BRIDGE 073/084

NH ROUTE 125
OVER LITTLE RIVER

NH Standard Dredge & Fill Application

Prepared By:

McFarland Johnson

Lee
41322
X-A004(593)

April 2024

NHDOT Lee 41322
NH Route 125 over Little River
NHDES Standard Dredge & Fill Permit Application
April 2024

Contents

NHDES Standard Dredge and Fill Wetlands Permit Application Form

STANDARD DREDGE AND FILL WETLANDS PERMIT APPLICATION

Water Division / Land Resources Management

Check the Status of your Application

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

APPLICANT'S NAME: NH Dept of Transportation **TOWN NAME:** Lee

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

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

SECTION 1 - REQUIRED PLANNING FOR ALL PROJECTS (Env-Wt 306.05; RSA 482-A:3, I(d)(2)) Please use the Wetland Permit Planning Tool (WPPT), the Natural Heritage Bureau (NHB) DataCheck Tool, the Aquatic Restoration Mapper, or other sources to assist in identifying key features such as: Priority Resource Areas (PRAs), protected species or habitats, coastal areas, designated rivers, or designated prime wetlands.	
Has the required planning been completed?	● Yes ○ No
Does the property contain a PRA? If yes, provide the following information:	● Yes ○ No
• Does the project qualify for an Impact Classification Adjustment (e.g. NH Fish and Game Department (NHFG) 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): American featherfoil, tufted yellow-loosestrife, American eel, Blanding's turtle, spotted turtle, wood turtle ○ NHB Project ID #: NHB24-0428	● 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): Lamprey River LAC • A copy of the application was sent to the LAC on Month: Day: Year:	● Yes ○ No

For dredging projects, is the subject property contaminated? • If yes, list contaminant:	○ Yes ◉ No
Is there potential to impact impaired waters, class A waters, or outstanding resource waters?	○ Yes ◉ No
For stream crossing projects, provide watershed size (see WPPT or Stream Stats): 18.4 sq mi	

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

Provide a description of the project and the purpose of the project, the need for the proposed impacts to jurisdictional areas, an outline of the scope of work to be performed, and whether impacts are temporary or permanent.

The proposed project will involve the replacement of Bridge No. 073/084 that carries NH Route 125 over the Little River in Lee. The purpose of the proposed project is to address the serious condition of the existing structure, remove the bridge from the NH State Red List, maintain a structurally sound crossing, and improve the hydraulic conveyance and geomorphic compatibility of the stream crossing. The existing bridge structure consists of an 18' wide x 12' tall CMP. The proposed alternative consists of a 100'-0" single span steel girder bridge founded on integral abutments. Portions of the channel through the structure will be reconstructed and realigned at the inlet. In addition, the proposed project includes minor roadway reconstruction, regrading of roadway shoulders, repaving, and installation of guardrail along the bridge approaches. The project will result in 509 SF of permanent wetland impact (PRA), 315 LF of permanent impact to channel and banks, and 7,244 SF of temporary impact to wetlands, banks, and channel.

SECTION 3 - PROJECT LOCATION

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

ADDRESS: NH Route 125

TOWN/CITY: Lee

TAX MAP/BLOCK/LOT/UNIT: ROW

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

(Optional) LATITUDE/LONGITUDE in decimal degrees (to five decimal places): 43.1187N, -71.0346W

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, Jennifer Reczek, PE		
MAILING ADDRESS: 7 Hazen Drive		
TOWN/CITY: Concord	STATE: NH	ZIP CODE: 03302
EMAIL ADDRESS: jennifer.e.reczek@dot.nh.gov		
FAX:	PHONE: 603-271-2731	
ELECTRONIC COMMUNICATION: By initialing here, I hereby authorize NHDES to communicate all matters relative to this application electronically. JER		

SECTION 5 - AUTHORIZED AGENT INFORMATION (Env-Wt 311.04(c)) ☐ N/A		
LAST NAME, FIRST NAME, M.I.: Perron, Christine		
COMPANY NAME: McFarland Johnson		
MAILING ADDRESS: 53 Regional Drive		
TOWN/CITY: Concord	STATE: NH	ZIP CODE: 03301
EMAIL ADDRESS: cperron@mjinc.com		
FAX:	PHONE: 603-225-2978	
ELECTRONIC COMMUNICATION: By initialing here, I hereby authorize NHDES to communicate all matters relative to this application electronically. CJP		

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

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

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

Env-Wt 400: Wetland boundaries and the ordinary high water mark and top of bank of surface waters were delineated by McFarland-Johnson, Inc. in 2019. Delineated resources were classified using the USFWS (Cowardin et al.) Wetland Classification System. The NHDES WPPT was reviewed and PRAs located in the vicinity of the proposed project include Floodplain Wetlands Adjacent to Tier 3 Streams and Peatlands. No peatlands were documented in the project area during the wetland delineation.Wetland 4 and portions of Wetland 6 are located within the FEMA mapped 100-year floodplain, making these PRAs.
Env-Wt 500: The proposed project type is classified as a Public Highways project pursuant to Env-Wt 527. The proposed project has been designed in accordance with the criteria specified in Env-Wt 527.04 and is consistent with RSA 482-A, RSA 483-B, 485-A, RSA 487, and RSA 212-A. The purpose of the proposed project is to address the serious condition of the existing structure and remove the existing bridge from the NH State Red List. The project also addresses Env-Wt 514 Bank Stabilization and natural bank stabilization measures have been incorporated to the extent possible. Impacts to wetlands and surface waters have been minimized and avoided to the maximum extent practicable.
Env-Wt 600: N/A
Env-Wt 700: N/A
Env-Wt 900: The proposed project involves the replacement of an existing Tier 3 stream crossing that has contributed to flooding. A geomorphic stream assessment was completed and used to inform design of the replacement structure. The structure requires approval as an alternative design under Env-Wt 904.10 and the technical report is included elsewhere in the application.

SECTION 8 - AVOIDANCE AND MINIMIZATION

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

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

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

SECTION 9 - MITIGATION REQUIREMENT (Env-Wt 311.02)

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

Mitigation Pre-Application Meeting Date: Month: Day: Year: January 18, 2023

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

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

	JURISDICTIONAL AREA	PERM. SF	PERM. LF	PERM. ATF	TEMP. SF	TEMP. LF	TEMP. ATF
Wetlands	Forested Wetland			☐			☐
	Scrub-shrub Wetland			☐	3506		☐
	Emergent Wetland	509		☐	455		☐
	Wet Meadow			☐			☐
	Vernal Pool			☐			☐
	Designated Prime Wetland			☐			☐
	Duly-established 100-foot Prime Wetland Buffer			☐			☐
Surface	Intermittent / Ephemeral Stream			☐	725	157	☐
	Perennial Stream or River	2138	135	☐	1519	51	☐
	Lake / Pond			☐			☐
	Docking - Lake / Pond			☐			☐
	Docking - River			☐			☐
Banks	Bank - Intermittent Stream			☐			☐
	Bank - Perennial Stream / River	735	180	☐	1039	144	☐
	Bank / Shoreline - Lake / Pond			☐			☐
Tidal	Tidal Waters			☐			☐
	Tidal Marsh			☐			☐
	Sand Dune			☐			☐
	Undeveloped Tidal Buffer Zone (TBZ)			☐			☐
	Previously-developed TBZ			☐			☐
	Docking - Tidal Water			☐			☐
	TOTAL	3382	315		7244	352	

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): 10,626	SF	× $0.40 =	$ 4250
Seasonal docking structure:	SF	× $2.00 =	$
Permanent docking structure:	SF	× $4.00 =	$
Projects proposing shoreline structures (including docks) add $400 =			$
		Total =	$ 4250
The application fee for minor or major impact is the above calculated total or $400, whichever is greater =			$

$4,250.40

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:	To the best of the signer's knowledge and belief, all required notifications have been provided.
Initials:	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:	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.
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):	PRINT NAME LEGIBLY: Jennifer Reczek, PE	DATE:
SIGNATURE (APPLICANT, IF DIFFERENT FROM OWNER):	PRINT NAME LEGIBLY:	DATE:
SIGNATURE (AGENT, IF APPLICABLE): Christine Perron	PRINT NAME LEGIBLY: Christine Perron, CWS	DATE: 4/16/24

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: RSA482-A:3 I(a) Exempt, State Agency, 4 copies sent Certified Mail	PRINT NAME LEGIBLY: Not Applicable - Exempt
TOWN/CITY: Lee	DATE: Not Applicable

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".

USGS Location Map

Project Location

0 2,000 4,000

Feet

NH DEPARTMENT OF TRANSPORTATION, LEE - 41322
NH ROUTE 125 OVER LITTLE RIVER
BRIDGE NO. 073/084, LEE, NEW HAMPSHIRE

USGS LOCATION MAP

SCALE :	DATE :	FIGURE :
1 inch = 2,000 feet	DECEMBER 2022	1

McFarland Johnson

J:\18805.05 Lee Permitting\Draw\GIS\Wetland Permitting Figures\Lee 41322 - Figure 1 - USGS Location Map.mxd

Tax Map

Bridge 073/084

Project Location

Tax parcels

Roads

Rivers & Streams

0 300 600

Feet

NH DEPARTMENT OF TRANSPORTATION, LEE - 41322
NH ROUTE 125 OVER LITTLE RIVER
BRIDGE NO. 073/084, LEE, NEW HAMPSHIRE

TAX MAP

SCALE :	DATE :	FIGURE :
1 inch = 300 feet	DECEMBER 2022	2

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J:\18805.05 Lee Permitting\Draw\GIS\Wetland Permitting Figures\Lee 41322 - Figure 2 - Tax Map.mxd

Supplemental Narrative

STANDARD DREDGE AND FILL WETLANDS PERMIT APPLICATION
NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION
LEE 41322 – NH ROUTE 125 OVER LITTLE RIVER
BRIDGE NO. 073/084 REPLACEMENT
LEE, NEW HAMPSHIRE

SUPPLEMENTAL NARRATIVE

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Introduction

The proposed project will involve the replacement of Bridge No. 073/084 that carries NH Route 125 over the Little River in Lee. The existing bridge structure consists of an 18’ wide x 12’ tall, corrugated metal pipe (CMP). The pipe was installed in 1972 and is in serious condition (condition rated 3 out of 9) due to significant section loss of the invert. The existing pipe was added to the NHDOT State Red List in 2014 and is ranked 11th on the 2020 NHDOT Priority List. The crossing structure is hydraulically undersized, resulting in scour and bank erosion immediately downstream as well as impounded water upstream during storm events.

The following document contains additional information on the existing conditions, jurisdictional resources, proposed project, and impacts, intended to support the New Hampshire Department of

Environmental Services (NHDES) Standard Dredge and Fill Permit Application for the proposed Lee 41322 project.

Purpose & Need

The purpose of the proposed project is to address the serious condition of the existing structure, remove the bridge from the NH State Red List, maintain a structurally sound crossing, and improve the hydraulic conveyance and geomorphic compatibility of the stream crossing. The project is needed because the existing CMP is in serious condition and flooding occurs upstream from the crossing during storm events. The proposed project would replace the existing undersized crossing with a larger bridge span that would ensure the continued safe operation of the NH Route 125 corridor, reduce upstream flooding events, improve geomorphic compatibility, and improve aquatic organism and terrestrial wildlife passage at the crossing location.

Existing Conditions

Wetlands and surface waters in the project area were delineated by McFarland-Johnson, Inc., in accordance with the US Army Corps of Engineers (USACE) and NH Department of Environmental Services (NHDES) standards in November 2019.

Surface Waters

Surface waters located in the project area consist of the Little River and a small, unnamed intermittent tributary of the Little River located in the southeast bridge quadrant along the toe-of-slope of the existing roadway embankment. At the location of Bridge No. 073/084, the Little River is a third order stream, with a watershed size of approximately 18.4 square miles. Based on the size of the watershed the crossing is a Tier 3 stream crossing. The average measured bankfull width in the vicinity of the crossing is approximately 32 feet. Based on the valley dimensions and channel geometry, slope, and materials, the Rosgen stream type in the vicinity of the crossing is E5. The Little River is a tributary of the Lamprey River, with the confluence of the two rivers located approximately two miles east of the study area.

Surface Water Impairments

According to the New Hampshire 2020/2022 303(d) List (most recent available), the segment of the Little River that flows through the project area (Assessment Unit ID: NHRIV600030707-07) is listed as impaired by aluminum, lead, and pH for Aquatic Life Integrity.

Floodplains

FEMA mapped 100-year floodplain (Zone A) associated with the Little River is located upstream and downstream from the existing crossing. The proposed project is not anticipated to be an obstruction to flood flows, substantially alter drainage, or result in an increase in the base flood elevation.

Shoreland Water Quality Protection Act

The Shoreland Water Quality Protection Act (SWQPA) (RSA 483-B) applies to fourth order and greater streams and rivers; rivers or river segments designated under RSA 483, the Rivers Management and Protection Program; lakes and ponds greater than 10 acres in size; and tidal waters subject to the ebb and flow of the tide. All designated rivers are subject to the SWQPA, with the exception of the first, second, and third order portions of the Oyster River and the Lamprey River Watershed. As mentioned above the segment of the Little River in the project area is a third order river. Therefore, the proposed project is not subject to the jurisdiction of the SWQPA and will not require a Shoreland Permit from NHDES.

Wetlands

Two palustrine wetlands were delineated in the project area. Wetland 4 is an emergent wetland located in the northeast quadrant of the bridge. The wetland is dominated by deer-tongue grass, tussock sedge, rough goldenrod, soft rush, red osier dogwood, and red maple. Wetland 6 is a large palustrine scrub-shrub and forested (PSS/FO) wetland located in the southeast bridge quadrant. The wetland is located along the toe-of-slope of the NH Route 125 roadway embankment and extends southeast, beyond the limits of the study area. Vegetation in Wetland 6 is dominated by cinnamon fern, royal fern, sensitive fern, winterberry, highbush blueberry, sweet pepperbush, white meadowsweet, and red maple. The wetland is associated with an intermittent stream that outlets into the Little River.

Designated Prime Wetlands

The Town of Lee does not contain any Designated Prime Wetlands. The proposed project is not located within 100 feet of any Designated Prime Wetlands.

Priority Resource Areas

Wetland 4 and portions of Wetland 6 are located within the 100-year floodplain and are, therefore, floodplain wetlands adjacent to a Tier 3 stream crossing, making these NHDES Priority Resource Areas.

Rare, Threatened, and Endangered Species and Exemplary Natural Communities

State Listed

The NHB DataCheck Results Letter (NHB22-2366) indicated that there are documented occurrences of American featherfoil (*Hottonia inflata*), tufted yellow-loosestrife (*Lysimachia thyrsiflora*), American eel (*Anguilla rostrata*), Blanding's turtle (*Emydoidea blandingii*), spotted turtle (*Clemmys guttata*), and wood turtle (*Glyptemys insculpta*) located in the vicinity of the proposed project. A survey for tufted yellow loosestrife was completed on August 27, 2020. No individual plants or populations were observed. A survey for American featherfoil was completed on May 12, 2022. No individual plants or populations were documented in the study area. A survey for small whorled pogonia was completed on July 6, 2022. No individual plants or populations were observed. The current NHB DataCheck Results Letter (NHB24-0428) did not identify any additional occurrences of plants or natural communities of concern.

Coordination with NH Fish & Game has been ongoing since 2019, prior to the implementation of Fis 1004 (see attached correspondence included with this permit application).

The following avoidance and minimization measures will be implemented for wildlife species of concern:

- To avoid impacts to spring anadromous fish spawning runs, particularly of river herring, which have been observed at the NH Route 155 crossing about 1.5 miles downstream of NH Route 125, no in-water work shall occur between April 15 and July 1.
- Wildlife-friendly erosion control measures will be utilized during construction (such as erosion control berm, Filtrexx or equal filter sock, and coco or jute matting).

- Streambed simulation material will be installed over riprap within the channel of the Little River to improve habitat and aquatic organism passage.
- Wildlife shelves will be incorporated along both banks of the river through the new bridge structure.
- All riprap used on the project will be void-filled riprap.
- Plantings will be provided along the Little River.
- Educational flyers for Blanding's turtle, wood turtle, and spotted turtle will be included in construction contract documents.

Federally Listed

The United States Fish and Wildlife Service's (USFWS) Information for Planning and Consultation (IPaC) webtool was accessed on February 12, 2024, to generate an updated Official Species List and to review the proposed project for federally listed species and critical habitats protected under the Endangered Species Act (ESA). The Official Species List identified two federally listed species, the federally endangered northern long-eared bat (*Myotis septentrionalis*, NLEB) and the federally threatened small whorled pogonia (*Isotria medeoloides*), as well as one candidate species, the monarch butterfly (*Danaus plexippus*), as potentially occurring within the proposed project area. There is no critical habitat for any federally listed species identified in the vicinity of the proposed project.

The NLEB has the potential to occur throughout New Hampshire. According to the USFWS, suitable summer habitat for NLEB consists of a variety of forested habitats. This species generally prefers closed canopy forest with an open understory. Potential roost trees include live trees or snags, at least 3" in diameter, with exfoliating bark, cracks, crevices, or cavities. Bridges and other structures can also provide suitable roosting habitat. The existing bridge was reviewed for evidence of occupancy or usage by bats, and the Bridge/Structure Bat Assessment Form was completed on July 19, 2022. No signs or evidence of bats using the existing structure were observed. NLEB overwinters in hibernacula such as caves and mines. The NHB did not report any known winter hibernacula or maternity roost trees in the vicinity of the project. Tree clearing within the project area will be selective and minimal, and entirely located within 300' of the edge of pavement. The project is eligible for review under the Programmatic Biological Opinion for Transportation Projects in the Range of the Indiana Bat and Northern Long-Eared Bat. The IPaC Determination Key was completed and submitted to USFWS and the USFWS provided a Consistency Letter dated August 30, 2022. A Likely to Adversely Affect determination was made for Northern Long-Eared Bat. A No Effect Determination was made for small whorled pogonia because this species was not identified in the project area.

The monarch butterfly is a candidate for listing under the ESA. The USFWS will review the monarch's status each year until resources are available to begin developing a proposal to list the monarch as threatened or endangered under the ESA. The candidate status of the monarch does not provide protection under the ESA, and no further coordination with the USFWS is required at this time. Monarch habitat includes non-forested, non-shrubby areas where there is potential for nectar species (flowering plants) and/or milkweed plants, including, but not limited to, regularly or semi-regularly mowed areas within the ROW and where a clear zone is maintained. The proposed project area includes some potential monarch habitat, but the project would not permanently change that habitat and no monarch conservation measures are included in the project at this time. Following construction, roadside areas would continue to provide potential habitat.

Fisheries

Coordination with the New Hampshire Fish and Game Department (NHFG) regarding fisheries has been completed (see attached correspondence included with this permit application). The Little River is identified by the Wetland Permit Planning Tool as a cold water fishery as well as an eastern brook trout water; however, John Magee at NHFG confirmed that this section of the Little River does not contain eastern brook trout and is not a cold water fishery. Based on coordination with NHFG, the Little River is known to support river herring and American eel, which are diadromous species.

Env-Wt 307.10 (g)(1) prescribes a time of year restriction between October 1 and March 31 for any documented occurrence of a cold water fishery or threatened or endangered fishery. Based on NHFG coordination, as noted above, the project is not located in a cold water fishery. However, NHFG has requested that no in-water work should occur between April 15 and July 1 to protect diadromous fish spawning runs. The construction sequence located elsewhere in this application incorporates the time of year restriction for diadromous fish.

Proposed Project

The proposed project will involve the replacement of Bridge No. 073/084 that carries NH Route 125 over the Little River. The existing bridge structure consists of an 18’ wide x 12’ tall CMP. The proposed alternative consists of a 100’-0” single span steel girder bridge founded on integral abutments. Portions of the channel through the structure will be reconstructed and realigned at the inlet. In addition, the proposed project includes minor roadway reconstruction, regrading of roadway shoulders, repaving, and installation of guardrail along the bridge approaches. The bridge will be constructed using phased construction techniques over one construction season, with minor paving and other punch-list items being completed the following construction season. A temporary roadway diversion will be constructed on a new alignment on the east side on NH Route 125 to maintain two lanes of traffic flow throughout the duration of construction.

Impacts

Surface Waters

The proposed project will result in 135 LF of permanent impacts to the channel of the Little River and 180 LF of permanent impacts to the banks of the Little River, for a total of 315 LF. To accommodate the larger crossing that is proposed and to better align the stream with the crossing, the stream channel will be realigned on the upstream side of the bridge. The approximate bankfull width of the constructed stream channel will be 34 feet, matching the width of the reference reach. Simulated streambed material will be used in the channel and root wads will be installed at the north edge of the channel to aid in stabilization. Reconstructed banks will consist of fabric encapsulated soil lifts, live stakes, and shrubs. A floodplain bench will be constructed along each bank through the crossing, stabilized with void-filled riprap covered with humus, and seeded with a riparian seed mix. The proposed design will result in approximately 143 LF of restored stream channel and 276 LF of restored banks, for a total of 419 LF of restored channel and banks.

The project will result in 157 LF of temporary impacts to the intermittent stream located in the southeast bridge quadrant along the toe-of-slope of the existing roadway embankment. Temporary impacts will be required for stream diversion to allow the Contractor access to the river during construction. It is anticipated that the Contractor will utilize a temporary pipe and temporary construction mats to maintain stream flow and minimize impacts to the intermittent stream. Upon completion of construction, stream flow will be restored in the natural channel of the intermittent stream.

Priority Resource Areas

Wetland 4 and portions of Wetland 6 are Priority Resource Areas (PRA). The only proposed permanent impacts to a PRA will be in Wetland 4 (Impact Location Q), consisting of 509 SF of impact to accommodate the stream realignment and fabric-encapsulated soil lifts that are proposed for channel stabilization.

Temporary impacts will occur in Wetland 6 (Impact Locations Y and Z) and Wetland 4 (Impact Location V), totaling 3,960 SF of temporary impact to a PRA. Temporary impacts are necessary to provide construction access to the river. No grubbing of vegetation will occur within temporary impact locations and geotextile fabric and construction mats will be placed under temporary fill to avoid rutting and compaction.

Mitigation

Permanent impacts have been minimized and avoided to the maximum extent practicable. The proposed project is self-mitigating based on the overall improvements to the existing crossing structure. The proposed project will result in improved geomorphic compatibility, hydraulic capacity, terrestrial wildlife passage (wildlife shelves), and aquatic organism passage (simulated streambed, reduced water velocities through the structure). Therefore, no mitigation in the form of an in-lieu fee payment to the NHDES Aquatic Resource Mitigation (ARM) Fund is proposed for the 135 LF of permanent channel impacts and 180 LF of permanent bank impacts associated with the proposed project.

The total area of permanent wetland and surface water impacts is 3,382 SF, which does not exceed the US Army Corps' 5,000 SF mitigation threshold.

Permanent impacts to a PRA total 509 SF. An in-lieu fee payment will be provided as mitigation for PRA impacts.

More details on mitigation are included in the Mitigation Narrative included elsewhere in this application.

Easements

The proposed project will require temporary and permanent easements located outside the existing right-of-way. Permanent channel easements will be located upstream and downstream of the bridge to build and maintain the reconstructed stream channel. Temporary construction easements will be located on the Southeast, Southwest, Northwest, and Northeast quadrants of the bridge to provide access to build the bridge and relocated stream channel. A NHDOT Right-of-Way Public Hearing was held on August 2, 2023. The NHDOT Bureau of Right-of-Way will secure the necessary easements prior to construction.

Attachment A: Minor and Major Projects

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

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

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

APPLICANT'S NAME: **NHDOT** **TOWN NAME:** Lee

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.
AN ALTERNATIVES ANALYSIS WAS COMPLETED FOR THE PROPOSED PROJECT TO IDENTIFY A PREFERRED ALTERNATIVE THAT MINIMIZED IMPACTS TO THE MAXIMUM EXTENT PRACTICABLE WHILE STILL ACCOMPLISHING THE PURPOSE OF THE PROJECT. THE PURPOSE OF THE PROJECT IS TO ADDRESS THE SERIOUS CONDITION OF THE EXISTING STRUCTURE, REMOVE THE BRIDGE FROM THE NH STATE RED LIST, MAINTAIN A STRUCTURALLY SOUND CROSSING, AND IMPROVE THE HYDRAULIC CONVEYANCE AND GEOMORPHIC COMPATIBILITY OF THE STREAM CROSSING. THE PROJECT IS NEEDED BECAUSE THE EXISTING CMP IS IN SERIOUS CONDITION AND FLOODING OCCURS UPSTREAM FROM THE CROSSING DURING STORM EVENTS. THE PROPOSED PROJECT WILL REPLACE THE EXISTING UNDERSIZED CROSSING WITH A LARGER BRIDGE SPAN THAT ENSURES THE CONTINUED SAFE OPERATION OF THE NH ROUTE 125 CORRIDOR, REDUCES UPSTREAM FLOODING EVENTS, IMPROVES GEOMORPHIC COMPATIBILITY, AND IMPROVES AQUATIC ORGANISM AND TERRESTRIAL WILDLIFE PASSAGE AT THE CROSSING LOCATION. REHABILITATION ALTERNATIVES DID NOT ADDRESS THE HYDRAULIC DEFICIENCIES OF THE EXISTING STRUCTURE; THEREFORE, BRIDGE REHABILITATION WAS NOT CONSIDERED FURTHER. MULTIPLE BRIDGE ALTERNATIVES WERE EVALUATED BASED ON COSTS, RIGHT-OF-WAY IMPACTS, AND ENVIRONMENTAL IMPACTS. THE PROPOSED ALTERNATIVE FULLY ADDRESSES THE PURPOSE OF THE PROJECT, MINIMIZES IMPACTS ON THE LITTLE RIVER, AND PROVIDES SUBSTANTIAL BENEFITS TO THE STREAM SYSTEM WHILE BALANCING COSTS.

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.

The proposed project is not anticipated to impact any tidal or non-tidal marshes. Wetlands in the project area are scrub-shrub/forested wetlands and a small emergent wetland adjacent to the Little River.

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

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

The proposed project will maintain all existing hydrologic connections between adjacent wetland and stream systems. The proposed bridge structure will increase the hydraulic opening of the crossing and provide improved geomorphic compatibility.

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.

The proposed project has avoided and minimized impacts to jurisdictional wetlands and surface waters to the maximum extent practicable. There are minimal alternatives for the project due to the location of the existing bridge, and State owned right-of-way. Multiple alternatives were considered and the selected alternative minimizes changes to the roadway profile and reduces the required grading, helping to reduce impacts to adjacent wetlands, streams, and adjacent properties. Roadway slopes were steepened where possible to avoid impacting wetlands and streams. The project area does not contain vernal pools or exemplary natural communities.

Based on coordination with NHFG, the Little River is known to support river herring and American eel, which are diadromous species. NHFG has requested that no in-water work occur between April 15 and July 1 to protect diadromous fish spawning runs.

Wildlife-friendly erosion control measures will be utilized during construction (such as erosion control berm, Filtrexx or equal filter sock, and coco or jute matting).

Streambed simulation material will be installed over riprap within the channel to improve habitat and aquatic organism passage.

Wildlife shelves will be incorporated along both banks of the river through the new bridge structure.

All riprap used on the project will be void-filled riprap. Plantings will be provided along the Little River.

Educational flyers for Blanding’s turtle, wood turtle, and spotted turtle will be included in construction contract documents.

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

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

The proposed project will not significantly impact public commerce, navigation, or recreation. The Little River is not a navigable waterway in the project area. Traffic disruptions along NH Route 125 will be minimized and short-term.

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.

FEMA mapped 100-year floodplain (Zone A) associated with the Little River is located upstream and downstream from the existing crossing. Wetland 4 and portions of Wetland 6 are located within the 100-year floodplain. Due to their proximity to the existing crossing, it is not possible to avoid impacts to floodplain wetlands. Permanent impacts have been minimized and avoided to the maximum extent practicable. The proposed project will result in substantial improvements in hydraulic capacity and geomorphic compatibility, providing an overall benefit to the stream system.

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.

Wetland 6 is a large palustrine scrub-shrub and forested (PSS/FO) wetland located in the southeast bridge quadrant. The wetland is located along the toe-of-slope of the NH Route 125 roadway embankment and extends southeast, beyond the limits of the study area. Permanent impacts to Wetland 6 have been avoided.Temporary impacts are necessary to provide construction access to the river. No grubbing of vegetation will occur within temporary impact locations and geotextile fabric and construction mats will be placed under temporary fill to avoid rutting and compaction.

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

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

The project area is not located within any NHDES Groundwater Classification Areas and is not underlain by a stratified drift aquifer with high transmissivity. There are no public water supply wells or wellhead protection areas in the vicinity of the proposed project. The proposed bridge replacement and associated roadway improvements are not anticipated to impact wells, groundwater, or aquifer levels.

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.

Impacts to stream channels have been avoided and minimized to the maximum extent practicable. However, due to the nature of the proposed project, impacts associated with the bridge replacement were unavoidable. The proposed project will result in 135 LF of permanent impacts to the channel of the Little River and 180 LF of permanent impacts to the banks of the Little River, for a total of 315 LF. Overall, the proposed project will result in substantial improvements to the stream system over the existing condition by providing a crossing with improved geomorphic compatibility and hydraulic capacity, and by incorporating simulated streambed material in the channel and bio-engineered banks using rootwads, fabric-encapsulated soil, and plantings.

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 - the project does not involve a shoreline structure.

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 - the project does not involve a shoreline structure.

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 - the project does not involve a shoreline structure.

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 - the project does not involve a shoreline structure.

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 - the project does not involve a shoreline structure.

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 - the project does not involve a shoreline structure.

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: Highway Methodology
NAME OF CERTIFIED WETLAND SCIENTIST (FOR NON-TIDAL PROJECTS) OR QUALIFIED COASTAL PROFESSIONAL (FOR TIDAL PROJECTS) WHO COMPLETED THE ASSESSMENT: CHRISTINE PERRON, CWS
DATE OF ASSESSMENT: 2/12/24
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.

NHDES Avoidance and Minimization Checklist

AVOIDANCE AND MINIMIZATION CHECKLIST

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

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

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

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

The following definitions and abbreviations apply to this worksheet:

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

SECTION 1 - CONTACT/LOCATION INFORMATION	
APPLICANT LAST NAME, FIRST NAME, M.I.: Reczek, Jennifer	
PROJECT STREET ADDRESS: NH Route 125	PROJECT TOWN: Lee
TAX MAP/LOT NUMBER: N/A - ROW	

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

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

The proposed project will replace Bridge No. 073/084 that carries NH Route 125 over the Little River in Lee.

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

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

Natural Resource Agency Coordination Meeting Minutes

BUREAU OF ENVIRONMENT
CONFERENCE REPORT

Final

SUBJECT: NHDOT Monthly Natural Resource Agency Coordination Meeting
DATE OF CONFERENCE: January 18, 2023
LOCATION OF CONFERENCE: Virtual meeting held via Zoom

ATTENDED BY:

NHDOT
Matt Urban
Andrew O'Sullivan
Jon Evans
Marc Laurin
Rebecca Martin
Dillan Schmidt
Chris Carucci
Dillan Schmidt
John Sargent
Meli Dube

ACOE
Mike Hicks

USCG
Gary Croot

EPA
Jean Brochi

NHDES
Karl Benedict
Mary Ann Tilton

NHB
Absent

NH Fish & Game
Mike Dionne
Kevin Newton

Federal Highway
Absent

US Fish & Wildlife
Absent

The Nature Conservancy
Absent

NH Transportation & Wildlife Workgroup
Absent

Consultants/ Public Participants
Brooke Stubbs
Michael Leach
Gerard Fortin
Alanna Gerton
Peter Walker
Stephen Hoffmann
Christine Perron
Sam White

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

Table of Contents:

Kevin Newton (NHFGD) had no further comments.
Mike Hicks (USACE) requested that floodplain impacts should be addressed.
Jean Brochi (USEPA) emphasized earlier comment by Karl Benedict that if there will be a change in the plan there may need to be a second mitigation discussion.
Gary Croot (USCG) indicated that there is no Coast Guard jurisdiction in this river segment.

Lee, #41322 (X-A004(593))

Stephen Hoffmann reintroduced the Lee 41322 project involving the replacement of the structure carrying NH Route 125 over the Little River in Lee, NH. The project was previously presented at the October 2019, August 2020, and December 2021 NHDOT Natural Resource Agency Meetings. The purpose of this meeting was to present the selected alternative, provide project updates since the December 2021 meeting, discuss resource area impacts, and obtain concurrence from the resource agencies on the permitting and mitigation approach.

Updates since the prior resource agency meetings included: increasing the span length of the selected alternative from 90 feet to 100 feet; updated NHB DataCheck Results letter now includes spotted turtle and wood turtle in addition to the state listed species identified on prior NHB DataCheck Results Letters; rare plant survey completed in 2022 for American featherfoil and small whorled pogonia (no rare plants documented in the project area); and the advertising date has shifted from June 20223 to June 2024.

The existing structure consists of an 18' wide x 12' high corrugated metal pipe (CMP) that was installed in 1972 and was added to the State Red List in 2014. At the location of the crossing, the Little River has a watershed area of approximately 18.4 square miles making this a Tier 3 stream crossing. The Little River is also part of the Lamprey River Watershed and is a NH Designated River. The average bankfull width of the river at this location is 32' and the design channel bankfull width of the reference reach is 34'. Additional resources located within the project area include wetlands, priority resource areas (PRAs, floodplain wetlands adjacent to Tier 3 stream), 100-year floodplain (Zone A), and rare plants and animals identified by NHB and USFWS. Rare plants identified by NHB and USFWS include tufted yellow loosestrife, American featherfoil, and small whorled pogonia. A rare plant survey was completed in August 2020 and no rare species were identified. Based on coordination with NHB an additional rare plant survey was completed in June 2022 and again no rare species were documented in the project areas. Rare wildlife species include American eel, Blanding's turtle, spotted turtle, and wood turtle. NHF&G made the following recommendations based on preliminary coordination: 1) Time of year restriction from April 15th through July 1st to protect diadromous fish spawning runs, particularly river herring which has been documented in the Little River downstream from the project area, and American eel; 2) Wildlife friendly erosion control matting; and 3) Limiting riprap in the river channel. The NHDES WPPT was reviewed and the segment of the Little River was identified as a cold water fishery and an eastern brook trout water. However, John Magee at NHFG confirmed that this section of the Little River does not contain eastern brook trout and is not a cold water fishery.

The selected alternative consists of a 100-foot single span bridge structure with a channel realignment originating on the upstream side of the bridge. The proposed project will construct approximately 143 linear feet of "new" stream channel through the proposed structure. The approximate bankfull width of the constructed stream channel is approximately 34 feet, matching the width of the reference reach. The proposed project also includes terrestrial wildlife shelves/floodplain benches (minimum of 3 feet wide) along both banks through the proposed structure. The project also includes streambed simulation material overtop proposed rip rap in the reconstructed channel as well as natural bank stabilization techniques.

The proposed channel alignment and natural bank stabilization were designed by Sean Sweeney of Headwaters Consulting, LLC. Natural bank stabilization techniques include void filled riprap, fabric encapsulated soil lifts, root wad bank revetment, and seeding/shrub plantings.

The proposed project will be constructed in phases, including a temporary traffic diversion located along an alignment shifted to the east in order to maintain two-way traffic throughout the duration of construction. This will involve extending the existing CMP at the outlet to accommodate the temporary diversion alignment. The project is anticipated to advertise in June 2024 with construction likely scheduled to start in the Fall of 2024. The temporary diversion and associated instream impacts will be completed outside the NHFG time of year restriction from April 15 – July 1. Direct impacts to the forested/scrub-shrub wetland along the toe-of-slope in the southeast bridge quadrant were avoided to the maximum extent practicable. The temporary fill slope lines associated with the temporary diversion were kept out of the wetland. However, temporary impacts will still be required for construction access, erosion control, vegetation removal, and utility relocations.

Permanent and temporary impacts to jurisdictional areas were presented and are summarized in the table below:

Lee 41322 Impact Summary Table						
RESOURCE AREA	**PERMANENT IMPACTS**		**TEMPORARY IMPACTS**		**CREATION**	
	SF	**LF**	**SF**	**LF**	**SF**	**LF**
Channel	2,125	127	2,256	86	2,960	143
Bank	735	180	1,062	266	1,868	276
Palustrine Wetlands (Non-PRA)	-	-	3,317	-	-	-
Palustrine Wetlands (PRAs)	235	-	728	-	-	-

The proposed project is anticipated to require a Major Impact Standard Dredge and Fill Permit from NHDES for replacement of a Tier 3 stream crossing and associated impacts to PRA wetlands. The proposed stream crossing is anticipated to be permitted as a Tier 3 alternative design because the 100-foot span does not fully meet the bankfull width x entrenchment ratio.

Mr. Hoffmann highlighted the proposed improvements of the bridge replacement project including improved geomorphic compatibility, hydraulic capacity, terrestrial wildlife passage (wildlife shelves), aquatic organism passage (simulated streambed, reduced water velocities through the structure), natural bank stabilization techniques, and proposed plantings. Mr. Hoffmann asked for concurrence from the resource agencies on whether the stream channel and bank impacts could be considered self-mitigating. Mr. Hoffmann also indicated that mitigation is assumed to be required for the 235 square feet of permanent PRA wetland impacts. The NHDES Standard Dredge and Fill application will be prepared in submitted to NHDES by fall 2023.

Andy O'Sullivan with NHDOT asked if the in-lieu-fee payment amount had been calculated for the proposed 235 SF of permanent PRA wetland impacts. Mr. Hoffmann indicated that it had not been determined at this time.

Karl Benedict with NHDES requested that the methods of restoration for areas of temporary impacts be provided and discussed in the permit application. Mr. Benedict also suggested changing the heading in the impact summary table from "Creation" to "Restoration" or "Enhancement". In addition, Mr. Benedict indicated that the crossing itself could be considered self-mitigating and agreed that mitigation would be required for the PRA impacts. Mr. Benedict suggested re-evaluating the project classification based on the Bank Stabilization Rules (Env-Wt 514) to determine the classification of the bank stabilization work. Mr. Benedict also indicated that NHDES would likely require two years of additional monitoring/oversight following completion of the project.

Mary Ann Tilton with NHDES had left the meeting, no comments were received.

Mike Dionne with NHFG had no comments.

Kevin Newton with NHFG indicated that the proposed project appeared to comply with the NHFG recommendations and conditions and asked for clarification on the time of year restriction and whether it included all construction or just instream work. Mr. Hoffmann indicated that the original restriction proposed by NHFG was for instream work only, and that additional work outside the stream could be completed during this window in order to complete the project in a timely manner. Mr. Newton noted that turtles may be attracted to disturbed areas associated with the project and indicated that NHFG would provide construction fliers on the rare species of turtle potentially found in the project area to educate the contractor.

Mike Hicks with USACE had no comments.

Jean Brochi with US EPA had no comments.

Gary Croot with the USCG indicated that the Little River is not a navigable water and had no further concerns.

Mitigation

Stream Crossing

Existing Conditions

Bridge 073/084 carries the Little River under NH Route 125. The existing 18’ wide x 12’ high culvert is 90 feet in length with no natural bottom and no accommodation of terrestrial wildlife passage. The existing culvert was installed in the 1970s and replaced a steel through girder bridge, which was constructed in 1937. When the culvert was installed, it was placed perpendicular to the roadway in the middle of the bridge abutments, which changed the alignment of the river and created a sharp approach angle for the river into the culvert. Approximately 80 feet of the realigned channel upstream from the existing culvert is lined with stone and the stone lining appears to have raised the historic thalweg elevation by as much as 30 to 36 inches at the high point.

General flood history was obtained from the Lee Highway Department Supervisor and other property owners, who conveyed that there is a history of flooding of West Mill Pond Road, which runs adjacent to Little River, near the NH Route 125 crossing. Anecdotal evidence suggests this flooding did not occur prior to the replacement of a previous through-girder structure with the existing CMP in the early 1970s. The Existing Condition model indicates that flows are routed through the existing culvert for the 10-, 50- and 100-year floods, but the headwater is equal to or greater than the existing pipe height (i.e., submerged inlet). Velocities through the culvert during a 100-year flood are 13.9 feet/second. The high velocities have resulted in a large scour hole at the outlet.

Proposed Conditions

The replacement crossing structure will be a 100-foot single span bridge structure. To accommodate the larger crossing that is proposed and to better align the stream with the crossing, the stream channel will be realigned on the upstream side of the bridge and a channel will constructed through the bridge to connect with the downstream channel. The approximate bankfull width of the constructed stream channel will be 34 feet, matching the width of the reference reach. Simulated streambed material will be used in the channel and root wads will be installed at the northwest edge of the channel to aid in stabilization. Reconstructed banks will consist of fabric encapsulated soil, live stakes, and shrubs. A floodplain bench will be constructed along each bank through the crossing, which will provide terrestrial wildlife passage. All exposed riprap used on the project will be void-filled riprap.

The proposed project will result in 135 LF of permanent impacts to the channel of the Little River and 180 LF of permanent impacts to the banks of the Little River, for a total of 315 LF.

The proposed design will result in approximately 143 LF of restored stream channel and 276 LF of restored banks, for a total of 419 LF of restored channel and banks.

The proposed bridge will substantially improve the hydraulic capacity of the crossing. Hydraulic analysis was performed using the USACOE River Analysis System (HEC-RAS) version 5.0.7. The hydraulic model was run for existing and proposed conditions for the 10-, 50-, 100-, and 500-year flood events. Based on the proposed bridge replacement, the freeboard at the 100-year flood event is roughly 7.5 feet. Water velocity during the Q100 storm drops to 5.5 feet/second in the proposed condition. Downstream water surface elevations are largely unaffected by the proposed replacement structure. Please see the Hydrologic & Hydraulic Report included elsewhere in this application for additional details.

Env-Wt 902.27 "Self-mitigating" as applied to stream crossings means *the design of the crossing incorporates measures or features to offset the loss of the affected resource's functions and values in an area where the new functions and values are sustainable. Examples of self-mitigating measures or features include, but are not limited to, eliminating a barrier to aquatic organism passage, improving the hydraulic capacity of an under-sized crossing, and improving geomorphic compatibility*. The proposed project will result in improved geomorphic compatibility, hydraulic capacity, terrestrial wildlife passage, and aquatic organism passage (simulated streambed material, reduced water velocities through the structure). The proposed design also incorporates bio-engineering methods of bank stabilization (root wads, soil encapsulated lifts, and plantings). Therefore, the stream crossing meets and exceeds the criteria for self-mitigation. No mitigation in the form of an in-lieu fee payment to the NHDES Aquatic Resource Mitigation (ARM) Fund is proposed for permanent channel and bank impacts.

Wetland Impacts

Permanent and temporary impacts have been minimized and avoided to the maximum extent practicable. The total area of permanent wetland and channel impacts is 3,382 SF, which does not exceed the USACE's 5,000 SF mitigation threshold. Permanent impacts to a Priority Resource Area (Wetland 4) total 509 SF. Wetland 4 is a small emergent wetland (PEM1E) adjacent to the Little River within the 100-year floodplain. The wetland is adjacent to the Little River bridge and is located approximately 40 feet from NH Route 125. The principal functions and values are sediment retention, nutrient removal, and sediment/shoreline stabilization. A Wetland Function-Value Evaluation Form is included elsewhere in this application.

An in-lieu fee payment of $2,895.22 will be provided as mitigation for 509 SF of permanent impacts to the PRA.

2023 VALUES

TOWN	Land Value
Acworth	$2,095
Albany	$1,303
Alexandria	$3,962
Allenstown	$13,080
Alstead	$4,102
Alton	$37,380
Amherst	$39,639
Andover	$6,603
Antrim	$5,885
Ashland	$20,978
Atkinson	$67,802
Auburn	$30,681
Barnstead	$13,032
Barrington	$16,260
Bartlett	$9,729
Bath	$2,650
Bean's Grant	$619
Bean's Purchase	$619
Bedford	$67,802
Belmont	$17,724
Bennington	$6,052
Benton	$619
Berlin	$2,225
Bethlehem	$1,509
Boscawen	$9,837
Bow	$28,228
Bradford	$6,391
Brentwood	$27,495
Bridgewater	$22,302
Bristol	$23,501
Brookfield	$3,842
Brookline	$28,753
Cambridge	$619
Campton	$7,546
Canaan	$7,392
Candia	$15,186
Canterbury	$6,356
Carroll	$4,182
Center Harbor	$54,231
Chandler's Purchase	$619
Charlestown	$4,017
Chatham	$770

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

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

	1	**Convert square feet of impact to acres:**	
INSERT SQ FT OF IMPACT		Square feet of impact =	509.00
			43560.00
		Acres of impact =	0.0117
	2	**Determine acreage of wetland construction:**	
		Forested wetlands:	0.0175
		Tidal wetlands:	0.0351
		All other areas:	0.0175
	3	**Wetland construction cost:**	
		Forested wetlands:	$1,899.93
		Tidal Wetlands:	$3,799.86
		All other areas:	$1,899.93
	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:	29254
		Forested wetlands:	$512.75
		Tidal wetlands:	$1,025.50
		All other areas:	$512.75
	5	**Construction + land costs:**	
		Forested wetland:	$2,412.68
		Tidal wetlands:	$4,825.36
		All other areas:	$2,412.68
	6	**NHDES Administrative cost:**	
		Forested wetlands:	$482.54
		Tidal wetlands:	$965.07
		All other areas:	$482.54
	************	**TOTAL ARM PAYMENT*************	
		Forested wetlands:	$2,895.22
		Tidal wetlands:	$5,790.43
		All other areas:	$2,895.22

Wetlands Functions & Values Evaluation Forms

Wetland Function-Value Evaluation Form

Total area of wetland Unknown Human made? No Is wetland part of a wildlife corridor? Yes or a "habitat island"? No

Adjacent land use Forested, residential; Speedway Distance to nearest roadway or other development 40'

Dominant wetland systems present PFO/PEM/R2UB Contiguous undeveloped buffer zone present No

Is the wetland a separate hydraulic system? no If not, where does the wetland lie in the drainage basin? mid

How many tributaries contribute to the wetland? 1 Wildlife & vegetation diversity/abundance (see attached list)

Wetland I.D. F
Latitude 43.118716 Longitude -71.034206
Prepared by: CH Date 2/12/2024
Wetland Impact:
Type NA Area NA

Evaluation based on:
Office x Field ____
Corps manual wetland delineation completed? Y x N ____

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge		2, 4, 7		Limited recharge/discharge
Floodflow Alteration	Y	5, 6, 10, 13, 18		Wetland is floodplain contiguous with Little River
Fish and Shellfish Habitat	Y	1,4,7,8,10,14,17	X	Potential for fish and shellfish habitat in Little River.
Sediment/Toxicant Retention	Y	1, 2, 3, 4, 7, 10, 16	X	Potential for sediment retention in floodplain/fringe wetland
Nutrient Removal	Y	3, 4, 7, 8, 10, 11, 13	X	Potential for nutrient retention in floodplain/fringe wetland
Production Export	Y	1, 2, 7, 10		Diversity of woody and herbaceous vegetation
Sediment/Shoreline Stabilization	Y	3, 4, 7, 9, 12, 14, 15	X	Diversity of woody and herbaceous vegetation
Wildlife Habitat	Y	6, 7, 8, 12, 15, 21		Wetland is a floodplain/fringe wetland contiguous with Little River, diversity of woody and herbaceous veg
Recreation	Y	2, 8, 9, 10		Wetland contiguous with Little River
Educational/Scientific Value	Y	8, 11, 13		Limited educational value
Uniqueness/Heritage	Y	4, 10, 11, 16, 22		Wetland contiguous with Little River
Visual Quality/Aesthetics		1		Limited aesthetic potential
ES Endangered Species Habitat	Y			NHB...
Other				

Notes:

* Refer to backup list of numbered considerations.

Wetland Function-Value Evaluation Form

Total area of wetland Unknown Human made? no Is wetland part of a wildlife corridor? Yes or a "habitat island"? No

Adjacent land use Forested, residential; Speedway Distance to nearest roadway or other development 20'

Dominant wetland systems present PFO/PSS/R2UB Contiguous undeveloped buffer zone present no

Is the wetland a separate hydraulic system? No If not, where does the wetland lie in the drainage basin? Mid

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

Wetland I.D. G
Latitude 43.117951 Longitude -71.035122
Prepared by: CH Date 2/12/2024
Wetland Impact:
Type NA Area NA

Evaluation based on:
Office X Field X

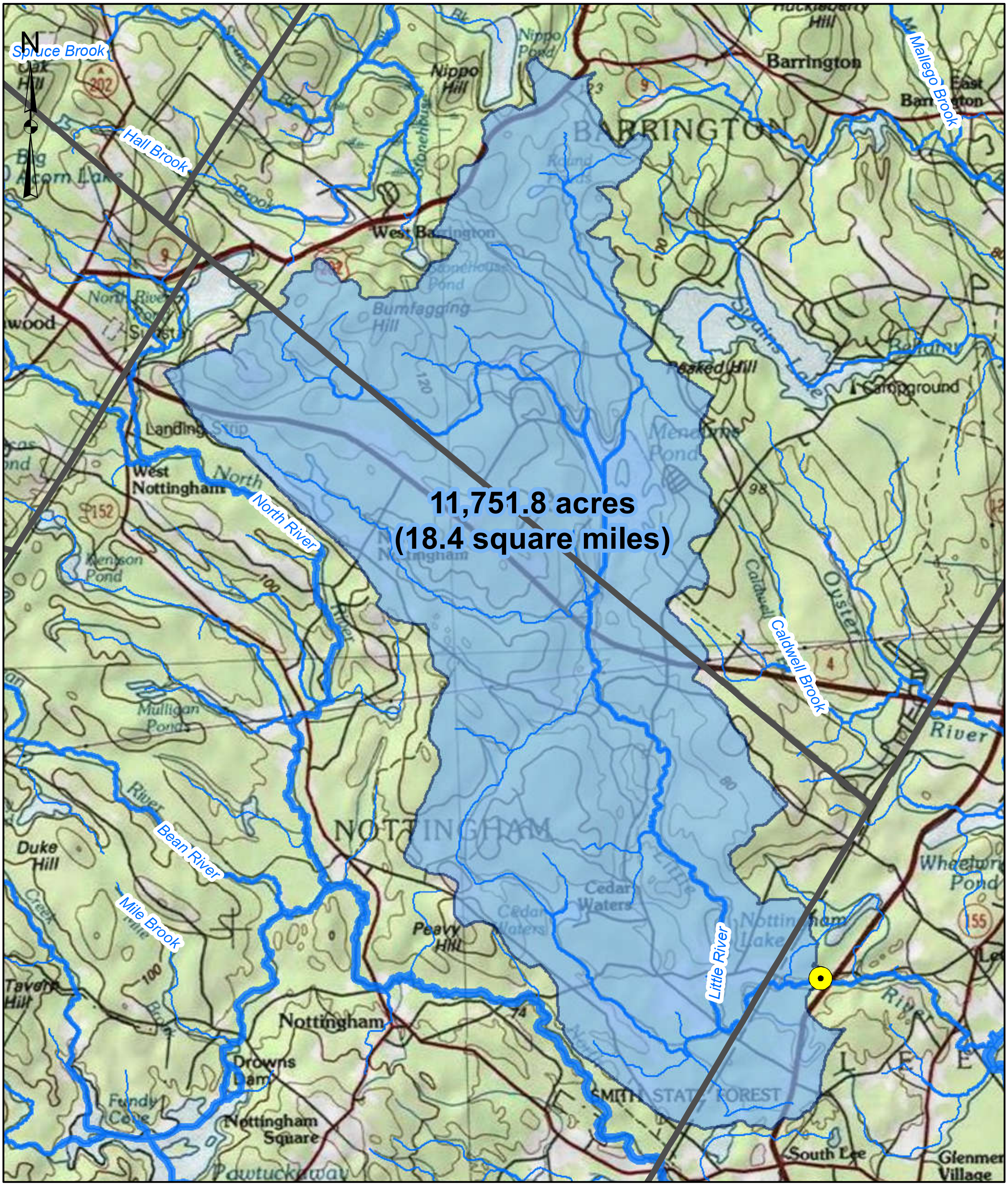
Corps manual wetland delineation completed? Y X N

Function/Value	Suitability Y / N	Rationale (Reference #)*	Principal Function(s)/Value(s)	Comments
Groundwater Recharge/Discharge	Y	2, 4, 7		Limited recharge/discharge
Floodflow Alteration		5, 6, 7, 9, 10, 13, 18	X	Standing water in wetland at time of delineation, diversity of woody and herbaceous veg
Fish and Shellfish Habitat		1, 4, 7, 8, 10, 14, 17	X	Wetland skirts tributary to Little River; Potential for fish and shellfish habitat in Little River.
Sediment/Toxicant Retention		1, 2, 3, 4, 7, 10, 16	X	Potential for sediment retention in floodplain portion of wetland
Nutrient Removal		3, 4, 7, 8, 10, 11, 13	X	Potential for nutrient retention in floodplain portion of wetland
Production Export		1, 2, 7, 10		Diversity of woody and herbaceous vegetation
Sediment/Shoreline Stabilization		3, 4, 7, 9, 12, 14, 15	X	Diversity of woody and herbaceous vegetation
Wildlife Habitat		6, 7, 8, 12, 15, 21		Wetland skirts tributary to Little River, diversity of woody and herbaceous veg
Recreation		2, 8, 9, 10		Wetland skirts tributary to Little River
Educational/Scientific Value		8, 11, 13		Limited educational value
Uniqueness/Heritage		4, 10, 11, 12, 16, 22		Wetland skirts tributary to Little River
Visual Quality/Aesthetics		1, 9		Limited aesthetic potential
ES Endangered Species Habitat	Y			NHB
Other				

Notes:

* Refer to backup list of numbered considerations.

Stream Crossing Watershed Map



Lee 41322 Crossing Location

Town Boundary

Little River Watershed Area

Rivers & Streams

0 5,500 11,000

Feet

NH DEPARTMENT OF TRANSPORTATION, LEE - 41322
NH ROUTE 125 OVER LITTLE RIVER
BRIDGE NO. 073/084, LEE, NEW HAMPSHIRE

LITTLE RIVER STREAM CROSSING WATERSHED MAP

SCALE :	DATE :	FIGURE :
1 inch = 5,600 feet	JANUARY 2023	3

McFarland Johnson

J:\18805.05 Lee Permitting\Draw\GIS\Wetland Permitting Figures\Lee 41322 - Figure 3 - Little River Watershed Map.mxd

NHDES Stream Crossing Worksheet

WETLANDS PERMIT APPLICATION
STREAM CROSSING WORKSHEET
Land Resources Management
Wetlands Bureau

RSA 482-A/ Env-Wt-900

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

1. Tier Classifications

Determine the contributing watershed size at USGS StreamStats

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

Size of contributing watershed at the crossing location:	**11,752** acres

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

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

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

- ☒ On a watercourse where the contributing watershed is more than 640 acres
- ☒ Within a Designated River Corridor unless:
  - a. The crossing would be a tier 1 stream based on contributing watershed size; or
  - b. The structure does not create a direct surface water connection to the designated river as depicted on the national hydrography dataset as found on GRANIT
- ☐ On a watercourse that is listed on the surface water assessment 305(b) report
- ☒ Within a 100-year floodplain (see *section 2* below)
- ☒ In a jurisdictional area having any protected species or habitat (NHB DataCheck)
- ☐ In a Prime Wetland or within a duly-established 100-foot buffer, unless a waiver has been granted pursuant to RSA 482-A:11,IV(b) and Env-Wt 706

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

2. 100-year Floodplain

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

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

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

☒ Elevation of the 100-year floodplain at the inlet: ____**128.92**______ feet (FEMA El. or Modeled El.)

3. Calculating Peak Discharge

Existing 100-year peak discharge (Q) calculated in cubic feet per second (CFS): _____**1780**_______ CFS	Calculation method: **StreamStats for NH**
Estimated Bankfull discharge at the crossing location: _____**626**______ CFS	Calculation method: **Reg. Hydr. Curve**

Note: If Tier 1 then skip to Section 10

4. Predicted Channel Geometry based on Regional Hydraulic Curves

*For **Tier 2**, **Tier 3** and **Tier 4** Crossings Only*

Bankfull Width: ____**52**___ feet	Mean Bankfull Depth: _____**2.8**____ feet
Bankfull Cross Sectional Area: ____**144**____ square feet	

5. Cross Sectional Channel Geometry: Measurements of the Existing Stream within a Reference Reach

*For **Tier 2**, **Tier 3** and **Tier 4** Crossings Only*

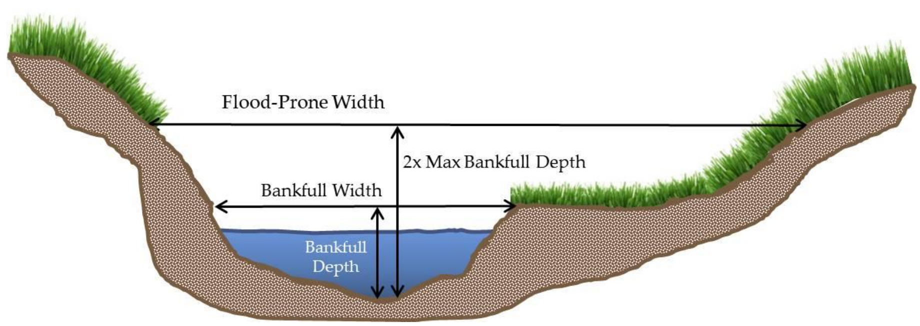
Describe the reference reach location: **Approx 520' Upstream**

Reference reach watershed size: ____**11,742**___ acres

Parameter	**Cross Section 1** Describe bed form _______**Glide**_______ (*e.g. pool, riffle, glide*)	**Cross Section 2** Describe bed form ________**Glide**______ (*e.g. pool, riffle, glide*)	**Cross Section 3** Describe bed form ________**Glide**_______ (*e.g. pool, riffle, glide*)	**Range**
Bankfull Width	_____**36**______ **feet**	_______**33**______ **feet**	_______**33**______ **feet**	**33 - 36 (AVG: 34) feet**
Bankfull Cross Sectional Area	_____**101**______ **SF**	_______**99**______ **SF**	_______**116**_____ **SF**	**99 - 116 (AVG: 105) SF**
Mean Bankfull Depth	_____**2.8**______ **feet**	______**3.0**______ **feet**	_______**3.5**______ **feet**	**2.8 - 3.5 (AVG: 3.1) feet**
Width to Depth Ratio	_____**12.9**______	_______**11**______	_______**9.4**______	**9.4 - 12.9 AVG: 11.1**
Max Bankfull Depth	_____**3.4**________ **feet**	______**3.5**______ **feet**	_______**4.2**______ **feet**	**3.4 - 4.2 (AVG: 3.7) feet**
Flood Prone Width	_____**98**_______ **feet**	______**107**______ **feet**	_______**115**_____ **feet**	**98 - 115 (AVG: 107) feet**
Entrenchment Ratio	_____**2.7**_______	______**3.2**_______	_______**3.5**______	**2.7 - 3.5 (AVG: 3.1)**

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

Figure 1: Determining the Reference Reach Attributes



6. Longitudinal Parameters of the Reference Reach and Crossing Location

*For **Tier 2**, **Tier 3** and **Tier 4** Crossings Only*

Average Channel Slope of the Reference Reach: ____**0.3 %**_____
Average Channel Slope at the Crossing Location: ____**0.4 %**____

7. Plan View Geometry

*For **Tier 2**, **Tier 3** and **Tier 4** Crossings Only*

Sinuosity of the Reference Reach: ___**1.39**______
Sinuosity of the Crossing Location: ___**1.11**______

Note: Sinuosity is measured a distance of at least 20 times bankfull width, or 2 meander belt widths

8. Substrate Classification based on Field Observations *For **Tier 2, Tier 3** and **Tier 4** Crossings Only*	
% of reach that is *bedrock*	______0___ __ %
% of reach that is *boulder*	______0__ ___ %
% of reach that is *cobble*	______5______ %
% of reach that is *gravel*	______10_____ %
% of reach that is *sand*	______80_____ %
% of reach that is *silt*	______5______ %

9. Stream Type of Reference Reach *For **Tier 2, Tier 3** and **Tier 4** Crossings Only*	
Stream Type of Reference Reach:	___C5___________

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

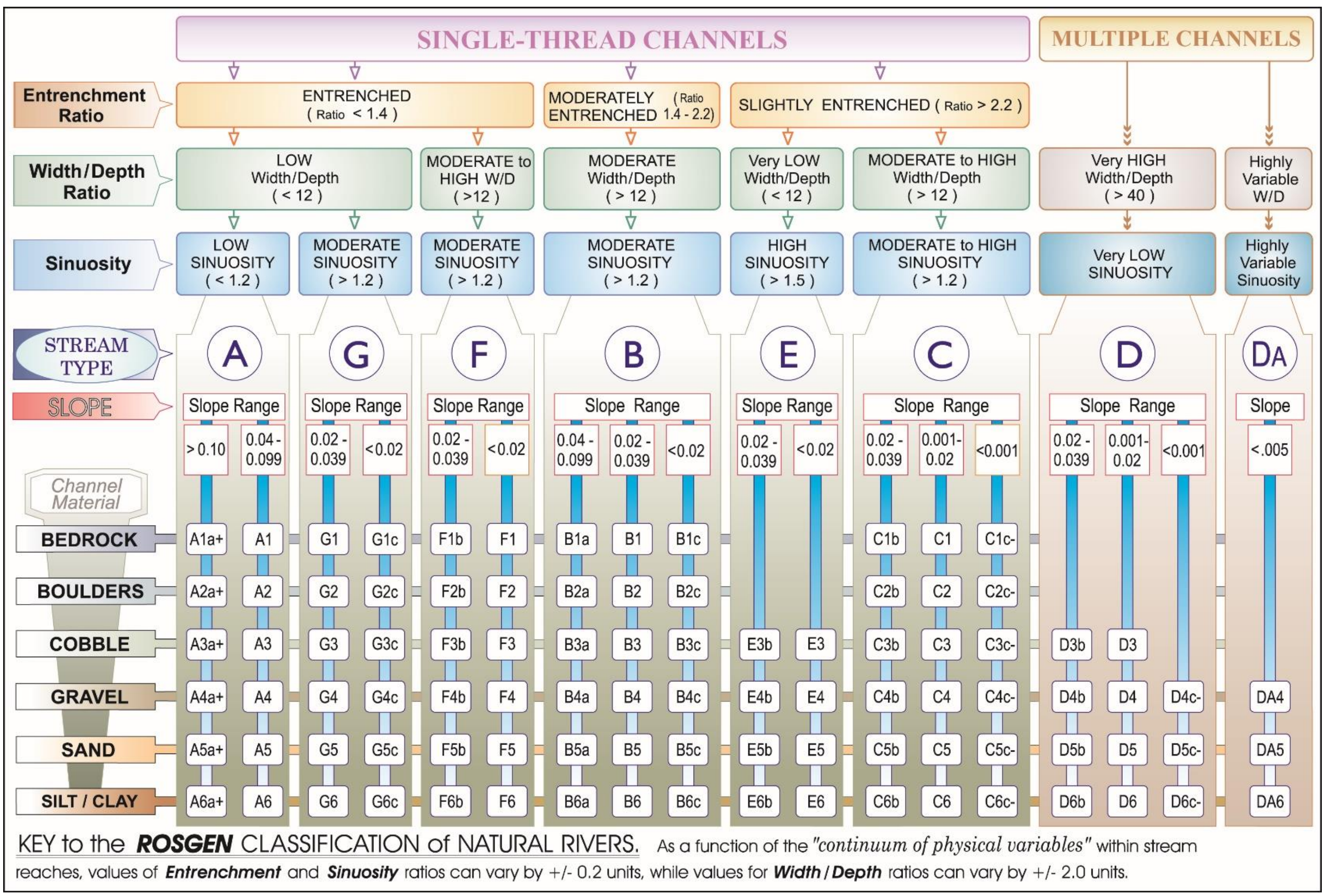


Figure 2. Reference from Applied River Morphology, Rosgen, 1996

Existing Conditions

10. Crossing Structure Metrics		
Existing Structure Type:	☐ Bridge Span ☒ Pipe Arch ☐ Open-bottom Culvert ☐ Closed-bottom Culvert ☐ Closed-bottom Culvert with stream simulation ☐ Other: ____________	
Existing Crossing Span *(perpendicular to flow)*	_____18______ feet	**Culvert Diameter** ___18 x 12___ feet **Inlet Elevation** ____115.67_______
Existing Crossing Length *(parallel to flow)*	_____92______ feet	**Outlet Elevation** ___115.67_____ **Culvert Slope** ______0%_______

Proposed Conditions

Proposed Structure Type:	**Tier 1**	**Tier 2**	**Tier 3**	**Alternative Design**
Bridge Span	☐	☐	☒	☐
Pipe Arch	☐	☐		☐
Closed-bottom Culvert	☐	☐		☐
Open-bottom Culvert	☐	☐	☐	☐
Closed-bottom Culvert with stream simulation	☐	☐	☐	☐

Proposed structure Span *(perpendicular to flow)*	__87 (clear)__ feet	**Culvert Diameter** ___N/A_______ feet **Inlet Elevation** _____N/A_____
Proposed Structure Length *(parallel to flow)*	___50______ feet	**Outlet Elevation** ___N/A_____ **Culvert Slope** _____N/A_____
Proposed Entrenchment Ratio* *For **Tier 2**, **Tier 3** and **Tier 4** Crossings Only*	_____1.5_______	*Note: To accommodate the entrenchment ratio, floodplain drainage structures may be utilized*

* *Note: Proposed Entrenchment Ratio must meet the minimum ratio for each stream type listed in **Figure 3**, otherwise the applicant must address the Alternative Design criteria listed in Env-Wt 904.09*

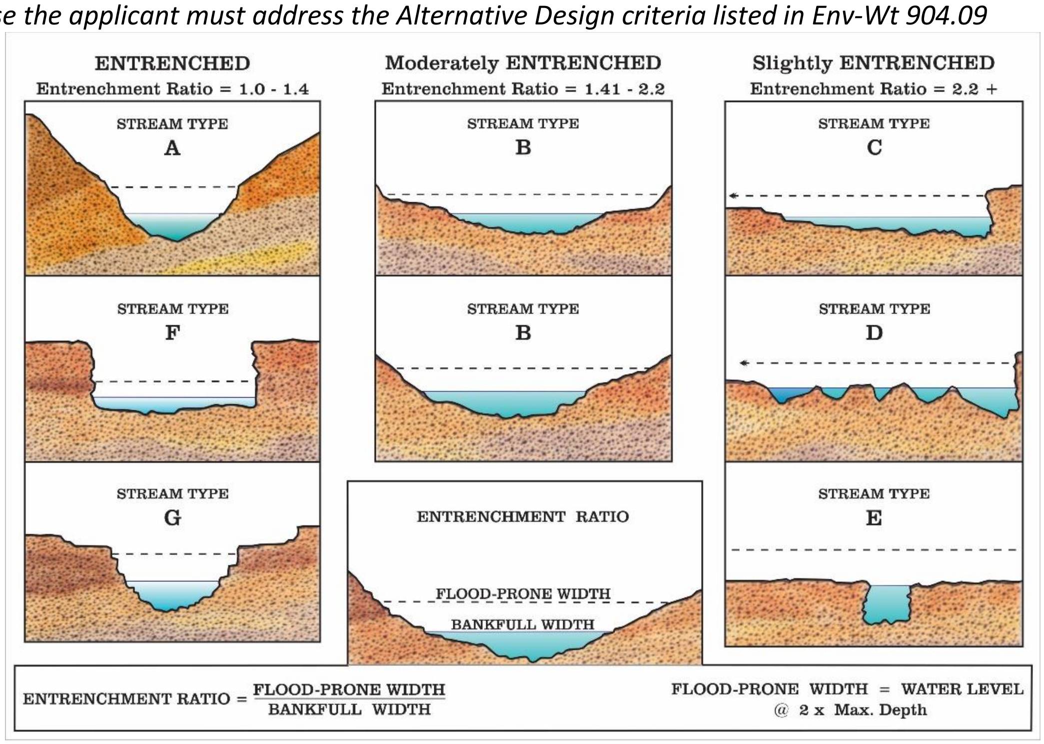


Figure 3. Reference from Applied River Morphology, Rosgen, 1996

11. Crossing Structure Hydraulics		
	Existing	**Proposed**
100 year flood stage elevation at inlet	______128.92______	______124.34 ______
Flow velocity at outlet in feet per second (FPS)	_____13.88______	______4.81_______
Calculated 100 year peak discharge (Q) for the proposed structure in CFS		_____1780______
Calculated 50 year peak discharge (Q) for the proposed structure in CFS		_____1490______

12. Crossing Structure Openness Ratio

*For **Tier 2**, **Tier 3** and **Tier 4** Crossings Only*

Crossing Structure Openness Ratio = _____N/A_____

Openness box culvert = (height x width)/length

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

13. General Design Considerations

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

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

☒ Not be a barrier to sediment transport

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

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

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

☒ Maintain or enhance geomorphic compatibility by:

a. Minimizing the potential for inlet obstruction by sediment, wood, or debris; and
b. Preserving the natural alignment of the stream channel

☒ Preserve watercourse connectivity where it currently exists

☒ Restore watercourse connectivity where:

a. Connectivity previously was disrupted as a result of human activity(ies); and
b. Restoration of connectivity will benefit aquatic life upstream or downstream of the crossing, or both

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

☒ Not cause water quality degradation

14. Tier-Specific Design Criteria

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

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

15. Alternative Design

NOTE: If the proposed crossing does not meet all of the general design considerations, the Tier specific design criteria, or the minimum entrenchment ratio for each given stream type listed in **Figure 3**, then an alternative design plan and associated requirements must be addressed pursuant to Env-Wt 904.09.

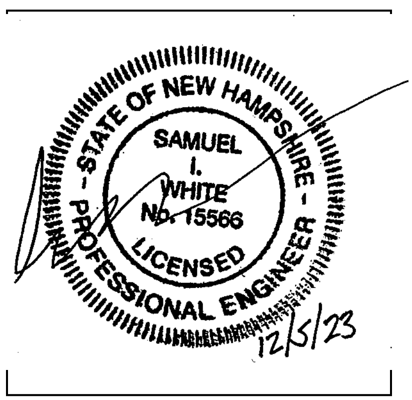
☒ I have submitted an alternative design and addressed each requirement listed in Env-Wt 904.09

Env-Wt 904.10 Alternative Design Technical Report

STANDARD DREDGE AND FILL WETLANDS PERMIT APPLICATION
NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION
LEE 41322
US ROUTE 125 BRIDGE REPLACEMENT
LEE, NEW HAMPSHIRE

Env-Wt 904.10 Alternative Design Technical Report

Prepared By:
Christine Perron, CWS, McFarland-Johnson, Inc.
Samuel White, PE, McFarland-Johnson, Inc.



Introduction

The following technical report is intended to support the alternative design request for the proposed New Hampshire Department of Transportation (NHDOT) Lee 41322 project involving the replacement of Bridge No. 073/084 carrying US Route 125 over the Little River. This is a Tier 3 stream crossing based on the size of the contributing watershed area. The existing stream crossing structure will be replaced and will require approval as an alternative design since the crossing has a history of contributing to flooding.

The proposed project complies with Env-Wt 900 to the maximum extent practicable. However, installing a structure in full compliance with Env-Wt 900 is not practicable for the reasons discussed herein. A Hydrologic & Hydraulic Report for the bridge (included with this permit application package) has been prepared to summarize the results of the hydraulic analysis, and is intended to supplement the findings in this report.

The proposed project will result in substantial improvements over the existing conditions by replacing the existing undersized crossing structure with a larger structure that provides a larger hydraulic opening, improved geomorphic compatibility, improved aquatic organism and terrestrial wildlife passage at the crossing location, and improved flood resiliency.

Env-Wt 904.10 <u>Alternative Designs</u>

Approval of an alternative design for the proposed bridge replacement structure is requested because a design that fully adheres to the Tier 3 design criteria is not practicable for the reasons discussed below.

Under the NHDES Stream Crossing Rules (Env-Wt 900), a fully compliant stream crossing structure at Bridge 073/084 that meets all the Tier 3 design criteria would require fully spanning 106 feet of channel and floodplain. This length was derived from the average entrenchment ratio x bankfull width of the reference reach (3.1 x 34 feet = 105.4 feet), which would span the entire flood prone width of the stream.

A 100-foot span is proposed. With proposed riprap in front of the abutments, which is necessary for protection of the structure, a bankfull width of approximately 34 feet can be achieved through the structure, but the resulting entrenchment ratio will be approximately 2.4. A larger structure that could fully achieve the entrenchment ratio of the reference reach (3.1) would be a 136-foot span. The conceptual-level cost estimate of a 136-foot span that could provide an entrenchment ratio of 3.1 is $4,960,000. The estimated cost of the proposed 100-foot span is $3,940,000. These costs are based on the NHDOT slope intercept method assuming a cost of $350/SF of bridge.

A 136-foot span would require taller abutments to maintain clearance between the superstructure and ground under the bridge (larger span would require deeper steel girders). The goal of the project is to use integral abutments due to their lower construction and maintenance costs. Taller abutments become more difficult to reinforce for passive earth pressures. Additionally, re-grading the ground through the bridge for a larger span would require greater removal limits for the existing abutments that were left in place when the existing corrugated metal pipe was installed. Larger/deeper removal limits for these existing abutments will add more complexity to the temporary earth supports needed to maintain traffic during construction. These factors would further increase the overall project costs for a 136-foot span.

The proposed 100’-0” single span structure will substantially improve the hydraulic capacity, geomorphic compatibility, and wildlife usage of the crossing while minimizing impacts to jurisdictional resource areas and adjacent properties, and balancing costs.

Env-Wt 904.01 **General Design Considerations**

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

(1) Not be a barrier to sediment transport;

The proposed bridge structure will provide a larger hydraulic opening with improved geomorphic compatibility over the existing conditions. The proposed structure is not anticipated to be a barrier to sediment transport.

Despite the past channel realignment and constriction created by the existing stream crossing, the channel appears both laterally and vertically stable. No indications of active bank erosion, bed degradation, or bed aggradation were observed. No in-stream sediment deposition features were found in the vicinity of the crossing.

The absence of sediment deposits and the channel’s low width-to-depth ratio (i.e. narrow, deep cross-section) suggest that it has adequate sediment transport competence. The absence of sediment deposits and active bank erosion along with the intact riparian buffers that extend well upstream from the crossing also suggest that the supply of sediment is low. The Little River flows out of Nottingham Lake about 1.5 miles upstream from the crossing. In addition, Pea Porridge Brook flows through a large wetland depression just above its confluence with the river about one mile upstream from the crossing. Both the lake and this wetland likely trap sediment and reduce the amount of sediment supplied to the river reach at the crossing. The absence of in-stream sediment deposits may also indicate that the sediment grain sizes are small enough to be passed through the system even under backwater conditions.

(2) Not restrict high flows and maintain existing low flows;

The proposed bridge will substantially improve the hydraulic capacity of the crossing. Hydraulic analysis was performed using the USACOE River Analysis System (HEC-RAS) version 5.0.7. The hydraulic model was run for existing and proposed conditions for the 10-, 50-, 100-and 500-year flood events. Based on the proposed bridge replacement, the freeboard at the 100-year flood event is roughly 7.5 feet (there was negative 1.5 feet in the existing condition). Water velocity during the Q100 storm drops from 13.9 fps to 5.5 fps in the proposed condition. Downstream water surface elevations are largely unaffected by the proposed replacement structure. Please see the Hydrologic & Hydraulic Report included elsewhere in this application for additional details.

The reconstructed channel will incorporate a thalweg to maintain a low flow channel through the structure. See channel cross sections in the enclosed wetland impact plan set.

(3) Not obstruct or otherwise substantially disrupt the movement of aquatic organisms indigenous to the waterbody beyond the actual duration of construction;

The proposed bridge will substantially improve aquatic organism passage. Simulated streambed material will be used in the channel and root wads will be installed along the northern bank to aid in stabilization. As noted above, water velocities will be reduced and low flows will be maintained.

(4) Not cause an increase in the frequency of flooding or overtopping of banks;

As noted above, the proposed bridge passes the 100-year flood event with approximately 7.5 feet of freeboard. The existing culvert currently has a headwater equal to or greater than the existing pipe height during the 100-year flood event.

(5) Maintain or enhance geomorphic compatibility by:

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

The proposed bridge will substantially improve geomorphic compatibility by providing a larger structure that will minimize the potential for obstruction by sediment, wood, or other debris.

b. Preserving the natural alignment of the stream channel;

The existing culvert was installed in the 1970s and replaced a steel through girder bridge, which was constructed in 1937. When the culvert was installed, it was placed perpendicular to the roadway in the middle of the bridge abutments, which changed the alignment of the river and created a sharp approach angle for the river into the culvert. Approximately 80 feet of the realigned channel upstream from the existing culvert is lined with stone and the stone lining appears to have raised the historic thalweg elevation by as much as 30 to 36 inches at the high point. To accommodate the larger crossing that is proposed and to better align the stream with the crossing, the stream channel will be realigned on the upstream side of the bridge and a channel will constructed through the bridge to connect with the downstream channel. The approximate bankfull width of the constructed stream channel will be 34 feet, matching the width of the reference reach.

(6) Preserve watercourse connectivity where it currently exists;

Watercourse connectivity will be enhanced by the larger hydraulic opening, improved geomorphic compatibility, simulated streambed material, and the grading of the streambed to provide a low flow channel.

(7) Restore watercourse connectivity where:

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

The existing undersized culvert will be removed and replaced with a larger bridge structure that will improve connectivity of the Little River.

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

The larger hydraulic opening, proposed channel grading, and simulated streambed material through the proposed crossing structure will help restore connectivity and improve aquatic organism passage. The proposed bridge will also restore terrestrial wildlife passage at the crossing by allowing dry passage via floodplain benches through the structure.

(8) Not cause erosion, aggradation, or scouring upstream or downstream of the crossing; and

The proposed bridge improves geomorphic compatibility and is not anticipated to cause erosion, aggradation, or scouring upstream or downstream from the crossings.

Despite the past channel realignment and constriction created by the stream crossing, the channel appears both laterally and vertically stable. No indications of active bank erosion, bed degradation, or bed aggradation were observed. The channel is connected to narrow active floodplain surfaces at the bankfull flood level. This indicates that the channel is not incised. In addition, no headcuts were observed in the vicinity of the crossing. A large scour pool is located immediately below the existing outlet. It is unclear whether this pool was excavated when the channel was realigned, if it formed as a result of high exit velocities, or a combination of these. Regardless, high exit velocities have maintained the pool and prevented it from filling with sediment. Based on the NHDOT channel bottom survey and water level measurements, the flow depth in this pool at the time of the stream assessment was about 10 feet, which is over twice the maximum flow depth measured at any point in the unaltered channel. This scour pool will remain following construction of the new bridge.

The proposed bridge will incorporate simulated streambed material in the channel and root wads will be installed along the northern edge of the channel to aid in stabilization. Reconstructed banks will consist of fabric encapsulated soil, live stakes, and shrubs. A floodplain bench will be constructed along each bank through the crossing, which will provide terrestrial wildlife passage. All exposed riprap used on the project will be void-filled riprap.

(9) Not cause water quality degradation.
Appropriate soil erosion and sediment controls will be installed prior to the start of construction and maintained throughout the duration of the project.

Env-Wt 904.07 **<u>Design Criteria for Tier 2, Tier 3, and Tier 4 Stream Crossings</u>**

(a) Unless otherwise specified, all design criteria in this section shall apply to new and replacement tier 2, tier 3, and tier 4 stream crossings.
The proposed project involves the replacement of a Tier 3 Stream Crossing.

(b) Tier 2 and tier 3 stream crossings shall be designed in accordance with the NH stream crossing guidelines, available as noted in Appendix B;
The proposed crossing structure has been designed in accordance with the NH Stream Crossing Guidelines (2009) to the maximum extent practicable.

NH Stream Crossing Guidelines

a) General Considerations

i. Application
The general considerations apply to permanent replacement stream crossings.

ii. Crossing Site Selection
The proposed project involves the replacement of an existing crossing. Due to the location of the existing roadway infrastructure, alternative site selections were not feasible.

iii. Accounting for Variability
A geomorphic stream assessment was completed. The proposed design is based on this stream assessment and bio-engineering principles of stream restoration that will help accommodate natural variability of the stream system.

iv. Structure Slope

The slope of the reconstructed channel will match the upstream and downstream sections of the Little River.

v. Structure Alignment

The river at the crossing was previously realigned when the existing crossing was installed in 1972. This realignment affected about 350 feet of the channel. As noted above, the stream channel will be realigned on the upstream side of the bridge to better align with the crossing and a channel will constructed through the bridge to connect with the downstream channel.

vi. Bridges vs. Closed Bottom Structures

The proposed project is proposing a bridge span.

vii. Structure Width

As noted above, a 100-foot span is proposed. With proposed riprap in front of the abutments, which is necessary for protection of the structure, a bankfull width of approximately 34 feet can be achieved through the structure, and the resulting entrenchment ratio will be approximately 2.4 between abutments.

viii. Embedding Structures

Not applicable – the proposed structure is a bridge span.

ix. Natural Substrate Within the Structure

Simulated streambed material will be used in the channel and root wads will be installed along the northern edge of the channel to aid in stabilization. Reconstructed banks will consist of fabric encapsulated soil, live stakes, and shrubs. A floodplain bench will be constructed along each bank through the crossing, which will provide terrestrial wildlife passage. All exposed riprap used on the project will be void-filled riprap.

x. Maintaining Depth at Low Flow in Enclosed Structures

The proposed crossing will be a bridge span over a reconstructed stream channel that will incorporate a thalweg to maintain low flows.

xi. ***Rare, Threatened, and Endangered Species***

Coordination with NHFG regarding fisheries has been completed (see avoidance and minimization measures described elsewhere in this application).

xii. ***Openness Ratio***

The openness ratio of the proposed structure will be substantially improved over the existing condition.

viii. ***Intermittent Streams***

An intermittent stream is located in the southeast bridge quadrant. However, no stream crossing is proposed and impacts to this stream will be limited to temporary impacts during construction.

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

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

The proposed project meets the general design considerations in Env-Wt 904.01. Please refer to the Env-Wt 904.01 General Design Considerations section of this report.

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

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

The proposed crossing accommodates the 100-year storm.

b. Flows sufficient to:

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

The proposed bridge will not increase flooding on upstream or downstream properties.

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

The proposed project will provide a substantially larger hydraulic opening that will improve geomorphic compatibility and channel stability. The proposed project is not anticipated to affect flows or sediment transport characteristics in a way that could adversely affect the channel stability of the stream, and the project incorporates bio-engineering design principles to enhance channel and bank stability.

c. **Applicable federal, state, or local requirements;**
The proposed project will comply with applicable federal, state, and local requirements.

(3) **With the bed forms and streambed characteristics necessary to cause water depths and velocities within the crossing structure at a variety of flows to be comparable to those found in the natural channel upstream and downstream of the stream crossing;**
The reconstructed channel will provide streambed characteristics similar to the upstream and downstream reaches and will maintain water depths, slopes, and velocities to the maximum extent possible. The streambed simulation material has been sized appropriately to match the existing natural substrate. The proposed project will replace the existing undersized crossing with a bridge, resulting in larger a hydraulic opening, improvements in geomorphic compatibility, and reduced water velocities.

(4) **To provide a vegetated bank on both sides of the watercourse or to provide a wildlife shelf of suitable substrate and access to allow for wildlife passage;**
Reconstructed banks will consist of fabric encapsulated soil, live stakes, and shrubs. A floodplain bench will be constructed along each bank through the crossing, which will provide terrestrial wildlife passage.

(5) **To preserve the natural alignment and gradient of the stream channel, so as to accommodate natural flow regimes and the functioning of the natural floodplain;**
To accommodate the larger crossing that is proposed and to better align the stream with the crossing, the stream channel will be realigned on the upstream side of the bridge and a channel will be constructed through the bridge to connect with the downstream channel. The slope of the reconstructed channel will match the upstream and downstream sections of the Little River. Floodplain benches will be constructed through the crossing.

(6) **To simulate a natural stream channel;**
The proposed project has been designed to simulate the natural stream channel to the maximum extent practicable by providing a larger crossing, improved geomorphic compatibility, simulated streambed material, and bio-engineered banks.

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

The proposed bridge will provide substantially larger hydraulic opening, which is anticipated to improve sediment transport competence.

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

Impacts to the Little River and adjacent wetlands have been minimized to the maximum extent practicable.

(d) NOT APPLICABLE

Hydrologic & Hydraulic Report

Prepared For:

New Hampshire DOT

NH Route 125 over Little River
Bridge No. 073/084

Lee, NH

Hydrologic & Hydraulic Report

Prepared By:

McFarland Johnson

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STATE OF NEW HAMPSHIRE
Ronald L Joy
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JOY
No. 07038
LICENSED
PROFESSIONAL ENGINEER

Designed By: Timothy Aguilar, PE
Checked By: Ron Joy, PE

State Project No. 41322

September 2021

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INTRODUCTION & PROJECT DESCRIPTION

The scope of New Hampshire Department of Transportation (NHDOT) State Project No. 41322 is to review replacement options for Bridge No. 073/084 over Little River in Lee, New Hampshire. The existing bridge was constructed in 1972 and is an 18' wide x 12' high Corrugated Metal Pipe (CMP). The bridge is on the State Red List and is classified as 'Structurally Deficient' primarily due to the culvert invert section loss. The purpose of the Hydraulic Report is to investigate hydraulic design parameters in support of identifying a suitable new bridge span to meet the identified hydraulic, environmental, and geomorphic design criteria, and to identify channel scour characteristics and potential scour countermeasures.

Bridge No. 073/084 is located on NH Route 125, approximately 2.6 miles south of the intersection with US Route 4. See Figure 1 for a Site Location Map. The project site is located within a FEMA Zone A area, which estimates 100-year flood levels using approximate methodologies. Therefore, the FEMA Flood Insurance Study (FIS) does not provide detailed drainage areas, discharges, nor estimated Water Surface Elevations (WSELs). A FEMA Flood Insurance Rate Maps (FIRM) is available, which designates the project site as "Zone A – No Base Flood Elevations determined", see Appendix B.

Little River is a Tier 3, 10.4-mile-long, river located in south-eastern New Hampshire. The stream bed is comprised mostly of silty sand with some cobbles within the study area. Within the general vicinity of the crossing, the overbanks are moderately vegetated and relatively flat. Little River is a tributary of the Lamprey River, part of the Great Bay and Piscataqua River watershed. Little River begins as an outlet of Mendums Pond, approximately 8.3 miles upstream of the NH Route 125 crossing. The river flows beyond the crossing east for 2.1 miles merging with several unnamed streams until its confluence with the Lamprey River.

General flood history was obtained from the Lee Highway Department Supervisor and other property owners, who conveyed that there is a history of flooding of West Mill Pond Road, which runs adjacent to Little River, near to the NH Route 125 crossing. Anecdotal evidence suggests this flooding did not occur prior to the replacement of a previous through-girder structure with the existing CMP in the early 1970's.

To provide the required hydraulic design criteria, the bridge replacement will raise the low chord of the structure and lengthen the clear span. A wildlife shelf will be incorporated into the channel section through the structure to allow for the passage of small, semi-aquatic or terrestrial animals. Preliminary details of the bridge replacement are detailed in the Bridge Type, Size, and Location (TSL) Study Report, submitted under a separate cover.

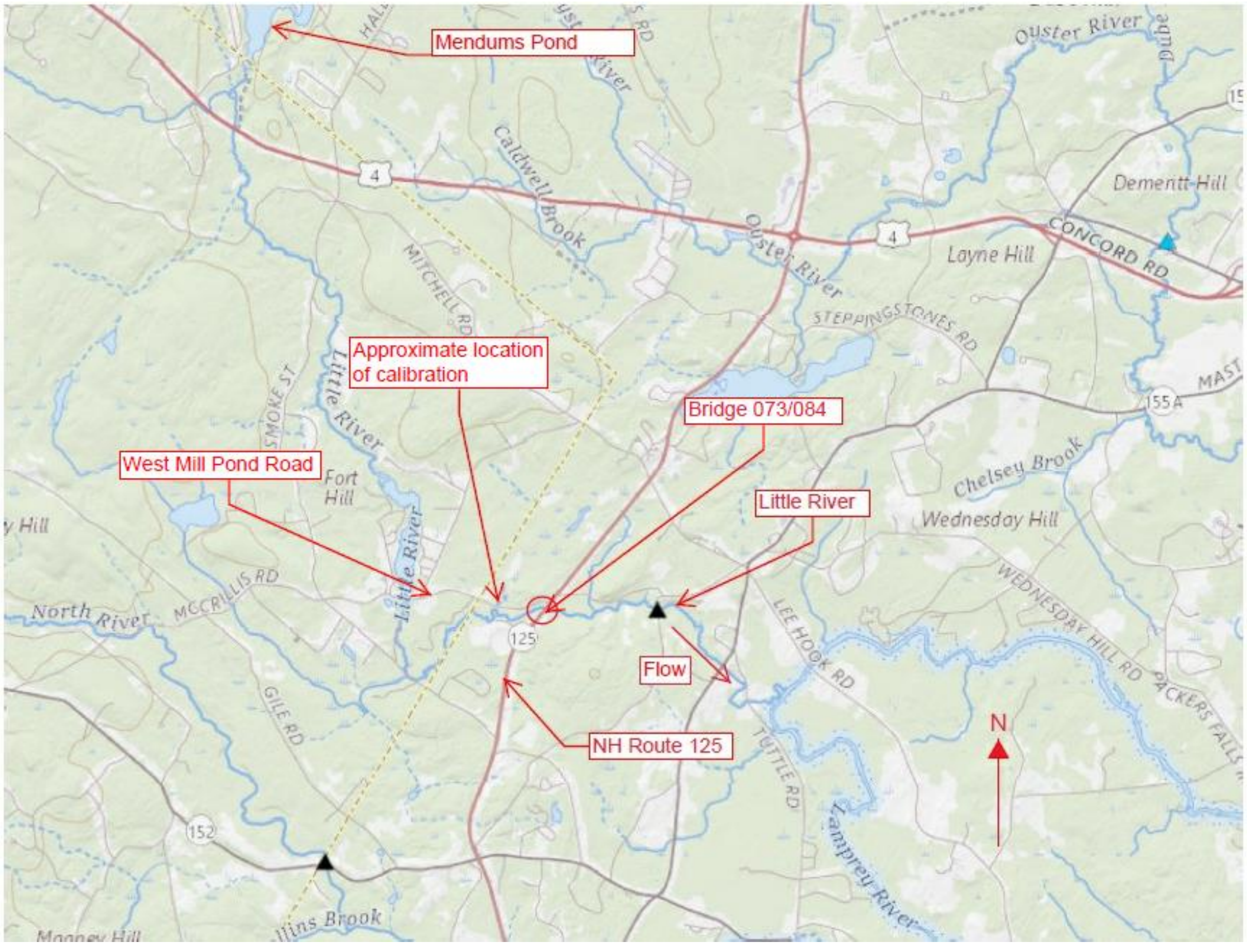


Figure 1 – Site Location Map

HYDROLOGIC ANALYSIS

StreamStats for NH was used as the primary hydrologic analysis tool, in accordance with NHHOT Bridge Design Manual, since the structure is not located on a gaged stream. The discharges calculated were checked using the 5-parameter equation from FHWA Report No. FHWA-RD-77-158, “Runoff Estimates for Small Rural Watersheds and Development of a Sound Design Method”. Discharges were found to be within the standard percent error. The following design discharges were used.

Table 1 – Little River Peak Flood Discharges at NH Route 125

Bridge Identification Number (NBI & State)	Drainage Area (Square Miles)	Method	Peak Flood Discharges (cfs)			
			10-Year	50-Year	100-Year	500-Year
014500730008400	18.36	StreamStats (Design)	947	1490	1780	2480
		5-Parameter (Check)	867	1483	1736	N/A
Error Check	Standard Error (Design)		32.3%	36.4%	38.6%	44.1%
	Design vs. Check (Percent Difference)		8.4%	0.5%	2.5%	N/A

See Appendix D page 34 for Drainage Area Map and Appendix D pages 35-41 for hydrology calculations.

DESIGN CRITERIA

The design of the proposed bridge must comply with the following hydraulic regulations and criteria, including:

- **Design Frequency and Freeboard** – NH Route 125 is classified as a NH Highway Tier 2 highway, a Principal Arterial. NHDOT Bridge Design Manual Table 2.7.5-1 specifies 100-year and 500-year events for the Design and Check floods. NHDOT Bridge Design Manual 2.7.6 defines minimum freeboard as the vertical distance between the low chord elevation and the design water surface elevation (100-year) and specifies a minimum freeboard value of 1 foot.

- **FEMA Regulatory Compliance** –The bridge is not located within a FEMA Regulatory Floodplain. Increase of the 100-year flood elevations up to 1 foot will be acceptable provided that increasing the bridge clear span does not significantly increase flood damage downstream of the crossing.

- ☼ **Designing the Bridge to Resist Scour** – Scour criteria has been developed by the Federal Highway Administration (FHWA) document "Evaluating Scour at Bridges" (HEC-18). The scour countermeasures will be designed to withstand the 100-year flood. The bridge will also be checked for conditions under the predicted 500-year scour conditions to prevent failure of the structure (safety factors at least equal to 1.0).

HYDRAULIC ANALYSIS

Methodology – Historical technical records were collected from NHDOT. For both the existing and proposed conditions, the channel and bridge geometry used for hydraulic modeling was obtained from NHDOT field survey. The study reach ranged approximately 1260 feet downstream of the bridge to 590 feet upstream of the bridge. See Appendix E page 43 for the Plan of the Hydraulic Model.

Water surface profiles were generated using the United States Army Corps of Engineers (USACOE) River Analysis System (HEC-RAS) Version 5.0.7. Subcritical discharge scenarios were modeled for the 10-, 50-, 100-, and 500-year flood events. Supercritical and mixed flow scenarios were not necessary to run since the Froude Numbers never approached or exceeded 1.0.

Manning's roughness (n) values of 0.045 for the main channel and 0.09 for the overbanks were used, and subcritical steady flow contraction and expansion coefficients were determined. Modeling considered unobstructed flow without the potential effects of debris or ice. All elevations have incorporated the North American Vertical Datum of 1988 (NAVD88) datum.

Existing Conditions – The Existing Conditions model incorporated channel cross sections obtained from NHDOT surveyed topo model. Channel bank locations were estimated based on a combination of review of survey data and site examinations. Ineffective flow areas were incorporated into the cross sections immediately upstream and downstream of the bridge. Internal bridge cross sections and approach sections were skewed 30-degrees.

The Existing Condition model indicates that flows are routed through the existing culvert for the 10-, 50-, and 100-year floods, but the headwater is equal to or greater than the existing pipe height (i.e., submerged inlet). It is feasible that a 500-year flood could overtop the roadway.

Calibration – Existing FIS or HEC-2 data was not available at this site, so a formal calibrated model could not be prepared to compare to FEMA results. However, the existing conditions results were compared to anecdotal information data obtained from first-hand accounts of flooding activities. This was done by comparing the upstream WSEL at Q100 to the reported flood elevations from the May 2006 and April 2007 storm events. The National Oceanic and Atmospheric Administration (NOAA) reported that the

May 2006 storm exceed the 100-year storm and the April 2007 storm was approximately equal to a 100-year storm event.

West Mill Pond Road, which runs adjacent to the Little River, is at approximately EL 126. Town of Lee Officials reported that West Mill Pond Road overtopped by approximately 3.5 feet during the May 2006 storm event, producing an estimated WSEL of 129.5. West Mill Pond Road was also overtopped during the April 2007 event; however, it is unknown by how much.

The furthest upstream 100-year WSEL in the existing conditions model has been estimated to be EL 129.48. It is estimated that the upstream model point is located approximately 1200 feet from the 2006 observance point. As such, the existing conditions model has been reasonably calibrated to an observed event.

Proposed Conditions – The current proposed structure is an 87-foot clear span steel girder structure with concrete integral abutments. The Proposed Conditions models were created by replacing the existing bridge with the new proposed bridge, modifying the internal bridge cross sections, and modifying the ineffective flow areas.

Cross sections upstream of the bridge were also modified according to the proposed grading. The outlet of the structure will be maintained, while the inlet will be reoriented to allow the stream to flow at a more natural skew to NH Route 125.

The Proposed Conditions model also incorporates a wildlife shelf along both abutments located approximately 1 foot above the ordinary high water. The proposed conditions bridge cross sections are skewed at 20-degrees. The estimated low chord elevation was set at EL 132.

Tables 2 compares the WSELs, velocities, and other hydraulic parameters between the existing condition and the proposed conditions models at Q10, Q50, and Q100.

Table 2 - WSEL & Velocity Comparison (Existing vs. Proposed)

River Sta	Profile	Plan	E.G. Elev (ft)	W.S. Elev (ft)	Crit W.S. (ft)	Top Width (ft)	Q Channel (cfs)	Vel Chnl (ft/s)
4383	Q10	Prop Cond	122.76	122.51	119.49	66.72	860.59	4.19
4383	Q10	Existing Con	124.70	124.29	120.62	57.23	804.22	5.54
4383	Q50	Prop Cond	124.26	123.90	120.58	74.56	1306.09	5.15
4383	Q50	Existing Con	127.75	127.33	122.24	189.32	1160.72	5.79
4383	Q100	Prop Cond	124.79	124.34	121.03	77.40	1543.80	5.74
4383	Q100	Existing Con	129.33	128.92	122.88	846.60	1328.57	5.80
4315 BR U	Q10	Prop Cond	122.68	122.45	119.03	52.68	871.65	3.98
4315 BR U	Q50	Prop Cond	124.17	123.83	120.17	56.87	1320.86	4.94
4315 BR U	Q100	Prop Cond	124.69	124.26	120.64	58.18	1560.42	5.52
4318 Culvert #1	Q10	Existing Con	124.70	124.29	4.93	57.23	947.00	8.50
4318 Culvert #1	Q50	Existing Con	127.75	127.33	6.25	189.32	1490.00	11.08
4318 Culvert #1	Q100	Existing Con	129.32	128.92	6.86	846.60	1780.00	12.39
4315 BR D	Q10	Prop Cond	122.60	122.39	119.05	53.73	793.56	3.96
4315 BR D	Q50	Prop Cond	124.08	123.75	120.05	57.80	1193.24	4.93
4315 BR D	Q100	Prop Cond	124.58	124.17	120.50	59.06	1407.46	5.53
4239	Q10	Prop Cond	122.48	122.38	117.15	118.69	737.49	2.88
4239	Q10	Existing Con	122.46	122.32	117.32	108.48	786.58	3.36
4239	Q50	Prop Cond	123.90	123.75	118.57	149.29	1071.70	3.60
4239	Q50	Existing Con	123.87	123.63	118.74	137.17	1170.75	4.32
4239	Q100	Prop Cond	124.35	124.17	119.06	151.87	1249.59	4.02
4239	Q100	Existing Con	124.31	124.01	119.27	138.63	1379.01	4.89
4132	Q10	Prop Cond	122.36	122.19	117.06	104.87	832.87	3.59
4132	Q10	Existing Con	122.36	122.19		122.00	832.86	3.59
4132	Q50	Prop Cond	123.73	123.46	118.05	170.86	1218.43	4.56
4132	Q50	Existing Con	123.73	123.46		170.86	1218.43	4.56
4132	Q100	Prop Cond	124.15	123.83	118.86	182.50	1414.88	5.10
4132	Q100	Existing Con	124.15	123.83		182.50	1414.88	5.10

For river station locations see Appendix E, page E2.

SCOUR ANALYSIS & COUNTERMEASURES

Scour Analysis – A scour assessment was conducted for the proposed structure. The scour calculations were performed in accordance with FHWA HEC-18 using the HEC-RAS Hydraulic Design Function. D_{50} soil parameters were estimated based on field observations made during the geomorphic site assessment. See Appendix F for more information.

- Contraction scour – Contraction scour is the general lowering of the streambed within the bridge opening waterway. It usually occurs over most of the entire bridge opening and is the result of constrictions in the floodplain flow area caused by the bridge structure and roadway embankments. The channel bed of Little River was determined to be operating in live-bed conditions for both the 100- and 500-year flood events, as the velocities exceed the critical velocity for entraining sediment across the flow width.

- Abutment Scour – Local abutment scour occurs when the abutment and roadway embankments obstruct the flow. This results in an increase in velocities and the creation of a horizontal vortex along the length of the abutment. Local abutment scours were determined to be zero for both the 100- and 500-year flood events, as the WSEL is confined within the channel and does not extend above the top of banks to be encroached upon by the abutments.

- Total Potential Scour – The total potential scour for the existing structure is the sum of the contraction scour plus the abutment scour.

Table 3 – Scour Summary, Proposed Structure

Element	Contraction Scour (feet)		Abutment Scour (feet)		Total Scour (feet)	
	100-Year	500-Year	100-Year	500-Year	100-Year	500-Year
Abutment	1.5	2.5	0	0	1.5	2.5

Scour depths reported are the max of the left bank, channel, or right bank, as applicable. The riprap armoring was not considered in scour analysis (i.e., the natural D_{50} for the channel was used across the entire section).

Proposed Riprap Countermeasures – The riprap sizing and limits were established for the abutments in accordance with guidance provided in FHWA HEC-23. See Appendix F pages 137 to 138 for stone protection sizing backup calculations. The following riprap is recommended:

- 2’-0” thick, NHDOT Riprap, Class III (D_{50} = 0.92 feet)

Toe key-ins, transitional filter layers, lateral limits, and flank features will be considered during Final Design, and will be constructed in accordance with NHDOT standards.

CONCLUSIONS & RECOMMENDATIONS

The existing 18’ x 12’ CMP is undersized. Though the culvert conveys the water under the roadway without overtopping, the structure does not meet the headwater requirements for a NH Highway Tier 2 resource.

An 87-foot-long clear span structure is the preferred alternative, as it fits between the existing site constraints, meets minimum geomorphic criteria, provides required freeboard, and allows the existing roadway profile to be maintained. Scour depth was estimated to be approximately 1.5 feet at Q100 and 2.5 feet at Q500. Class III Riprap placed a minimum of 2’-0” thick is recommended for scour countermeasures. Exact limits and final details will be provided in final design.

The figure below depicts water surface profiles for the existing and proposed conditions for the 10-year and 100-year events. The following observations were made:

- By replacing the existing culvert with the 87-foot-long clear span bridge, the upstream WSELs dropped 1.8 feet for the 10-year event and 4.6 feet for the 100-year event immediately upstream of the structure, as existing backwater retained by the existing culvert is conveyed at a lower elevation.

- Velocities at the upstream river section (RS 4896) increased from 2.4 fps to 3.6 fps for the 10-year event and 1.9 fps to 4.3 fps for the 100-year event. Subcritical flow regime is maintained at all cross sections for both the existing and proposed conditions.

- Velocities through the existing culvert greatly exceed the velocities in the proposed condition, with 13.9 fps and 5.5 fps for the existing and proposed at Q100, respectively. Physical evidence of this velocity through the existing culvert is seen by the scour hole at the outlet.

- Given that subcritical flows are maintained throughout the study reach, the downstream WSEL’s are largely unaffected by the proposed replacement structure.

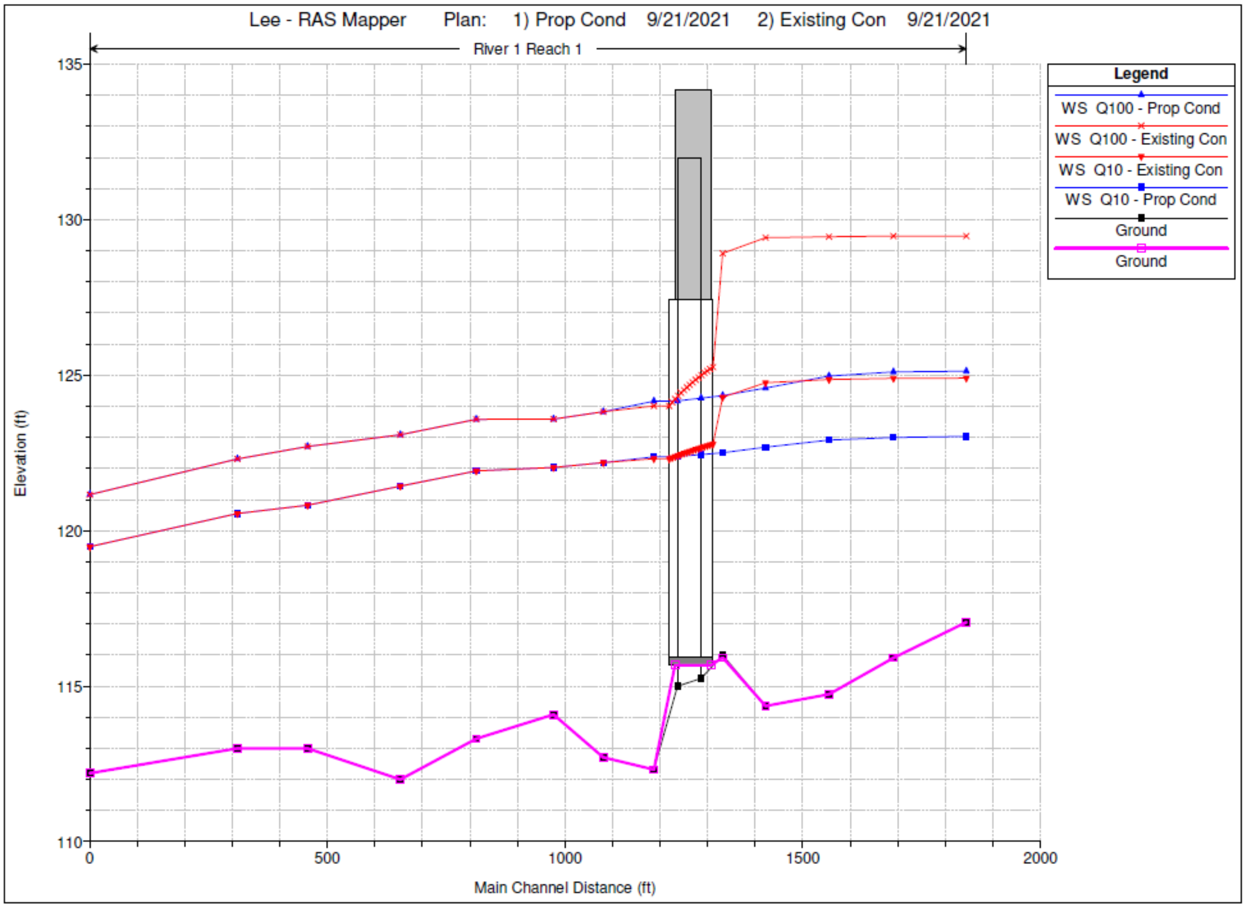


Figure 2 - Water Surface Profiles – Existing vs. Proposed (10-Year & 100-Year Events)

Table 4 – Hydraulic Design Parameters

Drainage Area (square miles):	18.4					
Flood Event:	Q50		Q100		Q500	
Discharge:	1490		1780		2480	
Existing or Proposed:	Exist	Prop	Exist	Prop	Exist	Prop
Design Flood Elevation:	127.33	123.9	128.92	124.34	134.18	125.37
Low Chord Elevation (feet):	127.42	132	127.42	132	127.42	132
Freeboard (feet):	0.09	8.1	-1.5	7.66	-6.76	6.63
Decrease in Upstream WSEL (feet):	3.43		4.58		8.81	
Maximum Velocity at Bridge (fps)	12.1	4.9	13.9	5.5	17.8	6.7

APPENDIX A

PHOTOGRAPHS

Photo 1: Looking Upstream

Photo 2: Looking Downstream

Photo 3: Inlet

Photo 4: Outlet

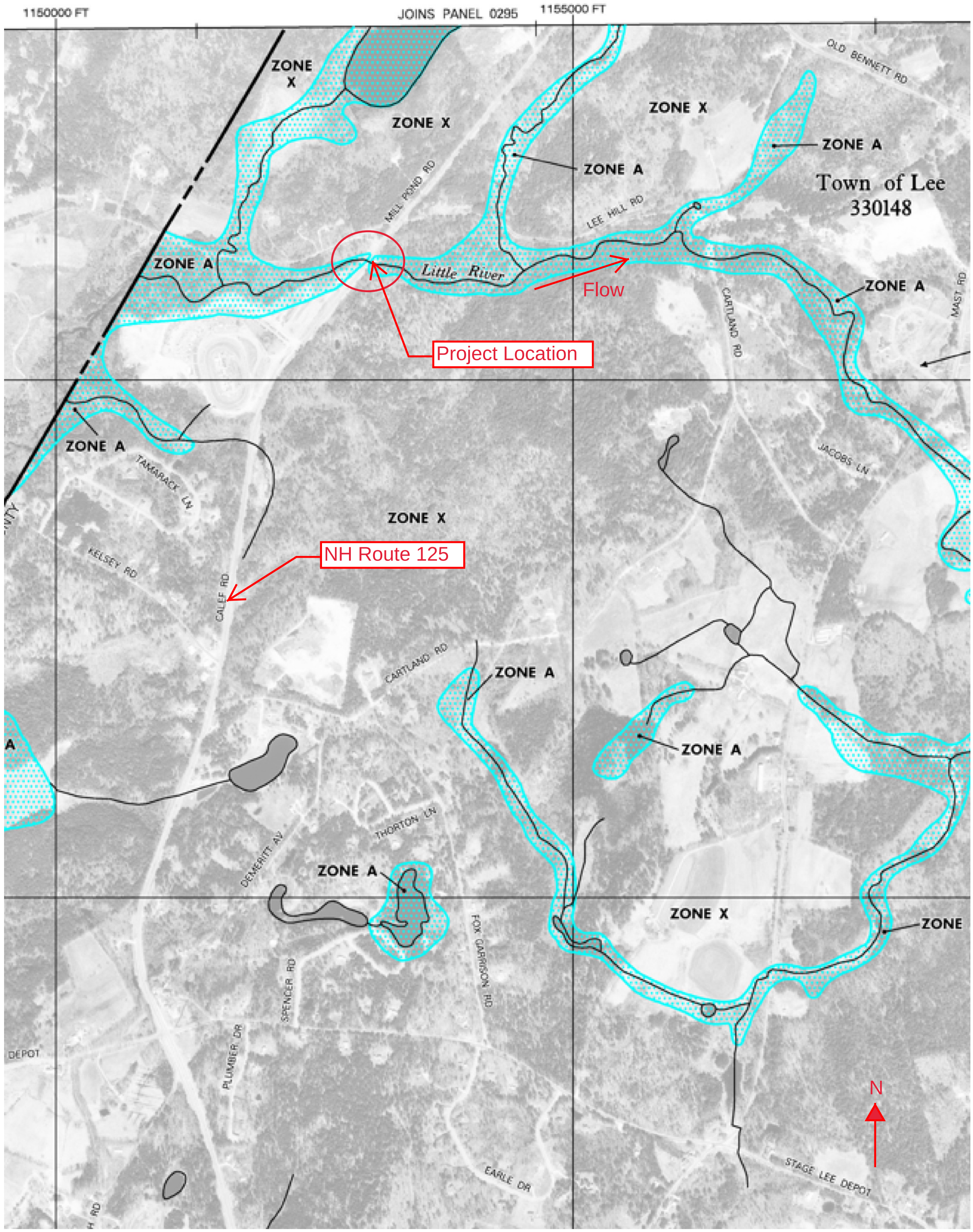
Photo 5: Upstream Reach

Photo 6: Downstream Reach

APPENDIX B

FEMA FIRM

Snip From: FEMA FIRM
Map Number 33017C0360D
Panel 360 of 405



APPENDIX C

FLUVIAL GEOMORPHOLOGY BACKUP

WETLANDS PERMIT APPLICATION
STREAM CROSSING WORKSHEET
Land Resources Management
Wetlands Bureau

RSA 482-A/ Env-Wt-900

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

1. Tier Classifications

Determine the contributing watershed size at USGS StreamStats

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

Size of contributing watershed at the crossing location:	**11,752** acres

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

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

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

- ☒ On a watercourse where the contributing watershed is more than 640 acres
- ☒ Within a Designated River Corridor unless:
  - a. The crossing would be a tier 1 stream based on contributing watershed size; or
  - b. The structure does not create a direct surface water connection to the designated river as depicted on the national hydrography dataset as found on GRANIT
- ☐ On a watercourse that is listed on the surface water assessment 305(b) report
- ☒ Within a 100-year floodplain (see *section 2* below)
- ☒ In a jurisdictional area having any protected species or habitat (NHB DataCheck)
- ☐ In a Prime Wetland or within a duly-established 100-foot buffer, unless a waiver has been granted pursuant to RSA 482-A:11,IV(b) and Env-Wt 706

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

2. 100-year Floodplain

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

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

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

☒ Elevation of the 100-year floodplain at the inlet: ____**128.92**______ feet (FEMA El. or Modeled El.)

3. Calculating Peak Discharge

Existing 100-year peak discharge (Q) calculated in cubic feet per second (CFS): _____**1780**_______ CFS	Calculation method: **StreamStats for NH**
Estimated Bankfull discharge at the crossing location: _____**626**______ CFS	Calculation method: **Reg. Hydr. Curve**

Note: If Tier 1 then skip to Section 10

4. Predicted Channel Geometry based on Regional Hydraulic Curves

*For **Tier 2**, **Tier 3** and **Tier 4** Crossings Only*

Bankfull Width: ____**52**___ feet	Mean Bankfull Depth: _____**2.8**____ feet
Bankfull Cross Sectional Area: ____**144**____ square feet	

5. Cross Sectional Channel Geometry: Measurements of the Existing Stream within a Reference Reach

*For **Tier 2**, **Tier 3** and **Tier 4** Crossings Only*

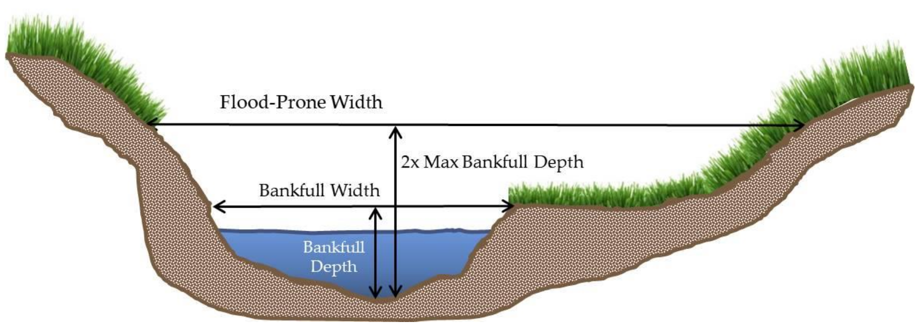
Describe the reference reach location: **Approx 520' Upstream**

Reference reach watershed size: ____**11,742**___ acres

Parameter	**Cross Section 1** Describe bed form _______**Glide**______ (*e.g. pool, riffle, glide*)	**Cross Section 2** Describe bed form _______**Glide**_____ (*e.g. pool, riffle, glide*)	**Cross Section 3** Describe bed form _______**Glide**______ (*e.g. pool, riffle, glide*)	**Range**
Bankfull Width	_____**36**_____ **feet**	______**33**_____ **feet**	______**33**_____ **feet**	**33 - 36 (AVG: 34) feet**
Bankfull Cross Sectional Area	_____**101**_____ **SF**	______**99**_____ **SF**	______**116**_____ **SF**	**99 - 116 (AVG: 105) SF**
Mean Bankfull Depth	_____**2.8**_____ **feet**	_____**3.0**_____ **feet**	______**3.5**_____ **feet**	**2.8 - 3.5 (AVG: 3.1) feet**
Width to Depth Ratio	_____**12.9**_____	______**11**_____	______**9.4**_____	**9.4 - 12.9 AVG: 11.1**
Max Bankfull Depth	_____**3.4**_______ **feet**	_____**3.5**_____ **feet**	______**4.2**_____ **feet**	**3.4 - 4.2 (AVG: 3.7) feet**
Flood Prone Width	_____**98**______ **feet**	_____**107**_____ **feet**	______**115**_____ **feet**	**98 - 115 (AVG: 107) feet**
Entrenchment Ratio	_____**2.7**______	_____**3.2**______	______**3.5**_____	**2.7 - 3.5 (AVG: 3.1)**

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

Figure 1: Determining the Reference Reach Attributes



6. Longitudinal Parameters of the Reference Reach and Crossing Location

*For **Tier 2**, **Tier 3** and **Tier 4** Crossings Only*

Average Channel Slope of the Reference Reach: ____**0.3 %**_____
Average Channel Slope at the Crossing Location: ____**0.4 %**____

7. Plan View Geometry

*For **Tier 2**, **Tier 3** and **Tier 4** Crossings Only*

Sinuosity of the Reference Reach: ___**1.39**______
Sinuosity of the Crossing Location: ___**1.11**______

Note: Sinuosity is measured a distance of at least 20 times bankfull width, or 2 meander belt widths

8. Substrate Classification based on Field Observations *For **Tier 2, Tier 3** and **Tier 4** Crossings Only*	
% of reach that is *bedrock*	______0___ __ %
% of reach that is *boulder*	______0__ ___ %
% of reach that is *cobble*	______5______ %
% of reach that is *gravel*	______10_____ %
% of reach that is *sand*	______80_____ %
% of reach that is *silt*	______5______ %

9. Stream Type of Reference Reach *For **Tier 2, Tier 3** and **Tier 4** Crossings Only*	
Stream Type of Reference Reach:	___C5___________

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

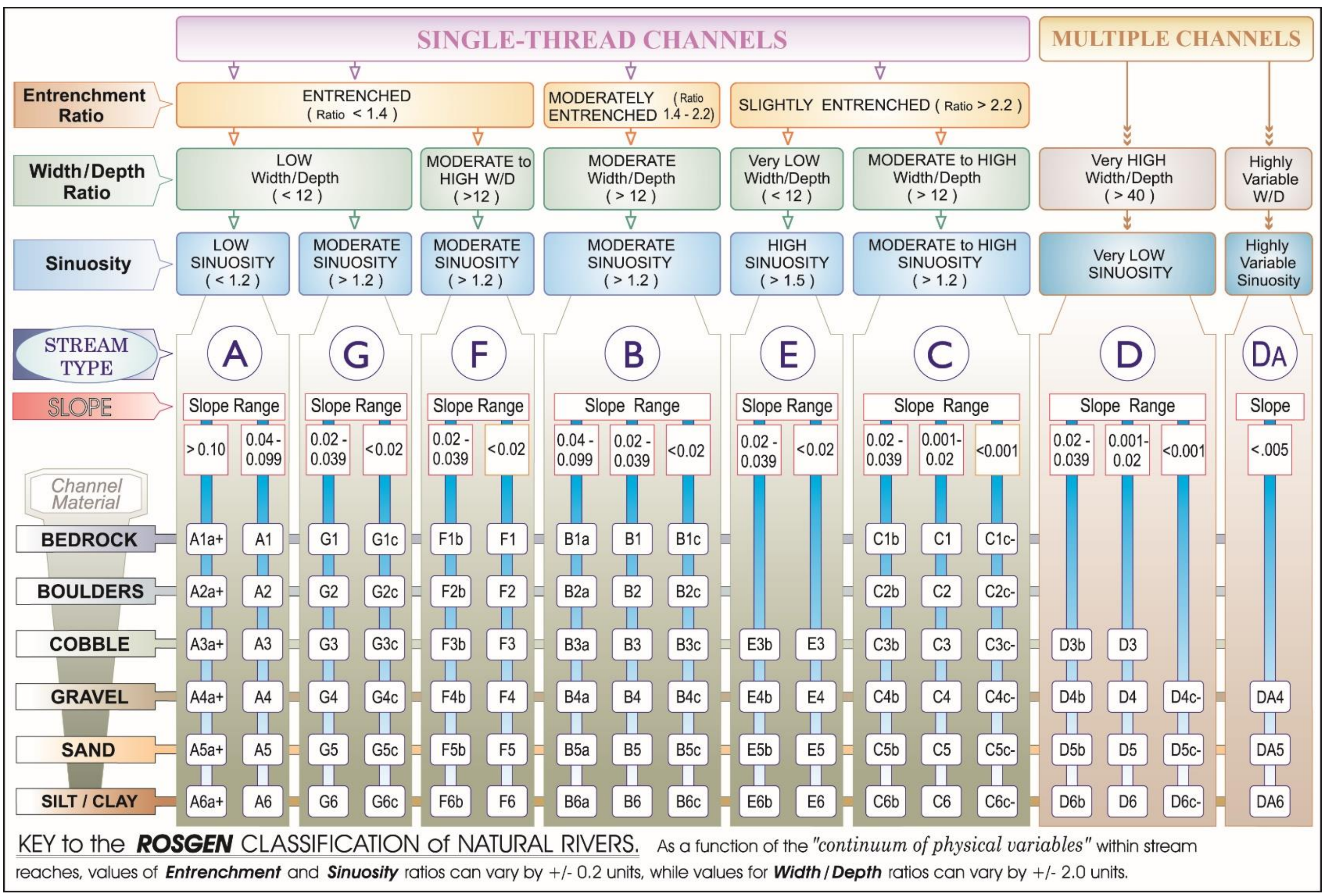


Figure 2. Reference from Applied River Morphology, Rosgen, 1996

10. Crossing Structure Metrics

Existing Conditions

Existing Structure Type:	☐ Bridge Span ☒ Pipe Arch ☐ Open-bottom Culvert ☐ Closed-bottom Culvert ☐ Closed-bottom Culvert with stream simulation ☐ Other: ____________	
Existing Crossing Span *(perpendicular to flow)*	_____18______ feet	**Culvert Diameter** ___18 x 12___ feet **Inlet Elevation** ____115.67_______
Existing Crossing Length *(parallel to flow)*	_____92______ feet	**Outlet Elevation** ___115.67_____ **Culvert Slope** ______0%_______

Proposed Conditions

Proposed Structure Type:	**Tier 1**	**Tier 2**	**Tier 3**	**Alternative Design**
Bridge Span	☐	☐	☒	☐
Pipe Arch	☐	☐		☐
Closed-bottom Culvert	☐	☐		☐
Open-bottom Culvert	☐	☐	☐	☐
Closed-bottom Culvert with stream simulation	☐	☐	☐	☐

Proposed structure Span *(perpendicular to flow)*	__87 (clear)__ feet	**Culvert Diameter** ___N/A_______ feet **Inlet Elevation** _____N/A_____
Proposed Structure Length *(parallel to flow)*	___50_____ feet	**Outlet Elevation** ___N/A_____ **Culvert Slope** _____N/A_____
Proposed Entrenchment Ratio* *For **Tier 2**, **Tier 3** and **Tier 4** Crossings Only*	_____1.5_______	*Note: To accommodate the entrenchment ratio, floodplain drainage structures may be utilized*

* *Note: Proposed Entrenchment Ratio must meet the minimum ratio for each stream type listed in **Figure 3**, otherwise the applicant must address the Alternative Design criteria listed in Env-Wt 904.09*

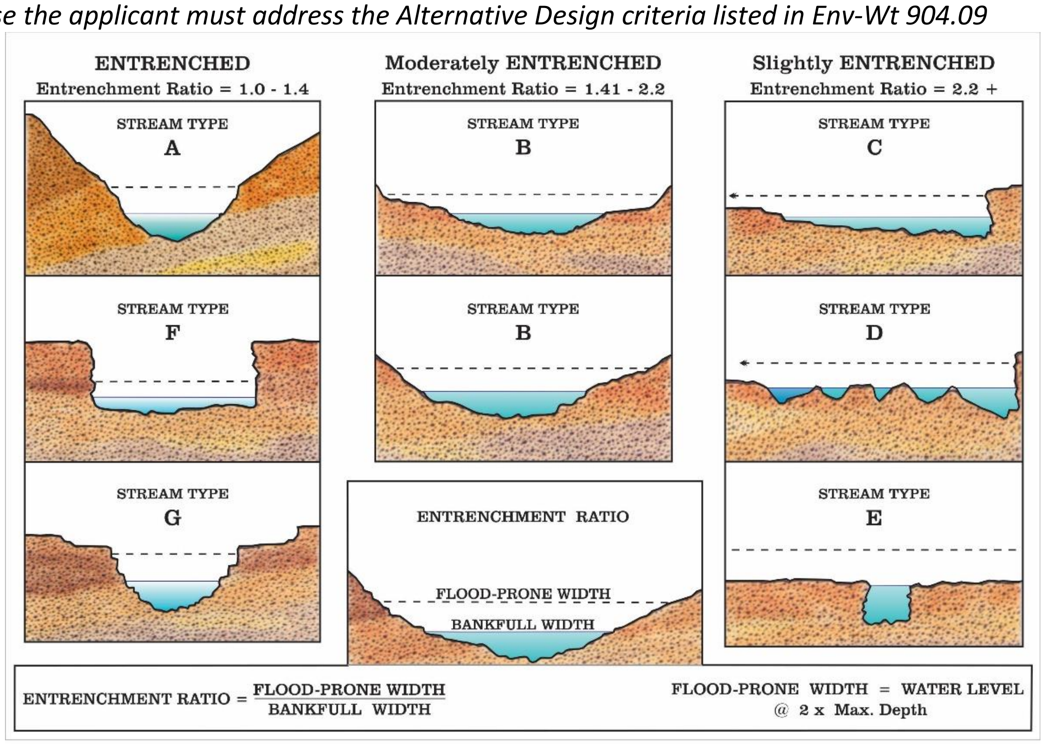


Figure 3. Reference from Applied River Morphology, Rosgen, 1996

11. Crossing Structure Hydraulics

	Existing	Proposed
100 year flood stage elevation at inlet	______128.92_____	______124.34 _____
Flow velocity at outlet in feet per second (FPS)	____13.88______	______4.81_______
Calculated 100 year peak discharge (Q) for the proposed structure in CFS		____1780_____
Calculated 50 year peak discharge (Q) for the proposed structure in CFS		____1490_____

12. Crossing Structure Openness Ratio

*For **Tier 2**, **Tier 3** and **Tier 4** Crossings Only*

Crossing Structure Openness Ratio = _____N/A_____

Openness box culvert = (height x width)/length

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

13. General Design Considerations

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

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

- ☒ Not be a barrier to sediment transport
- ☒ Prevent the restriction of high flows and maintain existing low flows
- ☒ Not obstruct or otherwise substantially disrupt the movement of aquatic life indigenous to the waterbody beyond the actual duration of construction
- ☒ Not cause an increase in the frequency of flooding or overtopping of banks
- ☒ Maintain or enhance geomorphic compatibility by:
  a. Minimizing the potential for inlet obstruction by sediment, wood, or debris; and
  b. Preserving the natural alignment of the stream channel
- ☒ Preserve watercourse connectivity where it currently exists
- ☒ Restore watercourse connectivity where:
  a. Connectivity previously was disrupted as a result of human activity(ies); and
  b. Restoration of connectivity will benefit aquatic life upstream or downstream of the crossing, or both
- ☒ Not cause erosion, aggradation, or scouring upstream or downstream of the crossing
- ☒ Not cause water quality degradation

14. Tier-Specific Design Criteria

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

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

15. Alternative Design

NOTE: If the proposed crossing does not meet all of the general design considerations, the Tier specific design criteria, or the minimum entrenchment ratio for each given stream type listed in **Figure 3**, then an alternative design plan and associated requirements must be addressed pursuant to Env-Wt 904.09.

☒ I have submitted an alternative design and addressed each requirement listed in Env-Wt 904.09

September 10, 2021

Stephen Hoffmann
McFarland Johnson, Inc.
53 Regional Drive
Concord, NH 03301
(603) 225-2978 ext. 1280
SHoffmann@mjinc.com

Subject: Lee 41322 Bridge Replacement
Bridge Location and Channel Realignment Evaluation

Steve:

We have completed an evaluation of two bridge location and channel realignment options for the replacement of Bridge No. 073/084 carrying NH Route 125 over the Little River in Lee, NH. These are referred to as Option 1 and Option 3C. Each option is described below and illustrated on the attached site plan drawings. The final section of this letter report includes our recommendations for the preferred option.

Option 1

Option 1 entails maintaining the existing river channel location on the downstream side of NH Route 125 and realigning the channel upstream from the highway and through the stream crossing. Additional design criteria provided by MJ for this option are as follows:

- Bridge type: Single span pile-supported bridge on integral abutments located at the top of riprap-faced earthen embankments
- Maximum bridge span: 90 feet (measured between center of bearings along the highway centerline, i.e. skewed length)
- Maximum bridge skew: 20 degrees
- Maximum embankment slope: 1 vertical to 1.5 horizontal
- Minimum 3-foot wide inspection shelves at the top of the embankments in front of the abutments
- Reference channel geometry:
  - Bankfull channel width: 34 feet
  - Bankfull channel cross-sectional area: 100 square feet
  - Mean bankfull channel depth: 2.9 feet
  - Bankfull width-to-depth ratio: 12
  - Maximum bankfull channel depth: 4.0 feet

- Minimum width of floodplain bench/wildlife shelf adjacent to each bank of the realigned channel: 3 feet

Utilizing the reference channel geometry and the existing site survey provided by MJ, we identified a proposed channel alignment which, to the greatest extent practicable, provides a smooth transition between the river reach on the upstream side of the highway and the channel downstream from the existing CMP outlet (see Figure 1 and attached Option 1 site plan drawing).

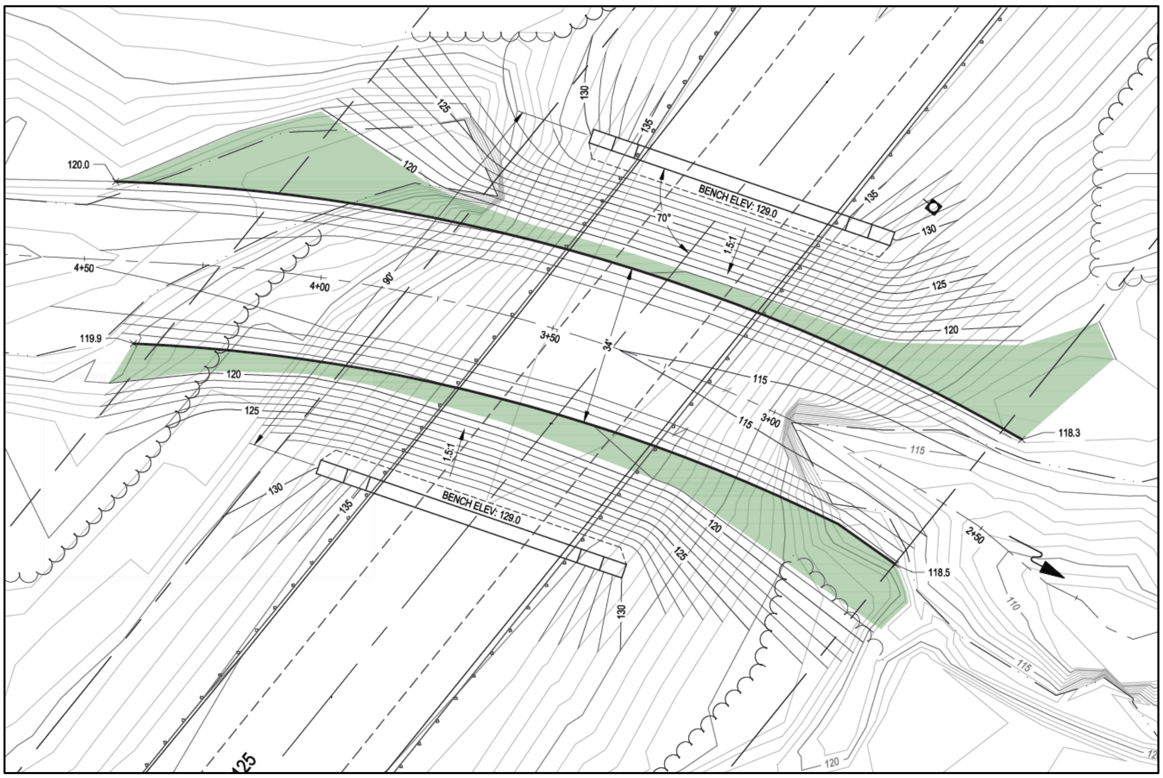


Figure 1 – Portion of Option 1 site plan drawing

The realigned channel would depart the existing channel approximately 90 feet upstream from the existing CMP inlet and would tie into the existing channel bed at the outlet of the existing CMP, though grading to establish the new riverbanks and floodplain bench/wildlife shelf would extend about another 40 feet below the CMP outlet. The upstream departure point is at the upstream end of a river segment which appears to have been narrowed by previous construction work.

The proposed channel alignment has a centerline radius of 340 feet, or ten times the reference bankfull channel width. This is considered a gradual meander bend which is unlikely to create excessive flow turbulence or erosion forces on the outside bank.

Once the horizontal channel alignment was designed, an existing ground surface profile along the proposed thalweg was created from the existing ground digital elevation model (DEM) provided by MJ. This profile was used to design the proposed thalweg profile, which has a slope of 0.82% (see Figure 2).

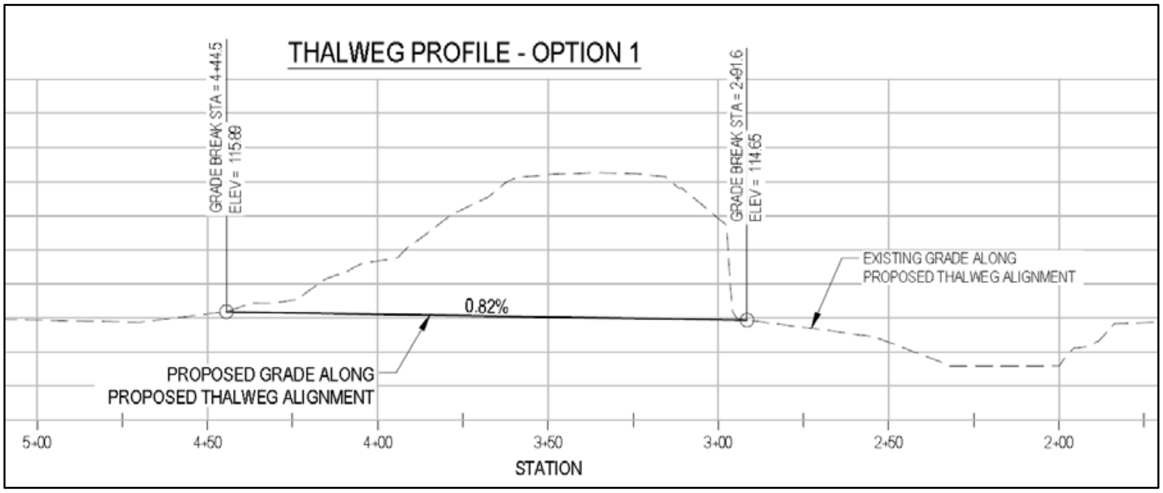


Figure 2 – Portion of Option 1 thalweg profile

Once the proposed thalweg profile was designed, the channel grading was designed using the bankfull channel cross-section shown in Figure 3.

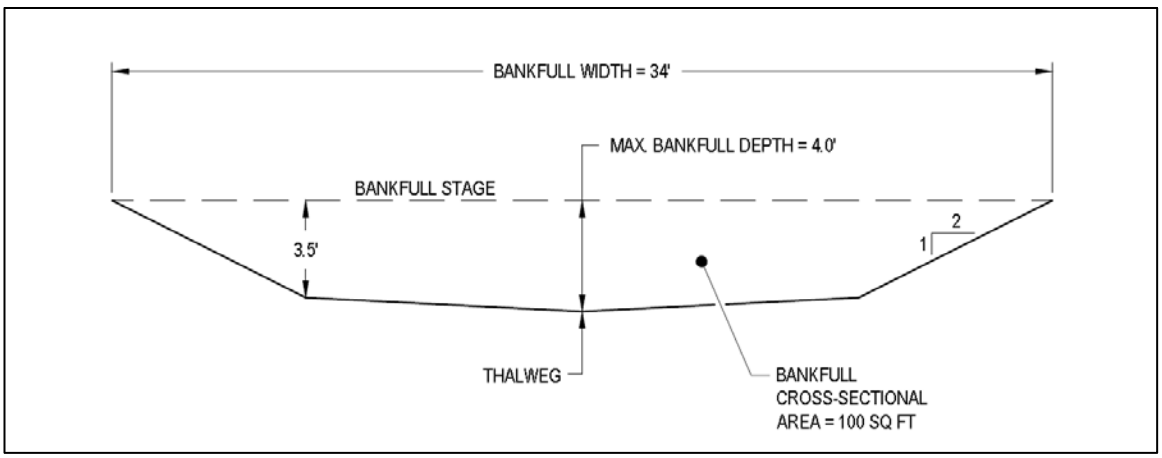


Figure 3 – Typical bankfull channel cross-section

The overbank grading was then designed using a minimum floodplain bench/wildlife shelf width of 3 feet and a maximum embankment slope of 1.5:1. Based on this grading, the bridge abutment locations were then designed to allow the highest, equal inspection shelf/top of embankment elevation at each abutment. The resulting inspection shelf/top of embankment elevation is 129.0, which is estimated to be about 3 to 4 feet below the superstructure low chord.

Once the abutment locations were established, the grading was finalized, including in the areas around the abutments and wingwalls and at the upstream and downstream slope limits. In addition, under this step the widths of the floodplain benches/wildlife shelves were expanded to maximize the waterway opening area without having to lower the inspection shelf/top of embankment elevations. The final bridge abutment locations, channel alignment, and grading are shown in Figure 1 and on the attached Option 1 site plan drawing.

Under Option 1 the bridge span (from center of bearing to center of bearing along the highway centerline) would be 90 feet, the skew angle would be 20 degrees, and the total length of channel realignment would be about 200 feet. The minimum flood prone width of the realigned channel would be about 52 feet which would result in an entrenchment ratio of about 1.5 and a stream type of Bc.

From a plan view perspective, the proposed channel alignment under Option 1 would provide a smooth transition from the river upstream of the highway to the river downstream from the highway without any abrupt or sharp bends or impacting any steep, sensitive river banks. The floodplain benches/wildlife shelves proposed under this option would also connect existing narrow floodplains at either end of the crossing to create contiguous floodplain surfaces through the crossing for overbank flow conveyance and terrestrial wildlife passage.

From a channel profile perspective, the proposed channel thalweg profile under Option 1 would also provide a smooth transition between the thalweg profiles upstream and downstream from the highway without creating any knickpoints or overly steep slopes which would likely induce channel degradation. The slope of the realigned channel bed (0.82%) would be steeper than the average slope of the river reach in the vicinity of the crossing (about 0.4%); however, due to tailwater grade control, the average reach slope would be unchanged.

From a cross-sectional geometry perspective, the proposed bridge span and skew under Option 1 would allow for the reestablishment of an open channel with reference bankfull channel geometry and adjacent overbank conveyance areas so as to minimize the waterway constriction. In general, Option 1 would result in significant improvements to channel morphology and stability and aquatic and terrestrial wildlife habitats. It would also likely reduce flood inundation and fluvial erosion hazards.

The channel would be skewed to the highway at an angle of about 20 degrees, which is more or less equal to the abutment skew and would therefore maximize the height of the embankments and minimize the height of the abutments and wingwalls and length of the wingwalls.

In summary, it appears Option 1 would be acceptable from river morphology, wildlife habitat, flood hazard, and bridge construction perspectives.

Option 3C

Option 3C entails maintaining the existing river channel location on the upstream side of NH Route 125 and realigning the channel downstream from the highway and through the stream crossing so as to more or less restore the historic river alignment which existed prior to installation of the existing CMP. Additional design criteria provided by MJ for this option are the same as for Option 1. These include a maximum span of 90 feet, maximum skew of 20 degrees, and a bankfull channel width of 34 feet.

The design procedure used for Option 1 was also used for Option 3C. This included:

- identifying a channel alignment which provides a smooth transition between the river reaches on either side of the highway;

- plotting an existing ground surface profile along the proposed thalweg and designing the proposed thalweg profile;

- designing the channel grading using the bankfull channel cross-section shown in Figure 3;

- designing the overbank grading and bridge abutment locations; and

- finalizing the grading around the abutments and wingwalls and at the upstream and downstream slope limits.

The proposed abutment locations, channel alignment, and grading are shown in Figure 4 and on the attached Option 3C site plan drawing.

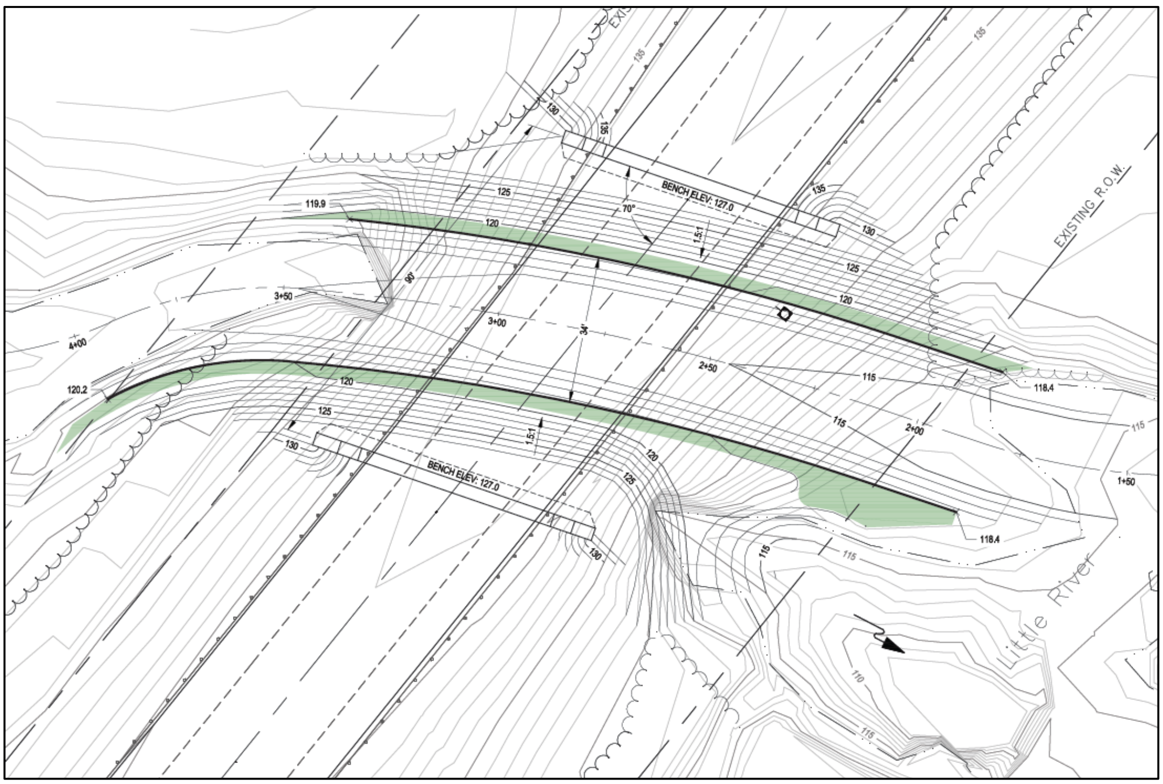


Figure 4 – Portion of Option 3C site plan drawing

The realigned channel would depart the existing channel approximately 75 feet upstream from the existing CMP inlet and would tie into the historic river channel about 50 feet downstream from the easterly right-of-way line. The total length of channel reconstruction under this option would be approximately 250 feet.

The river segment immediately above the CMP inlet has been constricted to a width as narrow as approximately 20 feet. As a result, although Option 3C would maintain the existing channel alignment upstream from the highway, substantial grading would be needed to restore the reference channel geometry in this area, primarily via the removal of fill on the south side of the channel. Consequently, there is not a significant difference in the amount of upstream channel construction work between this option and Option 1.

The proposed channel alignment through the bridge opening would have a centerline radius of 583 feet, or approximately 17 times the reference bankfull channel width. This is a very gradual meander bend that would not likely result in excessive erosion forces on the outside (north) bank. However, the river would make a relatively short but sharp bend as it approaches the bridge opening. This bend would be about 50 feet long with a radius of 92 feet, or approximately 2.7 times the reference bankfull channel width. This is considered a tight bend which would raise some concerns about the stability of the tall, steep bank on the north side of the river just upstream from the bridge. In addition, although the channel realignment work would not directly impact the tall, steep bank on the north side of the river immediately downstream from the crossing, it would redirect the full channel flow along this bank which could increase scouring forces and erosion rates.

The thalweg of the realigned river segment would have a slope of 0.99% (see Figure 5).

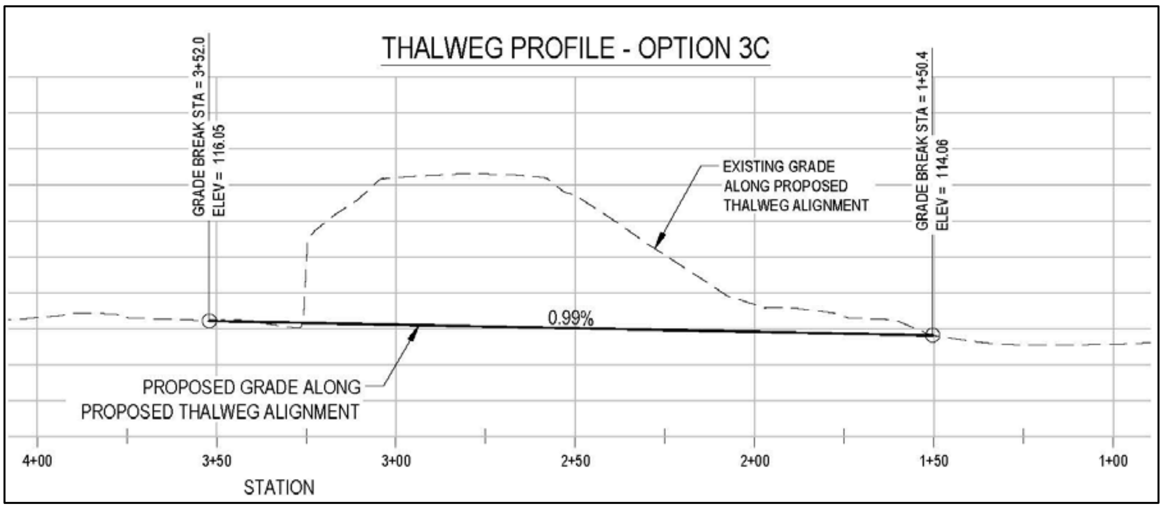


Figure 5 – Portion of Option 3C thalweg profile

The bridge span and skew angle under Option 3C would be the same as under Option 1 – 90 feet and 20 degrees, respectively. However, due to the greater skew angle between the realigned channel and the highway (approximately 30 degrees under Option 3C as compared to about 20 degrees under Option 1), the inspection shelves/top of embankments adjacent to the abutments would only be at elevation 127.0. This is 2 feet lower than under Option 1 and is estimated to be about 5 to 6 feet below the superstructure low chord.

The minimum flood prone width of the realigned channel under Option 3C would be 52 feet. This is the same as under Option 1 and would result in an entrenchment ratio of about 1.5 and a stream type of Bc.

From a plan view perspective, the proposed channel alignment under Option 3C would provide a relatively smooth transition between the river segments on either side of the highway; however, there would be a short, but sharp, bend upstream from the bridge opening and tall, steep banks which are more susceptible to erosion would border the north side of the realigned channel above and below the stream crossing. Therefore, as compared to Option 1, this option would likely have a greater potential to induce bank erosion in the vicinity of the crossing.

The floodplain bench/wildlife shelf proposed along the south side of the realigned channel under Option 3C would connect to existing narrow floodplains at either end of the crossing to create a contiguous floodplain surface through the crossing on the south side of the river. However, there are no floodplains which exist along the north side of the river at the crossing, only tall, steep banks. Therefore, the floodplain bench/wildlife shelf proposed along the north side of the realigned channel through the crossing would be an isolated feature unconnected to other floodplain surfaces and would have limited utility as a terrestrial wildlife corridor.

From a channel profile perspective, the thalweg profile under Option 3C would provide a smooth transition between the thalweg profiles upstream and downstream from the highway without creating any abrupt grade breaks or excessively steep slopes that would likely cause channel degradation. The slope of the realigned channel bed (0.99%) would be steeper than that under Option 1 (0.82%) and also steeper than the average slope of the river reach in the vicinity of the crossing (about 0.4%); however, due to a high point in the river bed downstream from the realigned channel, the average slope of the river reach would be unchanged.

From a cross-sectional geometry perspective, the proposed bridge span and skew under Option 3C would reduce the waterway constriction by allowing for the restoration of an open channel with reference bankfull channel geometry and adjacent overbank conveyance areas. As compared to the existing crossing, this option would be significantly more compatible with the morphology of the Little River and would likely reduce flood inundation hazards and improve aquatic and terrestrial wildlife habitats.

As previously described, under Option 3C the channel would be skewed to the highway at an angle of about 30 degrees, which is approximately 10 degrees greater than the abutment skew. As a result, compared to Option 1, the height of the embankment slopes beneath the superstructure would be about 2 feet less and the abutments and wingwalls would be approximately 2 feet taller.

Recommendations

Between the two options studied, Option 1 is preferred. As compared to Option 3C, Option 1 would result in:

- a smoother transition between the river alignments on either side of the highway;
- a flatter channel bed slope that is more similar to the average slope of the river reach in the vicinity of the crossing;
- better floodplain connectivity;
- no direct or indirect impacts to sensitive river banks;
- a shorter length of channel realignment; and
- shorter abutment and wingwall heights.

Our evaluation was limited to the bridge geometry criteria provided by MJ, including a maximum span of 90 feet and a maximum embankment slope of 1.5:1. It is our opinion that the design could be improved by flattening the embankment slopes to 2:1 as this would increase the waterway opening area, reduce flow velocities and scouring forces within the bridge opening, and improve the stability of the embankment slopes. This change; however, would require lengthening the bridge span to about 100 feet, which would undoubtedly increase the cost of the superstructure.

Our final recommendation is that a two-dimensional (2D) flow model be developed to support final design of the channel realignment and stream crossing, including the abutment scour analysis to be completed per the NHDOT Bridge Design Manual (i.e. HEC-18). 2D models typically provide a more accurate simulation of hydraulic conditions, particularly in areas with complex flow patterns such as those which exist immediately below the crossing. Furthermore, HEC-18, Section 8.2.1 states that: "Two-dimensional models should be used on all but the simplest bridge crossings as a matter of course."

I can be reached at (603) 616-6850 or via email at sean@headwatershydrology.com if you have any questions.

Sincerely,

Sean P. Sweeney, P.E., CWS
Manager
Headwaters Consulting, LLC

Enclosures

Y:\HEADWATERS\Projects\2021\2106 - MFJ Lee 41322\docs\reports\2106_Phase1_Memo.docx

GRID
LEGEND
PROPOSED TOP OF BANK
PROPOSED THALWEG
PROPOSED FLOODPLAIN BENCH (WILDLIFE SHELF)
PROPOSED 1' CONTOUR
120
PROPOSED 5' CONTOUR
EXISTING R.O.W.
EXISTING R.O.W.
BENCH ELEV. 129.0
BENCH ELEV. 129.0
120.0
119.9
118.3
118.5
Little River
Little River
NH ROUTE 125
EXISTING SLOPE EASEMENT
LEE–EPPING
MAINTENANCE SPECIAL
#1006
ledge
conc block
conc block
OPTION 1 DESIGN CRITERIA:
1. MAINTAIN EXISTING BRIDGE OUTLET
2. MAXIMUM BRIDGE SPAN: 90'
3. MAXIMUM BRIDGE SKEW: 20°
0 10 20 40
SCALE IN FEET
CONCEPTUAL PLAN
NOT FOR CONSTRUCTION
DATE OF PRINT: 08-17-21
HEADWATERS
Consulting, LLC
P.O. Box 744, Littleton, NH 03561
McFARLAND JOHNSON, INC.
LEE 41322
NH ROUTE 125 OVER THE
LITTLE RIVER
LEE, NH
OPTION 1
NO.
REVISION
DATE
1
REVISED ABUTMENT SLOPES TO MAX. 1.5:1 &
NARROWED WILDLIFE SHELF TO MIN. 3' WIDE
08/17/21
DATE:
AUG. 2021
PROJECT #:
2106
ENGINEERED BY:
SPS
DRAWN BY:
SPS
SHEET 1 OF 1


LEGEND
PROPOSED TOP OF BANK
PROPOSED THALWEG
PROPOSED FLOODPLAIN BENCH (WILDLIFE SHELF)
PROPOSED 1' CONTOUR
PROPOSED 5' CONTOUR
GRID
EXISTING R.O.W.
BENCH ELEV. 127.0
Little River
NH ROUTE 125
EXISTING SLOPE EASEMENT
LEE–EPPING
MAINTENANCE SPECIAL
#1006
ledge
conc block
OPTION 3C DESIGN CRITERIA:
1. MAINTAIN EXISTING BRIDGE INLET
2. MAXIMUM BRIDGE SPAN: 90'
3. MAXIMUM BRIDGE SKEW: 20°
SCALE IN FEET
CONCEPTUAL PLAN
NOT FOR CONSTRUCTION
DATE OF PRINT: 08-17-21
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P.O. Box 744, Littleton, NH 03561
McFARLAND JOHNSON, INC.
LEE 41322
NH ROUTE 125 OVER THE
LITTLE RIVER
LEE, NH
OPTION 3C
NO.
REVISION
DATE
DATE: AUG. 2021
PROJECT #: 2106
ENGINEERED BY: SPS
DRAWN BY: SPS
SHEET 1 OF 1

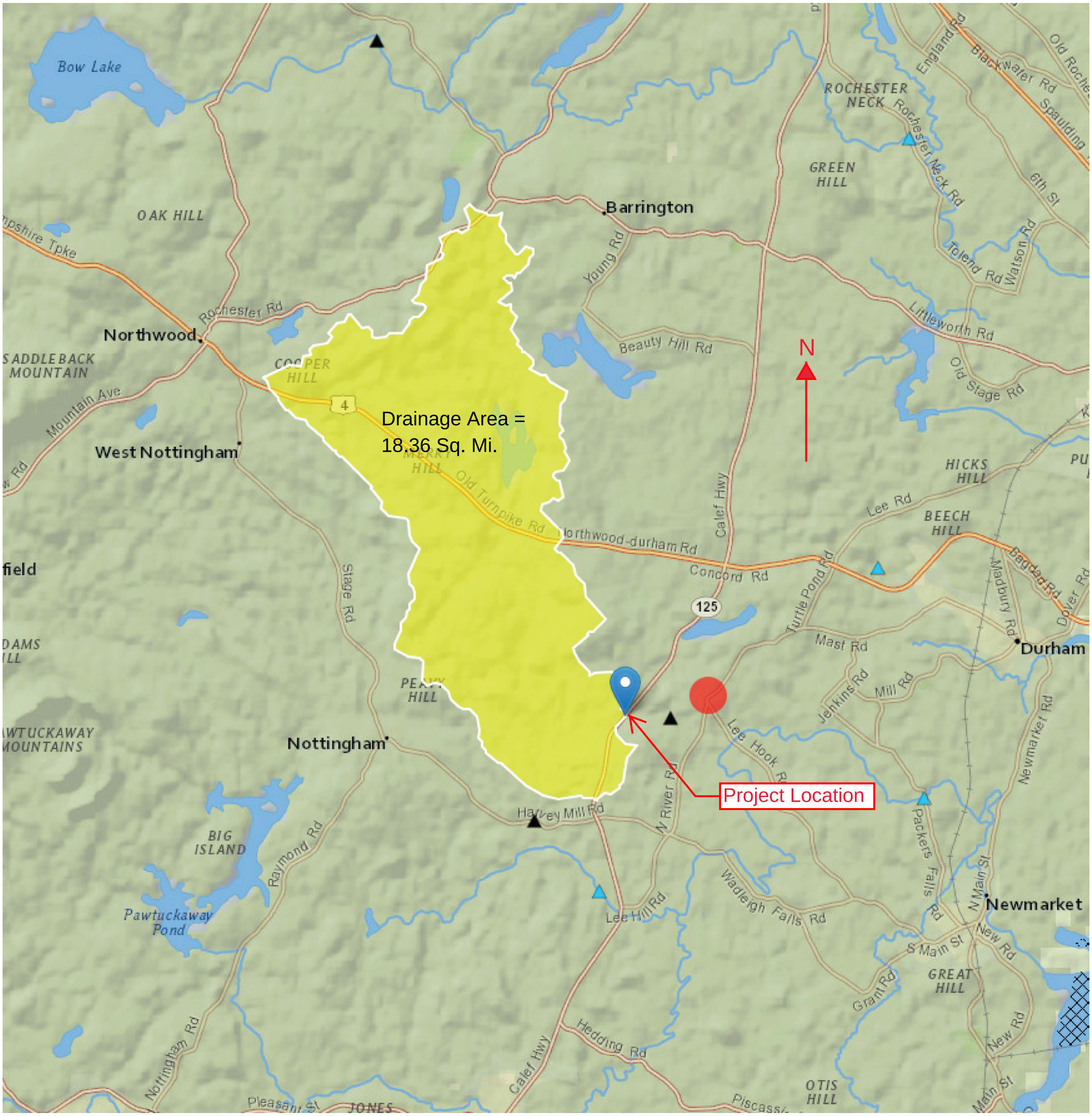
APPENDIX D

HYDROLOGY DOCUMENTATION

Drainage Area Map

Little River at NH Route 125 Crossing

Lee, NH



McFarland Johnson

53 Regional Drive
Concord, NH
Phone (603) 225-2978

JOB:	NH Route 125 Over Little River		
SHEET:		OF:	
CALC. BY:	MAH	DATE:	08/14/2019
CHCKD. BY:	TEPA	DATE:	09/10/2019
TASK:	5 Parameter Method		

Reference: *Runoff Estimates for Small Rural Watersheds and Development of a Sound Design Method, Volume II.*

Criteria	Value	Reference
Hydrophysiographic Zone:	9	Figure 3 (Pg. 12)
10-Year Peak Runoff Estimate P_{60} (in):	1.73	Appendix D-33 (Pg. 167)
Watershed Area A (sq mi):	18.36	USGS StreamSTATS Info
Iso-eroent factor R:	95	Appendix C-33 (Pg. 113)
Max Stream Elevation:	377	USGS from Terrian Navigator
Min Streambed Elevation:	115	USGS from Terrian Navigator
Difference in Elevation (ft):	262	
Stream Length (ft) :	53575	USGS from Terrian Navigator
Total Length of principal channel (miles):	10.15	Length of stream
10 Year Runoff Estimate (Unadjusted) (cfs):	**913**	

Adjusted Flows for Storage

Criteria	Value	Reference
Watershed Percent Wetlands (%):	9.5%	USGS StreamSTATS Info
Additional Watershed Storage Percent (%):	0.0%	No Additional Bodies of Water
Total Storage Percentage (%):	9.5%	N
Storage Correction Factor:	95%	Figure 5 (Pg. 15)
10 Year Runoff Estimate (Adjusted for Storage) (cfs):	**867**	

Storage Adjusted Flow Summary

Criteria	Value	Reference
$Q_{2.33}$ Storage Adjusted Flow (cfs):	**414**	Ref Figure 7
Q_{50} Storage Adjusted Flow (cfs):	**1483**	Ref Figure 7
Q_{100} Storage Adjusted Flow (cfs):	**1736**	Ref Figure 7

USGS StreamStats Flows

Criteria	Value	Reference
10 Year Peak Flood:	**947**	USGS StreamStats
Standard Percent Error:	**32.3%**	
50 Year Peak Flood:	**1490**	USGS StreamStats
Standard Percent Error:	**36.4%**	
100 Year Peak Flood:	**1780**	USGS StreamStats
Standard Percent Error:	**38.6%**	

Percent Difference: StreamStats vs. 5-Parameter Method

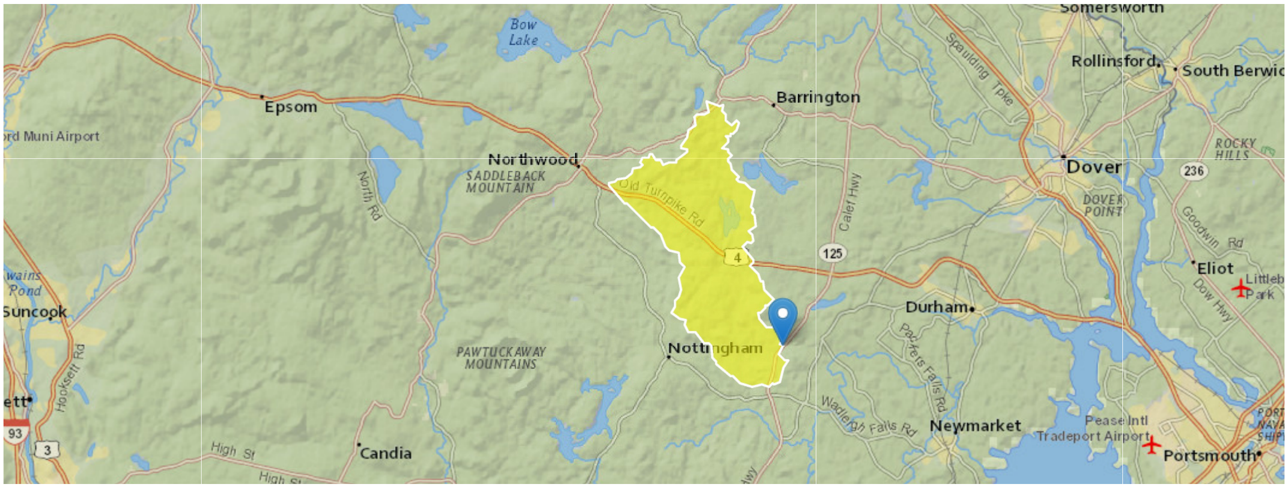
Criteria	Value	Within Tolerance?
10 Year Peak Flood	**9%**	**OK**
50 Year Peak Flood	**0%**	**OK**
100 Year Peak Flood	**3%**	**OK**

Conclusion:

The StreamStats peak flows will be used for the hydraulic design. The 5-Parameter Method is within the standard error of predicition, and is therefore a valid check.

StreamStats Report

Region ID:	NH
Workspace ID:	NH20190812122804918000
Clicked Point (Latitude, Longitude):	43.11877, -71.03448
Time:	2019-08-12 08:28:21 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	18.36	square miles
APRAVPRE	Mean April Precipitation	4.227	inches
WETLAND	Percentage of Wetlands	9.4494	percent
CSL10_85	Change in elevation divided by length between points 10 and 85 percent of distance along main channel to basin divide - main channel method not known	33.8	feet per mi

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

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	18.36	square miles	0.7	1290
APRAVPRE	Mean April Precipitation	4.227	inches	2.79	6.23
WETLAND	Percent Wetlands	9.4494	percent	0	21.8
CSL10_85	Stream Slope 10 and 85 Method	33.8	feet per mi	5.43	543

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

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

Statistic	Value	Unit	PII	Plu	SEp	Equiv. Yrs.
2 Year Peak Flood	443	ft^3/s	274	717	30.1	3.2
5 Year Peak Flood	720	ft^3/s	440	1180	31.1	4.7
10 Year Peak Flood	947	ft^3/s	568	1580	32.3	6.2
25 Year Peak Flood	1250	ft^3/s	723	2140	34.3	8
50 Year Peak Flood	1490	ft^3/s	841	2640	36.4	9
100 Year Peak Flood	1780	ft^3/s	973	3270	38.6	9.8
500 Year Peak Flood	2480	ft^3/s	1250	4910	44.1	11

Peak-Flow Statistics Citations

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

Application Version: 4.3.8

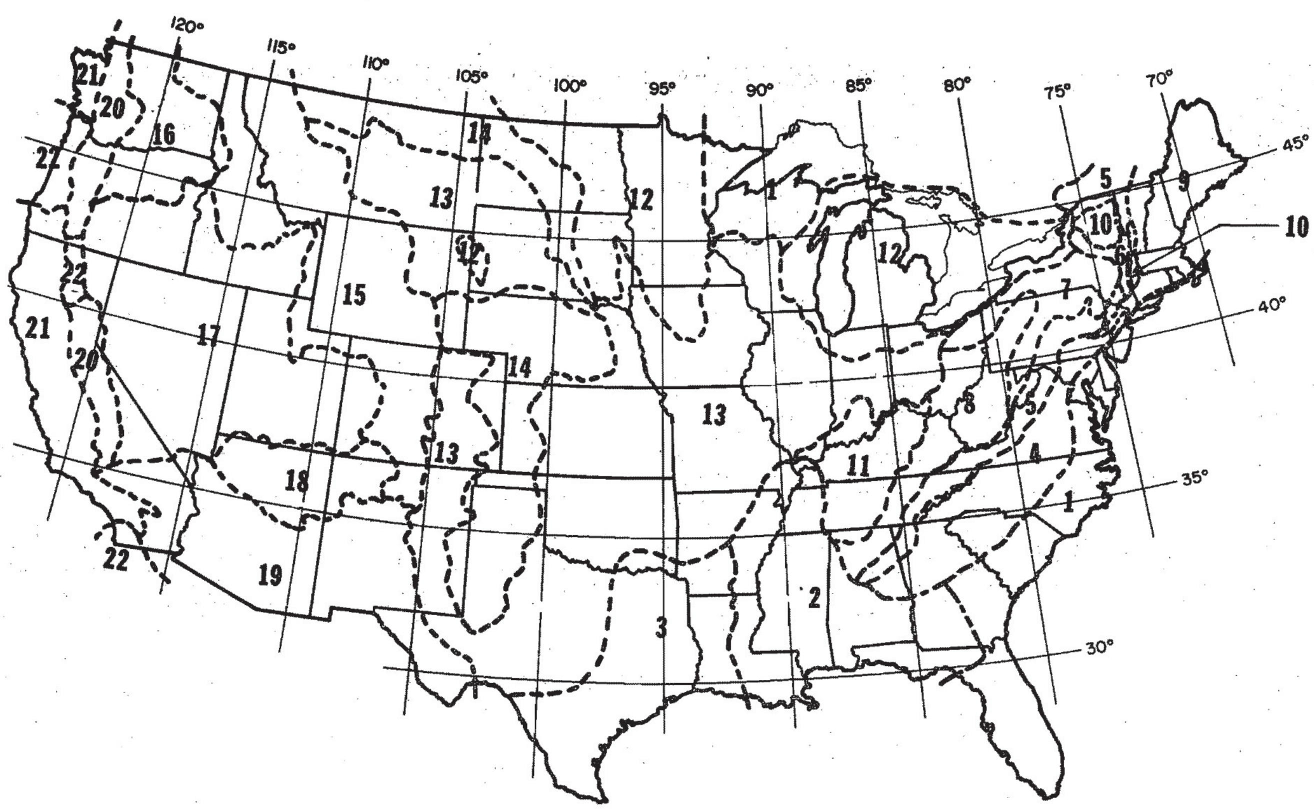
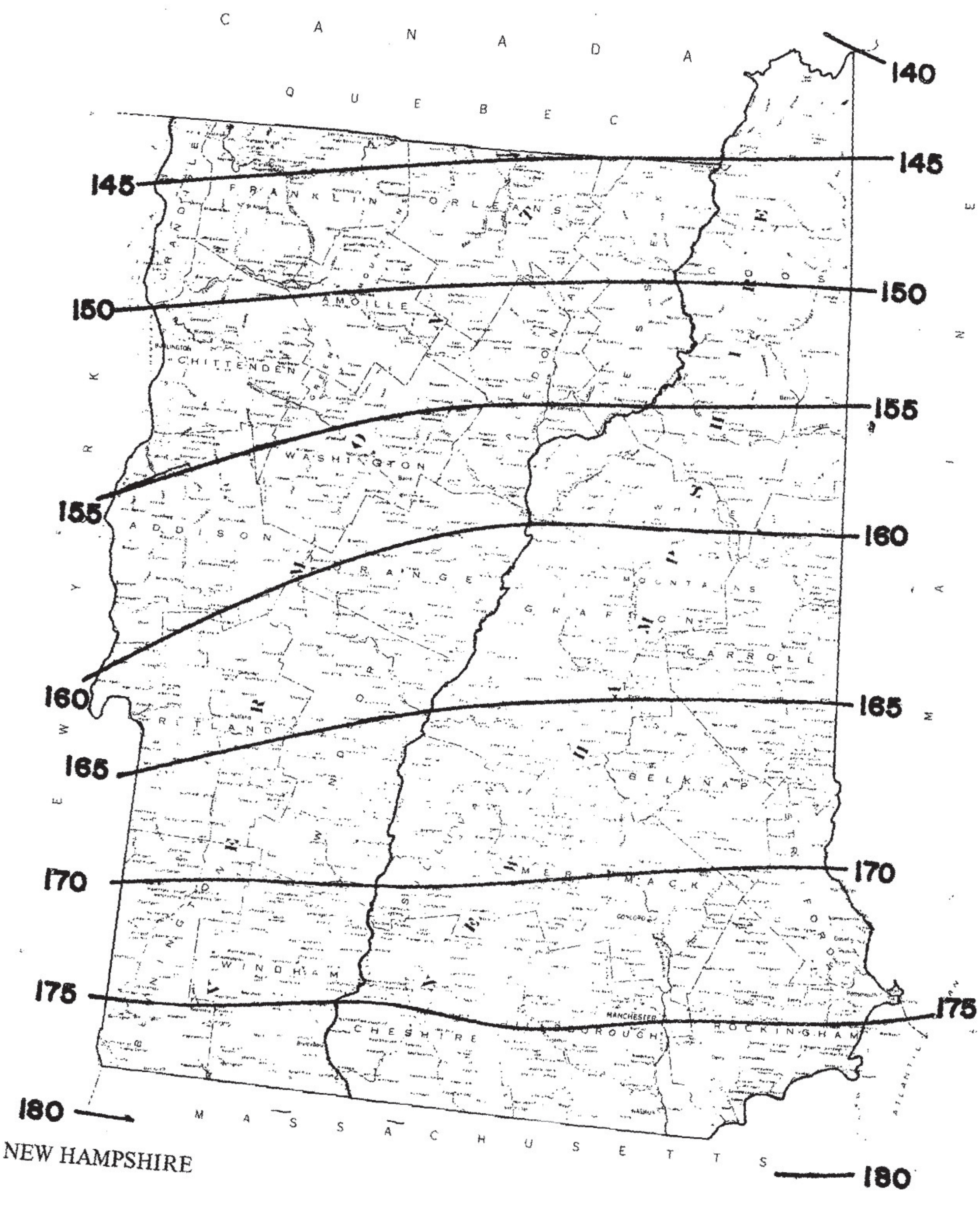
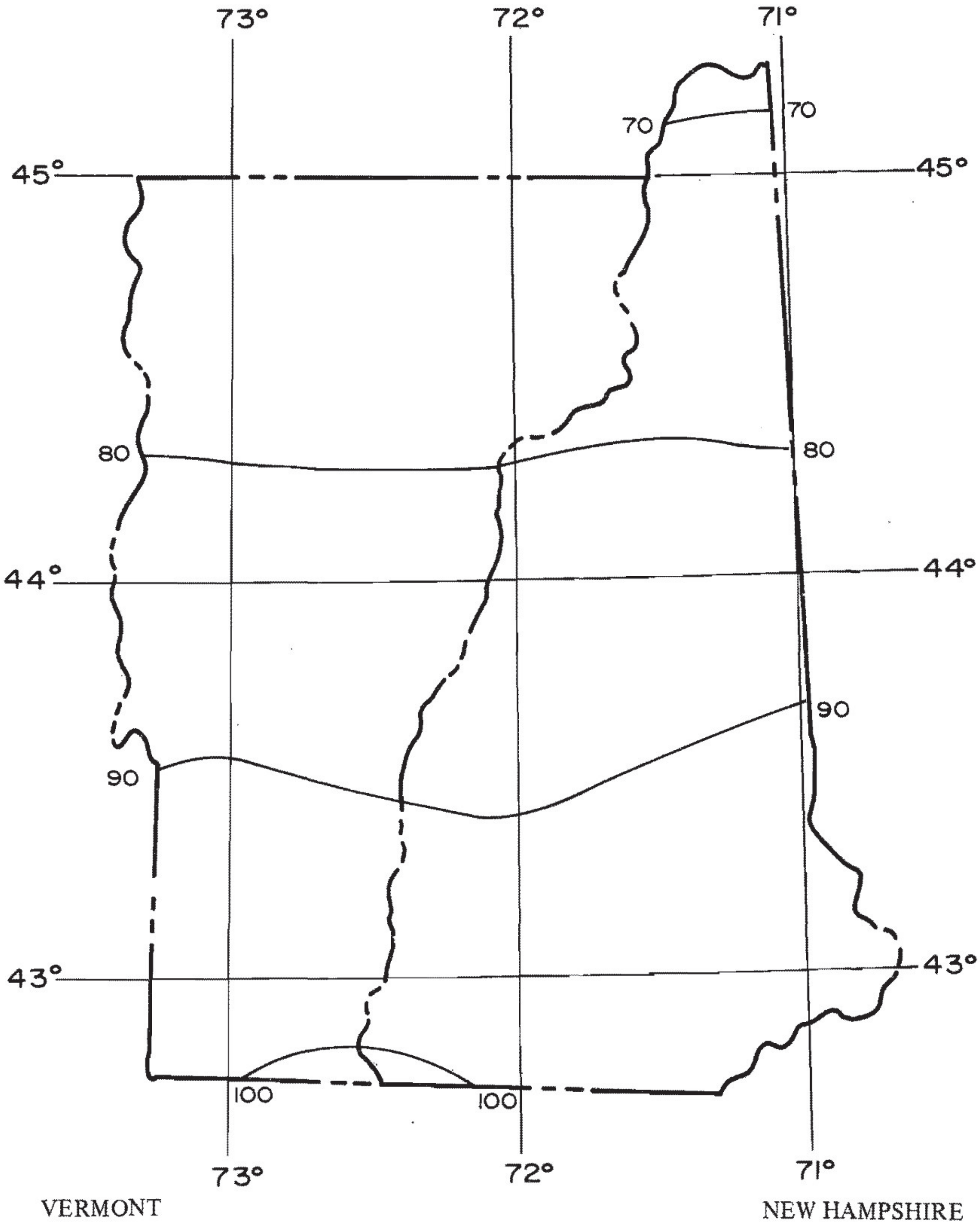


Figure 3. Hydrophysiographic zone map for the contiguous United States. Prepared from an analysis of the physiographic sections of the United States defined by Fenneman and Johnson (ref. 3). (See Figure 38 of Volume I, Research Report.)



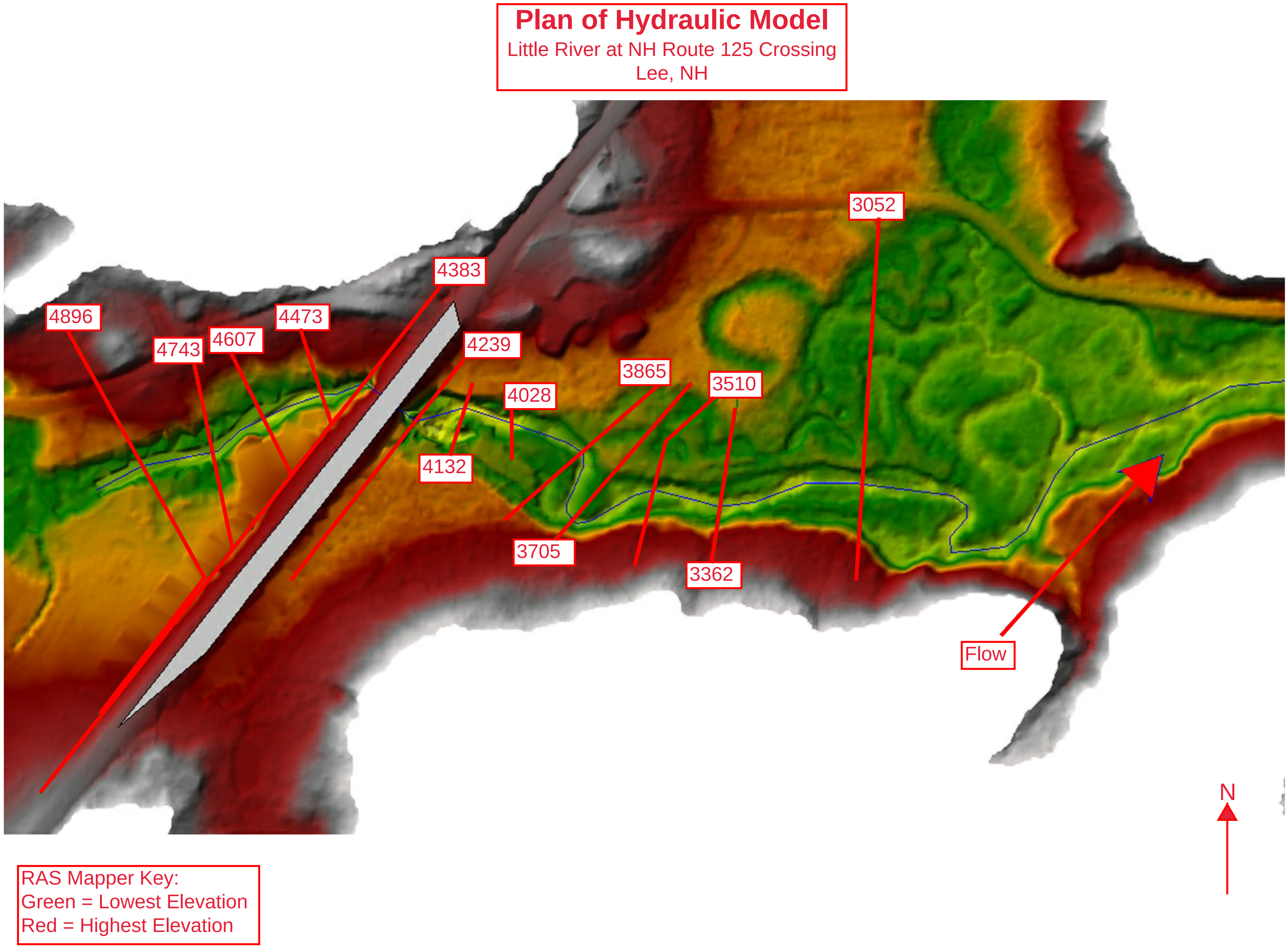
Appendix D-33. Isohyetal map of 10-year 1-hour rainfall for New Hampshire.
Appendix D-50. Isohyetal map of 10-year 1-hour rainfall for Vermont.



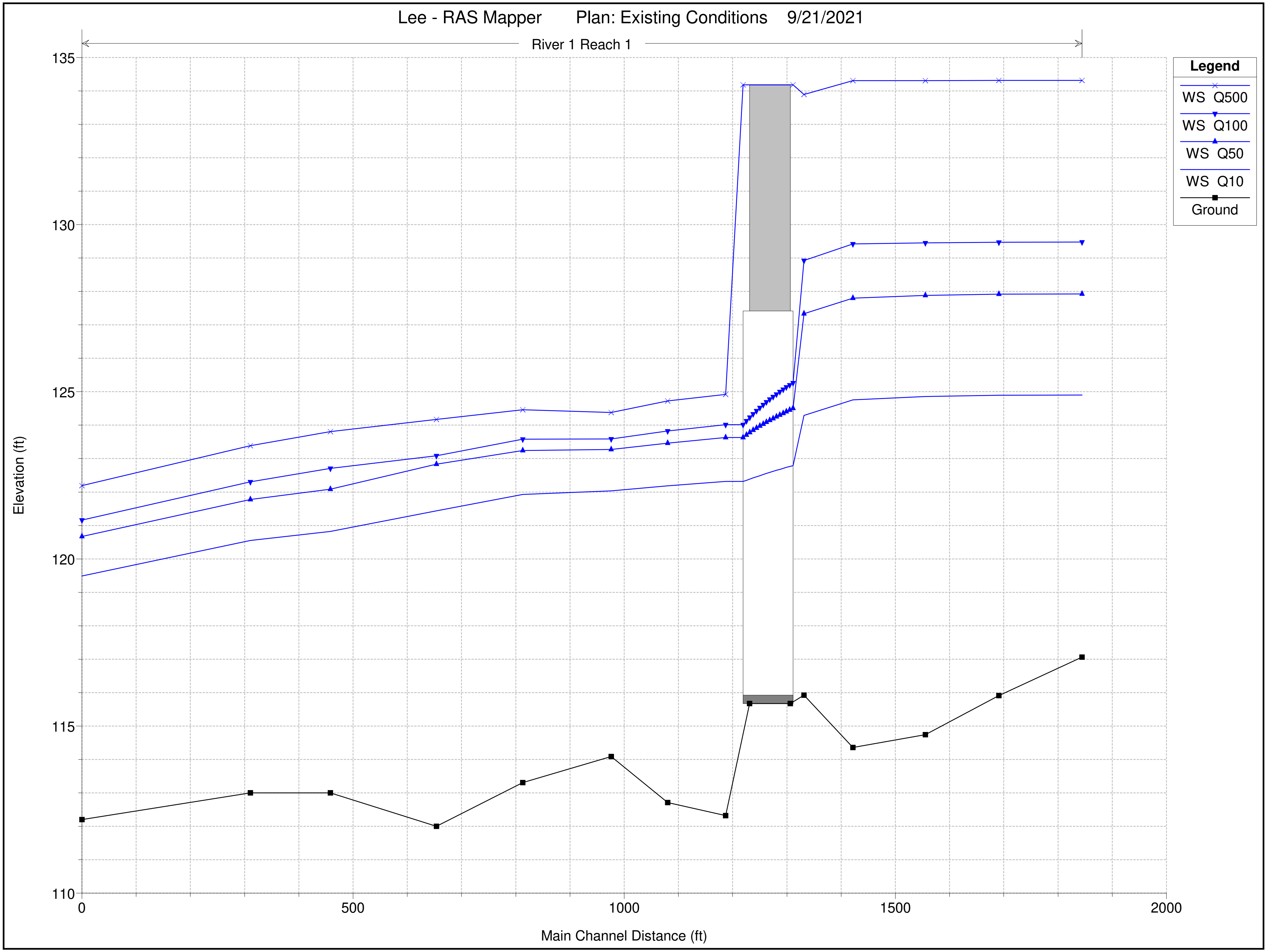
Appendix C-33. Isoerodent, R, map of New Hampshire.
Appendix C-50. Isoerodent, R, map of Vermont.

APPENDIX E

HYDRAULIC DOCUMENTATION



Plan of Hydraulic Model
Little River at NH Route 125 Crossing
Lee, NH
4896
4743
4607
4473
4383
4239
4028
4132
3865
3510
3705
3362
3052
Flow
N
RAS Mapper Key:
Green = Lowest Elevation
Red = Highest Elevation


Lee - RAS Mapper Plan: Existing Conditions 9/21/2021
River 1 Reach 1
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Elevation (ft)
Main Channel Distance (ft)
135
130
125
120
115
110
0
500
1000
1500
2000

```
                    HEC-RAS HEC-RAS 5.0.7 March 2019
                      U.S. Army Corps of Engineers
                     Hydrologic Engineering Center
                           609 Second Street
                           Davis, California

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

```
PROJECT DATA
Project Title: Lee - RAS Mapper
Project File : Lee-RASMapper.prj
Run Date and Time: 9/21/2021 9:15:12 AM

Project in English units

Project Description:
Existing Conditions model. 18' culvert



PLAN DATA

Plan Title: Existing Conditions
Plan File : m:\18283.06 Lee 41322 - TSL\Design\H&H\HEC RAS - RAS Mapper\Lee-RASMapper.p04

           Geometry Title: ExistingConditions_Combined
           Geometry File : m:\18283.06 Lee 41322 - TSL\Design\H&H\HEC RAS - RAS Mapper\Lee-RASMapper.g04

           Flow Title    : LeeHydrology
           Flow File     : m:\18283.06 Lee 41322 - TSL\Design\H&H\HEC RAS - RAS Mapper\Lee-RASMapper.f02

Plan Summary Information:
Number of:  Cross Sections =   13    Multiple Openings  =    0
            Culverts       =    1    Inline Structures  =    0
            Bridges        =    0    Lateral Structures =    0

Computational Information
    Water surface calculation tolerance  =  0.01
    Critical depth calculation tolerance =  0.01
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.3
    Flow tolerance factor                =  0.001

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



FLOW DATA
```

Flow Title: LeeHydrology
Flow File : m:\18283.06 Lee 41322 - TSL\Design\H&H\HEC RAS - RAS Mapper\Lee-RASMapper.f02

Flow Data (cfs)

River	Reach	RS	Q10	Q50	Q100	Q500	Q100+30%
River 1	Reach 1	4896	947	1490	1780	2480	2315

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
River 1	Reach 1	Q10	Normal S = 0.004	Normal S = 0.004
River 1	Reach 1	Q50	Normal S = 0.004	Normal S = 0.004
River 1	Reach 1	Q100	Normal S = 0.004	Normal S = 0.004
River 1	Reach 1	Q500	Normal S = 0.004	Normal S = 0.004
River 1	Reach 1	Q100+30%	Normal S = 0.004	Normal S = 0.004

GEOMETRY DATA

Geometry Title: ExistingConditions_Combined
Geometry File : m:\18283.06 Lee 41322 - TSL\Design\H&H\HEC RAS - RAS Mapper\Lee-RASMapper.g04

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 4896

INPUT
Description:
Station Elevation Data num= 33

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-205	140	0	130	30.5	130.48	103.87	125.85	122.96	120.25
126.1	119.37	130.75	119.33	145.66	119.36	146.85	118.52	148.06	117.45
148.08	117.45	153.68	117.11	165.18	117.06	184.79	117.1	184.81	117.1
185.71	118.34	187.36	119.97	190.75	120.02	194.6	120.02	200.07	119.48
205.45	120.85	210.36	122.74	236.69	122.89	241.84	123.02	264.38	122.35
282.56	124.5	291.03	124.59	360.08	125.02	377.59	125.71	387.61	125.9
413.04	126.13	752	130	882	135				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-205	.09	148.08	.045	184.79	.09

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
148.08	184.79	159.6	153.4	150.1	.1	.3

CROSS SECTION OUTPUT Profile #Q10

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	124.97	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.07	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	124.90	Reach Len. (ft)	159.60	153.40	150.10
Crit W.S. (ft)		Flow Area (sq ft)	177.22	286.03	273.34
E.G. Slope (ft/ft)	0.000342	Area (sq ft)	177.22	286.03	273.34
Q Total (cfs)	947.00	Flow (cfs)	140.37	686.61	120.03
Top Width (ft)	234.29	Top Width (ft)	40.98	36.71	156.59
Vel Total (ft/s)	1.29	Avg. Vel. (ft/s)	0.79	2.40	0.44
Max Chl Dpth (ft)	7.84	Hydr. Depth (ft)	4.32	7.79	1.75
Conv. Total (cfs)	51187.0	Conv. (cfs)	7587.0	37112.3	6487.6

Length Wtd. (ft)	153.93	Wetted Per. (ft)	42.45	36.72	158.58
Min Ch El (ft)	117.06	Shear (lb/sq ft)	0.09	0.17	0.04
Alpha	2.60	Stream Power (lb/ft s)	0.07	0.40	0.02
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)	4.99	8.83	6.58
C & E Loss (ft)	0.01	Cum SA (acres)	1.95	1.26	2.63

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q50

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	127.97				
Vel Head (ft)	0.04	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	127.93	Reach Len. (ft)	159.60	153.40	150.10
Crit W.S. (ft)		Flow Area (sq ft)	343.48	396.98	1058.06
E.G. Slope (ft/ft)	0.000173	Area (sq ft)	343.48	396.98	1058.06
Q Total (cfs)	1490.00	Flow (cfs)	198.96	842.50	448.54
Top Width (ft)	499.39	Top Width (ft)	77.11	36.71	385.57
Vel Total (ft/s)	0.83	Avg. Vel. (ft/s)	0.58	2.12	0.42
Max Chl Dpth (ft)	10.87	Hydr. Depth (ft)	4.45	10.81	2.74
Conv. Total (cfs)	113348.3	Conv. (cfs)	15135.6	64091.4	34121.3
Length Wtd. (ft)	153.74	Wetted Per. (ft)	78.77	36.72	387.59
Min Ch El (ft)	117.06	Shear (lb/sq ft)	0.05	0.12	0.03
Alpha	3.85	Stream Power (lb/ft s)	0.03	0.25	0.01
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	10.09	11.32	15.15
C & E Loss (ft)	0.01	Cum SA (acres)	3.36	1.26	6.99

CROSS SECTION OUTPUT Profile #Q100

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	129.51				
Vel Head (ft)	0.03	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	129.48	Reach Len. (ft)	159.60	153.40	150.10
Crit W.S. (ft)		Flow Area (sq ft)	482.31	453.98	1762.30
E.G. Slope (ft/ft)	0.000113	Area (sq ft)	482.31	453.98	1762.30
Q Total (cfs)	1780.00	Flow (cfs)	235.88	850.61	693.50
Top Width (ft)	659.99	Top Width (ft)	101.71	36.71	521.56
Vel Total (ft/s)	0.66	Avg. Vel. (ft/s)	0.49	1.87	0.39
Max Chl Dpth (ft)	12.42	Hydr. Depth (ft)	4.74	12.37	3.38
Conv. Total (cfs)	167724.9	Conv. (cfs)	22226.5	80151.3	65347.2
Length Wtd. (ft)	153.39	Wetted Per. (ft)	103.43	36.72	523.59
Min Ch El (ft)	117.06	Shear (lb/sq ft)	0.03	0.09	0.02
Alpha	4.07	Stream Power (lb/ft s)	0.02	0.16	0.01
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	15.11	12.97	27.60
C & E Loss (ft)	0.00	Cum SA (acres)	5.06	1.26	11.38

CROSS SECTION OUTPUT Profile #Q500

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	134.32				
Vel Head (ft)	0.01	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	134.31	Reach Len. (ft)	159.60	153.40	150.10
Crit W.S. (ft)		Flow Area (sq ft)	1358.00	631.50	4735.18
E.G. Slope (ft/ft)	0.000025	Area (sq ft)	1358.00	631.50	4735.18
Q Total (cfs)	2480.00	Flow (cfs)	358.22	695.89	1425.88
Top Width (ft)	952.62	Top Width (ft)	236.53	36.71	679.38
Vel Total (ft/s)	0.37	Avg. Vel. (ft/s)	0.26	1.10	0.30
Max Chl Dpth (ft)	17.25	Hydr. Depth (ft)	5.74	17.20	6.97
Conv. Total (cfs)	495114.5	Conv. (cfs)	71516.7	138930.3	284667.6
Length Wtd. (ft)	152.70	Wetted Per. (ft)	238.38	36.72	681.50
Min Ch El (ft)	117.06	Shear (lb/sq ft)	0.01	0.03	0.01
Alpha	2.96	Stream Power (lb/ft s)	0.00	0.03	0.00
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	29.24	18.27	71.78
C & E Loss (ft)	0.00	Cum SA (acres)	6.99	1.26	13.93

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 4743

INPUT
Description:
Station Elevation Data num= 51

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-21	135	0	131.77	122.94	118.91	123.49	118.5	124.05	118.47
134.41	118.3	137.12	118.76	141.42	119.42	149.82	119.73	160.91	119.91
162.38	119.9	162.8	119.62	164.12	117.22	164.13	117.22	169.34	116.89
172.77	116.73	175.62	116.65	182.42	116.05	183.92	116.14	192.28	115.91
194.97	116.03	195.24	116.08	196.81	116.37	198.45	116.87	198.47	116.91
198.92	117.82	200.61	119.62	207.45	119.78	210.58	119.79	215.89	119.26
218.96	118.74	222.81	118.72	248.86	119.3	305.81	124.51	315.53	125.3
333.74	126.46	379.39	126.87	394.02	126.98	397.88	127	401.27	126.99
431.83	127.15	439.22	126.98	450.04	126.88	472.78	126.23	502.85	126.3
514.5	126.2	521.42	126.33	569.94	126.69	571.3	126.7	789	130
920	135								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-21	.09	164.12	.045	198.47	.09

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
164.12	198.47	133.3	135.5	142.3	.1	.3

Right Levee Station= 431.43 Elevation= 127.11

CROSS SECTION OUTPUT Profile #Q10

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	124.92	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.03	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	124.90	Reach Len. (ft)	133.30	135.50	142.30
Crit W.S. (ft)	119.44	Flow Area (sq ft)	407.22	291.36	460.58
E.G. Slope (ft/ft)	0.000154	Area (sq ft)	407.22	291.36	460.58
Q Total (cfs)	947.00	Flow (cfs)	212.18	495.04	239.78
Top Width (ft)	244.90	Top Width (ft)	98.43	34.35	112.12
Vel Total (ft/s)	0.82	Avg. Vel. (ft/s)	0.52	1.70	0.52
Max Chl Dpth (ft)	8.99	Hydr. Depth (ft)	4.14	8.48	4.11
Conv. Total (cfs)	76276.5	Conv. (cfs)	17090.0	39873.5	19313.0
Length Wtd. (ft)	136.12	Wetted Per. (ft)	100.48	34.53	113.80
Min Ch El (ft)	115.91	Shear (lb/sq ft)	0.04	0.08	0.04
Alpha	2.46	Stream Power (lb/ft s)	0.02	0.14	0.02
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	3.92	7.82	5.31
C & E Loss (ft)	0.00	Cum SA (acres)	1.70	1.14	2.17

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	127.94	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	127.92	Reach Len. (ft)	133.30	135.50	142.30
Crit W.S. (ft)	120.44	Flow Area (sq ft)	748.01	395.08	1202.00
E.G. Slope (ft/ft)	0.000107	Area (sq ft)	748.01	395.08	1202.00
Q Total (cfs)	1490.00	Flow (cfs)	411.59	685.76	392.66
Top Width (ft)	614.83	Top Width (ft)	127.30	34.35	453.18
Vel Total (ft/s)	0.64	Avg. Vel. (ft/s)	0.55	1.74	0.33
Max Chl Dpth (ft)	12.01	Hydr. Depth (ft)	5.88	11.50	2.65
Conv. Total (cfs)	143923.1	Conv. (cfs)	39756.4	66239.0	37927.8

Length Wtd. (ft)	136.08	Wetted Per. (ft)	129.50	34.53	454.94
Min Ch El (ft)	115.91	Shear (lb/sq ft)	0.04	0.08	0.02
Alpha	3.71	Stream Power (lb/ft s)	0.02	0.13	0.01
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	8.09	9.92	11.25
C & E Loss (ft)	0.00	Cum SA (acres)	2.98	1.14	5.55

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	129.49	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	129.47	Reach Len. (ft)	133.30	135.50	142.30
Crit W.S. (ft)	120.75	Flow Area (sq ft)	957.67	448.53	1987.08
E.G. Slope (ft/ft)	0.000069	Area (sq ft)	957.67	448.53	1987.08
Q Total (cfs)	1780.00	Flow (cfs)	463.72	680.16	636.12
Top Width (ft)	732.36	Top Width (ft)	142.17	34.35	555.84
Vel Total (ft/s)	0.52	Avg. Vel. (ft/s)	0.48	1.52	0.32
Max Chl Dpth (ft)	13.56	Hydr. Depth (ft)	6.74	13.06	3.57
Conv. Total (cfs)	214177.7	Conv. (cfs)	55797.1	81839.7	76541.0
Length Wtd. (ft)	136.94	Wetted Per. (ft)	144.46	34.53	557.61
Min Ch El (ft)	115.91	Shear (lb/sq ft)	0.03	0.06	0.02
Alpha	3.55	Stream Power (lb/ft s)	0.01	0.08	0.00
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	12.47	11.38	21.14
C & E Loss (ft)	0.00	Cum SA (acres)	4.61	1.14	9.52

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	134.32	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.00	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	134.31	Reach Len. (ft)	133.30	135.50	142.30
Crit W.S. (ft)	121.36	Flow Area (sq ft)	1747.56	614.73	5078.80
E.G. Slope (ft/ft)	0.000018	Area (sq ft)	1747.56	614.73	5078.80
Q Total (cfs)	2480.00	Flow (cfs)	554.02	590.93	1335.05
Top Width (ft)	918.52	Top Width (ft)	180.65	34.35	703.52
Vel Total (ft/s)	0.33	Avg. Vel. (ft/s)	0.32	0.96	0.26
Max Chl Dpth (ft)	18.40	Hydr. Depth (ft)	9.67	17.90	7.22
Conv. Total (cfs)	580805.7	Conv. (cfs)	129749.5	138394.0	312662.2
Length Wtd. (ft)	138.59	Wetted Per. (ft)	183.25	34.53	705.37
Min Ch El (ft)	115.91	Shear (lb/sq ft)	0.01	0.02	0.01
Alpha	2.52	Stream Power (lb/ft s)	0.00	0.02	0.00
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	23.55	16.08	54.88
C & E Loss (ft)	0.00	Cum SA (acres)	6.23	1.14	11.55

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 4607

INPUT
Description:
Station Elevation Data num= 53

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-26	135	0	130.77	68.92	122.66	95.25	119.62	107	119.35
116.44	119.63	117.3	118.53	119.16	117.38	126.27	117.32	139.13	117.12
143.05	116.92	145.43	116.88	150.35	114.88	153.85	114.74	157.96	115.11
164	116.7	166.41	116.84	168.69	117.18	172.45	117.63	172.46	117.63

174.45	118.34	175.33	118.72	175.49	118.66	180.64	119.22	188.59	123.47
189.01	123.98	189.28	123.95	196.38	125.47	215.87	125.86	242.7	126.33
281.06	127.48	282.39	127.51	336.19	127.99	341.59	127.99	350.81	127.87
393.71	127.28	397.29	127.3	401.18	126.99	405.42	126.3	408.04	126.27
409.36	126.27	412.12	127.6	412.44	127.71	413.34	127.66	422.27	127.99
423.55	128.09	433.79	127.05	435.69	126.97	442.19	126.79	483.6	126.96
700	127.5	883	130	1014	135				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-26	.09	119.16	.045	172.45	.09

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
119.16	172.45	142.7	133.8	135.5	.1	.3

Right Levee Station= 341.64 Elevation= 128

CROSS SECTION OUTPUT Profile #Q10

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	124.90				
Vel Head (ft)	0.04	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	124.86	Reach Len. (ft)	142.70	133.80	135.50
Crit W.S. (ft)	118.72	Flow Area (sq ft)	250.15	441.01	81.39
E.G. Slope (ft/ft)	0.000174	Area (sq ft)	250.15	441.01	81.39
Q Total (cfs)	947.00	Flow (cfs)	127.08	778.48	41.45
Top Width (ft)	143.30	Top Width (ft)	68.93	53.29	21.08
Vel Total (ft/s)	1.23	Avg. Vel. (ft/s)	0.51	1.77	0.51
Max Chl Dpth (ft)	10.12	Hydr. Depth (ft)	3.63	8.28	3.86
Conv. Total (cfs)	71867.8	Conv. (cfs)	9643.9	59078.5	3145.5
Length Wtd. (ft)	134.87	Wetted Per. (ft)	70.11	53.97	22.73
Min Ch El (ft)	114.74	Shear (lb/sq ft)	0.04	0.09	0.04
Alpha	1.74	Stream Power (lb/ft s)	0.02	0.16	0.02
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)	2.91	6.68	4.43
C & E Loss (ft)	0.01	Cum SA (acres)	1.44	1.00	1.95

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	127.92				
Vel Head (ft)	0.04	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	127.88	Reach Len. (ft)	142.70	133.80	135.50
Crit W.S. (ft)	119.52	Flow Area (sq ft)	497.22	602.02	289.61
E.G. Slope (ft/ft)	0.000129	Area (sq ft)	497.22	602.02	289.61
Q Total (cfs)	1490.00	Flow (cfs)	279.30	1127.66	83.04
Top Width (ft)	299.44	Top Width (ft)	94.61	53.29	151.54
Vel Total (ft/s)	1.07	Avg. Vel. (ft/s)	0.56	1.87	0.29
Max Chl Dpth (ft)	13.14	Hydr. Depth (ft)	5.26	11.30	1.91
Conv. Total (cfs)	131133.9	Conv. (cfs)	24581.4	99244.4	7308.1
Length Wtd. (ft)	135.48	Wetted Per. (ft)	95.96	53.97	153.28
Min Ch El (ft)	114.74	Shear (lb/sq ft)	0.04	0.09	0.02
Alpha	2.36	Stream Power (lb/ft s)	0.02	0.17	0.00
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	6.18	8.37	8.82
C & E Loss (ft)	0.00	Cum SA (acres)	2.64	1.00	4.56

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	129.48				

Vel Head (ft)	0.03	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	129.45	Reach Len. (ft)	142.70	133.80	135.50
Crit W.S. (ft)	119.95	Flow Area (sq ft)	656.44	685.79	1483.51
E.G. Slope (ft/ft)	0.000079	Area (sq ft)	656.44	685.79	1483.51
Q Total (cfs)	1780.00	Flow (cfs)	317.55	1094.23	368.22
Top Width (ft)	831.77	Top Width (ft)	107.97	53.29	670.51
Vel Total (ft/s)	0.63	Avg. Vel. (ft/s)	0.48	1.60	0.25
Max Chl Dpth (ft)	14.71	Hydr. Depth (ft)	6.08	12.87	2.21
Conv. Total (cfs)	200591.9	Conv. (cfs)	35785.0	123311.3	41495.6
Length Wtd. (ft)	135.71	Wetted Per. (ft)	109.41	53.97	672.75
Min Ch El (ft)	114.74	Shear (lb/sq ft)	0.03	0.06	0.01
Alpha	4.08	Stream Power (lb/ft s)	0.01	0.10	0.00
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)	10.00	9.62	15.47
C & E Loss (ft)	0.00	Cum SA (acres)	4.23	1.00	7.52

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	134.31	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	134.31	Reach Len. (ft)	142.70	133.80	135.50
Crit W.S. (ft)	120.72	Flow Area (sq ft)	1266.16	944.55	5165.99
E.G. Slope (ft/ft)	0.000018	Area (sq ft)	1266.16	944.55	5165.99
Q Total (cfs)	2480.00	Flow (cfs)	376.95	884.62	1218.44
Top Width (ft)	1017.64	Top Width (ft)	140.91	53.29	823.44
Vel Total (ft/s)	0.34	Avg. Vel. (ft/s)	0.30	0.94	0.24
Max Chl Dpth (ft)	19.57	Hydr. Depth (ft)	8.99	17.72	6.27
Conv. Total (cfs)	589415.9	Conv. (cfs)	89587.9	210245.3	289582.7
Length Wtd. (ft)	136.00	Wetted Per. (ft)	142.72	53.97	825.76
Min Ch El (ft)	114.74	Shear (lb/sq ft)	0.01	0.02	0.01
Alpha	3.13	Stream Power (lb/ft s)	0.00	0.02	0.00
Frctn Loss (ft)	0.00	Cum Volume (acre-ft)	18.94	13.66	38.14
C & E Loss (ft)	0.00	Cum SA (acres)	5.74	1.00	9.06

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 4473

INPUT
Description:
Station Elevation Data num= 45

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-65	135	-38	130	0	126.22	29.7	123.83	46.67	122.12
55.44	120.49	66.71	119.94	67.6	119.83	69.47	118.15	70.82	117.09
74.31	116.47	77.42	115.93	77.62	115.89	84.05	114.36	87.73	115.01
93.36	116.25	99.66	116.94	105.78	117.64	106.64	118.23	109.89	119.19
110.4	119.4	111.43	120.19	116.2	122.53	120.89	124.42	141.46	124.66
147.46	125.56	149.27	126.15	150.02	126.38	165.46	126.85	170.67	127.52
172.45	127.36	175.93	127.11	183.37	126.65	187.84	126.75	192.1	126.88
225.73	126.93	231.76	127.02	232.65	127	249.55	127.02	280.28	127.38
425	127.5	590	127	777	128.5	900	130	1050	135

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-65	.09	70.82	.045	105.78	.09

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
70.82	105.78	99	90.3	81.7	.3	.5

Right Levee   Station= 170.79   Elevation= 127.49

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	124.86	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.10	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	124.76	Reach Len. (ft)	99.00	90.30	81.70
Crit W.S. (ft)	118.92	Flow Area (sq ft)	141.80	303.73	60.13
E.G. Slope (ft/ft)	0.000393	Area (sq ft)	141.80	303.73	60.13
Q Total (cfs)	947.00	Flow (cfs)	88.43	831.78	26.79
Top Width (ft)	123.93	Top Width (ft)	52.64	34.96	36.33
Vel Total (ft/s)	1.87	Avg. Vel. (ft/s)	0.62	2.74	0.45
Max Chl Dpth (ft)	10.40	Hydr. Depth (ft)	2.69	8.69	1.66
Conv. Total (cfs)	47752.7	Conv. (cfs)	4459.2	41942.5	1351.0
Length Wtd. (ft)	90.54	Wetted Per. (ft)	53.94	35.51	37.88
Min Ch El (ft)	114.36	Shear (lb/sq ft)	0.06	0.21	0.04
Alpha	1.89	Stream Power (lb/ft s)	0.04	0.58	0.02
Frctn Loss (ft)	0.07	Cum Volume (acre-ft)	2.27	5.53	4.21
C & E Loss (ft)	0.09	Cum SA (acres)	1.24	0.87	1.86

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	127.89	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.09	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	127.80	Reach Len. (ft)	99.00	90.30	81.70
Crit W.S. (ft)	119.88	Flow Area (sq ft)	356.82	410.22	481.68
E.G. Slope (ft/ft)	0.000267	Area (sq ft)	356.82	410.22	481.68
Q Total (cfs)	1490.00	Flow (cfs)	244.54	1131.41	114.05
Top Width (ft)	706.04	Top Width (ft)	86.73	34.96	584.34
Vel Total (ft/s)	1.19	Avg. Vel. (ft/s)	0.69	2.76	0.24
Max Chl Dpth (ft)	13.44	Hydr. Depth (ft)	4.11	11.73	0.82
Conv. Total (cfs)	91152.8	Conv. (cfs)	14960.3	69215.5	6977.0
Length Wtd. (ft)	90.66	Wetted Per. (ft)	88.18	35.51	586.17
Min Ch El (ft)	114.36	Shear (lb/sq ft)	0.07	0.19	0.01
Alpha	4.11	Stream Power (lb/ft s)	0.05	0.53	0.00
Frctn Loss (ft)	0.05	Cum Volume (acre-ft)	4.78	6.82	7.62
C & E Loss (ft)	0.10	Cum SA (acres)	2.35	0.87	3.42

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	129.46	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.04	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	129.42	Reach Len. (ft)	99.00	90.30	81.70
Crit W.S. (ft)	120.45	Flow Area (sq ft)	510.35	466.79	1572.46
E.G. Slope (ft/ft)	0.000136	Area (sq ft)	510.35	466.79	1572.46
Q Total (cfs)	1780.00	Flow (cfs)	282.73	1000.84	496.43
Top Width (ft)	884.74	Top Width (ft)	103.00	34.96	746.78
Vel Total (ft/s)	0.70	Avg. Vel. (ft/s)	0.55	2.14	0.32
Max Chl Dpth (ft)	15.06	Hydr. Depth (ft)	4.95	13.35	2.11
Conv. Total (cfs)	152677.6	Conv. (cfs)	24250.5	85846.3	42580.8
Length Wtd. (ft)	89.83	Wetted Per. (ft)	104.53	35.51	748.61
Min Ch El (ft)	114.36	Shear (lb/sq ft)	0.04	0.11	0.02
Alpha	5.46	Stream Power (lb/ft s)	0.02	0.24	0.01
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)	8.09	7.85	10.71
C & E Loss (ft)	0.11	Cum SA (acres)	3.88	0.87	5.31

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Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q500

  E.G. Elev (ft)            134.31    Element                  Left OB    Channel   Right OB
  Vel Head (ft)               0.01    Wt. n-Val.                 0.090      0.045      0.090
  W.S. Elev (ft)            134.31    Reach Len. (ft)            99.00      90.30      81.70
  Crit W.S. (ft)            121.56    Flow Area (sq ft)        1090.29     637.56    5716.41
  E.G. Slope (ft/ft)      0.000021    Area (sq ft)             1090.29     637.56    5716.41
  Q Total (cfs)            2480.00    Flow (cfs)                337.58     669.20    1473.22
  Top Width (ft)           1090.44    Top Width (ft)            132.07      34.96     923.40
  Vel Total (ft/s)            0.33    Avg. Vel. (ft/s)            0.31       1.05       0.26
  Max Chl Dpth (ft)          19.95    Hydr. Depth (ft)            8.26      18.24       6.19
  Conv. Total (cfs)       534912.4    Conv. (cfs)              72813.4   144339.6   317759.4
  Length Wtd. (ft)           88.51    Wetted Per. (ft)          134.02      35.51     925.32
  Min Ch El (ft)            114.36    Shear (lb/sq ft)            0.01       0.02       0.01
  Alpha                       3.15    Stream Power (lb/ft s)      0.00       0.03       0.00
  Frctn Loss (ft)             0.01    Cum Volume (acre-ft)       15.08      11.23      21.22
  C & E Loss (ft)             0.09    Cum SA (acres)              5.29       0.87       6.34


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION


RIVER: River 1
REACH: Reach 1            RS: 4383

INPUT
Description:
Station Elevation Data    num=      98
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  140.33   3.031  140.13  24.102  138.95  46.072  138.84   56.23  138.93
  57.634   138.9   66.84  138.46  67.411  138.41  71.083   138.4  73.517  138.53
  75.716   138.7  84.672  139.06  89.435  139.37 101.048  139.04 102.745  138.97
 103.932     139 112.029  138.89 117.476  137.78 119.806  137.18   125.6   136.7
 132.242   136.6 145.388  134.23 147.883  133.88 150.662  133.31 160.319  131.71
 164.242  131.38 181.684  129.18 188.023  129.23  201.94  128.47 220.221  128.29
 227.124  128.04 234.035  127.78 238.452  127.88 241.847  125.74 243.007  125.49
 244.661  124.46 252.126  121.68 259.825  117.09 260.501  116.78 260.509  116.77
 260.986  116.74 265.506  115.92 270.425  116.23 272.816  116.04 276.894  116.73
 277.968   116.9 278.002  116.93 279.501  118.28 282.133  120.37 282.818  120.65
 303.742  124.55 307.335  125.14 308.375  125.21 311.353  125.39 340.903  126.05
 354.871  126.56 375.422  127.28 377.882  127.65  378.73  127.56 380.367  127.42
 389.088   126.8 394.319  126.93 397.229  127.03 420.135  127.08 430.155  127.24
 431.618  127.21 459.695  127.24 476.227  127.47  478.47  127.52 526.206  128.02
 529.722  128.02 535.732  127.92 575.552  127.29 578.868  127.31 581.778  127.04
 585.822  126.29 588.326  126.25 589.287  126.25 591.885   127.7 591.911   127.7
 591.928  127.71 600.528  128.07 601.438  128.16 610.981  127.03 612.747  126.94
 617.433   126.8 661.357  127.01 663.246  127.01 680.245   127.1 690.741  126.83
 706.113  126.67 721.295  126.17 755.391  126.26 761.184   126.2  764.64  126.28
 810.513  126.67    1150     130    1300     135

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .09 259.825    .045 278.002     .09

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
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259.825 278.002 153.5 144.5 154.5 .6 .8

Ineffective Flow num= 3

Sta L	Sta R	Elev	Permanent
0	239.378	134	T
290.3	866.025	134	T
866.025	1400	135	F

Right Levee Station= 434.45 Elevation= 127.47

Skew Angle = 30

CROSS SECTION OUTPUT Profile #Q10

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	124.70	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.41	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	124.29	Reach Len. (ft)	153.50	144.50	154.50
Crit W.S. (ft)	120.62	Flow Area (sq ft)	46.92	145.04	47.70
E.G. Slope (ft/ft)	0.001801	Area (sq ft)	46.92	145.04	61.23
Q Total (cfs)	947.00	Flow (cfs)	66.12	804.22	76.66
Top Width (ft)	57.23	Top Width (ft)	14.71	18.18	24.35
Vel Total (ft/s)	3.95	Avg. Vel. (ft/s)	1.41	5.54	1.61
Max Chl Dpth (ft)	8.37	Hydr. Depth (ft)	3.19	7.98	3.88
Conv. Total (cfs)	22316.6	Conv. (cfs)	1558.2	18951.8	1806.6
Length Wtd. (ft)	144.50	Wetted Per. (ft)	16.44	18.42	13.73
Min Ch El (ft)	115.92	Shear (lb/sq ft)	0.32	0.88	0.39
Alpha	1.69	Stream Power (lb/ft s)	0.45	4.91	0.63
Frctn Loss (ft)		Cum Volume (acre-ft)	2.06	5.07	4.09
C & E Loss (ft)		Cum SA (acres)	1.16	0.81	1.81

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	127.75	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.42	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	127.33	Reach Len. (ft)	153.50	144.50	154.50
Crit W.S. (ft)	122.24	Flow Area (sq ft)	100.93	200.35	85.12
E.G. Slope (ft/ft)	0.001278	Area (sq ft)	100.93	200.35	241.27
Q Total (cfs)	1490.00	Flow (cfs)	159.73	1160.72	169.55
Top Width (ft)	189.32	Top Width (ft)	20.51	18.18	150.64
Vel Total (ft/s)	3.86	Avg. Vel. (ft/s)	1.58	5.79	1.99
Max Chl Dpth (ft)	11.41	Hydr. Depth (ft)	4.94	11.02	6.92
Conv. Total (cfs)	41683.6	Conv. (cfs)	4468.6	32471.8	4743.2
Length Wtd. (ft)	144.50	Wetted Per. (ft)	22.98	18.42	13.73
Min Ch El (ft)	115.92	Shear (lb/sq ft)	0.35	0.87	0.49
Alpha	1.81	Stream Power (lb/ft s)	0.55	5.03	0.99
Frctn Loss (ft)		Cum Volume (acre-ft)	4.26	6.18	6.94
C & E Loss (ft)		Cum SA (acres)	2.22	0.81	2.73

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	129.33	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.40	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	128.92	Reach Len. (ft)	153.50	144.50	154.50
Crit W.S. (ft)	122.88	Flow Area (sq ft)	133.44	229.25	104.68
E.G. Slope (ft/ft)	0.001068	Area (sq ft)	163.56	229.25	1451.18
Q Total (cfs)	1780.00	Flow (cfs)	232.61	1328.57	218.82
Top Width (ft)	846.60	Top Width (ft)	66.19	18.18	762.23
Vel Total (ft/s)	3.81	Avg. Vel. (ft/s)	1.74	5.80	2.09
Max Chl Dpth (ft)	13.00	Hydr. Depth (ft)	6.53	12.61	8.51
Conv. Total (cfs)	54459.4	Conv. (cfs)	7116.7	40647.9	6694.8
Length Wtd. (ft)	144.50	Wetted Per. (ft)	22.98	18.42	13.73
Min Ch El (ft)	115.92	Shear (lb/sq ft)	0.39	0.83	0.51

Alpha	1.79	Stream Power (lb/ft s)	0.68	4.81	1.06
Frctn Loss (ft)		Cum Volume (acre-ft)	7.32	7.13	7.88
C & E Loss (ft)		Cum SA (acres)	3.69	0.81	3.90

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	134.21	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.32	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	133.89	Reach Len. (ft)	153.50	144.50	154.50
Crit W.S. (ft)	124.21	Flow Area (sq ft)	235.08	319.61	165.81
E.G. Slope (ft/ft)	0.000575	Area (sq ft)	635.79	319.61	5954.17
Q Total (cfs)	2480.00	Flow (cfs)	438.55	1695.89	345.56
Top Width (ft)	1119.05	Top Width (ft)	112.04	18.18	988.82
Vel Total (ft/s)	3.44	Avg. Vel. (ft/s)	1.87	5.31	2.08
Max Chl Dpth (ft)	17.97	Hydr. Depth (ft)	11.50	17.58	13.48
Conv. Total (cfs)	103419.0	Conv. (cfs)	18288.0	70720.8	14410.1
Length Wtd. (ft)	144.50	Wetted Per. (ft)	22.98	18.42	13.73
Min Ch El (ft)	115.92	Shear (lb/sq ft)	0.37	0.62	0.43
Alpha	1.73	Stream Power (lb/ft s)	0.69	3.30	0.90
Frctn Loss (ft)		Cum Volume (acre-ft)	13.12	10.23	10.27
C & E Loss (ft)		Cum SA (acres)	5.01	0.81	4.55

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CULVERT

RIVER: River 1
REACH: Reach 1 RS: 4318

INPUT
Description:
Distance from Upstream XS = 25
Deck/Roadway Width = 75
Weir Coefficient = 2.6
Bridge Deck/Roadway Skew = 30
Upstream Deck/Roadway Coordinates
num= 12

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
0	138.517	110	86.589	137.842	110	173.179	137.15	110
259.768	136.392	110	346.358	135.7	110	432.947	135.042	110
519.537	134.358	110	606.126	134.175	110	692.716	134.475	110
779.305	135.342	110	865.895	135.75	110	1300	140	110

Upstream Bridge Cross Section Data
Station Elevation Data num= 450

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	140.46	8.747	140.11	11.085	139.93	13.337	139.79	16.974	139.51
19.745	139.27	22.517	139.05	23.556	138.99	24.335	138.95	26.5	138.97
28.752	139.03	30.917	139	33.775	139	37.586	138.95	39.751	138.96
44.947	138.9	50.662	138.89	53.001	138.95	55.252	138.92	57.417	138.86
65.472	138.5	68.503	138.43	72.919	138.5	77.769	138.83	79.501	138.93
84.091	139.12	86.429	139.25	88.941	139.33	90.5	139.32	101.238	139.02
103.75	138.97	106.435	138.66	109.206	138.37	110.418	138.27	112.323	138.08
114.835	137.9	121.417	137.51	122.196	137.42	123.235	137.22	124.708	136.89
125.833	136.68	128.778	136.66	131.549	136.6	132.069	136.58	132.415	136.53
134.667	136.15	136.832	135.73	139.084	135.34	141.249	134.93	142.808	134.66
144.366	134.38	146.878	134.01	148.35	133.73	150.082	133.38	151.121	133.19
156.751	132.28	159.175	131.85	160.475	131.69	164.112	131.36	170.001	130.64
172.166	130.34	176.496	129.82	178.748	129.51	180.999	129.24	183.164	129.21
187.581	129.24	198.666	128.66	199.879	128.61	201.524	128.5	202.39	128.5

203.603	128.47	204.295	128.43	206.027	128.43	209.665	128.37	210.964	128.38
215.467	128.34	219.624	128.28	223.348	128.17	227.072	128.01	227.332	127.98
229.497	127.6	231.748	127.24	236.165	126.46	236.858	126.35	238.33	126.1
239.369	126.01	241.794	125.64	242.747	125.47	243.44	125.1	244.306	124.55
245.518	123.69	246.211	123.15	246.731	122.9	248.982	121.89	250.455	121.23
251.58	120.73	252.966	120.1	254.611	119.36	256.603	118.4	257.383	118.08
259.115	117.31	260.414	116.76	260.5	116.744	261.54	116.55	262.665	116.39
264.571	116.19	268.468	115.67	271.447	115.97	273.664	116.24	275.829	116.61
276.349	116.87	276.955	117.14	277.561	117.36	277.994	117.393	278.081	117.4
278.86	117.95	279.726	118.75	280.073	119.02	281.285	119.76	282.497	120.67
283.797	120.76	284.663	120.87	285.355	120.93	286.221	120.97	288.127	121.02
291.331	121.05	292.37	121.1	293.496	121.25	293.756	121.31	295.748	122.13
296.094	122.26	297.307	122.61	297.913	122.75	300.164	123.16	302.329	123.7
304.581	124.38	305.967	124.85	306.746	125.1	307.699	125.15	308.392	125.14
308.998	125.16	313.328	124.84	316.099	124.6	317.831	124.47	318.264	124.45
318.871	124.44	319.477	124.47	324.413	124.82	326.578	124.94	333.247	125.42
335.412	125.54	337.663	125.7	338.443	125.8	339.222	125.86	339.828	125.95
341.301	126.22	341.734	126.33	342.08	126.42	342.946	126.59	344.072	126.69
348.662	126.66	351.606	126.6	353.079	126.6	354.031	126.56	355.33	126.56
356.543	126.5	358.015	126.47	360.873	126.35	365.116	126.19	366.329	126.17
374.816	127.26	376.375	127.5	377.5	127.64	378.713	127.57	381.744	127.33
383.649	127.21	386.161	127.01	388.412	126.86	388.586	126.85	389.798	126.85
391.617	126.88	397.159	127.06	399.411	127.37	399.671	127.39	402.182	127.38
403.828	127.34	406.079	127.32	409.543	127.25	410.756	127.25	411.189	127.23
412.661	127.2	413.267	127.22	414.48	127.18	415.692	127.2	416.731	127.15
416.905	127.15	417.078	127.14	418.204	127.18	419.329	127.13	419.416	127.13
419.589	127.13	420.629	127.18	421.495	127.14	422.361	127.15	423.14	127.2
423.746	127.18	425.132	127.21	425.565	127.23	425.911	127.22	428.076	127.26
428.769	127.26	430.328	127.27	433.532	127.24	442.799	127.26	443.578	127.26
444.704	127.26	445.31	127.27	445.743	127.26	447.562	127.26	447.735	127.28
449.034	127.28	450.333	127.27	451.459	127.29	453.104	127.27	453.971	127.31
454.577	127.29	455.876	127.29	456.395	127.32	457.608	127.33	458.734	127.3
458.907	127.3	460.119	127.33	461.505	127.28	462.544	127.36	463.41	127.35
463.843	127.36	464.276	127.34	465.056	127.38	465.662	127.38	466.268	127.39
467.134	127.35	467.827	127.36	468.78	127.41	469.905	127.4	469.992	127.4
471.204	127.44	472.417	127.44	472.677	127.42	474.928	127.48	475.448	127.47
477.353	127.51	478.306	127.51	479.865	127.56	483.242	127.57	483.502	127.58
483.848	127.57	485.494	127.59	486.013	127.62	486.706	127.61	489.737	127.65
492.249	127.66	497.099	127.73	500.649	127.75	506.192	127.83	509.05	127.83
514.592	127.91	517.45	127.92	522.993	128	529.575	128.02	531.653	128
533.991	127.94	538.408	127.89	540.227	127.84	545.076	127.78	547.241	127.73
551.398	127.68	552.611	127.64	556.595	127.59	559.366	127.53	564.908	127.47
567.42	127.41	571.057	127.37	571.577	127.35	572.356	127.33	574.781	127.28
575.907	127.22	578.159	127.07	579.717	127.03	580.93	127.05	582.229	127.1
583.441	127.17	584.481	127.26	584.654	127.27	589.157	127.54	589.59	127.51
590.803	127.55	591.409	127.6	592.102	127.6	592.881	127.77	593.574	127.8
594.526	127.77	595.739	127.9	597.991	127.98	598.51	128	599.463	128.06
600.242	128.11	600.675	128.12	601.281	128.11	602.407	128.02	608.123	127.37
609.682	127.17	610.548	127.1	612.453	126.98	613.492	126.96	615.311	126.89
629.081	126.19	629.254	126.18	630.293	126.11	631.506	126.05	640.426	126.3
643.197	126.41	651.598	126.64	654.455	126.75	656.187	126.8	661.124	126.95
662.336	126.96	662.769	126.98	664.241	126.98	664.848	126.96	665.627	127.01
666.06	127.02	666.407	127.02	667.273	126.99	668.398	127.03	669.784	126.99
670.823	127.01	672.209	126.99	673.075	127.02	673.421	126.99	674.028	127.02
674.72	127	675.24	127.01	675.933	126.97	676.799	127.02	677.145	127.01
677.405	127.01	678.358	126.95	679.57	127.03	679.657	127.03	680.869	126.93
681.822	126.99	682.082	127	683.294	126.89	684.593	126.99	685.199	126.92
685.806	126.85	686.239	126.88	687.018	126.95	688.23	126.83	689.443	126.95
690.655	126.85	691.954	127	692.907	126.96	693.167	126.98	693.6	126.98
694.379	127.06	695.072	127.04	695.678	127.09	696.371	127.12	696.891	127.18
697.324	127.18	698.103	127.26	699.315	127.35	699.489	127.35	700.874	127.45
701.914	127.54	703.039	127.57	703.905	127.51	704.252	127.37	704.771	127.18
705.551	126.93	706.763	126.67	707.543	126.57	710.314	126.5	713.172	126.39
714.125	126.36	714.991	126.34	715.424	126.36	715.943	126.31	716.636	126.29
717.156	126.27	717.848	126.3	718.714	126.23	719.061	126.22	719.407	126.21

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 720.273  126.29 721.486  126.22 721.572  126.22 722.785  126.33 723.824  126.31
  725.21   126.4 725.989  126.39 727.115  126.44 727.721  126.48 728.154  126.48
 730.406  126.63  733.87  126.93 736.988  127.21 738.287  127.25 739.239  127.22
 741.318  127.09 743.656  126.97 747.466  126.73 748.073  126.71 748.679  126.68
 749.891  126.61  752.23  126.46  752.49  126.45 753.615  126.42 755.088  126.31
  756.04  126.33 756.906   126.3 757.339  126.28 757.859  126.23 758.552  126.23
 759.071  126.22 759.764  126.24  760.63  126.21 763.488  126.25   764.7  126.33
  765.74  126.36 777.085  126.91 778.903  127.03 779.509  127.06 781.155  127.14
 781.934  127.16 785.658   127.2 787.737  127.25 797.003  127.33 799.774  127.39
 802.979  127.38 803.239  127.39 804.191   127.4 807.655   127.4 807.915   127.4
 808.175  127.41 809.128  127.42 810.513  127.43    1150     130    1300     135

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0      .1   260.5     .05 277.994      .1

Bank Sta: Left   Right    Coeff Contr.   Expan.
        261.54 275.829             .6       .8
Ineffective Flow     num=       3
   Sta L   Sta R    Elev  Permanent
       0 239.378     134       T
   290.3 866.025     134       T
 866.025    1400     135       F
Right Levee     Station=  434.45      Elevation=  127.47
Skew Angle = 30

Downstream  Deck/Roadway Coordinates
    num=      13
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
       0 138.517     110  86.589 137.842     110 173.179  137.15     110
 259.768 136.392     110 346.358   135.7     110 432.947 135.042     110
 519.537 134.358     110 606.126 134.175     110 692.716 134.475     110
 779.305 135.342     110 865.895   135.5     110    1100     136     110
    1200     140     110

Downstream Bridge Cross Section Data
Station Elevation Data    num=     228
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  137.91   6.668  137.27   9.786  137.11  12.298  136.96  15.502  136.73
  17.754  136.62  19.312   136.6    26.5  136.59  30.917  136.53  36.113   136.4
  38.192  136.42  39.751  136.34  44.514  136.34  46.765   136.4  48.584   136.5
  51.702  136.61  53.001  136.69  54.213  136.71  56.638  136.81  57.417  136.86
  58.457  136.95   59.15  136.98  60.362     137  61.228  137.04  64.086  137.06
  66.857  137.12  70.235  137.16  71.447  137.21  76.383  137.55  77.596  137.59
  78.895  137.61  86.256  137.62  87.469  137.71  88.335   137.8    90.5  138.13
  92.059  138.37  92.751   138.5  97.601  139.54  98.554  139.69  99.333  139.75
 101.585  139.77  103.75  139.82 104.789  139.74 106.002  139.66 108.773  139.38
 110.938  139.14 113.363  138.89 114.835  138.73     117  138.51 119.252  138.15
 121.417   137.7 123.235  137.29 125.747  136.72 129.384  135.81 133.974  134.62
 136.745  133.86 142.375  132.29 144.193  131.81 145.492  131.52 147.917  130.99
 150.082  130.57 152.334   130.1 152.853     130 153.546  129.89 155.278  129.65
 158.916  129.19 160.215     129 163.939  128.51 165.584  128.28 167.749  128.16
 168.875  128.16 170.347  128.21 172.166  128.24 173.811   128.3 176.409 128.335
 177.535  128.35  179.96  128.29 183.684  128.23 185.416  128.16 186.109  128.11
 189.919  127.81 191.218 127.773 192.344  127.74 195.462  127.71 198.493  127.66
 199.705  127.62 200.831  127.56 204.642   127.3 206.634  127.19 209.492   127.1
 210.791  127.04 214.514  126.91  220.75  126.63 221.876  126.69 222.915  126.81
 223.175  126.82 224.387  126.76  225.08  126.68 227.332  126.43 228.111  126.38
 229.324  126.36 237.378  126.42 237.984  126.47 239.196  126.51 242.747  126.37
 249.069  126.24 251.407  126.22 268.121  125.91 269.247  125.86 270.979   125.7
 273.664   125.4 275.829  125.09 280.246  124.37 281.112  124.21 282.151  124.05
 282.324  123.98 282.497  123.91 283.537  123.04 284.922  121.96 287.694  119.63
 288.473  119.19 289.079  118.97 290.552  118.62 293.409  117.95 295.921  117.46
 297.133  117.34 297.913  117.31 298.346  117.33 300.164  117.33 300.857  117.37
 301.723  117.34 302.329  117.35 303.282  117.46 304.581   117.5 305.794  117.63
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 306.746  117.71 307.266  117.79 308.218  117.88 309.431  117.94 318.524  118.07
 321.295  118.14 323.027  118.15 330.995  118.28 332.467  118.18   332.9  118.11
 333.247     118 335.412   116.6 336.624   116.1 349.493  115.97 352.472  115.67
 355.451  115.97 363.731   116.1 364.164  116.26 364.943   116.7 365.982  117.47
 366.156  117.65 366.329   117.8  368.58   120.2 368.667  120.28  368.84   120.3
 369.879  120.22 370.745  120.31 371.092  120.27 371.612  120.18 372.391   120.1
 372.997  120.14 373.603  120.15 374.816  120.04 376.028  120.03 377.241  119.97
 377.327  119.98 377.327     120  378.54   120.9 379.579  121.56 379.752  121.65
 380.012  121.69 381.744  121.63 382.783   121.6 383.476  121.65 383.996  121.68
 384.688  121.71 385.555  121.72 397.246  122.54 399.411  122.64 402.355  122.64
 403.221  122.47 404.434  122.26 405.127  122.17 408.244  121.47  409.37   121.5
 410.496  121.48 413.094  121.82 413.527  121.89 414.307  122.01 414.913  122.16
 416.385  122.78 416.731  122.94 417.078  123.03  418.03   123.2 420.455  123.31
 421.668  123.48 428.076  124.88 430.328  125.12 434.745  125.57 435.264   125.6
 435.957  125.61 440.201  125.56 447.995  125.54  450.16  125.57 452.671  125.66
 458.301  125.95 458.647  125.96 464.882  125.97 466.701  126.01 467.827  126.06
 470.079  126.17 473.456   126.3 474.409  126.35 474.755  126.37 475.708  126.41
 535.057   126.5 727.184     127 767.653   127.5 835.013     128  863.09   128.5
 906.919  128.65    1100     130    1200     135

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0      .1 336.624     .05 364.164      .1

Bank Sta: Left   Right    Coeff Contr.   Expan.
       336.624 363.731             .6       .8
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0 308.599     134       T
 388.776    1200     134       T
Left Levee      Station=  332.71      Elevation=  118.31
Right Levee     Station=  399.15      Elevation=  122.76
Skew Angle = 30

Upstream Embankment side slope              =       0 horiz. to 1.0 vertical
Downstream Embankment side slope            =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins         =
Energy head used in spillway design         =
Spillway height used in design              =
Weir crest shape                            = Broad Crested

Number of Culverts =  1

Culvert Name     Shape      Rise    Span
Culvert #1     Pipe Arch   11.75      18
FHWA Chart # 36- 31 inch corner radius; Corrugated metal
FHWA Scale # 1 - Projecting
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    Top n  Bottom n  Depth Blocked  Entrance Loss Coef   Exit Loss Coef
                 20      92     .028     .028      .25                   .7                1
Upstream   Elevation =  115.67
           Centerline Station =  268.47
Downstream Elevation =  115.67
           Centerline Station =  352.47

CULVERT OUTPUT  Profile #Q10  Culv Group:  Culvert #1

  Q Culv Group (cfs)       947.00    Culv Full Len (ft)
  # Barrels                     1    Culv Vel US (ft/s)          8.50
  Q Barrel (cfs)           947.00    Culv Vel DS (ft/s)          9.09
  E.G. US. (ft)            124.70    Culv Inv El Up (ft)       115.67
  W.S. US. (ft)            124.29    Culv Inv El Dn (ft)       115.67
  E.G. DS (ft)             122.46    Culv Frctn Ls (ft)          0.31
  W.S. DS (ft)             122.32    Culv Exit Loss (ft)         1.14
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Delta EG (ft)	2.24	Culv Entr Loss (ft)	0.79
Delta WS (ft)	1.97	Q Weir (cfs)	
E.G. IC (ft)	123.83	Weir Sta Lft (ft)	
E.G. OC (ft)	124.70	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	122.79	Weir Max Depth (ft)	
Culv WS Outlet (ft)	122.32	Weir Avg Depth (ft)	
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	4.93	Min El Weir Flow (ft)	134.19

CULVERT OUTPUT Profile #Q50 Culv Group: Culvert #1

Q Culv Group (cfs)	1490.00	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	11.08
Q Barrel (cfs)	1490.00	Culv Vel DS (ft/s)	12.10
E.G. US. (ft)	127.75	Culv Inv El Up (ft)	115.67
W.S. US. (ft)	127.33	Culv Inv El Dn (ft)	115.67
E.G. DS (ft)	123.87	Culv Frctn Ls (ft)	0.51
W.S. DS (ft)	123.63	Culv Exit Loss (ft)	2.04
Delta EG (ft)	3.88	Culv Entr Loss (ft)	1.34
Delta WS (ft)	3.70	Q Weir (cfs)	
E.G. IC (ft)	127.04	Weir Sta Lft (ft)	
E.G. OC (ft)	127.75	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	124.51	Weir Max Depth (ft)	
Culv WS Outlet (ft)	123.63	Weir Avg Depth (ft)	
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	6.25	Min El Weir Flow (ft)	134.19

CULVERT OUTPUT Profile #Q100 Culv Group: Culvert #1

Q Culv Group (cfs)	1780.00	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	12.39
Q Barrel (cfs)	1780.00	Culv Vel DS (ft/s)	13.88
E.G. US. (ft)	129.32	Culv Inv El Up (ft)	115.67
W.S. US. (ft)	128.92	Culv Inv El Dn (ft)	115.67
E.G. DS (ft)	124.31	Culv Frctn Ls (ft)	0.64
W.S. DS (ft)	124.01	Culv Exit Loss (ft)	2.70
Delta EG (ft)	5.01	Culv Entr Loss (ft)	1.67
Delta WS (ft)	4.91	Q Weir (cfs)	
E.G. IC (ft)	128.79	Weir Sta Lft (ft)	
E.G. OC (ft)	129.32	Weir Sta Rgt (ft)	
Culvert Control	Outlet	Weir Submerg	
Culv WS Inlet (ft)	125.26	Weir Max Depth (ft)	
Culv WS Outlet (ft)	124.01	Weir Avg Depth (ft)	
Culv Nml Depth (ft)		Weir Flow Area (sq ft)	
Culv Crt Depth (ft)	6.86	Min El Weir Flow (ft)	134.19

CULVERT OUTPUT Profile #Q500 Culv Group: Culvert #1

Q Culv Group (cfs)	2479.94	Culv Full Len (ft)	
# Barrels	1	Culv Vel US (ft/s)	15.38
Q Barrel (cfs)	2479.94	Culv Vel DS (ft/s)	17.76
E.G. US. (ft)	134.21	Culv Inv El Up (ft)	115.67
W.S. US. (ft)	133.89	Culv Inv El Dn (ft)	115.67
E.G. DS (ft)	125.37	Culv Frctn Ls (ft)	1.82
W.S. DS (ft)	124.92	Culv Exit Loss (ft)	4.45
Delta EG (ft)	8.85	Culv Entr Loss (ft)	2.57
Delta WS (ft)	8.97	Q Weir (cfs)	0.06
E.G. IC (ft)	134.21	Weir Sta Lft (ft)	595.28
E.G. OC (ft)	133.56	Weir Sta Rgt (ft)	612.74
Culvert Control	Inlet	Weir Submerg	0.00

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  Culv WS Inlet (ft)        127.42    Weir Max Depth (ft)         0.02
  Culv WS Outlet (ft)       124.92    Weir Avg Depth (ft)         0.01
  Culv Nml Depth (ft)                 Weir Flow Area (sq ft)      0.20
  Culv Crt Depth (ft)         8.54    Min El Weir Flow (ft)     134.19


Warning: During the culvert outlet control computations, the program could not balance the culvert/weir flow.  The reported
         outlet energy grade answer may not be valid.
Note:    During the supercritical calculations a hydraulic jump occurred inside of the culvert.

CROSS SECTION


RIVER: River 1
REACH: Reach 1           RS: 4239

INPUT
Description:
Station Elevation Data    num=      68
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  137.65   6.781  137.22  55.079  137.14  59.643  136.99  93.037  139.69
  98.692  139.71 104.685  139.82 122.759  137.46 143.578  131.98 144.956  131.66
  153.85  130.27 178.237  128.37  179.38   128.3  214.28  127.26 223.435   126.9
 237.767  126.43 241.613   126.4 269.429  125.89 274.409  125.35 282.593  124.02
  282.74  123.93 286.456  120.23 292.085  119.52 296.788  117.35 303.551  117.41
  306.59  117.68 307.326  117.87 308.201   117.9 327.357  118.23 332.709  118.31
 332.943  118.29 333.064  118.25 336.268  116.22 337.221  115.94 338.737  115.41
  342.92  113.85 344.479  112.99 350.463  112.32 350.671  112.37 350.723  112.38
 350.887  112.37 360.284  114.87 364.484  116.33 364.501  116.34 365.532  116.81
 368.719  120.32 368.892  120.48 369.681  120.38 377.578  120.12 383.536  121.66
 399.152  122.76 403.022  122.74 409.388  121.31 414.628  121.98 417.087  122.15
 417.555  122.65 422.603  124.52  446.93  125.94 458.769  125.96 475.708  126.17
 535.057   126.5 727.184     127 767.653   127.5 835.013     128  863.09   128.5
 906.919  128.65    1100     130    1200     135

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .09 336.268    .045 364.484     .09

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       336.268 364.484            163.4   106.6   256.9             .6       .8
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0 308.599     134       T
 388.776    1200     134       T
Left Levee      Station=  332.71      Elevation=  118.31
Right Levee     Station=  399.15      Elevation=  122.76
Skew Angle = 30

CROSS SECTION OUTPUT  Profile #Q10

  E.G. Elev (ft)            122.46    Element                   Left OB    Channel   Right OB
  Vel Head (ft)               0.15    Wt. n-Val.                 0.090      0.045      0.090
  W.S. Elev (ft)            122.32    Reach Len. (ft)           163.40     106.60     256.90
  Crit W.S. (ft)            117.32    Flow Area (sq ft)         119.02     233.97      47.06
  E.G. Slope (ft/ft)      0.000654    Area (sq ft)              210.04     233.97      47.64
  Q Total (cfs)             947.00    Flow (cfs)                131.07     786.58      29.35
  Top Width (ft)            108.48    Top Width (ft)             51.91      28.22      28.36
  Vel Total (ft/s)            2.37    Avg. Vel. (ft/s)            1.10       3.36       0.62
  Max Chl Dpth (ft)          10.00    Hydr. Depth (ft)            4.30       8.29       1.94
  Conv. Total (cfs)        37019.8    Conv. (cfs)               5123.9    30748.7     1147.2
  Length Wtd. (ft)          121.49    Wetted Per. (ft)           28.27      29.47      26.23
  Min Ch El (ft)            112.32    Shear (lb/sq ft)            0.17       0.32       0.07
  Alpha                       1.71    Stream Power (lb/ft s)      0.19       1.09       0.05
  Frctn Loss (ft)             0.08    Cum Volume (acre-ft)        2.06       4.67       4.09
```

C & E Loss (ft)	0.02	Cum SA (acres)	1.05	0.74	1.71

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q50

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	123.87	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.23	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	123.63	Reach Len. (ft)	163.40	106.60	256.90
Crit W.S. (ft)	118.74	Flow Area (sq ft)	155.46	271.12	79.05
E.G. Slope (ft/ft)	0.000887	Area (sq ft)	279.26	271.12	121.68
Q Total (cfs)	1490.00	Flow (cfs)	238.15	1170.75	81.09
Top Width (ft)	137.17	Top Width (ft)	53.23	28.22	55.72
Vel Total (ft/s)	2.95	Avg. Vel. (ft/s)	1.53	4.32	1.03
Max Chl Dpth (ft)	11.31	Hydr. Depth (ft)	5.62	9.61	3.25
Conv. Total (cfs)	50029.1	Conv. (cfs)	7996.4	39309.9	2722.8
Length Wtd. (ft)	128.33	Wetted Per. (ft)	28.27	29.47	26.23
Min Ch El (ft)	112.32	Shear (lb/sq ft)	0.30	0.51	0.17
Alpha	1.74	Stream Power (lb/ft s)	0.47	2.20	0.17
Frctn Loss (ft)	0.12	Cum Volume (acre-ft)	4.26	5.60	6.94
C & E Loss (ft)	0.02	Cum SA (acres)	2.10	0.74	2.36

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q100

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	124.31	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.30	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	124.01	Reach Len. (ft)	163.40	106.60	256.90
Crit W.S. (ft)	119.27	Flow Area (sq ft)	166.01	281.89	88.32
E.G. Slope (ft/ft)	0.001081	Area (sq ft)	299.64	281.89	143.13
Q Total (cfs)	1780.00	Flow (cfs)	293.31	1379.01	107.68
Top Width (ft)	138.63	Top Width (ft)	53.66	28.22	56.75
Vel Total (ft/s)	3.32	Avg. Vel. (ft/s)	1.77	4.89	1.22
Max Chl Dpth (ft)	11.69	Hydr. Depth (ft)	6.00	9.99	3.64
Conv. Total (cfs)	54142.3	Conv. (cfs)	8921.6	41945.3	3275.3
Length Wtd. (ft)	130.60	Wetted Per. (ft)	28.27	29.47	26.23
Min Ch El (ft)	112.32	Shear (lb/sq ft)	0.40	0.65	0.23
Alpha	1.74	Stream Power (lb/ft s)	0.70	3.16	0.28
Frctn Loss (ft)	0.14	Cum Volume (acre-ft)	7.32	5.93	7.88
C & E Loss (ft)	0.02	Cum SA (acres)	3.48	0.74	2.45

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q500

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	125.37	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.45	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	124.92	Reach Len. (ft)	163.40	106.60	256.90
Crit W.S. (ft)	120.32	Flow Area (sq ft)	191.13	307.50	110.37
E.G. Slope (ft/ft)	0.001477	Area (sq ft)	350.87	307.50	196.93
Q Total (cfs)	2480.00	Flow (cfs)	433.69	1863.77	182.54
Top Width (ft)	152.43	Top Width (ft)	59.22	28.22	65.00
Vel Total (ft/s)	4.07	Avg. Vel. (ft/s)	2.27	6.06	1.65
Max Chl Dpth (ft)	12.60	Hydr. Depth (ft)	6.91	10.90	4.54
Conv. Total (cfs)	64520.0	Conv. (cfs)	11283.0	48488.1	4748.9
Length Wtd. (ft)	135.96	Wetted Per. (ft)	28.27	29.47	26.23
Min Ch El (ft)	112.32	Shear (lb/sq ft)	0.62	0.96	0.39
Alpha	1.73	Stream Power (lb/ft s)	1.42	5.83	0.64
Frctn Loss (ft)	0.20	Cum Volume (acre-ft)	13.12	6.66	10.27
C & E Loss (ft)	0.01	Cum SA (acres)	4.71	0.74	2.68

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 4132

INPUT
Description:
Station Elevation Data num= 46

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	129.9	80.76	125.97	87.57	125.77	115.4	126.08	117.38	125.79
119.1	125.16	119.6	125.05	125.75	121.13	128.8	119.19	129.06	116.93
130.17	115.57	135.04	113.97	136.99	113.53	137.67	113.42	143.19	112.71
143.6	112.74	144.24	112.88	147.61	113.25	150.88	113.62	153.79	113.86
153.99	113.93	157.63	115.15	159.39	115.63	161.19	118.01	161.24	118.03
161.42	118.05	172.06	118.84	176.05	119.08	178.11	118.7	180.61	119.56
190.24	121.09	193.6	119.17	196.44	116.61	203.23	115.12	205.17	114.45
211.85	114.12	213.55	114.09	215.92	114.6	221.92	115.96	223.41	116.37
228.29	120.84	229	122.26	230.5	122.2	250.22	122.15	255.8	122.25
493	130								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.09	130.17	.045	157.63	.09

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
130.17	157.63	102.2	104.5	111.3	.1	.3

Ineffective Flow num= 1

Sta L	Sta R	Elev	Permanent
190.12	493	121.01	T

CROSS SECTION OUTPUT Profile #Q10

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	122.36	Wt. n-Val.	0.090	0.045	0.090
Vel Head (ft)	0.18	Reach Len. (ft)	102.20	104.50	111.30
W.S. Elev (ft)	122.19	Flow Area (sq ft)	14.73	232.19	153.26
Crit W.S. (ft)		Area (sq ft)	14.73	232.19	337.89
E.G. Slope (ft/ft)	0.000706	Flow (cfs)	8.59	832.86	105.55
Q Total (cfs)	947.00	Top Width (ft)	6.08	27.46	88.46
Top Width (ft)	122.00	Avg. Vel. (ft/s)	0.58	3.59	0.69
Vel Total (ft/s)	2.37	Hydr. Depth (ft)	2.42	8.46	1.73
Max Chl Dpth (ft)	9.48	Conv. (cfs)	323.2	31339.3	3971.7
Conv. Total (cfs)	35634.2	Wetted Per. (ft)	9.61	28.10	94.66
Length Wtd. (ft)	104.96	Shear (lb/sq ft)	0.07	0.36	0.07
Min Ch El (ft)	112.71	Stream Power (lb/ft s)	0.04	1.31	0.05
Alpha	2.03	Cum Volume (acre-ft)	1.64	4.10	2.95
Frctn Loss (ft)	0.09	Cum SA (acres)	0.94	0.67	1.37
C & E Loss (ft)	0.01				

Warning: Divided flow computed for this cross-section.

CROSS SECTION OUTPUT Profile #Q50

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	123.73	Wt. n-Val.	0.090	0.045	0.090
Vel Head (ft)	0.27	Reach Len. (ft)	102.20	104.50	111.30
W.S. Elev (ft)	123.46	Flow Area (sq ft)	23.76	267.23	300.85
Crit W.S. (ft)		Area (sq ft)	23.76	267.23	485.48
E.G. Slope (ft/ft)	0.000946	Flow (cfs)	19.04	1218.43	252.53
Q Total (cfs)	1490.00	Top Width (ft)	8.08	27.46	135.32
Top Width (ft)	170.86	Avg. Vel. (ft/s)	0.80	4.56	0.84
Vel Total (ft/s)	2.52				

Max Chl Dpth (ft)	10.75	Hydr. Depth (ft)	2.94	9.73	2.22
Conv. Total (cfs)	48438.6	Conv. (cfs)	619.1	39609.9	8209.6
Length Wtd. (ft)	105.35	Wetted Per. (ft)	11.99	28.10	141.58
Min Ch El (ft)	112.71	Shear (lb/sq ft)	0.12	0.56	0.13
Alpha	2.70	Stream Power (lb/ft s)	0.09	2.56	0.11
Frctn Loss (ft)	0.12	Cum Volume (acre-ft)	3.70	4.94	5.15
C & E Loss (ft)	0.01	Cum SA (acres)	1.98	0.67	1.80

CROSS SECTION OUTPUT Profile #Q100

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	124.15				
Vel Head (ft)	0.32	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	123.83	Reach Len. (ft)	102.20	104.50	111.30
Crit W.S. (ft)		Flow Area (sq ft)	26.79	277.16	351.81
E.G. Slope (ft/ft)	0.001130	Area (sq ft)	26.79	277.16	536.44
Q Total (cfs)	1780.00	Flow (cfs)	24.50	1414.88	340.62
Top Width (ft)	182.50	Top Width (ft)	8.65	27.46	146.39
Vel Total (ft/s)	2.71	Avg. Vel. (ft/s)	0.91	5.10	0.97
Max Chl Dpth (ft)	11.12	Hydr. Depth (ft)	3.10	10.09	2.40
Conv. Total (cfs)	52957.2	Conv. (cfs)	728.9	42094.4	10133.8
Length Wtd. (ft)	105.47	Wetted Per. (ft)	12.66	28.10	152.66
Min Ch El (ft)	112.71	Shear (lb/sq ft)	0.15	0.70	0.16
Alpha	2.84	Stream Power (lb/ft s)	0.14	3.55	0.16
Frctn Loss (ft)	0.15	Cum Volume (acre-ft)	6.71	5.24	5.88
C & E Loss (ft)	0.01	Cum SA (acres)	3.36	0.67	1.85

CROSS SECTION OUTPUT Profile #Q500

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	125.16				
Vel Head (ft)	0.43	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	124.73	Reach Len. (ft)	102.20	104.50	111.30
Crit W.S. (ft)		Flow Area (sq ft)	35.23	301.93	496.30
E.G. Slope (ft/ft)	0.001425	Area (sq ft)	35.23	301.93	680.94
Q Total (cfs)	2480.00	Flow (cfs)	39.97	1832.51	607.52
Top Width (ft)	211.52	Top Width (ft)	10.06	27.46	174.00
Vel Total (ft/s)	2.98	Avg. Vel. (ft/s)	1.13	6.07	1.22
Max Chl Dpth (ft)	12.02	Hydr. Depth (ft)	3.50	11.00	2.85
Conv. Total (cfs)	65703.1	Conv. (cfs)	1059.0	48549.1	16095.1
Length Wtd. (ft)	105.76	Wetted Per. (ft)	14.34	28.10	180.28
Min Ch El (ft)	112.71	Shear (lb/sq ft)	0.22	0.96	0.24
Alpha	3.12	Stream Power (lb/ft s)	0.25	5.80	0.30
Frctn Loss (ft)	0.19	Cum Volume (acre-ft)	12.40	5.92	7.68
C & E Loss (ft)	0.01	Cum SA (acres)	4.58	0.67	1.97

CROSS SECTION

RIVER: River 1
REACH: Reach 1   RS: 4028

INPUT
Description:
Station Elevation Data   num=   28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	125.89	17.7	126.46	56.96	122.74	58.38	122.67	59.05	122.42
63.78	119.66	64.49	119.55	68.12	119.04	79.32	118.14	84.06	116.04
84.33	115.92	84.53	115.3	86.2	114.82	87.52	114.49	89.2	114.42
93.84	114.09	99.03	114.68	102.46	114.76	109.02	115.44	110.17	115.58
111.89	117.21	113.41	119.71	118.23	119.85	133.86	121.17	141.73	121.56
155.73	120.41	175.42	122.24	260	130				

Manning's n Values   num=   3

Sta	n Val	Sta	n Val	Sta	n Val
0	.09	84.06	.045	110.17	.09

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
84.06	110.17	180.8	162.9	161.8	.1	.3

Right Levee   Station= 141.73   Elevation= 121.56

CROSS SECTION OUTPUT Profile #Q10

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	122.27	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.23	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	122.03	Reach Len. (ft)	180.80	162.90	161.80
Crit W.S. (ft)	118.14	Flow Area (sq ft)	78.52	190.93	84.01
E.G. Slope (ft/ft)	0.001166	Area (sq ft)	78.52	190.93	84.01
Q Total (cfs)	947.00	Flow (cfs)	93.66	797.32	56.03
Top Width (ft)	113.50	Top Width (ft)	24.35	26.11	63.04
Vel Total (ft/s)	2.68	Avg. Vel. (ft/s)	1.19	4.18	0.67
Max Chl Dpth (ft)	7.94	Hydr. Depth (ft)	3.22	7.31	1.33
Conv. Total (cfs)	27734.2	Conv. (cfs)	2742.9	23350.5	1640.8
Length Wtd. (ft)	163.75	Wetted Per. (ft)	25.52	26.79	65.29
Min Ch El (ft)	114.09	Shear (lb/sq ft)	0.22	0.52	0.09
Alpha	2.07	Stream Power (lb/ft s)	0.27	2.17	0.06
Frctn Loss (ft)	0.19	Cum Volume (acre-ft)	1.53	3.59	2.42
C & E Loss (ft)	0.03	Cum SA (acres)	0.90	0.60	1.17

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	123.60	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	123.27	Reach Len. (ft)	180.80	162.90	161.80
Crit W.S. (ft)	119.48	Flow Area (sq ft)	112.21	223.30	170.52
E.G. Slope (ft/ft)	0.001450	Area (sq ft)	112.21	223.30	170.52
Q Total (cfs)	1490.00	Flow (cfs)	156.14	1154.53	179.33
Top Width (ft)	135.38	Top Width (ft)	32.74	26.11	76.53
Vel Total (ft/s)	2.94	Avg. Vel. (ft/s)	1.39	5.17	1.05
Max Chl Dpth (ft)	9.18	Hydr. Depth (ft)	3.43	8.55	2.23
Conv. Total (cfs)	39124.8	Conv. (cfs)	4099.9	30315.9	4708.9
Length Wtd. (ft)	164.21	Wetted Per. (ft)	34.09	26.79	78.83
Min Ch El (ft)	114.09	Shear (lb/sq ft)	0.30	0.75	0.20
Alpha	2.43	Stream Power (lb/ft s)	0.41	3.90	0.21
Frctn Loss (ft)	0.19	Cum Volume (acre-ft)	3.54	4.35	4.31
C & E Loss (ft)	0.07	Cum SA (acres)	1.93	0.60	1.53

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	123.99	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.41	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	123.59	Reach Len. (ft)	180.80	162.90	161.80
Crit W.S. (ft)	120.14	Flow Area (sq ft)	122.90	231.42	194.83
E.G. Slope (ft/ft)	0.001764	Area (sq ft)	122.90	231.42	194.83
Q Total (cfs)	1780.00	Flow (cfs)	188.45	1351.43	240.12
Top Width (ft)	142.05	Top Width (ft)	36.02	26.11	79.92
Vel Total (ft/s)	3.24	Avg. Vel. (ft/s)	1.53	5.84	1.23
Max Chl Dpth (ft)	9.50	Hydr. Depth (ft)	3.41	8.86	2.44
Conv. Total (cfs)	42376.9	Conv. (cfs)	4486.4	32173.8	5716.7
Length Wtd. (ft)	164.46	Wetted Per. (ft)	37.38	26.79	82.23
Min Ch El (ft)	114.09	Shear (lb/sq ft)	0.36	0.95	0.26
Alpha	2.51	Stream Power (lb/ft s)	0.56	5.56	0.32
Frctn Loss (ft)	0.21	Cum Volume (acre-ft)	6.54	4.63	4.94

C & E Loss (ft)	0.09	Cum SA (acres)	3.31	0.60	1.56

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	124.95	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.57	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	124.38	Reach Len. (ft)	180.80	162.90	161.80
Crit W.S. (ft)	121.27	Flow Area (sq ft)	154.99	252.24	262.03
E.G. Slope (ft/ft)	0.002304	Area (sq ft)	154.99	252.24	262.03
Q Total (cfs)	2480.00	Flow (cfs)	276.71	1782.87	420.42
Top Width (ft)	159.16	Top Width (ft)	44.44	26.11	88.61
Vel Total (ft/s)	3.71	Avg. Vel. (ft/s)	1.79	7.07	1.60
Max Chl Dpth (ft)	10.29	Hydr. Depth (ft)	3.49	9.66	2.96
Conv. Total (cfs)	51665.6	Conv. (cfs)	5764.6	37142.4	8758.6
Length Wtd. (ft)	165.06	Wetted Per. (ft)	45.84	26.79	90.96
Min Ch El (ft)	114.09	Shear (lb/sq ft)	0.49	1.35	0.41
Alpha	2.67	Stream Power (lb/ft s)	0.87	9.57	0.66
Frctn Loss (ft)	0.24	Cum Volume (acre-ft)	12.17	5.25	6.48
C & E Loss (ft)	0.14	Cum SA (acres)	4.52	0.60	1.64

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 3865

INPUT
Description:
Station Elevation Data num= 204

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	125	0	124.77	1.2	124.68	6.5	124.35	7.7	124.22
9.2	124.01	13.3	123.27	14.9	123.04	17.9	122.56	20.9	122.19
27.9	121.83	30	121.75	31.7	121.73	33.3	121.72	36	121.78
39	121.82	40.2	121.87	42	121.91	45	122	47.3	122.1
49.3	122.21	50.2	122.23	53	122.25	57.4	122.23	65.7	122.4
68.1	122.41	70	122.37	76.1	122.36	81.2	122.17	82.7	122.13
84.2	122.06	92.1	122.32	93.2	122.34	96.9	122.29	97.5	122.32
102.3	122.7	105.4	122.75	106.8	122.79	110.9	122.96	113.9	122.94
115.3	122.91	116.2	122.92	118.9	122.98	123.4	122.94	126.9	122.94
129.6	122.97	134.9	123.09	138.4	123.08	139.4	123.1	141.4	123.2
143	123.22	144.4	123.17	145.6	123.09	148.3	122.79	151	122.55
153.5	122.35	156.4	122.03	159.2	121.81	161.7	121.67	163.5	121.6
166.3	121.51	169.2	121.45	169.7	121.44	176.2	121.75	180.4	121.85
183.6	121.89	186.2	122	188.4	122.12	193.8	122.27	194.7	122.28
195.6	122.27	198.7	122.16	199.1	122.13	200.3	121.98	201.8	121.74
203.2	121.5	204.5	121.24	208.8	120.12	210.7	119.61	212.5	119.09
216.7	117.97	220.5	116	222.8	115	228	113.31	232.9	115
234.8	116	237.2	117.28	239.3	117.64	241.4	117.97	241.9	118.07
244.6	118.66	247.3	119.2	249.9	119.52	251.3	119.66	252.6	119.75
255.6	119.92	260.7	120.33	264.1	120.56	264.9	120.59	266	120.57
268.7	120.41	269.7	120.39	270.9	120.43	271.4	120.46	274	120.37
276.7	120.13	279.4	119.92	280	119.9	282.5	119.84	283	119.82
283.9	119.76	286	119.53	287.4	119.43	288.2	119.38	289	119.38
290.1	119.41	291	119.47	292.8	119.57	295	119.59	298.1	119.59
299.5	119.51	300.8	119.31	302.3	119.22	303.4	119.04	304.1	118.98
305.2	118.92	306.1	118.77	306.6	118.72	307.1	118.66	308	118.61
308.8	118.51	310.1	118.41	310.8	118.38	311.5	118.31	313.7	118.16

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   316.1  117.92   319.1   117.7   322.2  117.53   323.6  117.48   328.2  117.38
   330.2  117.38   332.9  117.53   334.9  117.84   337.2  118.12   340.9  118.52
   343.2  118.71   343.4  118.73   344.8  118.78   347.7  118.85   348.9  118.92
   349.1  118.94   349.3  118.96   350.5  119.21   351.6  119.47   356.9  120.62
   357.6  120.71   358.3  120.78   359.6  120.76   360.4  120.72   361.8  120.66
   362.3  120.67   363.2   120.7   364.3   120.8   364.7  120.84     365  120.88
   366.1  120.94   367.5  120.99   370.3  120.88   371.7  120.76     373  120.67
   375.7  120.41   380.2  119.78     381  119.68   383.7  119.44   385.9  119.74
   391.7  120.72     393  120.75   394.1  120.75   394.4  120.75   395.8  120.95
   397.1  121.21   397.2  121.26   397.4  121.31   399.7  121.97   400.5  122.12
   403.5  122.89   405.7  123.51   409.5   124.6   412.5  125.63   412.8  125.74
   413.1  125.82   414.2   126.1   415.8  126.36   418.5  126.85   421.5  127.08
   422.7  127.12   424.2   127.1     427  127.02   428.4     127   434.5  126.95
   439.6  126.96   442.6  127.22   445.6  127.53447.0034  127.64

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .09   216.7    .045   239.3     .09

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        216.7   239.3            155.6   159.3   182.2             .1       .3
Left Levee      Station=  193.78      Elevation=  122.27
Right Levee     Station=  264.08      Elevation=  120.56

CROSS SECTION OUTPUT  Profile #Q10

  E.G. Elev (ft)            122.05    Element                   Left OB    Channel   Right OB
  Vel Head (ft)               0.12    Wt. n-Val.                 0.090      0.045      0.090
  W.S. Elev (ft)            121.93    Reach Len. (ft)           155.60     159.30     182.20
  Crit W.S. (ft)            119.33    Flow Area (sq ft)          29.42     146.30     393.77
  E.G. Slope (ft/ft)      0.001109    Area (sq ft)               29.42     146.30     393.77
  Q Total (cfs)             947.00    Flow (cfs)                 23.74     530.54     392.71
  Top Width (ft)            198.90    Top Width (ft)             16.06      22.60     160.24
  Vel Total (ft/s)            1.66    Avg. Vel. (ft/s)            0.81       3.63       1.00
  Max Chl Dpth (ft)           8.62    Hydr. Depth (ft)            1.83       6.47       2.46
  Conv. Total (cfs)        28431.0    Conv. (cfs)                712.8    15928.1    11790.1
  Length Wtd. (ft)          164.08    Wetted Per. (ft)           16.55      24.44     161.23
  Min Ch El (ft)            113.31    Shear (lb/sq ft)            0.12       0.41       0.17
  Alpha                       2.82    Stream Power (lb/ft s)      0.10       1.50       0.17
  Frctn Loss (ft)             0.26    Cum Volume (acre-ft)        1.30       2.96       1.53
  C & E Loss (ft)             0.02    Cum SA (acres)              0.82       0.51       0.76


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q50

  E.G. Elev (ft)            123.35    Element                   Left OB    Channel   Right OB
  Vel Head (ft)               0.10    Wt. n-Val.                 0.090      0.045      0.090
  W.S. Elev (ft)            123.24    Reach Len. (ft)           155.60     159.30     182.20
  Crit W.S. (ft)            120.56    Flow Area (sq ft)         222.98     176.11     608.74
  E.G. Slope (ft/ft)      0.000908    Area (sq ft)              222.98     176.11     608.74
  Q Total (cfs)            1490.00    Flow (cfs)                117.74     653.82     718.45
  Top Width (ft)            391.28    Top Width (ft)            203.22      22.60     165.46
  Vel Total (ft/s)            1.48    Avg. Vel. (ft/s)            0.53       3.71       1.18
  Max Chl Dpth (ft)           9.93    Hydr. Depth (ft)            1.10       7.79       3.68
  Conv. Total (cfs)        49445.7    Conv. (cfs)               3907.1    21696.9    23841.7
  Length Wtd. (ft)          164.67    Wetted Per. (ft)          203.95      24.44     166.61
  Min Ch El (ft)            113.31    Shear (lb/sq ft)            0.06       0.41       0.21
  Alpha                       3.08    Stream Power (lb/ft s)      0.03       1.52       0.24
  Frctn Loss (ft)             0.22    Cum Volume (acre-ft)        2.84       3.61       2.86
  C & E Loss (ft)             0.02    Cum SA (acres)              1.44       0.51       1.08
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Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	123.69	Wt. n-Val.	0.090	0.045	0.090
Vel Head (ft)	0.11	Reach Len. (ft)	155.60	159.30	182.20
W.S. Elev (ft)	123.58	Flow Area (sq ft)	291.59	183.71	664.53
Crit W.S. (ft)	120.77	Area (sq ft)	291.59	183.71	664.53
E.G. Slope (ft/ft)	0.000982	Flow (cfs)	190.24	729.40	860.36
Q Total (cfs)	1780.00	Top Width (ft)	205.12	22.60	166.65
Top Width (ft)	394.36	Avg. Vel. (ft/s)	0.65	3.97	1.29
Vel Total (ft/s)	1.56	Hydr. Depth (ft)	1.42	8.13	3.99
Max Chl Dpth (ft)	10.27	Conv. (cfs)	6071.4	23278.4	27458.2
Conv. Total (cfs)	56808.1	Wetted Per. (ft)	205.88	24.44	167.85
Length Wtd. (ft)	164.62	Shear (lb/sq ft)	0.09	0.46	0.24
Min Ch El (ft)	113.31	Stream Power (lb/ft s)	0.06	1.83	0.31
Alpha	3.00	Cum Volume (acre-ft)	5.67	3.86	3.35
Frctn Loss (ft)	0.25	Cum SA (acres)	2.81	0.51	1.10
C & E Loss (ft)	0.02				

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	124.58	Wt. n-Val.	0.090	0.045	0.090
Vel Head (ft)	0.12	Reach Len. (ft)	155.60	159.30	182.20
W.S. Elev (ft)	124.46	Flow Area (sq ft)	474.76	203.62	812.74
Crit W.S. (ft)	121.56	Area (sq ft)	474.76	203.62	812.74
E.G. Slope (ft/ft)	0.000987	Flow (cfs)	420.41	868.15	1191.44
Q Total (cfs)	2480.00	Top Width (ft)	211.99	22.60	169.72
Top Width (ft)	404.31	Avg. Vel. (ft/s)	0.89	4.26	1.47
Vel Total (ft/s)	1.66	Hydr. Depth (ft)	2.24	9.01	4.79
Max Chl Dpth (ft)	11.15	Conv. (cfs)	13382.4	27634.6	37925.5
Conv. Total (cfs)	78942.6	Wetted Per. (ft)	212.82	24.44	171.04
Length Wtd. (ft)	164.12	Shear (lb/sq ft)	0.14	0.51	0.29
Min Ch El (ft)	113.31	Stream Power (lb/ft s)	0.12	2.19	0.43
Alpha	2.72	Cum Volume (acre-ft)	10.87	4.40	4.48
Frctn Loss (ft)	0.21	Cum SA (acres)	3.98	0.51	1.16
C & E Loss (ft)	0.01				

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 3705

INPUT
Description:
Station Elevation Data num= 171

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	124.94	.3	124.92	2.3	124.7	5.6	124.31	8.4	123.96
11.2	123.56	14	123.09	16.3	122.7	18.3	122.41	18.9	122.34
26.9	121.84	31	121.16	32.2	121.06	32.5	121.05	34.8	121.1
35.9	121.14	37.5	121.16	39.6	121.31	45	121.65	50.7	121.95
54.1	122.28	55.1	122.33	57.2	122.4	58.7	122.42	59.4	122.41
60.2	122.35	63.3	122.06	65.1	121.99	66.3	121.95	67.9	121.95

69.3	121.93	71.9	121.83	73.6	121.84	75.5	121.83	77.2	121.81
79.2	121.76	82.5	121.72	84.9	121.66	90.5	121.47	92	121.38
93.2	121.41	98.5	121.69	101.1	121.77	103.3	121.79	106.4	121.84
112	122.06	114.4	122.1	117	122.19	121.1	121.84	122.3	121.7
125	121.41	127.6	121.35	130.3	121.34	133.3	121.31	135.6	121.21
138.2	121.13	140.9	121.02	143.5	120.94	147.3	120.95	151.5	121.09
155.8	121.35	157.2	121.46	161.5	121.9	162.1	121.98	165.7	122.21
170	122.53	171.4	122.53	172.8	122.59	174.2	122.56	175.4	122.58
177.1	122.55	179	122.58	179.9	122.56	182.1	122.56	188.6	122.43
191.2	122.44	195.5	122.49	204.5	122.55	209.5	122.54	212.5	122.59
215.1	122.87	218.6	123.06	221	123.05	223.1	123	226.7	122.94
228.4	122.89	230.9	122.85	233.7	122.96	238	123.19	241.6	123.33
244.3	123.26	245.1	123.2	246	123.1	249.1	122.68	252.2	122.18
254.9	121.7	259.3	120.93	261.3	120.6	263.5	120.19	267.4	119.66
268.2	119.58	269.2	119.53	276.1	119.48	278.8	119.51	280.5	119.57
282	119.6	282.6	119.63	283.4	119.68	285.6	119.84	288.7	119.95
291.9	120.01	293.3	120.06	297.3	120.14	299	120.17	300	120.17
300.4	120.17	303.9	120.31	305.3	120.35	307	120.37	313.2	120.15
318.8	120.16	321.2	120.19	323.8	120.16	331.8	119.88	334.4	119.88
338.7	119.71	344.3	119.6	350.4	119.43	352.8	119.39	357.1	119.24
361.3	119.07	365.6	118.87	369.9	118.62	370.9	118.51	371.3	118.46
374	117.98	375.5	117.79	376.9	117	379.5	115.5	382.6	113
384	112.25	384.8	112	385.4	112.25	388.3	113.5	394	117.5
395.4	117.95	398.3	118.44	401.4	119.08	403.4	119.47	406.7	120.2
408.1	120.54	411.3	121.37	414	122.12	419.7	123.87	422.3	124.65
432.2	127.46	435.1	128.22	437.9	128.84	440.5	129.25	441	129.28
442.2	129.32	443.2	129.32	445	129.37	445.8	129.36	448.5	129.39
449.2	129.38	453.2	129.22	453.8	129.22	454.9	129.32	456.4	129.48
459.6634	129.89								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.09	376.9	.045	394	.09

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
376.9	394	221.6	195.4	195.8	.1	.3

Left Levee Station= 241.64 Elevation= 123.33

CROSS SECTION OUTPUT Profile #Q10

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	121.76	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	121.43	Reach Len. (ft)	221.60	195.40	195.80
Crit W.S. (ft)	119.31	Flow Area (sq ft)	206.76	119.76	35.50
E.G. Slope (ft/ft)	0.002547	Area (sq ft)	206.76	119.76	35.50
Q Total (cfs)	947.00	Flow (cfs)	246.28	654.16	46.56
Top Width (ft)	155.11	Top Width (ft)	120.48	17.10	17.53
Vel Total (ft/s)	2.62	Avg. Vel. (ft/s)	1.19	5.46	1.31
Max Chl Dpth (ft)	9.43	Hydr. Depth (ft)	1.72	7.00	2.03
Conv. Total (cfs)	18765.3	Conv. (cfs)	4880.3	12962.4	922.6
Length Wtd. (ft)	199.12	Wetted Per. (ft)	120.95	20.18	17.98
Min Ch El (ft)	112.00	Shear (lb/sq ft)	0.27	0.94	0.31
Alpha	3.08	Stream Power (lb/ft s)	0.32	5.15	0.41
Frctn Loss (ft)	0.55	Cum Volume (acre-ft)	0.88	2.48	0.63
C & E Loss (ft)	0.01	Cum SA (acres)	0.57	0.44	0.39

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	123.11	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.28	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	122.83	Reach Len. (ft)	221.60	195.40	195.80
Crit W.S. (ft)	121.11	Flow Area (sq ft)	381.16	143.71	63.50

E.G. Slope (ft/ft)	0.002095	Area (sq ft)	381.16	143.71	63.50
Q Total (cfs)	1490.00	Flow (cfs)	591.53	803.97	94.50
Top Width (ft)	168.37	Top Width (ft)	128.94	17.10	22.33
Vel Total (ft/s)	2.53	Avg. Vel. (ft/s)	1.55	5.59	1.49
Max Chl Dpth (ft)	10.83	Hydr. Depth (ft)	2.96	8.40	2.84
Conv. Total (cfs)	32551.3	Conv. (cfs)	12922.8	17564.0	2064.5
Length Wtd. (ft)	201.11	Wetted Per. (ft)	129.53	20.18	22.98
Min Ch El (ft)	112.00	Shear (lb/sq ft)	0.38	0.93	0.36
Alpha	2.80	Stream Power (lb/ft s)	0.60	5.21	0.54
Frctn Loss (ft)	0.51	Cum Volume (acre-ft)	1.76	3.02	1.46
C & E Loss (ft)	0.02	Cum SA (acres)	0.85	0.44	0.68

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	123.43	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	123.09	Reach Len. (ft)	221.60	195.40	195.80
Crit W.S. (ft)	121.45	Flow Area (sq ft)	413.85	148.02	69.22
E.G. Slope (ft/ft)	0.002520	Area (sq ft)	413.85	148.02	69.22
Q Total (cfs)	1780.00	Flow (cfs)	737.01	926.20	116.79
Top Width (ft)	171.05	Top Width (ft)	130.80	17.10	23.15
Vel Total (ft/s)	2.82	Avg. Vel. (ft/s)	1.78	6.26	1.69
Max Chl Dpth (ft)	11.09	Hydr. Depth (ft)	3.16	8.66	2.99
Conv. Total (cfs)	35456.8	Conv. (cfs)	14681.0	18449.5	2326.3
Length Wtd. (ft)	204.24	Wetted Per. (ft)	131.41	20.18	23.84
Min Ch El (ft)	112.00	Shear (lb/sq ft)	0.50	1.15	0.46
Alpha	2.75	Stream Power (lb/ft s)	0.88	7.22	0.77
Frctn Loss (ft)	0.44	Cum Volume (acre-ft)	4.41	3.25	1.81
C & E Loss (ft)	0.03	Cum SA (acres)	2.21	0.44	0.70

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	124.36	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.19	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	124.17	Reach Len. (ft)	221.60	195.40	195.80
Crit W.S. (ft)	122.09	Flow Area (sq ft)	1052.50	166.61	96.32
E.G. Slope (ft/ft)	0.001656	Area (sq ft)	1052.50	166.61	96.32
Q Total (cfs)	2480.00	Flow (cfs)	1416.46	914.51	149.03
Top Width (ft)	414.02	Top Width (ft)	370.21	17.10	26.71
Vel Total (ft/s)	1.89	Avg. Vel. (ft/s)	1.35	5.49	1.55
Max Chl Dpth (ft)	12.17	Hydr. Depth (ft)	2.84	9.74	3.61
Conv. Total (cfs)	60940.7	Conv. (cfs)	34806.4	22472.1	3662.2
Length Wtd. (ft)	207.63	Wetted Per. (ft)	371.28	20.18	27.56
Min Ch El (ft)	112.00	Shear (lb/sq ft)	0.29	0.85	0.36
Alpha	3.46	Stream Power (lb/ft s)	0.39	4.68	0.56
Frctn Loss (ft)	0.33	Cum Volume (acre-ft)	8.14	3.72	2.58
C & E Loss (ft)	0.00	Cum SA (acres)	2.94	0.44	0.75

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 3510

INPUT
Description:

Station Elevation Data num= 146

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	125	0	124.02	2.5	123.8	5	123.55	8.6	123.29
9.6	123.16	10.4	122.98	12.4	122.61	17.5	121.61	18.6	121.4
20.4	121.08	22.3	120.8	23.7	120.61	26.7	120.32	28	120.27
29.3	120.27	32.2	120.19	33.6	120.06	38.1	119.56	41.1	119.47
43.1	119.47	46.4	119.51	49.9	119.47	51.2	119.5	54	119.59
58.8	119.69	61.7	120	67.6	120.75	70.6	121.01	76.5	121.45
78.9	121.61	79.4	121.66	83.9	121.86	86.6	122.01	88.3	122.07
91.2	122.14	97.5	122.21	98.7	122.25	101.6	122.3	105.6	122.32
108.9	122.15	113.8	121.63	117.8	121.02	120	120.64	121.4	120.44
128.4	119.74	130.1	119.6	132.9	119.45	134.1	119.42	135.5	119.4
138.4	119.56	139.8	119.56	141	119.51	144	119.3	145.4	119.28
148.3	119.3	150.2	119.37	152.7	119.56	159.1	120.14	161.3	120.2
163.3	120.28	165.4	120.42	167.3	120.52	175.6	121.02	181.9	121.36
183.9	121.44	190.1	121.83	192.2	121.94	196.3	122.09	198.3	122.22
200.4	122.31	204.5	122.42	208.6	122.41	210.7	122.38	212.8	122.31
216.9	122.12	218.9	122.01	223	121.42	225.1	121.15	229.2	120.26
231.3	119.85	233.3	119.37	235.4	118.92	239.5	117.96	245.7	115.5
247.8	114.5	249.8	113.5	251.9	113	253.9	113.5	258.3	114.5
260.1	115.5	264.9	117.37	268.2	117.73	270.4	117.99	274.5	118.41
278.7	118.77	280.7	118.92	282.8	119.04	286.9	119.2	293	119.03
296.3	118.91	297.2	118.87	299.3	118.68	301.3	118.83	303.4	119.31
305.4	119.82	307.5	120.48	309.2	121.42	311.6	122.9	312.8	123.56
313.7	124.01	314.4	124.29	315.7	124.74	319.9	126.31	321.9	126.82
324	127.2	324.4	127.29	326	127.77	328.1	128.25	330.2	128.52
334.3	129.25	338.4	129.78	340.5	130.01	342.5	130.06	344.6	130.05
350.8	130.09	354.9	130.02	355.8	130.07	356.9	130.15	361.1	130.54
367.1	130.95	369.3	131.14	377.5	131.7	381.6	131.96	383.7	132.12
387.8	132.5	391.9	132.81	394	132.91	396.1	133.03	398.1	133.18
398.7	133.19	400.2	133.18	402.2	133.13	404.3	133.36	407	133.68
408.2787	133.84								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.09	239.5	.045	268.2	.09

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
239.5	268.2	148.9	147.5	155.8	.1	.3

Left Levee Station= 208.67 Elevation= 122.41

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	121.21	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.39	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	120.82	Reach Len. (ft)	148.90	147.50	155.80
Crit W.S. (ft)	118.75	Flow Area (sq ft)	18.05	154.64	75.85
E.G. Slope (ft/ft)	0.002980	Area (sq ft)	18.05	154.64	75.85
Q Total (cfs)	947.00	Flow (cfs)	20.04	822.76	104.20
Top Width (ft)	81.51	Top Width (ft)	12.89	28.70	39.92
Vel Total (ft/s)	3.81	Avg. Vel. (ft/s)	1.11	5.32	1.37
Max Chl Dpth (ft)	7.82	Hydr. Depth (ft)	1.40	5.39	1.90
Conv. Total (cfs)	17348.3	Conv. (cfs)	367.1	15072.3	1908.9
Length Wtd. (ft)	148.12	Wetted Per. (ft)	13.21	30.49	40.31
Min Ch El (ft)	113.00	Shear (lb/sq ft)	0.25	0.94	0.35
Alpha	1.71	Stream Power (lb/ft s)	0.28	5.02	0.48
Frctn Loss (ft)	0.34	Cum Volume (acre-ft)	0.31	1.86	0.38
C & E Loss (ft)	0.03	Cum SA (acres)	0.23	0.34	0.26

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	122.58	Element	Left OB	Channel	Right OB

Vel Head (ft)	0.50	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	122.09	Reach Len. (ft)	148.90	147.50	155.80
Crit W.S. (ft)	120.06	Flow Area (sq ft)	39.29	190.96	127.77
E.G. Slope (ft/ft)	0.003105	Area (sq ft)	39.29	190.96	127.77
Q Total (cfs)	1490.00	Flow (cfs)	52.55	1193.79	243.67
Top Width (ft)	92.79	Top Width (ft)	22.01	28.70	42.08
Vel Total (ft/s)	4.16	Avg. Vel. (ft/s)	1.34	6.25	1.91
Max Chl Dpth (ft)	9.09	Hydr. Depth (ft)	1.79	6.65	3.04
Conv. Total (cfs)	26737.8	Conv. (cfs)	943.0	21422.2	4372.5
Length Wtd. (ft)	148.47	Wetted Per. (ft)	22.42	30.49	42.82
Min Ch El (ft)	113.00	Shear (lb/sq ft)	0.34	1.21	0.58
Alpha	1.85	Stream Power (lb/ft s)	0.45	7.59	1.10
Frctn Loss (ft)	0.37	Cum Volume (acre-ft)	0.69	2.27	1.03
C & E Loss (ft)	0.03	Cum SA (acres)	0.47	0.34	0.54

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	122.96	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.26	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	122.71	Reach Len. (ft)	148.90	147.50	155.80
Crit W.S. (ft)	120.51	Flow Area (sq ft)	426.04	208.74	154.16
E.G. Slope (ft/ft)	0.001851	Area (sq ft)	426.04	208.74	154.16
Q Total (cfs)	1780.00	Flow (cfs)	458.24	1069.15	252.62
Top Width (ft)	299.41	Top Width (ft)	227.62	28.70	43.09
Vel Total (ft/s)	2.26	Avg. Vel. (ft/s)	1.08	5.12	1.64
Max Chl Dpth (ft)	9.71	Hydr. Depth (ft)	1.87	7.27	3.58
Conv. Total (cfs)	41370.4	Conv. (cfs)	10650.3	24848.9	5871.2
Length Wtd. (ft)	148.61	Wetted Per. (ft)	228.68	30.49	44.00
Min Ch El (ft)	113.00	Shear (lb/sq ft)	0.22	0.79	0.40
Alpha	3.23	Stream Power (lb/ft s)	0.23	4.05	0.66
Frctn Loss (ft)	0.28	Cum Volume (acre-ft)	2.28	2.45	1.31
C & E Loss (ft)	0.01	Cum SA (acres)	1.30	0.34	0.55

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	124.03	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.22	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	123.81	Reach Len. (ft)	148.90	147.50	155.80
Crit W.S. (ft)	121.40	Flow Area (sq ft)	680.96	240.33	202.66
E.G. Slope (ft/ft)	0.001548	Area (sq ft)	680.96	240.33	202.66
Q Total (cfs)	2480.00	Flow (cfs)	891.02	1236.64	352.34
Top Width (ft)	310.89	Top Width (ft)	237.09	28.70	45.10
Vel Total (ft/s)	2.21	Avg. Vel. (ft/s)	1.31	5.15	1.74
Max Chl Dpth (ft)	10.81	Hydr. Depth (ft)	2.87	8.37	4.49
Conv. Total (cfs)	63028.0	Conv. (cfs)	22644.9	31428.7	8954.5
Length Wtd. (ft)	148.77	Wetted Per. (ft)	238.22	30.49	46.29
Min Ch El (ft)	113.00	Shear (lb/sq ft)	0.28	0.76	0.42
Alpha	2.93	Stream Power (lb/ft s)	0.36	3.92	0.74
Frctn Loss (ft)	0.25	Cum Volume (acre-ft)	3.73	2.81	1.91
C & E Loss (ft)	0.02	Cum SA (acres)	1.40	0.34	0.58

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 3362

INPUT
Description:
Station Elevation Data num= 142

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	125.03	1.2	124.97	3.3	124.93	5.3	124.92	15.4	124.72
21.5	124.7	27.6	124.41	29.4	124.28	33.6	123.82	35.7	123.68
41.7	123.56	43.7	123.48	45.8	123.38	47	123.38	47.8	123.37
49.8	123.18	51.8	122.93	53.9	122.73	55.8	122.5	59.9	122.05
62	121.87	64	121.77	68	121.5	72.1	121.28	76.1	121.1
80.2	120.85	82.2	120.69	83.8	120.44	84.2	120.39	86.2	120.25
92.6	119.71	94.3	119.53	96.4	119.47	99.6	119.53	102.4	119.54
104.4	119.62	106.5	119.66	108.5	119.59	110.2	119.73	111	119.78
111.9	119.81	112.5	119.84	114.6	119.84	116.6	120.04	124.2	121.18
126.7	121.51	128.7	121.75	132.8	121.98	134.8	122.12	136.8	122.11
138.8	122.07	140.9	122.06	142.9	121.98	144.9	121.77	149	121.29
153	121.31	155	121.39	157.6	121.51	159.1	121.6	161.1	121.75
163.1	121.78	165.1	121.69	169.2	121.55	173.2	121.31	175.3	121.22
177.3	121.01	181.3	120.64	183.9	120.38	185.4	120.21	187.4	119.91
189.4	119.68	191.4	119.59	195.5	119.49	197.5	119.46	201.6	119.35
203.6	119.19	205.6	118.98	207.6	118.8	209.6	118.49	211.7	118.09
213.7	117.62	215.7	117.08	217.7	116.76	219.8	116.46	221.8	116
229.9	113.5	235.9	113	239.9	113.5	248.1	116.3	250.1	116.68
252.1	117.27	252.4	117.36	254.2	118.39	256.18	119.152	256.2	119.16
258.2	119.09	259	119.14	259.4	119.21	260.2	119.24	261.1	119.42
262.2	119.61	262.9	119.7	263.8	119.77	264.3	119.83	264.6	119.84
266.3	119.79	268.3	119.7	269.9	120.21	270.3	120.34	272.4	121.21
274.4	122.05	275.2	122.39	275.7	122.58	276.4	122.89	282.5	125.76
284.5	126.55	288.5	128.08	292.4	129.06	294.6	129.67	296.6	130.05
300.7	130.53	302.7	130.74	308.8	131.23	312.8	130.98	314.8	130.89
316.9	130.89	318.9	130.87	320.8	130.89	322.9	131	325.8	131.34
329	131.68	331	131.83	333.1	132.04	335.1	132.22	336.6	132.43
339.1	132.8	343.2	133.34	345.4	133.58	349.2	134.04	353.3	134.41
355.3	134.57	355.757	134.63						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.09	215.7	.045	250.1	.09

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
215.7	250.1	323.9	310.7	323.6	.1	.3

Left Levee Station= 136.81 Elevation= 122.11

CROSS SECTION OUTPUT Profile #Q10

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	120.84	Wt. n-Val.	0.090	0.045	0.090
Vel Head (ft)	0.29	Reach Len. (ft)	323.90	310.70	323.60
W.S. Elev (ft)	120.55	Flow Area (sq ft)	45.10	198.72	30.32
Crit W.S. (ft)	117.66	Area (sq ft)	45.10	198.72	30.32
E.G. Slope (ft/ft)	0.001812	Flow (cfs)	38.41	881.73	26.86
Q Total (cfs)	947.00	Top Width (ft)	33.53	34.40	20.72
Top Width (ft)	88.65	Avg. Vel. (ft/s)	0.85	4.44	0.89
Vel Total (ft/s)	3.45	Hydr. Depth (ft)	1.34	5.78	1.46
Max Chl Dpth (ft)	7.55	Conv. (cfs)	902.5	20715.1	631.0
Conv. Total (cfs)	22248.6	Wetted Per. (ft)	33.81	35.43	21.43
Length Wtd. (ft)	311.37	Shear (lb/sq ft)	0.15	0.63	0.16
Min Ch El (ft)	113.00	Stream Power (lb/ft s)	0.13	2.81	0.14
Alpha	1.54	Cum Volume (acre-ft)	0.20	1.26	0.19
Frctn Loss (ft)	0.81	Cum SA (acres)	0.16	0.23	0.15
C & E Loss (ft)	0.02				

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

			Left OB	Channel	Right OB
E.G. Elev (ft)	122.18	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.40	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	121.78	Reach Len. (ft)	323.90	310.70	323.60
Crit W.S. (ft)	118.70	Flow Area (sq ft)	100.84	240.90	57.53
E.G. Slope (ft/ft)	0.002089	Area (sq ft)	100.84	240.90	57.53
Q Total (cfs)	1490.00	Flow (cfs)	108.75	1304.80	76.45
Top Width (ft)	128.90	Top Width (ft)	70.85	34.40	23.66
Vel Total (ft/s)	3.73	Avg. Vel. (ft/s)	1.08	5.42	1.33
Max Chl Dpth (ft)	8.78	Hydr. Depth (ft)	1.42	7.00	2.43
Conv. Total (cfs)	32602.4	Conv. (cfs)	2379.6	28550.0	1672.8
Length Wtd. (ft)	312.39	Wetted Per. (ft)	71.21	35.43	24.62
Min Ch El (ft)	113.00	Shear (lb/sq ft)	0.18	0.89	0.30
Alpha	1.86	Stream Power (lb/ft s)	0.20	4.80	0.40
Frctn Loss (ft)	0.88	Cum Volume (acre-ft)	0.45	1.54	0.69
C & E Loss (ft)	0.02	Cum SA (acres)	0.31	0.23	0.42

Warning: Divided flow computed for this cross-section.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	122.67	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.37	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	122.30	Reach Len. (ft)	323.90	310.70	323.60
Crit W.S. (ft)	119.12	Flow Area (sq ft)	267.27	258.97	70.28
E.G. Slope (ft/ft)	0.001912	Area (sq ft)	267.27	258.97	70.28
Q Total (cfs)	1780.00	Flow (cfs)	273.07	1408.38	98.55
Top Width (ft)	217.42	Top Width (ft)	158.12	34.40	24.90
Vel Total (ft/s)	2.98	Avg. Vel. (ft/s)	1.02	5.44	1.40
Max Chl Dpth (ft)	9.30	Hydr. Depth (ft)	1.69	7.53	2.82
Conv. Total (cfs)	40705.6	Conv. (cfs)	6244.6	32207.2	2253.7
Length Wtd. (ft)	313.24	Wetted Per. (ft)	158.77	35.43	25.97
Min Ch El (ft)	113.00	Shear (lb/sq ft)	0.20	0.87	0.32
Alpha	2.66	Stream Power (lb/ft s)	0.21	4.75	0.45
Frctn Loss (ft)	0.84	Cum Volume (acre-ft)	1.09	1.66	0.91
C & E Loss (ft)	0.03	Cum SA (acres)	0.64	0.23	0.43

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	123.76	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.38	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	123.39	Reach Len. (ft)	323.90	310.70	323.60
Crit W.S. (ft)	120.52	Flow Area (sq ft)	443.44	296.15	98.57
E.G. Slope (ft/ft)	0.001840	Area (sq ft)	443.44	296.15	98.57
Q Total (cfs)	2480.00	Flow (cfs)	593.38	1727.54	159.08
Top Width (ft)	231.77	Top Width (ft)	170.02	34.40	27.35
Vel Total (ft/s)	2.96	Avg. Vel. (ft/s)	1.34	5.83	1.61
Max Chl Dpth (ft)	10.39	Hydr. Depth (ft)	2.61	8.61	3.60
Conv. Total (cfs)	57820.3	Conv. (cfs)	13834.5	40276.8	3708.9
Length Wtd. (ft)	314.35	Wetted Per. (ft)	170.72	35.43	28.65
Min Ch El (ft)	113.00	Shear (lb/sq ft)	0.30	0.96	0.40
Alpha	2.78	Stream Power (lb/ft s)	0.40	5.60	0.64
Frctn Loss (ft)	0.82	Cum Volume (acre-ft)	1.81	1.90	1.37
C & E Loss (ft)	0.03	Cum SA (acres)	0.70	0.23	0.46

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 3052

INPUT
Description:
Station Elevation Data num= 299

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	123.76	2	123.66	4	123.66	6	123.71	8	123.82
10	123.61	12	123.46	14	123.29	16	123.14	18	122.85
20	122.47	22	122.25	26	122.2	28	122.12	30	122.12
34	122.06	36	121.91	40.1	121.47	40.6	121.44	44.1	121.33
46.1	121.24	50.1	121.12	54.1	121.08	56.5	120.98	60.1	120.88
64.1	120.71	68.1	120.49	74.1	120.25	76.1	120.13	78.4	120.03
80.3	119.92	82.1	119.84	84.1	119.73	87.8	119.72	92.2	119.62
94.2	119.61	104.2	119.71	106.2	119.7	108.2	119.81	110.2	119.95
112.2	120.07	114.2	120.16	118.2	120.09	120.6	120.12	126.2	119.97
128.2	119.98	130.2	120.06	136.2	120.45	140.6	120.68	142.3	120.8
144.3	120.9	146.3	120.94	148.3	120.76	155.7	120.47	158.3	120.42
160.3	120.34	164.3	120.1	166.3	120.06	167	120.06	167.6	120.03
168.3	120.03	170.3	119.95	172.3	119.86	172.7	119.86	174	119.84
174.6	119.84	178.3	119.75	180.3	119.65	184.3	119.31	186.3	119.07
190.3	118.47	192.3	118.25	196.4	117.98	198.4	117.88	204.4	117.86
206.6	117.89	208.2	117.93	210.3	117.94	212.4	117.97	216.4	118.16
218.4	118.23	220.4	118.26	224.4	118.28	228.4	118.39	234.4	118.46
238.4	118.59	244.4	118.69	246.5	118.83	250.9	119.33	252.5	119.48
256.5	119.83	258.5	119.91	262.5	119.75	264.5	119.66	266.5	119.69
270.5	119.82	272.5	119.84	274.6	119.84	276.5	119.72	278.5	119.54
280.2	119.21	282.5	118.8	284.5	118.5	286.5	118.26	290.5	117.87
292.5	117.77	294.5	117.74	296.5	117.74	298.6	117.84	299.1	117.84
301	117.82	304.7	117.69	306.6	117.69	308.5	117.75	310.4	117.79
312.3	117.8	316.6	117.69	318.6	117.78	324.6	118.27	327.4	118.43
330.6	118.65	332.6	118.59	338.6	118.37	340.6	118.32	344.6	118.35
347.1	118.4	348.1	118.44	349.2	118.45	350.7	118.44	354.7	118.31
356.7	118.27	358.7	118.39	360.7	118.55	362.1	118.62	362.7	118.65
364.7	118.66	370.7	118.31	372.6	118.29	374.5	118.29	376.7	118.28
378.3	118.29	380.7	118.38	382.7	118.49	386.7	118.6	390.7	118.75
396.7	118.68	398.7	118.76	400.8	118.86	404.7	118.94	408.8	119.09
412.8	119.28	416.8	119.42	422.8	119.9	424.8	120	432.8	120.31
434.9	120.34	436.9	120.31	440.8	120.19	441.1	120.19	442.8	120.21
444.8	120.42	446.8	120.66	448.8	120.85	450.8	121.02	454.9	121.29
455.6	121.31	456.1	121.33	456.9	121.35	460.9	121.33	462.9	121.36
464.9	121.24	467	121.15	468.3	121.11	468.9	121.1	470.9	121.19
474.9	121.51	478.9	121.7	482.9	121.83	484.9	121.83	486.9	121.86
488.9	121.88	492.9	121.77	498.8	121.69	500.9	121.69	502.9	121.75
505	121.85	507	122.01	509	122.13	511	122.16	513	122.26
517	122.38	521	122.38	523	122.28	525	122.06	527	121.88
529	121.53	533	120.1	535	119.41	537.3	118.77	539	118.31
541	117.8	543	117.44	549	115	557.5	113	561.1	112.2
565.1	113	570.7	115	571.1	116.83	573.1	117.51	575.1	118.12
575.8	118.2	576.4	118.34	577.1	118.42	577.9	118.41	578.3	118.4
581.1	118.33	585.1	118.29	587.1	118.32	589.1	118.62	590.7	119.01
592.9	119.51	593.1	119.57	595.1	119.94	601.1	120.5	605.1	120.57
607.1	120.57	609.2	120.62	610.3	120.61	613.2	120.61	615.2	120.58
619.2	120.48	621.2	120.36	621.6	120.31	623.2	120.11	624.9	119.97
627.2	119.85	629.2	119.6	636.7	118.41	639.2	118.09	641.2	117.91
643.2	117.78	645.2	117.62	647.2	117.51	651.2	117.9	651.8	117.92
652.7	117.99	653.2	118.01	655.2	118.46	657	118.96	657.2	119.03
657.5	119.1	659.3	119.63	661.2	120.12	665	121.24	666.9	121.77

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   667.3  121.87   669.3  122.52   673.3  123.77   679.3  125.84   681.3  126.31
     682  126.45   682.6  126.56   683.3   126.7   685.3  127.15   687.3  127.55
   689.6  127.82   693.3  128.38   695.3   128.6   697.1  128.83   697.3  128.86
   699.3  129.14   701.3  129.37   702.8   129.5     704  129.58   705.3  129.67
   709.3  129.97   715.4  130.34   721.1  130.79   723.5  130.94   725.4  131.09
   725.7   131.1   727.5  131.13   731.4  131.14   731.8  131.14   732.9  131.16
   735.4  131.18     736  131.19   739.4  131.25   745.4  131.44   751.4  131.74
   751.8  131.76   753.1  131.85   753.7  131.89   755.3  132.01   755.4  132.02
   757.4  132.16   759.4  132.32   761.7  132.53762.2267  132.57

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .09     543    .045   573.1     .09

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
           543   573.1                0      0       0            .1       .3
Left Levee      Station=  516.98      Elevation=  122.38
Right Levee     Station=  607.15      Elevation=  120.57

CROSS SECTION OUTPUT  Profile #Q10

  E.G. Elev (ft)            120.01    Element                  Left OB    Channel   Right OB
  Vel Head (ft)               0.52    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)            119.49    Reach Len. (ft)
  Crit W.S. (ft)            117.45    Flow Area (sq ft)          9.15     155.44      20.93
  E.G. Slope (ft/ft)      0.004005    Area (sq ft)               9.15     155.44      20.93
  Q Total (cfs)             947.00    Flow (cfs)                10.05     914.37      22.59
  Top Width (ft)             58.04    Top Width (ft)             8.23      30.10      19.71
  Vel Total (ft/s)            5.10    Avg. Vel. (ft/s)           1.10       5.88       1.08
  Max Chl Dpth (ft)           7.29    Hydr. Depth (ft)           1.11       5.16       1.06
  Conv. Total (cfs)        14964.7    Conv. (cfs)               158.8    14449.0      356.9
  Length Wtd. (ft)                    Wetted Per. (ft)           8.49      32.91      19.95
  Min Ch El (ft)            112.20    Shear (lb/sq ft)           0.27       1.18       0.26
  Alpha                       1.28    Stream Power (lb/ft s)     0.30       6.95       0.28
  Frctn Loss (ft)                     Cum Volume (acre-ft)
  C & E Loss (ft)                     Cum SA (acres)


Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q50

  E.G. Elev (ft)            121.28    Element                  Left OB    Channel   Right OB
  Vel Head (ft)               0.61    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)            120.67    Reach Len. (ft)
  Crit W.S. (ft)            118.75    Flow Area (sq ft)         20.87     190.98     129.54
  E.G. Slope (ft/ft)      0.003996    Area (sq ft)              20.87     190.98     129.54
  Q Total (cfs)            1490.00    Flow (cfs)                31.40    1287.32     171.28
  Top Width (ft)            131.66    Top Width (ft)            11.59      30.10      89.97
  Vel Total (ft/s)            4.36    Avg. Vel. (ft/s)           1.50       6.74       1.32
  Max Chl Dpth (ft)           8.47    Hydr. Depth (ft)           1.80       6.34       1.44
  Conv. Total (cfs)        23570.9    Conv. (cfs)               496.8    20364.6     2709.5
  Length Wtd. (ft)                    Wetted Per. (ft)          12.05      32.91      90.84
  Min Ch El (ft)            112.20    Shear (lb/sq ft)           0.43       1.45       0.36
  Alpha                       2.07    Stream Power (lb/ft s)     0.65       9.76       0.47
  Frctn Loss (ft)                     Cum Volume (acre-ft)
  C & E Loss (ft)                     Cum SA (acres)


Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q100

  E.G. Elev (ft)            121.81    Element                  Left OB    Channel   Right OB
  Vel Head (ft)               0.65    Wt. n-Val.                0.090      0.045      0.090
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W.S. Elev (ft)	121.16	Reach Len. (ft)			
Crit W.S. (ft)	119.33	Flow Area (sq ft)	26.87	205.69	173.93
E.G. Slope (ft/ft)	0.004006	Area (sq ft)	26.87	205.69	173.93
Q Total (cfs)	1780.00	Flow (cfs)	44.42	1458.80	276.78
Top Width (ft)	134.69	Top Width (ft)	12.96	30.10	91.62
Vel Total (ft/s)	4.38	Avg. Vel. (ft/s)	1.65	7.09	1.59
Max Chl Dpth (ft)	8.96	Hydr. Depth (ft)	2.07	6.83	1.90
Conv. Total (cfs)	28121.6	Conv. (cfs)	701.8	23047.1	4372.7
Length Wtd. (ft)		Wetted Per. (ft)	13.51	32.91	92.57
Min Ch El (ft)	112.20	Shear (lb/sq ft)	0.50	1.56	0.47
Alpha	2.17	Stream Power (lb/ft s)	0.82	11.09	0.75
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	122.91	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.72	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	122.19	Reach Len. (ft)			
Crit W.S. (ft)	120.43	Flow Area (sq ft)	42.60	236.73	270.27
E.G. Slope (ft/ft)	0.004007	Area (sq ft)	42.60	236.73	270.27
Q Total (cfs)	2480.00	Flow (cfs)	74.11	1843.80	562.09
Top Width (ft)	144.46	Top Width (ft)	19.18	30.10	95.18
Vel Total (ft/s)	4.51	Avg. Vel. (ft/s)	1.74	7.79	2.08
Max Chl Dpth (ft)	9.99	Hydr. Depth (ft)	2.22	7.86	2.84
Conv. Total (cfs)	39179.5	Conv. (cfs)	1170.7	29128.7	8880.1
Length Wtd. (ft)		Wetted Per. (ft)	19.83	32.91	96.27
Min Ch El (ft)	112.20	Shear (lb/sq ft)	0.54	1.80	0.70
Alpha	2.27	Stream Power (lb/ft s)	0.93	14.01	1.46
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

SUMMARY OF MANNING'S N VALUES

River:River 1

Reach	River Sta.	n1	n2	n3
Reach 1	4896	.09	.045	.09
Reach 1	4743	.09	.045	.09
Reach 1	4607	.09	.045	.09
Reach 1	4473	.09	.045	.09
Reach 1	4383	.09	.045	.09
Reach 1	4318	Culvert		
Reach 1	4239	.09	.045	.09
Reach 1	4132	.09	.045	.09
Reach 1	4028	.09	.045	.09
Reach 1	3865	.09	.045	.09
Reach 1	3705	.09	.045	.09
Reach 1	3510	.09	.045	.09
Reach 1	3362	.09	.045	.09
Reach 1	3052	.09	.045	.09

SUMMARY OF REACH LENGTHS

River: River 1

Reach	River Sta.	Left	Channel	Right
Reach 1	4896	159.6	153.4	150.1
Reach 1	4743	133.3	135.5	142.3
Reach 1	4607	142.7	133.8	135.5
Reach 1	4473	99	90.3	81.7
Reach 1	4383	153.5	144.5	154.5
Reach 1	4318	Culvert		
Reach 1	4239	163.4	106.6	256.9
Reach 1	4132	102.2	104.5	111.3
Reach 1	4028	180.8	162.9	161.8
Reach 1	3865	155.6	159.3	182.2
Reach 1	3705	221.6	195.4	195.8
Reach 1	3510	148.9	147.5	155.8
Reach 1	3362	323.9	310.7	323.6
Reach 1	3052	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: River 1

Reach	River Sta.	Contr.	Expan.
Reach 1	4896	.1	.3
Reach 1	4743	.1	.3
Reach 1	4607	.1	.3
Reach 1	4473	.3	.5
Reach 1	4383	.6	.8
Reach 1	4318	Culvert	
Reach 1	4239	.6	.8
Reach 1	4132	.1	.3
Reach 1	4028	.1	.3
Reach 1	3865	.1	.3
Reach 1	3705	.1	.3
Reach 1	3510	.1	.3
Reach 1	3362	.1	.3
Reach 1	3052	.1	.3

Profile Output Table - Standard Table 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	4896	Q10	947.00	117.06	124.90		124.97	0.000342	2.40	736.59	234.29	0.15
Reach 1	4896	Q50	1490.00	117.06	127.93		127.97	0.000173	2.12	1798.52	499.39	0.11
Reach 1	4896	Q100	1780.00	117.06	129.48		129.51	0.000113	1.87	2698.59	659.99	0.09
Reach 1	4896	Q500	2480.00	117.06	134.31		134.32	0.000025	1.10	6724.68	952.62	0.05
Reach 1	4743	Q10	947.00	115.91	124.90	119.44	124.92	0.000154	1.70	1159.16	244.90	0.10
Reach 1	4743	Q50	1490.00	115.91	127.92	120.44	127.94	0.000107	1.74	2345.08	614.83	0.09
Reach 1	4743	Q100	1780.00	115.91	129.47	120.75	129.49	0.000069	1.52	3393.28	732.36	0.07
Reach 1	4743	Q500	2480.00	115.91	134.31	121.36	134.32	0.000018	0.96	7441.09	918.52	0.04
Reach 1	4607	Q10	947.00	114.74	124.86	118.72	124.90	0.000174	1.77	772.55	143.30	0.11
Reach 1	4607	Q50	1490.00	114.74	127.88	119.52	127.92	0.000129	1.87	1388.86	299.44	0.10
Reach 1	4607	Q100	1780.00	114.74	129.45	119.95	129.48	0.000079	1.60	2825.74	831.77	0.08
Reach 1	4607	Q500	2480.00	114.74	134.31	120.72	134.31	0.000018	0.94	7376.71	1017.64	0.04

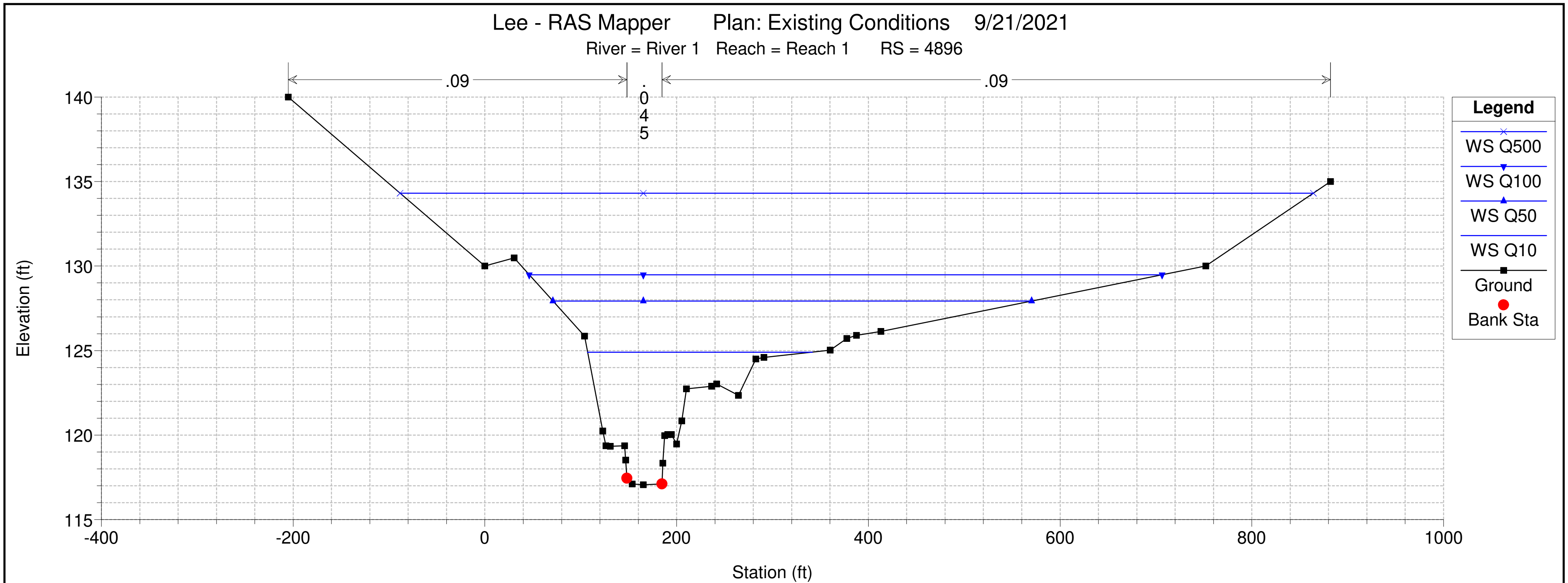
Reach 1	4473	Q10	947.00	114.36	124.76	118.92	124.86	0.000393	2.74	505.66	123.93	0.16
Reach 1	4473	Q50	1490.00	114.36	127.80	119.88	127.89	0.000267	2.76	1248.72	706.04	0.14
Reach 1	4473	Q100	1780.00	114.36	129.42	120.45	129.46	0.000136	2.14	2549.60	884.74	0.10
Reach 1	4473	Q500	2480.00	114.36	134.31	121.56	134.31	0.000021	1.05	7444.26	1090.44	0.04
Reach 1	4383	Q10	947.00	115.92	124.29	120.62	124.70	0.001801	5.54	239.65	57.23	0.35
Reach 1	4383	Q50	1490.00	115.92	127.33	122.24	127.75	0.001278	5.79	386.40	189.32	0.31
Reach 1	4383	Q100	1780.00	115.92	128.92	122.88	129.33	0.001068	5.80	467.36	846.60	0.29
Reach 1	4383	Q500	2480.00	115.92	133.89	124.21	134.21	0.000575	5.31	720.49	1119.05	0.22
Reach 1	4318		Culvert									
Reach 1	4239	Q10	947.00	112.32	122.32	117.32	122.46	0.000654	3.36	400.06	108.48	0.21
Reach 1	4239	Q50	1490.00	112.32	123.63	118.74	123.87	0.000887	4.32	505.63	137.17	0.25
Reach 1	4239	Q100	1780.00	112.32	124.01	119.27	124.31	0.001081	4.89	536.21	138.63	0.27
Reach 1	4239	Q500	2480.00	112.32	124.92	120.32	125.37	0.001477	6.06	609.00	152.43	0.32
Reach 1	4132	Q10	947.00	112.71	122.19		122.36	0.000706	3.59	400.18	122.00	0.22
Reach 1	4132	Q50	1490.00	112.71	123.46		123.73	0.000946	4.56	591.84	170.86	0.26
Reach 1	4132	Q100	1780.00	112.71	123.83		124.15	0.001130	5.10	655.76	182.50	0.28
Reach 1	4132	Q500	2480.00	112.71	124.73		125.16	0.001425	6.07	833.46	211.52	0.32
Reach 1	4028	Q10	947.00	114.09	122.03	118.14	122.27	0.001166	4.18	353.46	113.50	0.27
Reach 1	4028	Q50	1490.00	114.09	123.27	119.48	123.60	0.001450	5.17	506.04	135.38	0.31
Reach 1	4028	Q100	1780.00	114.09	123.59	120.14	123.99	0.001764	5.84	549.14	142.05	0.35
Reach 1	4028	Q500	2480.00	114.09	124.38	121.27	124.95	0.002304	7.07	669.26	159.16	0.40
Reach 1	3865	Q10	947.00	113.31	121.93	119.33	122.05	0.001109	3.63	569.49	198.90	0.25
Reach 1	3865	Q50	1490.00	113.31	123.24	120.56	123.35	0.000908	3.71	1007.84	391.28	0.23
Reach 1	3865	Q100	1780.00	113.31	123.58	120.77	123.69	0.000982	3.97	1139.83	394.36	0.25
Reach 1	3865	Q500	2480.00	113.31	124.46	121.56	124.58	0.000987	4.26	1491.12	404.31	0.25
Reach 1	3705	Q10	947.00	112.00	121.43	119.31	121.76	0.002547	5.46	362.03	155.11	0.36
Reach 1	3705	Q50	1490.00	112.00	122.83	121.11	123.11	0.002095	5.59	588.37	168.37	0.34
Reach 1	3705	Q100	1780.00	112.00	123.09	121.45	123.43	0.002520	6.26	631.09	171.05	0.37
Reach 1	3705	Q500	2480.00	112.00	124.17	122.09	124.36	0.001656	5.49	1315.43	414.02	0.31
Reach 1	3510	Q10	947.00	113.00	120.82	118.75	121.21	0.002980	5.32	248.55	81.51	0.40
Reach 1	3510	Q50	1490.00	113.00	122.09	120.06	122.58	0.003105	6.25	358.03	92.79	0.43
Reach 1	3510	Q100	1780.00	113.00	122.71	120.51	122.96	0.001851	5.12	788.94	299.41	0.33
Reach 1	3510	Q500	2480.00	113.00	123.81	121.40	124.03	0.001548	5.15	1123.95	310.89	0.31
Reach 1	3362	Q10	947.00	113.00	120.55	117.66	120.84	0.001812	4.44	274.15	88.65	0.33
Reach 1	3362	Q50	1490.00	113.00	121.78	118.70	122.18	0.002089	5.42	399.28	128.90	0.36
Reach 1	3362	Q100	1780.00	113.00	122.30	119.12	122.67	0.001912	5.44	596.52	217.42	0.35
Reach 1	3362	Q500	2480.00	113.00	123.39	120.52	123.76	0.001840	5.83	838.16	231.77	0.35
Reach 1	3052	Q10	947.00	112.20	119.49	117.45	120.01	0.004005	5.88	185.52	58.04	0.46
Reach 1	3052	Q50	1490.00	112.20	120.67	118.75	121.28	0.003996	6.74	341.38	131.66	0.47
Reach 1	3052	Q100	1780.00	112.20	121.16	119.33	121.81	0.004006	7.09	406.50	134.69	0.48
Reach 1	3052	Q500	2480.00	112.20	122.19	120.43	122.91	0.004007	7.79	549.60	144.46	0.49

HEC-RAS Plan: Existing Con River: River 1 Reach: Reach 1

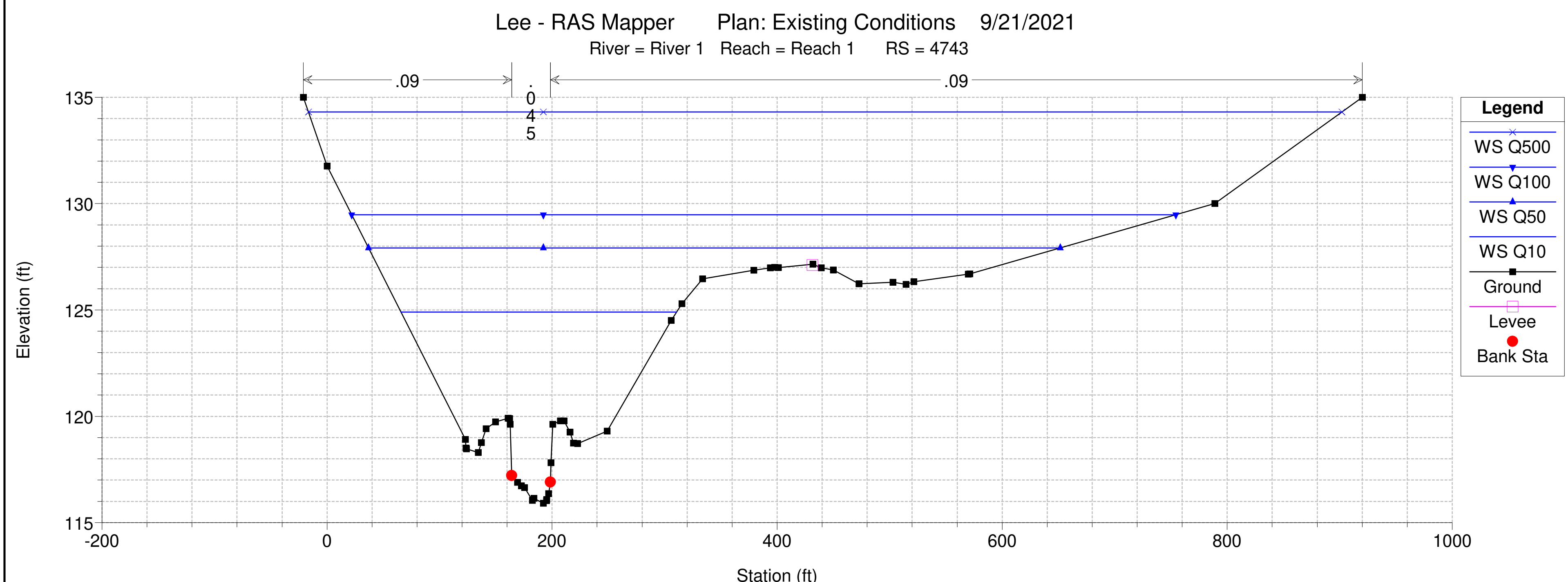
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	4896	Q10	947.00	117.06	124.90		124.97	0.000342	2.40	736.59	234.29	0.15
Reach 1	4896	Q50	1490.00	117.06	127.93		127.97	0.000173	2.12	1798.52	499.39	0.11
Reach 1	4896	Q100	1780.00	117.06	129.48		129.51	0.000113	1.87	2698.59	659.99	0.09
Reach 1	4896	Q500	2480.00	117.06	134.31		134.32	0.000025	1.10	6724.68	952.62	0.05
Reach 1	4743	Q10	947.00	115.91	124.90	119.44	124.92	0.000154	1.70	1159.16	244.90	0.10
Reach 1	4743	Q50	1490.00	115.91	127.92	120.44	127.94	0.000107	1.74	2345.08	614.83	0.09
Reach 1	4743	Q100	1780.00	115.91	129.47	120.75	129.49	0.000069	1.52	3393.28	732.36	0.07
Reach 1	4743	Q500	2480.00	115.91	134.31	121.36	134.32	0.000018	0.96	7441.09	918.52	0.04
Reach 1	4607	Q10	947.00	114.74	124.86	118.72	124.90	0.000174	1.77	772.55	143.30	0.11
Reach 1	4607	Q50	1490.00	114.74	127.88	119.52	127.92	0.000129	1.87	1388.86	299.44	0.10
Reach 1	4607	Q100	1780.00	114.74	129.45	119.95	129.48	0.000079	1.60	2825.74	831.77	0.08
Reach 1	4607	Q500	2480.00	114.74	134.31	120.72	134.31	0.000018	0.94	7376.71	1017.64	0.04
Reach 1	4473	Q10	947.00	114.36	124.76	118.92	124.86	0.000393	2.74	505.66	123.93	0.16
Reach 1	4473	Q50	1490.00	114.36	127.80	119.88	127.89	0.000267	2.76	1248.72	706.04	0.14
Reach 1	4473	Q100	1780.00	114.36	129.42	120.45	129.46	0.000136	2.14	2549.60	884.74	0.10
Reach 1	4473	Q500	2480.00	114.36	134.31	121.56	134.31	0.000021	1.05	7444.26	1090.44	0.04
Reach 1	4383	Q10	947.00	115.92	124.29	120.62	124.70	0.001801	5.54	239.65	57.23	0.35
Reach 1	4383	Q50	1490.00	115.92	127.33	122.24	127.75	0.001278	5.79	386.40	189.32	0.31
Reach 1	4383	Q100	1780.00	115.92	128.92	122.88	129.33	0.001068	5.80	467.36	846.60	0.29
Reach 1	4383	Q500	2480.00	115.92	133.89	124.21	134.21	0.000575	5.31	720.49	1119.05	0.22
Reach 1	4318		Culvert									
Reach 1	4239	Q10	947.00	112.32	122.32	117.32	122.46	0.000654	3.36	400.06	108.48	0.21
Reach 1	4239	Q50	1490.00	112.32	123.63	118.74	123.87	0.000887	4.32	505.63	137.17	0.25
Reach 1	4239	Q100	1780.00	112.32	124.01	119.27	124.31	0.001081	4.89	536.21	138.63	0.27
Reach 1	4239	Q500	2480.00	112.32	124.92	120.32	125.37	0.001477	6.06	609.00	152.43	0.32
Reach 1	4132	Q10	947.00	112.71	122.19		122.36	0.000706	3.59	400.18	122.00	0.22
Reach 1	4132	Q50	1490.00	112.71	123.46		123.73	0.000946	4.56	591.84	170.86	0.26
Reach 1	4132	Q100	1780.00	112.71	123.83		124.15	0.001130	5.10	655.76	182.50	0.28
Reach 1	4132	Q500	2480.00	112.71	124.73		125.16	0.001425	6.07	833.46	211.52	0.32
Reach 1	4028	Q10	947.00	114.09	122.03	118.14	122.27	0.001166	4.18	353.46	113.50	0.27
Reach 1	4028	Q50	1490.00	114.09	123.27	119.48	123.60	0.001450	5.17	506.04	135.38	0.31
Reach 1	4028	Q100	1780.00	114.09	123.59	120.14	123.99	0.001764	5.84	549.14	142.05	0.35
Reach 1	4028	Q500	2480.00	114.09	124.38	121.27	124.95	0.002304	7.07	669.26	159.16	0.40

HEC-RAS Plan: Existing Con River: River 1 Reach: Reach 1 (Continued)

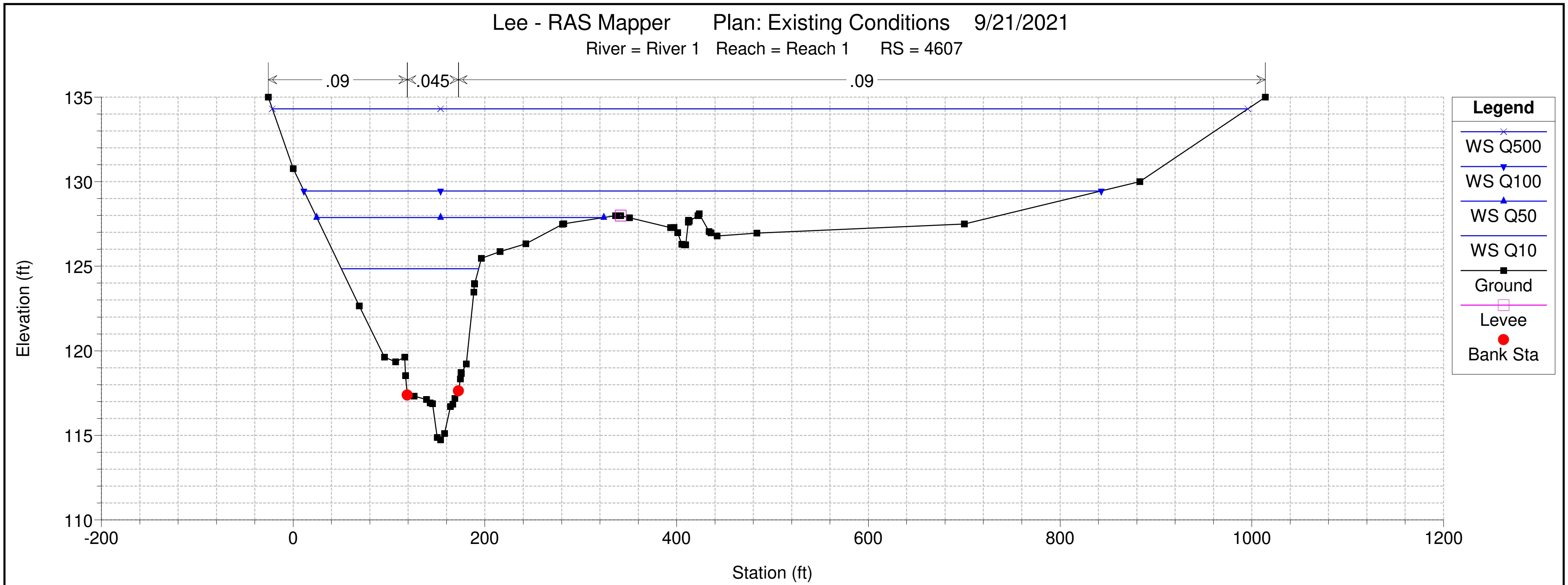
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	3865	Q10	947.00	113.31	121.93	119.33	122.05	0.001109	3.63	569.49	198.90	0.25
Reach 1	3865	Q50	1490.00	113.31	123.24	120.56	123.35	0.000908	3.71	1007.84	391.28	0.23
Reach 1	3865	Q100	1780.00	113.31	123.58	120.77	123.69	0.000982	3.97	1139.83	394.36	0.25
Reach 1	3865	Q500	2480.00	113.31	124.46	121.56	124.58	0.000987	4.26	1491.12	404.31	0.25
Reach 1	3705	Q10	947.00	112.00	121.43	119.31	121.76	0.002547	5.46	362.03	155.11	0.36
Reach 1	3705	Q50	1490.00	112.00	122.83	121.11	123.11	0.002095	5.59	588.37	168.37	0.34
Reach 1	3705	Q100	1780.00	112.00	123.09	121.45	123.43	0.002520	6.26	631.09	171.05	0.37
Reach 1	3705	Q500	2480.00	112.00	124.17	122.09	124.36	0.001656	5.49	1315.43	414.02	0.31
Reach 1	3510	Q10	947.00	113.00	120.82	118.75	121.21	0.002980	5.32	248.55	81.51	0.40
Reach 1	3510	Q50	1490.00	113.00	122.09	120.06	122.58	0.003105	6.25	358.03	92.79	0.43
Reach 1	3510	Q100	1780.00	113.00	122.71	120.51	122.96	0.001851	5.12	788.94	299.41	0.33
Reach 1	3510	Q500	2480.00	113.00	123.81	121.40	124.03	0.001548	5.15	1123.95	310.89	0.31
Reach 1	3362	Q10	947.00	113.00	120.55	117.66	120.84	0.001812	4.44	274.15	88.65	0.33
Reach 1	3362	Q50	1490.00	113.00	121.78	118.70	122.18	0.002089	5.42	399.28	128.90	0.36
Reach 1	3362	Q100	1780.00	113.00	122.30	119.12	122.67	0.001912	5.44	596.52	217.42	0.35
Reach 1	3362	Q500	2480.00	113.00	123.39	120.52	123.76	0.001840	5.83	838.16	231.77	0.35
Reach 1	3052	Q10	947.00	112.20	119.49	117.45	120.01	0.004005	5.88	185.52	58.04	0.46
Reach 1	3052	Q50	1490.00	112.20	120.67	118.75	121.28	0.003996	6.74	341.38	131.66	0.47
Reach 1	3052	Q100	1780.00	112.20	121.16	119.33	121.81	0.004006	7.09	406.50	134.69	0.48
Reach 1	3052	Q500	2480.00	112.20	122.19	120.43	122.91	0.004007	7.79	549.60	144.46	0.49

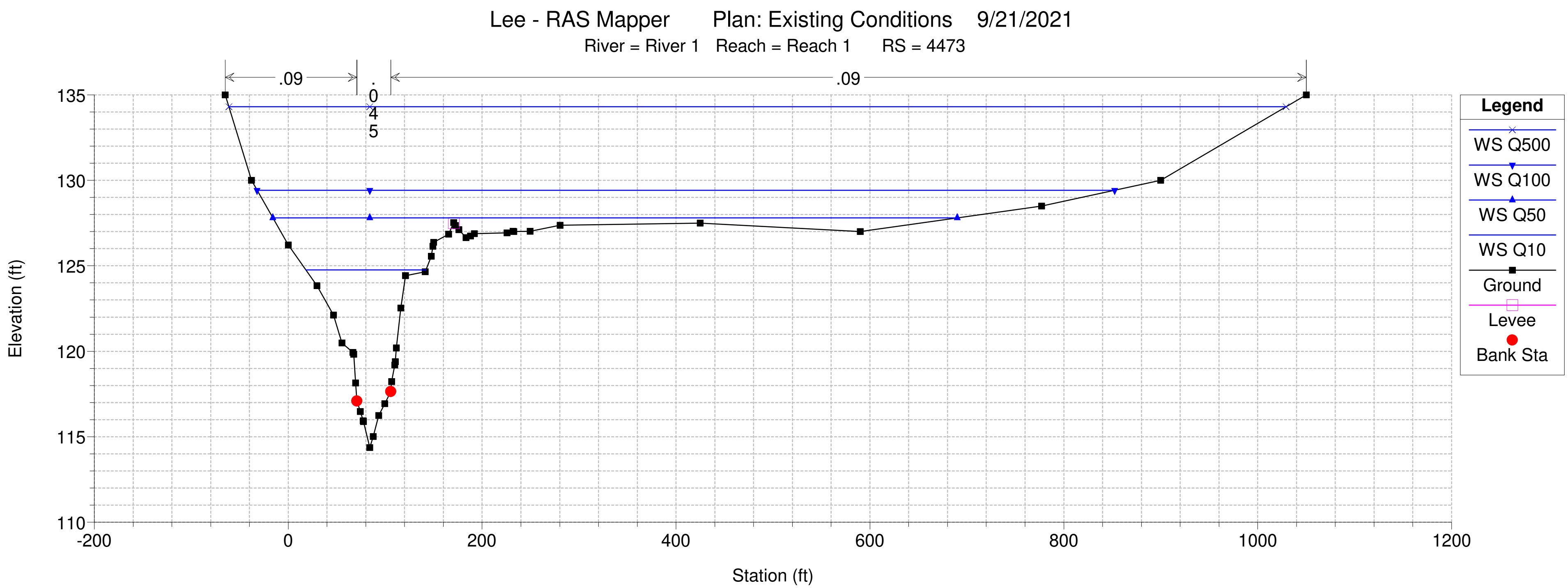


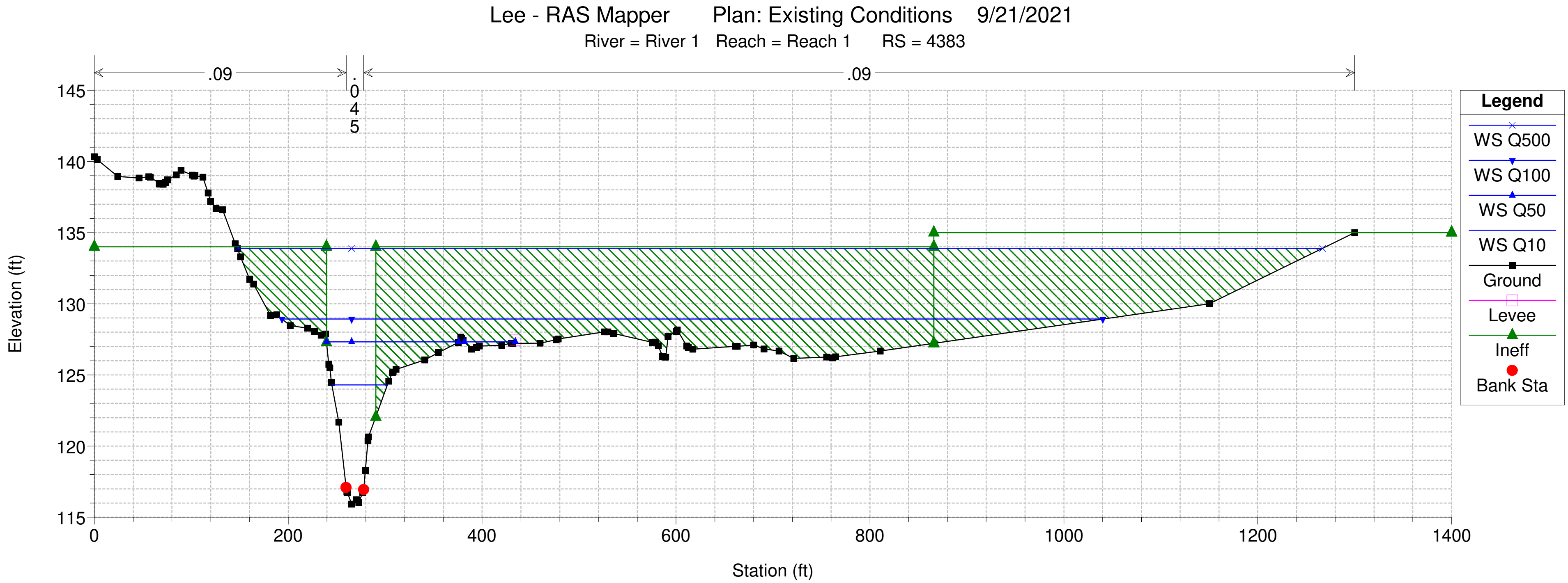
Lee - RAS Mapper Plan: Existing Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4896
.09
.045
.09
Elevation (ft)
Station (ft)
140
135
130
125
120
115
-400
-200
0
200
400
600
800
1000
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Bank Sta

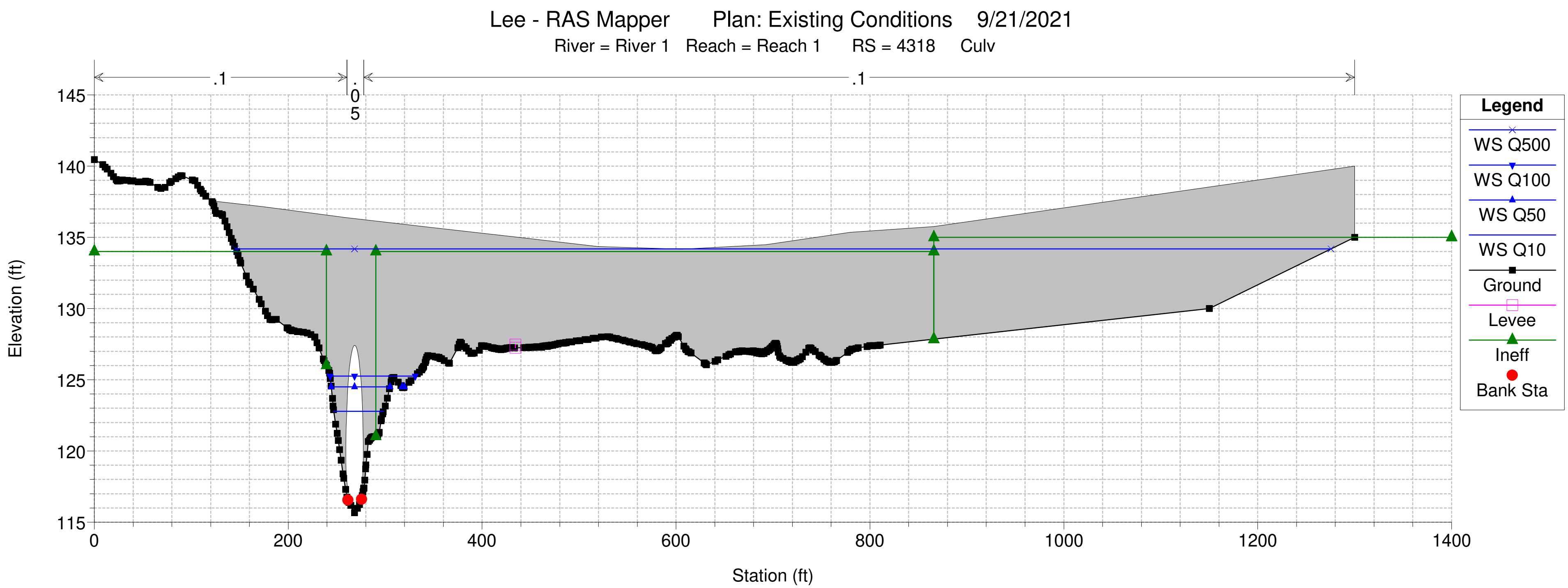


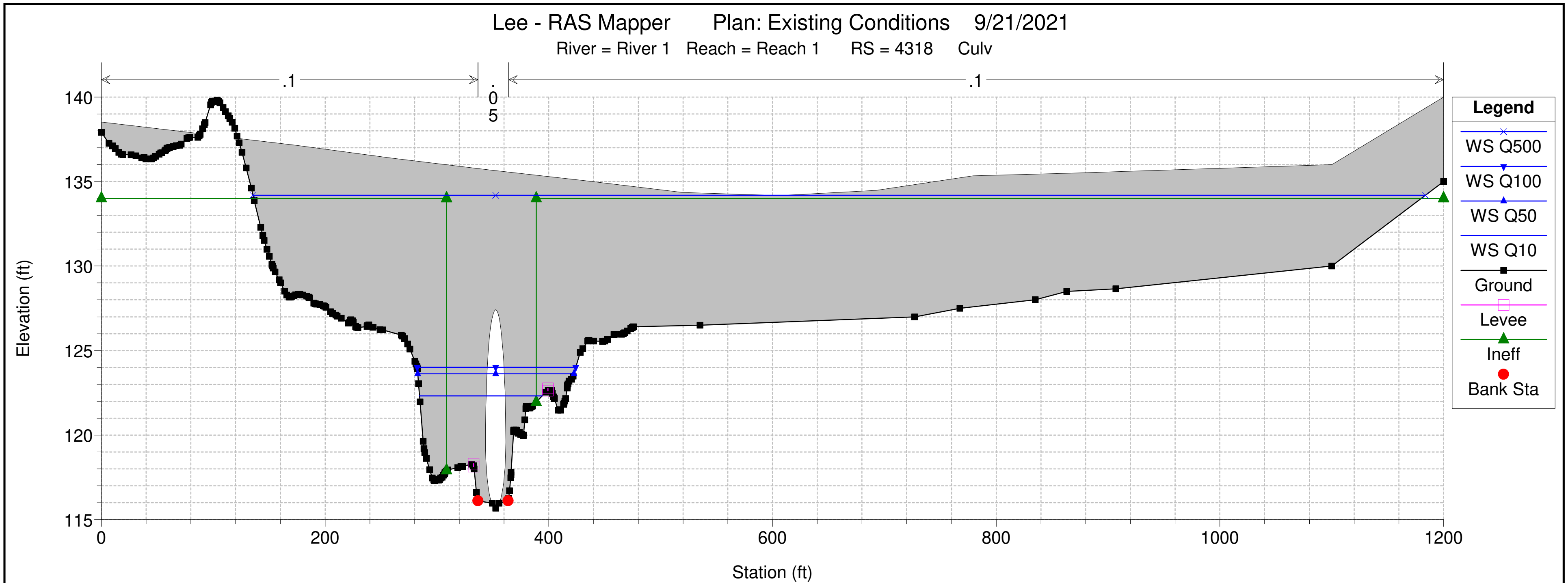
Lee - RAS Mapper Plan: Existing Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4743
.09
.045
.09
Elevation (ft)
Station (ft)
135
130
125
120
115
-200
0
200
400
600
800
1000
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta


Lee - RAS Mapper Plan: Existing Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4607
.09
.045
.09
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta

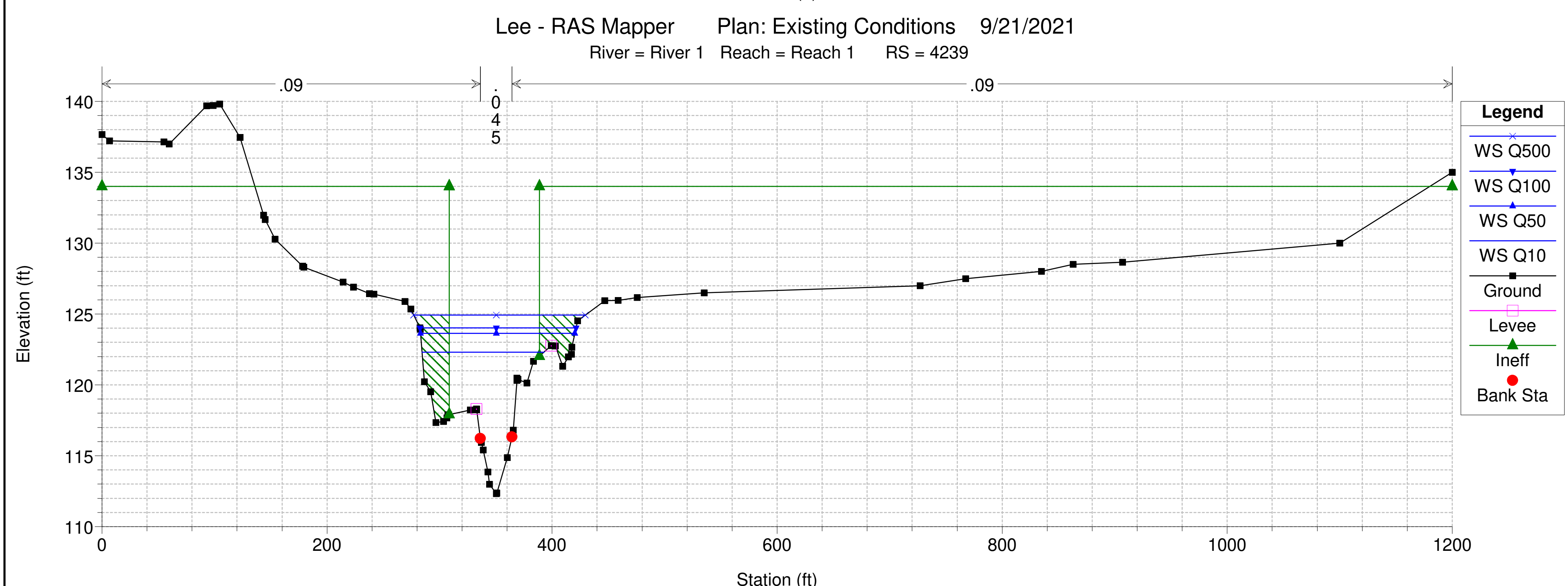

Lee - RAS Mapper Plan: Existing Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4473
.09
.045
.09
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta


Lee - RAS Mapper Plan: Existing Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4383
.09
.045
.09
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Ineff
Bank Sta

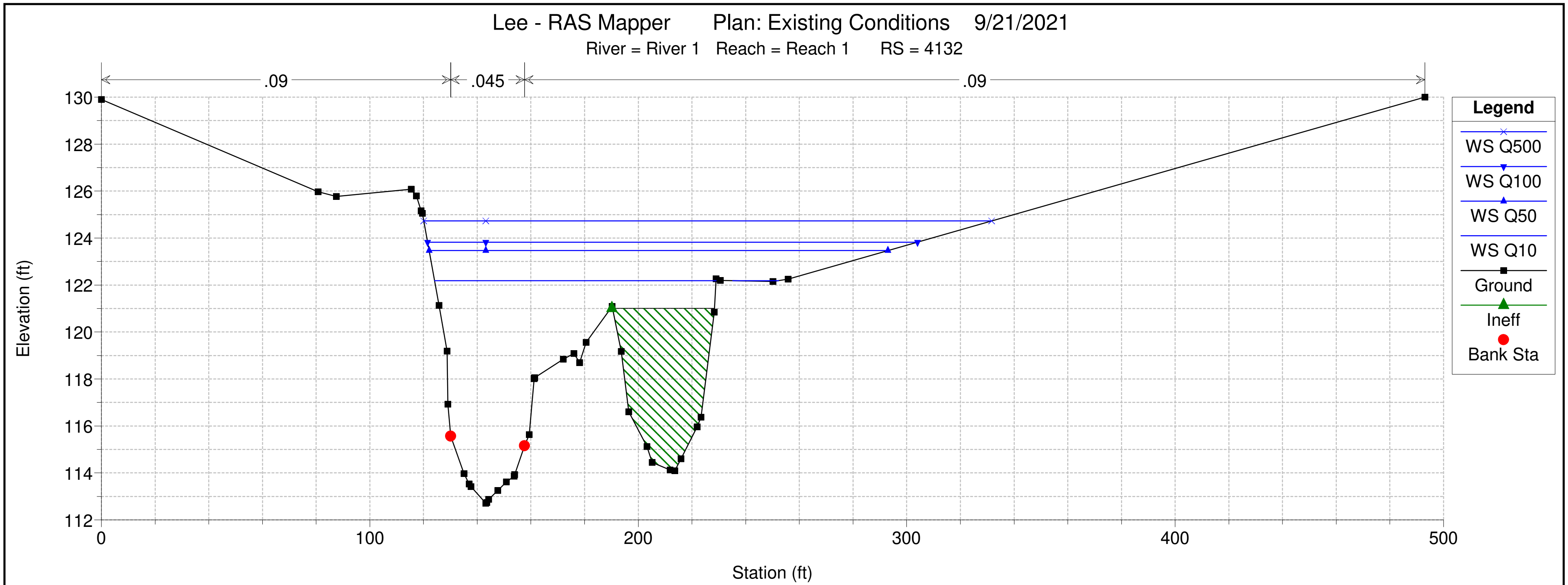

Lee - RAS Mapper Plan: Existing Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4318 Culv
.1
.05
.1
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Ineff
Bank Sta

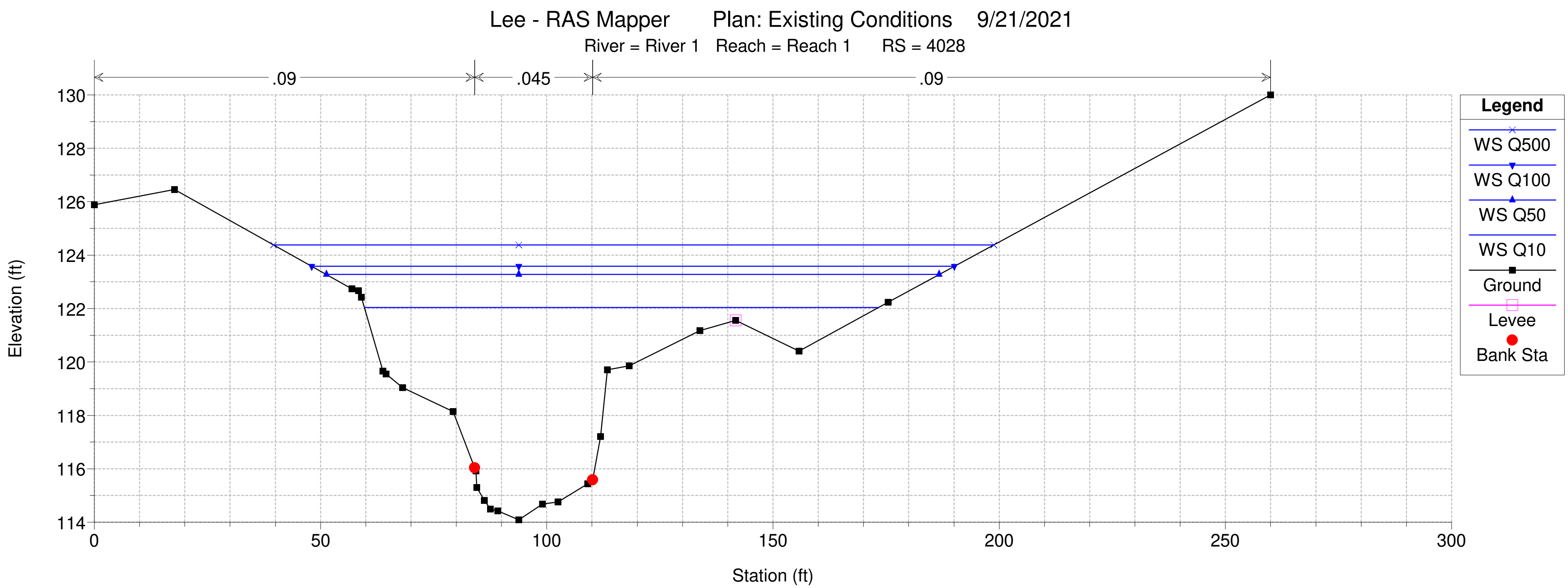


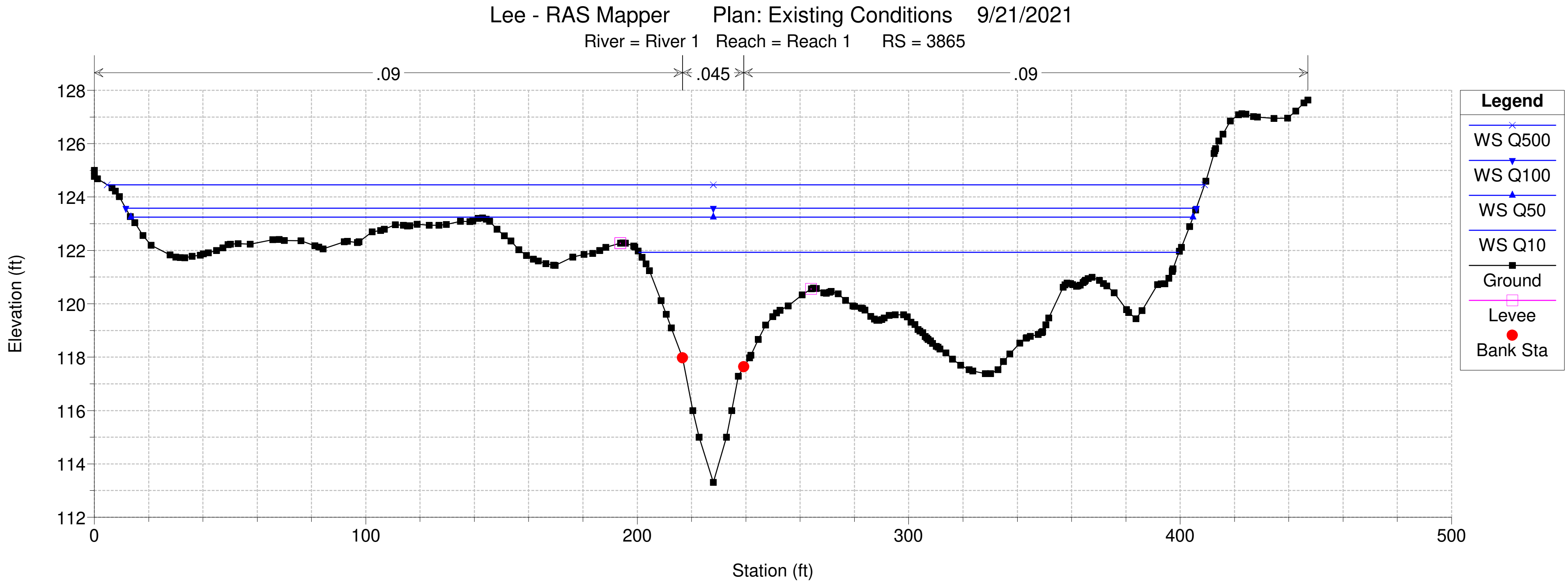
Lee - RAS Mapper Plan: Existing Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4318 Culv
.1
.05
.1
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Ineff
Bank Sta



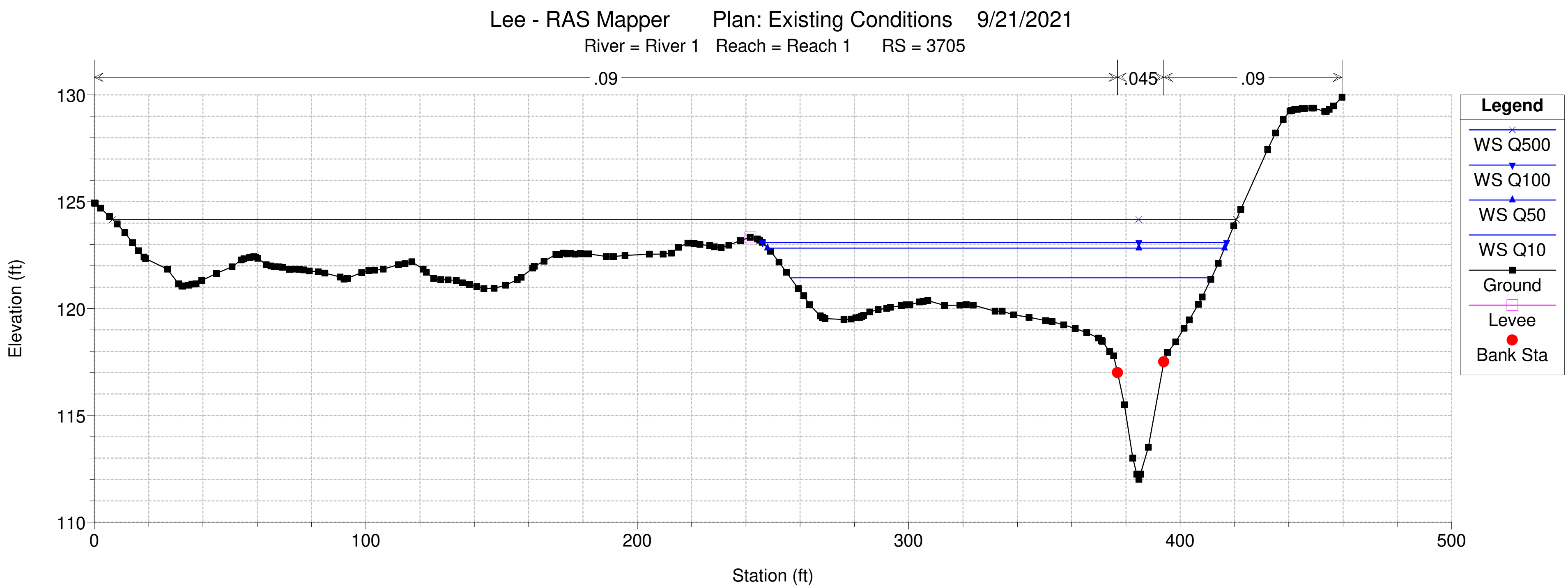
Lee - RAS Mapper Plan: Existing Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4239
.09
.045
.09
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Ineff
Bank Sta


Lee - RAS Mapper Plan: Existing Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4132
.09
.045
.09
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
130
128
126
124
122
120
118
116
114
112
0
100
200
300
400
500

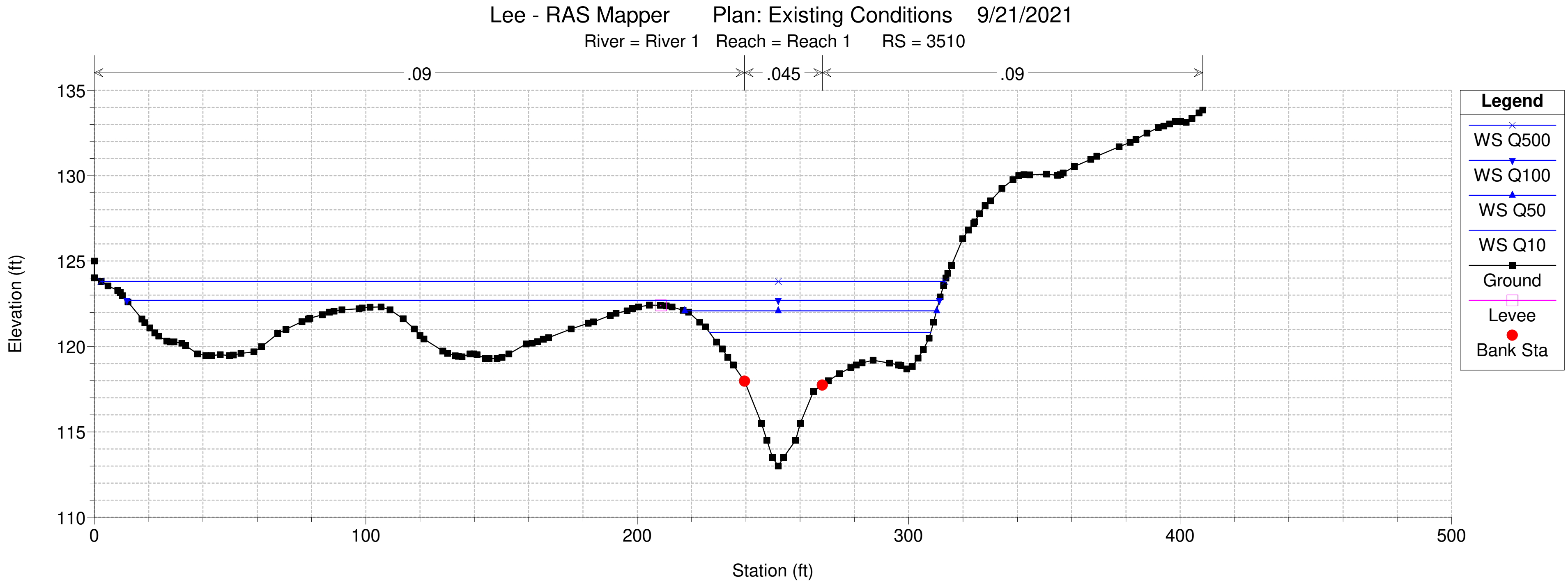

Lee - RAS Mapper Plan: Existing Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4028
.09
.045
.09
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
130
128
126
124
122
120
118
116
114
0
50
100
150
200
250
300



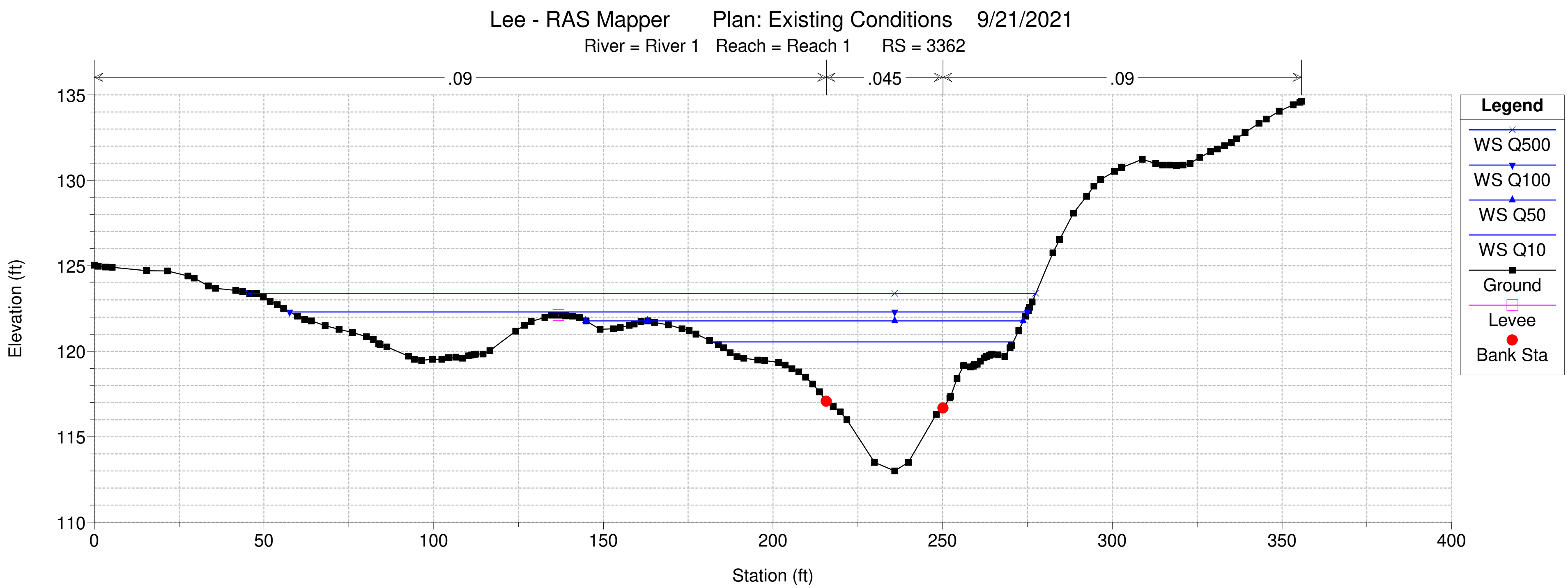
Lee - RAS Mapper Plan: Existing Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 3865
.09
.045
.09
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta



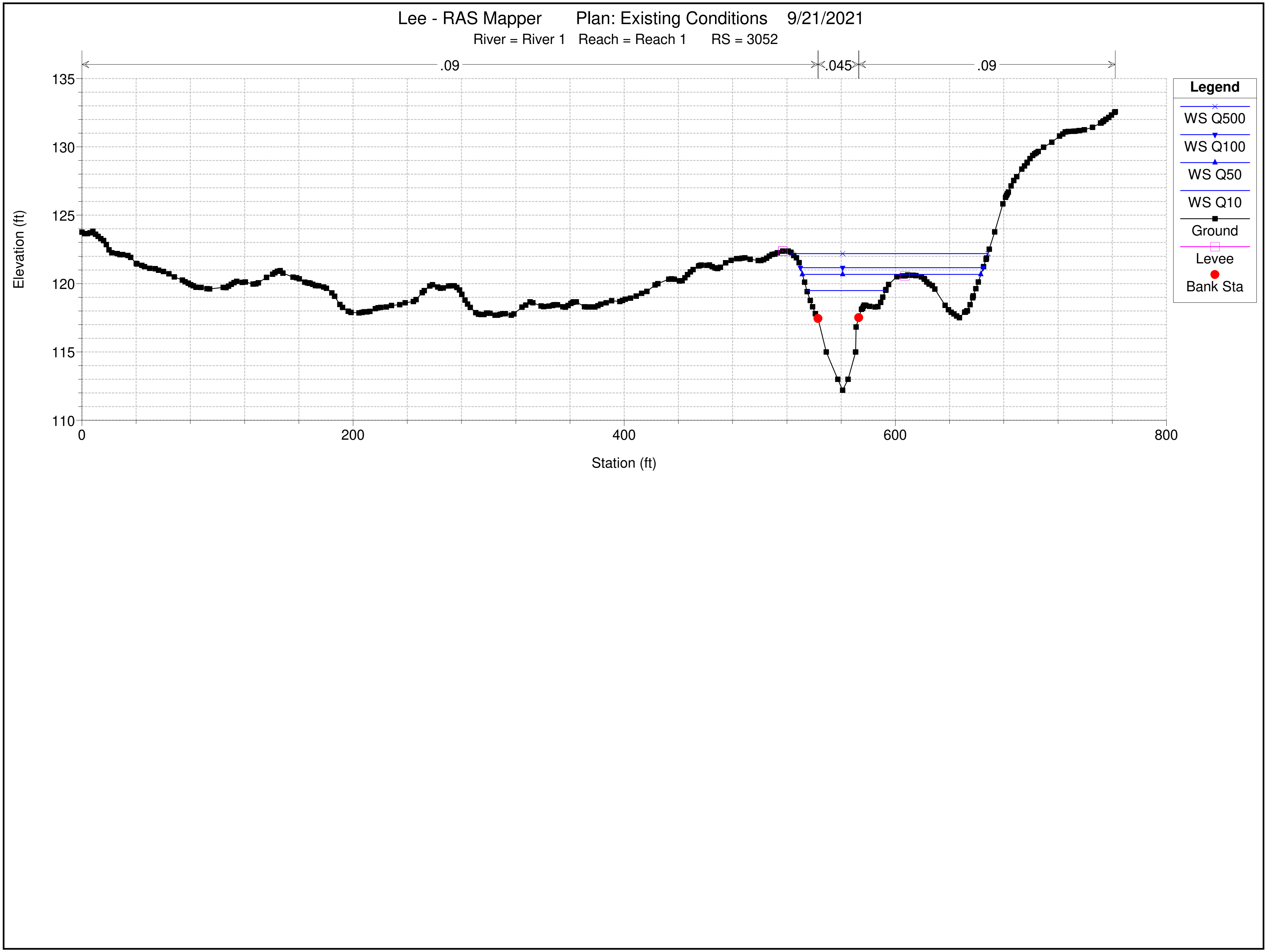
Lee - RAS Mapper Plan: Existing Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 3705
.09
.045
.09
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta



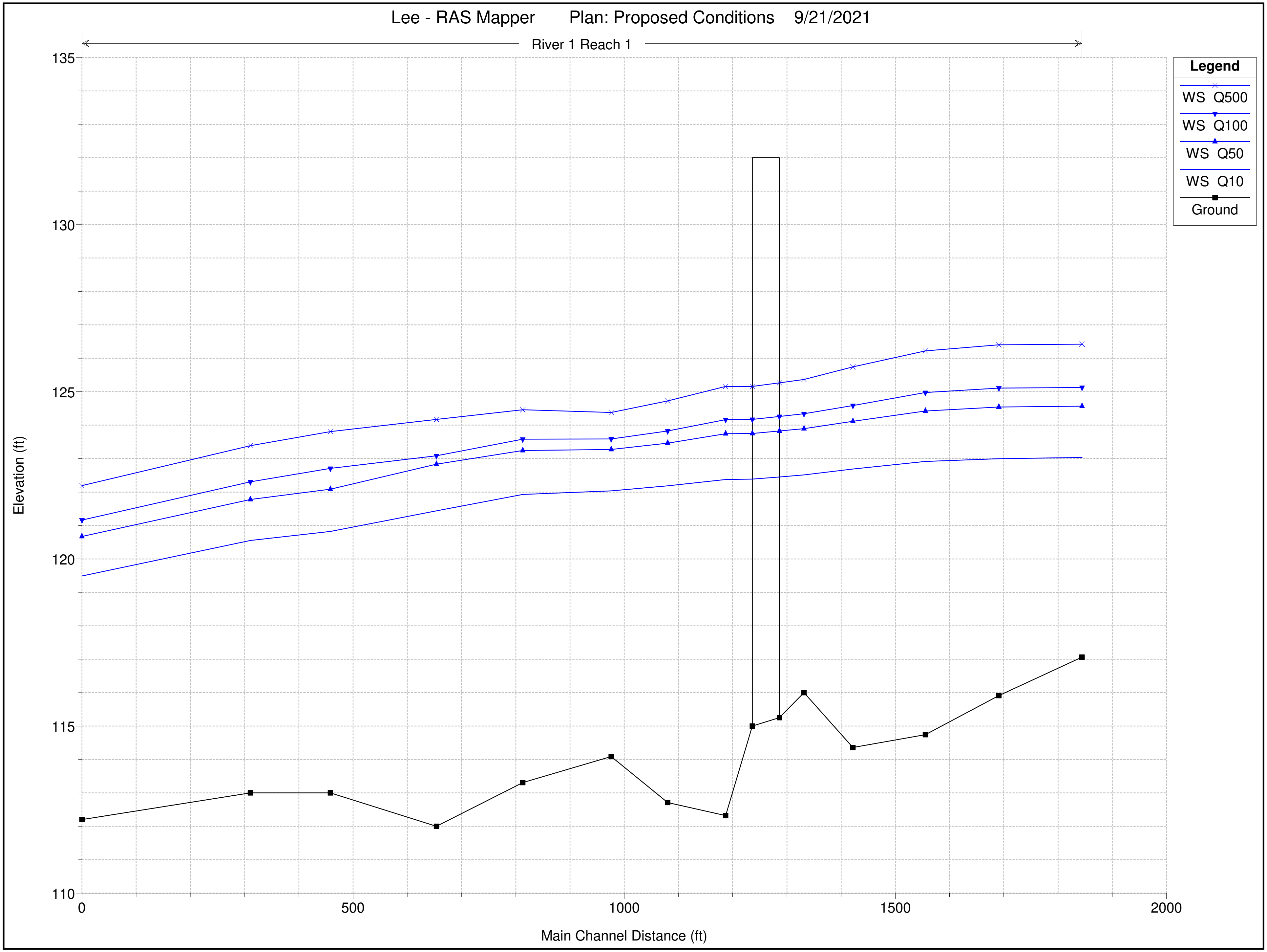
Lee - RAS Mapper Plan: Existing Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 3510
.09
.045
.09
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta



Lee - RAS Mapper Plan: Existing Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 3362
.09
.045
.09
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta



Lee - RAS Mapper Plan: Existing Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 3052
.09
.045
.09
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta
Elevation (ft)
135
130
125
120
115
110
0
200
400
600
800
Station (ft)


Lee - RAS Mapper Plan: Proposed Conditions 9/21/2021
River 1 Reach 1
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Elevation (ft)
Main Channel Distance (ft)
135
130
125
120
115
110
0
500
1000
1500
2000

```
                     HEC-RAS HEC-RAS 5.0.7 March 2019
                       U.S. Army Corps of Engineers
                      Hydrologic Engineering Center
                            609 Second Street
                            Davis, California

      X     X  XXXXXX    XXXX        XXXX       XX      XXXX
      X     X  X        X    X       X   X     X  X    X
      X     X  X        X            X   X    X    X   X
      XXXXXXX  XXXX     X       XXX  XXXX     XXXXXX    XXXX
      X     X  X        X            X  X     X    X        X
      X     X  X        X    X       X   X    X    X        X
      X     X  XXXXXX    XXXX        X    X   X    X   XXXXX
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PROJECT DATA
Project Title: Lee - RAS Mapper
Project File : Lee-RASMapper.prj
Run Date and Time: 9/21/2021 9:32:32 AM

Project in English units

Project Description:
Existing Conditions model. 18' culvert

PLAN DATA

Plan Title: Proposed Conditions
Plan File : m:\18283.06 Lee 41322 - TSL\Design\H&H\HEC RAS - RAS Mapper\Lee-RASMapper.p06

Geometry Title: ProposedConditions
Geometry File : m:\18283.06 Lee 41322 - TSL\Design\H&H\HEC RAS - RAS Mapper\Lee-RASMapper.g06

Flow Title : LeeHydrology
Flow File : m:\18283.06 Lee 41322 - TSL\Design\H&H\HEC RAS - RAS Mapper\Lee-RASMapper.f02

Plan Summary Information:

Number of:	Cross Sections	= 13	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 1	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations = 20
Maximum difference tolerance = 0.3
Flow tolerance factor = 0.001

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

FLOW DATA

Flow Title: LeeHydrology
Flow File : m:\18283.06 Lee 41322 - TSL\Design\H&H\HEC RAS - RAS Mapper\Lee-RASMapper.f02

Flow Data (cfs)

River	Reach	RS	Q10	Q50	Q100	Q500	Q100+30%
River 1	Reach 1	4896	947	1490	1780	2480	2315

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
River 1	Reach 1	Q10	Normal S = 0.004	Normal S = 0.004
River 1	Reach 1	Q50	Normal S = 0.004	Normal S = 0.004
River 1	Reach 1	Q100	Normal S = 0.004	Normal S = 0.004
River 1	Reach 1	Q500	Normal S = 0.004	Normal S = 0.004
River 1	Reach 1	Q100+30%	Normal S = 0.004	Normal S = 0.004

GEOMETRY DATA

Geometry Title: ProposedConditions
Geometry File : m:\18283.06 Lee 41322 - TSL\Design\H&H\HEC RAS - RAS Mapper\Lee-RASMapper.g06

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 4896

INPUT
Description:
Station Elevation Data num= 33

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-205	140	0	130	30.5	130.48	103.87	125.85	122.96	120.25
126.1	119.37	130.75	119.33	145.66	119.36	146.85	118.52	148.06	117.45
148.08	117.45	153.68	117.11	165.18	117.06	184.79	117.1	184.81	117.1
185.71	118.34	187.36	119.97	190.75	120.02	194.6	120.02	200.07	119.48
205.45	120.85	210.36	122.74	236.69	122.89	241.84	123.02	264.38	122.35
282.56	124.5	291.03	124.59	360.08	125.02	377.59	125.71	387.61	125.9
413.04	126.13	752	130	882	135				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-205	.09	148.08	.045	184.79	.09

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
148.08	184.79	159.6	153.4	150.1	.1	.3

CROSS SECTION OUTPUT Profile #Q10

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	123.20	Wt. n-Val.	0.090	0.045	0.090
Vel Head (ft)	0.17	Reach Len. (ft)	159.60	153.40	150.10
W.S. Elev (ft)	123.03	Flow Area (sq ft)	106.57	217.41	88.74
Crit W.S. (ft)		Area (sq ft)	106.57	217.41	88.74
E.G. Slope (ft/ft)	0.001095	Flow (cfs)	120.49	777.49	49.02
Q Total (cfs)	947.00	Top Width (ft)	34.61	36.71	85.38
Top Width (ft)	156.70	Avg. Vel. (ft/s)	1.13	3.58	0.55
Vel Total (ft/s)	2.29	Hydr. Depth (ft)	3.08	5.92	1.04
Max Chl Dpth (ft)	5.97	Conv. (cfs)	3640.9	23494.8	1481.5
Conv. Total (cfs)	28617.2				

Length Wtd. (ft)	153.94	Wetted Per. (ft)	35.80	36.72	87.28
Min Ch El (ft)	117.06	Shear (lb/sq ft)	0.20	0.40	0.07
Alpha	2.03	Stream Power (lb/ft s)	0.23	1.45	0.04
Frctn Loss (ft)	0.11	Cum Volume (acre-ft)	3.94	8.40	5.52
C & E Loss (ft)	0.03	Cum SA (acres)	1.72	1.32	2.24

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q50

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	124.75	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.18	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	124.57	Reach Len. (ft)	159.60	153.40	150.10
Crit W.S. (ft)		Flow Area (sq ft)	163.57	273.62	229.58
E.G. Slope (ft/ft)	0.000981	Area (sq ft)	163.57	273.62	229.58
Q Total (cfs)	1490.00	Flow (cfs)	211.88	1079.36	198.76
Top Width (ft)	180.49	Top Width (ft)	39.83	36.71	103.95
Vel Total (ft/s)	2.23	Avg. Vel. (ft/s)	1.30	3.94	0.87
Max Chl Dpth (ft)	7.51	Hydr. Depth (ft)	4.11	7.45	2.21
Conv. Total (cfs)	47582.5	Conv. (cfs)	6766.3	34469.0	6347.3
Length Wtd. (ft)	153.89	Wetted Per. (ft)	41.24	36.72	105.94
Min Ch El (ft)	117.06	Shear (lb/sq ft)	0.24	0.46	0.13
Alpha	2.33	Stream Power (lb/ft s)	0.31	1.80	0.11
Frctn Loss (ft)	0.10	Cum Volume (acre-ft)	7.27	10.19	9.40
C & E Loss (ft)	0.03	Cum SA (acres)	2.93	1.32	3.10

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	125.34	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.21	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	125.13	Reach Len. (ft)	159.60	153.40	150.10
Crit W.S. (ft)		Flow Area (sq ft)	186.39	294.16	311.25
E.G. Slope (ft/ft)	0.001069	Area (sq ft)	186.39	294.16	311.25
Q Total (cfs)	1780.00	Flow (cfs)	266.52	1271.41	242.08
Top Width (ft)	256.41	Top Width (ft)	41.74	36.71	177.96
Vel Total (ft/s)	2.25	Avg. Vel. (ft/s)	1.43	4.32	0.78
Max Chl Dpth (ft)	8.07	Hydr. Depth (ft)	4.47	8.01	1.75
Conv. Total (cfs)	54445.1	Conv. (cfs)	8151.9	38888.8	7404.4
Length Wtd. (ft)	153.92	Wetted Per. (ft)	43.23	36.72	179.95
Min Ch El (ft)	117.06	Shear (lb/sq ft)	0.29	0.53	0.12
Alpha	2.72	Stream Power (lb/ft s)	0.41	2.31	0.09
Frctn Loss (ft)	0.11	Cum Volume (acre-ft)	10.79	10.81	10.80
C & E Loss (ft)	0.04	Cum SA (acres)	4.37	1.32	3.39

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	126.65	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.23	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	126.42	Reach Len. (ft)	159.60	153.40	150.10
Crit W.S. (ft)		Flow Area (sq ft)	245.34	341.71	576.80
E.G. Slope (ft/ft)	0.001029	Area (sq ft)	245.34	341.71	576.80
Q Total (cfs)	2480.00	Flow (cfs)	352.75	1601.70	525.55
Top Width (ft)	343.65	Top Width (ft)	53.25	36.71	253.69
Vel Total (ft/s)	2.13	Avg. Vel. (ft/s)	1.44	4.69	0.91
Max Chl Dpth (ft)	9.36	Hydr. Depth (ft)	4.61	9.31	2.27

```
  Conv. Total (cfs)        77293.7    Conv. (cfs)            10994.1    49919.9    16379.7
  Length Wtd. (ft)          153.80    Wetted Per. (ft)         54.87      36.72     255.70
  Min Ch El (ft)            117.06    Shear (lb/sq ft)          0.29       0.60       0.14
  Alpha                       3.23    Stream Power (lb/ft s)    0.41       2.80       0.13
  Frctn Loss (ft)             0.11    Cum Volume (acre-ft)     17.77      12.24      14.57
  C & E Loss (ft)             0.04    Cum SA (acres)            5.75       1.32       4.01
```

CROSS SECTION

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RIVER: River 1
REACH: Reach 1           RS: 4743

INPUT
Description:
Station Elevation Data    num=      51
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     -21     135       0  131.77  122.94  118.91  123.49   118.5  124.05  118.47
  134.41   118.3  137.12  118.76  141.42  119.42  149.82  119.73  160.91  119.91
  162.38   119.9   162.8  119.62  164.12  117.22  164.13  117.22  169.34  116.89
  172.77  116.73  175.62  116.65  182.42  116.05  183.92  116.14  192.28  115.91
  194.97  116.03  195.24  116.08  196.81  116.37  198.45  116.87  198.47  116.91
  198.92  117.82  200.61  119.62  207.45  119.78  210.58  119.79  215.89  119.26
  218.96  118.74  222.81  118.72  248.86   119.3  305.81  124.51  315.53   125.3
  333.74  126.46  379.39  126.87  394.02  126.98  397.88     127  401.27  126.99
  431.83  127.15  439.22  126.98  450.04  126.88  472.78  126.23  502.85   126.3
   514.5   126.2  521.42  126.33  569.94  126.69   571.3   126.7     789     130
     920     135

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     -21     .09  164.12    .045  198.47     .09

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        164.12  198.47           133.3   135.5   142.3             .1       .3
Right Levee     Station=  431.43      Elevation=  127.11

CROSS SECTION OUTPUT  Profile #Q10

  E.G. Elev (ft)            123.06    Element                 Left OB    Channel   Right OB
  Vel Head (ft)               0.06    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)            123.00    Reach Len. (ft)          133.30     135.50     142.30
  Crit W.S. (ft)            119.44    Flow Area (sq ft)        237.42     226.08     268.16
  E.G. Slope (ft/ft)      0.000483    Area (sq ft)             237.42     226.08     268.16
  Q Total (cfs)             947.00    Flow (cfs)               174.73     574.27     198.00
  Top Width (ft)            205.42    Top Width (ft)            80.26      34.35      90.81
  Vel Total (ft/s)            1.29    Avg. Vel. (ft/s)          0.74       2.54       0.74
  Max Chl Dpth (ft)           7.09    Hydr. Depth (ft)          2.96       6.58       2.95
  Conv. Total (cfs)        43083.0    Conv. (cfs)             7949.4    26125.9     9007.7
  Length Wtd. (ft)          136.03    Wetted Per. (ft)         82.21      34.53      92.40
  Min Ch El (ft)            115.91    Shear (lb/sq ft)          0.09       0.20       0.09
  Alpha                       2.46    Stream Power (lb/ft s)    0.06       0.50       0.06
  Frctn Loss (ft)             0.07    Cum Volume (acre-ft)      3.31       7.62       4.91
  C & E Loss (ft)             0.00    Cum SA (acres)            1.51       1.19       1.93


Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q50

  E.G. Elev (ft)            124.61    Element                 Left OB    Channel   Right OB
  Vel Head (ft)               0.07    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)            124.54    Reach Len. (ft)          133.30     135.50     142.30
  Crit W.S. (ft)            120.44    Flow Area (sq ft)        372.60     279.06     421.24
```

E.G. Slope (ft/ft)	0.000463	Area (sq ft)	372.60	279.06	421.24
Q Total (cfs)	1490.00	Flow (cfs)	324.41	798.09	367.50
Top Width (ft)	237.07	Top Width (ft)	95.01	34.35	107.72
Vel Total (ft/s)	1.39	Avg. Vel. (ft/s)	0.87	2.86	0.87
Max Chl Dpth (ft)	8.63	Hydr. Depth (ft)	3.92	8.12	3.91
Conv. Total (cfs)	69280.2	Conv. (cfs)	15084.0	37108.5	17087.7
Length Wtd. (ft)	136.11	Wetted Per. (ft)	97.04	34.53	109.38
Min Ch El (ft)	115.91	Shear (lb/sq ft)	0.11	0.23	0.11
Alpha	2.45	Stream Power (lb/ft s)	0.10	0.67	0.10
Frctn Loss (ft)	0.07	Cum Volume (acre-ft)	6.29	9.21	8.27
C & E Loss (ft)	0.00	Cum SA (acres)	2.68	1.19	2.73

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	125.19	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.08	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	125.11	Reach Len. (ft)	133.30	135.50	142.30
Crit W.S. (ft)	120.75	Flow Area (sq ft)	428.20	298.60	484.52
E.G. Slope (ft/ft)	0.000488	Area (sq ft)	428.20	298.60	484.52
Q Total (cfs)	1780.00	Flow (cfs)	405.07	917.66	457.27
Top Width (ft)	249.51	Top Width (ft)	100.45	34.35	114.72
Vel Total (ft/s)	1.47	Avg. Vel. (ft/s)	0.95	3.07	0.94
Max Chl Dpth (ft)	9.20	Hydr. Depth (ft)	4.26	8.69	4.22
Conv. Total (cfs)	80576.9	Conv. (cfs)	18336.8	41540.4	20699.7
Length Wtd. (ft)	136.12	Wetted Per. (ft)	102.51	34.53	116.40
Min Ch El (ft)	115.91	Shear (lb/sq ft)	0.13	0.26	0.13
Alpha	2.46	Stream Power (lb/ft s)	0.12	0.81	0.12
Frctn Loss (ft)	0.07	Cum Volume (acre-ft)	9.67	9.77	9.43
C & E Loss (ft)	0.01	Cum SA (acres)	4.11	1.19	2.88

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	126.50	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.10	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	126.40	Reach Len. (ft)	133.30	135.50	142.30
Crit W.S. (ft)	121.36	Flow Area (sq ft)	566.08	343.02	645.21
E.G. Slope (ft/ft)	0.000513	Area (sq ft)	566.08	343.02	645.21
Q Total (cfs)	2480.00	Flow (cfs)	612.98	1185.91	681.12
Top Width (ft)	281.53	Top Width (ft)	112.81	34.35	134.37
Vel Total (ft/s)	1.60	Avg. Vel. (ft/s)	1.08	3.46	1.06
Max Chl Dpth (ft)	10.49	Hydr. Depth (ft)	5.02	9.99	4.80
Conv. Total (cfs)	109459.1	Conv. (cfs)	27054.7	52342.0	30062.3
Length Wtd. (ft)	136.10	Wetted Per. (ft)	114.94	34.53	136.10
Min Ch El (ft)	115.91	Shear (lb/sq ft)	0.16	0.32	0.15
Alpha	2.48	Stream Power (lb/ft s)	0.17	1.10	0.16
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)	16.29	11.03	12.47
C & E Loss (ft)	0.01	Cum SA (acres)	5.45	1.19	3.35

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 4607

INPUT
Description:

```
Station Elevation Data    num=      53
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
     -26     135       0  130.77   68.92  122.66   95.25  119.62     107  119.35
  116.44  119.63   117.3  118.53  119.16  117.38  126.27  117.32  139.13  117.12
  143.05  116.92  145.43  116.88  150.35  114.88  153.85  114.74  157.96  115.11
     164   116.7  166.41  116.84  168.69  117.18  172.45  117.63  172.46  117.63
  174.45  118.34  175.33  118.72  175.49  118.66  180.64  119.22  188.59  123.47
  189.01  123.98  189.28  123.95  196.38  125.47  215.87  125.86   242.7  126.33
  281.06  127.48  282.39  127.51  336.19  127.99  341.59  127.99  350.81  127.87
  393.71  127.28  397.29   127.3  401.18  126.99  405.42   126.3  408.04  126.27
  409.36  126.27  412.12   127.6  412.44  127.71  413.34  127.66  422.27  127.99
  423.55  128.09  433.79  127.05  435.69  126.97  442.19  126.79   483.6  126.96
     700   127.5     883     130    1014     135

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     -26     .09  119.16    .045  172.45     .09

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       119.16  172.45            142.7   133.8   135.5             .1        .3
Right Levee     Station=  341.64      Elevation=     128

CROSS SECTION OUTPUT  Profile #Q10

  E.G. Elev (ft)           123.00    Element                   Left OB    Channel   Right OB
  Vel Head (ft)              0.08    Wt. n-Val.                 0.090      0.045      0.090
  W.S. Elev (ft)           122.91    Reach Len. (ft)           142.70     133.80     135.50
  Crit W.S. (ft)           118.72    Flow Area (sq ft)         132.08     337.28      47.61
  E.G. Slope (ft/ft)     0.000477    Area (sq ft)              132.08     337.28      47.61
  Q Total (cfs)            947.00    Flow (cfs)                 87.00     824.88      35.11
  Top Width (ft)           120.78    Top Width (ft)             52.39      53.29      15.10
  Vel Total (ft/s)           1.83    Avg. Vel. (ft/s)            0.66       2.45       0.74
  Max Chl Dpth (ft)          8.17    Hydr. Depth (ft)            2.52       6.33       3.15
  Conv. Total (cfs)       43380.7    Conv. (cfs)               3985.5    37786.7     1608.5
  Length Wtd. (ft)         134.49    Wetted Per. (ft)           53.45      53.97      16.27
  Min Ch El (ft)           114.74    Shear (lb/sq ft)            0.07       0.19       0.09
  Alpha                      1.57    Stream Power (lb/ft s)      0.05       0.45       0.06
  Frctn Loss (ft)            0.09    Cum Volume (acre-ft)        2.74       6.74       4.39
  C & E Loss (ft)            0.01    Cum SA (acres)              1.31       1.05       1.76


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q50

  E.G. Elev (ft)           124.54    Element                   Left OB    Channel   Right OB
  Vel Head (ft)              0.12    Wt. n-Val.                 0.090      0.045      0.090
  W.S. Elev (ft)           124.43    Reach Len. (ft)           142.70     133.80     135.50
  Crit W.S. (ft)           119.52    Flow Area (sq ft)         221.13     417.96      72.71
  E.G. Slope (ft/ft)     0.000526    Area (sq ft)              221.13     417.96      72.71
  Q Total (cfs)           1490.00    Flow (cfs)                186.80    1239.48      63.73
  Top Width (ft)           137.61    Top Width (ft)             65.26      53.29      19.06
  Vel Total (ft/s)           2.09    Avg. Vel. (ft/s)            0.84       2.97       0.88
  Max Chl Dpth (ft)          9.69    Hydr. Depth (ft)            3.39       7.84       3.81
  Conv. Total (cfs)       64941.8    Conv. (cfs)               8141.5    54022.8     2777.5
  Length Wtd. (ft)         134.78    Wetted Per. (ft)           66.41      53.97      20.66
  Min Ch El (ft)           114.74    Shear (lb/sq ft)            0.11       0.25       0.12
  Alpha                      1.70    Stream Power (lb/ft s)      0.09       0.75       0.10
  Frctn Loss (ft)            0.11    Cum Volume (acre-ft)        5.38       8.13       7.47
  C & E Loss (ft)            0.02    Cum SA (acres)              2.43       1.05       2.53


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
```

1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	125.11	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.14	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	124.98	Reach Len. (ft)	142.70	133.80	135.50
Crit W.S. (ft)	119.95	Flow Area (sq ft)	258.23	447.21	83.87
E.G. Slope (ft/ft)	0.000582	Area (sq ft)	258.23	447.21	83.87
Q Total (cfs)	1780.00	Flow (cfs)	242.97	1458.54	78.49
Top Width (ft)	144.83	Top Width (ft)	69.92	53.29	21.62
Vel Total (ft/s)	2.26	Avg. Vel. (ft/s)	0.94	3.26	0.94
Max Chl Dpth (ft)	10.24	Hydr. Depth (ft)	3.69	8.39	3.88
Conv. Total (cfs)	73796.1	Conv. (cfs)	10073.2	60468.7	3254.2
Length Wtd. (ft)	134.87	Wetted Per. (ft)	71.10	53.97	23.28
Min Ch El (ft)	114.74	Shear (lb/sq ft)	0.13	0.30	0.13
Alpha	1.75	Stream Power (lb/ft s)	0.12	0.98	0.12
Frctn Loss (ft)	0.12	Cum Volume (acre-ft)	8.62	8.61	8.50
C & E Loss (ft)	0.02	Cum SA (acres)	3.85	1.05	2.66

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	126.41	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.19	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	126.22	Reach Len. (ft)	142.70	133.80	135.50
Crit W.S. (ft)	120.72	Flow Area (sq ft)	351.76	513.48	127.57
E.G. Slope (ft/ft)	0.000685	Area (sq ft)	351.76	513.48	127.57
Q Total (cfs)	2480.00	Flow (cfs)	402.06	1992.14	85.80
Top Width (ft)	197.73	Top Width (ft)	80.49	53.29	63.95
Vel Total (ft/s)	2.50	Avg. Vel. (ft/s)	1.14	3.88	0.67
Max Chl Dpth (ft)	11.48	Hydr. Depth (ft)	4.37	9.64	1.99
Conv. Total (cfs)	94775.2	Conv. (cfs)	15364.9	76131.3	3279.0
Length Wtd. (ft)	135.10	Wetted Per. (ft)	81.74	53.97	65.67
Min Ch El (ft)	114.74	Shear (lb/sq ft)	0.18	0.41	0.08
Alpha	1.97	Stream Power (lb/ft s)	0.21	1.58	0.06
Frctn Loss (ft)	0.14	Cum Volume (acre-ft)	14.88	9.70	11.21
C & E Loss (ft)	0.03	Cum SA (acres)	5.15	1.05	3.02

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 4473

INPUT
Description:
Station Elevation Data num= 45

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-65	135	-38	130	0	126.22	29.7	123.83	46.67	122.12
55.44	120.49	66.71	119.94	67.6	119.83	69.47	118.15	70.82	117.09
74.31	116.47	77.42	115.93	77.62	115.89	84.05	114.36	87.73	115.01
93.36	116.25	99.66	116.94	105.78	117.64	106.64	118.23	109.89	119.19
110.4	119.4	111.43	120.19	116.2	122.53	120.89	124.42	141.46	124.66
147.46	125.56	149.27	126.15	150.02	126.38	165.46	126.85	170.67	127.52

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  172.45  127.36  175.93  127.11  183.37  126.65  187.84  126.75   192.1  126.88
  225.73  126.93  231.76  127.02  232.65     127  249.55  127.02  280.28  127.38
     425   127.5     590     127     777   128.5     900     130    1050     135

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
     -65     .09   70.82    .045  105.78     .09

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         70.82  105.78               99    90.3    81.7             .3       .5
Right Levee     Station=  170.79      Elevation=  127.49

CROSS SECTION OUTPUT  Profile #Q10

  E.G. Elev (ft)           122.89    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.20    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)           122.69    Reach Len. (ft)           99.00      90.30      81.70
  Crit W.S. (ft)           118.92    Flow Area (sq ft)         57.78     231.31      28.07
  E.G. Slope (ft/ft)     0.001074    Area (sq ft)              57.78     231.31      28.07
  Q Total (cfs)            947.00    Flow (cfs)                47.37     872.89      26.74
  Top Width (ft)            75.53    Top Width (ft)            29.76      34.96      10.81
  Vel Total (ft/s)           2.99    Avg. Vel. (ft/s)           0.82       3.77       0.95
  Max Chl Dpth (ft)          8.33    Hydr. Depth (ft)           1.94       6.62       2.60
  Conv. Total (cfs)       28898.9    Conv. (cfs)              1445.6    26637.4      815.9
  Length Wtd. (ft)          90.52    Wetted Per. (ft)          30.97      35.51      12.01
  Min Ch El (ft)           114.36    Shear (lb/sq ft)           0.13       0.44       0.16
  Alpha                      1.48    Stream Power (lb/ft s)     0.10       1.65       0.15
  Frctn Loss (ft)            0.12    Cum Volume (acre-ft)       2.43       5.87       4.27
  C & E Loss (ft)            0.01    Cum SA (acres)             1.17       0.92       1.72


Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q50

  E.G. Elev (ft)           124.42    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.30    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)           124.12    Reach Len. (ft)           99.00      90.30      81.70
  Crit W.S. (ft)           119.88    Flow Area (sq ft)        110.56     281.28      46.05
  E.G. Slope (ft/ft)     0.001275    Area (sq ft)             110.56     281.28      46.05
  Q Total (cfs)           1490.00    Flow (cfs)               117.05    1317.65      55.30
  Top Width (ft)            93.97    Top Width (ft)            44.66      34.96      14.35
  Vel Total (ft/s)           3.40    Avg. Vel. (ft/s)           1.06       4.68       1.20
  Max Chl Dpth (ft)          9.75    Hydr. Depth (ft)           2.48       8.05       3.21
  Conv. Total (cfs)       41731.3    Conv. (cfs)              3278.3    36904.2     1548.8
  Length Wtd. (ft)          90.65    Wetted Per. (ft)          45.94      35.51      15.83
  Min Ch El (ft)           114.36    Shear (lb/sq ft)           0.19       0.63       0.23
  Alpha                      1.69    Stream Power (lb/ft s)     0.20       2.95       0.28
  Frctn Loss (ft)            0.14    Cum Volume (acre-ft)       4.84       7.06       7.28
  C & E Loss (ft)            0.02    Cum SA (acres)             2.25       0.92       2.48


Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q100

  E.G. Elev (ft)           124.97    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.38    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)           124.59    Reach Len. (ft)           99.00      90.30      81.70
  Crit W.S. (ft)           120.45    Flow Area (sq ft)        133.01     297.77      54.25
  E.G. Slope (ft/ft)     0.001497    Area (sq ft)             133.01     297.77      54.25
  Q Total (cfs)           1780.00    Flow (cfs)               159.31    1570.29      50.40
  Top Width (ft)           114.88    Top Width (ft)            50.52      34.96      29.40
  Vel Total (ft/s)           3.67    Avg. Vel. (ft/s)           1.20       5.27       0.93
  Max Chl Dpth (ft)         10.23    Hydr. Depth (ft)           2.63       8.52       1.85
```

Conv. Total (cfs)	46000.0	Conv. (cfs)	4117.0	40580.6	1302.4
Length Wtd. (ft)	90.75	Wetted Per. (ft)	51.82	35.51	30.94
Min Ch El (ft)	114.36	Shear (lb/sq ft)	0.24	0.78	0.16
Alpha	1.83	Stream Power (lb/ft s)	0.29	4.13	0.15
Frctn Loss (ft)	0.16	Cum Volume (acre-ft)	7.97	7.46	8.28
C & E Loss (ft)	0.02	Cum SA (acres)	3.65	0.92	2.58

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	126.24	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.50	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	125.75	Reach Len. (ft)	99.00	90.30	81.70
Crit W.S. (ft)	121.56	Flow Area (sq ft)	199.93	338.30	99.25
E.G. Slope (ft/ft)	0.001714	Area (sq ft)	199.93	338.30	99.25
Q Total (cfs)	2480.00	Flow (cfs)	285.28	2077.87	116.86
Top Width (ft)	142.14	Top Width (ft)	64.93	34.96	42.25
Vel Total (ft/s)	3.89	Avg. Vel. (ft/s)	1.43	6.14	1.18
Max Chl Dpth (ft)	11.39	Hydr. Depth (ft)	3.08	9.68	2.35
Conv. Total (cfs)	59911.4	Conv. (cfs)	6891.7	50196.7	2823.0
Length Wtd. (ft)	90.82	Wetted Per. (ft)	66.27	35.51	43.89
Min Ch El (ft)	114.36	Shear (lb/sq ft)	0.32	1.02	0.24
Alpha	2.11	Stream Power (lb/ft s)	0.46	6.26	0.28
Frctn Loss (ft)	0.19	Cum Volume (acre-ft)	13.98	8.39	10.85
C & E Loss (ft)	0.04	Cum SA (acres)	4.91	0.92	2.86

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 4383

INPUT
Description:
Station Elevation Data num= 97

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	140.33	3.289	140.13	26.153	138.95	49.991	138.84	61.013	138.93
62.537	138.9	72.525	138.46	73.146	138.41	77.13	138.4	79.771	138.53
82.156	138.7	91.875	139.06	97.043	139.37	109.643	139.04	111.485	138.97
112.773	139	121.559	138.89	127.469	137.78	129.997	137.18	136.284	136.7
143.491	136.6	157.756	134.23	160.463	133.88	163.477	133.31	173.956	131.71
178.213	131.38	197.139	129.18	204.017	129.23	219.118	128.47	238.953	128.29
246.444	128.04	268.564	127	271.947	126	275.142	125	278.243	124
281.438	123	284.351	122	286.982	121	289.519	120	303.051	119
305.212	118	307.373	117	310.099	116	328.874	116	333.403	117
335.621	118	337.819	119	344.83	120	346.653	121	348.532	122
350.599	123	353.418	124	356.801	125	369.902	126.05	385.058	126.56
407.357	127.28	410.026	127.65	410.946	127.56	412.722	127.42	422.185	126.8
427.861	126.93	431.019	127.03	455.873	127.08	466.745	127.24	468.333	127.21
498.798	127.24	516.737	127.47	519.171	127.52	570.967	128.02	574.782	128.02
581.303	127.92	624.51	127.29	628.108	127.31	631.266	127.04	635.654	126.29
638.371	126.25	639.414	126.25	642.233	127.7	642.261	127.7	642.28	127.71
651.611	128.07	652.599	128.16	662.953	127.03	664.869	126.94	669.954	126.8
717.614	127.01	719.664	127.01	738.109	127.1	749.498	126.83	766.177	126.67
782.651	126.17	819.647	126.26	825.933	126.2	829.683	126.28	879.458	126.67
1247.823	130	1410.583	135						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.09	303.051	.045	337.819	.09

```
Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       303.051 337.819            153.5   144.5   154.5             .6       .8
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  229.34     135       F
  401.141410.583     135       F
Right Levee     Station=  410.03      Elevation=  127.65
Skew Angle = 20

CROSS SECTION OUTPUT  Profile #Q10

  E.G. Elev (ft)           122.76    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.25    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)           122.51    Reach Len. (ft)           45.00      45.00      45.00
  Crit W.S. (ft)           119.49    Flow Area (sq ft)         48.87     205.25      26.93
  E.G. Slope (ft/ft)     0.001579    Area (sq ft)              48.87     205.25      26.93
  Q Total (cfs)            947.00    Flow (cfs)                56.87     860.59      29.54
  Top Width (ft)            66.72    Top Width (ft)            20.19      34.77      11.77
  Vel Total (ft/s)           3.37    Avg. Vel. (ft/s)           1.16       4.19       1.10
  Max Chl Dpth (ft)          6.51    Hydr. Depth (ft)           2.42       5.90       2.29
  Conv. Total (cfs)       23832.9    Conv. (cfs)              1431.3    21658.3      743.4
  Length Wtd. (ft)          45.00    Wetted Per. (ft)          20.68      35.93      12.46
  Min Ch El (ft)           116.00    Shear (lb/sq ft)           0.23       0.56       0.21
  Alpha                      1.42    Stream Power (lb/ft s)     0.27       2.36       0.23
  Frctn Loss (ft)            0.07    Cum Volume (acre-ft)       2.31       5.42       4.22
  C & E Loss (ft)            0.02    Cum SA (acres)             1.12       0.85       1.70


Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT  Profile #Q50

  E.G. Elev (ft)           124.26    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.37    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)           123.90    Reach Len. (ft)           45.00      45.00      45.00
  Crit W.S. (ft)           120.58    Flow Area (sq ft)         79.81     253.51      45.56
  E.G. Slope (ft/ft)     0.001799    Area (sq ft)              79.81     253.51      45.56
  Q Total (cfs)           1490.00    Flow (cfs)               120.52    1306.09      63.38
  Top Width (ft)            74.56    Top Width (ft)            24.48      34.77      15.31
  Vel Total (ft/s)           3.93    Avg. Vel. (ft/s)           1.51       5.15       1.39
  Max Chl Dpth (ft)          7.90    Hydr. Depth (ft)           3.26       7.29       2.98
  Conv. Total (cfs)       35132.5    Conv. (cfs)              2841.8    30796.2     1494.5
  Length Wtd. (ft)          45.00    Wetted Per. (ft)          25.20      35.93      16.27
  Min Ch El (ft)           116.00    Shear (lb/sq ft)           0.36       0.79       0.31
  Alpha                      1.52    Stream Power (lb/ft s)     0.54       4.08       0.44
  Frctn Loss (ft)            0.08    Cum Volume (acre-ft)       4.62       6.50       7.20
  C & E Loss (ft)            0.01    Cum SA (acres)             2.17       0.85       2.45


Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT  Profile #Q100

  E.G. Elev (ft)           124.79    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.45    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)           124.34    Reach Len. (ft)           45.00      45.00      45.00
  Crit W.S. (ft)           121.03    Flow Area (sq ft)         90.99     268.95      52.68
  E.G. Slope (ft/ft)     0.002063    Area (sq ft)              90.99     268.95      52.68
  Q Total (cfs)           1780.00    Flow (cfs)               154.72    1543.80      81.48
  Top Width (ft)            77.40    Top Width (ft)            25.87      34.77      16.76
  Vel Total (ft/s)           4.31    Avg. Vel. (ft/s)           1.70       5.74       1.55
  Max Chl Dpth (ft)          8.34    Hydr. Depth (ft)           3.52       7.74       3.14
  Conv. Total (cfs)       39186.0    Conv. (cfs)              3406.2    33986.1     1793.7
  Length Wtd. (ft)          45.00    Wetted Per. (ft)          26.65      35.93      17.78
```

Min Ch El (ft)	116.00	Shear (lb/sq ft)	0.44	0.96	0.38
Alpha	1.55	Stream Power (lb/ft s)	0.75	5.54	0.59
Frctn Loss (ft)	0.09	Cum Volume (acre-ft)	7.72	6.88	8.18
C & E Loss (ft)	0.01	Cum SA (acres)	3.56	0.85	2.54

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q500

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	126.01	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.64	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	125.37	Reach Len. (ft)	45.00	45.00	45.00
Crit W.S. (ft)	121.98	Flow Area (sq ft)	119.17	304.62	72.26
E.G. Slope (ft/ft)	0.002541	Area (sq ft)	119.17	304.62	72.26
Q Total (cfs)	2480.00	Flow (cfs)	248.61	2108.41	122.98
Top Width (ft)	87.43	Top Width (ft)	29.09	34.77	23.58
Vel Total (ft/s)	5.00	Avg. Vel. (ft/s)	2.09	6.92	1.70
Max Chl Dpth (ft)	9.37	Hydr. Depth (ft)	4.10	8.76	3.07
Conv. Total (cfs)	49196.4	Conv. (cfs)	4931.7	41825.0	2439.6
Length Wtd. (ft)	45.00	Wetted Per. (ft)	30.03	35.93	24.71
Min Ch El (ft)	116.00	Shear (lb/sq ft)	0.63	1.35	0.46
Alpha	1.65	Stream Power (lb/ft s)	1.31	9.31	0.79
Frctn Loss (ft)	0.11	Cum Volume (acre-ft)	13.62	7.72	10.69
C & E Loss (ft)	0.02	Cum SA (acres)	4.80	0.85	2.80

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE

RIVER: River 1
REACH: Reach 1 RS: 4315

INPUT
Description:
Distance from Upstream XS = 45
Deck/Roadway Width = 50
Weir Coefficient = 2.6
Bridge Deck/Roadway Skew = 20
Upstream Deck/Roadway Coordinates
num= 2

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
274.39	135	132	356.143	135	132

Upstream Bridge Cross Section Data
Station Elevation Data num= 99

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	140.33	3.289	140.13	26.153	138.95	49.991	138.84	61.013	138.93
62.537	138.9	72.525	138.46	73.146	138.41	77.13	138.4	79.771	138.53
82.156	138.7	91.875	139.06	97.043	139.37	109.643	139.04	111.485	138.97
112.773	139	121.559	138.89	127.469	137.78	129.997	137.18	136.284	136.7
143.491	136.6	157.756	134.23	160.463	133.88	163.477	133.31	173.956	131.71
178.213	131.38	197.139	129.18	204.017	129.23	274.39	129	279.126	129
280.649	128	282.171	127	283.703	126	285.225	125	286.747	124
288.27	123	289.792	122	291.314	121	292.836	120	297.413	119
299.452	118	301.482	117	303.521	116	311.132	115.25	318.744	115.25
326.355	116	328.394	117	330.443	118	332.491	119	338.064	120
339.586	121	341.108	122	342.621	123	344.144	124	345.666	125
347.179	126	348.701	127	350.223	128	351.746	129	356.143	129
412.722	127.42	422.185	126.8	427.861	126.93	431.019	127.03	455.873	127.08
466.745	127.24	468.333	127.21	498.798	127.24	516.737	127.47	519.171	127.52
570.967	128.02	574.782	128.02	581.303	127.92	624.51	127.29	628.108	127.31
631.266	127.04	635.654	126.29	638.371	126.25	639.414	126.25	642.233	127.7

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 642.261   127.7  642.28  127.71 651.611  128.07 652.599  128.16 662.953  127.03
 664.869  126.94 669.954   126.8 717.614  127.01 719.664  127.01 738.109   127.1
 749.498  126.83 766.177  126.67 782.651  126.17 819.647  126.26 825.933   126.2
 829.683  126.28 879.458  126.671247.823     1301410.583     135

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .09 279.126    .045 351.746     .09

Bank Sta: Left   Right    Coeff Contr.   Expan.
       297.413 332.491             .6       .8
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  229.34     135       F
  401.141410.583     135       F
Right Levee     Station=  410.03      Elevation=  127.65
Skew Angle = 20

Downstream  Deck/Roadway Coordinates
    num=       2
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
 347.686     135     132  429.44     135     132

Downstream Bridge Cross Section Data
Station Elevation Data    num=      60
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  137.65   7.358  137.22  59.764  137.14  64.717  136.99 100.951  139.69
 107.087  139.71  113.59  139.82 133.201  137.46 155.792  131.98 157.287  131.66
 166.937  130.27 193.398  128.37 194.639   128.3 232.507  127.26 242.442   126.9
 257.993  126.43 262.166   126.4 347.686     129  351.68     129 353.183     128
 354.687     127 356.181     126 357.675     125 359.179     124 360.673     123
 362.176     122  363.67     121 365.174     120 366.668     119 371.912     118
 373.875     117 375.858     116 383.714     115 391.091     115 398.279     116
 400.243     117 402.198     118 410.289     119 411.773     120 413.258     121
 414.743     122 416.227     123 417.712     124 419.197     125 420.672     126
 422.157     127 423.642     128 425.126     129  429.44     129 484.947  125.94
 497.794  125.96 516.173  126.17 580.571   126.5 789.041     127 832.952   127.5
 906.042     128 936.507   128.5 984.065  128.65 1193.57     1301302.077     135

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .09  351.68    .045 425.126     .09

Bank Sta: Left   Right    Coeff Contr.   Expan.
       371.912 402.198             .6       .8
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  322.94     135       F
  454.181302.077     135       F
Left Levee      Station=  361.01      Elevation=  118.31
Right Levee     Station=  433.11      Elevation=  122.76
Skew Angle = 20

Upstream Embankment side slope             =       0 horiz. to 1.0 vertical
Downstream Embankment side slope           =       0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .98
Elevation at which weir flow begins        =
Energy head used in spillway design        =
Spillway height used in design             =
Weir crest shape                           = Broad Crested

Number of Abutments =  2

Abutment Data
Upstream     num=       4
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     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 140.954     115 140.954     135  274.39     135  274.39     115
Downstream     num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
  93.969     115  93.969     135 347.686     135 347.686     115

Abutment Data
Upstream     num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
 356.143     115 356.143     1351409.539     1351409.539     115
Downstream     num=       4
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
  429.44     115  429.44     1351409.539     1351409.539     115

Number of Bridge Coefficient Sets =  1

Low Flow Methods and Data
       Energy
Selected Low Flow Methods = Highest Energy Answer

High Flow Method
       Energy Only

Additional Bridge Parameters
       Add Friction component to Momentum
       Do not add Weight component to Momentum
       Class B flow critical depth computations use critical depth
           inside the bridge at the upstream end
       Criteria to check for pressure flow = Upstream energy grade line

BRIDGE OUTPUT  Profile #Q10

  E.G. US. (ft)              122.76    Element                 Inside BR US  Inside BR DS
  W.S. US. (ft)              122.51    E.G. Elev (ft)              122.68        122.60
  Q Total (cfs)              947.00    W.S. Elev (ft)              122.45        122.39
  Q Bridge (cfs)             947.00    Crit W.S. (ft)              119.03        119.05
  Q Weir (cfs)                         Max Chl Dpth (ft)             7.20          7.39
  Weir Sta Lft (ft)                    Vel Total (ft/s)              3.67          3.51
  Weir Sta Rgt (ft)                    Flow Area (sq ft)           258.31        269.49
  Weir Submerg                         Froude # Chl                  0.28          0.27
  Weir Max Depth (ft)                  Specif Force (cu ft)        870.69        903.34
  Min El Weir Flow (ft)      135.01    Hydr Depth (ft)               4.90          5.02
  Min El Prs (ft)            132.00    W.P. Total (ft)              55.81         57.04
  Delta EG (ft)                0.28    Conv. Total (cfs)          25971.6       27210.8
  Delta WS (ft)                0.13    Top Width (ft)               52.68         53.73
  BR Open Area (sq ft)       913.97    Frctn Loss (ft)               0.06          0.04
  BR Open Vel (ft/s)           3.67    C & E Loss (ft)               0.01          0.09
  BR Sluice Coef                       Shear Total (lb/sq ft)        0.38          0.36
  BR Sel Method         Energy only    Power Total (lb/ft s)         1.41          1.26


Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT  Profile #Q50

  E.G. US. (ft)              124.26    Element                 Inside BR US  Inside BR DS
  W.S. US. (ft)              123.90    E.G. Elev (ft)              124.17        124.08
  Q Total (cfs)             1490.00    W.S. Elev (ft)              123.83        123.75
  Q Bridge (cfs)            1490.00    Crit W.S. (ft)              120.17        120.05
  Q Weir (cfs)                         Max Chl Dpth (ft)             8.58          8.75
  Weir Sta Lft (ft)                    Vel Total (ft/s)              4.46          4.31
  Weir Sta Rgt (ft)                    Flow Area (sq ft)           333.76        345.66
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Weir Submerg		Froude # Chl	0.32	0.31
Weir Max Depth (ft)		Specif Force (cu ft)	1381.70	1423.98
Min El Weir Flow (ft)	135.01	Hydr Depth (ft)	5.87	5.98
Min El Prs (ft)	132.00	W.P. Total (ft)	60.82	61.94
Delta EG (ft)	0.37	Conv. Total (cfs)	37582.3	38922.9
Delta WS (ft)	0.15	Top Width (ft)	56.87	57.80
BR Open Area (sq ft)	913.97	Frctn Loss (ft)	0.08	0.04
BR Open Vel (ft/s)	4.46	C & E Loss (ft)	0.02	0.14
BR Sluice Coef		Shear Total (lb/sq ft)	0.54	0.51
BR Sel Method	Energy only	Power Total (lb/ft s)	2.40	2.20

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #Q100

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	124.79	E.G. Elev (ft)	124.69	124.58
W.S. US. (ft)	124.34	W.S. Elev (ft)	124.26	124.17
Q Total (cfs)	1780.00	Crit W.S. (ft)	120.64	120.50
Q Bridge (cfs)	1780.00	Max Chl Dpth (ft)	9.01	9.17
Q Weir (cfs)		Vel Total (ft/s)	4.96	4.81
Weir Sta Lft (ft)		Flow Area (sq ft)	358.64	370.23
Weir Sta Rgt (ft)		Froude # Chl	0.34	0.34
Weir Submerg		Specif Force (cu ft)	1602.74	1644.27
Weir Max Depth (ft)		Hydr Depth (ft)	6.16	6.27
Min El Weir Flow (ft)	135.01	W.P. Total (ft)	62.40	63.45
Min El Prs (ft)	132.00	Conv. Total (cfs)	41663.6	42940.0
Delta EG (ft)	0.44	Top Width (ft)	58.18	59.06
Delta WS (ft)	0.18	Frctn Loss (ft)	0.09	0.05
BR Open Area (sq ft)	913.97	C & E Loss (ft)	0.02	0.18
BR Open Vel (ft/s)	4.96	Shear Total (lb/sq ft)	0.65	0.63
BR Sluice Coef		Power Total (lb/ft s)	3.25	3.01
BR Sel Method	Energy only			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

BRIDGE OUTPUT Profile #Q500

		Element	Inside BR US	Inside BR DS
E.G. US. (ft)	126.01	E.G. Elev (ft)	125.88	125.75
W.S. US. (ft)	125.37	W.S. Elev (ft)	125.26	125.16
Q Total (cfs)	2480.00	Crit W.S. (ft)	121.63	121.47
Q Bridge (cfs)	2480.00	Max Chl Dpth (ft)	10.01	10.16
Q Weir (cfs)		Vel Total (ft/s)	5.92	5.77
Weir Sta Lft (ft)		Flow Area (sq ft)	418.69	429.76
Weir Sta Rgt (ft)		Froude # Chl	0.39	0.39
Weir Submerg		Specif Force (cu ft)	2185.27	2225.98
Weir Max Depth (ft)		Hydr Depth (ft)	6.84	6.93
Min El Weir Flow (ft)	135.01	W.P. Total (ft)	66.06	66.99
Min El Prs (ft)	132.00	Conv. Total (cfs)	51964.7	53105.0
Delta EG (ft)	0.59	Top Width (ft)	61.24	61.99
Delta WS (ft)	0.21	Frctn Loss (ft)	0.11	0.07
BR Open Area (sq ft)	913.97	C & E Loss (ft)	0.02	0.27
BR Open Vel (ft/s)	5.92	Shear Total (lb/sq ft)	0.90	0.87
BR Sluice Coef		Power Total (lb/ft s)	5.34	5.04
BR Sel Method	Energy only			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

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Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION


RIVER: River 1
REACH: Reach 1           RS: 4239

INPUT
Description:
Station Elevation Data    num=      68
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  137.65   7.358  137.22  59.764  137.14  64.717  136.99 100.951  139.69
 107.087  139.71  113.59  139.82 133.201  137.46 155.792  131.98 157.287  131.66
 166.937  130.27 193.398  128.37 194.639   128.3 232.507  127.26 242.442   126.9
 257.993  126.43 262.166   126.4 292.348  125.89 297.751  125.35 306.631  124.02
 306.791  123.93 310.823  120.23 316.931  119.52 322.034  117.35 329.372  117.41
  332.67  117.68 333.468  117.87 334.418   117.9 355.203  118.23  361.01  118.31
 361.264  118.29 361.395  118.25 364.872  116.22 365.906  115.94 367.551  115.41
  372.09  113.85 373.782  112.99 380.275  112.32   380.5  112.37 380.557  112.38
 380.734  112.37 390.931  114.87 395.488  116.33 395.506  116.34 396.625  116.81
 400.084  120.32 400.271  120.48 401.128  120.38 409.697  120.12 416.161  121.66
 433.105  122.76 437.305  122.74 444.212  121.31 449.898  121.98 452.566  122.15
 453.074  122.65 458.551  124.52 484.947  125.94 497.794  125.96 516.173  126.17
 580.571   126.5 789.041     127 832.952   127.5 906.042     128 936.507   128.5
 984.065  128.65 1193.57     1301302.077     135

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .09 364.872    .045 395.488     .09

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
       364.872 395.488           163.4   106.6   256.9             .6       .8
Ineffective Flow     num=       2
   Sta L   Sta R    Elev  Permanent
       0  322.94     135       F
  454.1813022.077    135       F
Left Levee      Station=  361.01      Elevation=  118.31
Right Levee     Station=  433.11      Elevation=  122.76
Skew Angle = 20

CROSS SECTION OUTPUT  Profile #Q10

  E.G. Elev (ft)           122.48    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.10    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)           122.38    Reach Len. (ft)          163.40     106.60     256.90
  Crit W.S. (ft)           117.15    Flow Area (sq ft)        188.85     255.70      53.57
  E.G. Slope (ft/ft)     0.000473    Area (sq ft)             231.28     255.70      53.57
  Q Total (cfs)            947.00    Flow (cfs)               183.22     737.49      26.29
  Top Width (ft)           118.69    Top Width (ft)            56.39      30.62      31.69
  Vel Total (ft/s)           1.90    Avg. Vel. (ft/s)           0.97       2.88       0.49
  Max Chl Dpth (ft)         10.06    Hydr. Depth (ft)           4.50       8.35       1.69
  Conv. Total (cfs)       43539.7    Conv. (cfs)              8423.8    33907.2     1208.7
  Length Wtd. (ft)         122.81    Wetted Per. (ft)          42.53      31.77      33.53
  Min Ch El (ft)           112.32    Shear (lb/sq ft)           0.13       0.24       0.05
  Alpha                      1.84    Stream Power (lb/ft s)     0.13       0.69       0.02
  Frctn Loss (ft)            0.07    Cum Volume (acre-ft)       2.10       4.70       4.11
  C & E Loss (ft)            0.04    Cum SA (acres)             1.05       0.74       1.65


Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT  Profile #Q50
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  E.G. Elev (ft)            123.90    Element                  Left OB    Channel   Right OB
  Vel Head (ft)               0.15    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)            123.75    Reach Len. (ft)          163.40     106.60     256.90
  Crit W.S. (ft)            118.57    Flow Area (sq ft)        246.29     297.65     138.14
  E.G. Slope (ft/ft)      0.000602    Area (sq ft)             309.56     297.65     138.89
  Q Total (cfs)            1490.00    Flow (cfs)               321.80    1071.70      96.50
  Top Width (ft)            149.29    Top Width (ft)            57.88      30.62      60.79
  Vel Total (ft/s)            2.18    Avg. Vel. (ft/s)           1.31       3.60       0.70
  Max Chl Dpth (ft)          11.43    Hydr. Depth (ft)           5.87       9.72       2.35
  Conv. Total (cfs)        60722.4    Conv. (cfs)             13114.4    43675.1     3932.9
  Length Wtd. (ft)          130.70    Wetted Per. (ft)          42.53      31.77      61.00
  Min Ch El (ft)            112.32    Shear (lb/sq ft)           0.22       0.35       0.09
  Alpha                       2.04    Stream Power (lb/ft s)     0.28       1.27       0.06
  Frctn Loss (ft)             0.10    Cum Volume (acre-ft)       4.32       5.63       6.99
  C & E Loss (ft)             0.07    Cum SA (acres)             2.10       0.74       2.38
```

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q100

```
  E.G. Elev (ft)            124.35    Element                  Left OB    Channel   Right OB
  Vel Head (ft)               0.19    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)            124.17    Reach Len. (ft)          163.40     106.60     256.90
  Crit W.S. (ft)            119.06    Flow Area (sq ft)        263.99     310.57     162.91
  E.G. Slope (ft/ft)      0.000710    Area (sq ft)             334.15     310.57     164.81
  Q Total (cfs)            1780.00    Flow (cfs)               392.42    1249.59     137.99
  Top Width (ft)            151.87    Top Width (ft)            59.22      30.62      62.03
  Vel Total (ft/s)            2.41    Avg. Vel. (ft/s)           1.49       4.02       0.85
  Max Chl Dpth (ft)          11.85    Hydr. Depth (ft)           6.30      10.14       2.78
  Conv. Total (cfs)        66779.5    Conv. (cfs)             14722.1    46880.3     5177.1
  Length Wtd. (ft)          133.46    Wetted Per. (ft)          42.53      31.77      61.00
  Min Ch El (ft)            112.32    Shear (lb/sq ft)           0.28       0.43       0.12
  Alpha                       2.04    Stream Power (lb/ft s)     0.41       1.74       0.10
  Frctn Loss (ft)             0.12    Cum Volume (acre-ft)       7.39       5.96       7.94
  C & E Loss (ft)             0.08    Cum SA (acres)             3.49       0.74       2.46
```

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION OUTPUT Profile #Q500

```
  E.G. Elev (ft)            125.42    Element                  Left OB    Channel   Right OB
  Vel Head (ft)               0.26    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)            125.16    Reach Len. (ft)          163.40     106.60     256.90
  Crit W.S. (ft)            119.99    Flow Area (sq ft)        305.56     340.92     221.09
  E.G. Slope (ft/ft)      0.000911    Area (sq ft)             396.14     340.92     230.93
  Q Total (cfs)            2480.00    Flow (cfs)               567.03    1653.00     259.97
  Top Width (ft)            171.39    Top Width (ft)            65.84      30.62      74.93
  Vel Total (ft/s)            2.86    Avg. Vel. (ft/s)           1.86       4.85       1.18
  Max Chl Dpth (ft)          12.84    Hydr. Depth (ft)           7.29      11.14       3.77
  Conv. Total (cfs)        82159.4    Conv. (cfs)             18785.0    54762.0     8612.5
  Length Wtd. (ft)          139.84    Wetted Per. (ft)          42.53      31.77      61.00
  Min Ch El (ft)            112.32    Shear (lb/sq ft)           0.41       0.61       0.21
  Alpha                       2.03    Stream Power (lb/ft s)     0.76       2.96       0.24
  Frctn Loss (ft)             0.16    Cum Volume (acre-ft)      13.20       6.70      10.37
  C & E Loss (ft)             0.10    Cum SA (acres)             4.72       0.74       2.71
```

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

CROSS SECTION

```
RIVER: River 1
REACH: Reach 1           RS: 4132

INPUT
Description:
Station Elevation Data    num=      46
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0   129.9   80.76  125.97   87.57  125.77   115.4  126.08  117.38  125.79
   119.1  125.16   119.6  125.05  125.75  121.13   128.8  119.19  129.06  116.93
  130.17  115.57  135.04  113.97  136.99  113.53  137.67  113.42  143.19  112.71
   143.6  112.74  144.24  112.88  147.61  113.25  150.88  113.62  153.79  113.86
  153.99  113.93  157.63  115.15  159.39  115.63  161.19  118.01  161.24  118.03
  161.42  118.05  172.06  118.84  176.05  119.08  178.11   118.7  180.61  119.56
  190.24  121.09   193.6  119.17  196.44  116.61  203.23  115.12  205.17  114.45
  211.85  114.12  213.55  114.09  215.92   114.6  221.92  115.96  223.41  116.37
  228.29  120.84     229  122.26   230.5   122.2  250.22  122.15   255.8  122.25
     493     130

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .09  130.17    .045  157.63     .09

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
        130.17  157.63           102.2   104.5   111.3             .1       .3
Ineffective Flow     num=       1
   Sta L   Sta R    Elev  Permanent
  190.12     493  121.01       T
Right Levee     Station=     229      Elevation=  122.26

CROSS SECTION OUTPUT  Profile #Q10

  E.G. Elev (ft)           122.36    Element                   Left OB    Channel   Right OB
  Vel Head (ft)              0.18    Wt. n-Val.                 0.090      0.045      0.090
  W.S. Elev (ft)           122.19    Reach Len. (ft)           102.20     104.50     111.30
  Crit W.S. (ft)           117.06    Flow Area (sq ft)          14.73     232.19     152.93
  E.G. Slope (ft/ft)     0.000706    Area (sq ft)               14.73     232.19     337.57
  Q Total (cfs)            947.00    Flow (cfs)                  8.59     832.87     105.54
  Top Width (ft)           104.87    Top Width (ft)              6.08      27.46      71.33
  Vel Total (ft/s)           2.37    Avg. Vel. (ft/s)            0.58       3.59       0.69
  Max Chl Dpth (ft)          9.48    Hydr. Depth (ft)            2.42       8.46       2.14
  Conv. Total (cfs)       35633.7    Conv. (cfs)                323.2    31339.2     3971.3
  Length Wtd. (ft)         104.96    Wetted Per. (ft)            9.61      28.10      77.53
  Min Ch El (ft)           112.71    Shear (lb/sq ft)            0.07       0.36       0.09
  Alpha                      2.03    Stream Power (lb/ft s)      0.04       1.31       0.06
  Frctn Loss (ft)            0.09    Cum Volume (acre-ft)        1.64       4.10       2.95
  C & E Loss (ft)            0.01    Cum SA (acres)              0.94       0.67       1.35


CROSS SECTION OUTPUT  Profile #Q50

  E.G. Elev (ft)           123.73    Element                   Left OB    Channel   Right OB
  Vel Head (ft)              0.27    Wt. n-Val.                 0.090      0.045      0.090
  W.S. Elev (ft)           123.46    Reach Len. (ft)           102.20     104.50     111.30
  Crit W.S. (ft)           118.05    Flow Area (sq ft)          23.76     267.23     300.85
  E.G. Slope (ft/ft)     0.000946    Area (sq ft)               23.76     267.23     485.48
  Q Total (cfs)           1490.00    Flow (cfs)                 19.04    1218.43     252.53
  Top Width (ft)           170.86    Top Width (ft)              8.08      27.46     135.32
  Vel Total (ft/s)           2.52    Avg. Vel. (ft/s)            0.80       4.56       0.84
  Max Chl Dpth (ft)         10.75    Hydr. Depth (ft)            2.94       9.73       2.22
  Conv. Total (cfs)       48438.6    Conv. (cfs)                619.1    39609.9     8209.6
  Length Wtd. (ft)         105.35    Wetted Per. (ft)           11.99      28.10     141.58
  Min Ch El (ft)           112.71    Shear (lb/sq ft)            0.12       0.56       0.13
  Alpha                      2.70    Stream Power (lb/ft s)      0.09       2.56       0.11
  Frctn Loss (ft)            0.12    Cum Volume (acre-ft)        3.70       4.94       5.15
  C & E Loss (ft)            0.01    Cum SA (acres)              1.98       0.67       1.80
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CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	124.15	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.32	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	123.83	Reach Len. (ft)	102.20	104.50	111.30
Crit W.S. (ft)	118.86	Flow Area (sq ft)	26.79	277.16	351.81
E.G. Slope (ft/ft)	0.001130	Area (sq ft)	26.79	277.16	536.44
Q Total (cfs)	1780.00	Flow (cfs)	24.50	1414.88	340.62
Top Width (ft)	182.50	Top Width (ft)	8.65	27.46	146.39
Vel Total (ft/s)	2.71	Avg. Vel. (ft/s)	0.91	5.10	0.97
Max Chl Dpth (ft)	11.12	Hydr. Depth (ft)	3.10	10.09	2.40
Conv. Total (cfs)	52957.2	Conv. (cfs)	728.9	42094.4	10133.8
Length Wtd. (ft)	105.47	Wetted Per. (ft)	12.66	28.10	152.66
Min Ch El (ft)	112.71	Shear (lb/sq ft)	0.15	0.70	0.16
Alpha	2.84	Stream Power (lb/ft s)	0.14	3.55	0.16
Frctn Loss (ft)	0.15	Cum Volume (acre-ft)	6.71	5.24	5.88
C & E Loss (ft)	0.01	Cum SA (acres)	3.36	0.67	1.85

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	125.16	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.43	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	124.73	Reach Len. (ft)	102.20	104.50	111.30
Crit W.S. (ft)	120.25	Flow Area (sq ft)	35.23	301.93	496.30
E.G. Slope (ft/ft)	0.001425	Area (sq ft)	35.23	301.93	680.94
Q Total (cfs)	2480.00	Flow (cfs)	39.97	1832.51	607.52
Top Width (ft)	211.52	Top Width (ft)	10.06	27.46	174.00
Vel Total (ft/s)	2.98	Avg. Vel. (ft/s)	1.13	6.07	1.22
Max Chl Dpth (ft)	12.02	Hydr. Depth (ft)	3.50	11.00	2.85
Conv. Total (cfs)	65703.1	Conv. (cfs)	1059.0	48549.1	16095.1
Length Wtd. (ft)	105.76	Wetted Per. (ft)	14.34	28.10	180.28
Min Ch El (ft)	112.71	Shear (lb/sq ft)	0.22	0.96	0.24
Alpha	3.12	Stream Power (lb/ft s)	0.25	5.80	0.30
Frctn Loss (ft)	0.19	Cum Volume (acre-ft)	12.40	5.92	7.68
C & E Loss (ft)	0.01	Cum SA (acres)	4.58	0.67	1.97

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 4028

INPUT
Description:
Station Elevation Data num= 28

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	125.89	17.7	126.46	56.96	122.74	58.38	122.67	59.05	122.42
63.78	119.66	64.49	119.55	68.12	119.04	79.32	118.14	84.06	116.04
84.33	115.92	84.53	115.3	86.2	114.82	87.52	114.49	89.2	114.42
93.84	114.09	99.03	114.68	102.46	114.76	109.02	115.44	110.17	115.58
111.89	117.21	113.41	119.71	118.23	119.85	133.86	121.17	141.73	121.56
155.73	120.41	175.42	122.24	260	130				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.09	84.06	.045	110.17	.09

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
84.06	110.17	180.8	162.9	161.8	.1	.3

Right Levee Station= 141.73 Elevation= 121.56

CROSS SECTION OUTPUT Profile #Q10

E.G. Elev (ft)	122.27	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.23	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	122.03	Reach Len. (ft)	180.80	162.90	161.80
Crit W.S. (ft)	118.14	Flow Area (sq ft)	78.52	190.93	84.01
E.G. Slope (ft/ft)	0.001166	Area (sq ft)	78.52	190.93	84.01
Q Total (cfs)	947.00	Flow (cfs)	93.66	797.32	56.03
Top Width (ft)	113.50	Top Width (ft)	24.35	26.11	63.04
Vel Total (ft/s)	2.68	Avg. Vel. (ft/s)	1.19	4.18	0.67
Max Chl Dpth (ft)	7.94	Hydr. Depth (ft)	3.22	7.31	1.33
Conv. Total (cfs)	27734.2	Conv. (cfs)	2742.9	23350.5	1640.8
Length Wtd. (ft)	163.75	Wetted Per. (ft)	25.52	26.79	65.29
Min Ch El (ft)	114.09	Shear (lb/sq ft)	0.22	0.52	0.09
Alpha	2.07	Stream Power (lb/ft s)	0.27	2.17	0.06
Frctn Loss (ft)	0.19	Cum Volume (acre-ft)	1.53	3.59	2.42
C & E Loss (ft)	0.03	Cum SA (acres)	0.90	0.60	1.17

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	123.60	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	123.27	Reach Len. (ft)	180.80	162.90	161.80
Crit W.S. (ft)	119.48	Flow Area (sq ft)	112.21	223.30	170.52
E.G. Slope (ft/ft)	0.001450	Area (sq ft)	112.21	223.30	170.52
Q Total (cfs)	1490.00	Flow (cfs)	156.14	1154.53	179.33
Top Width (ft)	135.38	Top Width (ft)	32.74	26.11	76.53
Vel Total (ft/s)	2.94	Avg. Vel. (ft/s)	1.39	5.17	1.05
Max Chl Dpth (ft)	9.18	Hydr. Depth (ft)	3.43	8.55	2.23
Conv. Total (cfs)	39124.8	Conv. (cfs)	4099.9	30315.9	4708.9
Length Wtd. (ft)	164.21	Wetted Per. (ft)	34.09	26.79	78.83
Min Ch El (ft)	114.09	Shear (lb/sq ft)	0.30	0.75	0.20
Alpha	2.43	Stream Power (lb/ft s)	0.41	3.90	0.21
Frctn Loss (ft)	0.19	Cum Volume (acre-ft)	3.54	4.35	4.31
C & E Loss (ft)	0.07	Cum SA (acres)	1.93	0.60	1.53

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	123.99	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.41	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	123.59	Reach Len. (ft)	180.80	162.90	161.80
Crit W.S. (ft)	120.14	Flow Area (sq ft)	122.90	231.42	194.83
E.G. Slope (ft/ft)	0.001764	Area (sq ft)	122.90	231.42	194.83
Q Total (cfs)	1780.00	Flow (cfs)	188.45	1351.43	240.12
Top Width (ft)	142.05	Top Width (ft)	36.02	26.11	79.92
Vel Total (ft/s)	3.24	Avg. Vel. (ft/s)	1.53	5.84	1.23
Max Chl Dpth (ft)	9.50	Hydr. Depth (ft)	3.41	8.86	2.44
Conv. Total (cfs)	42376.9	Conv. (cfs)	4486.4	32173.8	5716.7
Length Wtd. (ft)	164.46	Wetted Per. (ft)	37.38	26.79	82.23
Min Ch El (ft)	114.09	Shear (lb/sq ft)	0.36	0.95	0.26
Alpha	2.51	Stream Power (lb/ft s)	0.56	5.56	0.32
Frctn Loss (ft)	0.21	Cum Volume (acre-ft)	6.54	4.63	4.94
C & E Loss (ft)	0.09	Cum SA (acres)	3.31	0.60	1.56

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	124.95	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.57	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	124.38	Reach Len. (ft)	180.80	162.90	161.80
Crit W.S. (ft)	121.27	Flow Area (sq ft)	154.99	252.24	262.03
E.G. Slope (ft/ft)	0.002304	Area (sq ft)	154.99	252.24	262.03
Q Total (cfs)	2480.00	Flow (cfs)	276.71	1782.87	420.42
Top Width (ft)	159.16	Top Width (ft)	44.44	26.11	88.61
Vel Total (ft/s)	3.71	Avg. Vel. (ft/s)	1.79	7.07	1.60
Max Chl Dpth (ft)	10.29	Hydr. Depth (ft)	3.49	9.66	2.96
Conv. Total (cfs)	51665.6	Conv. (cfs)	5764.6	37142.4	8758.6
Length Wtd. (ft)	165.06	Wetted Per. (ft)	45.84	26.79	90.96
Min Ch El (ft)	114.09	Shear (lb/sq ft)	0.49	1.35	0.41
Alpha	2.67	Stream Power (lb/ft s)	0.87	9.57	0.66
Frctn Loss (ft)	0.24	Cum Volume (acre-ft)	12.17	5.25	6.48
C & E Loss (ft)	0.14	Cum SA (acres)	4.52	0.60	1.64

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 3865

INPUT
Description:
Station Elevation Data num= 204

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	125	0	124.77	1.2	124.68	6.5	124.35	7.7	124.22
9.2	124.01	13.3	123.27	14.9	123.04	17.9	122.56	20.9	122.19
27.9	121.83	30	121.75	31.7	121.73	33.3	121.72	36	121.78
39	121.82	40.2	121.87	42	121.91	45	122	47.3	122.1
49.3	122.21	50.2	122.23	53	122.25	57.4	122.23	65.7	122.4
68.1	122.41	70	122.37	76.1	122.36	81.2	122.17	82.7	122.13
84.2	122.06	92.1	122.32	93.2	122.34	96.9	122.29	97.5	122.32
102.3	122.7	105.4	122.75	106.8	122.79	110.9	122.96	113.9	122.94
115.3	122.91	116.2	122.92	118.9	122.98	123.4	122.94	126.9	122.94
129.6	122.97	134.9	123.09	138.4	123.08	139.4	123.1	141.4	123.2
143	123.22	144.4	123.17	145.6	123.09	148.3	122.79	151	122.55
153.5	122.35	156.4	122.03	159.2	121.81	161.7	121.67	163.5	121.6
166.3	121.51	169.2	121.45	169.7	121.44	176.2	121.75	180.4	121.85
183.6	121.89	186.2	122	188.4	122.12	193.8	122.27	194.7	122.28
195.6	122.27	198.7	122.16	199.1	122.13	200.3	121.98	201.8	121.74
203.2	121.5	204.5	121.24	208.8	120.12	210.7	119.61	212.5	119.09
216.7	117.97	220.5	116	222.8	115	228	113.31	232.9	115
234.8	116	237.2	117.28	239.3	117.64	241.4	117.97	241.9	118.07
244.6	118.66	247.3	119.2	249.9	119.52	251.3	119.66	252.6	119.75
255.6	119.92	260.7	120.33	264.1	120.56	264.9	120.59	266	120.57
268.7	120.41	269.7	120.39	270.9	120.43	271.4	120.46	274	120.37
276.7	120.13	279.4	119.92	280	119.9	282.5	119.84	283	119.82
283.9	119.76	286	119.53	287.4	119.43	288.2	119.38	289	119.38
290.1	119.41	291	119.47	292.8	119.57	295	119.59	298.1	119.59
299.5	119.51	300.8	119.31	302.3	119.22	303.4	119.04	304.1	118.98
305.2	118.92	306.1	118.77	306.6	118.72	307.1	118.66	308	118.61
308.8	118.51	310.1	118.41	310.8	118.38	311.5	118.31	313.7	118.16
316.1	117.92	319.1	117.7	322.2	117.53	323.6	117.48	328.2	117.38
330.2	117.38	332.9	117.53	334.9	117.84	337.2	118.12	340.9	118.52
343.2	118.71	343.4	118.73	344.8	118.78	347.7	118.85	348.9	118.92
349.1	118.94	349.3	118.96	350.5	119.21	351.6	119.47	356.9	120.62
357.6	120.71	358.3	120.78	359.6	120.76	360.4	120.72	361.8	120.66
362.3	120.67	363.2	120.7	364.3	120.8	364.7	120.84	365	120.88
366.1	120.94	367.5	120.99	370.3	120.88	371.7	120.76	373	120.67

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   375.7  120.41   380.2  119.78     381  119.68   383.7  119.44   385.9  119.74
   391.7  120.72     393  120.75   394.1  120.75   394.4  120.75   395.8  120.95
   397.1  121.21   397.2  121.26   397.4  121.31   399.7  121.97   400.5  122.12
   403.5  122.89   405.7  123.51   409.5   124.6   412.5  125.63   412.8  125.74
   413.1  125.82   414.2   126.1   415.8  126.36   418.5  126.85   421.5  127.08
   422.7  127.12   424.2   127.1     427  127.02   428.4     127   434.5  126.95
   439.6  126.96   442.6  127.22   445.6  127.53447.0034  127.64

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .09   216.7    .045   239.3     .09

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         216.7   239.3            155.6   159.3   182.2             .1       .3
Left Levee      Station=  193.78      Elevation=  122.27
Right Levee     Station=  264.08      Elevation=  120.56

CROSS SECTION OUTPUT  Profile #Q10

  E.G. Elev (ft)           122.05    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.12    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)           121.93    Reach Len. (ft)          155.60     159.30     182.20
  Crit W.S. (ft)           119.33    Flow Area (sq ft)         29.42     146.30     393.77
  E.G. Slope (ft/ft)     0.001109    Area (sq ft)              29.42     146.30     393.77
  Q Total (cfs)            947.00    Flow (cfs)                23.74     530.54     392.71
  Top Width (ft)           198.90    Top Width (ft)            16.06      22.60     160.24
  Vel Total (ft/s)           1.66    Avg. Vel. (ft/s)           0.81       3.63       1.00
  Max Chl Dpth (ft)          8.62    Hydr. Depth (ft)           1.83       6.47       2.46
  Conv. Total (cfs)       28431.0    Conv. (cfs)               712.8    15928.1    11790.1
  Length Wtd. (ft)         164.08    Wetted Per. (ft)          16.55      24.44     161.23
  Min Ch El (ft)           113.31    Shear (lb/sq ft)           0.12       0.41       0.17
  Alpha                      2.82    Stream Power (lb/ft s)     0.10       1.50       0.17
  Frctn Loss (ft)            0.26    Cum Volume (acre-ft)       1.30       2.96       1.53
  C & E Loss (ft)            0.02    Cum SA (acres)             0.82       0.51       0.76


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q50

  E.G. Elev (ft)           123.35    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.10    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)           123.24    Reach Len. (ft)          155.60     159.30     182.20
  Crit W.S. (ft)           120.56    Flow Area (sq ft)        222.98     176.11     608.74
  E.G. Slope (ft/ft)     0.000908    Area (sq ft)             222.98     176.11     608.74
  Q Total (cfs)           1490.00    Flow (cfs)               117.74     653.82     718.45
  Top Width (ft)           391.28    Top Width (ft)           203.22      22.60     165.46
  Vel Total (ft/s)           1.48    Avg. Vel. (ft/s)           0.53       3.71       1.18
  Max Chl Dpth (ft)          9.93    Hydr. Depth (ft)           1.10       7.79       3.68
  Conv. Total (cfs)       49445.7    Conv. (cfs)              3907.1    21696.9    23841.7
  Length Wtd. (ft)         164.67    Wetted Per. (ft)         203.95      24.44     166.61
  Min Ch El (ft)           113.31    Shear (lb/sq ft)           0.06       0.41       0.21
  Alpha                      3.08    Stream Power (lb/ft s)     0.03       1.52       0.24
  Frctn Loss (ft)            0.22    Cum Volume (acre-ft)       2.84       3.61       2.86
  C & E Loss (ft)            0.02    Cum SA (acres)             1.44       0.51       1.08


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q100
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E.G. Elev (ft)	123.69	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.11	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	123.58	Reach Len. (ft)	155.60	159.30	182.20
Crit W.S. (ft)	120.77	Flow Area (sq ft)	291.59	183.71	664.53
E.G. Slope (ft/ft)	0.000982	Area (sq ft)	291.59	183.71	664.53
Q Total (cfs)	1780.00	Flow (cfs)	190.24	729.40	860.36
Top Width (ft)	394.36	Top Width (ft)	205.12	22.60	166.65
Vel Total (ft/s)	1.56	Avg. Vel. (ft/s)	0.65	3.97	1.29
Max Chl Dpth (ft)	10.27	Hydr. Depth (ft)	1.42	8.13	3.99
Conv. Total (cfs)	56808.1	Conv. (cfs)	6071.4	23278.4	27458.2
Length Wtd. (ft)	164.62	Wetted Per. (ft)	205.88	24.44	167.85
Min Ch El (ft)	113.31	Shear (lb/sq ft)	0.09	0.46	0.24
Alpha	3.00	Stream Power (lb/ft s)	0.06	1.83	0.31
Frctn Loss (ft)	0.25	Cum Volume (acre-ft)	5.67	3.86	3.35
C & E Loss (ft)	0.02	Cum SA (acres)	2.81	0.51	1.10

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	124.58	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.12	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	124.46	Reach Len. (ft)	155.60	159.30	182.20
Crit W.S. (ft)	121.56	Flow Area (sq ft)	474.76	203.62	812.74
E.G. Slope (ft/ft)	0.000987	Area (sq ft)	474.76	203.62	812.74
Q Total (cfs)	2480.00	Flow (cfs)	420.41	868.15	1191.44
Top Width (ft)	404.31	Top Width (ft)	211.99	22.60	169.72
Vel Total (ft/s)	1.66	Avg. Vel. (ft/s)	0.89	4.26	1.47
Max Chl Dpth (ft)	11.15	Hydr. Depth (ft)	2.24	9.01	4.79
Conv. Total (cfs)	78942.6	Conv. (cfs)	13382.4	27634.6	37925.5
Length Wtd. (ft)	164.12	Wetted Per. (ft)	212.82	24.44	171.04
Min Ch El (ft)	113.31	Shear (lb/sq ft)	0.14	0.51	0.29
Alpha	2.72	Stream Power (lb/ft s)	0.12	2.19	0.43
Frctn Loss (ft)	0.21	Cum Volume (acre-ft)	10.87	4.40	4.48
C & E Loss (ft)	0.01	Cum SA (acres)	3.98	0.51	1.16

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 3705

INPUT
Description:
Station Elevation Data num= 171

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	124.94	.3	124.92	2.3	124.7	5.6	124.31	8.4	123.96
11.2	123.56	14	123.09	16.3	122.7	18.3	122.41	18.9	122.34
26.9	121.84	31	121.16	32.2	121.06	32.5	121.05	34.8	121.1
35.9	121.14	37.5	121.16	39.6	121.31	45	121.65	50.7	121.95
54.1	122.28	55.1	122.33	57.2	122.4	58.7	122.42	59.4	122.41
60.2	122.35	63.3	122.06	65.1	121.99	66.3	121.95	67.9	121.95
69.3	121.93	71.9	121.83	73.6	121.84	75.5	121.83	77.2	121.81
79.2	121.76	82.5	121.72	84.9	121.66	90.5	121.47	92	121.38
93.2	121.41	98.5	121.69	101.1	121.77	103.3	121.79	106.4	121.84
112	122.06	114.4	122.1	117	122.19	121.1	121.84	122.3	121.7
125	121.41	127.6	121.35	130.3	121.34	133.3	121.31	135.6	121.21
138.2	121.13	140.9	121.02	143.5	120.94	147.3	120.95	151.5	121.09
155.8	121.35	157.2	121.46	161.5	121.9	162.1	121.98	165.7	122.21

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     170  122.53   171.4  122.53   172.8  122.59   174.2  122.56   175.4  122.58
   177.1  122.55     179  122.58   179.9  122.56   182.1  122.56   188.6  122.43
   191.2  122.44   195.5  122.49   204.5  122.55   209.5  122.54   212.5  122.59
   215.1  122.87   218.6  123.06     221  123.05   223.1     123   226.7  122.94
   228.4  122.89   230.9  122.85   233.7  122.96     238  123.19   241.6  123.33
   244.3  123.26   245.1   123.2     246   123.1   249.1  122.68   252.2  122.18
   254.9   121.7   259.3  120.93   261.3   120.6   263.5  120.19   267.4  119.66
   268.2  119.58   269.2  119.53   276.1  119.48   278.8  119.51   280.5  119.57
     282   119.6   282.6  119.63   283.4  119.68   285.6  119.84   288.7  119.95
   291.9  120.01   293.3  120.06   297.3  120.14     299  120.17     300  120.17
   300.4  120.17   303.9  120.31   305.3  120.35     307  120.37   313.2  120.15
   318.8  120.16   321.2  120.19   323.8  120.16   331.8  119.88   334.4  119.88
   338.7  119.71   344.3   119.6   350.4  119.43   352.8  119.39   357.1  119.24
   361.3  119.07   365.6  118.87   369.9  118.62   370.9  118.51   371.3  118.46
     374  117.98   375.5  117.79   376.9     117   379.5   115.5   382.6     113
     384  112.25   384.8     112   385.4  112.25   388.3   113.5     394   117.5
   395.4  117.95   398.3  118.44   401.4  119.08   403.4  119.47   406.7   120.2
   408.1  120.54   411.3  121.37     414  122.12   419.7  123.87   422.3  124.65
   432.2  127.46   435.1  128.22   437.9  128.84   440.5  129.25     441  129.28
   442.2  129.32   443.2  129.32     445  129.37   445.8  129.36   448.5  129.39
   449.2  129.38   453.2  129.22   453.8  129.22   454.9  129.32   456.4  129.48
459.6634  129.89

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .09   376.9    .045     394     .09

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         376.9     394            221.6   195.4   195.8             .1       .3
Left Levee      Station=  241.64      Elevation=  123.33

CROSS SECTION OUTPUT  Profile #Q10

  E.G. Elev (ft)            121.76    Element                   Left OB    Channel   Right OB
  Vel Head (ft)               0.33    Wt. n-Val.                  0.090      0.045      0.090
  W.S. Elev (ft)            121.43    Reach Len. (ft)            221.60     195.40     195.80
  Crit W.S. (ft)            119.31    Flow Area (sq ft)          206.76     119.76      35.50
  E.G. Slope (ft/ft)      0.002547    Area (sq ft)               206.76     119.76      35.50
  Q Total (cfs)             947.00    Flow (cfs)                 246.28     654.16      46.56
  Top Width (ft)            155.11    Top Width (ft)             120.48      17.10      17.53
  Vel Total (ft/s)            2.62    Avg. Vel. (ft/s)             1.19       5.46       1.31
  Max Chl Dpth (ft)           9.43    Hydr. Depth (ft)             1.72       7.00       2.03
  Conv. Total (cfs)        18765.3    Conv. (cfs)                4880.3    12962.4      922.6
  Length Wtd. (ft)          199.12    Wetted Per. (ft)           120.95      20.18      17.98
  Min Ch El (ft)            112.00    Shear (lb/sq ft)             0.27       0.94       0.31
  Alpha                       3.08    Stream Power (lb/ft s)       0.32       5.15       0.41
  Frctn Loss (ft)             0.55    Cum Volume (acre-ft)         0.88       2.48       0.63
  C & E Loss (ft)             0.01    Cum SA (acres)               0.57       0.44       0.39


Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q50

  E.G. Elev (ft)            123.11    Element                   Left OB    Channel   Right OB
  Vel Head (ft)               0.28    Wt. n-Val.                  0.090      0.045      0.090
  W.S. Elev (ft)            122.83    Reach Len. (ft)            221.60     195.40     195.80
  Crit W.S. (ft)            121.11    Flow Area (sq ft)          381.16     143.71      63.50
  E.G. Slope (ft/ft)      0.002095    Area (sq ft)               381.16     143.71      63.50
  Q Total (cfs)            1490.00    Flow (cfs)                 591.53     803.97      94.50
  Top Width (ft)            168.37    Top Width (ft)             128.94      17.10      22.33
  Vel Total (ft/s)            2.53    Avg. Vel. (ft/s)             1.55       5.59       1.49
  Max Chl Dpth (ft)          10.83    Hydr. Depth (ft)             2.96       8.40       2.84
  Conv. Total (cfs)        32551.3    Conv. (cfs)               12922.8    17564.0     2064.5
  Length Wtd. (ft)          201.11    Wetted Per. (ft)           129.53      20.18      22.98
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Min Ch El (ft)	112.00	Shear (lb/sq ft)	0.38	0.93	0.36
Alpha	2.80	Stream Power (lb/ft s)	0.60	5.21	0.54
Frctn Loss (ft)	0.51	Cum Volume (acre-ft)	1.76	3.02	1.46
C & E Loss (ft)	0.02	Cum SA (acres)	0.85	0.44	0.68

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	123.43	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	123.09	Reach Len. (ft)	221.60	195.40	195.80
Crit W.S. (ft)	121.45	Flow Area (sq ft)	413.85	148.02	69.22
E.G. Slope (ft/ft)	0.002520	Area (sq ft)	413.85	148.02	69.22
Q Total (cfs)	1780.00	Flow (cfs)	737.01	926.20	116.79
Top Width (ft)	171.05	Top Width (ft)	130.80	17.10	23.15
Vel Total (ft/s)	2.82	Avg. Vel. (ft/s)	1.78	6.26	1.69
Max Chl Dpth (ft)	11.09	Hydr. Depth (ft)	3.16	8.66	2.99
Conv. Total (cfs)	35456.8	Conv. (cfs)	14681.0	18449.5	2326.3
Length Wtd. (ft)	204.24	Wetted Per. (ft)	131.41	20.18	23.84
Min Ch El (ft)	112.00	Shear (lb/sq ft)	0.50	1.15	0.46
Alpha	2.75	Stream Power (lb/ft s)	0.88	7.22	0.77
Frctn Loss (ft)	0.44	Cum Volume (acre-ft)	4.41	3.25	1.81
C & E Loss (ft)	0.03	Cum SA (acres)	2.21	0.44	0.70

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	124.36	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.19	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	124.17	Reach Len. (ft)	221.60	195.40	195.80
Crit W.S. (ft)	122.09	Flow Area (sq ft)	1052.50	166.61	96.32
E.G. Slope (ft/ft)	0.001656	Area (sq ft)	1052.50	166.61	96.32
Q Total (cfs)	2480.00	Flow (cfs)	1416.46	914.51	149.03
Top Width (ft)	414.02	Top Width (ft)	370.21	17.10	26.71
Vel Total (ft/s)	1.89	Avg. Vel. (ft/s)	1.35	5.49	1.55
Max Chl Dpth (ft)	12.17	Hydr. Depth (ft)	2.84	9.74	3.61
Conv. Total (cfs)	60940.7	Conv. (cfs)	34806.4	22472.1	3662.2
Length Wtd. (ft)	207.63	Wetted Per. (ft)	371.28	20.18	27.56
Min Ch El (ft)	112.00	Shear (lb/sq ft)	0.29	0.85	0.36
Alpha	3.46	Stream Power (lb/ft s)	0.39	4.68	0.56
Frctn Loss (ft)	0.33	Cum Volume (acre-ft)	8.14	3.72	2.58
C & E Loss (ft)	0.00	Cum SA (acres)	2.94	0.44	0.75

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 3510

INPUT
Description:
Station Elevation Data num= 146

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	125	0	124.02	2.5	123.8	5	123.55	8.6	123.29
9.6	123.16	10.4	122.98	12.4	122.61	17.5	121.61	18.6	121.4
20.4	121.08	22.3	120.8	23.7	120.61	26.7	120.32	28	120.27
29.3	120.27	32.2	120.19	33.6	120.06	38.1	119.56	41.1	119.47
43.1	119.47	46.4	119.51	49.9	119.47	51.2	119.5	54	119.59

58.8	119.69	61.7	120	67.6	120.75	70.6	121.01	76.5	121.45
78.9	121.61	79.4	121.66	83.9	121.86	86.6	122.01	88.3	122.07
91.2	122.14	97.5	122.21	98.7	122.25	101.6	122.3	105.6	122.32
108.9	122.15	113.8	121.63	117.8	121.02	120	120.64	121.4	120.44
128.4	119.74	130.1	119.6	132.9	119.45	134.1	119.42	135.5	119.4
138.4	119.56	139.8	119.56	141	119.51	144	119.3	145.4	119.28
148.3	119.3	150.2	119.37	152.7	119.56	159.1	120.14	161.3	120.2
163.3	120.28	165.4	120.42	167.3	120.52	175.6	121.02	181.9	121.36
183.9	121.44	190.1	121.83	192.2	121.94	196.3	122.09	198.3	122.22
200.4	122.31	204.5	122.42	208.6	122.41	210.7	122.38	212.8	122.31
216.9	122.12	218.9	122.01	223	121.42	225.1	121.15	229.2	120.26
231.3	119.85	233.3	119.37	235.4	118.92	239.5	117.96	245.7	115.5
247.8	114.5	249.8	113.5	251.9	113	253.9	113.5	258.3	114.5
260.1	115.5	264.9	117.37	268.2	117.73	270.4	117.99	274.5	118.41
278.7	118.77	280.7	118.92	282.8	119.04	286.9	119.2	293	119.03
296.3	118.91	297.2	118.87	299.3	118.68	301.3	118.83	303.4	119.31
305.4	119.82	307.5	120.48	309.2	121.42	311.6	122.9	312.8	123.56
313.7	124.01	314.4	124.29	315.7	124.74	319.9	126.31	321.9	126.82
324	127.2	324.4	127.29	326	127.77	328.1	128.25	330.2	128.52
334.3	129.25	338.4	129.78	340.5	130.01	342.5	130.06	344.6	130.05
350.8	130.09	354.9	130.02	355.8	130.07	356.9	130.15	361.1	130.54
367.1	130.95	369.3	131.14	377.5	131.7	381.6	131.96	383.7	132.12
387.8	132.5	391.9	132.81	394	132.91	396.1	133.03	398.1	133.18
398.7	133.19	400.2	133.18	402.2	133.13	404.3	133.36	407	133.68
408.2787	133.84								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.09	239.5	.045	268.2	.09

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
239.5	268.2	148.9	147.5	155.8	.1	.3

Left Levee Station= 208.67 Elevation= 122.41

CROSS SECTION OUTPUT Profile #Q10

		Element	Left OB	Channel	Right OB
E.G. Elev (ft)	121.21	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.39	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	120.82	Reach Len. (ft)	148.90	147.50	155.80
Crit W.S. (ft)	118.75	Flow Area (sq ft)	18.05	154.64	75.85
E.G. Slope (ft/ft)	0.002980	Area (sq ft)	18.05	154.64	75.85
Q Total (cfs)	947.00	Flow (cfs)	20.04	822.76	104.20
Top Width (ft)	81.51	Top Width (ft)	12.89	28.70	39.92
Vel Total (ft/s)	3.81	Avg. Vel. (ft/s)	1.11	5.32	1.37
Max Chl Dpth (ft)	7.82	Hydr. Depth (ft)	1.40	5.39	1.90
Conv. Total (cfs)	17348.3	Conv. (cfs)	367.1	15072.3	1908.9
Length Wtd. (ft)	148.12	Wetted Per. (ft)	13.21	30.49	40.31
Min Ch El (ft)	113.00	Shear (lb/sq ft)	0.25	0.94	0.35
Alpha	1.71	Stream Power (lb/ft s)	0.28	5.02	0.48
Frctn Loss (ft)	0.34	Cum Volume (acre-ft)	0.31	1.86	0.38
C & E Loss (ft)	0.03	Cum SA (acres)	0.23	0.34	0.26

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q50

E.G. Elev (ft)	122.58	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.50	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	122.09	Reach Len. (ft)	148.90	147.50	155.80
Crit W.S. (ft)	120.06	Flow Area (sq ft)	39.29	190.96	127.77
E.G. Slope (ft/ft)	0.003105	Area (sq ft)	39.29	190.96	127.77
Q Total (cfs)	1490.00	Flow (cfs)	52.55	1193.79	243.67
Top Width (ft)	92.79	Top Width (ft)	22.01	28.70	42.08
Vel Total (ft/s)	4.16	Avg. Vel. (ft/s)	1.34	6.25	1.91

Max Chl Dpth (ft)	9.09	Hydr. Depth (ft)	1.79	6.65	3.04
Conv. Total (cfs)	26737.8	Conv. (cfs)	943.0	21422.2	4372.5
Length Wtd. (ft)	148.47	Wetted Per. (ft)	22.42	30.49	42.82
Min Ch El (ft)	113.00	Shear (lb/sq ft)	0.34	1.21	0.58
Alpha	1.85	Stream Power (lb/ft s)	0.45	7.59	1.10
Frctn Loss (ft)	0.37	Cum Volume (acre-ft)	0.69	2.27	1.03
C & E Loss (ft)	0.03	Cum SA (acres)	0.47	0.34	0.54

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	122.96	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.26	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	122.71	Reach Len. (ft)	148.90	147.50	155.80
Crit W.S. (ft)	120.51	Flow Area (sq ft)	426.04	208.74	154.16
E.G. Slope (ft/ft)	0.001851	Area (sq ft)	426.04	208.74	154.16
Q Total (cfs)	1780.00	Flow (cfs)	458.24	1069.15	252.62
Top Width (ft)	299.41	Top Width (ft)	227.62	28.70	43.09
Vel Total (ft/s)	2.26	Avg. Vel. (ft/s)	1.08	5.12	1.64
Max Chl Dpth (ft)	9.71	Hydr. Depth (ft)	1.87	7.27	3.58
Conv. Total (cfs)	41370.4	Conv. (cfs)	10650.3	24848.9	5871.2
Length Wtd. (ft)	148.61	Wetted Per. (ft)	228.68	30.49	44.00
Min Ch El (ft)	113.00	Shear (lb/sq ft)	0.22	0.79	0.40
Alpha	3.23	Stream Power (lb/ft s)	0.23	4.05	0.66
Frctn Loss (ft)	0.28	Cum Volume (acre-ft)	2.28	2.45	1.31
C & E Loss (ft)	0.01	Cum SA (acres)	1.30	0.34	0.55

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	124.03	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.22	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	123.81	Reach Len. (ft)	148.90	147.50	155.80
Crit W.S. (ft)	121.40	Flow Area (sq ft)	680.96	240.33	202.66
E.G. Slope (ft/ft)	0.001548	Area (sq ft)	680.96	240.33	202.66
Q Total (cfs)	2480.00	Flow (cfs)	891.02	1236.64	352.34
Top Width (ft)	310.89	Top Width (ft)	237.09	28.70	45.10
Vel Total (ft/s)	2.21	Avg. Vel. (ft/s)	1.31	5.15	1.74
Max Chl Dpth (ft)	10.81	Hydr. Depth (ft)	2.87	8.37	4.49
Conv. Total (cfs)	63028.0	Conv. (cfs)	22644.9	31428.7	8954.5
Length Wtd. (ft)	148.77	Wetted Per. (ft)	238.22	30.49	46.29
Min Ch El (ft)	113.00	Shear (lb/sq ft)	0.28	0.76	0.42
Alpha	2.93	Stream Power (lb/ft s)	0.36	3.92	0.74
Frctn Loss (ft)	0.25	Cum Volume (acre-ft)	3.73	2.81	1.91
C & E Loss (ft)	0.02	Cum SA (acres)	1.40	0.34	0.58

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 3362

INPUT
Description:
Station Elevation Data num= 142

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	125.03	1.2	124.97	3.3	124.93	5.3	124.92	15.4	124.72
21.5	124.7	27.6	124.41	29.4	124.28	33.6	123.82	35.7	123.68

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    41.7  123.56    43.7  123.48    45.8  123.38      47  123.38    47.8  123.37
    49.8  123.18    51.8  122.93    53.9  122.73    55.8   122.5    59.9  122.05
      62  121.87      64  121.77      68   121.5    72.1  121.28    76.1   121.1
    80.2  120.85    82.2  120.69    83.8  120.44    84.2  120.39    86.2  120.25
    92.6  119.71    94.3  119.53    96.4  119.47    99.6  119.53   102.4  119.54
   104.4  119.62   106.5  119.66   108.5  119.59   110.2  119.73     111  119.78
   111.9  119.81   112.5  119.84   114.6  119.84   116.6  120.04   124.2  121.18
   126.7  121.51   128.7  121.75   132.8  121.98   134.8  122.12   136.8  122.11
   138.8  122.07   140.9  122.06   142.9  121.98   144.9  121.77     149  121.29
     153  121.31     155  121.39   157.6  121.51   159.1   121.6   161.1  121.75
   163.1  121.78   165.1  121.69   169.2  121.55   173.2  121.31   175.3  121.22
   177.3  121.01   181.3  120.64   183.9  120.38   185.4  120.21   187.4  119.91
   189.4  119.68   191.4  119.59   195.5  119.49   197.5  119.46   201.6  119.35
   203.6  119.19   205.6  118.98   207.6   118.8   209.6  118.49   211.7  118.09
   213.7  117.62   215.7  117.08   217.7  116.76   219.8  116.46   221.8     116
   229.9   113.5   235.9     113   239.9   113.5   248.1   116.3   250.1  116.68
   252.1  117.27   252.4  117.36   254.2  118.39  256.18 119.152   256.2  119.16
   258.2  119.09     259  119.14   259.4  119.21   260.2  119.24   261.1  119.42
   262.2  119.61   262.9   119.7   263.8  119.77   264.3  119.83   264.6  119.84
   266.3  119.79   268.3   119.7   269.9  120.21   270.3  120.34   272.4  121.21
   274.4  122.05   275.2  122.39   275.7  122.58   276.4  122.89   282.5  125.76
   284.5  126.55   288.5  128.08   292.4  129.06   294.6  129.67   296.6  130.05
   300.7  130.53   302.7  130.74   308.8  131.23   312.8  130.98   314.8  130.89
   316.9  130.89   318.9  130.87   320.8  130.89   322.9     131   325.8  131.34
     329  131.68     331  131.83   333.1  132.04   335.1  132.22   336.6  132.43
   339.1   132.8   343.2  133.34   345.4  133.58   349.2  134.04   353.3  134.41
   355.3  134.57 355.757  134.63

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .09   215.7    .045   250.1     .09

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
         215.7   250.1            323.9   310.7   323.6             .1       .3
Left Levee      Station=  136.81      Elevation=  122.11

CROSS SECTION OUTPUT  Profile #Q10

  E.G. Elev (ft)           120.84    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.29    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)           120.55    Reach Len. (ft)          323.90     310.70     323.60
  Crit W.S. (ft)           117.66    Flow Area (sq ft)         45.10     198.72      30.32
  E.G. Slope (ft/ft)     0.001812    Area (sq ft)              45.10     198.72      30.32
  Q Total (cfs)            947.00    Flow (cfs)                38.41     881.73      26.86
  Top Width (ft)            88.65    Top Width (ft)            33.53      34.40      20.72
  Vel Total (ft/s)           3.45    Avg. Vel. (ft/s)           0.85       4.44       0.89
  Max Chl Dpth (ft)          7.55    Hydr. Depth (ft)           1.34       5.78       1.46
  Conv. Total (cfs)       22248.6    Conv. (cfs)               902.5    20715.1      631.0
  Length Wtd. (ft)         311.37    Wetted Per. (ft)          33.81      35.43      21.43
  Min Ch El (ft)           113.00    Shear (lb/sq ft)           0.15       0.63       0.16
  Alpha                      1.54    Stream Power (lb/ft s)     0.13       2.81       0.14
  Frctn Loss (ft)            0.81    Cum Volume (acre-ft)       0.20       1.26       0.19
  C & E Loss (ft)            0.02    Cum SA (acres)             0.16       0.23       0.15


Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than
         1.4.  This may indicate the need for additional cross sections.
Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q50

  E.G. Elev (ft)           122.18    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.40    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)           121.78    Reach Len. (ft)          323.90     310.70     323.60
  Crit W.S. (ft)           118.70    Flow Area (sq ft)        100.84     240.90      57.53
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E.G. Slope (ft/ft)	0.002089	Area (sq ft)	100.84	240.90	57.53
Q Total (cfs)	1490.00	Flow (cfs)	108.75	1304.80	76.45
Top Width (ft)	128.90	Top Width (ft)	70.85	34.40	23.66
Vel Total (ft/s)	3.73	Avg. Vel. (ft/s)	1.08	5.42	1.33
Max Chl Dpth (ft)	8.78	Hydr. Depth (ft)	1.42	7.00	2.43
Conv. Total (cfs)	32602.4	Conv. (cfs)	2379.6	28550.0	1672.8
Length Wtd. (ft)	312.39	Wetted Per. (ft)	71.21	35.43	24.62
Min Ch El (ft)	113.00	Shear (lb/sq ft)	0.18	0.89	0.30
Alpha	1.86	Stream Power (lb/ft s)	0.20	4.80	0.40
Frctn Loss (ft)	0.88	Cum Volume (acre-ft)	0.45	1.54	0.69
C & E Loss (ft)	0.02	Cum SA (acres)	0.31	0.23	0.42

Warning: Divided flow computed for this cross-section.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q100

E.G. Elev (ft)	122.67	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.37	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	122.30	Reach Len. (ft)	323.90	310.70	323.60
Crit W.S. (ft)	119.12	Flow Area (sq ft)	267.27	258.97	70.28
E.G. Slope (ft/ft)	0.001912	Area (sq ft)	267.27	258.97	70.28
Q Total (cfs)	1780.00	Flow (cfs)	273.07	1408.38	98.55
Top Width (ft)	217.42	Top Width (ft)	158.12	34.40	24.90
Vel Total (ft/s)	2.98	Avg. Vel. (ft/s)	1.02	5.44	1.40
Max Chl Dpth (ft)	9.30	Hydr. Depth (ft)	1.69	7.53	2.82
Conv. Total (cfs)	40705.6	Conv. (cfs)	6244.6	32207.2	2253.7
Length Wtd. (ft)	313.24	Wetted Per. (ft)	158.77	35.43	25.97
Min Ch El (ft)	113.00	Shear (lb/sq ft)	0.20	0.87	0.32
Alpha	2.66	Stream Power (lb/ft s)	0.21	4.75	0.45
Frctn Loss (ft)	0.84	Cum Volume (acre-ft)	1.09	1.66	0.91
C & E Loss (ft)	0.03	Cum SA (acres)	0.64	0.23	0.43

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	123.76	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.38	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	123.39	Reach Len. (ft)	323.90	310.70	323.60
Crit W.S. (ft)	120.52	Flow Area (sq ft)	443.44	296.15	98.57
E.G. Slope (ft/ft)	0.001840	Area (sq ft)	443.44	296.15	98.57
Q Total (cfs)	2480.00	Flow (cfs)	593.38	1727.54	159.08
Top Width (ft)	231.77	Top Width (ft)	170.02	34.40	27.35
Vel Total (ft/s)	2.96	Avg. Vel. (ft/s)	1.34	5.83	1.61
Max Chl Dpth (ft)	10.39	Hydr. Depth (ft)	2.61	8.61	3.60
Conv. Total (cfs)	57820.3	Conv. (cfs)	13834.5	40276.8	3708.9
Length Wtd. (ft)	314.35	Wetted Per. (ft)	170.72	35.43	28.65
Min Ch El (ft)	113.00	Shear (lb/sq ft)	0.30	0.96	0.40
Alpha	2.78	Stream Power (lb/ft s)	0.40	5.60	0.64
Frctn Loss (ft)	0.82	Cum Volume (acre-ft)	1.81	1.90	1.37
C & E Loss (ft)	0.03	Cum SA (acres)	0.70	0.23	0.46

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION

RIVER: River 1
REACH: Reach 1 RS: 3052

INPUT
Description:
Station Elevation Data num= 299

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	123.76	2	123.66	4	123.66	6	123.71	8	123.82
10	123.61	12	123.46	14	123.29	16	123.14	18	122.85
20	122.47	22	122.25	26	122.2	28	122.12	30	122.12
34	122.06	36	121.91	40.1	121.47	40.6	121.44	44.1	121.33
46.1	121.24	50.1	121.12	54.1	121.08	56.5	120.98	60.1	120.88
64.1	120.71	68.1	120.49	74.1	120.25	76.1	120.13	78.4	120.03
80.3	119.92	82.1	119.84	84.1	119.73	87.8	119.72	92.2	119.62
94.2	119.61	104.2	119.71	106.2	119.7	108.2	119.81	110.2	119.95
112.2	120.07	114.2	120.16	118.2	120.09	120.6	120.12	126.2	119.97
128.2	119.98	130.2	120.06	136.2	120.45	140.6	120.68	142.3	120.8
144.3	120.9	146.3	120.94	148.3	120.76	155.7	120.47	158.3	120.42
160.3	120.34	164.3	120.1	166.3	120.06	167	120.06	167.6	120.03
168.3	120.03	170.3	119.95	172.3	119.86	172.7	119.86	174	119.84
174.6	119.84	178.3	119.75	180.3	119.65	184.3	119.31	186.3	119.07
190.3	118.47	192.3	118.25	196.4	117.98	198.4	117.88	204.4	117.86
206.6	117.89	208.2	117.93	210.3	117.94	212.4	117.97	216.4	118.16
218.4	118.23	220.4	118.26	224.4	118.28	228.4	118.39	234.4	118.46
238.4	118.59	244.4	118.69	246.5	118.83	250.9	119.33	252.5	119.48
256.5	119.83	258.5	119.91	262.5	119.75	264.5	119.66	266.5	119.69
270.5	119.82	272.5	119.84	274.6	119.84	276.5	119.72	278.5	119.54
280.2	119.21	282.5	118.8	284.5	118.5	286.5	118.26	290.5	117.87
292.5	117.77	294.5	117.74	296.5	117.74	298.6	117.84	299.1	117.84
301	117.82	304.7	117.69	306.6	117.69	308.5	117.75	310.4	117.79
312.3	117.8	316.6	117.69	318.6	117.78	324.6	118.27	327.4	118.43
330.6	118.65	332.6	118.59	338.6	118.37	340.6	118.32	344.6	118.35
347.1	118.4	348.1	118.44	349.2	118.45	350.7	118.44	354.7	118.31
356.7	118.27	358.7	118.39	360.7	118.55	362.1	118.62	362.7	118.65
364.7	118.66	370.7	118.31	372.6	118.29	374.5	118.29	376.7	118.28
378.3	118.29	380.7	118.38	382.7	118.49	386.7	118.6	390.7	118.75
396.7	118.68	398.7	118.76	400.8	118.86	404.7	118.94	408.8	119.09
412.8	119.28	416.8	119.42	422.8	119.9	424.8	120	432.8	120.31
434.9	120.34	436.9	120.31	440.8	120.19	441.1	120.19	442.8	120.21
444.8	120.42	446.8	120.66	448.8	120.85	450.8	121.02	454.9	121.29
455.6	121.31	456.1	121.33	456.9	121.35	460.9	121.33	462.9	121.36
464.9	121.24	467	121.15	468.3	121.11	468.9	121.1	470.9	121.19
474.9	121.51	478.9	121.7	482.9	121.83	484.9	121.83	486.9	121.86
488.9	121.88	492.9	121.77	498.8	121.69	500.9	121.69	502.9	121.75
505	121.85	507	122.01	509	122.13	511	122.16	513	122.26
517	122.38	521	122.38	523	122.28	525	122.06	527	121.88
529	121.53	533	120.1	535	119.41	537.3	118.77	539	118.31
541	117.8	543	117.44	549	115	557.5	113	561.1	112.2
565.1	113	570.7	115	571.1	116.83	573.1	117.51	575.1	118.12
575.8	118.2	576.4	118.34	577.1	118.42	577.9	118.41	578.3	118.4
581.1	118.33	585.1	118.29	587.1	118.32	589.1	118.62	590.7	119.01
592.9	119.51	593.1	119.57	595.1	119.94	601.1	120.5	605.1	120.57
607.1	120.57	609.2	120.62	610.3	120.61	613.2	120.61	615.2	120.58
619.2	120.48	621.2	120.36	621.6	120.31	623.2	120.11	624.9	119.97
627.2	119.85	629.2	119.6	636.7	118.41	639.2	118.09	641.2	117.91
643.2	117.78	645.2	117.62	647.2	117.51	651.2	117.9	651.8	117.92
652.7	117.99	653.2	118.01	655.2	118.46	657	118.96	657.2	119.03
657.5	119.1	659.3	119.63	661.2	120.12	665	121.24	666.9	121.77
667.3	121.87	669.3	122.52	673.3	123.77	679.3	125.84	681.3	126.31
682	126.45	682.6	126.56	683.3	126.7	685.3	127.15	687.3	127.55
689.6	127.82	693.3	128.38	695.3	128.6	697.1	128.83	697.3	128.86
699.3	129.14	701.3	129.37	702.8	129.5	704	129.58	705.3	129.67
709.3	129.97	715.4	130.34	721.1	130.79	723.5	130.94	725.4	131.09
725.7	131.1	727.5	131.13	731.4	131.14	731.8	131.14	732.9	131.16
735.4	131.18	736	131.19	739.4	131.25	745.4	131.44	751.4	131.74

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   751.8  131.76   753.1  131.85   753.7  131.89   755.3  132.01   755.4  132.02
   757.4  132.16   759.4  132.32   761.7  132.53762.2267  132.57

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0     .09     543    .045   573.1     .09

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
            543   573.1               0       0       0              .1       .3
Left Levee      Station=  516.98      Elevation=  122.38
Right Levee     Station=  607.15      Elevation=  120.57

CROSS SECTION OUTPUT  Profile #Q10

  E.G. Elev (ft)           120.01    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.52    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)           119.49    Reach Len. (ft)
  Crit W.S. (ft)           117.45    Flow Area (sq ft)          9.15     155.44      20.93
  E.G. Slope (ft/ft)     0.004005    Area (sq ft)               9.15     155.44      20.93
  Q Total (cfs)            947.00    Flow (cfs)                10.05     914.37      22.59
  Top Width (ft)            58.04    Top Width (ft)             8.23      30.10      19.71
  Vel Total (ft/s)           5.10    Avg. Vel. (ft/s)           1.10       5.88       1.08
  Max Chl Dpth (ft)          7.29    Hydr. Depth (ft)           1.11       5.16       1.06
  Conv. Total (cfs)       14964.7    Conv. (cfs)               158.8    14449.0      356.9
  Length Wtd. (ft)                   Wetted Per. (ft)           8.49      32.91      19.95
  Min Ch El (ft)           112.20    Shear (lb/sq ft)           0.27       1.18       0.26
  Alpha                      1.28    Stream Power (lb/ft s)     0.30       6.95       0.28
  Frctn Loss (ft)                    Cum Volume (acre-ft)
  C & E Loss (ft)                    Cum SA (acres)


Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q50

  E.G. Elev (ft)           121.28    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.61    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)           120.67    Reach Len. (ft)
  Crit W.S. (ft)           118.75    Flow Area (sq ft)         20.87     190.98     129.54
  E.G. Slope (ft/ft)     0.003996    Area (sq ft)              20.87     190.98     129.54
  Q Total (cfs)           1490.00    Flow (cfs)                31.40    1287.32     171.28
  Top Width (ft)           131.66    Top Width (ft)            11.59      30.10      89.97
  Vel Total (ft/s)           4.36    Avg. Vel. (ft/s)           1.50       6.74       1.32
  Max Chl Dpth (ft)          8.47    Hydr. Depth (ft)           1.80       6.34       1.44
  Conv. Total (cfs)       23570.9    Conv. (cfs)               496.8    20364.6     2709.5
  Length Wtd. (ft)                   Wetted Per. (ft)          12.05      32.91      90.84
  Min Ch El (ft)           112.20    Shear (lb/sq ft)           0.43       1.45       0.36
  Alpha                      2.07    Stream Power (lb/ft s)     0.65       9.76       0.47
  Frctn Loss (ft)                    Cum Volume (acre-ft)
  C & E Loss (ft)                    Cum SA (acres)


Note:    Multiple critical depths were found at this location.  The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT  Profile #Q100

  E.G. Elev (ft)           121.81    Element                  Left OB    Channel   Right OB
  Vel Head (ft)              0.65    Wt. n-Val.                0.090      0.045      0.090
  W.S. Elev (ft)           121.16    Reach Len. (ft)
  Crit W.S. (ft)           119.33    Flow Area (sq ft)         26.87     205.69     173.93
  E.G. Slope (ft/ft)     0.004006    Area (sq ft)              26.87     205.69     173.93
  Q Total (cfs)           1780.00    Flow (cfs)                44.42    1458.80     276.78
  Top Width (ft)           134.69    Top Width (ft)            12.96      30.10      91.62
  Vel Total (ft/s)           4.38    Avg. Vel. (ft/s)           1.65       7.09       1.59
  Max Chl Dpth (ft)          8.96    Hydr. Depth (ft)           2.07       6.83       1.90
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Conv. Total (cfs)	28121.6	Conv. (cfs)	701.8	23047.1	4372.7
Length Wtd. (ft)		Wetted Per. (ft)	13.51	32.91	92.57
Min Ch El (ft)	112.20	Shear (lb/sq ft)	0.50	1.56	0.47
Alpha	2.17	Stream Power (lb/ft s)	0.82	11.09	0.75
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

CROSS SECTION OUTPUT Profile #Q500

E.G. Elev (ft)	122.91	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.72	Wt. n-Val.	0.090	0.045	0.090
W.S. Elev (ft)	122.19	Reach Len. (ft)			
Crit W.S. (ft)	120.43	Flow Area (sq ft)	42.60	236.73	270.27
E.G. Slope (ft/ft)	0.004007	Area (sq ft)	42.60	236.73	270.27
Q Total (cfs)	2480.00	Flow (cfs)	74.11	1843.80	562.09
Top Width (ft)	144.46	Top Width (ft)	19.18	30.10	95.18
Vel Total (ft/s)	4.51	Avg. Vel. (ft/s)	1.74	7.79	2.08
Max Chl Dpth (ft)	9.99	Hydr. Depth (ft)	2.22	7.86	2.84
Conv. Total (cfs)	39179.5	Conv. (cfs)	1170.7	29128.7	8880.1
Length Wtd. (ft)		Wetted Per. (ft)	19.83	32.91	96.27
Min Ch El (ft)	112.20	Shear (lb/sq ft)	0.54	1.80	0.70
Alpha	2.27	Stream Power (lb/ft s)	0.93	14.01	1.46
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, energy was used.

SUMMARY OF MANNING'S N VALUES

River:River 1

Reach	River Sta.	n1	n2	n3
Reach 1	4896	.09	.045	.09
Reach 1	4743	.09	.045	.09
Reach 1	4607	.09	.045	.09
Reach 1	4473	.09	.045	.09
Reach 1	4383	.09	.045	.09
Reach 1	4315	Bridge		
Reach 1	4239	.09	.045	.09
Reach 1	4132	.09	.045	.09
Reach 1	4028	.09	.045	.09
Reach 1	3865	.09	.045	.09
Reach 1	3705	.09	.045	.09
Reach 1	3510	.09	.045	.09
Reach 1	3362	.09	.045	.09
Reach 1	3052	.09	.045	.09

SUMMARY OF REACH LENGTHS

River: River 1

Reach	River Sta.	Left	Channel	Right
Reach 1	4896	159.6	153.4	150.1
Reach 1	4743	133.3	135.5	142.3

Reach 1	4607	142.7	133.8	135.5
Reach 1	4473	99	90.3	81.7
Reach 1	4383	153.5	144.5	154.5
Reach 1	4315	Bridge		
Reach 1	4239	163.4	106.6	256.9
Reach 1	4132	102.2	104.5	111.3
Reach 1	4028	180.8	162.9	161.8
Reach 1	3865	155.6	159.3	182.2
Reach 1	3705	221.6	195.4	195.8
Reach 1	3510	148.9	147.5	155.8
Reach 1	3362	323.9	310.7	323.6
Reach 1	3052	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: River 1

Reach	River Sta.	Contr.	Expan.
Reach 1	4896	.1	.3
Reach 1	4743	.1	.3
Reach 1	4607	.1	.3
Reach 1	4473	.3	.5
Reach 1	4383	.6	.8
Reach 1	4315	Bridge	
Reach 1	4239	.6	.8
Reach 1	4132	.1	.3
Reach 1	4028	.1	.3
Reach 1	3865	.1	.3
Reach 1	3705	.1	.3
Reach 1	3510	.1	.3
Reach 1	3362	.1	.3
Reach 1	3052	.1	.3

Profile Output Table - Standard Table 1

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Reach 1	4896	Q10	947.00	117.06	123.03		123.20	0.001095	3.58	412.72	156.70	0.26
Reach 1	4896	Q50	1490.00	117.06	124.57		124.75	0.000981	3.94	666.77	180.49	0.25
Reach 1	4896	Q100	1780.00	117.06	125.13		125.34	0.001069	4.32	791.80	256.41	0.27
Reach 1	4896	Q500	2480.00	117.06	126.42		126.65	0.001029	4.69	1163.84	343.65	0.27
Reach 1	4743	Q10	947.00	115.91	123.00	119.44	123.06	0.000483	2.54	731.66	205.42	0.17
Reach 1	4743	Q50	1490.00	115.91	124.54	120.44	124.61	0.000463	2.86	1072.89	237.07	0.18
Reach 1	4743	Q100	1780.00	115.91	125.11	120.75	125.19	0.000488	3.07	1211.32	249.51	0.18
Reach 1	4743	Q500	2480.00	115.91	126.40	121.36	126.50	0.000513	3.46	1554.31	281.53	0.19
Reach 1	4607	Q10	947.00	114.74	122.91	118.72	123.00	0.000477	2.45	516.97	120.78	0.17
Reach 1	4607	Q50	1490.00	114.74	124.43	119.52	124.54	0.000526	2.97	711.80	137.61	0.19
Reach 1	4607	Q100	1780.00	114.74	124.98	119.95	125.11	0.000582	3.26	789.30	144.83	0.20
Reach 1	4607	Q500	2480.00	114.74	126.22	120.72	126.41	0.000685	3.88	992.81	197.73	0.22
Reach 1	4473	Q10	947.00	114.36	122.69	118.92	122.89	0.001074	3.77	317.15	75.53	0.26
Reach 1	4473	Q50	1490.00	114.36	124.12	119.88	124.42	0.001275	4.68	437.89	93.97	0.29
Reach 1	4473	Q100	1780.00	114.36	124.59	120.45	124.97	0.001497	5.27	485.04	114.88	0.32
Reach 1	4473	Q500	2480.00	114.36	125.75	121.56	126.24	0.001714	6.14	637.47	142.14	0.35
Reach 1	4383	Q10	947.00	116.00	122.51	119.49	122.76	0.001579	4.19	281.04	66.72	0.30
Reach 1	4383	Q50	1490.00	116.00	123.90	120.58	124.26	0.001799	5.15	378.88	74.56	0.34

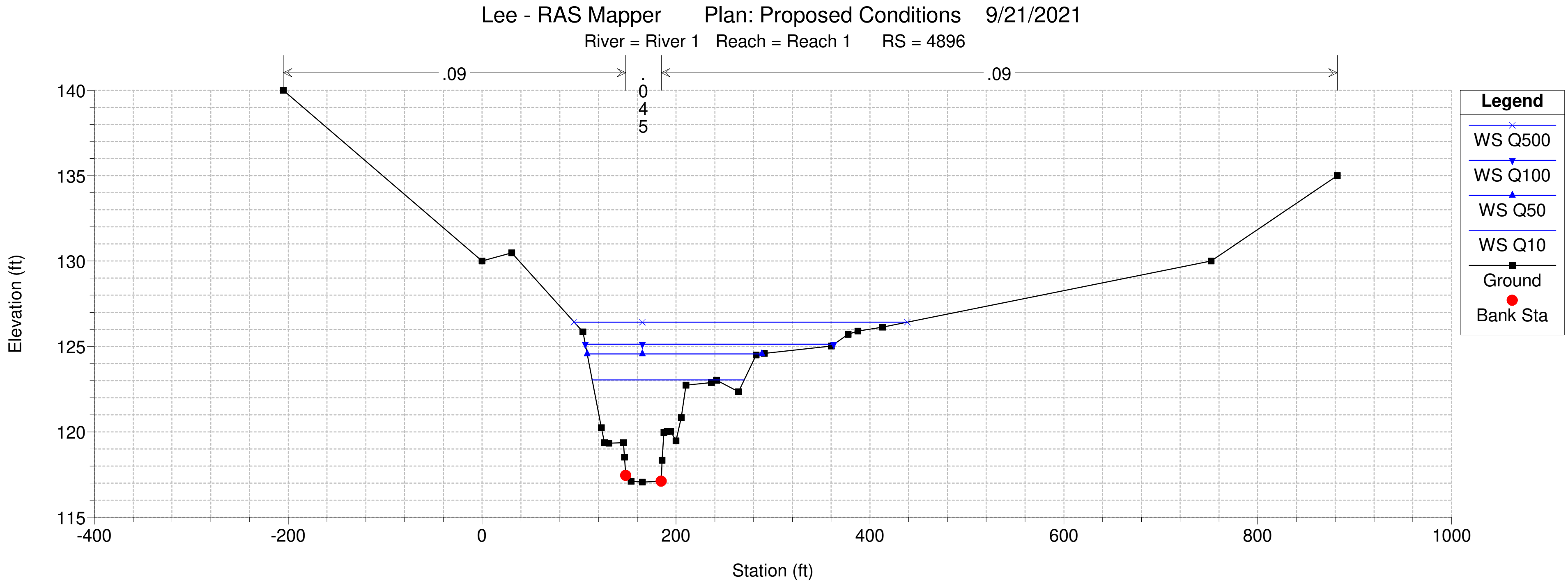
Reach 1	4383	Q100	1780.00	116.00	124.34	121.03	124.79	0.002063	5.74	412.62	77.40	0.36
Reach 1	4383	Q500	2480.00	116.00	125.37	121.98	126.01	0.002541	6.92	496.05	87.43	0.41
Reach 1	4315		Bridge									
Reach 1	4239	Q10	947.00	112.32	122.38	117.15	122.48	0.000473	2.88	498.12	118.69	0.18
Reach 1	4239	Q50	1490.00	112.32	123.75	118.57	123.90	0.000602	3.60	682.08	149.29	0.20
Reach 1	4239	Q100	1780.00	112.32	124.17	119.06	124.35	0.000710	4.02	737.46	151.87	0.22
Reach 1	4239	Q500	2480.00	112.32	125.16	119.99	125.42	0.000911	4.85	867.56	171.39	0.26
Reach 1	4132	Q10	947.00	112.71	122.19	117.06	122.36	0.000706	3.59	399.85	104.87	0.22
Reach 1	4132	Q50	1490.00	112.71	123.46	118.05	123.73	0.000946	4.56	591.84	170.86	0.26
Reach 1	4132	Q100	1780.00	112.71	123.83	118.86	124.15	0.001130	5.10	655.76	182.50	0.28
Reach 1	4132	Q500	2480.00	112.71	124.73	120.25	125.16	0.001425	6.07	833.46	211.52	0.32
Reach 1	4028	Q10	947.00	114.09	122.03	118.14	122.27	0.001166	4.18	353.46	113.50	0.27
Reach 1	4028	Q50	1490.00	114.09	123.27	119.48	123.60	0.001450	5.17	506.04	135.38	0.31
Reach 1	4028	Q100	1780.00	114.09	123.59	120.14	123.99	0.001764	5.84	549.14	142.05	0.35
Reach 1	4028	Q500	2480.00	114.09	124.38	121.27	124.95	0.002304	7.07	669.26	159.16	0.40
Reach 1	3865	Q10	947.00	113.31	121.93	119.33	122.05	0.001109	3.63	569.49	198.90	0.25
Reach 1	3865	Q50	1490.00	113.31	123.24	120.56	123.35	0.000908	3.71	1007.84	391.28	0.23
Reach 1	3865	Q100	1780.00	113.31	123.58	120.77	123.69	0.000982	3.97	1139.83	394.36	0.25
Reach 1	3865	Q500	2480.00	113.31	124.46	121.56	124.58	0.000987	4.26	1491.12	404.31	0.25
Reach 1	3705	Q10	947.00	112.00	121.43	119.31	121.76	0.002547	5.46	362.03	155.11	0.36
Reach 1	3705	Q50	1490.00	112.00	122.83	121.11	123.11	0.002095	5.59	588.37	168.37	0.34
Reach 1	3705	Q100	1780.00	112.00	123.09	121.45	123.43	0.002520	6.26	631.09	171.05	0.37
Reach 1	3705	Q500	2480.00	112.00	124.17	122.09	124.36	0.001656	5.49	1315.43	414.02	0.31
Reach 1	3510	Q10	947.00	113.00	120.82	118.75	121.21	0.002980	5.32	248.55	81.51	0.40
Reach 1	3510	Q50	1490.00	113.00	122.09	120.06	122.58	0.003105	6.25	358.03	92.79	0.43
Reach 1	3510	Q100	1780.00	113.00	122.71	120.51	122.96	0.001851	5.12	788.94	299.41	0.33
Reach 1	3510	Q500	2480.00	113.00	123.81	121.40	124.03	0.001548	5.15	1123.95	310.89	0.31
Reach 1	3362	Q10	947.00	113.00	120.55	117.66	120.84	0.001812	4.44	274.15	88.65	0.33
Reach 1	3362	Q50	1490.00	113.00	121.78	118.70	122.18	0.002089	5.42	399.28	128.90	0.36
Reach 1	3362	Q100	1780.00	113.00	122.30	119.12	122.67	0.001912	5.44	596.52	217.42	0.35
Reach 1	3362	Q500	2480.00	113.00	123.39	120.52	123.76	0.001840	5.83	838.16	231.77	0.35
Reach 1	3052	Q10	947.00	112.20	119.49	117.45	120.01	0.004005	5.88	185.52	58.04	0.46
Reach 1	3052	Q50	1490.00	112.20	120.67	118.75	121.28	0.003996	6.74	341.38	131.66	0.47
Reach 1	3052	Q100	1780.00	112.20	121.16	119.33	121.81	0.004006	7.09	406.50	134.69	0.48
Reach 1	3052	Q500	2480.00	112.20	122.19	120.43	122.91	0.004007	7.79	549.60	144.46	0.49

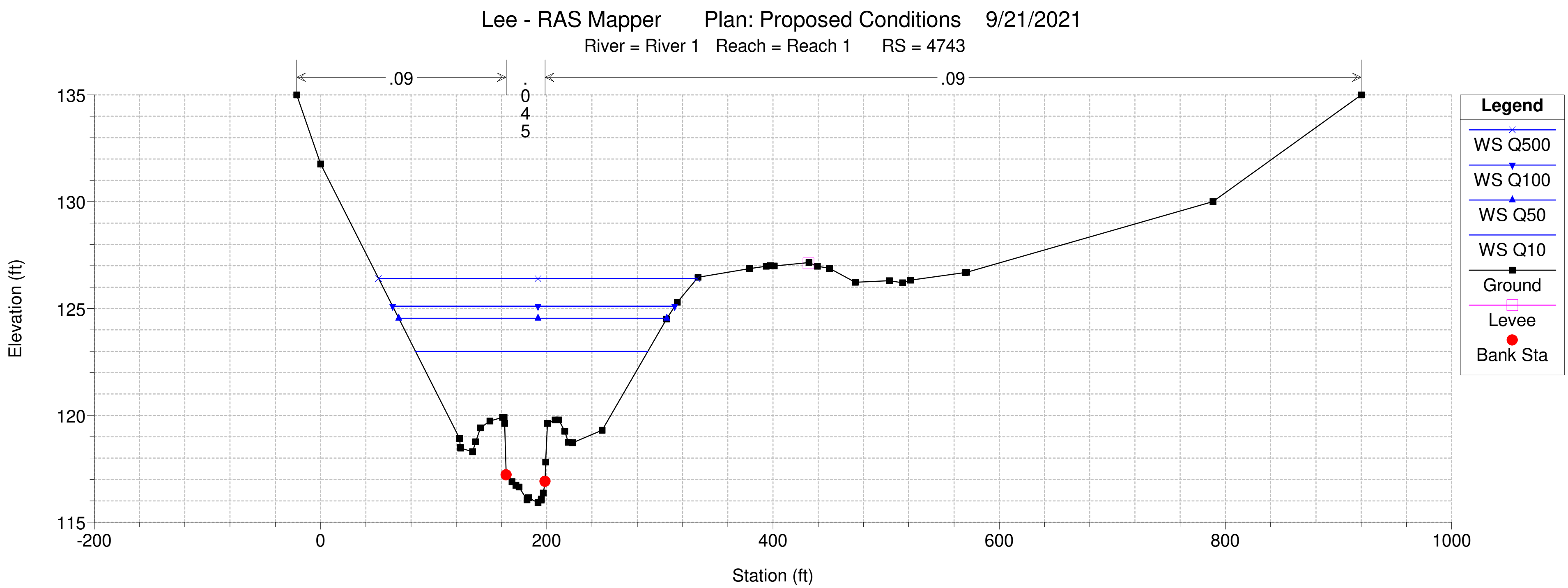
HEC-RAS Plan: Prop Cond River: River 1 Reach: Reach 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	4896	Q10	947.00	117.06	123.03		123.20	0.001095	3.58	412.72	156.70	0.26
Reach 1	4896	Q50	1490.00	117.06	124.57		124.75	0.000981	3.94	666.77	180.49	0.25
Reach 1	4896	Q100	1780.00	117.06	125.13		125.34	0.001069	4.32	791.80	256.41	0.27
Reach 1	4896	Q500	2480.00	117.06	126.42		126.65	0.001029	4.69	1163.84	343.65	0.27
Reach 1	4743	Q10	947.00	115.91	123.00	119.44	123.06	0.000483	2.54	731.66	205.42	0.17
Reach 1	4743	Q50	1490.00	115.91	124.54	120.44	124.61	0.000463	2.86	1072.89	237.07	0.18
Reach 1	4743	Q100	1780.00	115.91	125.11	120.75	125.19	0.000488	3.07	1211.32	249.51	0.18
Reach 1	4743	Q500	2480.00	115.91	126.40	121.36	126.50	0.000513	3.46	1554.31	281.53	0.19
Reach 1	4607	Q10	947.00	114.74	122.91	118.72	123.00	0.000477	2.45	516.97	120.78	0.17
Reach 1	4607	Q50	1490.00	114.74	124.43	119.52	124.54	0.000526	2.97	711.80	137.61	0.19
Reach 1	4607	Q100	1780.00	114.74	124.98	119.95	125.11	0.000582	3.26	789.30	144.83	0.20
Reach 1	4607	Q500	2480.00	114.74	126.22	120.72	126.41	0.000685	3.88	992.81	197.73	0.22
Reach 1	4473	Q10	947.00	114.36	122.69	118.92	122.89	0.001074	3.77	317.15	75.53	0.26
Reach 1	4473	Q50	1490.00	114.36	124.12	119.88	124.42	0.001275	4.68	437.89	93.97	0.29
Reach 1	4473	Q100	1780.00	114.36	124.59	120.45	124.97	0.001497	5.27	485.04	114.88	0.32
Reach 1	4473	Q500	2480.00	114.36	125.75	121.56	126.24	0.001714	6.14	637.47	142.14	0.35
Reach 1	4383	Q10	947.00	116.00	122.51	119.49	122.76	0.001579	4.19	281.04	66.72	0.30
Reach 1	4383	Q50	1490.00	116.00	123.90	120.58	124.26	0.001799	5.15	378.88	74.56	0.34
Reach 1	4383	Q100	1780.00	116.00	124.34	121.03	124.79	0.002063	5.74	412.62	77.40	0.36
Reach 1	4383	Q500	2480.00	116.00	125.37	121.98	126.01	0.002541	6.92	496.05	87.43	0.41
Reach 1	4315		Bridge									
Reach 1	4239	Q10	947.00	112.32	122.38	117.15	122.48	0.000473	2.88	498.12	118.69	0.18
Reach 1	4239	Q50	1490.00	112.32	123.75	118.57	123.90	0.000602	3.60	682.08	149.29	0.20
Reach 1	4239	Q100	1780.00	112.32	124.17	119.06	124.35	0.000710	4.02	737.46	151.87	0.22
Reach 1	4239	Q500	2480.00	112.32	125.16	119.99	125.42	0.000911	4.85	867.56	171.39	0.26
Reach 1	4132	Q10	947.00	112.71	122.19	117.06	122.36	0.000706	3.59	399.85	104.87	0.22
Reach 1	4132	Q50	1490.00	112.71	123.46	118.05	123.73	0.000946	4.56	591.84	170.86	0.26
Reach 1	4132	Q100	1780.00	112.71	123.83	118.86	124.15	0.001130	5.10	655.76	182.50	0.28
Reach 1	4132	Q500	2480.00	112.71	124.73	120.25	125.16	0.001425	6.07	833.46	211.52	0.32
Reach 1	4028	Q10	947.00	114.09	122.03	118.14	122.27	0.001166	4.18	353.46	113.50	0.27
Reach 1	4028	Q50	1490.00	114.09	123.27	119.48	123.60	0.001450	5.17	506.04	135.38	0.31
Reach 1	4028	Q100	1780.00	114.09	123.59	120.14	123.99	0.001764	5.84	549.14	142.05	0.35
Reach 1	4028	Q500	2480.00	114.09	124.38	121.27	124.95	0.002304	7.07	669.26	159.16	0.40

HEC-RAS Plan: Prop Cond River: River 1 Reach: Reach 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Reach 1	3865	Q10	947.00	113.31	121.93	119.33	122.05	0.001109	3.63	569.49	198.90	0.25
Reach 1	3865	Q50	1490.00	113.31	123.24	120.56	123.35	0.000908	3.71	1007.84	391.28	0.23
Reach 1	3865	Q100	1780.00	113.31	123.58	120.77	123.69	0.000982	3.97	1139.83	394.36	0.25
Reach 1	3865	Q500	2480.00	113.31	124.46	121.56	124.58	0.000987	4.26	1491.12	404.31	0.25
Reach 1	3705	Q10	947.00	112.00	121.43	119.31	121.76	0.002547	5.46	362.03	155.11	0.36
Reach 1	3705	Q50	1490.00	112.00	122.83	121.11	123.11	0.002095	5.59	588.37	168.37	0.34
Reach 1	3705	Q100	1780.00	112.00	123.09	121.45	123.43	0.002520	6.26	631.09	171.05	0.37
Reach 1	3705	Q500	2480.00	112.00	124.17	122.09	124.36	0.001656	5.49	1315.43	414.02	0.31
Reach 1	3510	Q10	947.00	113.00	120.82	118.75	121.21	0.002980	5.32	248.55	81.51	0.40
Reach 1	3510	Q50	1490.00	113.00	122.09	120.06	122.58	0.003105	6.25	358.03	92.79	0.43
Reach 1	3510	Q100	1780.00	113.00	122.71	120.51	122.96	0.001851	5.12	788.94	299.41	0.33
Reach 1	3510	Q500	2480.00	113.00	123.81	121.40	124.03	0.001548	5.15	1123.95	310.89	0.31
Reach 1	3362	Q10	947.00	113.00	120.55	117.66	120.84	0.001812	4.44	274.15	88.65	0.33
Reach 1	3362	Q50	1490.00	113.00	121.78	118.70	122.18	0.002089	5.42	399.28	128.90	0.36
Reach 1	3362	Q100	1780.00	113.00	122.30	119.12	122.67	0.001912	5.44	596.52	217.42	0.35
Reach 1	3362	Q500	2480.00	113.00	123.39	120.52	123.76	0.001840	5.83	838.16	231.77	0.35
Reach 1	3052	Q10	947.00	112.20	119.49	117.45	120.01	0.004005	5.88	185.52	58.04	0.46
Reach 1	3052	Q50	1490.00	112.20	120.67	118.75	121.28	0.003996	6.74	341.38	131.66	0.47
Reach 1	3052	Q100	1780.00	112.20	121.16	119.33	121.81	0.004006	7.09	406.50	134.69	0.48
Reach 1	3052	Q500	2480.00	112.20	122.19	120.43	122.91	0.004007	7.79	549.60	144.46	0.49


Lee - RAS Mapper Plan: Proposed Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4896
.09
.045
.09
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Bank Sta
Elevation (ft)
Station (ft)


Lee - RAS Mapper Plan: Proposed Conditions 9/21/2021
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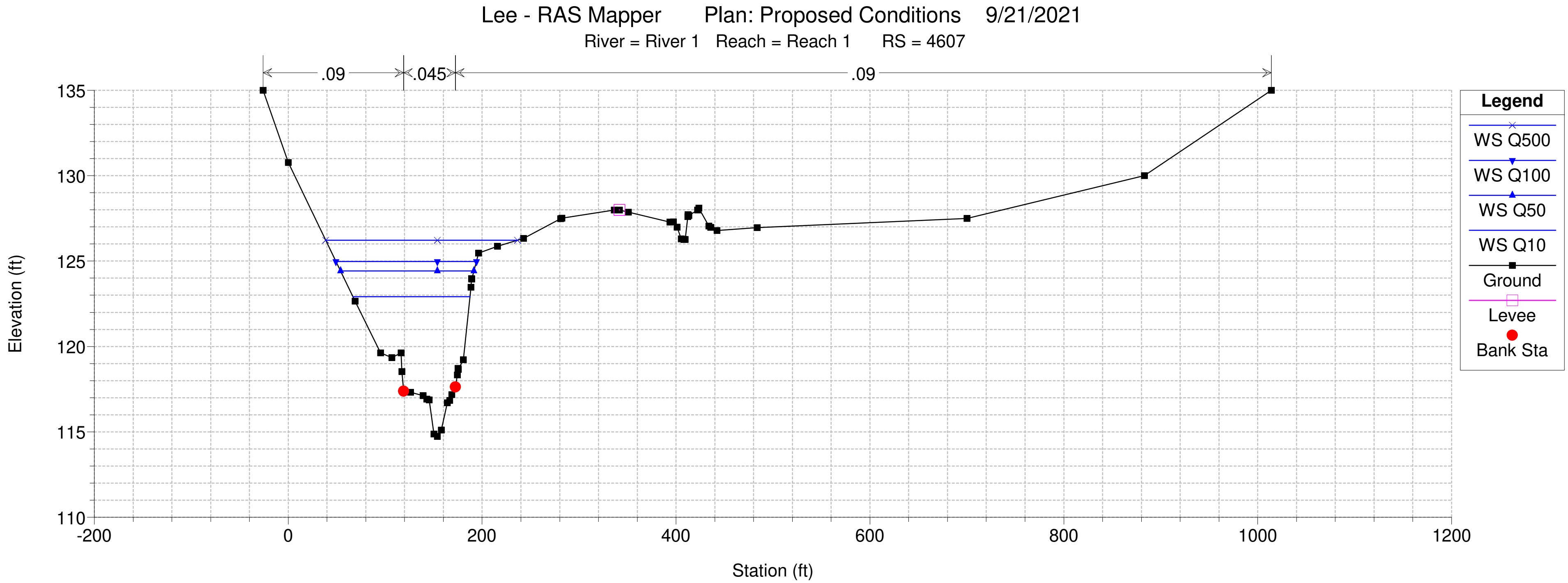
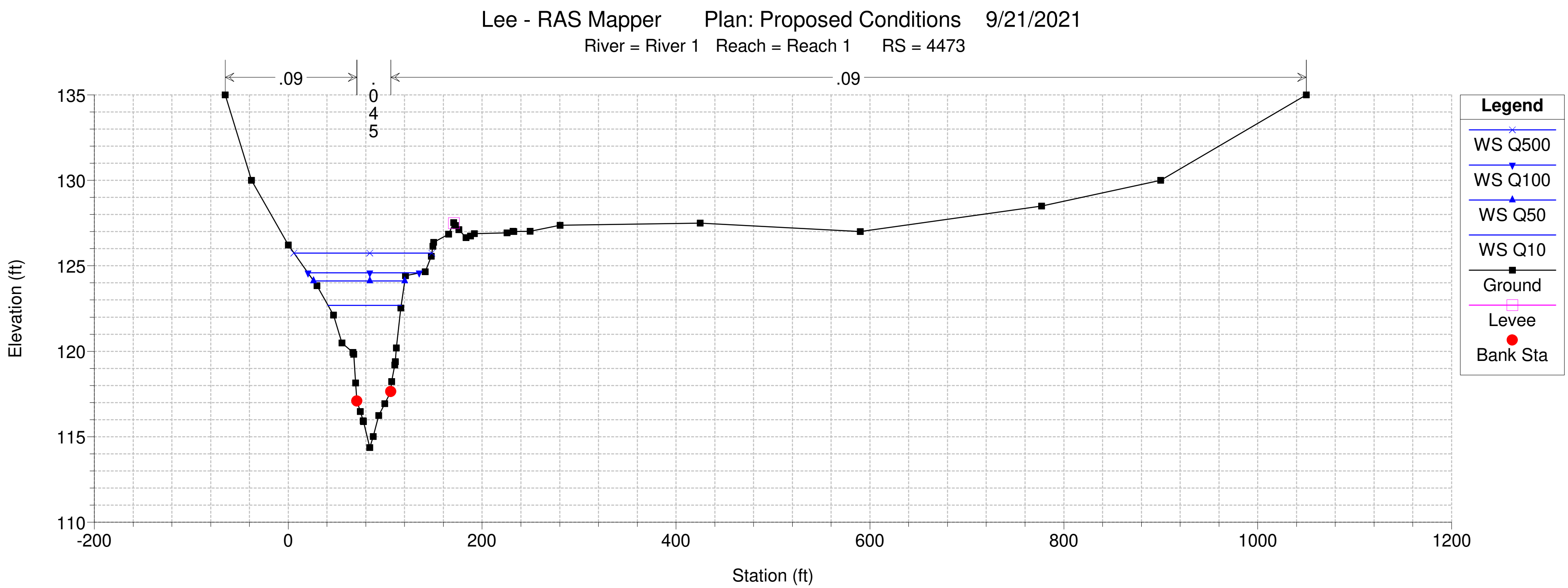
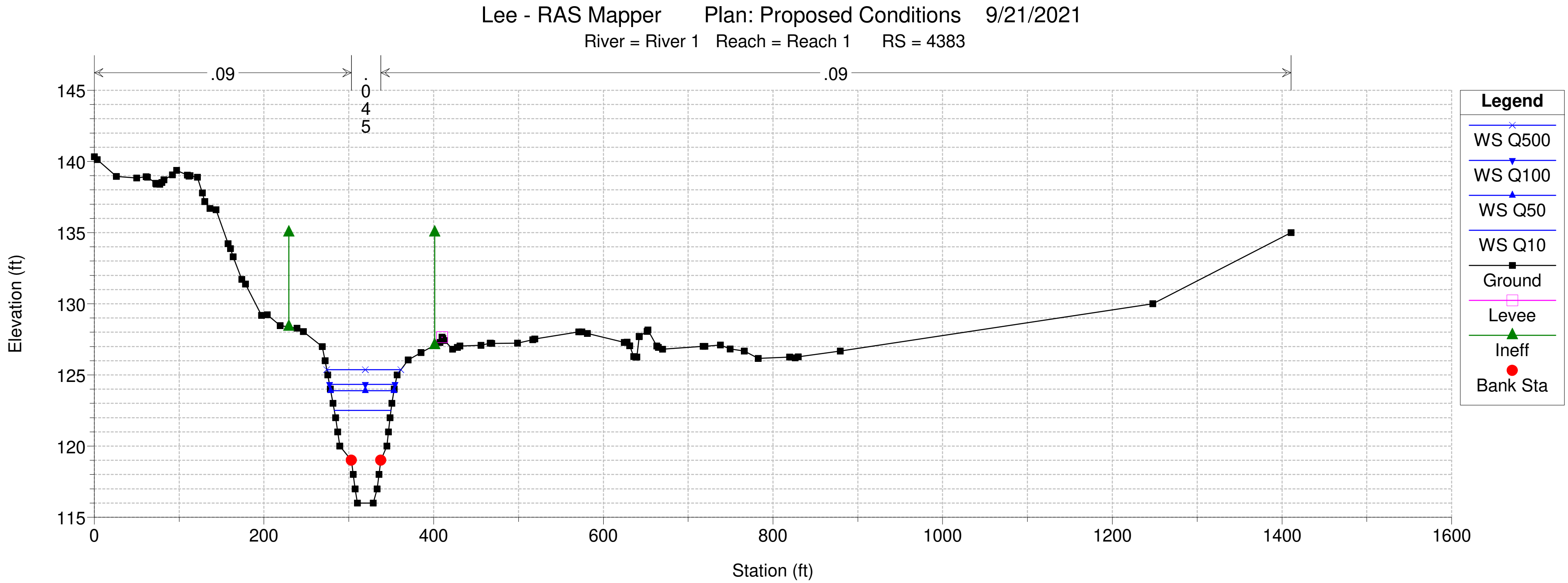
.09
.045
.09
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)

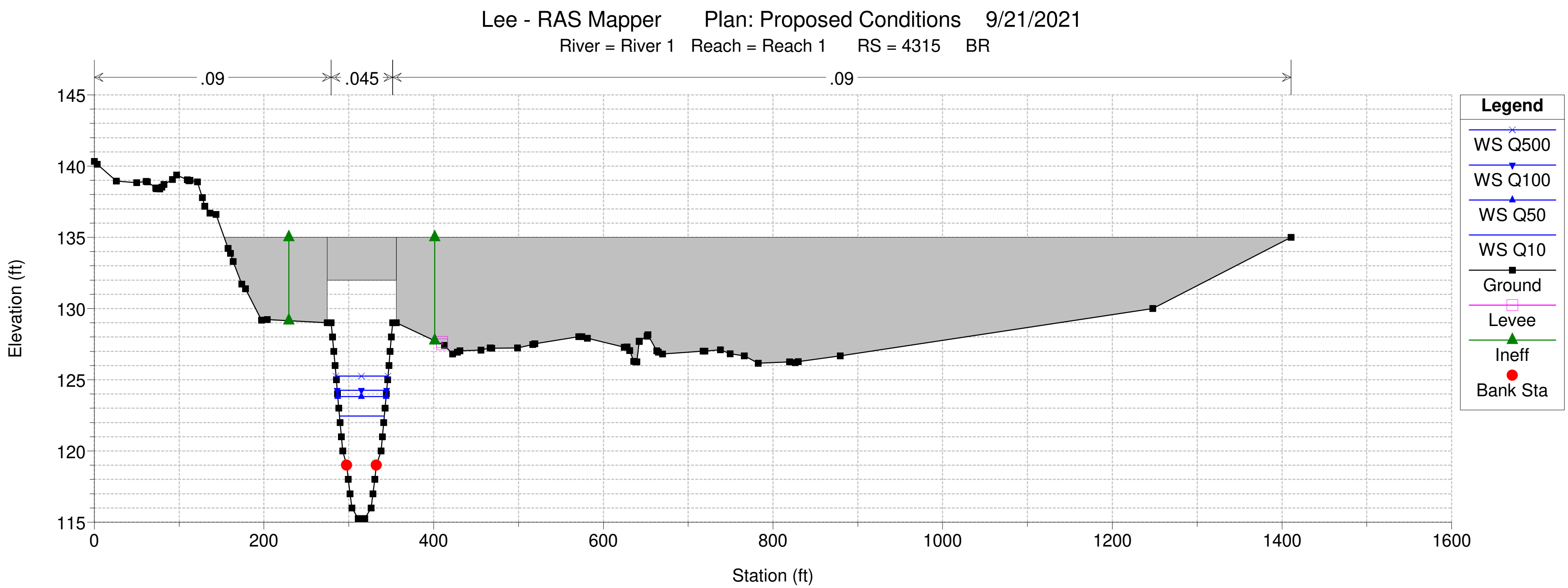


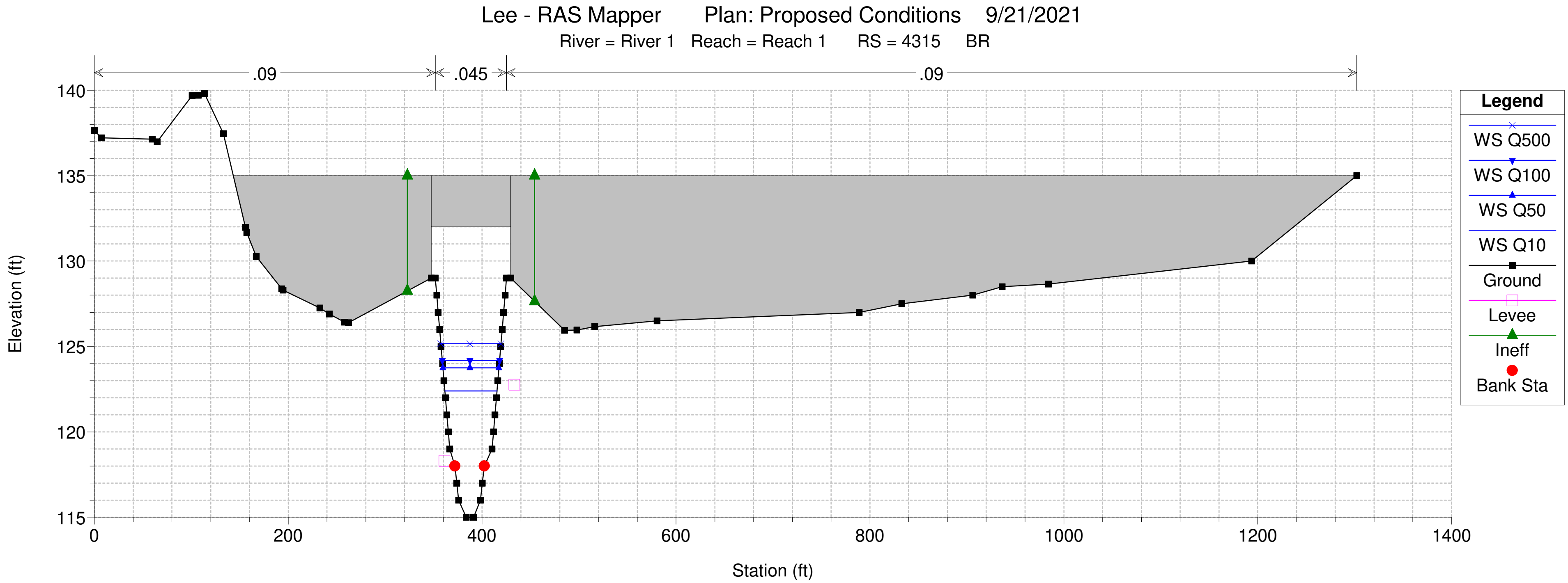
Lee - RAS Mapper Plan: Proposed Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4607
.09
.045
.09
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta



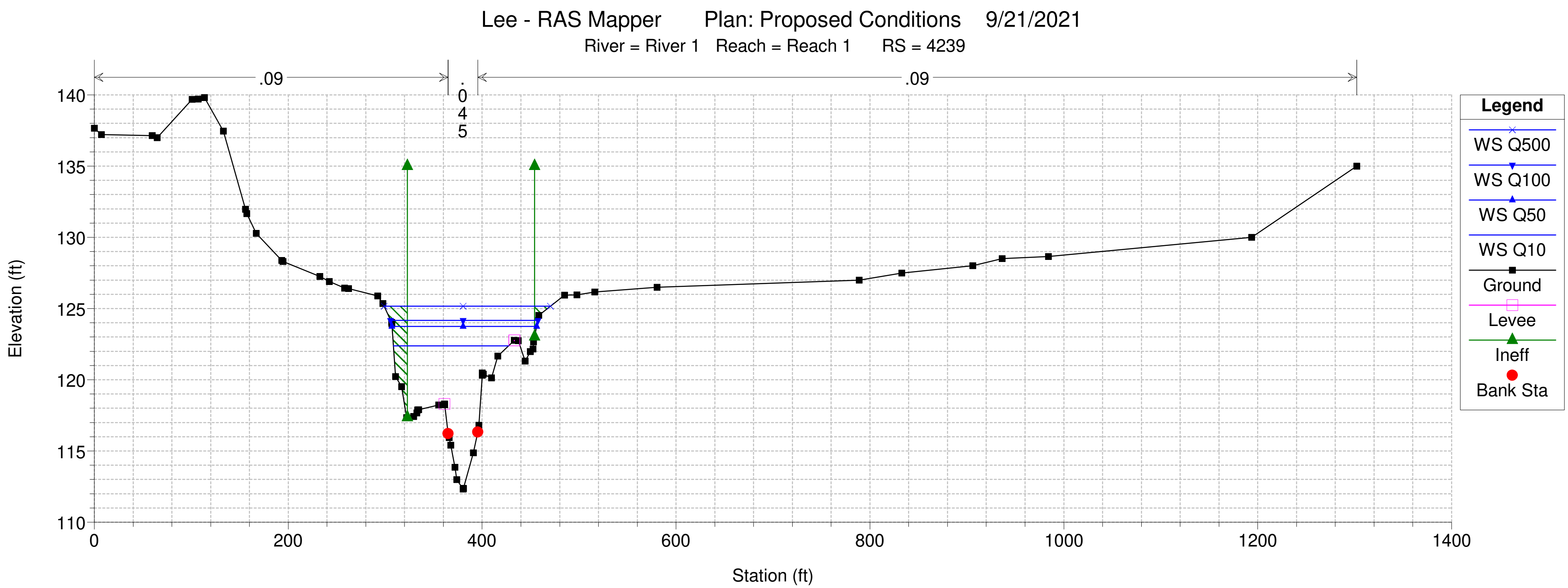
Lee - RAS Mapper Plan: Proposed Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4473
.09
.045
.09
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta


Lee - RAS Mapper Plan: Proposed Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4383
.09
.045
.09
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Ineff
Bank Sta

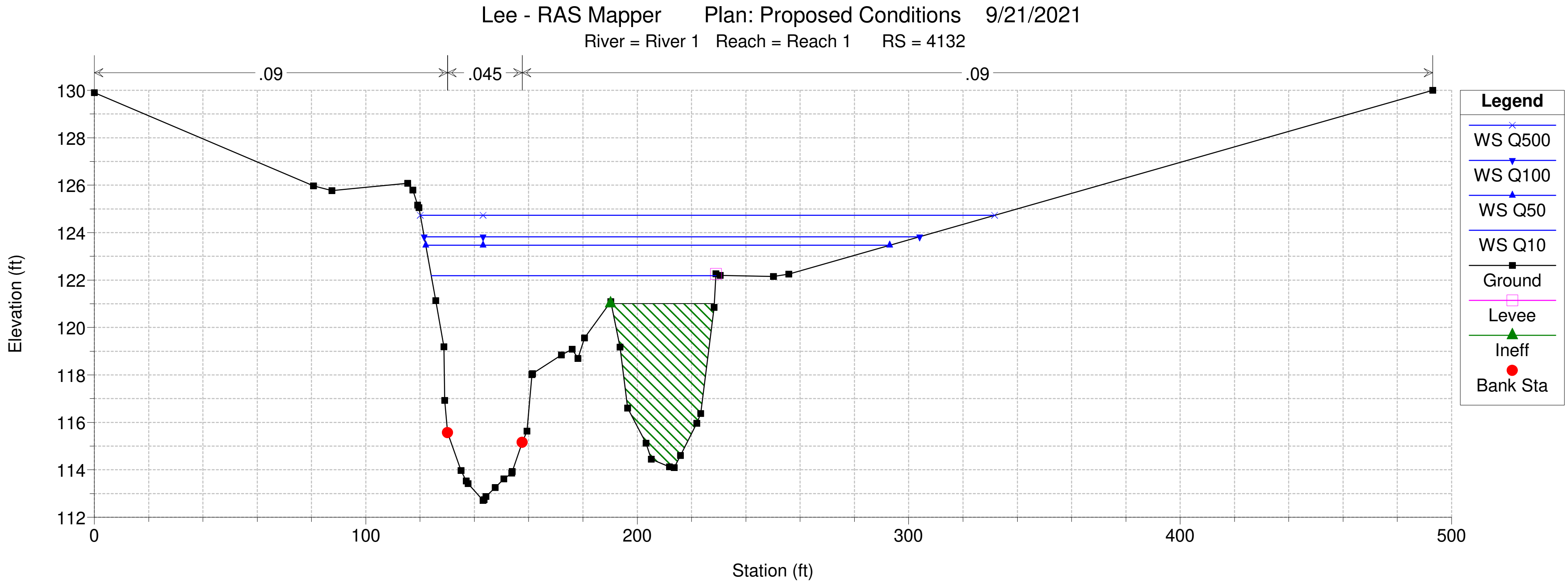

Lee - RAS Mapper Plan: Proposed Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4315 BR
.09
.045
.09
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Ineff
Bank Sta

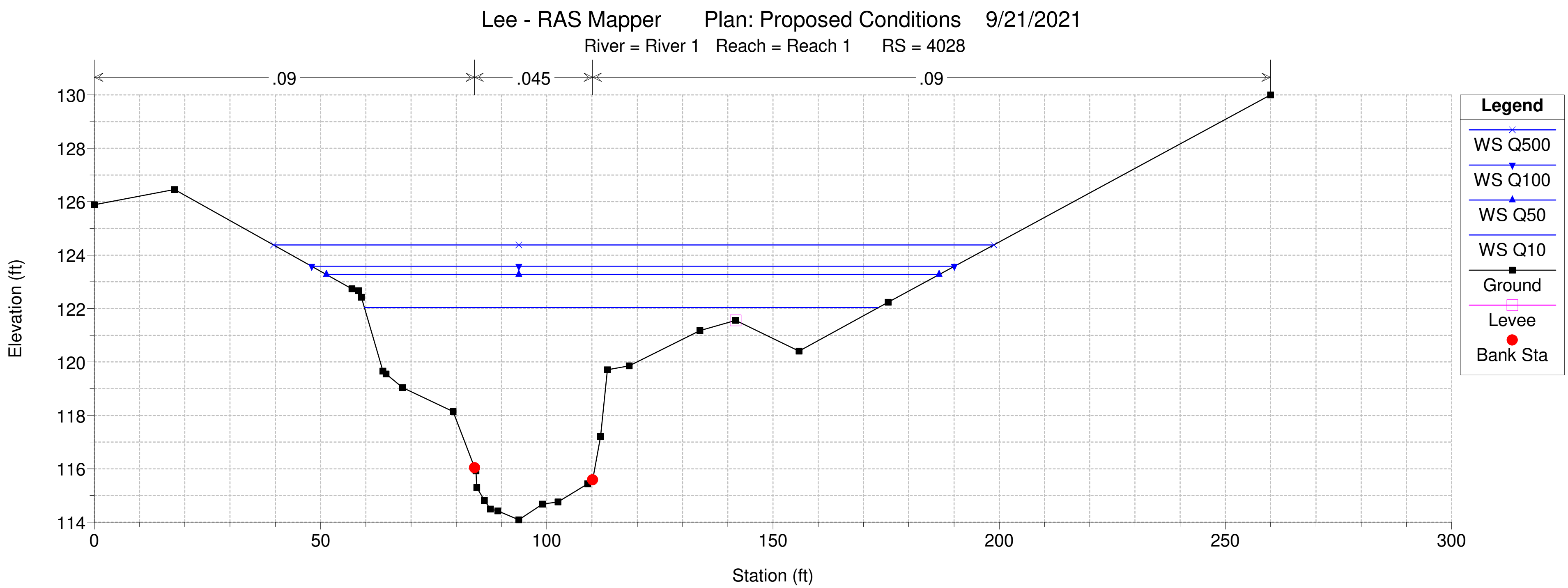


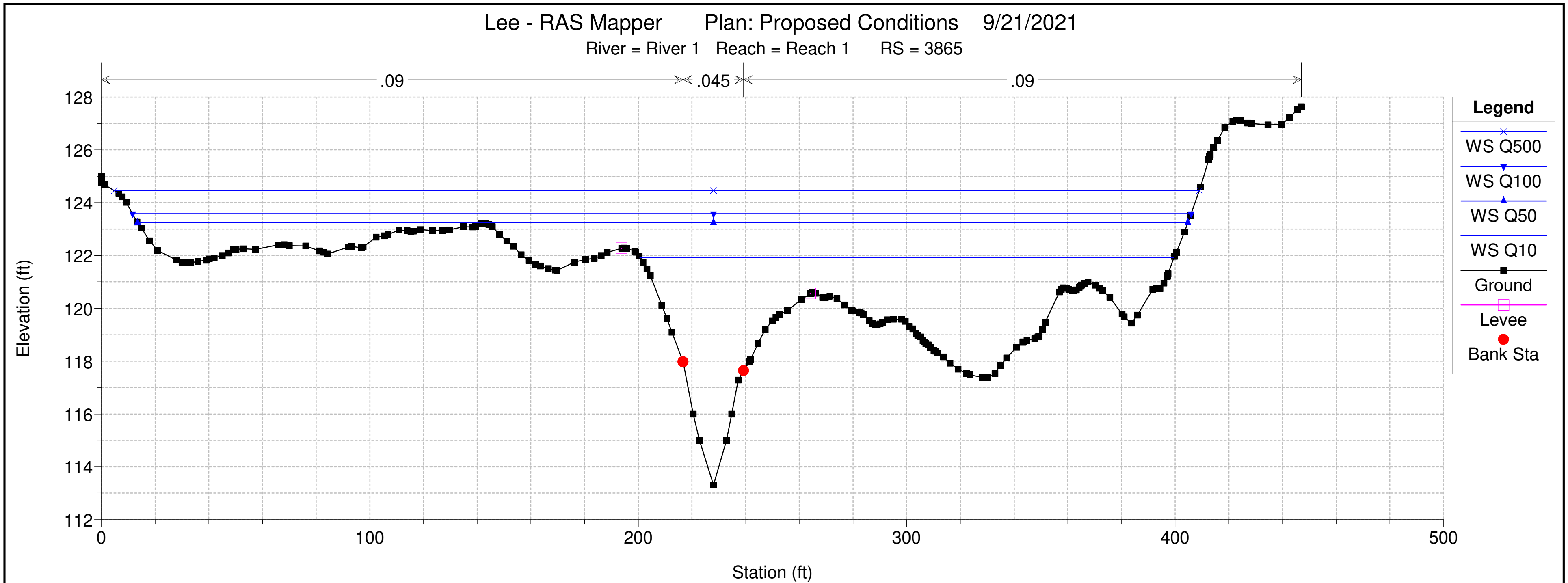
Lee - RAS Mapper Plan: Proposed Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4315 BR
.09
.045
.09
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
Station (ft)



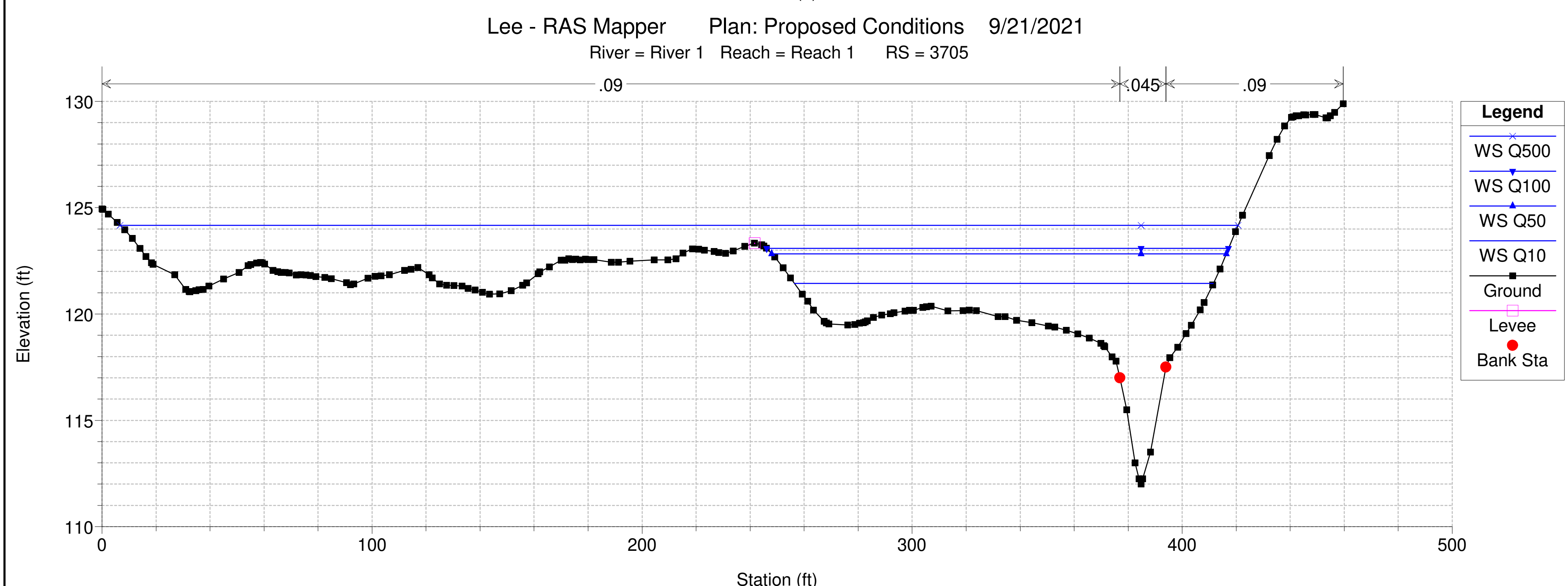
Lee - RAS Mapper Plan: Proposed Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4239
.09
.045
.09
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Lee - RAS Mapper Plan: Proposed Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4132
.09
.045
.09
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Ineff
Bank Sta

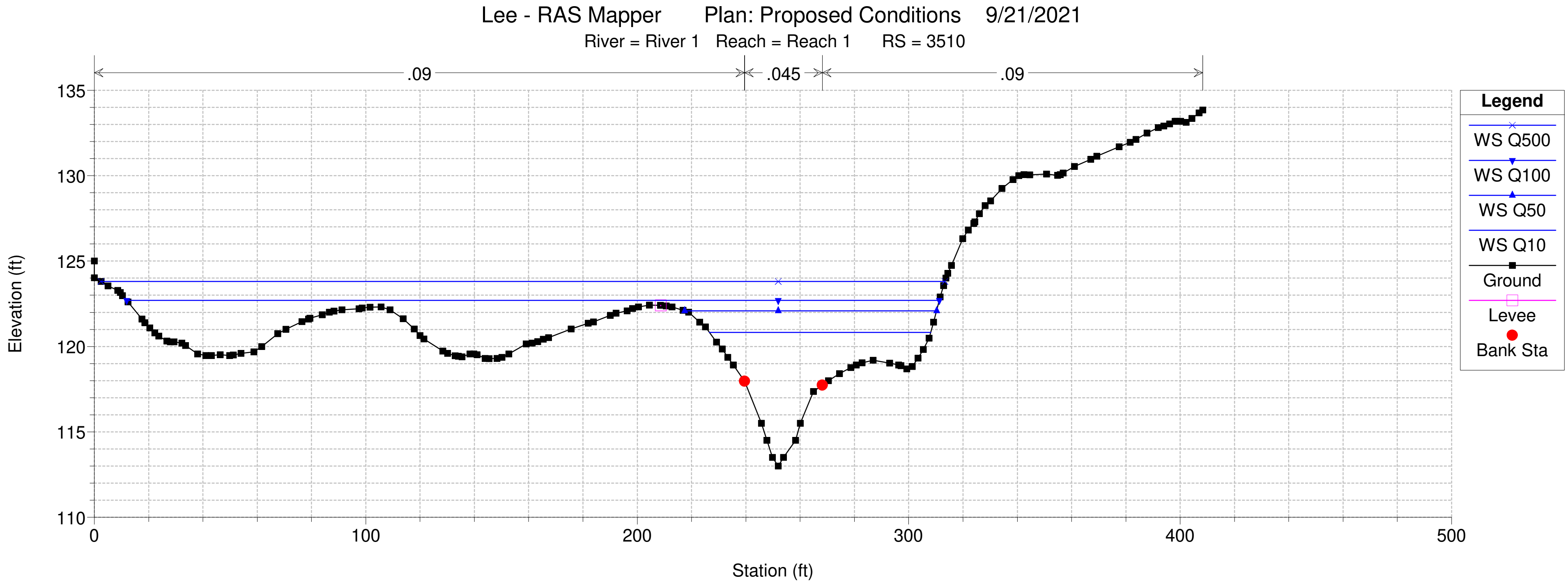

Lee - RAS Mapper Plan: Proposed Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 4028
.09
.045
.09
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta

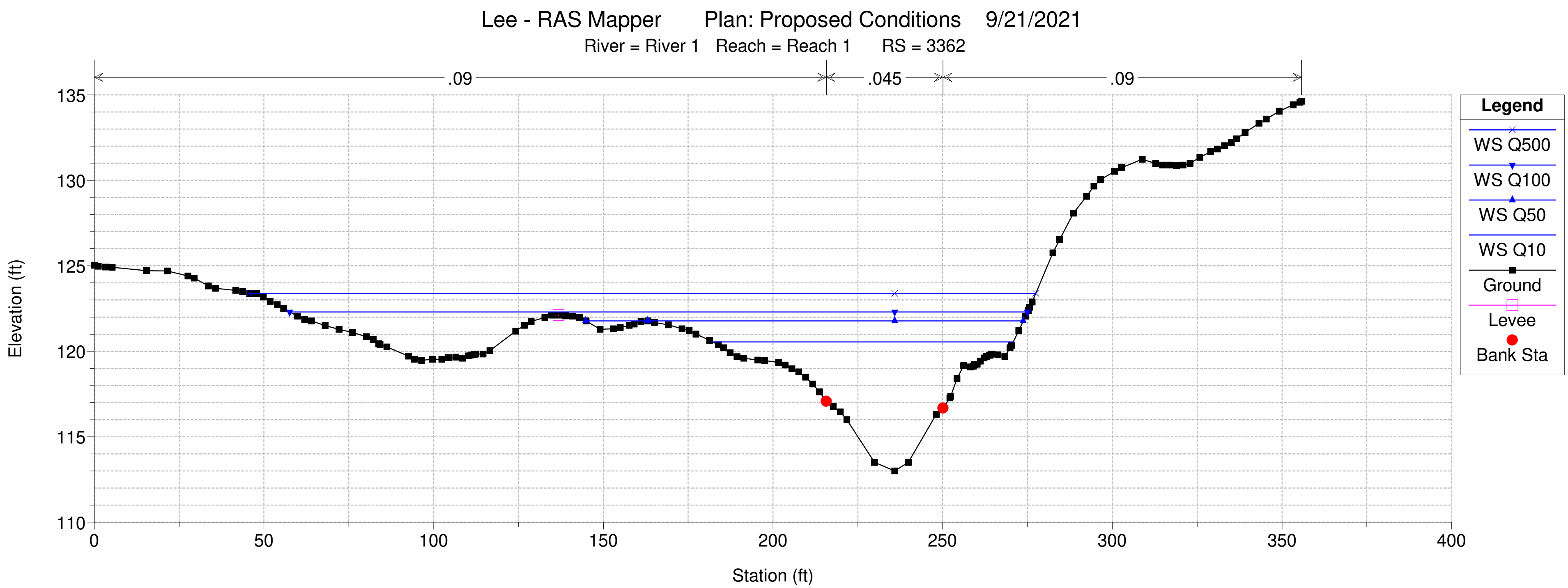


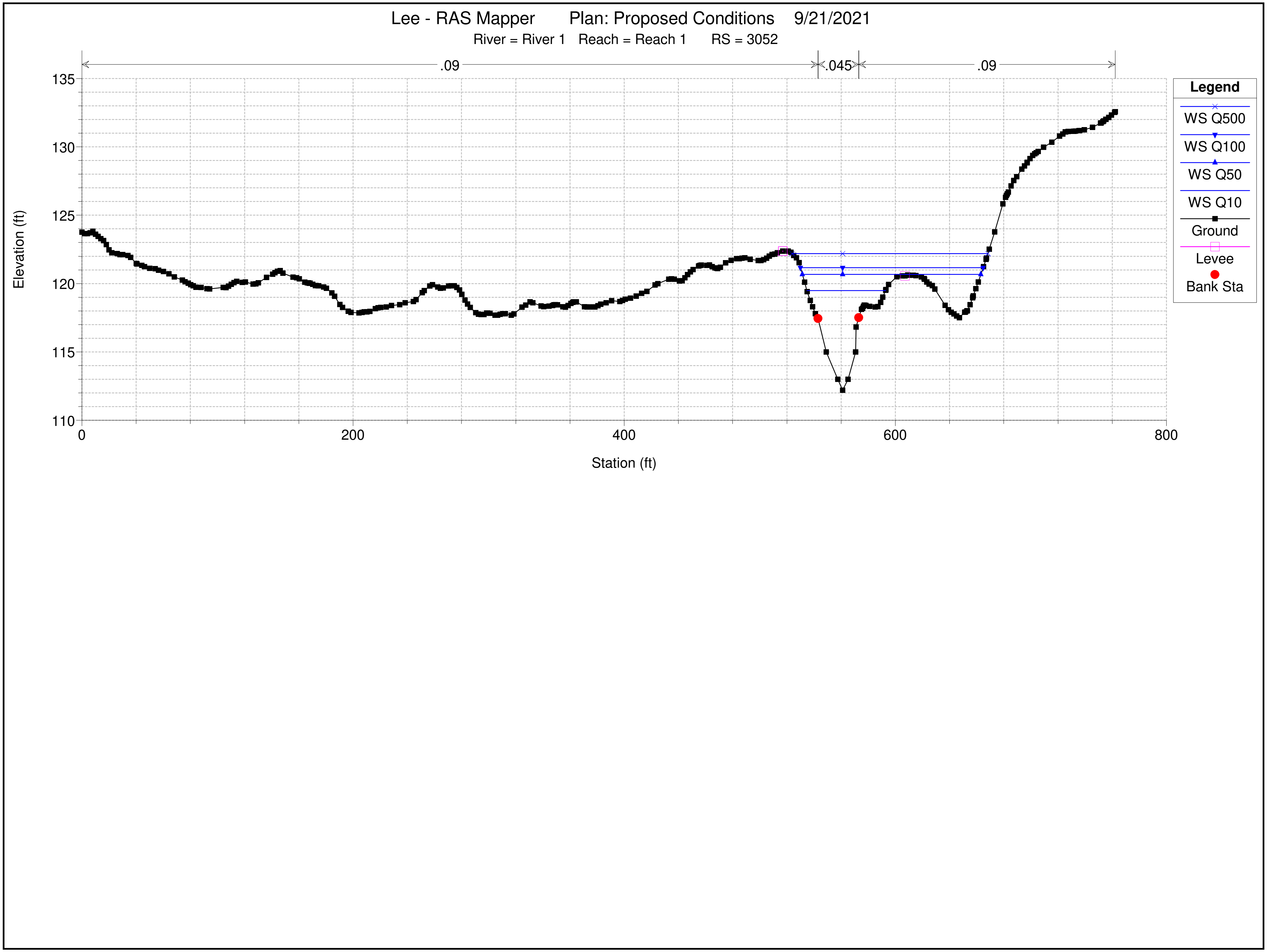
Lee - RAS Mapper Plan: Proposed Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 3865
.09
.045
.09
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta



Lee - RAS Mapper Plan: Proposed Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 3705
.09
.045
.09
Elevation (ft)
Station (ft)
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta


Lee - RAS Mapper Plan: Proposed Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 3510
.09
.045
.09
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta
Elevation (ft)
135
130
125
120
115
110
0
100
200
300
400
500
Station (ft)


Lee - RAS Mapper Plan: Proposed Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 3362
.09
.045
.09
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta
Elevation (ft)
135
130
125
120
115
110
0
50
100
150
200
250
300
350
400
Station (ft)


Lee - RAS Mapper Plan: Proposed Conditions 9/21/2021
River = River 1 Reach = Reach 1 RS = 3052
.09
.045
.09
Legend
WS Q500
WS Q100
WS Q50
WS Q10
Ground
Levee
Bank Sta
Elevation (ft)
Station (ft)
135
130
125
120
115
110
0
200
400
600
800

APPENDIX F

SCOUR CALCULATIONS & COUNTERMEASURE DESIGN

D50 Estimates for Scour Analysis

Field Analysis Results			
Substrate Material	**Use Size (Percent Finer)**	**Percentage of Total**	**Cumulative Percent Finer**
Silt/Clay (<0.002")	**0.002**	5.0%	5.0%
Sand (0.002" - 0.08")	**0.08**	80.0%	80.0%
Gravel (0.08"-2.5")	**1**	10.0%	90.0%
Cobble (2.51"-10")	**7.5**	5.0%	95.0%

Calculate D50 & D95 Using Line of Best Fit

x = e^[(y-0.8586)/0.1092]

D50 = 0.037 inches
D50 = 0.952053917 mm

D95 = 2.309 inches
D95 = 58.65926367 mm

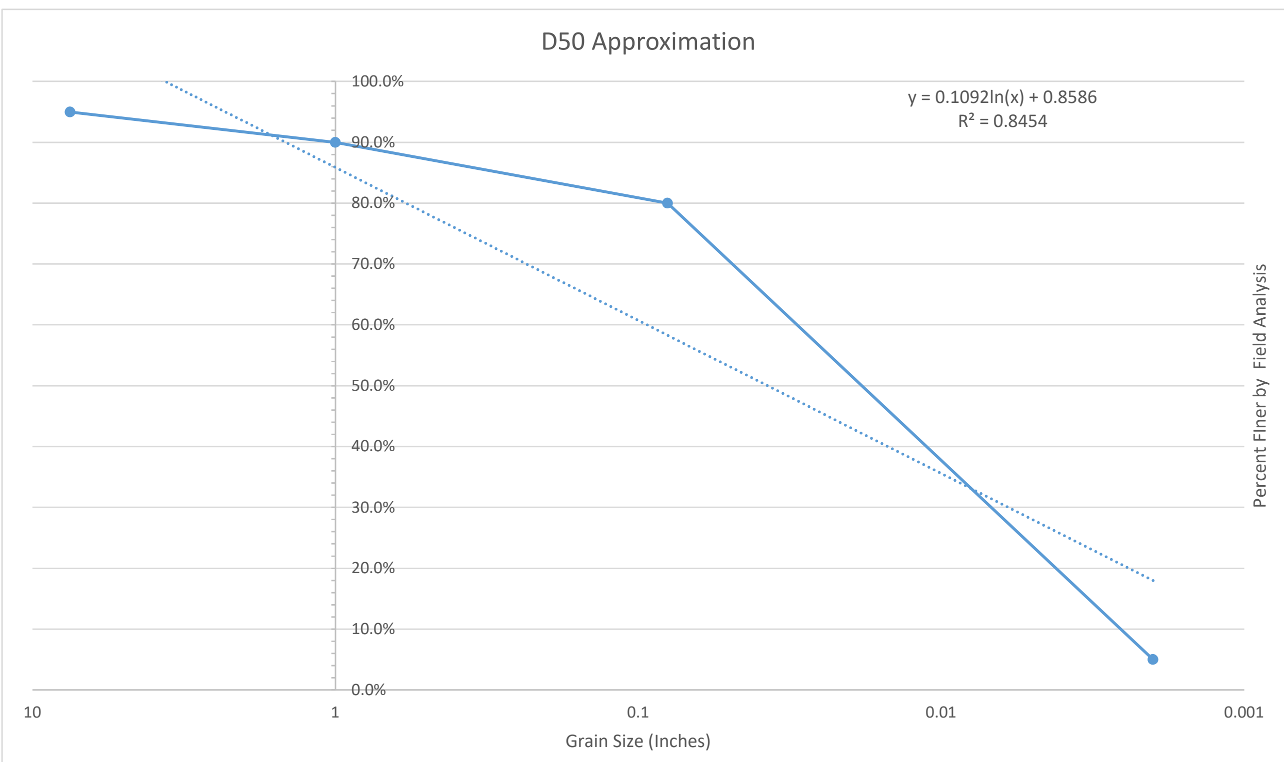
To help eliminate small particle bias, reduce D50 by the amount of data scatter (R^2).

D50 = 0.807912954 mm

SAY D50 =	**0.8**	**mm**

D95 = 49.77825115 mm

SAY D95 =	**49**	**mm**



Q100 Scour

Little River at NH Route 125 Crossing
Lee, NH

Contraction Scour

	Left	Channel	Right
Input Data			
Average Depth (ft):	2.63	8.52	1.85
Approach Velocity (ft/s):	1.20	5.27	0.93
Br Average Depth (ft):	3.22	8.06	3.35
BR Opening Flow (cfs):	101.15	1560.42	118.43
BR Top WD (ft):	11.06	35.08	12.05
Grain Size D50 (mm):	0.80	0.80	0.80
Approach Flow (cfs):	159.31	1570.29	50.40
Approach Top WD (ft):	50.52	34.96	29.40
K1 Coefficient:	0.640	0.640	0.640
Results			
Scour Depth Ys (ft):	1.03	0.40	1.17
Critical Velocity (ft/s):	1.81	2.21	1.71
Equation:	Clear	Live	Clear

Use Design Scour Depth = 1.5 feet
(max scour, rounded up to nearest 6 inches)

Q500 Scour

Little River at NH Route 125 Crossing
Lee, NH

Contraction Scour

		Left	Channel	Right
Input Data				
	Average Depth (ft):	3.08	9.68	2.35
	Approach Velocity (ft/s):	1.43	6.14	1.18
	Br Average Depth (ft):	3.77	9.07	3.92
	BR Opening Flow (cfs):	166.72	2120.41	192.88
	BR Top WD (ft):	12.59	35.08	13.58
	Grain Size D50 (mm):	0.80	0.80	0.80
	Approach Flow (cfs):	285.28	2077.87	116.86
	Approach Top WD (ft):	64.93	34.96	42.25
	K1 Coefficient:	0.640	0.640	0.640
Results				
	Scour Depth Ys (ft):	2.07	0.76	2.28
	Critical Velocity (ft/s):	1.86	2.26	1.78
	Equation:	Clear	Live	Clear

Use Design Scour Depth = 2.5 feet
(max scour, rounded up to nearest 6 inches)

RIPRAP DESIGN - ABUTMENTS
SCOUR COUNTERMEASURES
ABUTMENT A & ABUTMENT B

Calculations based on HEC-23 Design Guide 14 ROCK RIPRAP AT BRIDGE ABUTMENTS

DEFINITION OF TERMS

D_{50} = MEDIAN STONE DIAMETER, ft
V = CHARACTERISTIC AVERAGE VELOCITY IN THE CONTRACTED SECTION
Sg = 2.65 = SPECIFIC GRAVITY OF ROCK RIPRAP
g = GRAVITATIONAL ACCELERATION = 32.2 ft/sec^2
y = DEPTH OF FLOW IN THE CONTRACTED BRIDGE OPENING
(depth measured in front of abutment)

FORMULAE

Fr = **V/(gy)^0.5** FROUDE NUMBER

D_{50}/y = **K/(Sg-1)*(V^2/gy)** USE THIS WHEN FROUDE NUMBER IS <= 0.80
K = 1.02 FOR A VERTICAL WALL ABUTMENT
0.89 FOR A SPILL -THROUGH ABUTMENT

D_{50}/y = **K/(Sg-1)*(V^2/gy)^0.14** USE THIS WHEN FROUDE NUMBER IS > 0.80
K = 0.69 FOR A VERTICAL WALL ABUTMENT
0.61 FOR A SPILL -THROUGH ABUTMENT

SBR = SET-BACK LENGTH/AVERAGE CHANNEL FLOW DEPTH

SETBACK LENGTH IS THE DISTANCE FROM THE NEAR EDGE OF THE MAIN CHANNEL TO THE TOE OF THE ABUTMENT

SET-BACK RATIO (SBR)

SETBACK LENGTH = 11.96 ft
AVERAGE DEPTH = 4.76 ft (@ Q100)

SBR = 2.51 **SBR < 5.0**

SINCE SBR IS LESS THAN 5, V=Q/A

McFARLAND-JOHNSON, INC.
53 Regional Drive
Concord, New Hampshire 03301-8500

JOB: **NH Route 125 over Little River, Lee, NH**
SHEET NO.: OF
BY: **TEPA** DATE: **9/21/2021**
CHECKED: DATE:

M:\18283.06 Lee 41322 - TSL\Design\H&H\05 Scour\[RipRap Lee.xlsx]Rip-Rap Abutment

RIPRAP DESIGN - ABUTMENTS
SCOUR COUNTERMEASURES
ABUTMENT A & ABUTMENT B

RIPRAP SIZE CALCULATION

SECTION	Q (cfs)		A (sf)	V (ft/sec)	WSEL (ft)	y (ft)	Fr	Median Stone Size D_{50} (feet)	Average Flow Depth at Abutment
Bridge (Upstream)	947	10	258.31	3.67	122.45	2.17	0.44	0.26	N/A
	1490	50	333.72	4.46	123.83	2.97	0.46	0.38	N/A
	1780	100	358.64	4.96	124.26	3.22	0.49	0.47	N/A
	2480	500	418.69	5.92	125.26	3.77	0.54	0.67	N/A
Bridge (Downstream)	947	10	269.48	3.51	122.39	2.81	0.37	0.24	N/A
	1490	50	342.66	4.35	123.75	3.60	0.40	0.36	N/A
	1780	100	370.23	4.81	124.17	3.83	0.43	0.44	N/A
	2480	500	429.76	5.77	125.16	4.38	0.49	0.64	N/A

Maximum 500-Year D50 (feet) = 0.67

Average Channel Elevation Adjacent to Abutment

Maximum 100-Year D50 (feet) = 0.47

Upstream	0.0
Downstream	0.0

*WSEL does not reach exposed abutment.

NHDOT Riprap D_{50}

Riprap	D_{50} (inches)	D_{50} (feet)	Min. Layer Depth 1.5x D50(feet)
Riprap, Class I	5	0.42	0.625
Riprap, Class III	11	0.92	1.375
Riprap, Class V	17	1.42	2.125
Riprap, Class VII	23	1.92	2.875
Riprap, Class IX	35	2.92	4.375

*Riprap D50 sizes are the minimum allowed by FHWA FP 14, Table 705-1
Riprap sizes above are the allowable options per NHDOT specifications, Table 583-1

Conclusion: Riprap, Class III, with a minimum layer thickness of 1.375 feet is acceptable for both Abutment A and Abutment B. Construction shall be in accordance with NHDOT Standards.

Bank/Shoreline Stabilization Worksheet

BANK/SHORELINE STABILIZATION PROJECT-SPECIFIC WORKSHEET FOR STANDARD APPLICATION

Water Division/Land Resources Management

Wetlands Bureau

Check the Status of your Application

RSA/Rule: RSA 482/ Env-Wt 514

APPLICANT LAST NAME, FIRST NAME, M.I.: NHDOT

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

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

SECTION 1 - APPROVAL CRITERIA (Env-Wt 514.02)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

☒ A narrative and photos that:

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

  The ripirian area of the Little River within the project area is mixed forest.

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

  Despite the past channel realignment and constriction created by the existing stream crossing, the channel appears both laterally and vertically stable. No indications of active bank erosion, bed degradation, or bed aggradation were observed.

  A large scour pool is located immediately below the outlet of the existing crossing. It is unclear whether this pool was excavated when the channel was realigned, if it formed as a result of high exit velocities, or a combination of these. Regardless, high exit velocities have maintained the pool and prevented it from filling with sediment. Based on the NHDOT channel bottom survey and water level measurements, the flow depth in this pool at the time of the stream assessment was about 10 feet, which is over twice the maximum flow depth measured at any point in the unaltered channel.

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

  The proposed channel and bank restoration follows principals of the Guidelines for Naturalized River Channel Design and Bank Stabilization and was designed by qualified Professional Engineers and fluvial geomorphologists.

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

  The proposed project will result in improved geomorphic compatibility, hydraulic capacity, terrestrial wildlife passage, and aquatic organism passage (simulated streambed material, reduced water velocities through the structure). The proposed design incorporates bio-engineering methods of bank stabilization (root wads, fabric encapsulated soil lifts, and plantings).

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

  See enclosed hydraulic report

A cross-section plan that shows:

☒ The difference in elevation between the lowest point of the bank/shoreline slope to be impacted by the construction and the highest point of the bank/shoreline slope to be impacted.

☒ The linear distance across the proposed project area as measured along a straight line between the highest and lowest point of the bank/shoreline slope to be impacted.

☐ The existing and proposed slope of the bank/shoreline.

☒ The normal high water line or ordinary high water mark, as applicable.

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

☒ Designation of minimum and maximum stone size.

☒ Gradation.

☒ Minimum rip-rap thickness.

☒ Type of bedding for stone.

☐ Cross-section and plan views of the proposed installation.

☒ A description of anticipated turbulence, flows, restricted space, or similar factors that would render vegetation and bioengineering stabilization methods physically impracticable.

☒ Engineering plans for rip-rap in excess of 100 linear feet along the bank or bed of a stream or river, including in-stream revetments, stamped by a professional engineer.

☒ If the project proposes rip-rap adjacent to great ponds or other surface waters where the state holds fee simple ownership to the bed, a stamped surveyed plan showing the location of the normal high water line and the footprint of the proposed project.

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

☒ Cross-section and plan views of the proposed installation and sufficient plans to clearly indicate the relationship of the project to fixed points of reference, abutting properties, and features of the natural shoreline.

☒ If the application is for a wall adjacent to a great pond or other surface water where the state holds fee simple ownership to the bed, a surveyed plan, stamped by a licensed land surveyor, showing the location of the normal high water line and the footprint of the proposed project.

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

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

☒ Incorporate stormwater diversion and retention to minimize erosion.

☒ Retain natural vegetation to the maximum extent possible.

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

☒ Avoid and minimize impacts to adjacent properties and infrastructure.

☒ Avoid and minimize impacts to water quality.

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

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

☒ For bioengineering projects, be in accordance with NEH 654, Technical Supplement 141, Streambank Soil Bioengineering, dated August 2007, USDA NRCS.

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

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

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

☒ Materials used to emulate a natural channel bottom must:

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

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

☒ Bank/shoreline stabilization areas must:

(1) Have at least 75% successful establishment of vegetation after two growing seasons, or
(2) Be replanted and re-established until a functional lacustrine, wetland, or riparian system has been reestablished in accordance with the approved plans.

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

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

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

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

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

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

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

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

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

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

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

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

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

Refer to Env-Wt 514.07 for project classification.

NH NHB DataCheck Results Letter

NHB DataCheck Results Letter
NH Natural Heritage Bureau
Please note: maps and NHB record pages are **confidential** and shall be redacted from public documents.

To: Christine Perron, McFarland Johnson
53 Regional Drive
Concord, NH 03301
cperron@mjinc.com

From: NHB Review
NH Natural Heritage Bureau
Main Contact: Ashley Litwinenko - nhbreview@dncr.nh.gov

cc: NHFG Review

Date: 02/20/2024 (valid until 02/20/2025)
Re: DataCheck Review by NH Natural Heritage Bureau and NH Fish & Game
Permits: NHDES - Wetland Standard Dredge & Fill - Major, USACE - General Permit, USEPA - Stormwater Pollution Prevention

NHB ID: NHB24-0428

Town: Lee
Location: NH Route 125

Project Description: This submittal is a renewal of NHB22-0931. The proposed NHDOT Lee 41322 project involves the replacement of Bridge No. 073/084 carrying NH Rte. 125 over the Little River, in Lee, NH. The existing crossing structure consists of an 18'x12' corrugated metal pipe (CMP). The proposed project will replace the deteriorating, undersized pipe with a 90'-0" single span bridge. The proposed project will also realign a portion of the stream channel through the new bridge, provide simulated streambed material, and wildlife shelves to accommodate terrestrial wildlife passage. Rare plant surveys for American featherfoil, tufted yellow loosestrife, and small whorled pogonia have been completed and no rare plants were identified.

Next Steps for Applicant:

NHB's database has been searched for records of rare species and exemplary natural communities. Please carefully read the comments and consultation requirements below.

NHB Comments: Surveys were completed in 2020 for tufted yellow-loosestrife (Lysimachia thyrsiflora), and in both 2020 and 2022 surveys occured for American featherfoil (Hottonia inflata) and small whorled pogonia (Isotria medeoloides). None of these species were found in the proposed impact areas during these surveys. Please contact NHB to confirm if all proposed impact areas containing suitable habitat were previously surveyed.

NHFG Comments: Please refer to NHFG consultation requirements below.

NHB Consultation

If this NHB DataCheck letter includes records of rare plants and/or natural communities/systems, please contact NHB and provide any requested supplementary materials by emailing nhbreview@dncr.nh.gov.

If this NHB DataCheck letter DOES NOT include any records of rare plants and/or natural communities/systems, no further consultation with NHB is required.

NH Fish and Game Department Consultation

If this NHB DataCheck letter DOES NOT include ANY wildlife species records, then, based on the information submitted, no further consultation with the NH Fish and Game Department pursuant to Fis 1004 is required.

If this NHB DataCheck letter includes a record for a threatened (T) or endangered (E) wildlife species, consultation with the New Hampshire Fish and Game Department under Fis 1004 may be required. To review the Fis 1000 rules (effective February 3, 2022), please go to https://www.wildlife.nh.gov/wildlife-and-habitat/nongame-and-endangered-species/environmental-review. All requests for consultation and submittals should be sent via email to NHFGreview@wildlife.nh.gov or can be sent by mail, and **must include the NHB DataCheck results letter number and "Fis 1004 consultation request" in the subject line**.

If the NHB DataCheck response letter does not include a threatened or endangered wildlife species but includes other wildlife species (e.g., Species of Special Concern), consultation under Fis 1004 is not required; however, some species are protected under other state laws or rules, so coordination with NH Fish & Game is highly recommended or may be required for certain permits. While some permitting processes are exempt from required consultation under Fis 1004 (e.g., *statutory permit by notification, permit by rule, permit by notification, routine roadway registration, docking structure registration, or conditional authorization by rule*), coordination with NH Fish & Game may still be required under the rules governing those specific permitting processes, and it is recommended you contact the applicable permitting agency. For projects not requiring consultation under Fis 1004, but where additional coordination with NH Fish and Game is requested, please email NHFGreview@wildlife.nh.gov, and include the NHB DataCheck results letter number and "review request" in the email subject line.
Contact NH Fish & Game at (603) 271-0467 with questions.

NHB Database Records:

The following record(s) have been documented in the vicinity of the proposed project.
Please see the map and detailed information about the record(s) on the following pages.

Plant species	State[1]	Federal	Notes
American featherfoil (*Hottonia inflata*)*	E	--	Threats this species inare mainly herbicide.
tufted yellow-loosestrife (*Lysimachia thyrsiflora*)*	T	--	As a resident of peatlands, this species is susceptible to any changes to the wetland's hydrology (especially that which causes pooling), increased nutrient input from stormwater runoff, and sedimentation from nearby disturbances.

Vertebrate species	State[1]	Federal	Notes
American Eel (*Anguilla rostrata*)	SC	--	Contact the NH Fish & Game Dept (see above).
Blanding's Turtle (*Emydoidea blandingii*)	E	--	Contact the NH Fish & Game Dept (see below).
Spotted Turtle (*Clemmys guttata*)	T	--	Contact the NH Fish & Game Dept (see below).

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

For all animal reviews, refer to 'IMPORTANT: NHFG Consultation' section above.

Disclaimer: NHB's database can only tell you of known occurrences that have been reported to NHFG/NHB. Known occurrences are based on information gathered by qualified biologists or members of the public, reported to our offices, and verified by NHB/NHFG.
However, many areas have never been surveyed, or have only been surveyed for certain species.
NHB recommends surveys to determine what species/natural communities are present onsite.

NHB & NHFG Correspondence

Christine J. Perron

From: DNCR: NHB Review <nhbreview@dncr.nh.gov>
Sent: Friday, July 15, 2022 9:59 AM
To: Christine J. Perron
Cc: Stephen Hoffmann
Subject: RE: NHDOT Project - Lee 41322 (NHB20-0931)

Hi Christine,

Thanks to everyone who worked to verify that no rare plant species are in the project impact areas. I'll save this information in the project folder.

Jessica Bouchard (she/her/hers)
Ecologist
New Hampshire Natural Heritage Bureau (NHB)
Division of Forests & Lands
NH Dept. of Natural & Cultural Resources
172 Pembroke Rd
Concord, NH 03301
(603) 568-1804 (cell)

[NHB DataCheck Tool]

From: Christine J. Perron <CPerron@mjinc.com>
Sent: Tuesday, July 12, 2022 12:12 PM
To: DNCR: NHB Review <nhbreview@dncr.nh.gov>
Cc: Stephen Hoffmann <SHoffmann@mjinc.com>
Subject: NHDOT Project - Lee 41322 (NHB20-0931)

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

Good afternoon,

I am writing to follow up on the comments received below and at the December 15, 2021 NHDOT Natural Resource Agency Meeting (https://www.nh.gov/dot/org/projectdevelopment/environment/units/project-management/documents/December152021FinalNRAMminutes.pdf)

McFarland Johnson staff completed a survey for American featherfoil on May 12, 2022 and for small whorled pogonia on July 6, 2022 within the areas shown on the attached figure.. Neither species was identified in the survey areas.

Please let me know if you need any additional information or have any further concerns.
Thanks,
Christine

McFarland Johnson

Christine J. Perron, CWS | Regional Environmental Manager
603-225-2978
Visit our website to see how MJ employee owners are innovating to improve our world.

From: Lamb, Amy <Amy.E.Lamb@dncr.nh.gov>
Sent: Wednesday, September 9, 2020 1:54 PM
To: Christine J. Perron <CPerron@mjinc.com>
Cc: Stephen Hoffmann <shoffmann@mjinc.com>
Subject: RE: Lee 41322 NHB20-0931

Hi Christine,

Thank you for completing the survey for American featherfoil (*Hottonia inflata*), tufted yellow-loosestrife (*Lysimachia thyrsiflora*), and small whorled pogonia (*Isotria medeoloides*) at the Lee 41322 project site (NHB20-0931) on August 27, 2020. My comments for each species are as follows.

American featherfoil
This species typically occurs in slow-moving waters of streams and rivers (often forested riparian areas), as well as swamps, marshes, ponds, and beaver-influenced wetlands in New Hampshire. There is a documented occurrence of this species upstream from the project site, where a brook intersects with the Little River.

This species was not observed within the project area. Please note that this species tends to senesce earlier in the year (as early as the first week in July). **If you will be onsite next year (spring 2021, late May-June), keep an eye out for this species in wetland impact areas matching the habitats described above and please contact me as soon as possible if you see it.**

Tufted yellow-loosestrife
This species occurs in marshes, forested swamps, edges of fens, and wetlands flanking streams in New Hampshire. There is a nearby record of this species in Little River Marsh. I would expect tufted yellow-loosestrife to still be identifiable in late August. Since this species was not observed during surveys, **NHB does not have further concerns about tufted yellow-loosestrife.**

Small whorled pogonia
In NH, this species occurs in mixed hardwood-conifer forests, in areas with open understories, a thick duff layer, on gentle, generally south-facing slopes (slope direction ranges from east to south to west), often in association with ephemeral drainages underlain by hardpan. There appears to be limited habitat for this species within the project area, but areas 5, 6, and 8 from the survey area map showed habitat potential. These areas roughly coincide with a Species Distribution Model model developed by NatureServe that approximates the range-wide habitat for this species (NatureServe, 2018). However, if there will be no impacts to these areas, then NHB would not have concerns about potential impacts to the species. **If the project should change to include impacts in areas 5, 6, or 8, contact NHB.** 2020 has been a dry year, which could affect growth of the species (some years, this orchid does not put up above-ground shoots).

Please contact me with any questions.

Thank you,
Amy

Amy Lamb
Ecological Information Specialist
(603) 892-5162 – work cell
amy.lamb@dncr.nh.gov

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

NHB DataCheck Tool

From: Christine J. Perron <CPerron@mjinc.com>
Sent: Wednesday, September 02, 2020 4:13 PM
To: Lamb, Amy <Amy.Lamb@dncr.nh.gov>
Cc: Stephen Hoffmann <shoffmann@mjinc.com>
Subject: Lee 41322 NHB20-0931

Hi Amy,

A survey was completed for tufted yellow loosestrife and featherfoil on August 27, 2020. We also checked for potential small whorled pogonia habitat. A map of the surveyed area is attached along with photos.

I know that you had asked that the survey for loosestrife be done in June when it would be flowering. I apologize that we delayed the survey as long as we did. Is it safe to assume that the stems and leaves would still be visible in August? The leaves and stem are pretty distinctive and there were no wetland plants observed with opposite leaves that could not be identified as other species. However, if you think it was too late for the plant to present, I can make sure that another survey is done in next June.

Featherfoil was not identified during the survey.

There were some areas of potentially suitable habitat for small whorled pogonia within the areas labeled as 5, 6, and 8 on the attached figure. Impacts to the areas where this habitat occurs are not anticipated.

Let me know if you need any additional information.
Thanks Amy!
Christine

Christine Perron, CWS
Project Manager • Senior Environmental Analyst
McFarland Johnson
53 Regional Drive • Concord, NH 03301
OFFICE: 603-225-2978 ext. 1280
www.mjinc.com

From: Lamb, Amy <Amy.Lamb@dncr.nh.gov>
Sent: Wednesday, April 3, 2019 11:32 AM
To: Stephen Hoffmann <shoffmann@mjinc.com>
Subject: RE: NHB review: NHB19-0856

Hi Steve,

Thanks for sending these photos so quickly. Generally, tufted yellow loosestrife (*Lysimachia thyrsiflora*) occurs in marshes, forested swamps, edges of fens, and wetlands flanking streams in New Hampshire. Overall, the photos depict limited habitat at this site, but there is a small patch of marsh vegetation downstream of the culvert (left side when facing downstream). See photos 5, 6, and 7. While the habitat is not ideal here, you could do a spot check for the plant in June if you are out in the field at that time. It has fairly distinctive flowers and should be readily identifiable in mid-June.

Best,
Amy

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

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

From: Stephen Hoffmann [mailto:shoffmann@mjinc.com]
Sent: Wednesday, April 03, 2019 9:17 AM
To: Lamb, Amy
Cc: Tuttle, Kim
Subject: RE: NHB review: NHB19-0856

Good Morning Amy and Kim,

Amy, please find the attached site photos of the existing crossing of NH Route 125 over the Little River per your request. As I previously mentioned in the description, the project is still in the preliminary design phase but the existing metal corrugated pipe will be replaced with a bridge structure compliant with the NH stream crossing guidelines. The exact areas of impacts have not been determined at this time, so I included general photos of the entire area.

Kim, please let me know if you have any concerns regarding the proposed project as it relates to American eel, Blanding's turtle, or any other fish or wildlife species. Let me know if you have any questions or require any additional information.

Thanks,
Steve

From: Lamb, Amy <Amy.Lamb@dncr.nh.gov>
Sent: Tuesday, April 2, 2019 11:54 AM
To: Stephen Hoffmann <shoffmann@mjinc.com>

Cc: Tuttle, Kim <Kim.Tuttle@wildlife.nh.gov>
Subject: NHB review: NHB19-0856

Attached, please find the review we have completed. If your review memo includes potential impacts to plants or natural communities please contact me for further information. If your project had potential impacts to wildlife, please contact NH Fish and Game at the phone number listed on the review.

Best,
Amy

Amy Lamb
Ecological Information Specialist

NH Natural Heritage Bureau
DNCR - Forests & Lands
172 Pembroke Rd
Concord, NH 03301
603-271-2834

Christine J. Perron

From:	Magee, John <john.a.magee@wildlife.nh.gov>
Sent:	Thursday, January 12, 2023 11:14 AM
To:	Stephen Hoffmann
Cc:	Dionne, Michael
Subject:	RE: NHDOT Lee 41322 Little River Cold Water Fishery Question

Hi Steve. I checked our fish survey database, and the Little River there does not have wild brook trout. It has a warm water fish community.

John

John Magee (he/him/his)
M.S., Certified Fisheries Professional
Fisheries Habitat Research and Management Programs Coordinator
New Hampshire Fish and Game Department
11 Hazen Drive, Concord, NH 03301
Phone 603-271-2744
Fax 603-271-5829

From: Stephen Hoffmann <SHoffmann@mjinc.com>
Sent: Thursday, January 12, 2023 10:11 AM
To: Magee, John <john.a.magee@wildlife.nh.gov>
Subject: NHDOT Lee 41322 Little River Cold Water Fishery Question

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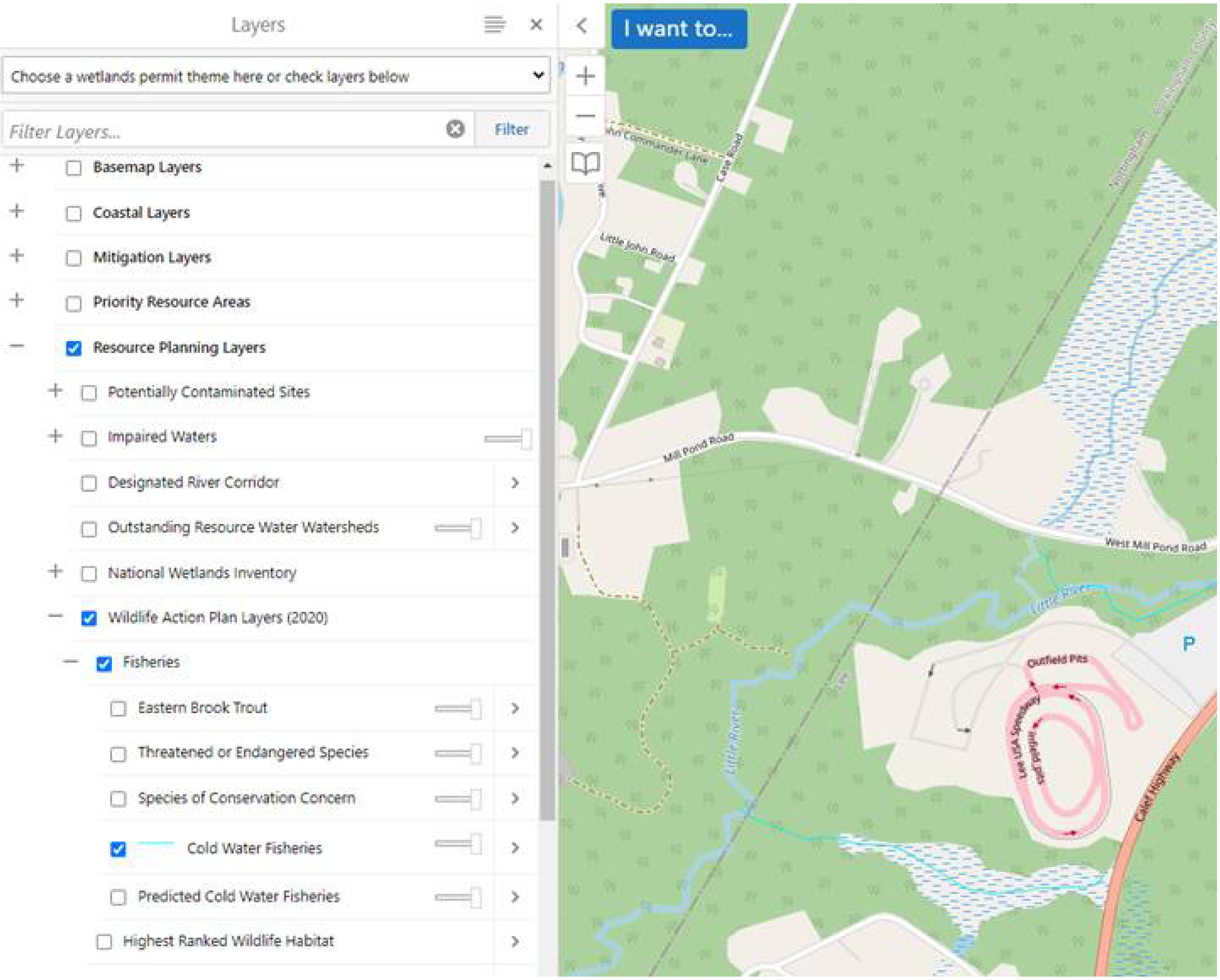
Good Morning John,

I am reaching out regarding the subject NHDOT project involving the replacement of the existing crossing structure carrying NH Route 125 over the Little River in Lee, New Hampshire (43.11874° N, -71.03454° W). I believe you were cc'd on the initial coordination with NHFG regarding the species on the NHB DataCheck Results. Kim Tuttle and Mike Dionne indicated that the biggest fisheries concern is diadromous fish spawning runs including river herring and American eel. We are working out the details of the construction sequence now but should be able to avoid instream work between April 15-July 1 to minimize impacts to these species.

According to the NHDES WPPT and the NH Wildlife Action Plan (2020) data layers, the segment of the Little River in the project area is identified as an Eastern Brook Trout Water and a Cold Water Fishery. I just wanted to double check with you regarding the presence of eastern brook trout and/or a cold water fish assemblage. As you can see on the snip below, the section of the Little River that is identified as a Cold Water Fishery/Brook Trout Water is a relatively short, discontinuous segment of the Little River. I've also attached a photo of the Little River at the outlet of the existing structure, and another taken upstream from the crossing. Let me know if you have any questions or need any additional information.

Thanks,

Steve



Thanks,
Steve

McFarland Johnson

Stephen Hoffmann | Environmental Analyst
802-862-9381

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Christine J. Perron

From: Tuttle, Kim <Kim.A.Tuttle@wildlife.nh.gov>
Sent: Friday, August 12, 2022 8:49 AM
To: Stephen Hoffmann; Christine J. Perron
Cc: FGC: NHFG review; Magee, John; Dionne, Michael; Patterson, Cheri; Duclos, Kristin
Subject: RE: UPDATE: NHB19-0856 / NHB22-2366 - NH Route 125 bridge over the Little River Replacement

Hi Steve,

In this case, the diadromous fish restriction (no any instream work from April 15-July 1) takes precedence to protect the herring and eel runs. I also spoke with Mike Dionne, our new department Environmental Review Coordinator, about this timing conflict and we recommend to DES that the coldwater fishery time restriction can be waived, if necessary.

Thanks,

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

As of February 3, 2022, New Hampshire Fish and Game requirements for environmental review consultation have changed. To review the new rules, please go to Proposed Rules | Legislative | New Hampshire Fish and Game Department (state.nh.us). All requests for consultation and submittals should be sent via email to NHFGreview@wildlife.nh.gov or can be sent by mail. **The NHB datacheck results letter number needs to be included in the email subject line.**

The requirements for consultation (Fis 1004) shall not apply to the following: statutory permit by notification, permit by rule, permit by notification, routine roadway registration, docking structure registration, or conditional authorization by rule. Review requests for these projects can be sent directly to kim.tuttle@wildlife.nh.gov.

From: Stephen Hoffmann <SHoffmann@mjinc.com>
Sent: Thursday, August 11, 2022 5:00 PM
To: Tuttle, Kim <Kim.A.Tuttle@wildlife.nh.gov>; Christine J. Perron <CPerron@mjinc.com>
Cc: FGC: NHFG review <NHFGreview@wildlife.nh.gov>; Magee, John <john.a.magee@wildlife.nh.gov>
Subject: RE: UPDATE: NHB19-0856 / NHB22-2366 - NH Route 125 bridge over the Little River Replacement

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

Hi Kim,

Thank you for confirming the recommendations below.

After taking a closer look at the project I think some additional discussion on the TOY restrictions will be required to determine a construction schedule and sequence that will be feasible for the project while minimizing impacts to fisheries. According to the fisheries data layers on the NHDES Wetlands Permit Planning Tool (WPPT), the Little River is also identified as a cold water fishery as well as an eastern brook trout water. According to the NHDES Wetlands Rules, "in non-tidal waters, no dredging shall occur between October 1 and March 31 for any documented occurrence of a cold water fishery or a threatened or endangered fishery…" [Env-Wt 307.10(g)(1)]. Does the cold water fisheries data layer constitute a "documented occurrence"? If so, the window for instream work with the two restrictions in place would severely restrict the construction schedule, and it is unlikely that the project could be constructed given the short windows.

The proposed project is anticipated to be constructed using phased construction techniques starting in spring 2024 and completed the end of summer 2025. I will need to talk with the design team further to determine which phases of construction will require instream work and when. I will be on vacation starting tomorrow 8/12 through 8/26 but would like to continue this discussion when I return. If you have any additional questions or need anything further in the meantime, Christine Perron (copied here) should be able to assist you.

Thanks,
Steve

McFarland Johnson

Stephen Hoffmann | Environmental Analyst
802-862-9381

From: Tuttle, Kim <Kim.A.Tuttle@wildlife.nh.gov>
Sent: Thursday, August 11, 2022 3:26 PM
To: Stephen Hoffmann <SHoffmann@mjinc.com>; Christine J. Perron <CPerron@mjinc.com>
Cc: FGC: NHFG review <NHFGreview@wildlife.nh.gov>; Magee, John <john.a.magee@wildlife.nh.gov>
Subject: FW: UPDATE: NHB19-0856 / NHB22-2366 - NH Route 125 bridge over the Little River Replacement

Hello Steve,

This time of year restriction was included in our original recommendations. Kim T.

From: Dionne, Michael <Michael.A.Dionne@wildlife.nh.gov>
Sent: Thursday, August 11, 2022 2:43 PM
To: Tuttle, Kim <Kim.A.Tuttle@wildlife.nh.gov>
Cc: Patterson, Cheri <Cheri.A.Patterson@wildlife.nh.gov>; Magee, John <john.a.magee@wildlife.nh.gov>
Subject: Re: UPDATE: NHB19-0856 / NHB22-2366 - NH Route 125 bridge over the Little River Replacement

Hi Kim,
I just discussed this with Cheri and we are still good with it as long as they are not doing any instream work from April 15-July 1.

Mike Dionne

Marine Biologist

NH Fish and Game Department

225 Main St. Durham, NH 03824

(603) 868-1095, michael.dionne@wildlife.nh.gov

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Did you know? *New Hampshire Fish and Game has been conserving New Hampshire's wildlife and their habitats since 1865.*

From: Tuttle, Kim <Kim.A.Tuttle@wildlife.nh.gov>
Sent: Wednesday, August 10, 2022 2:33 PM
To: Dionne, Michael <Michael.A.Dionne@wildlife.nh.gov>; Magee, John <john.a.magee@wildlife.nh.gov>
Subject: FW: UPDATE: NHB19-0856 / NHB22-2366 - NH Route 125 bridge over the Little River Replacement

Can you guys take a look at this one last time?

From: Stephen Hoffmann <SHoffmann@mjinc.com>
Sent: Wednesday, August 10, 2022 2:10 PM
To: Tuttle, Kim <Kim.A.Tuttle@wildlife.nh.gov>
Cc: Christine J. Perron <CPerron@mjinc.com>
Subject: RE: UPDATE: NHB19-0856 / NHB22-2366 - NH Route 125 bridge over the Little River Replacement

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

Hi Kim,

I'm just confirming whether you have any additional questions or concerns regarding the proposed project. Does NHFG have any additional recommendations in addition to the original recommendations from back in 2019 included in the email chain below?

Thanks,
Steve

McFarland Johnson

Stephen Hoffmann | Environmental Analyst
802-862-9381
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From: Tuttle, Kim <Kim.A.Tuttle@wildlife.nh.gov>
Sent: Thursday, August 4, 2022 10:13 AM
To: Stephen Hoffmann <SHoffmann@mjinc.com>
Subject: RE: UPDATE: NHB19-0856 / NHB22-2366 - NH Route 125 bridge over the Little River Replacement

Thanks Steve.

Kim

From: Stephen Hoffmann <SHoffmann@mjinc.com>
Sent: Tuesday, August 2, 2022 1:47 PM
To: Tuttle, Kim <Kim.A.Tuttle@wildlife.nh.gov>
Cc: Dionne, Michael <Michael.A.Dionne@wildlife.nh.gov>; Carpenter, Matthew <mathew.a.carpenter@wildlife.nh.gov>; Christine J. Perron <CPerron@mjinc.com>; FGC: NHFG review <NHFGreview@wildlife.nh.gov>; Magee, John <john.a.magee@wildlife.nh.gov>
Subject: RE: UPDATE: NHB19-0856 / NHB22-2366 - NH Route 125 bridge over the Little River Replacement

Hi Kim,

The project is still in the preliminary design phase, so we do not have a final plan set with wildlife protection notes as you requested. We are completing the NEPA document now and will include the NHFG recommendations as environmental commitments in the NEPA document to ensure these are carried out. Please find the preliminary channel realignment plan attached. This plan shows the locations of the proposed wildlife shelves. We are not proposing concrete walkways. The wildlife shelves will consist of an area that is graded relatively flat and the surface will likely be specified to be crushed stone or similar fine-grained material to fill in the larger voids of the riprap underneath. Let me know if you have any additional questions.

Thanks,
Steve

McFarland Johnson

Stephen Hoffmann | Environmental Analyst
802-862-9381
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From: Tuttle, Kim <Kim.A.Tuttle@wildlife.nh.gov>
Sent: Friday, July 29, 2022 9:02 AM
To: Stephen Hoffmann <SHoffmann@mjinc.com>
Cc: Dionne, Michael <Michael.A.Dionne@wildlife.nh.gov>; Carpenter, Matthew <mathew.a.carpenter@wildlife.nh.gov>; Christine J. Perron <CPerron@mjinc.com>; FGC: NHFG review <NHFGreview@wildlife.nh.gov>; Magee, John <john.a.magee@wildlife.nh.gov>
Subject: RE: UPDATE: NHB19-0856 / NHB22-2366 - NH Route 125 bridge over the Little River Replacement

Hello Stephen,

Please send over the plans so we can take a look at this one again including the protected wildlife notes. I am especially interested in the wildlife shelves. Hopefully, these are constructed natural banks along the side(s) of the river. We do not recommend concrete walkway type shelves for wildlife.

Thanks,

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

As of February 3, 2022, New Hampshire Fish and Game requirements for environmental review consultation have changed. To review the new rules, please go to Proposed Rules | Legislative | New Hampshire Fish and Game Department (state.nh.us). All requests for consultation and submittals should be sent via email to NHFGreview@wildlife.nh.gov or can be sent by mail. **The NHB datacheck results letter number needs to be included in the email subject line.**

The requirements for consultation (Fis 1004) shall not apply to the following: statutory permit by notification, permit by rule, permit by notification, routine roadway registration, docking structure registration, or conditional authorization by rule. Review requests for these projects can be sent directly to kim.tuttle@wildlife.nh.gov.

From: Stephen Hoffmann <SHoffmann@mjinc.com>
Sent: Friday, July 29, 2022 8:41 AM
To: Tuttle, Kim <Kim.Tuttle@wildlife.nh.gov>
Cc: Dionne, Michael <Michael.Dionne@wildlife.nh.gov>; Carpenter, Matthew <Matthew.Carpenter@wildlife.nh.gov>; Christine J. Perron <CPerron@mjinc.com>
Subject: UPDATE: NHB19-0856 / NHB22-2366 - NH Route 125 bridge over the Little River Replacement

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

Good Morning Kim,

I am reaching out regarding the NHDOT bridge replacement project that you originally reviewed back in 2019. The proposed project involves replacing an existing 12' high x 18' wide corrugated metal pipe that carries the Little River under NH Route 125 in Lee, New Hampshire. The proposed replacement structure would consist of a 100'-0" single span bridge. The substantially larger structure would provide improved hydraulic capacity, improved stream geomorphic compatibility, and would provide floodplain benches/wildlife shelves along both banks through the structure, where there are currently none. I attached a photo of the existing structure looking upstream from the outlet. The proposed project would realign and reconstruct the portion of the channel through the structure and immediately upstream at the inlet. Streambed simulation material will be installed overtop proposed areas of riprap to improve aquatic organism habitat and passage.

The original NHB DataCheck results letter (4/1/2019) included American eel and Blanding's turtle. However, I updated the NHB DataCheck results letter (7/28/2022), and additional species have been added since that time. The current results also include spotted turtle and wood turtle. I assume the recommendations will remain the same since Blanding's turtle was included in the original results, but I wanted to reach out and continue this coordination since a couple of years have gone by and the NHB records have been updated.

A summary of your original recommendations from 2019 is provided below:

- Recommended time of year restriction on instream work from April 15 - July 1 (river herring and other anadromous fish spawning runs)
- Wildlife friendly/biodegradable erosion control matting (reptiles, amphibians, and other wildlife)
- Recommended that riprap not extend across the entire width of the channel (turtles and other aquatic species)

  NOTE: Portions of the channel will have to be reconstructed, and riprap will likely be installed across the entire channel through the structure to protect against scour and stabilize the channel and protect the bridge structure. However, as I mentioned above, streambed simulation material will be installed overtop areas of riprap in the channel to improve habitat and provide improved aquatic organism passage. We are also improving the terrestrial wildlife connectivity/passage at the crossing location by incorporating wildlife shelves along both banks of the river.

Please let me know if you have any questions or concerns regarding the proposed project.

Thanks,
Steve

McFarland Johnson

Stephen Hoffmann | Environmental Analyst
802-862-9381
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From: Tuttle, Kim <Kim.Tuttle@wildlife.nh.gov>
Sent: Wednesday, April 3, 2019 1:52 PM
To: Stephen Hoffmann <shoffmann@mjinc.com>

Cc: Dionne, Michael <Michael.Dionne@wildlife.nh.gov>; Carpenter, Matthew <Matthew.Carpenter@wildlife.nh.gov>
Subject: RE: NHB19-0856 replacement NH Route 125 bridge over the Little River

Thanks Steve. The project sounds like it will improve aquatic species passage for protected turtles as well as eel and river herring by reducing velocities.

Thanks,

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

From: Stephen Hoffmann [mailto:shoffmann@mjinc.com]
Sent: Wednesday, April 3, 2019 1:43 PM
To: Tuttle, Kim
Cc: Dionne, Michael; Carpenter, Matthew
Subject: RE: NHB19-0856 replacement NH Route 125 bridge over the Little River

Hi Kim,

Thank you for your quick response regarding NHFG concerns. I will pass this information along to ensure that the recommendations below are incorporated into the project. As I mentioned, we will be replacing the existing corrugated metal pipe with a bridge structure that will span the entire river. Hopefully this will result in improved aquatic organism passage at the Route 125 crossing.

Thanks,
Steve

From: Tuttle, Kim <Kim.Tuttle@wildlife.nh.gov>
Sent: Wednesday, April 3, 2019 12:46 PM
To: Stephen Hoffmann <shoffmann@mjinc.com>
Cc: Dionne, Michael <Michael.Dionne@wildlife.nh.gov>; Carpenter, Matthew <Matthew.Carpenter@wildlife.nh.gov>
Subject: NHB19-0856 replacement NH Route 125 bridge over the Little River

Steve,

I have consulted with NHFG Marine Division about this one. Our biggest concern at this time is job timing to avoid impacts to spring anadromous fish spawning runs, particularly of river herring, which have been observed at the RT 155 crossing about 1.5 miles downstream of RT 125. Unless there is an impassable beaver dam or something other fish passage barrier, we can't see why herring wouldn't reach RT 125. Just to be safe, Marine Division has recommended restricting construction from April 15-July 1.

We recommend that the use of welded plastic or 'biodegradable plastic' netting or thread in erosion control matting not be used at this site. There are numerous documented cases of snakes and other wildlife being trapped and killed in erosion control matting with synthetic netting and thread. The use of erosion control berm, Filtrexx or equal filter sock, or several 'wildlife friendly' options such as woven organic material (e.g. coco or jute matting such as North American

Green SC150BN or equivalent) are commercially available, if needed. Let us know the specific product you intend on using as you get closer to permitting.

We also recommend that rip- rap not extend across the entire width of the riverbed as it can be difficult for turtle to negotiate. Armoring abutments is fine but we recommend using a larger stone so that it doesn't extend more than 3 ft. out into the river.

Sincerely,

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

From: Stephen Hoffmann [mailto:shoffmann@mjinc.com]
Sent: Wednesday, April 3, 2019 9:17 AM
To: Lamb, Amy
Cc: Tuttle, Kim
Subject: RE: NHB review: NHB19-0856

Good Morning Amy and Kim,

Amy, please find the attached site photos of the existing crossing of NH Route 125 over the Little River per your request. As I previously mentioned in the description, the project is still in the preliminary design phase but the existing metal corrugated pipe will be replaced with a bridge structure compliant with the NH stream crossing guidelines. The exact areas of impacts have not been determined at this time, so I included general photos of the entire area.

Kim, please let me know if you have any concerns regarding the proposed project as it relates to American eel, Blanding's turtle, or any other fish or wildlife species. Let me know if you have any questions or require any additional information.

Thanks,
Steve

From: Lamb, Amy <Amy.Lamb@dncr.nh.gov>
Sent: Tuesday, April 2, 2019 11:54 AM
To: Stephen Hoffmann <shoffmann@mjinc.com>
Cc: Tuttle, Kim <Kim.Tuttle@wildlife.nh.gov>
Subject: NHB review: NHB19-0856

Attached, please find the review we have completed. If your review memo includes potential impacts to plants or natural communities please contact me for further information. If your project had potential impacts to wildlife, please contact NH Fish and Game at the phone number listed on the review.

Best,
Amy

Amy Lamb
Ecological Information Specialist

NH Natural Heritage Bureau
DNCR - Forests & Lands
172 Pembroke Rd
Concord, NH 03301
603-271-2834

USFWS Official Species List

United States Department of the Interior

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

In Reply Refer To: February 12, 2024
Project Code: 2022-0067074
Project Name: Lee 41322 - Bridge Replacement (Bridge No. 073/084) NH Route 125 over Little River

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

To Whom It May Concern:

Updated 4/12/2023 - *Please review this letter each time you request an Official Species List, we will continue to update it with additional information and links to websites may change.*

About Official Species Lists

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. Federal and non-Federal project proponents have responsibilities under the Act to consider effects on listed species.

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 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. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested by returning to an existing project's page in IPaC.

Endangered Species Act Project Review

Please visit the "**New England Field Office Endangered Species Project Review and**

Consultation” website for step-by-step instructions on how to consider effects on listed species and prepare and submit a project review package if necessary:

https://www.fws.gov/office/new-england-ecological-services/endangered-species-project-review

NOTE Please <u>do not</u> use the **Consultation Package Builder** tool in IPaC except in specific situations following coordination with our office. Please follow the project review guidance on our website instead and reference your **Project Code** in all correspondence.

Northern Long-eared Bat - (**Updated 4/12/2023**) The Service published a final rule to reclassify the northern long-eared bat (NLEB) as endangered on November 30, 2022. The final rule went into effect on March 31, 2023. You may utilize the **Northern Long-eared Bat Rangewide Determination Key** available in IPaC. More information about this Determination Key and the Interim Consultation Framework are available on the northern long-eared bat species page:

https://www.fws.gov/species/northern-long-eared-bat-myotis-septentrionalis

For projects that previously utilized the 4(d) Determination Key, the change in the species' status may trigger the need to re-initiate consultation for any actions that are not completed and for which the Federal action agency retains discretion once the new listing determination becomes effective. If your project was not completed by March 31, 2023, and may result in incidental take of NLEB, please reach out to our office at newengland@fws.gov to see if reinitiation is necessary.

Additional Info About Section 7 of the Act
Under section 7(a)(2) of the Act and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to determine whether projects may affect threatened and endangered species and/or designated critical habitat. If a Federal agency, or its non-Federal representative, determines 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 Federal agency also may need to consider proposed species and proposed critical habitat in the consultation. 50 CFR 402.14(c)(1) specifies the information required for consultation under the Act regardless of the format of the evaluation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

https://www.fws.gov/service/section-7-consultations

In addition to consultation requirements under Section 7(a)(2) of the ESA, please note that under sections 7(a)(1) 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. Please contact NEFO if you would like more information.

Candidate species that appear on the enclosed species list have no current protections under the

ESA. The species' occurrence on an official species list does not convey a requirement to consider impacts to this species as you would a proposed, threatened, or endangered species. The ESA does not provide for interagency consultations on candidate species under section 7, however, the Service recommends that all project proponents incorporate measures into projects to benefit candidate species and their habitats wherever possible.

Migratory Birds

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

https://www.fws.gov/program/migratory-bird-permit

https://www.fws.gov/library/collections/bald-and-golden-eagle-management

Please feel free to contact us at **newengland@fws.gov** with your **Project Code** in the subject line if you need more information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat.

Attachment(s): Official Species List

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

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

This species list is provided by:

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

PROJECT SUMMARY

Project Code:	2022-0067074
Project Name:	Lee 41322 - Bridge Replacement (Bridge No. 073/084) NH Route 125 over Little River
Project Type:	Bridge - Replacement
Project Description:	The proposed project involves the replacement of Bridge No. 073/084 that carries NH Route 125 (Calef Highway) over the Little River, in the town of Lee, New Hampshire. The existing bridge structure consists of a deteriorated 18' wide by 12' tall corrugated metal pipe, installed in 1972. The proposed project will replace the existing undersized and deteriorating pipe with a 90'-0" single span steel girder bridge structure founded on integral abutments. Tree clearing and vegetation removal will be required for the construction of the larger bridge span as well as the temporary bridge and roadway realignment associated with the construction phasing.

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@43.11873968486411,-71.03457375237505,14z

Counties: Strafford County, New Hampshire

ENDANGERED SPECIES ACT SPECIES

There is a total of 3 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	Endangered

INSECTS

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

FLOWERING PLANTS

NAME	STATUS
Small Whorled Pogonia *Isotria medeoloides* Population: No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1890	Threatened

CRITICAL HABITATS

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

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

IPAC USER CONTACT INFORMATION

Agency: McFarland Johnson
Name: Christine Perron
Address: 53 Regional Drive
City: Concord
State: NH
Zip: 03301
Email cperron@mjinc.com
Phone: 6032252978

LEAD AGENCY CONTACT INFORMATION

Lead Agency: Federal Highway Administration

USFWS Correspondence

United States Department of the Interior

FISH AND WILDLIFE SERVICE

New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5087
https://www.fws.gov/office/new-england-ecological-services

August 30, 2022

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

Re: Lee 41322 - Bridge Replacement (Bridge No. 073/084) (Project code: 2022-0067074)

Dear Melilotus Dube:

The U.S. Fish and Wildlife Service (Service) is responding to your request, dated August 25, 2022, to verify that the New Hampshire Department of Transportation (NHDOT) Project 41322 (Project), the proposed replacement of an existing corrugated metal pipe in Lee, New Hampshire, may rely on the revised February 5, 2018, 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 (dated August 3, 2022) on August 25, 2022 via electronic transmission. This letter provides the Service's response as to whether the Federal Highway Administration may rely on the BO to comply with section 7(a)(2) of the Endangered Species Act of 1973 (ESA) (87 Stat. 884, as amended; U.S.C. 1531 *et seq.*) for the Project's effects to the NLEB.

The NHDOT, as the non-Federal agency representative for the Federal Transportation Agency, has determined that the Project may affect, and is likely to adversely affect the NLEB. The Project consists of the replacement of the existing metal pipe with a 100-foot single-span bridge structure at the crossing of NH Route 125 over the Little River. Approximately 0.1 acre of tree clearing will occur, which may be implemented during the bat active season.

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

Conclusion

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

Incidental Take of the Northern Long-eared Bat

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

Reporting Dead or Injured Bats

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

Reinitiation Notice

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

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

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

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

Sincerely yours,

AUDREY MAYER

Digitally signed by AUDREY MAYER
Date: 2022.08.30 12:06:48 -04'00'

Audrey Mayer
Supervisor
New England Field Office

cc: Reading file
Melilotus Dube/NHDOT, via email
Rebecca Martin/NHDOT, via email
ES: SvonOettingen:jd:8-30-22:603-748-8537

APPENDIX D: Bridge/Structure Bat Assessment Form

Bridge/Structure Bat Assessment Form Instructions

- This form will be completed to document bat occupancy or bat use of bridges, culverts, and other structures. This form shall be submitted to the appropriate personnel within the DOT and USFWS for recordkeeping (or uploaded into the Information, Planning, and Consultation (IPaC) Determination Key for use of the Programmatic Biological Opinion for Transportation Projects in the Range of the Indiana Bat and Northern Long-Eared Bat) prior to conducting: any activities below the deck surface either from the underside or from above the deck surface that bore down to the underside; any activities that could impact expansion joints; any activities involving deck removal on bridges; or any activities involving structure demolition for bridges, culverts, and/or other structures.
- Assessments must be completed within two (2) years of conducting any work (see the above bullet), regardless of whether assessments have been conducted in the past. Assessments must be completed in appropriate weather conditions, suitable for the assessor to observe common signs of bat use.
- Evidence of bat use may include visual observation (live and/or dead), presence of guano, presence of staining, audible observation, and/or odor observation. Presence of one or more indicators is sufficient evidence that bats may be using the bridge, culvert, and/or other structure.
- If bat use of a bridge, culvert, and/or other structure is noted, additional studies may be undertaken during bat active season to identify the specific bat species utilizing the structure, or protected bat species presence can be assumed, in order to comply with threatened and endangered species regulations. Bat active season dates, typically between April and November, vary regionally and by species, so assessors should consult with their local USFWS Field Office for more specific active season dates.
- For use of the Programmatic Biological Opinion for Transportation Projects in the Range of the Indiana Bat and Northern Long-Eared Bat – If the bridge/structure is 1,000 feet or more from suitable bat habitat[1] (e.g., an urban or agricultural area without suitable foraging habitat or corridors linking the bridge to suitable foraging habitat), check the appropriate box and fill out the table below. **No further assessment is required.**

<table>
<tr><td>Date & Time of Assessment</td><td>DOT Project #</td><td>Route/Facility Carried</td><td>County</td></tr>
<tr><td>Federal Structure ID</td><td>Structure Coordinates (latitude and longitude)</td><td colspan="2">☐ This bridge/structure is 1,000 feet or more from suitable bat habitat[2]

Name:___________________________________

Signature: ________________________________</td></tr>
</table>

- Any questions pertaining to assessments or this form should be directed to the local USFWS Field Office.

[1] Refer to the USFWS's summer survey guidance for the definition of suitable habitat (http://www.fws.gov/midwest/endangered/mammals/inba/inbasummersurveyguidance.html).

[2] This condition is only for use of the Programmatic Biological Opinion for Transportation Projects in the Range of the Indiana Bat and Northern Long-Eared Bat

Bridge/Structure Bat Assessment Form

Date & Time of Assessment: July 19, 2022	DOT Project Number: Lee 41322	Route/Facility Carried: NH Route 125	County: Stafford
Federal Structure ID: Bridge No. 73/084	Structure Coordinates (latitude and longitude): 43.11874, -71.03456	Structure Height (approximate): 12'	Structure Length: 110'

Structure Type (check one)

Bridge Construction Style

( ) Cast-in-place	( ) Pre-stressed Girder
( ) Flat Slab/Box	( ) Steel I-beam
( ) Truss (Side View)	( ) Covered
( ) Parallel Box Beam	( ) Other:

Culvert Type	*Other Structure*
( ) Box (•) Pipe/Round ( ) Other:	( ) Corrugated Metal Pipe 12' high x 18' wide x 110' long

Structure Material (check all that apply)

Deck Material	*Beam Material*	*End/Back Wall Material*
[ ] Metal	[ ] None	[ ] Concrete
[ ] Concrete	[ ] Concrete	[ ] Timber
[ ] Timber	[ ] Steel	[ ] Stone/Masonry
[ ] Open grid	[ ] Timber	[X] Other: N/A
[X] Other: N/A	[X] Other: N/A	

Creosote Evidence

( ) Yes (•) No
( ) Unknown

Culvert Material

[X] Metal
[ ] Concrete
[ ] Plastic
[ ] Stone/Masonry
[ ] Other:

Notes:

Crossings Traversed (check all that apply)

[ ] Bare ground	[ ] Open vegetation
[ ] Rip-rap	[ ] Closed vegetation
[X] Flowing water	[ ] Railroad
[ ] Standing water	[ ] Road/trail - Type:
[ ] Seasonal water	[ ] Other:

Surrounding Habitat (check all that apply)

[ ] Agricultural	[ ] Grassland
[ ] Commercial	[ ] Ranching
[ ] Residential-urban	[ ] Riparian/wetland
[X] Residential-rural	[ ] Mixed use
[X] Woodland/forested	[X] Other: Open Fields / Roadway ROW

Areas Assessed (check all that apply)

Check all areas that apply. If an area is not present in the structure, check the "not present" box.
Document all bat indicators observed during the assessment. Include the species present, if known, and provide photo documentation as indicated.

Area (check if assessed)	Assessment Notes	Evidence of Bats (include photos if present)
[X] All crevices and cracks: **Bridges/culverts:** rough surfaces or imperfections in concrete **Other structures:** soffits, rafters, attic areas	[ ] Not present	[ ] Visual - live # 0 dead # 0; [ ] Guano; [ ] Staining; [ ] Audible; [ ] Odor; [ ] Photos; [ ] Species
[ ] Concrete surfaces (open roosting on concrete)	[X] Not present	[ ] Visual - live # dead #; [ ] Guano; [ ] Staining; [ ] Audible; [ ] Odor; [ ] Photos; [ ] Species
[ ] Spaces between concrete end walls and the bridge deck	[X] Not present	[ ] Visual - live # dead #; [ ] Guano; [ ] Staining; [ ] Audible; [ ] Odor; [ ] Photos; [ ] Species
[ ] Crack between concrete railings on top of the bridge deck (Gap, Railing)	[X] Not present	[ ] Visual - live # dead #; [ ] Guano; [ ] Staining; [ ] Audible; [ ] Odor; [ ] Photos; [ ] Species
[ ] Vertical surfaces on concrete I-beams	[X] Not present	[ ] Visual - live # dead #; [ ] Guano; [ ] Staining; [ ] Audible; [ ] Odor; [ ] Photos; [ ] Species
[ ] Spaces between walls, ceiling joists	[X] Not present	[ ] Visual - live # dead #; [ ] Guano; [ ] Staining; [ ] Audible; [ ] Odor; [ ] Photos; [ ] Species
[ ] Weep holes, scupper drains, and inlets/pipes	[X] Not present	[ ] Visual - live # dead #; [ ] Guano; [ ] Staining; [ ] Audible; [ ] Odor; [ ] Photos; [ ] Species
[X] All guiderails	[ ] Not present W-Beam Guardrail	[ ] Visual - live # 0 dead # 0; [ ] Guano; [ ] Staining; [ ] Audible; [ ] Odor; [ ] Photos; [ ] Species
[ ] All expansion joints	[X] Not present	[ ] Visual - live # dead #; [ ] Guano; [ ] Staining; [ ] Audible; [ ] Odor; [ ] Photos; [ ] Species

Name: Stephen Hoffmann, McFarland-Johnson, Inc.	Signature: Stephen Hoffmann

Section 106 Programmatic Agreement Appendix B Certification

Section 106 Programmatic Agreement – Cultural Resources Review Effect Finding

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

Date Reviewed: (Desktop or Field Review Date)	7/13/2022		
Project Name:	Lee		
State Number:	41322	**FHWA Number:**	X-A004(593)
Environmental Contact: **Email Address:**	Melilotus Dube Melilotus.M.Dube@dot.nh.gov	**DOT Project Manager:**	David Scott

Project Description: The proposed project involves the complete replacement of Bridge No. 073/084 carrying NH Route 125 over the Little River in Lee, New Hampshire. The existing 18' wide x 12' tall, corrugated metal pipe was installed in 1972 and is currently listed as in 'serious' condition (3 out of 9) and was added to the NHDOT 'Red List' in 2014. The proposed project will replace the existing structure with a 100'-0" single span steel girder bridge superstructure founded on integral abutments.

Please select the applicable activity/activities:

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

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

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

The proposed project involves the complete replacement of a non-historic bridge structure. Bridge No. 073/084 consists of a corrugated metal pipe that was installed in 1972. According to the NHDOT Historic Bridge Inventory (HBI) review, the existing structure was determined to not be eligible for listing on the National Register of Historic Places. The bridge also qualifies for inclusion in the Program Comment for Common Post 1945 Concrete and Steel Bridges, and therefore, is considered non-historic. A Phase IA Archaeological Sensitivity Assessment and Phase IB Intensive Archaeological Investigation was completed by Monadnock Archaeological Consulting, LLC, in September 2020. The results of the study did not identify any archaeological sites and indicated that the project area has been extensively disturbed. Based on these findings, no additional study was recommended. Two potentially historic properties were identified northeast of Bridge No. 073/04 along NH Route 125 included: 351 Calef Highway (17-03-0100), built in 1925; and 334 Calef Highway (16-04-0200), built in 1962. The associated highway work is anticipated to tie into the existing alignment of NH Route 125 at Thompson Mill Road, located just south of these properties. Therefore, neither potentially historic property is anticipated to be impacted by the proposed project and inventory forms were not completed.

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

Coordination Efforts:

Has an RPR been submitted to NHDOT for this project?	Yes	NHDHR R&C # assigned?	11792
Please identify public outreach effort contacts; method of outreach and date:	A Public Information Meeting was held on June 22, 2022 at 6:00 PM, at the Lee Public Safety Complex, 2nd Floor. No public comments pertaining to cultural and historic resources were received.		

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

☒	**No Potential to Cause Effects**	☐	**No Historic Properties Affected**
This finding serves as the Section 106 Memorandum of Effect. No further coordination is necessary.			

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

☐	**This project does *not* comply with Appendix B. Review will continue under Stipulation VII of the Programmatic Agreement. Please contact NHDOT Cultural Resources Staff to determine next steps.**

NHDOT comments:

Sheila Charles

7/25/2022

NHDOT Cultural Resources Staff

Date

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

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

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

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

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

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

USACE Appendix B and Supplemental Narrative

US Army Corps of Engineers®
New England District

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

USACE Section 404 Checklist

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

1. Impaired Waters	Yes	No
1.1 Will any work occur within 1 mile upstream in the watershed of an impaired water? See the following to determine if there is an impaired water in the vicinity of your work area. * https://nhdes-surface-water-quality-assessment-site-nhdes.hub.arcgis.com/ https://www.des.nh.gov/water/rivers-and-lakes/water-quality-assessment https://www4.des.state.nh.us/onestopdatamapper/onestopmapper.aspx	X	
2. Wetlands	Yes	No
2.1 Are there are streams, brooks, rivers, ponds, or lakes within 200 feet of any proposed work?	X	
2.2 Are there proposed impacts to tidal SAS, prime wetlands, or priority resource areas? Applicants may obtain information from the NH Department of Resources and Economic Development Natural Heritage Bureau (NHB) DataCheck Tool for information about resources located on the property at https://www4.des.state.nh.us/NHB-DataCheck/.	X	
2.3 If wetland crossings are proposed, are they adequately designed to maintain hydrology, sediment transport & wildlife passage?	X	
2.4 Would the project remove part or all of a riparian buffer? (Riparian buffers are lands adjacent to streams where vegetation is strongly influenced by the presence of water. They are often thin lines of vegetation containing native grasses, flowers, shrubs and/or trees that line the stream banks. They are also called vegetated buffer zones.)	X	
2.5 The overall project site is more than 40 acres?		X
2.6 What is the area of the previously filled wetlands?	unknown	
2.7 What is the area of the proposed fill in wetlands?	2647 sf	
2.8 What % of the overall project sire will be previously and proposed filled wetlands?	unknown	
3. Wildlife	Yes	No
3.1 Has the NHB & USFWS determined that there are known occurrences of rare species, exemplary natural communities, Federal and State threatened and endangered species and habitat, in the vicinity of the proposed project? (All projects require an NHB ID number & a USFWS IPAC determination.) NHB DataCheck Tool: https://www4.des.state.nh.us/NHB-DataCheck/. USFWS IPAC website: https://ipac.ecosphere.fws.gov/	X	

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

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

1.1 Will any work occur within 1 mile upstream in the watershed of an impaired water?

According to the New Hampshire 2020/2022 303(d) List (most recent available), the segment of the Little River that flows through the project area (Assessment Unit ID: NHRIV600030707-07) is listed as impaired by aluminum, lead, and pH for Aquatic Life Integrity. The project will not contribute to or cause surface water impairments.

2.1 Are there streams, brooks, rivers, ponds, or lakes within 200 feet of any proposed work?

Little River is a third order perennial stream at the existing NH Route 125 bridge crossing (Bridge No. 073/084). An unnamed first order intermittent tributary of Little River is located in the southeast quadrant of the bridge. There are no other surface waters located within 200 feet of the proposed work.

2.2 Are there proposed impacts to tidal SAS, prime wetlands, or priority resource areas?

Wetland 4 and portions of Wetland 6 are Priority Resource Areas (PRA). The only proposed permanent impacts to a PRA will be in Wetland 4 (Impact Location Q), consisting of 509 SF of impact from required grading and bank stabilization.

Temporary impacts will occur in Wetland 6 (Impact Locations Y and Z) and Wetland 4 (Impact Location V), totaling 3,961 SF of temporary impact to a PRA. Temporary impacts are necessary to provide construction access to the river. No grubbing of vegetation will occur within temporary impact locations and geotextile fabric and construction mats will be placed under temporary fill to avoid rutting and compaction.

2.3 If wetland crossings are proposed, are they adequately designed to maintain hydrology, sediment transport, & wildlife passage?

The proposed project will replace the existing 18’ wide x 12’ high Corrugated Metal Pipe (CMP) with a 100’-0” single span steel girder superstructure founded on integral abutments. To accommodate the larger crossing that is proposed and to better align the stream with the crossing, the stream channel will be realigned on the upstream side of the bridge and a channel will constructed through the bridge to connect with the downstream channel. The proposed project will result in improved geomorphic compatibility, hydraulic capacity, terrestrial wildlife passage, and aquatic organism passage. Simulated streambed material will be used in the channel and root wads will be installed at the northwest edge of the channel to aid in stabilization. Reconstructed banks will consist of fabric encapsulated soil, live stakes, and shrubs. A floodplain bench will be constructed along each bank through the crossing, which will provide terrestrial wildlife passage. All exposed riprap used on the project will be void-filled riprap.

2.4 Would the project remove part or all of a riparian buffer?

Tree clearing has been minimized to the maximum extent practicable, and impacts to the riparian buffer are primarily located directly adjacent to the existing roadway infrastructure. These areas have experienced prior disturbance from previous construction of the existing roadway infrastructure. Plantings have been incorporated into the proposed design.

2.7 What is the area of the proposed fill in wetlands?

The proposed project is anticipated to result in 2,360 SF of permanent impacts to palustrine wetlands and stream channel. The proposed impacts are associated with the proposed bridge replacement, required grading, and channel reconstruction.

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?

The United States Fish and Wildlife Service's (USFWS) Information for Planning and Consultation (IPaC) webtool was accessed on February 12, 2024, to generate an updated Official Species List and to review the proposed project for federally listed species and critical habitats protected under the Endangered Species Act (ESA). The Official Species List identified two federally listed species: the federally endangered northern long-eared bat (*Myotis septentrionalis*, NLEB) and the federally threatened small whorled pogonia (*Isotria medeoloides*), as well as one candidate species, the monarch butterfly (*Danaus plexippus*), as potentially occurring within the proposed project area. There is no critical habitat for any federally listed species identified in the vicinity of the proposed project. The NLEB has the potential to occur throughout New Hampshire. According to the USFWS, suitable summer habitat for NLEB consists of a variety of forested habitats. This species generally prefers closed canopy forest with an open understory. Potential roost trees include live trees or snags, at least 3" in diameter, with exfoliating bark, cracks, crevices, or cavities. Bridges and other structures can also provide suitable roosting habitat. The existing culvert structure was reviewed for evidence of occupancy or usage by bats, and a Bridge/Structure Bat Assessment Form was completed on July 19, 2022. No signs or evidence of bats using the existing structures were observed. NLEB overwinters in hibernacula such as caves and mines. The NHB did not report any known winter hibernacula or maternity roost trees in the vicinity of the project. Tree clearing within the project area would be selective and minimal, and entirely located within 300' of the edge of pavement. The project is eligible for review under the Programmatic Biological Opinion for Transportation Projects in the Range of the Indiana Bat and Northern Long-Eared Bat. The IPaC Determination Key was completed and submitted to USFWS and the USFWS provided a Consistency Letter dated August 30, 2022. A Likely to Adversely Affect determination was made for Northern Long-Eared Bat.

The monarch butterfly is a candidate for listing under the ESA. The USFWS will review the monarch's status each year until resources are available to begin developing a proposal to list the monarch as threatened or endangered under the ESA. The candidate status of the monarch does not provide protection under the ESA, and no further coordination with the USFWS is required at this time. Monarch habitat includes non-forested, non-shrubby areas where there is potential for nectar species (flowering plants) and/or milkweed plants, including, but not limited to, regularly or semi-regularly mowed areas within the ROW and where a clear zone is maintained. The proposed project area includes some potential monarch habitat, but the project would not permanently change that habitat and no monarch conservation measures are included in the project at this time. Following construction, roadside areas would continue to provide potential habitat.

The proposed project was submitted to and reviewed by the New Hampshire Natural Heritage Bureau (NHB) via the online DataCheck Tool to check for state listed rare species and exemplary natural communities The NHB DataCheck Results Letter (NHB22-2366), dated July 28, 2022, indicated that there are documented occurrences of American featherfoil (*Hottonia inflata*), tufted yellow-loosestrife (*Lysimachia thyrsiflora*), American eel (*Anguilla rostrata*), Blanding's turtle (*Emydoidea blandingii*), spotted turtle (*Clemmys guttata*), and wood turtle (*Glyptemys insculpta*) located in the vicinity of the proposed project. A survey for tufted yellow loosestrife was completed on August 27, 2020. No individual plants or populations were observed. A survey for American featherfoil was completed on May 12, 2022. No individual plants or populations were documented in the study area. A survey for small whorled pogonia was completed on July 6, 2022. No individual plants or populations were observed. The current NHB DataCheck Results Letter (NHB24-0428) did not identify any additional occurrences of plants or natural communities of concern.

Coordination with NH Fish & Game has been ongoing since 2019, prior to the implementation of Fis 1004 (see attached correspondence included with this permit application).

The following avoidance and minimization measures will be implemented for wildlife species of concern:

- To avoid impacts to spring anadromous fish spawning runs, particularly of river herring, which have been observed at the NH Route 155 crossing about 1.5 miles downstream of NH Route 125, no in-water work shall occur between April 15 and July 1.
- Wildlife-friendly erosion control measures will be utilized during construction (such as erosion control berm, Filtrexx or equal filter sock, and coco or jute matting).
- Streambed simulation material will be installed over riprap within the channel to improve habitat and aquatic organism passage.
- Wildlife shelves will be incorporated along both banks of the river through the new bridge structure.
- All riprap used on the project will be void-filled riprap.
- Plantings will be provided along the Little River.
- Educational flyers for Blanding's turtle, wood turtle, and spotted turtle will be included in construction contract documents.

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.")

The proposed project is not located within an area identified as Highest Ranked Habitat in NH, or Highest Ranked Habitat in Ecological Region. The project is anticipated to result in substantial improvements in terrestrial wildlife and aquatic organism passage.

4.1 Is the proposed project within the 100-year floodplain of an adjacent river or stream?

FEMA mapped 100-year floodplain (Zone A) associated with the Little River is located upstream and downstream from the existing crossing. The proposed bridge will substantially improve the hydraulic capacity of the crossing. Hydraulic analysis was performed using the USACOE River Analysis System (HEC-RAS) version 5.0.7. The hydraulic model was run for existing and proposed conditions for the 10-, 50-, 100-, and 500-year flood events. Based on the proposed bridge replacement, the freeboard at the 100-year flood event is roughly 7.5 feet. Water velocity during the Q100 storm drops to 5.5 feet/second in the proposed condition. Downstream water surface elevations are largely unaffected by the proposed replacement structure. The project will not result in a loss of flood storage and compensatory flood storage is not proposed. Please see the Hydrologic & Hydraulic Report included elsewhere in this application for additional details.

5. Historic/Archaeological Resources

The proposed project was reviewed under the NHDOT's Section 106 Programmatic Agreement. It was determined that the proposed project has "No Potential to Cause Effects." The Appendix B Certification is included with this submittal.

USACE Wetland Determination Data Forms

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: NH Route 125 over the Little River City/County: Lee / Strafford County Sampling Date: 11/21/2019

Applicant/Owner: NHDOT State: NH Sampling Point: F-UPL

Investigator(s): McFarland Johnson, Inc. (SH, CG) Section, Township, Range: N/A

Landform (hillside, terrace, etc.): Hillslope Local relief (concave, convex, none): Convex Slope %: 10-12

Subregion (LRR or MLRA): LRR R Lat: 43.118759 Long: -71.034250 Datum: NAD83

Soil Map Unit Name: Saugatuck loamy sand NWI classification: UPL

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil X, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___	No X	**Is the Sampled Area within a Wetland?** **Yes** ___ **No** X
Hydric Soil Present?	Yes ___	No X	
Wetland Hydrology Present?	Yes ___	No X	If yes, optional Wetland Site ID: ___

Remarks: (Explain alternative procedures here or in a separate report.)
Disturbed soils along roadway embankment, stone/gravel @ 7"

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9)
___ Aquatic Fauna (B13)
___ Marl Deposits (B15)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres on Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Thin Muck Surface (C7)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes ___	No X	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No X	Depth (inches): ___

Wetland Hydrology Present? **Yes** ___ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: F-UPL

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	15	Yes	FAC
2. *Fagus grandifolia*	7	Yes	FACU
3. *Tsuga canadensis*	7	Yes	FACU
4.			
5.			
6.			
7.			
	29	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1. *Robinia pseudoacacia*	40	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
	40	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Solidago rugosa*	30	Yes	FAC
2. *Danthonia spicata*	15	Yes	UPL
3. *Dichanthelium clandestinum*	10	No	FACW
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	55	=Total Cover	
Woody Vine Stratum (Plot size: 15)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33.3% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	10	x 2 =	20
FAC species	45	x 3 =	135
FACU species	54	x 4 =	216
UPL species	15	x 5 =	75
Column Totals:	124 (A)		446 (B)

Prevalence Index = B/A = 3.60

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** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point F-UPL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-7	10YR 3/3	100					Loamy/Clayey	Sandy Loam / Gravelly

[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)
___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ High Chroma Sands (S11) (**LRR K, L)**
___ 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)
___ Marl (F10) (**LRR K, L**)

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**)
___ 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 (F22)
___ 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** X

Remarks:
This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)
Stone fill/gravel @ 7"

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: NH Route 125 over the Little River City/County: Lee / Strafford County Sampling Date: 11/21/2019

Applicant/Owner: NHDOT State: NH Sampling Point: F-WET

Investigator(s): McFarland Johnson, Inc. (SH, CG) Section, Township, Range: N/A

Landform (hillside, terrace, etc.): Floodplain Local relief (concave, convex, none): Concave Slope %: 0-1

Subregion (LRR or MLRA): LRR R Lat: 43.118716 Long: -71.034206 Datum: NAD83

Soil Map Unit Name: Saugatuck loamy sand NWI classification: PEM

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes X No ___	**Is the Sampled Area**
Hydric Soil Present? Yes X No ___	**within a Wetland? Yes** X **No** ___
Wetland Hydrology Present? Yes X No ___	If yes, optional Wetland Site ID: F

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)

___ Surface Water (A1)	___ Water-Stained Leaves (B9)	
___ High Water Table (A2)	___ Aquatic Fauna (B13)	
X Saturation (A3)	___ Marl Deposits (B15)	
___ Water Marks (B1)	___ Hydrogen Sulfide Odor (C1)	
___ Sediment Deposits (B2)	___ Oxidized Rhizospheres on Living Roots (C3)	
___ Drift Deposits (B3)	___ Presence of Reduced Iron (C4)	
___ Algal Mat or Crust (B4)	___ Recent Iron Reduction in Tilled Soils (C6)	
___ Iron Deposits (B5)	___ Thin Muck Surface (C7)	
___ Inundation Visible on Aerial Imagery (B7)	___ Other (Explain in Remarks)	
___ Sparsely Vegetated Concave Surface (B8)		

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes X	No ___	Depth (inches): 16
Saturation Present? (includes capillary fringe)	Yes X	No ___	Depth (inches): 0

Wetland Hydrology Present? Yes X **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: F-WET

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	15	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	15	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1. *Cornus amomum*	10	Yes	FACW
2. *Spiraea alba*	5	Yes	FACW
3. *Spiraea tomentosa*	2	No	FACW
4.			
5.			
6.			
7.			
	17	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Dichanthelium clandestinum*	40	Yes	FACW
2. *Carex stricta*	25	Yes	OBL
3. *Solidago rugosa*	10	No	FAC
4. *Juncus effusus*	10	No	OBL
5. *Onoclea sensibilis*	5	No	FACW
6. *Lythrum salicaria*	5	No	OBL
7.			
8.			
9.			
10.			
11.			
12.			
	95	=Total Cover	
Woody Vine Stratum (Plot size: 15)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	5	(A)
Total Number of Dominant Species Across All Strata:	5	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	100.0%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	40	x 1 =	40
FACW species	62	x 2 =	124
FAC species	25	x 3 =	75
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	127	(A)	239 (B)

Prevalence Index = B/A = 1.88

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
X 2 - Dominance Test is >50%
X 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** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point F-WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-6	10YR 4/1	85	7.5YR 3/4	15	C	M	Loamy/Clayey	Prominent redox concentrations
6-18	2.5Y 5/2	80	7.5YR 3/4	20	C	M	Sandy	Prominent redox concentrations

[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)
- X Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
- ___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
- ___ High Chroma Sands (S11) (**LRR K, L)**
- ___ Loamy Mucky Mineral (F1) (**LRR K, L**)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Marl (F10) (**LRR K, L**)

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**)
- ___ 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 (F22)
- ___ 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** X **No** ___

Remarks:
This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: NH Route 125 over the Little River City/County: Lee / Strafford County Sampling Date: 11/21/2019

Applicant/Owner: NHDOT State: NH Sampling Point: G-UPL

Investigator(s): McFarland Johnson, Inc. (SH, CG) Section, Township, Range: N/A

Landform (hillside, terrace, etc.): Hillslope Local relief (concave, convex, none): Convex Slope %: 5-7

Subregion (LRR or MLRA): LRR R Lat: 43.118002 Long: -71.035151 Datum: NAD83

Soil Map Unit Name: Saugatuck loamy sand NWI classification: UPL

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation X , Soil X , or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___ No X	**Is the Sampled Area**
Hydric Soil Present?	Yes ___ No X	**within a Wetland?** **Yes** ___ **No** X
Wetland Hydrology Present?	Yes ___ No X	If yes, optional Wetland Site ID: ___

Remarks: (Explain alternative procedures here or in a separate report.)
Disturbed soils - roadway embankment
Disturbed vegetation - utility right-of-way

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)	___ Water-Stained Leaves (B9)	
___ High Water Table (A2)	___ Aquatic Fauna (B13)	
___ Saturation (A3)	___ Marl Deposits (B15)	
___ Water Marks (B1)	___ Hydrogen Sulfide Odor (C1)	
___ Sediment Deposits (B2)	___ Oxidized Rhizospheres on Living Roots (C3)	
___ Drift Deposits (B3)	___ Presence of Reduced Iron (C4)	
___ Algal Mat or Crust (B4)	___ Recent Iron Reduction in Tilled Soils (C6)	
___ Iron Deposits (B5)	___ Thin Muck Surface (C7)	
___ Inundation Visible on Aerial Imagery (B7)	___ Other (Explain in Remarks)	
___ Sparsely Vegetated Concave Surface (B8)		

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Moss Trim Lines (B16)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ Microtopographic Relief (D4)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes ___	No X	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No X	Depth (inches): ___

Wetland Hydrology Present? Yes ___ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION – Use scientific names of plants.

Sampling Point: G-UPL

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
6.			
7.			
		=Total Cover	
Sapling/Shrub Stratum (Plot size: 15)			
1. *Quercus alba*	20	Yes	FACU
2. *Quercus rubra*	15	Yes	FACU
3. *Elaeagnus umbellata*	15	Yes	UPL
4. *Ilex verticillata*	10	No	FACW
5. *Acer rubrum*	10	No	FAC
6. *Spiraea alba*	10	No	FACW
7. *Vaccinium corymbosum*	5	No	FACW
	85	=Total Cover	
Herb Stratum (Plot size: 5)			
1. *Solidago rugosa*	12	Yes	FAC
2. *Rubus hispidus*	5	Yes	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	17	=Total Cover	
Woody Vine Stratum (Plot size: 15)			
1.			
2.			
3.			
4.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 5 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 40.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	30	x 2 =	60
FAC species	22	x 3 =	66
FACU species	35	x 4 =	140
UPL species	15	x 5 =	75
Column Totals:	102 (A)		341 (B)

Prevalence Index = B/A = 3.34

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** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point G-UPL

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features				Texture	Remarks
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
0-3	10YR 3/2	100					Sandy	
3-11	10YR 3/4	100					Sandy	
11-18	10YR 3/6	100					Sandy	

[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)

___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
___ Thin Dark Surface (S9) (**LRR R, MLRA 149B**)
___ High Chroma Sands (S11) (**LRR K, L)**
___ 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)
___ Marl (F10) (**LRR K, L**)

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**)
___ 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 (F22)
___ 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** X

Remarks:
This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

WETLAND DETERMINATION DATA FORM – Northcentral and Northeast Region

Project/Site: NH Route 125 over the Little River City/County: Lee / Strafford County Sampling Date: 11/21/2019

Applicant/Owner: NHDOT State: NH Sampling Point: G-WET

Investigator(s): McFarland Johnson, Inc. (SH, CG) Section, Township, Range: N/A

Landform (hillside, terrace, etc.): Depression Local relief (concave, convex, none): Concave Slope %: 0-1

Subregion (LRR or MLRA): LRR R Lat: 43.117951 Long: -71.035122 Datum: NAD83

Soil Map Unit Name: Saugatuck loamy sand NWI classification: PSS/FO

Are climatic / hydrologic conditions on the site typical for this time of year? Yes X No ___ (If no, explain in Remarks.)

Are Vegetation X , Soil ___ , or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes X No ___

Are Vegetation ___ , Soil ___ , or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No ___	**Is the Sampled Area within a Wetland?** **Yes** X **No** ___
Hydric Soil Present?	Yes X No ___	
Wetland Hydrology Present?	Yes X No ___	If yes, optional Wetland Site ID: G

Remarks: (Explain alternative procedures here or in a separate report.)
Wetland G is a large PSS/FO wetland located along the toe-of-slope of NH Route 125. The PSS portion is located adjacent to the roadway and vegetation is disturbed due to maintenance of a utility line right-of-way. The wetland transitions into a PFO moving further away from the roadway and utility lines. The wetland area drains to Stream H, an intermittent stream originating in Wetland G and tributary to the Little River, with the confluence located in the southeast bridge quadrant.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)	___ Water-Stained Leaves (B9)
X High Water Table (A2)	___ Aquatic Fauna (B13)
X Saturation (A3)	___ Marl Deposits (B15)
___ Water Marks (B1)	___ Hydrogen Sulfide Odor (C1)
___ Sediment Deposits (B2)	___ Oxidized Rhizospheres on Living Roots (C3)
___ Drift Deposits (B3)	___ Presence of Reduced Iron (C4)
___ Algal Mat or Crust (B4)	___ Recent Iron Reduction in Tilled Soils (C6)
___ Iron Deposits (B5)	___ Thin Muck Surface (C7)
___ Inundation Visible on Aerial Imagery (B7)	___ Other (Explain in Remarks)
___ Sparsely Vegetated Concave Surface (B8)	

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Moss Trim Lines (B16)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- X Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ Microtopographic Relief (D4)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No ___	Depth (inches): ___
Water Table Present?	Yes X	No ___	Depth (inches): 2
Saturation Present? (includes capillary fringe)	Yes X	No ___	Depth (inches): 0

Wetland Hydrology Present? **Yes** X **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
Portions of the wetland contained surface water.

VEGETATION – Use scientific names of plants.

Sampling Point: G-WET

Tree Stratum (Plot size: 30)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Acer rubrum*	18	Yes	FAC
2.			
3.			
4.			
5.			
6.			
7.			
	18 =Total Cover		

Sapling/Shrub Stratum (Plot size: 15)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Ilex verticillata*	40	Yes	FACW
2. *Acer rubrum*	20	Yes	FAC
3. *Spiraea alba*	20	Yes	FACW
4. *Betula populifolia*	10	No	FAC
5. *Quercus rubra*	10	No	FACU
6. *Vaccinium corymbosum*	5	No	FACW
7. *Pinus strobus*	3	No	FACU
	108 =Total Cover		

Herb Stratum (Plot size: 5)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Onoclea sensibilis*	5	Yes	FACW
2. *Rubus hispidus*	2	Yes	FACW
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	7 =Total Cover		

Woody Vine Stratum (Plot size: 15)	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: 6 (A)

Total Number of Dominant Species Across All Strata: 6 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	72	x 2 =	144
FAC species	48	x 3 =	144
FACU species	13	x 4 =	52
UPL species	0	x 5 =	0
Column Totals:	133 (A)		340 (B)

Prevalence Index = B/A = 2.56

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 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** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point G-WET

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-4	10YR 2/1	100					Loamy/Clayey	
4-16	10YR 6/1	100					Sandy	

[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)
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___ Sandy Gleyed Matrix (S4)
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___ Stripped Matrix (S6)
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___ Polyvalue Below Surface (S8) (**LRR R, MLRA 149B**)
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___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Marl (F10) (**LRR K, L**)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR K, L, MLRA 149B**)
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___ Red Parent Material (F21)
___ Very Shallow Dark Surface (F22)
___ 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** X **No** ___

Remarks:
This data form is revised from Northcentral and Northeast Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

Photo Log

Photo 1: Little River facing upstream from inlet (November 2019) IMPACT LOCATION(S): A, B, C, D, E, F, G, H, I

Photo 2: Little River (November 2019) IMPACT LOCATION(S): C, D, E, F

Photo 3: Little River facing downstream toward inlet (November 2019) IMPACT LOCATION(S): A, B, C, D, E, F, G, H, I

Photo 2: Little River facing upstream toward outlet of Bridge 074/085 (November 2019) IMPACT LOCATION(S): K, L, M, N, O, P, Q, R, S, T, U, V, W, X

Photo 3: Intermittent stream (November 2019) IMPACT LOCATION(S): AA

Photo 4: Intermittent Stream (November 2019) IMPACT LOCATION(S): J, Y

Photo 5: Wetland G (November 2019) IMPACT LOCATION(S): Z

Construction Sequence

STANDARD DREDGE AND FILL WETLANDS PERMIT APPLICATION
NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION
BRIDGE NO. 073/084 REPLACEMENT
NH ROUTE 125 over LITTLE RIVER
LEE, NEW HAMPSHIRE
MARCH 2024

Anticipated Construction Sequence

Notes:

- The project is anticipated to advertise August 27, 2024.
- The start of construction is anticipated to be in January 2025. Construction will be phased with two lanes of traffic being maintained throughout construction. The first phase of construction will shift traffic to the west side of the bridge to build a temporary diversion to the east. Phase two will shift traffic onto the diversion so that a portion of the new bridge can be built to the west. Phase three will shift traffic onto the new portion of the bridge, and the remaining section of bridge will be built to the east. Phase four will shift traffic to its final configuration on the completed bridge. Bridge construction substantial completion is anticipated by December 2025.
- Final paving and minor slope work (seeding/final grading) will be completed during the spring of 2026.
- The initial stream diversion structure is anticipated to be installed prior to April 15th to accommodate the time of year restriction for in water work associated with diadromous fish migration (no in water work between April 15th and July 1st). The next phase of stream diversion will be installed after July 1st. See stream diversion narrative below for additional information.
- The project will implement the attached turbidity mixing zone.

- The following sequence is preliminary and likely order of construction, but the exact means and methods will ultimately be decided by the selected contractor.

<u>Construction Sequence:</u>

1.) Complete required tree clearing (January 2025)
2.) Complete overhead utility relocations (January/February 2025)
3.) Install appropriate perimeter controls for soil erosion and sediment control (February/March 2025)
4.) Shift traffic to western side of NH Route 125 for construction phase 1 (March 2025)
5.) Install temporary roadway diversion and first phase of stream diversion structure which directs and maintains water in the existing corrugated metal pipe (March/April 2025)
6.) Shift traffic onto the completed temporary diversion (April 2025)
7.) Construct western portion of the bridge and shift traffic upon completion (April – June 2025)
8.) Remove temporary roadway diversion and portions of the exiting abutments (June – July 2025)
9.) Shift stream diversion outside existing pipe via sandbag cofferdams along the proposed realigned channel such that the existing pipe can be removed (July 2025)
10.) Complete stream realignment and install bioengineered stream stabilization components along new stream channel (July-August 2025). Sandbag cofferdams maintaining the river flow will be shifted as needed to complete installation of bioengineered stream stabilization components.
11.) Install remaining portion of the bridge to the east (September – October 2025)
12.) Complete final grading and riprap installation around abutments and wingwalls. Complete approach roadway paving and guardrail installation (October/November 2025)
13.) Remove stream diversion structures (November 2025)
14.) Shift traffic onto completed bridge in final configuration (November 2025)
15.) Complete final wearing course paving, final slope work, seeding, and planting (April/May 2026)
16.) Remove perimeter controls (June 2026)

<u>Little River Description of Stream Diversion Phasing:</u>

<u>Phase 1:</u> Maintain stream flow through existing corrugated metal pipe. Install sandbag cofferdams as needed to direct and maintain flow into the pipe.

Phase 2: Once the first section of the proposed bridge is complete and traffic is shifted onto it, the stream diversion will be reconfigured to redirect the stream flow around the existing metal pipe via sandbag cofferdams (to the south of the existing pipe). This will allow the existing pipe to be removed out of the flow of water from the stream.

Phase 3: The sandbag cofferdams maintaining the flow of the stream will be shifted as needed to complete the installation of streambank stabilization components. Shifts in the location of the sandbags will be completed such that the installation of streambank stabilization components will be complete out of the flow of the stream. The turbidity mixing zone will be utilized, as required, to shift the position of the cofferdams.

Phase 4: Remove stream diversion structures once the proposed stream realignment and all streambank stabilization component installation has been complete.

Maintenance of Intermittent Stream (Southeast Corner of Bridge): The intermittent stream on the southeast corner of the bridge drains the larger wetland to the south of the project into the Little River. During construction, the stream will be routed through a pipe when the area it occupies is required for construction access. The stream channel will be protected from construction vehicles via construction matts.

Turbidity Mixing Zone Designation Plan

TURBIDITY MIXING ZONE DESIGNATION

When implementing this mixing zone, turbidity in the Little River as needed for in-water work and construction discharges, shall be monitored, and controlled as follows to meet New Hampshire Surface Water Quality Standards Env-Wq 1703.11. Such mixing zones shall meet the criteria in New Hampshire Surface Water Quality Standards Env-Wq 1707.02.

1. **Consistency with Env-Wq 1707.02 Criteria for Approval of Mixing Zones:**
   The NHDES may only approve a mixing zone if it:
   - *(a)* *Meets the criteria in Env-Wq 1703.03(c)(1);*
     Adherence to this procedure, environmental commitments made for this project, the contract documents, as applicable, and all necessary environmental permits ensures that the criteria of this rule are met. Any potential impacts shall be limited to a short duration, and low intensity. Additional detail may be found in the **Compliance Summary** section (9) below.
   - *(b)* *Does not interfere with biological communities or populations of indigenous species;*
     Adherence to this procedure, environmental commitments made for this project, the contract documents, as applicable, and all necessary environmental permits ensures that the criteria of this rule are met. Any potential impacts shall be limited to a short duration, and low intensity. Additional detail may be found in the **Compliance Summary** section (9) below.
   - *(c)* *Does not result in the accumulation of pollutant s in the sediment or biota;*
     Adherence to this procedure, environmental commitments made for this project, the contract documents, as applicable, and all necessary environmental permits ensures that the criteria of this rule are met. Additional detail may be found in the **Compliance Summary** section (9) below.
   - *(d)* *Allows a zone of passage for swimming and drifting organisms;*
     Adherence to this procedure, environmental commitments made for this project, the contract documents, as applicable, and all necessary environmental permits ensures that the criteria of this rule are met. Any potential impacts shall be limited to a short duration, and low intensity. Additional detail may be found in the **General Conditions** section (2), and **Compliance Summary** section (9) below.
   - *(e)* *Does not interfere with existing and designated uses of the surface water;*
     Adherence to this procedure, environmental commitments made for this project, the contract documents, as applicable, and all necessary environmental permits ensures that the criteria of this rule are met. Additional detail may be found in the **Compliance Summary** section (9) below.
   - *(f)* *Does not impinge upon spawning grounds or nursery areas, or both, of any indigenous aquatic species;*
     Adherence to this procedure, environmental commitments made for this project, the contract documents, as applicable, and all necessary environmental permits ensures that the criteria of this rule are met. Additional detail may be found in the **General Conditions** section (2), and **Compliance Summary** section (9) below.

(g) *Does not result in the mortality of any plants, animals, humans, or aquatic life within the mixing zone;*
Adherence to this procedure, environmental commitments made for this project, the contract documents, as applicable, and all necessary environmental permits ensures that the criteria of this rule are met. Additional detail may be found in the **General Conditions** section (2), and **Compliance Summary** section (9) below.

(h) *Does not exceed the chronic toxicity value of 1.0 TUc at the mixing zone boundary; and*
This criterion is not applicable to this mixing zone, which is only designated for short term, low intensity turbidity.

(i) *Does not result in an overlap with another mixing zone.*
This mixing zone does not overlap with another mixing zone.

2. General Conditions:

a. All proposed monitoring for turbidity in the waterbody during in-water work, as needed, shall be completed by a qualified Contractor approved by NHDOT and shall be conducted in accordance with the specifications below.
b. All turbidity monitoring measurements, and visual monitoring (with photo documentation) shall be conducted as described in sections below.
c. With NHDOT approval, turbidity measurements using turbidity meters or probes do not need to be made if the Contractor believes that it would be unsafe for personnel to collect turbidity measurements due to conditions such as high-water velocity and/or icy conditions. In these instances, NHDES shall be notified consistent with the **Notification** section (8) below.
d. At the discretion of NHDOT, the use of this mixing zone may be suspended and/or started on an as needed basis. NHDES shall be notified consistent with the **Notification** section (8) below.
e. The proposed mixing zone area will extend from the discharge location to Monitoring Station DS-3 as shown in the figure below in Section 3. All in-water work will be conducted in discrete work zones that will not cause a visible turbid plume that would span the entire width of the channel at any given time. A zone of passage from the discharge location to Monitoring Station DS-3 shall be maintained by implementing the monitoring program described in Section 3 below and implementing the **Required Actions to Control Turbidity** section (4) below.

3. Monitoring Stations and Monitoring Frequency:

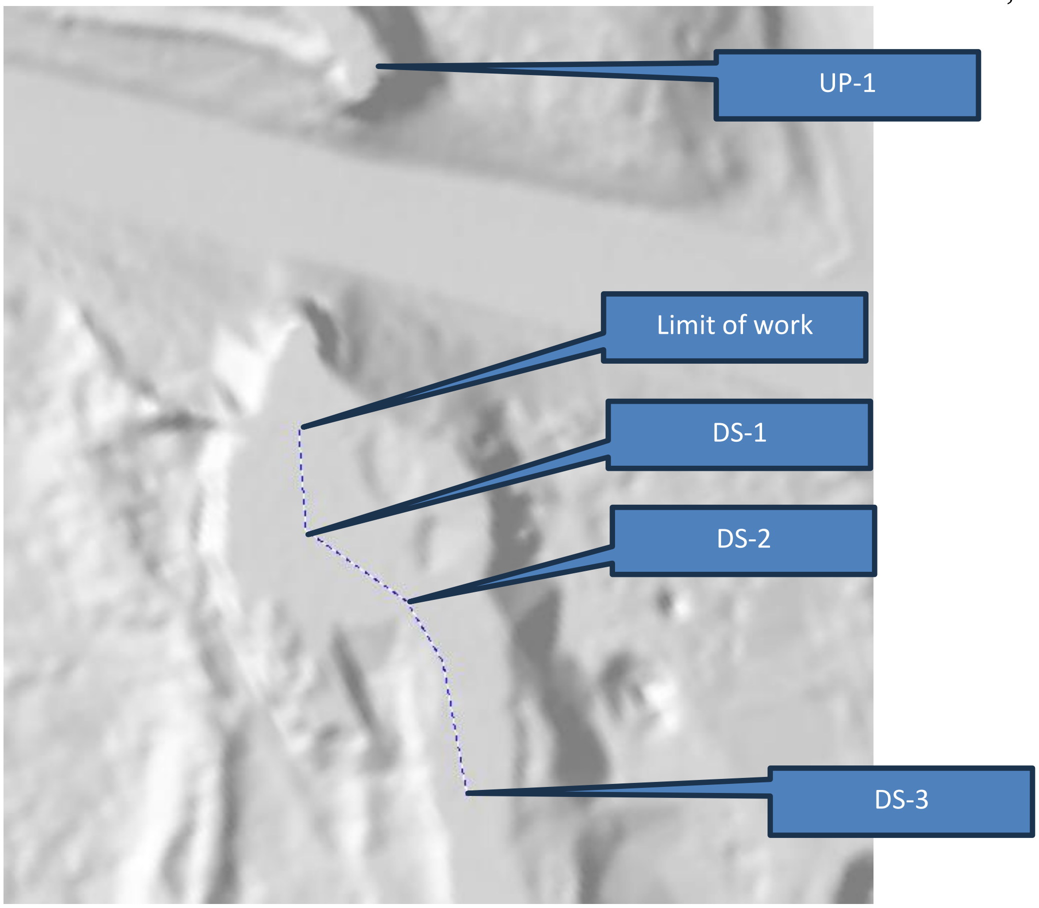
Markers (buoys or similar devices) shall be set up in the waterbody at the locations, and monitored, as described below:

a. **Upstream – Background (UP-1):** A marker designating the background station shall be placed in the waterbody just upstream of the work site in an area not disturbed by the construction activity. The purpose of this station is to provide baseline/background turbidity information. Visual observations with photo-documentation and in-water turbidity measurements shall be taken as follows, each day that in-water work is conducted under this mixing zone, and/or when any construction activity is undertaken that could potentially result in increased in-water turbidity:
    i. Daily prior to the commence of in-water work.

   ii. Midday while in-water work is being performed; and
   iii. Daily at the conclusion of in-water work.

b. **Downstream 1 (DS-1)[1]:** A marker shall be placed 37.5 feet downstream from the work site in the channel. Aquatic organism passage will be assessed at this location. During construction activities that could potentially result in increased in-water turbidity, visual monitoring shall take place every hour.
c. **Downstream 2 (DS-2):** A marker shall be placed 75 feet downstream from the work site in the channel. During construction activities that could potentially result in increased in-water turbidity, monitoring for turbidity shall be conducted as follows:
   i. Visual Monitoring shall take place every hour.
   ii. Turbidity measurements shall be taken hourly if there is visible turbidity.
d. **Downstream 3 (DS-3):** A marker shall be placed 150 feet downstream from the work site. The purpose of this station is to designate the end of the mixing zone and determine compliance with turbidity-related surface water quality standards. At this location, there shall be no visible turbidity, or turbidity measurements in any part of the channel shall not exceed 10 NTUs above the measured background at UP-1. During construction activities that could potentially result in increased in-water turbidity, monitoring for turbidity shall be conducted as follows:
   i. Visual monitoring with photo-documentation shall take place every hour.
   ii. Turbidity measurements shall be taken hourly if there is visible turbidity.
   iii. If there is visible turbidity at DS-2, visual monitoring with photo-documentation and turbidity measurements shall be taken every hour at DS-3 for a minimum of 2 hours after visible turbidity is observed at DS-2.

[1] In some instances, the establishment of a monitoring location for aquatic organism passage (DS-1) may not be applicable due to the nature of the waterbody (e.g. narrow, shallow, or slow-moving watercourse). In these instances, monitoring station DS-1 may be eliminated from the mixing zone, in which case DS-2 would be renamed DS-1, etc. It is still assumed that aquatic organism passage would not be affected provided that the provisions of this mixing zone are implemented, including the general conditions, and corrective actions as outlined herein, and turbidity levels in the discharge are typical for the type of work.



4. **Required Actions to Control Turbidity:**
    a. **DS-1:** If turbidity is visible in more than ¼ of the channel at this station, work shall be assessed immediately to determine the cause of the increased turbidity, and corrective actions shall be taken to limit visible turbidity to no more than ¼ of the channel. It is assumed that if turbidity is visible in more than ¼ of the channel, the turbid discharge could be impacting aquatic organism passage.
    b. **DS-2:** If turbidity is visible in any part of the channel at this station, a turbidity measurement shall be taken. If turbidity is greater than 25 NTUs above background, work shall be assessed immediately to determine the cause of the increased turbidity, and corrective actions shall be taken. It is assumed that if there is visible turbidity at this station, there is a high potential that turbidity will not meet the turbidity water quality standard at DS-3.
    c. **DS-3:** If turbidity is visible in any part of the channel at this compliance station, a turbidity measurement shall be taken within the turbid plume. If the turbidity measurement is greater than 10 NTUs above the background measurement at UP-1, work shall be stopped and assessed immediately to determine the cause of the increased turbidity, and corrective actions shall be taken to bring turbidity levels to no more than 10 NTUs above the background measurement at UP-1. A description of the corrective action(s) shall be included in a monitoring report. The report shall be provided to NHDES consistent with the **Notification** section (8) below.

5. Meter Monitoring Protocols:

Field measurements of turbidity using turbidity meters shall comply with the following:

a. Monitoring frequency at each location shall comply with item 2 above.

b. Results for in water measurements, calibration and QA/QC shall be recorded on field data sheets, as well as the date, time, location, and the names of those conducting the monitoring.

c. Sampling Procedures for Hand-held Meters
   - i. Rinse the sampling container three times with water from the waterbody.
   - ii. Submerge the sampling container a minimum of an arm's length upstream and allow the container to fill. Collect samples approximately one foot below the surface or at mid-depth (whichever is less) by placing a finger or thumb over the container opening, submersing the container to the appropriate depth, and then removing your finger or thumb from the container opening and allowing the container to fill.
   - iii. Do not collect any water immediately adjacent to legs or boots.
   - iv. Ensure that any introduced air bubbles are removed prior to analysis.
   - v. Immediately cap the sample container, measure in the field using a turbidity meter and record results on the field data sheet.

d. Sampling Procedures Using Dataloggers (Optional):
   - i. Dataloggers can be used instead of hand-held meters to automatically collect the majority of near-continuous (i.e., every 15 minutes) turbidity measurements.
   - ii. Dataloggers shall be calibrated according to manufacturer's instructions, with results recorded on the field data sheet.
   - iii. On the same day that dataloggers are deployed as well as prior to and on the same day that dataloggers are retrieved, hand-held turbidity measurements shall be made in the water next to the datalogger for comparison to datalogger results.
   - iv. Dataloggers shall be retrieved, data downloaded, recalibrated, and redeployed at least once every 2 weeks.
   - v. If dataloggers are used, hand-held turbidity meter measurements shall also be taken at least twice per day as a back-up in case the datalogger malfunctions and/or the data (which is downloaded at least once every 2 weeks) is later found to be invalid.

e. Quality Control and Quality Assurance
   - i. Turbidity meters shall have an accuracy of + 2% for readings below 100 NTUs and + 3% for readings above 100 NTUs, and a resolution of ± 0.1 NTU. Prior to monitoring, meter specifications shall be provided to NHDOT for approval.
   - ii. Hand-held meters shall be recalibrated daily with results recorded on the field data sheet.
   - iii. Duplicate samples shall be taken for every 10th sample with results and identification of the duplicate sample clearly identified and recorded on the

field data sheet. If the relative difference[2] between the duplicate measurement and the original measurement exceeds 10%, recalibrate the turbidity meter and re-measure turbidity.

iv. Blank samples shall be taken every 10th sample and recorded on the field data sheet. Blank samples shall be taken by filling a sample container with deionized water and measuring the turbidity immediately following measurement of the 10th sample.

6. **Visual Monitoring with Photo Documentation Protocols:**

Visual monitoring for turbidity and photo documentation shall comply with the following:

a. Visual monitoring results shall be recorded on field data sheets. Field data sheets for visual monitoring shall include the names of the individual conducting the observations, the date, time, location, and result (i.e., visual turbidity or no visual turbidity) of each observation, and the date/time when work was ordered to be stopped and the date/time when work was allowed to resume.
b. Photos of each station shall be taken during each observation. Each photo shall include the date, time, and location.
c. Photos must be taken from a location and angle that will clearly show visible turbidity should it occur. Use of drones for this purpose is allowed. Prior to construction, the Contractor shall provide photos of each monitoring location to NHDOT for approval proving that the proposed method to photograph conditions in-water will clearly show visible turbidity should it occur.

7. **Documentation, Notification and Reporting:**

a. The Contractor shall maintain electronic copies of all field data sheets, datalogger data in MS Excel format (if dataloggers are used) and photos (with date, time, and location) and submit them to NHDOT and/or NHDES within 48 hours of receiving a request.
b. Reports that include the results from the previous week shall be transmitted to NHDOT by Tuesday of the following week. The weekly reports shall include the following:
    i. If turbidity data was not collected, an explanation as to why and when it wasn't collected with supporting information (i.e., gage information showing high flows, photos showing ice build-up, etc.).
    ii. A summary of any data that was collected that did not meet the QA/QC requirements.
    iii. Turbidity meter results including the date, time, and location.

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2 The relative percent difference (RPD) is equal to the following:

$$RPD = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100\%$$

where x_1 is the original sample concentration and x_2 is the replicate sample concentration

iv. The dates, times, locations, and associated photos.
v. The dates and times when work was stopped due to exceedances of any of the criteria above.
vi. The dates, times, associated photos at each location and turbidity meter results, when work was allowed to resume.
vii. The dates, times, and nature of corrective actions.
viii. If dataloggers are used and retrieved the previous week, an MS Excel plot showing all datalogger results with NTUs on the y-axis and time/date on the x-axis.

8. **Notification:**
   a. NHDOT shall be notified **immediately** when turbidity measurements at the downstream mixing zone compliance station D-3 indicate that an exceedance of the surface water quality standard for turbidity has occurred.
   b. NHDES shall be notified **within 24 hours** when it is determined that monitoring cannot be conducted due to unsafe conditions.
   c. If use of this mixing zone has been suspended due to no work that could reasonably cause turbid conditions, or not yet started, NHDES shall be notified **within 24 hours** of the start or resumption of use of this mixing zone.
   d. NHDES shall be notified **within 24 hours** if a failure is discovered in maintaining a zone of passage during in-water work in accordance with General Condition 2e.
   e. Notifications relating to a non-compliance event (identified in Section 8a and 8d above) shall include:
      i. A description of the exceedance,
      ii. The probable cause of the exceedance,
      iii. Corrective actions that were taken, or that will be taken, to address the exceedance, and
      iv. An estimate of the amount of time needed until the exceedance is corrected, if not already corrected.
   f. Notifications shall be submitted to the NHDES Watershed Management Bureau, Judith E. Sears Houston, at judith.e.houston@des.nh.gov, or (603) 271-2983.

9. **Compliance Summary:**
   a. At the mixing zone compliance station DS-3, water quality standards for turbidity shall be met. If turbidity exceeds water quality standards (no more than 10 NTU above background), work shall be stopped, and corrective actions undertaken.
   b. Examples of corrective actions that may be taken by the Contractor, with approval of NHDOT include, but are not limited to:
      i. Work stoppage until turbidity at the end of the mixing zone DS-3 returns to a compliant measurement,
      ii. Stabilizing any un-stabilized soil,
      iii. Modification of construction procedures,
      iv. Evaluation and correction of water quality control measures,
      v. Evaluation and correction of erosion and sediment controls (Stormwater Control Measures (SCM)),
      vi. Enhanced SCM deployment; and/or

vii. Use of other SCMs.

c. Expected in-water measurements of between 50 NTU and 10 NTU above background fall within a range of toxicity that is not acutely toxic to aquatic organisms, meaning that short durations of exposure are not detrimentally harmful.

d. According to the EPA, "*All species of fish and other aquatic life must tolerate a range of dissolved solids concentrations in order to survive under natural conditions… Major increases in stream suspended solids (25 ppm [7 NTU] turbidity upstream versus 390 ppm [114 NTU] downstream) caused smothering of bottom invertebrates, reducing organism density to only 7.3 per square foot versus 25.5 per square foot upstream (Tebo, 1955)…"*Quality Criteria for Water 1986, EPA, Publication 440/5-86-001, May 1, 1986 p270 (https://www.epa.gov/sites/default/files/2018-10/documents/quality-criteria-water-1986.pdf).

e. NOAA reports here: Section 7 Effect Analysis: Turbidity in the Greater Atlantic Region | NOAA Fisheries that, "S*tudies of the effects of turbid water on fish suggest that concentrations of suspended sediment can reach thousands of milligrams per liter [1,000 mg/L = 292 NTU] before an acute toxic reaction is expected (Burton 1993)"*

f. The use of short duration construction turbidity mixing zones is limited to:
   i. Daily, only when needed;
   ii. Suspension at the completion of each day of work; and
   iii. Used only during active construction discharges and associated in-water construction operations.

Wetland Impact and Erosion Control Plan Set

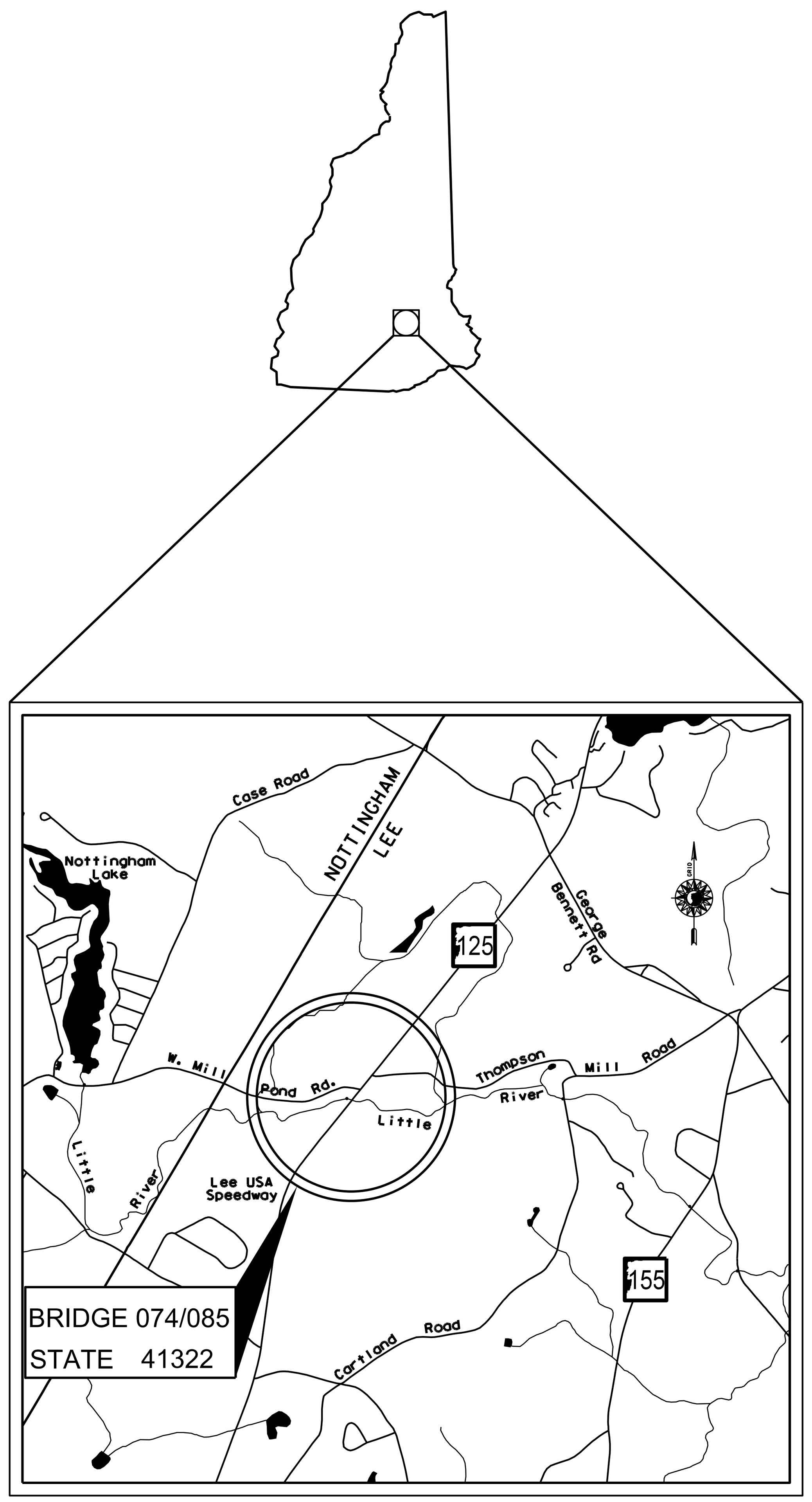
STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION

WETLANDS PLANS
FEDERAL AID PROJECT

X-A004(593)
NH PROJECT NO. 41322
N.H. ROUTE 125

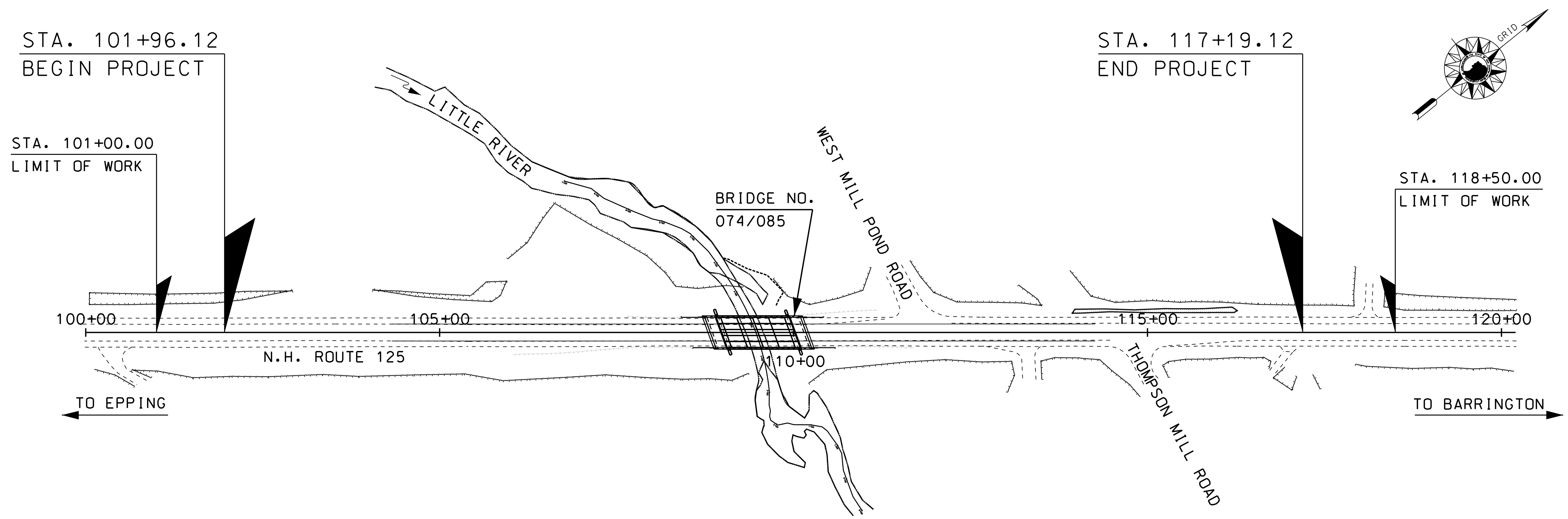
NH ROUTE 125
DESIGN DATA

AVERAGE DAILY TRAFFIC 2019	18,900
AVERAGE DAILY TRAFFIC 2039	23,050
PERCENT OF TRUCKS	10%
DESIGN SPEED	60 MPH
LENGTH OF PROJECT	0.3 MILES



LOCATION MAP

1/2 1/4 0 1/2 1 mi.
GRAPHIC SCALE



TOWN OF LEE
COUNTY OF STRAFFORD
SCALE: 100:1

APRIL 16, 2024

DRAWN BY M. LOVETTE DATE 10/27/22
CHECKED BY S. WHITE DATE 10/27/22

PLANS PREPARED BY
McFarland Johnson
McFARLAND JOHNSON
53 REGIONAL DRIVE
CONCORD, N.H. 03301
(603)225-2978

STATE OF NEW HAMPSHIRE SAMUEL L. WHITE No. 15586 LICENSED PROFESSIONAL ENGINEER 12/5/23

STATE OF NEW HAMPSHIRE STEPHEN C. HOFFMANN No. 00306 CERTIFIED WETLAND SCIENTIST

WETLANDS AND SURFACE WATERS WERE DELINEATED BY MCFARLAND JOHNSON, INC. IN NOVEMBER 2019, IN ACCORDANCE WITH THE CORPS OF ENGINEERS WETLAND DELINEATION MANUAL AND THE REGIONAL SUPPLEMENT TO THE CORPS OF ENGINEERS WETLAND DELINEATION MANUAL NORTHCENTRAL AND NORTHEAST REGION, VERSION 2.0 (JANUARY 2012).

FOR CONSTRUCTION AND ALIGNMENT DETAILS - SEE CONSTRUCTION PLANS

NHDOT THE STATE OF NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION

RECOMMENDED FOR APPROVAL:

DIRECTOR OF PROJECT DEVELOPMENT DATE

MUNICIPAL HIGHWAYS ENGINEER
BUREAU OF PLANNING AND COMMUNITY ASSISTANCE DATE

APPROVED:

ASSISTANT COMMISSIONER AND CHIEF ENGINEER DATE

DRAWING NAME	FEDERAL PROJECT NO.	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
41322Cover	X-A004(593)	41322	1	17

GENERAL

	PROPOSED ROADWAY	existing roadway	(pavement removed outside slope lines)
EDGE OF PAVEMENT			
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)
FINISHED GRADE ELEVATION (RIGHT) — 72.5 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	41322sym1-2	41322	2	17

DRAINAGE

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

BOUNDARIES / RIGHT-OF-WAY

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

UTILITIES

existing — PROPOSED

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

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

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

TRAFFIC SIGNALS / ITS

existing — PROPOSED

MAST ARM (existing) — 30' MA (NOTE ANGLE FROM ℄)
OPTICOM RECEIVER
OPTICOM STROBE
TRAFFIC SIGNAL
PEDESTAL WITH PEDESTRIAN SIGNAL HEADS AND PUSH BUTTON UNIT
SIGNAL CONDUIT — C — C — C — PC — PC — 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 — 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	41322sym1-2	41322	3	17

WETLAND IMPACT SUMMARY - NEW HAMPSHIRE												
			AREA IMPACTS						LINEAR STREAM IMPACTS FOR MITIGATION			
			PERMANENT						PERMANENT			
WETLAND NUMBER	WETLAND CLASS-IFICATION	LOCATION	N.H.W.B (NON-WETLAND)		A.C.O.E. (WETLAND)		TEMPORARY		BANK LEFT	BANK RIGHT	CHANNEL	COMMENTS
			SF	LF	SF	LF	SF	LF	LF	LF	LF	
1	BANK	A					619	57				TEMPORARY IMPACTS - ACCESS TO COMPLETE STREAMBANK GRADING/PLANTINGS & STREAMBED SIMULATION MATERIAL INSTALL
3	R2UB2H	B					847	23				TEMPORARY IMPACTS - ACCESS TO INSTALL WATER DIVERSION & STREAMBED SIMULATION MATERIAL
3	R2UB2H	C			620	31					31	PERMANENT STREAM IMPACTS - CHANNEL REALIGNMENT & STREAMBED SIMULATION MATERIAL INSTALL
2	BANK	D					313	58				TEMPORARY BANK IMPACTS - ACCESS TO REALIGN STREAM CHANNEL & INSTALL CHANNEL STABILIZATION ITEMS
2	BANK	E	191	80					80			PERMANENT BANK IMPACTS - CHANNEL REALIGNMENT
3	R2UB2H	F			1062	55					55	PERMANENT STREAM IMPACTS - STREAM REALIGNMENT & ROOTWAD & FABRIC-ENCAPSULATED SOIL LIFT CHANNEL STABILIZATION
1	BANK	G	47	25						25		PERMANENT BANK IMPACTS - STREAM REALIGNMENT & ROOTWAD & FABRIC-ENCAPSULATED SOIL LIFT CHANNEL STABILIZATION
1	BANK	H	239	35						35		PERMANENT BANK IMPACTS - CHANNEL REALIGNMENT & STREAMBED SIMULATION MATERIAL INSTALL
1	BANK	I	138	12						12		PERMANENT BANK IMPACTS - CHANNEL REALIGNMENT & FABRIC-ENCAPSULATED SOIL LIFT INSTALLATION
5	R4SBC	J					196	35				TEMPORARY STREAM IMPACTS - ACCESS TO COMPLETE FINAL CHANNEL GRADING, TEMPORARY UTILITY RELOCATION, COFFERDAM INSTALL
1	BANK	K					9	8				TEMPORARY BANK IMPACTS - TEMPORARY ROADWAY DIVERSION & ACCESS FOR FINAL GRADING
3	R2UB2H	L			16	5					5	PERMANENT STREAM IMPACTS - STREAM REALIGNMENT & STREAMBED SIMULATION INSTALLATION
1	BANK	M	105	18						18		PERMANENT BANK IMPACTS - STREAM REALIGNMENT & FABRIC-ENCAPSULATED SOIL LIFT CHANNEL STABILIZATION
3	R2UB2H	N			16	6					6	PERMANENT STREAM IMPACTS - STREAM REALIGNMENT & FABRIC-ENCAPSULATED SOIL LIFT CHANNEL STABILIZATION
1	BANK	O	3	4						4		PERMANENT BANK IMPACTS - STREAM REALIGNMENT & FABRIC-ENCAPSULATED SOIL LIFT CHANNEL STABILIZATION
3	R2UB2H	P			359	19					19	PERMANENT STREAM IMPACTS - STREAM REALIGNMENT & STREAMBED SIMULATION INSTALLATION
4	PEM1E	Q			509							PERMANENT WETLAND IMPACTS - STREAM REALIGNMENT & FABRIC-ENCAPSULATED SOIL LIFT CHANNEL STABILIZATION
3	R2UB2H	R			65	19					19	PERMANENT STREAM IMPACTS - STREAM REALIGNMENT & FABRIC-ENCAPSULATED SOIL LIFT CHANNEL STABILIZATION
2	BANK	S	12	6					6			PERMANENT BANK IMPACTS - FILL ASSOCIATED WITH STREAM REALIGNMENT
2	BANK	T					92	17				TEMPORARY BANK IMPACTS - CONSTRUCTION ACCESS TO COMPLETE STREAM REALIGNMENT AND ROOTWAD STRUCTURE INSTALL
3	R2UB2H	U					101	12				TEMPORARY STREAM IMPACTS - CONSTRUCTION ACCESS TO COMPLETE STREAM REALIGNMENT AND ROOTWAD STRUCTURE INSTALL
4	PEM1E	V					455					TEMPORARY WETLAND IMPACTS - CONSTRUCTION ACCESS TO COMPLETE STREAM REALIGNMENT AND ROOTWAD STRUCTURE INSTALL
3	R2UB2H	W					571	16				TEMPORARY STREAM IMPACTS - ACCESS FOR WATER DIVERSION & STREAMBED SIMULATION MATERIAL INSTALL
1	BANK	X					6	4				TEMPORARY BANK IMPACTS - ACCESS FOR WATER DIVERSION AND FINAL STREAM REALIGNMENT GRADING
6	PSS1/FO1E	Y					359					TEMPORARY WETLAND IMPACTS - ACCESS FOR WATER DIVERSION, FINAL STREAM REALIGNMENT GRADING, PERIMETER CONTROL, & UTILITY RELOCATION
6	PSS1/FO1E	Z					3147					TEMPORARY WETLAND IMPACTS - ACCESS FOR WATER DIVERSION, FINAL STREAM REALIGNMENT GRADING, PERIMETER CONTROL, & UTILITY RELOCATION
5	R4SBC	AA					529	122				TEMPORARY STREAM IMPACTS - ACCESS FOR WATER DIVERSION, FINAL STREAM REALIGNMENT GRADING, PERIMETER CONTROL, & UTILITY RELOCATION
		TOTAL	735	180	2647	135	7244	352	86	94	135	

NEW HAMPSHIRE IMPACTS

PERMANENT IMPACTS: 3,382 SF
TEMPORARY IMPACTS: 7,244 SF
TOTAL IMPACTS: 10,626 SF

LITTLE RIVER CLASSIFICATION:
R2UB2H (RIVERINE, LOWER PERENNIAL, UNCONSOLIDATED BOTTOM, SAND, PERMANENTLY FLOODED)

UNNAMED INTERMITTENT STREAM CLASSIFICATION:
R4SBC (RIVERINE, INTERMITTENT, STREAM BED, SEASONALLY FLOODED)

WETLAND CLASSIFICATIONS:
PEM1E (PALUSTRINE, EMERGENT, PERSISTENT, SEASONALLY FLOODED/SATURATED)

PSS1/FO1E (PALUSTRINE, SCRUB-SHRUB, BROAD-LEAVED DECIDUOUS / FORESTED, BROAD-LEAVED DECIDUOUS, SEASONALLY FLOODED/SATURATED)

NOT TO SCALE

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
41322wetsum	41322	4	17

REVISIONS AFTER PROPOSAL: DESCRIPTION | STATION | STATION | DATE | NUMBER

SDR PROCESSED M. LOVETT DATE 08/31/23
NEW DESIGN S. LISTER DATE 08/31/23
SHEET CHECKED S. IRELAND DATE 08/31/23
AS BUILT DETAILS DATE

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

* BRIDGE SUPERSTRUCTURE NOT SHOWN FOR CLARITY *

REVISIONS AFTER PROPOSAL			
NUMBER	DATE	STATION	DESCRIPTION

SDR PROCESSED	M. LOVETT	DATE	08≤31≤23
NEW DESIGN	S. LISTER	DATE	08≤31≤23
SHEET CHECKED	S. IRELAND	DATE	08≤31≤23
AS BUILT DETAILS		DATE	

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF BRIDGE DESIGN

WETLAND PLAN 01

McFarland Johnson

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
41322WetlandPln	41322	5	17

EROSION CONTROL NOTES AND STRATEGIES

1. Erosion Control/Stormwater Control Selection, Sequencing and Maintenance
   - 1.1. Comply with RSA 485-A:17 Terrain Alteration.
   - 1.2. Install and maintain all erosion control/stormwater controls in accordance with the New Hampshire Stormwater Management Manual, Volume 3, Erosion and Sediment Controls During Construction, December 2008 (BMP Manual), available from the NH Department of Environmental Services (NHDES).
   - 1.3. Install erosion control/stormwater control measures prior to the start of work and in accordance with the manufacturer's recommendations.
   - 1.4. Select erosion control/stormwater control measures based on the size and nature of the project and physical characteristics of the site, including slope, soil type, vegetative cover, and proximity to jurisdictional areas.
   - 1.5. Install perimeter controls prior to earth disturbing activities.
   - 1.6. Install stormwater treatment ponds and drainage swales before rough grading the site.
   - 1.7. Clean, replace, and augment stormwater control measures and infiltration basins as necessary to prevent sedimentation beyond project limits throughout the project duration.
   - 1.8. Inspect erosion and sediment control measures in accordance with Section 645 of the specifications, weekly, and within 24 hours (during normal work hours), of any storm event greater than 0.25 inches of rain in a 24-hour period.
   - 1.9. Contain stockpiles with temporary perimeter controls. Protect inactive soil stockpiles with soil stabilization measures (temporary erosion control seed mix and mulch, soil binder) or cover them with anchored tarps. If the stockpile is to remain undisturbed for more than 14 days, mulch the stockpile.
   - 1.10. Maintain temporary erosion and stormwater control measures in place until the area has been permanently stabilized.
   - 1.11. An area is considered stable if one of the following has occurred:
     - Base course gravels have been installed in areas to be paved;
     - A minimum of 85% vegetative growth has been established;
     - A minimum of 3"of non-erosive material such as stone or rip-rap has been installed;
     - Temporary slope stabilization has been properly installed (see Table 1).
   - 1.12. Direct runoff to temporary practices until permanent stormwater infrastructure is constructed and stabilized.
   - 1.13. 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.
   - 1.14. Plan activities to account for sensitive site conditions
     - Sequence construction to limit the duration and area of exposed soils.
     - Clearly flag areas to be protected in the field and provide construction barrier to prevent trafficking outside of work areas.
     - Protect and maximize existing native vegetation and natural forest buffers between construction activities and sensitive areas.
     - When work is undertaken in a flowing watercourse, implement stream flow diversion methods prior to any excavation or filling activity.
   - 1.15. Utilize storm drain inlet protection to prevent sediment from entering a storm drainage system prior to the permanent stabilization of the contributing disturbed area.
   - 1.16. Use care to ensure that sediments do not enter any existing catch basins during construction. Place temporary inlet protection at inlets in areas of soil disturbance that are subject to sedimentation.
   - 1.17. Construct, stabilize, and maintain temporary and permanent ditches in a manner that will minimize scour. Direct temporary and permanent ditches to drain to sediment basins or stormwater collection areas.
   - 1.18. Supplement channel protection measures with perimeter control measures when ditch lines occur at the bottom of long fill slopes. Install the perimeter controls on the fill slope to minimize the potential for fill slope sediment deposits in the ditch line.
   - 1.19. Divert sediment laden water away from drainage inlet structures to the extent possible.
   - 1.20. Install sediment barriers and sediment traps at drainage inlets to prevent sediment from entering the drainage system.
   - 1.21. Clean catch basins, drainage pipes, and culverts if significant sediment is deposited.
   - 1.22. Construct and stabilize dewatering infiltration basins prior to any excavation that may require dewatering.
   - 1.23. Place and stabilize temporary sediment basins or traps at locations where concentrated flow (channels and pipes) discharge to the surrounding environment from areas of unstabilized earth disturbing activities.
   - 1.24. Stabilize, to appropriate anticipated velocities, conveyance channels or pumping systems needed to convey construction stormwater to basins and discharge locations prior to use.
   - 1.25. Size temporary sediment basins to contain the 2-year, 24 hour storm event.
   - 1.26. Size temporary sediment traps to contain 3,600 cubic feet of storage for each acre of drainage area.
   - 1.27. Construct detention basins to accommodate the 2-year, 24-hour storm event.

2. Construction Planning
   - 2.1. Divert off site runoff or clean water away from the construction activities to reduce the volume that needs to be treated on site.
   - 2.2. Divert storm runoff from upslope drainage areas away from disturbed areas, slopes and around active work areas to a stabilized outlet location.
   - 2.3. Construct impermeable barriers, as necessary, to collect or divert concentrated flows from work or disturbed areas.
   - 2.4. Locate staging areas and stockpiles outside of wetlands jurisdiction.
   - 2.5. Do not store, maintain, or repair mobile heavy equipment in wetlands, unless equipment cannot be practicably removed and secondary containment is provided.
   - 2.6. Provide a water truck to control excessive dust, at the discretion of the Contract Administrator.

3. Site Stabilization
   - 3.1. Stabilize all areas of unstabilized soil as soon as practicable, but no later than 45 days after initial disturbance.
   - 3.2. Limit unstabilized soil to a maximum of 5 acres unless documentation is provided that demonstrates that cuts and fills are such that 5 acres is unreasonable.
   - 3.3. Use erosion control seed mix in all inactive construction areas that will not be permanently seeded within two weeks of disturbance and prior to September 15th of any given year in order to achieve vegetative stabilization prior to the end of the growing season.
   - 3.4. Apply, and reapply as necessary, soil tackifiers in accordance with the manufacturer's specifications to minimize soil and mulch loss until permanent vegetation is established.
   - 3.5. Stabilize basins, ditches and swales prior to directing runoff to them.
   - 3.6. Stabilize roadway and parking areas within 72 hours of achieving finished grade.
   - 3.7. Stabilize cut and fill slopes within 72 hours of achieving finished grade.
   - 3.8. When temporarily stabilizing soils and slopes, utilize the techniques outlined in Table 1.
   - 3.9. Stabilize all areas that can be stabilized prior to opening up new areas to construction activities.
   - 3.10. Utilize Table 1 when selecting temporary soil stabilization measures.
   - 3.11. Divert off-site water through the project in an appropriate manner so as not to disturb the upstream or downstream soils, vegetation or hydrology beyond the permitted area.
   - 3.12. Install and maintain construction exits anywhere traffic leaves a construction site onto a public right-of-way.
   - 3.13. Sweep all construction related debris and soil from the adjacent paved roadways, as necessary.

4. Slope Protection
   - 4.1. Intercept and divert storm runoff from upslope drainage areas away from unprotected and newly established areas and slopes to a stabilized outlet or conveyance.
   - 4.2. Consider how groundwater seepage on cut slopes may impact slope stability and incorporate appropriate measures to minimize erosion.
   - 4.3. Convey storm water down the slope in a stabilized channel or slope drain.
   - 4.4. The outer face of the fill slope should be in a loose, ruffled condition prior to turf establishment.

5. Winter Construction
   - 5.1. To minimize erosion and sedimentation impacts, limit the extent and duration of winter excavation and earthwork activities. The maximum amount of disturbed earth shall not exceed a total of 5 acres from May 1st through October 15th, 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 contractor's Critical Path Method (CPM) schedule, and the contractor has adequate resources available to ensure that environmental requirements will be met.
   - 5.2. Construction performed any time between October 15th and May 1st of any year is considered winter construction. During winter construction:
     - Stabilize all proposed vegetation areas which do not exhibit a minimum of 85% vegetative growth by October 15th, or which are disturbed after October 15th, in accordance with Table 1.
     - Stabilize all ditches or swales which do not exhibit a minimum of 85% vegetative growth by October 15th, or which are disturbed after October 15th, in accordance with Table 1.
     - Protect incomplete road surfaces, where base course gravels have not been installed, and where work has stopped for the season after October 15th, in accordance with Table 1.
     - Unless a winter construction plan has been approved by NHDOT, conduct winter excavation and earthwork such that no more than 1 acre of the project is without stabilization an any one time.

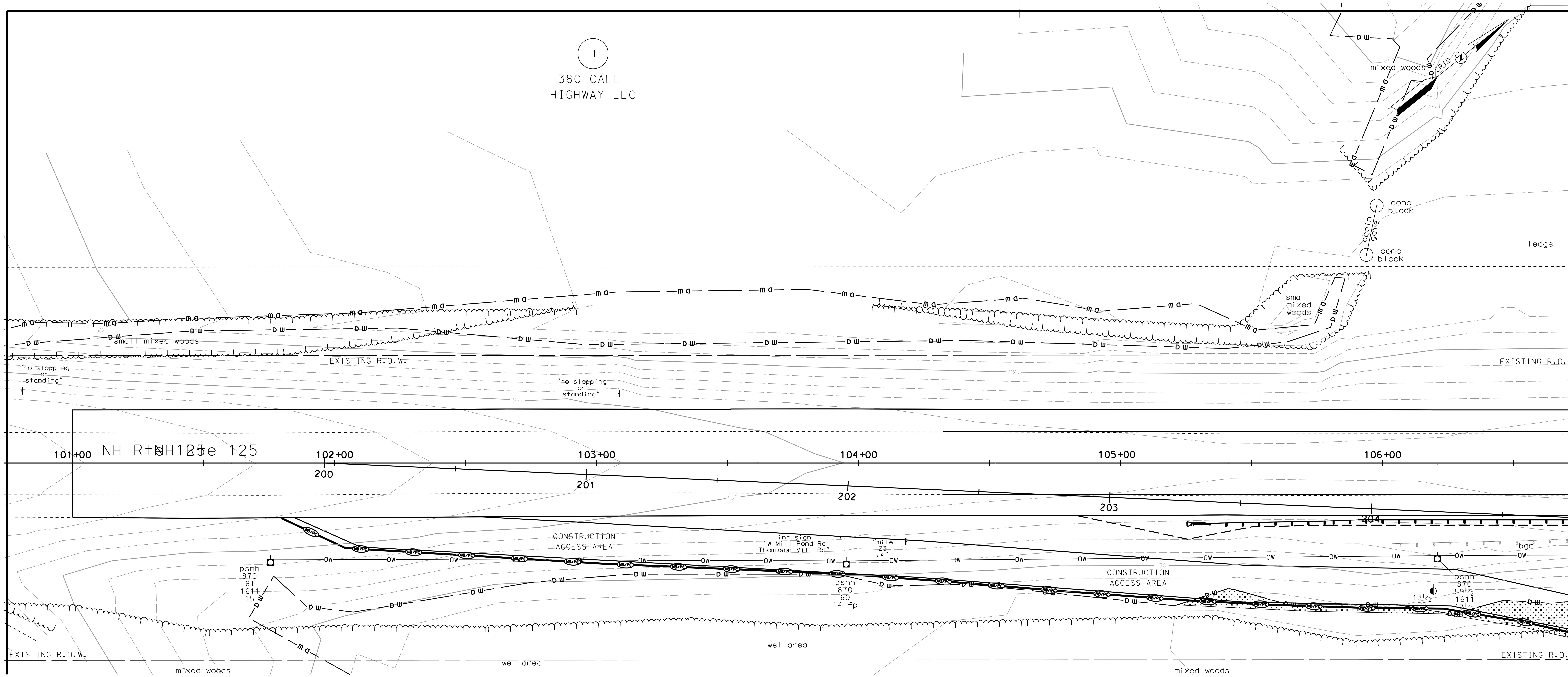
6. Wildlife Protection Measures
   - 6.1. Report all observations of threatened and endangered species on the project site to the Department's Bureau of Environment by phone at 603-271-3226 or by email at Bureau16@dot.nh.gov, indicating in the subject line the project name, number, and that a threatened/endangered species was found.
   - 6.2. Photograph the observed species and nearby elements of habitat or areas of land disturbance and provide them to the Department's Bureau of Environment at the above email address.
   - 6.3. In the event that a threatened or endangered species is observed on the project during work, the species shall not be disturbed, handled, or harmed prior to receiving direction from the Bureau of Environment.
   - 6.4. Utilize wildlife friendly erosion control methods when:
     - Erosion control blankets are used,
     - A protected species or habitat is documented,
     - The proposed work is in or adjacent to a priority resource area, and/or when specifically requested by NHB or NHF&G

GUIDANCE ON SELECTING TEMPORARY SOIL STABILIZATION MEASURES
TABLE 1

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	YES1	YES1	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. Do not apply products containing polyacrylamide (PAM) directly to, or within 100 feet of any surface water without NHDES approval.
3. Install all methods in Table 1 per the manufacturer's recommendation for time of year and steepness of slope.



EROSION CONTROL PLAN LEGEND

PERIMETER CONTROL
- SILT FENCE
- EROSION CONTROL MIX BERM
- EROSION CONTROL MIX SOX
- TURBIDITY CURTAIN
- SHEET PILE
- COFFER DAM

NATURAL BUFFER/PERIMETER CONTROL
- SILT FENCE
- EROSION CONTROL MIX BERM
- EROSION CONTROL MIX SOX
- TURBIDITY CURTAIN
- SHEET PILE
- COFFER DAM

CHANNEL PROTECTION
- STONE CHECK DAMS
- STRAW WATTLES
- CHANNEL MATTING
- CLASS D EROSION STONE
- CLASS C STONE

STREAM DIVERSION
- DRAIN THROUGH PIPE OR CHANNEL

UNIMPACTED RIVERINE SURFACE WATERS
- NO WORK AND/OR IMPACT

ROUTINE ROADWAY QUALIFYING ACTIVITY
- NO WORK AND/OR IMPACT

NOTES

1. NO WORK SHALL BE CONDUCTED OUTSIDE OF THE EXISTING ROW UNTIL TEMPORARY CONSTRUCTION EASEMENTS HAVE BEEN OBTAINED.

2. THE CONCRETE WASHOUT AREA SHALL BE IN AN UPLAND & 20FT FROM ANY WETLANDS OR SURFACE WATERS IN ACCORDANCE WITH THE PROJECT PERMITS AND NHDES WETLAND RULES.

3. CONSTRUCTION MATS SHALL BE PLACED IN ACCORDANCE WITH NHDES WETLAND RULES ENV-WT 307.05(A), ENV-WT 307.11(K), ENV-WT 307.15, AND ENV-WT 521.05(E).

20 0 20 40
SCALE IN FEET

McFarland Johnson

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

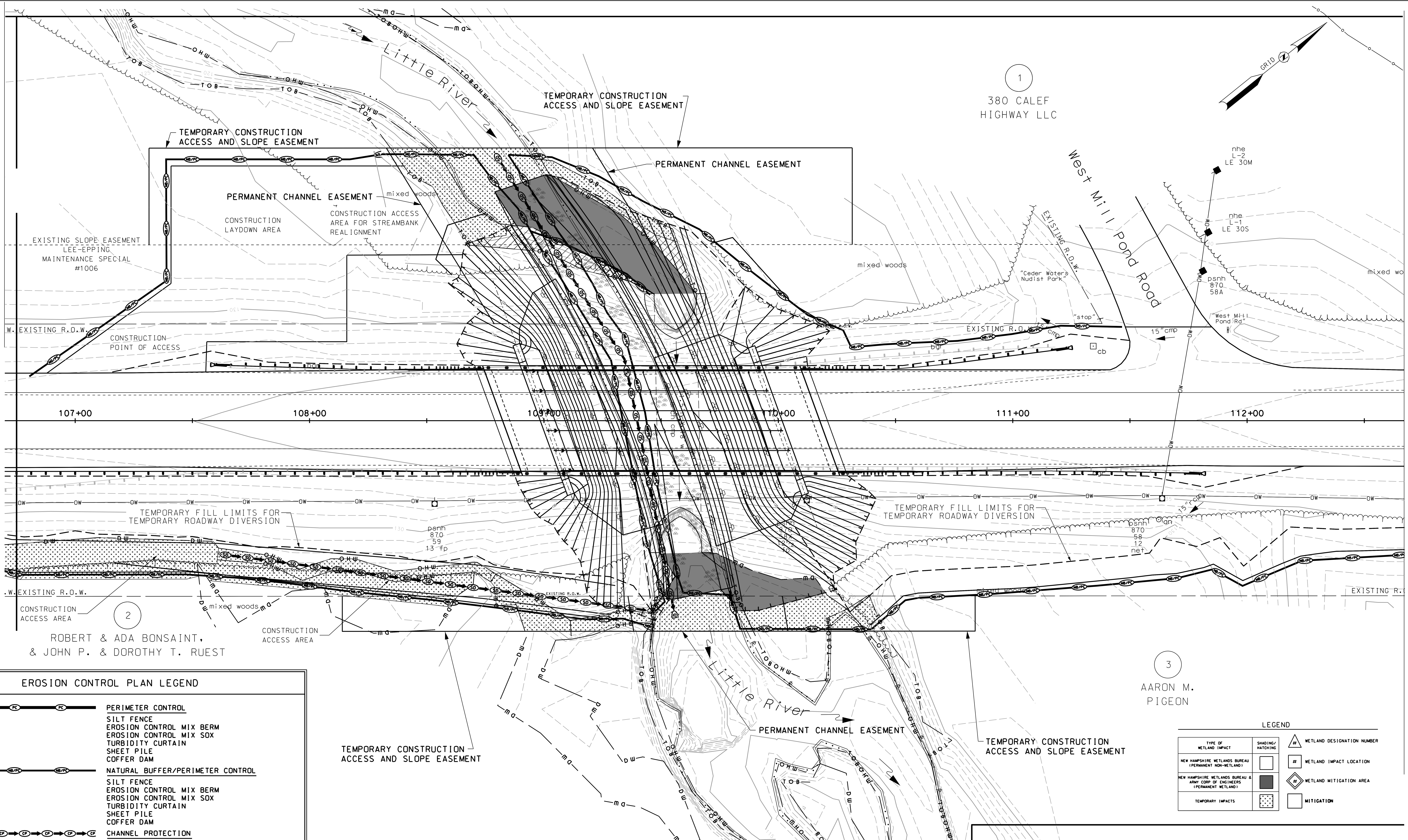
EROSION CONTROL PLAN 01

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
41322eroplans	41322	7	17

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED	M. LOVETT	DATE 08\31\23
NEW DESIGN	S. LISTER	DATE 08\31\23
SHEET CHECKED	S. IRELAND	DATE 08\31\23
AS BUILT DETAILS		DATE



EROSION CONTROL PLAN LEGEND

PERIMETER CONTROL
SILT FENCE
EROSION CONTROL MIX BERM
EROSION CONTROL MIX SOX
TURBIDITY CURTAIN
SHEET PILE
COFFER DAM

NATURAL BUFFER/PERIMETER CONTROL
SILT FENCE
EROSION CONTROL MIX BERM
EROSION CONTROL MIX SOX
TURBIDITY CURTAIN
SHEET PILE
COFFER DAM

CHANNEL PROTECTION
STONE CHECK DAMS
STRAW WATTLES
CHANNEL MATTING
CLASS D EROSION STONE
CLASS C STONE

STREAM DIVERSION
DRAIN THROUGH PIPE OR CHANNEL

UNIMPACTED RIVERINE SURFACE WATERS
NO WORK AND/OR IMPACT

ROUTINE ROADWAY QUALIFYING ACTIVITY
NO WORK AND/OR IMPACT

NOTES

1. NO WORK SHALL BE CONDUCTED OUTSIDE OF THE EXISTING ROW UNTIL TEMPORARY CONSTRUCTION EASEMENTS HAVE BEEN OBTAINED.

2. THE CONCRETE WASHOUT AREA SHALL BE IN AN UPLAND & 20FT FROM ANY WETLANDS OR SURFACE WATERS IN ACCORDANCE WITH THE PROJECT PERMITS AND NHDES WETLAND RULES.

3. CONSTRUCTION MATS SHALL BE PLACED IN ACCORDANCE WITH NHDES WETLAND RULES ENV-WT 307.05(A), ENV-WT 307.11(K), ENV-WT 307.15, AND ENV-WT 521.05(E).

20 0 20 40
SCALE IN FEET

McFarland Johnson

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

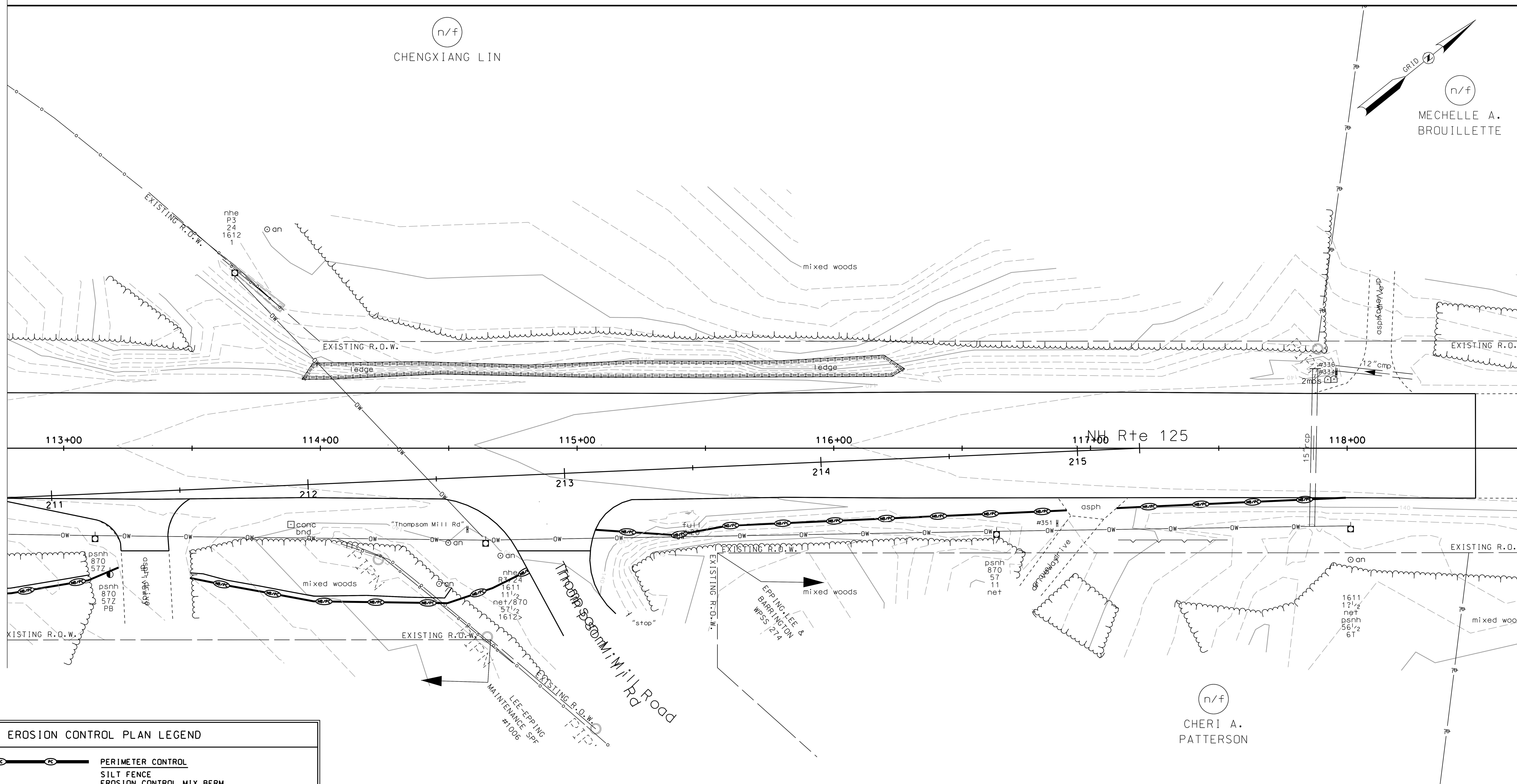
EROSION CONTROL PLAN 02

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
41322eroplans	41322	8	17

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED M. LOVETT	DATE 08\31\23	
NEW DESIGN S. LISTER	DATE 08\31\23	
SHEET CHECKED S. IRELAND	DATE 08\31\23	
AS BUILT DETAILS	DATE	



EROSION CONTROL PLAN LEGEND

PERIMETER CONTROL
SILT FENCE
EROSION CONTROL MIX BERM
EROSION CONTROL MIX SOX
TURBIDITY CURTAIN
SHEET PILE
COFFER DAM

NATURAL BUFFER/PERIMETER CONTROL
SILT FENCE
EROSION CONTROL MIX BERM
EROSION CONTROL MIX SOX
TURBIDITY CURTAIN
SHEET PILE
COFFER DAM

CHANNEL PROTECTION
STONE CHECK DAMS
STRAW WATTLES
CHANNEL MATTING
CLASS D EROSION STONE
CLASS C STONE

STREAM DIVERSION
DRAIN THROUGH PIPE OR CHANNEL

UNIMPACTED RIVERINE SURFACE WATERS
NO WORK AND/OR IMPACT

ROUTINE ROADWAY QUALIFYING ACTIVITY
NO WORK AND/OR IMPACT

NOTES

1. NO WORK SHALL BE CONDUCTED OUTSIDE OF THE EXISTING ROW UNTIL TEMPORARY CONSTRUCTION EASEMENTS HAVE BEEN OBTAINED.

2. THE CONCRETE WASHOUT AREA SHALL BE IN AN UPLAND & 20FT FROM ANY WETLANDS OR SURFACE WATERS IN ACCORDANCE WITH THE PROJECT PERMITS AND NHDES WETLAND RULES.

3. CONSTRUCTION MATS SHALL BE PLACED IN ACCORDANCE WITH NHDES WETLAND RULES ENV-WT 307.05(A), ENV-WT 307.11(K), ENV-WT 307.15, AND ENV-WT 521.05(E).

20 0 20 40
SCALE IN FEET

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCCESSED M. LOVETT DATE 08/31/23
NEW DESIGN S. LISTER DATE 08/31/23
SHEET CHECKED S. IRELAND DATE 08/31/23
AS BUILT DETAILS DATE

McFarland Johnson

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

EROSION CONTROL PLAN 03

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
41322eroplans	41322	9	17

LEGEND

- IMPACT ATTENUATOR
- COFFERDAM
- TRAFFIC FLOW ARROW
- PORTABLE CONCRETE BARRIER

REVISIONS AFTER PROPOSAL			
NUMBER	DATE	STATION	DESCRIPTION

SDR PROCESSED	M. LOVETT	DATE 08/31/23
NEW DESIGN	S. LISTER	DATE 08/31/23
SHEET CHECKED	S. IRELAND	DATE 08/31/23
AS BUILT DETAILS		DATE

McFarland Johnson

STATE OF NEW HAMPSHIRE

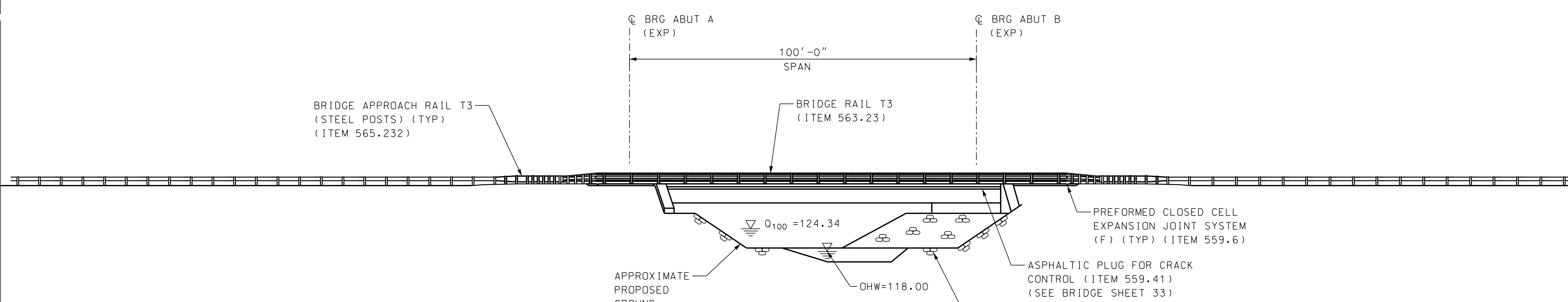
DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF BRIDGE DESIGN

TRAFFIC CONTROL PHASE 2

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
41322TrafficControlPhase241322		10	17

PLAN

SCALE: 1" = 20'



ELEVATION

SCALE: 1" = 20'

HYDRAULIC DATA:

DRAINAGE AREA:	18.36 SQ MILES
DESIGN FLOOD:	Q100
DESIGN FLOOD FLOW:	1780 CFS
DESIGN FLOOD ELEVATION:	124.34 FT
DESIGN FLOOD VELOCITY:	5.5 FPS
DESIGN FLOOD SCOUR DEPTH:	1.5 FT
CHECK FLOOD:	Q500
SCOUR CHECK FLOW:	2480 CFS
SCOUR CHECK DEPTH:	2.5 FT
BRIDGE FULL WATERWAY OPENING PERP. TO RIVER:	1084 SQ FT

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED	P. SURPRENANT	DATE 10/2023
NEW DESIGN	S. MERKWAN	DATE 10/2023
SHEET CHECKED	S. WHITE	DATE 10/2023
AS BUILT DETAILS		DATE

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STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF BRIDGE DESIGN

GENERAL PLAN & ELEVATION

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
41322WPGenPlan	41322	11	17

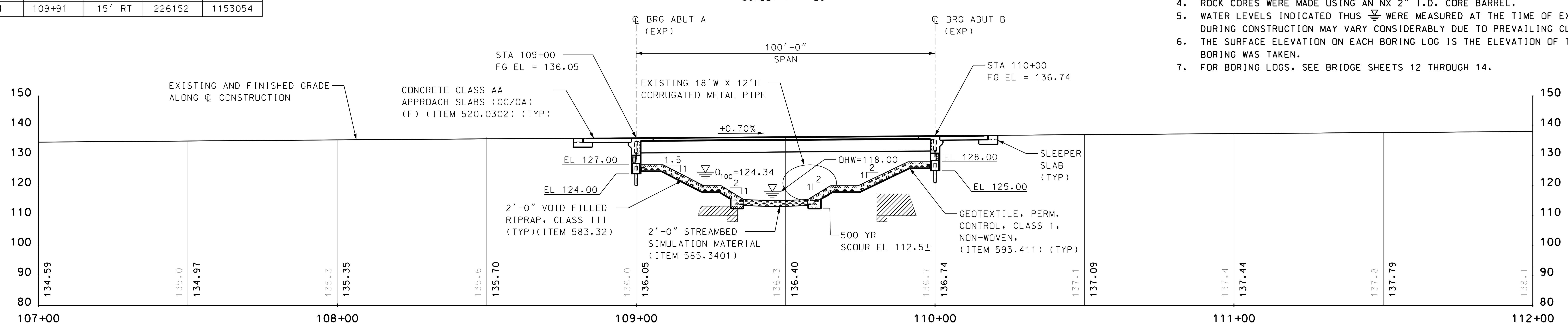
BORING LOCATIONS				
NUMBER	STATION	OFFSET	NORTHING	EASTING
B01	108+92	16' LT	226094	1152968
B02	109+00	15' RT	226081	1152997
B03	109+86	16' LT	226167	1153027
B04	109+91	15' RT	226152	1153054

SITE PLAN

SCALE: 1" = 20'

BORING NOTES

1. BORINGS INDICATED THUS WERE MADE BY THE NHDOT IN NOVEMBER, MARCH AND APRIL 2021. FIGURES IN THE "BLOWS PER" COLUMN INDICATE THE NUMBER OF BLOWS REQUIRED TO DRIVE A 2" STANDARD SPLIT SPOON SAMPLER 6", USING A 140 LB. WEIGHT FALLING 30 INCHES.
2. BORINGS ARE FOR DESIGN PURPOSES SHOWING CONDITIONS AT BORING POINTS ONLY AND DO NOT NECESSARILY INDICATE MATERIAL TO BE ENCOUNTERED DURING CONSTRUCTION.
3. THE GEOTECHNICAL ENGINEERING REPORT IS AVAILABLE ON-LINE IN THE BID PACKAGE ON THE INVITATION TO BID WEB PAGE DURING THE BIDDING PERIOD. AFTER THE CONTRACT HAS BEEN AWARDED THE REPORT IS AVAILABLE IN THE NHDOT BUREAU OF MATERIALS AND RESEARCH OFFICE.
4. ROCK CORES WERE MADE USING AN NX 2" I.D. CORE BARREL.
5. WATER LEVELS INDICATED THUS WERE MEASURED AT THE TIME OF EXPLORATION. THE WATER LEVELS ENCOUNTERED DURING CONSTRUCTION MAY VARY CONSIDERABLY DUE TO PREVAILING CLIMATE, RAINFALL, OR OTHER FACTORS.
6. THE SURFACE ELEVATION ON EACH BORING LOG IS THE ELEVATION OF THE EXISTING GROUND AT THE TIME THE BORING WAS TAKEN.
7. FOR BORING LOGS, SEE BRIDGE SHEETS 12 THROUGH 14.



PROFILE

SCALE: 1" = 20'

LEGEND

- LIMITS OF EXISTING ABUTMENTS TO REMAIN. REMOVAL TO 3'-0" BELOW FINISH GRADE PAID FOR UNDER ITEM 206.2, ROCK STRUCTURE EXCAVATION.
- LIMITS OF FABRIC-ENCAPSULATED SOIL (FES) (ITEM 645.456)

REVISIONS AFTER PROPOSAL		
NUMBER	DATE	STATION	DESCRIPTION

SDR PROCESSED	P. SURPRENANT	DATE 10/2023
NEW DESIGN	S. MERKWAN	DATE 10/2023
SHEET CHECKED	S. WHITE	DATE 10/2023
AS BUILT DETAILS		DATE

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STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION * BUREAU OF BRIDGE DESIGN

SITE PLAN AND PROFILE

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
41322WPSitePlan	41322	12	17

CHANNEL PROFILE (LITTLE RIVER)

SCALE: 1" = 10'

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED	HEADWATERS	DATE 07/2023
NEW DESIGN	HEADWATERS	DATE 07/2023
SHEET CHECKED	HEADWATERS	DATE 07/2023
AS BUILT DETAILS		DATE

HEADWATERS Consulting, LLC

McFarland Johnson

STATE OF NEW HAMPSHIRE

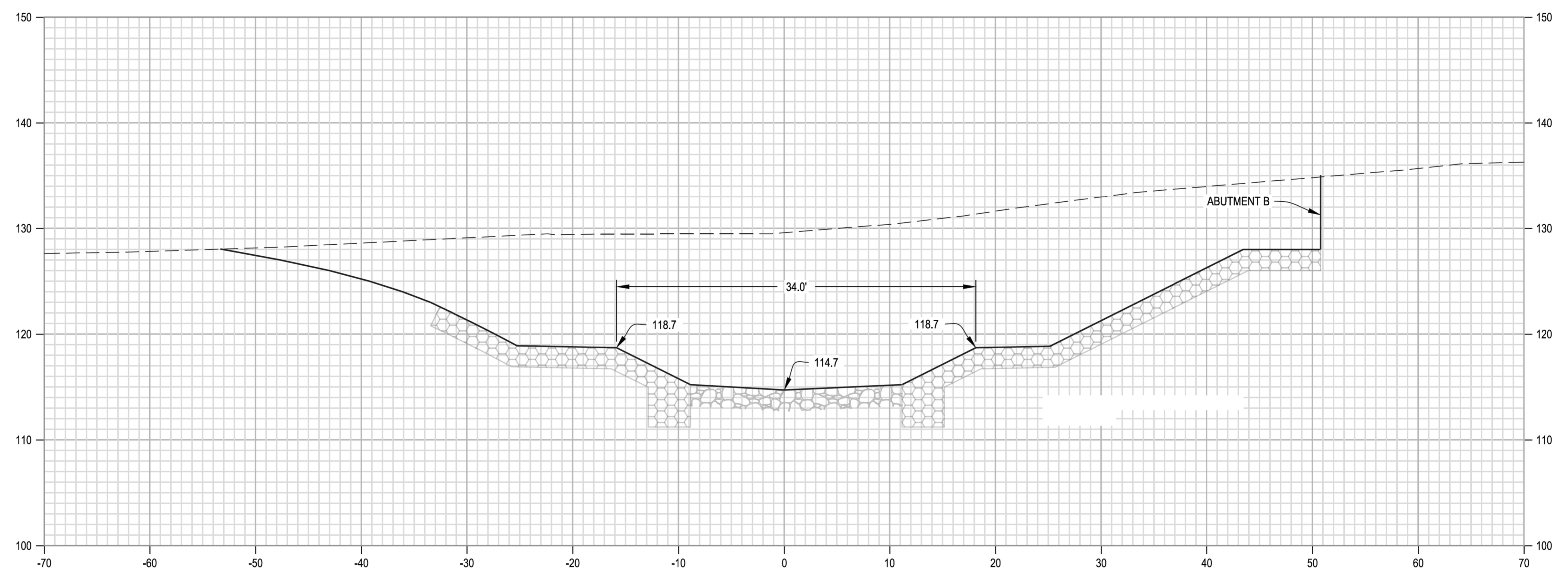
DEPARTMENT OF TRANSPORTATION ◇ BUREAU OF BRIDGE DESIGN

CHANNEL PROFILE

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
41322WPChannel_Profile	41322	13	17

REVISIONS AFTER PROPOSAL			
NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED	HEADWATERS	DATE 07/2023
NEW DESIGN	HEADWATERS	DATE 07/2023
SHEET CHECKED	HEADWATERS	DATE 07/2023
AS BUILT DETAILS		DATE



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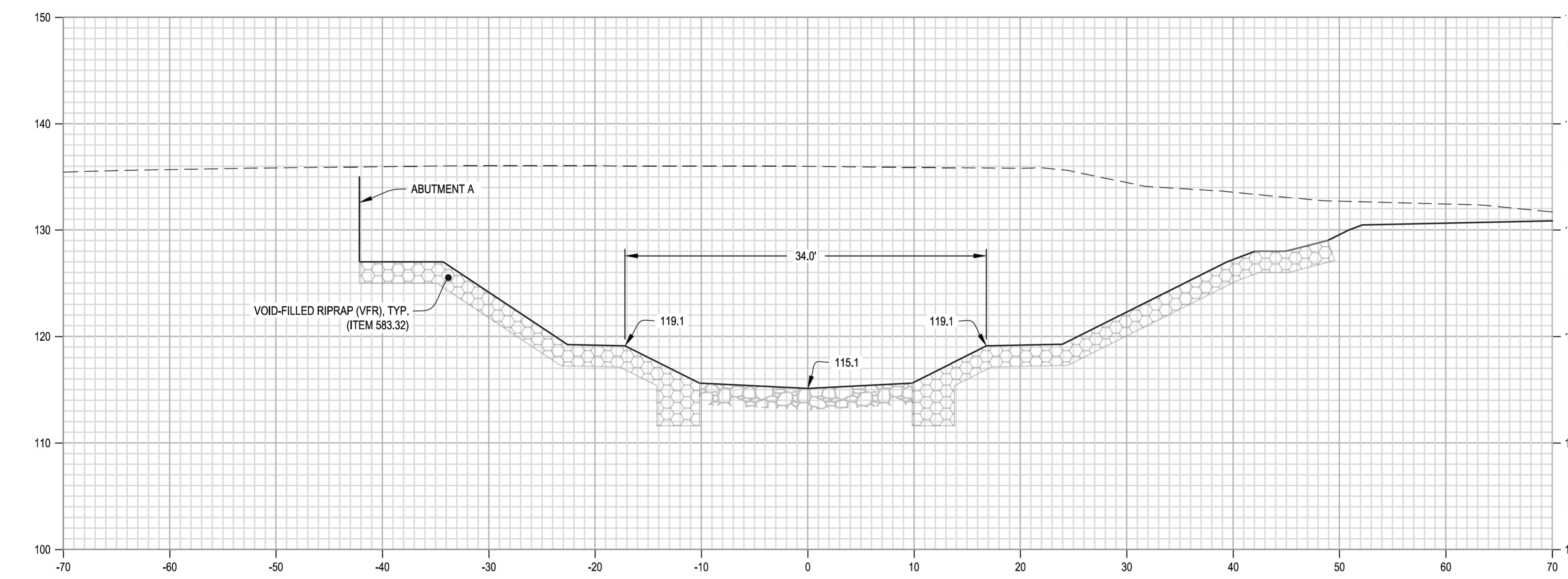

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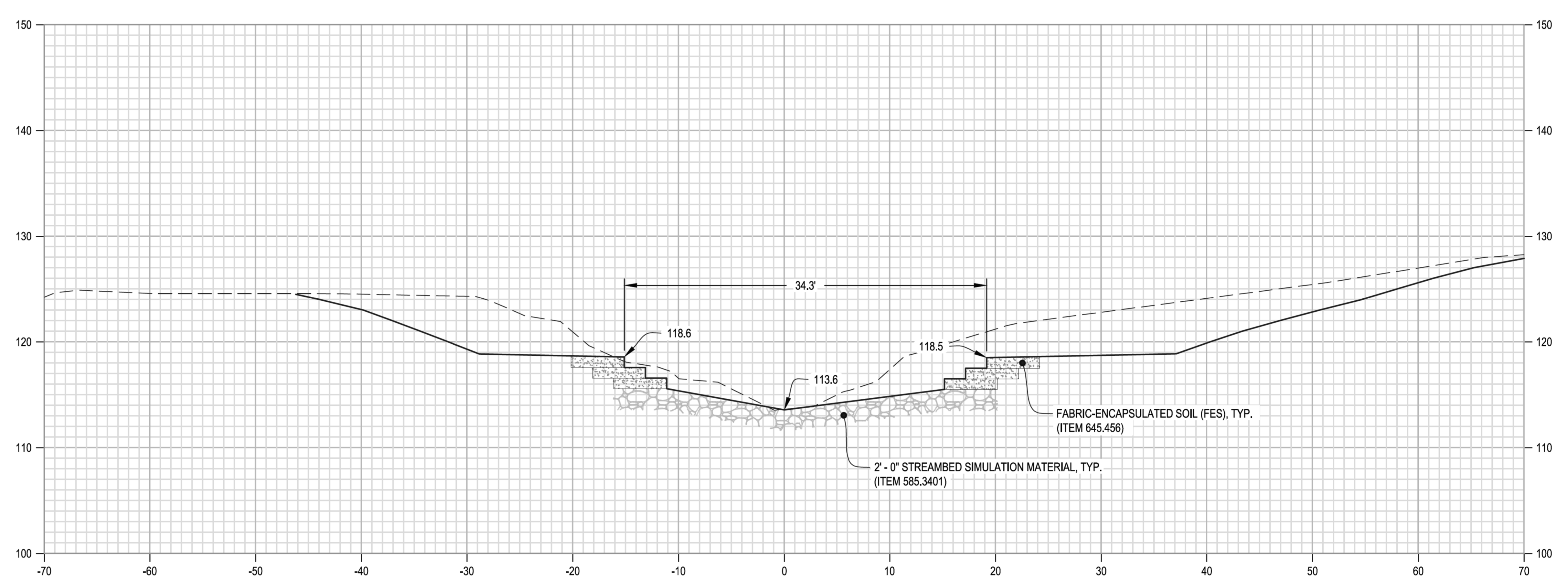
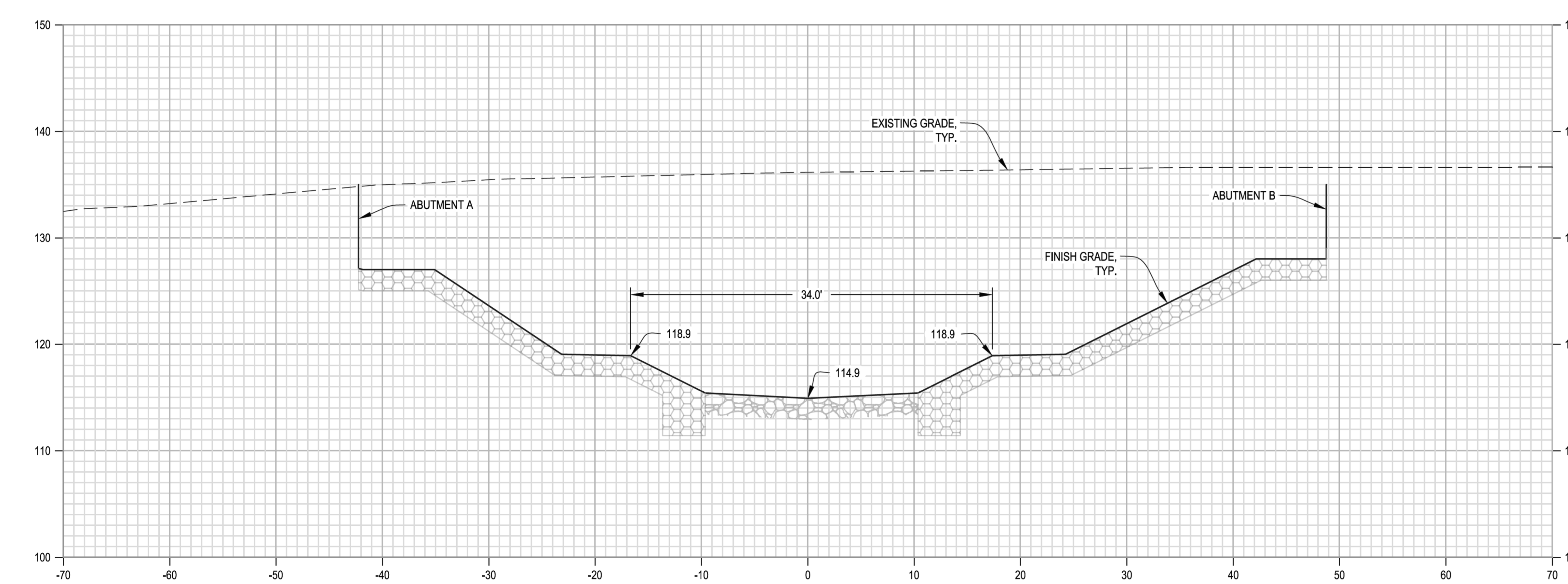
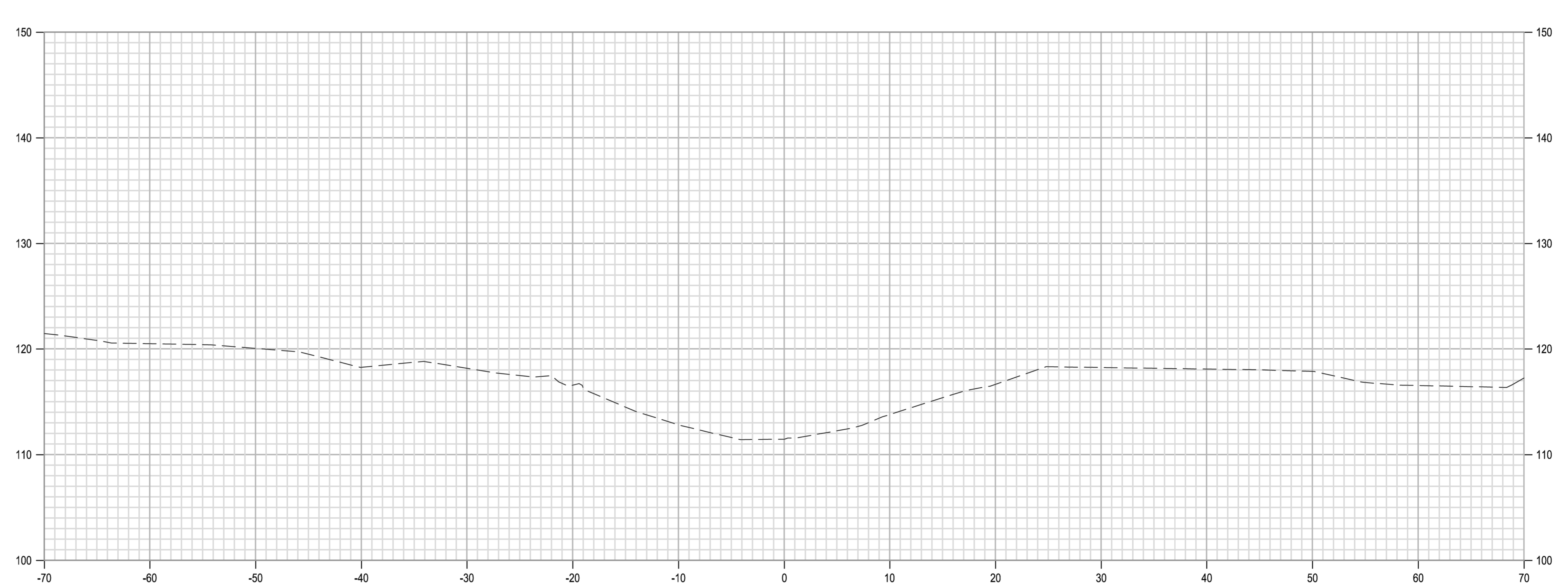


2+75



3+25



2+50

CHANNEL CROSS SECTIONS

SCALE: 1" = 10'

HEADWATERS Consulting, LLC

McFarland Johnson

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF BRIDGE DESIGN

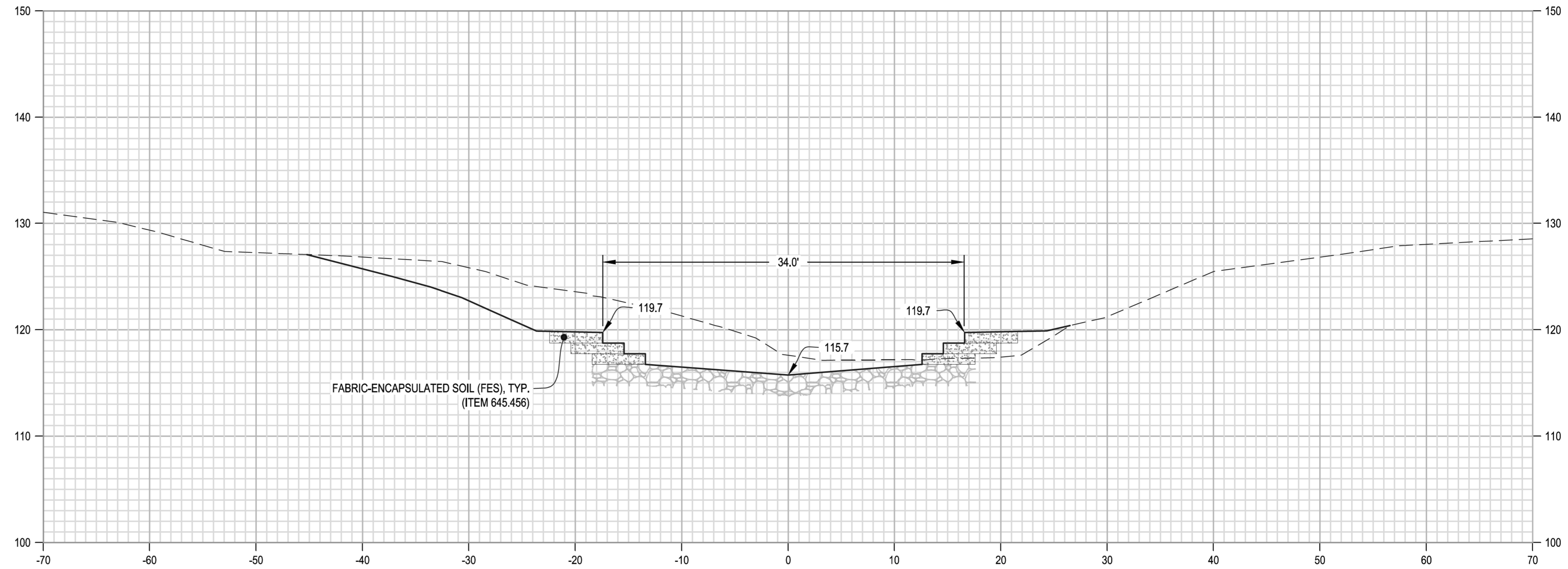
CHANNEL CROSS SECTIONS
(1 OF 2)

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
41322Channel_Cross_Sections.dgn	41322	14	17

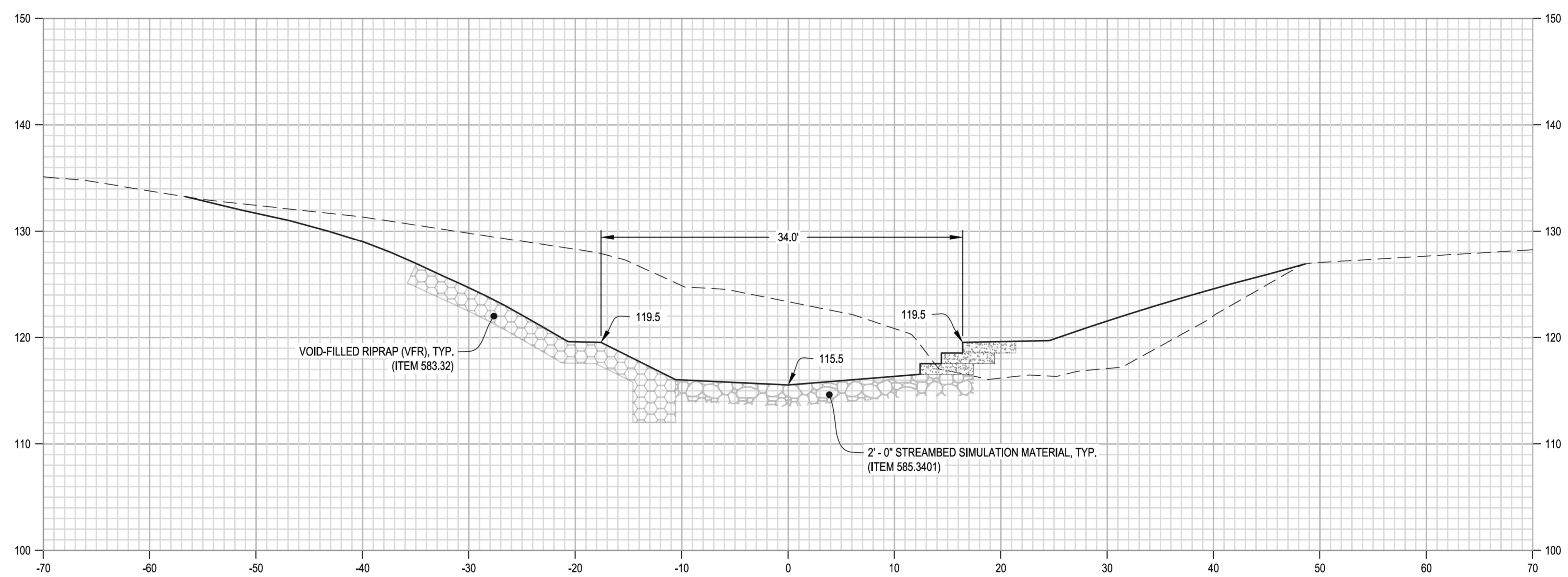
REVISIONS AFTER PROPOSAL			
NUMBER	DATE	STATION	STATION

DESCRIPTION

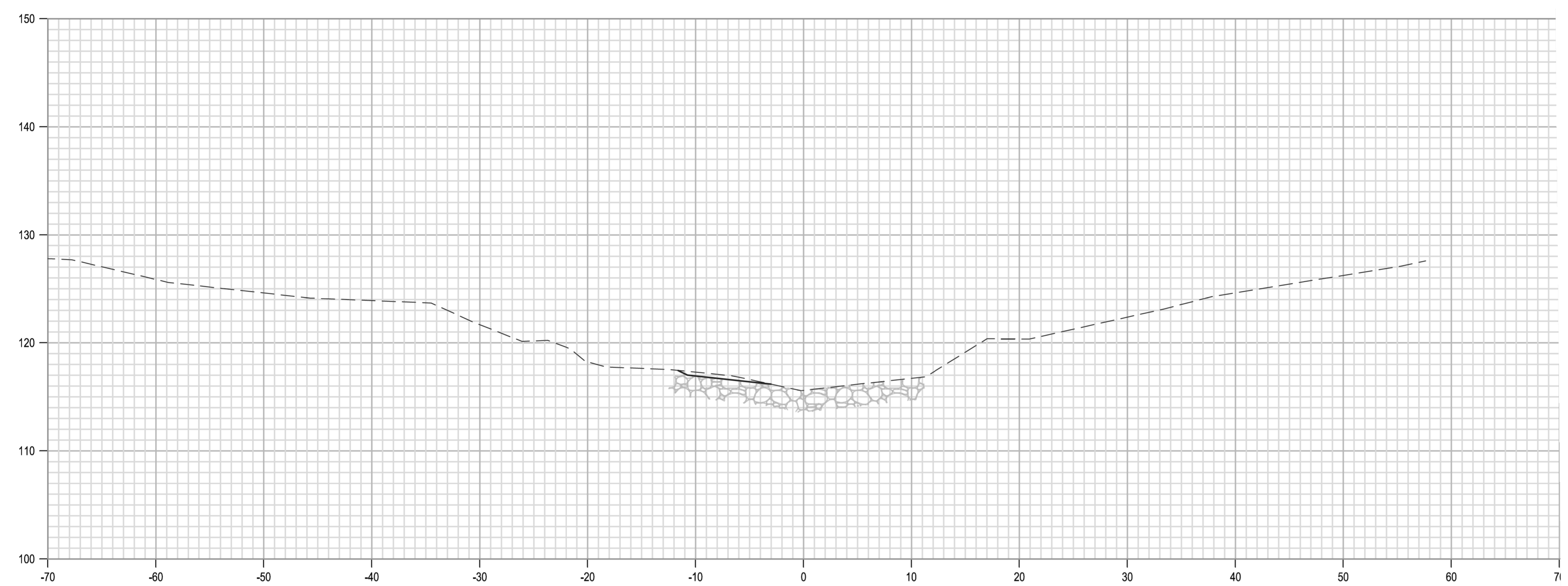
SDR PROCESSED HEADWATERS DATE 07/2023
NEW DESIGN HEADWATERS DATE 07/2023
SHEET CHECKED HEADWATERS DATE 07/2023
AS BUILT DETAILS DATE



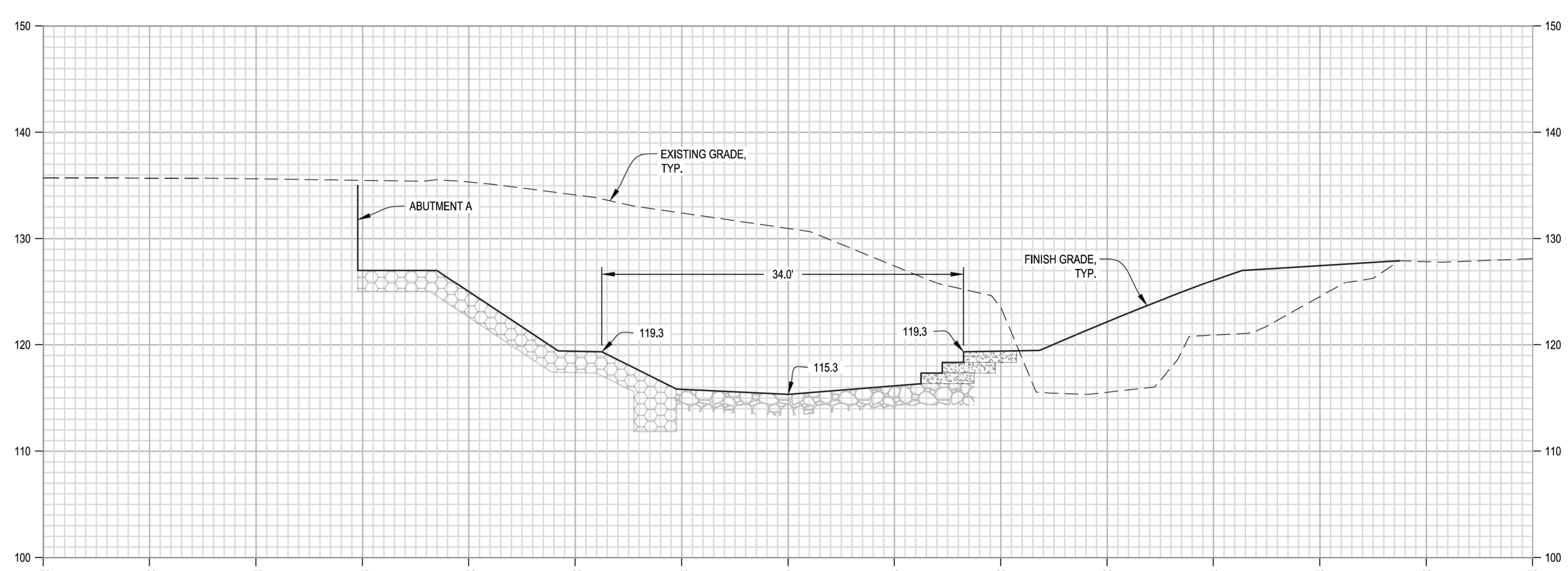
4+25



4+00



4+50



3+75

CHANNEL CROSS SECTIONS

SCALE: 1" = 10'

HEADWATERS Consulting, LLC

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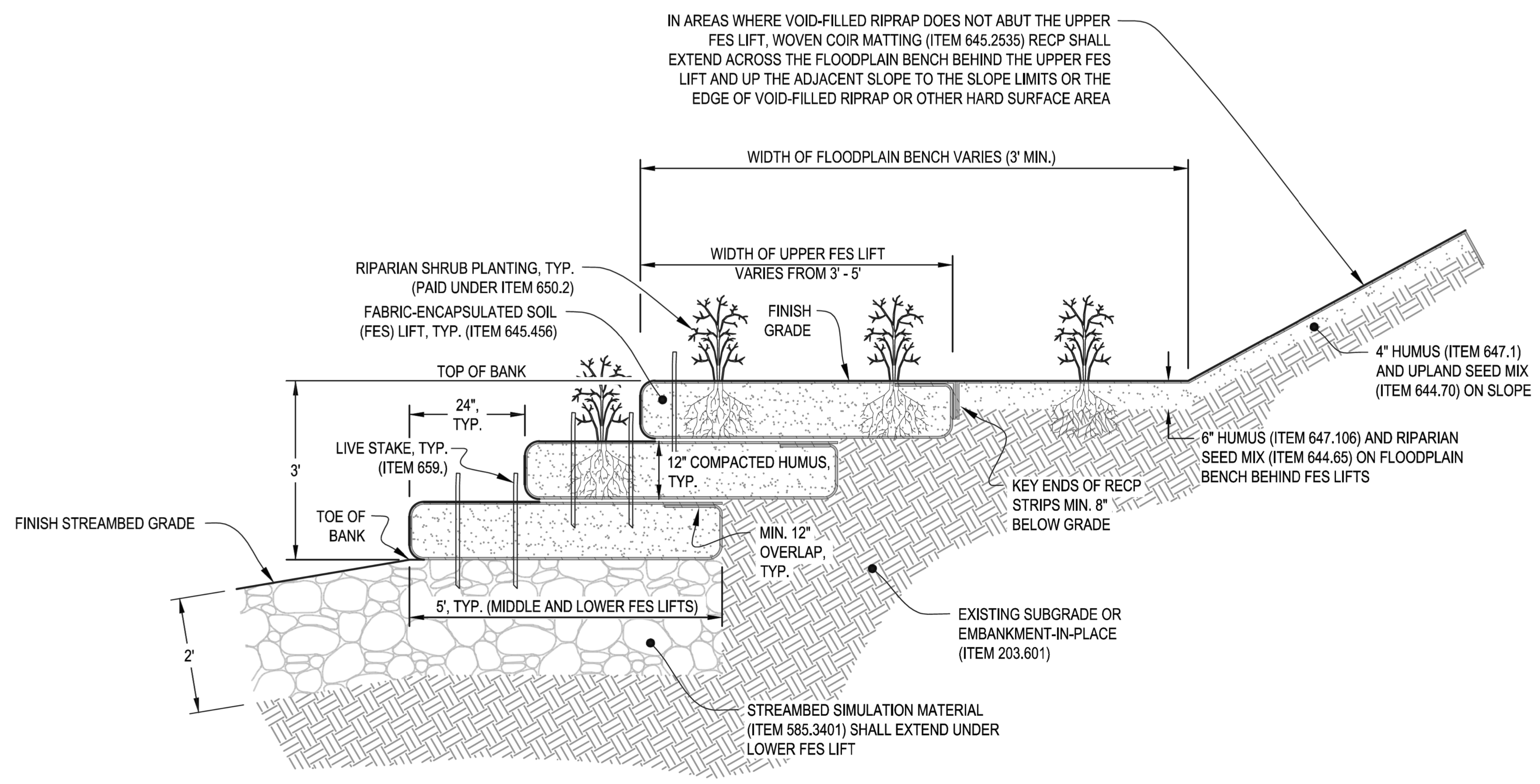
STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ◦ BUREAU OF BRIDGE DESIGN

CHANNEL CROSS SECTIONS
(2 OF 2)

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
41322Channel_Cross_Sections	41322	15	17



NOTES:

1. THIS DETAIL APPLIES TO THE FOLLOWING SECTIONS OF RESTORED RIVERBANK:

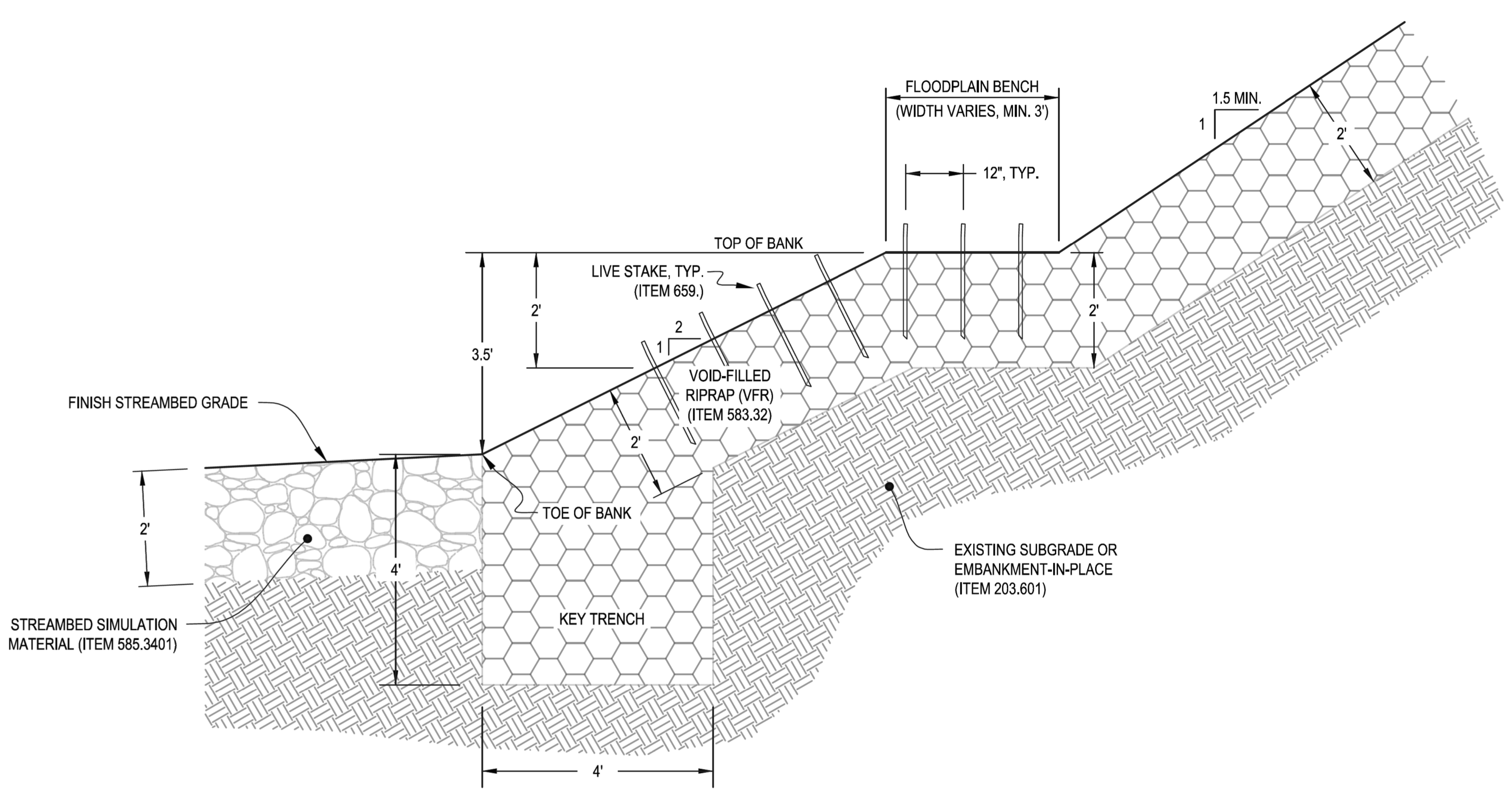
   RIVER STA 2+53.0 TO 2+80.1 R
   RIVER STA 3+60.6 TO 4+44.3 R
   RIVER STA 2+54.5 TO 2+92.3 L
   RIVER STA 4+10.9 TO 4+38.8 L

2. THREE LIFTS OF FABRIC-ENCAPSULATED SOIL (FES) SHALL BE CONSTRUCTED.

3. THE WIDTH OF THE UPPER FES LIFT VARIES FROM 3 TO 5 FEET DEPENDING ON THE WIDTH OF THE FLOODPLAIN BENCH. WHERE THE FLOODPLAIN BENCH IS LESS THAN 5 FEET WIDE, THE WIDTH OF THE UPPER FES LIFT SHALL MATCH THE WIDTH OF THE FLOODPLAIN BENCH. WHERE THE FLOODPLAIN BENCH WIDTH IS EQUAL TO OR GREATER THAN 5 FEET, THE UPPER FES LIFT SHALL BE 5 FEET WIDE.

4. THE MIDDLE AND LOWER FES LIFTS SHALL BE 5 FEET WIDE IN ALL AREAS.

TYPICAL FABRIC-ENCAPSULATED SOIL (FES) RIVERBANK RESTORATION DETAIL
(NOT TO SCALE)



NOTES:

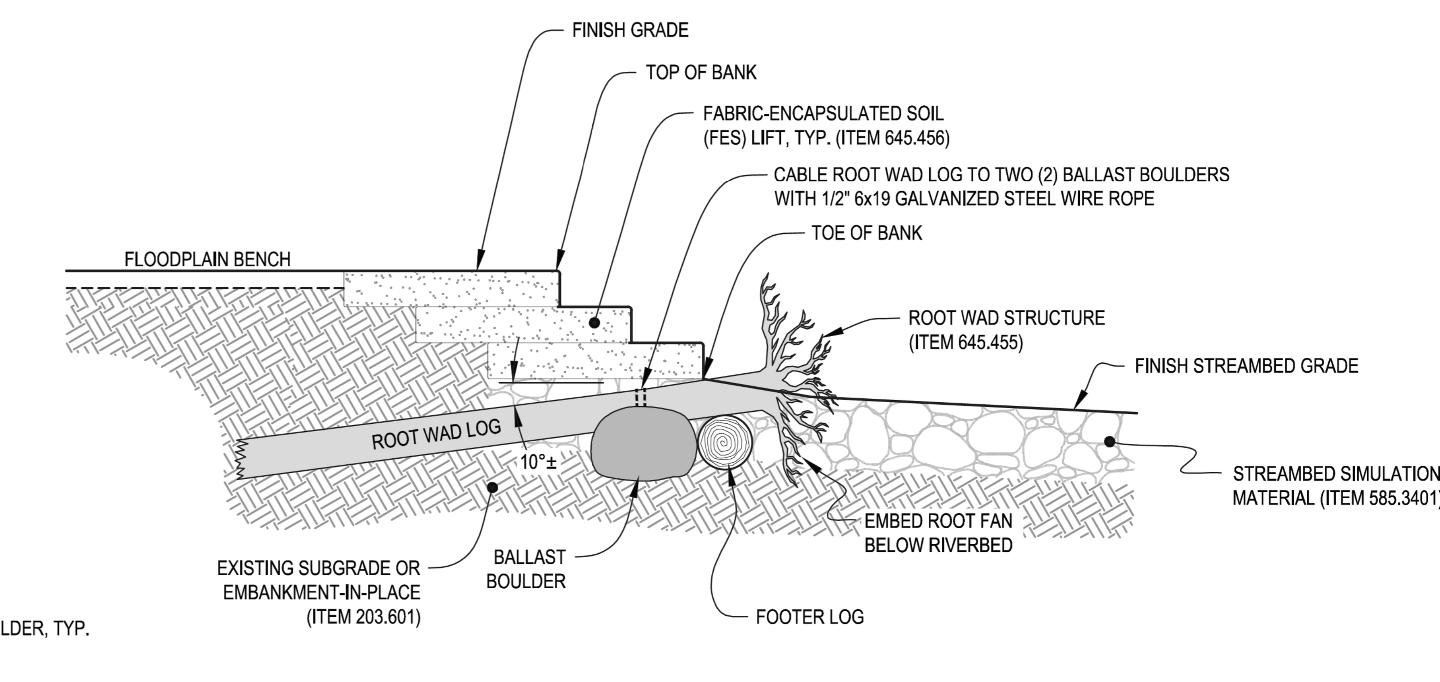
1. THIS DETAIL APPLIES TO THE FOLLOWING SECTIONS OF RESTORED RIVERBANK:

   RIVER STA 2+80.1 TO 3+60.6 R
   RIVER STA 2+92.3 TO 4+10.9 L

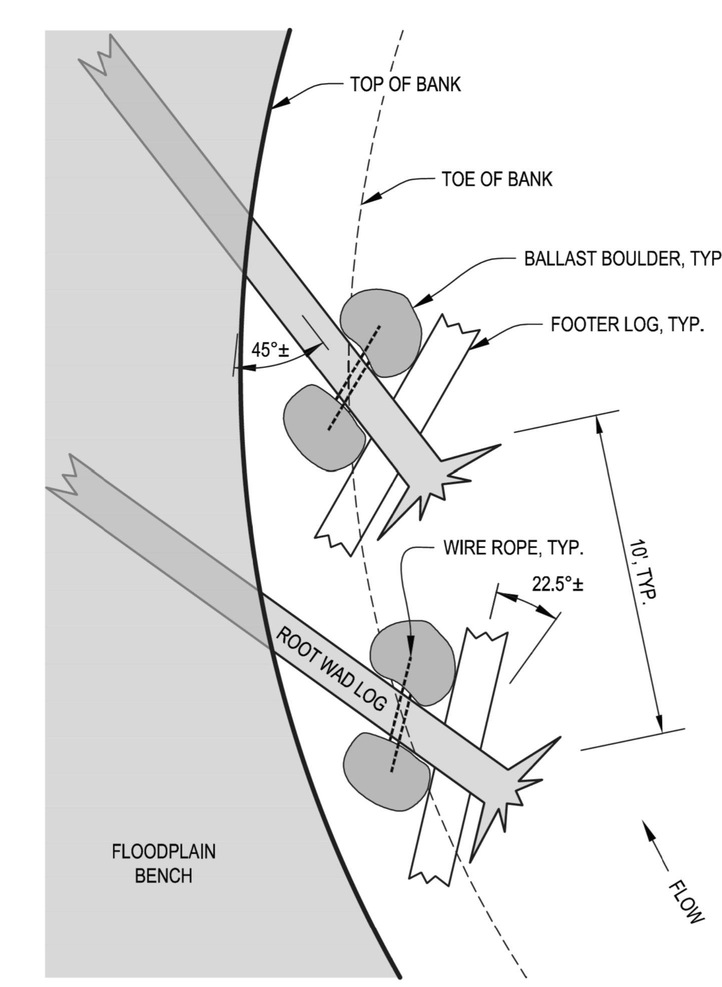
2. LIVE STAKES (ITEM 645.4) SHALL ONLY BE PLANTED ALONG THE FOLLOWING SECTIONS OF RESTORED RIVERBANK WHICH DO NOT INCLUDE THE AREAS BENEATH THE SUPERSTRUCTURE THAT ARE BETWEEN APPROXIMATELY 5 FEET UPSTREAM OF THE DOWNSTREAM SUPERSTRUCTURE DRIP LINE AND APPROXIMATELY 5 FEET DOWNSTREAM FROM THE UPSTREAM SUPERSTRUCTURE DRIP LINE:

   RIVER STA 2+80.1 TO 3+12.1 R
   RIVER STA 3+49.7 TO 3+60.6 R
   RIVER STA 2+92.3 TO 3+22.5 L
   RIVER STA 3+64.6 TO 4+10.9 L

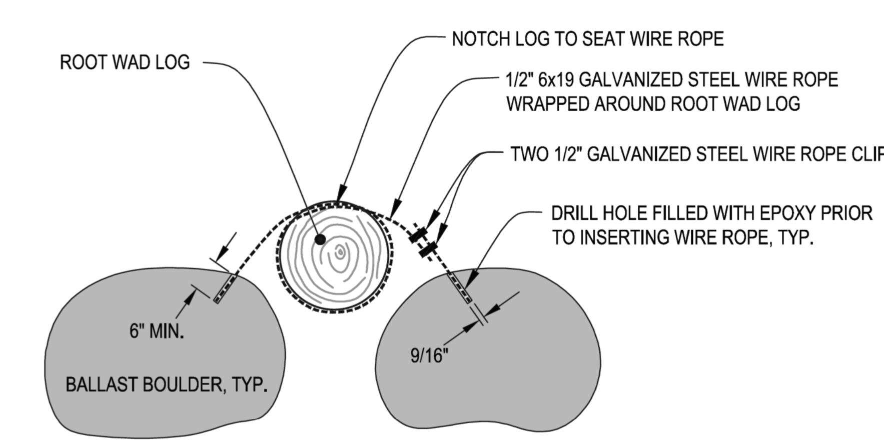
TYPICAL VOID-FILLED RIPRAP (VFR) RIVERBANK RESTORATION DETAIL
(NOT TO SCALE)



SECTION VIEW



PLAN VIEW



BALLAST BOULDER CABLING DETAIL

ROOT WAD STRUCTURE DETAIL
(NOT TO SCALE)

REVISIONS AFTER PROPOSAL			
NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED HEADWATERS DATE 07/2023
NEW DESIGN HEADWATERS DATE 07/2023
SHEET CHECKED HEADWATERS DATE 07/2023
AS BUILT DETAILS DATE

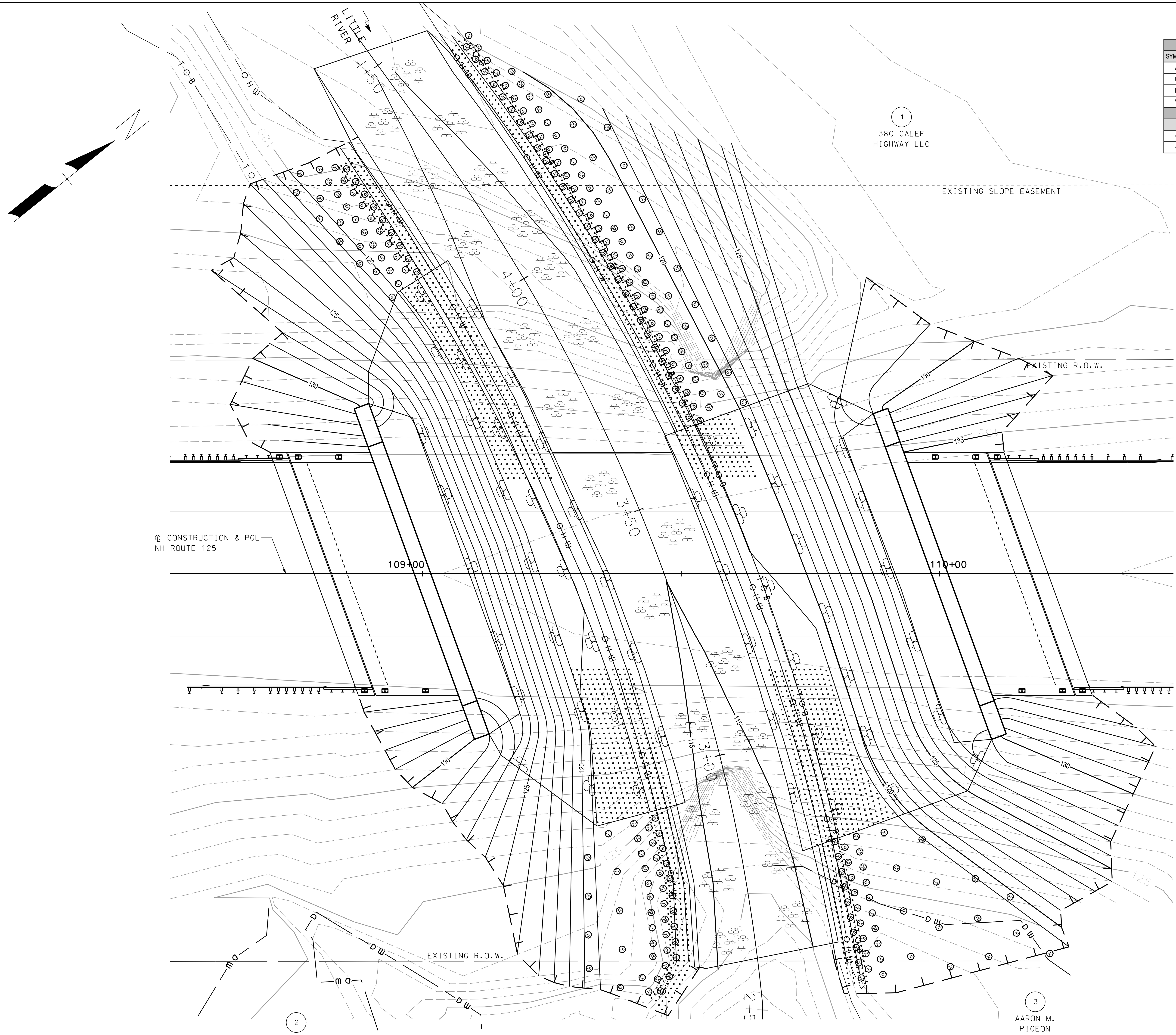
HEADWATERS Consulting, LLC

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF BRIDGE DESIGN

STREAM RESTORATION DETAILS

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
41322HeadwatersDetails	41322	16	17



PLANTING PLAN

SCALE: 1" = 10'

PLANTING SCHEDULE

RIPARIAN SHRUBS					
SYMBOL	SCIENTIFIC NAME	COMMON NAME	MIN. CONTAINER SIZE	MIN. PLANT HEIGHT	QUANTITY
AI	ALNUS INCANA	SPECKLED ALDER	# 1	24"	105
CA	CORNUS AMOMUM	SILKY DOGWOOD	# 1	24"	50
IV	ILEX VERTICILLATA	WINTERBERRY	# 1	24"	35
VC	VACCINIUM CORYMBOSUM	HIGHBUSH BLUEBERRY	# 1	24"	40
LIVE STAKES					
	SCIENTIFIC NAME	COMMON NAME	DIAMETER BASAL END	MIN. LENGTH	QUANTITY
•	SALIX DISCOLOR	PUSSY WILLOW	½ - 1"	24"	1,075
•	CORNUS AMOMUM	SILKY DOGWOOD	½ - 1"	24"	1,075

(ALL ABOVE PLANTINGS INCLUDED IN ITEM 650.2)

PLANTING LEGEND

- AI SPECKLED ALDER RIPARIAN SHRUB PLANTING
- CA SILKY DOGWOOD RIPARIAN SHRUB PLANTING
- IV WINTERBERRY RIPARIAN SHRUB PLANTING
- VC HIGHBUSH BLUEBERRY RIPARIAN SHRUB PLANTING
- • PUSSY WILLOW OR SILKY DOGWOOD LIVE STAKE

1. SEED DISTURBED SLOPES WITH UPLAND SEED MIX, INCLUDED IN ITEM 644.70.

2. SEED ALL WILDLIFE SHELF AREAS WITH RIPARIAN SEED MIX, INCLUDED IN ITEM 644.65.

3. STABILIZE DISTURBED SLOPES WITH WOVEN COIR MATTING FOR EROSION CONTROL (ITEM 645.2535).

4. ALL PLANTINGS SHALL BE IN ACCORDANCE WITH SECTION 650 OF THE STANDARD SPECIFICATIONS AND INCLUDED IN ITEM 650.2.

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED M. LOVETT DATE 08/31/23
NEW DESIGN S. LISTER DATE 08/31/23
SHEET CHECKED S. IRELAND DATE 08/31/23
AS BUILT DETAILS DATE

HEADWATERS Consulting, LLC

McFarland Johnson

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION • BUREAU OF BRIDGE DESIGN

PLANTING PLAN

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
41322PlantingPlan	41322	17	17