2	☐ Yes ☒ No		☐ Yes ☐ No	
3	☐ Yes ☒ No		☐ Yes ☐ No	
4	☐ Yes ☒ No		☐ Yes ☐ No	
5	☒ Yes ☐ No	15	☐ Yes ☐ No	
6	☐ Yes ☒ No		☐ Yes ☐ No	
7	☒ Yes ☐ No	3, 4	☐ Yes ☐ No	
8	☐ Yes ☒ No		☐ Yes ☐ No	
9	☐ Yes ☒ No		☐ Yes ☐ No	
10	☒ Yes ☐ No	1, 2, 9	☐ Yes ☐ No	
11	☐ Yes ☒ No		☐ Yes ☐ No	
12	☐ Yes ☒ No		☐ Yes ☐ No	
13	☐ Yes ☒ No		☐ Yes ☐ No	
14	☒ Yes ☐ No	1, 3, 20	☐ Yes ☐ No	Potential vernal pool present (outside of project area)

SECTION 7 - ATTACHMENTS (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)
[X] Wildlife and vegetation diversity/abundance list.
[X] Photograph of wetland attached.
[X] 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 for more information)

Wetland Functions and Values Data Sheet

Pulpit Brook

Amherst

Wetland ID:	Wetland 7	**Delineator(s):**	Jamie O'Brien
Cowardin Classification:	PFO, 100%		
Number of Flags:	7	**Open Water:**	No
Wetland Open/Closed	Open	**Wetland Open Details**	1, 7
Associated Stream:	No	**Stream ID:**	N/A
Vernal Pool/Potential	No	**VP/PVP ID:**	N/A
Vernal Pool Identified:			
Wetland Description:	Small wetland continues off project area into larger wetland, possible pvp		

Functions and Values:

Groundwater Recharge/Discharge	Suitable
Floodflow Alteration	No
Fish/Shellfish Habitat	No
Sediment/Toxicant Retention	Suitable
Nutrient Removal/Retention	Suitable
Sediment/Shoreline Stabilization	No
Production Export	No
Wildlife Habitat	Suitable
Recreation	No
Education/Scientific Value	No
Uniqueness/Heritage	No
Visual Quality/Aesthetics	No
Rare/Threatened and Endangered Species	No
Other	No

Dominant Plants:

Tree
Acer rubrum

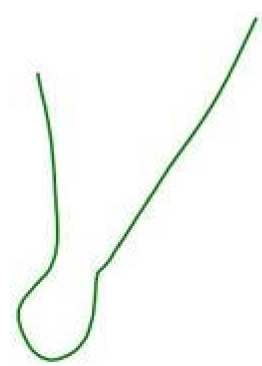
Sapling/ Shrub

Herb/Seedling
Osmunda claytoniana

Woody Vine

Invasives

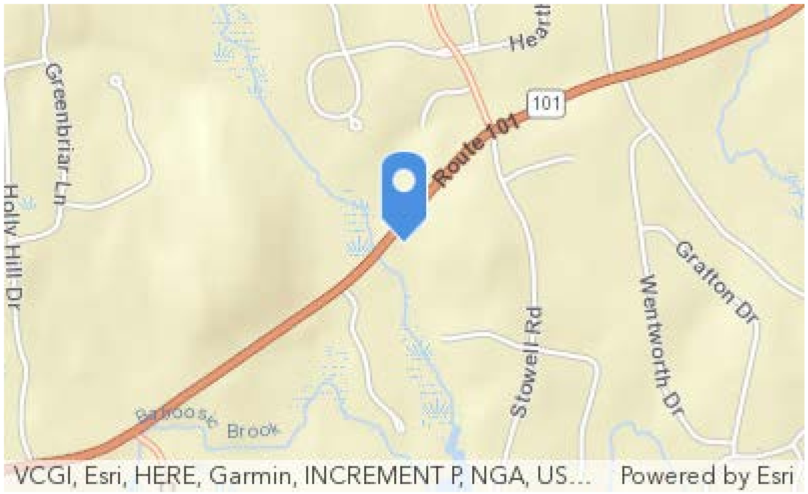
Sketch:



Soils:

Texture:	Sandy loam
Parent Material:	Alluvium
Restrictive Layer:	No
Hydric Soil Indicator(s):	
Soil Notes:	

Location:



Photos:

Near flag 3 facing open/PVP area (7/30/2020)

Wetland 8
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.: NH 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 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 Written Narrative (NHDES-W-06-089) or 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 with 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, Residential development, Highway (NH Route 101)	
CONTIGUOUS UNDEVELOPED BUFFER ZONE PRESENT? ☐ Yes ☒ No	
DISTANCE TO NEAREST ROADWAY OR OTHER DEVELOPMENT (in feet): 20 feet	
SECTION 2 - DELINEATION (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)	
CERTIFIED WETLAND SCIENTIST (if in a non-tidal area) or QUALIFIED COASTAL PROFESSIONAL (if in a tidal area) who prepared this assessment: Lee Carbonneau (NH Certified Wetland Scientist #123)	
DATE(S) OF SITE VISIT(S): 11/2016, 11/2018	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 field 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: 8	LOCATION: (LAT/ LONG) 42.906024/-71.569943
WETLAND AREA: 1,809.7+ SqFt	DOMINANT WETLAND SYSTEMS PRESENT: PEM/PSS, Riverine
HOW MANY TRIBUTARIES CONTRIBUTE TO THE WETLAND? 1	COWARDIN CLASS: PEM2B/PSS1B, R2UB2/4
IS THE WETLAND A SEPARATE HYDRAULIC SYSTEM? ☐ Yes ☒ No if not, where does the wetland lie in the drainage basin? Low in the Pulpit Brook watershed, just above confluence with Baboosic Brook	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: Temp. E&S	PROPOSED WETLAND IMPACT AREA: 181sf

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 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		☐ Yes ☒ No	Functional but disturbed
2	☐ Yes ☒ No		☐ Yes ☒ No	
3	☒ Yes ☐ No	1, 4, 7, 8, 10, 12, 14, 16, 17	☐ Yes ☒ No	Tier 3 perennial stream
4	☒ Yes ☐ No	1, 5, 7, 8, 9, 10, 13	☒ Yes ☐ No	FEMA floodplain
5	☒ Yes ☐ No	7, 15	☒ Yes ☐ No	
6	☐ Yes ☒ No		☐ Yes ☒ No	
7	☒ Yes ☐ No	1, 2, 3, 4, 5, 10, 14	☒ Yes ☐ No	
8	☒ Yes ☐ No	1, 4	☐ Yes ☒ No	Spotted salamander eggs in wetland
9	☐ Yes ☒ No		☐ Yes ☒ No	
10	☒ Yes ☐ No	1, 2, 3, 5, 9, 10, 12	☒ Yes ☐ No	road runnoff, perennial stream, vegetation
11	☒ Yes ☐ No	3	☐ Yes ☒ No	stable streambanks
12	☐ Yes ☒ No		☐ Yes ☒ No	
13	☐ Yes ☒ No		☐ Yes ☒ No	

13	☐ Yes ☐ No		☐ Yes ☐ No	
14	☒ Yes ☐ No	4,5,6,8,19,20	☒ Yes ☐ No	large marsh/shrub wetland

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

☒ Wildlife and vegetation diversity/abundance list.

☒ Photograph of wetland attached.

☒ 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 for more information)

See PBW5 for Pulpit Brook Stream F&V Assessment

Wetland Functions and Values Data Sheet

Pulpit Brook

Amherst

Wetland ID:	Wetland 8	**Delineator(s):**	Vicki Chase
Cowardin Classification:			
Number of Flags:		**Open Water:**	Yes
Wetland Open/Closed	Open	**Wetland Open Details**	
Associated Stream:	Yes	**Stream ID:**	Pulpit Brook
Vernal Pool/Potential	No	**VP/PVP ID:**	N/A
Vernal Pool Identified:			
Wetland Description:	Scrub-shrub and emergent wetland surrounding Pulpit Brook		

Functions and Values:

Groundwater Recharge/Discharge	Principal
Floodflow Alteration	Principal
Fish/Shellfish Habitat	Suitable
Sediment/Toxicant Retention	Principal
Nutrient Removal/Retention	Principal
Sediment/Shoreline Stabilization	Suitable
Production Export	Suitable
Wildlife Habitat	Principal
Recreation	No
Education/Scientific Value	No
Uniqueness/Heritage	No
Visual Quality/Aesthetics	No
Rare/Threatened and Endangered Species	No
Other	No

Dominant Plants:

Tree

Sapling/ Shrub
Alnus incana

Herb/Seedling
Carex stricta, Phalaris arundinacea, Sparganium sp., Pontederia cordata

Woody Vine

Invasives
Lythrum salicaria

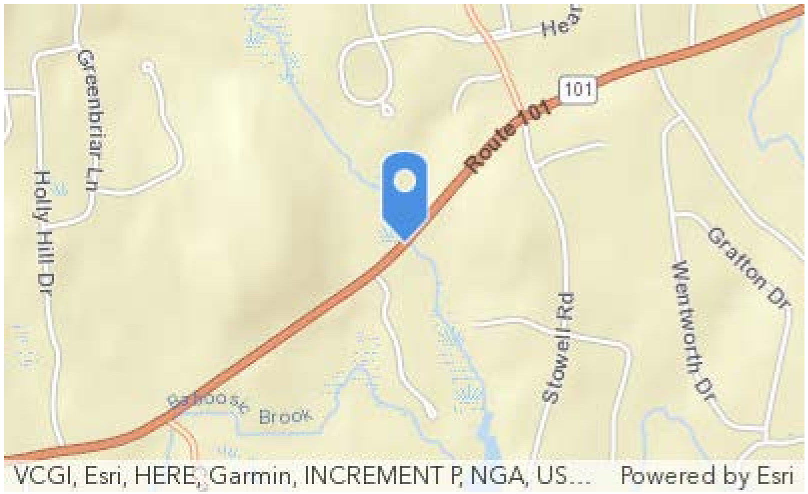
Sketch:

Soils:

Texture:
Parent Material:
Restrictive Layer:
Hydric Soil Indicator(s):
Soil Notes:

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

Location:



Photos:

Facing north from culvert headwall (5/9/2018)

Facing northwest near NH Route 101 (5/9/2018)

Facing southwest along NH Route 101 (5/9/2018)

Facing headwall and NH Route 101 from W8 (6/16/2017)

Close up of vegetation near culvert (6/16/2017)

Wetland 11

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.: NH 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 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 Written Narrative (NHDES-W-06-089) or 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 with 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: Field, highway (NH Route 101)	
CONTIGUOUS UNDEVELOPED BUFFER ZONE PRESENT? ☐ Yes ☒ No	
DISTANCE TO NEAREST ROADWAY OR OTHER DEVELOPMENT (in feet): < 10 feet	
SECTION 2 - DELINEATION (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)	
CERTIFIED WETLAND SCIENTIST (if in a non-tidal area) or QUALIFIED COASTAL PROFESSIONAL (if in a tidal area) who prepared this assessment: Lee Carbonneau (NH Certified Wetland Scientist #123)	
DATE(S) OF SITE VISIT(S): 11/15/2018	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 field 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: 11	LOCATION: (LAT/ LONG) 42.904232, /-71.572681
WETLAND AREA: 5111 SqFt	DOMINANT WETLAND SYSTEMS PRESENT: PFO
HOW MANY TRIBUTARIES CONTRIBUTE TO THE WETLAND? 0	COWARDIN CLASS: PEM1E
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: temp stream impacts	PROPOSED WETLAND IMPACT AREA: 91 sf

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 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		☐ Yes ☒ No	Very small, adjacent to road and develpoment
2	☐ Yes ☒ No		☐ Yes ☒ No	
3	☐ Yes ☒ No		☐ Yes ☒ No	No open water component; adjacent to intermittent stream
4	☒ Yes ☐ No	4, 5, 6, 7, 8, 9	☐ Yes ☒ No	
5	☒ Yes ☐ No	4, 11	☐ Yes ☒ No	wetland outlet constricted by culvert
6	☐ Yes ☒ No		☐ Yes ☒ No	
7	☐ Yes ☒ No	4, 11	☐ Yes ☒ No	
8	☐ Yes ☒ No	4, 7	☐ Yes ☒ No	
9	☐ Yes ☒ No		☐ Yes ☒ No	
10	☒ Yes ☐ No	1, 2, 10, 11, 16	☐ Yes ☒ No	
11	☐ Yes ☒ No	2, 4	☐ Yes ☒ No	
12	☐ Yes ☒ No		☐ Yes ☒ No	
13	☐ Yes ☒ No		☐ Yes ☒ No	
14	☐ Yes ☒ No	10	☐ Yes ☒ No	

SECTION 6 - STREAM RESOURCES SUMMARY	
DESCRIPTION OF STREAM: Stream 1, Intermittent	STREAM TYPE (ROSGEN):
HAVE FISHERIES BEEN DOCUMENTED? ☐ Yes ☒ No	DOES THE STREAM SYSTEM APPEAR STABLE? ☒ Yes ☐ No
OTHER KEY ON-SITE FUNCTIONS OF NOTE:	
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		☐ Yes ☒ No	
2	☐ Yes ☒ No		☐ Yes ☒ No	
3	☐ Yes ☒ No		☐ Yes ☒ No	
4	☐ Yes ☒ No		☐ Yes ☒ No	
5	☒ Yes ☐ No		☐ Yes ☒ No	
6	☐ Yes ☒ No		☐ Yes ☒ No	
7	☐ Yes ☒ No		☐ Yes ☒ No	
8	☐ Yes ☒ No		☐ Yes ☒ No	
9	☐ Yes ☒ No		☐ Yes ☒ No	
10	☐ Yes ☒ No		☐ Yes ☒ No	
11	☐ Yes ☒ No		☐ Yes ☒ No	
12	☐ Yes ☒ No		☐ Yes ☒ No	
13	☐ Yes ☒ No		☐ Yes ☒ No	
14	☐ Yes ☒ No		☐ Yes ☒ No	

SECTION 7 - ATTACHMENTS (USACE HIGHWAY METHODOLOGY; Env-Wt 311.10)
☐ Wildlife and vegetation diversity/abundance list.
☐ Photograph of wetland attached.
☒ 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 for more information)

Wetland Functions and Values Data Sheet

Pulpit Brook

Bedford, NH

Wetland ID:	Wetland 11	**Delineator(s):**	Ben Griffith
Cowardin Classification:	PEM1E, 100%	**Survey Date:**	November 14, 2018
Number of Flags:	6	**Open Water:**	No
Wetland Open/Closed	Closed	**Wetland Open Details**	
Associated Stream:	Yes	**Stream ID:**	S1
Vernal Pool/Potential	No	**VP/PVP ID:**	
Vernal Pool Identified:			
Wetland Description:	small wetland on flat along stream		

Functions and Values:

Groundwater Recharge/Discharge	Suitable
Floodflow Alteration	Suitable
Fish/Shellfish Habitat	No
Sediment/Toxicant Retention	Suitable
Nutrient Removal/Retention	No
Production Export	No
Sediment/Shoreline Stabilization	No
Wildlife Habitat	No
Recreation	No
Education/Scientific Value	No
Uniqueness/Heritage	No
Visual Quality/Aesthetics	No
Rare/Threatened and Endangered Species	No
Other	No

Dominant Plants:

Tree

Sapling/ Shrub

Herb/Seedling

Calamagrostis canadensis Dactylis glomerata Onoclea sensibilis

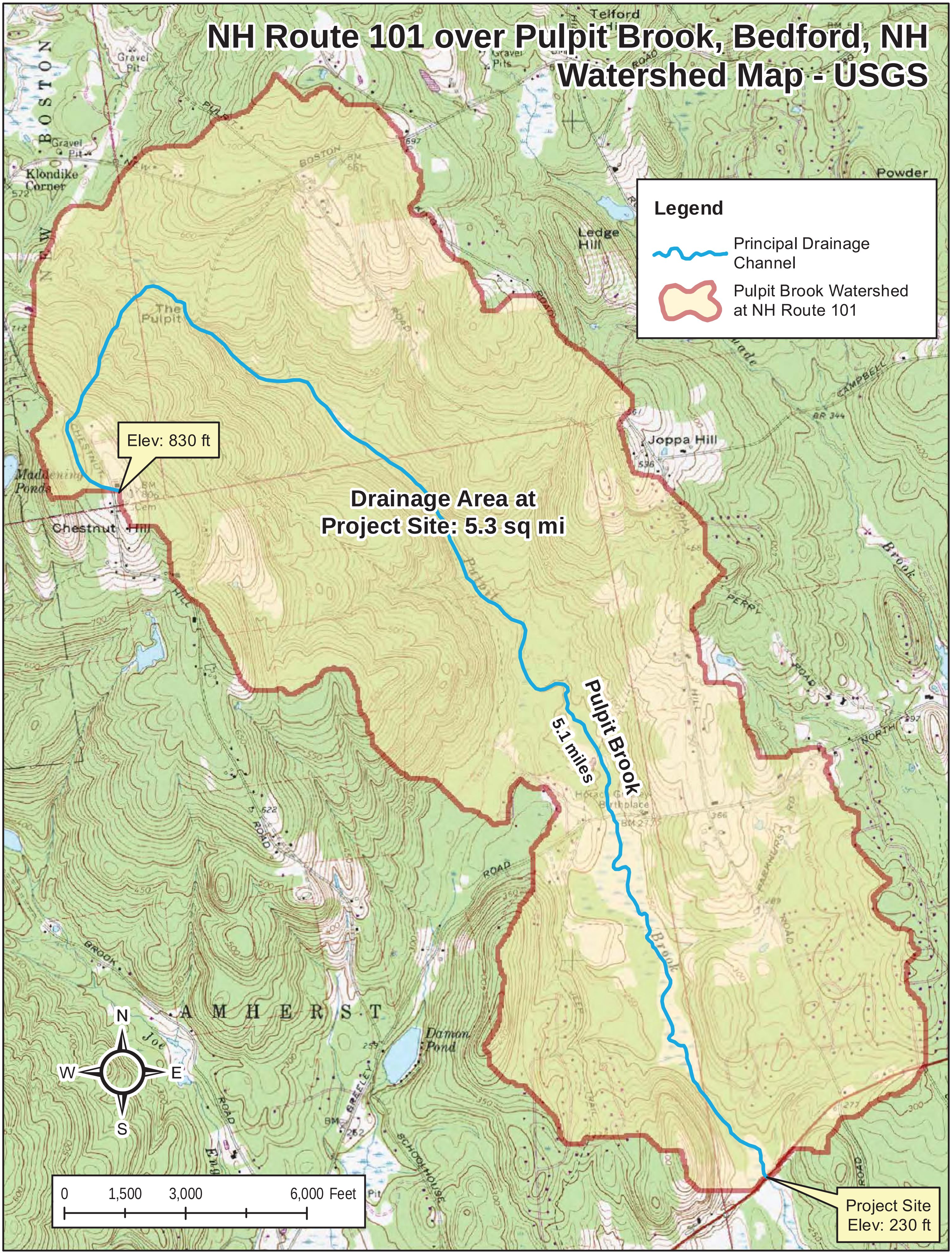
Woody Vine

Invasives

Soils:

Texture: Loamy
Parent Material: Till
Restrictive Layer: No
Hydric Soil Indicator(s):
Soil Notes:

USGS Map with Watershed Boundaries


NH Route 101 over Pulpit Brook, Bedford, NH
Watershed Map - USGS
Legend
Principal Drainage Channel
Pulpit Brook Watershed at NH Route 101
Elev: 830 ft
Drainage Area at Project Site: 5.3 sq mi
Pulpit Brook
5.1 miles
Project Site
Elev: 230 ft
N
S
E
W
0
1,500
3,000
6,000 Feet
Telford
Klondike Corner
Ledge Hill
Joppa Hill
Chestnut Hill
Powder
The Pulpit
Maddening Ponds
Damon Pond
A M H E R S T
B O S T O N

NH Department of Transportation
Tier 3 Stream Form

NH Department of Transportation
Bureau of Highway Design
Bedford – Rt. 101 Crossing of Pulpit Brook, 13692C #

Env-Wt 904.05 Design Criteria for Tier 2 and Tier 3 Stream Crossings
New Tier 2 Crossings;
Replacement Tier 2 Crossings that have a history of flooding;
New & Replacement Tier 3 Crossings

Please describe how the project meets the following criteria:

(a) The crossing shall be designed in accordance with the NH Stream Crossing Guidelines.
Hydraulic and geomorphologic surveys were completed by Headwaters Hydrology and the selected bridge design developed based on the flood-prone width and entrenchment ratio of this E-type stream. A minimum 48-foot clear span bridge would meet the NHDES stream rules. The deficient twin culverts on Tier 3 Pulpit Brook will be replaced with a 50.5-foot open span bridge that will pass the 100-year storm; provides a 22-ft channel that improves aquatic organism passage; adds 4.5-foot, level wildlife shelves on each side of the channel for wildlife; and restores streambed habitat. The hydraulic report is attached to the application.

(b) The design shall include bed forms and stream bed characteristics necessary to cause water depths and velocities within the crossing at a variety of flows to be comparable to those found in the natural channel upstream and downstream of the crossing.
A pebble count revealed bed material consisting of medium sands to fine gravel. Stream slope will be maintained through the crossing, and similar materials will be installed in this low-gradient stream, and banks stabilized with natural materials. The hydraulic analysis (HEC-RAS models) covering about 660 feet up and downstream of the crossing, indicates that the design will pass the 100 year storm flow with 1 foot of freeboard.

(c) There shall be vegetated banks upstream and downstream of the crossing.
Streambanks up and downstream of the crossing are located in wetlands, and will be stabilized with an appropriate wetland seed mix

(d) The natural alignment and gradient of the stream channel shall be preserved so as to accommodate natural flow regimes and the functioning of the natural floodplain.
The current perpendicular stream crossing alignment will be preserved. Streambank width and bank height as measured in the reference cross section will be recreated through the crossing structure, thereby accommodating natural flow regimes in the channel and adjacent floodplain wetlands.

(e) The 100-year flood frequency shall be accommodated to ensure that there is (1) no increase in flood stages on abutting properties and (2) flow and sediment transport characteristics will not be affected in a manner that could adversely affect channel stability.
The base flood level will decrease upstream, alleviating roadway flooding and flooding on adjacent property that currently occurs (based on modeling) at the 50-year storm and above. The design complies with all local and federal floodplain management regulations.

(f) A natural stream channel shall be simulated through the structure.

A new channel with stream simulation and dimensions similar to the upstream Pulpit Brook reference station will be constructed at the crossing, replacing twin culverts that provided no aquatic habitat. This channel will have level shelves on both banks at floodplain elevation providing contiguous bank habitat between upstream and downstream floodplain wetlands.

(g) Sediment transport competence shall not be altered.
Sediment transport competence will be restored by bridging the channel.

A Tier 2 stream crossing shall be a span structure, pipe arch embedded with stream simulation, open-bottom culvert with stream simulation, or closed-bottom culvert embedded with stream simulation.

A Tier 3 stream crossing shall be a span structure or an open-bottom culvert with stream simulation.

If any of the above criteria cannot be met, approval for an alternative design must be requested and a technical report (Env-Wt 904.09) must be included with the application package.

Hydrology, River Geomorphology and
Hydraulics Summary Report
by
Headwaters Hydrology

September 21, 2017

Kleinfelder, Inc.
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Subject: NHDOT Bridge #090/065
NH Route 101 over Pulpit Brook, Bedford, NH
Summary Report on Hydrology, Stream Geomorphology, and Hydraulics

Thom:

We have completed our study of hydrology, stream geomorphology, and existing and proposed hydraulics for NH Route 101 over Pulpit Brook in Bedford, NH (NHDOT Bridge #090/065). This report presents the study results for your use in selecting, designing, and permitting the preferred bridge replacement alternative.

1. Summary

The existing bridge consists of twin 60-inch diameter, 70-foot long reinforced concrete pipes with a concrete headwall and dry-laid stone wingwalls at the inlet and a stone masonry headwall and wingwalls at the outlet. Hydraulic modeling with HEC-RAS indicates that under existing conditions the FEMA 50- and 100-year floods overtop the low point of Route 101 with maximum inundation depths of about 0.8 and 1.0 foot, respectively.

The crossing is located within a Regulatory Floodway and local and federal floodplain management regulations prohibit changes to the bridge which would increase 100-year flood levels by any amount without first obtaining a Conditional Letter of Map Revision (CLOMR).

Two clear span alternatives were evaluated – 40 feet and 48 feet – and two waterway opening configurations were evaluated for the 48-foot clear span: one with full height vertical abutments and the other with stub abutments atop riprap-stabilized embankments.

Hydraulic models of the bridge replacement alternatives indicate that all of the evaluated spans and waterway opening configurations would pass the 100-year flood with more than one foot of freeboard to the superstructure low chord. The models also show that 100-year flood levels for all replacement scenarios would decrease significantly at and upstream from the crossing and would therefore comply with local and federal floodplain management regulations. However, only the 48-foot span alternatives would satisfy the design criteria of the DES Stream Crossing Rules.

More detailed information concerning our study is presented in the remaining sections.

2. Hydrology

The drainage area of Pulpit Brook at NH Route 101 is approximately 5.3 square miles. The watershed is characterized by hilly terrain with elevations ranging from about 870 feet atop Chestnut Hill to approximately 230 feet at the project site. The watershed is nearly three times as long (5.6 miles) as it wide (2.0 miles). This watershed shape suggests that flood discharges at the project site are less in magnitude, but longer in duration, than those from a comparably sized circular-shaped basin as peak flows from tributaries in the lower portions of the watershed likely pass the bridge site prior to the arrival of peak flows from the upper tributaries.

Figure 1 – Watershed boundary and flowlines overlaid on 2015 aerial photography

The watershed is predominantly forested with areas of low-density residential development concentrated in the southern and northeastern portions of the catchment. There are few ponds, wetlands, or other floodwater storage areas in the upper portion of the watershed; however, the brook flows through several broad, low-gradient valley segments and a 60± acre beaver pond in the lower portion of the watershed where significant floodwater storage likely occurs.

The following methods were used to estimate peak flood flows at the project site:

- FHWA 5-parameter Method;
- Flows used in the effective FEMA Flood Insurance Study (FIS) as determined from HEC-2 engineering backup data;
- USGS regression equations (Streamstats); and
- NH and VT Regional Hydraulic Geometry Curves (bankfull flow estimates only).

Table 1 summarizes the peak flow estimates.

Table 1 – Peak flow estimates for Pulpit Brook at NH Route 101 (cfs)

Method	Q_{BKF}	Q_2	$Q_{2.33}$	Q_{10}	Q_{50}	Q_{100}	Q_{500}
USGS Regression	-	179	-	398	644	778	1100
FIS	-	-	-	420	760	900	1450
FHWA	-	-	260	550	940	1090	-
NH Curves	192	-	-	-	-	-	-
VT Curves	105	-	-	-	-	-	-

The design flood for this bridge is the 100-year peak flow.

As shown in Table 1, The FHWA 5-parameter method yielded the highest flow estimates and the USGS regression equations predict the lowest flows with the FIS flows falling in-between. Because the regression equations were developed from measured flows, they likely yield the most accurate estimates based on historic conditions; however, because historic conditions may not accurately represent future conditions, more conservative flows should be utilized for design purposes. The FIS 50- and 100-year flows are about 15-20% greater than the values estimated with the regression method and are therefore considered conservative, but not overly so. The FHWA 50- and 100-year flows are about 40-50% greater than the regression method flows and are considered too conservative.

The FIS 100-year flow was used for determining compliance with: (1) NHDOT bridge design standards, which require the bridge to pass the 100-year flood with a minimum of one foot of freeboard to the low chord, and (2) local and federal floodplain management regulations, which prohibit increasing FIS 100-year flood levels by any amount without first obtaining a CLOMR.

Calculations and other supporting documentation relative to the hydrologic analysis are included in Appendix 1.

3. <u>Stream Geomorphology</u>

Pulpit Brook flows through a very broad, low gradient valley at the stream crossing. The valley has an average slope of approximately 0.13% and is about 600 feet wide at the highway. It is underlain by organic and glacial outwash deposits (Chocorua mucky peat) and is bordered by glacial till deposits (Canton soils) which form the valley walls. These characteristics, along with field survey and pebble count data, indicate that the stream type in the vicinity of the bridge is E5. This classification describes a slightly entrenched, sinuous, low-gradient channel that is flanked by broad floodplains, has a low width-to-depth ratio, and predominantly sand-sized substrate.

Bankfull channel widths measured at cross-sections located where the stream is a stable single-thread and morphology has not been significantly affected by the Route 101 crossing, the abandoned road and bridge just downstream from Route 101, or other anthropogenic factors ranged from 19' to 28'. Table 2 summarizes the bankfull channel dimensions measured at these reference cross-sections. Plots of the cross-section are included in Appendix 2 along with a Hydraulic Model Worksheet drawing showing their locations.

Table 2 – Measured channel and valley cross-sectional geometry at reference cross-sections

Cross-Section	Bankfull XS Area (sf)	Bankfull Width (ft)	Mean Bankfull Depth (ft)	Width to Depth Ratio	Max. Bankfull Depth (ft)	Width Flood Prone Area (ft)	Entrench Ratio
0	49	28	1.8	16	2.8	550	19.6
1037	37	19	1.9	10	2.7	560	29.5
1333	45	22	2.0	11	3.2	390	17.7

The average channel slope in the vicinity of the bridge was measured at 0.11%. Results of a pebble count indicate that the channel materials are comprised of about 66% sand and 34% gravel with a median particle size between one and two millimeters (very coarse sand). Plots of the surveyed longitudinal channel profile and particle size distribution are included in Appendix 2.

Due to their gentle slopes, broad floodplains, and erodible boundary materials, E-type streams can be sensitive to disturbance; however, despite the channel and floodplain obstructions created by the undersized culverts and highway embankment, the reach of Pulpit Brook in the project area is generally stable. No evidence of systemic bank erosion, degradation, or aggradation was observed and the measured channel geometry suggests that sediment transport competence is adequate, but not excessive. The stable condition is likely due to the dense vegetation in the floodplains and along the stream banks, the absence of other encroachments on the channel or valley bottom, and the watershed condition which is predominantly forested with only modest areas of dispersed impervious surfaces.

The NH Stream Crossing Guidelines require that new or replacement bridges accommodate the natural stream type at the crossing such that it does not change within the bridge opening. In order to maintain the stream type, the bridge span must be large enough to encompass a flood prone width great enough to prevent the entrenchment ratio (flood prone width ÷ bankfull channel width) from falling below the minimum value characteristic of the stream type. E-type streams have a minimum entrenchment ratio of 2.2. Using the median bankfull width measured at the reference cross-sections (22 feet), a minimum clear span of 48 feet (2.2 × 22) would be needed to meet the requirements of the DES Stream Crossing Rules.

4. Existing Hydraulics

The stream and valley cross-sections, road and bridge geometry, and flow estimates were used to develop an existing conditions subcritical, steady flow hydraulic model with the Corps of Engineers HEC-RAS program. The model covers about 1330 feet of Pulpit Brook beginning about 660 feet below the centerline of Route 101 and ending approximately 670 feet upstream from the highway and includes simulations of the following flood flows:

- FIS 10-, 50-, 100-, and 500-year flows;
- Bankfull flow estimated with the Vermont Regional Curves; and
- FHWA 2.33- and 100-year flows.

For the FIS flow simulations, starting flood elevations at the downstream end of the model (XS 0) were read from the FIS flood profiles (see FIS Flood Profile Exhibit in Appendix 3). For the bankfull flow, the elevation of the bankfull stage field indicator measured at XS 0 was used as the starting downstream water level. For the FHWA mean annual flood (i.e. 2.33-year flow), the measured average water surface slope of 0.11% was used in a normal depth calculation to estimate the starting downstream water level. Finally, for the FHWA 100-year flow, the starting downstream water level was estimated based on a prorated flow/stage relationship using the FIS 100- and 500-year flows and flood stages.

A Manning’s n roughness coefficient value of 0.040 was estimated for the channel. This is slightly higher than the value of 0.035 used in the FIS HEC-2 model. Manning’s roughness coefficients for overbank areas varied based on the land cover type and are summarized in Table 3.

Table 3 – Manning's n roughness coefficients used in hydraulic models

Location/Land Cover Type	Manning's n Estimate
Stream Channel	0.040
Marsh (herbaceous vegetation)	0.090
Forest and Shrubs	0.012
Hayfields and similar Seasonally Mowed Grass Areas	0.050
Lawns and similar Routinely Mowed Grass Areas	0.040
Paved and Gravel Surfaces	0.030

Figure 2 shows the existing FIS flood profiles along the modeled stream reach.

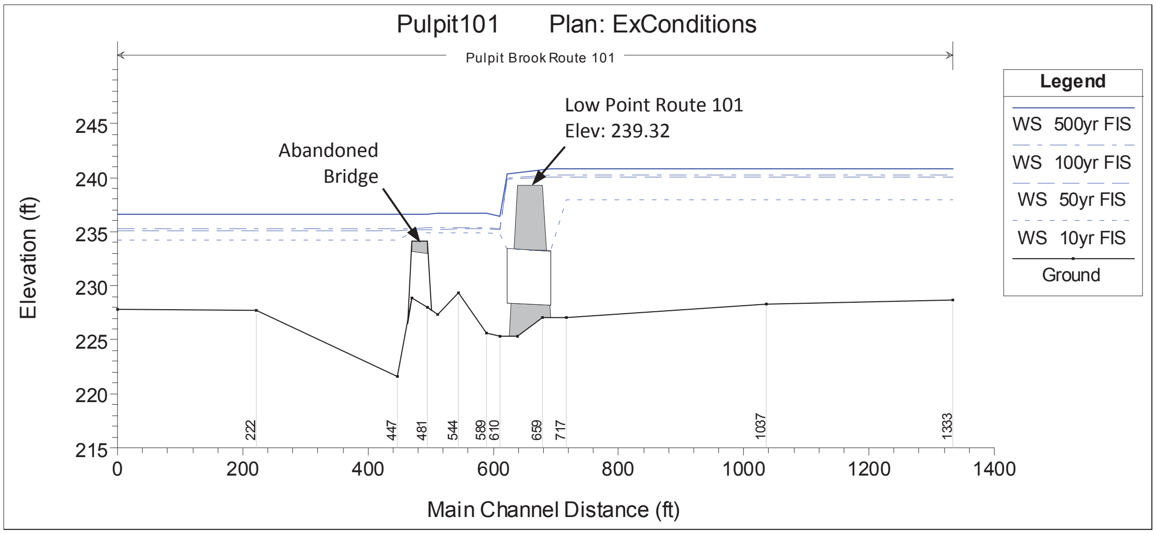


Figure 2 – Existing FIS flood profiles

Figure 3 shows the existing bridge (twin culvert) inlet cross-section with the calculated FIS flood stages.

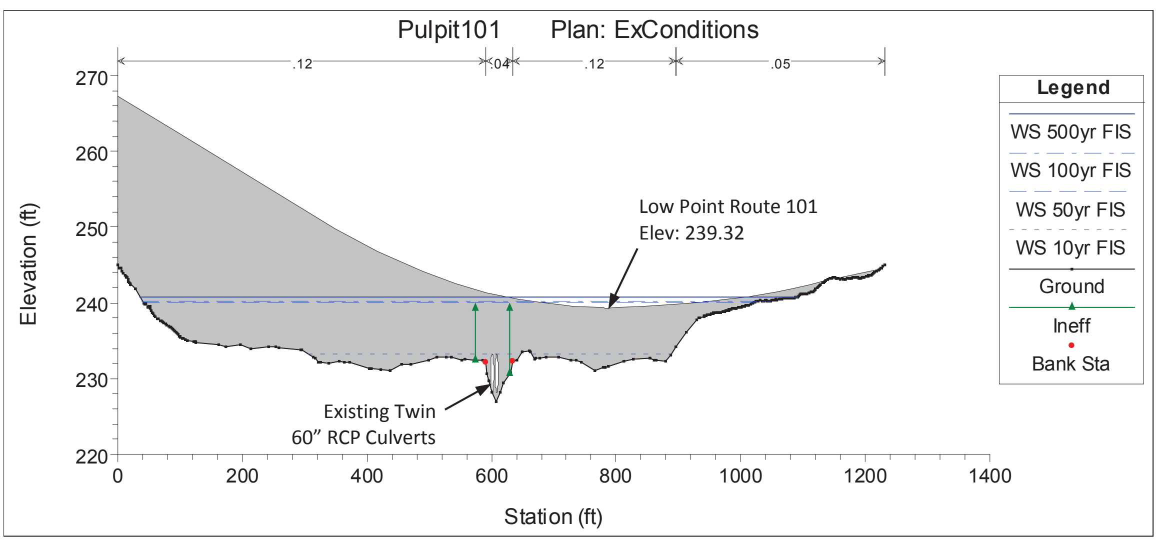


Figure 3 – Existing bridge inlet cross-section with calculated FIS flood stages

As shown in Figures 2 and 3, all of the FIS flows submerge the culvert inlets and the 50-, 100-, and 500-year flows overtop the highway low point by approximately 0.8, 1.0, and 1.5 feet respectively.

Figure 4 shows the bankfull and FHWA 2.33- and 100-year flood profiles along the modeled stream reach. The FHWA mean annual flood submerges the culvert inlets and the FHWA 100-year discharge overtops the highway low point by about 1.2 feet. Only the bankfull discharge flows freely through the existing stream crossing.

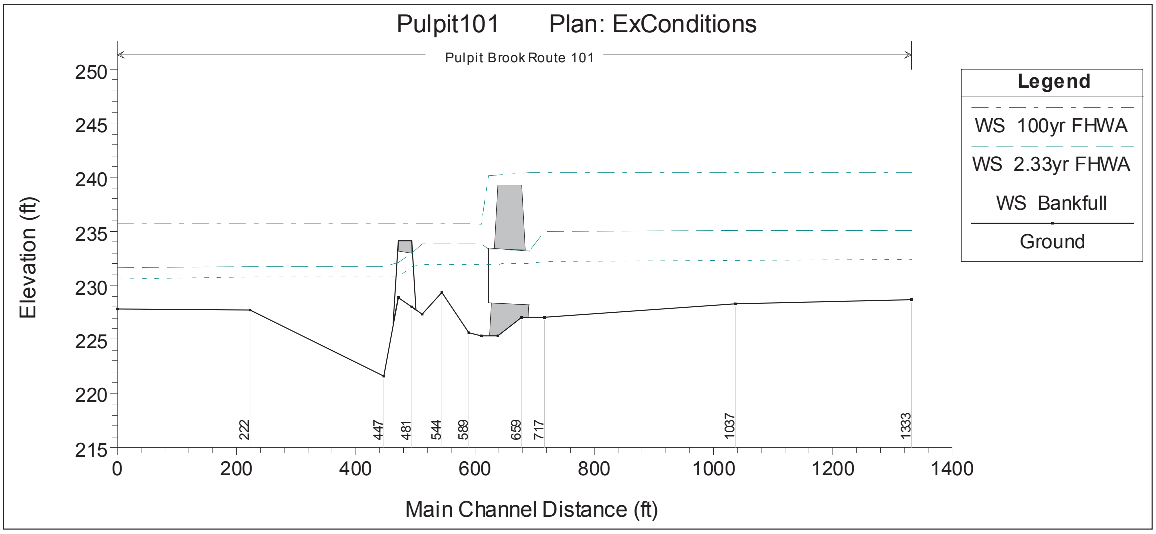


Figure 4 – Existing bankfull and FHWA flood profiles

Figure 5 shows the existing bridge (twin culvert) inlet cross-section with the calculated bankfull and FHWA 2.33- and 100-year flood stages.

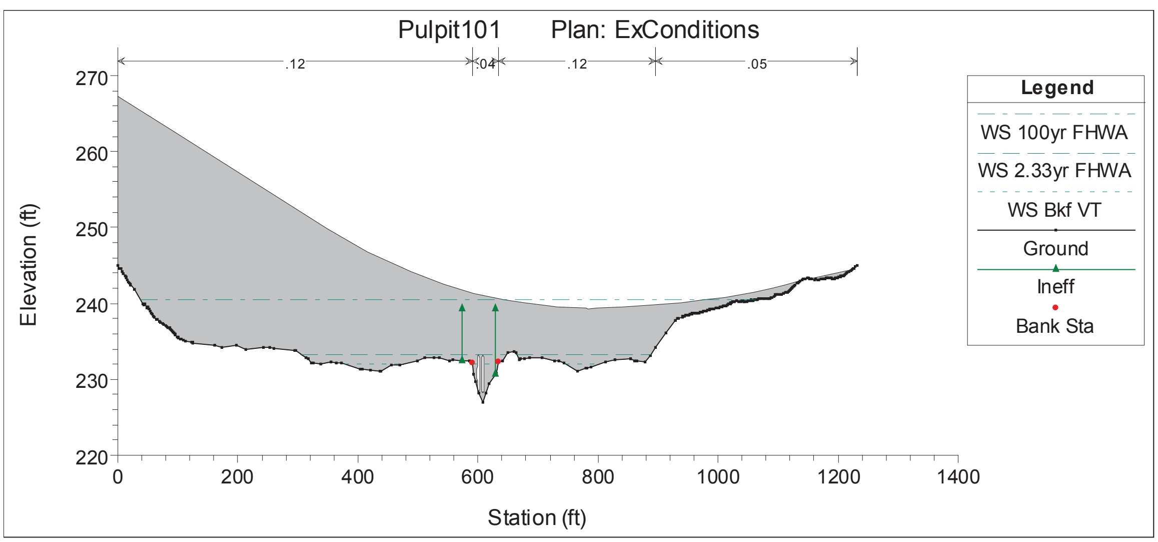


Figure 5 – Existing bridge inlet cross-section with calculated bankfull and FHWA flood stages

Additional output from the existing conditions HEC-RAS model is included in Appendix 3.

5. Proposed Hydraulics

Three bridge alternatives were studied as follows:

- Alternative 1: 40-foot clear span with full-height vertical abutments;
- Alternative 2: 48-foot clear span with full-height vertical abutments; and
- Alternative 3: 48-foot clear span with stub abutments.

A conceptual site plan and HEC-RAS model were prepared for each alternative. The site plans were developed to determine how the channel bottom, stream banks, and adjacent slopes would be graded to tie into the existing, undisturbed channel bed and banks and adjacent slopes upstream and downstream from the bridge. The HEC-RAS models were used to evaluate hydraulic conditions for each alternative. They were created by modifying the existing conditions model to include the proposed bridge, channel, and overbank geometries shown on the conceptual site plan drawings and adjusting the ineffective flow elevations and stations to account for the additional active flow area resulting from the wider spans.

For the 40-foot clear span alternative a total superstructure thickness (profile crown to low chord) of 38 inches was assumed. For the 48-foot clear span alternatives a total superstructure thickness of 42 inches was assumed. The highway profile was assumed to remain unchanged for all three alternatives.

The evaluated bridge spans are all significantly greater than the mean bankfull width measured at the reference stream cross-sections (22 feet). Therefore, the internal waterway opening geometry for all three alternatives includes a 22-foot wide channel centered within the opening flanked by floodplain surfaces at the bankfull flood elevation, which was determined to be 231.4 at the crossing.

5.A. Alternative 1: 40-Foot Clear Span with Full-Height Vertical Abutments

Alternative 1 includes a 40-foot clear span bridge over a 22-foot wide channel with 9-foot wide floodplains on either side. The abutment foundations were assumed to be below the bankfull flood level such that the abutment walls extend vertically from the bankfull elevation to the low chord as shown in Figure 6. The total waterway opening area is approximately 310 square feet.

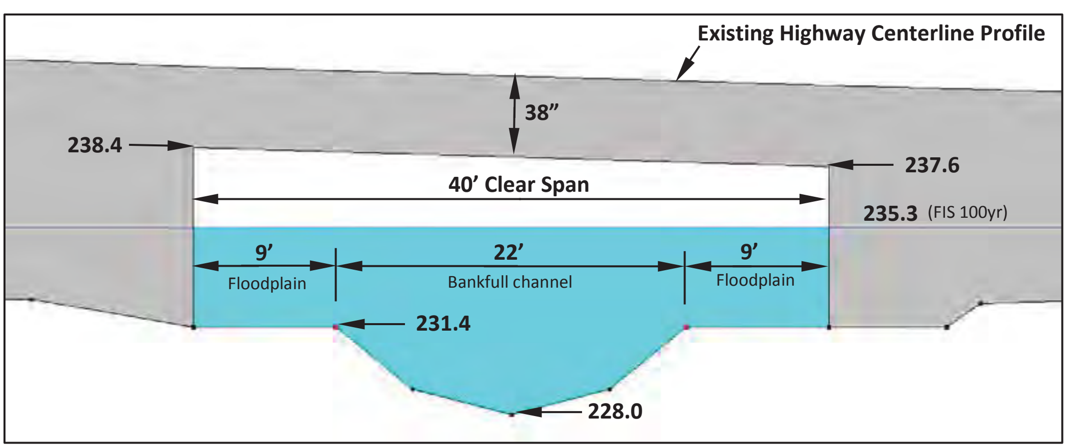


Figure 6 – Alternative 1 bridge inlet cross-section

Figure 7 shows a portion of the conceptual site plan for Alternative 1.

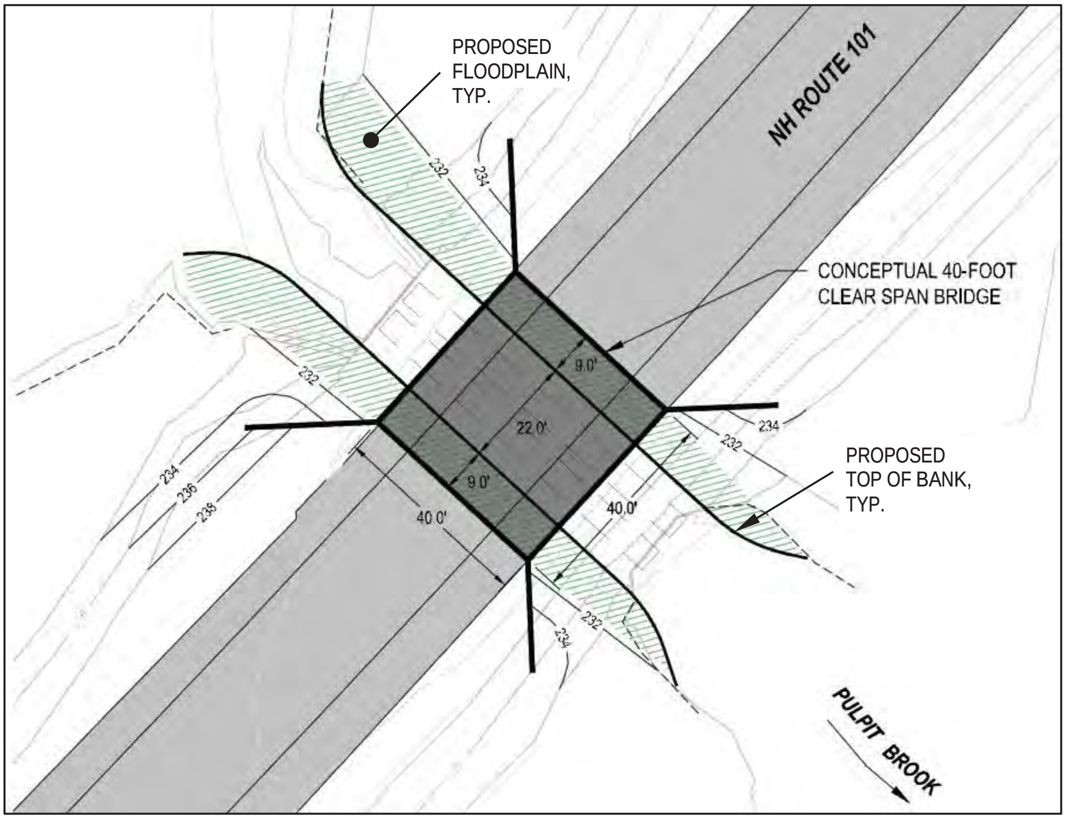


Figure 7 – Alternative 1 conceptual site plan

The hydraulic model for this alternative indicates that the bridge will pass both the FIS and FHWA 100-year discharges with two or more feet of freeboard to the superstructure low chord and will also pass the FIS 500-year flood with more than one foot of freeboard. Table 4 provides a hydraulic summary for Alternative 1.

Table 4 – Alternative 1 hydraulic summary

Flood Recurrence Interval	Flood Stage (ft, NAVD88)			Low Chord (ft, NAVD88)	Freeboard (ft)	Average Velocity (fps)	
	Upstream Bridge (XS 717)	Bridge Inlet	Bridge Outlet			Bridge Inlet	Bridge Outlet
Bankfull	232.0	232.0	231.9	237.6	5.6	1.5	1.5
2.33-year (FHWA)	233.9	233.8	233.8	237.6	3.8	1.8	1.8
10-year (FIS)	234.9	234.8	234.8	237.6	2.8	2.3	2.3
50-year (FIS)	235.5	235.1	235.1	237.6	2.5	3.9	3.9
100-year (FIS)	235.8	235.3	235.1	237.6	2.3	4.5	4.6
100-year (FHWA)	236.4	235.6	235.5	237.6	2.0	5.0	5.2
500-year (FIS)	237.5	236.4	236.2	237.6	1.2	5.8	6.0

Figure 8 compares the existing conditions and Alternative 1 FIS 100-year flood profiles. As shown, under this alternative and flow the highway would not be overtopped, flood levels upstream from the highway would decrease by up to 4.5 feet, and flood levels downstream from the highway would be unchanged.

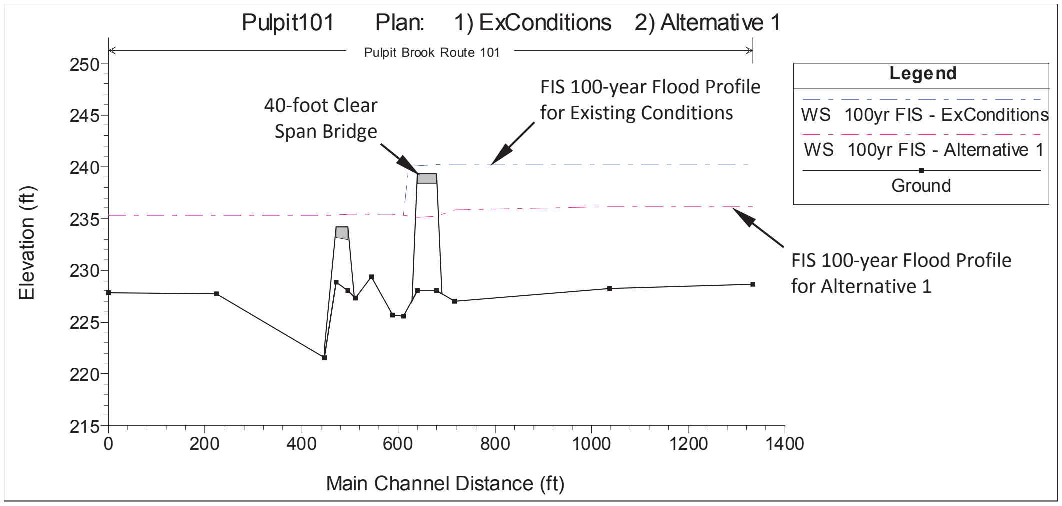


Figure 8 – FIS 100-year flood profiles for existing conditions and Alternative 1

More detailed output from the hydraulic model for this alternative is included in Appendix 3.

5.B. Alternative 2: 48-Foot Clear Span with Full-Height Vertical Abutments

Alternative 2 includes a 48-foot clear span bridge over a 22-foot wide channel flanked by 13-foot wide floodplains on both sides. The abutment walls were assumed to extend vertically from the bankfull elevation to the low chord as shown in Figure 9. The total waterway opening area is approximately 350 square feet.

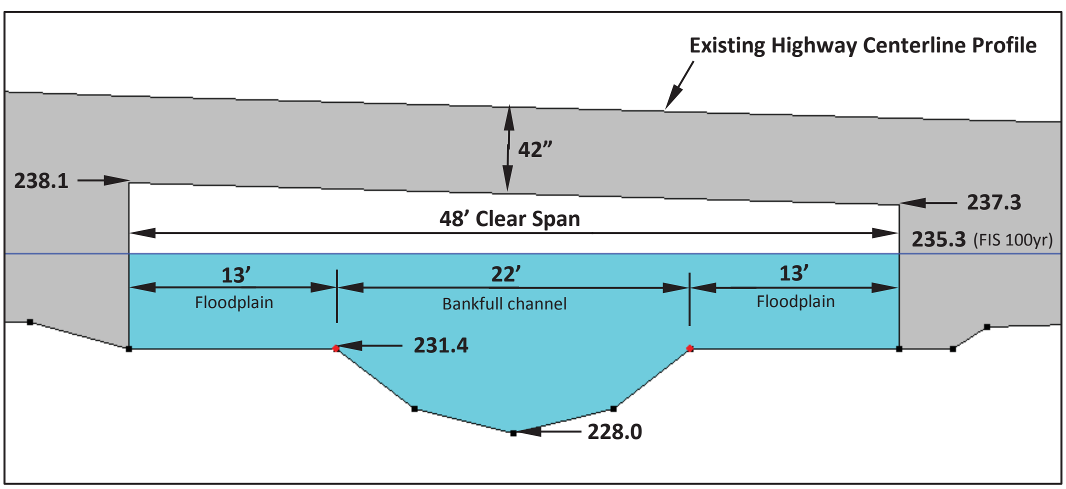


Figure 9 – Alternative 2 bridge inlet cross-section

Figure 10 shows a portion of the conceptual site plan for Alternative 2.

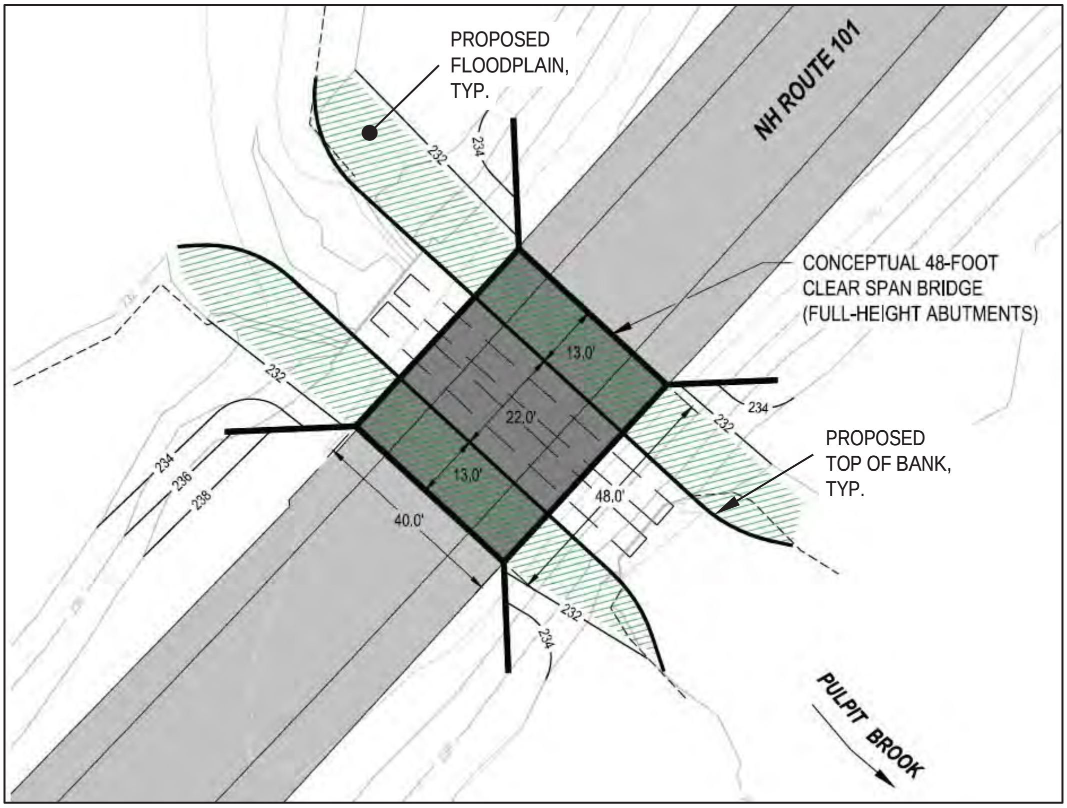


Figure 10 – Alternative 2 conceptual site plan

The hydraulic model for Alternative 2 indicates that the bridge will pass the FIS 100-year flow with 2.0 feet of freeboard to the superstructure low chord, the FHWA 100-year discharge with 1.6 feet of freeboard, and the FIS 500-year flood with 0.8 feet of freeboard. Table 5 provides a hydraulic summary for this alternative.

Table 5 – Alternative 2 hydraulic summary

Flood Recurrence Interval	Flood Stage (ft, NAVD88)			Low Chord (ft, NAVD88)	Freeboard (ft)	Average Velocity (fps)	
	Upstream Bridge (XS 717)	Bridge Inlet	Bridge Outlet			Bridge Inlet	Bridge Outlet
Bankfull	232.0	232.0	231.9	237.3	5.3	1.4	1.4
2.33-year (FHWA)	233.9	233.8	233.8	237.3	3.5	1.6	1.6
10-year (FIS)	234.9	234.8	234.8	237.3	2.5	2.0	2.0
50-year (FIS)	235.5	235.2	235.1	237.3	2.1	3.3	3.4
100-year (FIS)	235.7	235.3	235.2	237.3	2.0	3.8	3.9
100-year (FHWA)	236.3	235.7	235.5	237.3	1.6	4.3	4.4
500-year (FIS)	237.3	236.5	236.3	237.3	0.8	5.0	5.1

Figure 11 compares the existing conditions and Alternative 2 FIS 100-year flood profiles. Under this alternative and flow the highway would not be overtopped, upstream flood levels would decrease by up to 4.5 feet, and downstream flood levels would be unchanged.

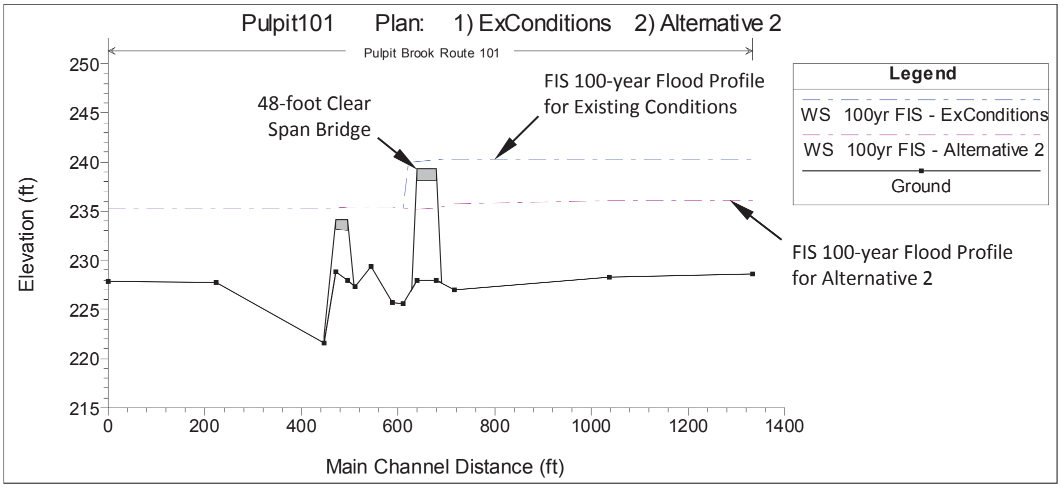


Figure 11 – FIS 100-year flood profiles for existing conditions and Alternative 2

More detailed output from the hydraulic model for Alternative 2 is included in Appendix 3.

5.C. Alternative 3: 48-Foot Clear Span with Stub Abutments

Alternative 3 includes a 48-foot clear span bridge over a 22-foot wide channel flanked by 4.8-foot wide floodplains on both sides. 2.6-foot high riprap-stabilized 2:1 earthen embankments would border the floodplains and stub abutments would be located on top of these embankments. Figure 12 shows the waterway opening geometry for this alternative. The total opening area is approximately 320 square feet.

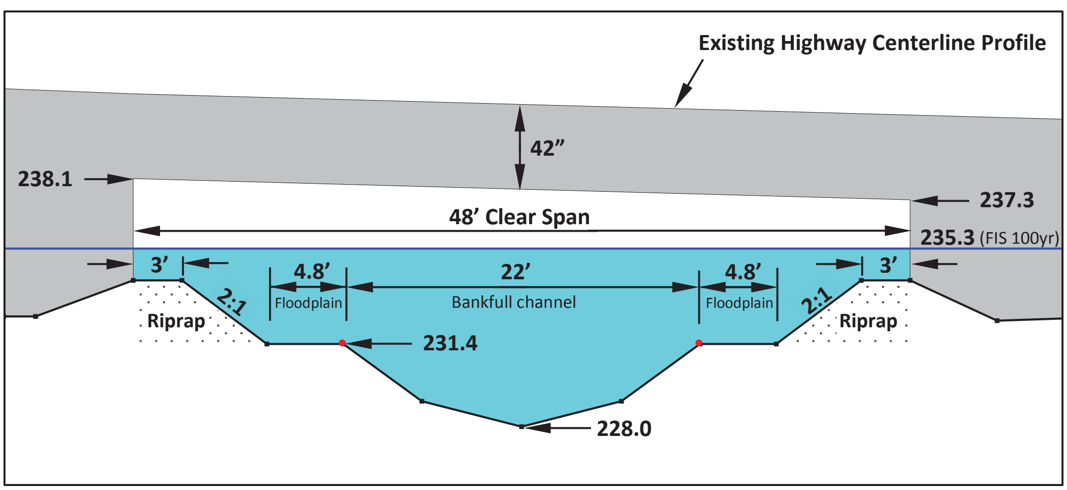


Figure 12 – Alternative 3 bridge inlet cross-section

Figure 13 shows a portion of the conceptual site plan for Alternative 3.

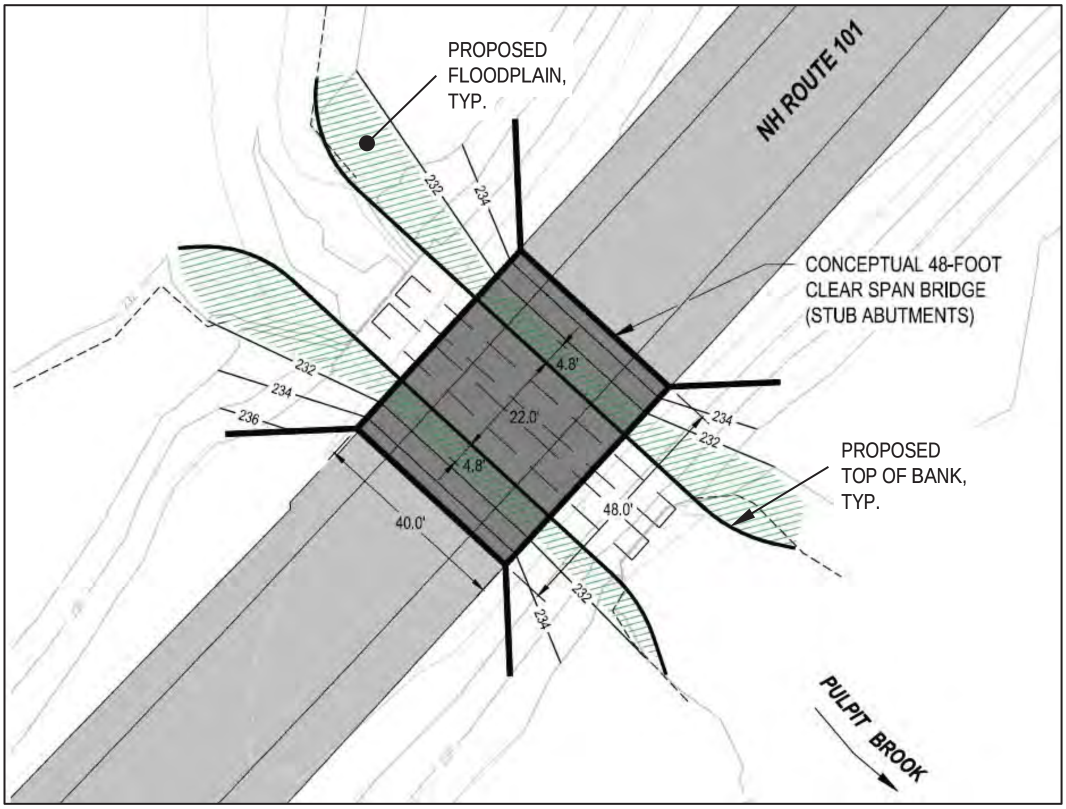


Figure 13 – Alternative 3 conceptual site plan

The hydraulic model for this alternative indicates that the bridge will pass the FIS 100-year flow with 2.0 feet of freeboard to the low chord, the FHWA 100-year discharge with 1.6 feet of freeboard, and the FIS 500-year flood with 0.8 feet of freeboard. Table 6 provides a hydraulic summary for Alternative 3.

Table 6 – Alternative 3 hydraulic summary

Flood Recurrence Interval	Flood Stage (ft, NAVD88)			Low Chord (ft, NAVD88)	Freeboard (ft)	Average Velocity (fps)	
	Upstream Bridge (XS 717)	Bridge Inlet	Bridge Outlet			Bridge Inlet	Bridge Outlet
Bankfull	232.0	232.0	231.9	237.3	5.3	1.6	1.6
2.33-year (FHWA)	233.9	233.8	233.8	237.3	3.5	1.9	1.9
10-year (FIS)	234.9	234.8	234.8	237.3	2.5	2.3	2.3
50-year (FIS)	235.5	235.2	235.1	237.3	2.1	3.8	3.9
100-year (FIS)	235.7	235.3	235.2	237.3	2.0	4.4	4.5
100-year (FHWA)	236.3	235.7	235.5	237.3	1.6	4.9	5.0
500-year (FIS)	237.3	236.5	236.3	237.3	0.8	5.5	5.7

Figure 14 compares the FIS 100-year flood profiles for existing conditions and Alternative 3. Under this alternative and flow the highway would not be overtopped, upstream flood levels would decrease by up to 4.5 feet, and downstream flood levels would be unchanged.

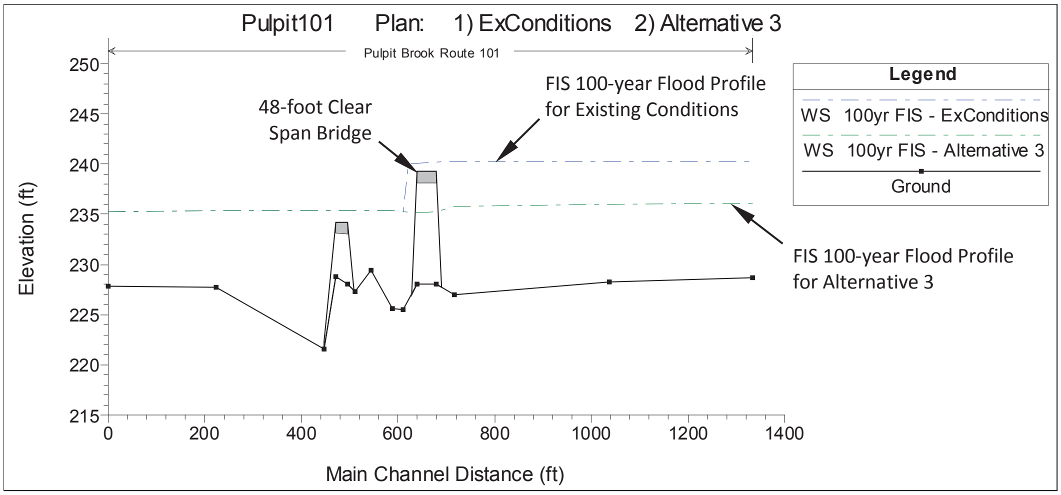


Figure 14 – FIS 100-year flood profiles for existing conditions and Alternative 3

More detailed output from the hydraulic model for this alternative is included in Appendix 3.

6. DES Wetland Permitting

The DES Stream Crossing Rules (Env-Wt 900) require new and replacement stream crossings to be designed in a manner which minimizes adverse impacts to stream channel stability, flood stages, and aquatic and terrestrial wildlife passage. The drainage area at the project site is greater than one square mile; therefore, the crossing is considered a "tier 3" crossing under Env-Wt 904.04 and the project will be classified as a "major impact" project under Env-Wt 303.02(p) and Env-Wt 903.01(g)(1). Env-Wt 904.04(d) requires that tier 3 stream crossings be span structures or open-bottomed culverts. All of the bridge replacement alternatives would satisfy this requirement.

The design criteria specified in Env-Wt 904.05 for replacement tier 3 stream crossings includes the requirement that there be no increase of 100-year flood levels on abutting properties [Env-Wt 904.05(e)(1)]. 100-year flood levels decrease significantly upstream from the crossing and are unchanged below the crossing for all of the studied alternatives. This is shown on the flood profiles in Figures 8, 11, and 14 above. Therefore, all of the bridge alternatives would also meet this criterion.

Env-Wt 904.05(c) requires that replacement tier 3 crossings provide a vegetated bank on both sides of the watercourse to allow for wildlife passage. All of the studied bridge alternatives provide sufficient area under the superstructure for banks and floodplains on both sides of the channel which could function as wildlife corridors. Whether or not vegetation could be established and maintained within the bridge opening, especially near the middle of the structure where sunlight penetration would be limited, is questionable; however, each alternative could provide wildlife passage below the superstructure even with only limited or partial vegetation cover. Therefore, all of the evaluated bridge replacement alternatives would likely satisfy this design requirement.

Env-Wt 904.05(a) requires that replacement tier 3 stream crossings be designed in accordance with the NH Stream Crossing Guidelines. In accordance with Section IV(c) of the NH Stream Crossing Guidelines, the design should "*accommodate the bankfull width,* *entrenchment ratio, bankfull width to depth ratio, and stream surface slope of the existing stream, within the natural ranges of variability for the stream type at the site of the stream crossing. To accommodate the entrenchment ratio, flood plain drainage structures may be utilized.*" Accommodating the entrenchment ratio is the principal requirement which would affect the bridge design.

As described under Section 3, Pulpit Brook is an E-type stream at the crossing site. E-type streams have entrenchment ratios of 2.2 or greater. Using the median bankfull width measured at the reference cross-sections in the vicinity of the bridge (22 feet), a minimum span of 48 feet (2.2 × 22) would be needed to accommodate a minimum entrenchment ratio of 2.2. Alternatives 2 and 3 would meet this requirement, but Alternative 1 would not.

In summary, an open-bottom structure with a minimum waterway opening span of 48 feet which does not increase 100-year flood levels and provides a vegetated bank on both sides of the channel for wildlife passage would be needed to fully comply with the DES Stream Crossing Rules. Alternatives 2 and 3 would meet all of these requirements and could therefore be permitted as compliant stream crossing designs. Alternative 1 would not meet the entrenchment ratio criteria of the Stream Crossing Guidelines and would therefore need to be permitted under the "Alternative Designs" section of the Stream Crossing Rules (Env-Wt 904.09). One of the primary requirements of permitting a crossing under this section is demonstrating that strict adherence to the rules is not "practicable" as defined in Env-Wt 101.69, which states: "*'Practicable' means available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes*". Considering that the 48-foot span alternatives appear feasible, it may not be possible to demonstrate to DES's satisfaction that cost or special site constraints render construction of a fully-compliant crossing impracticable.

7. Local and Federal Floodplain Management Regulations

The Town of Bedford participates in the National Flood Insurance Program (NFIP), which enables property owners in the community to purchase federally-subsidized flood insurance. Participation in the NFIP is contingent upon the Town adopting and enforcing a floodplain management ordinance that meets or exceeds minimum NFIP requirements as set forth in the Code of Federal Regulations (CFR) Title 44, Chapter I, Subchapter B. The Town has adopted a Floodplain Development Ordinance (FDO) under Article X of the most recent version of the Bedford Zoning Ordinance dated March 14, 2017. The FDO applies to all Special Flood Hazard Areas (SFHA's) identified on the effective FEMA Flood Insurance Rate Map (FIRM). Copies of the FDO and FIRM are attached in Appendix 4.

The project site is located within a Regulatory Floodway and a Zone AE Floodplain as shown on FIRM #33011C0364D and is therefore subject to the FDO regulations. Section 275-80.C.(1) of the FDO states: "*Along watercourses with a designated Regulatory Floodway, no encroachments, including fill, new construction, substantial improvements, and other development are allowed within the floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practices that the proposed encroachment would not result in any increase in flood levels within the community during the base flood discharge.*" As previously described, 100-year flood stages (a.k.a. base flood levels) would either decrease or remain unchanged for all of the alternatives; therefore, these designs would comply with applicable local and federal floodplain management regulations and a FEMA Conditional Letter of Map Amendment (CLOMR) will not be needed.

It appears, however, that a local building permit may be required for the project under Section 275-78 of the FDO which states: "*All proposed development in any special flood hazard area shall require a permit.*" Development is defined under Section 275-77 of the FDO as "*any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation, drilling operation, or storage of equipment or materials.*"

Furthermore, as set forth in 44 CFR §65.3, the Town will be required to submit new technical data to FEMA describing physical changes in the Special Flood Hazard Area (SFHA) and their effect on flooding conditions. This data is to be submitted no later than six months after it becomes available (i.e. after completion of construction). The types of technical data required to be submitted are described in 44 CFR §65.6. The following data is required for physical changes affecting hydraulic conditions:

- A description of the physical changes (e.g. new bridge);
- As-built plans;
- New hydraulic analysis and flood profiles reflecting the physical changes; and
- Revised floodplain and floodway delineations [44 CFR §65.6(c)(2)].

The format for submitting this information to FEMA is a Letter of Map Revision (LOMR).

Supporting documentation and calculations are attached. I can be reached at (603) 444-2544 or via email at sean@headwatershydrology.com if you have any questions.

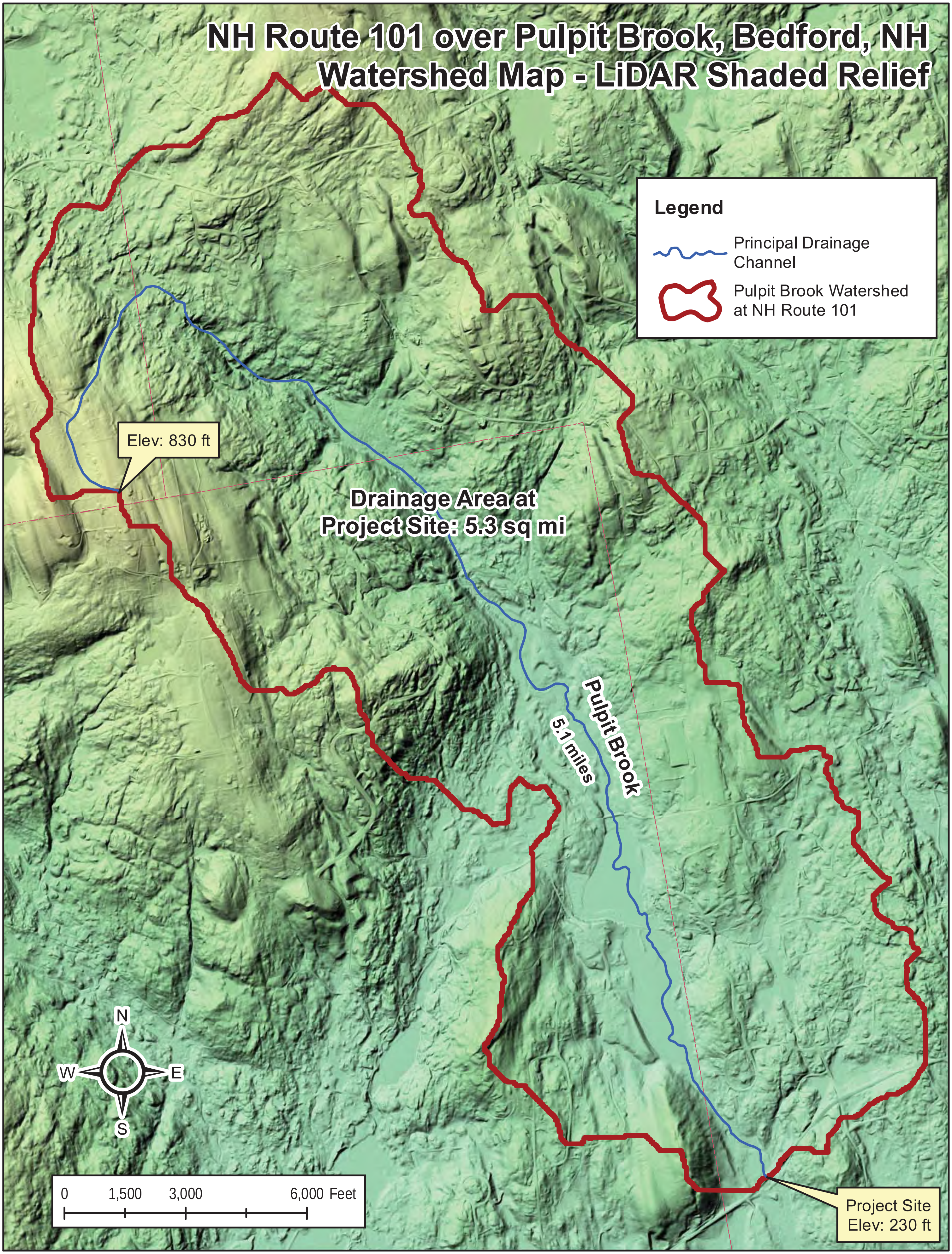
Sincerely,

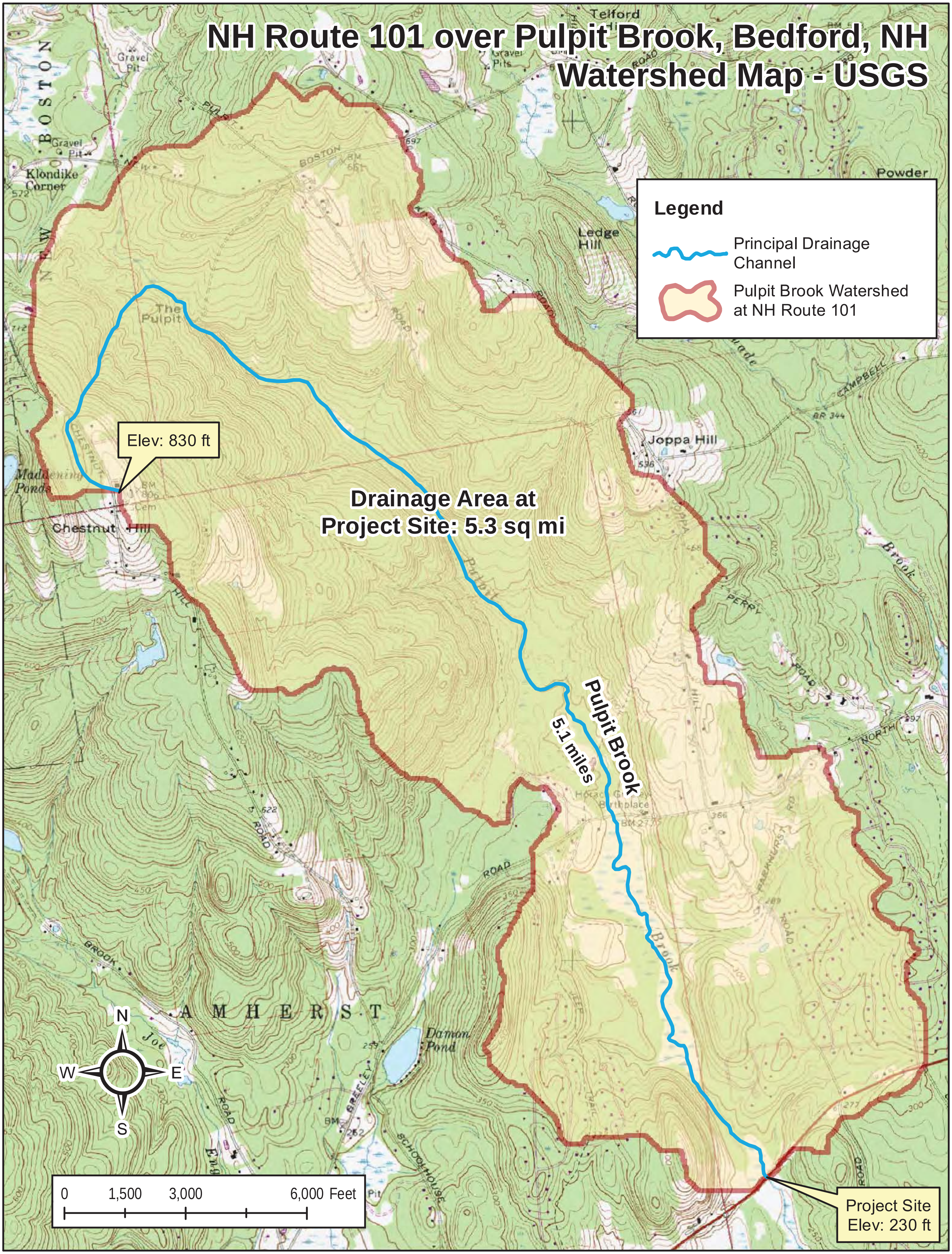
Sean P. Sweeney, P.E., CWS
Manager
Headwaters Hydrology, PLLC

Attachments: Appendices 1 through 5
Appendix 1 – Hydrologic Calculations and Supporting Documentation
Appendix 2 – Stream Geomorphology Assessment Data and Exhibits
Appendix 3 – Hydraulic Model Output and Supporting Documentation
Appendix 4 – FEMA FIRM and Bedford Floodplain Development Ordinance
Appendix 5 – Photographs

<u>APPENDIX 1</u>

Hydrologic Calculations and Supporting Documentation


NH Route 101 over Pulpit Brook, Bedford, NH
Watershed Map - LiDAR Shaded Relief
Legend
Principal Drainage Channel
Pulpit Brook Watershed at NH Route 101
Elev: 830 ft
Drainage Area at Project Site: 5.3 sq mi
Pulpit Brook
5.1 miles
Project Site
Elev: 230 ft
N
W
E
S
0
1,500
3,000
6,000 Feet


NH Route 101 over Pulpit Brook, Bedford, NH
Watershed Map - USGS
Legend
Principal Drainage Channel
Pulpit Brook Watershed at NH Route 101
Elev: 830 ft
Drainage Area at Project Site: 5.3 sq mi
Pulpit Brook
5.1 miles
Project Site
Elev: 230 ft
0
1,500
3,000
6,000 Feet
N
S
E
W
Chestnut Hill
Joppa Hill
Ledge Hill
Klondike Corner
Telford
Powder
Damon Pond
A M H E R S T
B O S T O N

Summary of Peak Discharge Estimates

5-Sep-17

Project Location: **Pulpit Brook at Route 101, Bedford, NH**
Drainage Area: 5.3 **sq. mi.**

Method	**Qbkf**	Q_{2}	$Q_{2.33}$	Q_{10}	Q_{50}	Q_{100}	Q_{500}
NH Regional Curves	192	-	-	-	-	-	-
VT Regional Curves	105	-	-	-	-	-	-
USGS Regression Equations	-	179	-	398	644	778	1100
FEMA FIS (HEC-2 Backup Data)	-	-	-	420	760	900	1450
FHWA 5-Parameter	-	-	260	550	940	1090	-

Note: all flows are reported in cfs.

FLOWS USED IN FEMA FLOOD INSURANCE STUDY
AT PROJECT SITE (FROM HEC-2 BACKUP DATA)

TABLE 5 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
PULPIT BROOK					
At confluence with Baboosic Brook	5.21	430	770	920	1,480
At downstream Amherst-		420	760	900	1,450
Bedford corporate limits	4.6	410	740	880	1,420
At upstream Amherst-Bedford corporate limits	1.6	185	340	400	465
PURGATORY BROOK					
At mouth	13.4	1,550	2,820	3,400	5,150
RIDDLE BROOK					
At confluence with Baboosic Brook	8.43	580	1,110	1,390	2,360
At State Route 101	5.55	450	860	1,060	1,820
SALMON BROOK					
At confluence with Merrimack River	30.34	670	1,110	1,350	1,940
Downstream of confluence with Hassells Brook	28.82	660	1,110	1,350	1,920
Upstream of confluence with Hassells Brook	27.08	630	1,050	1,280	1,850
At Massachusetts State line	22.36	550	920	1,120	1,620
SAND BROOK					
At outlet of Gould Pond	10.0	170	355	415	820
At inlet of Gould Pond	8.8	470	1,135	1,425	2,725
At confluence with Nelson Brook	7.9	430	1,040	1,310	2,500
SECOND BROOK					
At confluence with Merrimack River	4.94	240	430	510	770
Upstream of Pelham Road bridge	4.43	225	395	480	715
Cross section O	3.95	205	360	435	645
SHEDD BROOK					
At confluence with Beards Brook	21.2	1,050	1,840	2,320	3,525
Downstream junction with Black Pond Brook at Station 2.685	20.0	975	1,715	2,170	3,250

StreamStats Version 3.0

Flow Statistics Ungaged Site Report

Date: Tues Sept 19, 2017 12:17:44 PM GMT-4
Study Area: New Hampshire
NAD 1983 Latitude: 42.9061 (42 54 22)
NAD 1983 Longitude: -71.5695 (-71 34 10)
Drainage Area: 5.29 mi2

StreamStats Peak Flow Estimates
Pulpit Brook at NH Route 101
Bedford, NH

Peak Flows Region Grid Basin Characteristics			
100% Peak Flow Statewide SIR2008 5206 (5.29 mi2)			
Parameter	**Value**	**Regression Equation Valid Range**	
		Min	**Max**
Drainage Area (square miles)	5.29	0.7	1290
Mean April Precipitation (inches)	3.932	2.79	6.23
Percent Wetlands (dimensionless)	5.8608	0	21.8
Stream Slope 10 and 85 Method (feet per mi)	85.3	5.43	543

Peak Flows Region Grid Statistics						
Statistic	**Value**	**Unit**	**Prediction Error (percent)**	**Equivalent years of record**	**90-Percent Prediction Interval**	
					Min	**Max**
PK2	179	ft3/s	30	3.2	110	289
PK5	298	ft3/s	31	4.7	182	488
PK10	398	ft3/s	32	6.2	238	664
PK25	533	ft3/s	34	8	309	919
PK50	644	ft3/s	36	9	363	1140
PK100	778	ft3/s	39	9.8	424	1430
PK500	1100	ft3/s	44	11	554	2190

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

Peak Flow Estimates - FHWA 5-Parameter Method

Methodology from Report No. FHWA-RD-77-159, "Runoff Estimates for Small Rural Watersheds and Development of a Sound Design Method"

computed by: SPS
date: 9/7/2017

Project Location: Pulpit Brook at NH Route 101, Bedford, NH

Hydrophysiographic Zone: 9 (appendix B-33)

$Q_{10} = 7.7165 * A^{0.5814} * R^{0.0547} * DH^{0.3865} * L^{0.0990} * P_{60}^{0.8217}$ (Table 1-C)

$Q_{2.33} = 0.46921 * Q_{10}^{1.00243}$ (Equation 8)

$Q_{50} = 1.45962 * Q_{10}^{1.02342}$ (Equation 9)

$Q_{100} = 1.64380 * Q_{10}^{1.02918}$ (Equation 10)

Variables:

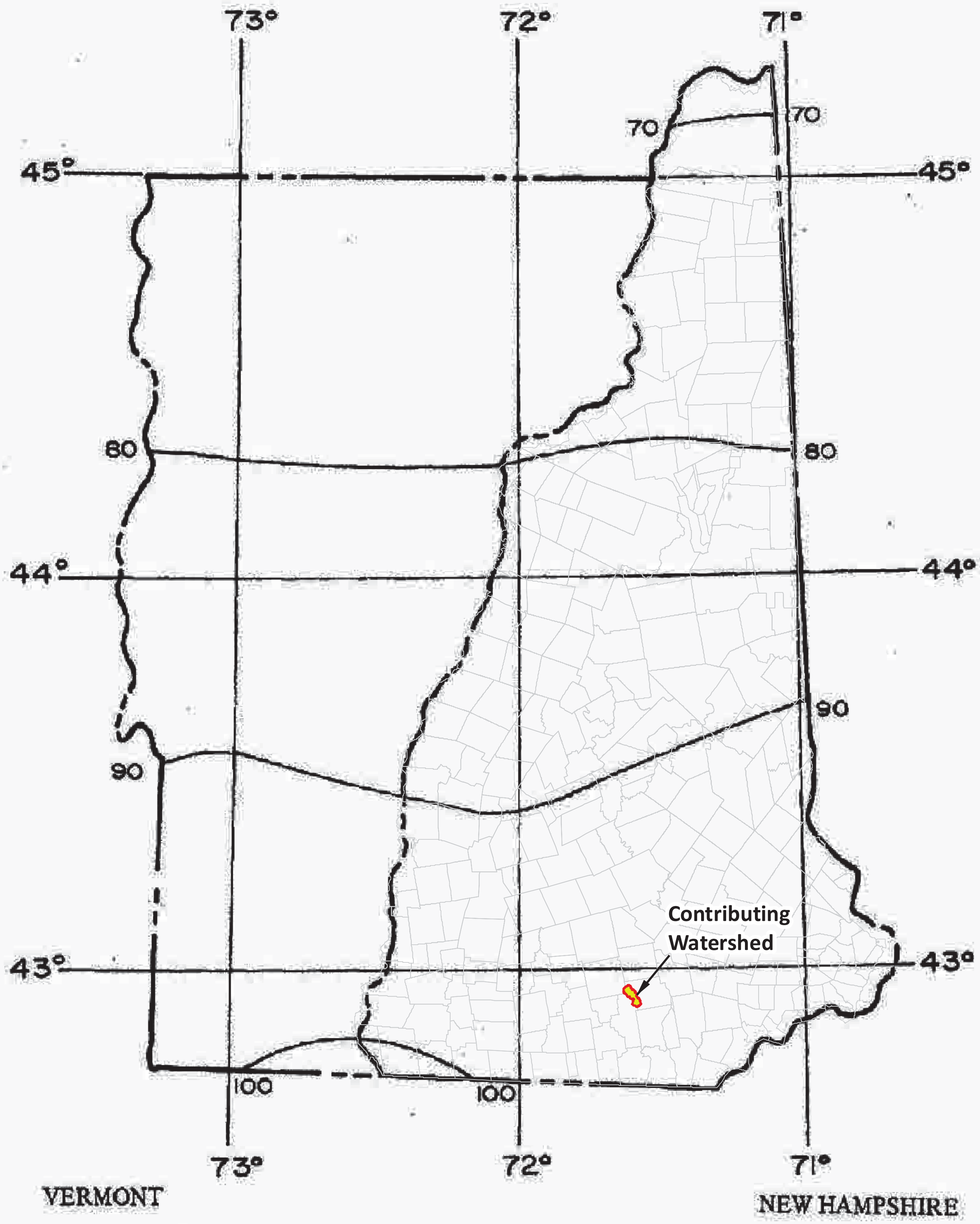
A = Watershed Area (sq. mi.)
R = Iso-erodent Factor
DH = Difference in elevation of principal drainage channel between the project site and its most distant point at the watershed boundary (ft.)
L = Length of principal drainage channel from the project site to the upstream watershed boundary (mi.)
P_{60} = 10-year, 60-minute rainfall at the centroid of the watershed (in.)
S = Percent surface water storage area (percent of watershed area covered by lakes, ponds, swamps, etc.
Storage Correction Multiplier = Q_{10} adjustment factor based on value of S

Variable	Value	Source
A	5.3	Streamstats automated watershed delineation (see Watershed Map)
R	95	Appendix C-33
DH	600	USGS Topographic Map and Field Survey Data (see Watershed Map)
L	5.1	USGS Topographic Map (see Watershed Map)
P_{60}	1.75	Appendix D-33
S	5.9	"Percent Wetlands" from StreamStats
Storage Correction Multiplier	0.96	Figure 5

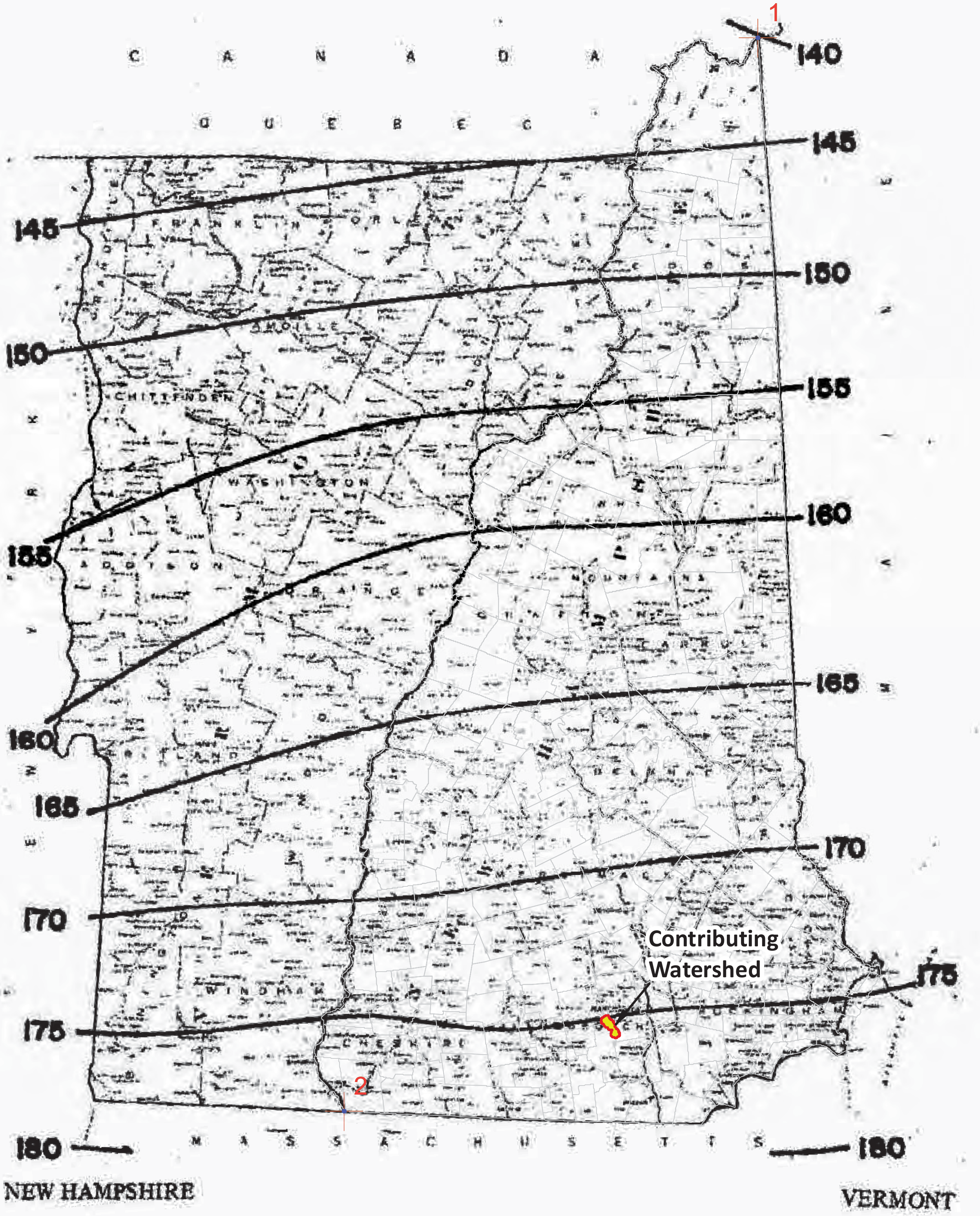
10-year Peak Flow

Unadjusted Q_{10} (cfs)	576	(not adjusted for surface water storage)
Adjusted Q_{10} (cfs)	553	(adjusted for surface water storage)

Peak Flow Estimates (cfs)	
$Q_{2.33}$	260
Q_{10}	550
Q_{50}	940
Q_{100}	1090



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



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

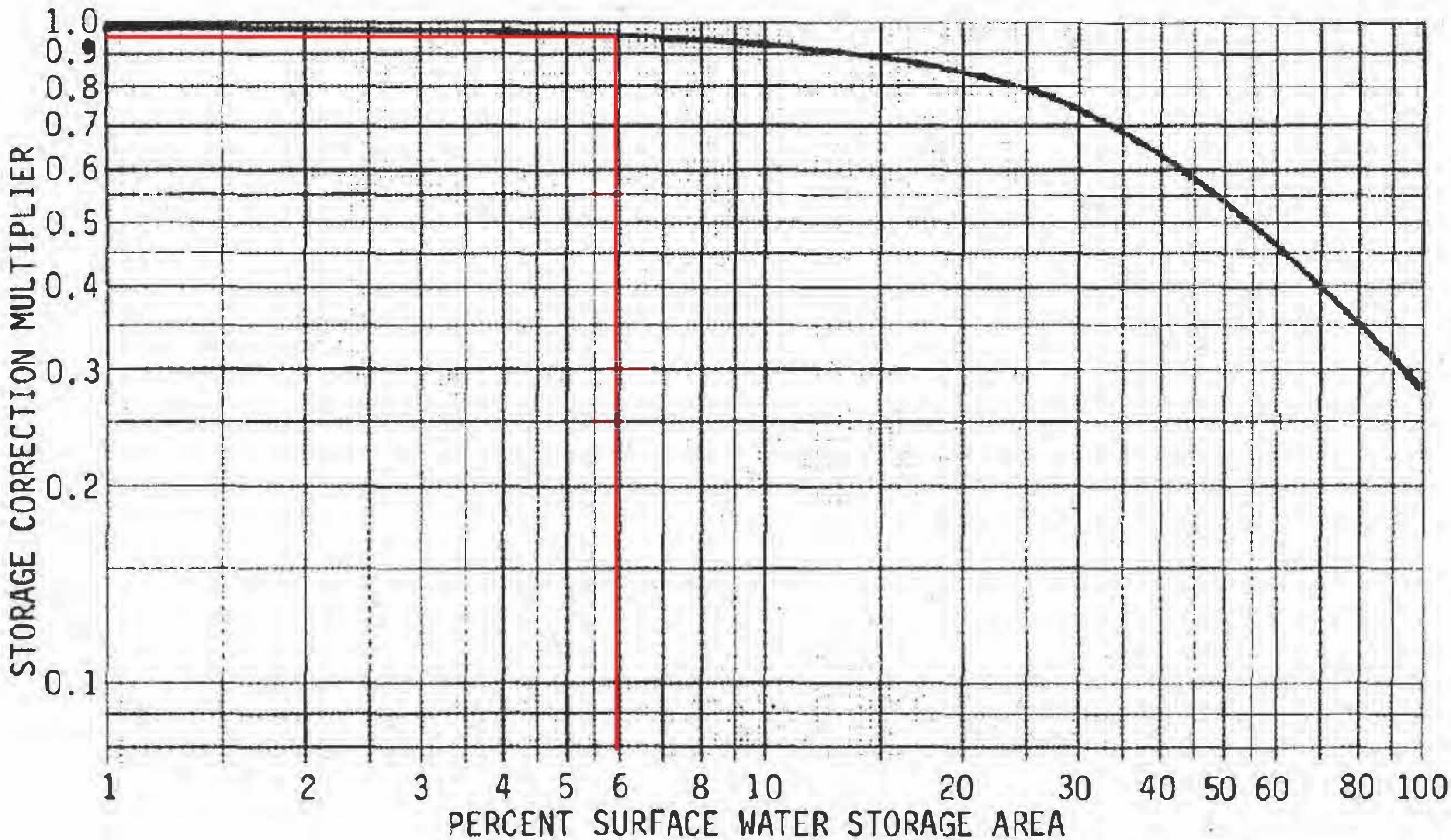
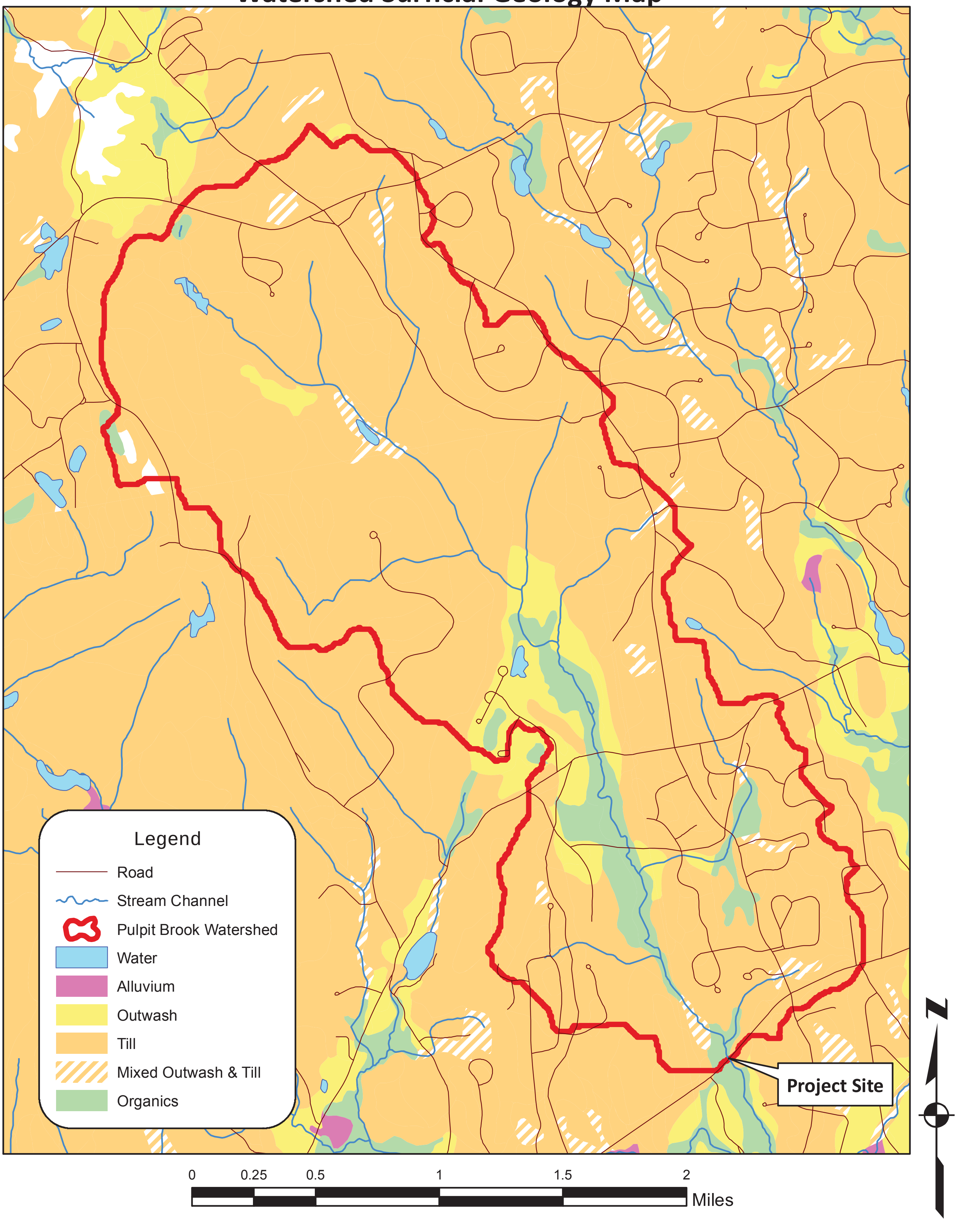


Figure 5. Storage correction curve. (Defines the relationship between the percentage of watershed area covered by lakes, ponds, swamps, playas, etc. and the multiplication factor required to correct a peak runoff estimate for storage.)

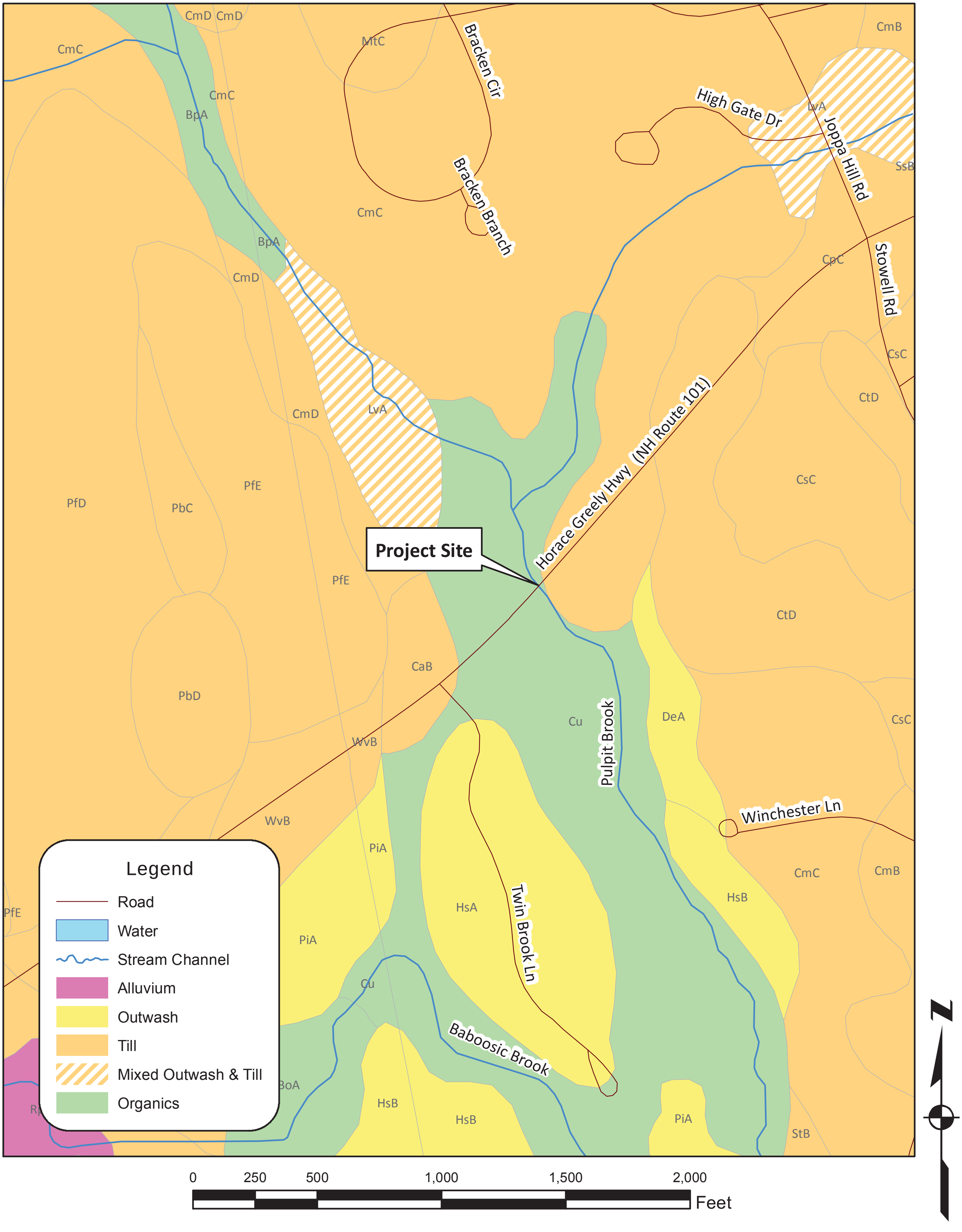
APPENDIX 2

Stream Geomorphology Assessment Data and Exhibits

NH Route 101 over Pulpit Brook
Bedford, NH
Watershed Surficial Geology Map



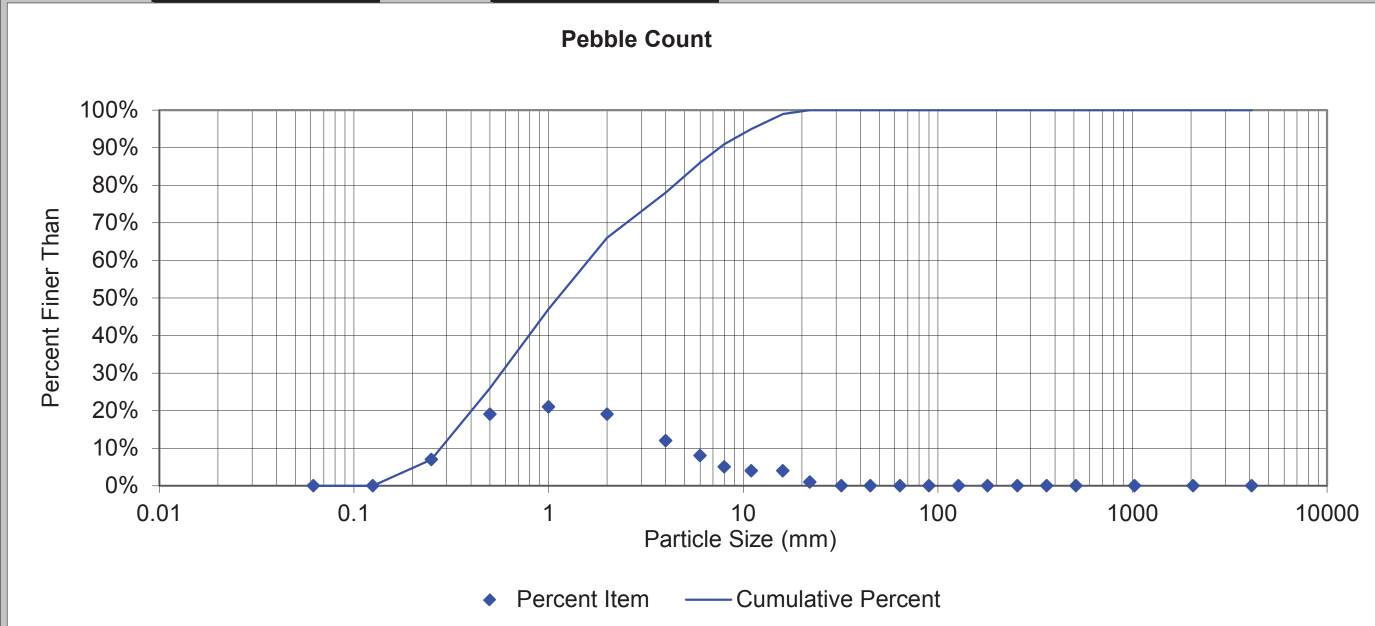
NH Route 101 over Pulpit Brook
Bedford, NH
Project Area Soils and Surficial Geology Map



Pebble Count Worksheet

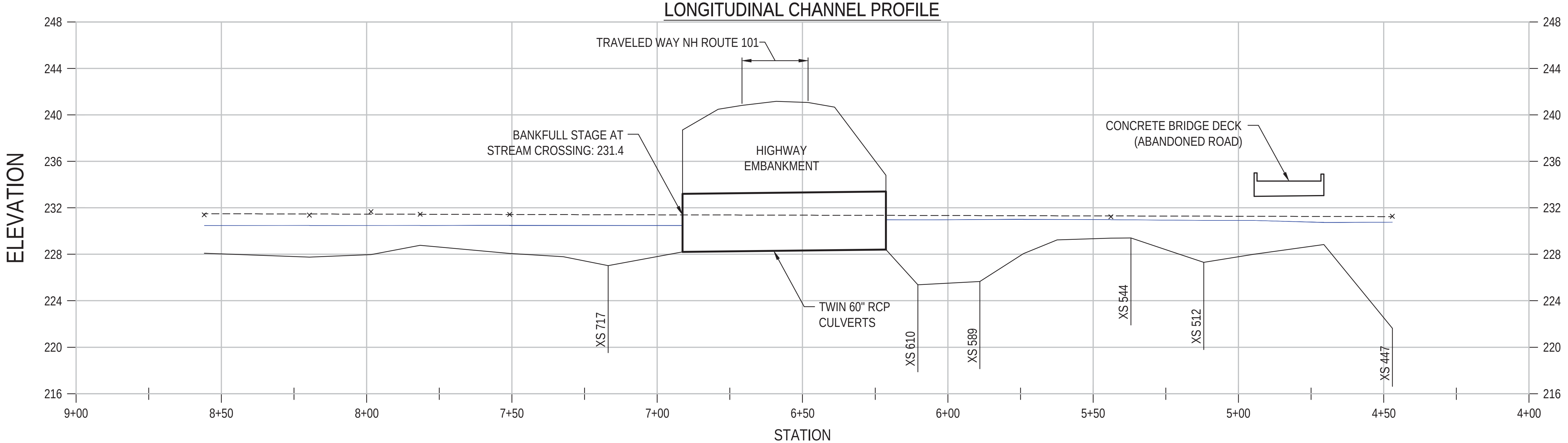
Stream Name:	Pulpit Brook	Date:	12/1/2016
Reach:	NH Route 101	Town:	Bedford, NH

Material	Size Range (mm)		No.
silt/clay	0	0.062	
very fine sand	0.062	0.125	
fine sand	0.125	0.25	7
medium sand	0.25	0.5	19
coarse sand	0.5	1	21
very coarse sand	1	2	19
very fine gravel	2	4	12
fine gravel	4	6	8
fine gravel	6	8	5
medium gravel	8	11	4
medium gravel	11	16	4
coarse gravel	16	22	1
coarse gravel	22	32	
very coarse gravel	32	45	
very coarse gravel	45	64	
small cobble	64	90	
medium cobble	90	128	
large cobble	128	180	
very large cobble	180	256	
small boulder	256	362	
small boulder	362	512	
medium boulder	512	1024	
large boulder	1024	2048	
very large boulder	2048	4096	
bedrock			
		Total Particles:	100



Size percent less than (mm)					Percent by substrate type					
D16	D35	D50	D84	D95	silt/clay	sand	gravel	cobble	boulder	bedrock
0	1	1	5	11	0%	66%	34%	0%	0%	0%

LONGITUDINAL CHANNEL PROFILE



PROFILE LEGEND

- THALWEG (DEEPEST POINT OF CHANNEL BOTTOM)
- WATER SURFACE
- × BANKFULL STAGE FIELD INDICATOR
- BANKFULL STAGE (BEST FIT LINE OF FIELD INDICATORS)

PROFILE NOTES:

1. FLOW IS FROM LEFT TO RIGHT
2. PROFILE PLOTTED WITH 4 TIMES VERTICAL EXAGGERATION
3. VERTICAL DATUM: NAVD 88
4. WATER SURFACE DOWNSTREAM FROM CULVERT SURVEYED 12/1/16
5. WATER SURFACE UPSTREAM FROM CULVERT SURVEYED 12/6/16

CHANNEL SLOPE CALCULATION:

1. WATER LEVEL AT XS 1333 ON 12/6/16: 231.42
2. WATER LEVEL AT XS 447 ON 12/6/16: 230.43
3. AVERAGE WATER SURFACE SLOPE = (231.42-230.43)/(1333-447)
= 0.99/886
= 0.0011 FT/FT

DATE OF PRINT: 9/19/17

Headwaters Hydrology PLLC
254 Manns Hill Road, Littleton, NH 03561 (603) 444-2544

KLEINFELDER, INC.
NH ROUTE 101 OVER
PULPIT BROOK
BRIDGE REPLACEMENT
BEDFORD, NH

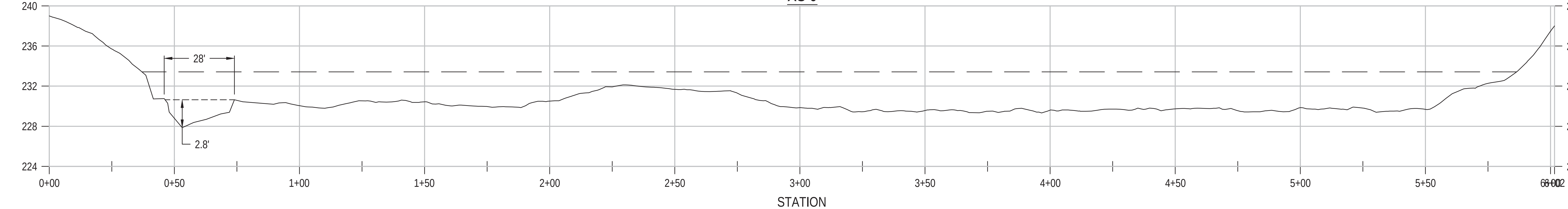
PLAN AND PROFILE

NO.	REVISION	DATE

DATE: SEPT 2017
PROJECT #: 1522
DESIGNED BY: N/A
DRAWN BY: SPS

SHEET 1 OF 1

XS 0

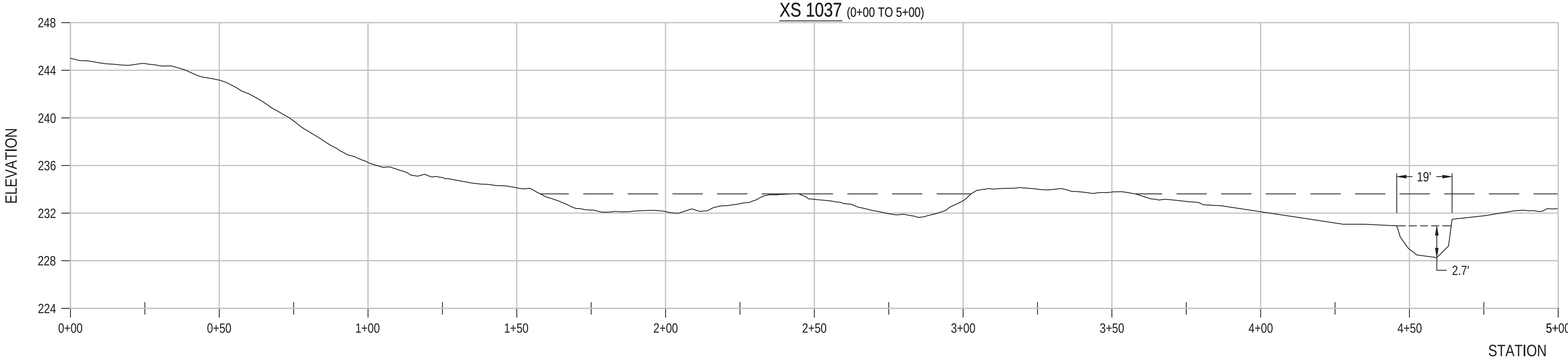


NOTE: ALL CROSS-SECTIONS ARE PLOTTED FROM LEFT TO RIGHT LOOKING DOWNSTREAM WITH 4 TIMES VERTICAL EXAGGERATION

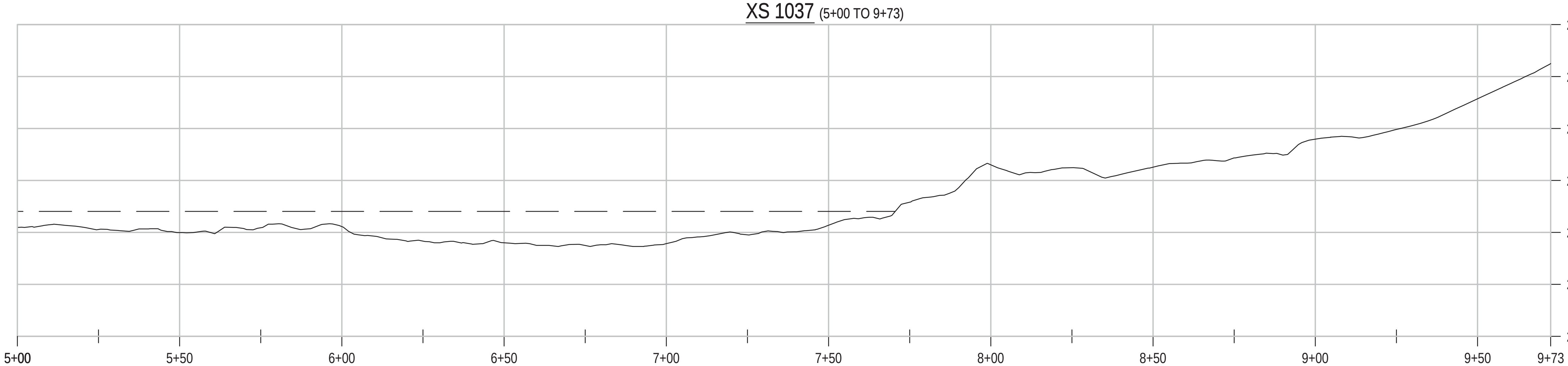
LEGEND:

- EXISTING GROUND (solid line)
- BANKFULL STAGE (short dashed line)
- FLOOD PRONE STAGE (long dashed line)

XS 1037 (0+00 TO 5+00)



XS 1037 (5+00 TO 9+73)



CHANNEL GEOMETRY

	XS 0	XS 1037
Abkf:	49 sf	37 sf
Wbkf:	28 ft	19 ft
Dbkf:	1.8 ft	1.9 ft
W/D Ratio:	16	10
Dmax bkf:	2.8 ft	2.7 ft
Wfpa:	550 ft	560 ft
Ent. Ratio:	19.6	29.5
Stream Type:	C5	E5

Headwaters Hydrology PLLC

254 Manns Hill Road, Littleton, NH 03561 (603) 444-2544

KLEINFELDER, INC.
NH ROUTE 101 OVER
PULPIT BROOK
BRIDGE REPLACEMENT

BEDFORD, NH

REFERENCE CHANNEL SECTIONS

NO.	REVISION	DATE

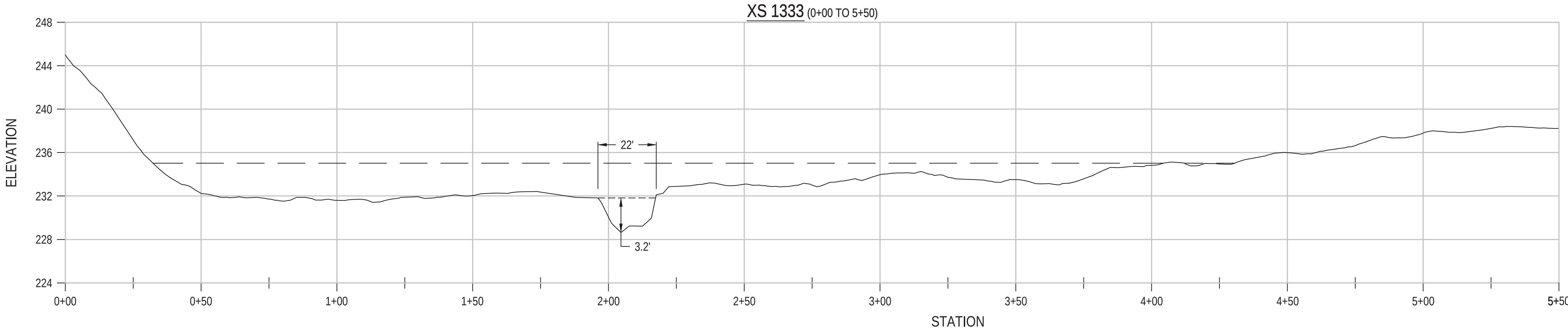
DATE: SEPT 2017

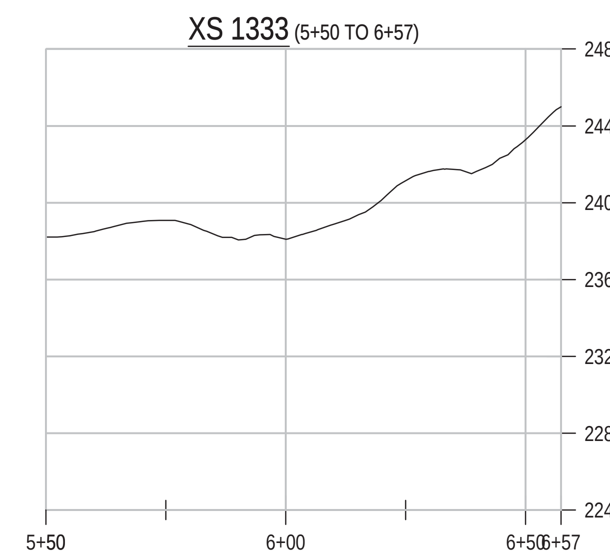
PROJECT #: 1522

DESIGNED BY: N/A

DRAWN BY: SPS

DATE OF PRINT: 9/13/17





LEGEND:

EXISTING GROUND
BANKFULL STAGE
FLOOD PRONE STAGE

NOTE: ALL CROSS-SECTIONS ARE PLOTTED FROM LEFT TO RIGHT LOOKING DOWNSTREAM WITH 4 TIMES VERTICAL EXAGGERATION

CHANNEL GEOMETRY (XS 1333)
Abkf: 45 sf
Wbkf: 22 ft
Dbkf: 2.0 ft
W/D Ratio: 11
Dmax bkf: 3.2 ft
Wfpa: 390 ft
Ent. Ratio: 17.7
Stream Type: E5

Headwaters Hydrology PLLC
254 Manns Hill Road, Littleton, NH 03561 (603) 444-2544

KLEINFELDER, INC.
NH ROUTE 101 OVER
PULPIT BROOK
BRIDGE REPLACEMENT
BEDFORD, NH

REFERENCE CHANNEL SECTIONS

NO.	REVISION	DATE

DATE: SEPT 2017
PROJECT #: 1522
DESIGNED BY: N/A
DRAWN BY: SPS

DATE OF PRINT: 9/13/17

Bankfull Discharge and Dimension Summary

Location: **NH Route 101 over Pulpit Brook, Bedford, NH**
Drainage Area: 5.3 sq mi

Bankfull Discharges and Dimension Estimated by NH and VT Regional Hydraulic Geometry Curves

parameter	NH Curves*	VT Curves**
Qbkf (cfs)	192	105
Abkf (sf)	53	43
Wbkf (ft)	27	27
Dbkf (ft)	2.0	1.6
Avg Velocity (fps)***	3.6	2.4

* NH Regional Hydraulic Geometry Curves, 2005
** Vermont Regional Hydraulic Geometry Curves, 2001 (Qbkf) and 2006 (Abkf, Wbkf, & Dbkf
*** Average velocity calculated as Qbkf/Abkf

Bankfull Channel Geometry Measurements

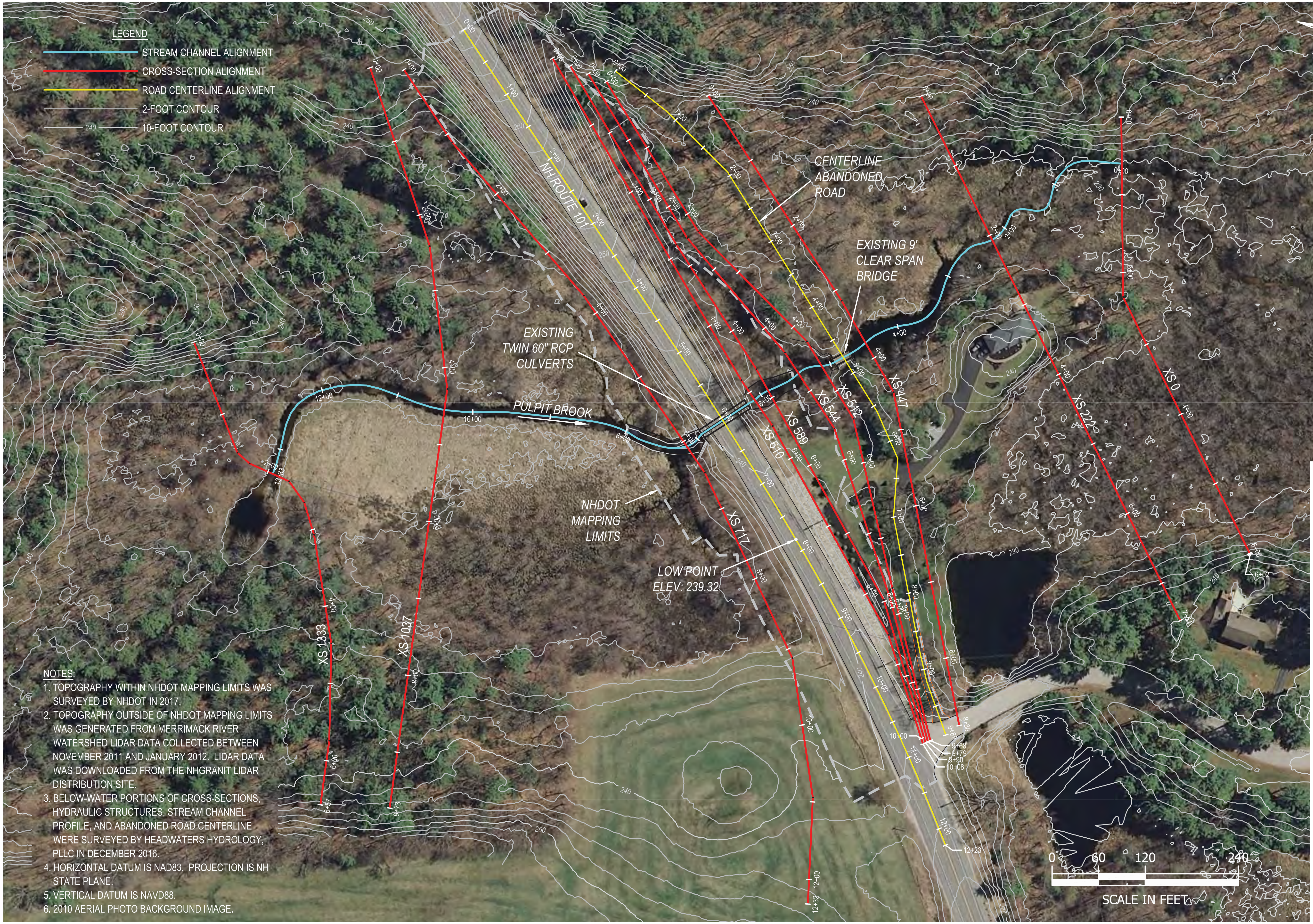
X-Section	Abkf (sf)	Wbkf (ft)	Dbkf (ft)	W/D	Dmax	Wfpa	Ent Ratio
0	49	28	1.8	16	2.8	550	19.6
1037	37	19	1.9	10	2.7	560	29.5
1333	45	22	2.0	11	3.2	390	17.7
average values:	44	23	1.9	12	2.9	500	22.3

Comparison of Bankfull Channel Geometry Measurements and Estimates

Parameter	Average Measured Value	Predicted Value NH Curves	VT Curves
Abkf (sf)	44	53	43
Wbkf (ft)	23	27	27
Dbkf (ft)	1.9	2.0	1.6

<u>APPENDIX 3</u>

Hydraulic Model Output and Supporting Documentation



NOTES:

1. TOPOGRAPHY WITHIN NHDOT MAPPING LIMITS WAS SURVEYED BY NHDOT IN 2017.
2. TOPOGRAPHY OUTSIDE OF NHDOT MAPPING LIMITS WAS GENERATED FROM MERRIMACK RIVER WATERSHED LIDAR DATA COLLECTED BETWEEN NOVEMBER 2011 AND JANUARY 2012. LIDAR DATA WAS DOWNLOADED FROM THE NHGRANIT LIDAR DISTRIBUTION SITE.
3. BELOW-WATER PORTIONS OF CROSS-SECTIONS, HYDRAULIC STRUCTURES, STREAM CHANNEL PROFILE, AND ABANDONED ROAD CENTERLINE WERE SURVEYED BY HEADWATERS HYDROLOGY, PLLC IN DECEMBER 2016.
4. HORIZONTAL DATUM IS NAD83. PROJECTION IS NH STATE PLANE.
5. VERTICAL DATUM IS NAVD88.
6. 2010 AERIAL PHOTO BACKGROUND IMAGE.

DATE OF PRINT: 9/14/17

Headwaters Hydrology PLLC
254 Manns Hill Road, Littleton, NH 03561 (603) 444-2544

KLEINFELDER, INC.
NH ROUTE 101 OVER
PULPIT BROOK
BRIDGE REPLACEMENT
BEDFORD, NH

HYDRAULIC MODEL WORKSHEET

NO.	REVISION	DATE

DATE: SEPT 2017

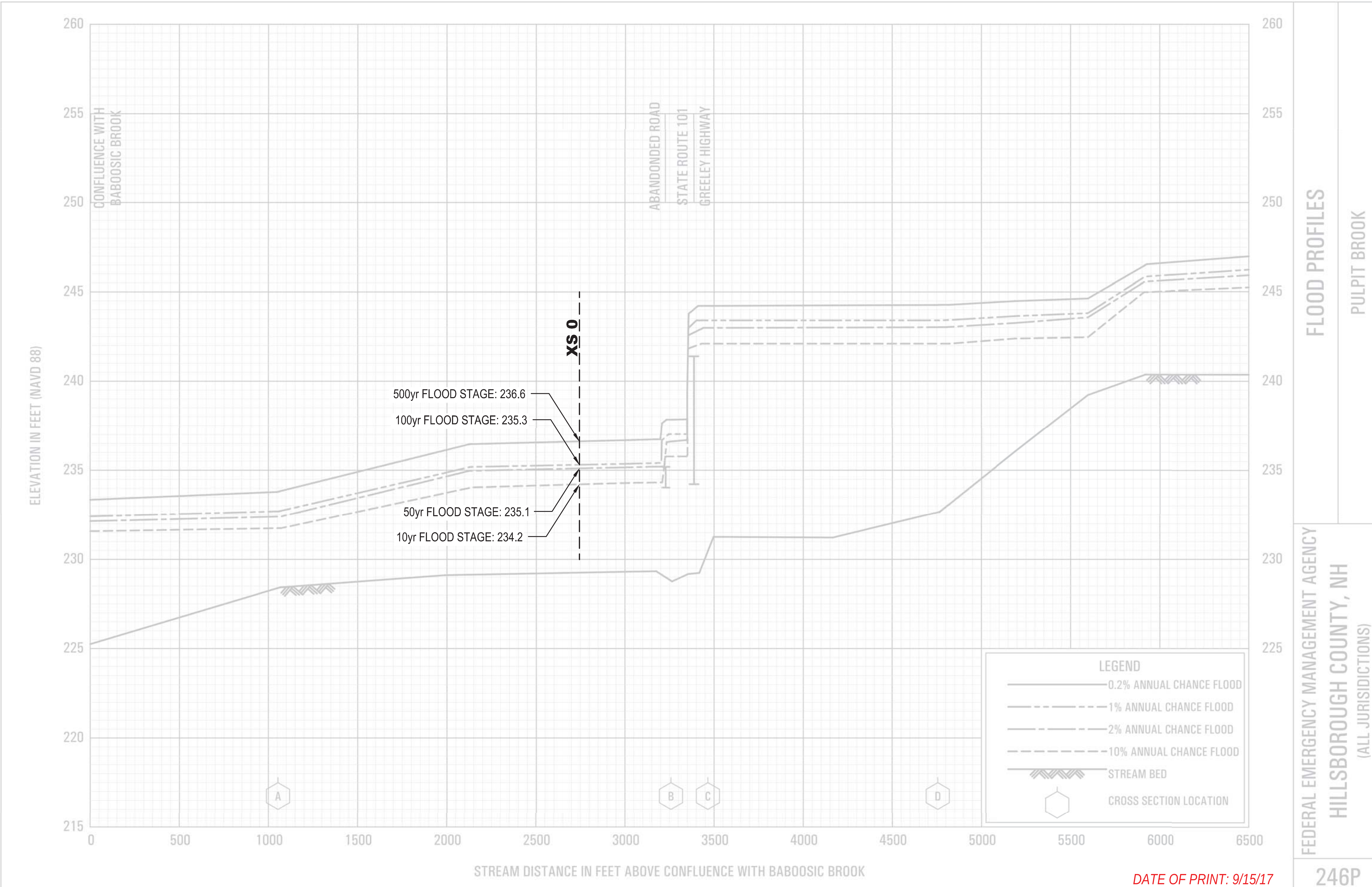
PROJECT #: 1522

DESIGNED BY: N/A

DRAWN BY: SPS

SHEET 1 OF 1

FIS FLOOD PROFILE EXHIBIT



DATE OF PRINT: 9/15/17

HEC-2 DATA FROM EFFECTIVE FLOOD INSURANCE STUDY (FIS)

PULPIT BROOK

FINAL-MULT

07-20-77

```
*************************************************
HEC2 VERSION UPDATED AUG 1976
ERROR CORRECTIONS 01,02,03,04,05,06,07,08,09,10
MODIFICATIONS 52,53,54,55,56,57,58,59
*************************************************
```

Peak Flows and Manning's Roughness Coefficients

```
T1 FLOOD INSURANCE STUDY  BEDFORD, NH   2789-31   MAY 77
T2 ANDERSON-NICHOLS D. NOONAN
T3     PULPIT BROOK 10 YEAR
```

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	0.	2.	0.	0.	0.0	0.0	0.0	0.	232.260	0.0

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	1.000	0.0	-1.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0

J3	1.000	2.000	3.000	4.000	8.020	10.000	26.000	0.0	0.0	0.0
QT	9.000	420.000	760.000	900.000	1450.000	900.000	900.000	900.000	900.000	900.000
NC	0.070	0.070	0.035	0.100	0.300	0.0	0.0	0.0	0.0	0.0
ET	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

A

X1	0.0	1[illegible].000	780.000	1340.000	0.0	0.0	0.0	0.0	0.0	0.0
GR	250.000	630.000	245.000	700.000	240.000	730.000	235.000	750.000	230.000	780.000
GR	228.000	990.000	226.000	1000.000	228.000	1010.000	230.000	1340.000	235.000	1360.000
GR	240.000	1570.000	245.000	1660.000	0.0	0.0	0.0	0.0	0.0	0.0
NC	0.0	0.0	0.0	0.400	0.700	0.0	0.0	0.0	0.0	0.0
ET	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

B

X1	0.200	11.000	967.000	1022.000	1050.000	1050.000	1050.000	0.0	0.0	0.0
GR	250.000	760.000	240.000	840.000	233.900	969.000	231.500	987.000	229.900	994.000
GR	229.100	1000.000	229.900	1006.000	233.100	1022.000	237.100	1055.000	245.000	1280.000
GR	248.000	1310.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ET	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

X1	0.400	11.000	985.000	1015.000	1050.000	1050.000	1050.000	0.0	0.0	0.0
GR	250.000	750.000	245.000	775.000	240.000	800.000	235.000	890.000	232.000	985.000
GR	230.000	1000.000	232.000	1015.000	235.000	1230.000	240.000	1320.000	245.000	1390.000
GR	250.000	1450.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ET	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

X1	0.597	10.000	990.000	1010.000	1040.000	1040.000	1040.000	0.0	0.0	0.0
GR	250.000	640.000	245.000	660.000	240.000	700.000	235.000	750.000	233.000	990.000
GR	230.000	1000.000	233.000	1010.000	235.000	1440.000	240.000	1510.000	245.000	1580.000
NC	0.070	0.070	0.035	0.250	0.500	0.0	0.0	0.0	0.0	0.0
ET	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

X1	0.607	12.000	995.500	1004.500	50.000	50.000	50.000	0.0	0.0	0.0
X3	10.000	0.0	0.0	0.0	0.0	0.0	0.0	234.800	234.800	0.0
GR	245.000	600.000	240.000	610.000	235.000	700.000	235.000	982.000	231.200	986.000
GR	235.000	990.000	231.500	995.500	230.900	1000.000	231.400	1004.500	235.000	1430.000

GR	240.000	1520.000	245.000	1600.000	0.0	0.0	0.0	0.0	0.0	0.0
SB	1.000	1.610	2.500	0.0	9.000	0.010	27.000	0.0	231.200	230.900
ET	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Abandoned Road

X1	0.611	16.000	995.500	1004.500	23.000	23.000	23.000	0.0	0.0	0.0
X2	0.0	0.0	1.000	234.800	234.800	0.0	0.0	0.0	0.0	0.0
X3	10.000	0.0	0.0	0.0	0.0	0.0	0.0	234.800	236.000	0.0
BT	9.000	950.000	236.100	0.0	982.000	235.000	0.0	986.000	234.800	0.0
BT	990.000	235.000	0.0	995.400	236.000	0.0	995.500	236.000	234.800	0.0
BT	236.000	234.800	1004.600	236.000	0.0	1050.000	235.100	0.0	0.0	1004.500
GR	245.000	550.000	240.000	580.000	235.000	680.000	236.100	950.000	235.000	0.0
GR	235.000	986.000	235.000	990.000	232.000	995.400	231.900	995.500	232.000	932.000
GR	231.900	1004.500	232.000	1004.600	236.000	1050.000	236.000	1450.000	240.000	1000.000
GR	245.000	1620.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1520.000
NC	0.0	0.0	0.0	0.500	0.800	0.0	0.0	0.0	0.0	0.0
ET	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

C

X1	0.617	13.000	990.000	1010.000	30.000	30.000	30.000	0.0	0.0	0.0
GR	250.000	750.000	245.000	800.000	240.000	870.000	235.000	920.000	234.000	965.000
GR	234.600	990.000	229.600	1000.000	234.500	1010.000	234.200	1080.000	240.000	1250.000
GR	245.000	1330.000	246.000	1495.000	250.000	1690.000	0.0	0.0	0.0	0.0
ET	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

X1	0.632	15.000	997.500	1002.500	80.000	80.000	80.000	0.0	0.0	0.0
X3	10.000	0.0	0.0	0.0	0.0	0.0	0.0	234.900	234.900	0.0
GR	255.000	400.000	250.000	750.000	245.000	910.000	240.000	920.000	235.000	980.000
GR	232.000	990.000	229.900	997.500	229.900	1000.000	229.900	1002.500	232.000	1010.000
GR	235.000	1020.000	240.000	1200.000	245.000	1390.000	250.000	1700.000	255.000	1370.000
SB	0.0	1.460	2.500	0.0	5.000	0.0	15.700	0.0	230.000	229.900
ET	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Route 101

X1	0.646	18.000	997.500	1002.500	73.000	73.000	73.000	0.0	0.0	0.0
X2	0.0	0.0	1.000	235.000	241.400	0.0	0.0	0.0	0.0	0.0
X3	10.000	0.0	0.0	0.0	0.0	0.0	0.0	242.200	241.400	0.0
BT	9.000	950.000	243.300	0.0	997.400	242.200	0.0	997.500	242.200	0.0
BT	998.000	242.200	234.500	1000.000	242.200	235.500	1002.000	242.200	234.500	232.500
BT	242.200	232.500	1002.600	242.000	0.0	1050.000	241.400	0.0	0.0	1002.500
GR	255.000	400.000	250.000	750.000	245.000	910.000	240.000	920.000	235.000	950.000
GR	235.000	980.000	232.500	997.400	232.500	997.500	230.500	998.000	230.000	1000.000
GR	230.500	1002.000	232.500	1002.500	232.500	1002.600	235.000	1020.000	240.000	1200.000
GR	245.000	1390.000	250.000	1700.000	255.000	1870.000	0.0	0.0	0.0	0.0
ET	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

D

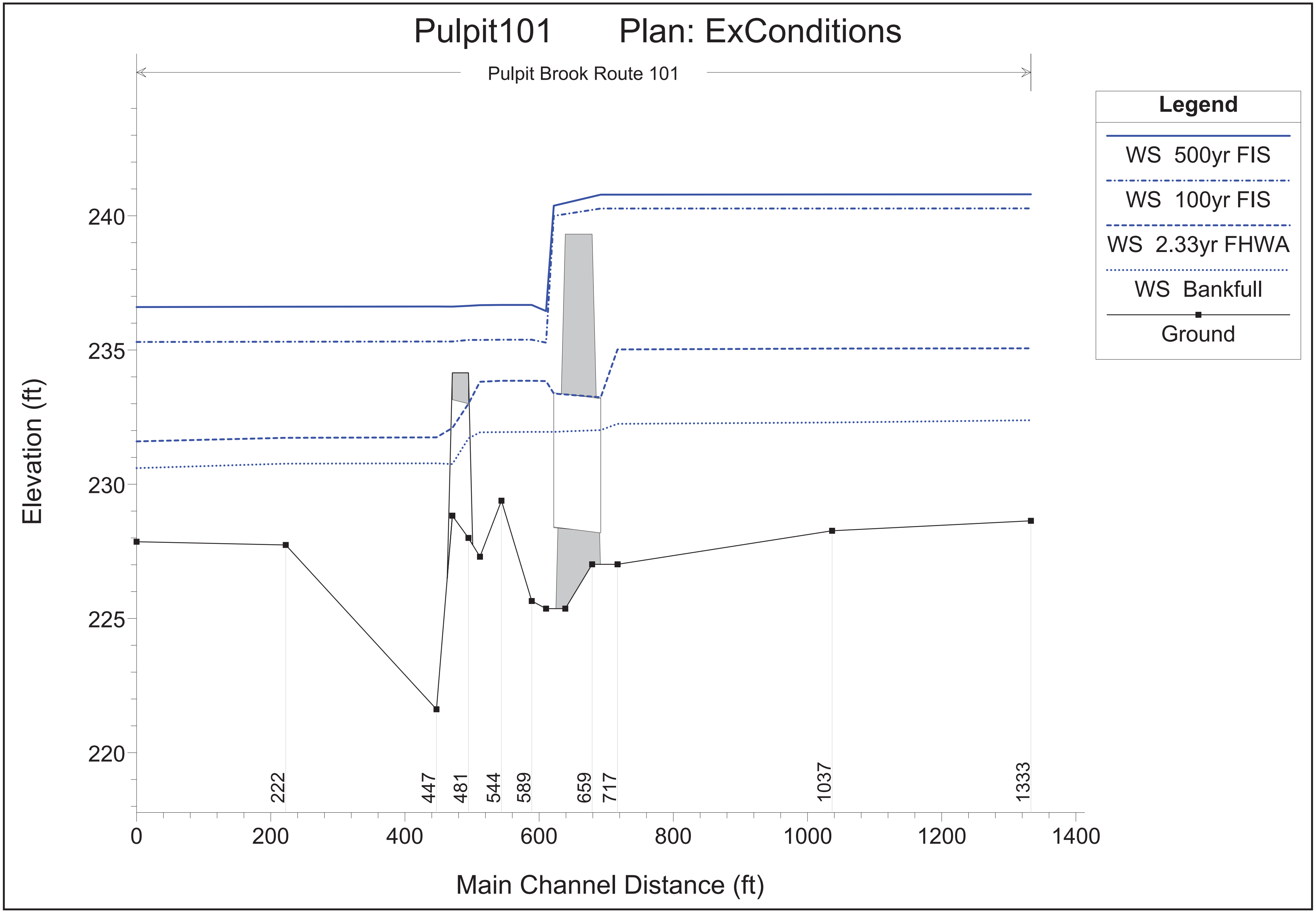
X1	0.656	11.000	990.000	1010.000	50.000	50.000	50.000	0.0	0.0	0.0
GR	250.000	0.0	245.000	100.000	240.000	300.000	235.000	700.000	233.000	990.000
GR	232.000	1000.000	233.000	1010.000	235.000	1150.000	240.000	1290.000	245.000	1450.000
GR	250.000	1580.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ET	0.0	0.0	0.0	0.100	0.300	0.0	0.0	0.0	0.0	0.0

X1	0.790	15.000	990.000	1010.000	710.000	710.000	710.000	0.0	0.0	0.0
GR	260.000	580.000	255.000	610.000	250.000	640.000	245.000	690.000	240.000	740.000
GR	235.000	770.000	234.000	990.000	232.000	1000.000	234.000	1010.000	235.000	1160.000
GR	240.000	1250.000	245.000	1350.000	250.000	1400.000	255.000	1420.000	260.000	1500.000
NC	0.0	0.0	0.0	0.500	0.800	0.0	0.0	0.0	0.0	0.0

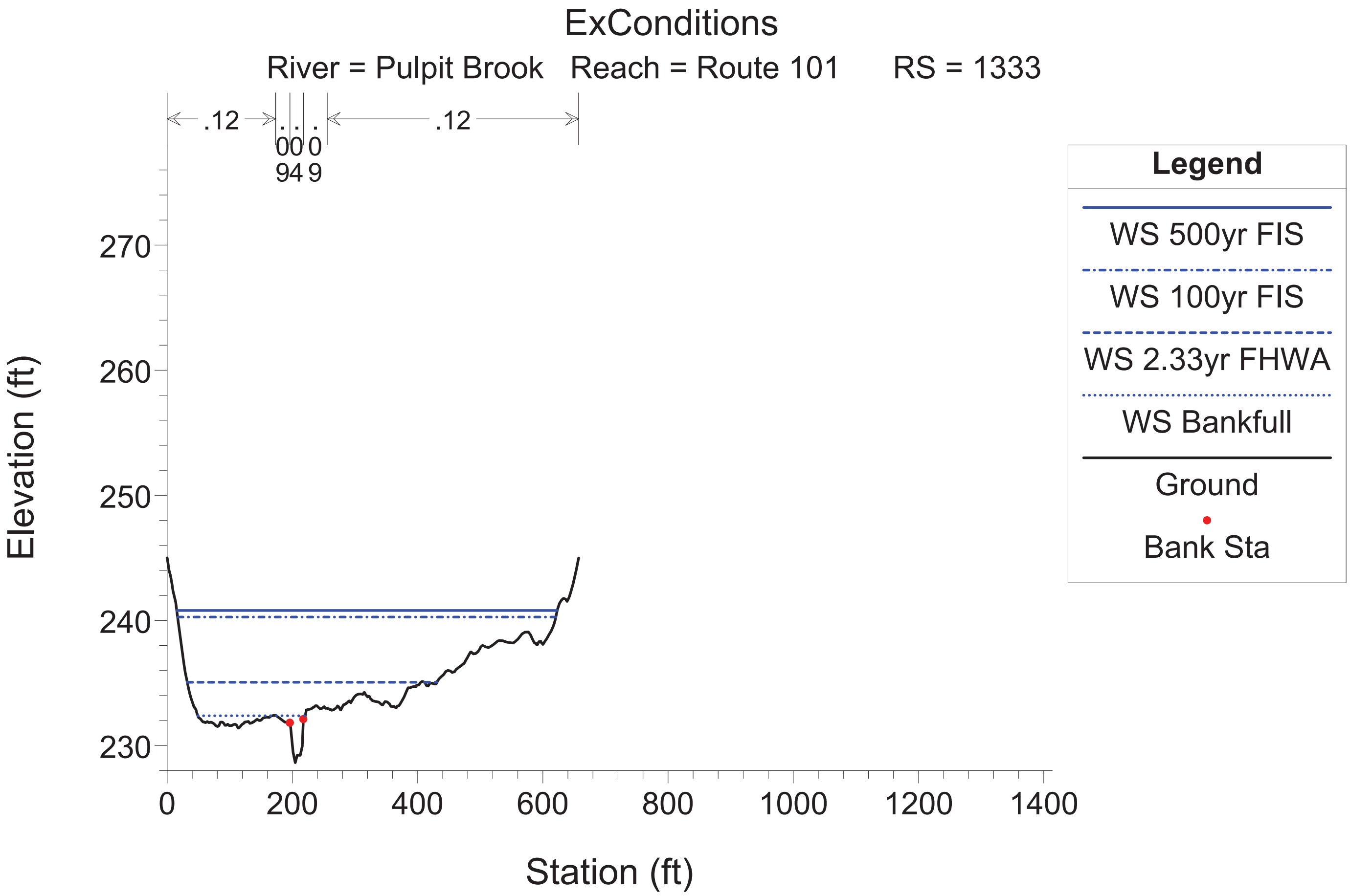
E

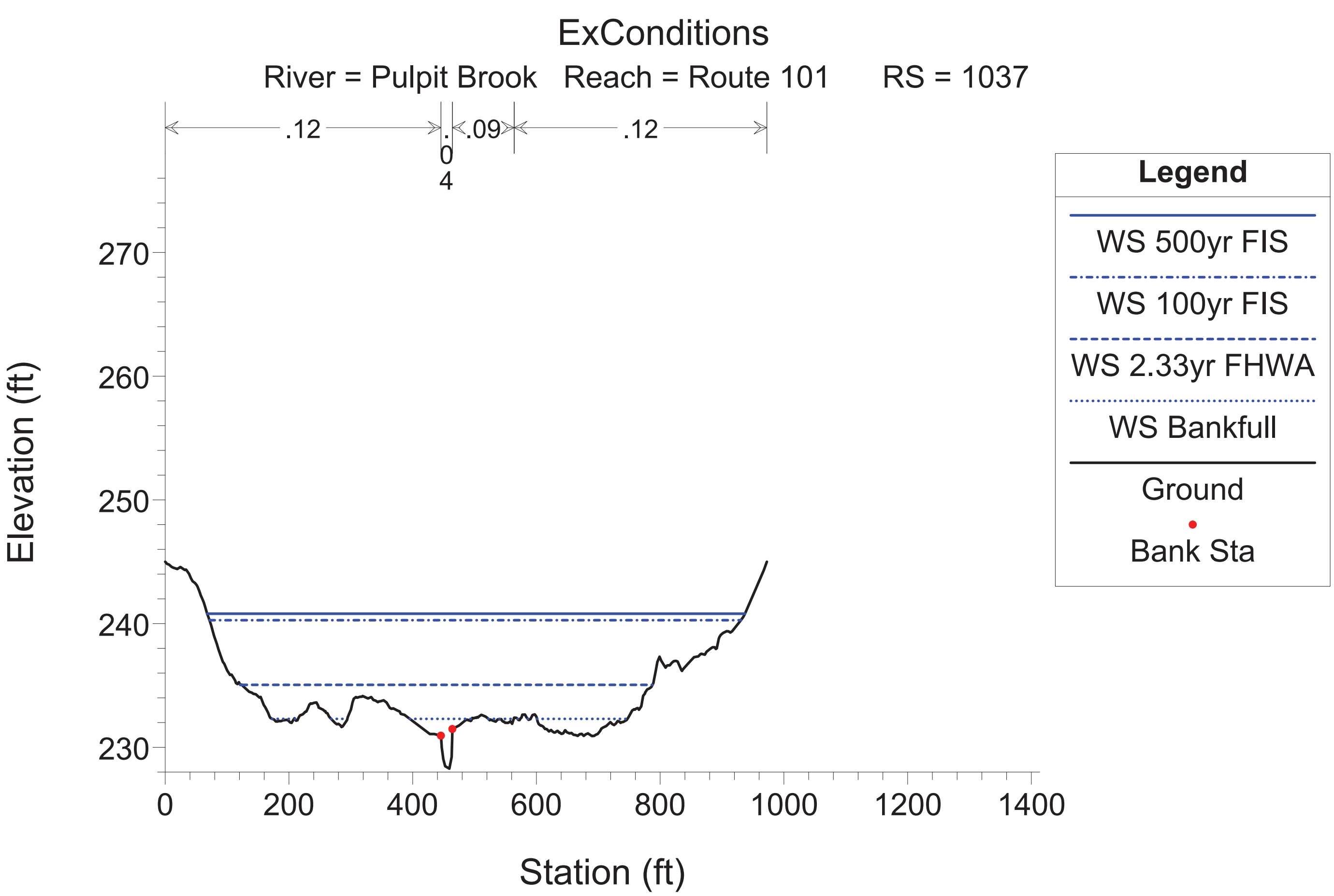
EI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
X1	0.900	11.000	986.000	1014.000	580.000	580.000	580.000	0.0	0.0	0.0
GR	250.000	730.000	245.000	800.000	240.000	870.000	237.700	980.000	235.000	986.00
GR	233.400	1000.000	235.100	1014.000	239.100	1025.000	244.900	1125.000	245.000	1160.00
GR	250.000	1185.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ET	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
X1	1.060	11.000	985.000	1015.000	845.000	845.000	845.000	0.0	0.0	0.0
GR	260.000	690.000	255.000	760.000	250.000	860.000	245.000	920.000	243.000	985.00
GR	240.000	1000.000	243.000	1015.000	245.000	1090.000	250.000	1140.000	255.000	1160.000
GR	260.000	1190.000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Existing Conditions Hydraulics

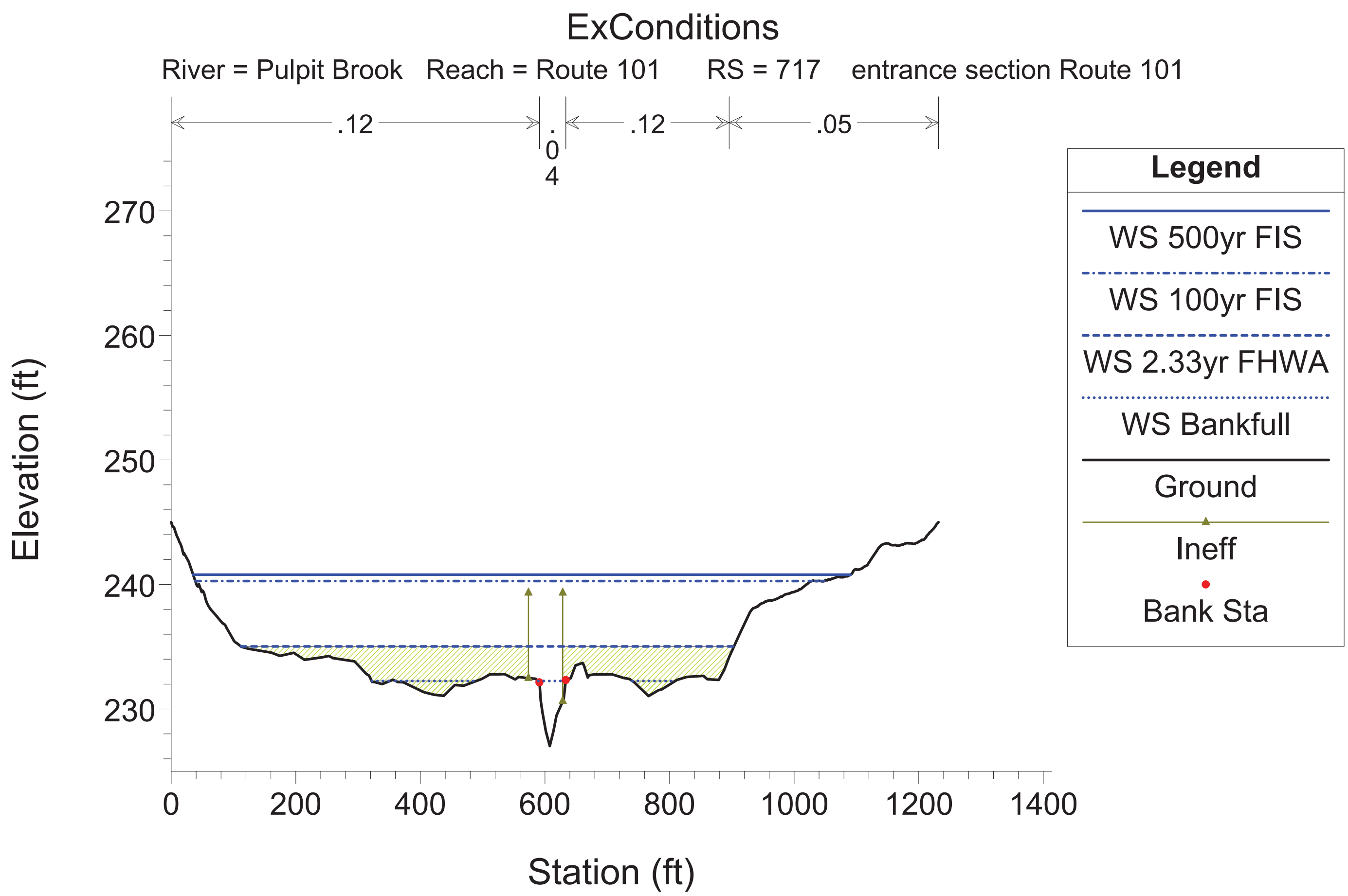


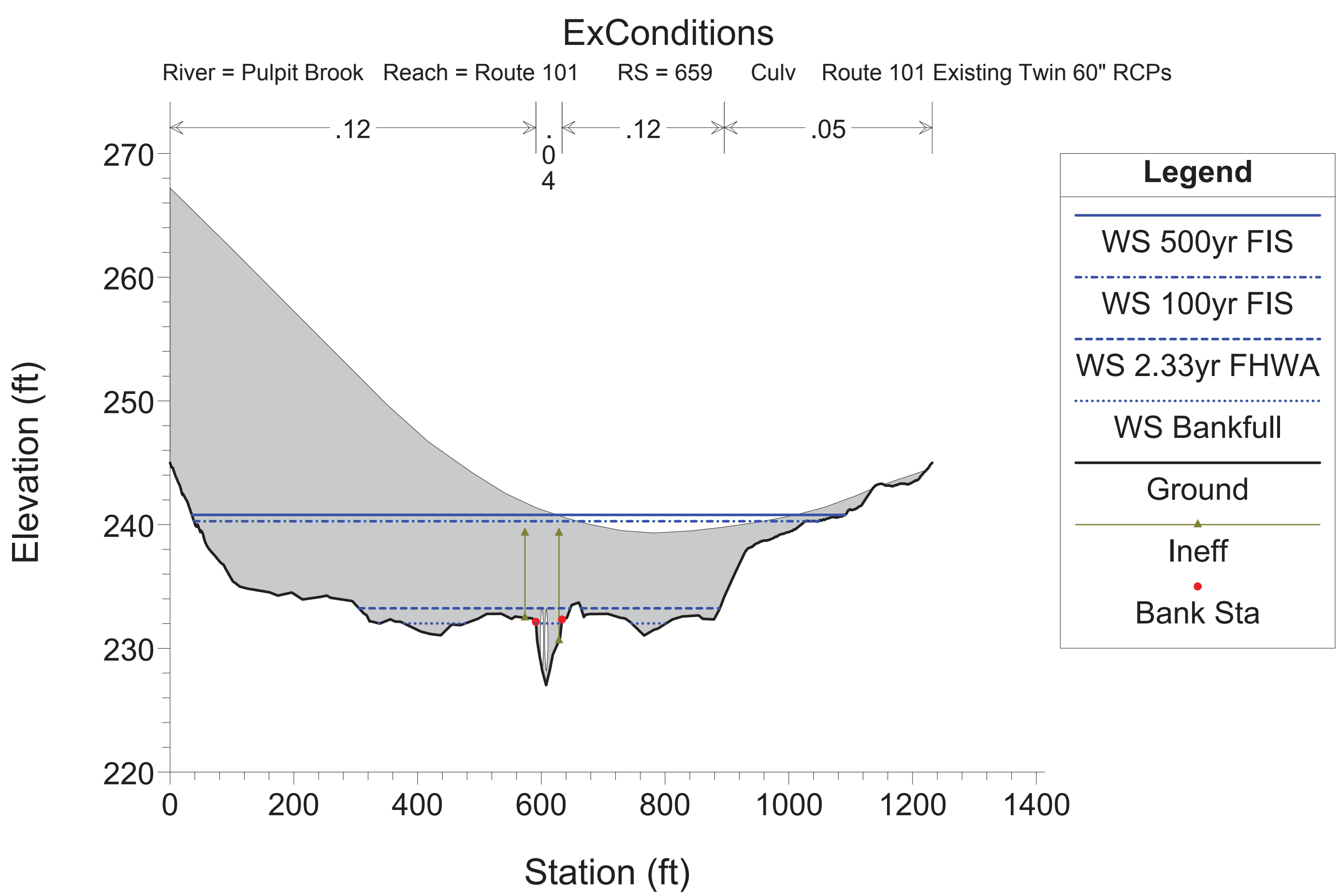
1 in Horiz. = 200 ft 1 in Vert. = 5 ft



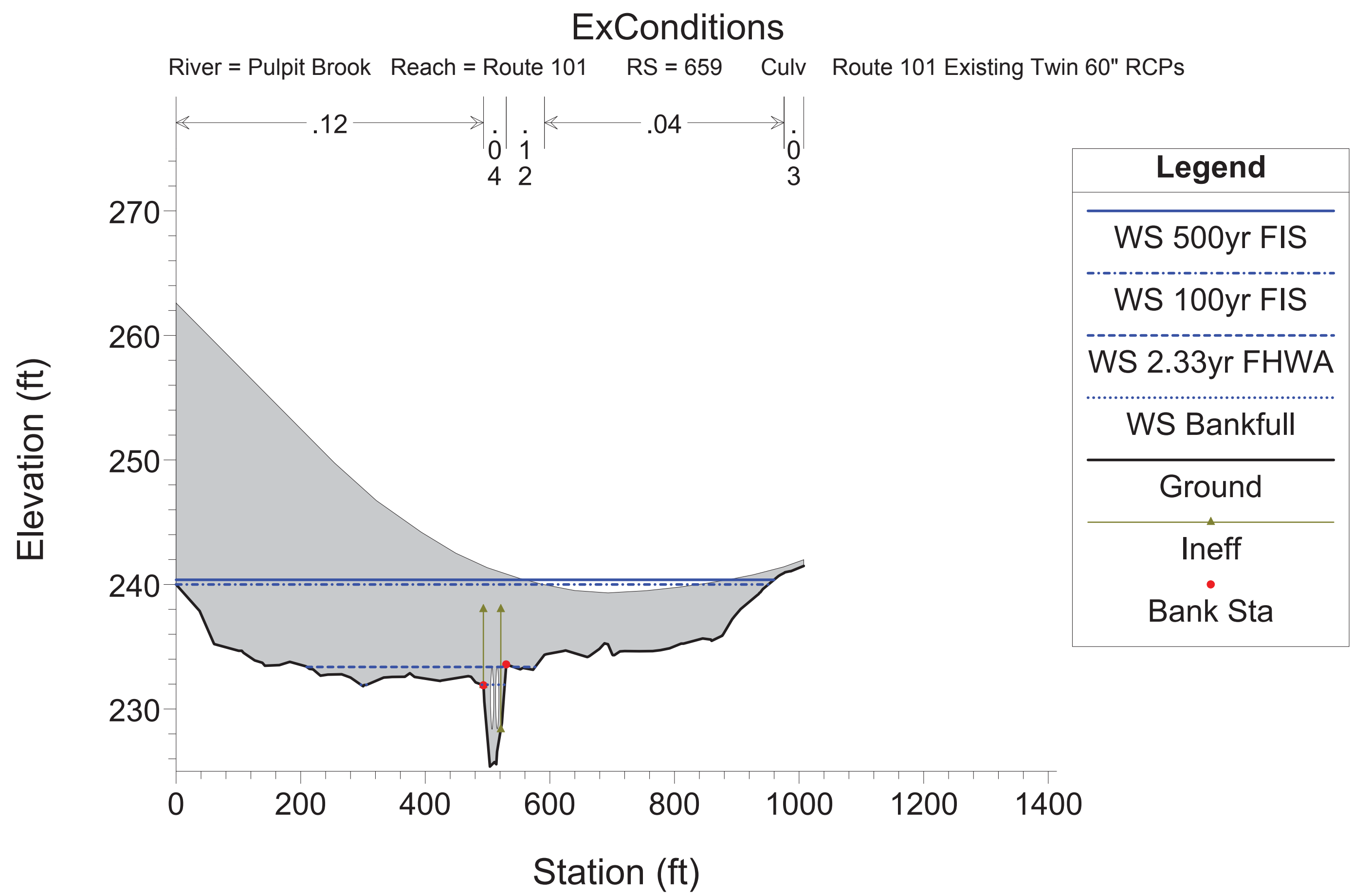


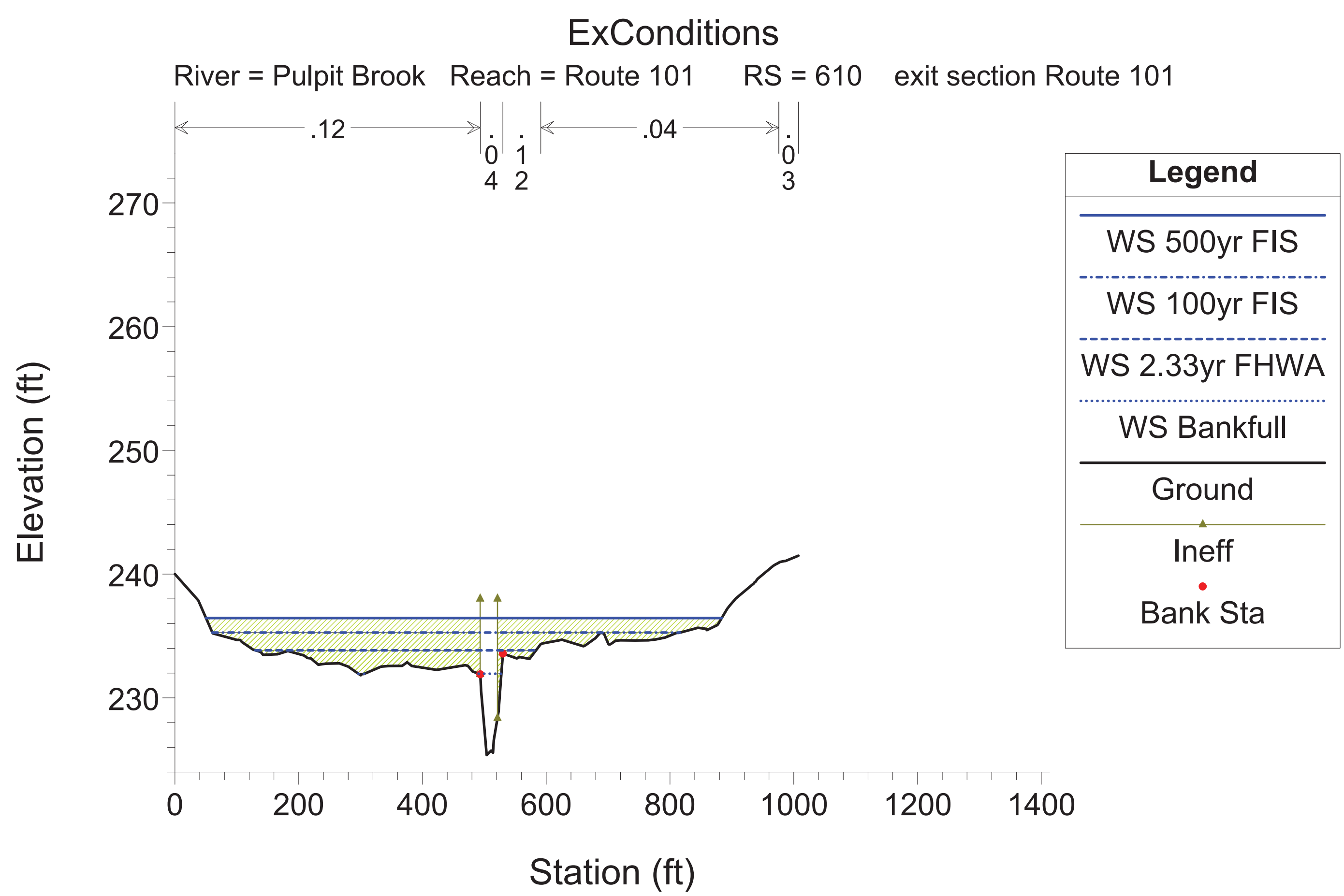
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



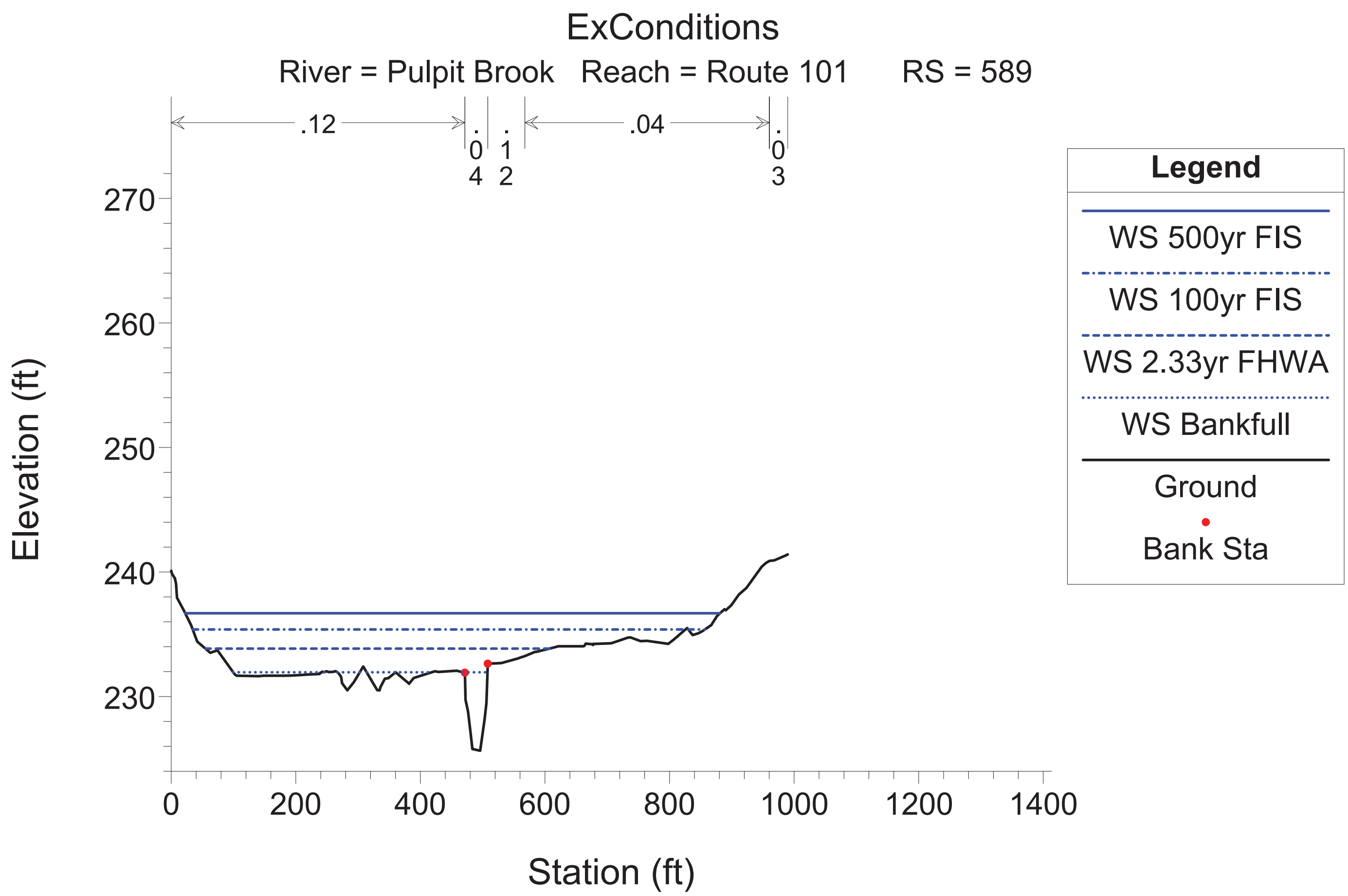


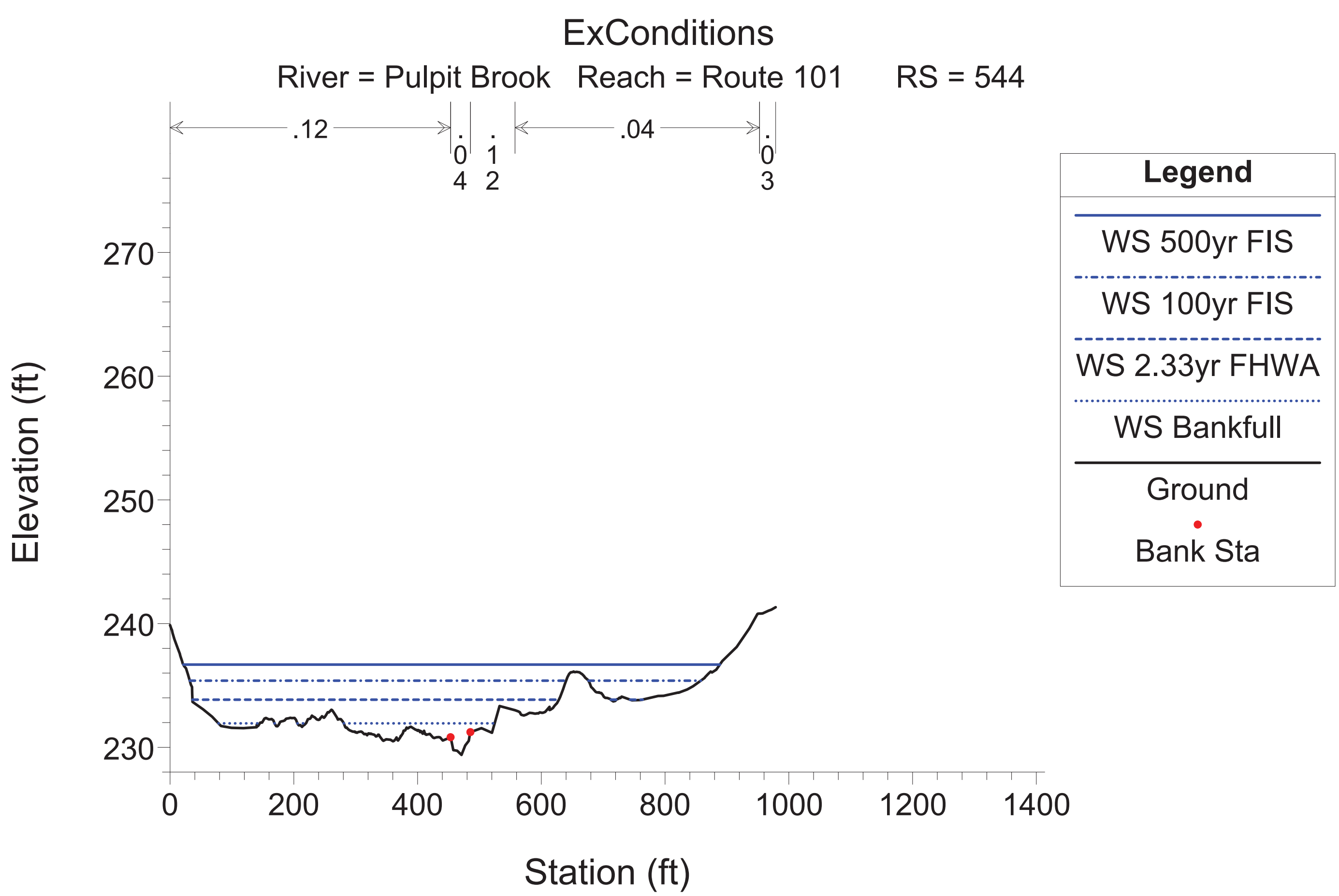
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



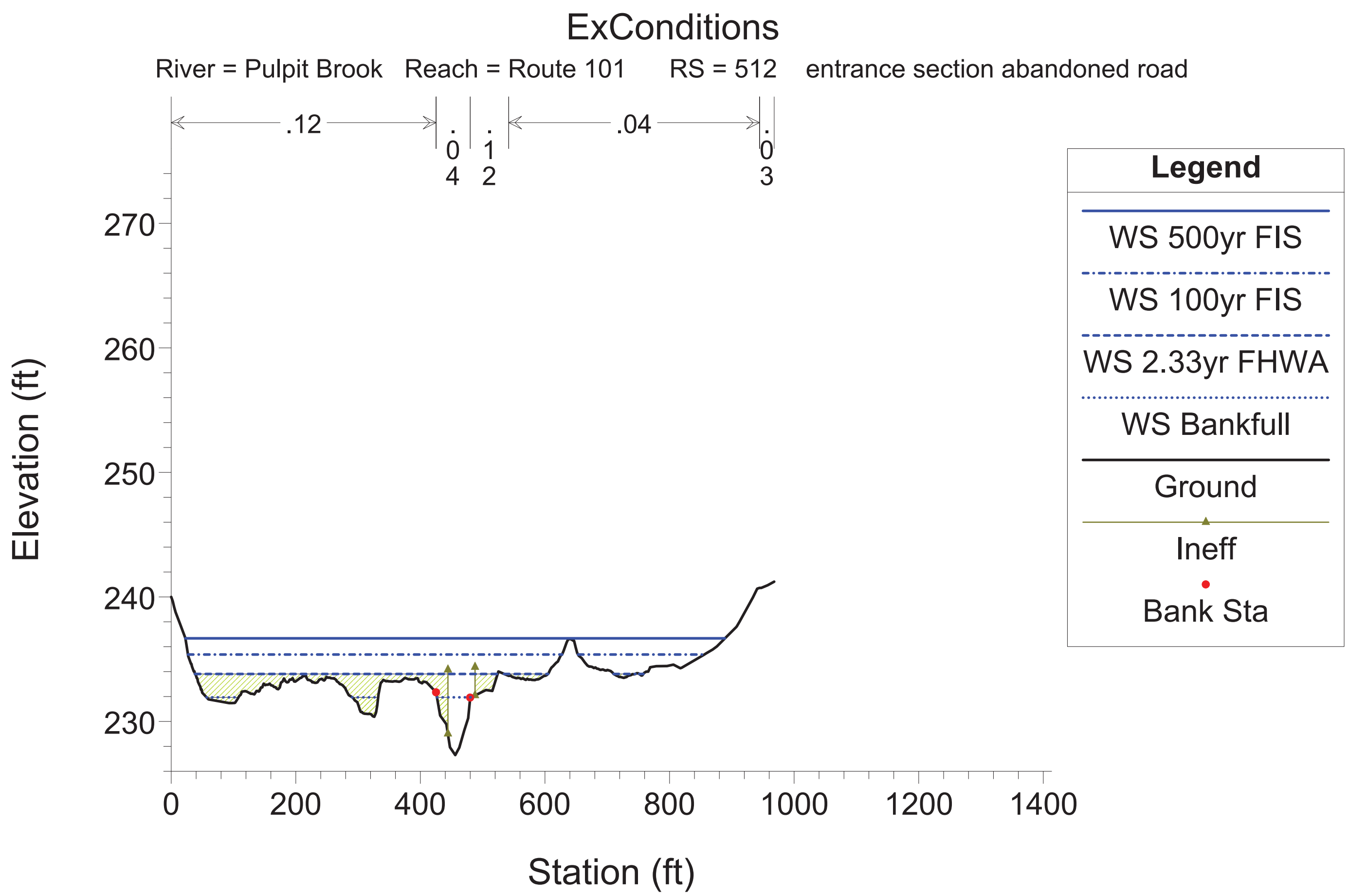


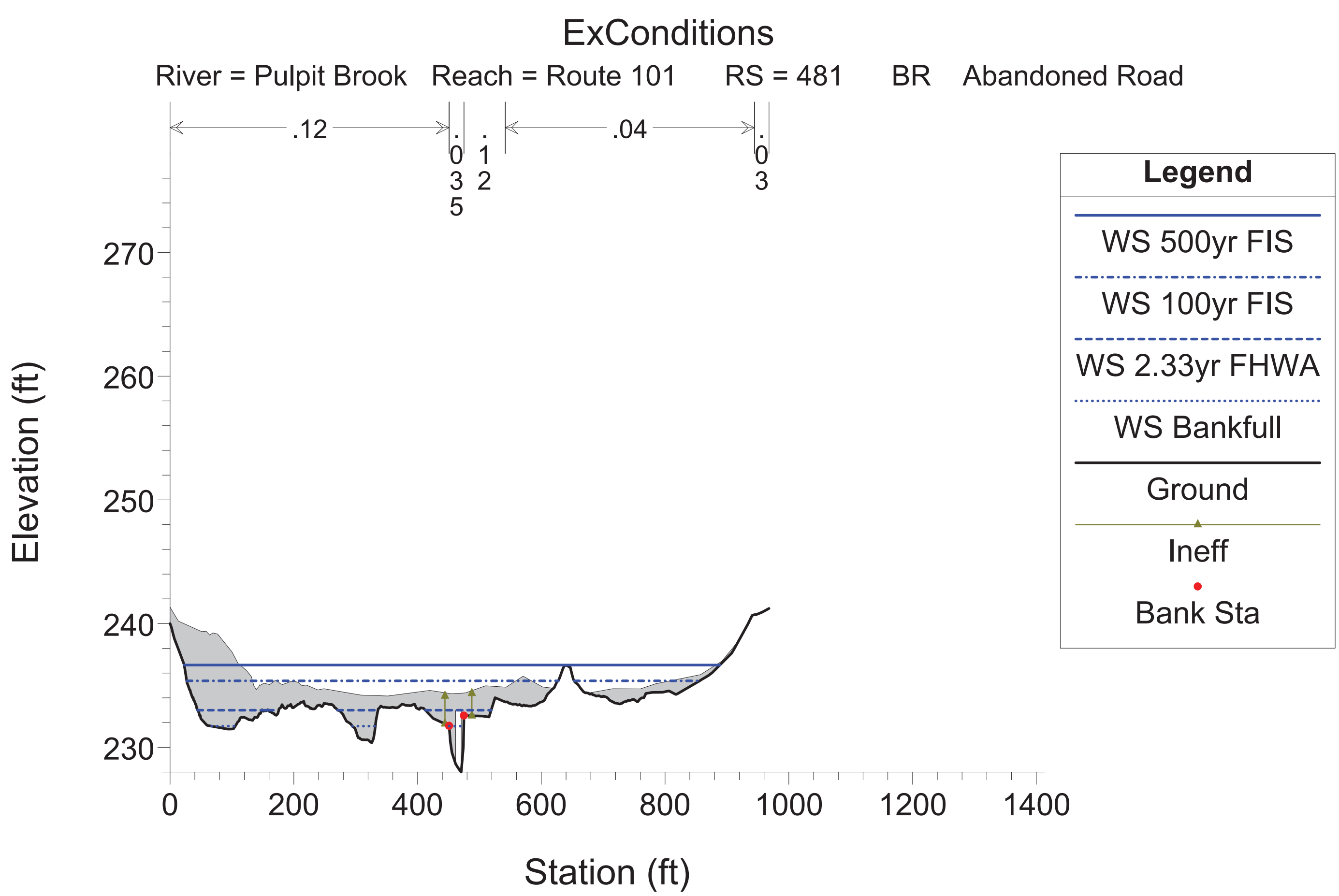
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



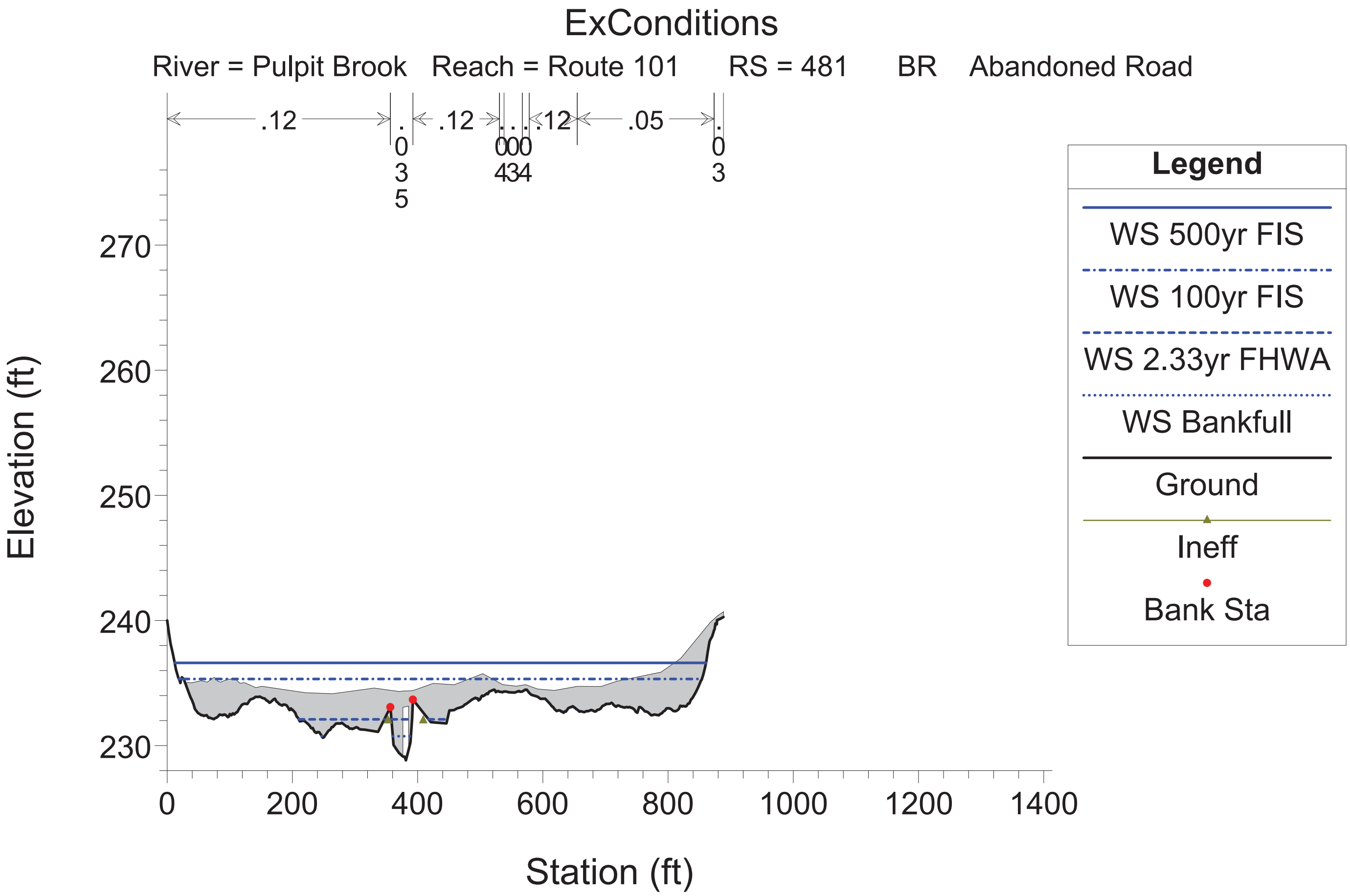


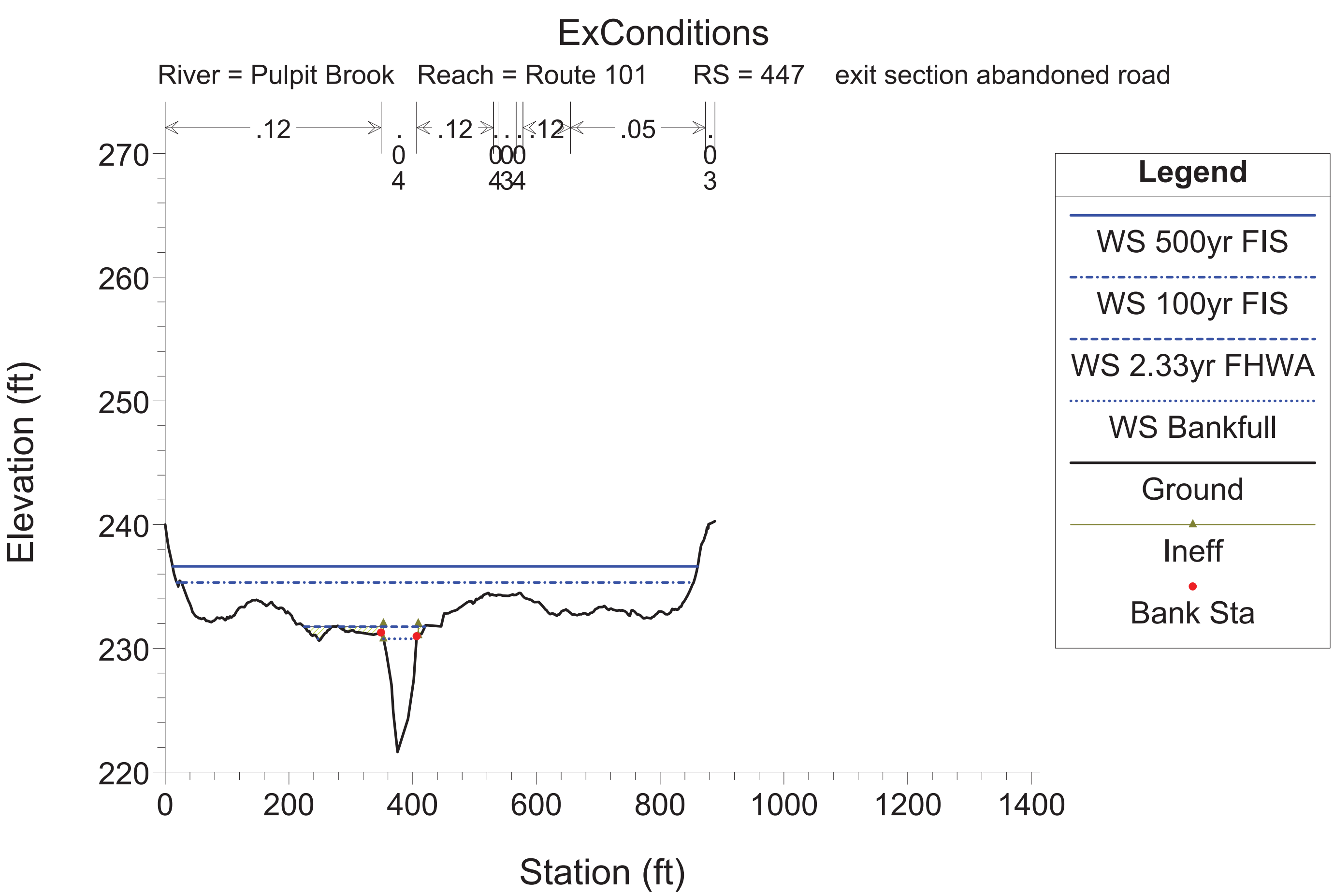
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



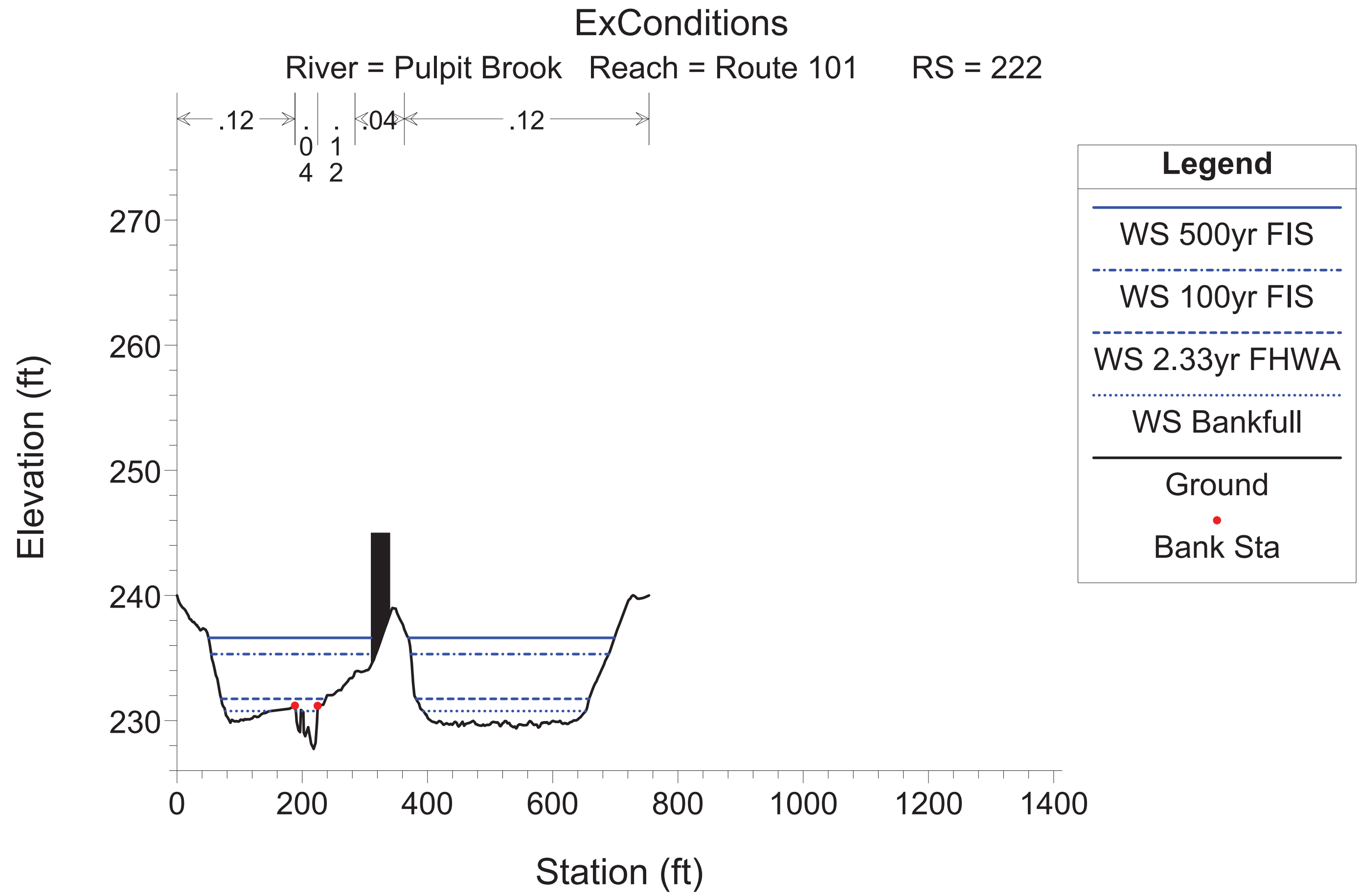


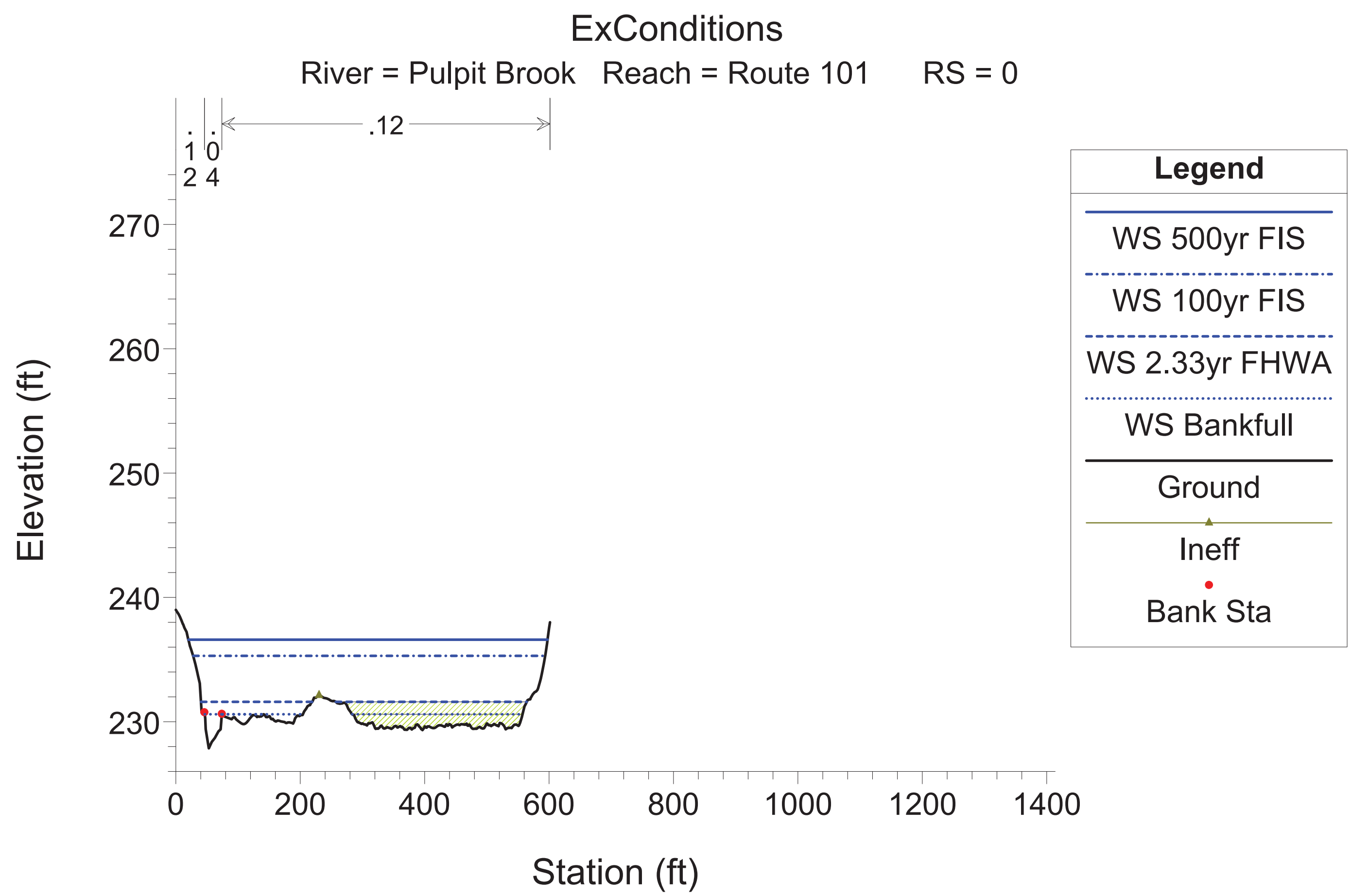
1 in Horiz. = 300 ft 1 in Vert. = 15 ft





1 in Horiz. = 300 ft 1 in Vert. = 15 ft





1 in Horiz. = 300 ft 1 in Vert. = 15 ft

HEC-RAS Plan: ExConditions River: Pulpit Brook Reach: Route 101

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Power Chan
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/ft s)
Route 101	0	Bankfull	105	227.9	230.6	229.5	230.7	0.0014	1.9	97	431	0.26	0.28
Route 101	0	2.33yr FHWA	260	227.9	231.6	230.4	231.7	0.0010	2.3	265	485	0.24	0.38
Route 101	0	10yr FIS	420	227.9	234.2	230.8	234.2	0.0000	0.6	2209	557	0.04	0.01
Route 101	0	50yr FIS	760	227.9	235.1	231.3	235.1	0.0000	0.8	2713	564	0.06	0.01
Route 101	0	100yr FIS	900	227.9	235.3	231.5	235.3	0.0001	1.0	2826	566	0.07	0.02
Route 101	0	100yr FHWA	1090	227.9	235.8	231.7	235.8	0.0001	1.1	3081	570	0.07	0.03
Route 101	0	500yr FIS	1450	227.9	236.6	232.1	236.6	0.0001	1.2	3569	577	0.08	0.04
Route 101	222	Bankfull	105	227.7	230.8		230.8	0.0003	0.9	338	366	0.12	0.03
Route 101	222	2.33yr FHWA	260	227.7	231.7		231.7	0.0002	1.0	743	443	0.11	0.03
Route 101	222	10yr FIS	420	227.7	234.2		234.2	0.0000	0.6	1967	552	0.05	0.01
Route 101	222	50yr FIS	760	227.7	235.1		235.1	0.0001	0.9	2474	568	0.06	0.02
Route 101	222	100yr FIS	900	227.7	235.3		235.3	0.0001	1.0	2589	571	0.07	0.02
Route 101	222	100yr FHWA	1090	227.7	235.8		235.8	0.0001	1.1	2848	577	0.07	0.03
Route 101	222	500yr FIS	1450	227.7	236.6		236.6	0.0001	1.2	3344	589	0.08	0.04
Route 101	447	Bankfull	105	221.6	230.8	223.7	230.8	0.0000	0.4	274	59	0.03	0.00
Route 101	447	2.33yr FHWA	260	221.6	231.7	224.6	231.8	0.0000	0.8	328	184	0.06	0.01
Route 101	447	10yr FIS	420	221.6	234.2	225.2	234.2	0.0000	0.7	1539	744	0.04	0.01
Route 101	447	50yr FIS	760	221.6	235.1	226.2	235.1	0.0000	0.9	2272	825	0.05	0.02
Route 101	447	100yr FIS	900	221.6	235.3	226.6	235.3	0.0000	1.0	2440	832	0.06	0.02
Route 101	447	100yr FHWA	1090	221.6	235.8	227.0	235.8	0.0000	1.0	2819	841	0.06	0.02
Route 101	447	500yr FIS	1450	221.6	236.6	227.7	236.6	0.0000	1.1	3539	849	0.06	0.03
Route 101	481		Bridge										
Route 101	512	Bankfull	105	227.3	231.9	228.7	231.9	0.0001	0.9	119	148	0.08	0.02
Route 101	512	2.33yr FHWA	260	227.3	233.8	229.5	233.8	0.0002	1.4	201	598	0.11	0.07
Route 101	512	10yr FIS	420	227.3	234.8	230.1	234.8	0.0000	0.8	1511	766	0.06	0.01
Route 101	512	50yr FIS	760	227.3	235.2	230.9	235.2	0.0001	1.2	1803	792	0.08	0.04
Route 101	512	100yr FIS	900	227.3	235.4	231.3	235.4	0.0001	1.3	1928	803	0.09	0.05
Route 101	512	100yr FHWA	1090	227.3	235.8	231.7	235.8	0.0001	1.3	2264	824	0.09	0.05
Route 101	512	500yr FIS	1450	227.3	236.7	232.3	236.7	0.0001	1.2	3010	866	0.08	0.05
Route 101	544	Bankfull	105	229.4	231.9		232.0	0.0003	1.1	264	333	0.13	0.04
Route 101	544	2.33yr FHWA	260	229.4	233.9		233.9	0.0001	0.7	1207	621	0.06	0.01
Route 101	544	10yr FIS	420	229.4	234.8		234.9	0.0000	0.7	1911	762	0.05	0.01
Route 101	544	50yr FIS	760	229.4	235.2		235.2	0.0001	1.0	2205	782	0.08	0.03
Route 101	544	100yr FIS	900	229.4	235.4		235.4	0.0001	1.1	2329	790	0.09	0.04
Route 101	544	100yr FHWA	1090	229.4	235.8		235.8	0.0001	1.2	2660	813	0.09	0.04
Route 101	544	500yr FIS	1450	229.4	236.7		236.7	0.0001	1.2	3407	867	0.08	0.04
Route 101	589	Bankfull	105	225.7	232.0		232.0	0.0000	0.6	285	323	0.05	0.01
Route 101	589	2.33yr FHWA	260	225.7	233.9		233.9	0.0000	0.7	1156	553	0.05	0.01
Route 101	589	10yr FIS	420	225.7	234.8		234.9	0.0000	0.7	1827	775	0.05	0.01
Route 101	589	50yr FIS	760	225.7	235.2		235.2	0.0001	1.1	2128	806	0.07	0.03
Route 101	589	100yr FIS	900	225.7	235.4		235.4	0.0001	1.3	2256	818	0.08	0.05
Route 101	589	100yr FHWA	1090	225.7	235.8		235.8	0.0001	1.3	2598	837	0.08	0.05
Route 101	589	500yr FIS	1450	225.7	236.7		236.7	0.0001	1.3	3346	858	0.07	0.05
Route 101	610	Bankfull	105	225.4	232.0	226.9	232.0	0.0001	0.8	136	47	0.06	0.01
Route 101	610	2.33yr FHWA	260	225.4	233.8	227.9	233.9	0.0001	1.4	189	454	0.09	0.06
Route 101	610	10yr FIS	420	225.4	234.8	228.6	234.9	0.0002	1.9	217	681	0.12	0.17
Route 101	610	50yr FIS	760	225.4	235.1	229.7	235.3	0.0006	3.4	226	732	0.21	0.89
Route 101	610	100yr FIS	900	225.4	235.3	230.1	235.5	0.0008	3.9	229	756	0.24	1.40
Route 101	610	100yr FHWA	1090	225.4	235.6	230.6	236.0	0.0010	4.6	240	807	0.27	2.15
Route 101	610	500yr FIS	1450	225.4	236.5	231.4	236.9	0.0013	5.5	262	833	0.32	3.76
Route 101	659		Culvert										
Route 101	717	Bankfull	105	227.0	232.3	229.0	232.3	0.0001	0.9	121	273	0.09	0.02
Route 101	717	2.33yr FHWA	260	227.0	235.0	229.9	235.0	0.0001	1.1	271	792	0.08	0.03
Route 101	717	10yr FIS	420	227.0	237.9	230.5	237.9	0.0001	1.2	431	867	0.07	0.04
Route 101	717	50yr FIS	760	227.0	240.1	231.3	240.1	0.0000	0.4	6311	982	0.02	0.00
Route 101	717	100yr FIS	900	227.0	240.3	231.6	240.3	0.0000	0.4	6483	999	0.02	0.00
Route 101	717	100yr FHWA	1090	227.0	240.5	232.0	240.5	0.0000	0.5	6692	1025	0.03	0.00
Route 101	717	500yr FIS	1450	227.0	240.8	232.7	240.8	0.0000	0.7	7019	1056	0.03	0.01
Route 101	1037	Bankfull	105	228.3	232.3		232.3	0.0002	1.2	268	364	0.11	0.05
Route 101	1037	2.33yr FHWA	260	228.3	235.1		235.1	0.0000	0.5	1798	665	0.04	0.00
Route 101	1037	10yr FIS	420	228.3	238.0		238.0	0.0000	0.4	3890	795	0.02	0.00
Route 101	1037	50yr FIS	760	228.3	240.1		240.1	0.0000	0.5	5660	855	0.02	0.00
Route 101	1037	100yr FIS	900	228.3	240.3		240.3	0.0000	0.5	5810	859	0.03	0.00
Route 101	1037	100yr FHWA	1090	228.3	240.5		240.5	0.0000	0.6	5988	863	0.03	0.00
Route 101	1037	500yr FIS	1450	228.3	240.8		240.8	0.0000	0.8	6261	869	0.04	0.01
Route 101	1333	Bankfull	105	228.6	232.4		232.4	0.0006	1.6	127	165	0.17	0.14
Route 101	1333	2.33yr FHWA	260	228.6	235.1		235.1	0.0001	0.9	896	393	0.07	0.02
Route 101	1333	10yr FIS	420	228.6	238.0		238.0	0.0000	0.6	2171	491	0.04	0.01
Route 101	1333	50yr FIS	760	228.6	240.1		240.1	0.0000	0.7	3398	603	0.04	0.01
Route 101	1333	100yr FIS	900	228.6	240.3		240.3	0.0000	0.9	3504	604	0.05	0.01
Route 101	1333	100yr FHWA	1090	228.6	240.5		240.5	0.0000	1.0	3629	605	0.05	0.02
Route 101	1333	500yr FIS	1450	228.6	240.8		240.8	0.0001	1.2	3822	608	0.07	0.04

HEC-RAS Plan: ExConditions River: Pulpit Brook Reach: Route 101

Reach	River Sta	Profile	Q Total	Q Channel	W.S. Elev	Vel Chnl	Hydr Depth C	Max Chl Dpth	Top W Chnl	Froude # Chl	Vel Total	Hydr Depth	Shear Chan	Shear LOB	Shear ROB	Vel Left	Vel Right
			(cfs)	(cfs)	(ft)	(ft/s)	(ft)	(ft)	(ft)		(ft/s)	(ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(ft/s)	(ft/s)
Route 101	0	Bankfull	105	93	230.6	1.9	1.7	2.7	28	0.26	1.1	0.6	0.1		0.0		0.2
Route 101	0	2.33yr FHWA	260	171	231.6	2.3	2.7	3.7	28	0.24	1.0	1.5	0.2	0.0	0.1	0.3	0.5
Route 101	0	10yr FIS	420	86	234.2	0.6	5.3	6.3	28	0.04	0.2	4.0	0.0	0.0	0.0	0.1	0.2
Route 101	0	50yr FIS	760	147	235.1	0.8	6.2	7.2	28	0.06	0.3	4.8	0.0	0.0	0.0	0.1	0.2
Route 101	0	100yr FIS	900	172	235.3	1.0	6.4	7.4	28	0.07	0.3	5.0	0.0	0.0	0.0	0.2	0.3
Route 101	0	100yr FHWA	1090	203	235.8	1.1	6.9	7.9	28	0.07	0.4	5.4	0.0	0.0	0.0	0.2	0.3
Route 101	0	500yr FIS	1450	260	236.6	1.2	7.7	8.7	28	0.08	0.4	6.2	0.0	0.0	0.0	0.2	0.4
Route 101	222	Bankfull	105	48	230.8	0.9	1.7	3.0	33	0.12	0.3	0.9	0.0	0.0	0.0	0.1	0.2
Route 101	222	2.33yr FHWA	260	88	231.7	1.0	2.5	4.0	36	0.11	0.3	1.7	0.0	0.0	0.0	0.2	0.3
Route 101	222	10yr FIS	420	107	234.2	0.6	5.0	6.5	36	0.05	0.2	3.6	0.0	0.0	0.0	0.2	0.2
Route 101	222	50yr FIS	760	183	235.1	0.9	5.9	7.4	36	0.06	0.3	4.4	0.0	0.0	0.0	0.2	0.3
Route 101	222	100yr FIS	900	214	235.3	1.0	6.1	7.6	36	0.07	0.3	4.5	0.0	0.0	0.0	0.3	0.3
Route 101	222	100yr FHWA	1090	252	235.8	1.1	6.5	8.0	36	0.07	0.4	4.9	0.0	0.0	0.0	0.3	0.3
Route 101	222	500yr FIS	1450	321	236.6	1.2	7.4	8.9	36	0.08	0.4	5.7	0.0	0.0	0.0	0.4	0.4
Route 101	447	Bankfull	105	105	230.8	0.4	5.1	9.2	53	0.03	0.4	5.1	0.0				
Route 101	447	2.33yr FHWA	260	260	231.7	0.8	6.1	10.1	58	0.06	0.8	5.8	0.0		0.0		0.1
Route 101	447	10yr FIS	420	313	234.2	0.7	8.2	12.6	58	0.04	0.3	2.1	0.0	0.0	0.0	0.1	0.1
Route 101	447	50yr FIS	760	465	235.1	0.9	9.1	13.5	58	0.05	0.3	2.8	0.0	0.0	0.0	0.1	0.2
Route 101	447	100yr FIS	900	527	235.3	1.0	9.3	13.7	58	0.06	0.4	2.9	0.0	0.0	0.0	0.2	0.2
Route 101	447	100yr FHWA	1090	584	235.8	1.0	9.7	14.2	58	0.06	0.4	3.4	0.0	0.0	0.0	0.2	0.3
Route 101	447	500yr FIS	1450	668	236.6	1.1	10.6	15.0	58	0.06	0.4	4.2	0.0	0.0	0.0	0.2	0.3
Route 101	481		Bridge														
Route 101	512	Bankfull	105	105	231.9	0.9	3.3	4.6	53	0.08	0.9	3.2	0.0		0.0		0.0
Route 101	512	2.33yr FHWA	260	257	233.8	1.4	5.2	6.5	55	0.11	1.3	4.6	0.0		0.0		0.2
Route 101	512	10yr FIS	420	235	234.8	0.8	5.6	7.5	55	0.06	0.3	2.0	0.0	0.0	0.0	0.1	0.2
Route 101	512	50yr FIS	760	379	235.2	1.2	6.0	7.9	55	0.08	0.4	2.3	0.0	0.0	0.0	0.2	0.3
Route 101	512	100yr FIS	900	430	235.4	1.3	6.1	8.1	55	0.09	0.5	2.4	0.0	0.0	0.0	0.3	0.4
Route 101	512	100yr FHWA	1090	465	235.8	1.3	6.5	8.5	55	0.09	0.5	2.7	0.0	0.0	0.0	0.3	0.4
Route 101	512	500yr FIS	1450	508	236.7	1.2	7.4	9.4	55	0.08	0.5	3.5	0.0	0.0	0.0	0.3	0.5
Route 101	544	Bankfull	105	66	231.9	1.1	2.0	2.6	32	0.13	0.4	0.8	0.0	0.0	0.0	0.2	0.2
Route 101	544	2.33yr FHWA	260	86	233.9	0.7	3.9	4.5	32	0.06	0.2	1.9	0.0	0.0	0.0	0.2	0.2
Route 101	544	10yr FIS	420	104	234.8	0.7	4.9	5.5	32	0.05	0.2	2.5	0.0	0.0	0.0	0.2	0.2
Route 101	544	50yr FIS	760	171	235.2	1.0	5.2	5.8	32	0.08	0.3	2.8	0.0	0.0	0.0	0.3	0.4
Route 101	544	100yr FIS	900	195	235.4	1.1	5.4	6.0	32	0.09	0.4	2.9	0.0	0.0	0.0	0.3	0.4
Route 101	544	100yr FHWA	1090	216	235.8	1.2	5.8	6.4	32	0.09	0.4	3.3	0.0	0.0	0.0	0.3	0.5
Route 101	544	500yr FIS	1450	248	236.7	1.2	6.7	7.3	32	0.08	0.4	3.9	0.0	0.0	0.0	0.3	0.5
Route 101	589	Bankfull	105	100	232.0	0.6	4.7	6.3	36	0.05	0.4	0.9	0.0	0.0		0.0	
Route 101	589	2.33yr FHWA	260	161	233.9	0.7	6.5	8.2	37	0.05	0.2	2.1	0.0	0.0	0.0	0.1	0.1
Route 101	589	10yr FIS	420	203	234.8	0.7	7.5	9.2	37	0.05	0.2	2.4	0.0	0.0	0.0	0.1	0.1
Route 101	589	50yr FIS	760	328	235.2	1.1	7.9	9.6	37	0.07	0.4	2.6	0.0	0.0	0.0	0.2	0.3
Route 101	589	100yr FIS	900	371	235.4	1.3	8.0	9.7	37	0.08	0.4	2.8	0.0	0.0	0.0	0.3	0.3
Route 101	589	100yr FHWA	1090	404	235.8	1.3	8.5	10.1	37	0.08	0.4	3.1	0.0	0.0	0.0	0.3	0.4
Route 101	589	500yr FIS	1450	435	236.7	1.3	9.3	11.0	37	0.07	0.4	3.9	0.0	0.0	0.0	0.3	0.5
Route 101	610	Bankfull	105	105	232.0	0.8	4.9	6.6	34	0.06	0.8	4.9	0.0	0.0		0.0	
Route 101	610	2.33yr FHWA	260	260	233.8	1.4	6.8	8.5	37	0.09	1.4	6.8	0.0	0.0		0.2	
Route 101	610	10yr FIS	420	420	234.8	1.9	7.8	9.5	37	0.12	1.9	7.7	0.1	0.0		0.4	
Route 101	610	50yr FIS	760	760	235.1	3.4	8.1	9.8	37	0.21	3.4	8.1	0.3	0.1		0.6	
Route 101	610	100yr FIS	900	899	235.3	3.9	8.2	9.9	37	0.24	3.9	8.2	0.4	0.2		0.8	
Route 101	610	100yr FHWA	1090	1089	235.6	4.6	8.6	10.3	37	0.27	4.5	8.6	0.5	0.2		0.9	
Route 101	610	500yr FIS	1450	1449	236.5	5.5	9.4	11.1	37	0.32	5.5	9.4	0.7	0.4		1.2	
Route 101	659		Culvert														
Route 101	717	Bankfull	105	105	232.3	0.9	3.2	5.2	42	0.09	0.9	3.0	0.0	0.0		0.0	
Route 101	717	2.33yr FHWA	260	250	235.0	1.1	6.0	8.0	42	0.08	1.0	4.9	0.0	0.0		0.2	
Route 101	717	10yr FIS	420	391	237.9	1.2	8.9	10.9	42	0.07	1.0	7.8	0.0	0.0		0.3	
Route 101	717	50yr FIS	760	178	240.1	0.4	10.8	13.1	42	0.02	0.1	6.4	0.0	0.0	0.0	0.1	0.1
Route 101	717	100yr FIS	900	209	240.3	0.4	11.0	13.3	42	0.02	0.1	6.5	0.0	0.0	0.0	0.1	0.1
Route 101	717	100yr FHWA	1090	250	240.5	0.5	11.2	13.5	42	0.03	0.2	6.5	0.0	0.0	0.0	0.1	0.1
Route 101	717	500yr FIS	1450	325	240.8	0.7	11.5	13.8	42	0.03	0.2	6.6	0.0	0.0	0.0	0.2	0.2
Route 101	1037	Bankfull	105	73	232.3	1.2	3.4	4.0	19	0.11	0.4	0.7	0.0	0.0	0.0	0.1	0.2
Route 101	1037	2.33yr FHWA	260	62	235.1	0.5	6.1	6.8	19	0.04	0.1	2.7	0.0	0.0	0.0	0.1	0.1
Route 101	1037	10yr FIS	420	64	238.0	0.4	9.0	9.7	19	0.02	0.1	4.9	0.0	0.0	0.0	0.1	0.1
Route 101	1037	50yr FIS	760	96	240.1	0.5	11.2	11.8	19	0.02	0.1	6.6	0.0	0.0	0.0	0.1	0.1
Route 101	1037	100yr FIS	900	112	240.3	0.5	11.3	12.0	19	0.03	0.2	6.8	0.0	0.0	0.0	0.1	0.1
Route 101	1037	100yr FHWA	1090	133	240.5	0.6	11.5	12.2	19	0.03	0.2	6.9	0.0	0.0	0.0	0.2	0.2
Route 101	1037	500yr FIS	1450	174	240.8	0.8	11.9	12.5	19	0.04	0.2	7.2	0.0	0.0	0.0	0.2	0.2
Route 101	1333	Bankfull	105	92	232.4	1.6	2.7	3.7	22	0.17	0.8	0.8	0.1	0.0	0.0	0.2	0.1
Route 101	1333	2.33yr FHWA	260	104	235.1	0.9	5.3	6.4	22	0.07	0.3	2.3	0.0	0.0	0.0	0.2	0.2
Route 101	1333	10yr FIS	420	110	238.0	0.6	8.2	9.3	22	0.04	0.2	4.4	0.0	0.0	0.0	0.2	0.1
Route 101	1333	50yr FIS	760	166	240.1	0.7	10.4	11.5	22	0.04	0.2	5.6	0.0	0.0	0.0	0.2	0.2
Route 101	1333	100yr FIS	900	193	240.3	0.9	10.6	11.6	22	0.05	0.3	5.8	0.0	0.0	0.0	0.3	0.2
Route 101	1333	100yr FHWA	1090	230	240.5	1.0	10.8	11.8	22	0.05	0.3	6.0	0.0	0.0	0.0	0.3	0.2
Route 101	1333	500yr FIS	1450	298	240.8	1.2	11.1	12.2	22	0.07	0.4	6.3	0.0	0.0	0.0	0.4	0.3

HEC-RAS Plan: ExConditions River: Pulpit Brook Reach: Route 101

Reach	River Sta	Profile	E.G. US.	W.S. US.	E.G. IC	E.G. OC	Min El Weir Flow	Q Total	Q Culv Group	Q Weir	Delta WS	Culv Vel US	Culv Vel DS
			(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft)	(ft/s)	(ft/s)
Route 101	659 Lt 60" RCP	Bankfull	232.3	232.3	231.1	232.3	239.3	105.0	52.1		0.3	3.3	3.5
Route 101	659 Rt 60" RCP	Bankfull	232.3	232.3	231.1	232.3	239.3	105.0	52.9		0.3	3.3	3.6
Route 101	659 Lt 60" RCP	2.33yr FHWA	235.0	235.0	233.3	235.0	239.3	260.0	129.3		1.2	6.6	6.6
Route 101	659 Rt 60" RCP	2.33yr FHWA	235.0	235.0	233.3	235.1	239.3	260.0	130.7		1.2	6.7	6.7
Route 101	659 Lt 60" RCP	10yr FIS	237.9	237.9	236.1	237.9	239.3	420.0	209.7		3.1	10.7	10.7
Route 101	659 Rt 60" RCP	10yr FIS	237.9	237.9	236.1	238.0	239.3	420.0	210.3		3.1	10.7	10.7
Route 101	659 Lt 60" RCP	50yr FIS	240.1	240.1	238.8	240.1	239.3	760.0	264.3	231.2	4.9	13.5	13.5
Route 101	659 Rt 60" RCP	50yr FIS	240.1	240.1	238.8	240.1	239.3	760.0	264.6	231.2	4.9	13.5	13.5
Route 101	659 Lt 60" RCP	100yr FIS	240.3	240.3	238.9	240.3	239.3	900.0	265.5	368.7	5.0	13.5	13.5
Route 101	659 Rt 60" RCP	100yr FIS	240.3	240.3	238.8	240.3	239.3	900.0	265.8	368.7	5.0	13.5	13.5
Route 101	659 Lt 60" RCP	100yr FHWA	240.5	240.5	238.6	240.5	239.3	1090.0	261.1	567.5	4.8	13.3	13.3
Route 101	659 Rt 60" RCP	100yr FHWA	240.5	240.5	238.6	240.5	239.3	1090.0	261.4	567.5	4.8	13.3	13.3
Route 101	659 Lt 60" RCP	500yr FIS	240.8	240.8	237.9	240.8	239.3	1450.0	247.5	954.7	4.3	12.6	12.6
Route 101	659 Rt 60" RCP	500yr FIS	240.8	240.8	237.9	240.8	239.3	1450.0	247.8	954.7	4.3	12.6	12.6

Plan: ExConditions   Pulpit Brook   Route 101 RS: 659   Culv Group: Lt 60" RCP   Profile: Bankfull

Q Culv Group (cfs)	52.14	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	3.29
Q Barrel (cfs)	52.14	Culv Vel DS (ft/s)	3.47
E.G. US. (ft)	232.26	Culv Inv El Up (ft)	228.24
W.S. US. (ft)	232.25	Culv Inv El Dn (ft)	228.38
E.G. DS (ft)	231.96	Culv Frctn Ls (ft)	0.00
W.S. DS (ft)	231.95	Culv Exit Loss (ft)	0.18
Delta EG (ft)	0.30	Culv Entr Loss (ft)	0.08
Delta WS (ft)	0.30	Q Weir (cfs)	
E.G. IC (ft)	231.10	Weir Sta Lft (ft)	
E.G. OC (ft)	232.26	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	232.01	Weir Max Depth (ft)	
Culv WS Outlet (ft)	231.95	Weir Avg Depth (ft)	
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	2.03	Min El Weir Flow (ft)	239.33

Plan: ExConditions   Pulpit Brook   Route 101 RS: 659   Culv Group: Lt 60" RCP   Profile: 2.33yr FH

Q Culv Group (cfs)	129.30	Culv Full Len (ft)	70.00
# Barrels	1	Culv Vel US (ft/s)	6.58
Q Barrel (cfs)	129.30	Culv Vel DS (ft/s)	6.58
E.G. US. (ft)	235.04	Culv Inv El Up (ft)	228.24
W.S. US. (ft)	235.02	Culv Inv El Dn (ft)	228.38
E.G. DS (ft)	233.87	Culv Frctn Ls (ft)	0.17
W.S. DS (ft)	233.84	Culv Exit Loss (ft)	0.64
Delta EG (ft)	1.17	Culv Entr Loss (ft)	0.34
Delta WS (ft)	1.18	Q Weir (cfs)	
E.G. IC (ft)	233.34	Weir Sta Lft (ft)	
E.G. OC (ft)	235.03	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	233.24	Weir Max Depth (ft)	
Culv WS Outlet (ft)	233.38	Weir Avg Depth (ft)	
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	3.25	Min El Weir Flow (ft)	239.33

Plan: ExConditions   Pulpit Brook   Route 101 RS: 659   Culv Group: Lt 60" RCP   Profile: 10yr FIS

Q Culv Group (cfs)	209.72	Culv Full Len (ft)	70.00
# Barrels	1	Culv Vel US (ft/s)	10.68
Q Barrel (cfs)	209.72	Culv Vel DS (ft/s)	10.68
E.G. US. (ft)	237.94	Culv Inv El Up (ft)	228.24
W.S. US. (ft)	237.92	Culv Inv El Dn (ft)	228.38
E.G. DS (ft)	234.88	Culv Frctn Ls (ft)	0.45
W.S. DS (ft)	234.82	Culv Exit Loss (ft)	1.71
Delta EG (ft)	3.06	Culv Entr Loss (ft)	0.89
Delta WS (ft)	3.10	Q Weir (cfs)	
E.G. IC (ft)	236.14	Weir Sta Lft (ft)	
E.G. OC (ft)	237.94	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	233.24	Weir Max Depth (ft)	
Culv WS Outlet (ft)	233.38	Weir Avg Depth (ft)	
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	4.12	Min El Weir Flow (ft)	239.33

Plan: ExConditions   Pulpit Brook   Route 101 RS: 659   Culv Group: Lt 60" RCP   Profile: 50yr FIS

Q Culv Group (cfs)	264.28	Culv Full Len (ft)	70.00
# Barrels	1	Culv Vel US (ft/s)	13.46
Q Barrel (cfs)	264.28	Culv Vel DS (ft/s)	13.46
E.G. US. (ft)	240.10	Culv Inv El Up (ft)	228.24
W.S. US. (ft)	240.10	Culv Inv El Dn (ft)	228.38
E.G. DS (ft)	235.32	Culv Frctn Ls (ft)	0.72
W.S. DS (ft)	235.15	Culv Exit Loss (ft)	2.64
Delta EG (ft)	4.77	Culv Entr Loss (ft)	1.41
Delta WS (ft)	4.95	Q Weir (cfs)	231.16
E.G. IC (ft)	238.81	Weir Sta Lft (ft)	673.88
E.G. OC (ft)	240.09	Weir Sta Rgt (ft)	935.46
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	233.24	Weir Max Depth (ft)	0.77
Culv WS Outlet (ft)	233.38	Weir Avg Depth (ft)	0.46
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	120.74
Culv Crt Depth (ft)	4.51	Min El Weir Flow (ft)	239.33

Plan: ExConditions Pulpit Brook Route 101 RS: 659 Culv Group: Lt 60" RCP Profile: 100yr FIS

Q Culv Group (cfs)	265.53	Culv Full Len (ft)	70.00
# Barrels	1	Culv Vel US (ft/s)	13.52
Q Barrel (cfs)	265.53	Culv Vel DS (ft/s)	13.52
E.G. US. (ft)	240.27	Culv Inv El Up (ft)	228.24
W.S. US. (ft)	240.27	Culv Inv El Dn (ft)	228.38
E.G. DS (ft)	235.52	Culv Frctn Ls (ft)	0.73
W.S. DS (ft)	235.28	Culv Exit Loss (ft)	2.60
Delta EG (ft)	4.76	Culv Entr Loss (ft)	1.42
Delta WS (ft)	5.00	Q Weir (cfs)	368.67
E.G. IC (ft)	238.87	Weir Sta Lft (ft)	659.99
E.G. OC (ft)	240.27	Weir Sta Rgt (ft)	957.00
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	233.24	Weir Max Depth (ft)	0.95
Culv WS Outlet (ft)	233.38	Weir Avg Depth (ft)	0.58
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	171.74
Culv Crt Depth (ft)	4.51	Min El Weir Flow (ft)	239.33

Plan: ExConditions Pulpit Brook Route 101 RS: 659 Culv Group: Lt 60" RCP Profile: 100yr FH

Q Culv Group (cfs)	261.09	Culv Full Len (ft)	70.00
# Barrels	1	Culv Vel US (ft/s)	13.30
Q Barrel (cfs)	261.09	Culv Vel DS (ft/s)	13.30
E.G. US. (ft)	240.48	Culv Inv El Up (ft)	228.24
W.S. US. (ft)	240.48	Culv Inv El Dn (ft)	228.38
E.G. DS (ft)	235.97	Culv Frctn Ls (ft)	0.70
W.S. DS (ft)	235.65	Culv Exit Loss (ft)	2.43
Delta EG (ft)	4.51	Culv Entr Loss (ft)	1.37
Delta WS (ft)	4.83	Q Weir (cfs)	567.51
E.G. IC (ft)	238.63	Weir Sta Lft (ft)	643.94
E.G. OC (ft)	240.47	Weir Sta Rgt (ft)	980.65
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	233.24	Weir Max Depth (ft)	1.16
Culv WS Outlet (ft)	233.38	Weir Avg Depth (ft)	0.71
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	238.55
Culv Crt Depth (ft)	4.49	Min El Weir Flow (ft)	239.33

Plan: ExConditions   Pulpit Brook   Route 101 RS: 659   Culv Group: Lt 60" RCP   Profile: 500yr FIS

Q Culv Group (cfs)	247.47	Culv Full Len (ft)	70.00
# Barrels	1	Culv Vel US (ft/s)	12.60
Q Barrel (cfs)	247.47	Culv Vel DS (ft/s)	12.60
E.G. US. (ft)	240.79	Culv Inv El Up (ft)	228.24
W.S. US. (ft)	240.79	Culv Inv El Dn (ft)	228.38
E.G. DS (ft)	236.93	Culv Frctn Ls (ft)	0.63
W.S. DS (ft)	236.45	Culv Exit Loss (ft)	1.99
Delta EG (ft)	3.86	Culv Entr Loss (ft)	1.23
Delta WS (ft)	4.34	Q Weir (cfs)	954.72
E.G. IC (ft)	237.92	Weir Sta Lft (ft)	624.86
E.G. OC (ft)	240.79	Weir Sta Rgt (ft)	1011.33
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	233.24	Weir Max Depth (ft)	1.48
Culv WS Outlet (ft)	233.38	Weir Avg Depth (ft)	0.91
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	353.47
Culv Crt Depth (ft)	4.41	Min El Weir Flow (ft)	239.33

Plan: ExConditions   Pulpit Brook   Route 101 RS: 659   Culv Group: Rt 60" RCP   Profile: Bankfull

Q Culv Group (cfs)	52.86	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	3.28
Q Barrel (cfs)	52.86	Culv Vel DS (ft/s)	3.55
E.G. US. (ft)	232.26	Culv Inv El Up (ft)	228.19
W.S. US. (ft)	232.25	Culv Inv El Dn (ft)	228.41
E.G. DS (ft)	231.96	Culv Frctn Ls (ft)	0.00
W.S. DS (ft)	231.95	Culv Exit Loss (ft)	0.19
Delta EG (ft)	0.30	Culv Entr Loss (ft)	0.08
Delta WS (ft)	0.30	Q Weir (cfs)	
E.G. IC (ft)	231.07	Weir Sta Lft (ft)	
E.G. OC (ft)	232.27	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	232.02	Weir Max Depth (ft)	
Culv WS Outlet (ft)	231.95	Weir Avg Depth (ft)	
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	2.04	Min El Weir Flow (ft)	239.33

Plan: ExConditions Pulpit Brook Route 101 RS: 659 Culv Group: Rt 60" RCP Profile: 2.33yr FH

Q Culv Group (cfs)	130.70	Culv Full Len (ft)	70.00
# Barrels	1	Culv Vel US (ft/s)	6.66
Q Barrel (cfs)	130.70	Culv Vel DS (ft/s)	6.66
E.G. US. (ft)	235.04	Culv Inv El Up (ft)	228.19
W.S. US. (ft)	235.02	Culv Inv El Dn (ft)	228.41
E.G. DS (ft)	233.87	Culv Frctn Ls (ft)	0.18
W.S. DS (ft)	233.84	Culv Exit Loss (ft)	0.66
Delta EG (ft)	1.17	Culv Entr Loss (ft)	0.34
Delta WS (ft)	1.18	Q Weir (cfs)	
E.G. IC (ft)	233.34	Weir Sta Lft (ft)	
E.G. OC (ft)	235.05	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	233.19	Weir Max Depth (ft)	
Culv WS Outlet (ft)	233.41	Weir Avg Depth (ft)	
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	3.27	Min El Weir Flow (ft)	239.33

Plan: ExConditions Pulpit Brook Route 101 RS: 659 Culv Group: Rt 60" RCP Profile: 10yr FIS

Q Culv Group (cfs)	210.28	Culv Full Len (ft)	70.00
# Barrels	1	Culv Vel US (ft/s)	10.71
Q Barrel (cfs)	210.28	Culv Vel DS (ft/s)	10.71
E.G. US. (ft)	237.94	Culv Inv El Up (ft)	228.19
W.S. US. (ft)	237.92	Culv Inv El Dn (ft)	228.41
E.G. DS (ft)	234.88	Culv Frctn Ls (ft)	0.46
W.S. DS (ft)	234.82	Culv Exit Loss (ft)	1.72
Delta EG (ft)	3.06	Culv Entr Loss (ft)	0.89
Delta WS (ft)	3.10	Q Weir (cfs)	
E.G. IC (ft)	236.11	Weir Sta Lft (ft)	
E.G. OC (ft)	237.95	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	233.19	Weir Max Depth (ft)	
Culv WS Outlet (ft)	233.41	Weir Avg Depth (ft)	
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	4.13	Min El Weir Flow (ft)	239.33

Plan: ExConditions   Pulpit Brook   Route 101 RS: 659   Culv Group: Rt 60" RCP   Profile: 50yr FIS

Q Culv Group (cfs)	264.56	Culv Full Len (ft)	70.00
# Barrels	1	Culv Vel US (ft/s)	13.47
Q Barrel (cfs)	264.56	Culv Vel DS (ft/s)	13.47
E.G. US. (ft)	240.10	Culv Inv El Up (ft)	228.19
W.S. US. (ft)	240.10	Culv Inv El Dn (ft)	228.41
E.G. DS (ft)	235.32	Culv Frctn Ls (ft)	0.72
W.S. DS (ft)	235.15	Culv Exit Loss (ft)	2.64
Delta EG (ft)	4.77	Culv Entr Loss (ft)	1.41
Delta WS (ft)	4.95	Q Weir (cfs)	231.16
E.G. IC (ft)	238.77	Weir Sta Lft (ft)	673.88
E.G. OC (ft)	240.10	Weir Sta Rgt (ft)	935.46
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	233.19	Weir Max Depth (ft)	0.77
Culv WS Outlet (ft)	233.41	Weir Avg Depth (ft)	0.46
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	120.74
Culv Crt Depth (ft)	4.51	Min El Weir Flow (ft)	239.33

Plan: ExConditions   Pulpit Brook   Route 101 RS: 659   Culv Group: Rt 60" RCP   Profile: 100yr FIS

Q Culv Group (cfs)	265.81	Culv Full Len (ft)	70.00
# Barrels	1	Culv Vel US (ft/s)	13.54
Q Barrel (cfs)	265.81	Culv Vel DS (ft/s)	13.54
E.G. US. (ft)	240.27	Culv Inv El Up (ft)	228.19
W.S. US. (ft)	240.27	Culv Inv El Dn (ft)	228.41
E.G. DS (ft)	235.52	Culv Frctn Ls (ft)	0.73
W.S. DS (ft)	235.28	Culv Exit Loss (ft)	2.61
Delta EG (ft)	4.76	Culv Entr Loss (ft)	1.42
Delta WS (ft)	5.00	Q Weir (cfs)	368.67
E.G. IC (ft)	238.84	Weir Sta Lft (ft)	659.99
E.G. OC (ft)	240.28	Weir Sta Rgt (ft)	957.00
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	233.19	Weir Max Depth (ft)	0.95
Culv WS Outlet (ft)	233.41	Weir Avg Depth (ft)	0.58
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	171.74
Culv Crt Depth (ft)	4.52	Min El Weir Flow (ft)	239.33

Plan: ExConditions Pulpit Brook Route 101 RS: 659 Culv Group: Rt 60" RCP Profile: 100yr FH

Q Culv Group (cfs)	261.40	Culv Full Len (ft)	70.00
# Barrels	1	Culv Vel US (ft/s)	13.31
Q Barrel (cfs)	261.40	Culv Vel DS (ft/s)	13.31
E.G. US. (ft)	240.48	Culv Inv El Up (ft)	228.19
W.S. US. (ft)	240.48	Culv Inv El Dn (ft)	228.41
E.G. DS (ft)	235.97	Culv Frctn Ls (ft)	0.71
W.S. DS (ft)	235.65	Culv Exit Loss (ft)	2.43
Delta EG (ft)	4.51	Culv Entr Loss (ft)	1.38
Delta WS (ft)	4.83	Q Weir (cfs)	567.51
E.G. IC (ft)	238.60	Weir Sta Lft (ft)	643.94
E.G. OC (ft)	240.48	Weir Sta Rgt (ft)	980.65
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	233.19	Weir Max Depth (ft)	1.16
Culv WS Outlet (ft)	233.41	Weir Avg Depth (ft)	0.71
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	238.55
Culv Crt Depth (ft)	4.49	Min El Weir Flow (ft)	239.33

Plan: ExConditions Pulpit Brook Route 101 RS: 659 Culv Group: Rt 60" RCP Profile: 500yr FIS

Q Culv Group (cfs)	247.82	Culv Full Len (ft)	70.00
# Barrels	1	Culv Vel US (ft/s)	12.62
Q Barrel (cfs)	247.82	Culv Vel DS (ft/s)	12.62
E.G. US. (ft)	240.79	Culv Inv El Up (ft)	228.19
W.S. US. (ft)	240.79	Culv Inv El Dn (ft)	228.41
E.G. DS (ft)	236.93	Culv Frctn Ls (ft)	0.63
W.S. DS (ft)	236.45	Culv Exit Loss (ft)	2.00
Delta EG (ft)	3.86	Culv Entr Loss (ft)	1.24
Delta WS (ft)	4.34	Q Weir (cfs)	954.72
E.G. IC (ft)	237.89	Weir Sta Lft (ft)	624.86
E.G. OC (ft)	240.80	Weir Sta Rgt (ft)	1011.33
Culvert Control	Outlet	Weir Submerg	0.00
Culv WS Inlet (ft)	233.19	Weir Max Depth (ft)	1.48
Culv WS Outlet (ft)	233.41	Weir Avg Depth (ft)	0.91
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	353.47
Culv Crt Depth (ft)	4.41	Min El Weir Flow (ft)	239.33

HEC-RAS Plan: ExConditions River: Pulpit Brook Reach: Route 101

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	Area
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)	(sq ft)
Route 101	222	Bankfull	230.8	230.8		0.12	0.00	365.7	5.4	48.5	51.1	0.9	338
Route 101	222	2.33yr FHWA	231.7	231.7		0.08	0.00	443.4	30.9	87.7	141.5	1.0	743
Route 101	222	10yr FIS	234.2	234.2		0.01	0.00	551.8	74.9	107.4	237.7	0.6	1967
Route 101	222	50yr FIS	235.1	235.1		0.01	0.00	568.3	139.2	182.7	438.1	0.9	2474
Route 101	222	100yr FIS	235.3	235.3		0.01	0.00	571.3	165.8	213.7	520.5	1.0	2589
Route 101	222	100yr FHWA	235.8	235.8		0.01	0.00	576.9	202.7	252.0	635.3	1.1	2848
Route 101	222	500yr FIS	236.6	236.6		0.01	0.00	588.8	272.6	321.5	855.9	1.2	3344
Route 101	447	Bankfull	230.8	230.8	223.7	0.01	0.00	58.7		105.0		0.4	275
Route 101	447	2.33yr FHWA	231.8	231.7	224.6	0.02	0.00	183.6		259.9	0.1	0.8	391
Route 101	447	10yr FIS	234.2	234.2	225.2	0.01	0.00	744.0	53.4	313.5	53.1	0.7	1539
Route 101	447	50yr FIS	235.1	235.1	226.2	0.01	0.00	825.2	125.4	464.9	169.7	0.9	2272
Route 101	447	100yr FIS	235.3	235.3	226.6	0.01	0.00	831.6	153.8	527.4	218.7	1.0	2440
Route 101	447	100yr FHWA	235.8	235.8	227.0	0.01	0.00	841.0	196.5	584.5	309.0	1.0	2819
Route 101	447	500yr FIS	236.6	236.6	227.7	0.01	0.00	848.6	284.1	668.1	497.8	1.1	3539
Route 101	481 BR D	Bankfull	231.6	230.8	230.8	0.00	0.40	9.0		105.0		7.2	15
Route 101	481 BR D	2.33yr FHWA	233.6	232.1	232.1			9.0		260.0		9.8	27
Route 101	481 BR D	10yr FIS	234.8	234.8	234.9			440.2	178.8	202.2	34.7	3.8	183
Route 101	481 BR D	50yr FIS	235.2	235.2	235.2			610.2	442.7	120.9	195.6	1.8	363
Route 101	481 BR D	100yr FIS	235.4	235.3	235.3			664.4	522.1	108.9	283.8	1.5	450
Route 101	481 BR D	100yr FHWA	235.8	235.8	235.3			762.5	572.0	85.7	419.2	1.0	775
Route 101	481 BR D	500yr FIS	236.6	236.6	235.5	0.00	0.01	798.0	465.5	277.2	707.3	2.4	1438
Route 101	481 BR U	Bankfull	231.9	231.7	229.9	0.14	0.19	9.0		105.0		3.4	31
Route 101	481 BR U	2.33yr FHWA	233.8	233.0	231.3					260.0		6.2	42
Route 101	481 BR U	10yr FIS	234.8	234.8	232.4			397.7	178.8	202.2	34.7	3.8	178
Route 101	481 BR U	50yr FIS	235.2	235.2	235.2			561.3	442.7	120.9	195.6	1.9	360
Route 101	481 BR U	100yr FIS	235.4	235.4	235.3			619.3	522.1	108.9	283.8	1.6	453
Route 101	481 BR U	100yr FHWA	235.8	235.8	235.3			698.7	572.0	85.7	419.2	1.1	726
Route 101	481 BR U	500yr FIS	236.7	236.6	235.5	0.03	0.00	768.5	414.2	208.9	826.8	2.2	1355
Route 101	512	Bankfull	231.9	231.9	228.7	0.01	0.05	147.7		105.0	0.0	0.9	205
Route 101	512	2.33yr FHWA	233.8	233.8	229.5			598.4		256.8	3.2	1.4	808
Route 101	512	10yr FIS	234.8	234.8	230.1			766.1	121.2	235.1	63.7	0.8	1511
Route 101	512	50yr FIS	235.2	235.2	230.9			791.8	227.3	379.4	153.3	1.2	1803
Route 101	512	100yr FIS	235.4	235.4	231.3			803.2	272.0	429.8	198.2	1.3	1928
Route 101	512	100yr FHWA	235.8	235.8	231.7			824.4	333.8	465.4	290.8	1.3	2264
Route 101	512	500yr FIS	236.7	236.7	232.3	0.00	0.01	865.9	445.8	508.4	495.9	1.2	3010
Route 101	544	Bankfull	232.0	231.9		0.01	0.00	332.5	35.5	66.3	3.2	1.1	264
Route 101	544	2.33yr FHWA	233.9	233.9		0.00	0.01	621.4	139.6	85.8	34.6	0.7	1207
Route 101	544	10yr FIS	234.9	234.8		0.00	0.00	761.6	217.5	103.8	98.7	0.7	1911
Route 101	544	50yr FIS	235.2	235.2		0.00	0.00	781.6	380.6	170.7	208.8	1.0	2205
Route 101	544	100yr FIS	235.4	235.4		0.00	0.00	789.7	444.6	194.8	260.6	1.1	2329
Route 101	544	100yr FHWA	235.8	235.8		0.00	0.00	812.9	520.7	216.4	352.9	1.2	2660
Route 101	544	500yr FIS	236.7	236.7		0.00	0.00	867.0	649.9	248.2	551.8	1.2	3407

Plan: ExConditions Pulpit Brook Route 101 RS: 481 Profile: Bankfull

E.G. US. (ft)	231.95	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	231.94	E.G. Elev (ft)	231.89	231.56
Q Total (cfs)	105.00	W.S. Elev (ft)	231.71	230.75
Q Bridge (cfs)	105.00	Crit W.S. (ft)	229.92	230.75
Q Weir (cfs)		Max Chl Dpth (ft)	3.71	1.92
Weir Sta Lft (ft)		Vel Total (ft/s)	3.43	7.22
Weir Sta Rgt (ft)		Flow Area (sq ft)	30.62	14.54
Weir Submerg		Froude # Chl	0.31	0.92
Weir Max Depth (ft)		Specif Force (cu ft)	63.45	35.47
Min El Weir Flow (ft)	234.16	Hydr Depth (ft)	3.40	1.62
Min El Prs (ft)	233.00	W.P. Total (ft)	15.77	11.84
Delta EG (ft)	1.17	Conv. Total (cfs)	2023.4	707.9
Delta WS (ft)	1.16	Top Width (ft)	9.00	9.00
BR Open Area (sq ft)	35.73	Frctn Loss (ft)	0.14	0.00
BR Open Vel (ft/s)	7.22	C & E Loss (ft)	0.19	0.40
Coef of Q		Shear Total (lb/sq ft)	0.33	1.69
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: ExConditions Pulpit Brook Route 101 RS: 481 Profile: 2.33yr FHWA

E.G. US. (ft)	233.85	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	233.82	E.G. Elev (ft)	233.85	233.58
Q Total (cfs)	260.00	W.S. Elev (ft)	233.00	232.10
Q Bridge (cfs)	260.00	Crit W.S. (ft)	231.28	232.10
Q Weir (cfs)		Max Chl Dpth (ft)	5.00	3.27
Weir Sta Lft (ft)		Vel Total (ft/s)	6.17	9.76
Weir Sta Rgt (ft)		Flow Area (sq ft)	42.15	26.64
Weir Submerg		Froude # Chl	0.49	0.95
Weir Max Depth (ft)		Specif Force (cu ft)	149.14	118.46
Min El Weir Flow (ft)	234.16	Hydr Depth (ft)		2.96
Min El Prs (ft)	233.00	W.P. Total (ft)	27.33	14.53
Delta EG (ft)	2.09	Conv. Total (cfs)	2388.7	1694.6
Delta WS (ft)	2.07	Top Width (ft)		9.00
BR Open Area (sq ft)	35.73	Frctn Loss (ft)		
BR Open Vel (ft/s)	7.28	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)	1.14	2.69
Br Sel Method	Press Only	Power Total (lb/ft s)	0.00	0.00

Plan: ExConditions Pulpit Brook Route 101 RS: 481 Profile: 10yr FIS

E.G. US. (ft)	234.85	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	234.84	E.G. Elev (ft)	234.85	234.85
Q Total (cfs)	420.00	W.S. Elev (ft)	234.84	234.84
Q Bridge (cfs)	183.25	Crit W.S. (ft)	232.38	234.94
Q Weir (cfs)	236.75	Max Chl Dpth (ft)	6.84	6.01
Weir Sta Lft (ft)	136.96	Vel Total (ft/s)	2.33	2.27
Weir Sta Rgt (ft)	767.78	Flow Area (sq ft)	180.19	185.22
Weir Submerg	0.01	Froude # Chl	0.32	0.34

Plan: ExConditions Pulpit Brook Route 101 RS: 481 Profile: 10yr FIS (Continued)

Weir Max Depth (ft)	0.70	Specif Force (cu ft)	262.98	221.04
Min El Weir Flow (ft)	234.16	Hydr Depth (ft)	0.45	0.42
Min El Prs (ft)	233.00	W.P. Total (ft)	425.05	465.80
Delta EG (ft)	0.63	Conv. Total (cfs)		
Delta WS (ft)	0.63	Top Width (ft)	397.68	440.24
BR Open Area (sq ft)	35.73	Frctn Loss (ft)		
BR Open Vel (ft/s)	5.13	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)		
Br Sel Method	Press/Weir	Power Total (lb/ft s)	0.00	0.00

Plan: ExConditions Pulpit Brook Route 101 RS: 481 Profile: 50yr FIS

E.G. US. (ft)	235.23	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	235.22	E.G. Elev (ft)	235.23	235.23
Q Total (cfs)	760.00	W.S. Elev (ft)	235.22	235.18
Q Bridge (cfs)	77.17	Crit W.S. (ft)	235.19	235.18
Q Weir (cfs)	682.83	Max Chl Dpth (ft)	7.22	6.35
Weir Sta Lft (ft)	133.96	Vel Total (ft/s)	2.07	1.94
Weir Sta Rgt (ft)	793.54	Flow Area (sq ft)	366.65	391.39
Weir Submerg	0.83	Froude # Chl	0.25	0.28
Weir Max Depth (ft)	1.08	Specif Force (cu ft)	383.96	337.08
Min El Weir Flow (ft)	234.16	Hydr Depth (ft)	0.65	0.64
Min El Prs (ft)	233.00	W.P. Total (ft)	588.79	635.86
Delta EG (ft)	0.11	Conv. Total (cfs)		
Delta WS (ft)	0.10	Top Width (ft)	561.32	610.22
BR Open Area (sq ft)	35.73	Frctn Loss (ft)		
BR Open Vel (ft/s)	2.16	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)		
Br Sel Method	Press/Weir	Power Total (lb/ft s)	0.00	0.00

Plan: ExConditions Pulpit Brook Route 101 RS: 481 Profile: 100yr FIS

E.G. US. (ft)	235.39	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	235.38	E.G. Elev (ft)	235.39	235.39
Q Total (cfs)	900.00	W.S. Elev (ft)	235.38	235.32
Q Bridge (cfs)	59.91	Crit W.S. (ft)	235.26	235.26
Q Weir (cfs)	840.09	Max Chl Dpth (ft)	7.37	6.49
Weir Sta Lft (ft)	133.12	Vel Total (ft/s)	1.95	1.82
Weir Sta Rgt (ft)	809.06	Flow Area (sq ft)	461.09	495.74
Weir Submerg	0.91	Froude # Chl	0.22	0.25
Weir Max Depth (ft)	1.24	Specif Force (cu ft)	452.98	398.68
Min El Weir Flow (ft)	234.16	Hydr Depth (ft)	0.74	0.75
Min El Prs (ft)	233.00	W.P. Total (ft)	646.86	690.04
Delta EG (ft)	0.06	Conv. Total (cfs)		
Delta WS (ft)	0.06	Top Width (ft)	619.34	664.35
BR Open Area (sq ft)	35.73	Frctn Loss (ft)		
BR Open Vel (ft/s)	1.68	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)		

Plan: ExConditions Pulpit Brook Route 101 RS: 481 Profile: 100yr FIS (Continued)

Br Sel Method	Press/Weir	Power Total (lb/ft s)	0.00	0.00

Plan: ExConditions Pulpit Brook Route 101 RS: 481 Profile: 100yr FHWA

E.G. US. (ft)	235.80	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	235.79	E.G. Elev (ft)	235.80	235.78
Q Total (cfs)	1090.00	W.S. Elev (ft)	235.79	235.77
Q Bridge (cfs)	38.72	Crit W.S. (ft)	235.30	235.28
Q Weir (cfs)	1051.28	Max Chl Dpth (ft)	7.79	6.94
Weir Sta Lft (ft)	129.99	Vel Total (ft/s)	1.48	1.37
Weir Sta Rgt (ft)	849.41	Flow Area (sq ft)	735.09	796.83
Weir Submerg	0.98	Froude # Chl	0.14	0.15
Weir Max Depth (ft)	1.65	Specif Force (cu ft)	679.61	653.00
Min El Weir Flow (ft)	234.16	Hydr Depth (ft)	1.05	1.04
Min El Prs (ft)	233.00	W.P. Total (ft)	726.35	788.31
Delta EG (ft)	0.02	Conv. Total (cfs)		
Delta WS (ft)	0.02	Top Width (ft)	698.74	762.54
BR Open Area (sq ft)	35.73	Frctn Loss (ft)		
BR Open Vel (ft/s)	1.08	C & E Loss (ft)		
Coef of Q		Shear Total (lb/sq ft)		
Br Sel Method	Press/Weir	Power Total (lb/ft s)	0.00	0.00

Plan: ExConditions Pulpit Brook Route 101 RS: 481 Profile: 500yr FIS

E.G. US. (ft)	236.68	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	236.67	E.G. Elev (ft)	236.67	236.65
Q Total (cfs)	1450.00	W.S. Elev (ft)	236.65	236.62
Q Bridge (cfs)	79.00	Crit W.S. (ft)	235.51	235.50
Q Weir (cfs)		Max Chl Dpth (ft)	8.65	7.79
Weir Sta Lft (ft)		Vel Total (ft/s)	1.07	1.01
Weir Sta Rgt (ft)		Flow Area (sq ft)	1354.62	1437.73
Weir Submerg		Froude # Chl	0.08	0.08
Weir Max Depth (ft)		Specif Force (cu ft)	1559.90	1576.16
Min El Weir Flow (ft)	234.16	Hydr Depth (ft)	1.76	1.80
Min El Prs (ft)	233.00	W.P. Total (ft)	796.26	823.87
Delta EG (ft)	0.05	Conv. Total (cfs)	43706.9	39725.7
Delta WS (ft)	0.05	Top Width (ft)	768.49	798.00
BR Open Area (sq ft)	35.73	Frctn Loss (ft)	0.03	0.00
BR Open Vel (ft/s)	2.21	C & E Loss (ft)	0.00	0.01
Coef of Q		Shear Total (lb/sq ft)	0.12	0.15
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

cHECk-RAS Report

HEC-RAS Project: *pulpit101.prj*
Plan File: *pulpit101.p01*
Geometry File: *pulpit101.g01*
Flow File: *pulpit101.f01*
Report Date: *9/20/2017*

Existing Conditions Model

Message ID	Message	Cross sections affected	Comments
BR PF 01	This is a Bridge Section. The selected profile is $profilename$. Type of flow is sluice gate pressure flow because, 1. EGEL 3 of $egel3$ is less than or equal to MinTopRd of $minelweirflow$. 2. EGEL 3 of $egel3$ is greater than or equal to MxLoCdU of $mxlocdu$. 3. WSEL 2 of $wsel2$ is less than MxLoCdD of $mxlocdd$.	481(Bridge-UP)	
BR PF 04	This is a Bridge Section. Input BrSelMthd is Press/Weir. The highest flood frequency profile is $profilename$. Type of flow is sluice gate pressure flow only. However, the highest flood frequency CritWS of $critws$at BR U is less than or equal to the WSEL of $wsel$ at BR U. Energy should be selected as the High Flow Method.	481(Bridge-UP)	
BR PW 02	This is a Bridge Section. The selected profile is $profilename$. Type of flow is submerged pressure and weir flow because, 1. EGEL 3 of $egel3$ is greater than MinTopRd of $minelweirflow$. 2. EGEL 3 of $egel3$ is equal to or greater than MxLoCdU of $mxlocdu$. 3. WSEL 2 of $wsel2$ is equal to or greater than MxLoCdD of $mxlocdd$.	481(Bridge-UP)	
CV PF 01	This is ($strucname$). The selected profile is $profilename$. Type of flow is pressure flow because, 1. EGEL 3 of $egel3$ is less than or equal to MinTopRd of $minelweirflow$. 2. CulvWSIn of $Culv_WS_Inlet$ is equal to or greater than MxLoCdU of $mxLocdu$. 3. CulvWSOut of $culvwsoutlet$ is equal to or greater than MxLoCdD of $mxlocdd$.	659	
CV PW 01	This is ($strucname$). The selected profile is $profilename$. Type of flow is low and weir flow because, 1. EGEL 3 of $egel3$ is greater than MinTopRd of $Min_El_Weir_Flow$. 2. EGEL 3 of $egel3$ is less than MxLoCdU of $MxLoCdU$.	659	

MP SW 01DD	The name of the stream is ($streamname$). The flow regime is subcritical or mixed flow. The downstream starting water-surface elevation, SWSEL, is computed from different methods. SWSEL of the 50 %-annual-chance flood is computed from SW_Method. SWSEL of the 10 %-annual-chance flood is computed from SW_Method. SWSEL of the 4 %-annual-chance flood is computed from SW_Method. SWSEL of the 2 %-annual-chance flood is computed from SW_Method. SWSEL of the 1%-annual-chance flood is computed from SW_Method. SWSEL of the 0.2%-annual-chance flood is computed from SW_Method. The same method should be used for all the profiles.		
ST DT 03	This is ($Structure$) section. The Contraction Length is longer than the Expansion Length. Section 4 channel distance of $Length_Chnl4$ is longer than Section 2 channel distance of $Length_Chnl2$. Section 4 and Section 1 should be relocated. The HEC-RAS geometry file may need to be recreated using a GIS program.	659(Culvert-UP)	
XS DC 02	Constant discharge used for the entire profile for $assignedname$ flood. At least two discharges should be selected; one at the mouth and the other at the middle of the watershed or above the confluence of a tributary. Or provide explanation why only one discharge should be used. Other flood frequencies should also be checked.		

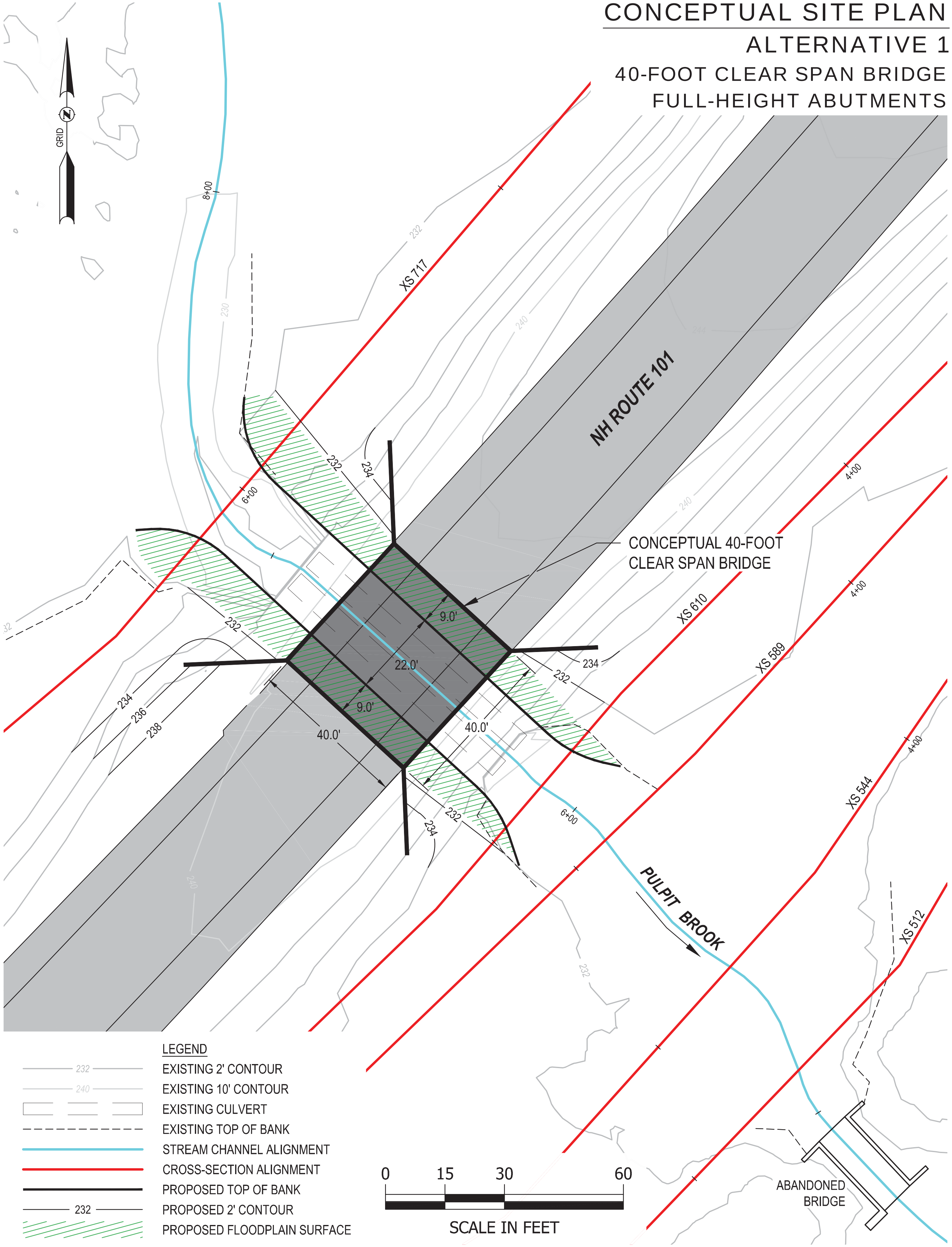
Alternative 1 Hydraulics

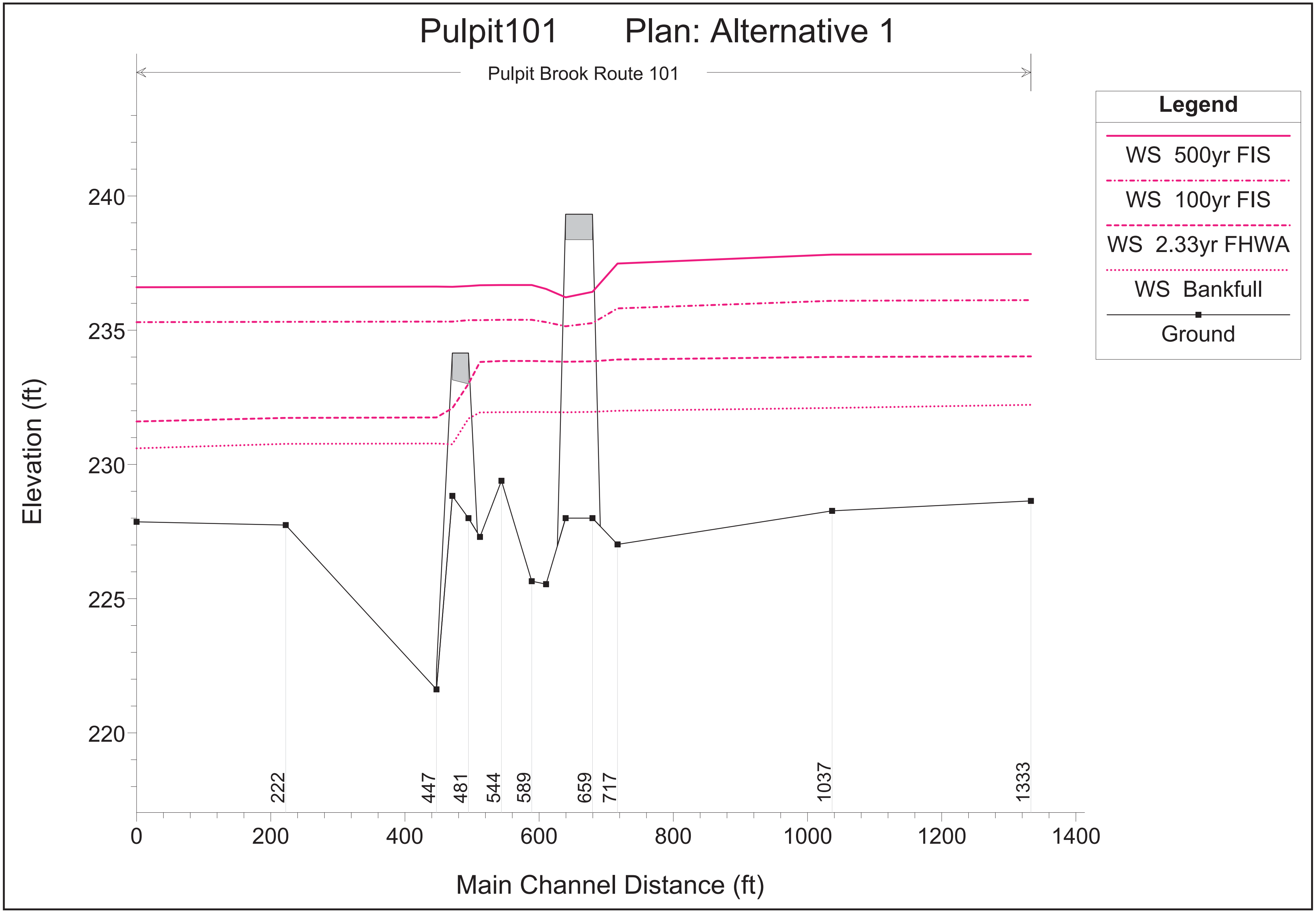
(Conceptual 40-Foot Clear Span Bridge with Full-Height Abutments)

CONCEPTUAL SITE PLAN

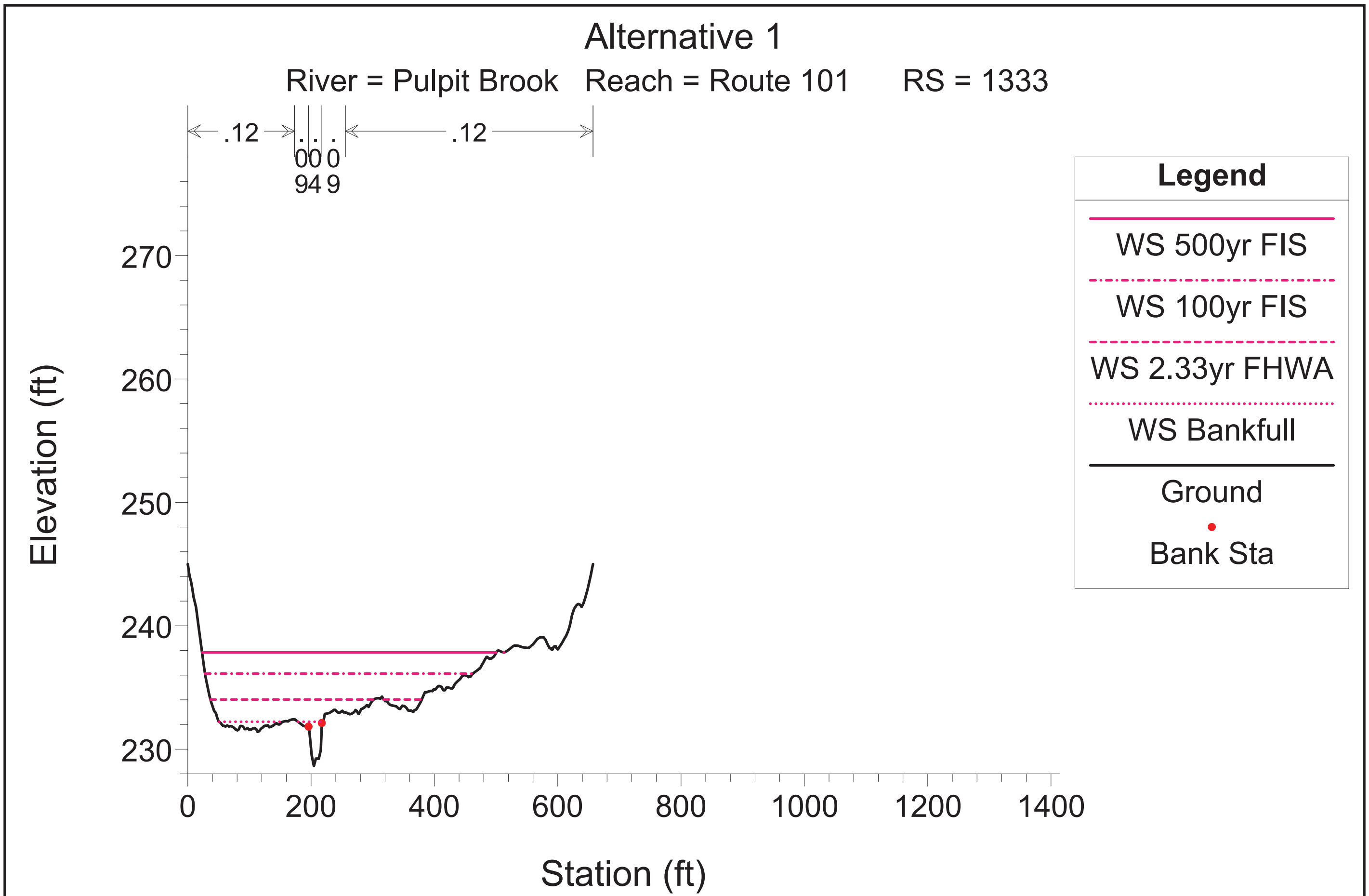
ALTERNATIVE 1

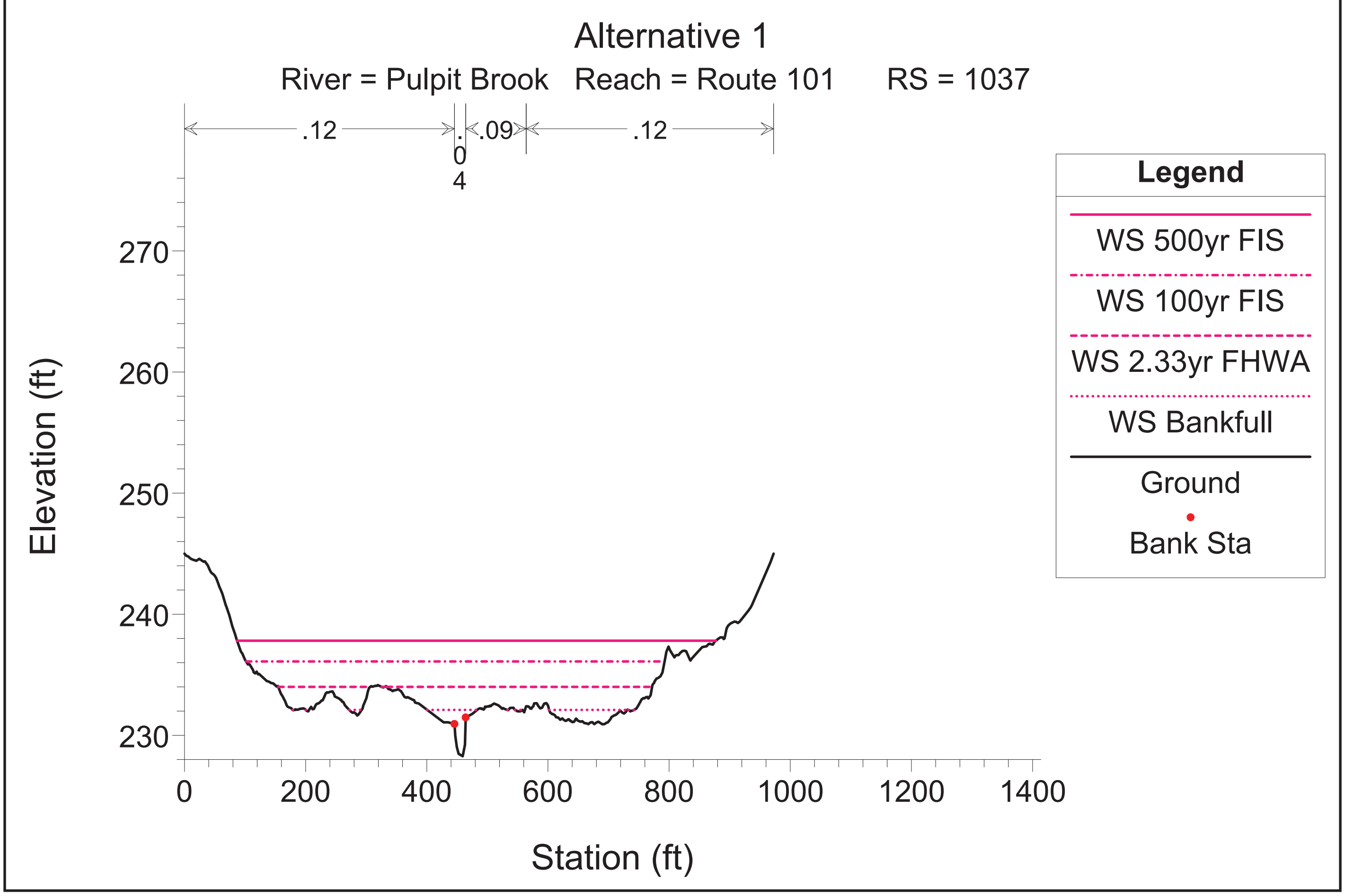
40-FOOT CLEAR SPAN BRIDGE
FULL-HEIGHT ABUTMENTS



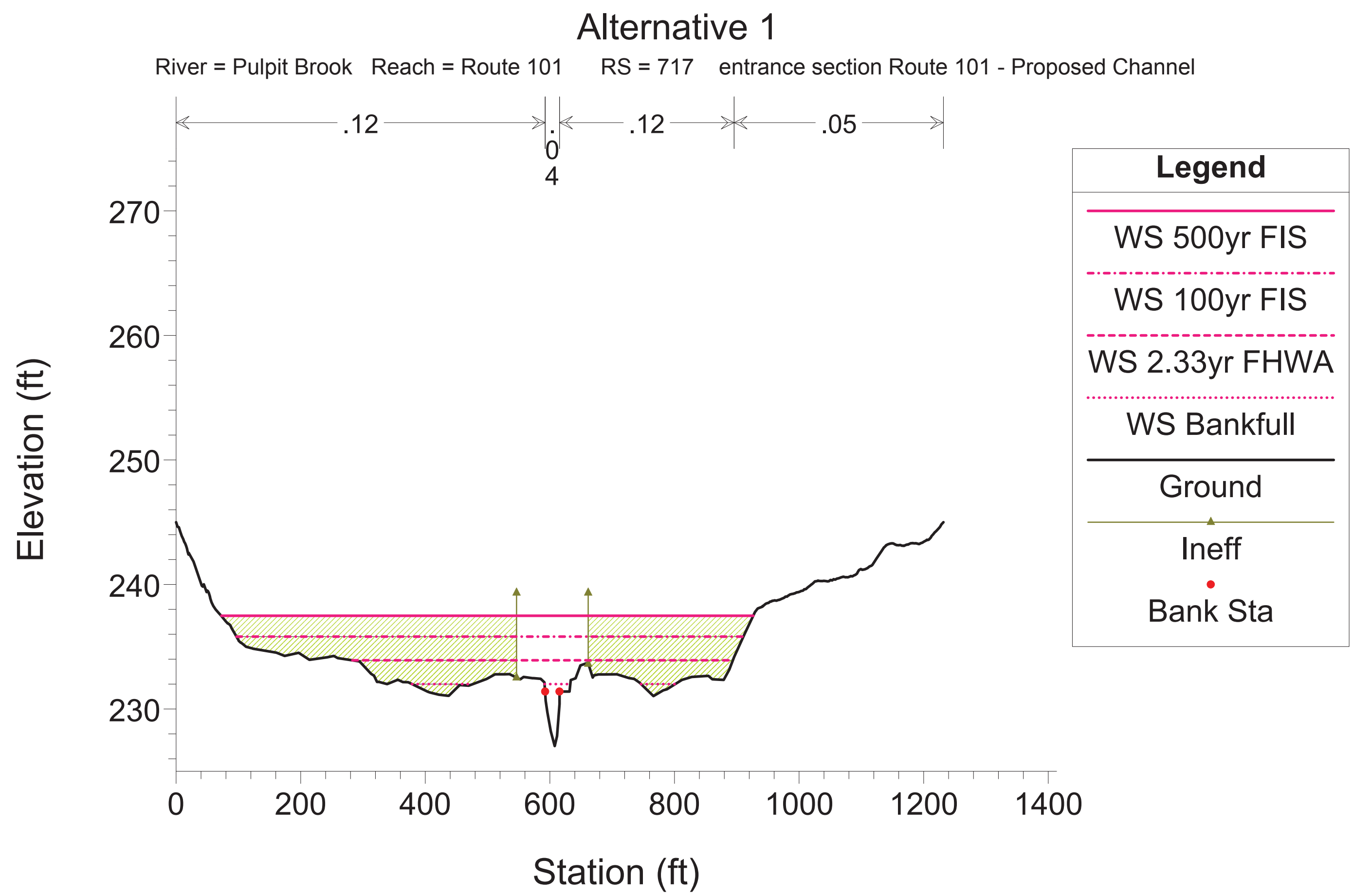


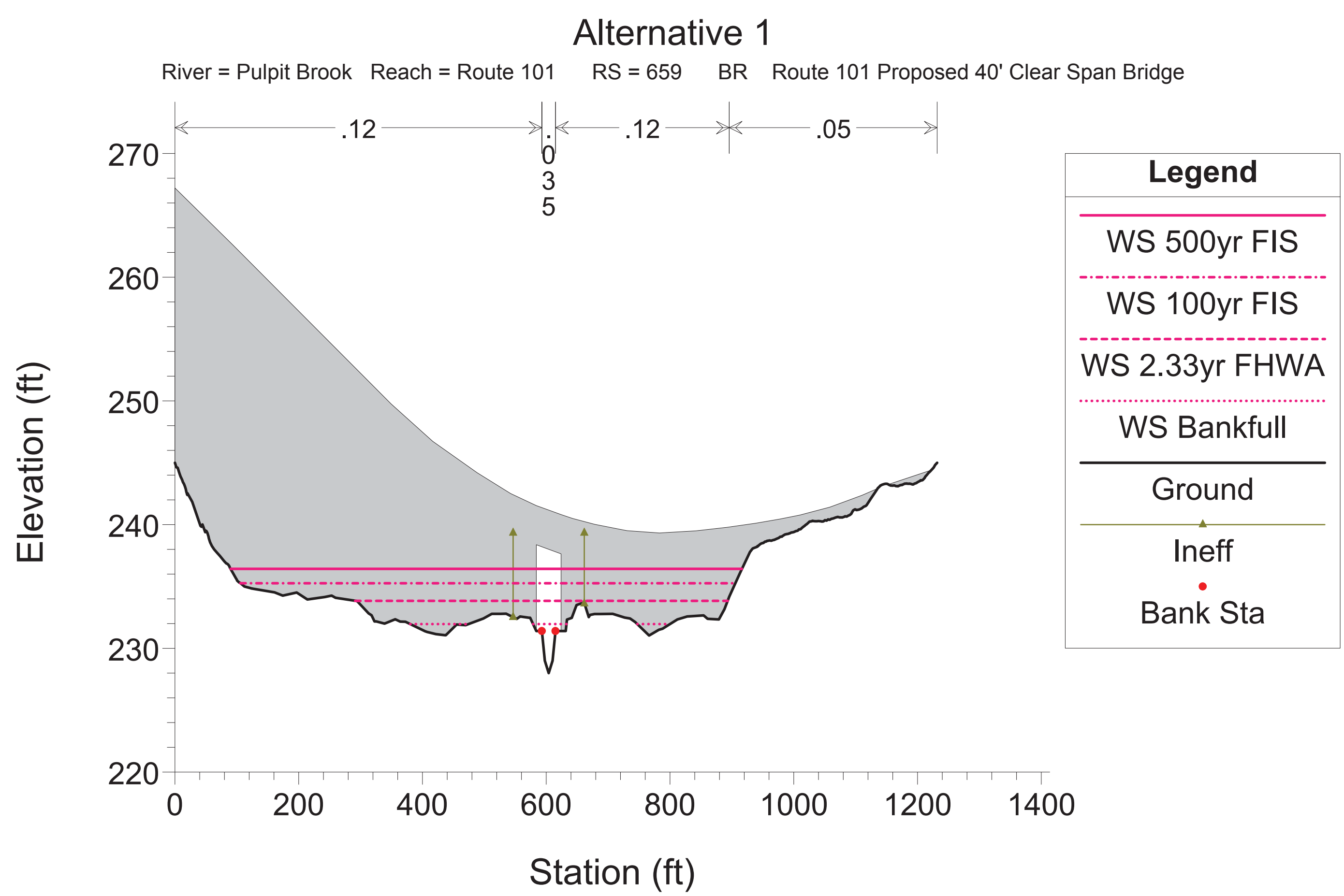
1 in Horiz. = 200 ft 1 in Vert. = 5 ft



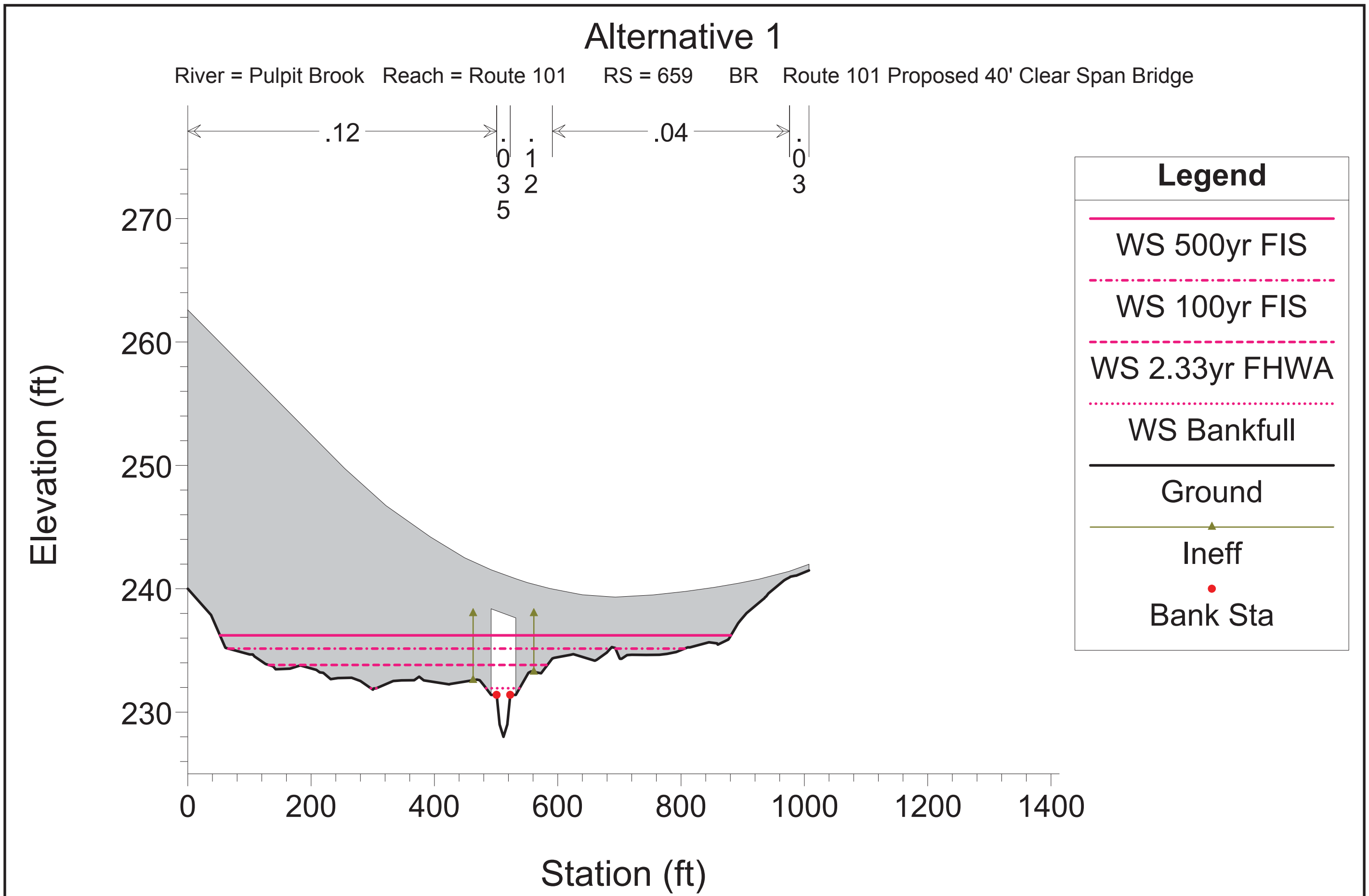


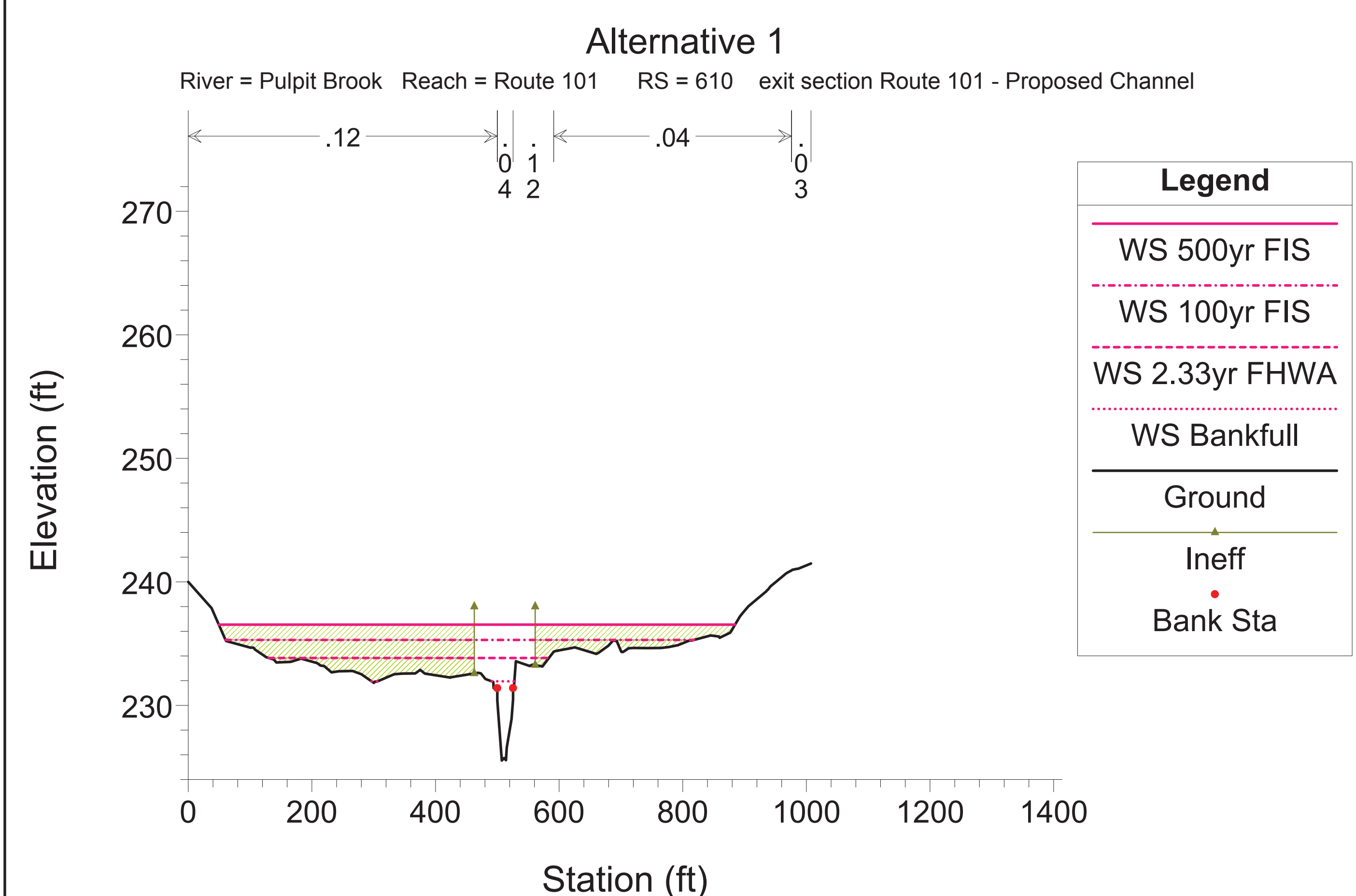
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



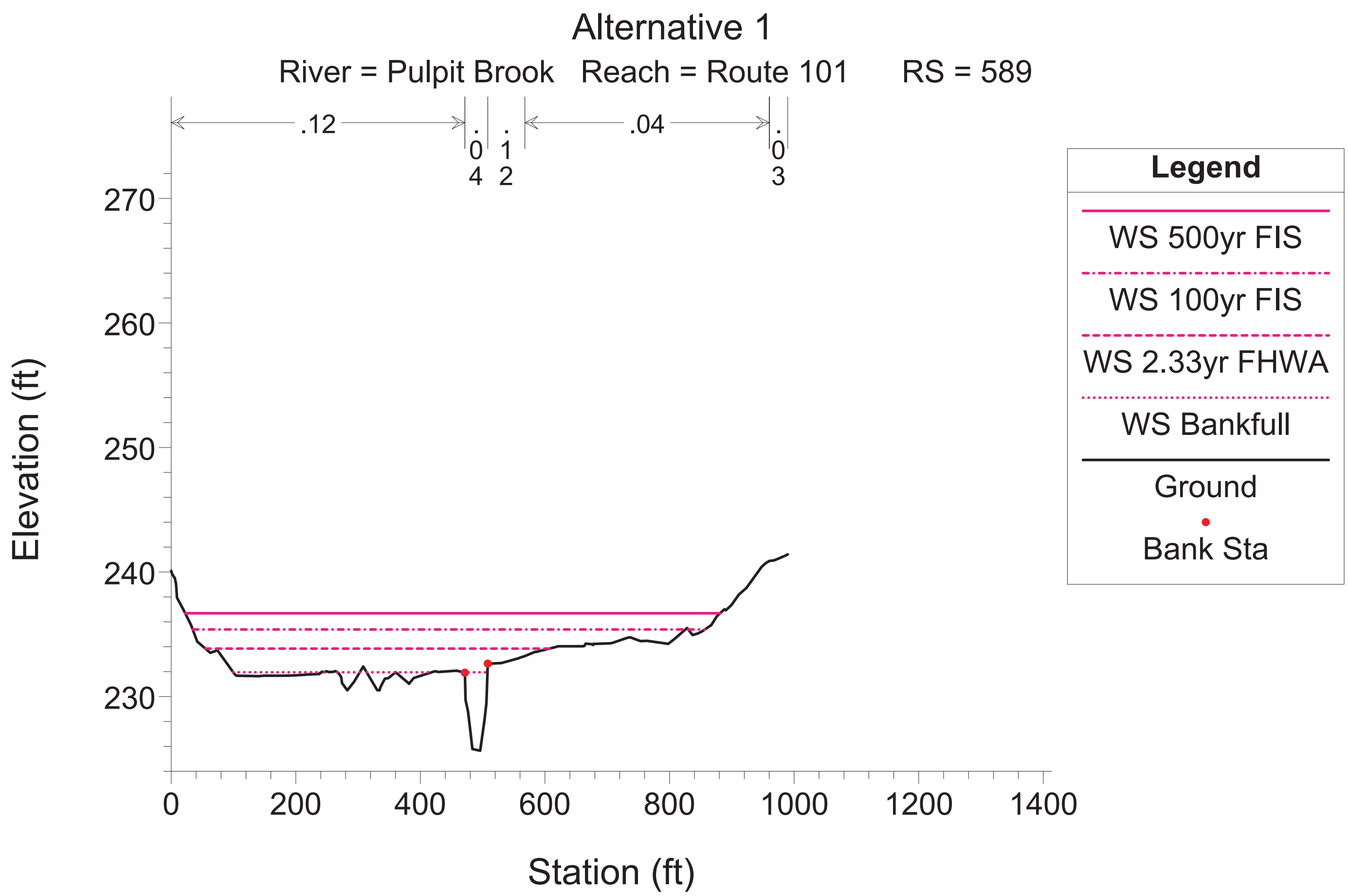


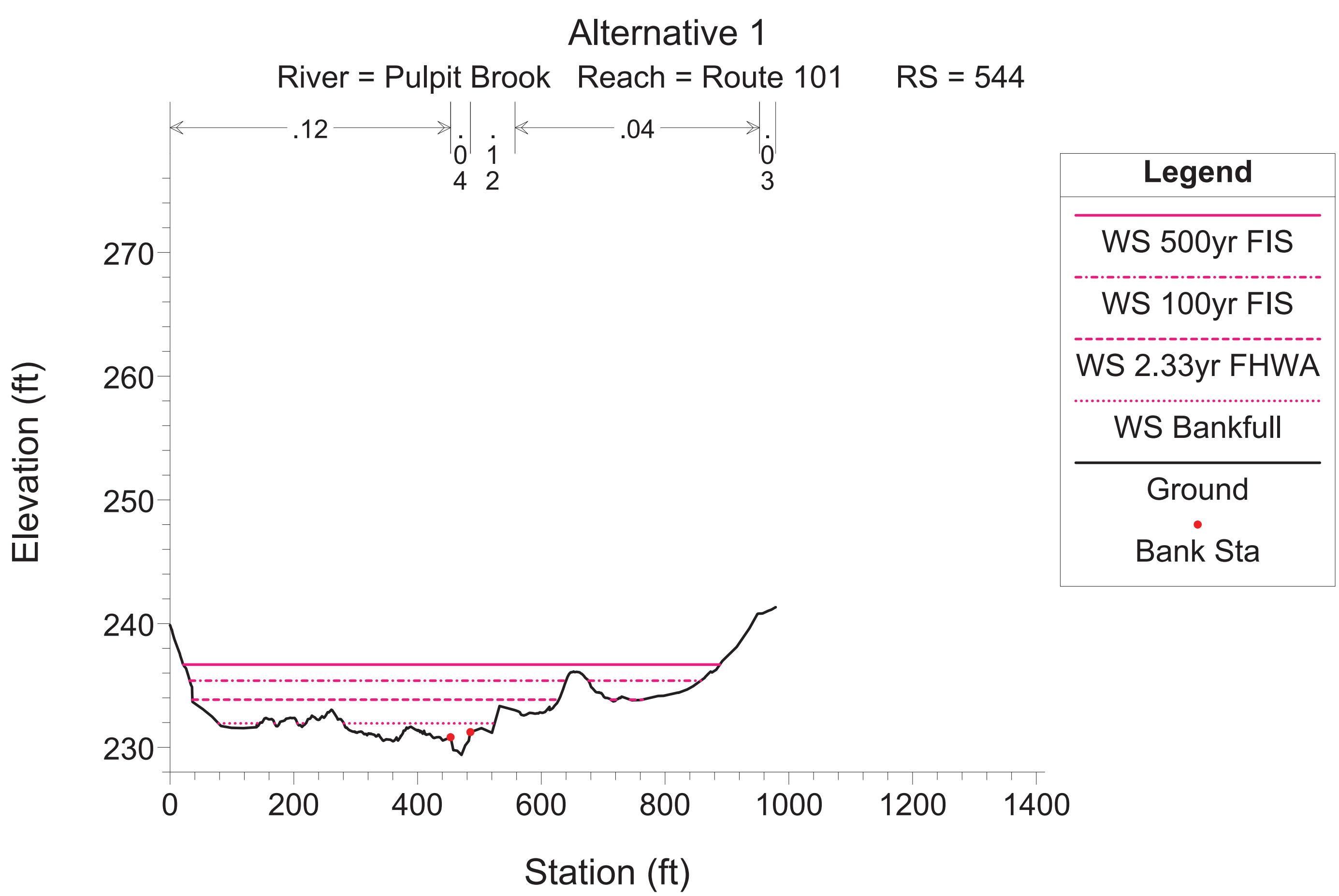
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



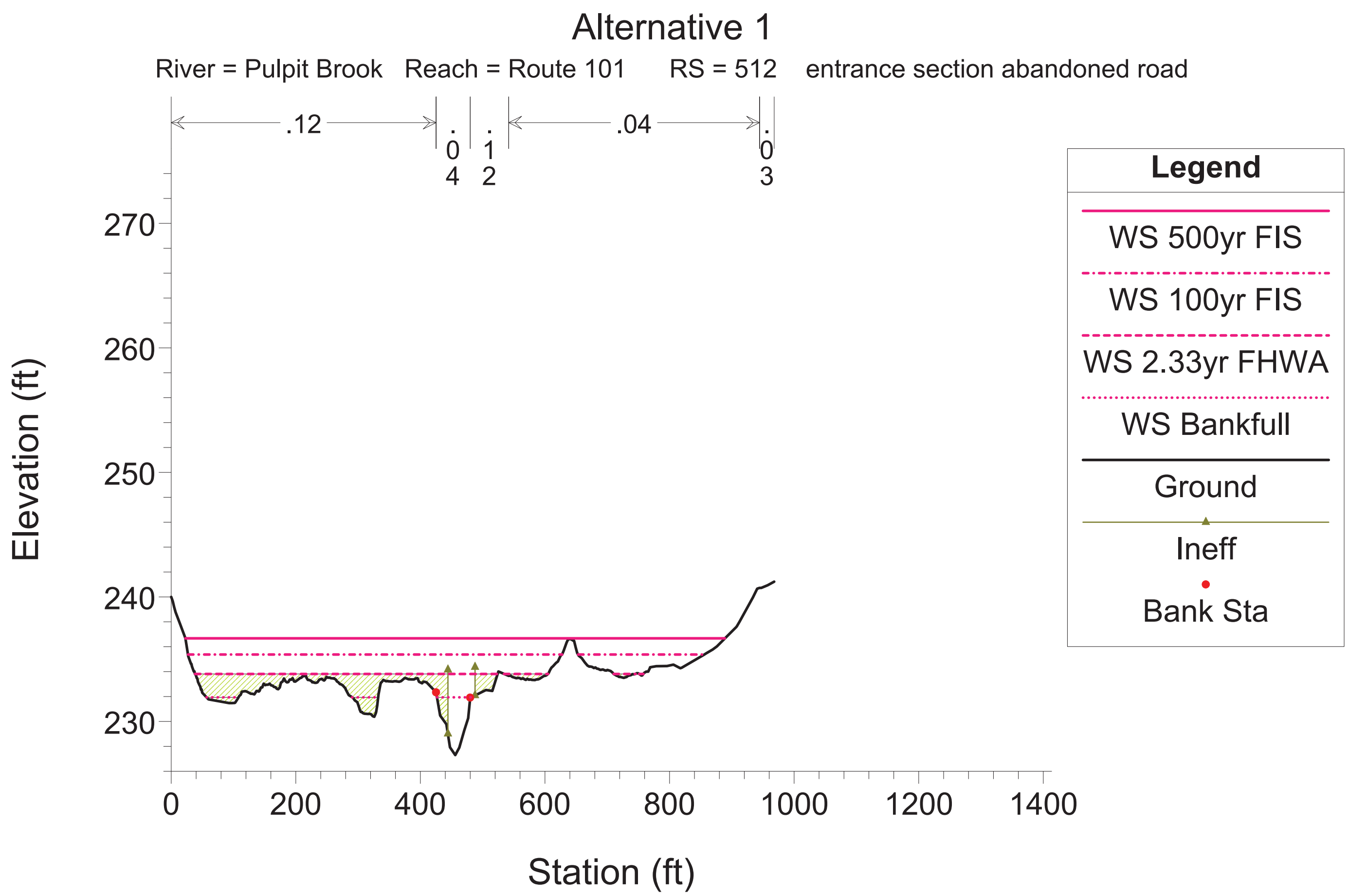


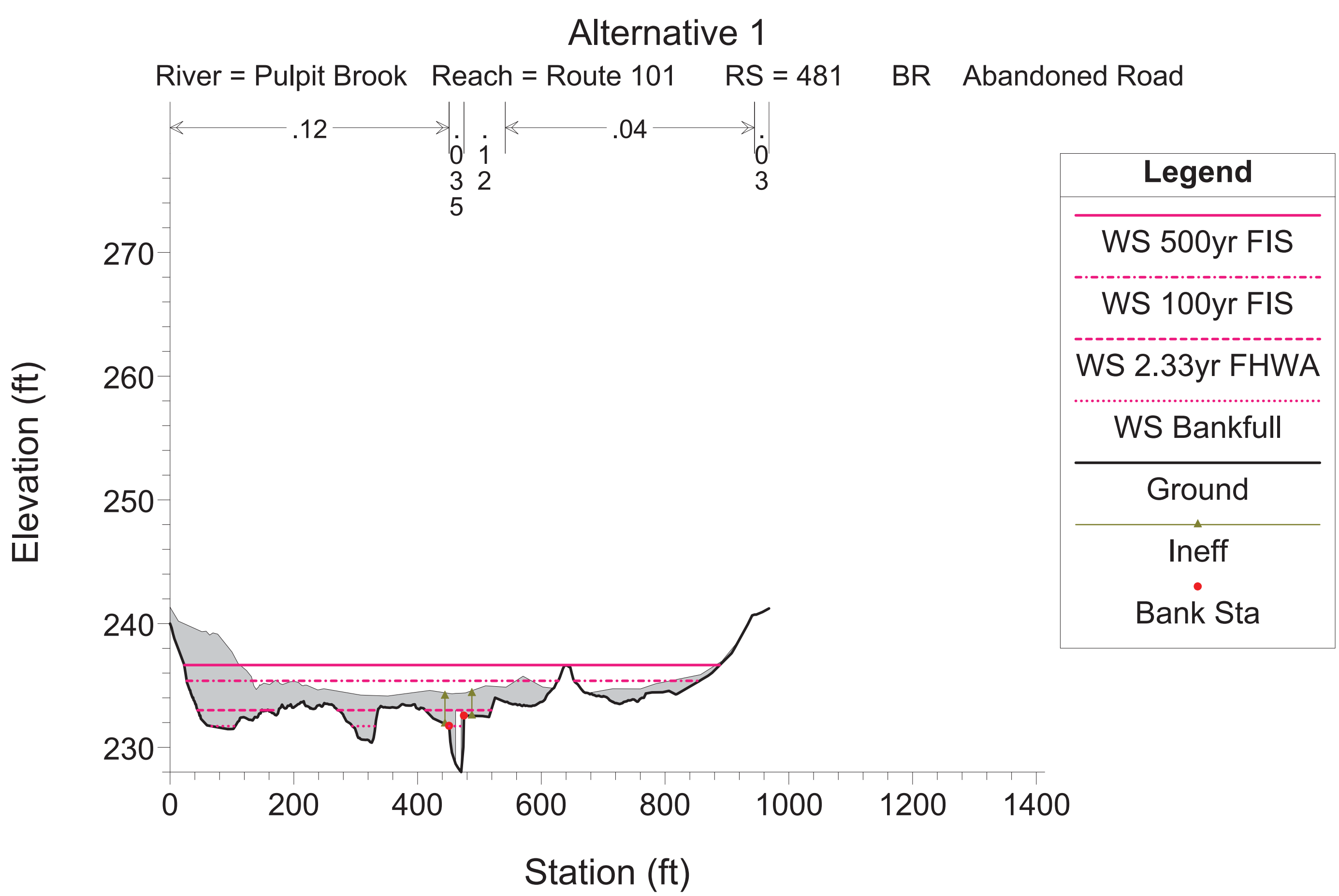
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



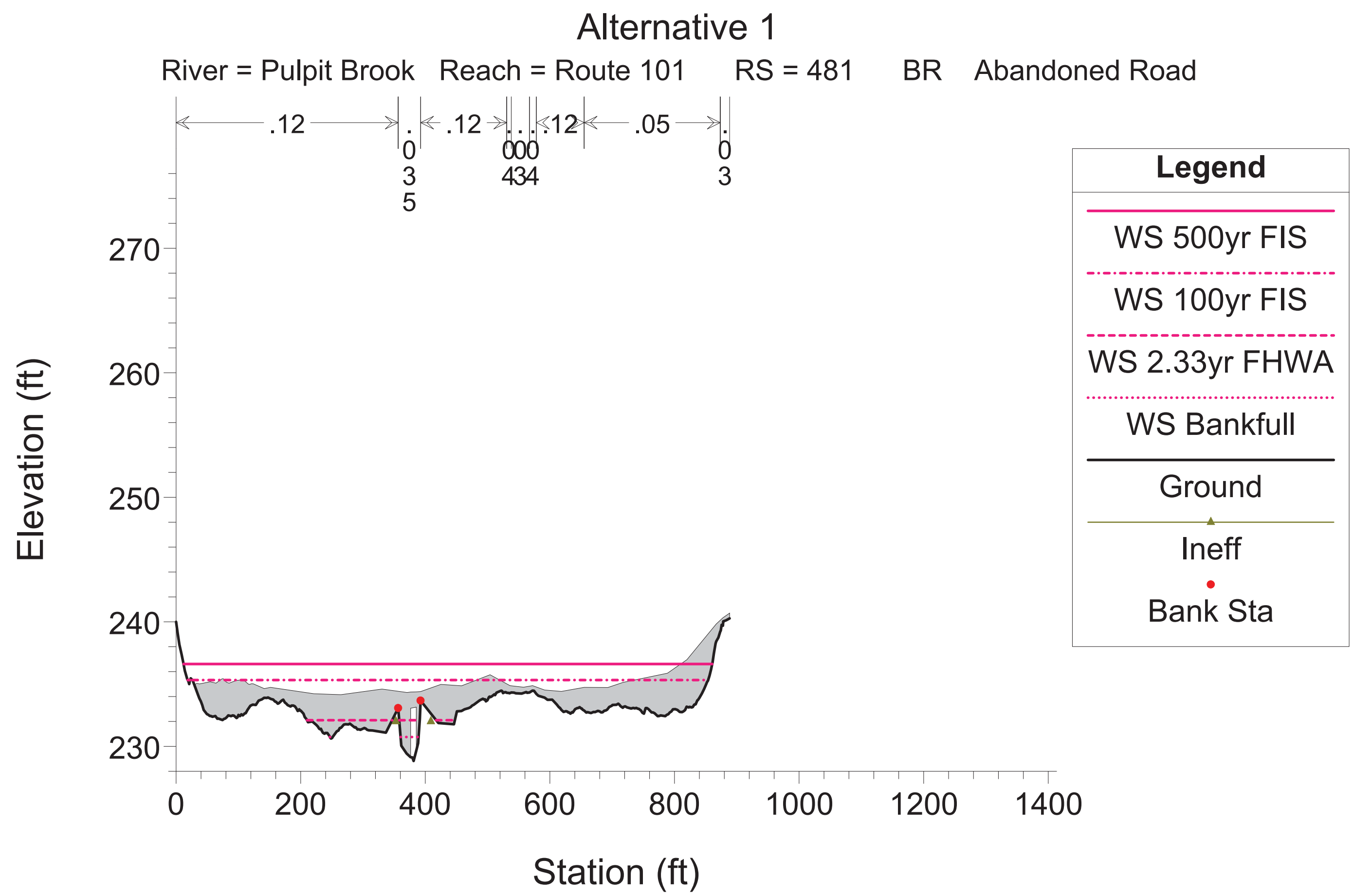


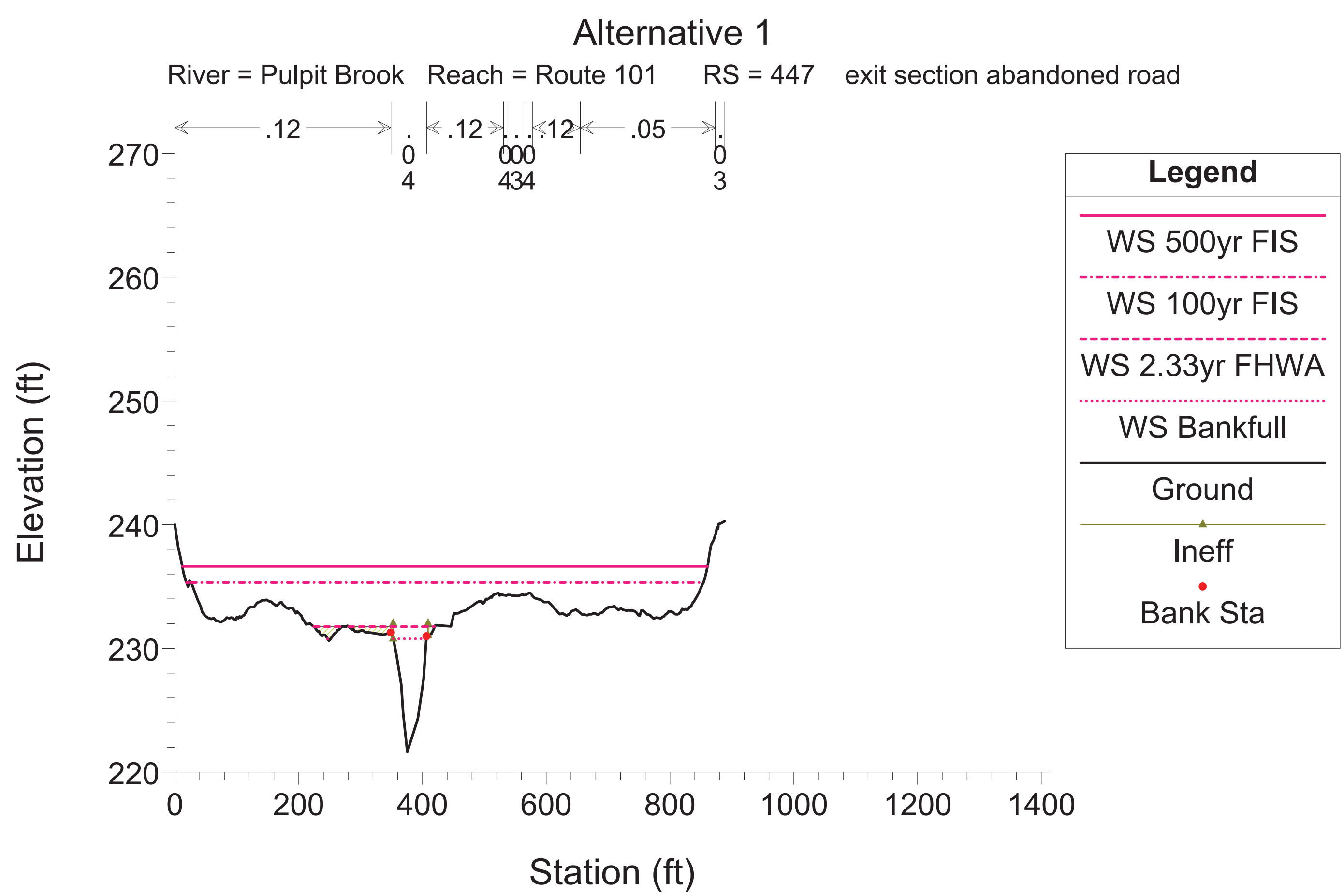
1 in Horiz. = 300 ft   1 in Vert. = 15 ft



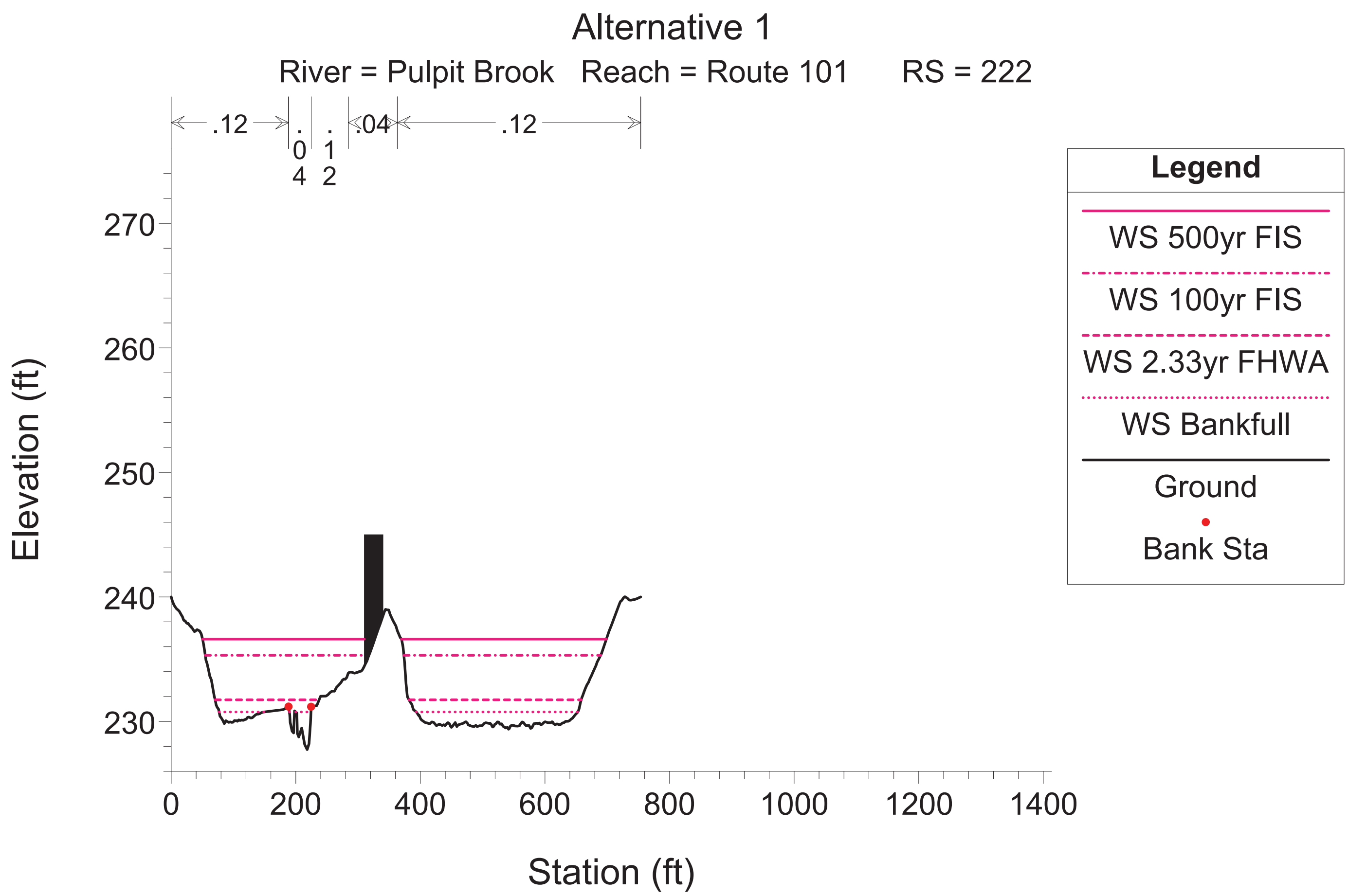


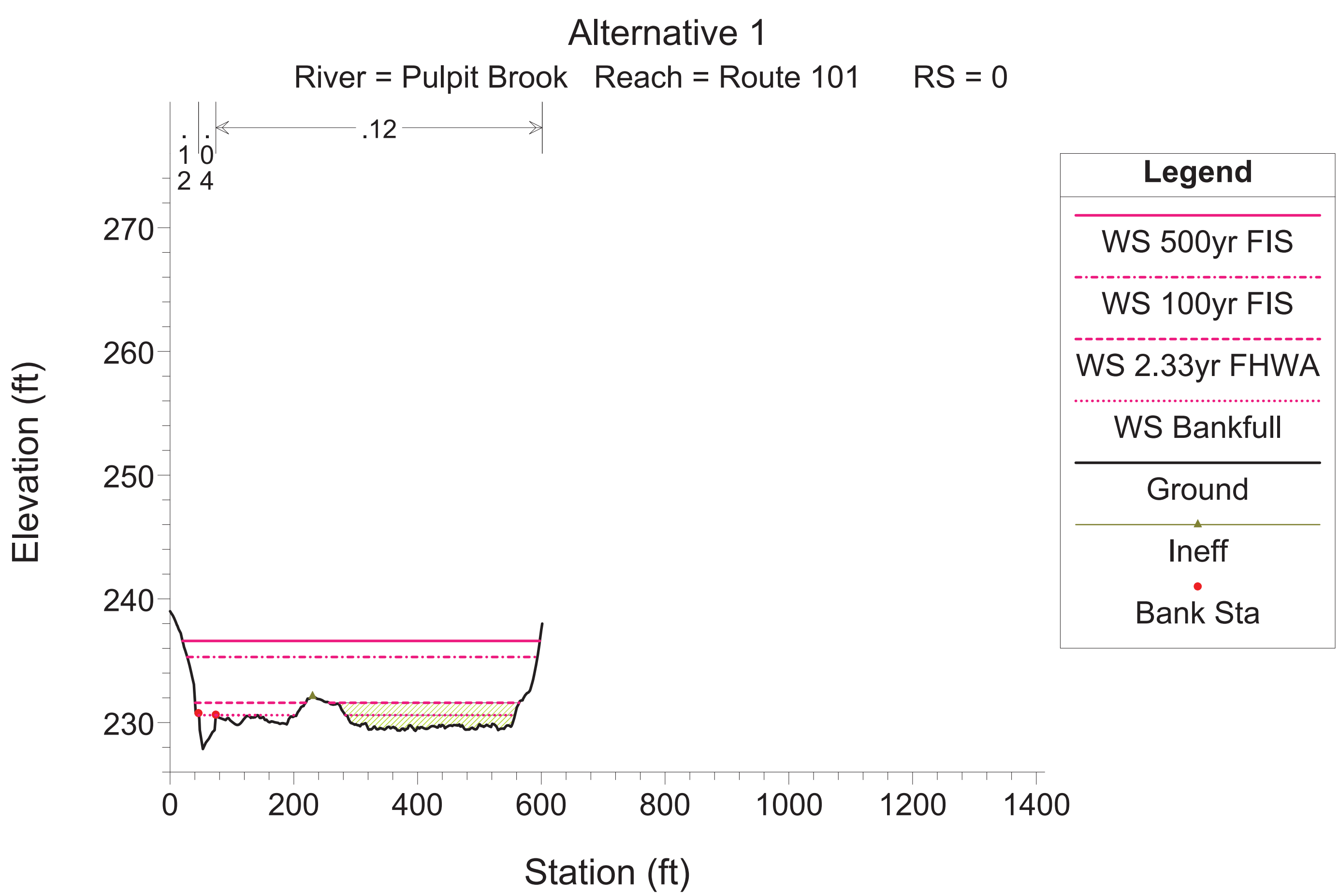
1 in Horiz. = 300 ft 1 in Vert. = 15 ft





1 in Horiz. = 300 ft 1 in Vert. = 15 ft





1 in Horiz. = 300 ft 1 in Vert. = 15 ft

HEC-RAS Plan: Alternative 1 River: Pulpit Brook Reach: Route 101

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Power Chan
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/ft s)
Route 101	0	Bankfull	105	227.9	230.6	229.5	230.7	0.0014	1.9	97	431	0.26	0.28
Route 101	0	2.33yr FHWA	260	227.9	231.6	230.4	231.7	0.0010	2.3	265	485	0.24	0.38
Route 101	0	10yr FIS	420	227.9	234.2	230.8	234.2	0.0000	0.6	2209	557	0.04	0.01
Route 101	0	50yr FIS	760	227.9	235.1	231.3	235.1	0.0000	0.8	2713	564	0.06	0.01
Route 101	0	100yr FIS	900	227.9	235.3	231.5	235.3	0.0001	1.0	2826	566	0.07	0.02
Route 101	0	100yr FHWA	1090	227.9	235.8	231.7	235.8	0.0001	1.1	3081	570	0.07	0.03
Route 101	0	500yr FIS	1450	227.9	236.6	232.1	236.6	0.0001	1.2	3569	577	0.08	0.04
Route 101	222	Bankfull	105	227.7	230.8		230.8	0.0003	0.9	338	366	0.12	0.03
Route 101	222	2.33yr FHWA	260	227.7	231.7		231.7	0.0002	1.0	743	443	0.11	0.03
Route 101	222	10yr FIS	420	227.7	234.2		234.2	0.0000	0.6	1967	552	0.05	0.01
Route 101	222	50yr FIS	760	227.7	235.1		235.1	0.0001	0.9	2474	568	0.06	0.02
Route 101	222	100yr FIS	900	227.7	235.3		235.3	0.0001	1.0	2589	571	0.07	0.02
Route 101	222	100yr FHWA	1090	227.7	235.8		235.8	0.0001	1.1	2848	577	0.07	0.03
Route 101	222	500yr FIS	1450	227.7	236.6		236.6	0.0001	1.2	3344	589	0.08	0.04
Route 101	447	Bankfull	105	221.6	230.8	223.7	230.8	0.0000	0.4	274	59	0.03	0.00
Route 101	447	2.33yr FHWA	260	221.6	231.8	224.6	231.8	0.0000	0.8	328	184	0.06	0.01
Route 101	447	10yr FIS	420	221.6	234.2	225.2	234.2	0.0000	0.7	1539	744	0.04	0.01
Route 101	447	50yr FIS	760	221.6	235.1	226.2	235.1	0.0000	0.9	2272	825	0.05	0.02
Route 101	447	100yr FIS	900	221.6	235.3	226.6	235.3	0.0000	1.0	2440	832	0.06	0.02
Route 101	447	100yr FHWA	1090	221.6	235.8	227.0	235.8	0.0000	1.0	2819	841	0.06	0.02
Route 101	447	500yr FIS	1450	221.6	236.6	227.7	236.6	0.0000	1.1	3539	849	0.06	0.03
Route 101	481		Bridge										
Route 101	512	Bankfull	105	227.3	231.9	228.7	231.9	0.0001	0.9	119	148	0.08	0.02
Route 101	512	2.33yr FHWA	260	227.3	233.8	229.5	233.8	0.0002	1.4	201	598	0.11	0.07
Route 101	512	10yr FIS	420	227.3	234.8	230.1	234.8	0.0000	0.8	1511	766	0.06	0.01
Route 101	512	50yr FIS	760	227.3	235.2	230.9	235.2	0.0001	1.2	1803	792	0.08	0.04
Route 101	512	100yr FIS	900	227.3	235.4	231.3	235.4	0.0001	1.3	1928	803	0.09	0.05
Route 101	512	100yr FHWA	1090	227.3	235.8	231.7	235.8	0.0001	1.3	2264	824	0.09	0.05
Route 101	512	500yr FIS	1450	227.3	236.7	232.3	236.7	0.0001	1.2	3010	866	0.08	0.05
Route 101	544	Bankfull	105	229.4	231.9		232.0	0.0003	1.1	264	333	0.13	0.04
Route 101	544	2.33yr FHWA	260	229.4	233.9		233.9	0.0001	0.7	1207	621	0.06	0.01
Route 101	544	10yr FIS	420	229.4	234.8		234.9	0.0000	0.7	1911	762	0.05	0.01
Route 101	544	50yr FIS	760	229.4	235.2		235.2	0.0001	1.0	2205	782	0.08	0.03
Route 101	544	100yr FIS	900	229.4	235.4		235.4	0.0001	1.1	2329	790	0.09	0.04
Route 101	544	100yr FHWA	1090	229.4	235.8		235.8	0.0001	1.2	2660	813	0.09	0.04
Route 101	544	500yr FIS	1450	229.4	236.7		236.7	0.0001	1.2	3407	867	0.08	0.04
Route 101	589	Bankfull	105	225.7	232.0		232.0	0.0000	0.6	285	323	0.05	0.01
Route 101	589	2.33yr FHWA	260	225.7	233.9		233.9	0.0000	0.7	1156	553	0.05	0.01
Route 101	589	10yr FIS	420	225.7	234.8		234.9	0.0000	0.7	1827	775	0.05	0.01
Route 101	589	50yr FIS	760	225.7	235.2		235.2	0.0001	1.1	2128	806	0.07	0.03
Route 101	589	100yr FIS	900	225.7	235.4		235.4	0.0001	1.3	2256	818	0.08	0.05
Route 101	589	100yr FHWA	1090	225.7	235.8		235.8	0.0001	1.3	2598	837	0.08	0.05
Route 101	589	500yr FIS	1450	225.7	236.7		236.7	0.0001	1.3	3346	858	0.07	0.05
Route 101	610	Bankfull	105	225.5	232.0	227.3	232.0	0.0001	0.9	122	47	0.07	0.02
Route 101	610	2.33yr FHWA	260	225.5	233.8	228.4	233.9	0.0002	1.5	251	454	0.10	0.08
Route 101	610	10yr FIS	420	225.5	234.8	229.2	234.9	0.0002	1.9	348	682	0.12	0.18
Route 101	610	50yr FIS	760	225.5	235.2	230.4	235.3	0.0006	3.3	381	734	0.21	0.85
Route 101	610	100yr FIS	900	225.5	235.3	230.7	235.5	0.0008	3.8	395	758	0.24	1.30
Route 101	610	100yr FHWA	1090	225.5	235.7	231.2	235.9	0.0010	4.3	433	812	0.26	1.84
Route 101	610	500yr FIS	1450	225.5	236.5	232.1	236.8	0.0011	4.9	517	835	0.29	2.75
Route 101	659		Bridge										
Route 101	717	Bankfull	105	227.0	232.0	229.0	232.0	0.0003	1.3	89	194	0.13	0.07
Route 101	717	2.33yr FHWA	260	227.0	233.9	230.0	234.0	0.0003	1.8	257	611	0.14	0.16
Route 101	717	10yr FIS	420	227.0	234.9	230.7	235.0	0.0003	2.2	376	786	0.15	0.27
Route 101	717	50yr FIS	760	227.0	235.5	231.9	235.7	0.0008	3.5	444	808	0.23	1.02
Route 101	717	100yr FIS	900	227.0	235.8	232.3	236.0	0.0009	3.9	476	814	0.25	1.39
Route 101	717	100yr FHWA	1090	227.0	236.4	233.1	236.6	0.0009	4.2	539	825	0.26	1.72
Route 101	717	500yr FIS	1450	227.0	237.5	234.0	237.7	0.0009	4.6	668	854	0.27	2.13
Route 101	1037	Bankfull	105	228.3	232.1		232.1	0.0003	1.3	204	269	0.13	0.08
Route 101	1037	2.33yr FHWA	260	228.3	234.0		234.0	0.0001	0.9	1124	595	0.07	0.02
Route 101	1037	10yr FIS	420	228.3	235.1		235.1	0.0001	0.9	1794	664	0.06	0.02
Route 101	1037	50yr FIS	760	228.3	235.8		235.8	0.0001	1.2	2281	683	0.08	0.04
Route 101	1037	100yr FIS	900	228.3	236.1		236.1	0.0001	1.3	2504	691	0.09	0.05
Route 101	1037	100yr FHWA	1090	228.3	236.7		236.7	0.0001	1.3	2911	722	0.08	0.05
Route 101	1037	500yr FIS	1450	228.3	237.8		237.8	0.0001	1.4	3782	791	0.08	0.06
Route 101	1333	Bankfull	105	228.6	232.2		232.3	0.0008	1.8	101	144	0.20	0.19
Route 101	1333	2.33yr FHWA	260	228.6	234.0		234.0	0.0002	1.5	527	327	0.12	0.09
Route 101	1333	10yr FIS	420	228.6	235.1		235.1	0.0002	1.5	898	394	0.11	0.08
Route 101	1333	50yr FIS	760	228.6	235.8		235.8	0.0003	2.0	1194	414	0.14	0.21
Route 101	1333	100yr FIS	900	228.6	236.1		236.1	0.0003	2.2	1332	435	0.15	0.25
Route 101	1333	100yr FHWA	1090	228.6	236.7		236.7	0.0003	2.2	1588	449	0.15	0.26
Route 101	1333	500yr FIS	1450	228.6	237.8		237.9	0.0002	2.2	2114	478	0.14	0.24

HEC-RAS Plan: Alternative 1 River: Pulpit Brook Reach: Route 101

Reach	River Sta	Profile	Q Total	Q Channel	W.S. Elev	Vel Chnl	Hydr Depth C	Max Chl Dpth	Top W Chnl	Froude # Chl	Vel Total	Hydr Depth	Shear Chan	Shear LOB	Shear ROB	Vel Left	Vel Right
			(cfs)	(cfs)	(ft)	(ft/s)	(ft)	(ft)	(ft)		(ft/s)	(ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(ft/s)	(ft/s)
Route 101	0	Bankfull	105	93	230.6	1.9	1.7	2.7	28	0.26	1.1	0.6	0.1		0.0		0.2
Route 101	0	2.33yr FHWA	260	171	231.6	2.3	2.7	3.7	28	0.24	1.0	1.5	0.2	0.0	0.1	0.3	0.5
Route 101	0	10yr FIS	420	86	234.2	0.6	5.3	6.3	28	0.04	0.2	4.0	0.0	0.0	0.0	0.1	0.2
Route 101	0	50yr FIS	760	147	235.1	0.8	6.2	7.2	28	0.06	0.3	4.8	0.0	0.0	0.0	0.1	0.2
Route 101	0	100yr FIS	900	172	235.3	1.0	6.4	7.4	28	0.07	0.3	5.0	0.0	0.0	0.0	0.2	0.3
Route 101	0	100yr FHWA	1090	203	235.8	1.1	6.9	7.9	28	0.07	0.4	5.4	0.0	0.0	0.0	0.2	0.3
Route 101	0	500yr FIS	1450	260	236.6	1.2	7.7	8.7	28	0.08	0.4	6.2	0.0	0.0	0.0	0.2	0.4
Route 101	222	Bankfull	105	48	230.8	0.9	1.7	3.0	33	0.12	0.3	0.9	0.0	0.0	0.0	0.1	0.2
Route 101	222	2.33yr FHWA	260	88	231.7	1.0	2.5	4.0	36	0.11	0.3	1.7	0.0	0.0	0.0	0.2	0.3
Route 101	222	10yr FIS	420	107	234.2	0.6	5.0	6.5	36	0.05	0.2	3.6	0.0	0.0	0.0	0.2	0.2
Route 101	222	50yr FIS	760	183	235.1	0.9	5.9	7.4	36	0.06	0.3	4.4	0.0	0.0	0.0	0.2	0.3
Route 101	222	100yr FIS	900	214	235.3	1.0	6.1	7.6	36	0.07	0.3	4.5	0.0	0.0	0.0	0.3	0.3
Route 101	222	100yr FHWA	1090	252	235.8	1.1	6.5	8.0	36	0.07	0.4	4.9	0.0	0.0	0.0	0.3	0.3
Route 101	222	500yr FIS	1450	321	236.6	1.2	7.4	8.9	36	0.08	0.4	5.7	0.0	0.0	0.0	0.4	0.4
Route 101	447	Bankfull	105	105	230.8	0.4	5.1	9.2	53	0.03	0.4	5.1	0.0				
Route 101	447	2.33yr FHWA	260	260	231.8	0.8	6.1	10.1	58	0.06	0.8	5.8	0.0		0.0		0.1
Route 101	447	10yr FIS	420	313	234.2	0.7	8.2	12.6	58	0.04	0.3	2.1	0.0	0.0	0.0	0.1	0.1
Route 101	447	50yr FIS	760	465	235.1	0.9	9.1	13.5	58	0.05	0.3	2.8	0.0	0.0	0.0	0.1	0.2
Route 101	447	100yr FIS	900	527	235.3	1.0	9.3	13.7	58	0.06	0.4	2.9	0.0	0.0	0.0	0.2	0.2
Route 101	447	100yr FHWA	1090	584	235.8	1.0	9.7	14.2	58	0.06	0.4	3.4	0.0	0.0	0.0	0.2	0.3
Route 101	447	500yr FIS	1450	668	236.6	1.1	10.6	15.0	58	0.06	0.4	4.2	0.0	0.0	0.0	0.2	0.3
Route 101	481		Bridge														
Route 101	512	Bankfull	105	105	231.9	0.9	3.3	4.6	53	0.08	0.9	3.2	0.0		0.0		0.0
Route 101	512	2.33yr FHWA	260	257	233.8	1.4	5.2	6.5	55	0.11	1.3	4.6	0.0		0.0		0.2
Route 101	512	10yr FIS	420	235	234.8	0.8	5.6	7.5	55	0.06	0.3	2.0	0.0	0.0	0.0	0.1	0.2
Route 101	512	50yr FIS	760	379	235.2	1.2	6.0	7.9	55	0.08	0.4	2.3	0.0	0.0	0.0	0.2	0.3
Route 101	512	100yr FIS	900	430	235.4	1.3	6.1	8.1	55	0.09	0.5	2.4	0.0	0.0	0.0	0.3	0.4
Route 101	512	100yr FHWA	1090	465	235.8	1.3	6.5	8.5	55	0.09	0.5	2.7	0.0	0.0	0.0	0.3	0.4
Route 101	512	500yr FIS	1450	508	236.7	1.2	7.4	9.4	55	0.08	0.5	3.5	0.0	0.0	0.0	0.3	0.5
Route 101	544	Bankfull	105	66	231.9	1.1	2.0	2.6	32	0.13	0.4	0.8	0.0	0.0	0.0	0.2	0.2
Route 101	544	2.33yr FHWA	260	86	233.9	0.7	3.9	4.5	32	0.06	0.2	1.9	0.0	0.0	0.0	0.2	0.2
Route 101	544	10yr FIS	420	104	234.8	0.7	4.9	5.5	32	0.05	0.2	2.5	0.0	0.0	0.0	0.2	0.2
Route 101	544	50yr FIS	760	171	235.2	1.0	5.2	5.8	32	0.08	0.3	2.8	0.0	0.0	0.0	0.3	0.4
Route 101	544	100yr FIS	900	195	235.4	1.1	5.4	6.0	32	0.09	0.4	2.9	0.0	0.0	0.0	0.3	0.4
Route 101	544	100yr FHWA	1090	216	235.8	1.2	5.8	6.4	32	0.09	0.4	3.3	0.0	0.0	0.0	0.3	0.5
Route 101	544	500yr FIS	1450	248	236.7	1.2	6.7	7.3	32	0.08	0.4	3.9	0.0	0.0	0.0	0.3	0.5
Route 101	589	Bankfull	105	100	232.0	0.6	4.7	6.3	36	0.05	0.4	0.9	0.0	0.0		0.0	
Route 101	589	2.33yr FHWA	260	161	233.9	0.7	6.5	8.2	37	0.05	0.2	2.1	0.0	0.0	0.0	0.1	0.1
Route 101	589	10yr FIS	420	203	234.8	0.7	7.5	9.2	37	0.05	0.2	2.4	0.0	0.0	0.0	0.1	0.1
Route 101	589	50yr FIS	760	328	235.2	1.1	7.9	9.6	37	0.07	0.4	2.6	0.0	0.0	0.0	0.2	0.3
Route 101	589	100yr FIS	900	371	235.4	1.3	8.0	9.7	37	0.08	0.4	2.8	0.0	0.0	0.0	0.3	0.3
Route 101	589	100yr FHWA	1090	404	235.8	1.3	8.5	10.1	37	0.08	0.4	3.1	0.0	0.0	0.0	0.3	0.4
Route 101	589	500yr FIS	1450	435	236.7	1.3	9.3	11.0	37	0.07	0.4	3.9	0.0	0.0	0.0	0.3	0.5
Route 101	610	Bankfull	105	105	232.0	0.9	4.6	6.4	26	0.07	0.9	3.3	0.0	0.0	0.0	0.1	0.1
Route 101	610	2.33yr FHWA	260	243	233.8	1.5	6.5	8.3	26	0.10	1.0	2.6	0.1	0.0	0.0	0.2	0.1
Route 101	610	10yr FIS	420	369	234.8	1.9	7.5	9.3	26	0.12	1.2	3.5	0.1	0.0	0.0	0.4	0.3
Route 101	610	50yr FIS	760	654	235.2	3.3	7.8	9.6	26	0.21	2.0	3.9	0.3	0.1	0.1	0.6	0.5
Route 101	610	100yr FIS	900	769	235.3	3.8	8.0	9.8	26	0.24	2.3	4.0	0.3	0.2	0.1	0.8	0.6
Route 101	610	100yr FHWA	1090	910	235.7	4.3	8.3	10.1	26	0.26	2.5	4.4	0.4	0.2	0.1	0.9	0.7
Route 101	610	500yr FIS	1450	1158	236.5	4.9	9.2	11.0	26	0.29	2.8	5.2	0.6	0.3	0.2	1.1	0.9
Route 101	659		Bridge														
Route 101	717	Bankfull	105	104	232.0	1.3	3.4	5.0	23	0.13	1.2	2.2	0.1	0.0	0.0	0.1	0.1
Route 101	717	2.33yr FHWA	260	223	233.9	1.8	5.3	6.9	23	0.14	1.0	2.2	0.1	0.0	0.0	0.3	0.3
Route 101	717	10yr FIS	420	324	234.9	2.2	6.4	7.9	23	0.15	1.1	3.3	0.1	0.1	0.1	0.4	0.4
Route 101	717	50yr FIS	760	556	235.5	3.5	7.0	8.5	23	0.23	1.7	3.9	0.3	0.1	0.1	0.7	0.7
Route 101	717	100yr FIS	900	645	235.8	3.9	7.2	8.8	23	0.25	1.9	4.1	0.4	0.2	0.2	0.8	0.8
Route 101	717	100yr FHWA	1090	751	236.4	4.2	7.8	9.3	23	0.26	2.0	4.7	0.4	0.2	0.2	0.9	0.9
Route 101	717	500yr FIS	1450	936	237.5	4.6	8.9	10.5	23	0.27	2.2	5.8	0.5	0.3	0.3	1.1	1.1
Route 101	1037	Bankfull	105	79	232.1	1.3	3.2	3.8	19	0.13	0.5	0.8	0.1	0.0	0.0	0.2	0.2
Route 101	1037	2.33yr FHWA	260	83	234.0	0.9	5.1	5.7	19	0.07	0.2	1.9	0.0	0.0	0.0	0.1	0.2
Route 101	1037	10yr FIS	420	100	235.1	0.9	6.1	6.8	19	0.06	0.2	2.7	0.0	0.0	0.0	0.2	0.2
Route 101	1037	50yr FIS	760	154	235.8	1.2	6.8	7.5	19	0.08	0.3	3.3	0.0	0.0	0.0	0.2	0.3
Route 101	1037	100yr FIS	900	172	236.1	1.3	7.2	7.8	19	0.09	0.4	3.6	0.0	0.0	0.0	0.3	0.3
Route 101	1037	100yr FHWA	1090	189	236.7	1.3	7.7	8.4	19	0.08	0.4	4.0	0.0	0.0	0.0	0.3	0.4
Route 101	1037	500yr FIS	1450	226	237.8	1.4	8.9	9.5	19	0.08	0.4	4.8	0.0	0.0	0.0	0.3	0.4
Route 101	1333	Bankfull	105	96	232.2	1.8	2.5	3.6	22	0.20	1.0	0.7	0.1	0.0	0.0	0.2	0.1
Route 101	1333	2.33yr FHWA	260	135	234.0	1.5	4.3	5.4	22	0.12	0.5	1.6	0.1	0.0	0.0	0.3	0.2
Route 101	1333	10yr FIS	420	168	235.1	1.5	5.4	6.4	22	0.11	0.5	2.3	0.1	0.0	0.0	0.4	0.3
Route 101	1333	50yr FIS	760	265	235.8	2.0	6.1	7.2	22	0.14	0.6	2.9	0.1	0.1	0.0	0.5	0.4
Route 101	1333	100yr FIS	900	298	236.1	2.2	6.4	7.5	22	0.15	0.7	3.1	0.1	0.1	0.0	0.6	0.4
Route 101	1333	100yr FHWA	1090	330	236.7	2.2	7.0	8.1	22	0.15	0.7	3.5	0.1	0.1	0.0	0.6	0.4
Route 101	1333	500yr FIS	1450	383	237.8	2.2	8.1	9.2	22	0.14	0.7	4.4	0.1	0.1	0.1	0.6	0.5

HEC-RAS Plan: Alternative 1 River: Pulpit Brook Reach: Route 101

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	Area
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)	(sq ft)
Route 101	222	Bankfull	230.8	230.8		0.12	0.00	365.7	5.4	48.5	51.1	0.9	338
Route 101	222	2.33yr FHWA	231.7	231.7		0.08	0.00	443.4	30.9	87.6	141.5	1.0	743
Route 101	222	10yr FIS	234.2	234.2		0.01	0.00	551.8	74.9	107.4	237.7	0.6	1967
Route 101	222	50yr FIS	235.1	235.1		0.01	0.00	568.3	139.2	182.7	438.1	0.9	2474
Route 101	222	100yr FIS	235.3	235.3		0.01	0.00	571.3	165.8	213.7	520.5	1.0	2589
Route 101	222	100yr FHWA	235.8	235.8		0.01	0.00	576.9	202.7	252.0	635.3	1.1	2848
Route 101	222	500yr FIS	236.6	236.6		0.01	0.00	588.8	272.6	321.5	855.9	1.2	3344
Route 101	447	Bankfull	230.8	230.8	223.7	0.01	0.00	58.7		105.0		0.4	275
Route 101	447	2.33yr FHWA	231.8	231.8	224.6	0.02	0.00	183.7		259.9	0.1	0.8	391
Route 101	447	10yr FIS	234.2	234.2	225.2	0.01	0.00	744.0	53.4	313.5	53.1	0.7	1539
Route 101	447	50yr FIS	235.1	235.1	226.2	0.01	0.00	825.2	125.4	464.9	169.7	0.9	2272
Route 101	447	100yr FIS	235.3	235.3	226.6	0.01	0.00	831.6	153.8	527.4	218.7	1.0	2440
Route 101	447	100yr FHWA	235.8	235.8	227.0	0.01	0.00	841.0	196.5	584.5	309.0	1.0	2819
Route 101	447	500yr FIS	236.6	236.6	227.7	0.01	0.00	848.6	284.1	668.1	497.8	1.1	3539
Route 101	481 BR D	Bankfull	231.6	230.8	230.8	0.00	0.40	9.0		105.0		7.2	15
Route 101	481 BR D	2.33yr FHWA	233.6	232.1	232.1			9.0		260.0		9.8	27
Route 101	481 BR D	10yr FIS	234.8	234.8	234.9			440.2	178.8	202.2	34.7	3.8	183
Route 101	481 BR D	50yr FIS	235.2	235.2	235.2			610.2	442.7	120.9	195.6	1.8	363
Route 101	481 BR D	100yr FIS	235.4	235.3	235.3			664.3	522.1	108.9	283.8	1.5	450
Route 101	481 BR D	100yr FHWA	235.8	235.8	235.3			762.5	572.0	85.7	419.1	1.0	775
Route 101	481 BR D	500yr FIS	236.6	236.6	235.5	0.00	0.01	798.0	465.5	277.2	707.2	2.4	1438
Route 101	481 BR U	Bankfull	231.9	231.7	229.9	0.14	0.19	9.0		105.0		3.4	31
Route 101	481 BR U	2.33yr FHWA	233.8	233.0	231.3					260.0		6.2	42
Route 101	481 BR U	10yr FIS	234.8	234.8	232.4			397.7	178.8	202.2	34.7	3.8	178
Route 101	481 BR U	50yr FIS	235.2	235.2	235.2			561.3	442.7	120.9	195.6	1.9	360
Route 101	481 BR U	100yr FIS	235.4	235.4	235.3			619.3	522.1	108.9	283.8	1.6	453
Route 101	481 BR U	100yr FHWA	235.8	235.8	235.3			698.7	572.0	85.7	419.1	1.1	726
Route 101	481 BR U	500yr FIS	236.7	236.6	235.5	0.03	0.00	768.5	414.2	208.9	826.8	2.2	1355
Route 101	512	Bankfull	231.9	231.9	228.7	0.01	0.05	147.7		105.0	0.0	0.9	205
Route 101	512	2.33yr FHWA	233.8	233.8	229.5			598.5		256.8	3.2	1.4	808
Route 101	512	10yr FIS	234.8	234.8	230.1			766.1	121.2	235.1	63.7	0.8	1511
Route 101	512	50yr FIS	235.2	235.2	230.9			791.8	227.3	379.4	153.3	1.2	1803
Route 101	512	100yr FIS	235.4	235.4	231.3			803.2	272.0	429.9	198.2	1.3	1928
Route 101	512	100yr FHWA	235.8	235.8	231.7			824.4	333.8	465.4	290.8	1.3	2264
Route 101	512	500yr FIS	236.7	236.7	232.3	0.00	0.01	865.9	445.8	508.4	495.9	1.2	3010
Route 101	544	Bankfull	232.0	231.9		0.01	0.00	332.5	35.5	66.3	3.2	1.1	264
Route 101	544	2.33yr FHWA	233.9	233.9		0.00	0.01	621.4	139.6	85.8	34.6	0.7	1207
Route 101	544	10yr FIS	234.9	234.8		0.00	0.00	761.6	217.5	103.8	98.7	0.7	1911
Route 101	544	50yr FIS	235.2	235.2		0.00	0.00	781.6	380.6	170.7	208.8	1.0	2205
Route 101	544	100yr FIS	235.4	235.4		0.00	0.00	789.7	444.6	194.8	260.6	1.1	2329
Route 101	544	100yr FHWA	235.8	235.8		0.00	0.00	812.9	520.7	216.4	352.9	1.2	2660
Route 101	544	500yr FIS	236.7	236.7		0.00	0.00	867.0	650.0	248.2	551.8	1.2	3407
Route 101	589	Bankfull	232.0	232.0		0.00	0.00	322.9	5.3	99.7		0.6	285
Route 101	589	2.33yr FHWA	233.9	233.9		0.00	0.00	552.6	94.0	160.9	5.1	0.7	1156
Route 101	589	10yr FIS	234.9	234.8		0.00	0.00	774.8	179.1	202.5	38.4	0.7	1827
Route 101	589	50yr FIS	235.2	235.2		0.00	0.00	806.0	326.0	328.0	106.0	1.1	2128
Route 101	589	100yr FIS	235.4	235.4		0.00	0.00	818.1	385.6	371.4	143.0	1.3	2256
Route 101	589	100yr FHWA	235.8	235.8		0.00	0.00	836.6	463.9	404.0	222.2	1.3	2598
Route 101	589	500yr FIS	236.7	236.7		0.00	0.00	858.3	592.4	435.1	422.5	1.3	3346
Route 101	610	Bankfull	232.0	232.0	227.3	0.00	0.00	47.1	0.2	104.7	0.1	0.9	122
Route 101	610	2.33yr FHWA	233.9	233.8	228.4	0.00	0.01	453.6	13.9	243.5	2.7	1.5	616
Route 101	610	10yr FIS	234.9	234.8	229.2	0.00	0.02	681.8	35.8	369.3	15.0	1.9	1132
Route 101	610	50yr FIS	235.3	235.2	230.4	0.00	0.07	734.5	71.8	654.4	33.8	3.3	1372
Route 101	610	100yr FIS	235.5	235.3	230.7	0.00	0.09	757.9	88.2	768.6	43.1	3.8	1474
Route 101	610	100yr FHWA	235.9	235.7	231.2	0.00	0.11	811.7	117.1	910.3	62.6	4.3	1776
Route 101	610	500yr FIS	236.8	236.5	232.1	0.00	0.15	835.1	181.5	1158.0	110.4	4.9	2477
Route 101	659 BR D	Bankfull	232.0	231.9	229.8	0.01	0.02	40.0	0.8	103.3	0.8	1.7	69
Route 101	659 BR D	2.33yr FHWA	233.9	233.8	230.8	0.01	0.03	40.0	8.9	242.3	8.9	2.4	144
Route 101	659 BR D	10yr FIS	234.9	234.8	231.6	0.01	0.05	40.0	17.0	386.0	17.0	3.2	183
Route 101	659 BR D	50yr FIS	235.5	235.1	232.6	0.03	0.14	40.0	31.7	696.5	31.7	5.4	194
Route 101	659 BR D	100yr FIS	235.7	235.1	233.0	0.04	0.19	40.0	37.9	824.1	37.9	6.3	197
Route 101	659 BR D	100yr FHWA	236.2	235.5	233.4	0.04	0.25	40.0	47.4	995.2	47.4	7.3	211
Route 101	659 BR D	500yr FIS	237.3	236.2	234.2	0.05	0.37	40.0	66.2	1317.5	66.2	8.6	240
Route 101	659 BR U	Bankfull	232.0	232.0	229.8	0.02	0.00	40.0	0.9	103.2	0.9	1.7	70
Route 101	659 BR U	2.33yr FHWA	233.9	233.8	230.8	0.02	0.00	40.0	8.9	242.2	8.9	2.4	145
Route 101	659 BR U	10yr FIS	235.0	234.8	231.6	0.02	0.00	40.0	17.1	385.9	17.1	3.1	184
Route 101	659 BR U	50yr FIS	235.5	235.1	232.6	0.07	0.00	40.0	32.0	696.0	32.0	5.4	197
Route 101	659 BR U	100yr FIS	235.8	235.3	233.0	0.09	0.01	40.0	38.4	823.2	38.4	6.2	202
Route 101	659 BR U	100yr FHWA	236.3	235.6	233.4	0.11	0.01	40.0	48.0	994.1	48.0	7.1	217
Route 101	659 BR U	500yr FIS	237.4	236.4	234.2	0.13	0.02	40.0	66.9	1316.2	66.9	8.3	249
Route 101	717	Bankfull	232.0	232.0	229.0	0.01	0.01	193.9	0.0	103.6	1.4	1.3	161
Route 101	717	2.33yr FHWA	234.0	233.9	230.0	0.01	0.01	610.6	18.5	223.3	18.2	1.8	1070
Route 101	717	10yr FIS	235.0	234.9	230.7	0.02	0.02	786.1	48.5	323.5	48.0	2.2	1808
Route 101	717	50yr FIS	235.7	235.5	231.9	0.04	0.08	807.9	102.2	556.2	101.5	3.5	2278
Route 101	717	100yr FIS	236.0	235.8	232.3	0.05	0.11	813.6	128.1	644.5	127.4	3.9	2506
Route 101	717	100yr FHWA	236.6	236.4	233.1	0.05	0.16	825.0	170.0	750.8	169.2	4.2	2960
Route 101	717	500yr FIS	237.7	237.5	234.0	0.06	0.23	853.8	257.4	936.1	256.5	4.6	3897
Route 101	1037	Bankfull	232.1	232.1		0.10	0.00	268.8	6.5	79.1	19.4	1.3	204
Route 101	1037	2.33yr FHWA	234.0	234.0		0.04	0.01	594.5	53.6	83.4	123.0	0.9	1124
Route 101	1037	10yr FIS	235.1	235.1		0.04	0.02	664.5	112.2	99.7	208.1	0.9	1794

HEC-RAS Plan: Alternative 1 River: Pulpit Brook Reach: Route 101 (Continued)

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	Area
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)	(sq ft)
Route 101	1037	50yr FIS	235.8	235.8		0.07	0.04	682.7	226.5	153.8	379.7	1.2	2281
Route 101	1037	100yr FIS	236.1	236.1		0.07	0.05	690.8	277.6	171.8	450.6	1.3	2504
Route 101	1037	100yr FHWA	236.7	236.7		0.07	0.06	722.0	355.4	189.4	545.2	1.3	2911
Route 101	1037	500yr FIS	237.8	237.8		0.06	0.06	790.5	526.8	225.8	697.5	1.4	3782

Plan: Alternative 1 Pulpit Brook Route 101 RS: 659 Profile: Bankfull

E.G. US. (ft)	232.02	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	232.00	E.G. Elev (ft)	232.00	231.99
Q Total (cfs)	105.00	W.S. Elev (ft)	231.96	231.94
Q Bridge (cfs)	105.00	Crit W.S. (ft)	229.81	229.81
Q Weir (cfs)		Max Chl Dpth (ft)	3.96	3.94
Weir Sta Lft (ft)		Vel Total (ft/s)	1.50	1.52
Weir Sta Rgt (ft)		Flow Area (sq ft)	69.84	69.04
Weir Submerg		Froude # Chl	0.15	0.15
Weir Max Depth (ft)		Specif Force (cu ft)	100.22	98.88
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	1.75	1.73
Min El Prs (ft)	238.37	W.P. Total (ft)	42.41	42.37
Delta EG (ft)	0.06	Conv. Total (cfs)	4838.5	4775.7
Delta WS (ft)	0.05	Top Width (ft)	40.00	40.00
BR Open Area (sq ft)	311.68	Frctn Loss (ft)	0.02	0.01
BR Open Vel (ft/s)	1.52	C & E Loss (ft)	0.00	0.02
Coef of Q		Shear Total (lb/sq ft)	0.05	0.05
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 1 Pulpit Brook Route 101 RS: 659 Profile: 2.33yr FHWA

E.G. US. (ft)	233.95	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	233.91	E.G. Elev (ft)	233.93	233.91
Q Total (cfs)	260.00	W.S. Elev (ft)	233.84	233.82
Q Bridge (cfs)	260.00	Crit W.S. (ft)	230.77	230.77
Q Weir (cfs)		Max Chl Dpth (ft)	5.84	5.82
Weir Sta Lft (ft)		Vel Total (ft/s)	1.79	1.80
Weir Sta Rgt (ft)		Flow Area (sq ft)	145.18	144.44
Weir Submerg		Froude # Chl	0.17	0.17
Weir Max Depth (ft)		Specif Force (cu ft)	315.41	312.80
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	3.63	3.61
Min El Prs (ft)	238.37	W.P. Total (ft)	46.18	46.14
Delta EG (ft)	0.08	Conv. Total (cfs)	12284.1	12197.2
Delta WS (ft)	0.06	Top Width (ft)	40.00	40.00
BR Open Area (sq ft)	311.68	Frctn Loss (ft)	0.02	0.01
BR Open Vel (ft/s)	1.80	C & E Loss (ft)	0.00	0.03
Coef of Q		Shear Total (lb/sq ft)	0.09	0.09
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 1 Pulpit Brook Route 101 RS: 659 Profile: 10yr FIS

E.G. US. (ft)	235.00	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	234.94	E.G. Elev (ft)	234.96	234.93
Q Total (cfs)	420.00	W.S. Elev (ft)	234.82	234.79
Q Bridge (cfs)	420.00	Crit W.S. (ft)	231.55	231.55
Q Weir (cfs)		Max Chl Dpth (ft)	6.82	6.79
Weir Sta Lft (ft)		Vel Total (ft/s)	2.28	2.29
Weir Sta Rgt (ft)		Flow Area (sq ft)	184.13	183.10
Weir Submerg		Froude # Chl	0.20	0.21

Plan: Alternative 1 Pulpit Brook Route 101 RS: 659 Profile: 10yr FIS (Continued)

Weir Max Depth (ft)		Specif Force (cu ft)	495.81	491.27
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	4.60	4.58
Min El Prs (ft)	238.37	W.P. Total (ft)	48.13	48.07
Delta EG (ft)	0.12	Conv. Total (cfs)	17150.7	17013.6
Delta WS (ft)	0.11	Top Width (ft)	40.00	40.00
BR Open Area (sq ft)	311.68	Frctn Loss (ft)	0.02	0.01
BR Open Vel (ft/s)	2.29	C & E Loss (ft)	0.00	0.05
Coef of Q		Shear Total (lb/sq ft)	0.14	0.14
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 1 Pulpit Brook Route 101 RS: 659 Profile: 50yr FIS

E.G. US. (ft)	235.67	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	235.53	E.G. Elev (ft)	235.55	235.48
Q Total (cfs)	760.00	W.S. Elev (ft)	235.14	235.05
Q Bridge (cfs)	760.00	Crit W.S. (ft)	232.60	232.60
Q Weir (cfs)		Max Chl Dpth (ft)	7.14	7.05
Weir Sta Lft (ft)		Vel Total (ft/s)	3.86	3.93
Weir Sta Rgt (ft)		Flow Area (sq ft)	196.91	193.59
Weir Submerg		Froude # Chl	0.34	0.35
Weir Max Depth (ft)		Specif Force (cu ft)	636.38	622.01
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	4.92	4.84
Min El Prs (ft)	238.37	W.P. Total (ft)	48.77	48.60
Delta EG (ft)	0.36	Conv. Total (cfs)	18881.7	18425.6
Delta WS (ft)	0.37	Top Width (ft)	40.00	40.00
BR Open Area (sq ft)	311.68	Frctn Loss (ft)	0.07	0.03
BR Open Vel (ft/s)	3.93	C & E Loss (ft)	0.00	0.14
Coef of Q		Shear Total (lb/sq ft)	0.41	0.42
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 1 Pulpit Brook Route 101 RS: 659 Profile: 100yr FIS

E.G. US. (ft)	235.98	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	235.81	E.G. Elev (ft)	235.82	235.72
Q Total (cfs)	900.00	W.S. Elev (ft)	235.27	235.15
Q Bridge (cfs)	900.00	Crit W.S. (ft)	232.96	232.96
Q Weir (cfs)		Max Chl Dpth (ft)	7.26	7.15
Weir Sta Lft (ft)		Vel Total (ft/s)	4.45	4.56
Weir Sta Rgt (ft)		Flow Area (sq ft)	202.08	197.33
Weir Submerg		Froude # Chl	0.39	0.40
Weir Max Depth (ft)		Specif Force (cu ft)	705.74	685.60
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	5.05	4.93
Min El Prs (ft)	238.37	W.P. Total (ft)	49.02	48.79
Delta EG (ft)	0.49	Conv. Total (cfs)	19599.5	18939.7
Delta WS (ft)	0.51	Top Width (ft)	40.00	40.00
BR Open Area (sq ft)	311.68	Frctn Loss (ft)	0.09	0.04
BR Open Vel (ft/s)	4.56	C & E Loss (ft)	0.01	0.19
Coef of Q		Shear Total (lb/sq ft)	0.54	0.57

Plan: Alternative 1 Pulpit Brook Route 101 RS: 659 Profile: 100yr FIS (Continued)

Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 1 Pulpit Brook Route 101 RS: 659 Profile: 100yr FHWA

E.G. US. (ft)	236.56	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	236.36	E.G. Elev (ft)	236.34	236.23
Q Total (cfs)	1090.00	W.S. Elev (ft)	235.63	235.48
Q Bridge (cfs)	1090.00	Crit W.S. (ft)	233.41	233.40
Q Weir (cfs)		Max Chl Dpth (ft)	7.63	7.48
Weir Sta Lft (ft)		Vel Total (ft/s)	5.03	5.17
Weir Sta Rgt (ft)		Flow Area (sq ft)	216.84	210.63
Weir Submerg		Froude # Chl	0.43	0.45
Weir Max Depth (ft)		Specif Force (cu ft)	843.59	816.43
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	5.42	5.27
Min El Prs (ft)	238.37	W.P. Total (ft)	49.76	49.45
Delta EG (ft)	0.63	Conv. Total (cfs)	21704.8	20809.4
Delta WS (ft)	0.68	Top Width (ft)	40.00	40.00
BR Open Area (sq ft)	311.68	Frctn Loss (ft)	0.11	0.04
BR Open Vel (ft/s)	5.17	C & E Loss (ft)	0.01	0.25
Coef of Q		Shear Total (lb/sq ft)	0.69	0.73
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 1 Pulpit Brook Route 101 RS: 659 Profile: 500yr FIS

E.G. US. (ft)	237.70	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	237.48	E.G. Elev (ft)	237.41	237.26
Q Total (cfs)	1450.00	W.S. Elev (ft)	236.43	236.22
Q Bridge (cfs)	1450.00	Crit W.S. (ft)	234.17	234.17
Q Weir (cfs)		Max Chl Dpth (ft)	8.43	8.22
Weir Sta Lft (ft)		Vel Total (ft/s)	5.83	6.03
Weir Sta Rgt (ft)		Flow Area (sq ft)	248.64	240.37
Weir Submerg		Froude # Chl	0.48	0.50
Weir Max Depth (ft)		Specif Force (cu ft)	1153.12	1113.51
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	6.22	6.01
Min El Prs (ft)	238.37	W.P. Total (ft)	51.35	50.94
Delta EG (ft)	0.85	Conv. Total (cfs)	26513.2	25227.4
Delta WS (ft)	0.95	Top Width (ft)	40.00	40.00
BR Open Area (sq ft)	311.68	Frctn Loss (ft)	0.13	0.05
BR Open Vel (ft/s)	6.03	C & E Loss (ft)	0.02	0.37
Coef of Q		Shear Total (lb/sq ft)	0.90	0.97
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

cHECk-RAS Report

HEC-RAS Project: *pulpit101.prj*
Plan File: *pulpit101.p02*
Geometry File: *pulpit101.g02*
Flow File: *pulpit101.f01*
Report Date: *9/20/2017*

Alternative 1 Model

Message ID	Message	Cross sections affected	Comments
BR LF 01	This is ($strucname$). The selected profile is $profilename$. Type of flow is low flow because, 1. EGEL 3 of $egel3$ is less than or equal to MinTopRd of $minelweirflow$. 2. EGEL 3 of $egel3$ is less than MxLoCdU of $mxlocdu$.	659(Bridge-UP)	
BR PF 01	This is a Bridge Section. The selected profile is $profilename$. Type of flow is sluice gate pressure flow because, 1. EGEL 3 of $egel3$ is less than or equal to MinTopRd of $minelweirflow$. 2. EGEL 3 of $egel3$ is greater than or equal to MxLoCdU of $mxlocdu$. 3. WSEL 2 of $wsel2$ is less than MxLoCdD of $mxlocdd$.	481(Bridge-UP)	
BR PF 04	This is a Bridge Section. Input BrSelMthd is Press/Weir. The highest flood frequency profile is $profilename$. Type of flow is sluice gate pressure flow only. However, the highest flood frequency CritWS of $critws$at BR U is less than or equal to the WSEL of $wsel$ at BR U. Energy should be selected as the High Flow Method.	481(Bridge-UP)	
BR PW 02	This is a Bridge Section. The selected profile is $profilename$. Type of flow is submerged pressure and weir flow because, 1. EGEL 3 of $egel3$ is greater than MinTopRd of $minelweirflow$. 2. EGEL 3 of $egel3$ is equal to or greater than MxLoCdU of $mxlocdu$. 3. WSEL 2 of $wsel2$ is equal to or greater than MxLoCdD of $mxlocdd$.	481(Bridge-UP)	
MP SW 01DD	The name of the stream is ($streamname$). The flow regime is subcritical or mixed flow. The downstream starting water-surface elevation, SWSEL, is computed from different methods. SWSEL of the 50 %-annual-chance flood is computed from SW_Method. SWSEL of the 10 %-annual-chance flood is computed from SW_Method. SWSEL of the 4 %-annual-chance flood is computed from SW_Method. SWSEL of the 2 %-annual-chance flood is computed from SW_Method. SWSEL of the 1%-annual-chance flood is computed from SW_Method. SWSEL of the 0.2%-annual-chance flood is computed from SW_Method. The same method should be used for all the profiles.		

ST DT 03	This is ($Structure$) section. The Contraction Length is longer than the Expansion Length. Section 4 channel distance of $Length_Chnl4$ is longer than Section 2 channel distance of $Length_Chnl2$. Section 4 and Section 1 should be relocated. The HEC-RAS geometry file may need to be recreated using a GIS program.	659(Bridge-UP)	
XS DC 02	Constant discharge used for the entire profile for $assignedname$ flood. At least two discharges should be selected; one at the mouth and the other at the middle of the watershed or above the confluence of a tributary. Or provide explanation why only one discharge should be used. Other flood frequencies should also be checked.		

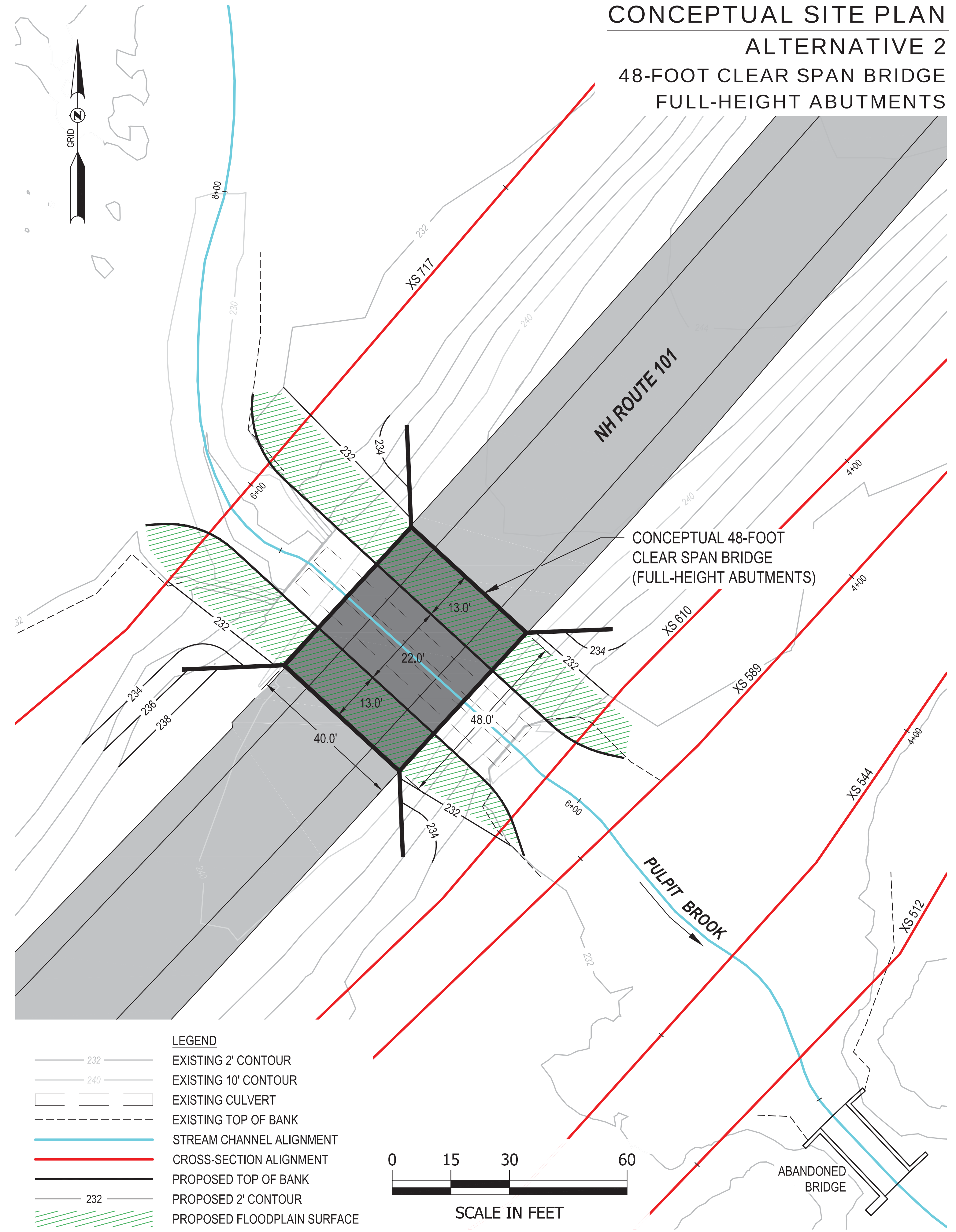
Alternative 2 Hydraulics

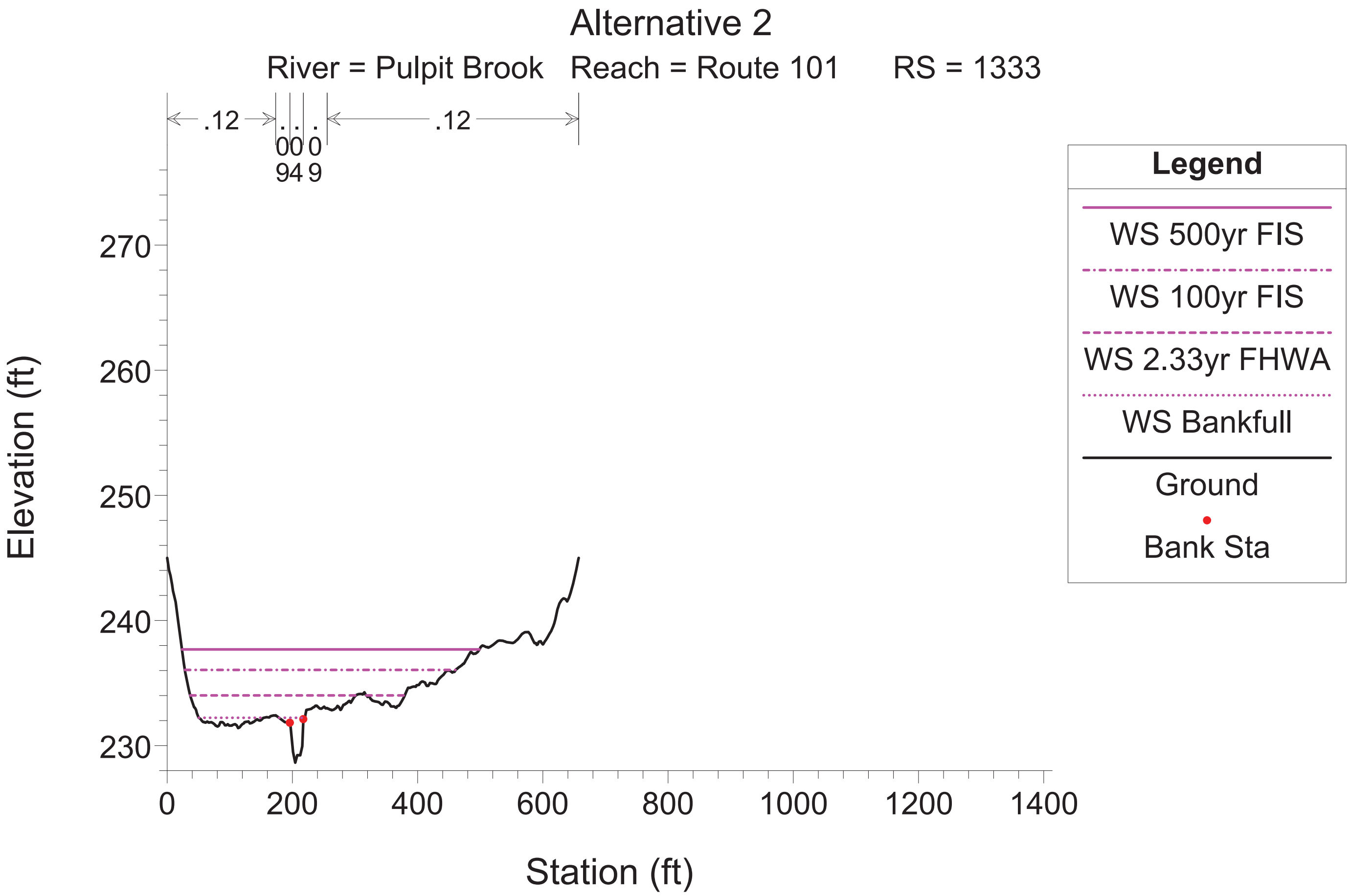
(Conceptual 48-Foot Clear Span Bridge with Full-Height Abutments)

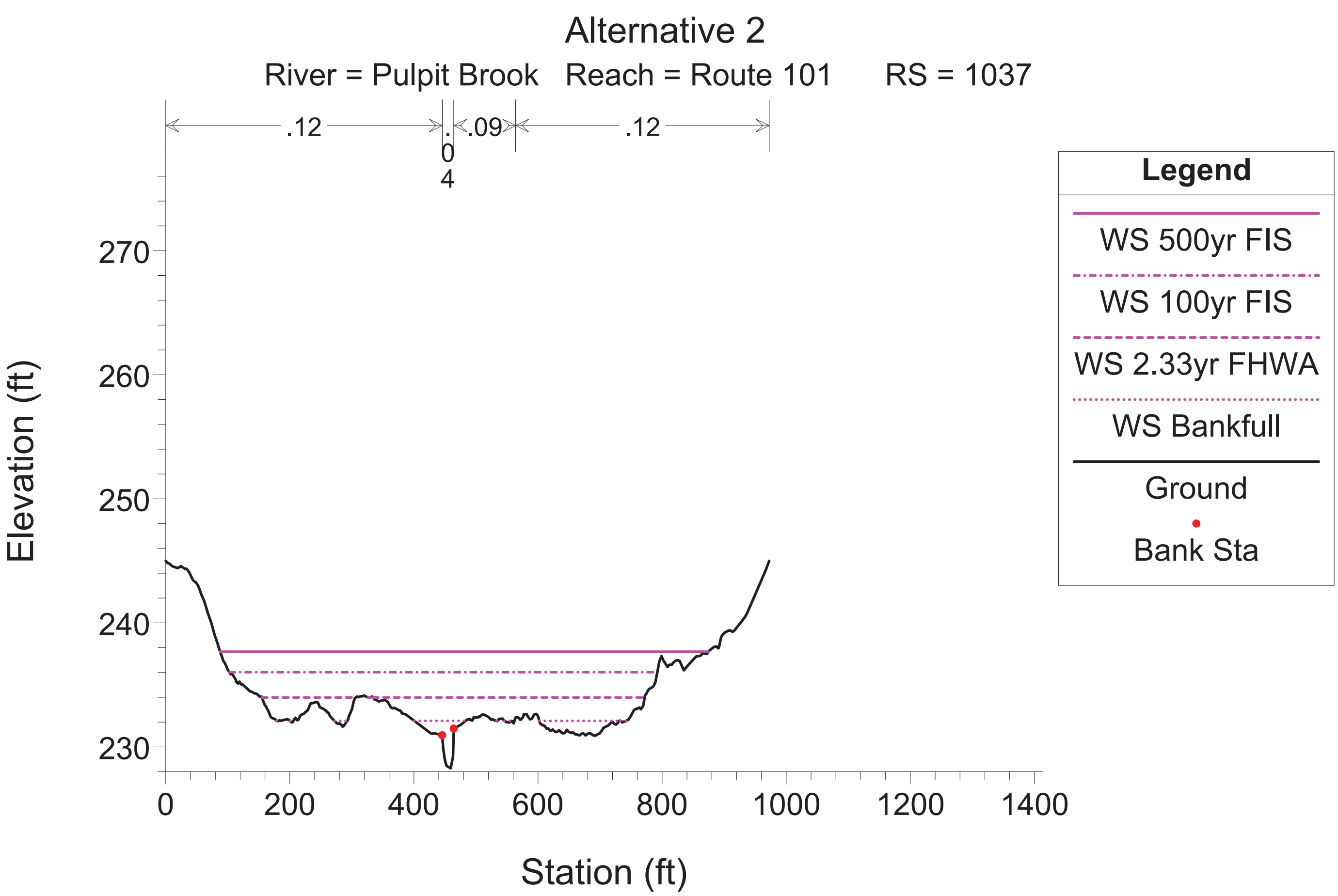
CONCEPTUAL SITE PLAN

ALTERNATIVE 2

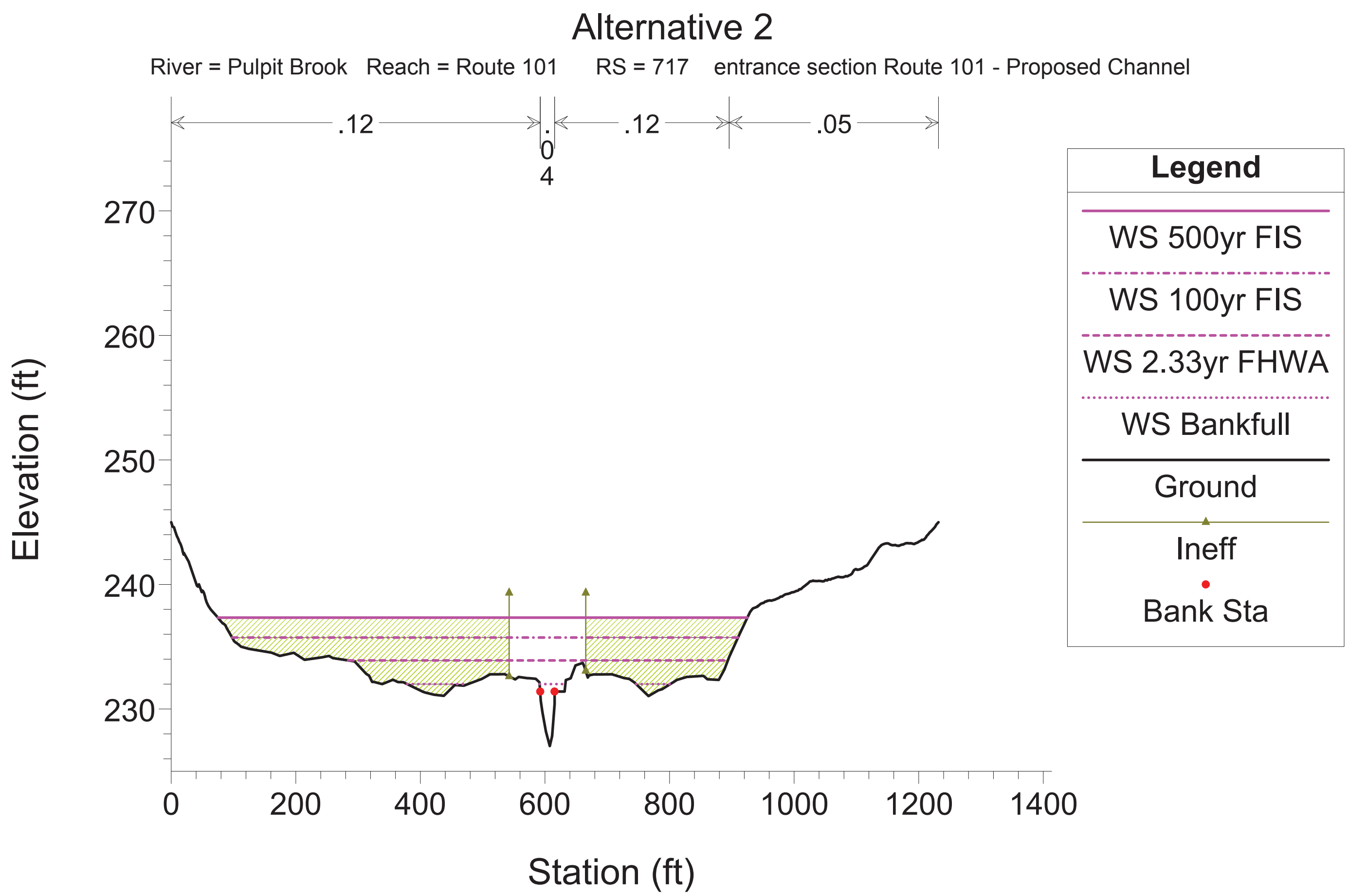
48-FOOT CLEAR SPAN BRIDGE
FULL-HEIGHT ABUTMENTS

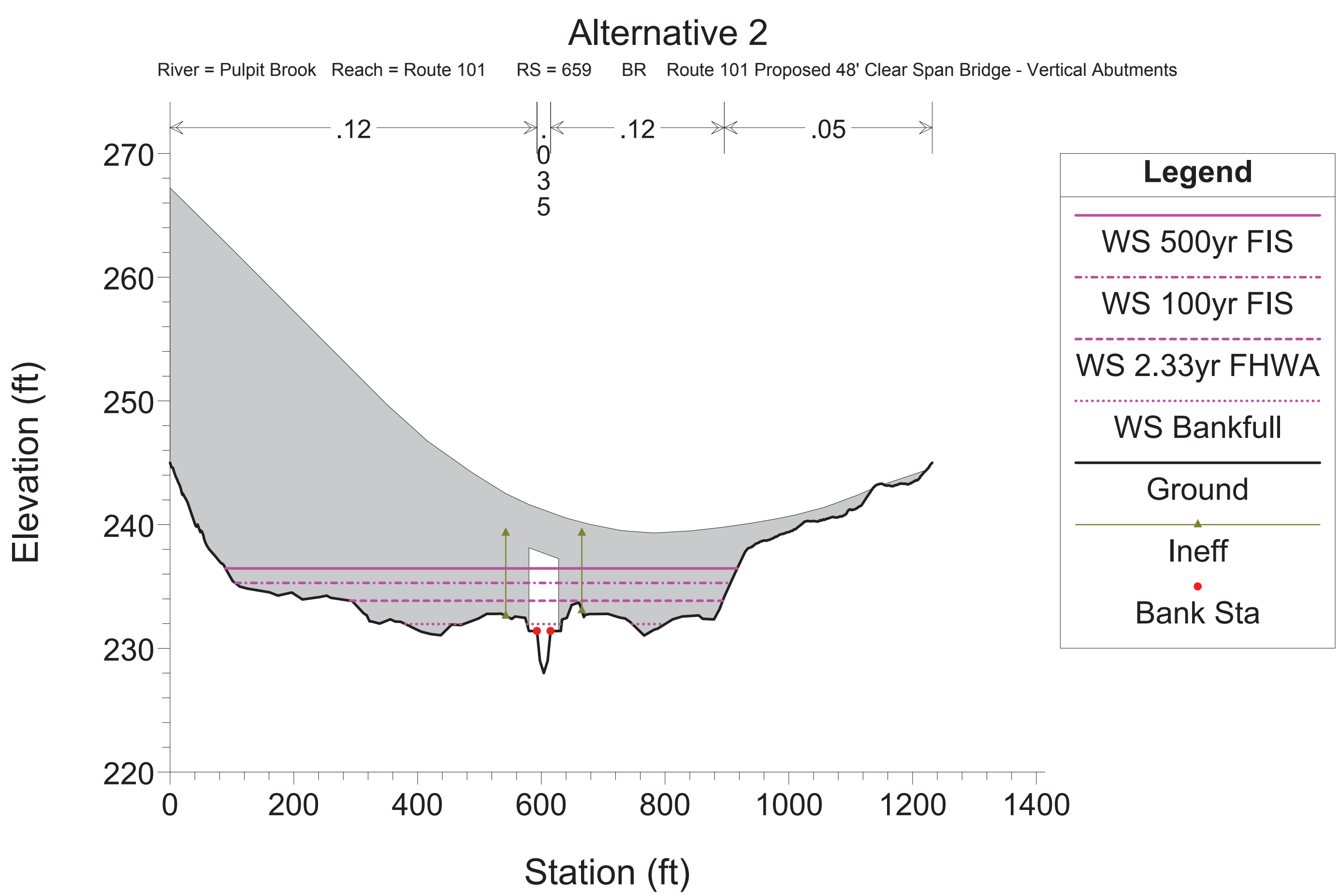






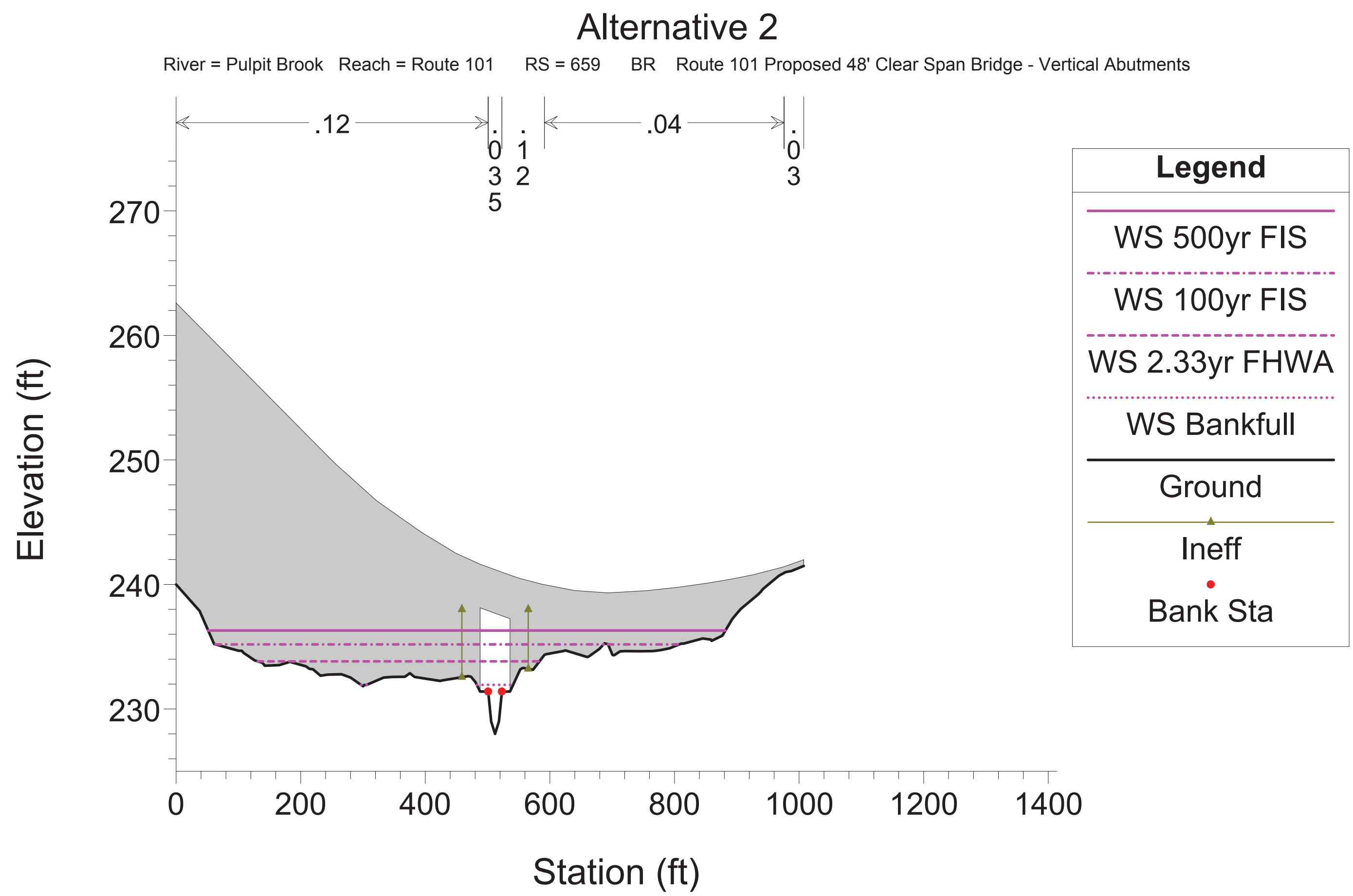
1 in Horiz. = 300 ft 1 in Vert. = 15 ft

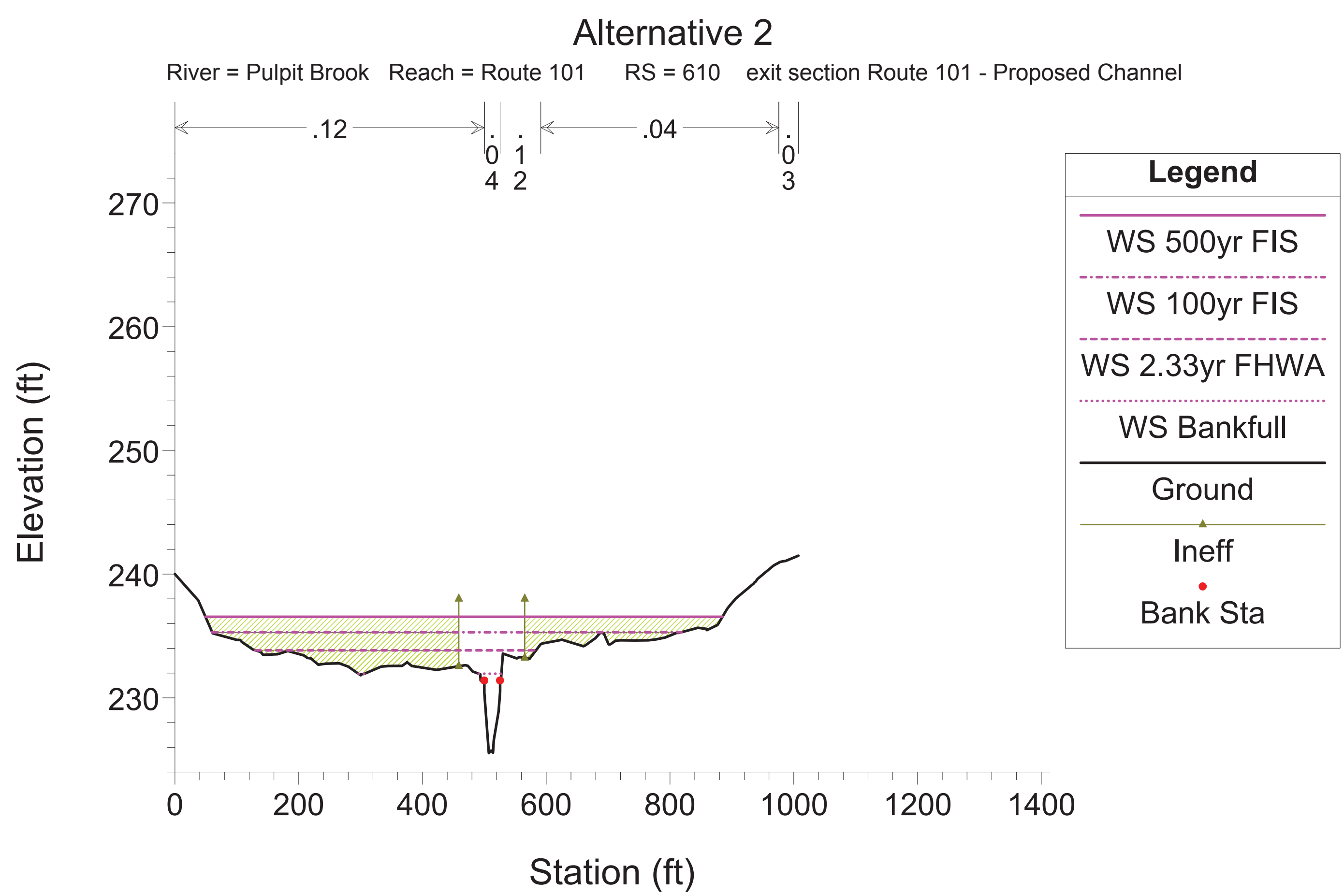




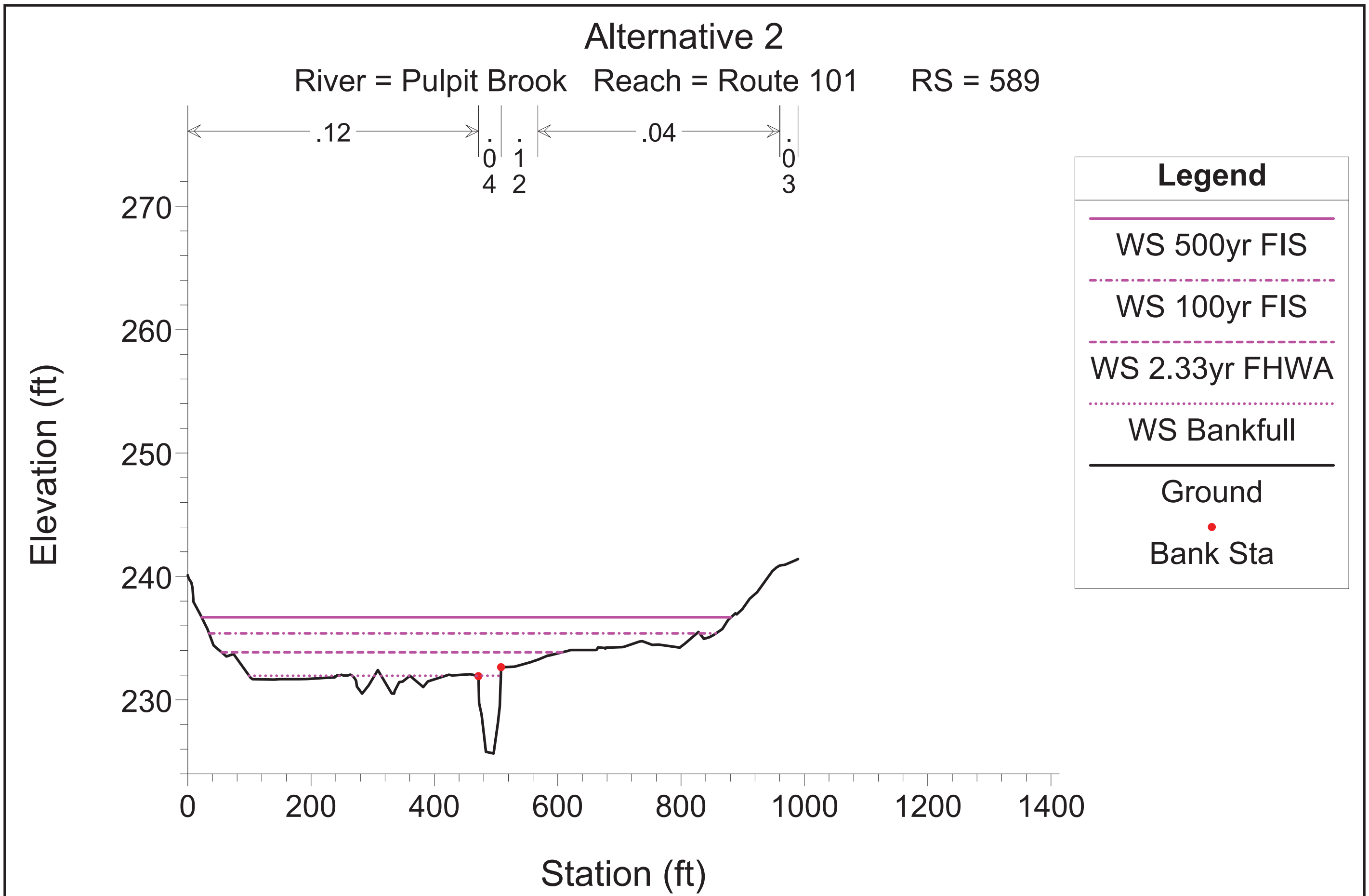
1 in Horiz. = 300 ft   1 in Vert. = 15 ft

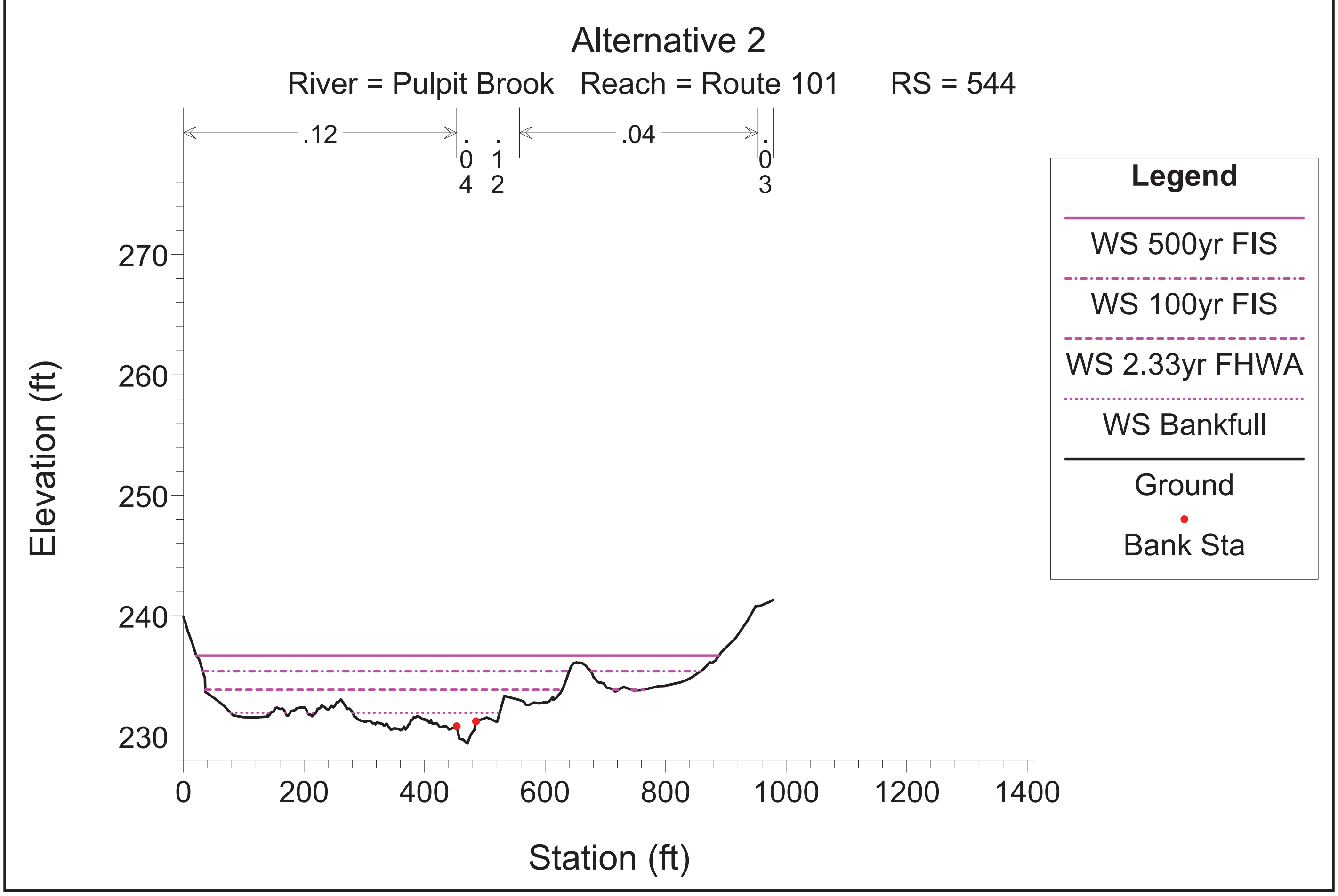
Alternative 2



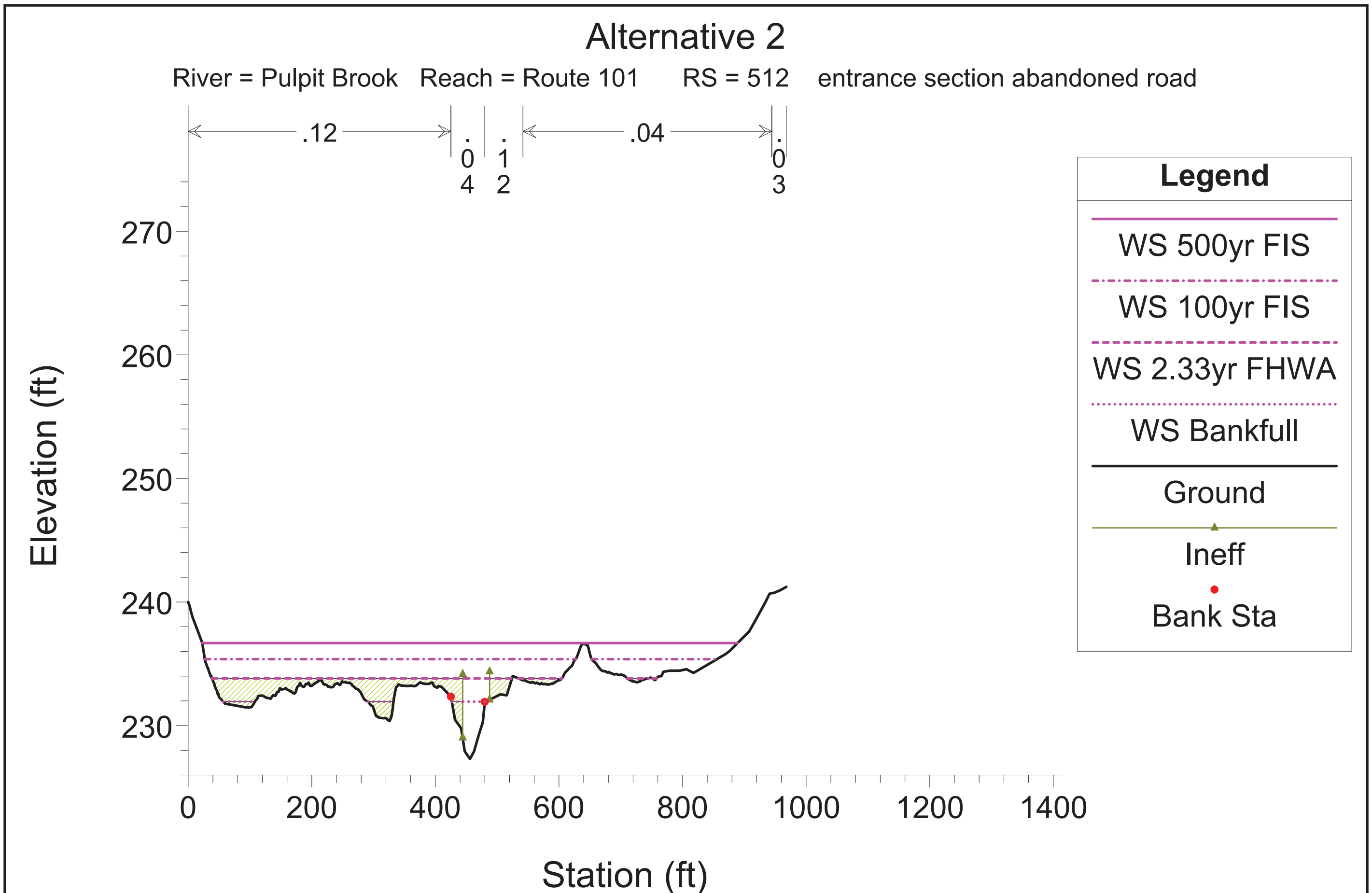


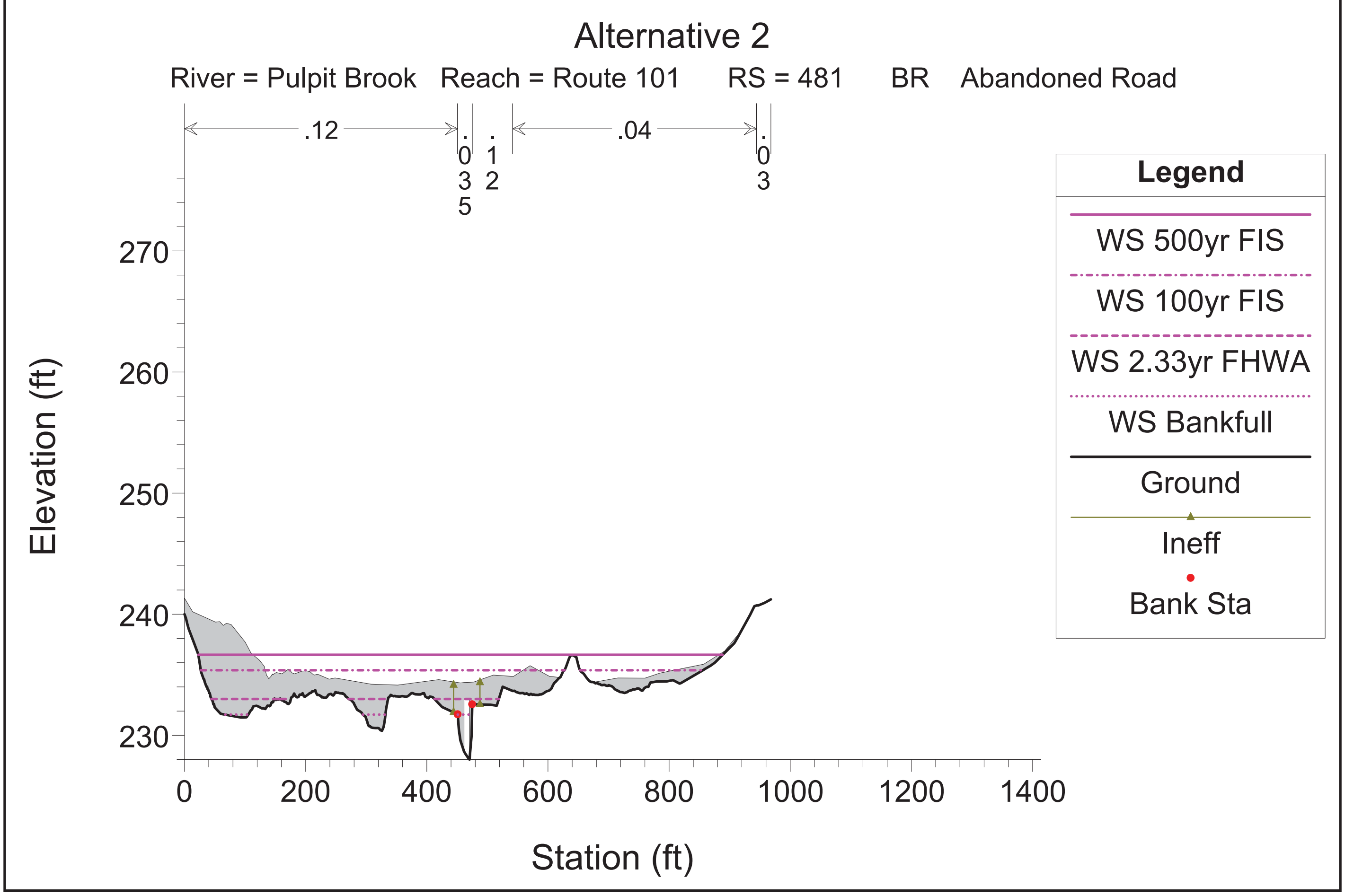
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



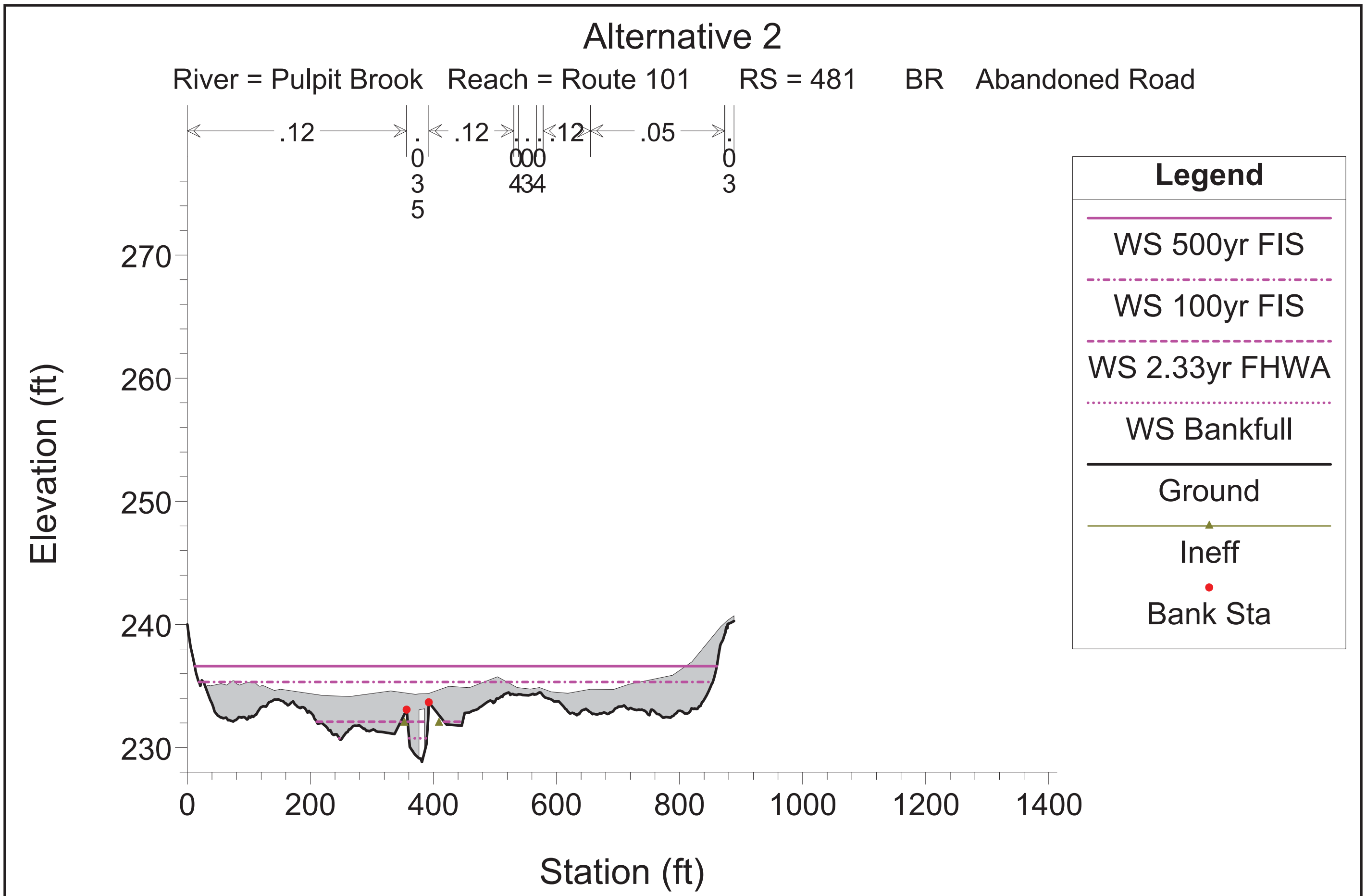


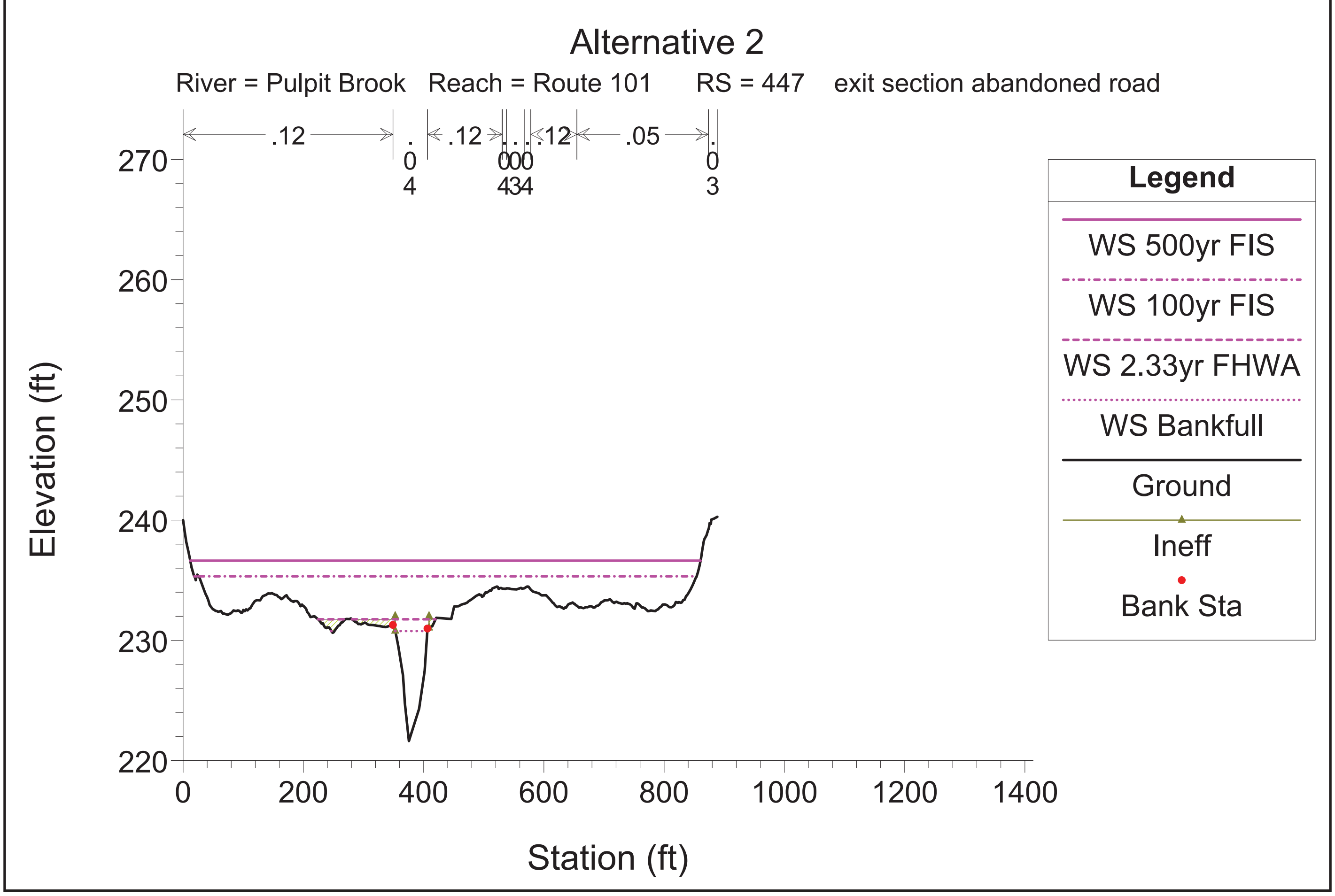
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



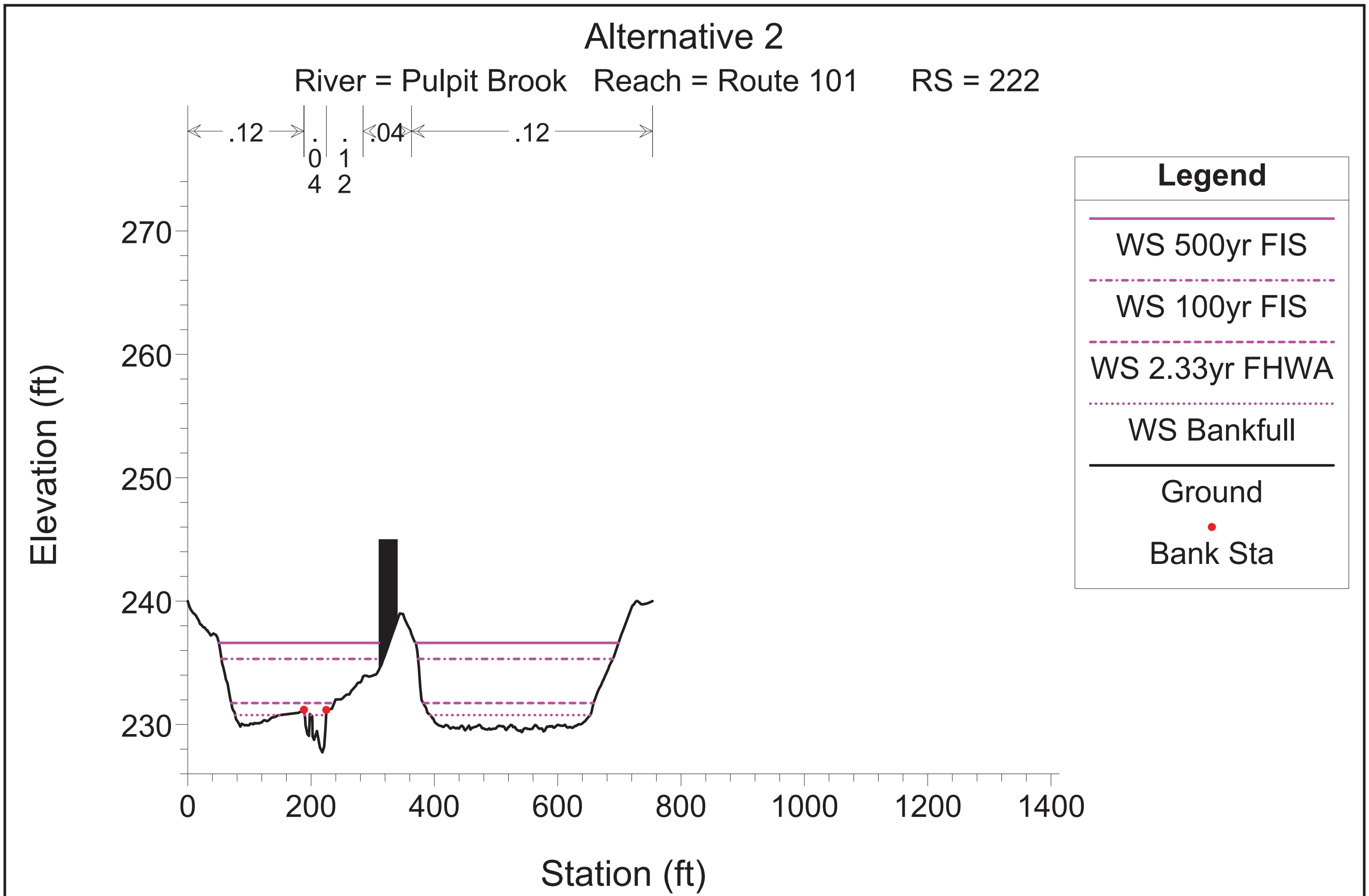


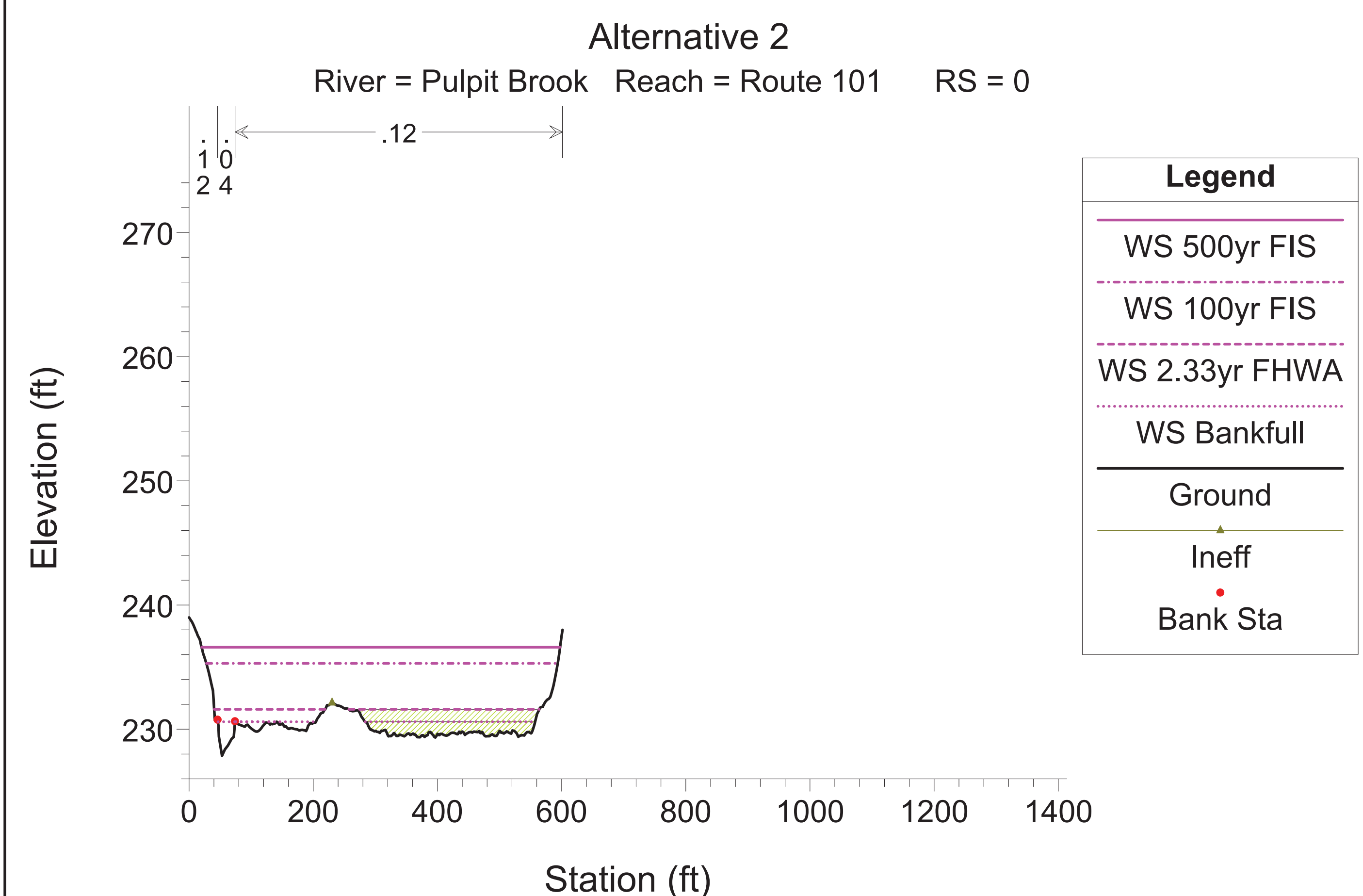
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



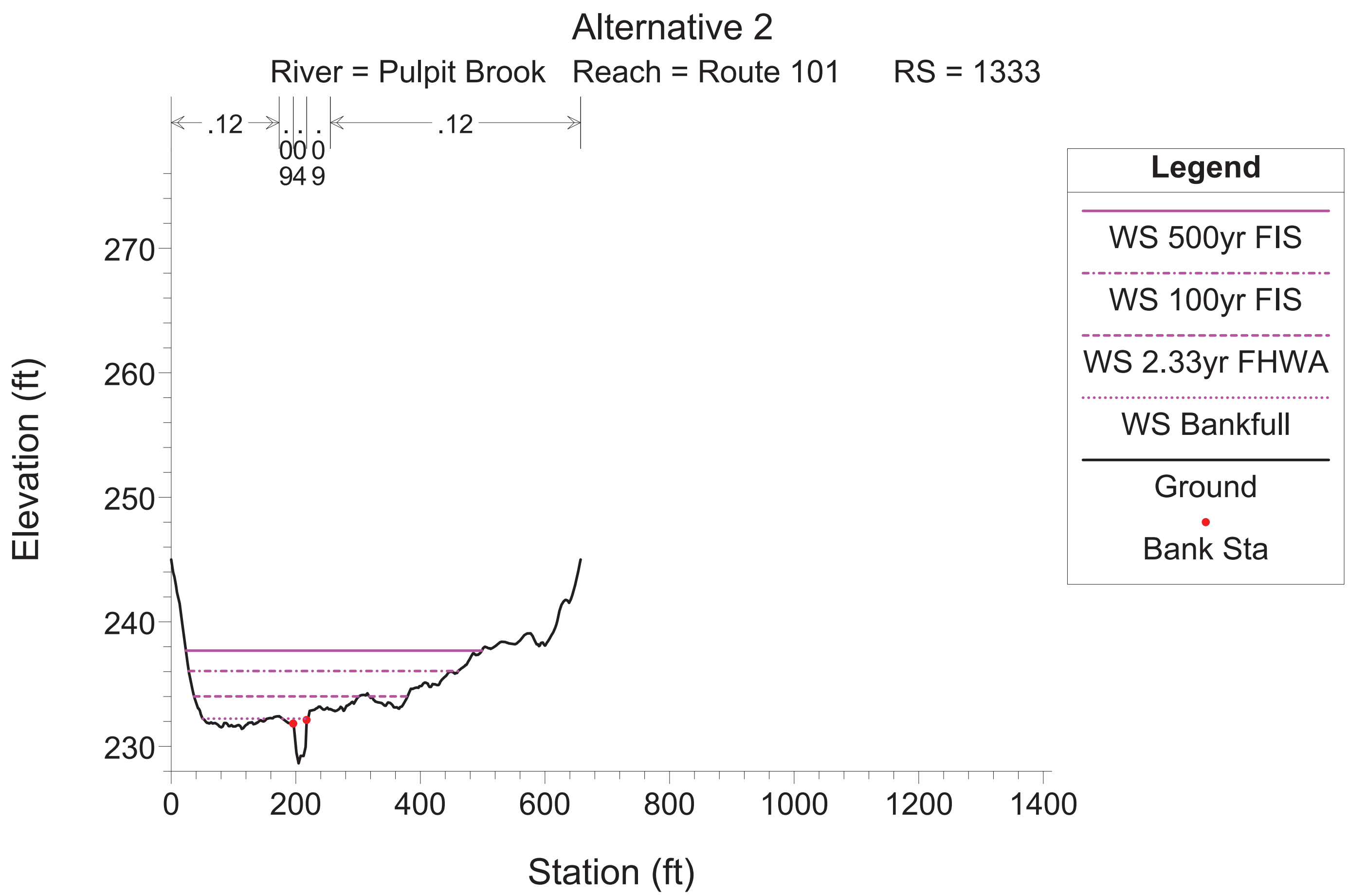


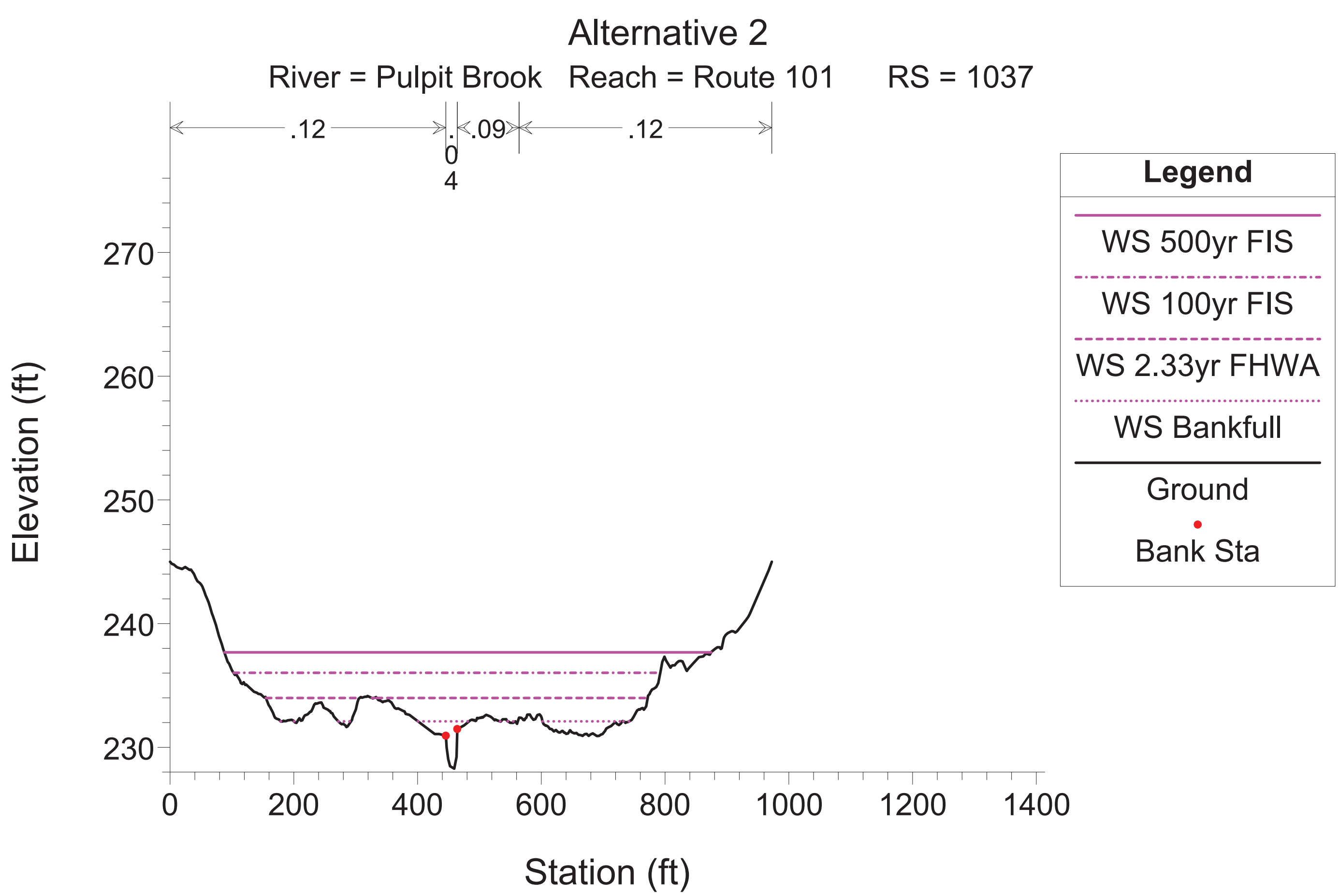
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



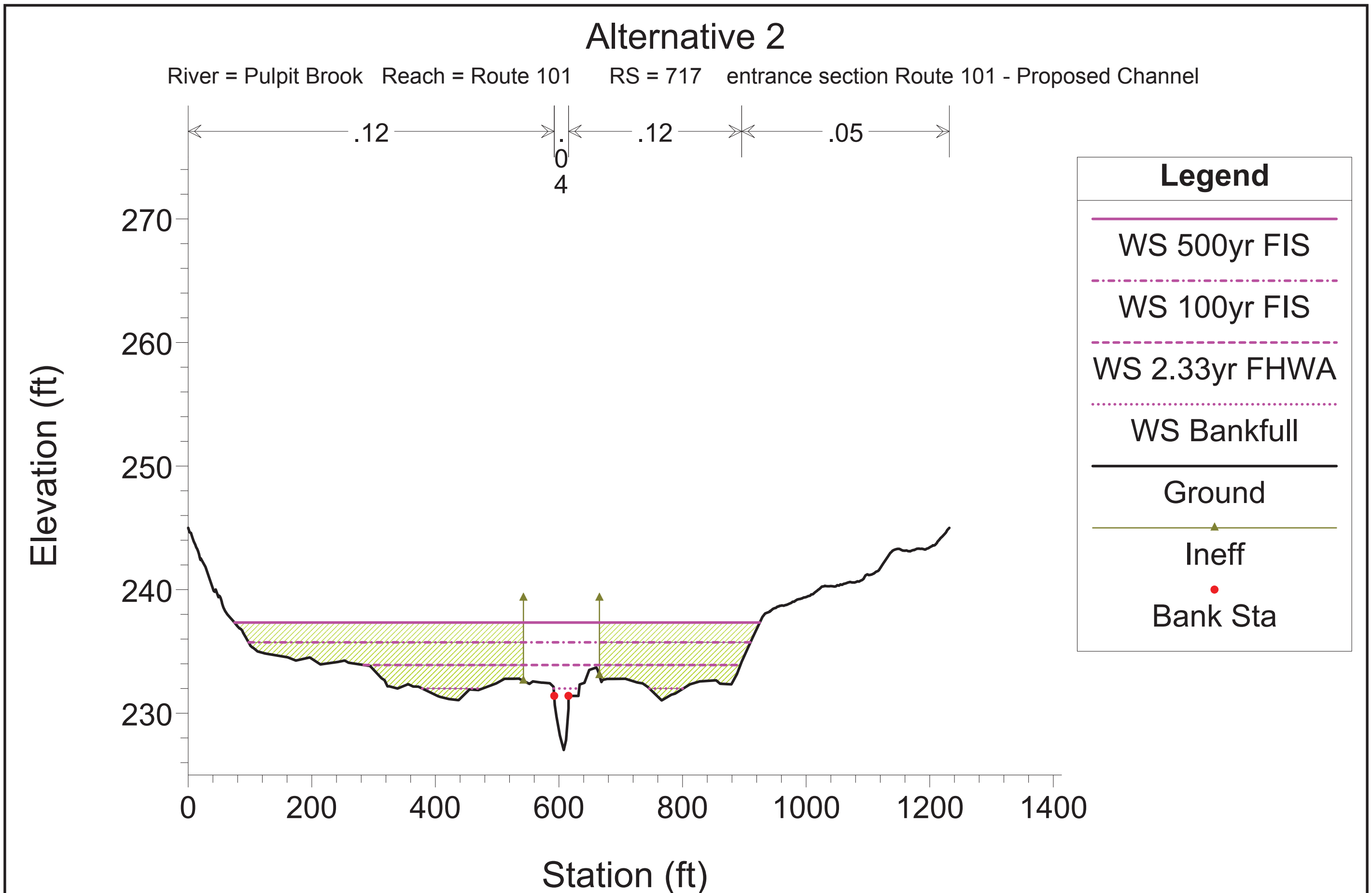


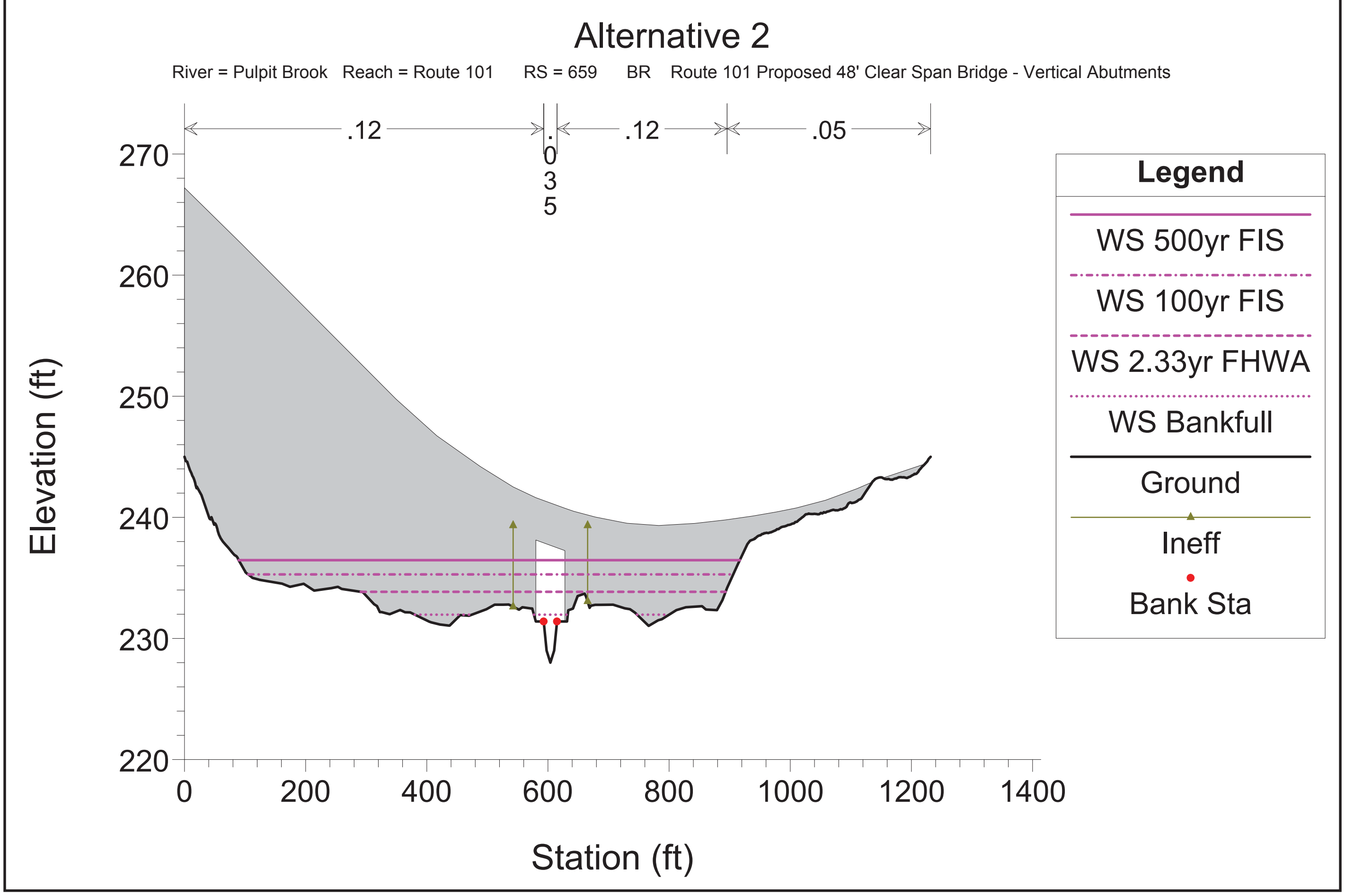
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



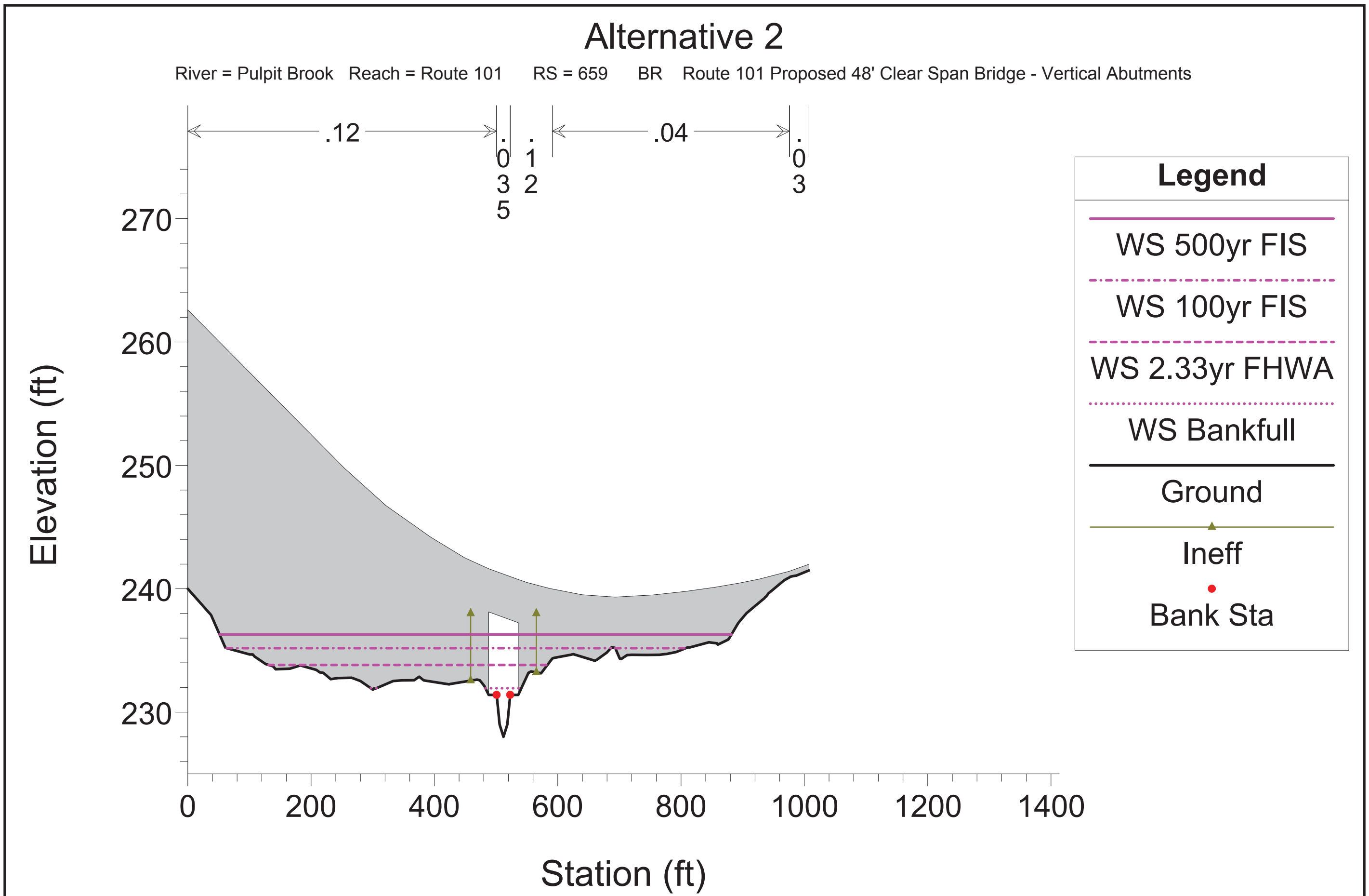


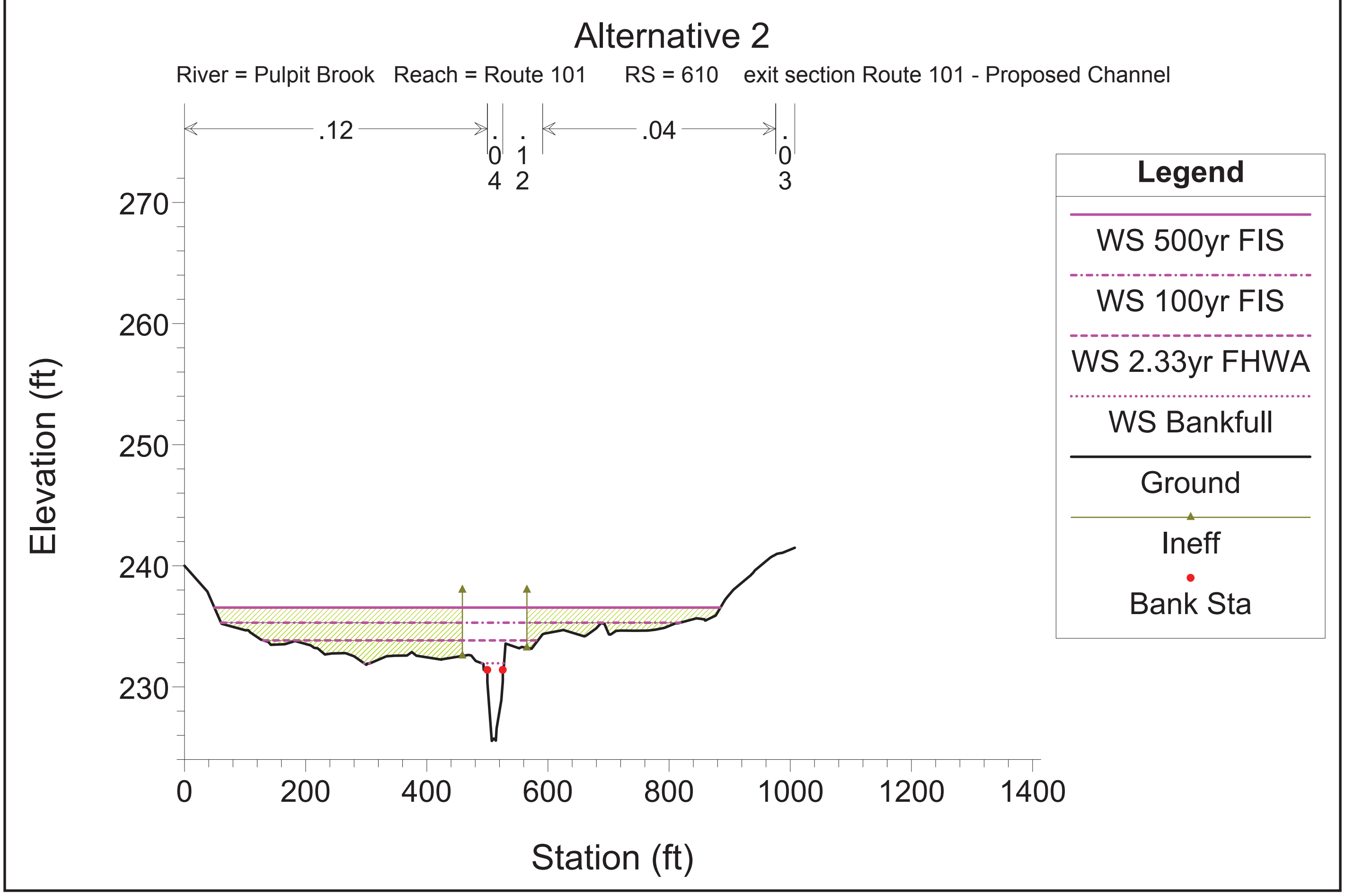
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



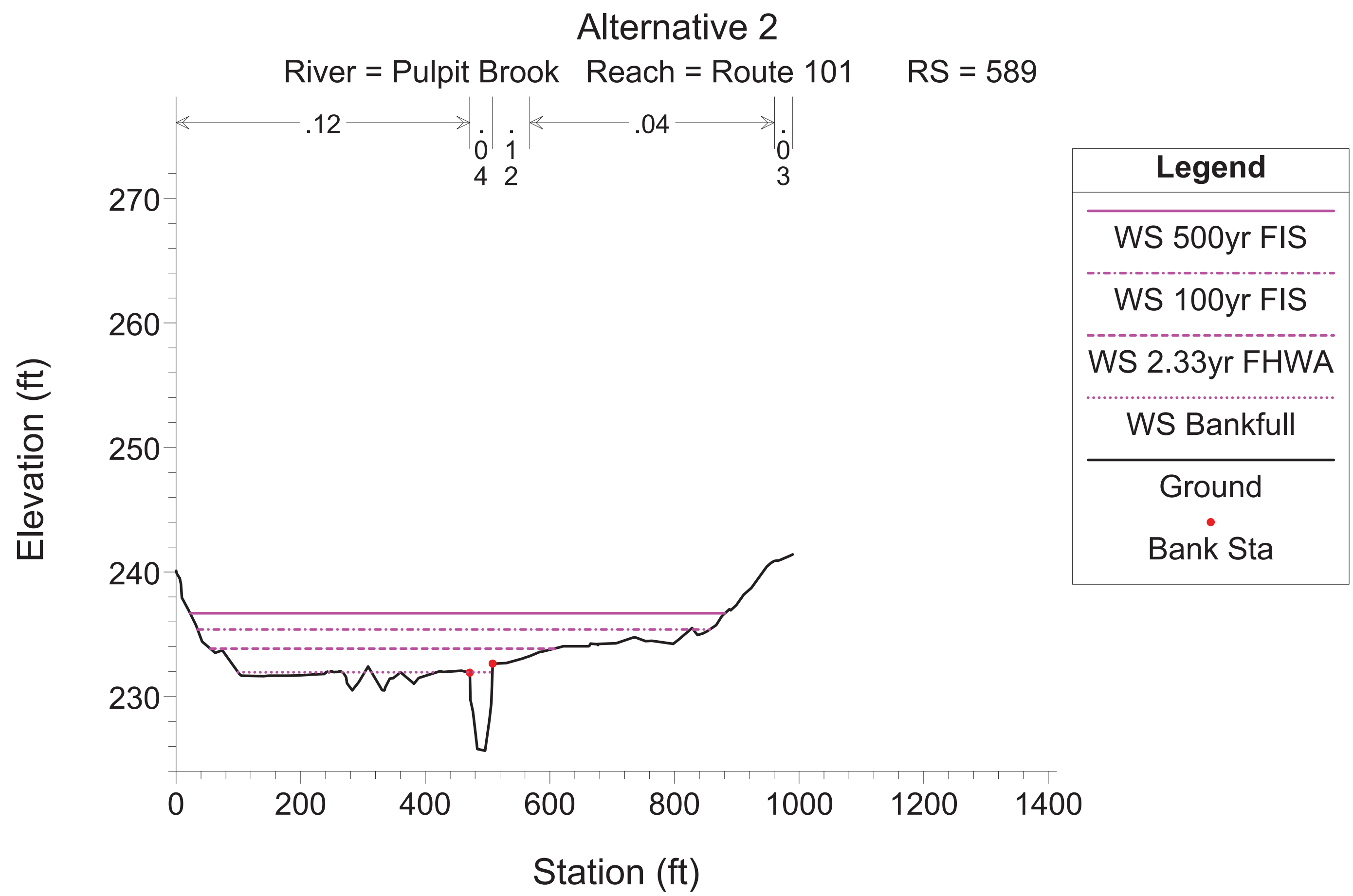


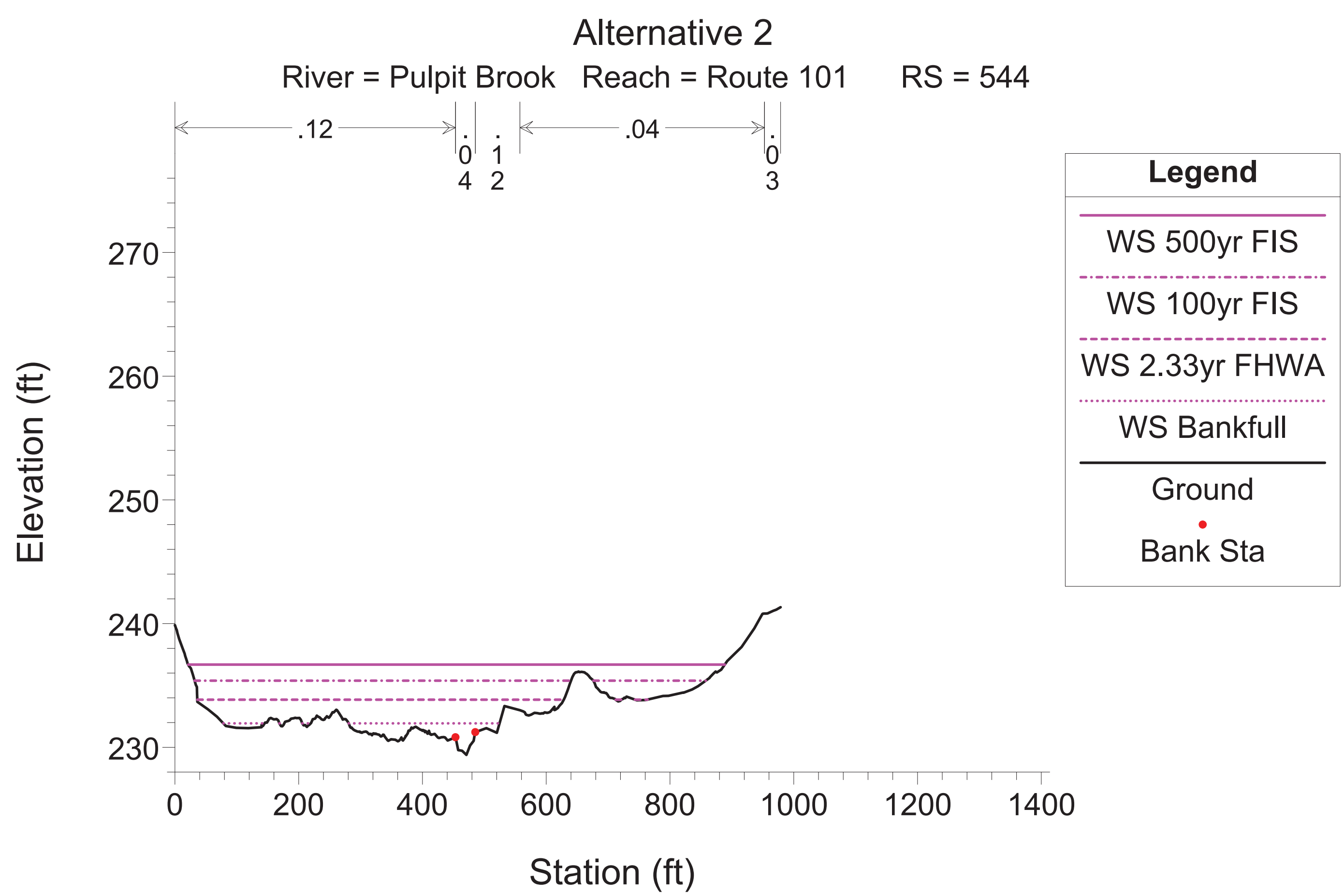
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



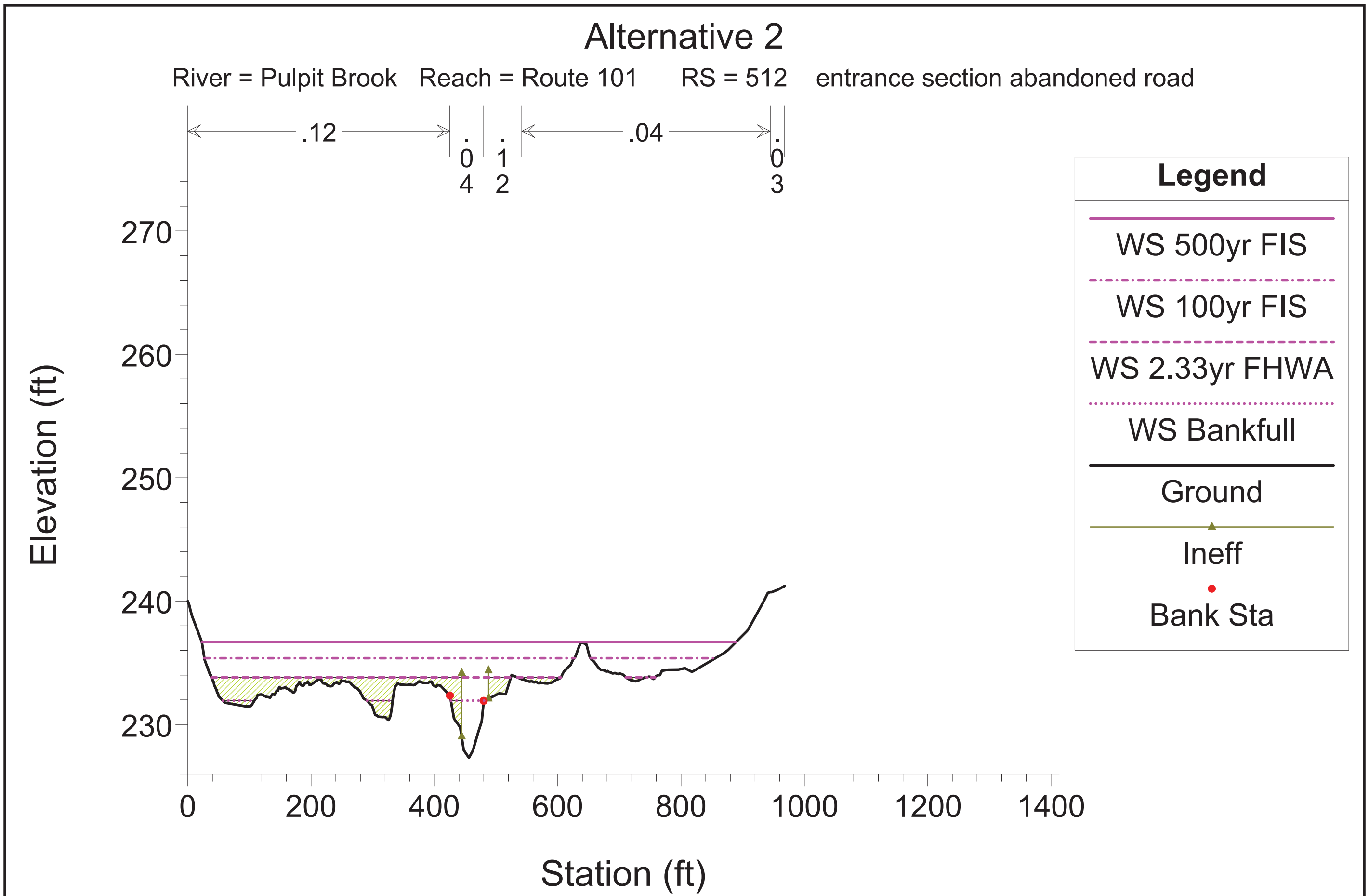


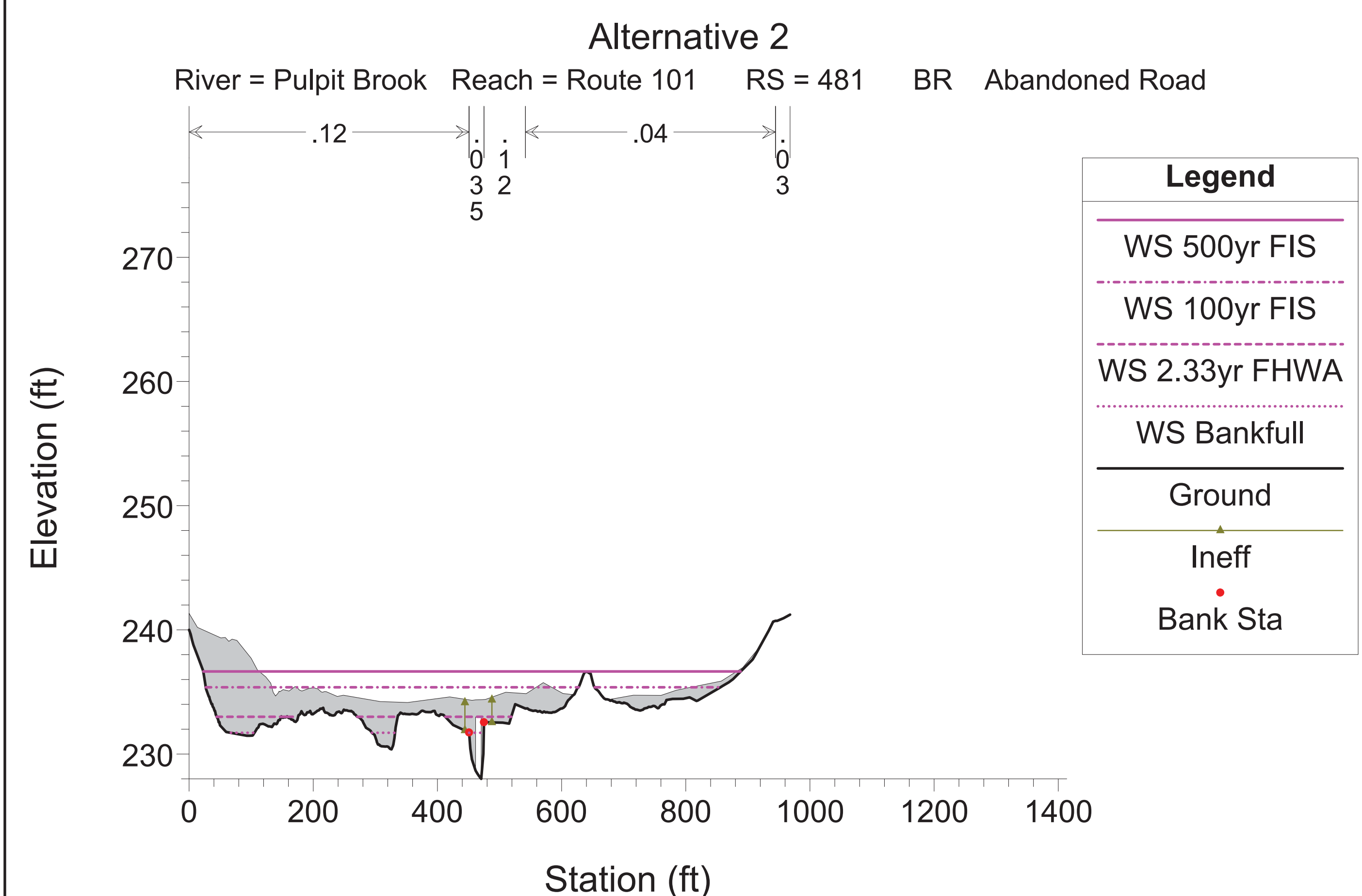
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



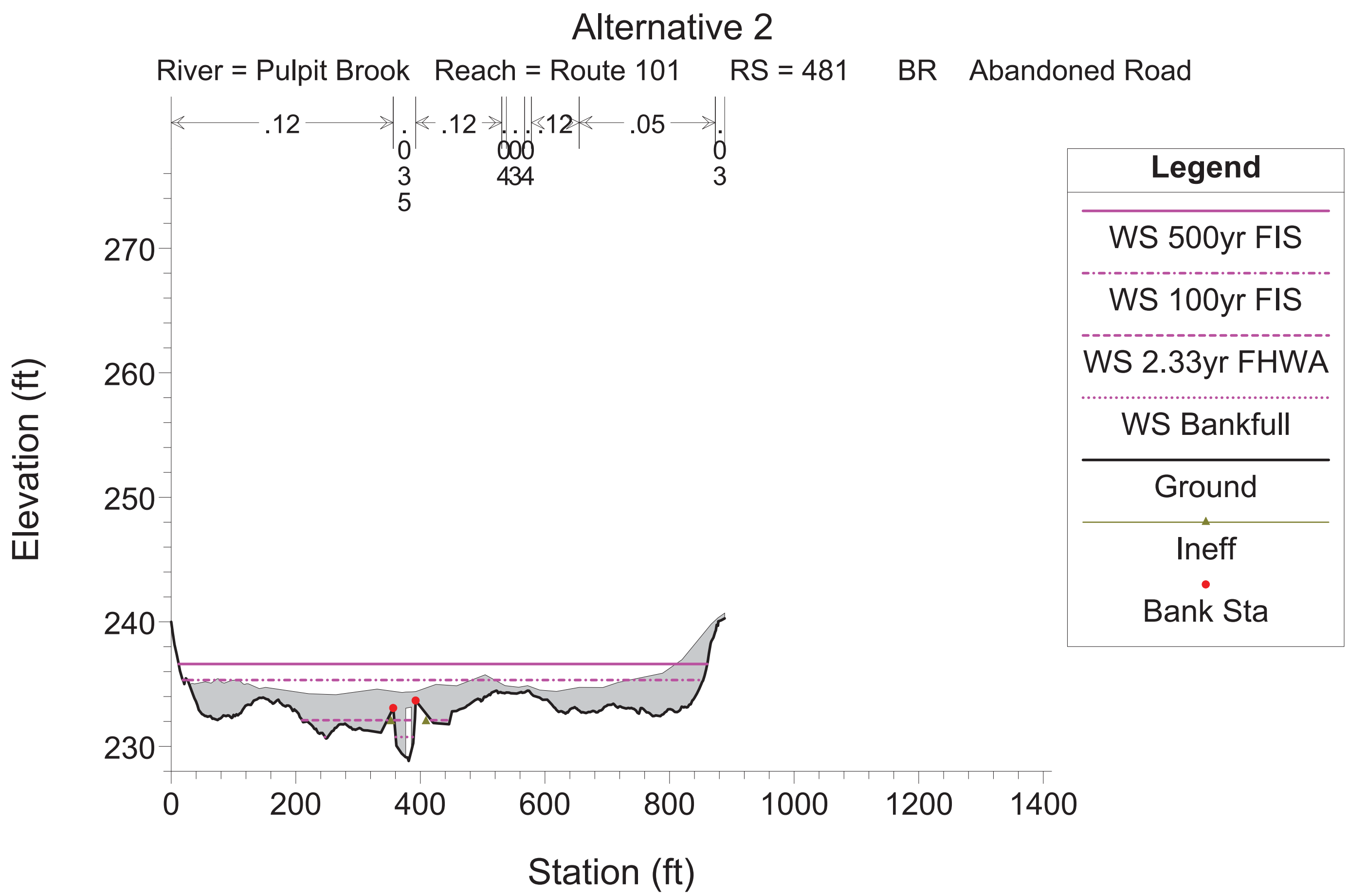


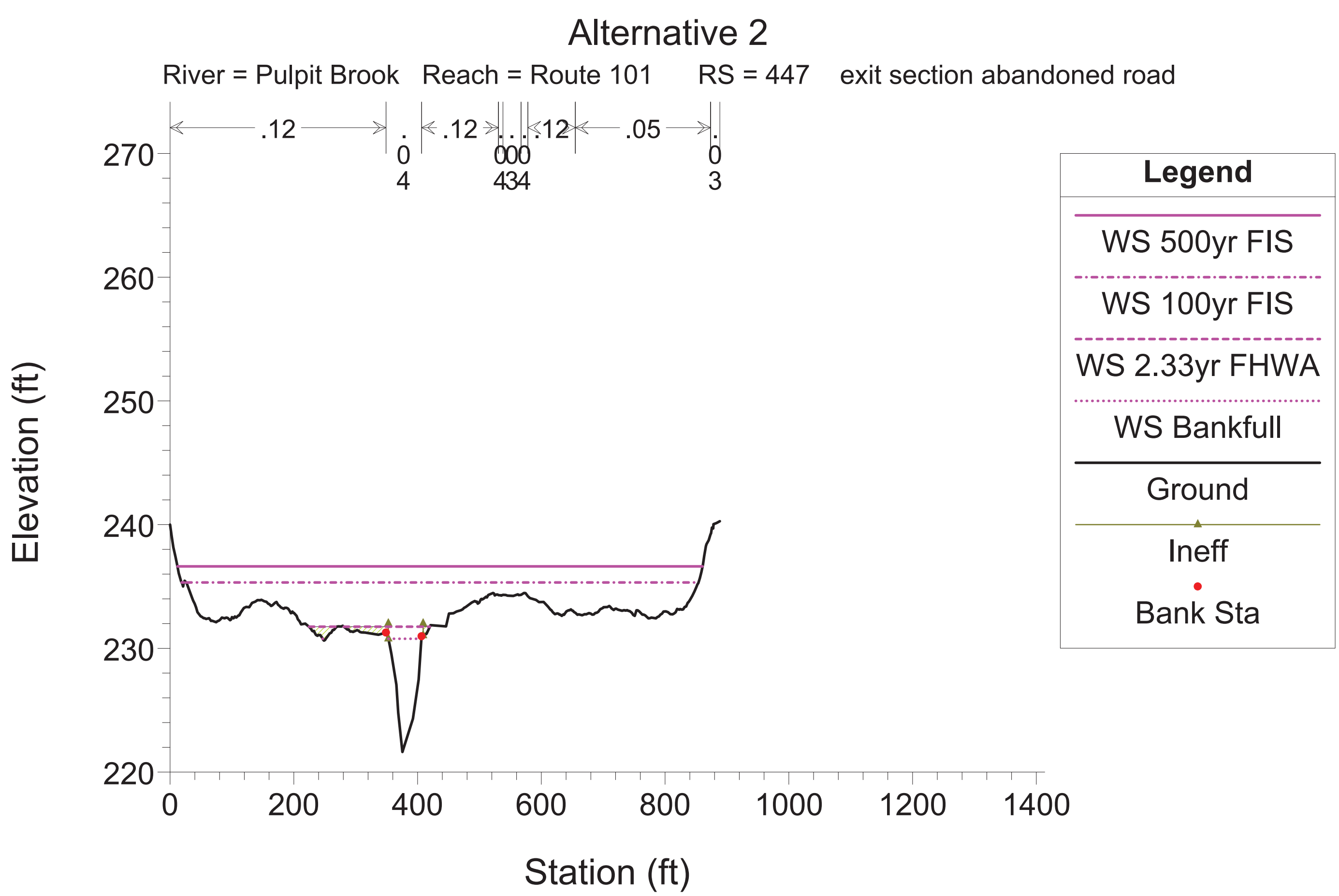
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



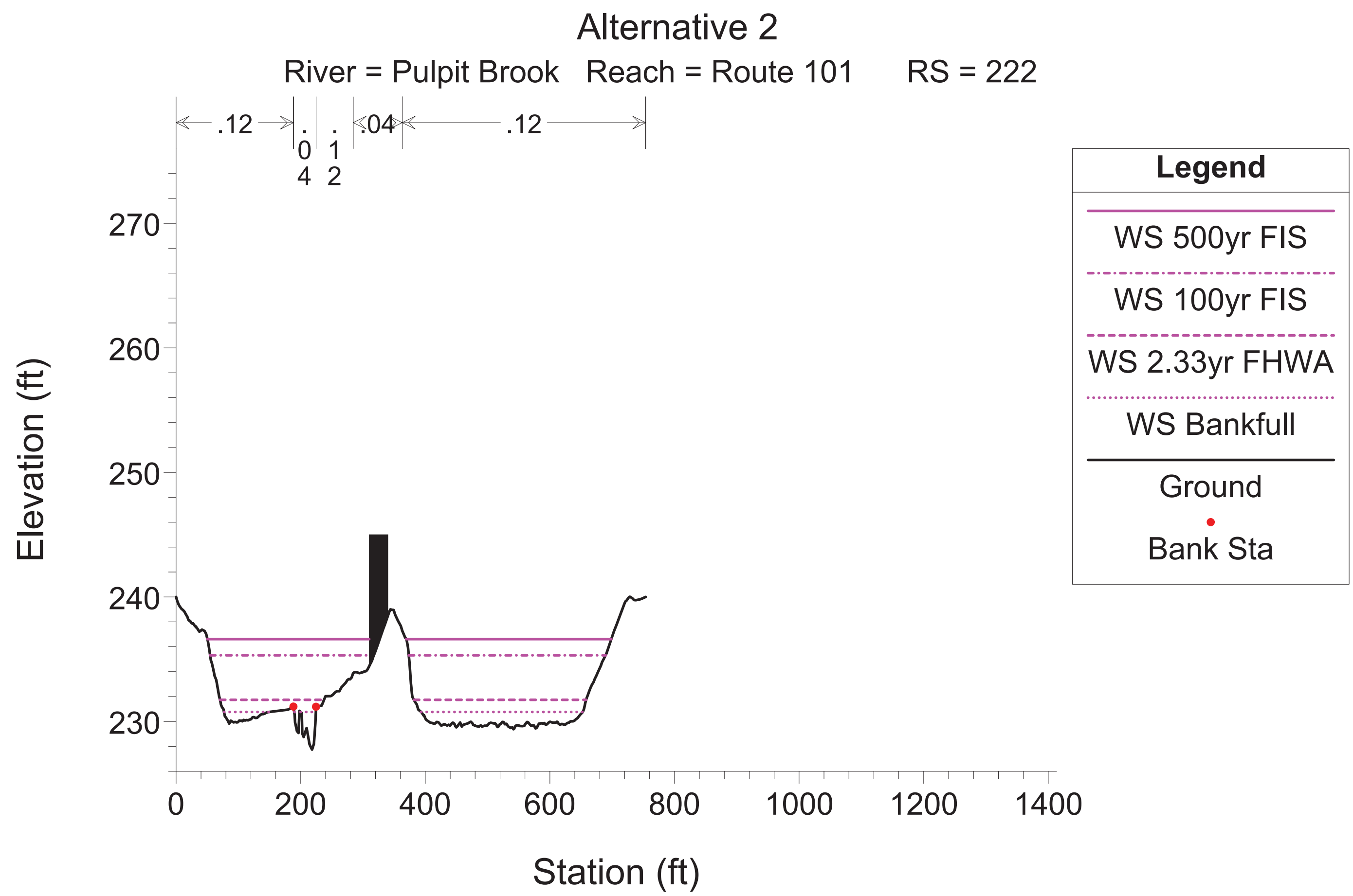


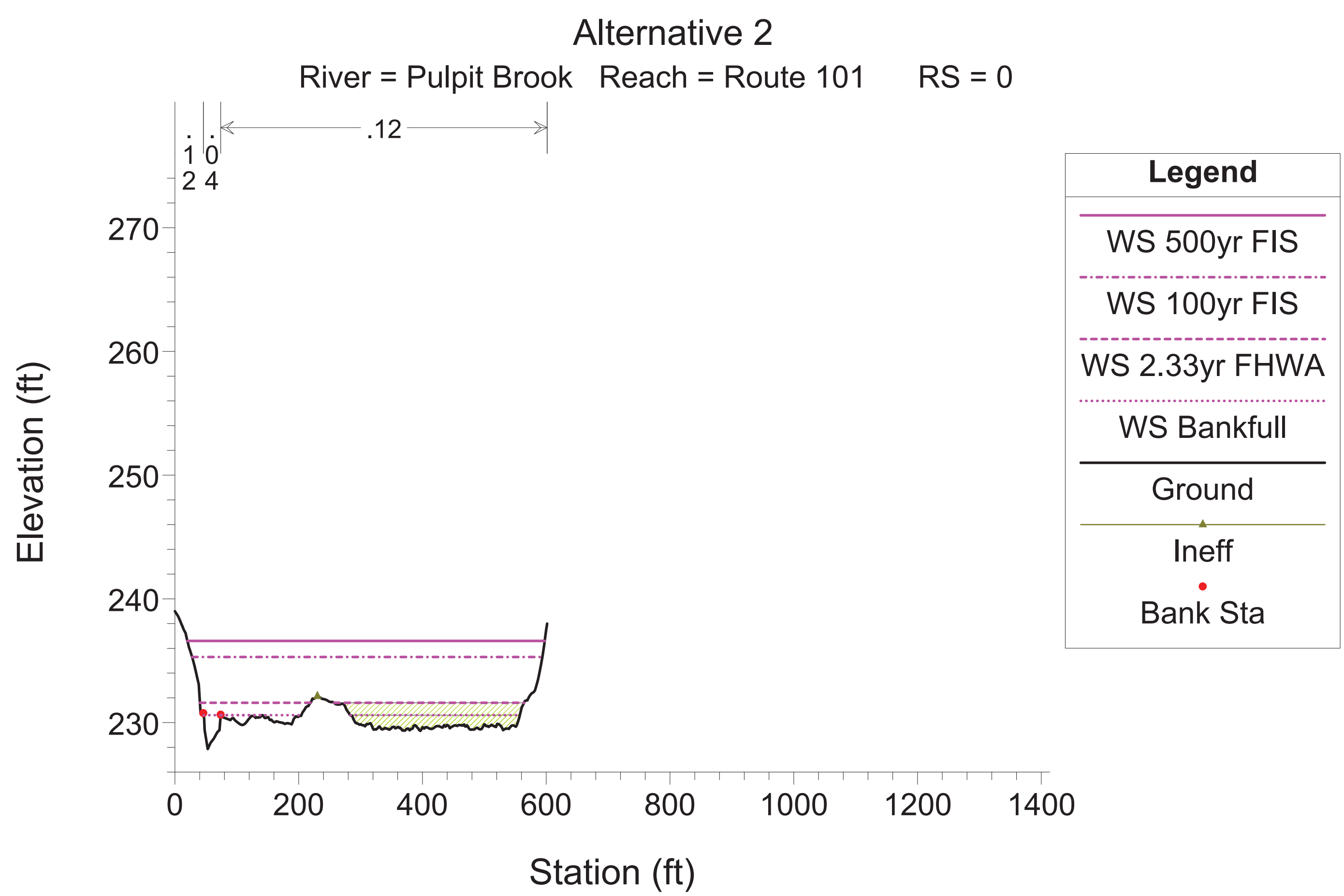
1 in Horiz. = 300 ft   1 in Vert. = 15 ft





1 in Horiz. = 300 ft 1 in Vert. = 15 ft





1 in Horiz. = 300 ft 1 in Vert. = 15 ft

HEC-RAS Plan: Alternative 2 River: Pulpit Brook Reach: Route 101

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Power Chan
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/ft s)
Route 101	0	Bankfull	105	227.9	230.6	229.5	230.7	0.0014	1.9	97	431	0.26	0.28
Route 101	0	2.33yr FHWA	260	227.9	231.6	230.4	231.7	0.0010	2.3	265	485	0.24	0.38
Route 101	0	10yr FIS	420	227.9	234.2	230.8	234.2	0.0000	0.6	2209	557	0.04	0.01
Route 101	0	50yr FIS	760	227.9	235.1	231.3	235.1	0.0000	0.8	2713	564	0.06	0.01
Route 101	0	100yr FIS	900	227.9	235.3	231.5	235.3	0.0001	1.0	2826	566	0.07	0.02
Route 101	0	100yr FHWA	1090	227.9	235.8	231.7	235.8	0.0001	1.1	3081	570	0.07	0.03
Route 101	0	500yr FIS	1450	227.9	236.6	232.1	236.6	0.0001	1.2	3569	577	0.08	0.04
Route 101	222	Bankfull	105	227.7	230.8		230.8	0.0003	0.9	338	366	0.12	0.03
Route 101	222	2.33yr FHWA	260	227.7	231.7		231.7	0.0002	1.0	743	443	0.11	0.03
Route 101	222	10yr FIS	420	227.7	234.2		234.2	0.0000	0.6	1967	552	0.05	0.01
Route 101	222	50yr FIS	760	227.7	235.1		235.1	0.0001	0.9	2474	568	0.06	0.02
Route 101	222	100yr FIS	900	227.7	235.3		235.3	0.0001	1.0	2589	571	0.07	0.02
Route 101	222	100yr FHWA	1090	227.7	235.8		235.8	0.0001	1.1	2848	577	0.07	0.03
Route 101	222	500yr FIS	1450	227.7	236.6		236.6	0.0001	1.2	3344	589	0.08	0.04
Route 101	447	Bankfull	105	221.6	230.8	223.7	230.8	0.0000	0.4	274	59	0.03	0.00
Route 101	447	2.33yr FHWA	260	221.6	231.8	224.6	231.8	0.0000	0.8	328	184	0.06	0.01
Route 101	447	10yr FIS	420	221.6	234.2	225.2	234.2	0.0000	0.7	1539	744	0.04	0.01
Route 101	447	50yr FIS	760	221.6	235.1	226.2	235.1	0.0000	0.9	2272	825	0.05	0.02
Route 101	447	100yr FIS	900	221.6	235.3	226.6	235.3	0.0000	1.0	2440	832	0.06	0.02
Route 101	447	100yr FHWA	1090	221.6	235.8	227.0	235.8	0.0000	1.0	2819	841	0.06	0.02
Route 101	447	500yr FIS	1450	221.6	236.6	227.7	236.6	0.0000	1.1	3539	849	0.06	0.03
Route 101	481		Bridge										
Route 101	512	Bankfull	105	227.3	231.9	228.7	231.9	0.0001	0.9	119	148	0.08	0.02
Route 101	512	2.33yr FHWA	260	227.3	233.8	229.5	233.8	0.0002	1.4	201	598	0.11	0.07
Route 101	512	10yr FIS	420	227.3	234.8	230.1	234.8	0.0000	0.8	1511	766	0.06	0.01
Route 101	512	50yr FIS	760	227.3	235.2	230.9	235.2	0.0001	1.2	1803	792	0.08	0.04
Route 101	512	100yr FIS	900	227.3	235.4	231.3	235.4	0.0001	1.3	1928	803	0.09	0.05
Route 101	512	100yr FHWA	1090	227.3	235.8	231.7	235.8	0.0001	1.3	2264	824	0.09	0.05
Route 101	512	500yr FIS	1450	227.3	236.7	232.3	236.7	0.0001	1.2	3010	866	0.08	0.05
Route 101	544	Bankfull	105	229.4	231.9		232.0	0.0003	1.1	264	333	0.13	0.04
Route 101	544	2.33yr FHWA	260	229.4	233.9		233.9	0.0001	0.7	1207	621	0.06	0.01
Route 101	544	10yr FIS	420	229.4	234.8		234.9	0.0000	0.7	1911	762	0.05	0.01
Route 101	544	50yr FIS	760	229.4	235.2		235.2	0.0001	1.0	2205	782	0.08	0.03
Route 101	544	100yr FIS	900	229.4	235.4		235.4	0.0001	1.1	2329	790	0.09	0.04
Route 101	544	100yr FHWA	1090	229.4	235.8		235.8	0.0001	1.2	2660	813	0.09	0.04
Route 101	544	500yr FIS	1450	229.4	236.7		236.7	0.0001	1.2	3407	867	0.08	0.04
Route 101	589	Bankfull	105	225.7	232.0		232.0	0.0000	0.6	285	323	0.05	0.01
Route 101	589	2.33yr FHWA	260	225.7	233.9		233.9	0.0000	0.7	1156	553	0.05	0.01
Route 101	589	10yr FIS	420	225.7	234.8		234.9	0.0000	0.7	1827	775	0.05	0.01
Route 101	589	50yr FIS	760	225.7	235.2		235.2	0.0001	1.1	2128	806	0.07	0.03
Route 101	589	100yr FIS	900	225.7	235.4		235.4	0.0001	1.3	2256	818	0.08	0.05
Route 101	589	100yr FHWA	1090	225.7	235.8		235.8	0.0001	1.3	2598	837	0.08	0.05
Route 101	589	500yr FIS	1450	225.7	236.7		236.7	0.0001	1.3	3346	858	0.07	0.05
Route 101	610	Bankfull	105	225.5	232.0	227.3	232.0	0.0001	0.9	122	47	0.07	0.02
Route 101	610	2.33yr FHWA	260	225.5	233.8	228.4	233.9	0.0002	1.5	259	454	0.10	0.08
Route 101	610	10yr FIS	420	225.5	234.8	229.2	234.9	0.0002	1.9	364	682	0.12	0.17
Route 101	610	50yr FIS	760	225.5	235.2	230.4	235.3	0.0006	3.2	400	735	0.20	0.82
Route 101	610	100yr FIS	900	225.5	235.3	230.7	235.5	0.0008	3.7	414	758	0.23	1.25
Route 101	610	100yr FHWA	1090	225.5	235.7	231.2	235.9	0.0009	4.2	456	812	0.26	1.75
Route 101	610	500yr FIS	1450	225.5	236.5	232.1	236.8	0.0011	4.8	547	835	0.28	2.58
Route 101	659		Bridge										
Route 101	717	Bankfull	105	227.0	232.0	229.0	232.0	0.0003	1.3	89	194	0.13	0.07
Route 101	717	2.33yr FHWA	260	227.0	233.9	230.0	233.9	0.0003	1.8	264	610	0.14	0.16
Route 101	717	10yr FIS	420	227.0	234.9	230.7	235.0	0.0003	2.2	390	785	0.15	0.26
Route 101	717	50yr FIS	760	227.0	235.5	231.9	235.6	0.0008	3.4	458	807	0.23	1.01
Route 101	717	100yr FIS	900	227.0	235.7	232.3	235.9	0.0009	3.8	490	812	0.25	1.39
Route 101	717	100yr FHWA	1090	227.0	236.3	233.1	236.5	0.0010	4.2	554	823	0.27	1.72
Route 101	717	500yr FIS	1450	227.0	237.3	234.0	237.5	0.0010	4.5	686	850	0.27	2.14
Route 101	1037	Bankfull	105	228.3	232.1		232.1	0.0003	1.3	204	268	0.13	0.08
Route 101	1037	2.33yr FHWA	260	228.3	234.0		234.0	0.0001	0.9	1119	593	0.07	0.02
Route 101	1037	10yr FIS	420	228.3	235.0		235.0	0.0001	0.9	1783	663	0.06	0.02
Route 101	1037	50yr FIS	760	228.3	235.7		235.7	0.0001	1.2	2245	682	0.08	0.05
Route 101	1037	100yr FIS	900	228.3	236.0		236.0	0.0001	1.3	2454	690	0.09	0.06
Route 101	1037	100yr FHWA	1090	228.3	236.6		236.6	0.0001	1.4	2841	711	0.09	0.06
Route 101	1037	500yr FIS	1450	228.3	237.7		237.7	0.0001	1.4	3665	787	0.08	0.06
Route 101	1333	Bankfull	105	228.6	232.2		232.3	0.0008	1.8	101	144	0.20	0.20
Route 101	1333	2.33yr FHWA	260	228.6	234.0		234.0	0.0002	1.5	524	326	0.12	0.09
Route 101	1333	10yr FIS	420	228.6	235.1		235.1	0.0002	1.5	891	392	0.11	0.08
Route 101	1333	50yr FIS	760	228.6	235.7		235.8	0.0003	2.1	1173	413	0.15	0.22
Route 101	1333	100yr FIS	900	228.6	236.1		236.1	0.0003	2.2	1302	433	0.16	0.27
Route 101	1333	100yr FHWA	1090	228.6	236.6		236.6	0.0003	2.3	1544	448	0.15	0.28
Route 101	1333	500yr FIS	1450	228.6	237.7		237.7	0.0003	2.3	2045	475	0.14	0.27

HEC-RAS Plan: Alternative 2 River: Pulpit Brook Reach: Route 101

Reach	River Sta	Profile	Q Total	Q Channel	W.S. Elev	Vel Chnl	Hydr Depth C	Max Chl Dpth	Top W Chnl	Froude # Chl	Vel Total	Hydr Depth	Shear Chan	Shear LOB	Shear ROB	Vel Left	Vel Right
			(cfs)	(cfs)	(ft)	(ft/s)	(ft)	(ft)	(ft)		(ft/s)	(ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(ft/s)	(ft/s)
Route 101	0	Bankfull	105	93	230.6	1.9	1.7	2.7	28	0.26	1.1	0.6	0.1		0.0		0.2
Route 101	0	2.33yr FHWA	260	171	231.6	2.3	2.7	3.7	28	0.24	1.0	1.5	0.2	0.0	0.1	0.3	0.5
Route 101	0	10yr FIS	420	86	234.2	0.6	5.3	6.3	28	0.04	0.2	4.0	0.0	0.0	0.0	0.1	0.2
Route 101	0	50yr FIS	760	147	235.1	0.8	6.2	7.2	28	0.06	0.3	4.8	0.0	0.0	0.0	0.1	0.2
Route 101	0	100yr FIS	900	172	235.3	1.0	6.4	7.4	28	0.07	0.3	5.0	0.0	0.0	0.0	0.2	0.3
Route 101	0	100yr FHWA	1090	203	235.8	1.1	6.9	7.9	28	0.07	0.4	5.4	0.0	0.0	0.0	0.2	0.3
Route 101	0	500yr FIS	1450	260	236.6	1.2	7.7	8.7	28	0.08	0.4	6.2	0.0	0.0	0.0	0.2	0.4
Route 101	222	Bankfull	105	48	230.8	0.9	1.7	3.0	33	0.12	0.3	0.9	0.0	0.0	0.0	0.1	0.2
Route 101	222	2.33yr FHWA	260	88	231.7	1.0	2.5	4.0	36	0.11	0.3	1.7	0.0	0.0	0.0	0.2	0.3
Route 101	222	10yr FIS	420	107	234.2	0.6	5.0	6.5	36	0.05	0.2	3.6	0.0	0.0	0.0	0.2	0.2
Route 101	222	50yr FIS	760	183	235.1	0.9	5.9	7.4	36	0.06	0.3	4.4	0.0	0.0	0.0	0.2	0.3
Route 101	222	100yr FIS	900	214	235.3	1.0	6.1	7.6	36	0.07	0.3	4.5	0.0	0.0	0.0	0.3	0.3
Route 101	222	100yr FHWA	1090	252	235.8	1.1	6.5	8.0	36	0.07	0.4	4.9	0.0	0.0	0.0	0.3	0.3
Route 101	222	500yr FIS	1450	321	236.6	1.2	7.4	8.9	36	0.08	0.4	5.7	0.0	0.0	0.0	0.4	0.4
Route 101	447	Bankfull	105	105	230.8	0.4	5.1	9.2	53	0.03	0.4	5.1	0.0				
Route 101	447	2.33yr FHWA	260	260	231.8	0.8	6.1	10.1	58	0.06	0.8	5.8	0.0		0.0		0.1
Route 101	447	10yr FIS	420	313	234.2	0.7	8.2	12.6	58	0.04	0.3	2.1	0.0	0.0	0.0	0.1	0.1
Route 101	447	50yr FIS	760	465	235.1	0.9	9.1	13.5	58	0.05	0.3	2.8	0.0	0.0	0.0	0.1	0.2
Route 101	447	100yr FIS	900	527	235.3	1.0	9.3	13.7	58	0.06	0.4	2.9	0.0	0.0	0.0	0.2	0.2
Route 101	447	100yr FHWA	1090	584	235.8	1.0	9.7	14.2	58	0.06	0.4	3.4	0.0	0.0	0.0	0.2	0.3
Route 101	447	500yr FIS	1450	668	236.6	1.1	10.6	15.0	58	0.06	0.4	4.2	0.0	0.0	0.0	0.2	0.3
Route 101	481		Bridge														
Route 101	512	Bankfull	105	105	231.9	0.9	3.3	4.6	53	0.08	0.9	3.2	0.0		0.0		0.0
Route 101	512	2.33yr FHWA	260	257	233.8	1.4	5.2	6.5	55	0.11	1.3	4.6	0.0		0.0		0.2
Route 101	512	10yr FIS	420	235	234.8	0.8	5.6	7.5	55	0.06	0.3	2.0	0.0	0.0	0.0	0.1	0.2
Route 101	512	50yr FIS	760	379	235.2	1.2	6.0	7.9	55	0.08	0.4	2.3	0.0	0.0	0.0	0.2	0.3
Route 101	512	100yr FIS	900	430	235.4	1.3	6.1	8.1	55	0.09	0.5	2.4	0.0	0.0	0.0	0.3	0.4
Route 101	512	100yr FHWA	1090	465	235.8	1.3	6.5	8.5	55	0.09	0.5	2.7	0.0	0.0	0.0	0.3	0.4
Route 101	512	500yr FIS	1450	508	236.7	1.2	7.4	9.4	55	0.08	0.5	3.5	0.0	0.0	0.0	0.3	0.5
Route 101	544	Bankfull	105	66	231.9	1.1	2.0	2.6	32	0.13	0.4	0.8	0.0	0.0	0.0	0.2	0.2
Route 101	544	2.33yr FHWA	260	86	233.9	0.7	3.9	4.5	32	0.06	0.2	1.9	0.0	0.0	0.0	0.2	0.2
Route 101	544	10yr FIS	420	104	234.8	0.7	4.9	5.5	32	0.05	0.2	2.5	0.0	0.0	0.0	0.2	0.2
Route 101	544	50yr FIS	760	171	235.2	1.0	5.2	5.8	32	0.08	0.3	2.8	0.0	0.0	0.0	0.3	0.4
Route 101	544	100yr FIS	900	195	235.4	1.1	5.4	6.0	32	0.09	0.4	2.9	0.0	0.0	0.0	0.3	0.4
Route 101	544	100yr FHWA	1090	216	235.8	1.2	5.8	6.4	32	0.09	0.4	3.3	0.0	0.0	0.0	0.3	0.5
Route 101	544	500yr FIS	1450	248	236.7	1.2	6.7	7.3	32	0.08	0.4	3.9	0.0	0.0	0.0	0.3	0.5
Route 101	589	Bankfull	105	100	232.0	0.6	4.7	6.3	36	0.05	0.4	0.9	0.0	0.0		0.0	
Route 101	589	2.33yr FHWA	260	161	233.9	0.7	6.5	8.2	37	0.05	0.2	2.1	0.0	0.0	0.0	0.1	0.1
Route 101	589	10yr FIS	420	203	234.8	0.7	7.5	9.2	37	0.05	0.2	2.4	0.0	0.0	0.0	0.1	0.1
Route 101	589	50yr FIS	760	328	235.2	1.1	7.9	9.6	37	0.07	0.4	2.6	0.0	0.0	0.0	0.2	0.3
Route 101	589	100yr FIS	900	371	235.4	1.3	8.0	9.7	37	0.08	0.4	2.8	0.0	0.0	0.0	0.3	0.3
Route 101	589	100yr FHWA	1090	404	235.8	1.3	8.5	10.1	37	0.08	0.4	3.1	0.0	0.0	0.0	0.3	0.4
Route 101	589	500yr FIS	1450	435	236.7	1.3	9.3	11.0	37	0.07	0.4	3.9	0.0	0.0	0.0	0.3	0.5
Route 101	610	Bankfull	105	105	232.0	0.9	4.6	6.4	26	0.07	0.9	3.3	0.0	0.0	0.0	0.1	0.1
Route 101	610	2.33yr FHWA	260	242	233.8	1.5	6.5	8.3	26	0.10	1.0	2.4	0.1	0.0	0.0	0.2	0.1
Route 101	610	10yr FIS	420	365	234.8	1.9	7.5	9.3	26	0.12	1.2	3.4	0.1	0.0	0.0	0.4	0.3
Route 101	610	50yr FIS	760	646	235.2	3.2	7.8	9.6	26	0.20	1.9	3.8	0.3	0.1	0.1	0.6	0.5
Route 101	610	100yr FIS	900	758	235.3	3.7	8.0	9.8	26	0.23	2.2	3.9	0.3	0.2	0.1	0.7	0.6
Route 101	610	100yr FHWA	1090	896	235.7	4.2	8.4	10.2	26	0.26	2.4	4.3	0.4	0.2	0.1	0.9	0.7
Route 101	610	500yr FIS	1450	1135	236.5	4.8	9.2	11.0	26	0.28	2.7	5.1	0.5	0.3	0.2	1.1	0.9
Route 101	659		Bridge														
Route 101	717	Bankfull	105	104	232.0	1.3	3.4	5.0	23	0.13	1.2	2.2	0.1	0.0	0.0	0.1	0.1
Route 101	717	2.33yr FHWA	260	222	233.9	1.8	5.3	6.9	23	0.14	1.0	2.1	0.1	0.0	0.0	0.3	0.3
Route 101	717	10yr FIS	420	320	234.9	2.2	6.3	7.9	23	0.15	1.1	3.2	0.1	0.1	0.1	0.4	0.4
Route 101	717	50yr FIS	760	549	235.5	3.4	6.9	8.5	23	0.23	1.7	3.7	0.3	0.1	0.1	0.7	0.7
Route 101	717	100yr FIS	900	637	235.7	3.8	7.2	8.7	23	0.25	1.8	4.0	0.4	0.2	0.2	0.8	0.8
Route 101	717	100yr FHWA	1090	740	236.3	4.2	7.7	9.2	23	0.27	2.0	4.5	0.4	0.2	0.2	0.9	0.9
Route 101	717	500yr FIS	1450	920	237.3	4.5	8.8	10.3	23	0.27	2.1	5.6	0.5	0.3	0.3	1.1	1.1
Route 101	1037	Bankfull	105	79	232.1	1.3	3.2	3.8	19	0.13	0.5	0.8	0.1	0.0	0.0	0.2	0.2
Route 101	1037	2.33yr FHWA	260	84	234.0	0.9	5.1	5.7	19	0.07	0.2	1.9	0.0	0.0	0.0	0.1	0.2
Route 101	1037	10yr FIS	420	100	235.0	0.9	6.1	6.8	19	0.06	0.2	2.7	0.0	0.0	0.0	0.2	0.2
Route 101	1037	50yr FIS	760	155	235.7	1.2	6.8	7.4	19	0.08	0.3	3.3	0.0	0.0	0.0	0.2	0.3
Route 101	1037	100yr FIS	900	174	236.0	1.3	7.1	7.8	19	0.09	0.4	3.6	0.0	0.0	0.0	0.3	0.3
Route 101	1037	100yr FHWA	1090	192	236.6	1.4	7.6	8.3	19	0.09	0.4	4.0	0.0	0.0	0.0	0.3	0.4
Route 101	1037	500yr FIS	1450	230	237.7	1.4	8.7	9.4	19	0.08	0.4	4.7	0.0	0.0	0.0	0.3	0.4
Route 101	1333	Bankfull	105	96	232.2	1.8	2.5	3.6	22	0.20	1.0	0.7	0.1	0.0	0.0	0.2	0.1
Route 101	1333	2.33yr FHWA	260	135	234.0	1.5	4.3	5.4	22	0.12	0.5	1.6	0.1	0.0	0.0	0.3	0.2
Route 101	1333	10yr FIS	420	169	235.1	1.5	5.3	6.4	22	0.11	0.5	2.3	0.1	0.0	0.0	0.4	0.3
Route 101	1333	50yr FIS	760	267	235.7	2.1	6.0	7.1	22	0.15	0.6	2.8	0.1	0.1	0.0	0.5	0.4
Route 101	1333	100yr FIS	900	302	236.1	2.2	6.3	7.4	22	0.16	0.7	3.0	0.1	0.1	0.0	0.6	0.4
Route 101	1333	100yr FHWA	1090	335	236.6	2.3	6.9	8.0	22	0.15	0.7	3.4	0.1	0.1	0.0	0.6	0.5
Route 101	1333	500yr FIS	1450	390	237.7	2.3	8.0	9.1	22	0.14	0.7	4.3	0.1	0.1	0.1	0.6	0.5

HEC-RAS Plan: Alternative 2 River: Pulpit Brook Reach: Route 101

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	Area
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)	(sq ft)
Route 101	222	Bankfull	230.8	230.8		0.12	0.00	365.7	5.4	48.5	51.1	0.9	338
Route 101	222	2.33yr FHWA	231.7	231.7		0.08	0.00	443.4	30.9	87.6	141.5	1.0	743
Route 101	222	10yr FIS	234.2	234.2		0.01	0.00	551.8	74.9	107.4	237.7	0.6	1967
Route 101	222	50yr FIS	235.1	235.1		0.01	0.00	568.3	139.2	182.7	438.1	0.9	2474
Route 101	222	100yr FIS	235.3	235.3		0.01	0.00	571.3	165.8	213.7	520.5	1.0	2589
Route 101	222	100yr FHWA	235.8	235.8		0.01	0.00	576.9	202.7	252.0	635.3	1.1	2848
Route 101	222	500yr FIS	236.6	236.6		0.01	0.00	588.8	272.6	321.5	855.9	1.2	3344
Route 101	447	Bankfull	230.8	230.8	223.7	0.01	0.00	58.7		105.0		0.4	275
Route 101	447	2.33yr FHWA	231.8	231.8	224.6	0.02	0.00	183.7		259.9	0.1	0.8	391
Route 101	447	10yr FIS	234.2	234.2	225.2	0.01	0.00	744.0	53.4	313.5	53.1	0.7	1539
Route 101	447	50yr FIS	235.1	235.1	226.2	0.01	0.00	825.2	125.4	464.9	169.7	0.9	2272
Route 101	447	100yr FIS	235.3	235.3	226.6	0.01	0.00	831.6	153.8	527.4	218.7	1.0	2440
Route 101	447	100yr FHWA	235.8	235.8	227.0	0.01	0.00	841.0	196.5	584.5	309.0	1.0	2819
Route 101	447	500yr FIS	236.6	236.6	227.7	0.01	0.00	848.6	284.1	668.1	497.8	1.1	3539
Route 101	481 BR D	Bankfull	231.6	230.8	230.8	0.00	0.40	9.0		105.0		7.2	15
Route 101	481 BR D	2.33yr FHWA	233.6	232.1	232.1			9.0		260.0		9.8	27
Route 101	481 BR D	10yr FIS	234.8	234.8	234.9			440.2	178.8	202.2	34.7	3.8	183
Route 101	481 BR D	50yr FIS	235.2	235.2	235.2			610.2	442.7	120.9	195.6	1.8	363
Route 101	481 BR D	100yr FIS	235.4	235.3	235.3			664.3	522.0	108.9	283.8	1.5	450
Route 101	481 BR D	100yr FHWA	235.8	235.8	235.3			762.5	572.0	85.7	419.1	1.0	775
Route 101	481 BR D	500yr FIS	236.6	236.6	235.5	0.00	0.01	798.0	465.5	277.2	707.2	2.4	1438
Route 101	481 BR U	Bankfull	231.9	231.7	229.9	0.14	0.19	9.0		105.0		3.4	31
Route 101	481 BR U	2.33yr FHWA	233.8	233.0	231.3					260.0		6.2	42
Route 101	481 BR U	10yr FIS	234.8	234.8	232.4			397.7	178.8	202.2	34.7	3.8	178
Route 101	481 BR U	50yr FIS	235.2	235.2	235.2			561.3	442.7	120.9	195.6	1.9	360
Route 101	481 BR U	100yr FIS	235.4	235.4	235.3			619.3	522.0	108.9	283.8	1.6	453
Route 101	481 BR U	100yr FHWA	235.8	235.8	235.3			698.7	572.0	85.7	419.1	1.1	726
Route 101	481 BR U	500yr FIS	236.7	236.6	235.5	0.03	0.00	768.5	414.2	208.9	826.8	2.2	1355
Route 101	512	Bankfull	231.9	231.9	228.7	0.01	0.05	147.7		105.0	0.0	0.9	205
Route 101	512	2.33yr FHWA	233.8	233.8	229.5			598.5		256.8	3.2	1.4	808
Route 101	512	10yr FIS	234.8	234.8	230.1			766.1	121.2	235.1	63.7	0.8	1511
Route 101	512	50yr FIS	235.2	235.2	230.9			791.8	227.3	379.4	153.3	1.2	1803
Route 101	512	100yr FIS	235.4	235.4	231.3			803.2	272.0	429.9	198.2	1.3	1928
Route 101	512	100yr FHWA	235.8	235.8	231.7			824.4	333.8	465.4	290.8	1.3	2264
Route 101	512	500yr FIS	236.7	236.7	232.3	0.00	0.01	865.9	445.8	508.4	495.9	1.2	3010
Route 101	544	Bankfull	232.0	231.9		0.01	0.00	332.5	35.5	66.3	3.2	1.1	264
Route 101	544	2.33yr FHWA	233.9	233.9		0.00	0.01	621.4	139.6	85.8	34.6	0.7	1207
Route 101	544	10yr FIS	234.9	234.8		0.00	0.00	761.6	217.5	103.8	98.7	0.7	1911
Route 101	544	50yr FIS	235.2	235.2		0.00	0.00	781.6	380.6	170.7	208.8	1.0	2205
Route 101	544	100yr FIS	235.4	235.4		0.00	0.00	789.7	444.6	194.8	260.6	1.1	2329
Route 101	544	100yr FHWA	235.8	235.8		0.00	0.00	812.9	520.7	216.4	352.9	1.2	2660
Route 101	544	500yr FIS	236.7	236.7		0.00	0.00	867.0	650.0	248.2	551.8	1.2	3407
Route 101	589	Bankfull	232.0	232.0		0.00	0.00	322.9	5.3	99.7		0.6	285
Route 101	589	2.33yr FHWA	233.9	233.9		0.00	0.00	552.6	94.0	160.9	5.1	0.7	1156
Route 101	589	10yr FIS	234.9	234.8		0.00	0.00	774.8	179.1	202.5	38.4	0.7	1827
Route 101	589	50yr FIS	235.2	235.2		0.00	0.00	806.0	326.0	328.0	106.0	1.1	2128
Route 101	589	100yr FIS	235.4	235.4		0.00	0.00	818.1	385.6	371.4	143.0	1.3	2256
Route 101	589	100yr FHWA	235.8	235.8		0.00	0.00	836.6	463.9	404.0	222.2	1.3	2598
Route 101	589	500yr FIS	236.7	236.7		0.00	0.00	858.3	592.4	435.1	422.5	1.3	3346
Route 101	610	Bankfull	232.0	232.0	227.3	0.00	0.00	47.1	0.2	104.7	0.1	0.9	122
Route 101	610	2.33yr FHWA	233.9	233.8	228.4	0.00	0.01	453.6	14.7	242.4	2.9	1.5	616
Route 101	610	10yr FIS	234.9	234.8	229.2	0.00	0.02	681.9	38.2	365.3	16.5	1.9	1133
Route 101	610	50yr FIS	235.3	235.2	230.4	0.00	0.07	734.9	76.9	646.1	37.1	3.2	1374
Route 101	610	100yr FIS	235.5	235.3	230.7	0.00	0.09	758.3	94.5	758.2	47.3	3.7	1477
Route 101	610	100yr FHWA	235.9	235.7	231.2	0.00	0.11	812.0	125.5	895.9	68.6	4.2	1781
Route 101	610	500yr FIS	236.8	236.5	232.1	0.00	0.14	835.3	194.5	1135.0	120.6	4.8	2484
Route 101	659 BR D	Bankfull	232.0	231.9	229.8	0.01	0.02	48.0	1.2	102.6	1.2	1.7	73
Route 101	659 BR D	2.33yr FHWA	233.9	233.8	230.8	0.01	0.02	48.0	13.0	234.1	13.0	2.3	164
Route 101	659 BR D	10yr FIS	234.9	234.8	231.6	0.01	0.04	48.0	25.0	370.0	25.0	3.0	211
Route 101	659 BR D	50yr FIS	235.4	235.1	232.6	0.03	0.11	48.0	46.8	666.4	46.8	5.2	224
Route 101	659 BR D	100yr FIS	235.7	235.2	232.9	0.03	0.16	48.0	56.1	787.9	56.1	6.0	229
Route 101	659 BR D	100yr FHWA	236.2	235.5	233.4	0.04	0.21	48.0	70.2	949.6	70.2	6.9	246
Route 101	659 BR D	500yr FIS	237.2	236.3	234.1	0.05	0.30	48.0	98.6	1252.7	98.6	8.1	283
Route 101	659 BR U	Bankfull	232.0	232.0	229.8	0.02	0.00	48.0	1.3	102.4	1.3	1.7	74
Route 101	659 BR U	2.33yr FHWA	233.9	233.8	230.8	0.02	0.00	48.0	13.0	234.0	13.0	2.3	165
Route 101	659 BR U	10yr FIS	234.9	234.8	231.6	0.02	0.00	48.0	25.1	369.8	25.1	3.0	212
Route 101	659 BR U	50yr FIS	235.5	235.2	232.6	0.06	0.00	48.0	47.2	665.6	47.2	5.1	228
Route 101	659 BR U	100yr FIS	235.8	235.3	232.9	0.08	0.01	48.0	56.7	786.7	56.7	5.9	234
Route 101	659 BR U	100yr FHWA	236.3	235.7	233.4	0.09	0.01	48.0	71.0	948.1	71.0	6.7	252
Route 101	659 BR U	500yr FIS	237.3	236.5	234.1	0.11	0.01	48.0	99.6	1250.9	99.6	7.9	291
Route 101	717	Bankfull	232.0	232.0	229.0	0.01	0.01	193.7	0.0	103.6	1.4	1.3	161
Route 101	717	2.33yr FHWA	233.9	233.9	230.0	0.01	0.01	609.5	19.7	222.4	17.9	1.8	1065
Route 101	717	10yr FIS	235.0	234.9	230.7	0.02	0.02	784.8	51.4	319.8	48.8	2.2	1796
Route 101	717	50yr FIS	235.6	235.5	231.9	0.04	0.07	807.1	107.6	549.4	103.0	3.4	2238
Route 101	717	100yr FIS	235.9	235.7	232.3	0.05	0.09	812.2	134.3	636.5	129.1	3.8	2448
Route 101	717	100yr FHWA	236.5	236.3	233.1	0.05	0.13	823.2	177.8	740.4	171.9	4.2	2879
Route 101	717	500yr FIS	237.5	237.3	234.0	0.06	0.19	850.1	268.4	920.2	261.5	4.5	3773
Route 101	1037	Bankfull	232.1	232.1		0.10	0.00	268.4	6.5	79.1	19.4	1.3	204
Route 101	1037	2.33yr FHWA	234.0	234.0		0.04	0.01	593.3	53.5	83.6	122.9	0.9	1119
Route 101	1037	10yr FIS	235.0	235.0		0.04	0.02	663.4	111.9	100.1	208.0	0.9	1783

HEC-RAS Plan: Alternative 2 River: Pulpit Brook Reach: Route 101 (Continued)

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	Area
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)	(sq ft)
Route 101	1037	50yr FIS	235.7	235.7		0.07	0.04	681.9	225.0	155.4	379.6	1.2	2245
Route 101	1037	100yr FIS	236.0	236.0		0.08	0.05	689.6	275.4	174.0	450.6	1.3	2454
Route 101	1037	100yr FHWA	236.6	236.6		0.07	0.05	711.2	352.5	192.2	545.3	1.4	2841
Route 101	1037	500yr FIS	237.7	237.7		0.07	0.06	786.6	523.7	229.9	696.4	1.4	3665

Plan: Alternative 2 Pulpit Brook Route 101 RS: 659 Profile: Bankfull

E.G. US. (ft)	232.02	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	232.00	E.G. Elev (ft)	232.00	231.98
Q Total (cfs)	105.00	W.S. Elev (ft)	231.96	231.94
Q Bridge (cfs)	105.00	Crit W.S. (ft)	229.81	229.81
Q Weir (cfs)		Max Chl Dpth (ft)	3.96	3.94
Weir Sta Lft (ft)		Vel Total (ft/s)	1.41	1.43
Weir Sta Rgt (ft)		Flow Area (sq ft)	74.32	73.38
Weir Submerg		Froude # Chl	0.15	0.15
Weir Max Depth (ft)		Specif Force (cu ft)	101.40	100.00
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	1.55	1.53
Min El Prs (ft)	238.13	W.P. Total (ft)	50.41	50.37
Delta EG (ft)	0.06	Conv. Total (cfs)	4876.6	4812.6
Delta WS (ft)	0.05	Top Width (ft)	48.00	48.00
BR Open Area (sq ft)	349.40	Frctn Loss (ft)	0.02	0.01
BR Open Vel (ft/s)	1.43	C & E Loss (ft)	0.00	0.02
Coef of Q		Shear Total (lb/sq ft)	0.04	0.04
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 2 Pulpit Brook Route 101 RS: 659 Profile: 2.33yr FHWA

E.G. US. (ft)	233.94	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	233.90	E.G. Elev (ft)	233.92	233.90
Q Total (cfs)	260.00	W.S. Elev (ft)	233.85	233.83
Q Bridge (cfs)	260.00	Crit W.S. (ft)	230.77	230.77
Q Weir (cfs)		Max Chl Dpth (ft)	5.85	5.83
Weir Sta Lft (ft)		Vel Total (ft/s)	1.58	1.59
Weir Sta Rgt (ft)		Flow Area (sq ft)	164.85	164.01
Weir Submerg		Froude # Chl	0.16	0.16
Weir Max Depth (ft)		Specif Force (cu ft)	338.59	335.82
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	3.43	3.42
Min El Prs (ft)	238.13	W.P. Total (ft)	54.18	54.15
Delta EG (ft)	0.07	Conv. Total (cfs)	12727.0	12641.0
Delta WS (ft)	0.06	Top Width (ft)	48.00	48.00
BR Open Area (sq ft)	349.40	Frctn Loss (ft)	0.02	0.01
BR Open Vel (ft/s)	1.59	C & E Loss (ft)	0.00	0.02
Coef of Q		Shear Total (lb/sq ft)	0.08	0.08
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 2 Pulpit Brook Route 101 RS: 659 Profile: 10yr FIS

E.G. US. (ft)	234.98	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	234.93	E.G. Elev (ft)	234.95	234.92
Q Total (cfs)	420.00	W.S. Elev (ft)	234.82	234.80
Q Bridge (cfs)	420.00	Crit W.S. (ft)	231.58	231.58
Q Weir (cfs)		Max Chl Dpth (ft)	6.82	6.80
Weir Sta Lft (ft)		Vel Total (ft/s)	1.98	1.99
Weir Sta Rgt (ft)		Flow Area (sq ft)	211.73	210.62
Weir Submerg		Froude # Chl	0.19	0.19

Plan: Alternative 2 Pulpit Brook Route 101 RS: 659 Profile: 10yr FIS (Continued)

Weir Max Depth (ft)		Specif Force (cu ft)	540.87	536.16
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	4.41	4.39
Min El Prs (ft)	238.13	W.P. Total (ft)	56.14	56.09
Delta EG (ft)	0.11	Conv. Total (cfs)	17924.2	17793.4
Delta WS (ft)	0.10	Top Width (ft)	48.00	48.00
BR Open Area (sq ft)	349.40	Frctn Loss (ft)	0.02	0.01
BR Open Vel (ft/s)	1.99	C & E Loss (ft)	0.00	0.04
Coef of Q		Shear Total (lb/sq ft)	0.13	0.13
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 2 Pulpit Brook Route 101 RS: 659 Profile: 50yr FIS

E.G. US. (ft)	235.62	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	235.48	E.G. Elev (ft)	235.51	235.45
Q Total (cfs)	760.00	W.S. Elev (ft)	235.15	235.08
Q Bridge (cfs)	760.00	Crit W.S. (ft)	232.61	232.61
Q Weir (cfs)		Max Chl Dpth (ft)	7.15	7.08
Weir Sta Lft (ft)		Vel Total (ft/s)	3.34	3.39
Weir Sta Rgt (ft)		Flow Area (sq ft)	227.58	224.06
Weir Submerg		Froude # Chl	0.32	0.32
Weir Max Depth (ft)		Specif Force (cu ft)	686.66	671.67
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	4.74	4.67
Min El Prs (ft)	238.13	W.P. Total (ft)	56.80	56.65
Delta EG (ft)	0.31	Conv. Total (cfs)	19834.5	19403.6
Delta WS (ft)	0.31	Top Width (ft)	48.00	48.00
BR Open Area (sq ft)	349.40	Frctn Loss (ft)	0.06	0.03
BR Open Vel (ft/s)	3.39	C & E Loss (ft)	0.00	0.11
Coef of Q		Shear Total (lb/sq ft)	0.37	0.38
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 2 Pulpit Brook Route 101 RS: 659 Profile: 100yr FIS

E.G. US. (ft)	235.91	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	235.74	E.G. Elev (ft)	235.76	235.68
Q Total (cfs)	900.00	W.S. Elev (ft)	235.29	235.18
Q Bridge (cfs)	900.00	Crit W.S. (ft)	232.95	232.95
Q Weir (cfs)		Max Chl Dpth (ft)	7.29	7.18
Weir Sta Lft (ft)		Vel Total (ft/s)	3.85	3.93
Weir Sta Rgt (ft)		Flow Area (sq ft)	234.00	229.06
Weir Submerg		Froude # Chl	0.36	0.37
Weir Max Depth (ft)		Specif Force (cu ft)	757.39	736.50
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	4.88	4.77
Min El Prs (ft)	238.13	W.P. Total (ft)	57.07	56.86
Delta EG (ft)	0.42	Conv. Total (cfs)	20628.9	20015.6
Delta WS (ft)	0.43	Top Width (ft)	48.00	48.00
BR Open Area (sq ft)	349.40	Frctn Loss (ft)	0.08	0.03
BR Open Vel (ft/s)	3.93	C & E Loss (ft)	0.01	0.16
Coef of Q		Shear Total (lb/sq ft)	0.49	0.51

Plan: Alternative 2 Pulpit Brook Route 101 RS: 659 Profile: 100yr FIS (Continued)

Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 2 Pulpit Brook Route 101 RS: 659 Profile: 100yr FHWA

E.G. US. (ft)	236.45	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	236.27	E.G. Elev (ft)	236.27	236.17
Q Total (cfs)	1090.00	W.S. Elev (ft)	235.66	235.53
Q Bridge (cfs)	1090.00	Crit W.S. (ft)	233.37	233.37
Q Weir (cfs)		Max Chl Dpth (ft)	7.66	7.53
Weir Sta Lft (ft)		Vel Total (ft/s)	4.33	4.44
Weir Sta Rgt (ft)		Flow Area (sq ft)	252.01	245.70
Weir Submerg		Froude # Chl	0.40	0.41
Weir Max Depth (ft)		Specif Force (cu ft)	903.40	875.53
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	5.25	5.12
Min El Prs (ft)	238.13	W.P. Total (ft)	57.82	57.55
Delta EG (ft)	0.53	Conv. Total (cfs)	22919.2	22105.8
Delta WS (ft)	0.57	Top Width (ft)	48.00	48.00
BR Open Area (sq ft)	349.40	Frctn Loss (ft)	0.09	0.04
BR Open Vel (ft/s)	4.44	C & E Loss (ft)	0.01	0.21
Coef of Q		Shear Total (lb/sq ft)	0.62	0.65
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 2 Pulpit Brook Route 101 RS: 659 Profile: 500yr FIS

E.G. US. (ft)	237.55	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	237.34	E.G. Elev (ft)	237.30	237.18
Q Total (cfs)	1450.00	W.S. Elev (ft)	236.47	236.30
Q Bridge (cfs)	1450.00	Crit W.S. (ft)	234.09	234.10
Q Weir (cfs)		Max Chl Dpth (ft)	8.47	8.30
Weir Sta Lft (ft)		Vel Total (ft/s)	4.99	5.13
Weir Sta Rgt (ft)		Flow Area (sq ft)	290.73	282.67
Weir Submerg		Froude # Chl	0.44	0.46
Weir Max Depth (ft)		Specif Force (cu ft)	1234.11	1194.34
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	6.06	5.89
Min El Prs (ft)	238.13	W.P. Total (ft)	59.43	59.09
Delta EG (ft)	0.71	Conv. Total (cfs)	28147.1	27026.6
Delta WS (ft)	0.79	Top Width (ft)	48.00	48.00
BR Open Area (sq ft)	349.40	Frctn Loss (ft)	0.11	0.05
BR Open Vel (ft/s)	5.13	C & E Loss (ft)	0.01	0.30
Coef of Q		Shear Total (lb/sq ft)	0.81	0.86
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

cHECk-RAS Report

HEC-RAS Project: *pulpit101.prj*
Plan File: *pulpit101.p03*
Geometry File: *pulpit101.g03*
Flow File: *pulpit101.f01*
Report Date: *9/20/2017*

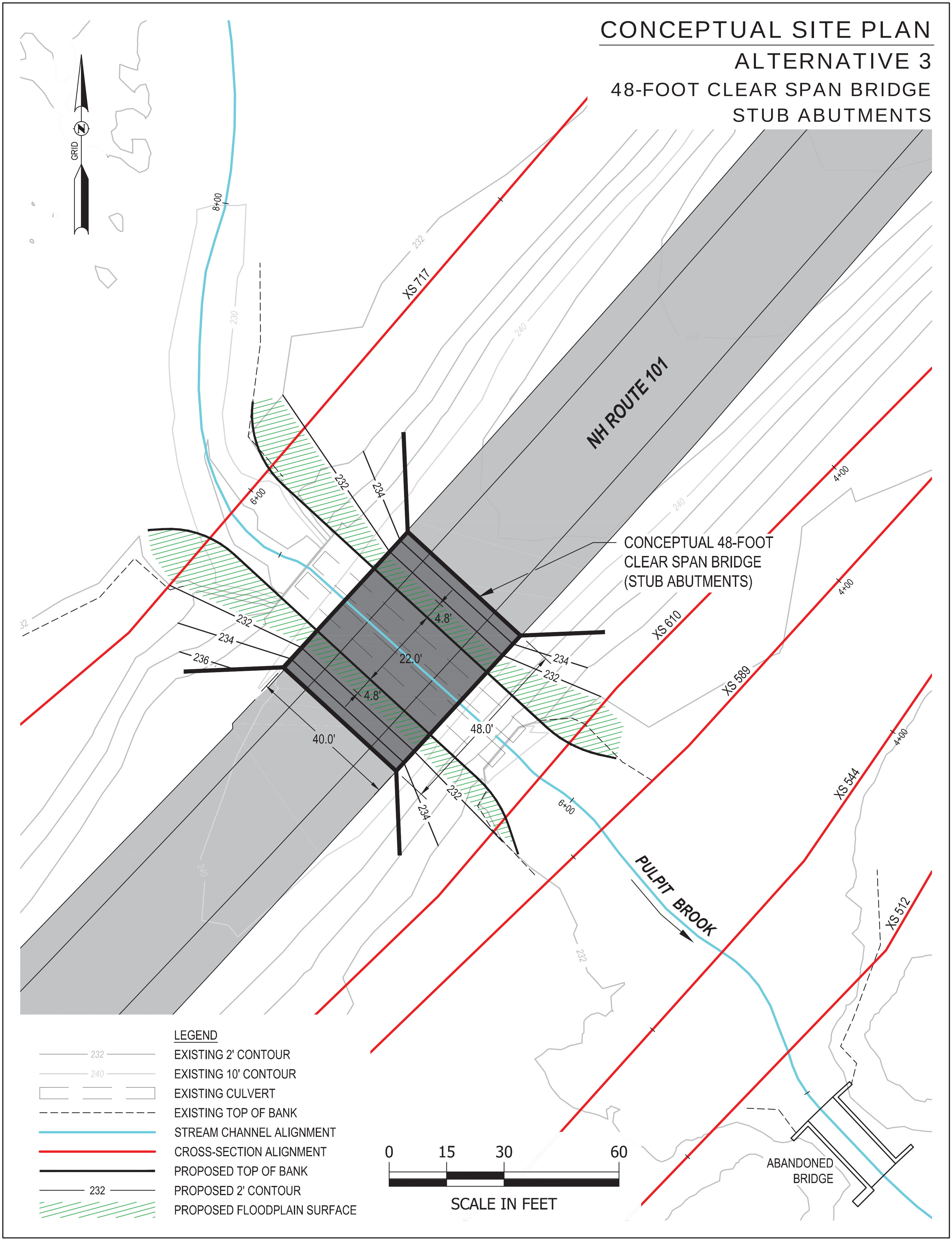
Alternative 2 Model

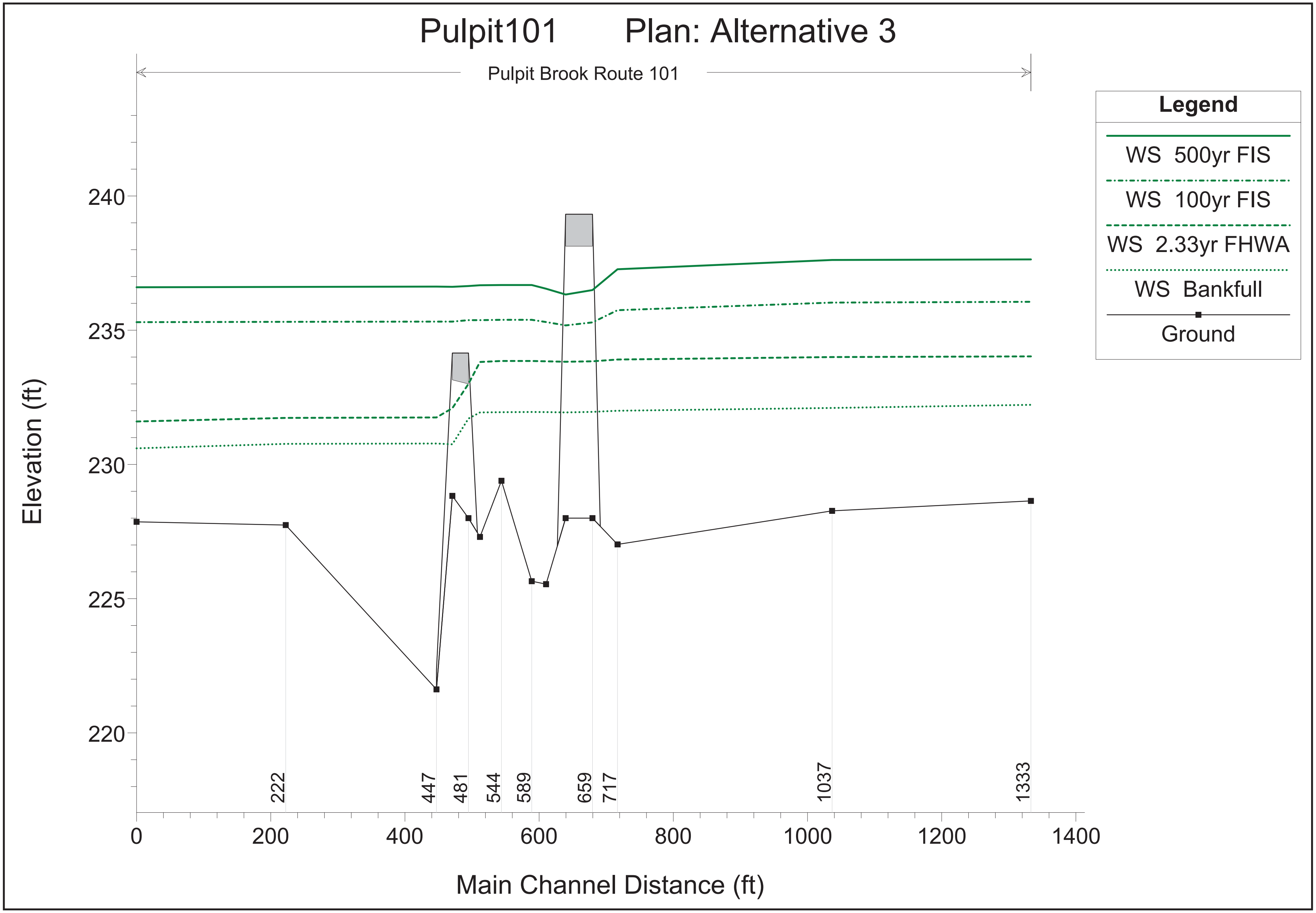
Message ID	Message	Cross sections affected	Comments
BR LF 01	This is ($strucname$). The selected profile is $profilename$. Type of flow is low flow because, 1. EGEL 3 of $egel3$ is less than or equal to MinTopRd of $minelweirflow$. 2. EGEL 3 of $egel3$ is less than MxLoCdU of $mxlocdu$.	659(Bridge-UP)	
BR PF 01	This is a Bridge Section. The selected profile is $profilename$. Type of flow is sluice gate pressure flow because, 1. EGEL 3 of $egel3$ is less than or equal to MinTopRd of $minelweirflow$. 2. EGEL 3 of $egel3$ is greater than or equal to MxLoCdU of $mxlocdu$. 3. WSEL 2 of $wsel2$ is less than MxLoCdD of $mxlocdd$.	481(Bridge-UP)	
BR PF 04	This is a Bridge Section. Input BrSelMthd is Press/Weir. The highest flood frequency profile is $profilename$. Type of flow is sluice gate pressure flow only. However, the highest flood frequency CritWS of $critws$at BR U is less than or equal to the WSEL of $wsel$ at BR U. Energy should be selected as the High Flow Method.	481(Bridge-UP)	
BR PW 02	This is a Bridge Section. The selected profile is $profilename$. Type of flow is submerged pressure and weir flow because, 1. EGEL 3 of $egel3$ is greater than MinTopRd of $minelweirflow$. 2. EGEL 3 of $egel3$ is equal to or greater than MxLoCdU of $mxlocdu$. 3. WSEL 2 of $wsel2$ is equal to or greater than MxLoCdD of $mxlocdd$.	481(Bridge-UP)	
MP SW 01DD	The name of the stream is ($streamname$). The flow regime is subcritical or mixed flow. The downstream starting water-surface elevation, SWSEL, is computed from different methods. SWSEL of the 50 %-annual-chance flood is computed from SW_Method. SWSEL of the 10 %-annual-chance flood is computed from SW_Method. SWSEL of the 4 %-annual-chance flood is computed from SW_Method. SWSEL of the 2 %-annual-chance flood is computed from SW_Method. SWSEL of the 1%-annual-chance flood is computed from SW_Method. SWSEL of the 0.2%-annual-chance flood is computed from SW_Method. The same method should be used for all the profiles.		

ST DT 03	This is ($Structure$) section. The Contraction Length is longer than the Expansion Length. Section 4 channel distance of $Length_Chnl4$ is longer than Section 2 channel distance of $Length_Chnl2$. Section 4 and Section 1 should be relocated. The HEC-RAS geometry file may need to be recreated using a GIS program.	659(Bridge-UP)	
XS DC 02	Constant discharge used for the entire profile for $assignedname$ flood. At least two discharges should be selected; one at the mouth and the other at the middle of the watershed or above the confluence of a tributary. Or provide explanation why only one discharge should be used. Other flood frequencies should also be checked.		

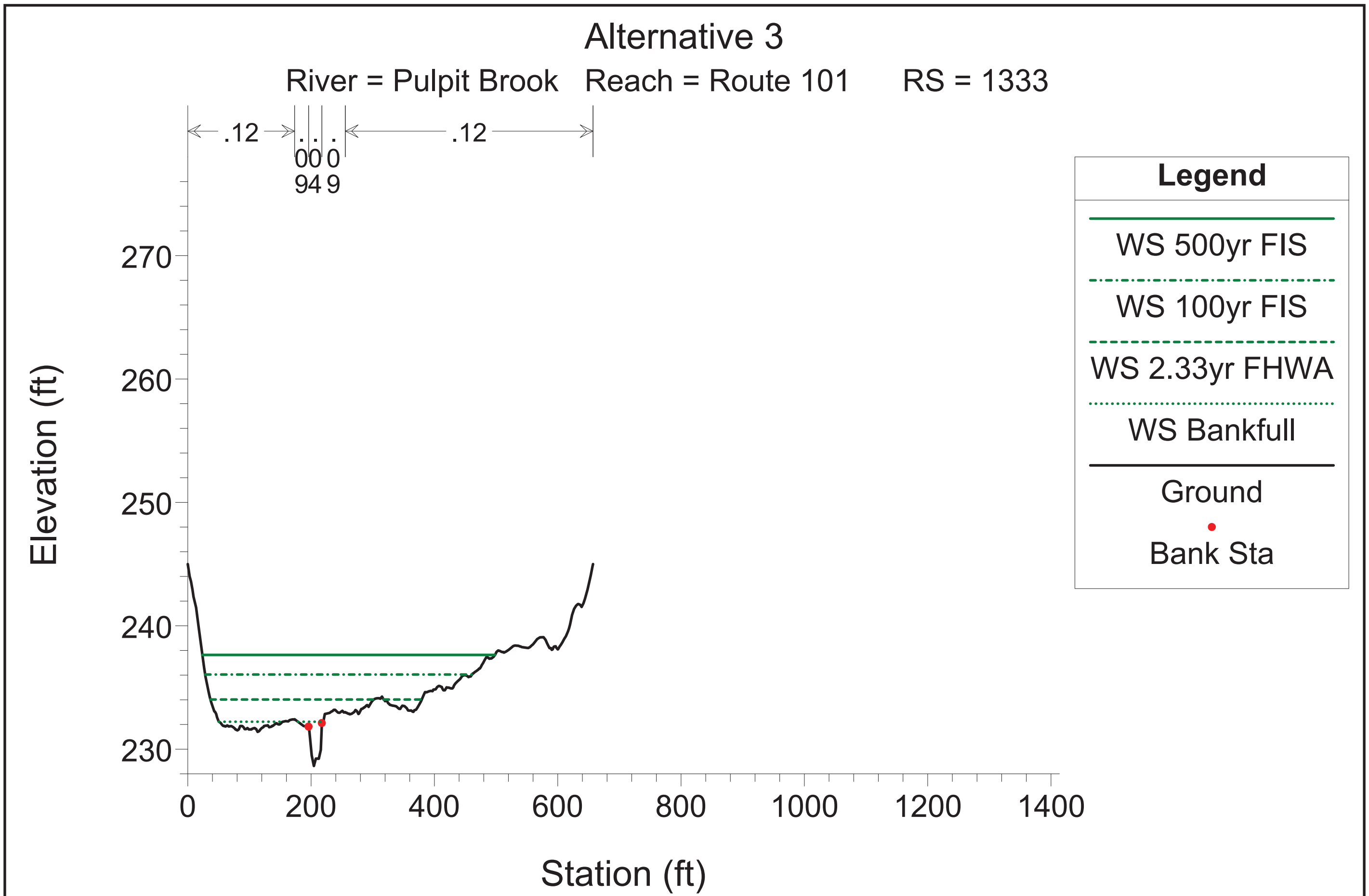
Alternative 3 Hydraulics

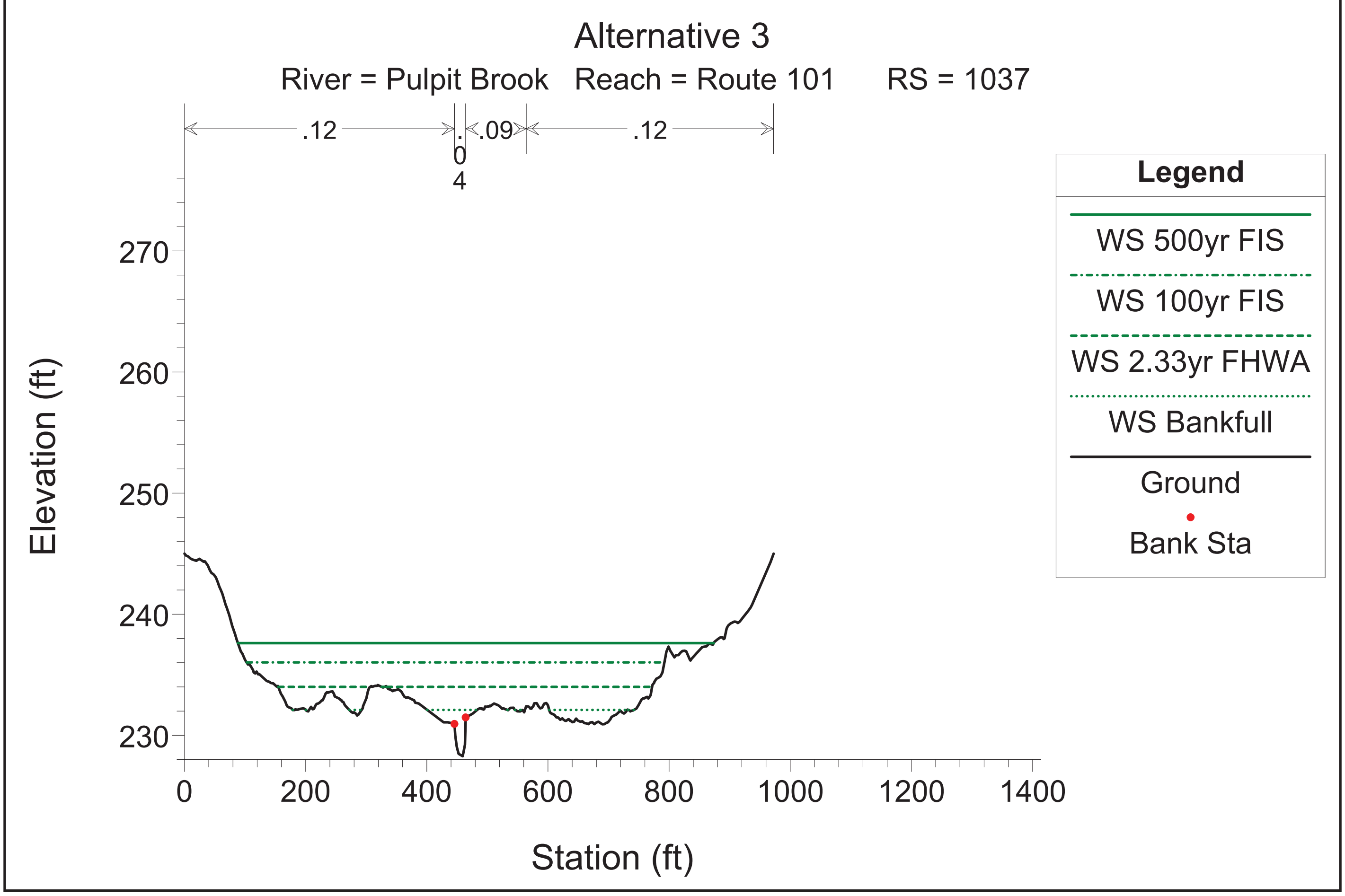
(Conceptual 48-Foot Clear Span Bridge with Stub Abutments)


CONCEPTUAL SITE PLAN
ALTERNATIVE 3
48-FOOT CLEAR SPAN BRIDGE
STUB ABUTMENTS
GRID
NH ROUTE 101
CONCEPTUAL 48-FOOT CLEAR SPAN BRIDGE (STUB ABUTMENTS)
PULPIT BROOK
ABANDONED BRIDGE
XS 717
XS 610
XS 589
XS 544
XS 512
4.8'
22.0'
4.8'
40.0'
48.0'
LEGEND
EXISTING 2' CONTOUR
EXISTING 10' CONTOUR
EXISTING CULVERT
EXISTING TOP OF BANK
STREAM CHANNEL ALIGNMENT
CROSS-SECTION ALIGNMENT
PROPOSED TOP OF BANK
PROPOSED 2' CONTOUR
PROPOSED FLOODPLAIN SURFACE
0 15 30 60
SCALE IN FEET

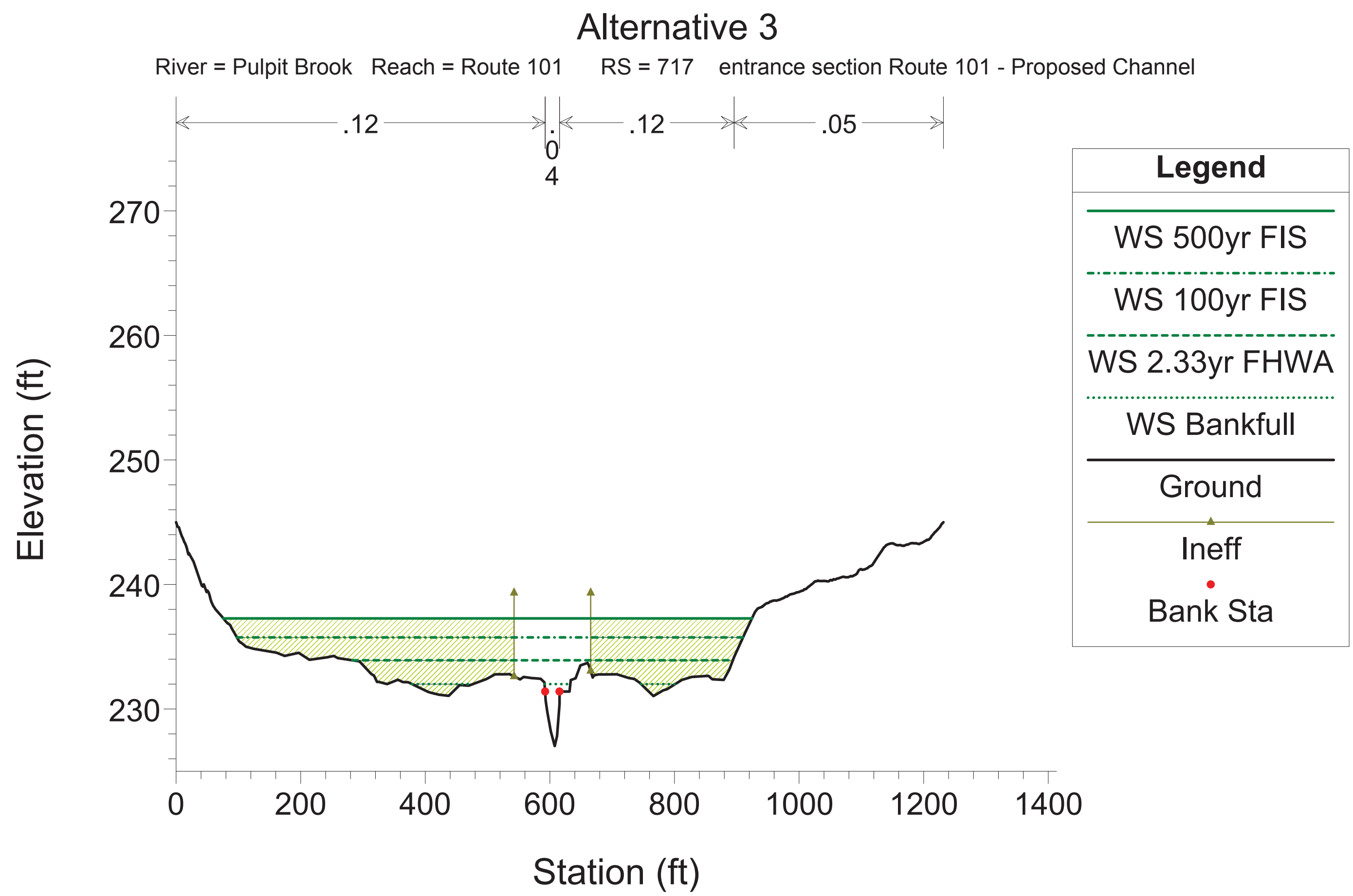


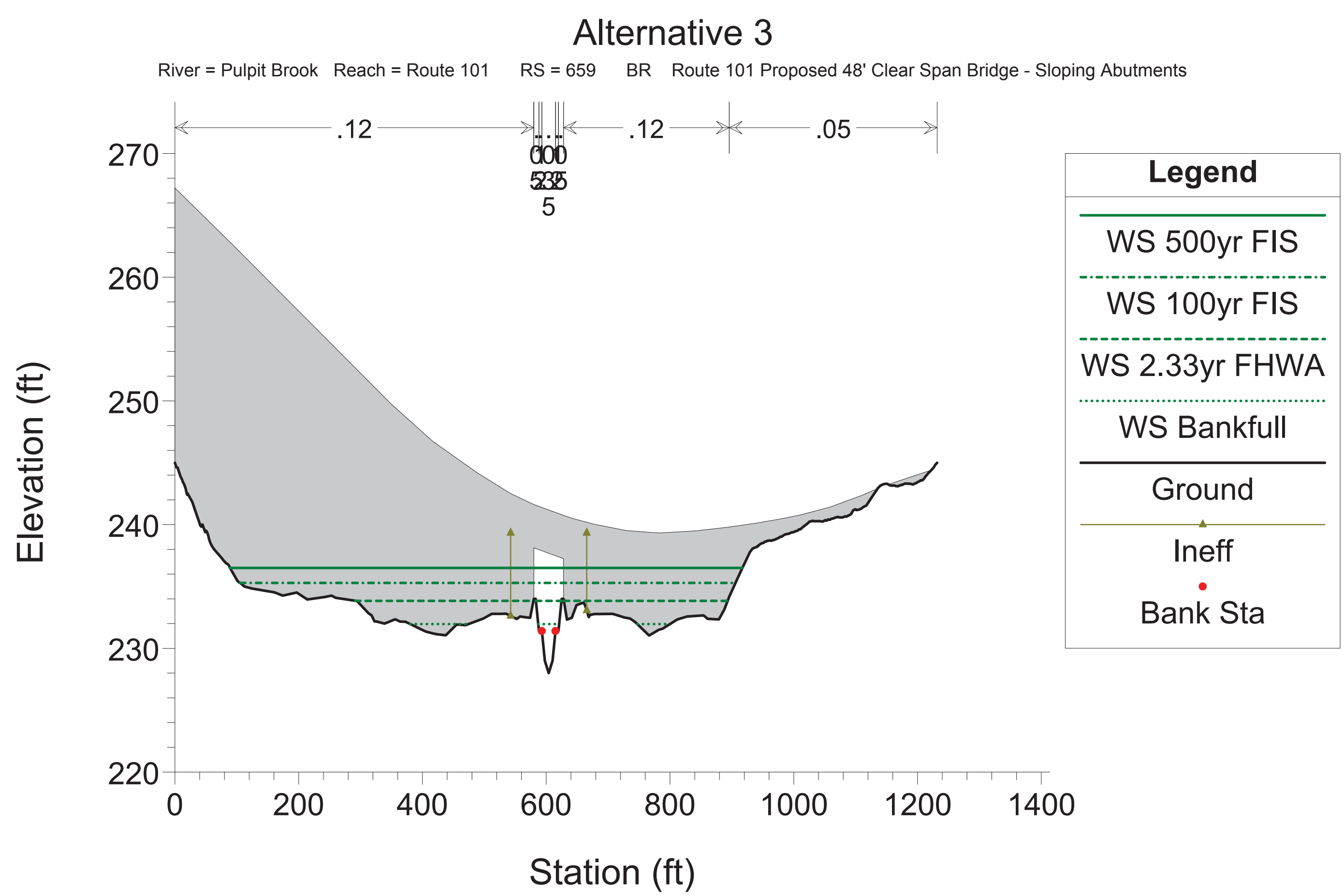
1 in Horiz. = 200 ft 1 in Vert. = 5 ft



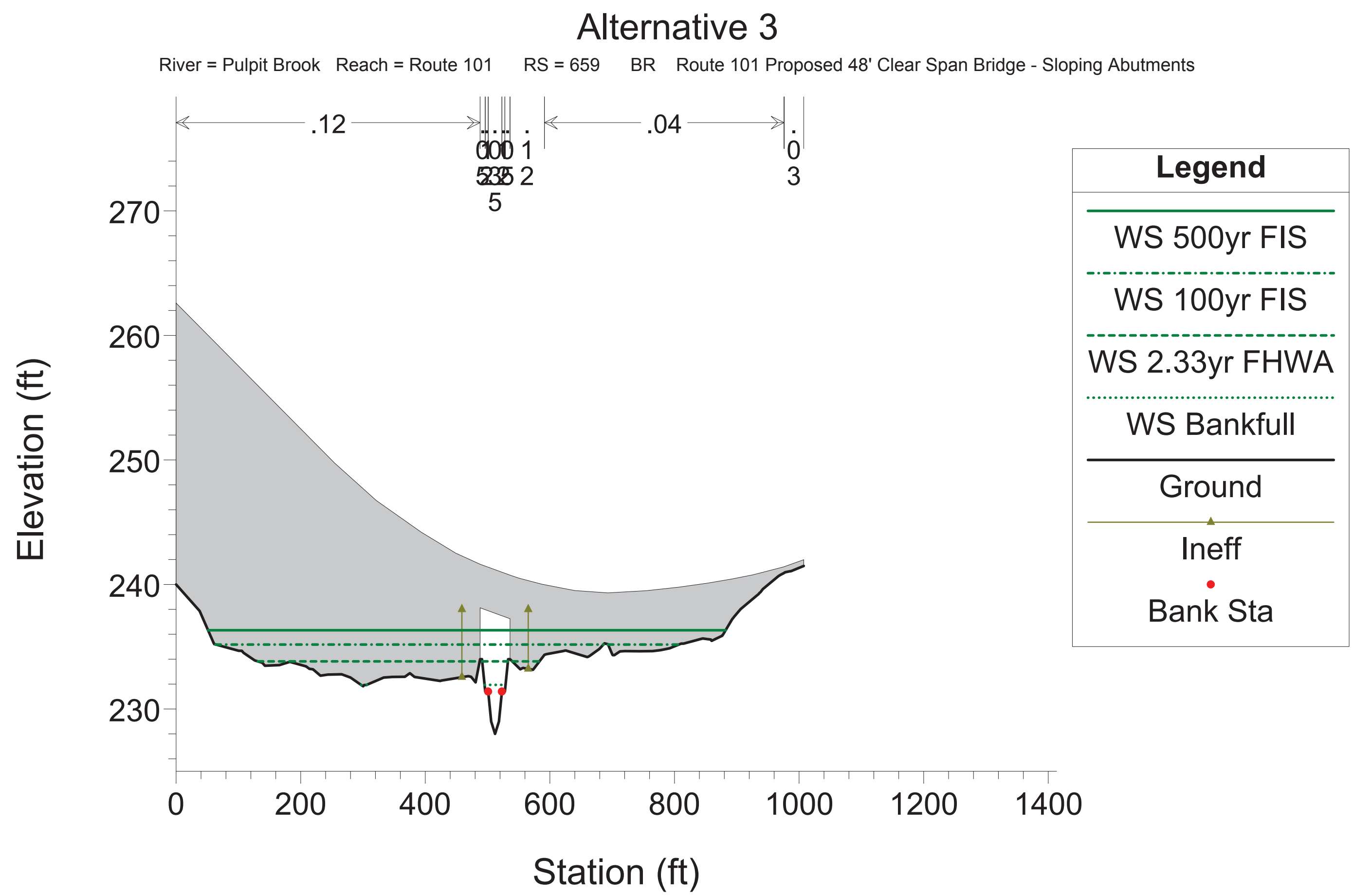


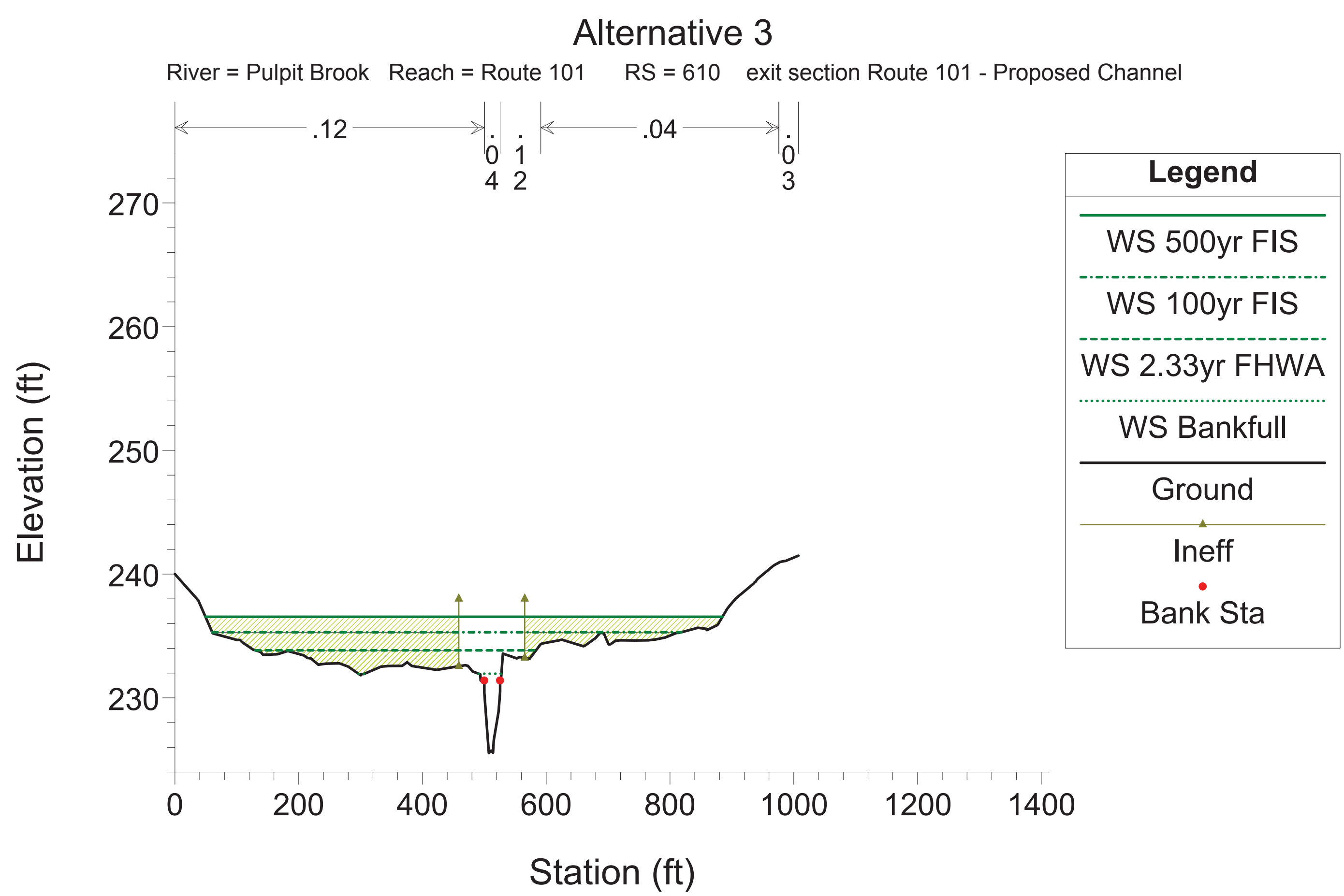
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



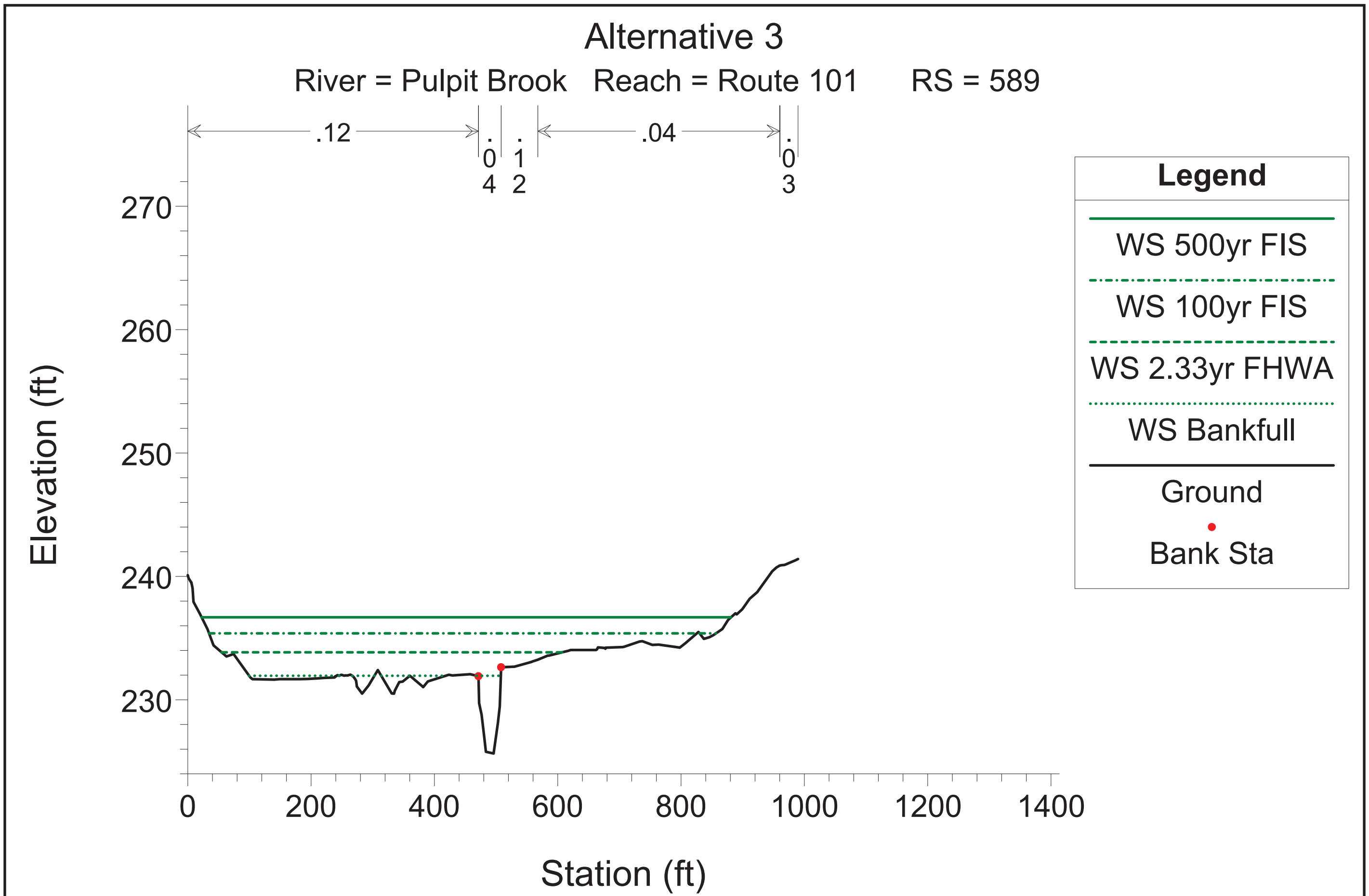


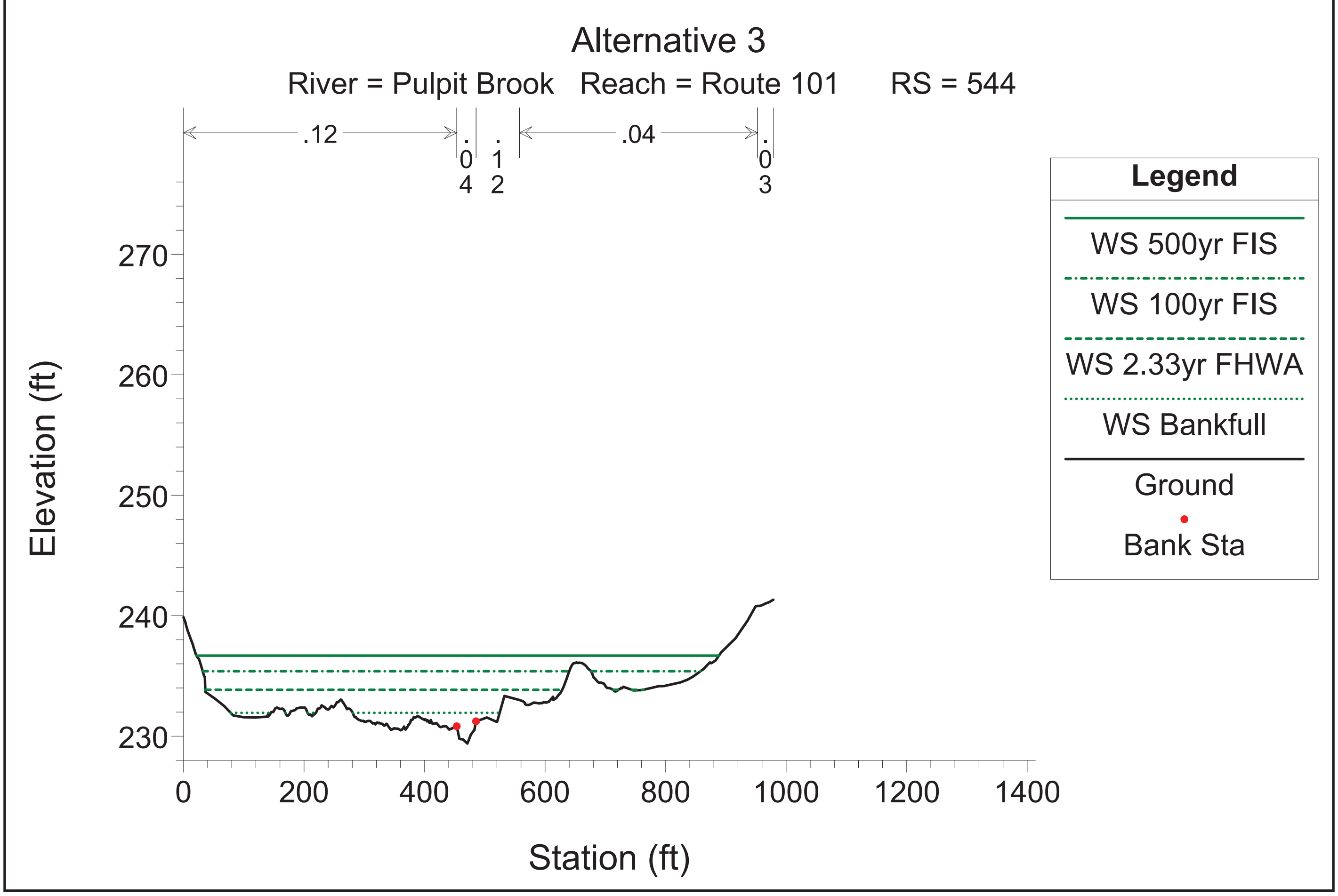
1 in Horiz. = 300 ft   1 in Vert. = 15 ft



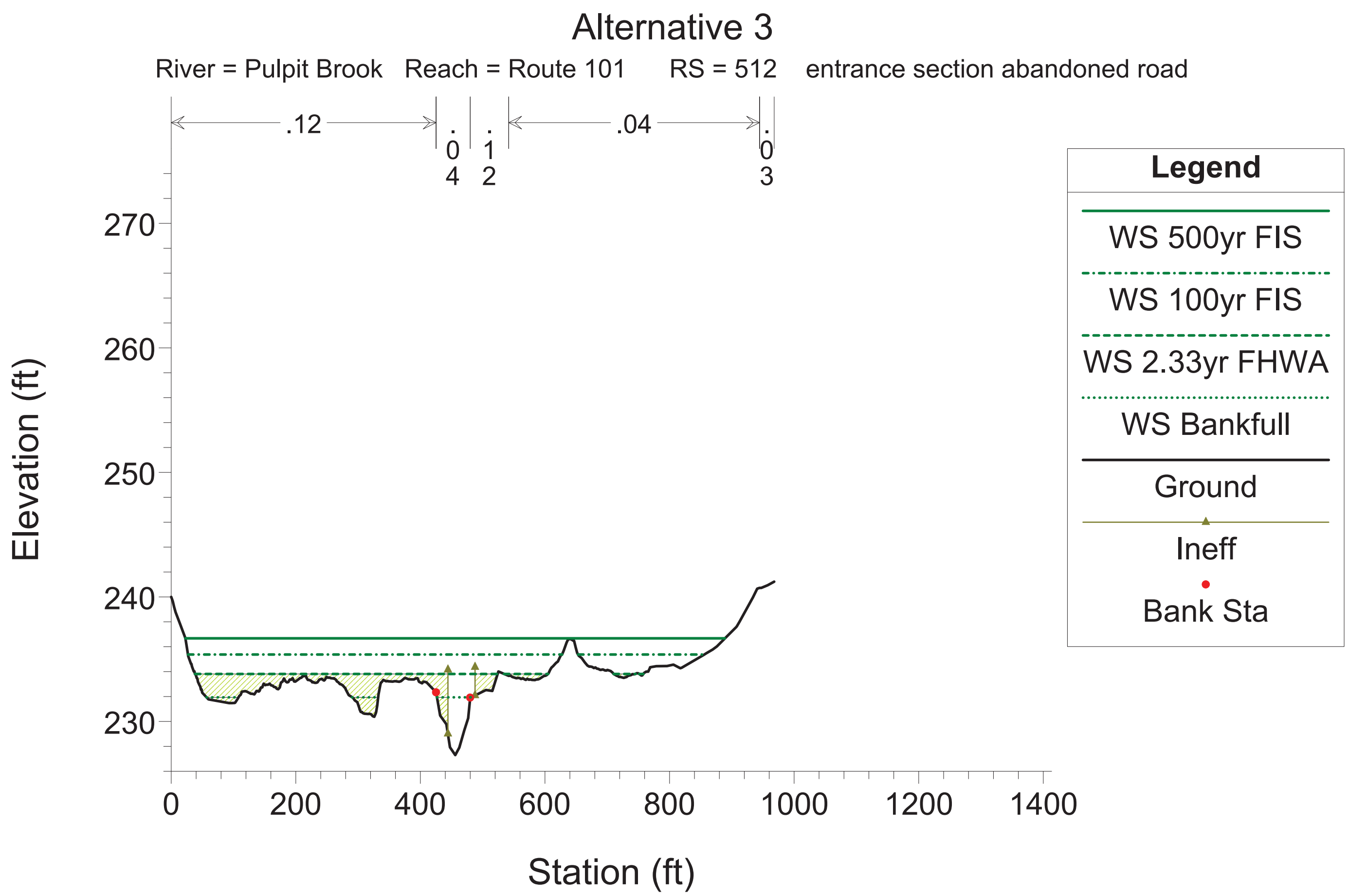


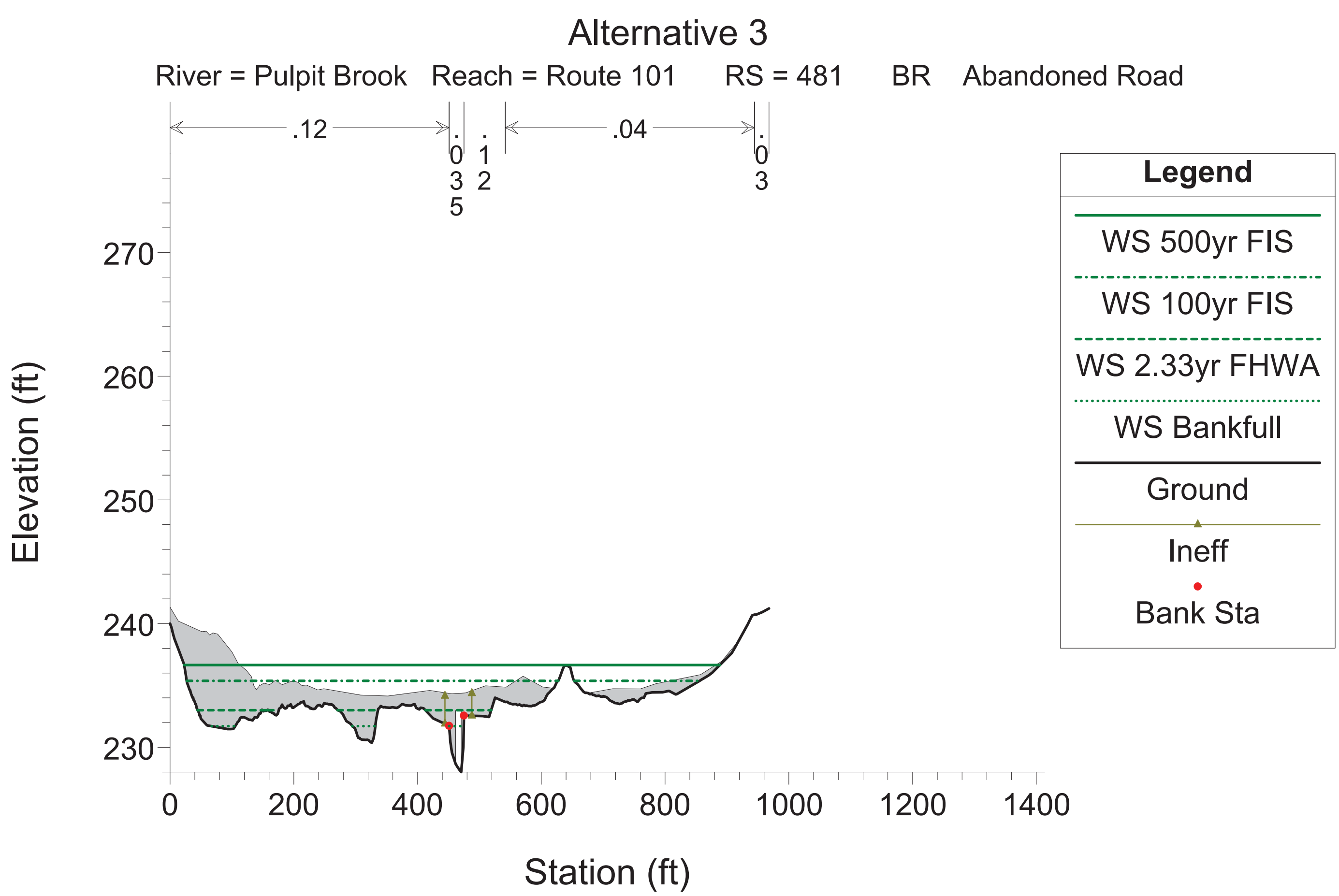
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



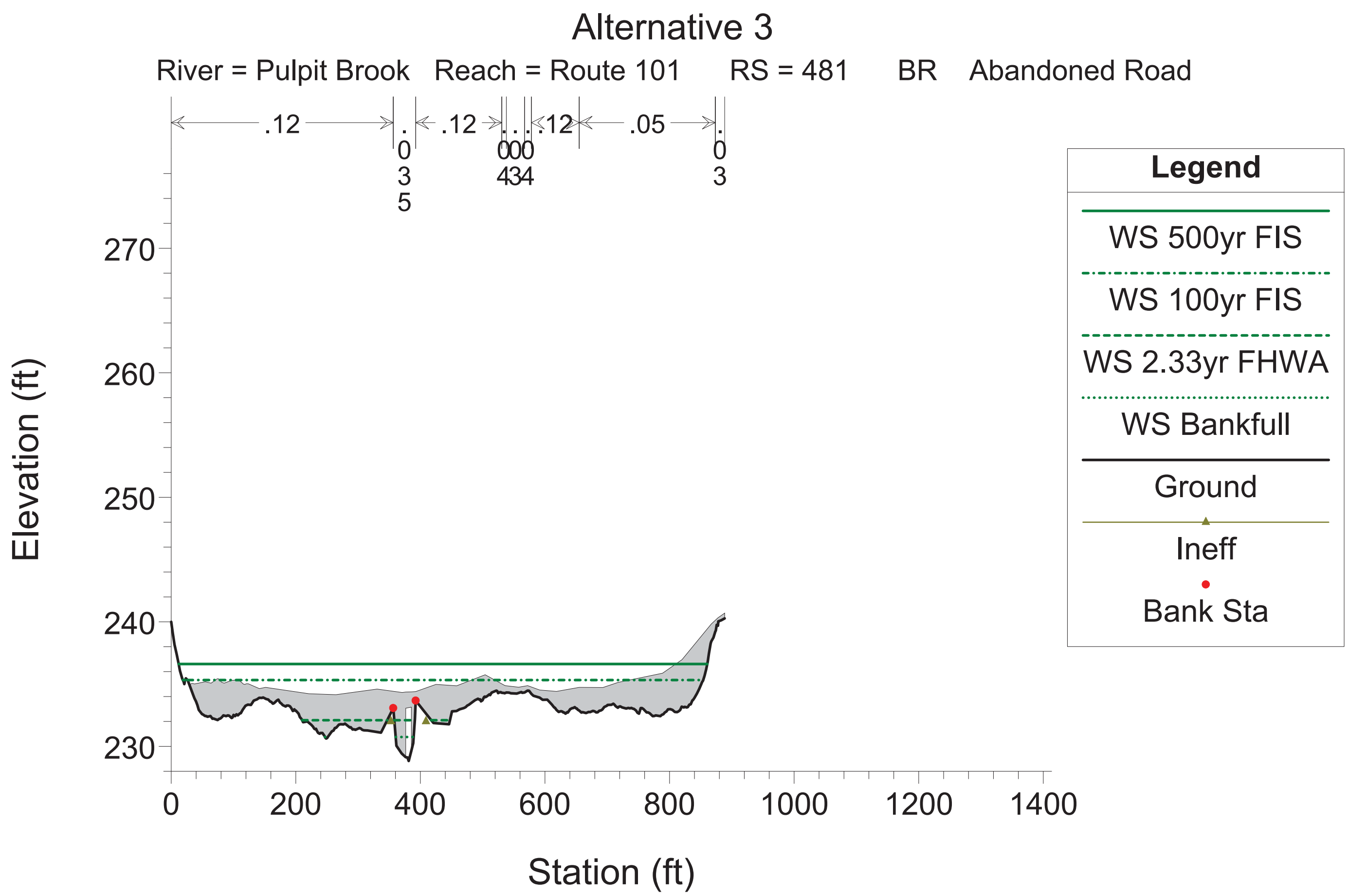


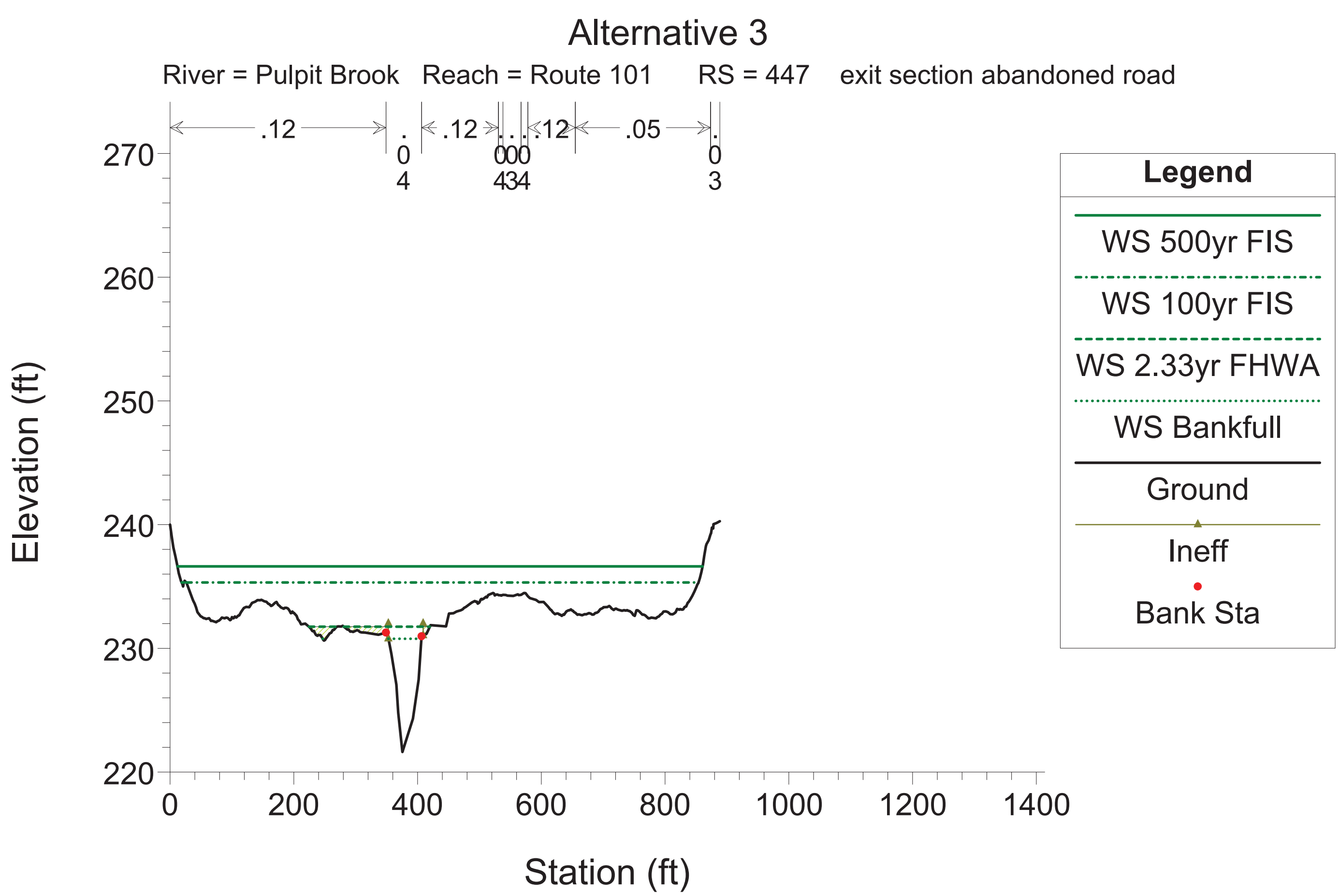
1 in Horiz. = 300 ft 1 in Vert. = 15 ft



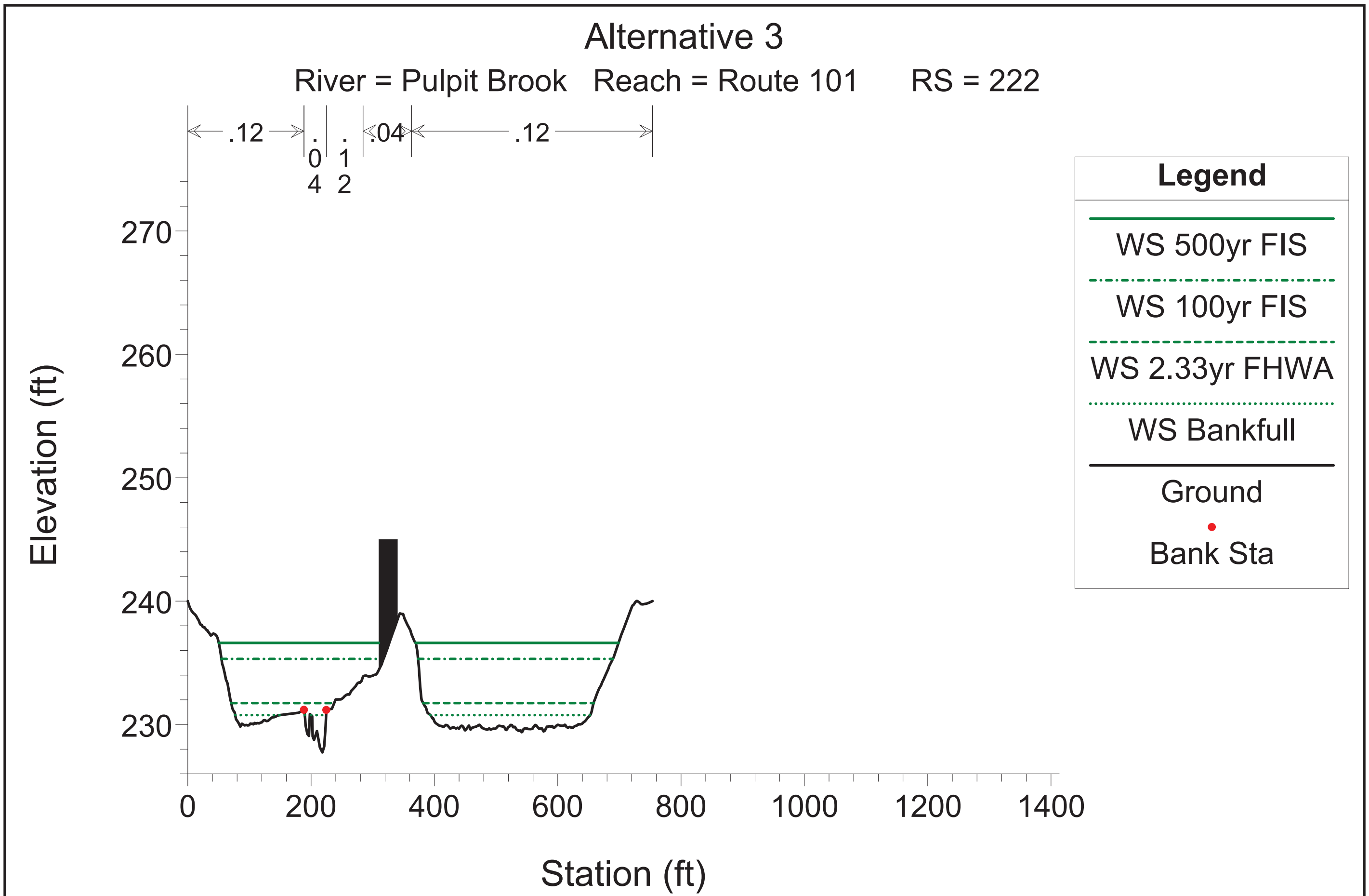


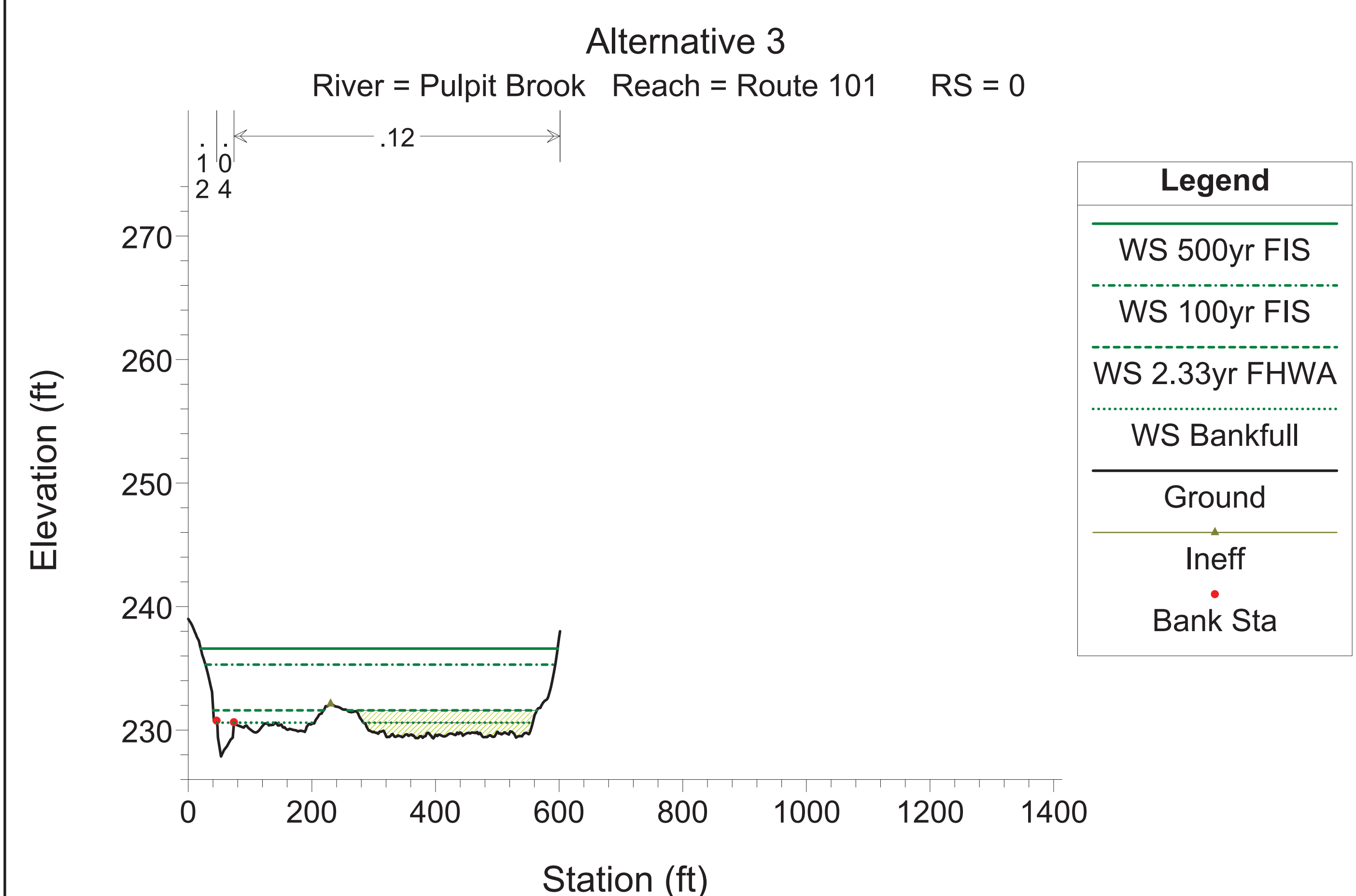
1 in Horiz. = 300 ft 1 in Vert. = 15 ft





1 in Horiz. = 300 ft 1 in Vert. = 15 ft





1 in Horiz. = 300 ft   1 in Vert. = 15 ft

HEC-RAS Plan: Alternative 3 River: Pulpit Brook Reach: Route 101

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	Power Chan
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(lb/ft s)
Route 101	0	Bankfull	105	227.9	230.6	229.5	230.7	0.0014	1.9	97	431	0.26	0.28
Route 101	0	2.33yr FHWA	260	227.9	231.6	230.4	231.7	0.0010	2.3	265	485	0.24	0.38
Route 101	0	10yr FIS	420	227.9	234.2	230.8	234.2	0.0000	0.6	2209	557	0.04	0.01
Route 101	0	50yr FIS	760	227.9	235.1	231.3	235.1	0.0000	0.8	2713	564	0.06	0.01
Route 101	0	100yr FIS	900	227.9	235.3	231.5	235.3	0.0001	1.0	2826	566	0.07	0.02
Route 101	0	100yr FHWA	1090	227.9	235.8	231.7	235.8	0.0001	1.1	3081	570	0.07	0.03
Route 101	0	500yr FIS	1450	227.9	236.6	232.1	236.6	0.0001	1.2	3569	577	0.08	0.04
Route 101	222	Bankfull	105	227.7	230.8		230.8	0.0003	0.9	338	366	0.12	0.03
Route 101	222	2.33yr FHWA	260	227.7	231.7		231.7	0.0002	1.0	743	443	0.11	0.03
Route 101	222	10yr FIS	420	227.7	234.2		234.2	0.0000	0.6	1967	552	0.05	0.01
Route 101	222	50yr FIS	760	227.7	235.1		235.1	0.0001	0.9	2474	568	0.06	0.02
Route 101	222	100yr FIS	900	227.7	235.3		235.3	0.0001	1.0	2589	571	0.07	0.02
Route 101	222	100yr FHWA	1090	227.7	235.8		235.8	0.0001	1.1	2848	577	0.07	0.03
Route 101	222	500yr FIS	1450	227.7	236.6		236.6	0.0001	1.2	3344	589	0.08	0.04
Route 101	447	Bankfull	105	221.6	230.8	223.7	230.8	0.0000	0.4	274	59	0.03	0.00
Route 101	447	2.33yr FHWA	260	221.6	231.8	224.6	231.8	0.0000	0.8	328	184	0.06	0.01
Route 101	447	10yr FIS	420	221.6	234.2	225.2	234.2	0.0000	0.7	1539	744	0.04	0.01
Route 101	447	50yr FIS	760	221.6	235.1	226.2	235.1	0.0000	0.9	2272	825	0.05	0.02
Route 101	447	100yr FIS	900	221.6	235.3	226.6	235.3	0.0000	1.0	2440	832	0.06	0.02
Route 101	447	100yr FHWA	1090	221.6	235.8	227.0	235.8	0.0000	1.0	2819	841	0.06	0.02
Route 101	447	500yr FIS	1450	221.6	236.6	227.7	236.6	0.0000	1.1	3539	849	0.06	0.03
Route 101	481		Bridge										
Route 101	512	Bankfull	105	227.3	231.9	228.7	231.9	0.0001	0.9	119	148	0.08	0.02
Route 101	512	2.33yr FHWA	260	227.3	233.8	229.5	233.8	0.0002	1.4	201	598	0.11	0.07
Route 101	512	10yr FIS	420	227.3	234.8	230.1	234.8	0.0000	0.8	1511	766	0.06	0.01
Route 101	512	50yr FIS	760	227.3	235.2	230.9	235.2	0.0001	1.2	1803	792	0.08	0.04
Route 101	512	100yr FIS	900	227.3	235.4	231.3	235.4	0.0001	1.3	1928	803	0.09	0.05
Route 101	512	100yr FHWA	1090	227.3	235.8	231.7	235.8	0.0001	1.3	2264	824	0.09	0.05
Route 101	512	500yr FIS	1450	227.3	236.7	232.3	236.7	0.0001	1.2	3010	866	0.08	0.05
Route 101	544	Bankfull	105	229.4	231.9		232.0	0.0003	1.1	264	333	0.13	0.04
Route 101	544	2.33yr FHWA	260	229.4	233.9		233.9	0.0001	0.7	1207	621	0.06	0.01
Route 101	544	10yr FIS	420	229.4	234.8		234.9	0.0000	0.7	1911	762	0.05	0.01
Route 101	544	50yr FIS	760	229.4	235.2		235.2	0.0001	1.0	2205	782	0.08	0.03
Route 101	544	100yr FIS	900	229.4	235.4		235.4	0.0001	1.1	2329	790	0.09	0.04
Route 101	544	100yr FHWA	1090	229.4	235.8		235.8	0.0001	1.2	2660	813	0.09	0.04
Route 101	544	500yr FIS	1450	229.4	236.7		236.7	0.0001	1.2	3407	867	0.08	0.04
Route 101	589	Bankfull	105	225.7	232.0		232.0	0.0000	0.6	285	323	0.05	0.01
Route 101	589	2.33yr FHWA	260	225.7	233.9		233.9	0.0000	0.7	1156	553	0.05	0.01
Route 101	589	10yr FIS	420	225.7	234.8		234.9	0.0000	0.7	1827	775	0.05	0.01
Route 101	589	50yr FIS	760	225.7	235.2		235.2	0.0001	1.1	2128	806	0.07	0.03
Route 101	589	100yr FIS	900	225.7	235.4		235.4	0.0001	1.3	2256	818	0.08	0.05
Route 101	589	100yr FHWA	1090	225.7	235.8		235.8	0.0001	1.3	2598	837	0.08	0.05
Route 101	589	500yr FIS	1450	225.7	236.7		236.7	0.0001	1.3	3346	858	0.07	0.05
Route 101	610	Bankfull	105	225.5	232.0	227.3	232.0	0.0001	0.9	122	47	0.07	0.02
Route 101	610	2.33yr FHWA	260	225.5	233.8	228.4	233.9	0.0002	1.5	259	454	0.10	0.08
Route 101	610	10yr FIS	420	225.5	234.8	229.2	234.9	0.0002	1.9	364	682	0.12	0.17
Route 101	610	50yr FIS	760	225.5	235.2	230.4	235.3	0.0006	3.2	400	735	0.20	0.82
Route 101	610	100yr FIS	900	225.5	235.3	230.7	235.5	0.0008	3.7	414	758	0.23	1.25
Route 101	610	100yr FHWA	1090	225.5	235.7	231.2	235.9	0.0009	4.2	456	812	0.26	1.75
Route 101	610	500yr FIS	1450	225.5	236.5	232.1	236.8	0.0011	4.8	547	835	0.28	2.58
Route 101	659		Bridge										
Route 101	717	Bankfull	105	227.0	232.0	229.0	232.0	0.0003	1.3	89	194	0.12	0.07
Route 101	717	2.33yr FHWA	260	227.0	233.9	230.0	233.9	0.0003	1.8	265	611	0.14	0.16
Route 101	717	10yr FIS	420	227.0	234.9	230.7	235.0	0.0003	2.2	391	785	0.15	0.26
Route 101	717	50yr FIS	760	227.0	235.5	231.9	235.6	0.0008	3.4	459	807	0.23	1.00
Route 101	717	100yr FIS	900	227.0	235.7	232.3	235.9	0.0009	3.8	490	812	0.25	1.38
Route 101	717	100yr FHWA	1090	227.0	236.3	233.1	236.4	0.0010	4.2	553	823	0.27	1.74
Route 101	717	500yr FIS	1450	227.0	237.3	234.0	237.5	0.0010	4.6	678	849	0.28	2.22
Route 101	1037	Bankfull	105	228.3	232.1		232.1	0.0003	1.3	204	269	0.13	0.08
Route 101	1037	2.33yr FHWA	260	228.3	234.0		234.0	0.0001	0.9	1123	594	0.07	0.02
Route 101	1037	10yr FIS	420	228.3	235.0		235.0	0.0001	0.9	1786	664	0.06	0.02
Route 101	1037	50yr FIS	760	228.3	235.7		235.7	0.0001	1.2	2250	682	0.08	0.05
Route 101	1037	100yr FIS	900	228.3	236.0		236.0	0.0001	1.3	2457	690	0.09	0.06
Route 101	1037	100yr FHWA	1090	228.3	236.6		236.6	0.0001	1.4	2833	710	0.09	0.06
Route 101	1037	500yr FIS	1450	228.3	237.6		237.6	0.0001	1.4	3621	786	0.09	0.07
Route 101	1333	Bankfull	105	228.6	232.2		232.3	0.0008	1.8	101	144	0.20	0.19
Route 101	1333	2.33yr FHWA	260	228.6	234.0		234.0	0.0002	1.5	526	327	0.12	0.09
Route 101	1333	10yr FIS	420	228.6	235.1		235.1	0.0002	1.5	893	392	0.11	0.08
Route 101	1333	50yr FIS	760	228.6	235.8		235.8	0.0003	2.1	1175	413	0.15	0.22
Route 101	1333	100yr FIS	900	228.6	236.1		236.1	0.0003	2.2	1303	433	0.15	0.27
Route 101	1333	100yr FHWA	1090	228.6	236.6		236.6	0.0003	2.3	1540	448	0.15	0.29
Route 101	1333	500yr FIS	1450	228.6	237.6		237.7	0.0003	2.3	2019	474	0.14	0.28

HEC-RAS Plan: Alternative 3 River: Pulpit Brook Reach: Route 101

Reach	River Sta	Profile	Q Total	Q Channel	W.S. Elev	Vel Chnl	Hydr Depth C	Max Chl Dpth	Top W Chnl	Froude # Chl	Vel Total	Hydr Depth	Shear Chan	Shear LOB	Shear ROB	Vel Left	Vel Right
			(cfs)	(cfs)	(ft)	(ft/s)	(ft)	(ft)	(ft)		(ft/s)	(ft)	(lb/sq ft)	(lb/sq ft)	(lb/sq ft)	(ft/s)	(ft/s)
Route 101	0	Bankfull	105	93	230.6	1.9	1.7	2.7	28	0.26	1.1	0.6	0.1		0.0		0.2
Route 101	0	2.33yr FHWA	260	171	231.6	2.3	2.7	3.7	28	0.24	1.0	1.5	0.2	0.0	0.1	0.3	0.5
Route 101	0	10yr FIS	420	86	234.2	0.6	5.3	6.3	28	0.04	0.2	4.0	0.0	0.0	0.0	0.1	0.2
Route 101	0	50yr FIS	760	147	235.1	0.8	6.2	7.2	28	0.06	0.3	4.8	0.0	0.0	0.0	0.1	0.2
Route 101	0	100yr FIS	900	172	235.3	1.0	6.4	7.4	28	0.07	0.3	5.0	0.0	0.0	0.0	0.2	0.3
Route 101	0	100yr FHWA	1090	203	235.8	1.1	6.9	7.9	28	0.07	0.4	5.4	0.0	0.0	0.0	0.2	0.3
Route 101	0	500yr FIS	1450	260	236.6	1.2	7.7	8.7	28	0.08	0.4	6.2	0.0	0.0	0.0	0.2	0.4
Route 101	222	Bankfull	105	48	230.8	0.9	1.7	3.0	33	0.12	0.3	0.9	0.0	0.0	0.0	0.1	0.2
Route 101	222	2.33yr FHWA	260	88	231.7	1.0	2.5	4.0	36	0.11	0.3	1.7	0.0	0.0	0.0	0.2	0.3
Route 101	222	10yr FIS	420	107	234.2	0.6	5.0	6.5	36	0.05	0.2	3.6	0.0	0.0	0.0	0.2	0.2
Route 101	222	50yr FIS	760	183	235.1	0.9	5.9	7.4	36	0.06	0.3	4.4	0.0	0.0	0.0	0.2	0.3
Route 101	222	100yr FIS	900	214	235.3	1.0	6.1	7.6	36	0.07	0.3	4.5	0.0	0.0	0.0	0.3	0.3
Route 101	222	100yr FHWA	1090	252	235.8	1.1	6.5	8.0	36	0.07	0.4	4.9	0.0	0.0	0.0	0.3	0.3
Route 101	222	500yr FIS	1450	321	236.6	1.2	7.4	8.9	36	0.08	0.4	5.7	0.0	0.0	0.0	0.4	0.4
Route 101	447	Bankfull	105	105	230.8	0.4	5.1	9.2	53	0.03	0.4	5.1	0.0				
Route 101	447	2.33yr FHWA	260	260	231.8	0.8	6.1	10.1	58	0.06	0.8	5.8	0.0		0.0		0.1
Route 101	447	10yr FIS	420	313	234.2	0.7	8.2	12.6	58	0.04	0.3	2.1	0.0	0.0	0.0	0.1	0.1
Route 101	447	50yr FIS	760	465	235.1	0.9	9.1	13.5	58	0.05	0.3	2.8	0.0	0.0	0.0	0.1	0.2
Route 101	447	100yr FIS	900	527	235.3	1.0	9.3	13.7	58	0.06	0.4	2.9	0.0	0.0	0.0	0.2	0.2
Route 101	447	100yr FHWA	1090	584	235.8	1.0	9.7	14.2	58	0.06	0.4	3.4	0.0	0.0	0.0	0.2	0.3
Route 101	447	500yr FIS	1450	668	236.6	1.1	10.6	15.0	58	0.06	0.4	4.2	0.0	0.0	0.0	0.2	0.3
Route 101	481		Bridge														
Route 101	512	Bankfull	105	105	231.9	0.9	3.3	4.6	53	0.08	0.9	3.2	0.0		0.0		0.0
Route 101	512	2.33yr FHWA	260	257	233.8	1.4	5.2	6.5	55	0.11	1.3	4.6	0.0		0.0		0.2
Route 101	512	10yr FIS	420	235	234.8	0.8	5.6	7.5	55	0.06	0.3	2.0	0.0	0.0	0.0	0.1	0.2
Route 101	512	50yr FIS	760	379	235.2	1.2	6.0	7.9	55	0.08	0.4	2.3	0.0	0.0	0.0	0.2	0.3
Route 101	512	100yr FIS	900	430	235.4	1.3	6.1	8.1	55	0.09	0.5	2.4	0.0	0.0	0.0	0.3	0.4
Route 101	512	100yr FHWA	1090	465	235.8	1.3	6.5	8.5	55	0.09	0.5	2.7	0.0	0.0	0.0	0.3	0.4
Route 101	512	500yr FIS	1450	508	236.7	1.2	7.4	9.4	55	0.08	0.5	3.5	0.0	0.0	0.0	0.3	0.5
Route 101	544	Bankfull	105	66	231.9	1.1	2.0	2.6	32	0.13	0.4	0.8	0.0	0.0	0.0	0.2	0.2
Route 101	544	2.33yr FHWA	260	86	233.9	0.7	3.9	4.5	32	0.06	0.2	1.9	0.0	0.0	0.0	0.2	0.2
Route 101	544	10yr FIS	420	104	234.8	0.7	4.9	5.5	32	0.05	0.2	2.5	0.0	0.0	0.0	0.2	0.2
Route 101	544	50yr FIS	760	171	235.2	1.0	5.2	5.8	32	0.08	0.3	2.8	0.0	0.0	0.0	0.3	0.4
Route 101	544	100yr FIS	900	195	235.4	1.1	5.4	6.0	32	0.09	0.4	2.9	0.0	0.0	0.0	0.3	0.4
Route 101	544	100yr FHWA	1090	216	235.8	1.2	5.8	6.4	32	0.09	0.4	3.3	0.0	0.0	0.0	0.3	0.5
Route 101	544	500yr FIS	1450	248	236.7	1.2	6.7	7.3	32	0.08	0.4	3.9	0.0	0.0	0.0	0.3	0.5
Route 101	589	Bankfull	105	100	232.0	0.6	4.7	6.3	36	0.05	0.4	0.9	0.0	0.0		0.0	
Route 101	589	2.33yr FHWA	260	161	233.9	0.7	6.5	8.2	37	0.05	0.2	2.1	0.0	0.0	0.0	0.1	0.1
Route 101	589	10yr FIS	420	203	234.8	0.7	7.5	9.2	37	0.05	0.2	2.4	0.0	0.0	0.0	0.1	0.1
Route 101	589	50yr FIS	760	328	235.2	1.1	7.9	9.6	37	0.07	0.4	2.6	0.0	0.0	0.0	0.2	0.3
Route 101	589	100yr FIS	900	371	235.4	1.3	8.0	9.7	37	0.08	0.4	2.8	0.0	0.0	0.0	0.3	0.3
Route 101	589	100yr FHWA	1090	404	235.8	1.3	8.5	10.1	37	0.08	0.4	3.1	0.0	0.0	0.0	0.3	0.4
Route 101	589	500yr FIS	1450	435	236.7	1.3	9.3	11.0	37	0.07	0.4	3.9	0.0	0.0	0.0	0.3	0.5
Route 101	610	Bankfull	105	105	232.0	0.9	4.6	6.4	26	0.07	0.9	3.3	0.0	0.0	0.0	0.1	0.1
Route 101	610	2.33yr FHWA	260	242	233.8	1.5	6.5	8.3	26	0.10	1.0	2.4	0.1	0.0	0.0	0.2	0.1
Route 101	610	10yr FIS	420	365	234.8	1.9	7.5	9.3	26	0.12	1.2	3.4	0.1	0.0	0.0	0.4	0.3
Route 101	610	50yr FIS	760	646	235.2	3.2	7.8	9.6	26	0.20	1.9	3.8	0.3	0.1	0.1	0.6	0.5
Route 101	610	100yr FIS	900	758	235.3	3.7	8.0	9.8	26	0.23	2.2	3.9	0.3	0.2	0.1	0.7	0.6
Route 101	610	100yr FHWA	1090	896	235.7	4.2	8.4	10.2	26	0.26	2.4	4.3	0.4	0.2	0.1	0.9	0.7
Route 101	610	500yr FIS	1450	1135	236.5	4.8	9.2	11.0	26	0.28	2.7	5.1	0.5	0.3	0.2	1.1	0.9
Route 101	659		Bridge														
Route 101	717	Bankfull	105	104	232.0	1.3	3.4	5.0	23	0.12	1.2	2.2	0.1	0.0	0.0	0.1	0.1
Route 101	717	2.33yr FHWA	260	222	233.9	1.8	5.3	6.9	23	0.14	1.0	2.2	0.1	0.0	0.0	0.3	0.3
Route 101	717	10yr FIS	420	320	234.9	2.2	6.4	7.9	23	0.15	1.1	3.2	0.1	0.1	0.1	0.4	0.4
Route 101	717	50yr FIS	760	549	235.5	3.4	6.9	8.5	23	0.23	1.7	3.7	0.3	0.1	0.1	0.7	0.7
Route 101	717	100yr FIS	900	636	235.7	3.8	7.2	8.7	23	0.25	1.8	4.0	0.4	0.2	0.2	0.8	0.8
Route 101	717	100yr FHWA	1090	741	236.3	4.2	7.7	9.2	23	0.27	2.0	4.5	0.4	0.2	0.2	0.9	0.9
Route 101	717	500yr FIS	1450	924	237.3	4.6	8.7	10.3	23	0.28	2.1	5.5	0.5	0.3	0.3	1.1	1.1
Route 101	1037	Bankfull	105	79	232.1	1.3	3.2	3.8	19	0.13	0.5	0.8	0.1	0.0	0.0	0.2	0.2
Route 101	1037	2.33yr FHWA	260	83	234.0	0.9	5.1	5.7	19	0.07	0.2	1.9	0.0	0.0	0.0	0.1	0.2
Route 101	1037	10yr FIS	420	100	235.0	0.9	6.1	6.8	19	0.06	0.2	2.7	0.0	0.0	0.0	0.2	0.2
Route 101	1037	50yr FIS	760	155	235.7	1.2	6.8	7.5	19	0.08	0.3	3.3	0.0	0.0	0.0	0.2	0.3
Route 101	1037	100yr FIS	900	174	236.0	1.3	7.1	7.8	19	0.09	0.4	3.6	0.0	0.0	0.0	0.3	0.3
Route 101	1037	100yr FHWA	1090	193	236.6	1.4	7.6	8.3	19	0.09	0.4	4.0	0.0	0.0	0.0	0.3	0.4
Route 101	1037	500yr FIS	1450	232	237.6	1.4	8.7	9.3	19	0.09	0.4	4.6	0.0	0.0	0.0	0.3	0.4
Route 101	1333	Bankfull	105	96	232.2	1.8	2.5	3.6	22	0.20	1.0	0.7	0.1	0.0	0.0	0.2	0.1
Route 101	1333	2.33yr FHWA	260	135	234.0	1.5	4.3	5.4	22	0.12	0.5	1.6	0.1	0.0	0.0	0.3	0.2
Route 101	1333	10yr FIS	420	168	235.1	1.5	5.3	6.4	22	0.11	0.5	2.3	0.1	0.0	0.0	0.4	0.3
Route 101	1333	50yr FIS	760	267	235.8	2.1	6.0	7.1	22	0.15	0.6	2.8	0.1	0.1	0.0	0.5	0.4
Route 101	1333	100yr FIS	900	301	236.1	2.2	6.3	7.4	22	0.15	0.7	3.0	0.1	0.1	0.0	0.6	0.4
Route 101	1333	100yr FHWA	1090	336	236.6	2.3	6.9	8.0	22	0.15	0.7	3.4	0.1	0.1	0.1	0.6	0.5
Route 101	1333	500yr FIS	1450	392	237.6	2.3	7.9	9.0	22	0.14	0.7	4.3	0.1	0.1	0.1	0.7	0.5

HEC-RAS Plan: Alternative 3 River: Pulpit Brook Reach: Route 101

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	Area
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)	(sq ft)
Route 101	222	Bankfull	230.8	230.8		0.12	0.00	365.7	5.4	48.5	51.1	0.9	338
Route 101	222	2.33yr FHWA	231.7	231.7		0.08	0.00	443.4	30.9	87.6	141.5	1.0	743
Route 101	222	10yr FIS	234.2	234.2		0.01	0.00	551.8	74.9	107.4	237.7	0.6	1967
Route 101	222	50yr FIS	235.1	235.1		0.01	0.00	568.3	139.2	182.7	438.1	0.9	2474
Route 101	222	100yr FIS	235.3	235.3		0.01	0.00	571.3	165.8	213.7	520.5	1.0	2589
Route 101	222	100yr FHWA	235.8	235.8		0.01	0.00	576.9	202.7	252.0	635.3	1.1	2848
Route 101	222	500yr FIS	236.6	236.6		0.01	0.00	588.8	272.6	321.5	855.9	1.2	3344
Route 101	447	Bankfull	230.8	230.8	223.7	0.01	0.00	58.7		105.0		0.4	275
Route 101	447	2.33yr FHWA	231.8	231.8	224.6	0.02	0.00	183.7		259.9	0.1	0.8	391
Route 101	447	10yr FIS	234.2	234.2	225.2	0.01	0.00	744.0	53.4	313.5	53.1	0.7	1539
Route 101	447	50yr FIS	235.1	235.1	226.2	0.01	0.00	825.2	125.4	464.9	169.7	0.9	2272
Route 101	447	100yr FIS	235.3	235.3	226.6	0.01	0.00	831.6	153.8	527.4	218.7	1.0	2440
Route 101	447	100yr FHWA	235.8	235.8	227.0	0.01	0.00	841.0	196.5	584.5	309.0	1.0	2819
Route 101	447	500yr FIS	236.6	236.6	227.7	0.01	0.00	848.6	284.1	668.1	497.8	1.1	3539
Route 101	481 BR D	Bankfull	231.6	230.8	230.8	0.00	0.40	9.0		105.0		7.2	15
Route 101	481 BR D	2.33yr FHWA	233.6	232.1	232.1			9.0		260.0		9.8	27
Route 101	481 BR D	10yr FIS	234.8	234.8	234.9			440.2	178.8	202.2	34.7	3.8	183
Route 101	481 BR D	50yr FIS	235.2	235.2	235.2			610.2	442.7	120.9	195.6	1.8	363
Route 101	481 BR D	100yr FIS	235.4	235.3	235.3			664.3	522.0	108.9	283.8	1.5	450
Route 101	481 BR D	100yr FHWA	235.8	235.8	235.3			762.5	572.0	85.7	419.1	1.0	775
Route 101	481 BR D	500yr FIS	236.6	236.6	235.5	0.00	0.01	798.0	465.5	277.2	707.2	2.4	1438
Route 101	481 BR U	Bankfull	231.9	231.7	229.9	0.14	0.19	9.0		105.0		3.4	31
Route 101	481 BR U	2.33yr FHWA	233.8	233.0	231.3					260.0		6.2	42
Route 101	481 BR U	10yr FIS	234.8	234.8	232.4			397.7	178.8	202.2	34.7	3.8	178
Route 101	481 BR U	50yr FIS	235.2	235.2	235.2			561.3	442.7	120.9	195.6	1.9	360
Route 101	481 BR U	100yr FIS	235.4	235.4	235.3			619.3	522.0	108.9	283.8	1.6	453
Route 101	481 BR U	100yr FHWA	235.8	235.8	235.3			698.7	572.0	85.7	419.1	1.1	726
Route 101	481 BR U	500yr FIS	236.7	236.6	235.5	0.03	0.00	768.5	414.2	208.9	826.8	2.2	1355
Route 101	512	Bankfull	231.9	231.9	228.7	0.01	0.05	147.7		105.0	0.0	0.9	205
Route 101	512	2.33yr FHWA	233.8	233.8	229.5			598.5		256.8	3.2	1.4	808
Route 101	512	10yr FIS	234.8	234.8	230.1			766.1	121.2	235.1	63.7	0.8	1511
Route 101	512	50yr FIS	235.2	235.2	230.9			791.8	227.3	379.4	153.3	1.2	1803
Route 101	512	100yr FIS	235.4	235.4	231.3			803.2	272.0	429.9	198.2	1.3	1928
Route 101	512	100yr FHWA	235.8	235.8	231.7			824.4	333.8	465.4	290.8	1.3	2264
Route 101	512	500yr FIS	236.7	236.7	232.3	0.00	0.01	865.9	445.8	508.4	495.9	1.2	3010
Route 101	544	Bankfull	232.0	231.9		0.01	0.00	332.5	35.5	66.3	3.2	1.1	264
Route 101	544	2.33yr FHWA	233.9	233.9		0.00	0.01	621.4	139.6	85.8	34.6	0.7	1207
Route 101	544	10yr FIS	234.9	234.8		0.00	0.00	761.6	217.5	103.8	98.7	0.7	1911
Route 101	544	50yr FIS	235.2	235.2		0.00	0.00	781.6	380.6	170.7	208.8	1.0	2205
Route 101	544	100yr FIS	235.4	235.4		0.00	0.00	789.7	444.6	194.8	260.6	1.1	2329
Route 101	544	100yr FHWA	235.8	235.8		0.00	0.00	812.9	520.7	216.4	352.9	1.2	2660
Route 101	544	500yr FIS	236.7	236.7		0.00	0.00	867.0	650.0	248.2	551.8	1.2	3407
Route 101	589	Bankfull	232.0	232.0		0.00	0.00	322.9	5.3	99.7		0.6	285
Route 101	589	2.33yr FHWA	233.9	233.9		0.00	0.00	552.6	94.0	160.9	5.1	0.7	1156
Route 101	589	10yr FIS	234.9	234.8		0.00	0.00	774.8	179.1	202.5	38.4	0.7	1827
Route 101	589	50yr FIS	235.2	235.2		0.00	0.00	806.0	326.0	328.0	106.0	1.1	2128
Route 101	589	100yr FIS	235.4	235.4		0.00	0.00	818.1	385.6	371.4	143.0	1.3	2256
Route 101	589	100yr FHWA	235.8	235.8		0.00	0.00	836.6	463.9	404.0	222.2	1.3	2598
Route 101	589	500yr FIS	236.7	236.7		0.00	0.00	858.3	592.4	435.1	422.5	1.3	3346
Route 101	610	Bankfull	232.0	232.0	227.3	0.00	0.00	47.1	0.2	104.7	0.1	0.9	122
Route 101	610	2.33yr FHWA	233.9	233.8	228.4	0.00	0.01	453.6	14.7	242.4	2.9	1.5	616
Route 101	610	10yr FIS	234.9	234.8	229.2	0.00	0.02	681.9	38.2	365.3	16.5	1.9	1133
Route 101	610	50yr FIS	235.3	235.2	230.4	0.00	0.07	734.9	76.9	646.1	37.1	3.2	1374
Route 101	610	100yr FIS	235.5	235.3	230.7	0.00	0.09	758.3	94.5	758.2	47.3	3.7	1477
Route 101	610	100yr FHWA	235.9	235.7	231.2	0.00	0.11	812.0	125.5	895.9	68.6	4.2	1781
Route 101	610	500yr FIS	236.8	236.5	232.1	0.00	0.14	835.3	194.5	1135.0	120.6	4.8	2484
Route 101	659 BR D	Bankfull	232.0	231.9	229.8	0.01	0.02	33.8	0.5	103.9	0.5	1.8	65
Route 101	659 BR D	2.33yr FHWA	233.9	233.8	230.8	0.01	0.03	41.3	9.4	241.1	9.4	2.4	136
Route 101	659 BR D	10yr FIS	234.9	234.8	231.5	0.01	0.04	48.0	22.6	374.7	22.6	3.1	181
Route 101	659 BR D	50yr FIS	235.5	235.1	232.7	0.03	0.12	48.0	45.2	669.6	45.2	5.2	195
Route 101	659 BR D	100yr FIS	235.7	235.2	233.0	0.04	0.16	48.0	55.3	789.5	55.3	6.0	200
Route 101	659 BR D	100yr FHWA	236.2	235.5	233.5	0.04	0.20	48.0	73.6	942.8	73.6	6.8	217
Route 101	659 BR D	500yr FIS	237.1	236.3	234.4	0.05	0.26	48.0	114.1	1221.8	114.1	7.8	255
Route 101	659 BR U	Bankfull	232.0	232.0	229.8	0.02	0.00	33.8	0.6	103.9	0.6	1.7	66
Route 101	659 BR U	2.33yr FHWA	233.9	233.8	230.8	0.02	0.00	41.4	9.5	241.0	9.5	2.4	137
Route 101	659 BR U	10yr FIS	235.0	234.8	231.5	0.02	0.00	48.0	22.8	374.3	22.8	3.0	183
Route 101	659 BR U	50yr FIS	235.5	235.2	232.7	0.06	0.00	48.0	46.3	667.4	46.3	5.1	199
Route 101	659 BR U	100yr FIS	235.8	235.3	233.0	0.08	0.01	48.0	57.1	785.9	57.1	5.9	205
Route 101	659 BR U	100yr FHWA	236.3	235.7	233.5	0.09	0.01	48.0	76.0	938.1	76.0	6.6	223
Route 101	659 BR U	500yr FIS	237.3	236.5	234.4	0.10	0.01	48.0	116.9	1216.2	116.9	7.6	263
Route 101	717	Bankfull	232.0	232.0	229.0	0.01	0.01	194.0	0.0	103.6	1.4	1.3	162
Route 101	717	2.33yr FHWA	233.9	233.9	230.0	0.01	0.01	610.6	19.8	222.2	18.0	1.8	1069
Route 101	717	10yr FIS	235.0	234.9	230.7	0.02	0.02	785.3	51.5	319.6	48.9	2.2	1800
Route 101	717	50yr FIS	235.6	235.5	231.9	0.04	0.07	807.2	107.7	549.1	103.2	3.4	2244
Route 101	717	100yr FIS	235.9	235.7	232.3	0.05	0.09	812.3	134.5	636.3	129.3	3.8	2452
Route 101	717	100yr FHWA	236.4	236.3	233.1	0.05	0.12	822.9	177.4	741.0	171.5	4.2	2868
Route 101	717	500yr FIS	237.5	237.3	234.0	0.06	0.17	848.6	266.7	923.6	259.7	4.6	3717
Route 101	1037	Bankfull	232.1	232.1		0.10	0.00	269.1	6.5	79.1	19.4	1.3	204
Route 101	1037	2.33yr FHWA	234.0	234.0		0.04	0.01	594.3	53.6	83.4	123.0	0.9	1123
Route 101	1037	10yr FIS	235.0	235.0		0.04	0.02	663.6	112.0	100.0	208.0	0.9	1786

HEC-RAS Plan: Alternative 3 River: Pulpit Brook Reach: Route 101 (Continued)

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	Area
			(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(cfs)	(cfs)	(cfs)	(ft/s)	(sq ft)
Route 101	1037	50yr FIS	235.7	235.7		0.07	0.04	682.0	225.2	155.2	379.6	1.2	2250
Route 101	1037	100yr FIS	236.0	236.0		0.08	0.05	689.7	275.6	173.8	450.6	1.3	2457
Route 101	1037	100yr FHWA	236.6	236.6		0.07	0.05	710.5	352.1	192.5	545.4	1.4	2833
Route 101	1037	500yr FIS	237.6	237.6		0.07	0.06	785.6	522.7	231.6	695.7	1.4	3621

Plan: Alternative 3 Pulpit Brook Route 101 RS: 659 Profile: Bankfull

E.G. US. (ft)	232.02	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	232.00	E.G. Elev (ft)	232.01	231.99
Q Total (cfs)	105.00	W.S. Elev (ft)	231.96	231.94
Q Bridge (cfs)	105.00	Crit W.S. (ft)	229.81	229.81
Q Weir (cfs)		Max Chl Dpth (ft)	3.96	3.94
Weir Sta Lft (ft)		Vel Total (ft/s)	1.60	1.61
Weir Sta Rgt (ft)		Flow Area (sq ft)	65.76	65.08
Weir Submerg		Froude # Chl	0.19	0.19
Weir Max Depth (ft)		Specif Force (cu ft)	99.08	97.81
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	1.94	1.93
Min El Prs (ft)	238.13	W.P. Total (ft)	35.39	35.30
Delta EG (ft)	0.06	Conv. Total (cfs)	4809.1	4747.1
Delta WS (ft)	0.05	Top Width (ft)	33.84	33.75
BR Open Area (sq ft)	320.28	Frctn Loss (ft)	0.02	0.01
BR Open Vel (ft/s)	1.61	C & E Loss (ft)	0.00	0.02
Coef of Q		Shear Total (lb/sq ft)	0.06	0.06
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 3 Pulpit Brook Route 101 RS: 659 Profile: 2.33yr FHWA

E.G. US. (ft)	233.95	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	233.91	E.G. Elev (ft)	233.92	233.91
Q Total (cfs)	260.00	W.S. Elev (ft)	233.84	233.82
Q Bridge (cfs)	260.00	Crit W.S. (ft)	230.77	230.77
Q Weir (cfs)		Max Chl Dpth (ft)	5.84	5.82
Weir Sta Lft (ft)		Vel Total (ft/s)	1.90	1.91
Weir Sta Rgt (ft)		Flow Area (sq ft)	136.61	135.85
Weir Submerg		Froude # Chl	0.20	0.20
Weir Max Depth (ft)		Specif Force (cu ft)	300.02	297.59
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	3.30	3.29
Min El Prs (ft)	238.13	W.P. Total (ft)	43.82	43.74
Delta EG (ft)	0.08	Conv. Total (cfs)	12347.0	12256.2
Delta WS (ft)	0.06	Top Width (ft)	41.37	41.30
BR Open Area (sq ft)	320.28	Frctn Loss (ft)	0.02	0.01
BR Open Vel (ft/s)	1.91	C & E Loss (ft)	0.00	0.03
Coef of Q		Shear Total (lb/sq ft)	0.09	0.09
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 3 Pulpit Brook Route 101 RS: 659 Profile: 10yr FIS

E.G. US. (ft)	234.99	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	234.93	E.G. Elev (ft)	234.95	234.93
Q Total (cfs)	420.00	W.S. Elev (ft)	234.82	234.80
Q Bridge (cfs)	420.00	Crit W.S. (ft)	231.52	231.52
Q Weir (cfs)		Max Chl Dpth (ft)	6.82	6.80
Weir Sta Lft (ft)		Vel Total (ft/s)	2.30	2.32
Weir Sta Rgt (ft)		Flow Area (sq ft)	182.54	181.36
Weir Submerg		Froude # Chl	0.20	0.20

Plan: Alternative 3 Pulpit Brook Route 101 RS: 659 Profile: 10yr FIS (Continued)

Weir Max Depth (ft)		Specif Force (cu ft)	474.01	469.78
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	3.80	3.78
Min El Prs (ft)	238.13	W.P. Total (ft)	52.16	52.11
Delta EG (ft)	0.11	Conv. Total (cfs)	17702.8	17553.4
Delta WS (ft)	0.10	Top Width (ft)	48.00	48.00
BR Open Area (sq ft)	320.28	Frctn Loss (ft)	0.02	0.01
BR Open Vel (ft/s)	2.32	C & E Loss (ft)	0.00	0.04
Coef of Q		Shear Total (lb/sq ft)	0.12	0.12
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 3 Pulpit Brook Route 101 RS: 659 Profile: 50yr FIS

E.G. US. (ft)	235.62	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	235.49	E.G. Elev (ft)	235.52	235.45
Q Total (cfs)	760.00	W.S. Elev (ft)	235.15	235.08
Q Bridge (cfs)	760.00	Crit W.S. (ft)	232.65	232.65
Q Weir (cfs)		Max Chl Dpth (ft)	7.15	7.08
Weir Sta Lft (ft)		Vel Total (ft/s)	3.83	3.90
Weir Sta Rgt (ft)		Flow Area (sq ft)	198.50	194.77
Weir Submerg		Froude # Chl	0.32	0.33
Weir Max Depth (ft)		Specif Force (cu ft)	611.17	597.94
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	4.14	4.06
Min El Prs (ft)	238.13	W.P. Total (ft)	52.83	52.67
Delta EG (ft)	0.32	Conv. Total (cfs)	19786.0	19289.7
Delta WS (ft)	0.32	Top Width (ft)	48.00	48.00
BR Open Area (sq ft)	320.28	Frctn Loss (ft)	0.06	0.03
BR Open Vel (ft/s)	3.90	C & E Loss (ft)	0.00	0.12
Coef of Q		Shear Total (lb/sq ft)	0.35	0.36
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 3 Pulpit Brook Route 101 RS: 659 Profile: 100yr FIS

E.G. US. (ft)	235.91	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	235.74	E.G. Elev (ft)	235.77	235.68
Q Total (cfs)	900.00	W.S. Elev (ft)	235.29	235.18
Q Bridge (cfs)	900.00	Crit W.S. (ft)	233.03	233.03
Q Weir (cfs)		Max Chl Dpth (ft)	7.29	7.18
Weir Sta Lft (ft)		Vel Total (ft/s)	4.39	4.50
Weir Sta Rgt (ft)		Flow Area (sq ft)	205.09	199.80
Weir Submerg		Froude # Chl	0.36	0.37
Weir Max Depth (ft)		Specif Force (cu ft)	678.40	659.98
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	4.27	4.16
Min El Prs (ft)	238.13	W.P. Total (ft)	53.10	52.88
Delta EG (ft)	0.42	Conv. Total (cfs)	20674.5	19959.8
Delta WS (ft)	0.44	Top Width (ft)	48.00	48.00
BR Open Area (sq ft)	320.28	Frctn Loss (ft)	0.08	0.04
BR Open Vel (ft/s)	4.50	C & E Loss (ft)	0.01	0.16
Coef of Q		Shear Total (lb/sq ft)	0.46	0.48

Plan: Alternative 3 Pulpit Brook Route 101 RS: 659 Profile: 100yr FIS (Continued)

Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 3 Pulpit Brook Route 101 RS: 659 Profile: 100yr FHWA

E.G. US. (ft)	236.44	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	236.25	E.G. Elev (ft)	236.27	236.17
Q Total (cfs)	1090.00	W.S. Elev (ft)	235.67	235.53
Q Bridge (cfs)	1090.00	Crit W.S. (ft)	233.50	233.51
Q Weir (cfs)		Max Chl Dpth (ft)	7.67	7.53
Weir Sta Lft (ft)		Vel Total (ft/s)	4.88	5.03
Weir Sta Rgt (ft)		Flow Area (sq ft)	223.44	216.82
Weir Submerg		Froude # Chl	0.39	0.41
Weir Max Depth (ft)		Specif Force (cu ft)	812.47	788.23
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	4.65	4.52
Min El Prs (ft)	238.13	W.P. Total (ft)	53.87	53.59
Delta EG (ft)	0.52	Conv. Total (cfs)	23231.9	22296.0
Delta WS (ft)	0.56	Top Width (ft)	48.00	48.00
BR Open Area (sq ft)	320.28	Frctn Loss (ft)	0.09	0.04
BR Open Vel (ft/s)	5.03	C & E Loss (ft)	0.01	0.20
Coef of Q		Shear Total (lb/sq ft)	0.57	0.60
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

Plan: Alternative 3 Pulpit Brook Route 101 RS: 659 Profile: 500yr FIS

E.G. US. (ft)	237.49	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	237.27	E.G. Elev (ft)	237.26	237.15
Q Total (cfs)	1450.00	W.S. Elev (ft)	236.49	236.33
Q Bridge (cfs)	1450.00	Crit W.S. (ft)	234.44	234.44
Q Weir (cfs)		Max Chl Dpth (ft)	8.49	8.33
Weir Sta Lft (ft)		Vel Total (ft/s)	5.52	5.69
Weir Sta Rgt (ft)		Flow Area (sq ft)	262.87	254.99
Weir Submerg		Froude # Chl	0.43	0.44
Weir Max Depth (ft)		Specif Force (cu ft)	1114.76	1081.52
Min El Weir Flow (ft)	239.33	Hydr Depth (ft)	5.48	5.31
Min El Prs (ft)	238.13	W.P. Total (ft)	55.51	55.18
Delta EG (ft)	0.65	Conv. Total (cfs)	29127.5	27907.2
Delta WS (ft)	0.72	Top Width (ft)	48.00	48.00
BR Open Area (sq ft)	320.28	Frctn Loss (ft)	0.10	0.05
BR Open Vel (ft/s)	5.69	C & E Loss (ft)	0.01	0.26
Coef of Q		Shear Total (lb/sq ft)	0.73	0.78
Br Sel Method	Energy only	Power Total (lb/ft s)	0.00	0.00

cHECk-RAS Report

HEC-RAS Project: *pulpit101.prj*
Plan File: *pulpit101.p05*
Geometry File: *pulpit101.g05*
Flow File: *pulpit101.f01*
Report Date: *9/20/2017*

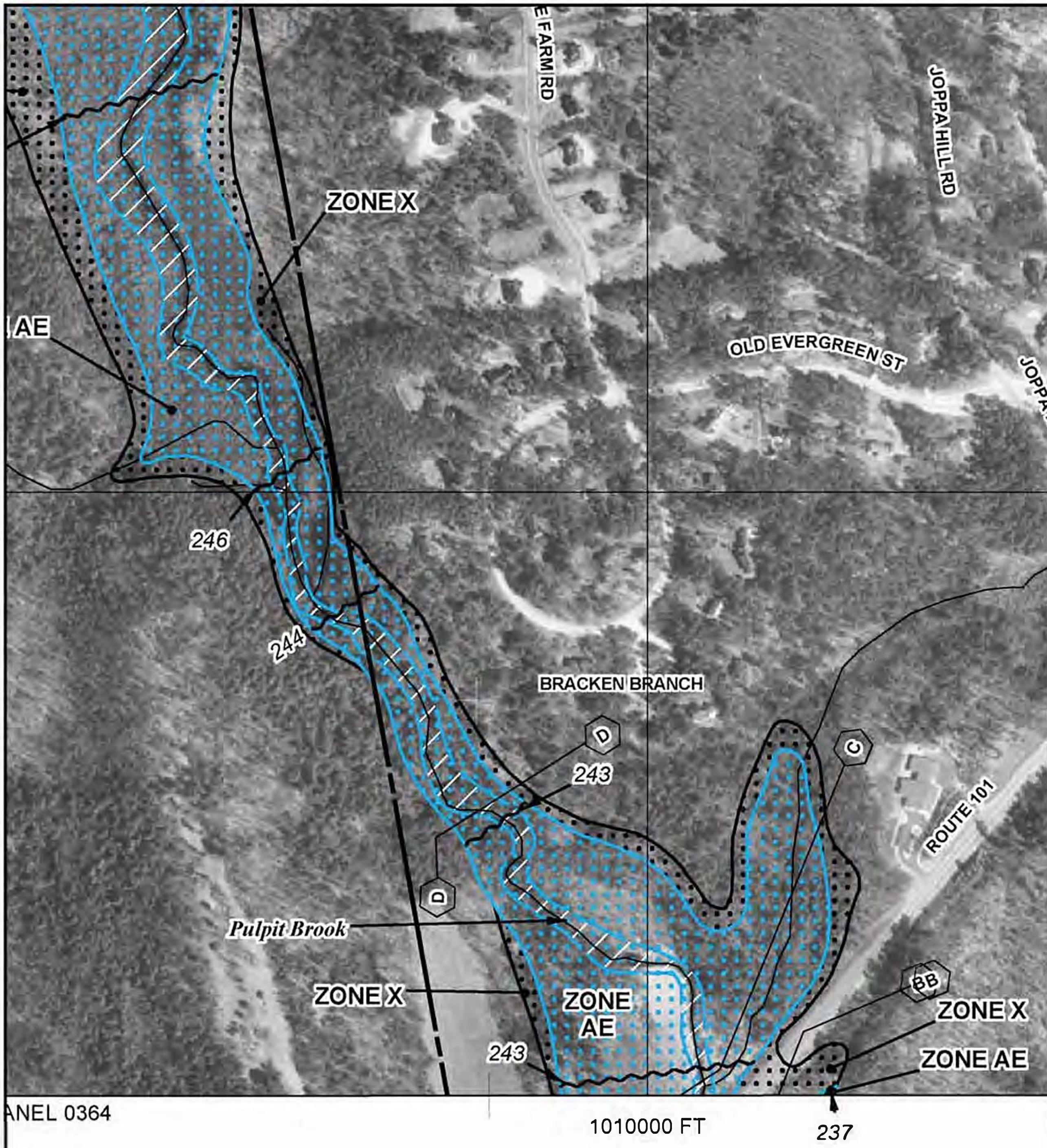
Alternative 3 Model

Message ID	Message	Cross sections affected	Comments
BR LF 01	This is ($strucname$). The selected profile is $profilename$. Type of flow is low flow because, 1. EGEL 3 of $egel3$ is less than or equal to MinTopRd of $minelweirflow$. 2. EGEL 3 of $egel3$ is less than MxLoCdU of $mxlocdu$.	659(Bridge-UP)	
BR PF 01	This is a Bridge Section. The selected profile is $profilename$. Type of flow is sluice gate pressure flow because, 1. EGEL 3 of $egel3$ is less than or equal to MinTopRd of $minelweirflow$. 2. EGEL 3 of $egel3$ is greater than or equal to MxLoCdU of $mxlocdu$. 3. WSEL 2 of $wsel2$ is less than MxLoCdD of $mxlocdd$.	481(Bridge-UP)	
BR PF 04	This is a Bridge Section. Input BrSelMthd is Press/Weir. The highest flood frequency profile is $profilename$. Type of flow is sluice gate pressure flow only. However, the highest flood frequency CritWS of $critws$at BR U is less than or equal to the WSEL of $wsel$ at BR U. Energy should be selected as the High Flow Method.	481(Bridge-UP)	
BR PW 02	This is a Bridge Section. The selected profile is $profilename$. Type of flow is submerged pressure and weir flow because, 1. EGEL 3 of $egel3$ is greater than MinTopRd of $minelweirflow$. 2. EGEL 3 of $egel3$ is equal to or greater than MxLoCdU of $mxlocdu$. 3. WSEL 2 of $wsel2$ is equal to or greater than MxLoCdD of $mxlocdd$.	481(Bridge-UP)	
MP SW 01DD	The name of the stream is ($streamname$). The flow regime is subcritical or mixed flow. The downstream starting water-surface elevation, SWSEL, is computed from different methods. SWSEL of the 50 %-annual-chance flood is computed from SW_Method. SWSEL of the 10 %-annual-chance flood is computed from SW_Method. SWSEL of the 4 %-annual-chance flood is computed from SW_Method. SWSEL of the 2 %-annual-chance flood is computed from SW_Method. SWSEL of the 1%-annual-chance flood is computed from SW_Method. SWSEL of the 0.2%-annual-chance flood is computed from SW_Method. The same method should be used for all the profiles.		

ST DT 03	This is ($Structure$) section. The Contraction Length is longer than the Expansion Length. Section 4 channel distance of $Length_Chnl4$ is longer than Section 2 channel distance of $Length_Chnl2$. Section 4 and Section 1 should be relocated. The HEC-RAS geometry file may need to be recreated using a GIS program.	659(Bridge-UP)	
XS DC 02	Constant discharge used for the entire profile for $assignedname$ flood. At least two discharges should be selected; one at the mouth and the other at the middle of the watershed or above the confluence of a tributary. Or provide explanation why only one discharge should be used. Other flood frequencies should also be checked.		

APPENDIX 4

FEMA Flood Insurance Rate Map (FIRM)
and
Bedford Floodplain Development Ordinance



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METE

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0362D

FIRM

FLOOD INSURANCE RATE MAP

HILLSBOROUGH COUNTY, NEW HAMPSHIRE

(ALL JURISDICTIONS)

PANEL 362 OF 701

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

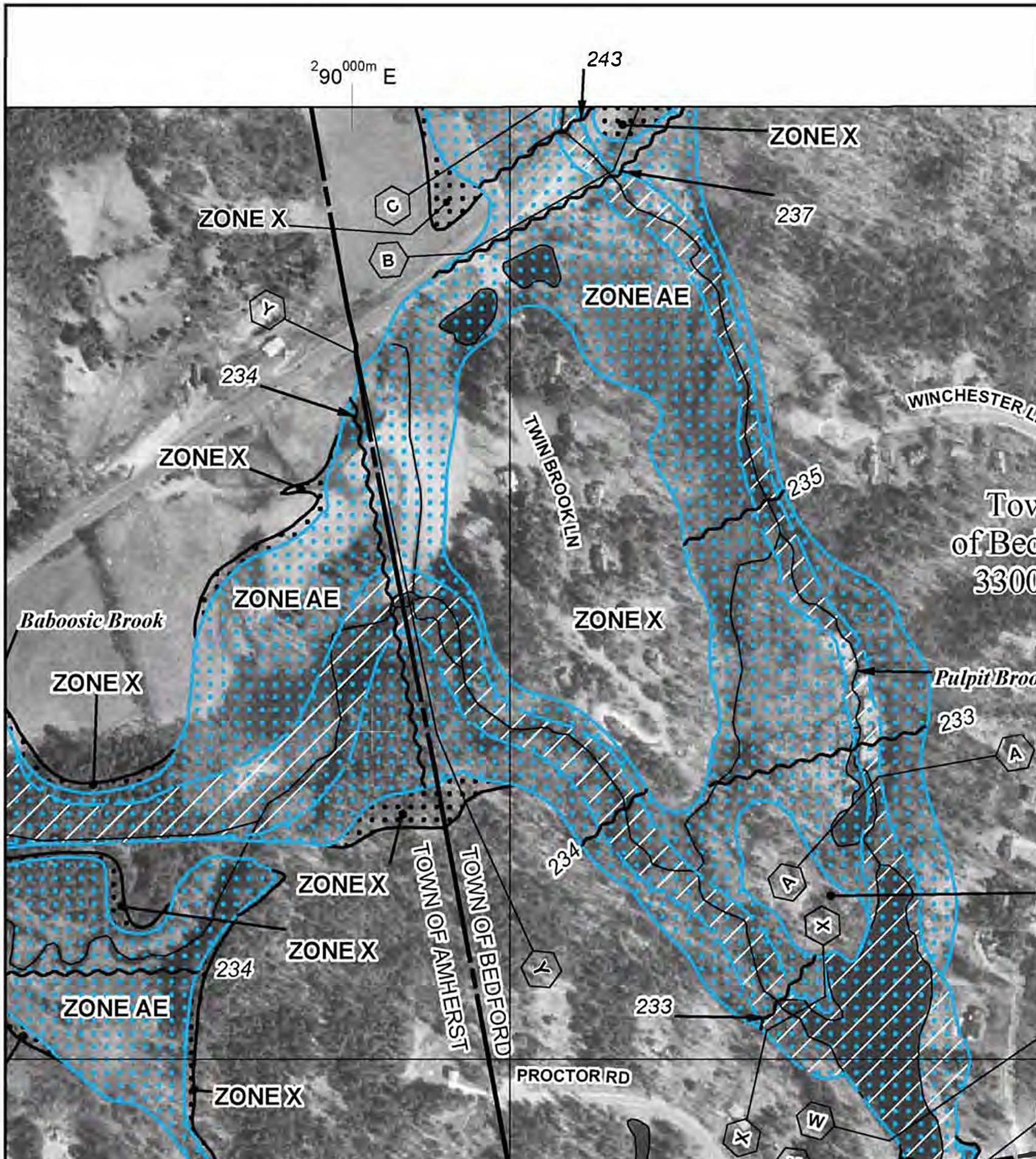
COMMUNITY	NUMBER	PANEL	SUFFIX
AMHERST, TOWN OF	330081	0362	D
BEDFORD, TOWN OF	330083	0362	D

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 33011C0362D

EFFECTIVE DATE SEPTEMBER 25, 2009

Federal Emergency Management Agency



MAP SCALE 1" = 500'

250 0 500 1000 FEET

METE

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0364D

FIRM

FLOOD INSURANCE RATE MAP

HILLSBOROUGH COUNTY, NEW HAMPSHIRE

(ALL JURISDICTIONS)

PANEL 364 OF 701

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
AMHERST, TOWN OF	330081	0364	D
BEDFORD, TOWN OF	330083	0364	D
MERRIMACK, TOWN OF	330095	0364	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 33011C0364D

EFFECTIVE DATE SEPTEMBER 25, 2009

Federal Emergency Management Agency

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

(2) The sign pertaining to the lease or sale of a lot or building on which placed shall be allowed so long as such sign does not exceed 18 square feet. **[Added 3-14-1989]**

G. Highway Commercial District.

(1) The following business signs are allowed: **[Amended 3-13-2012]**

(a) One ground or pole sign not to exceed 32 square feet in surface area;

(b) One flat sign to a business unit not to exceed 32 square feet in surface area; and

(c) Projecting sign.

(2) The sign pertaining to the lease or sale of a lot or building on which placed shall be allowed so long as such sign does not exceed 18 square feet. **[Added 3-14-1989]**

(3) Any wall sign or freestanding sign located 150 square feet or more from the edge of any street right-of-way providing frontage to a lot may increase the sign area by utilizing a formula of: distance in feet/4.25 = allowable area of sign. **[Added 3-9-1999]**

H. Performance Zoning District. **[Added 3-14-1989; amended 3-13-2012]**

(1) All signs shall be set back from the side and rear property lines at least 30 feet and from the front property line at least 10 feet. **[Amended 3-11-2008]**

(2) Refer to § 275-68 for specific signage standards in the Performance Zoning District (PZ).

(3) Any wall sign or freestanding sign located 150 square feet or more from the edge of any street right-of-way providing frontage to a lot may increase the sign area by utilizing a formula of: distance in feet/4.25 = allowable area of sign. **[Added 3-9-1999]**

§ 275-75. Political signs. [Amended 3-9-1999; 7-13-2011]

Political signs shall conform to all New Hampshire state statutes, including RSA 664:14 et seq. and as may be amended, and enforcement shall be through the office of the New Hampshire Attorney General.

ARTICLE X
Floodplain Development

§ 275-76. General provisions.

A. This article, adopted pursuant to the authority of RSA 674:16, shall be known as the "Town of Bedford Floodplain Development Ordinance." The regulations in this article shall overlay and supplement the regulations in the Town of Bedford Zoning Ordinance, and shall be considered part of the Zoning Ordinance for purposes of administration and appeals under state law.

B. If any provision of this article differs or appears to conflict with any provision of the Zoning Ordinance or other ordinance or regulation, the provision imposing the greater restriction or more stringent standard shall be controlling.

C. The following regulations in this article shall apply to all lands designated as special flood hazard areas by the Federal Emergency Management Agency (FEMA) in its Flood Insurance Study for the County of Hillsborough, N.H., dated September 25, 2009, or as amended, together with the associated Flood Insurance Rate Maps dated September 25, 2009, or as amended, which are declared to be a part of this article and are hereby incorporated by reference. **[Amended 3-8-1994; 7-22-2009]**

§ 275-77. Definitions.

The following definitions shall apply only to this article and shall not be affected by the provisions of any other ordinance of the Town of Bedford:

AREA OF SPECIAL FLOOD HAZARD — The land in the floodplain within the Town of Bedford subject to a one-percent or greater possibility of flooding in any given year. The area is designated on the FIRM as Zones A and AE. **[Amended 3-13-2007]**

BASE FLOOD — The flood having a one-percent possibility of being equaled or exceeded in any given year.

BASEMENT — Any area of a building having its floor subgrade on all sides.

BUILDING — See "structure."

DEVELOPMENT — Any man-made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation, drilling operation or storage of equipment or materials. **[Amended 3-13-2007]**

FEMA — The Federal Emergency Management Agency.

FLOOD or FLOODING — A general and temporary condition of partial or complete inundation of normally dry land areas from:

A. The overflow of inland or tidal waters; and

B. The unusual and rapid accumulation or runoff of surface waters from any source.

FLOOD INSURANCE STUDY — An examination, evaluation, and determination of flood hazards and, if appropriate, corresponding water surface elevations, or an examination and determination of mudslide or flood-related erosion hazards. **[Amended 3-13-2007]**

FLOOD INSURANCE RATE MAP (FIRM) — An official map incorporated with this article, on which FEMA has delineated both the special flood hazard areas and the risk premium zones applicable to the Town of Bedford.

FLOOD INSURANCE STUDY — An official report incorporated with this article in which FEMA has delineated both the special flood hazard areas and the risk premium zones applicable to the Town of Bedford.

FLOODPLAIN or FLOOD-PRONE AREA — Any land area susceptible to being inundated by water from any source. (See definition of "flooding.")

FLOODPLAIN MANAGEMENT REGULATIONS — Zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (such as a floodplain ordinance, grading ordinance, and erosion control ordinance) and other applications of police power. The term describes such state or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction. **[Added 3-8-1994]**

FLOODPROOFING — Any combination of structural and nonstructural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitation facilities, structures and their contents.

FLOODWAY — See "regulatory floodway."

FREEBOARD — A factor of safety usually expressed in feet above a flood level for purposes of floodplain management. Freeboard tends to compensate for the many unknown factors that could contribute to flood heights greater than the height calculated for a selected size flood and floodway conditions, such as wave action, bridge openings, and the hydrological effect of urbanization of the watershed. **[Added 3-8-1994]**

FUNCTIONALLY DEPENDENT USE — A use which cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term includes only docking and port facilities that are necessary for the loading/unloading of cargo or passengers and ship building/repair facilities but does not include long-term storage or related manufacturing facilities.

HIGHEST ADJACENT GRADE — The highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

HISTORIC STRUCTURE — Any structure that is:

A. Listed individually in the National Register of Historic Places (a listing maintained by the Department of Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;

B. Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered Historic District or a district preliminarily determined by the Secretary to qualify as a registered Historic District;

C. Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of the Interior; or

D. Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:

(1) By an approved state program as determined by the Secretary of the Interior; or

(2) Directly by the Secretary of the Interior in states without approved programs.

LOWEST FLOOR — The lowest floor of the lowest enclosed area (including basement). An unfinished or flood-resistant enclosure, usable solely for parking of vehicles, building access, or storage in an area other than a basement area, is not considered a building's lowest floor, provided that such an enclosure is not built so as to render the structure in violation of the applicable nonelevation design requirements of this article.

MANUFACTURED HOME — A structure, transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when connected to the required utilities. For floodplain management purposes, the term "manufactured home" includes park trailers, travel trailers, and other similar vehicles placed on site for greater than 180 days.

MEAN SEA LEVEL — The National Geodetic Vertical Datum (NGVD) of 1929 or other datum, to which base flood elevations shown on a community's Flood Insurance Rate Map are referenced.

NEW CONSTRUCTION — For the purposes of determining insurance rates, structures for which the start of construction commenced on or after the effective date of the initial FIRM or after December 31, 1974, whichever is later, and includes any subsequent improvements to such structures. For floodplain management purposes, "new construction" means structures for which the start of construction commenced on or after the effective date of a floodplain management regulation adopted by a community and includes any subsequent improvements to such structures. **[Added 3-13-2007]**

ONE-HUNDRED-YEAR FLOOD — See "base flood."

RECREATIONAL VEHICLE — A vehicle which is:

A. Built on a single chassis;

B. Four hundred square feet or less when measured at the largest horizontal projection;

C. Designed to be self-propelled or permanently towable by a light-duty truck; and

D. Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, or seasonal use. **[Added 3-8-1994]**

REGULATORY FLOODWAY — The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without increasing the water surface elevation. These areas are designated as floodways on the FIRM. **[Amended 3-13-2007]**

SPECIAL FLOOD HAZARD AREA — See "area of special flood hazard." **[Amended 3-13-2007]**

START OF CONSTRUCTION —

A. Includes substantial improvements and means the date the building permit was issued, provided the actual start of construction, repair, reconstruction, placement, or other improvement was within 180 days of the permit date.

B. The "actual start" means either the first placement of permanent construction of a structure on site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation, or the placement of manufactured home on a foundation.

C. Permanent construction does not include land preparation, such as clearing, grading, and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for a basement, footings, piers, or foundations, or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds, not occupied as dwelling units or part of the main structure.

STRUCTURE — For floodplain management purposes, a walled and roofed building, including a gas or liquid storage tank, that is principally above ground, as well as a manufactured home.

SUBSTANTIAL DAMAGE — Damage of any origin sustained by a structure whereby the cost of restoring the structure to its before-damaged condition would equal or exceed 50% of the market value of the structure before the damage occurred.

SUBSTANTIAL IMPROVEMENT —

A. Any combination of repairs, reconstruction, alteration, or improvements to a structure in which the cumulative cost equals or exceeds 50% of the market value of the structure. The market value of the structure should equal:

(1) The appraised value prior to the start of the initial repair or improvement; or

(2) In the case of damage, the value of the structure prior to the damage occurring.

B. For the purposes of this definition, "substantial improvement" is considered to occur when the first alteration of any wall, ceiling, floor, or other structural part of the building commences, whether or not that alteration affects the external dimensions of the structure. This term includes structures which have incurred substantial damage, regardless of actual repair work performed. The term does not, however, include any project for improvement of a structure required to comply with existing health, sanitary, or safety code specifications which are solely necessary to assure safe living conditions or any alteration of a historic structure, provided that the alteration will not preclude the structure's continued designation as a historic structure.

VIOLATION — The failure of a structure or other development after the adoption of the initial FIRM to be fully compliant with the community's floodplain management regulations. A structure or other development without the elevation certificate, other certifications, or other evidence of compliance required in 44 CFR 60.3(b)(5), (c)(4), (c)(10), (d)(3), (e)(2), (e)(4), or (e)(5) is presumed to be in violation until such time as that documentation is provided. The sections of this article that correspond to the sections of the CFR are §§ 275-79C, 275-81B(2), 275-80D and 275-80C(1). **[Added 3-13-2007]**

WATER SURFACE ELEVATION — The height, in relation to the National Geodetic Vertical Datum (NGVD) of 1929, or other datum, where specified, of floods of various magnitudes and frequencies in the floodplains.

§ 275-78. Applicability.

All proposed development in any special flood hazard areas shall require a permit.

§ 275-79. General requirements. [Amended 3-13-2007]

A. The Building Code Official shall review all building permit applications for new construction or substantial improvements to determine whether proposed building sites will be reasonably safe from flooding. If a proposed building site is located in a special flood hazard area, all new construction or substantial improvements shall be:

(1) Designed (or modified) and adequately anchored to prevent flotation, collapse, or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy;

(2) Constructed with materials resistant to flood damage;

(3) Constructed by methods and practices that minimize flood damages; and

(4) Constructed with electrical, heating, ventilation, plumbing, and air-conditioning equipment, and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

B. Where new or replacement water and sewer systems (including on-site systems) are proposed in a special flood hazard area, the applicant shall provide the Building Code Official with assurance that these systems will be designed to minimize or eliminate infiltration of floodwaters into the systems and discharges from the systems into floodwaters, and on-site waste disposal systems will be located to avoid impairment to them or contamination from them during periods of flooding.

C. For all new or substantially improved structures located in Zones A and AE, the applicant shall furnish the following information to the Building Code Official: the as-built elevation (in relation to NGVD) of the lowest floor (including basement) including whether or not such structures contain a basement; if the structure has been floodproofed, the as-built elevation (in relation to NGVD) to which the structure was floodproofed; any certification of floodproofing. The Building Code Official shall maintain these records for public inspection, and shall furnish such information upon request.

D. The Building Code Official shall not grant a building permit until the applicant certifies that all necessary permits have been received from those governmental agencies from which approval is required by federal or state law, including Section 404 of the Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C. § 1334.

§ 275-80. Alteration or relocation of watercourses.

A. Riverine situations.

(1) Prior to the alteration or relocation of a watercourse, the applicant for such authorization shall notify the Wetlands Bureau of the New Hampshire Environmental Services Department and submit copies of such notification to the Building Code Official, in addition to the copies required by the RSA 482-A:3. **[Amended 3-8-1994; 3-13-2007]**

(2) Further, the applicant shall be required to submit copies of said notification to those adjacent communities as determined by the Building Code Official, including notice of all scheduled hearings before the Wetlands Bureau. **[Amended 3-13-2007]**

B. Certification of maintenance of flood-carrying capability. The applicant shall submit to the Building Code Official, certification provided by a registered professional engineer, assuring that the flood-carrying capacity of an altered or relocated watercourse can and will be maintained.

C. Watercourses with a designated regulatory floodway.

(1) Along watercourses with a designated regulatory floodway, no encroachments, including fill, new construction, substantial improvements, and other development are allowed within the floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practices that the proposed encroachment would not result in any increase in flood levels within the community during the base flood discharge. **[Amended 3-13-2007]**

(2) In Zone A, the Building Code Official shall obtain, review, and reasonably utilize any floodway data available from federal, state, or other sources as criteria for requiring that development meet the floodway requirements of this section.

D. Watercourses without a designated regulatory floodway. Along watercourses that have not had a regulatory floodway designated, no new construction, substantial improvements, or other development (including fill) shall be permitted within Zone AE on the FIRM, unless it is demonstrated by the applicant that the cumulative effect of the proposed development, when combined with all existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within the community. **[Amended 3-13-2007]**

§ 275-81. Flood hazard areas defined.

A. In special flood hazard areas the Building Code Official shall determine the one-hundred-year flood elevation in the following order of precedence according to the data available:

(1) In Zone AE, refer to the elevation data provided in the community's Flood Insurance Study and accompanying FIRM.

(2) In Zone A, the Building Code Official shall obtain, review, and reasonably utilize any one-hundred-year flood elevation data available from any federal, state or other sources including data submitted for development proposals submitted to the community (i.e. subdivisions, site approvals).

(3) In Zone AO, the flood elevation is determined by adding the elevation of the highest adjacent grade to the depth number specified on the FIRM or, if no depth number is specified on the FIRM, at least two feet. **[Amended 3-13-2007]**

B. The Building Code Official's one-hundred-year flood elevation determination will be used as criteria for requiring in Zones A and AE that: **[Amended 3-8-1994; 3-13-2007]**

(1) All new construction or substantial improvement of residential structures have the lowest floor (including basement) elevated to or above the hundred-year flood elevation; and

(2) That all new construction or substantial improvements of nonresidential structures have the lowest floor (including basement) elevated to or above the one-hundred-year flood level, or together with attendant utility and sanitary facilities shall:

(a) Be floodproofed so that below the one-hundred-year flood elevation the structure is watertight with walls substantially impermeable to the passage of water;

(b) Have structural components capable of resisting hydrostatic and hydrodynamic loads and the effects of buoyancy; and

(c) Be certified by a registered professional engineer or architect that the design and methods of construction are in accordance with accepted standards of practice for meeting the provisions of this section.

(3) All manufactured homes to be placed or substantially improved within special flood hazard areas shall be elevated on a permanent foundation such that the lowest floor of the manufactured home is at or above the base flood level and be securely anchored to resist flotation, collapse, or lateral movement. Methods of anchoring may include, but are not limited to, use of over-the-top or frame ties to ground anchors. This requirement is in addition to applicable state and local anchoring requirements for resisting wind forces.

(4) Recreational vehicles placed on sites within zone AE shall either: **[Amended 3-13-2007]**

(a) Be on the site for fewer than 180 consecutive days;

(b) Be fully licensed and ready for highway use; or

(c) Meet all standards of Section 60.3(b)(1) of the National Flood Insurance Program Regulations and the elevation and anchoring requirements for manufactured homes in Paragraph (c)(6) of Section 60.3.

(5) For all new construction and substantial improvements, fully enclosed areas below the lowest floor that are subject to flooding are permitted, provided they meet the following requirements:

(a) The enclosed area is unfinished or flood-resistant, usable solely for the parking of vehicles, building access or storage;

(b) The area is not a basement; and

(c) The area shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwater; and

(d) Designs for meeting this requirement must either be certified by a registered professional engineer or architect or must meet or exceed the following minimum criteria: **[Amended 3-13-2007]**

[1] A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided.

[2] The bottom of all openings shall be no higher than one foot above grade. Openings may be equipped with screens, louvers, or other coverings or devices, provided that they permit the automatic entry and exit of floodwater.

§ 275-82. Variances and appeals.

A. Any order, requirement, decision, or determination of the Building Code Official made under this article may be appealed to the Zoning Board of Adjustment as set forth in RSA 676:5.

B. If the applicant, upon appeal, requests a variance as authorized by RSA 674:33, 1(b), the applicant shall have the burden of showing in addition to the usual variance standards under state law that:

(1) The variance will not result in increased flood heights, additional threats to public safety, or extraordinary public expense;

(2) If the requested variance is for activity within a designated regulatory floodway, no increase in flood levels during the base flood discharge will result; and

(3) The variance is the minimum necessary, considering the flood hazard, to afford relief.

C. The Zoning Board of Adjustment shall notify the applicant in writing that the issuance of a variance to construct below the base flood level will result in increased premium rates for flood insurance up to amounts as high as $25 for $100 of insurance coverage, and such construction below the base flood level increases risks to life and property. Such notification shall be maintained with a record of all variance actions.

D. The community shall: **[Added 3-13-1990]**

(1) Maintain a record of all variance actions, including their justification for their issuance; and

(2) Report such variances issued in its annual or biennial report submitted to FEMA's Federal Insurance Administrator.

ARTICLE XI
Administration and Enforcement

§ 275-83. Zoning Administrator; appointment; duties.

For the purposes of this chapter, the Bedford Town Manager as specified in the Town Charter is hereby given the power to appoint a Zoning Administrator who shall perform the duties of the office as designated in the various provisions of this chapter and shall report all violations of this chapter to the Town Manager.

§ 275-84. Administrative officer.

This chapter shall be administered by the Zoning Administrator who shall have the authority to make inspections necessary to carry out his/her duties in the enforcement of this chapter.

§ 275-85. Building permit procedure.

A. Code compliance. All structures shall be constructed in accordance with the most current applicable residential and nonresidential building codes as referenced in Chapter 92, § 92-9, of the Town of Bedford Code. **[Added 3-8-1994; amended 3-14-2000; 3-9-2010]**

B. Applicability. No building or structure shall be constructed, reconstructed, altered, or relocated nor shall any excavation be commenced without a duly authorized building permit issued by such Building Code Official.

C. Prerequisite approvals. **[Amended 3-11-1997; 3-9-2010]**

(1) An applicant for building permit approval shall be responsible for providing certified verification of all requisite local, state, and federal approvals prior to the issuance of said building permit.

(2) Prior to the start of construction, all wetlands shall be identified and flagged on the lot by a New Hampshire certified wetlands scientist. Flagging must be maintained during the construction and until a certificate of occupancy is issued by the

APPENDIX 5

Photographs

NH Route 101 over Pulpit Brook
NHDOT Bridge #090/065, Bedford, NH
Existing Conditions Photos

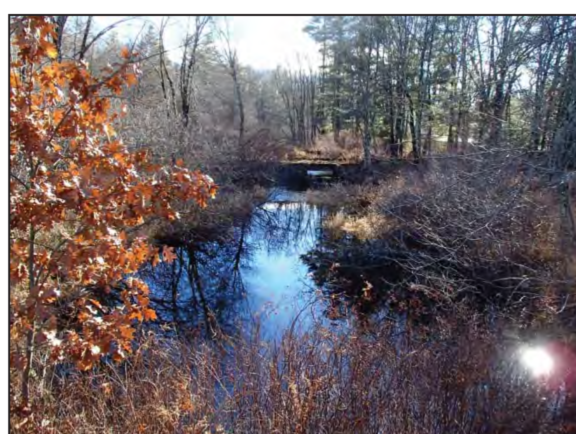
View upstream at reference Cross-Section 0. Photo date: 12-01-16

View upstream at Cross-Section 222. Photo date: 12-01-16

View upstream and across Pulpit Brook at outlet of abandoned bridge. Photo date: 12-01-16

View southwest along abandoned road toward abandoned bridge. Photo date: 12-01-16

View downstream toward inlet of abandoned Bridge. Photo date: 12-01-16



View downstream from Route 101. Photo date: 12-01-16

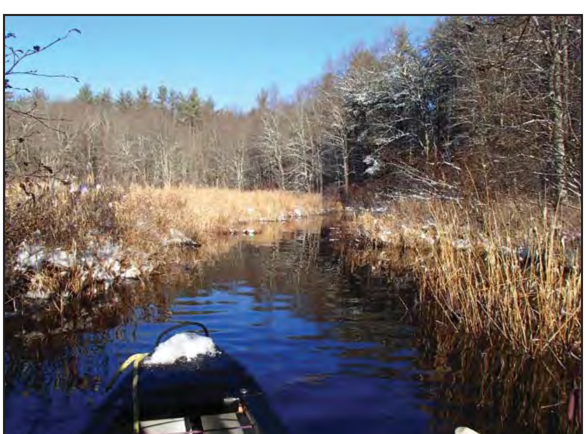
NH Route 101 over Pulpit Brook
NHDOT Bridge #090/065, Bedford, NH
Existing Conditions Photos

View upstream from abandoned bridge toward Route 101.
Photo date: 12-01-16

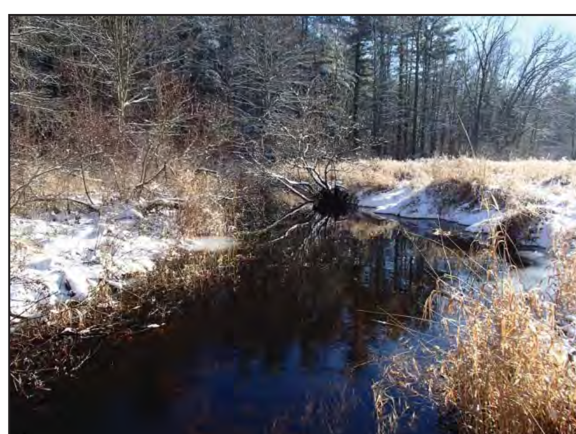
View upstream at outlet of existing twin 60" RCP culverts carrying Pulpit Brook under Route 101. Photo date: 12-01-16

View downstream at inlet of existing twin 60" RCP culverts carrying Pulpit Brook under Route 101. Photo date: 12-06-16

View upstream from Route 101. Photo date: 12-06-16



View upstream toward reference cross-section 1037. Photo date: 12-06-16



View downstream toward reference Cross-Section 1333. Photo date: 12-06-16

NH Natural Heritage Bureau Report

To: Jamie O'Brien, Normandeau Associates, Inc.
25 Nashua Road

Bedford, NH 03110

From: NH Natural Heritage Bureau

Date: 7/27/2020 (valid for one year from this date)

Re: Review by NH Natural Heritage Bureau of request submitted 7/21/2020

NHB File ID: NHB20-2146 **Applicant:** Marc Laurin

Location: Bedford
NH Route 101

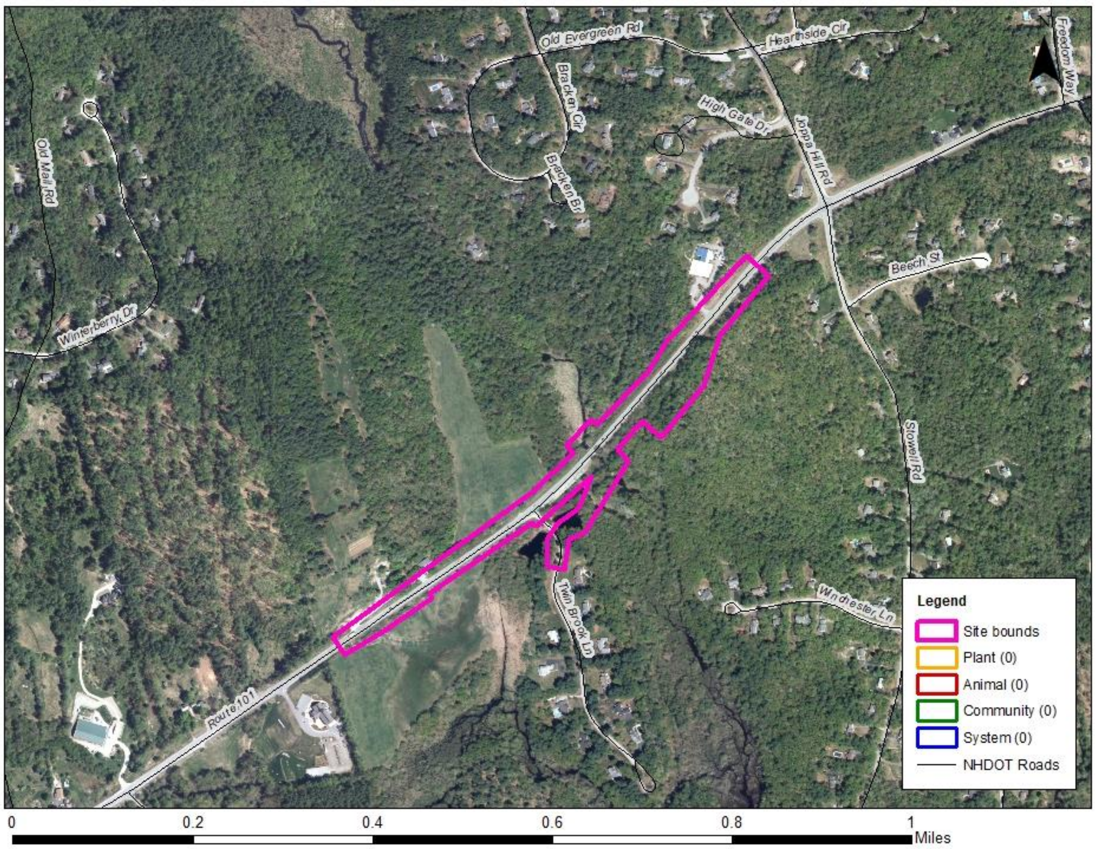
Project Description: This is a bridge replacement project of bridge number 090/065 carrying NH Route 101 over Pulpit Brook. The current bridge is on the NHDOT Red List due to its poor condition. The proposed project will maintain the existing 40'-0" wide roadway on the current alignment and correct the structure deficiencies to create safe, reliable passage over Pulpit Brook. A 48'-0" clear span replacement has been identified as the preferred option for meeting hydraulic requirements, stream crossing guidelines and other project goals.

The NH Natural Heritage database has been checked by staff of the NH Natural Heritage Bureau and/or the NH Nongame and Endangered Species Program for records of rare species and exemplary natural communities near the area mapped below. The species considered include those listed as Threatened or Endangered by either the state of New Hampshire or the federal government.

It was determined that, although there was a NHB record (e.g., rare wildlife, plant, and/or natural community) present in the vicinity, we do not expect that it will be impacted by the proposed project. This determination was made based on the project information submitted via the NHB Datacheck Tool on 7/21/2020, and cannot be used for any other project.

MAP OF PROJECT BOUNDARIES FOR: **NHB20-2146**

NHB20-2146



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

NH Fish and Game Correspondence

Vicki Chase

From:	Tuttle, Kim <Kim.Tuttle@wildlife.nh.gov>
Sent:	Monday, September 18, 2017 11:15 AM
To:	Vicki Chase
Subject:	RE: NHB17-1970 (NHB15-3219) Pulpit Brook Bedford

Hello Vicki,

We would need to know what size and type of pipes or bridge is proposed. Also as below, we would definitely like a natural bottom across the stream if one is to be reconstructed after the twin culvert are pulled or at least no rip-rap across the entire stream bed above and below the pipes if larger pipes are proposed. Avoid the use of welded plastic or 'biodegradable plastic' netting or thread in erosion control matting at this project site. There are numerous documented cases of snakes including the state endangered eastern hognose snake, documented in Bedford, and other wildlife being trapped and killed in erosion control matting with synthetic netting and thread. Several 'wildlife friendly' options such as woven organic material (e.g., coco matting) are commercially available.

Thanks,

Kim Tuttle
Wildlife Biologist
NH Fish and Game
11 Hazen Drive
Concord, NH o3301
603-271-6544

From: Vicki Chase [mailto:VChase@normandeau.com]
Sent: Monday, September 18, 2017 10:54 AM
To: Tuttle, Kim
Subject: RE: NHB15-3219 Pulpit Brook Bedford

Good morning Kim,

Our team ended up winning this job (Kleinfelder is the engineer). You provided helpful information for our proposal in this email thread – thanks. For the wetland permit and other environmental documentation, are there recommendations we should include for Blanding's turtles?

The correspondence in the thread below was from 2015, the NHB request was re-upped in June 2017, see attached.

Thanks for your help.

VICKI CHASE
NORMANDEAU ASSOCIATES, INC.
603-637-1111 (direct) | 603-731-7653 (cell)

From: Tuttle, Kim [mailto:Kim.Tuttle@wildlife.nh.gov]
Sent: Monday, November 23, 2015 10:35 AM

To: Vicki Chase <VChase@normandeau.com>
Subject: RE: NHB15-3219 Pulpit Brook Bedford

We would not require turtle surveys if the double pipes are upsized. We usually recommend one significantly larger culvert or bridge in order to provide aquatic species passage opportunities for Blanding's turtle but if the double pipes are upsized, that may be okay. Will the road be widened at some point? that's another reason why the openings should be upsized. If the length of the culverts will be increasing we would want to provide the same or more light/openness in the culvert to attract wildlife and not to increase velocities- so the pipe openings would have to increase.

From: Vicki Chase [mailto:VChase@normandeau.com]
Sent: Monday, November 23, 2015 10:25 AM
To: Tuttle, Kim
Subject: RE: NHB15-3219 Pulpit Brook Bedford

From DOT

This project involves rehabilitation or replacement of the Red List bridge (Br. No. 090/065) carrying NH Route 101 over Pulpit Brook in the Town of Bedford. This bridge was built in 1936 and is a twin 6.5-foot concrete pipe bridge. The bridge has a rail to rail width of 40 feet to accommodate one-lane of traffic in each direction, and handles 24,000 ADT in 2013.

From: Tuttle, Kim [mailto:Kim.Tuttle@wildlife.nh.gov]
Sent: Monday, November 23, 2015 10:24 AM
To: Vicki Chase
Subject: RE: NHB15-3219 Pulpit Brook Bedford

What is the size of the opening of the culverts there now?

From: Vicki Chase [mailto:VChase@normandeau.com]
Sent: Monday, November 23, 2015 10:14 AM
To: Tuttle, Kim
Subject: RE: NHB15-3219 Pulpit Brook Bedford

Here are some photos, a USGS topo, and an aerial of the crossing. I have no idea what size – as I mentioned at this stage we are just writing the technical proposal – the proposal is actually for "rehabilitation or replacement" so it is not even known if it will be replaced (although I suspect it will).

Would you require turtle surveys? We want to budget for it if so.

From: Tuttle, Kim [mailto:Kim.Tuttle@wildlife.nh.gov]
Sent: Monday, November 23, 2015 9:50 AM
To: Vicki Chase
Subject: NHB15-3219 Pulpit Brook Bedford

Vicki,

Can you provide a couple of photos of the crossing? What are you thinking for the width of the bridge? If you are putting in a bridge, we may not need a 'wildlife shelf' for turtles if the velocity of the water is not restricted resulting in significantly increased velocities. We would definitely like a natural bottom across the stream if one is to be reconstructed after the culvert is pulled.

Thanks,

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

From: Vicki Chase [mailto:VChase@normandeau.com]
Sent: Monday, November 23, 2015 9:42 AM
To: Tuttle, Kim
Subject: FW: NHB review: NHB15-3219

Kim, Normandeau Associates has been short-listed for the replacement of the Route 101 culvert over Pulpit Brook in Bedford, and I am writing an environmental scope of work for the project. As you can see on the attached, there are records of Blanding's turtles right at the crossing. To help in our planning process, what would you be likely to require in the way of surveys or studies (if any) for the turtles? I am guessing that the bridge would need to have a wildlife shelf – what timing restrictions for construction would be needed to accommodate the turtles?

Thanks for your help.

VICKI CHASE *Environmental Analyst*
Normandeau Associates, Inc.
25 Nashua Road, Bedford, NH 03110
603-637-1111(direct) 603-731-7653 (cell)

From: Lamb, Amy [mailto:Amy.Lamb@dred.nh.gov]
Sent: Monday, October 05, 2015 12:19 PM
To: Vicki Chase
Cc: Tuttle, Kim
Subject: NHB review: NHB15-3219

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

Note: Melissa Coppola is still working part-time on reviews, but I am now the reviewer at NH Natural Heritage. Please address future correspondence to me at: Amy.Lamb@dred.nh.gov
~~~~~~

Amy Lamb
Ecological Information Specialist
NH Natural Heritage Bureau
DRED - Forest & Lands
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US Fish & Wildlife Service
IPaC Results

Exhibit V

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

September 4, 2019

Marc G. Laurin
Bureau of Environment
NH Department of Transportation
7 Hazen Drive, P.O. Box 483
Concord, New Hampshire 03302-0483

Re: NH DOT Project 13692C, Bedford, NH
TAILS: 05E1NE00-2019-F-2257

Dear Mr. Laurin:

The U.S. Fish and Wildlife Service (Service) is responding to your request, dated August 9, 2019, to verify that the New Hampshire Department of Transportation (NHDOT) Project 13692C (Project), the proposed replacement of a bridge in Bedford, 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). We received your request and the associated LAA Consistency Letter on August 13, 2019. 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 Bridge No. 090/065 carrying U.S. Route 101 over Pulpit Brook and additional changes to the road alignment and a turning lane. Approximately 0.85 acre of tree clearing will occur which may be implemented during the bat active season. A bridge survey of the existing bridge did not document the presence of bat use.

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

APPENDIX D: Bridge/Structure Assessment Form

This form will be completed and submitted to the District Environmental Manager by the Contractor prior to conducting any work below the deck surface either from the underside; from activities above that bore down to the underside; from activities that could impact expansion joints; from deck removal on bridges; or from structure demolition for bridges/structures within 1000 feet of suitable bat habitat.

DOT Project #	Water Body	Date/Time of Inspection	Within 1,000ft of suitable bat habitat (circle one)
Bedford 13692C	Pulpit Brook	July 18, 2019 (14:00 – 14:45)	Yes No

Route	County	Federal Structure ID
NH 101	Hillsborough	090/065

If the bridge/structure is 1,000 feet or more from suitable bat habitat (e.g., an urban or agricultural area without suitable foraging habitat or corridors linking the bridge to suitable foraging habitat), check box and STOP HERE. No assessment required. ☐
Please submit to the U.S. Fish and Wildlife Service.

Areas Inspected (Check all that apply)

Bridges		Culverts/Other Structures		Summary Info (circle all that apply)			
All vertical crevices sealed at the top and 0.5-1.25" wide & ≥4" deep	N/A	Crevices, rough surfaces or imperfections in concrete	✓	Human disturbance or traffic under bridge/in culvert or at the structure	High	Low	None
All crevices >12" deep & not sealed	N/A	Spaces between walls, ceiling joists	N/A	Possible corridors for netting	None/poor	Marginal	Excellent
All guardrails	✓						
All expansion joints	N/A						
Spaces between concrete end walls and the bridge deck	N/A						

Vertical surfaces on concrete I-beams	N/A						

Evidence of Bats (Circle all that apply) Presence of one or more indicators is sufficient evidence that bats may be using the structure.

None

Visual (e.g. survey, thermal, emergent etc.)
- Live __number seen
- Dead __number seen

Photo documentation Y/N

Guano
Odor Y/N
Photo documentation Y/N

Staining definitively from bats
Photo documentation Y/N

Audible

Assessment Conducted By: SARAH BARNUM	**Signature(s):**
District Environmental Use Only: Date Received by District Environmental Manager: ______	

DOT Bat Assessment Form Instructions

1. Assessments must be completed no more than 2 years prior to conducting any work below the deck surface on all bridges, regardless of whether assessments have been conducted in the past.
2. Any bridge/structure suspected of providing habitat for any species of bat will be removed from work schedules until such time that the DOT has coordinated with the USFWS. Additional studies may be undertaken by the DOT to determine what species may be utilizing each structure identified as supporting bats prior to allowing any work to proceed.
3. Any questions should be directed to the District Environmental Manager.

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 10, 2019
Consultation Code: 05E1NE00-2019-SLI-2257
Event Code: 05E1NE00-2019-E-05772
Project Name: Bedford 13692C - Pulpit Brook

Subject: 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: 05E1NE00-2019-SLI-2257

Event Code: 05E1NE00-2019-E-05772

Project Name: Bedford 13692C - Pulpit Brook

Project Type: TRANSPORTATION

Project Description: The New Hampshire Department of Transportation proposes to replace Bridge 090/065 carrying NH Route 101 over Pulpit Brook in Bedford, NH. Addition of a turning lane and minor changes to the vertical and horizontal road alignment are also planned.

Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/place/42.90538600604083N71.5704687325663W

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.

---

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.

NH Division of Historical Resources
Effects Memo

Exhibit W

New Hampshire DOT
Department of Transportation

Victoria F. Sheehan
Commissioner

THE STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

William Cass, P.E.
Assistant Commissioner

RECEIVED
JUL 19 2019
RECEIVED
BUREAU OF ENVIRONMENT
JUL 22 2019
NH DEPARTMENT OF TRANSPORTATION

BEDFORD
X-A004(254)
13692C
RPR 9086

No Historic Properties Affected Memo

In order to assist the Federal Highway Administration (FHWA) in complying with Section 106 of the National Historic Preservation Act of 1966 and its amendments, The New Hampshire Department of Transportation (NHDOT), in consultation with the New Hampshire Division of Historical Resources (SHPO), has reviewed this undertaking according to the standards and procedures detailed in the 2018 Programmatic Agreement regarding the Federal-Aid Highway Program in New Hampshire.

Project Description:

The proposed action would replace Bridge No. 090/065 and include approach and drainage work. The existing culvert would be replaced with an approximately 50-foot precast concrete butted box beam bridge. The project includes roadway approach work that extends approximately 1,300 feet southwest of Bridge No. 090/065 on Route 101 and approximately 800 feet northeast of Bridge No. 090/065 on Route 101 (see APE map below). The project would retain two 12-foot travel lanes with 8-foot shoulders, but would add a left turn lane at Twin Brook Lane for westbound Route 101 traffic. The project would raise the centerline of construction by approximately 6 inches to accommodate proposed cross slopes. Guardrail would be installed in areas of proposed curbing and steeper side slopes.

Identification:

Above-Ground Resources
Bridge No. 090/065 is a twin reinforced pipe culvert built c.1951 and reconstructed in 2011. The culvert is 12.5 feet long and 70 feet wide. The culvert has a rubble stone headwall on the eastern elevation, concrete and rubble stone wingwalls, and a reinforced concrete headwall on the western elevation. The bridge carries NH Route 101 over Pulpit Brook in southwest Bedford.

Based on a review pursuant to 36 CFR 800.4, NH Department of Transportation (NHDOT) determined, through the use of the FHWA Program Comment for Common Post-1945 Concrete and Steel Bridges, that Bridge No. 090/065 is exempt from Section 106 review.

Below-Ground Resources
All necessary phases of archaeological survey have been completed as well. A Phase IA study was completed and archaeologists found low to non-existent potential for Pre-Contact or Post-Contact cultural deposits and recommended no further study.

Public Consultation:

NHDOT initiated consultation with SHPO by filing a Request for Project Review (RPR) from on October 12, 2017. NHDOT submitted an addendum to the 2017 RPR to SHPO on May 29, 2019. NHDOT submitted a Phase IA study to SHPO on May 30, 2019.

The chart below captures public meetings, past and future, about this project.

Date	Meeting
May 18, 2016	Public Information Meeting
February 13, 2018	Public Informational Meeting
June 20, 2019	Public Information Meeting
Anticipated September 2019	Design Public Hearing

The Town of Amherst's Conservation Commission was contacted via letter in late June 2019 about the Bragdon Farm. To date, the Town has not submitted a formal reply to the letter.

Determination of Effect:

Bridge No. 090/065 bridge is exempt from Section 106 review under the Program Comment for Common Post-1945 Concrete and Steel Bridges and Culverts. The Bragdon Farm property, located on both sides of Route 101, would require minimal grading for swales related to drainage improvements. All grading would be loamed and seeded and all swales vegetated. In addition, some riprap would be installed along Pulpit Brook at the replacement bridge, but this area would not be visible to most of the farm property. The proposed project would result in no impacts to the use or function of the Bragdon Farm.

Applying the criteria at 36 CFR 800.4(d)(1), the result of identification and evaluation for the undertaking is a finding of ***No Historic Properties Affected***.

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 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 both the no adverse effect determination and 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, consultation will continue, as appropriate, as this project proceeds.

Jill L Edelmann 7/19/2019

Jill Edelmann Date

Cultural Resources Manager

Concurred with by the NH State Historic Preservation Officer:

Nadine Miller, DSHPO 7/22/19

Elizabeth H. Muzzey Date

State Historic Preservation Officer

NH Division of Historical Resources

cc. Marc Laurin, NHDOT

Jennifer Reczek, NHDOT

Thom Marshall, Kleinfelder

Marika Labash, NHDHR

Photo Key Map by NH GRANIT

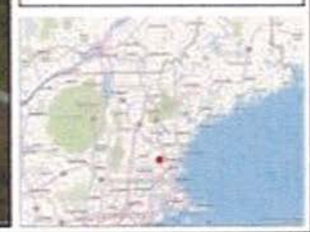
Legend

APE

Map Scale
1: 4,123

© NH GRANIT, www.granit.unh.edu
Map Generated: 1/3/2017

Notes



US Army Corps of Engineers
Appendix B and
Supplemental Narrative

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?	1 acre	
2.7 What is the area of the proposed fill in wetlands?	5,879 sf	
2.8 What is the % of previously and proposed fill in wetlands to the overall project site?	23% of ROW seg.	
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: https://wildlife.state.nh.us/wildlife/wap-high-rank.html. • Data Mapper: www.granit.unh.edu. • GIS: www.granit.unh.edu/data/downloadfreedata/category/databycategory.html.	X	
3.3 Would the project impact more than 20 acres of an undeveloped land block (upland, wetland/waterway) on the entire project site and/or on an adjoining property(s)?		X
3.4 Does the project propose more than a 10-lot residential subdivision, or a commercial or industrial development?		X
3.5 Are stream crossings designed in accordance with the GC 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?	X	
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.

USACE Appendix B – Explanations

1. Impaired Waters

There will be no work within 1 mile upstream of an impaired water. Please see attached Impaired Waters map with the project location (Attachment 1).

2. Wetlands

Route 101 was constructed in the 1950's across Pulpit Brook and its adjacent wetlands. NHDOT is proposing to replace the undersized twin culverts that carry Pulpit Brook under NH Route 101 with a clear span bridge, and slightly widen the road to provide a left turning lane into nearby Twin Brook Lane for safety reasons. Work will require permanent and temporary impacts to the stream and adjacent riparian buffer and wetlands. The project will restore stream hydraulic capacity and aquatic habitat connectivity through stream simulation, and the crossing structure will include a wildlife shelf for semi-aquatic wildlife movement. A previous NH Natural Heritage Bureau (NHB) report identified Blanding's turtle in the vicinity of the project. More recent NHB report did not identify any protected species impacts. Nevertheless, the project is incorporating NH Fish & Game Department recommendations to protect turtles by specifying wildlife friendly erosion and sedimentation controls. No construction timing restrictions were suggested by NH Fish & Game, but tree clearing will take place during the non-active season for northern long-eared bats, to the extent possible. The wetlands along Pulpit Brook are considered "wetlands of exceptional value" by the Town of Bedford (see NHDES Wetland Permit Application wetland report), and this floodplain wetlands adjacent to ta Tier 3 stream is a NHDES as a Priority Resource Area. Mitigation is required for the 5,879 sf of permanent impacts to wetlands. NHDES considers the stream work to be self-mitigating. Temporary impacts will be restored by grading to pre-construction elevations, placing wetland humus, and seeding with appropriate wetland seed mix.

3. Wildlife

As noted above in Explanation 2, a previous NH Natural Heritage Bureau (NHB) report (attached to the NHDES Wetland Permit Application) identified Blanding's turtle in the vicinity of the project. More recent NHB report did not identify any protected species impacts. The IPaC results (also attached to the wetland application) note that the project is in the range for northern long-eared bats. The project design and construction specifications include measures to protect these species. Wildlife Action Plan maps indicate highest-ranked habitat by State and Region for the project area (see Wetland Report attached to the NHDES Wetland Permit Application). The project will provide a better aquatic connection between ranked habitats on both sides of Route 101. Route 101 is an existing two-land road, and the road will be widened only slightly to accommodate a new turning lane, which will create a slightly greater separation between blocks of agricultural land (conservation parcels) on either side of the roadway. This is a small incremental impact relative to the benefits of the stream improvements. The stream crossing will meet NHDES stream crossing guidelines and GC 21. A hydraulic report is attached to the NH DES wetland permit application.

4. Flooding/Floodplain Values

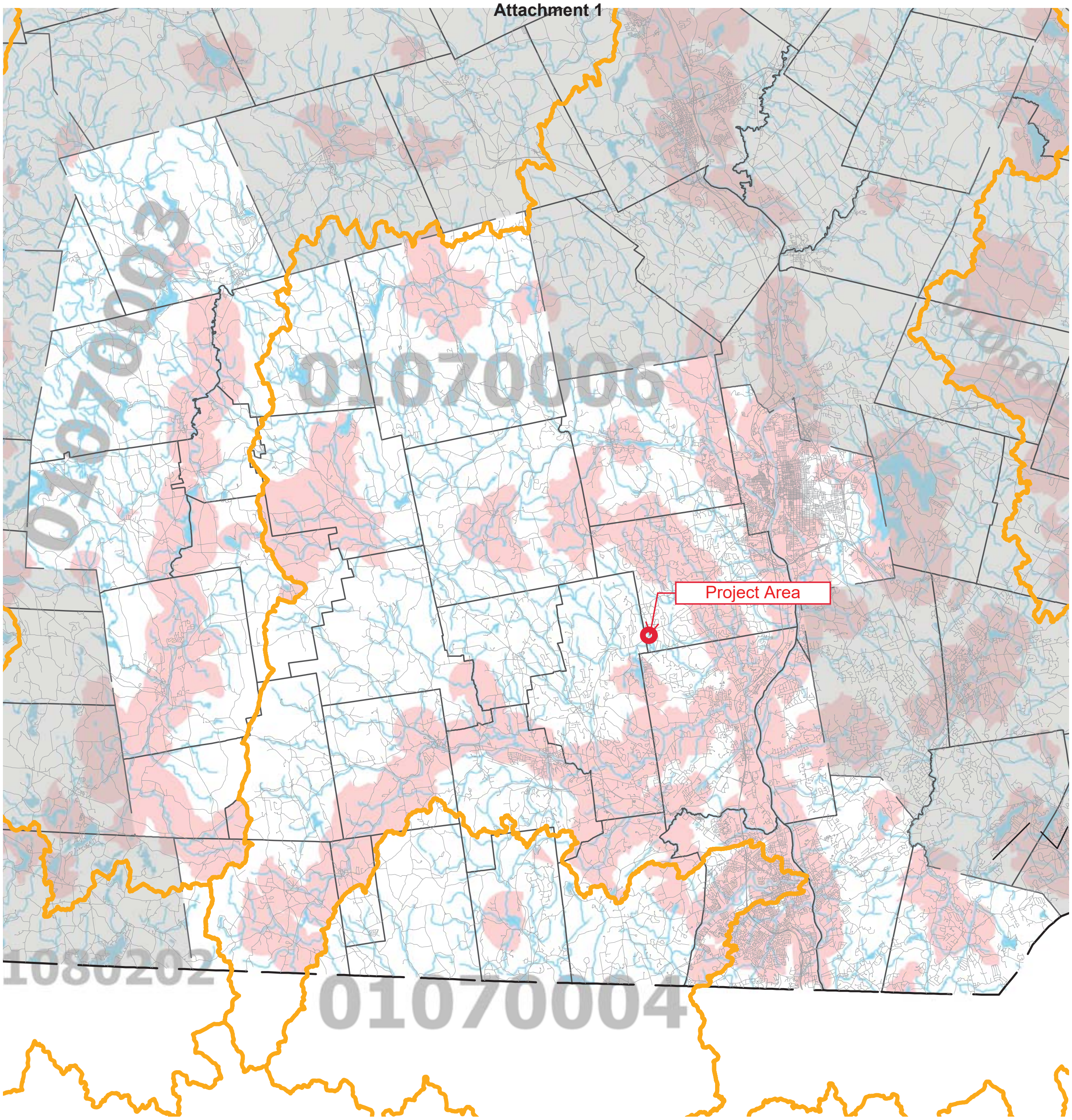
The project is located within the 100-year floodplain of Pulpit Brook, as mapped by the Federal Emergency Management Agency (FEMA) (See Wetland Report attached to the NHDES Wetland Permit Application). The road widening will require the placement of 237 CY of fill within the 100 year floodplain, and the replacement of the culverts will entail the removal of 421 CY within the floodway (Attachment 2). This equates to a net decrease of 184 CY of fill within this floodplain. The replacement of the culverts and fill with an open span bridge will also reduce upstream flood issues without increasing downstream flooding, as shown in the Hydraulic Report attached to the NHDES Wetland Permit Application. The temporary fill associated with the construction traffic diversion will be removed and existing grades restored, so this was not included in the calculations.

5. Historic/Archeological Resources

NHDOT initiated consultation with SHPO by filing a Request for Project Review (RPR) from on October 12, 2017. NHDOT submitted an addendum to the 201 7 RPR to SHPO on May 29, 2019. NHDOT submitted a Phase IA study to SHPO on May 30, 2019. Bridge No. 090/065 is exempt from Section 106 review under the Program Comment for Common Post-1945 Concrete and Steel Bridges and Culverts. The Bragdon Farm property, located on both sides of Route 101, would require minimal grading for swales related to drainage improvements. All grading would be loamed and seeded and all swales vegetated. In addition, some riprap would be installed along Pulpit Brook at the replacement bridge, but this area would not be visible to most of the farm property. The proposed project would result in no impacts to the use or function of the Bragdon Farm. Applying the criteria at 36 CFR 800.4(d)(l), the result of identification and evaluation for the undertaking is a finding of No Historic Properties Affected. The no-effects memo from the NH Division of Historical Resources is attached to the NHDES Wetland Permit application.

Hillsborough County: Impaired Waters Vicinity* for which No Additional Loading Criteria Applies

Attachment 1



*Vicinity based upon a 1 mile buffer of Assessment Units impaired in the 2006 SWQA for one or more of the following;

- Invertebrates,
- Cadmium,
- Chlorophyll *a*,
- Copper,
- Cyanobacteria,
- Dissolved Oxygen (% Sat or mg/L),
- Enterococcus,
- *E. coli*,
- Algal Growth,
- Fecal Coliform,
- Lead,
- Total Phosphorus,
- Sedimentation & Siltation,
- Zinc.

For more information on the 2006 Surface Water Quality Assessments see:
http://des.nh.gov/wmb/swqa/

0 1 2 4 6 8 10
Miles

N

NHDES

Major Divides (HUC8)
Roads(NHDOT)
State Boundary
County Boundary
Town Boundary
2006 Assessment Unit ID Lines (1:100k NHD)
2006 Assessment Unit ID Polygons(1:100k NHD)
One Mile Buffer on No Additional Loading AUIDs

This map is intended solely as a screening tool to assist you in identifying areas within 1 mile upstream in the watershed of an impaired waterbody. This map is not intended to show analytical results regarding pollutant loading or any other information related to sections 305(b) or 401 of the Clean Water Act or any other State or federal laws.

The coverages presented in this program are under constant revision as new sites or facilities are added. They may not contain all of the potential or existing sites or facilities. The Department is not responsible for the use or interpretation of this information, nor for any inaccuracies.

Map Prepared July 17, 2007.

H:\Water Quality\305(B)-303(D) PROGRAM\2006_Int_Aprch\Info_Rqsts\20061025_PMC_No_Add_Load

Attachment 2 - Flood Storage Calculations

Bedford 13692C Flood Storage Quantities - Proposed Fill vs Proposed Excavation

		Area (sf)				Volume	
Station	**Length (Ft)**	**Left**	**Right**	**Total**	**Average**	**cf**	**CY**
20050		0	0	0			
	50				0.27	13.5	0.50
20100		0	0.54	0.54			
	50				1.11	55.3	2.05
20150		0	1.67	1.67			
	50				0.84	41.8	1.55
20200		0	0	0			
	50				0.00	0.0	0.00
20250		0	0	0			
	50				0.39	19.5	0.72
20300		0	0.78	0.78			
	50				0.39	19.5	0.72
20350		0	0	0			
	50				0.00	0.0	0.00
20400		0	0	0			
	50				0.00	0.0	0.00
20450		0	0	0			
	50				1.52	76.0	2.81
20500		0	3.04	3.04			
	50				4.32	216.2	8.01
20550		0.009	5.6	5.609			
	50				4.62	231.0	8.55
20600		0	3.63	3.63			
	50				4.54	227.0	8.41
20650		0	5.45	5.45			
	50				7.17	358.5	13.28
20700		0	8.89	8.89			
	50				5.89	294.3	10.90
20750		0	2.88	2.88			
	50				4.92	245.8	9.10
20800		0	6.95	6.95			
	38				6.95	264.1	9.78
20838		0	6.95	6.95			

Bridge Clear Span (208+38 to 208+86)

		Area (sf)				Volume	
Station	**Length (Ft)**	**Left**	**Right**	**Total**	**Average**	**cf**	**CY**
20886		0	16.65	16.65			
	14				16.65	233.1	8.63
20900		0	16.65	16.65			
	50				17.78	888.8	32.92
20950		0	18.9	18.9			
	50				14.12	705.8	26.14
21000		0	9.33	9.33			
	50				13.53	676.3	25.05
21050		0	17.72	17.72			
	50				12.83	641.3	23.75
21100		0	7.93	7.93			
	50				6.71	335.3	12.42
21150		0	5.48	5.48			
	50				3.91	195.3	7.23
21200		0	2.33	2.33			
	50				1.17	58.3	2.16

21250		0	0	0			
	50				5.95	297.5	11.02
21300		0	11.9	11.9			
	50				5.95	297.5	11.02
21350		0	0	0			

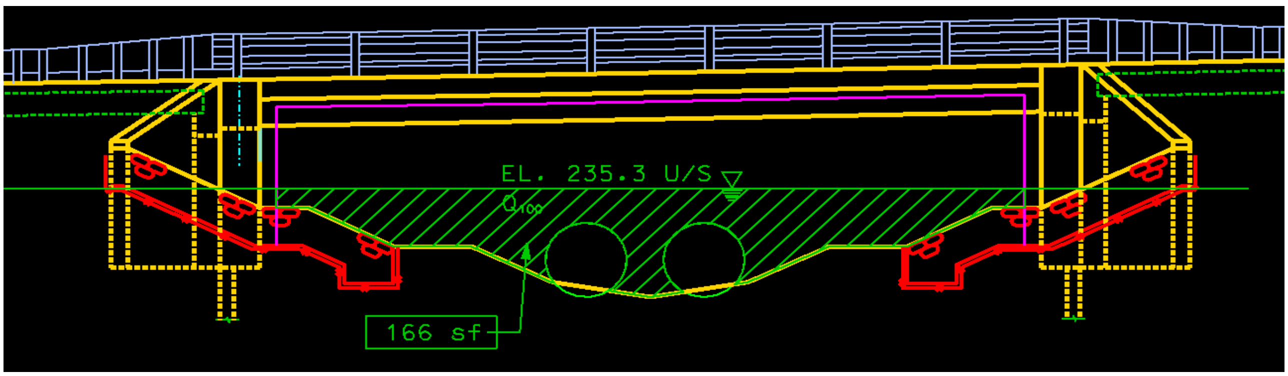
Total Roadway Fill Below Q100 (El. 235.3) = 237 CY

Material Excavated within Hydraulic Opening

Area = 166 sf
Length = 68.5 ft (Distance between existing headwalls (Conservative for Removal Calc, Actual will be higher))
Volume = 11371 cf

Volume Removed = 421 CY

Net Removal = 184 CY



US Army Corps of Engineers
Wetland Determination Data Sheets

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: Pulpit Brook - Bedford 13692C City/County: Bedford, Hillsborough Sampling Date: 8/11/20

Applicant/Owner: NH Department of Transportation State: NH Sampling Point: PBW5-Wet

Investigator(s): Lee Carbonneau; Normandeau Section, Township, Range: ____

Landform (hillslope, terrace, etc.): Floodplain Low terrace Local relief (concave, convex, none): Concave Slope (%): <5%

Subregion (LRR or MLRA): LRR R Lat: 42.905922° Long: -71.569734 Datum: ____

Soil Map Unit Name: Swansea Mucky Peat NWI classification: PEO1/PSS1

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ____ No ✓ (If no, explain in Remarks.) Dryer Than normal

Are Vegetation ____, Soil ____, or Hydrology ✓ significantly disturbed? Are "Normal Circumstances" present? Yes ____ No ✓

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.) Blocked Culvert Downstream

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No ____	Is the Sampled Area within a Wetland? Yes ✓ No ____
Hydric Soil Present?	Yes ✓ No ____	
Wetland Hydrology Present?	Yes ✓ No ____	If yes, optional Wetland Site ID: PBW5-Wet

Remarks: (Explain alternative procedures here or in a separate report.)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

Primary	Primary	Secondary Indicators (minimum of two required)
___ Surface Water (A1)	___ Water-Stained Leaves (B9)	___ Surface Soil Cracks (B6)
___ High Water Table (A2)	___ Aquatic Fauna (B13)	___ Drainage Patterns (B10)
✓ Saturation (A3)	___ Marl Deposits (B15)	___ Moss Trim Lines (B16)
___ Water Marks (B1)	✓ Hydrogen Sulfide Odor (C1)	✓ Dry-Season Water Table (C2)
___ Sediment Deposits (B2)	___ Oxidized Rhizospheres on Living Roots (C3)	___ Crayfish Burrows (C8)
___ Drift Deposits (B3)	___ Presence of Reduced Iron (C4)	___ Saturation Visible on Aerial Imagery (C9)
___ Algal Mat or Crust (B4)	___ Recent Iron Reduction in Tilled Soils (C6)	___ Stunted or Stressed Plants (D1)
___ Iron Deposits (B5)	___ Thin Muck Surface (C7)	___ Geomorphic Position (D2)
___ Inundation Visible on Aerial Imagery (B7)	___ Other (Explain in Remarks)	___ Shallow Aquitard (D3)
___ Sparsely Vegetated Concave Surface (B8)		___ Microtopographic Relief (D4)
		✓ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ____	No ✓	Depth (inches): ____
Water Table Present?	Yes ✓	No ____	Depth (inches): 12"
Saturation Present? (includes capillary fringe)	Yes ✓	No ____	Depth (inches): 6 inches

Wetland Hydrology Present? Yes ✓ No ____

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Pulpit Brook levels high due to clogged bridge below wetland area.

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: PBW5-W

Tree Stratum (Plot size: ________)	Absolute % Cover	Dominant Species?	Indicator Status
1. N/A			
2.			
3.			
4.			
5.			
6.			
7.			
		= Total Cover	

Sapling/Shrub Stratum (Plot size: 15' radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Cephalanthus occidentalis	5%	Yes	OBL
2. Sambucus nigra ssp. canadensis	2%	Yes	FACW
3.			
4.			
5.			
6.			
7.			
	7%	= Total Cover	

Herb Stratum (Plot size: 5' radius)	Absolute % Cover	Dominant Species?	Indicator Status
1. Calamagrostis canadensis	50%	✓	OBL
2. Spiraea alba	20%	✓	FACW
3. Rubus setosus	15%		FACW
4. Solidago rugosa	10%		FAC
5. Carex stricta	2%		OBL
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	97%	= Total Cover	

Woody Vine Stratum (Plot size: N/A)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
		= Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 4 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	57	x 1 =	57
FACW species	37	x 2 =	74
FAC species	10	x 3 =	30
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	94 (A)		161 (B)

Prevalence Index = B/A = 1.71

Hydrophytic Vegetation Indicators:

✓ 1 - Rapid Test for Hydrophytic Vegetation

✓ 2 - Dominance Test is >50%

✓ 3 - Prevalence Index is ≤3.0[1]

__ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

__ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Definitions of Vegetation Strata:

Tree – Woody plants 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub – Woody plants less than 3 in. DBH and greater than or equal to 3.28 ft (1 m) 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: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: PBW5-wet

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-6"	10 YR 5/2		7.5 YR 4/6				clay-loam	Faint H_2S odor
6-13"	10 YR 3/1						FSL	Saturated
13+	10 YR 6/2						Med Sand	Saturated

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.
[2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ✓ Depleted Below Dark Surface (A11)
- ✓ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7) **(LRR R, MLRA 149B)**
- ___ Polyvalue Below Surface (S8) **(LRR R, MLRA 149B)**
- ___ Thin Dark Surface (S9) **(LRR R, MLRA 149B)**
- ___ Loamy Mucky Mineral (F1) **(LRR K, L)**
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) **(LRR K, L, MLRA 149B)**
- ___ Coast Prairie Redox (A16) **(LRR K, L, R)**
- ___ 5 cm Mucky Peat or Peat (S3) **(LRR K, L, R)**
- ___ Dark Surface (S7) **(LRR K, L)**
- ___ Polyvalue Below Surface (S8) **(LRR K, L)**
- ___ Thin Dark Surface (S9) **(LRR K, L)**
- ___ Iron-Manganese Masses (F12) **(LRR K, L, R)**
- ___ Piedmont Floodplain Soils (F19) **(MLRA 149B)**
- ___ Mesic Spodic (TA6) **(MLRA 144A, 145, 149B)**
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: —

Depth (inches): —

Hydric Soil Present? Yes ✓ No ___

Remarks:

Color Photos With Captions

Bedford 13692C – Pulpit Brook Culvert Replacement Project
Wetland Photographs

Photo 1, above. Wetland 1, from flag #3, towards adjacent wet meadow. 7/28/20. (no impacts)

Photo 2, below. Wetland 2 at edge of managed hayfield. 7/27/20. (no impacts)

Photo 3, above. Wetland 3. 7/28/20. (no impacts)

Photo 4, below. Wetland 4, west of Twin Brook Lane. 7/30/20. (Impact T - minor temporary impacts to fringing forested wetland).

Photo 5, above. The downstream face of the existing twin culvert at the Pulpit Brook crossing. 6/16/17. (Temporary impacts K, L, M, and N, and permanent impacts G, H, I, O and Q at this location)

Photo 6, below. The upstream face of the existing culverts. 6/16/17. (Temporary impacts B, D, and F and permanent impacts A, C, and E at this location)

Photo 7, above. Northwestern edge of Wetland 5 in Pulpit Brook floodplain. 8/11/20. Temporary fill but permanent impact G at this location).
Photo 8, below. Eastern part of Wetland 5 looking west. 8/11/20. (Eastern edge of this wetland will have minor Temporary and permanent impacts R and S).

Bedford 13692C – Pulpit Brook Culvert Replacement Project
Wetland Photographs

Photo 9, above. Pulpit Brook in Wetland 5, above the old road and blocked culvert which is 50 yards downstream of Route 101. 8/11/20. (No impacts at this location)

Photo 10, below left: VP1. 5/9/18 and Photo 11, below right: VP 2. 5/9/18. (no VP impacts)

Photo 12, above. Wetland 6, on the east side of Twin Brook Lane. 7/30/20. (no impacts)

Photo 13, below. Wetland 7, looking south. 7/30/20. (no impacts)

Photo 14. Wetland 8, the PSS/PEM wetland along Pulpit Brook north of Route 101, looking north from Route 101 roadbank. 5/9/18. (Permanent bank/channel impacts/improvements A, C, and E; and temporary wetland/channel impacts B, D, and F).

Proposed Construction Schedule and Sequence

Construction Sequencing

The construction of this sequence for the project is proposed in three phases, with sub-phases for traffic control. Phase 1 will construct a temporary on-site traffic diversion (bypass) along the south side of the existing bridge, to accommodate traffic flow in both directions during Phase 2 & 3 of construction.

Phase 1 Temporary earth retaining systems (cofferdams), culvert extensions and concrete barrier will be used to construct the temporary roadway and protect the brook during construction.

<u>Phase 1 – Anticipated Water Diversion Sequence</u>
<u>(Fall 2021 to March 2022)</u>

1. Install erosion and sedimentation control prior to beginning any excavation and/or channel work. Silt booms (turbidity curtains) shall be installed upstream and downstream of the proposed work but within the limit of the proposed easements.
2. Install dewatering sedimentation basin(s), cofferdams and silt curtains/booms. Size, type, number and location(s) of basin(s) to be determined by contractor but approved by the engineer. Basins shall be placed as far back as possible from wetlands and surface waters with an undisturbed vegetated buffer and/or at a certified discharge point.
3. Install Phase 1 water diversion structures upstream and downstream of the project site. Maintain flow through one culvert or by other means.
4. Dewater channel within the water diversion structures/cofferdams into sedimentation basin(s).
5. Construct 1st culvert extension(s) and associated earthwork including muck removal. Replace muck under the stream bed location with approved simulated streambed material.
6. Install/Relocate water diversion structures upstream and downstream to shut off flow to the other culvert. Maintain flow through newly extended culvert or by other means.
7. Dewater channel into sedimentation basin(s).
8. Construct 2nd culvert extension and associated earthwork including muck removal as necessary.
9. Restore flow to both culverts through construction of the first phase of the bridge substructure.
10. Install sheetpile cofferdam within roadway at the edge of the first phase of bridge work (stageline).
11. Install environmental sheeting along the temporary roadway diversion approaches.
12. Construct temporary roadway diversion/bypass, removing muck beneath the temporary approaches, and replacing with suitable fill material as necessary.
13. Transition to Phase 2.

Phase 2 will construct the northern portion of the new proposed bridge and its approaches while traffic is carried on the temporary diversion.

Treatment Swale on west side of NH 101, including the conveyance swale and drive pipe that flows into it, is anticipated to be constructed during this phase.

<u>Phase 2 – Anticipated Channel Reconstruction and Cofferdam Sequence</u>
<u>(April 2022 to July 2022)</u>

1. Install northern portions of the bridge abutments and place rip rap in front of abutment and wingwalls.
2. Install water diversion structures upstream and downstream to shut off flow to the culvert(s). Maintain flow through one culvert.
3. Dewater into sedimentation basin(s).
4. Remove culvert segments west of stageline and reconstruct channel.
5. Install/Relocate water diversion structures upstream and downstream to shut off flow to the other culvert, if needed. Maintain flow through newly constructed channel and remaining culvert or by other means.
6. Dewater channel into sedimentation basin(s).
7. Remove culvert segments west of stageline and reconstruct channel.
8. Remove upstream water diversion structure and restore flow through entire width of newly constructed upstream channel and both culverts.
9. Complete northern half of bridge superstructure and roadway approach work and transition to Phase 3.

Phase 3 of construction will shift traffic onto the portion of permanent roadway and bridge constructed in Phase 2.

The remaining southern portion of the new proposed bridge and its approaches will be constructed in Phase 3.

The temporary access road, culvert extensions and temporary earth retaining systems will be removed.

The proposed drainage and treatment swale on the east side of NH 101 will be constructed.

Pavement reclaiming, final paving and diversion removal will be completed in Spring 2023.

<u>Phase 3 – Anticipated Channel Reconstruction and Cofferdam Sequence</u>
<u>(August 2022 to Spring 2023, with bridge work completed by November 2022)</u>

1. Install south half of bridge abutments and place rip rap in front of abutment and wingwalls.
2. Install water diversion structures upstream and downstream to shut off flow to remaining/extended culvert(s). Maintain flow through one culvert or by other means.
3. Dewater area into sedimentation basin(s).
4. Remove remaining culvert segments east of stageline and reconstruct channel.
5. Install/Relocate water diversion structures upstream and downstream to shut off flow to the other portion of the channel and culvert, if needed. Maintain flow through newly constructed channel or by other means.
6. Dewater sedimentation basin(s).
7. Remove remaining culvert segments east of stageline and reconstruct portion of channel.
8. Complete remaining Phase 3 superstructure and roadway work.
9. Remove Silt Booms and other associated erosion and sediment controls once all bridge work is complete and the area has been fully restored and stabilized.

Restoration

Restoration notes can be found on the Restoration Plan attached to the permit application. This narrative describes generally what is planned for the stream bed, banks, and wetlands. The stream bed under the new bridge will be provided with a natural substrate matching adjacent stream bed materials, which is comprised of medium to coarse sand and fine gravel. A level shelf approximately 4 ft wide on either side of the stream channel under the bridge will enhance passage for riparian/semi-aquatic wildlife. This shelf will be constructed of natural materials (soil and stone), and seed mix will be applied, although shading will limit herbaceous growth under the bridge. Stream banks temporarily impacted during construction will be stabilized with coir logs or compacted soil with interspersed stone, as appropriate. Compost socks shall be installed with no gaps between the soil and the fiber roll, and logs shall overlap at the ends. Compost socks will be held in place with stakes placed at least every three feet apart along the length of the roll. Wetland seed mix will also be sown on streambanks.

Upon removal of temporary fill in wetlands impacted by the temporary roadway diversion/bypass, the remaining subsoil will be graded so it is approximately 12 inches below the original wetland soil elevation, to accommodate approximately 12 inches of wetland humus (or topsoil amended to reach 4% organic matter) to match the elevation of the adjacent wetland. This wetland soil will be spread over the subsoil and seeded. If wetland surface soil was removed and temporarily stockpiled prior to traffic diversion construction, this material, supplemented by additional wetland soil, will be replaced. Only wetland soil free of invasive species will be reused on site. This is considered to be a permanent impact to soil character and function, and will be mitigated through an ARM fund payment. Nevertheless, with appropriate grades, surface soils and a wetland seed mix, some wetland functions will recover. The New England Wetland Plants (NEWP) Roadside Matrix Wet Meadow Seed Mix or an equivalent, will be sown at the toe of the permanent highway slope and in any other temporarily impacted wetland. Road embankment slopes and any temporarily disturbed upland area will be stabilized with an appropriate seed mix such as the NEWP NE Conservation/Wildlife Seed Mix or an equivalent.

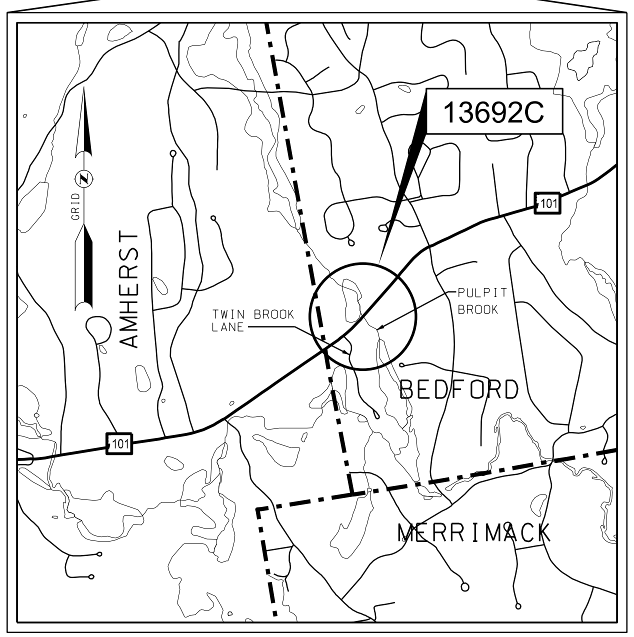
Permanent or temporary cover must be in place before the growing season ends. No disturbed area shall be left exposed during winter months. When and where permanent seeding is not appropriate, temporary cover consisting of annual ryegrass, will be applied. Temporary seed will be sown prior to October 15th.

Wetland Permitting Plans
and
Erosion Control Plans

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

WETLAND PLANS
FEDERAL AID PROJECT

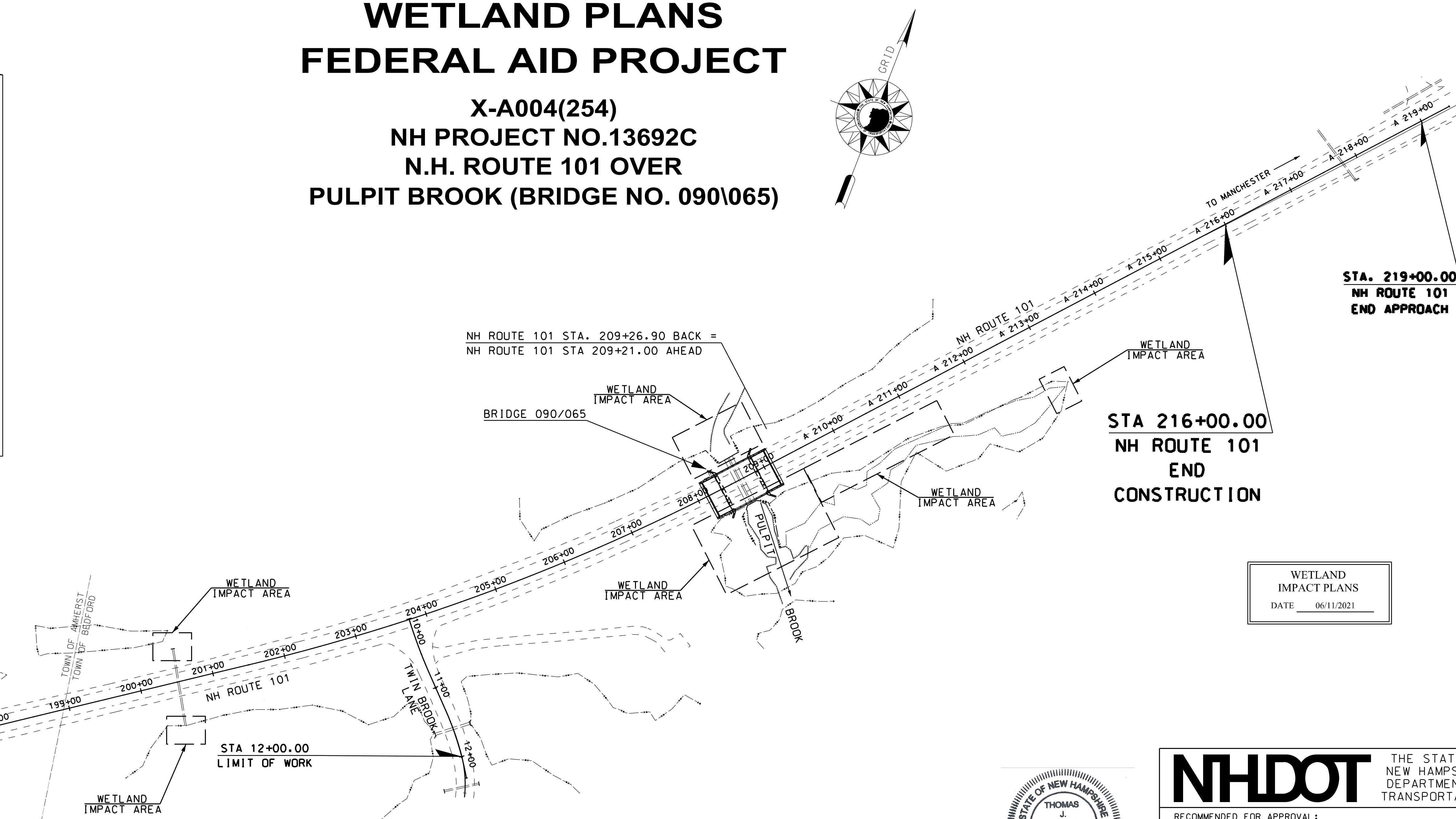
X-A004(254)
NH PROJECT NO.13692C
N.H. ROUTE 101 OVER
PULPIT BROOK (BRIDGE NO. 090\065)



LOCATION MAP

1/2 1/4 0 1/2 1 mi.

GRAPHIC SCALE



WETLAND
IMPACT PLANS
DATE 06/11/2021

TOWN OF BEDFORD

COUNTY OF HILLSBOROUGH

SCALE: 1" = 80'

FOR CONSTRUCTION AND ALIGNMENT DETAILS -
SEE CONSTRUCTION PLANS

WETLAND DELINEATION

NORMANDEAU
ASSOCIATES

BY:

STATE OF NEW HAMPSHIRE LEE E. CARBONNEAU 6/11/21 No. 123 CERTIFIED WETLAND SCIENTIST

KLEINFELDER
Bright People. Right Solutions.

McFarland Johnson

STATE OF NEW HAMPSHIRE THOMAS J. MARSHALL No. 10426 LICENSED PROFESSIONAL ENGINEER

STATE OF NEW HAMPSHIRE EUGENE W. McCARTHY No. 10209 LICENSED PROFESSIONAL ENGINEER

DRAWN BY	MAL	DATE	12/2020
CHECKED BY	EWM	DATE	12/2020

NHDOT THE STATE OF NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

RECOMMENDED FOR APPROVAL:

DIRECTOR OF PROJECT DEVELOPMENT — DATE

APPROVED:

ASSISTANT COMMISSIONER AND CHIEF ENGINEER — DATE

U. S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

APPROVED:

DIVISION ADMINISTRATOR — DATE

DRAWING NAME	FEDERAL PROJECT NO.	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
13692Cfcr	X-A004(254)	13692C	1	15

GENERAL

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

DRIVEWAYS — (label surface type)

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

FOUNDATION — (label type)

LEACH FIELD — leach field

BRIDGE CROSSINGS — STREAM — OVERPASS

STEPS AND WALK — (label type)

INTERMITTENT WATER COURSE

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

POTENTIAL WET AREA SYMBOL

BRUSH OR WOODS LINE

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

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

HEDGE — (label type)

MONITORING WELL — mon

WELL

FLAG POLE — fp

ORIGINAL GROUND (TYPICALS)

ROCK OUTCROP

ROCK LINE (TYPICALS & SECTIONS ONLY)

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

SIGNS — (single post) — (double post)

GAS PUMP — gp

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

STORAGE TANK FILLER CAP — fc

SEPTIC TANK — S

GRAVE — gr

MAILBOX — mb

VENT PIPE — vp

SATELLITE DISH ANTENNA — da

PHONE — ph

GROUND LIGHT/LAMP POST — gl lp

BORING LOCATION — B

TEST PIT — TP

INTERSTATE NUMBERED HIGHWAY — 293

UNITED STATES NUMBERED HIGHWAY — 3

STATE NUMBERED HIGHWAY — 102

SHORELAND - WETLAND

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

FLOODPLAIN / FLOODWAY

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

ENGINEERING

CONSTRUCTION BASELINE — 30 31 32

PC, PT, POT (ON CONST BASELINE)

PI (IN CONSTRUCTION BASELINES)

INTERSECTION OR EQUATION OF TWO LINES

ORIGINAL GROUND LINE (PROFILES AND CROSS-SECTIONS)

PROFILE GRADE LINE (PROFILES AND CROSS-SECTIONS)

SLOPE LINE — CLEARING LINE

CLEARING LINE

SLOPE LINE

SLOPE LINE (FILL)

SLOPE LINE (CUT)

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

SHEET 1 OF 2

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

STANDARD SYMBOLS

REVISION DATE	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
11-21-2014	stdsymb1-2	13692C	3	15

DRAINAGE

MANHOLE	(existing)	(PROPOSED)
CATCH BASIN	cb	
DROP INLET	di	

- DRAINAGE PIPE (existing) — (label size & type)
- DRAINAGE PIPE (PROPOSED)
- UNDERDRAIN (existing) W/ FLUSHING BASIN — fb — (label size & type)
- UNDERDRAIN (PROPOSED) W/ FLUSHING BASIN
- HEADER (existing & PROPOSED) — (with stone outlet protection)
- END SECTION (existing & PROPOSED) — METAL or PLASTIC; RCP
- OPEN DITCH (PROPOSED)
- EROSION CONTROL/ STONE SLOPE PROTECTION

show direction of flow

BOUNDARIES / RIGHT-OF-WAY

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

UTILITIES

	existing	PROPOSED
TELEPHONE POLE		
POWER POLE		
JOINT OCCUPANCY		
MISCELLANEOUS/UNKNOWN POLE		
GUY POLE OR PUSH BRACE		
LIGHT POLE		
LIGHT ON POWER POLE		
LIGHT ON JOINT POLE		

(plot point at face not center of symbol)

POLE STATUS:
REMOVE, LEAVE, PROPOSED, OR TEMPORARY AS APPLICABLE e.g.: R — L — P+04 25.0' — T+04 25.0'

	existing	PROPOSED
RAILROAD	(label ownership)	
RAILROAD SIGN		
RAILROAD SIGNAL		
UTILITY JUNCTION BOX	jb	JB
OVERHEAD WIRE	OW (label type)	OW

UNDERGROUND UTILITIES

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

MANHOLES

	existing	PROPOSED
SEWER	s	MHS
TELEPHONE	t	MHT
ELECTRICAL	e	MHE
GAS	g	MHG
UNKNOWN	u	

TRAFFIC SIGNALS / ITS

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

CONSTRUCTION NOTES

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

SHEET 2 OF 2

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION • BUREAU OF HIGHWAY DESIGN

STANDARD SYMBOLS

REVISION DATE	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
9-1-2016	stdsymb1-2	13692C	4	15

WETLAND IMPACT SUMMARY

WETLAND NUMBER	WETLAND CLASS-IFICATION	LOCATION	AREA IMPACTS						LINEAR STREAM IMPACTS FOR MITIGATION*			COMMENTS
			PERMANENT				TEMPORARY		PERMANENT			
			N.H.W.B. (NON-WETLAND)		N.H.W.B. & A.C.O.E. (WETLAND)				BANK LEFT	BANK RIGHT	CHANNEL	
			SF	LF	SF	LF	SF	LF	LF	LF	LF	
2	BANK	A	202	40								NEW WINGWALL (BANK IMPACT)
8	PSS1C	B					504					NEW WINGWALL
2	R2UB2	C			779	35						STREAM BED RESTORATION (CHANNEL IMPACT)
8	PSS1C	D					181					STREAM BED RESTORATION
2	BANK	E	174	31								NEW WINGWALL (BANK IMPACT)
6	PSS1C	F					184					NEW WINGWALL
5	PFO1E	G			1634							NEW WINGWALL AND DIVERSION (PRA WETLAND)
2	BANK	H	223	44								NEW WINGWALL AND DIVERSION (BANK IMPACT)
2	R2UB2	I			1407	52						STREAM BED RESTORATION (CHANNEL IMPACT)
5	PFO1E	J					32					DIVERSION (PRA WETLAND)
2	BANK	K					74	14				DIVERSION (BANK IMPACT)
5	PFO1E	L					268	18				STREAM BED RESTORATION (CHANNEL IMPACT)
2	BANK	M					40	18				DIVERSION (BANK IMPACT)
5	PFO1E	N					89					DIVERSION (PRA WETLAND)
2	BANK	O	84	46								NEW WINGWALL AND DIVERSION (BANK IMPACT)
2	BANK	P					28	25				NEW WINGWALL AND DIVERSION (BANK IMPACT)
5	PFO1E	Q			4123		76					WIDENING AND DIVERSION EMBANKMENT (PRA WETLAND)
5	PFO1E	R			11		102					VEGETATED SWALE 3 (PRA WETLAND)
5	PFO1E	S			111							VEGETATED SWALE 3 (PRA WETLAND)
4	PUB3H	T					213					CULVERT RESETTING
1	R4UB	U					91	19				CULVERT RESETTING
		TOTAL	683	161	8065	87	1882	94				

NEW HAMPSHIRE IMPACTS

PERMANENT IMPACTS: 8,748 F
TEMPORARY IMPACTS: 1,882 SF

TOTAL IMPACTS: 10,630 SF

* THE LINEAR STREAM IMPACTS FOR THIS PROJECT ARE CONSIDERED SELF-MITIGATING, AND ARE THEREFORE NOT INCLUDED IN THE RIGHT-HAND PORTION OF THIS TABLE.

WETLAND CLASSIFICATION CODES

PEM1E	PALUSTRINE, EMERGENT, HYPERHALINE, SEASONALLY FLOODED/SATURATED
PFO1E	PALUSTRINE, FORESTED, BROAD-LEAVED DECIDUOUS, SEASONALLY FLOODED/SATURATED
PSSIC	PALUSTRINE, SCRUB-SHRUB, BROAD-LEAVED DECIDUOUS, SEASONALLY FLOODED
PUB3H	PALUSTRINE, UNCONSOLIDATED BOTTOM, MUD, PERMANENTLY FLOODED
R2UB2	RIVERINE, LOWER PERENNIAL, UNCONSOLIDATED BOTTOM, SAND
R4SB	RIVERINE, INTERMITTENT, STREAMBED
R4UB	RIVERINE, INTERMITTENT, UNCONSOLIDATED BOTTOM

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

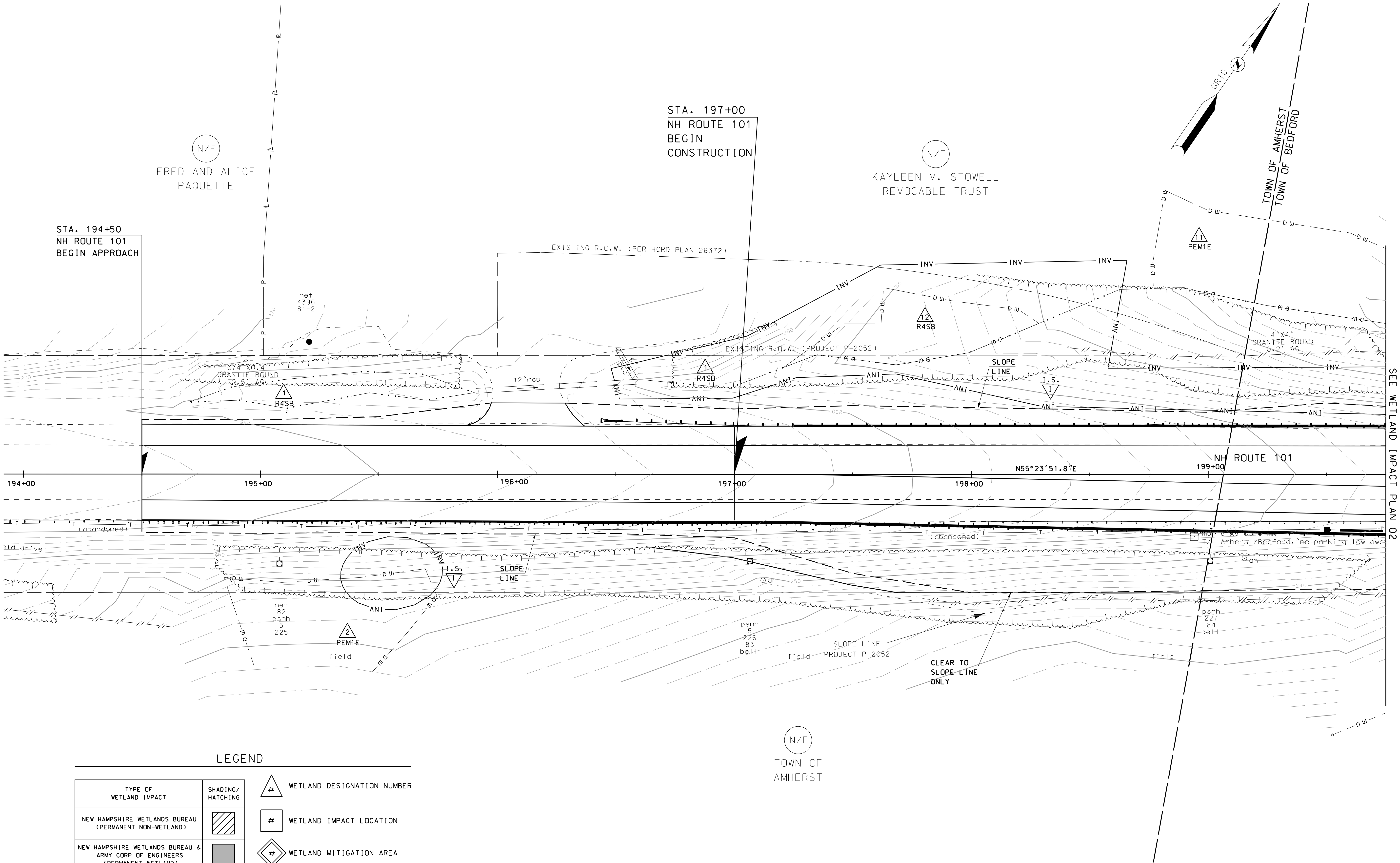
SDR PROCESSED NHDOT DATE 12-2020
NEW DESIGN BEP DATE 12-2020
SHEET CHECKED EWM DATE 12-2020
AS BUILT DETAILS

McFarland Johnson

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

WETLAND IMPACT SUMMARY SHEET

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
13692cwetsum	13692C	4	15



LEGEND

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

- WETLAND DESIGNATION NUMBER
- WETLAND IMPACT LOCATION
- WETLAND MITIGATION AREA
- MITIGATION

20 0 20 40
SCALE IN FEET

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STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

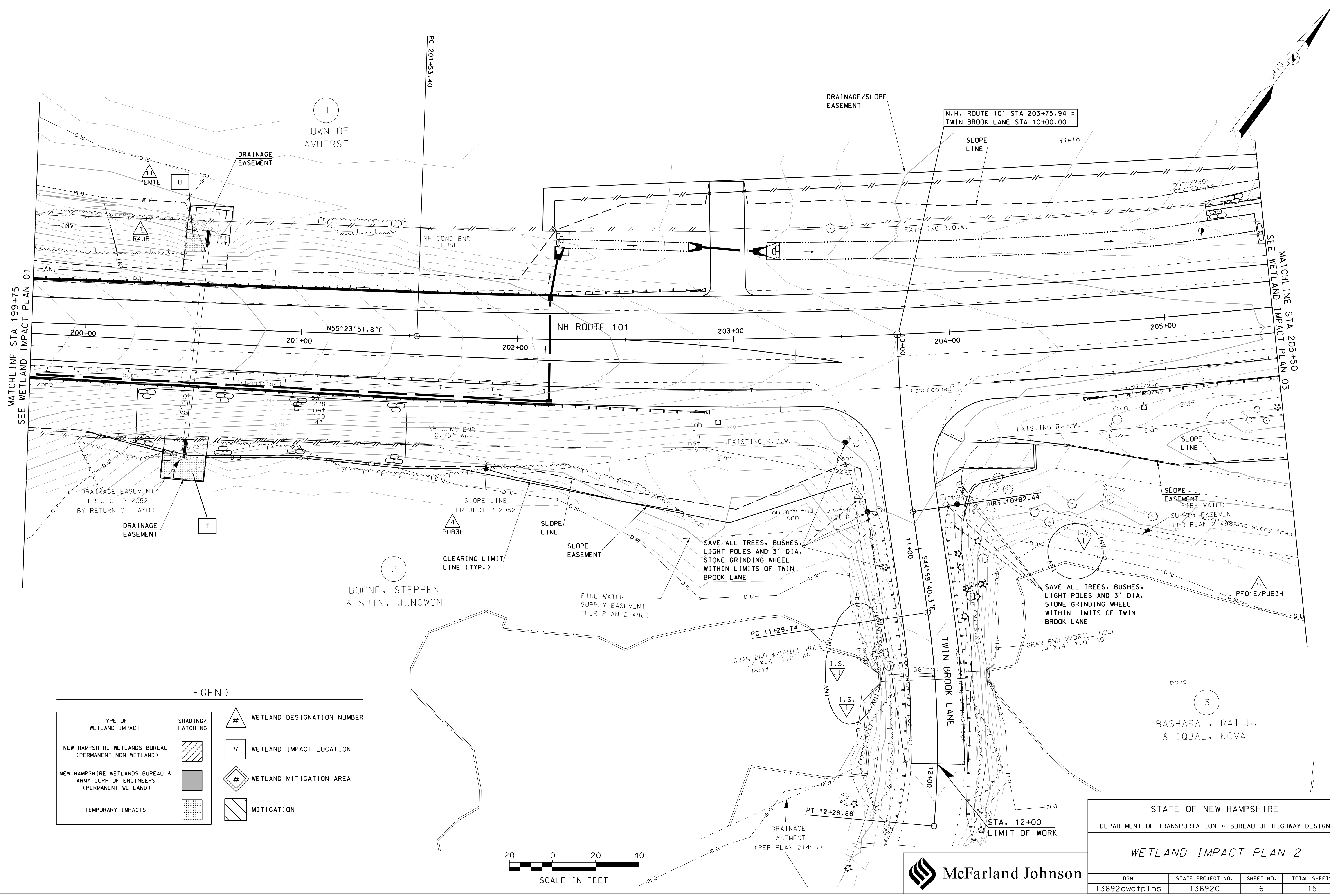
WETLAND IMPACT PLAN 01

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
13692cwetplns	13692C	5	15

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED NHDOT DATE 12-2020
NEW DESIGN BEP DATE 12-2020
SHEET CHECKED EWM DATE 12-2020
AS BUILT DETAILS



REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED NHDOT DATE 12-2020
NEW DESIGN BEP DATE 12-2020
SHEET CHECKED EWM DATE 12-2020
AS BUILT DETAILS

McFarland Johnson

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION • BUREAU OF HIGHWAY DESIGN

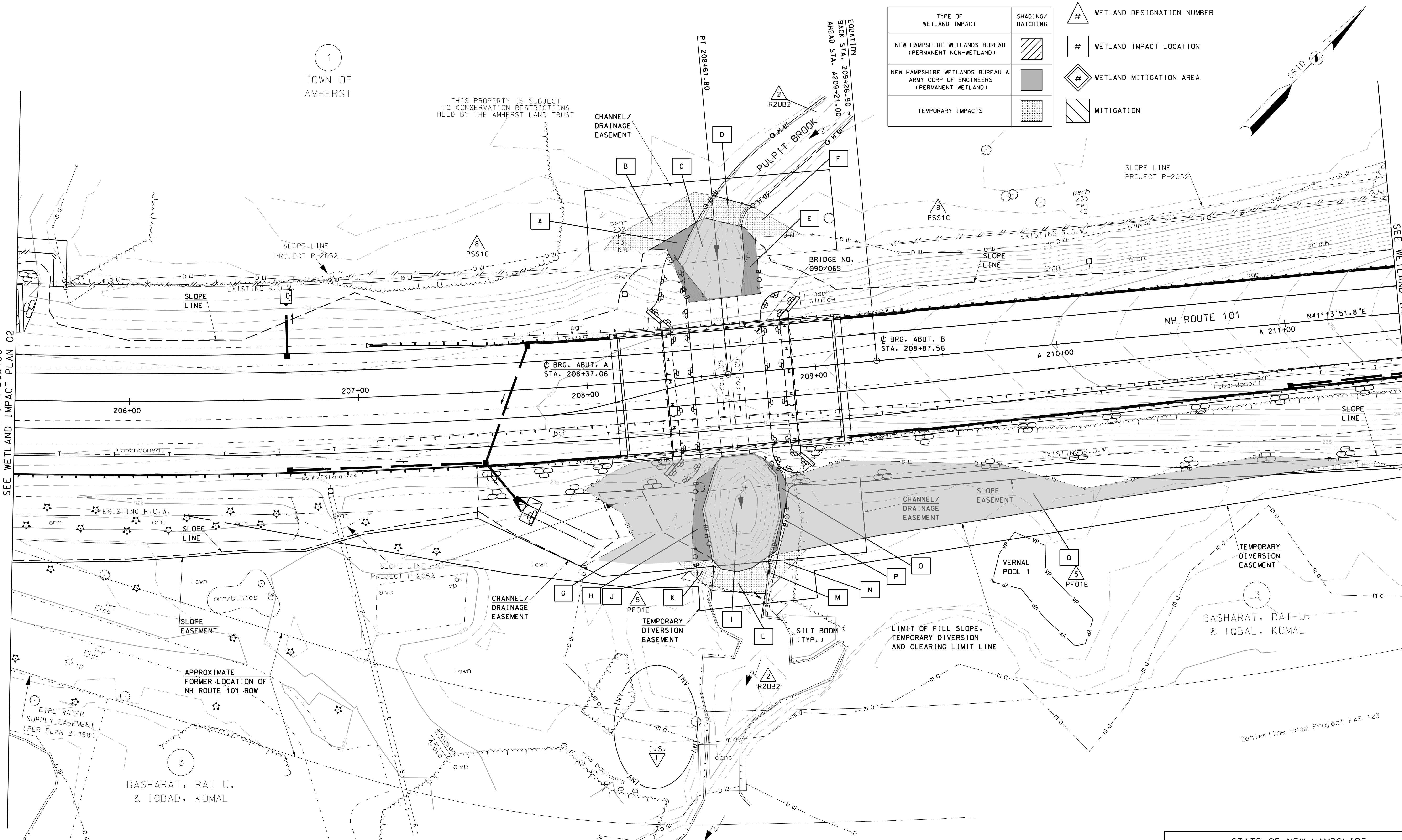
WETLAND IMPACT PLAN 2

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
13692cwetplns	13692C	6	15

LEGEND

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

- WETLAND DESIGNATION NUMBER
- WETLAND IMPACT LOCATION
- WETLAND MITIGATION AREA
- MITIGATION



20 0 20 40

SCALE IN FEET

NUMBER	DATE	STATION	STATION	REVISIONS AFTER PROPOSAL DESCRIPTION

SDR PROCESSED	NHDOT	DATE 12-2020
NEW DESIGN	BEP	DATE 12-2020
SHEET CHECKED	EWM	DATE 12-2020
AS BUILT DETAILS		

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STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

WETLAND IMPACT PLAN 03

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
13692cwetplns	13692C	7	15

REVISIONS AFTER PROPOSAL			
NUMBER	DATE	STATION	STATION	DESCRIPTION

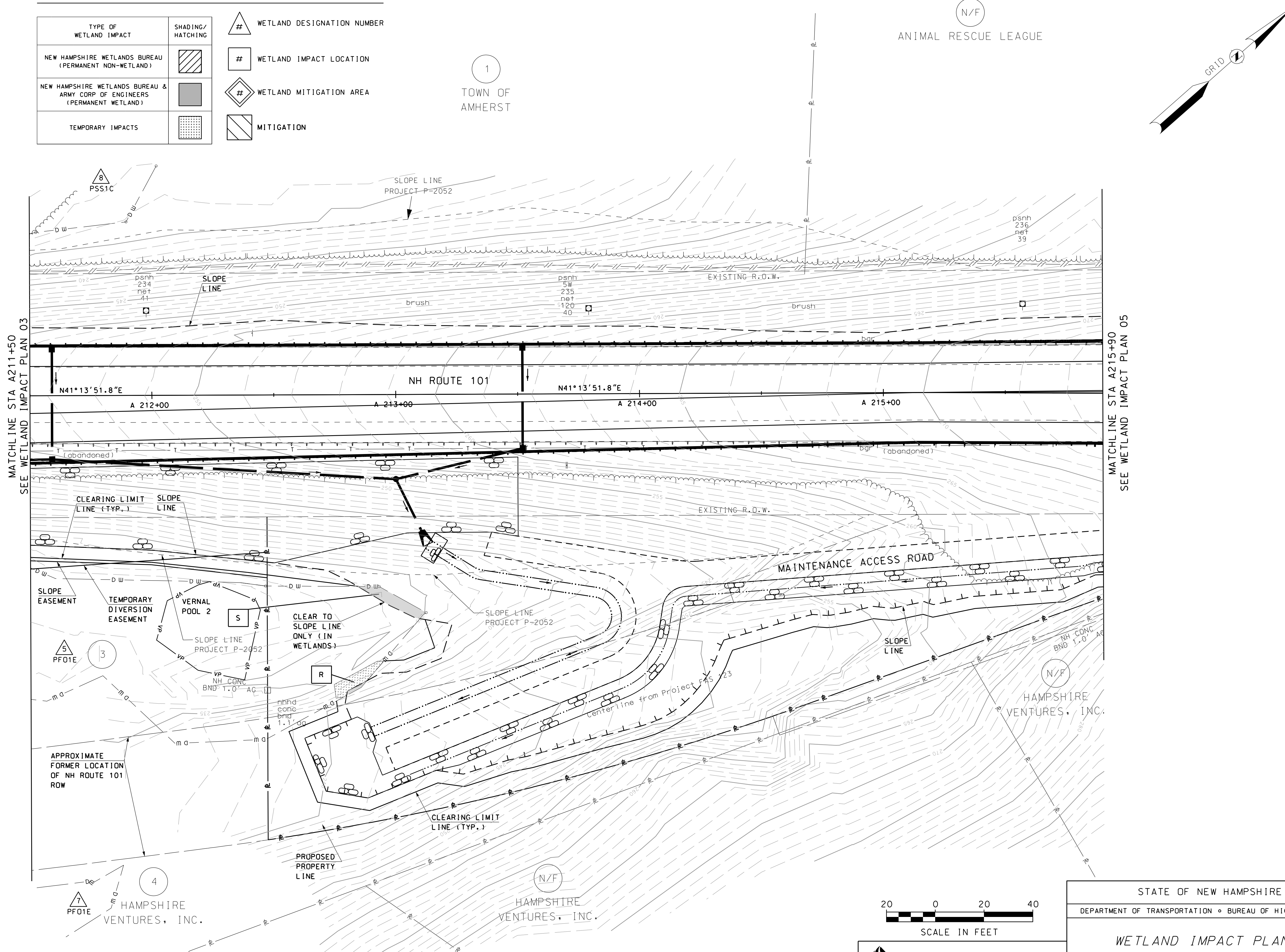
SDR PROCESSED NHDOT	NEW DESIGN BEP	SHEET CHECKED EWM
DATE 12-2020	DATE 12-2020	DATE 12-2020

AS BUILT DETAILS

LEGEND

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

- # WETLAND DESIGNATION NUMBER
- # WETLAND IMPACT LOCATION
- # WETLAND MITIGATION AREA
- MITIGATION



20 0 20 40
SCALE IN FEET

McFarland Johnson

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

WETLAND IMPACT PLAN 4

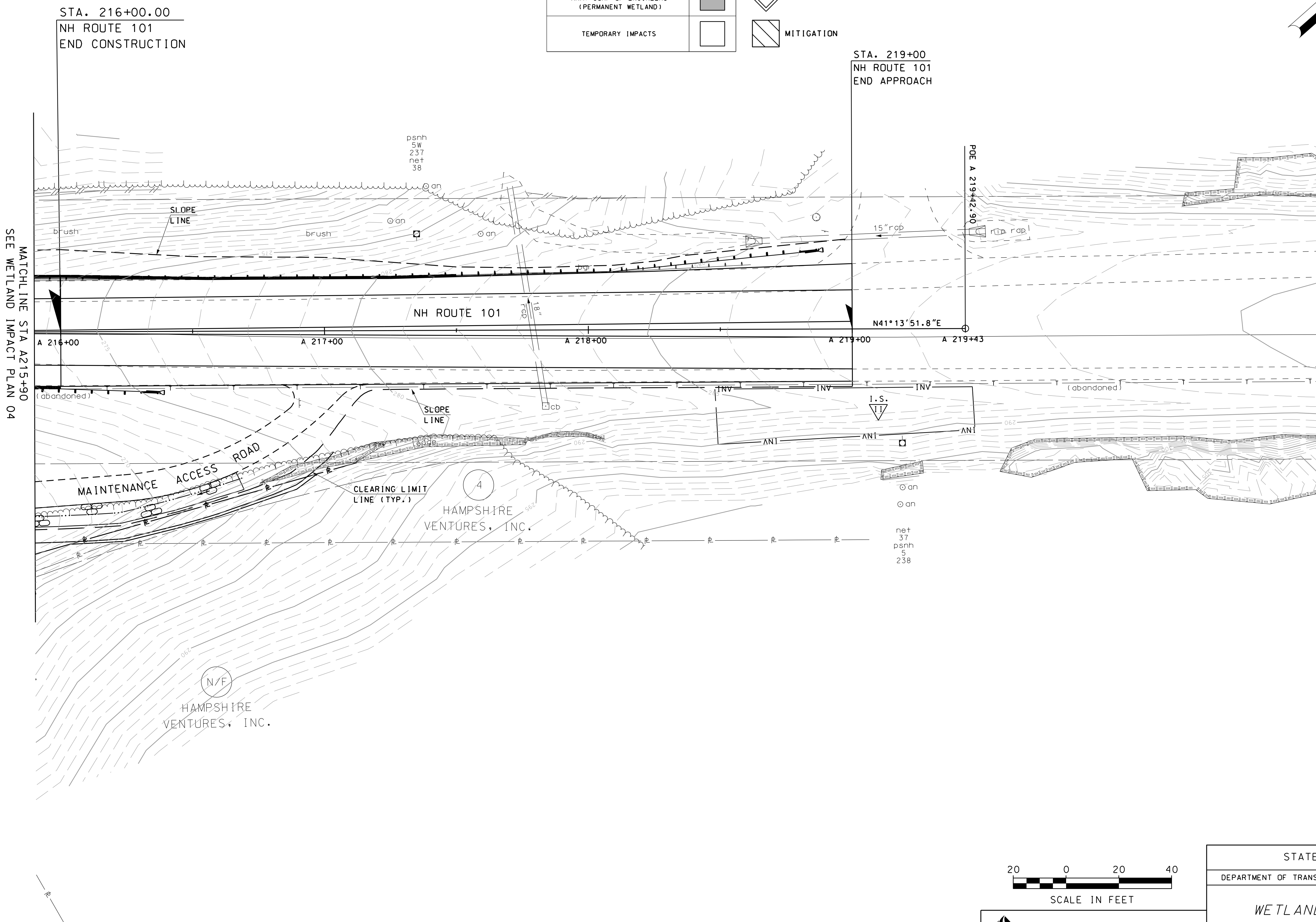
DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
13692cwetplns	13692C	8	15

LEGEND

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

- WETLAND DESIGNATION NUMBER
- WETLAND IMPACT LOCATION
- WETLAND MITIGATION AREA
- MITIGATION

GRID



20 0 20 40

SCALE IN FEET

NUMBER	DATE	STATION	STATION	DESCRIPTION

REVISIONS AFTER PROPOSAL

SDR PROCESSED NHDOT DATE 12-2020
NEW DESIGN BEP DATE 12-2020
SHEET CHECKED EWM DATE 12-2020
AS BUILT DETAILS

McFarland Johnson

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

WETLAND IMPACT PLAN 05

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
13692cwetplns	13692C	9	15

EROSION CONTROL STRATEGIES

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

TABLE 1

GUIDANCE ON SELECTING TEMPORARY SOIL STABILIZATION MEASURES

APPLICATION AREAS	DRY MULCH METHODS				HYDRAULICALLY APPLIED MULCHES[2]				ROLLED EROSION CONTROL BLANKETS[3]			
	HMT	WC	SG	CB	HM	SMM	BFM	FRM	SNSB	DNSB	DNSCB	DNCB
SLOPES[1]												
STEEPER THAN 2:1	NO	NO	YES	NO	NO	NO	NO	YES	NO	NO	NO	YES
2:1 SLOPE	YES[1]	YES[1]	YES	YES	NO	NO	YES	YES	NO	YES	YES	YES
3:1 SLOPE	YES	YES	YES	YES	NO	YES	YES	YES	YES	YES	YES	NO
4:1 SLOPE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO	NO
WINTER STABILIZATION	4T/AC	YES	YES	YES	NO	NO	YES	YES	YES	YES	YES	YES
CHANNELS												
LOW FLOW CHANNELS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES	YES
HIGH FLOW CHANNELS	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	YES

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

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

STATE OF NEW HAMPSHIRE

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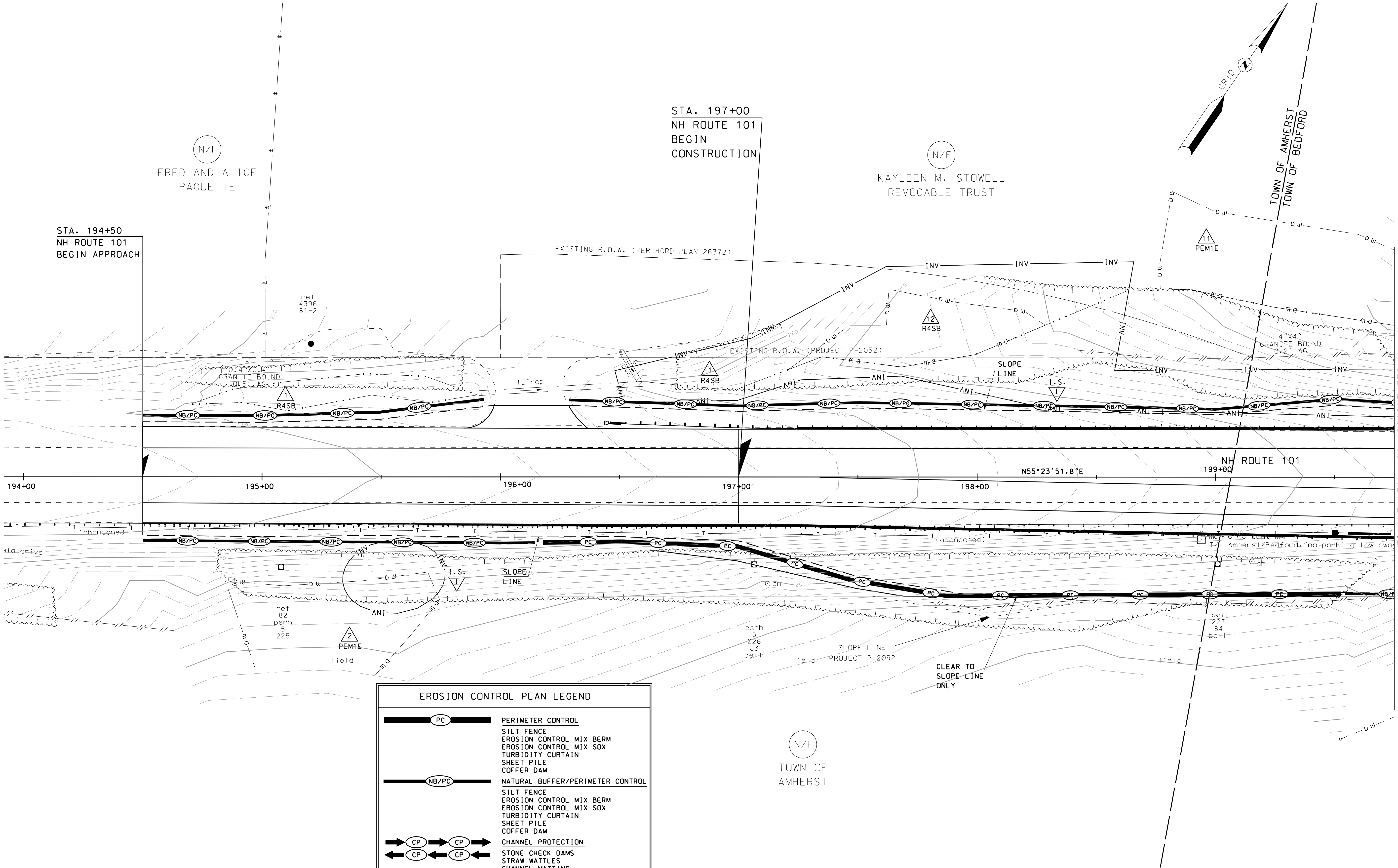
DEPARTMENT OF TRANSPORTATION • BUREAU OF HIGHWAY DESIGN

WETLAND IMPACT PLANS

REVISION DATE	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
12-21-2015	erosstrat	13692C	10	15



EROSION CONTROL PLAN LEGEND

PC — PERIMETER CONTROL
- SILT FENCE
- EROSION CONTROL MIX BERM
- EROSION CONTROL MIX SOX
- TURBIDITY CURTAIN
- SHEET PILE
- COFFER DAM

NB/PC — NATURAL BUFFER/PERIMETER CONTROL
- SILT FENCE
- EROSION CONTROL MIX BERM
- EROSION CONTROL MIX SOX
- TURBIDITY CURTAIN
- SHEET PILE
- COFFER DAM

CP — CHANNEL PROTECTION
- STONE CHECK DAMS
- STRAW WATTLES
- CHANNEL MATTING
- CLASS D EROSION STONE
- CLASS C STONE

CWB — CLEAN WATER BYPASS
- PUMP THROUGH PIPE
- DRAIN THROUGH PIPE OR CHANNEL

20 0 20 40
SCALE IN FEET

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

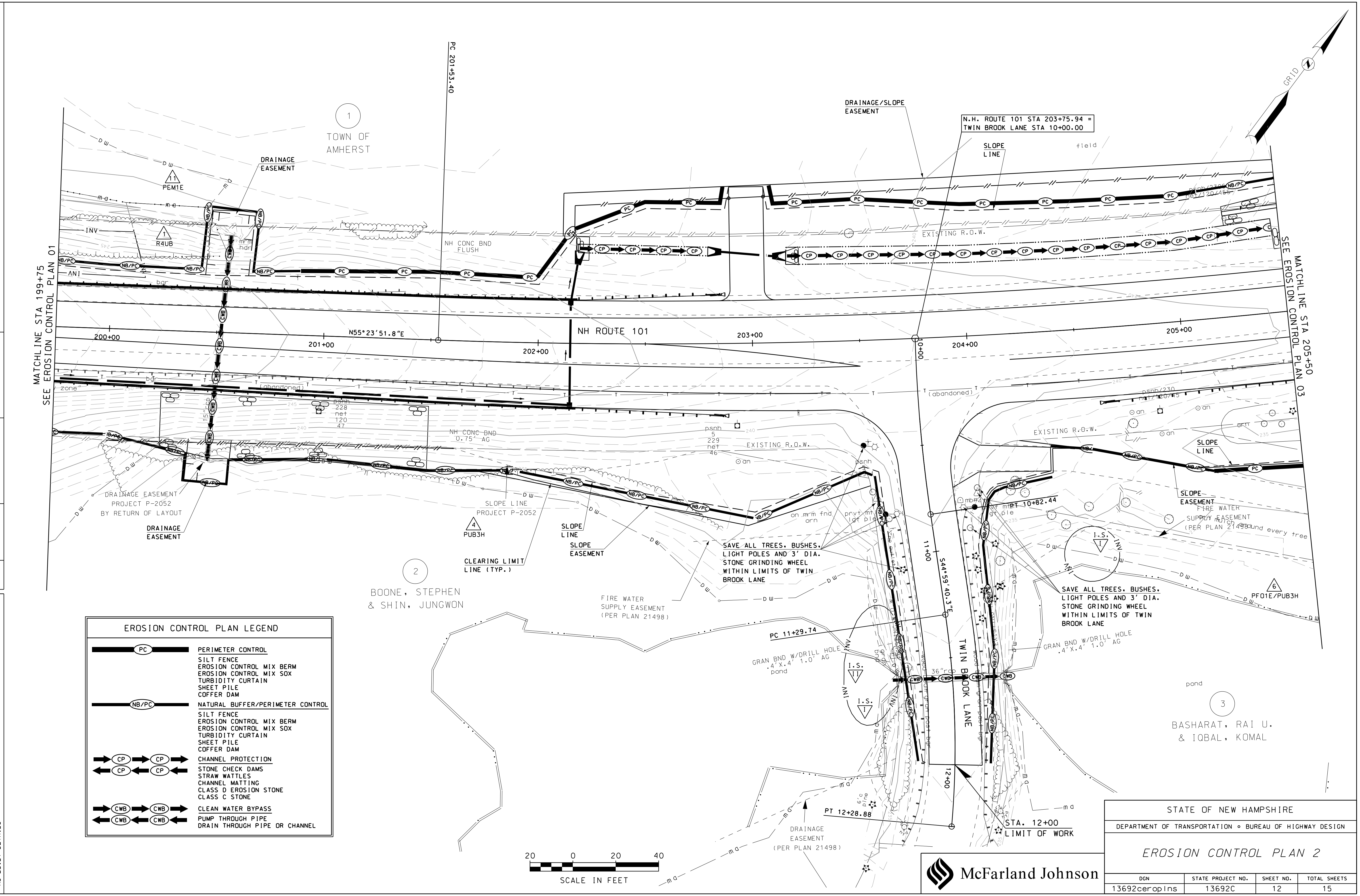
SDR PROCESSED NHDOT DATE 12-2020
NEW DESIGN BEP DATE 12-2020
SHEET CHECKED EWM DATE 12-2020
AS BUILT DETAILS

McFarland Johnson

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

EROSION CONTROL PLAN 1

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
13692ceroplns	13692C	11	15



EROSION CONTROL PLAN LEGEND

PC — PERIMETER CONTROL
- SILT FENCE
- EROSION CONTROL MIX BERM
- EROSION CONTROL MIX SOX
- TURBIDITY CURTAIN
- SHEET PILE
- COFFER DAM

NB/PC — NATURAL BUFFER/PERIMETER CONTROL
- SILT FENCE
- EROSION CONTROL MIX BERM
- EROSION CONTROL MIX SOX
- TURBIDITY CURTAIN
- SHEET PILE
- COFFER DAM

CP — CHANNEL PROTECTION
- STONE CHECK DAMS
- STRAW WATTLES
- CHANNEL MATTING
- CLASS D EROSION STONE
- CLASS C STONE

CWB — CLEAN WATER BYPASS
- PUMP THROUGH PIPE
- DRAIN THROUGH PIPE OR CHANNEL

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

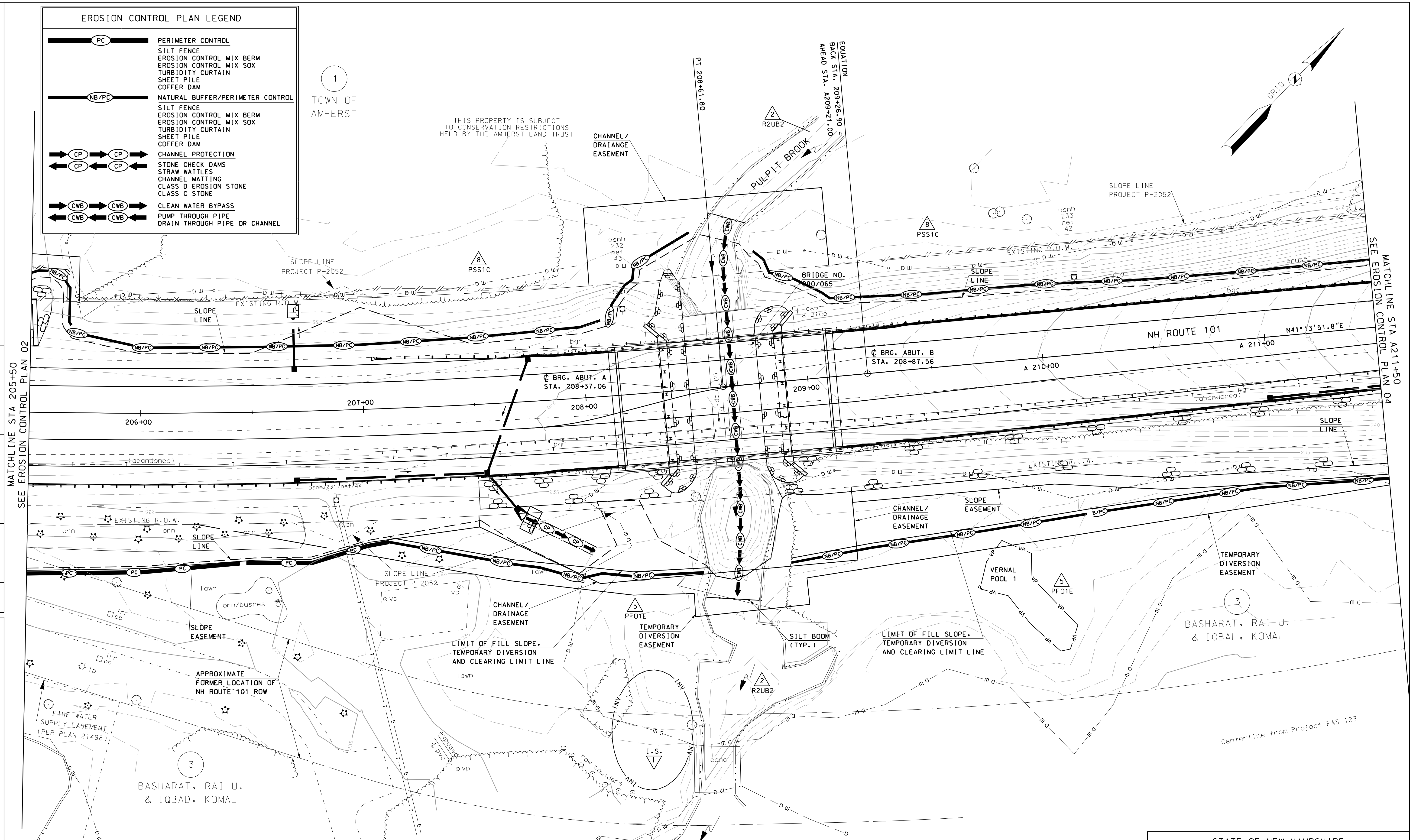
SDR PROCESSED NHDOT DATE 12-2020
NEW DESIGN BEP DATE 12-2020
SHEET CHECKED EWM DATE 12-2020
AS BUILT DETAILS

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION • BUREAU OF HIGHWAY DESIGN

EROSION CONTROL PLAN 2

McFarland Johnson

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
13692ceroplns	13692C	12	15



NUMBER	DATE	STATION	STATION	REVISIONS AFTER PROPOSAL DESCRIPTION

SDR PROCESSED NHDOT DATE 12-2020
NEW DESIGN BEP DATE 12-2020
SHEET CHECKED EWM DATE 12-2020
AS BUILT DETAILS

McFarland Johnson

STATE OF NEW HAMPSHIRE

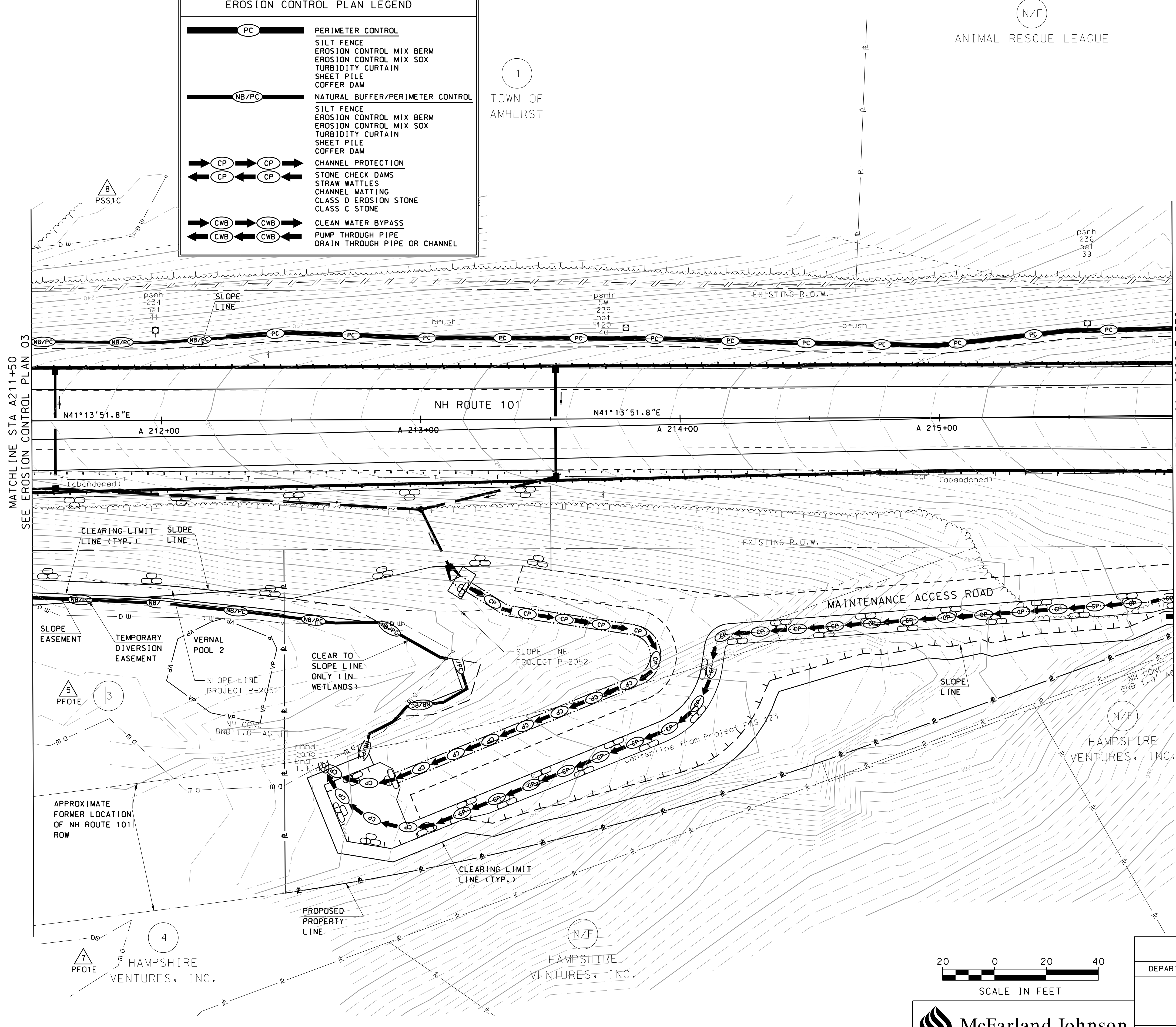
DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

EROSION CONTROL PLAN 3

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
13692ceroplns	13692C	13	15

EROSION CONTROL PLAN LEGEND

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



REVISIONS AFTER PROPOSAL				
NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED	NHDOT	DATE 12-2020
NEW DESIGN	BEP	DATE 12-2020
SHEET CHECKED	EWM	DATE 12-2020
AS BUILT DETAILS		

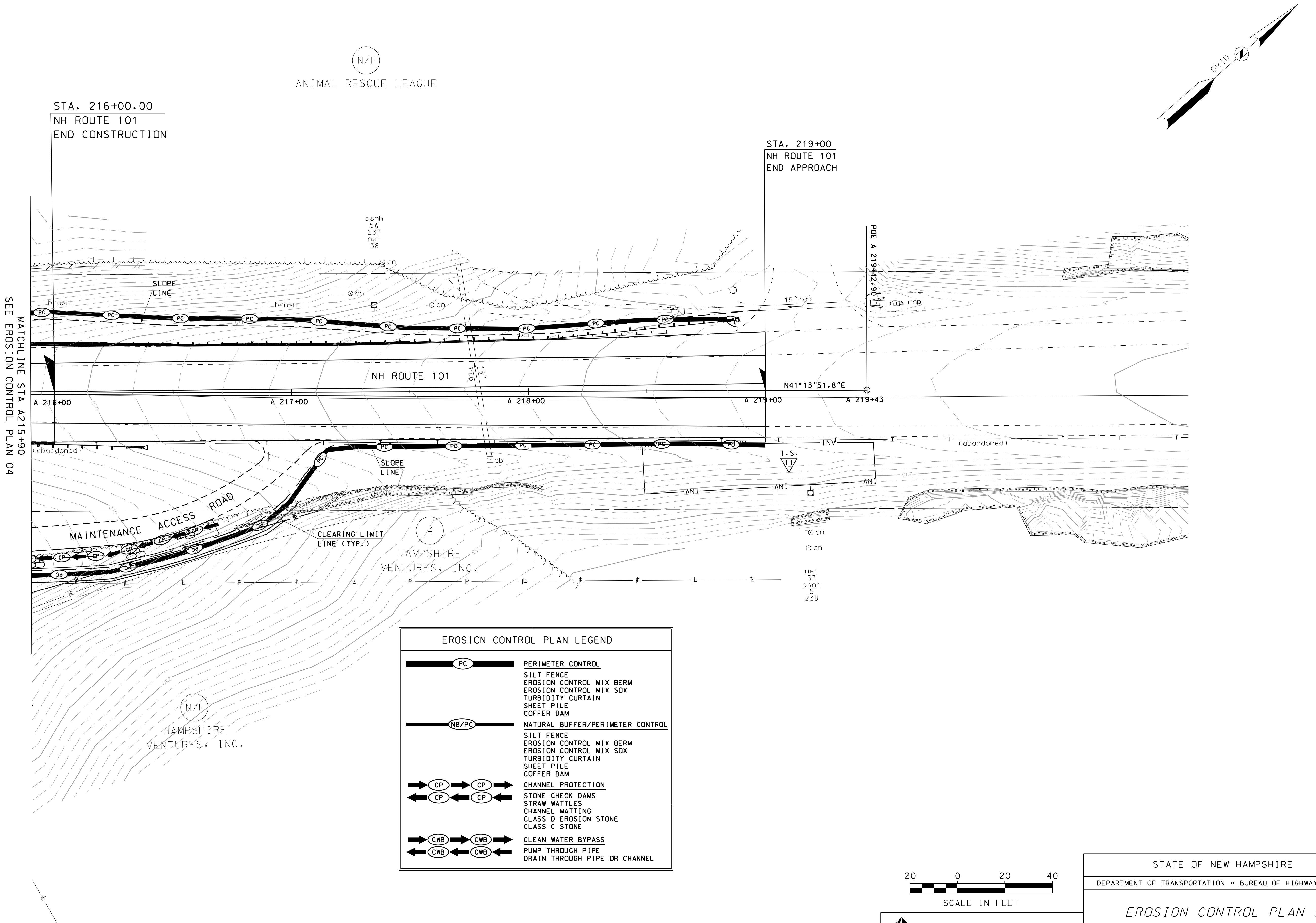
McFarland Johnson

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION • BUREAU OF HIGHWAY DESIGN

EROSION CONTROL PLAN 4

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
13692ceroplns	13692C	14	15



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

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STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION • BUREAU OF HIGHWAY DESIGN

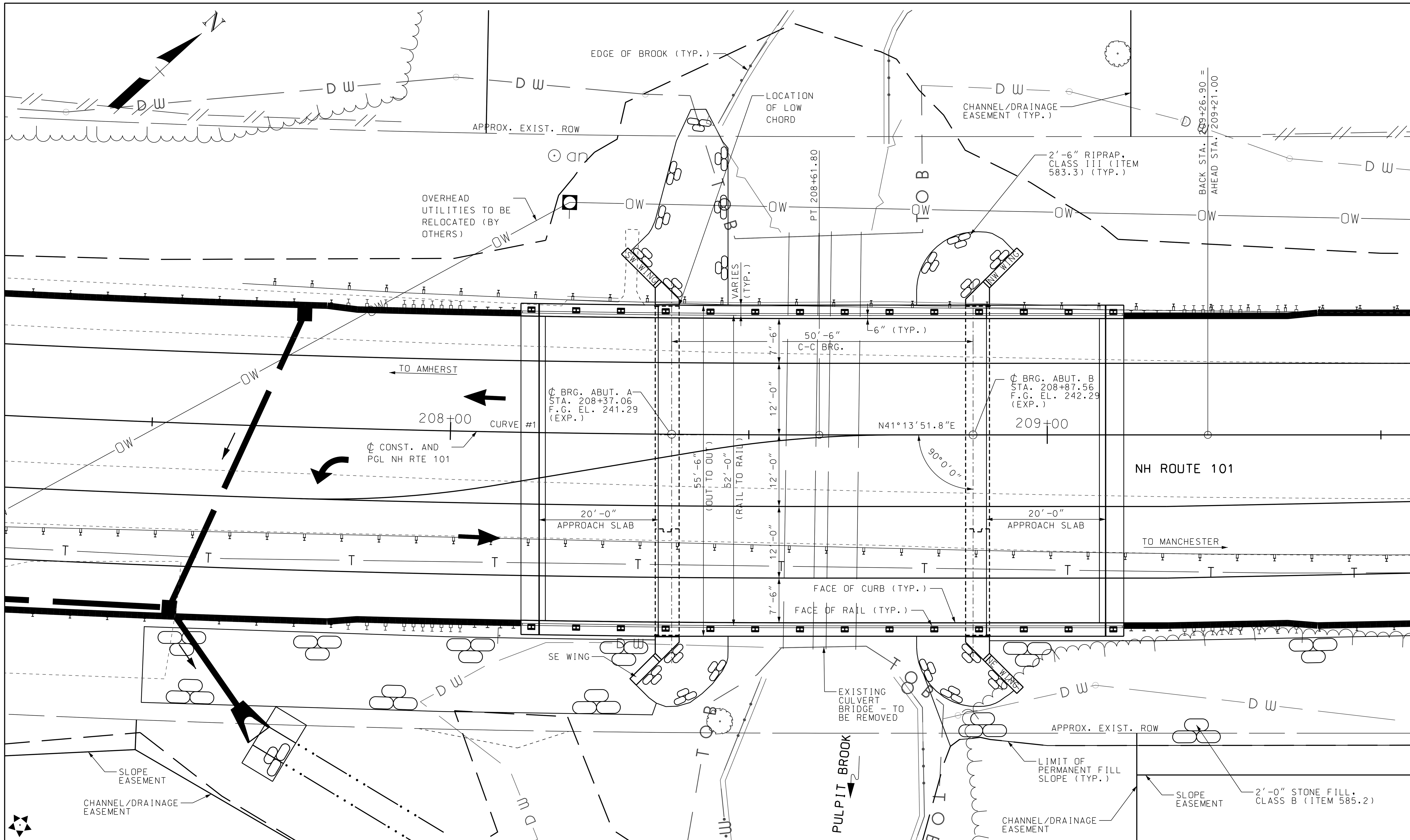
EROSION CONTROL PLAN 5

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
13692ceroplns	13692C	15	15

REVISIONS AFTER PROPOSAL			
NUMBER	DATE	STATION	DESCRIPTION

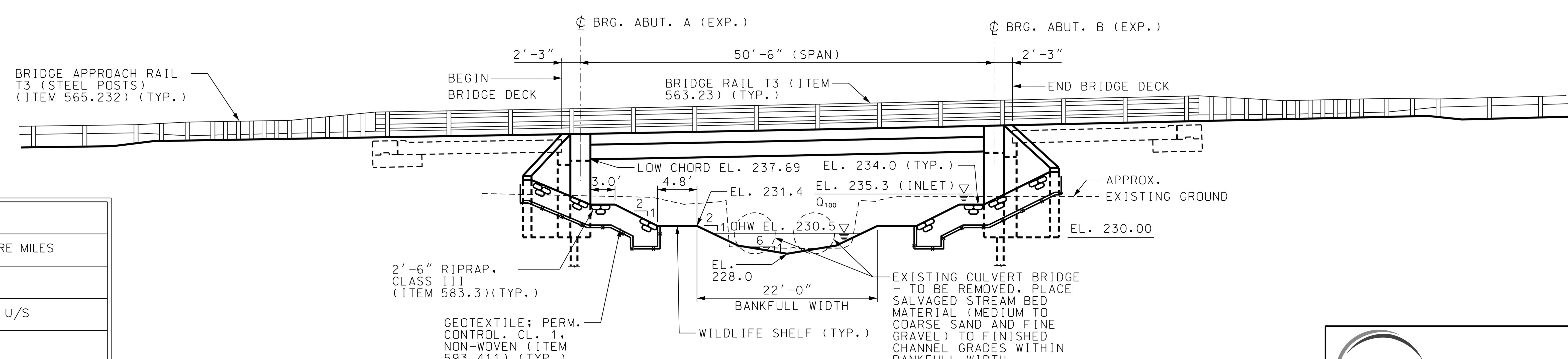
SDR PROCESSED	NHDOT	DATE 12-2020
NEW DESIGN	BEP	DATE 12-2020
SHEET CHECKED	EWM	DATE 12-2020
AS BUILT DETAILS		

Bridge General Plan and Elevation and
Restoration Plan



CURVE DATA #1
PI = 205+09.42
DELTA = 1°59'59.32"
R = 2865.06
L = 708.40'
T = 356.02'
E = 22.03'

GENERAL PLAN
SCALE: 1" = 10'



ELEVATION
SCALE: 1" = 10'

HYDRAULIC DATA	
DRAINAGE AREA	5.3 SQUARE MILES
DESIGN FLOOD DISCHARGE Q_{100}	900 CFS
DESIGN FLOOD ELEVATION Q_{100}	EL. 235.3 U/S
DESIGN FLOOD VELOCITY Q_{100}	4.5 FPS
SCOUR CHECK DISCHARGE Q_{500}	1450 CFS
BRIDGE FULL WATERWAY OPENING	320 SQ. FT.

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS
0 1 2 3

KLEINFELDER
Bright People. Right Solutions.

SUBDIRECTORY	.DGN LOCATOR	SHEET SCALE
---	---	AS NOTED

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

TOWN BEDFORD BRIDGE NO. 090/065 STATE PROJECT 13692C
LOCATION NH ROUTE 101 OVER PULPIT BROOK

GENERAL PLAN AND ELEVATION

REVISIONS AFTER PROPOSAL

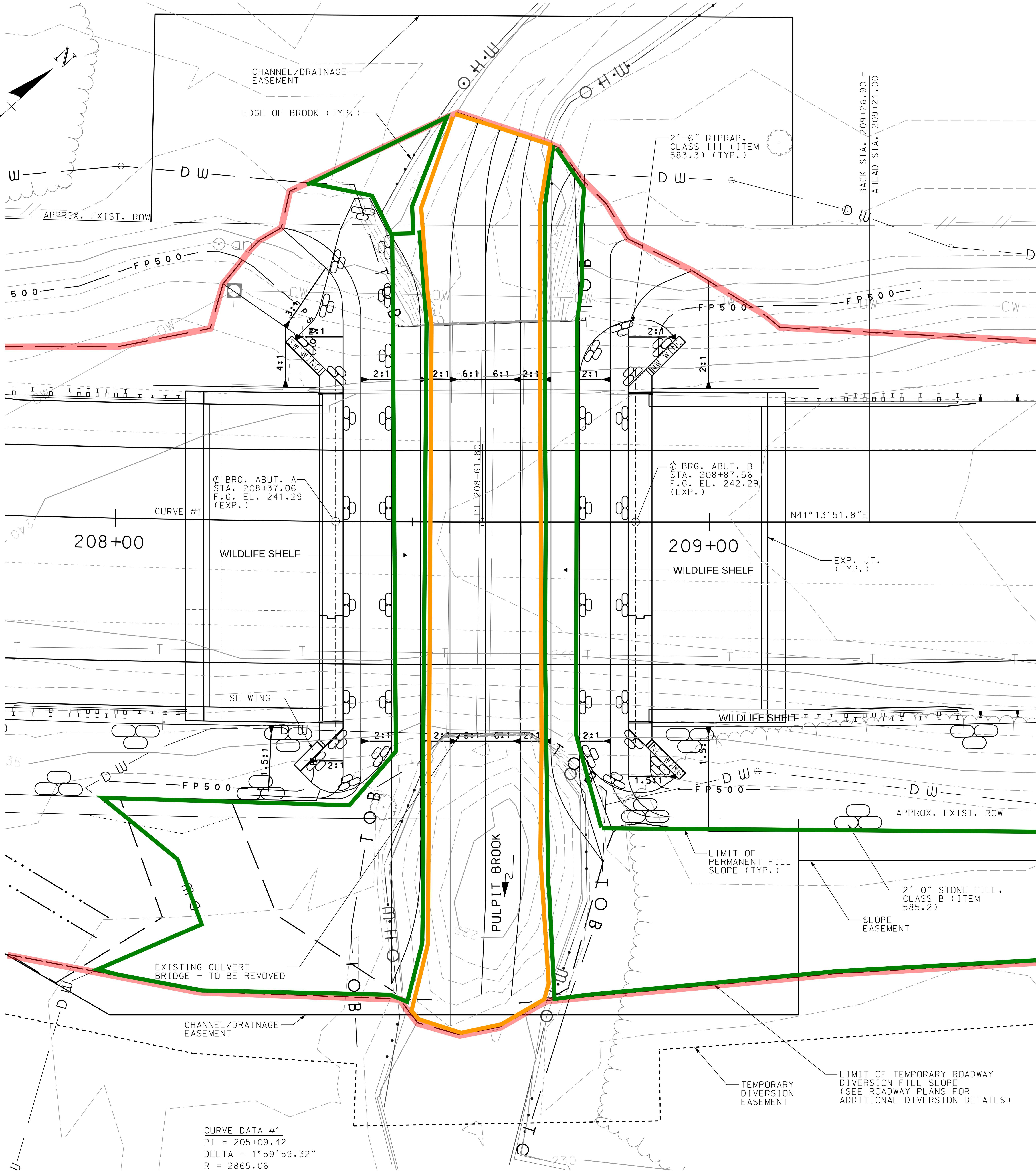
	BY	DATE		BY	DATE
DESIGNED	KSW	04/29	CHECKED	TJM	04/29
DRAWN	ARS	04/29	CHECKED	TJM	04/29
QUANTITIES	TAT	04/29	CHECKED	TJM	04/29

ISSUE DATE
REV. DATE
FEDERAL PROJECT NO. X-A004(254)
SHEET NO.
BRIDGE SHEET OF
FILE NUMBER ---
TOTAL SHEETS

LIMITS OF SITE DISTURBANCE AT CROSSING

STREAMBED RESTORATION - MEDIUM SAND TO FINE GRAVEL

WETLAND SEED MIX FOR ALL DISTURBED WETLANDS AND WILDLIFE SHELF



SITE PLAN

SCALE: 1" = 10'

RESTORATION NOTES

1. Upon removal of temporary fill in wetlands, the remaining subsoil will be graded so it is approximately 12 inches below the original wetland soil elevation.

2.12 inches of wetland humus (or topsoil amended to reach 4% organic matter) will be spread over the subsoil in wetlands. If wetland surface soil was removed and temporarily stockpiled prior to bypass construction, this material, supplemented by additional wetland soil, will be replaced. Only wetland soil free of invasive species may be reused on site.

3. The stream bed under the new bridge will be provided with a natural substrate matching adjacent stream bed materials, which is comprised of medium to coarse sand and fine gravel.

4. New stream banks and temporarily impacted stream banks will be stabilized with coir logs or compacted soil with interspersed stone, as appropriate. Coir logs shall be installed with no gaps exist between the soil and the fiber roll, and logs shall overlap at the ends. Install stakes at least every three feet apart along the length of the roll.

5. The floodplain benches adjacent to the stream channel under the bridge will be level to facilitate wildlife use.

6. Permanent or temporary cover must be in place before the growing season ends. No disturbed area shall be left exposed during winter months.

7. Temporary cover will consist of annual ryegrass, which will be sown prior to October 15th.

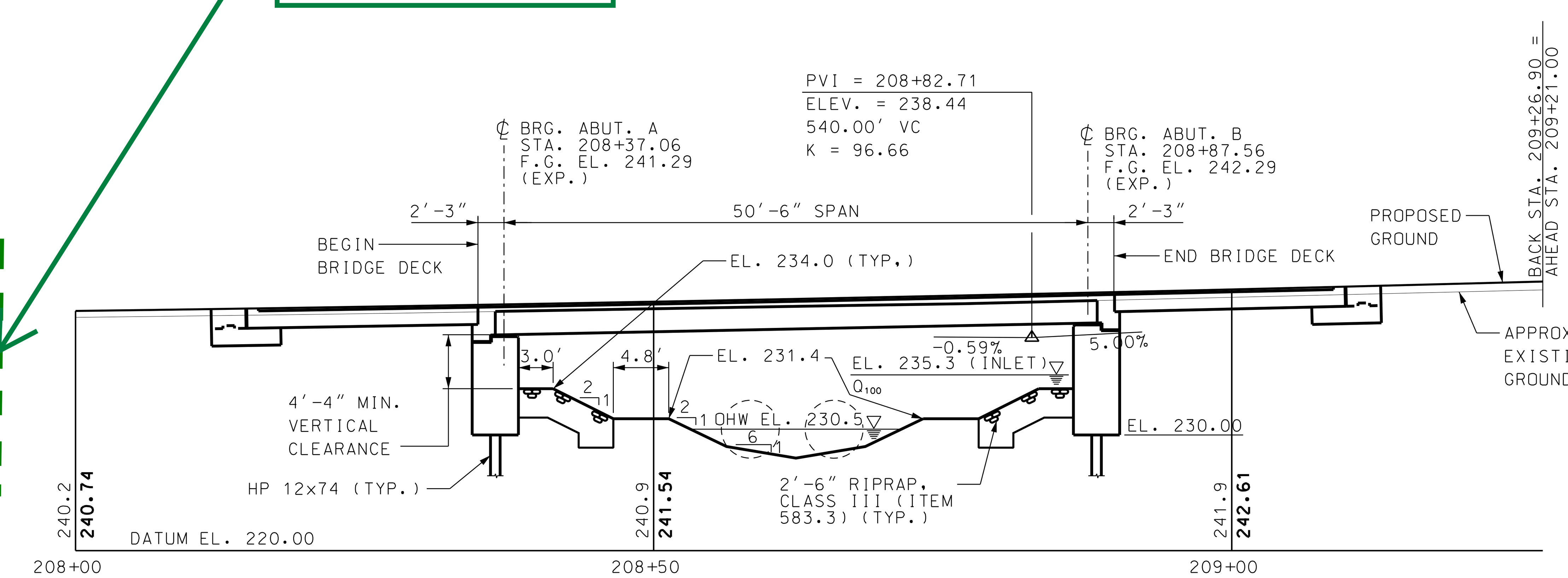
8. A permanent wetland seed mix will be sown over the restored wetland, stream banks, and wildlife benches. This mix will be the New England Wetland Plant Roadside Matrix Wet Meadow Seed Mix, New England Erosion Control/Restoration Mix for Detention Basins and Moist Sites, or equivalent as detailed in the planting table.

9. All temporarily disturbed uplands will be seeded with an appropriate upland seed mix to stabilize soils.

10. After sowing, seeded areas will be lightly raked or rolled to improve seed-to-soil contact and lightly mulched with clean, weed-free straw.

Seed Mix Type Recommendation	Plant Type	Seeding Rate	Location	Quantity
NEWP Roadside Matrix Wet Meadow Seed Mix	Seed	35 lbs/acre	Sow on wetland soils	7 lbs
NEWP NE Conservation/Wildlife Seed Mix	Seed	25 lbs/acre	Sow on uplands /side slopes	TBD

Restoration work extends to Station 211+00 along the temporary traffic diversion impact area



NOTE: SCOUR ELEVATIONS NOT SHOWN (TBD)

PROFILE

SCALE: 1" = 10'

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

0 1 2 3

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION * BUREAU OF BRIDGE DESIGN

TOWN BEDFORD | BRIDGE NO. 090/065 | STATE PROJECT 13692C

LOCATION NH ROUTE 101 OVER PULPIT BROOK

RESTORATION PLAN

KLEINFELDER Bright People. Right Solutions.

REVISIONS AFTER PROPOSAL

	BY	DATE		BY	DATE
DESIGNED	KSW	04/29	CHECKED	TJM	04/29
DRAWN	ARS	04/29	CHECKED	TJM	04/29
QUANTITIES	TAT	04/29	CHECKED	TJM	04/29

ISSUE DATE

REV. DATE

FEDERAL PROJECT NO. X-A004(254)

SHEET NO.

TOTAL SHEETS

BRIDGE SHEET OF

FILE NUMBER ---

SUBDIRECTORY	.DGN LOCATOR	SHEET SCALE
---	---	AS NOTED