Engineering Study

Townhouse Road and New Bridge Road over Northeast Pond

Milton-Lebanon 40658

NHDOT Bridge No. 168/151

August 18, 2023

Draft Submission

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1 Executive Summary

1.1 Description

NHDOT Bridge #168/152 carried Townhouse Road and New Bridge Road (Henceforth referred to as "The Roadway") over Northeast Pond in Milton, NH and Lebanon, ME. The bridge, built in 1948, was closed to traffic in 2010 due to maintenance concerns, the deck and superstructure removed in 2013, and the piers removed in 2015. Timber abutments remain, but there is currently no structure across the waterway in this location. The proposed bridge will be NHDOT Bridge #168/151.

This report will evaluate three alternatives for replacement of the bridge structure:

- Alternative 1 - Single Span Prefabricated Steel Truss Bridge
- Alternative 2 – Two-Span Steel Tub Girder Bridge
- Alternative 3 – Three-Span Precast Prestressed Box Beam

Other alternatives were investigated during the Engineering Study phase but were not advanced or included due to not meeting the purpose and need of this project by providing a safe, reliable, structurally sound crossing of suitable roadway width for the traveling public. Benefits and challenges associated with each alternative were considered, including impacts to natural resources, community needs, impacts to utilities and right-of-way, life cycle costs, and constructability. The project team held the following public meetings for outreach as part of the project development process.

- *Public Officials Meeting, 5/22/2023*

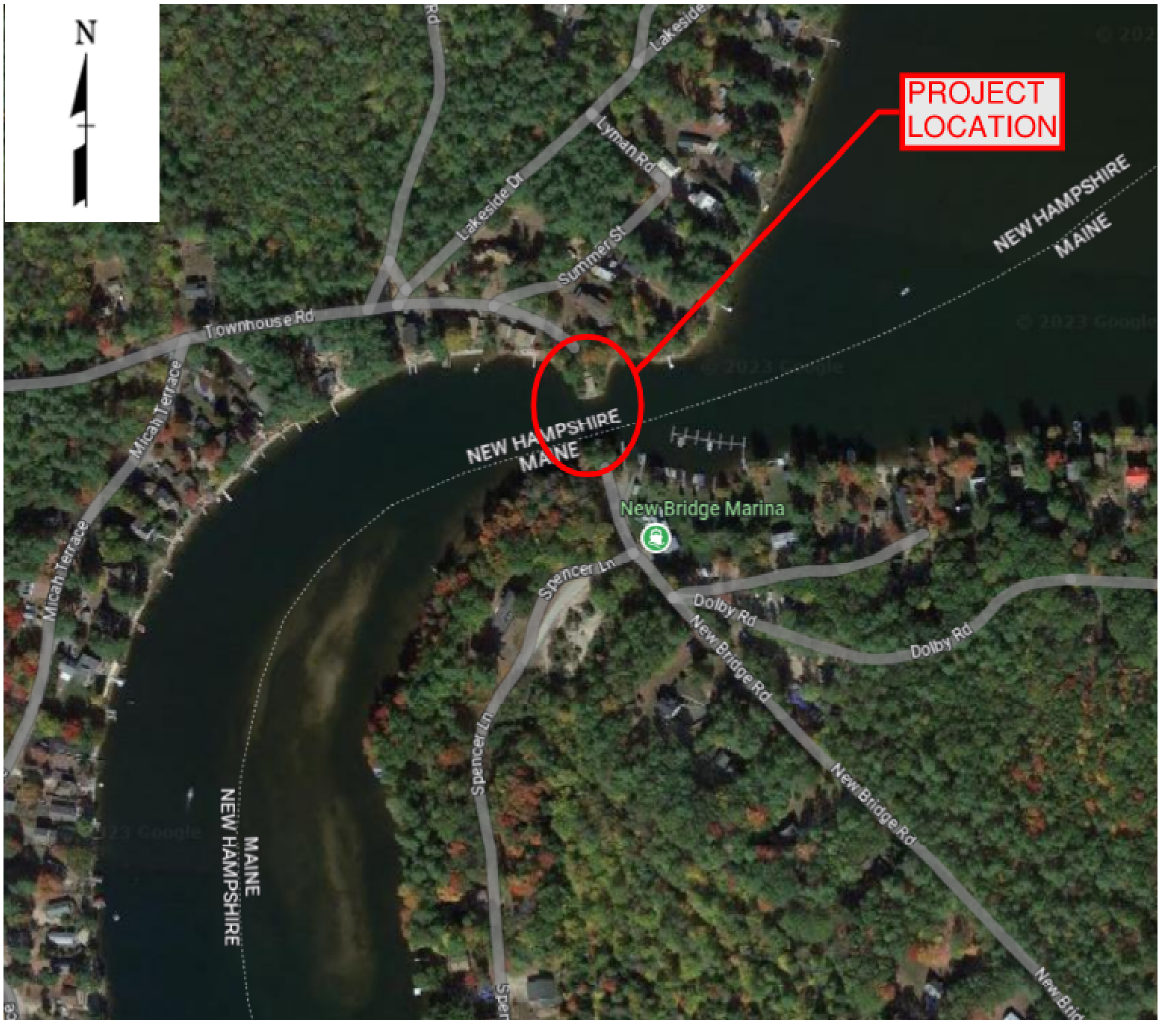
1.2 Recommendations

The preferred alternative is Alternative 2 which will utilize a steel tub girder superstructure with a 112'-0" span and a 9" thick concrete deck with integral wearing surface. The new bridge will provide a 26'-0" wide travel way consisting of two 10'-0" travel lanes and two 3'-0" shoulders, measured rail-to-rail, and will re-establish safe egress for local residents during high water events. Construction duration is estimated at 37 weeks.

The proposed horizontal alignment will match the alignment of the previous bridge. The proposed vertical alignment will be Profile No. 3 which will exceed the navigational clearance of the previous bridge while limiting ROW impacts. Superelevation on the approaches will be incorporated into the proposed design to improve the relationship between design speed and curvature. Conceptual level project cost and life cycle cost estimates were prepared based on a 100-year design life, and accounted for maintenance, repairs, and rehabilitations over the design life. Costs associated with the preferred alternative are:

- Project Cost - $2,719,000
- Life Cycle Cost - $3,011,229 (present-day dollars)

2 Location Map



Townhouse Road & New Bridge Road over Northeast Pond

Milton, NH - Lebanon, ME

3 Project Background

3.1 General

In December of 2021, NHDOT contracted with HDR to provide Part A Design Services to address the need to restore connectivity between Milton, NH and Lebanon, ME through the construction of NHDOT Bridge #168/151 (previously Bridge #168/152), Townhouse Rd (NH) and New Bridge Rd (ME) over Northeast Pond, NHDOT Project Number 40658. The work is performed as Task #3 under NHDOT Bridge Design Contract 41867.

Part A Design Services includes the Engineering Study Phase and Preliminary Design Phase. This report represents the culmination of the Engineering Study phase of the project, which includes data collection, a draft hydraulic report, assessment of existing environmental and cultural resources, alignment and profile studies, alternatives analysis, and recommendations for advancement of the project.

3.2 Public Involvement

In addition to the design development, this study considers public input in the form of Public Informational Meetings. Prior to HDR's involvement in the project, two previous public informational meetings were held (May 2011 and September 2012) to discuss the needs of this bridge. MaineDOT was the lead at both meetings. Some insights shared from these meetings with the project team, by MaineDOT, included:

- NH residents can become stranded during high water events,
- Consideration of vertical clearance of recreational boats is necessary,
- Project is within a tourist area,
- There is a need for budget conscious design and construction, and
- The bridge was used for foot traffic across the waterway prior to its removal.

The HDR team held a Public Officials meeting on May 22, 2023, to present initial bridge and roadway concepts to the towns. Some key suggestions and concerns given during the meeting included:

- *Maintain the navigational underclearance provided by the pre-existing bridge,*
- *Limit impacts to right-of-way, and*
- *Control Costs.*

4 Design Criteria

4.1 Purpose and Need

The Purpose and Need for the project are as follows:

Purpose:

- To provide a safe, reliable, and structurally sound crossing over Northeast Pond.
- To reconnect the communities of Milton, NH and Lebanon, ME.

Need:

- There is no existing bridge currently in the proposed location.
- The existing detour due to the bridge closure is approximately six miles long.

4.2 Design Speed

A design speed of 35 mph was established for this project.

4.3 General Roadway Design

The roadway will be designed in accordance with current AASHTO, MaineDOT, and NHDOT road design standards and guidelines.

Roadway Design Criteria

Roadway improvements have been designed according to the most recent version of the NHDOT Highway Design Manual and the 2018 AASHTO *A Policy on Geometric Design of Highways and Streets, 7th Edition*. Select horizontal and vertical controls for the design speed are summarized in Table 1 below. Complete roadway design criteria is provided in Appendix K.

Table 1. Roadway Horizontal and Vertical Control Summary

Criteria	Value
Max Superelevation, e_{max}	4%
Minimum Horizontal Curve Radius	371'
Minimum K (Crest)	29
Minimum K (Sag)	49
Minimum Stopping Sight Distance (Sag and Crest)	250'

Roadway Design Specifications

- AASHTO A Policy on Geometric Design of Highways and Streets, 7th Edition (2018)
- AASHTO Guide for the Development of Bicycle Facilities, 4th Edition

- NHDOT Highway Design Manual, 1999/2007
- MaineDOT Highway Design Guide and Engineering Instructions
- 2009 Manual of Uniform Traffic Control Devices (MUTCD)
- AASHTO Roadside Design Guide, 4th Edition (2011)
- NHDOT Standard Specifications for Road and Bridge Construction, 2016

4.4 General Bridge Design

The bridge will be designed in accordance with the NHDOT Bridge Design Manual and the AASHTO LRFD Bridge Design Specifications. Since the bridge will be located on the state boundary with Maine, the bridge will be designed to support HL-93 Modified live load in accordance with the MaineDOT Bridge Design Guide. The bridge rail will be designed to accommodate pedestrians and bicyclists. To meet the purpose and need of the project, the bridge will provide at least the underclearance of the pre-existing bridge.

Bridge Design Criteria

- Design Loading: HL-93 Modified per MaineDOT Bridge Design Guide.
- Bridge Rail: 42” tall with a TL-2 crash rating.
- Minimum Vertical Clearance: Maintain pre-existing condition, 5’-6” above Full Lake Level, at the center of the channel.

Bridge Design Specifications

- AASHTO Load and Resistance Factor Design Bridge Design Specifications (AASHTO LRFD), 9th Ed.
- NHDOT Bridge Design Manual (NHDOT BDM), v2.0.
- NHDOT Standard Specifications for Road and Bridge Construction, 2016.

5 Existing Conditions

5.1 NHDOT Bridge No. 168/152

The pre-existing bridge at the project location was jointly owned by the towns of Milton, NH and Lebanon, ME, and was constructed in 1948. The structure consisted of a Timber Beam-Stringer construction, resting on timber piles and timber abutments. The structure had an out-to-out span length of ~94’ with a rail-to-rail width of 24’-0”. The bridge remained open until 2010 when it was closed due to maintenance concerns and in 2013 the deck and superstructure were removed. The pier elements were removed in 2015. The only existing element remaining today is the timber abutments. The condition of the existing abutments was documented in an August 2021 inspection, citing the timber was severely cracked, decayed, and settled, with fill spilling into the water. The Bridge site is currently signed on both ends with a “Bridge Closed” sign and is fenced (NH side only) and barricaded to prevent vehicular travel.

According to the 1947 Bridge Plans, the existing bridge had a superstructure depth of 20 inches and provided a vertical navigational clearance of 5’-6” above full lake level.

Documents available to inform the pre-existing bridge include the following (developed by others):

- 1947 Bridge Plans (Appendix B)
- August 2021 Bridge Inspection Report by NHDOT (Appendix C).

HDR verified the conditions reported in the 2021 Inspection Report during a June 2022 site visit.

5.2 Townhouse Road

Townhouse Road in New Hampshire is classified as a Tier 5, Rural Local roadway within the anticipated project limits. It branches off NH Route 125 (White Mountain Highway) just north of Town House Pond and extends easterly for approximately one mile, terminating at the State line located on the pre-existing NHDOT Bridge No. 168/152 over Northeast Pond.

The existing lanes on Townhouse Road within the project area consists of two 10’ travel lanes and two 1’ paved shoulders. Formal lane markings end approximately 220’ west of the bridge abutment where the road narrows to a total width of 20’ of pavement. There are no existing sidewalks or guardrail along Townhouse Road within the project limits. Townhouse Road has a posted speed limit of 30 mph.

5.3 New Bridge Road

New Bridge Road in Maine is classified as a Priority 5 Local roadway within the project limits. New Bridge Road begins at the State line on the bridge over Northeast Pont and terminates at the intersection of T M Wentworth Rd and Gully Oven Rd in Lebanon, approximately 1 mile southeast of the crossing.

The existing lanes on New Bridge Road within the project area consists of two 9’-6” travel lanes with no formal lane markings. The pavement widens to 22 feet at the abutment. A 4’-3” paved sidewalk extends southeasterly from the abutment along the northern roadway edge for a length of approximately 30 feet. Short segments of guardrail are present that extend southeasterly from the abutment and along each roadway edge. There are no crashworthy end terminals present on the rail. Online photography of New Bridge Road from 2009 indicates there was a speed limit of 25 mph posted along the southbound lane approximately 185 feet south of the pre-existing bridge. This sign was not observed by team members during a 2022 site visit.

5.4 Existing Geometry

Townhouse Road generally runs west to east, however within the project limits, the roadway runs north to south. The existing horizontal alignment is generally defined by three (3) curves with a tangent across the pre-existing bridge. Curve #1 is a right-hand curve generally located outside the project limits in New Hampshire with a 650-foot radius. Curve #2 is a right-hand curve leading into the bridge approach consisting of a radius of 175 feet. Curve #3 is a left-hand curve leading away from the bridge on the Maine side and consists of a 530-foot radius. Curve #1 is normal crowned while Curve #2 is generally superelevated 2.5% and Curve #3 is generally superelevated 5.7%. Overall, Curve #2 is the controlling curve and meets current AASHTO design criteria for a 25-mph design speed. See existing alignment plans in Appendix D.

The existing vertical alignment is generally defined by four (4) curves. Vertical curve #1 is the most northwestern curve along the alignment and is an approximately 50-foot-long crest curve with a K value equal to 14. Vertical curve #2 is an approximately 90-foot-long sag curve, leading into the approach of the bridge, with a K value equal to 16. Vertical curve #3 is a crest curve located over the pre-existing bridge. Without existing survey over the pre-existing bridge, due to its 2013 removal, a crest curve with entrance and exit tangents matching the surveyed approach roadway grading were used to develop the curve. The curve is approximately 130 feet long with a K value equal to 91. Vertical curve #4 is a sag curve located within the Maine approach to the bridge. It is an approximately 150-foot-long curve with a K value equal to 21. Low points exist on either side of the pre-existing bridge; approximately 100 feet off the NH abutment and approximately 60 feet off the ME abutment. See Appendix D for the existing vertical alignment described above.

When evaluated against current AASHTO design criteria, the existing curves meet design speeds for current AASHTO design criteria as follows:

Table 2 Design speed based on existing curves

Curve	Design Speed based on Length	Design speed based on K value
#1	15-mph	25-mph
#2	30-mph	15-mph
#3	40-mph	50-mph
#4	50-mph	20-mph

5.4 Traffic and Crash Data

Existing traffic data for Townhouse Road over Northeast Pond dates back to 2008 prior to the closing of the bridge. The NHDOT Transportation Data Management System indicates an AADT of 620 vehicles per day (VPD) in 2008. The system uses annual growth projections to predict an AADT of 502 vpd across the bridge in 2021 if the bridge were still present. These traffic volumes are not anticipated to be indicative of the existing traffic volumes along Townhouse Road or New Bridge Road near the bridge with the bridge closed. As the bridge has been closed for several years, there is no recent crash data for the project location.

According to the August 2021 Bridge Inspection Report from the NHDOT Bureau of Bridge Design, the Average Annual Daily Traffic (AADT) in the corridor was 452 VPD in 2021, with 4% truck traffic, and expected to increase to 668 VPD in 2042.

5.5 Existing Drainage and Storm Water Treatment

On the New Hampshire side, the existing stormwater sheet flows off the roadway toward the inside of the right-hand curve and to a low point approximately 400 feet north of the bridge. The stormwater has created some erosion along the western gravel shoulder at the low point. On the Maine side, the existing stormwater sheet flows off the roadway and over the roadway embankments toward the pond. There is no existing stormwater treatment within the project limits.

5.6 Existing Utilities

There are existing overhead wires that run along the north side of Townhouse Road, prior to crossing over to the southwest side of the roadway and spanning across Northeast Pond parallel to the pre-existing bridge alignment. On the Maine side, the overhead wires continue to run along the southwest side of New Bridge Road within the project limits.

The utility poles on the New Hampshire side are jointly owned by Consolidated Communications (CCI) and Eversource (PSCO/EVR). The pole maintainer is PSCO/EVR and there is Metrocast, now Breezeline, also on the poles. The utility poles on the Maine side are jointly owned by CCI and Central Maine Power Company (CMP). The pole maintainer is CCI and there is the same CATV company on these poles. There is no direct buried cable on either side of the bridge area. Existing utility verification plans for Eversource and Breezeline are included in Appendix E.

5.7 Existing Right-Of-Way

The existing right-of-way on the Milton, NH side of the bridge is approximately 58 feet wide and centered on the existing roadway. There is no formal right-of-way on the Lebanon, ME side of the bridge. Plans received from MaineDOT list the area as Approximate Existing Limit of Wrought Portion (L.O.W.P.). This is a prescriptive easement and is approximately 33-feet wide. Existing ROW information for the project is included in Appendix F.

6 Existing Hydrology and Hydraulics

6.1 Overview

Northeast Pond flows generally in a southwesterly direction through the project site The bridge crossing is over a recreational lake with the water surface elevation controlled by the Milton Three Ponds Dam. The Milton Three Ponds Dam is approximately 2.0 miles downstream of the project site. The New Hampshire Department of Environmental Services maintains the Milton Three Ponds Dam lake elevation at 413.87 MSL during the summer months. The regulatory authority draws down the lake during the fall season to an elevation of approximately 410.62 MSL.

The project is located within a detailed FEMA study area with a regulated floodway. FEMA base flood elevations were established for the Northeast Pond. No water surface elevation (WSE) in the base flood elevation (100-yr) is allowable without a conditional letter of map revision (CLOMR). This project will not increase the FEMA base flood elevation.

6.2 Hydrology

This project is contained within the Salmon Falls River watershed, which covers approximately 330 square miles and straddles the southern border between New Hampshire and Maine. The project lies at the center of the watershed, between Milton County in New Hampshire and Lebanon County in Maine. The project drainage area is shown in blue in Figure 1. Additionally, the project's approximate location is denoted with a red star in the figure below.

Figure 1. Salmon Falls River Watershed

The project drainage area is 102 square miles and within the overall Salmon Falls River Watershed. The watershed primarily consists of residential, undeveloped forested areas, and rural land use. Peak flows were computed using the USGS StreamStats (ungaged sites) and compared to the FEMA Flows. The FEMA Flood Insurance Study flows were determined using USGS gage 01072100, which is downstream of both the project site and Milton Three Ponds Dam. The gage has a drainage area of 108.0 square miles. The FEMA flows were not transposed to correspond to the project drainage area. A summary of peak discharges used in the hydraulic analyses is provided in Table 3. Hydrology information for the project is included in Appendix G.

Table 3. Summary of Peak Discharges

Storm Event	FEMA Discharges (CFS)	StreamStats Discharges (CFS)
2-year		1,720
10-yr	2,930	3,390
50-yr	4,500	5,070
100-yr	5,290	5,980
500-yr	7,490	8,060

6.3 Hydraulics

The hydraulic analysis for the study area was performed using the U.S. Army Corps of Engineers Hydrologic Engineering Center's River Analysis System (HEC-RAS) version 6.3 hydraulic modeling program. Models were created to analyze duplicate effective, corrected effective, existing, and proposed conditions.

HEC-RAS study limits were set approximately 3,000 feet from the upstream face and 500 feet from the downstream face of the bridge. FEMA Cross Sections were incorporated from the HEC-2 model into the hydraulic model to extend the model further upstream and downstream due to the construction of the Northeast Pond due to the Bridge as well as comparing the published FEMA profile. FEMA cross section elevations were adjusted from NGVD 29 to NAVD 88. The existing and proposed model cross sections were updated with LiDAR, supplemental field survey data, and HEC-2 data. The hydraulic analysis and information for the project is included in Appendix G.

At this time the duplicate effective, corrected effective, and existing hydraulic models have been completed. The proposed hydraulic model is currently on hold pending the determination of the proposed structure type. It is anticipated that the proposed model will not increase water surface elevations in the final conditions as the abutments are proposed to be behind the existing abutments and the Northeast Pond water surface elevations are regulated.

6.4 Scour Analysis

The bridge site has potential for scour during large storms, however there is no existing scour recorded at the bridge. Scour will be assessed once the final proposed hydraulic model is completed.

6.5 Replacement Bridge Sizing

Typically, the NHDES Stream Crossing Guidelines are utilized to determine the span length for bridge alternatives. In this case, the bridge crosses a waterbody not a stream, and the span length should meet or exceed the existing condition, which is approximately 94 feet.

7 Existing Resources

7.1 Existing Environmental Resources

Northeast Pond

In 2010, the NHDES first adopted rules for permitting stream crossings and the Wetlands Bureau regulates the installation, replacement, or repair of stream crossings under RSA 482-A and Chapter Env-Wt-900. Based on coordination with NHDES, the crossing location is considered a ponded waterbody, therefore the NH Stream Crossing Rules do not apply to the proposed bridge structure (K. Benedict, NHDES, personal communication, February 13, 2020).

Northeast Pond is an approximately 645-acre waterbody located along the border between Strafford County, New Hampshire, and York County, Maine. Northeast Pond lies in the towns of Milton, New Hampshire, and Lebanon, Maine. Northeast Pond connects with Milton Pond to the south, whose outlet is the Salmon Falls River. Together with Town House Pond, a northwestern arm of Milton Pond, the water bodies form a single lake network known as Milton Three Ponds.

Maximum depths in the vicinity of the bridge crossing range from approximately two to seven feet. Average channel cross sections of Northeast Pond in the vicinity of the bridge are generally parabolic-shaped and water depths generally increase gradually from both shorelines. The majority of observed substrate in Northeast Pond in the vicinity of the bridge is dominated by coarse gravel, rubble, small to medium cobble, and scattered small boulders. Less coarse sandy substrates are located both to the west and east of the proposed bridge crossing along exposed beaches (see Appendix I). Sections of riprap exist along the edges of each existing bridge abutment.

Although the waterbody crossing for the proposed bridge is not identified as a "Designated River" according to the New Hampshire Rivers Management and Protection Program (RMPP),[1]work in the protected Shoreland, which is 250 feet landward of the reference line of public waters, falls under the jurisdiction of the Shoreland Water Quality Protection Act (SWQPA). The outer shoreland buffer zone in NH is depicted on the environmental constraints overview map (Appendix I, Attachment B), based on the surface elevation listed on the Consolidated List of Waterbodies Subject to the SWQPA and survey information[2]. See the Environmental Summary Memorandum (Appendix I) that describes the existing conditions of the proposed project area and documents the physical and the biological characteristics of Northeast Pond and surrounding upland and wetland habitats in the vicinity of the proposed project area for additional information.

Jurisdictional Resources

Wetlands and waterbodies, including the ordinary high water mark (OHWM) and top of bank (TOB) were delineated within the project area. The project area included the lands within

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[1] https://nhdes.maps.arcgis.com/apps/webappviewer/index.html?id=d3869f998e614d81925481ac71c3903e

[2] The Consolidated List of Water Bodies identifies the reference line for Northeast Pond at 414.67 feet above sea level.

approximately 25 feet of New Bridge Road and Townhouse Road in Maine and New Hampshire, respectively, from just south of the intersection of Dolby Road and New Bridge Road in Maine to just west of the Summer Street and Townhouse Road intersection in New Hampshire, as well as observable portions of Northeast Pond between the existing bridge abutments. Descriptive information, boundary information, and photographs of each wetland and Northeast Pond were collected. Features were delineated with flags labeled with an alpha-numeric sequence and each flag was located.

A New Hampshire Certified Wetland Scientist of HDR Engineering, Inc. performed wetland mapping on September 29, 2022, according to the U.S. Army Corps of Engineers (USACE) Wetlands Delineation Manual (Environmental Laboratory 1987) and *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region, Version 2.0* (Regional Supplement) (USACE 2012), which utilize the three parameter approach (i.e., evaluating the site for the presence of hydric soils, hydrophytic vegetation and wetland hydrology) for identifying wetlands and determining their jurisdictional limits. See the Environmental Summary Memorandum (Appendix I) that describes the existing conditions of the proposed project area and documents the physical and the biological characteristics of Northeast Pond and surrounding upland and wetland habitats in the vicinity of the proposed project area for additional information.

Northeast Pond is subject to the SWQPA, therefore the shoreland buffer zone in NH will be delineated on the final plans based on the Consolidated List of Waterbodies Subject to the SWQPA.

In NH a NHDES Standard Dredge and Fill Permit will be prepared and submitted based upon the final proposed alternative and associated impacts. As currently designed, each alternative in NH will also require preparation and submittal of a Shoreland Impact Permit. In Maine, an appropriate Natural Resources Protection Act (NRPA) permit will also be prepared and submitted based upon the final proposed alternative. Additionally, based upon the final proposed alternative, both NH and Maine USACE Section 404/Section 10 Permits will be prepared under the General Permit procedures.

Any temporary wetland, river bottom, and bank impacts during construction are anticipated to be restored to their pre-construction condition.

Floodplains and Floodways

Portions of the project area are in Federal Emergency Management Agency (FEMA) Zone AE and X of Northeast Pond, as depicted on the environmental constraints overview map (Appendix I, Attachment B). Based on data obtained from the FEMA Flood Map Service Center[3], FEMA mapped the Base Flood Elevation (BFE) at 421 feet upstream of the proposed bridge crossing. Additionally, based on a FEMA cross section with a 1% annual chance of flooding located slightly upstream of the proposed bridge, FEMA mapped the elevation at 420.8 feet. Portions of the project are also within the Maine Q3 Flood Zone A.

3 https://msc.fema.gov/portal/search?AddressQuery=northeast%20pond%2C%20maine

Invasive Species Identification
Four invasive plant species were observed in the project area, including oriental bittersweet (*Celastrus orbiculatus*), bush honeysuckles (*Lonicera morrowii/tartarica*), Japanese barberry (*Berberis thunbergii*), and bull thistle (*Cirsium vulgare*). See the Environmental Summary Memorandum (Appendix I) for additional information describing invasive plant species in the project area.

Threatened/Endangered Species, Wildlife, and Fisheries Habitat
The USFWS Information for Planning and Conservation (IPaC) tool, the New Hampshire Natural Heritage Bureau (NHB) DataCheck Tool, and the Maine Department of Inland Fisheries and Wildlife's (MDIFW) Environmental Review Tool were utilized to identify known or potential occurrences of threatened or endangered species or important habitat in the vicinity of the project. The databases were investigated, and it was determined that there are listed species in the vicinity of the proposed project.

Review of the USFWS IPaC tool indicates that there are three species listed in the vicinity of the proposed project: one mammal, the northern long-eared bat (NLEB) (*Myotis septentrionalis*) (Endangered); one insect, the monarch butterfly (*Danaus plexippus)* (candidate); and one plant species, the small whorled pogonia (*Isotria medeoloides*) (Threatened). As the proposed project will likely require federal permit authorization (i.e., USACE permit), federal permit nexus exists for the project, and consultation with the USFWS under Section 7 of the Endangered Species Act, will be required during the permitting phase of the project.

The NHB DataCheck and MDIFW Environmental Review Tools did not identify any known or potential occurrences of threatened or endangered species or important habitat in the vicinity of the proposed project area. The NHB DataCheck resulted in no recorded occurrences for sensitive species in the vicinity of the proposed project area (NHB File ID: NHB23-0803). An inquiry and summary of the project was sent to MDIFW on October 12, 2022, and a response was received on November 10, 2022, indicating that no known locations of State-listed Endangered, Threatened, or Special Concern wildlife species are within the project area that would be affected by the project.

The Maine Natural Areas Program (MNAP) was contacted on Monday, July 17th 2023 regarding the location of known rare and exemplary botanical features in the project vicinity. MNAP responded on July 25th 2023, indicating that a Special Concern species, Vasey's pondweed (*Potemogeton vayesi)* was recorded near the proposed bridge location near a boat launch at a marina approximately 100-feet from the proposed bridge on the Maine side. MNAP indicated that if any construction activities or other disturbance will impact the submerged substrate greater than a 50-foot distance from the northeast side of the current bridge, MNAP would like to visit the site to mark off the area so that impacts to the sensitive plant can be avoided.

Bat Roosting Habitat Survey
On September 29, 2022, HDR biologists conducted a habitat assessment for suitable summer habitat for the NLEB within the survey area, with a focus at the approach locations for the proposed bridge. The habitat assessment was conducted similarly to the procedures identified in the USFWS Range-wide Survey Guidelines for Indiana Bat & NLEB, Appendix A: Phase 1

Habitat Assessments for suitable summer habitat (USFWS 2023). For each tree greater than three inches diameter at breast height (dbh) in the vicinity of the proposed bridge approaches the HDR team mapped the location with a GPS and recorded the following information: species, condition (live or dead), dbh, and suitability as NLEB habitat (i.e., presence of furrows, crevices, holes, exfoliating bark).

The HDR assessment team identified small roadside wooded areas on the west and east sides of the survey area within the anticipated bridge approach work areas in Maine and New Hampshire containing 61 trees. Of the 61 trees surveyed, all were living with the exception of four snags (one unidentified snag, two white pine [*Pinus strobus*], and one yellow birch [*Betula alleghaniensis*]). All four snags exhibited some exfoliating bark and are potentially considered suitable summer roosting habitat for the NLEB. The remaining 57 trees, ranging from 3 to 26 inches dbh, consisted of red maple (12), yellow birch (2), white birch (2), American beech (1), pitch pine (5), white pine (23), black cherry (1), and red oak (11). One of the live red maple trees possesses minimal exfoliating bark with some cracks. This tree has a dbh of 11 inches and is considered potential suitable summer roosting habitat for the NLEB. A live yellow birch tree possesses peeling/exfoliating bark with a few crevices. This tree has a dbh of 16 inches and is also considered potential suitable summer roosting habitat for the NLEB. The remaining 55 trees have minimal to no exfoliating bark, minimal cracks and crevices, and are not considered suitable roost trees. See the Environmental Summary Memorandum (Appendix I) for additional information.

Hazardous Materials

The NHDES OneStop database was investigated on 7 July 2023 for information about potential environmental risk areas at or near the project. Examples of the data include remediation sites, underground storage tank locations, hazardous waste generators, environmental monitoring sites nonsecure, and local potential contamination sites. Sites that were found within the vicinity of the project limits include one occurrence of a remediation site (a sunken snowmobile that had been removed) and one environmental monitoring site nonsecure. From initial review the project is extremely unlikely to be affected by these types of sites or encounter any hazardous or contaminated materials. The Maine Department of Environmental Protection (MDEP) Spills and Site Cleanup website[4] was also investigated and no occurrences of any environmental risk areas were reported for the project area.

Water Quality

The project area is located within the Salmon Falls River watershed (HUC10 Code: 0106000305), Upper Salmon Falls sub-watershed (HUC10 Code: 010600030504).[5] A desktop review was conducted through the United States Environmental Protection Agency (EPA) How's My Waterway data mapper[6] to identify water quality within the project area and vicinity. Northeast Pond (Assessment Unit ID: NHLAK600030404-02) and Milton Pond (Assessment unit

[4] https://www.maine.gov/dep/spills/index.html
[5] http://nhdesonestop.sr.unh.edu/html5viewer/
[6] https://mywaterway.epa.gov/community/010600030504/overview

ID: NHLAK600030404-01-01) within the project limits were identified as impaired for fish consumption and aquatic life (acidity and mercury) in 2022 and are listed on the 303(d) list.

No probable sources contributing to impairment were identified. The project is not anticipated to impact groundwater quality within the proposed limits.

The NHDES 2022 303(d) list was reviewed to determine existing surface water impairments within the project limits, and Northeast Pond and Milton Pond were waterbodies included on the NHDES 2022 303(d) list. The waterbodies were listed due to their pH levels. At its current design, the proposed project is not anticipated to affect water quality by contributing additional stressors or pollutants to the existing conditions.

Literature Cited

Environmental Laboratory. 1987. United States Army Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1, U.S. Army Engineers Waterways Experiment Station, Vicksburg, MS. 100 pp.

United States Army Corps of Engineers (USACE). 2012. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region. Vicksburg, MS. 176 pp.

U.S. Fish and Wildlife Service (USFWS). 2023. Range-wide Indiana Bat and Northern Long-eared Bat Survey Guidelines. U.S. Fish and Wildlife Service, Region 3, Bloomington, MN. 76 pp.

7.2 Existing Cultural Resources

Historical and Archeological Resources
Independent Archeological Consultants (IAC) was retained to conduct an Archaeological Phase IA Survey for the project which consisted of conducting a records search and subsequent development of a report describing the historical and archaeological resources that are officially documented at the New Hampshire Division of Historical Resources (NHDHR) and the Maine Historic Preservation Commission (MHPC), and that are within or adjacent to the project area. The survey consisted of documentary research, including examination of the National and State Register of Historic Places, Historic District properties, as well as pre-contact and post-contact archaeological site inventory forms, cemeteries, and appropriate cultural resource management reports on file at the NHDHR and the MHPC for the Towns of Milton, New Hampshire and Lebanon, Maine, respectively. IAC also performed a comprehensive walkover inspection on July 22, 2022 in the project area to refine the desktop assessment based on current ground conditions. The field survey revealed widespread ground disturbance in the form of fill mounds, graded surfaces, and artificial landforms across the project area with a low potential for intact or informative cultural deposits related to Native American or Euroamerican activity. As a result of these conditions, IAC recommended no further archaeological survey for project impacts in Milton or Lebanon (IAC 2022). Additionally, regarding the Maine portion of the project, IAC corresponded with Dr. Arthur Spiess, Senior Archaeologist with MHPC. Dr. Spiess responded

indicating that MHPC's review of the project area resulted in a recommendation of no further survey (Dr. Arthur Spiess, personal communication 2022 *as cited in* IAC 2022). Existing cultural resource evaluation information is provided in Appendix J.

As the project advances in design, a Request for Project Review (RPR) Form with accompanying documentation for the project work will be submitted to the NHDHR. The project will also be reviewed by the cultural resources staff at the NHDOT Bureau of Environment prior to coordination with NHDHR State Historic Preservation Office. Additionally, as required, further consultation with MHPC will be performed. It is currently planned that this work will occur during the subsequent permitting phase of the project.

Literature Cited

Independent Archeological Consultants (IAC). 2022. Phase IA Archaeological Sensitivity Assessment/Phase 0 Archaeological Survey Milton, NH – Lebanon, ME (NHDOT 40658) Salmon Falls Bridge Replacement Project, Milton (Strafford County), New Hampshire and Lebanon (York County), Maine. September 7, 2022.

8 Traffic Control Considerations

Additional detour routes and road closures will not be required as the roadway is currently closed to thru traffic. Existing detour routes will be utilized throughout construction and access to adjacent driveways and the marina will be maintained.

9 Subsurface Investigation

Ten test borings were completed by NHDOT in June of 2022. Three borings were completed at each existing abutments, and two borings were completed on each approach roadway, approximately 100' and 200' from the abutments. Based on preliminary interpretation of the boring logs, it is anticipated the proposed bridge will be supported by steel piles bearing on glacial till or bedrock. Borings at the NH abutment encountered glacial till about 54 feet below existing grade and bedrock about 98 feet below existing grade. Borings at the ME abutment encountered glacial till about 26 feet below existing grade and bedrock about 107 feet below existing grade. It is anticipated that NHDOT's geotechnical report will be completed during Preliminary Design to identify the selected alternative to advance. If a multispan bridge type is selected for advancement, additional borings in the vicinity of the proposed piers will likely be required for the design.

10 Alternatives Development

10.1 Geometric Constraints for Bridge Replacement

Replacement bridge type selection was constrained by required channel clearance, the proposed roadway impacts, and span length.

To meet the concerns of the community, the proposed bridge should provide at least the same clearance as the pre-existing bridge while minimizing increases to roadway profile grade. To accommodate these concerns, the low chord of the proposed bridge should be at least El. 419.40, or 5'-6" above full lake level as measured at the center between the two abutments. Conceptual roadway profile studies identified a maximum superstructure depth of 37" would exceed the clearance provided by the pre-existing bridge.

A span length of 112'-0" will be utilized for all alternatives, which will place the abutments approximately 10 feet behind the existing timber abutments. This has the advantages of avoiding conflicts with existing steel piles, utilizing the existing abutments as support for abutment excavation, and keeping abutment construction away from the waterway.

Table 4. Proposed Geometric Constraints for Bridge Replacement Alternatives.

	Pre-existing	Proposed	Change
Span (C-C Abutment Brg.)	94'-0"	112'-0"	18'-0"
Low Chord Elevation	419.88'	419.88 (min)	+0'0" (min)
Structure Depth	20"	37" (max)	17" (max)

10.2 Proposed Roadway Alignments

The proposed horizontal roadway alignment matches the existing alignment. As horizontal curve #2 will match existing conditions and not meet current AASHTO minimum radius design criteria for the design speed, a design exception will be required. Several vertical alignments were developed to meet the proposed geometric constraints listed above and are dependent on the bridge superstructure option. The vertical alignments are described in more detail with each alternative below.

10.3 Proposed Bridge Superstructure

The NHDOT bridge manual contains a simple span bridge selection guide for various span lengths and recommends a variety of bridge types for a span length of 112'. These options include a single span prefabricated pony truss, single or multi-span precast prestressed concrete beams, and single or multi-span steel plate girder.

10.4 Proposed Bridge Substructure

As discussed in Section 9, it is anticipated the bridge will be supported by reinforced concrete substructure units on steel piles bearing on glacial till or bedrock. A geotechnical report will advise the substructure selection during Preliminary Design.

11 Description of Alternatives

This project assessed three bridge alternatives to address the purpose and need of the project. These alternatives are as follows:

1. Alternative 1 - Single Span Prefabricated Steel Truss Bridge

2. Alternative 2 – Two-Span Steel Tub Girder Bridge

3. Alternative 3 – Three-Span Precast Prestressed Deck Beam Bridge

11.1 Alternative 1 – Single Span Prefabricated Steel Truss Bridge

Alternative 1 proposes a bridge with a prefabricated steel pony truss superstructure with a concrete deck and integral wearing surface. The bridge would consist of a single 112'-0" span (center to center of bearing). The truss would be designed and delivered by a fabricator under contract to the selected contractor.

Superstructure

The proposed superstructure would consist of a 29'-0" wide x 9" thick composite cement concrete deck with integral wearing surface and supported by a stringer and floor beam system with a Warren style pony truss configuration. The superstructure would be 32'-4" wide out-to-out and approximately 36.5" deep measured from center of roadway crown to bottom of truss chord. All steel components would be galvanized.

Substructure

The proposed substructure components would consist of concrete abutments on steel piles constructed behind the existing timber abutments, which allows work to stay completely outside of the waterway.

Roadway Approaches

Profile No. 1

Initial bridge superstructure values indicated a centerline/center bridge elevation over the crossing as shown in Profile No. 1. to match existing clearances beneath the previous bridge. Profile No. 1 was also developed with improved roadway approach vertical geometry. For this profile, the vertical sag curve within the New Hampshire roadway approach was raised to improve the vertical curve geometry as best possible while providing a usable tie-in to the drive at house #222. The vertical sag curve within the Maine roadway approach to this profile was also raised to improve the vertical curve geometry as best possible while providing a usable tie-in to the marina driveway just south of the crossing. These two raises in grade result in significant impacts to abutting properties including the complete driveway for house #222 as well as the boat ramp and fueling building for the marina. While the vertical geometries were improved in this profile, they could not be improved enough to meet current AASHTO design criteria for a 35-mph design speed without takings of abutting properties. The sag curve in NH, as shown in Profile No. 1 meets current AASHTO design criteria for a 30-mph design speed while the sag curve in ME, as shown in Profile No. 1 meets current AASHTO design criteria for a 25-mph design speed.

Profile No. 2

Further refinement of the design indicated that Profile No. 1 could be lowered. This refinement included lowering the roadway elevation over the crossing, while still improving as best possible the vertical sag curves leading into and out of the bridge. The sag curves in NH and ME, as shown in Profile No. 2 meet current AASHTO design criteria for a 30-mph design speed.

Table 5 below summaries the two profiles described above. Both profiles can be found in Appendix A.

Table 5. Alternative 1 Profiles

	Profile No. 1	Profile No. 2
NH Drive Raise (Station 103+00)	9”	9”
ME Boat Ramp Raise (Station 107+50)	3’-4”	3’-1”
Raise in Grade on Bridge (Over pre-existing conditions)	4’-2”	3’-2”

As shown in the table above, the raise in grade at the critical drive stations did not significantly change between the two profiles. This is due to improving the approaching sag curve geometries. Even with the improvements to the approaching vertical geometries, design exceptions would be required for both curves as they don’t meet current AASHTO design criteria for the 35-mph design speed.

Bridge Construction
The abutments would be constructed behind the existing abutments, allowing the existing abutments to act as support of excavation for the proposed abutments. The truss components would be shipped in pieces and assembled on-site, then forming and placing of the cast-in-place concrete deck and curbs. Erection of the truss components will require a crane with a long reach.

Bridge Maintenance
Truss bridges require significant maintenance when compared to girder-type bridges. Pony trusses in particular expose the primary structural members to weather and roadway deicing salts and are likely to degrade faster. The connections and galvanized coating system, both in the truss members and below the deck in the stringer and floor beam system require regular inspection and maintenance.

11.2 Alternative 2 – Two-Span Steel Tub Girder Bridge

Alternative 2 proposes a two-span bridge consisting of a press brake formed steel tub girders with a concrete deck and integral wearing surface. The bridge would consist of two equal spans totaling 112’-0” (center to center of abutment bearing).

Superstructure
The proposed superstructure would consist of a 29’-0” wide (out-to-out) x 9” thick composite cement concrete deck with integral wearing surface and supported by 18” deep press brake formed tub girders. The superstructure would consist of the thin steel plate tubs press brake formed into a tub shape with both internal and external steel bracing and will be approximately 32” deep measured from center of roadway crown to bottom of exterior girder. All steel

components would be galvanized. The tubs would be erected in two simple spans and made continuous for live load, eliminating any bridge joint at the pier.

Substructure
The proposed bridge would be supported by two concrete abutments and one concrete pile bent pier cap on steel piles. The abutments would be located behind the existing timber abutments and the pier would be located approximately in the center of the waterway.

Roadway Approaches
Profile No. 3

Profile No. 3 was developed from input received from town officials at the May 22, 2023 Public Officials Meeting. Input received at that meeting included the following (not all inclusive):

- Clearance should be at least 5’-6”.
- Reduce impacts to the boat ramp and other adjacent parcels.
- Multiple span bridges are preferred to reduce superstructure depth and profile elevation.
- Design exceptions for horizontal curvature were acceptable.
- The roadway alignments can be designed to mimic the current roadway curvature.

Based on the above Profile No. 3 was developed and raises the centerline road/bridge grade approximately 2’-5” above the existing grade. It is included in Appendix A.

Bridge Construction
The abutments would be constructed behind the existing abutments, allowing the existing abutments to act as support of excavation for the proposed abutments. The pier would be constructed from a barge in the waterway. The tub girders would be shipped to the site and erected on the substructure units, then forming and placing of the cast-in-place concrete deck and curbs. The tubs are relatively lightweight and, combined with half the crane reach as a single span bridge, would require a relatively small crane to erect.

Bridge Maintenance
The structural steel will have a hot dipped galvanized coating to protect against corrosion, but the coating system will require maintenance. The steel tub girders will be capped with corrugated steel stay-in-place forms prior to pouring the concrete deck, which will leave the inside of the tubs inaccessible to bridge inspectors using typical techniques.

11.3 Alternative 3 – Three-Span Precast Prestressed Butted Deck Beam Bridge

Alternative 3 proposes a three-span bridge consisting of butted precast prestressed deck beams with a concrete overlay and bituminous concrete wearing surface. The bridge would consist of three equal spans totaling 112’-0” (center to center of abutment bearing).

Superstructure
The proposed superstructure would consist of a 29'-0" wide deck (out-to-out) with a 5" thick composite cement concrete overlay and 2 ½" bituminous concrete wearing surface supported by 12" deep butted precast prestressed concrete deck beams. The beams would be butted which eliminates most concrete formwork. The wearing surface on this alternative provides additional protection to the longitudinal joints between beams. The superstructure would be 23.5" deep measured from center of roadway crown to bottom of exterior girder. The deck beams would be erected in three simple spans and made continuous for live load, eliminating any bridge joint at the pier.

Substructure
The proposed bridge would be supported by two concrete abutments and two pile bent pier caps on concrete filled steel pipe piles. The abutments would be located behind the existing timber abutments and the piers would be located approximately at third points of the waterway, allowing boat traffic to utilize the deepest portion of the channel.

Roadway Approaches
The roadway approaches and profile for this alternative are the same as Alternative 2.

Bridge Construction
The abutments would be constructed behind the existing abutments, allowing the existing abutments to act as support of excavation for the proposed abutments. The piers would be constructed from a barge in the waterway. The deck beams would be shipped to the site and erected on the substructure units, then grouted and post-tensioned. Placing of the cast-in-place concrete deck and curbs occurs last with minimal formwork required, which shortens active construction duration. The short span would allow erection of the deck beams with a relatively small crane.

Bridge Maintenance
Concrete girder bridges tend to require less maintenance than steel girder bridges. There are no bolted connections, cross frames, or coating system to maintain. Butted deck beams provide a smooth bottom surface which is resistant to vandalism and debris buildup.

12 Impacts to Utilities

All three alternatives would require relocation of overhead utilities on the Milton side of the crossing. Although the proposed bridge does not directly impact utilities, it is anticipated that the utility poles closest to the bridge will require relocation to provide clearance for construction activities and approach work.

13 Impacts to Right-of-way

Alternative 1, with the improved vertical approach geometries shown in Profile Nos. 1 and 2, has more right-of-way impacts when compared to Alternatives 2 and 3 with Profile No. 3. Although Profiles No. 1 and No. 2 propose differing center of bridge elevations, the improved geometries of the approach vertical sag curves create similar impacts to abutting properties. Both Profile

No. 1 and Profile No. 2 propose impacts to the marina property including relocation of the boat launch and adjacent gas shed and underground tank. The right-of-way impacts associated with Alternatives 2 and 3 (Profile No. 3) are generally limited to within the right-of-way in New Hampshire with some impacts over the right-of-way near the bridge. In Maine there are impacts to the Marina property with reconstruction of the boat ramp required and to the property across the road from the marina.

Generally, impacts will be limited to temporary slope and driveway easements. Permanent retaining wall easements may be required on the southwest bridge quadrant in Maine.

14 Impacts to Drainage

Drainage patterns for all three alternatives will mimic existing conditions. Stormwater is anticipated to sheet flow off the pavement, along the roadway and toward Northeast and Milton Ponds. Roadside ditch lines and drive culverts will be implemented as needed to prevent impacts to abutting properties.

15 Impacts to Resources

The project as proposed will require unavoidable, temporary, and permanent impacts to state and federally regulated protected natural resources, specifically one unnamed wetland and Northeast Pond in the Salmon Falls River watershed/ Upper Salmon Falls sub-watershed. Impacts on aquatic resources will occur primarily to previously impacted resources associated with the original bridge construction and subsequent maintenance and eventual removal activities. The estimated amount of impact resulting from each alternative is discussed below.

Alternative 1 is anticipated to have the most impact to environmental resources (approx. 865 sq. ft.). Alternative 1 bridge work would not require in-water work for pier construction but would require raising the profiles on both Maine and New Hampshire approaches which extends the limits of work beyond the ROW. Impacts to a forested wetland (Wetland 1) (approx. 415 sq. ft.) in Maine would occur from construction of a retaining wall on the western side of the bridge. Scour countermeasures may be required at the streamside face of the abutments and filling/grading to raise the profiles would impact jurisdictional boundaries (approx. 450 sq. ft.). A scour analysis will be conducted during the next phase of design.

Alternative 2 is anticipated to have the least impact to environmental resources (approx. 405 sq. ft.). Alternative 2 bridge work requires in-water work for construction of a single pier (approx. 35 sq. ft.) to be located approximately in the center of the waterbody. Similar to Alternative 1, Alternative 2 would also require impacts to Wetland 1 for construction of a retaining wall on the western side of the bridge (approx. 60 sq. ft.) as well as impacts in jurisdictional boundaries associated with filling/grading to raise the profiles (approx. 310 sq. ft.).

Alternative 3 is anticipated to have impacts to environmental resources slightly higher than Alternative 2 (approx. 440 sq. ft.). Alternative 3 bridge work requires in-water work for the construction of two piers (approx. 70 sq. ft.) to be located approximately at third points along the waterway, allowing boat traffic to utilize the deepest portion of the crossing. Similar to

Alternatives 1 and 2, Alternative 3 would also require impacts to Wetland 1 for construction of a retaining wall on the western side of the bridge (approx. 60 sq. ft.) as well as impacts in jurisdictional boundaries associated with filling/grading to raise the profiles (approx. 310 sq. ft.).

Shoreland resources will be impacted for all three alternatives from clearing and grubbing activities and an increase in impermeable surfaces due to the widened roadway. Clearing of vegetation along Northeast Pond has the potential to reduce bank stability and increase erosion. In areas where these impacts are temporary, they will be minimized through the use of erosion control measures and by restoring, stabilizing, and seeding banks as soon as possible once construction is completed. Since the majority of terrestrial portions of the three alternatives will occur in rights-of-way, most of the vegetation that will be impacted within this area consists of previously disturbed shrubby and herbaceous cover with some forested areas. Herbaceous vegetation and successional shrubs within the area impacted by construction are expected to recover quickly following restoration and stabilization of the site.

Pier construction and disturbance within and along the waterbody associated with each alternative could create potential short-term effects on water quality caused by localized increases in turbidity and downstream sedimentation. Erosion and sediment controls will be installed/utilized to avoid or minimize effects on water quality. No long-term impacts on water quality from pier construction or scour countermeasures (if required) are expected.

As currently designed, each alternative in New Hampshire will require preparation and submittal of a Shoreland Impact Permit. Additionally, a NHDES Standard Dredge and Fill Permit will be required for each alternative. In Maine, an appropriate Natural Resources Protection Act (NRPA) permit will also be prepared for impacts associated with Wetland 1 and for impacts below the OHWM. Furthermore, each alternative will also require New Hampshire and Maine USACE Section 404/Section 10 Permits prepared under the General Permit procedures.

All three alternatives will maintain the navigational under-clearance provided by the pre-existing bridge. Based on initial assessment and site review, no impacts to cultural resources are anticipated for any of the alternatives. Coordination with NHDHR and MHPC is ongoing and will continue into the next phase of design. The proposed bridge will improve connectivity and enhance public safety between Milton, NH and Lebanon, ME. Temporary impacts in the form of visual, audible, recreational, and atmospheric effects as well as short term traffic delays and access are anticipated due to construction activities.

16 Life Cycle Cost Analysis

Life cycle cost analyses (LCCA) were performed for all three alternatives based on a 100-year service life and guidance from FHWA and NHDOT. The LCCA considered the capital cost (proposed project costs); maintenance such as cleaning, concrete sealing, and bridge inspection; preservation efforts such as pavement preservation, deck patching, joint replacement, and bearing rehabilitation; and rehabilitation efforts such as deck replacement, superstructure and substructure rehabilitation, bearing replacement, and bridge rail replacement. Costs are given in Present Value Dollars. The LCCA for each alternative is included in Appendix N.

16.1 Project Costs

Conceptual level project costs were developed for each alternative and consist of construction costs, preliminary engineering costs to design the project, construction engineering costs for office and field support, and ROW costs for land acquisition, property relocation, and construction easements.

Construction costs for each alternative were developed based on NHDOT weighted average unit prices and fabricator budget estimates. Alternative 2 has larger substructure costs because of the pier in the waterway. Alternative 3 had the largest substructure costs due to two piers in the waterway. Alternative 1 is anticipated to have larger roadway approach costs due to longer, taller retaining walls and larger fills associated with a larger profile adjustment. In total, Alternative 3 had the largest construction cost, followed by Alternative 2 and Alternative 1.

Preliminary engineering and construction engineering were estimated based on a percentage of the construction cost, and similarly Alternative 3 is anticipated to have the largest cost, followed by Alternative 2 and Alternative 1.

Alternative 1 is anticipated to require land acquisition, property relocation, and temporary construction easements. A conceptual estimate of $500,000 was developed to perform an appraisal of the impacted property, purchase land, relocate existing structures, and acquire temporary construction easements. Most of this cost is to reimburse the property owner for the removal and reconstruction of the existing docks, boat launch, dock house, and fueling station. Alternatives 2 and 3 are likely to require only temporary construction easements in order to construct the bridge approaches and regrade the paved area in front of the boat ramp.

Overall, Alternative 2 had the smallest project cost, followed by Alternative 1 and Alternative 3. Project costs can be seen in Table 6. Project cost estimates can be found in Appendix M.

Table 6. Project Cost Comparison

Alternative	Construction Cost	Preliminary Engineering	Construction Engineering	ROW	Project Cost
1	$2,132,000	$214,000	$214,000	$500,000	$3,060,000
2	$2,259,000	$226,000	$226,000	$8,000	$2,719,000
3	$2,709,000	$271,000	$271,000	$8,000	$3,251,000

16.2 Life Cycle Costs

Each bridge is anticipated to undergo routine maintenance, including annual pressure washing of the bridge deck, sealing of concrete curbs and exposed substructure units, brush clearing. Each alternative will also be inspected biennially. All three alternatives are anticipated to have similar routine maintenance costs.

In terms of preservation and rehabilitation efforts, Alternative 1 is anticipated to have the largest cost since the major structural elements of a truss bridges are more exposed and more susceptible to corrosion. Alternatives 2 and 3 have similar preservation and rehabilitation costs.

Overall, Alternative 2 had the smallest life cycle costs followed by Alternatives 1 and 3 which had similar life cycle costs. A comparison of life cycle costs for each alternative can be seen in Table 7.

Table 7. Life Cycle Cost Comparison (Present Value Dollars)

Alternative	Capital Cost	Maintenance Cost	Preservation and Rehabilitation Costs	Overall Life Cycle Cost
1	$3,060,000	$32, 151	$406,810	$3,498,961
2	$2,719,000	$32,151	$260,078	$3,011,229
3	$3,251,000	$32,151	$241,543	$3,524,694

17 Construction Schedule

A preliminary schedule was developed for all alternatives. All alternatives are anticipated to have similar durations between 36 weeks for Alternative 1 and 40 weeks for Alternative 3, beginning with the Contractor's Notice to Proceed (NTP). The additional duration to construct Alternatives 2 and 3 is due to in water work associated with the construction of the piers. Construction durations for each alternative are listed in Table 8.

Table 8. Approximate Construction Durations

Alternative	# Weeks from NTP
1	36
2	37
3	40

18 Alternatives Analysis

The three alternatives provide different structure types which bring different benefits and challenges to the project.

Each alternative is anticipated to have similar impacts to utilities and existing drainage and will likely be constructed in similar time frames.

Alternative 1 is anticipated to require significant ROW impacts due to the profile adjustments shown in Profile Nos. 1 and 2 to accommodate the required vertical clearance and improve existing vertical curvature. Alternatives 2 and 3 are not anticipated to have significant impacts to the ROW.

Alternative 3 is anticipated to have the most jurisdictional impacts due to the construction of two piers in the water and is anticipated to have some shoreland and wetland impacts due to roadway widening and raise in grade. Alternative 2 has about 50% of the jurisdictional impacts as Alternative 3, and similar shoreland and wetland impacts. Alternative 1 is not anticipated to have any jurisdictional impacts but is likely to have the most shoreland and wetland impacts due to the profile adjustments.

Alternative 2 has the smallest project cost and life cycle cost. Alternative 1 has the lowest construction cost, but requires the largest ROW cost, resulting a larger project cost when compared to Alternative 2. Alternative 1 also has the largest preservation and rehabilitation costs over its service life, resulting in a large life cycle cost when compared to Alternative 2. Alternative 3 is anticipated to have the highest construction cost and the highest life cycle cost, due primarily to the construction costs of a second pier in the waterway.

Table 9. Analysis Matrix

	Alternative 1 Single Span Steel Truss Bridge	Alternative 2 2 Span Steel Tub Girder	Alternative 3 3 Span Butted Concrete Deck Beam
Impacts to Utilities	Each alternative is anticipated to require relocation of aerial utilities on the Lebanon ME side of the bridge		
Impacts to ROW	✓ Alternative 1 is anticipated to require roadway profile adjustments which will result in ROW impacts on both the Milton and Lebanon approaches	✓ Minor impacts are anticipated in the form of temporary construction easements	✓ Minor impacts are anticipated in the form of temporary construction easements
Impacts to Drainage	Each alternative is anticipated to maintain existing sheet flow drainage		
Jurisdictional Impacts	✓ No jurisdictional impacts due to no piers in the water and proposed abutments in the dry.	✓ Some jurisdictional impacts due to pile placement for one pier in the waterway.	✓ Most jurisdictional impacts due to pile placement for two piers in the waterway.
Impacts to Wetland and Shoreland Resources	✓ Most impacts to shoreland and wetland resources due to profile adjustment.	✓ Minimizes shoreland and wetland impacts.	✓ Minimizes shoreland and wetland impacts.
Construction Schedule	Each alternative is anticipated to have a similar construction duration, between 36 and 40 weeks.		
Maintenance	✓ Steel truss bridge requires the most maintenance over the life of the structure	✓ Galvanized steel tub girder bridge requires normal steel girder bridge maintenance. Enclosed tub shape limits inspectable areas	✓ Butted prestressed concrete deck beams require the least maintenance of the alternatives.
Project Cost	✓ Alternative 1 has a greater project cost compared to Alternative 2.	✓ Alternative 2 has the smallest project cost.	✓ Alternative 3 has the largest project cost.
Life Cycle Cost	✓ Alternatives 1 and 3 have similar life cycle costs overall. Alternative 1 has the largest preservation and rehabilitation costs over the life of the bridge when compared to Alternatives 2 and 3.	✓ Alternative 2 has the smallest life cycle cost, providing the smallest project costs in combination with reduced preservation and rehabilitation costs over the life of the bridge, when compared to Alternative 1.	✓ Alternative 3 has the largest life cycle cost due mostly to the largest project cost, despite having favorable preservation and rehabilitation costs when compared to Alternative 1.

19 Recommendations

Each alternative was selected because it met the purpose and need of the project. While each alternative provides some benefits and challenges, Alternative 2 offers the most cost-effective balance. Alternative 2 minimizes impacts ROW and to shoreland and wetland resources. Alternative 2 does require some jurisdictional impacts, but the impacts are minimized to one pile bent style pier to avoid temporary impacts associated with a cofferdam and construction access. Alternative 2 is the least expensive alternative, both at a project cost level and a life cycle cost level, offering reduced preservation and rehabilitation costs over the life of the structure when compared to Alternative 1. Alternative 3, while also minimizing ROW impacts, does not minimize jurisdictional impacts or provide the most cost-effective solution.

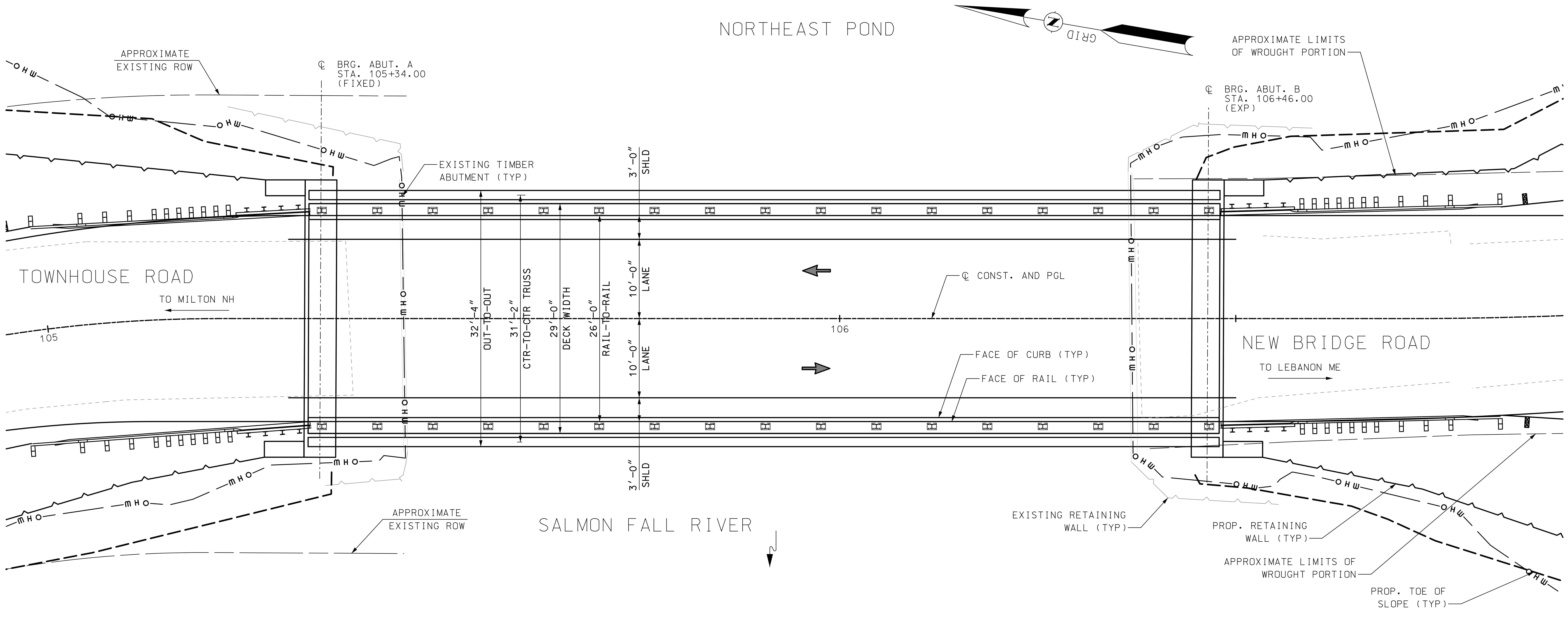
The preferred alternative is Alternative 2 which will utilize a steel tub girder superstructure with a 112'-0" span and a 9" thick concrete deck with integral wearing surface. The new bridge will be straight, providing a 26'-0" wide travel way consisting of two 10'-0" travel lanes and two 3'-0" shoulders, measured rail-to-rail. Construction duration is estimated at 37 weeks.

The proposed horizontal alignment will match the existing alignment over the bridge. The proposed vertical alignment will Profile No. 3. Superelevation will be incorporated into the proposed design to improve the relationship between design speed and curvature. .

Conceptual level project cost and life cycle cost estimates were prepared based on a 100-year design life, and accounted for maintenance, repairs, and rehabilitations over the design life. Costs associated with the preferred alternative are:

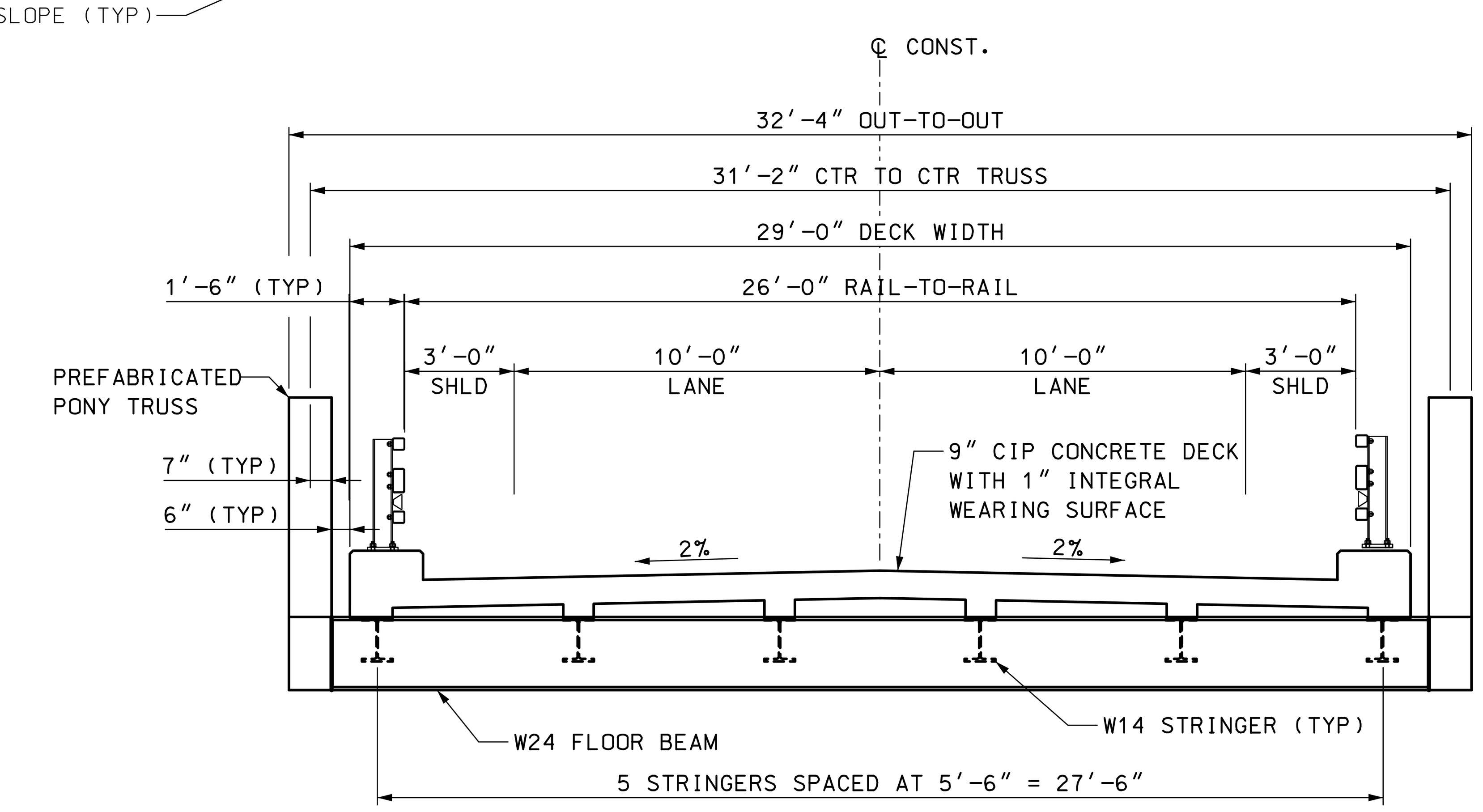
- Project Cost - $2,719,000
- Life Cycle Cost - $3,011,229 (present-day dollars)

APPENDIX A
Engineering Study Plans



PROPOSED PLAN

SCALE: 1/8" = 1'-0"



PROPOSED SECTION

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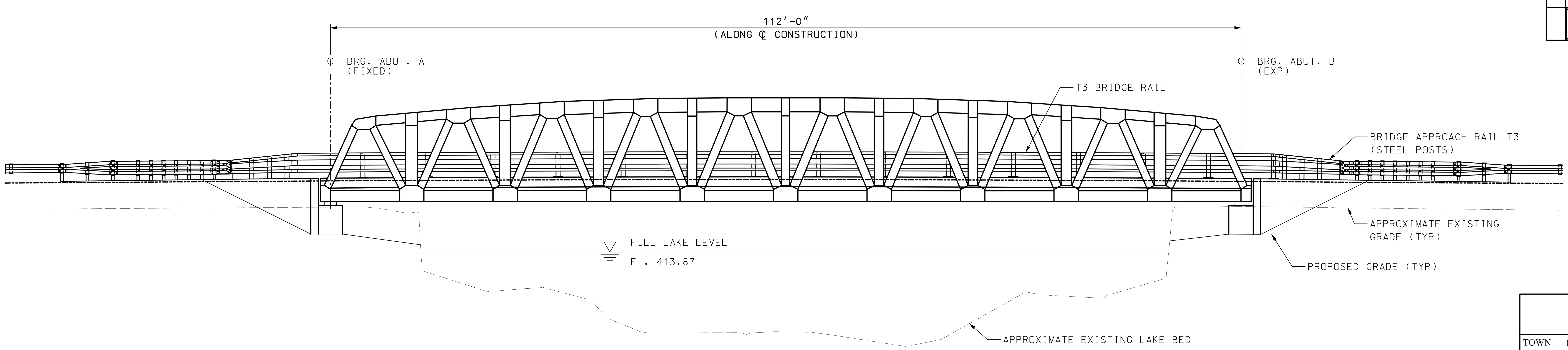

PROPOSED ELEVATION

SCALE: 1/8" = 1'-0"

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION * BUREAU OF BRIDGE DESIGN

TOWN: MILTON, NH - LEBANON, ME — BRIDGE NO. 168/151 — STATE PROJECT 40658

LOCATION: TOWNHOUSE RD OVER NORTHEAST POND

ALTERNATIVE 1 - SINGLE SPAN PONY TRUSS

BRIDGE SHEET 1 OF 3

FILE NUMBER

REVISIONS AFTER PROPOSAL

	BY	DATE		BY	DATE
DESIGNED	JPJ	07/23	CHECKED	PJL	7/23
DRAWN	JPJ	07/23	CHECKED	PJL	7/23
QUANTITIES			CHECKED		

SHEET SCALE | ISSUE DATE | REV. DATE | FEDERAL PROJECT NO. | SHEET NO. | TOTAL SHEETS

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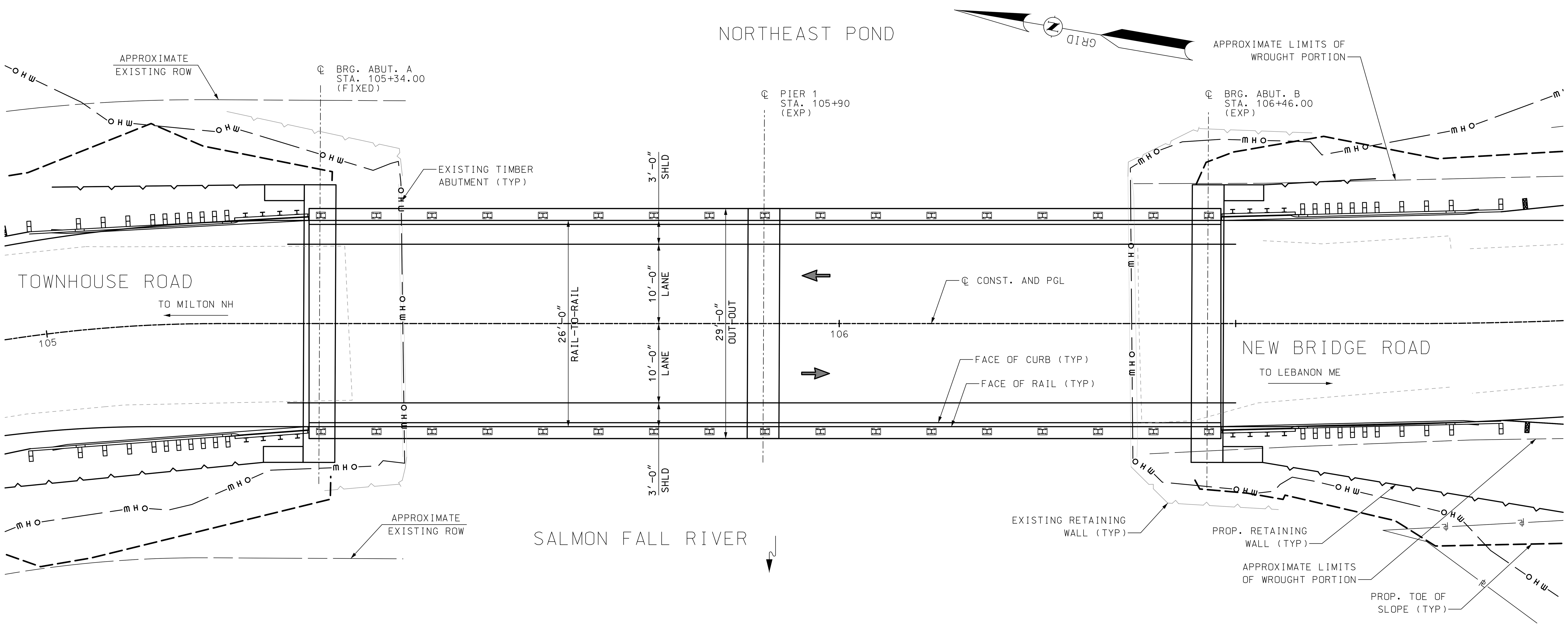
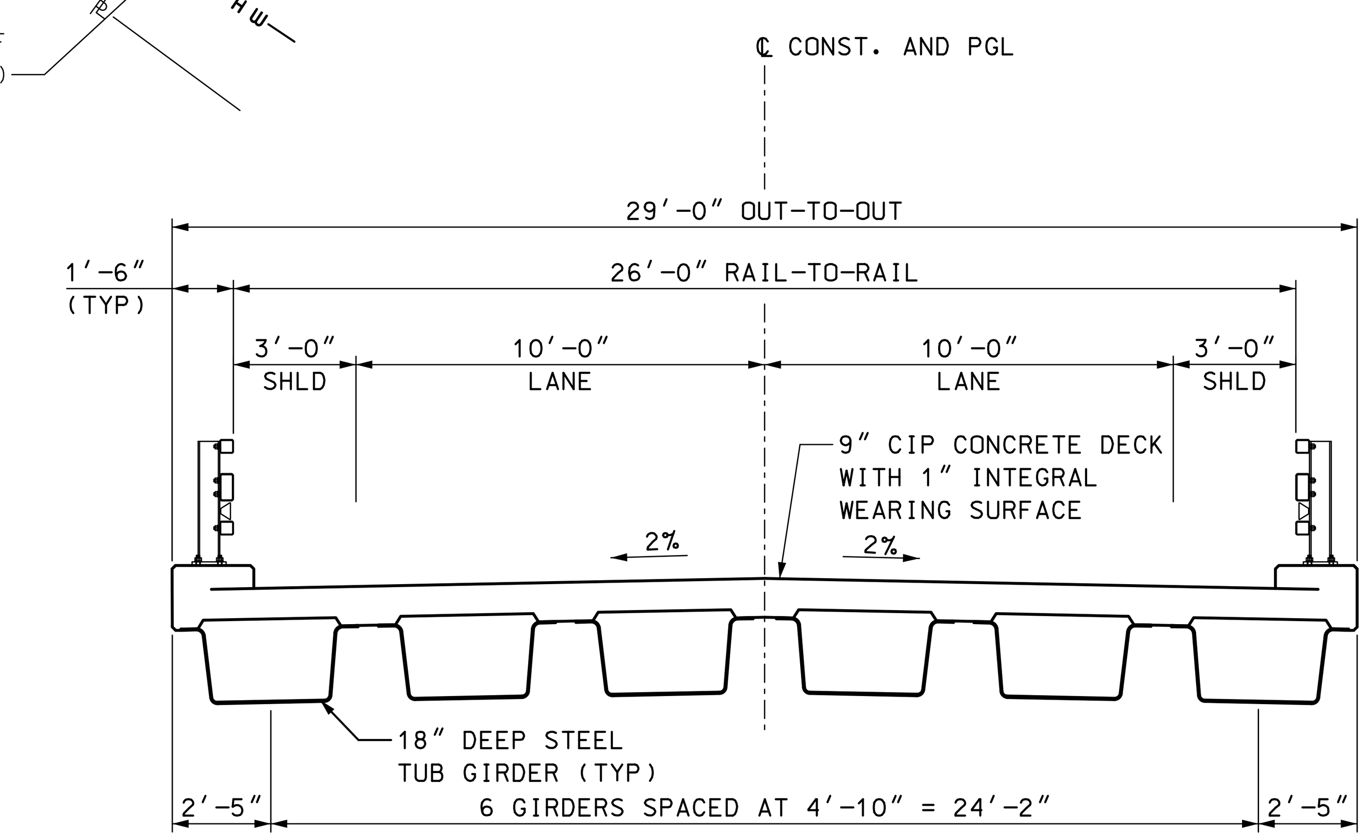


PROPOSED PLAN

SCALE: 1/8" = 1'-0"



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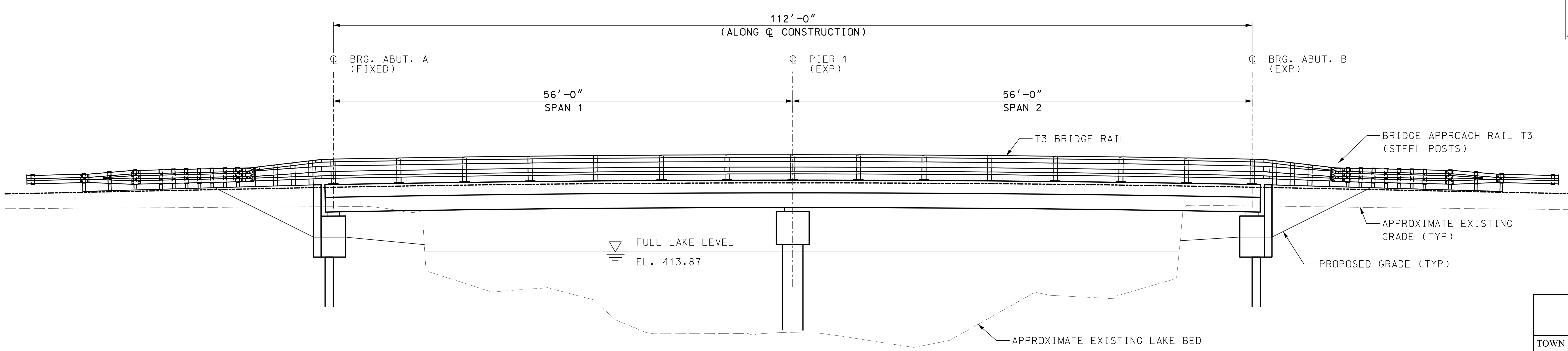


PROPOSED ELEVATION

SCALE: 1/8" = 1'-0"

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

TOWN MILTON, NH - LEBANON, ME — BRIDGE NO. 168/151 — STATE PROJECT 40658

LOCATION TOWNHOUSE RD OVER NORTHEAST POND

ALTERNATIVE 2 - TWO SPAN STEEL TUB GIRDERS

BRIDGE SHEET 2 OF 3

REVISIONS AFTER PROPOSAL

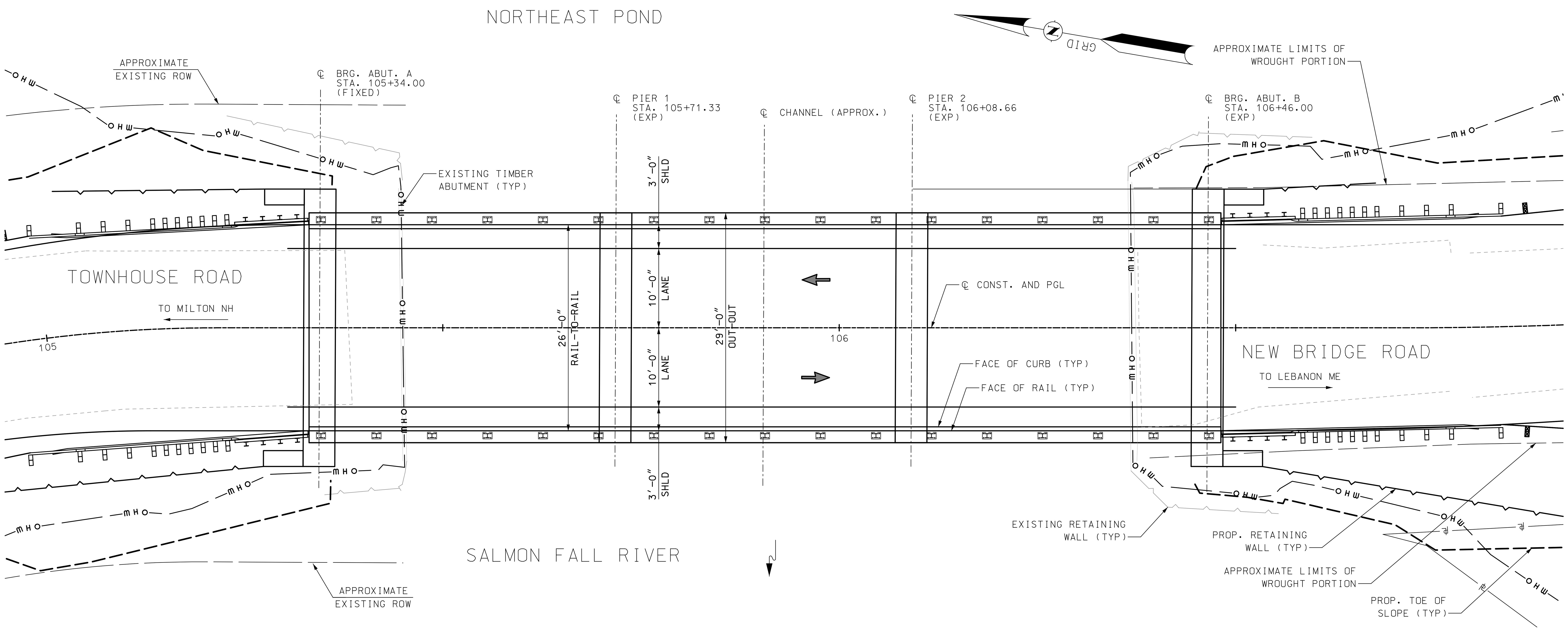
	BY	DATE		BY	DATE
DESIGNED	JPJ	07/23	CHECKED	PJL	7/23
DRAWN	JPJ	07/23	CHECKED	PJL	7/23
QUANTITIES			CHECKED		

SHEET SCALE

ISSUE DATE

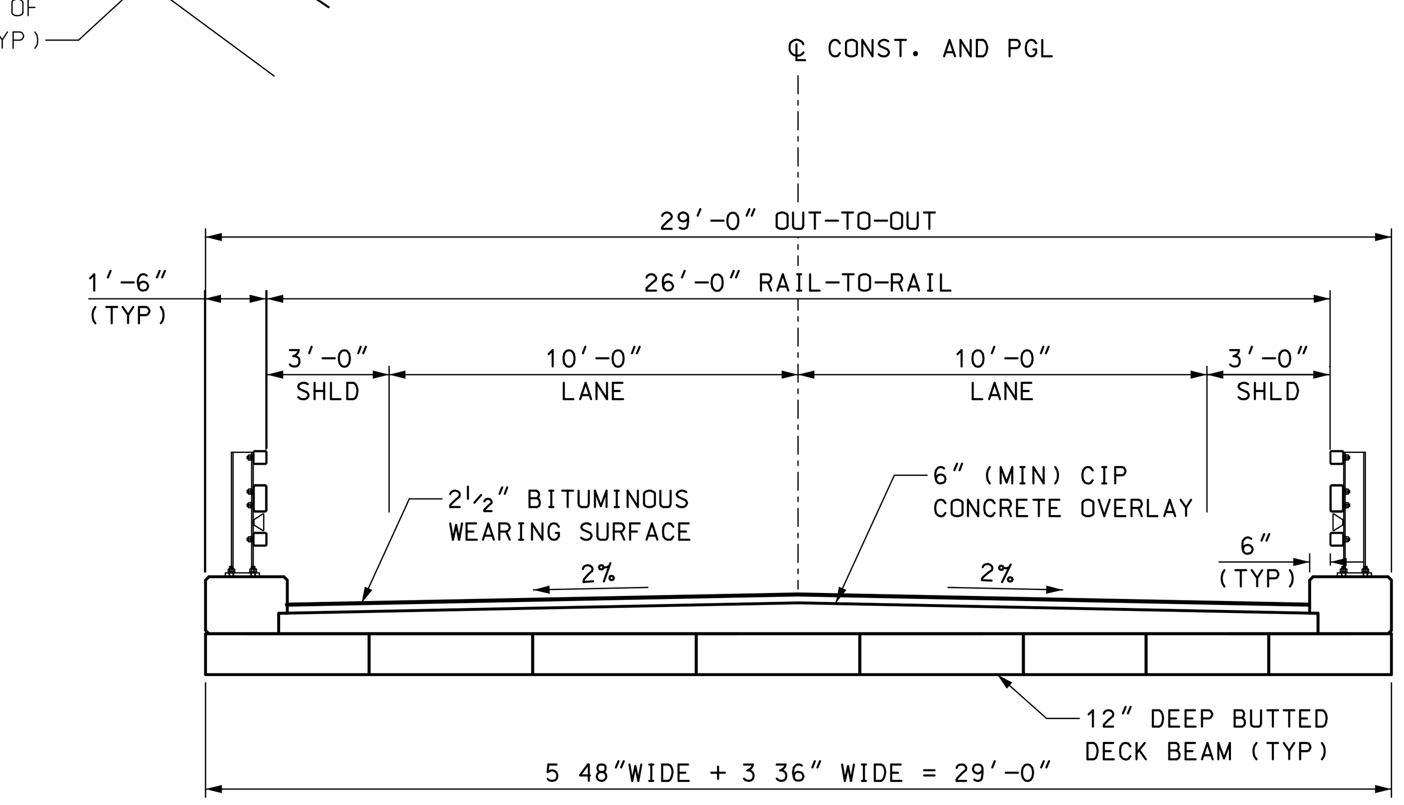
REV. DATE

FEDERAL PROJECT NO. | SHEET NO. | TOTAL SHEETS | FILE NUMBER



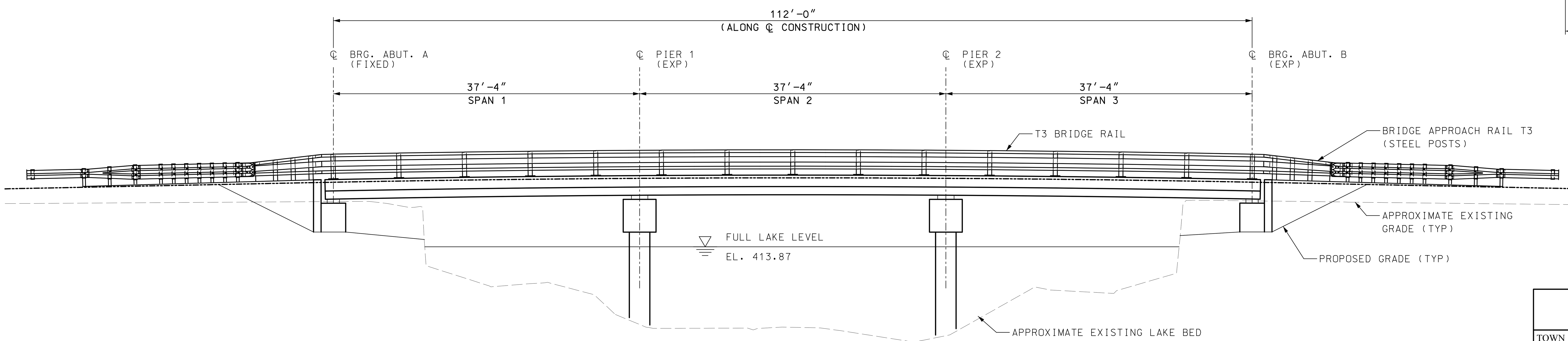
PROPOSED PLAN

SCALE: 1/8" = 1'-0"



PROPOSED SECTION

SCALE: 1/4" = 1'-0"



PROPOSED ELEVATION

SCALE: 1/8" = 1'-0"

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION * BUREAU OF BRIDGE DESIGN

TOWN MILTON, NH - LEBANON, ME | BRIDGE NO. 168/151 | STATE PROJECT 40658

LOCATION TOWNHOUSE RD OVER NORTHEAST POND

ALTERNATIVE 3 - THREE SPAN BUTTED DECK BEAMS

BRIDGE SHEET 3 OF 3

FILE NUMBER

REVISIONS AFTER PROPOSAL

	BY	DATE		BY	DATE
DESIGNED	JPJ	07/23	CHECKED	PJL	7/23
DRAWN	JPJ	07/23	CHECKED	PJL	7/23
QUANTITIES			CHECKED		

SHEET SCALE | ISSUE DATE | REV. DATE | FEDERAL PROJECT NO. | SHEET NO. | TOTAL SHEETS

REVISIONS AFTER PROPOSAL			
NUMBER	DATE	STATION	STATION

DESCRIPTION

SDR PROCESSED	NHDOT	DATE 10/2022
NEW DESIGN	HAB	DATE 7/2023
SHEET CHECKED	AGB	DATE 7/2023
AS BUILT DETAILS		DATE

HDR

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ⋄ BUREAU OF HIGHWAY DESIGN

GENERAL PLANS
ALTERNATIVE 1 - PROFILE NO. 1 AND 2

	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
GEN01	40658-GenPlans	40658	2	9

PROFILE NO. 1

SDR PROCESSED	NHDOT	DATE	10/2022
NEW DESIGN	HAB	DATE	7/2023
SHEET CHECKED	AGB	DATE	7/2023
AS BUILT DETAILS		DATE	

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

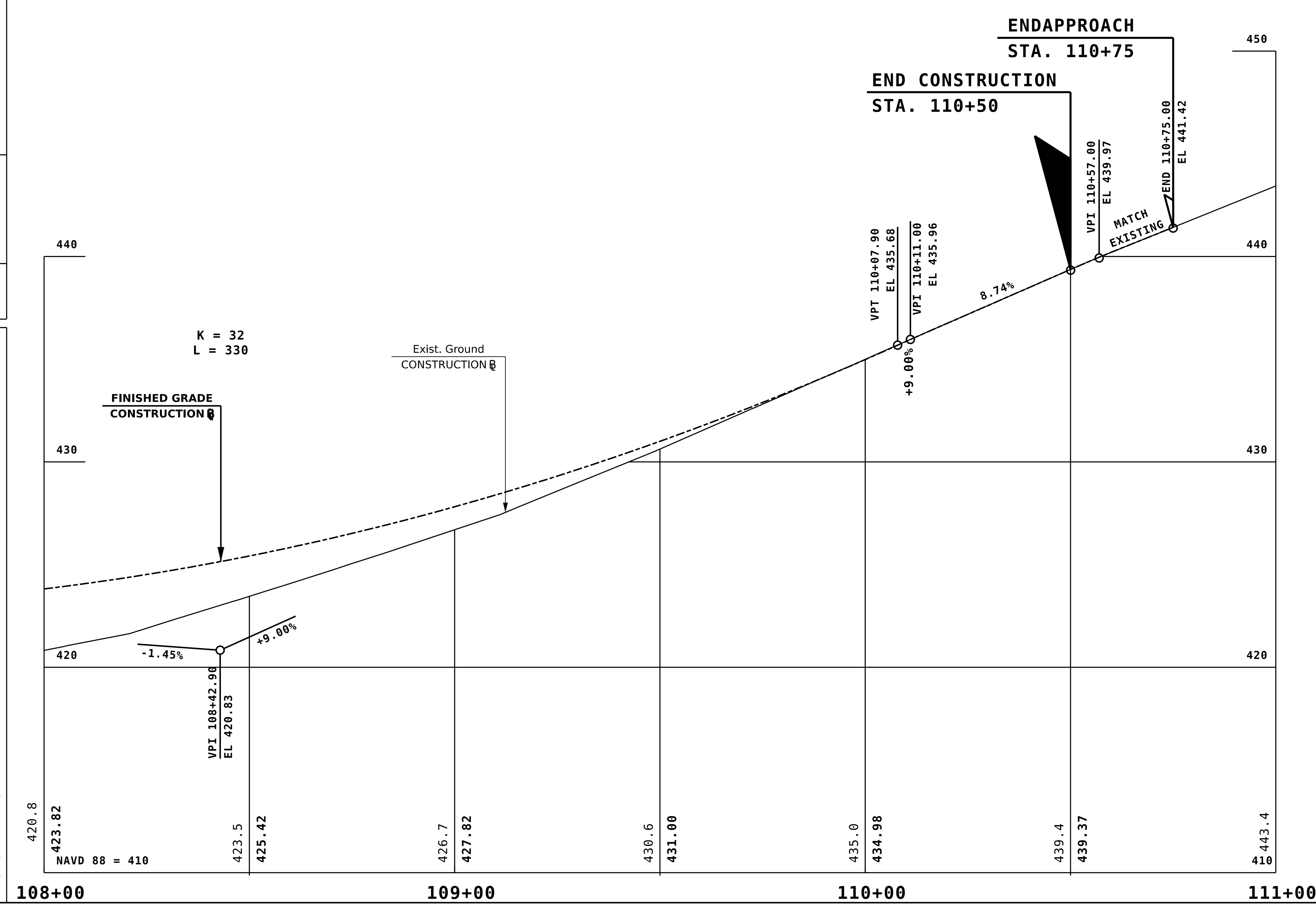
HDR

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ⋄ BUREAU OF HIGHWAY DESIGN

GENERAL PLANS
ALTERNATIVE 2 & 3 - PROFILE NO. 3

GEN01	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
	40658-GenPlans	40658	3	9



SCALE:
1"= 20' HORIZ.
1"= 4' VERT.

HDR

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ⚬ BUREAU OF HIGHWAY DESIGN

PROFILE NO. 1

	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
PRO01	40658-Geometry	12345	1	1

REVISIONS AFTER PROPOSAL

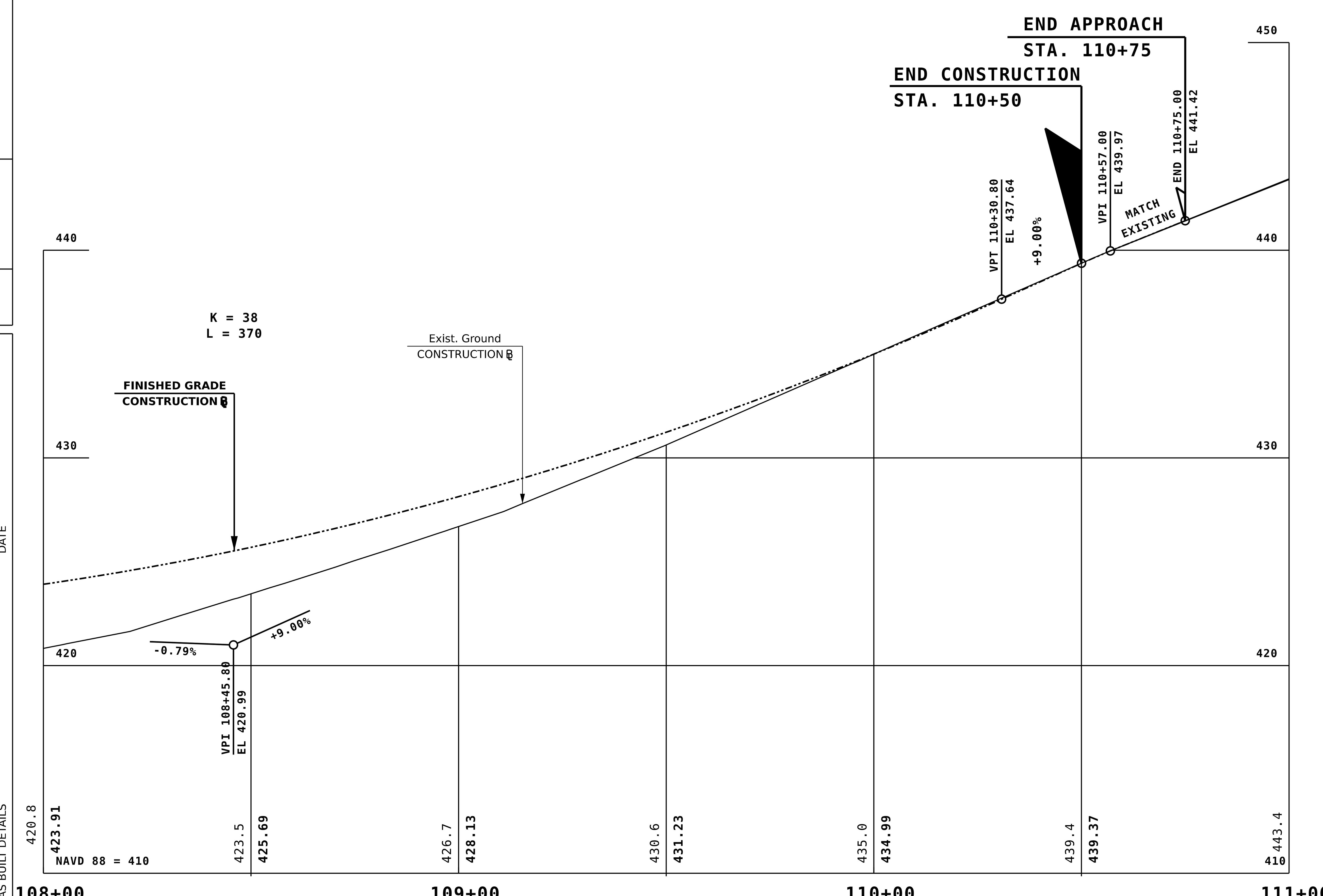
NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED NHDOT	DATE 10/2022	
NEW DESIGN HAB	DATE 7/2023	
SHEET CHECKED AGB	DATE 7/2023	
AS BUILT DETAILS	DATE	

40658-Geometry.dgn Profile 1- 20sc- 1 Span [Sheet] 8/16/2023 3:48:08 PM "OpenRoadsDesigner_HBROWN"

REVISIONS AFTER PROPOSAL			
NUMBER	DATE	STATION	DESCRIPTION

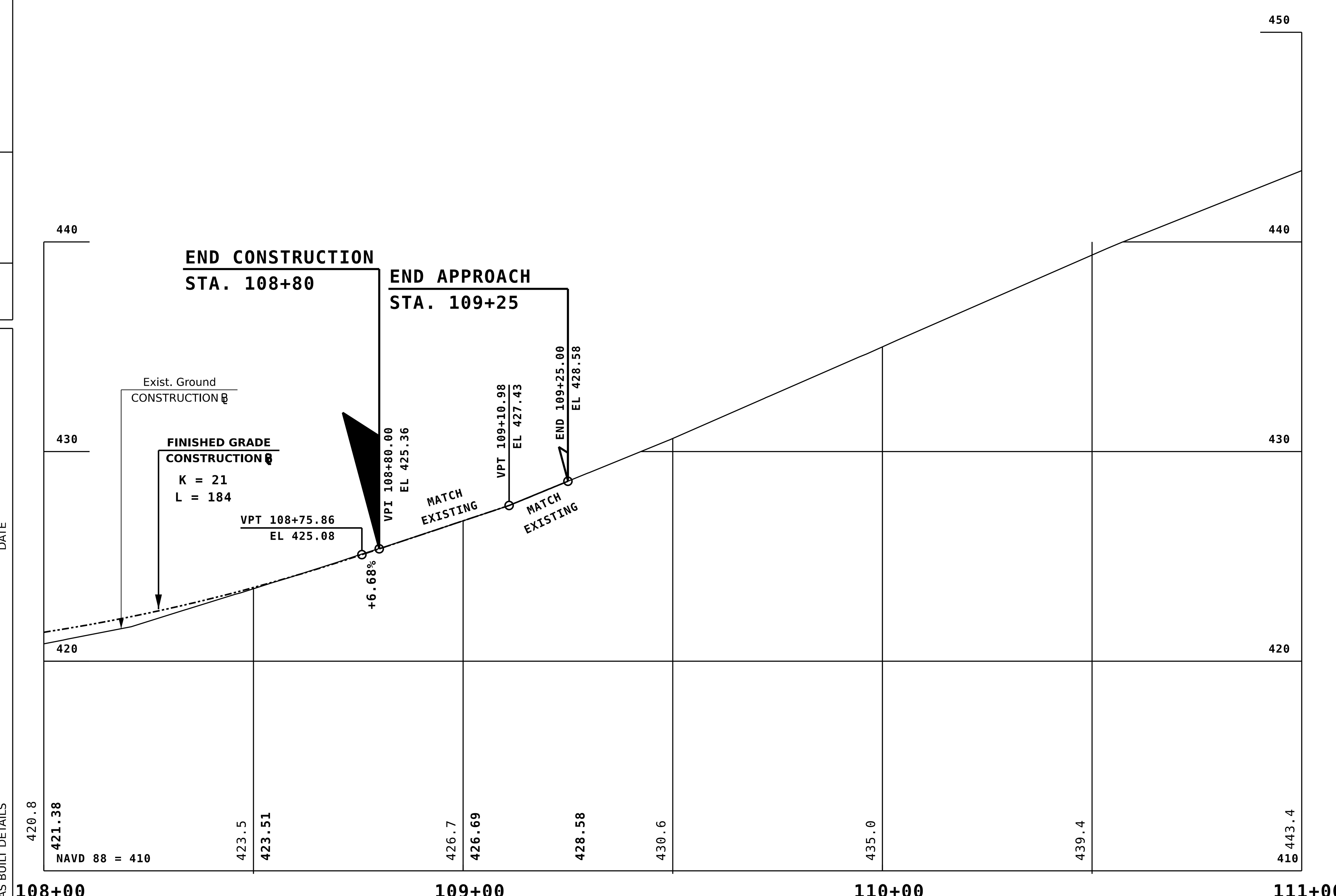
SDR PROCESSED	NHDOT	DATE 10/2022
NEW DESIGN	HAB	DATE 7/2023
SHEET CHECKED	AGB	DATE 7/2023
AS BUILT DETAILS		DATE



SCALE:
1"= 20' HORIZ.
1"= 4' VERT.

STATE OF NEW HAMPSHIRE			
DEPARTMENT OF TRANSPORTATION ⚬ BUREAU OF HIGHWAY DESIGN			
PROFILE NO. 2			
DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
40658-Geometry	12345	1	1

PRO02



SCALE:
1"= 20' HORIZ.
1"= 4' VERT.

HDR

REVISIONS AFTER PROPOSAL			
NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED	DATE 10/2022	NHDOT
NEW DESIGN	DATE 7/2023	HAB
SHEET CHECKED	DATE 7/2023	AGB
AS BUILT DETAILS	DATE	

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN

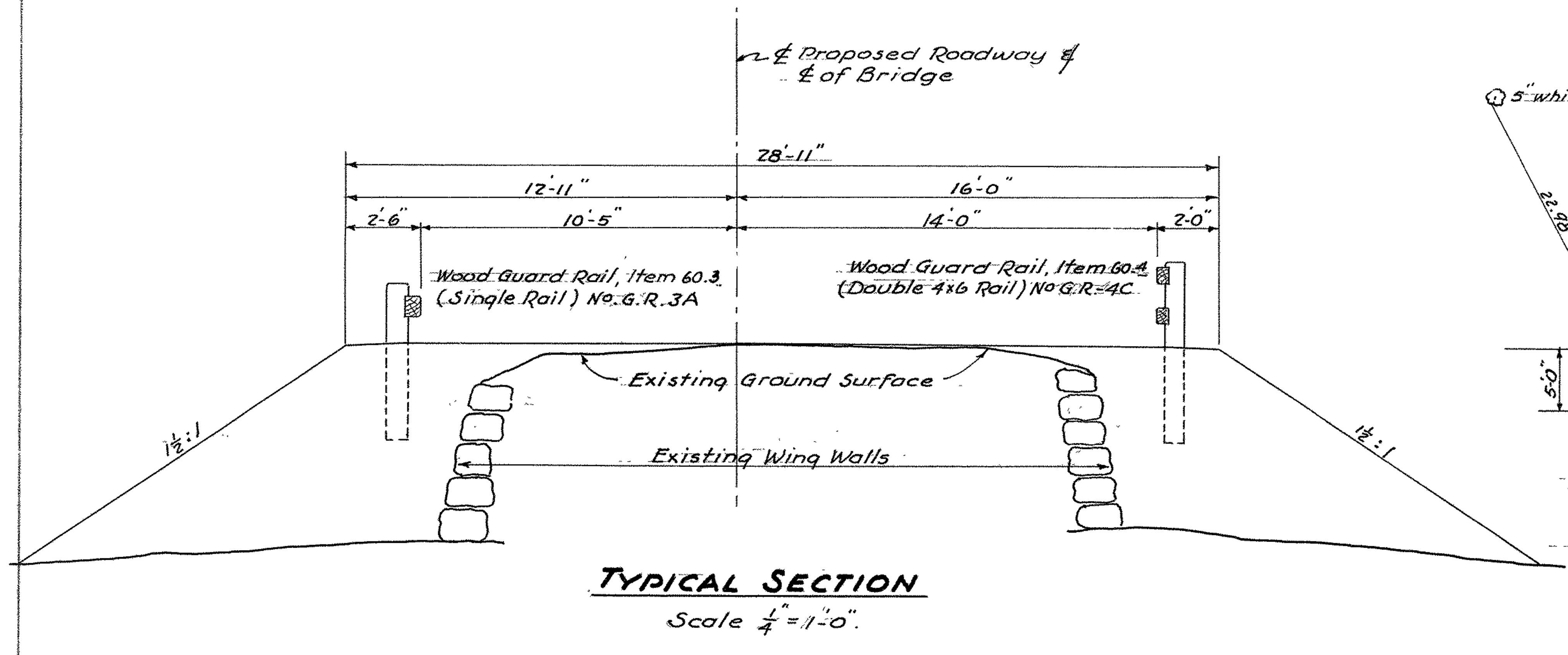
PROFILE NO. 3

	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
PRO03	40658-Geometry	12345	1	1

APPENDIX B

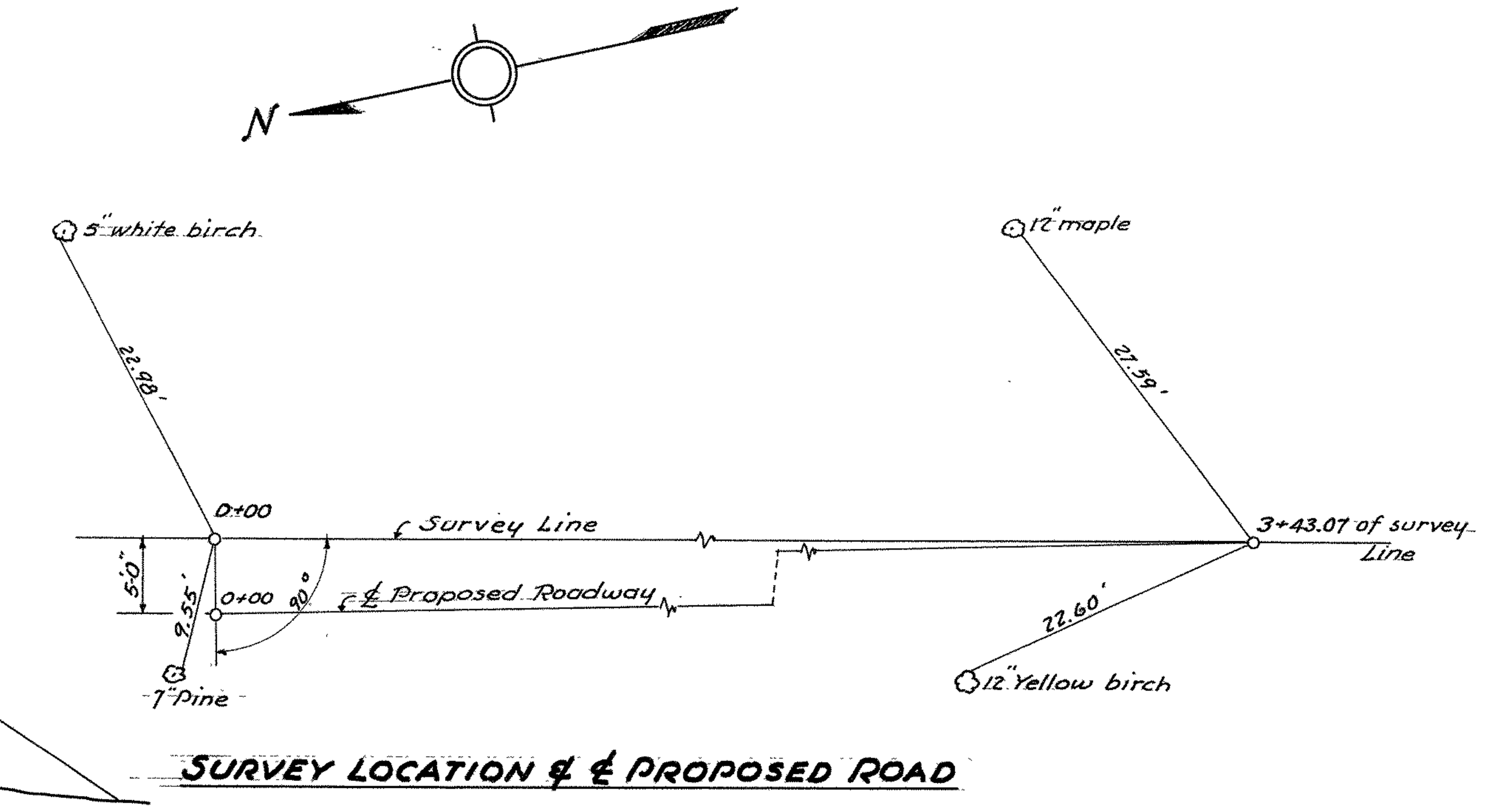
1947 Existing Bridge Plans

FED. ROAD DIST. NO.	STATE	PROJ. NO.	FISCAL YEAR	SHEET NO	TOTAL SHEETS
9	N. H.				

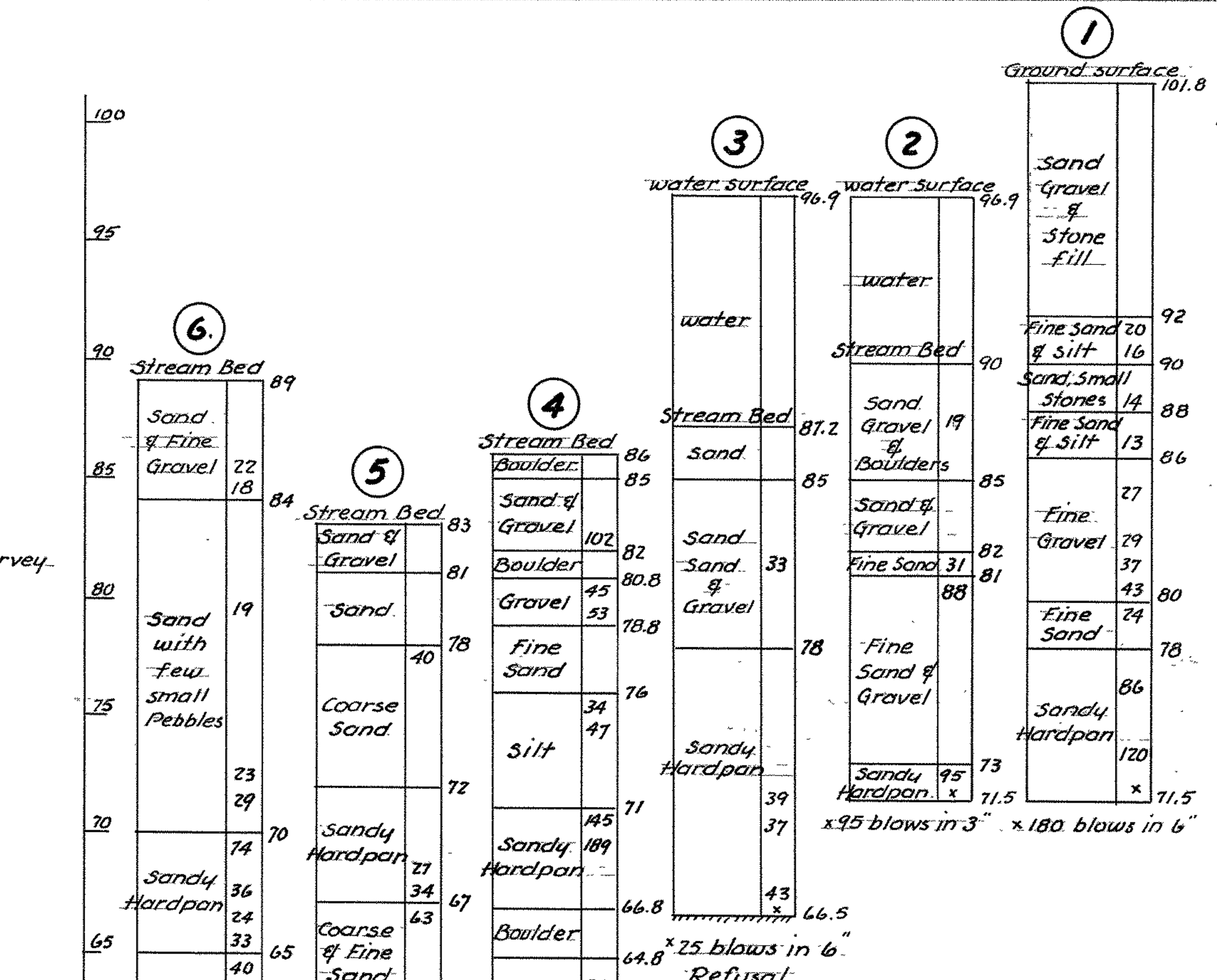


TYPICAL SECTION

Scale 1/4" = 1'-0"



SURVEY LOCATION ℄ ℄ PROPOSED ROAD



Borings by N.H.H.D. Concord, N.H. July 1 & Sept 9, 1947.

Figures in right hand column indicate number of blows required to drive 1 1/8 pipe 1 ft., using 135 lb. weight falling 2 ft.

Borings are for design and show conditions at boring points only and do not necessarily indicate nature of materials to be encountered during construction.

Samples of materials encountered are available for inspection at the office of the Bridge Engineer, Concord, N.H.

PLAN

GENERAL NOTES

Design Loading H-15-44

Specifications A.A.S.H.O. 1944 & N.H.H.D. 1941.

All timber shall be treated Douglas Fir or Southern Pine with a minimum allowable fiber stress of 1600 lbs per sq. inch.

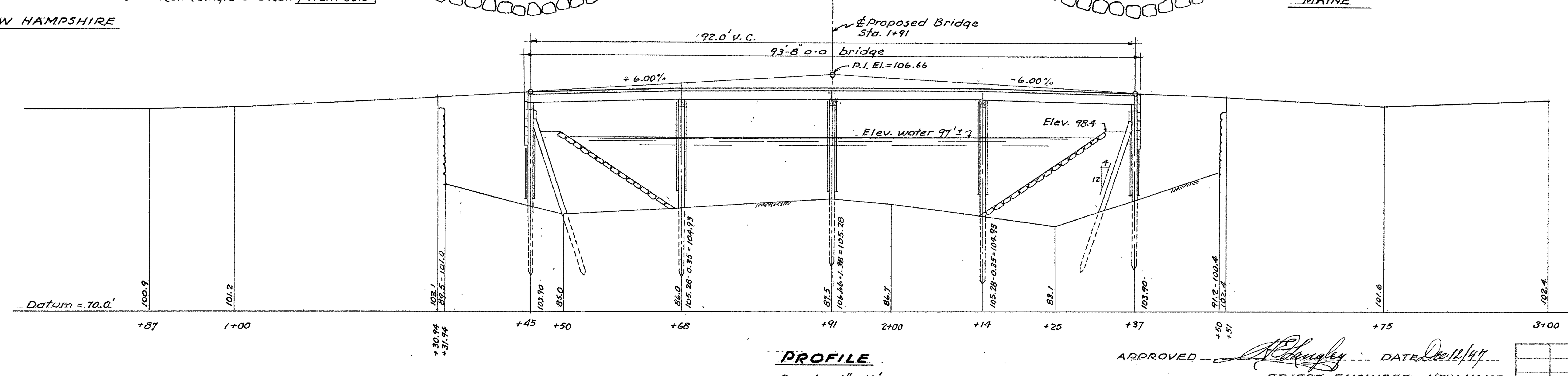
Piles shall be Southern Yellow Pine or Norway Pine and shall be treated with grade one creosote by the full-cell pressure process or the steam Lowry process to a final net retention of 18 lbs per cu. ft.

Piles shall be driven to develop a minimum capacity of 15 tons per pile, to a minimum penetration of 8 ft. Estimated length 30 feet.

All timber (except sidewalk floor, rails and rail posts) shall be treated with creosote-coal tar solution with a minimum net retention as specified in A.A.S.H.O. 1944. Timber in sidewalk floor, rails and rail posts shall be treated with chromated zinc chloride to retain .75 lbs of dry salt per cu. foot. 3 coats of hot creosote oil shall be applied to all vertical cut surfaces on piles.

All timber rough unless otherwise noted. 4"x12" Floor planks may be rough or S1S and shall be so laid that no two adjacent planks vary more than 1/16" in thickness and to have 1/4" open joints. 2"x12" sidewalk plank shall be S1S and to be laid with 1/4" open joints.

All wheel guard joints on curb side shall be made at a point halfway between rail posts.



PROFILE

Scale 1" = 10'

APPROVED [signature] DATE Dec 12/47
BRIDGE ENGINEER – NEW HAMP.

APPROVED Max L. Wilder DATE Dec. 19, 1947
BRIDGE ENGINEER – MAINE.

△	DESCRIPTION	BY	DATE
	REVISIONS		

STATE OF NEW HAMPSHIRE
HIGHWAY DEPARTMENT BRIDGE DIVISION

TOWN MILTON, N.H. - LEBANON, ME. BRIDGE NO. 168/152
FEDERAL PROJECT ____ STATE PROJECT Y-1033
ROUTE NO. ____ OVER SALMON FALLS RIVER
LOCATION CTR LEBANON RD. 1.1 MI.± EAST OF RT. NH 16

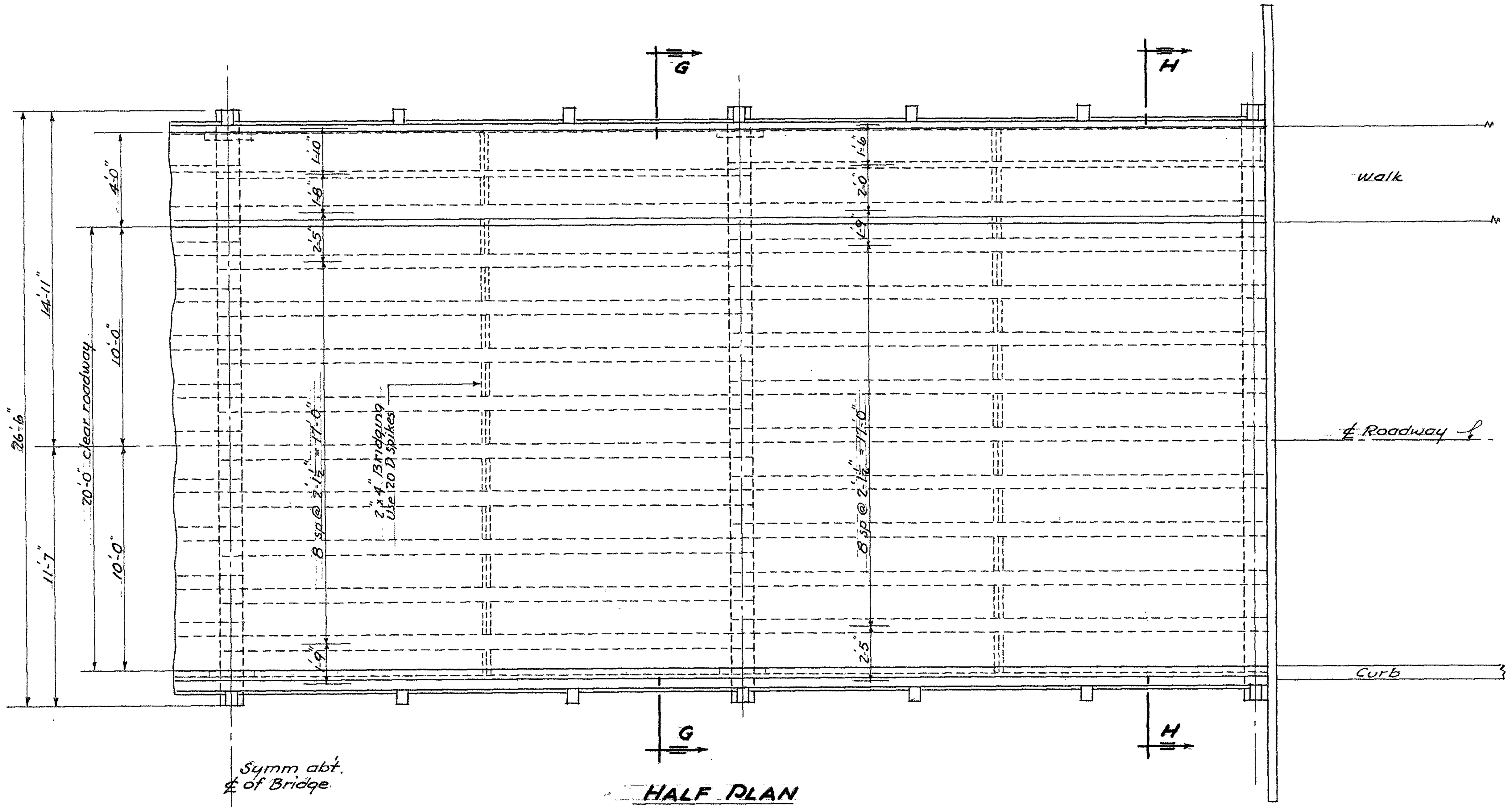
PLAN & PROFILE - BORINGS - TYP. SECTION

	BY	DATE		BY	DATE
DESIGNED	R.W.H.	Nov. 47	CHECKED	E.S.	Nov. 47
DRAWN	E.S.	"	CHECKED	R.H.	"
TRACED	W.H.P.	"	CHECKED	F.C.S.	Nov. 47
QUANTITIES	R.W.H.	"	CHECKED	E.S.	"

BRIDGE SHEET NO. 1 OF 3

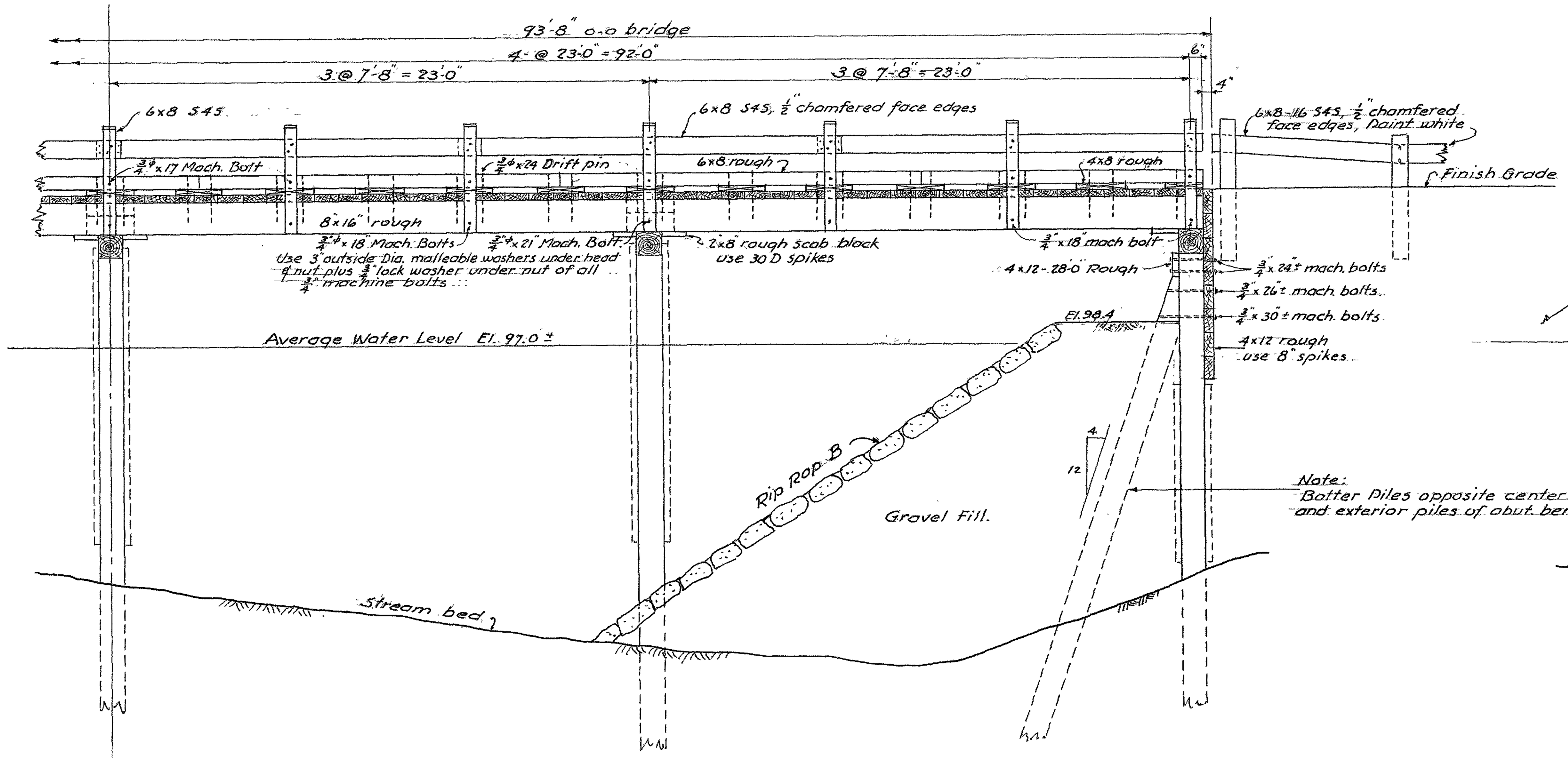
FILE NUMBER 2-9-2-3

PROJ. NO.	SHEET NO.	TOTAL SHEETS
Y-1033		



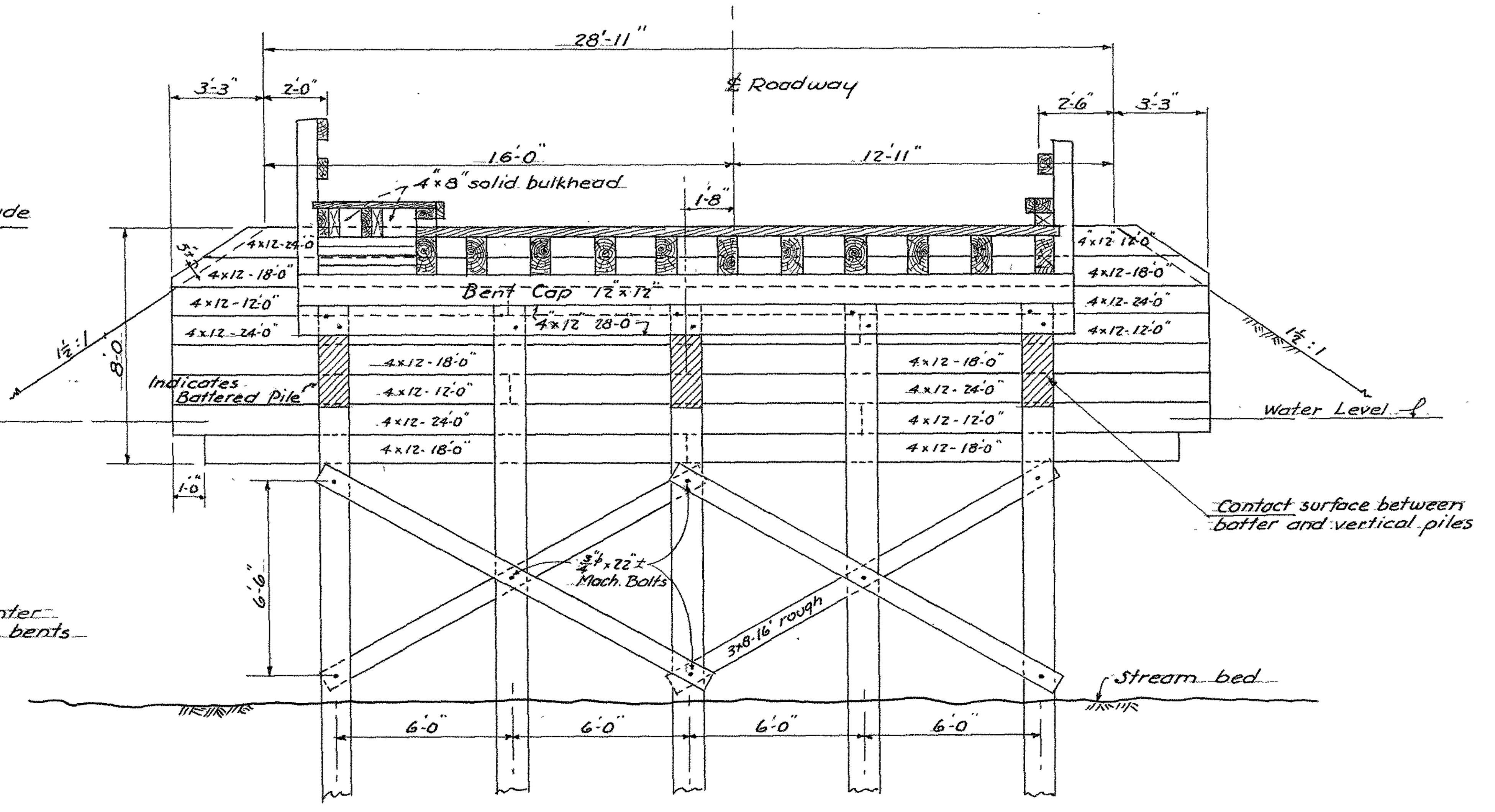
HALF PLAN

Scale ¼" = 1'-0"



HALF DNSTREAM ELEVATION

Scale ¼" = 1'-0"



DETAIL OF ABUTMENT BENT - SECTION H-H

Scale ¼" = 1'-0"

ESTIMATE OF QUANTITIES			
ITEM Nº	DESCRIPTION	UNIT	QUANTITY
14.1	Gravel Borrow	cu. yd.	2,240
* 31	Removing Superstructure	unit	1
ɸ 37	Structural Timber (treated)	M.B.M.	29,237
43.1	Timber Bearing Piles (treated)	lin. ft.	930
49.2	Rip Rap B	cu. yd.	220
60.3	Wood Guard Rail (Single 6x8)	lin. ft	144
60.4	" " " (Double 4x6)	" "	128

* Includes Pile Bents
ɸ Hardware subsidiary to Item 37

FED. ROAD DIV. NO.	STATE	PROJ. NO.	YEAR	NO.	SHEETS
9	N.H.				

STATE OF NEW HAMPSHIRE
HIGHWAY DEPARTMENT BRIDGE DIVISION

TOWN MILTON, N.H. - LEBANON, ME. BRIDGE NO. 168/152
FEDERAL PROJECT .... STATE PROJECT Y-1033
ROUTE NO. .... OVER SALMON FALLS RIVER
LOCATION CTR. LEBANON RD. 1.1 MI.± EAST OF RT. N.H. 16

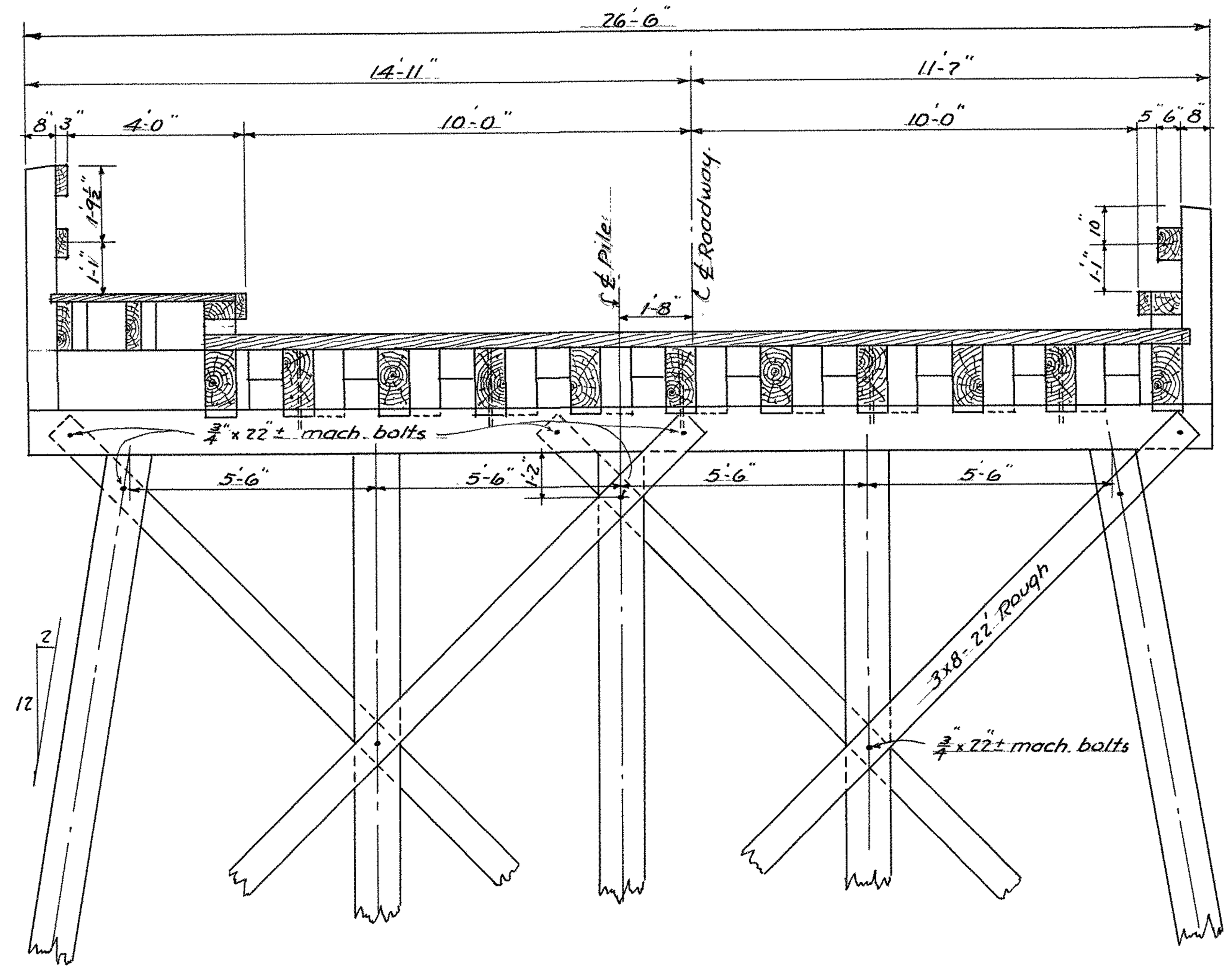
SUPERSTRUCTURE PLAN - ELEVATION - SECTION

	BY	DATE		BY	DATE	
DESIGNED	R.W.H.	Nov. 47	CHECKED	E.S.	Nov. 47	BRIDGE SHEET NO. 2 OF 3
DRAWN	E.S.	" "	CHECKED	R.H.	"	
TRACED	W.H.P.	" "	CHECKED	F.C.S.	Nov. 47	FILE NUMBER 2-9-2-3
QUANTITIES	R.W.H.	" "	CHECKED	E.S.	"	

△	DESCRIPTION	BY	DATE
	REVISIONS		

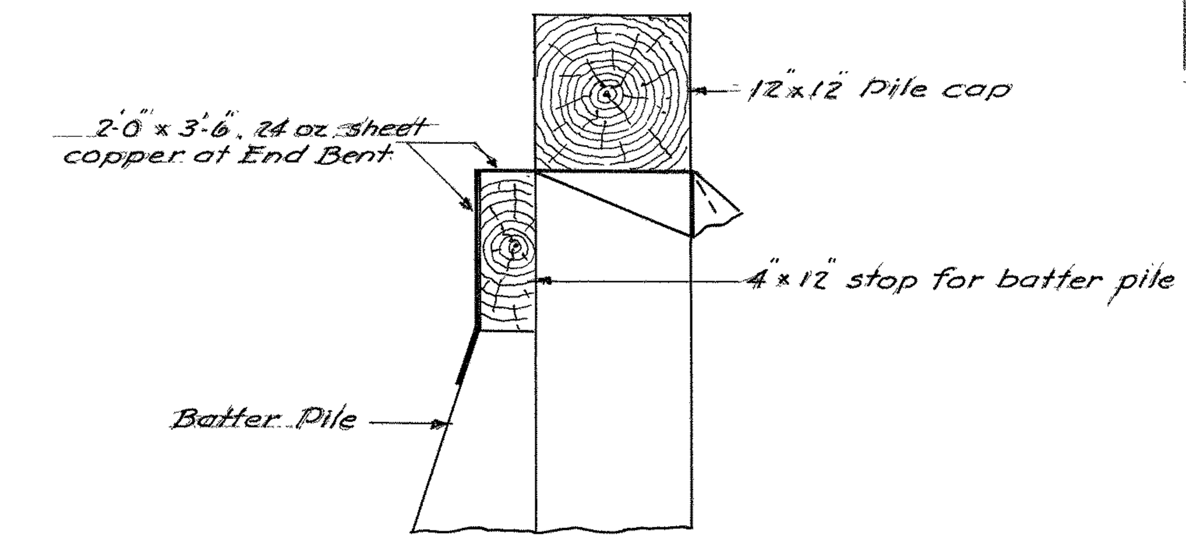
PROJ. NO.	SHEET NO.	TOTAL SHEETS
Y-1033		

FED. ROAD DIST. NO.	STATE	PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
9	N. H.				



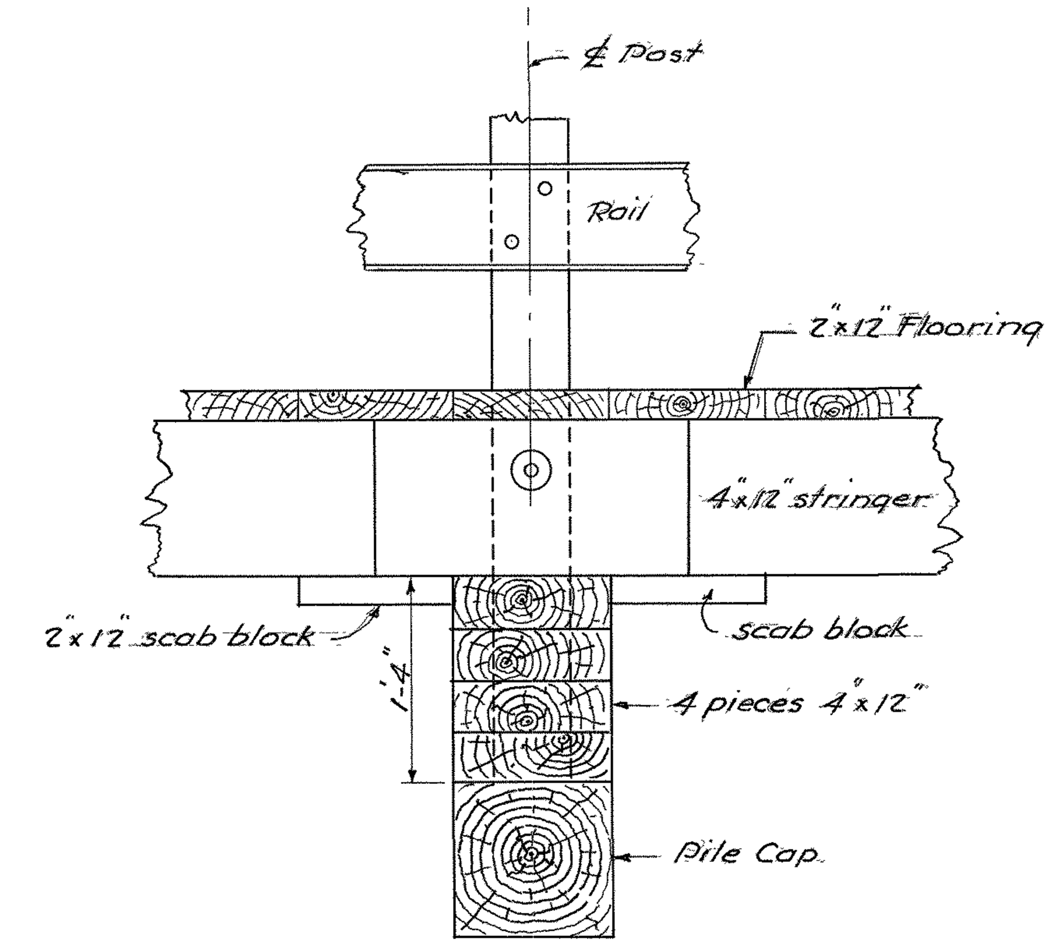
SECTION G-G (Sh # 2)

Scale ⅜" = 1'-0"

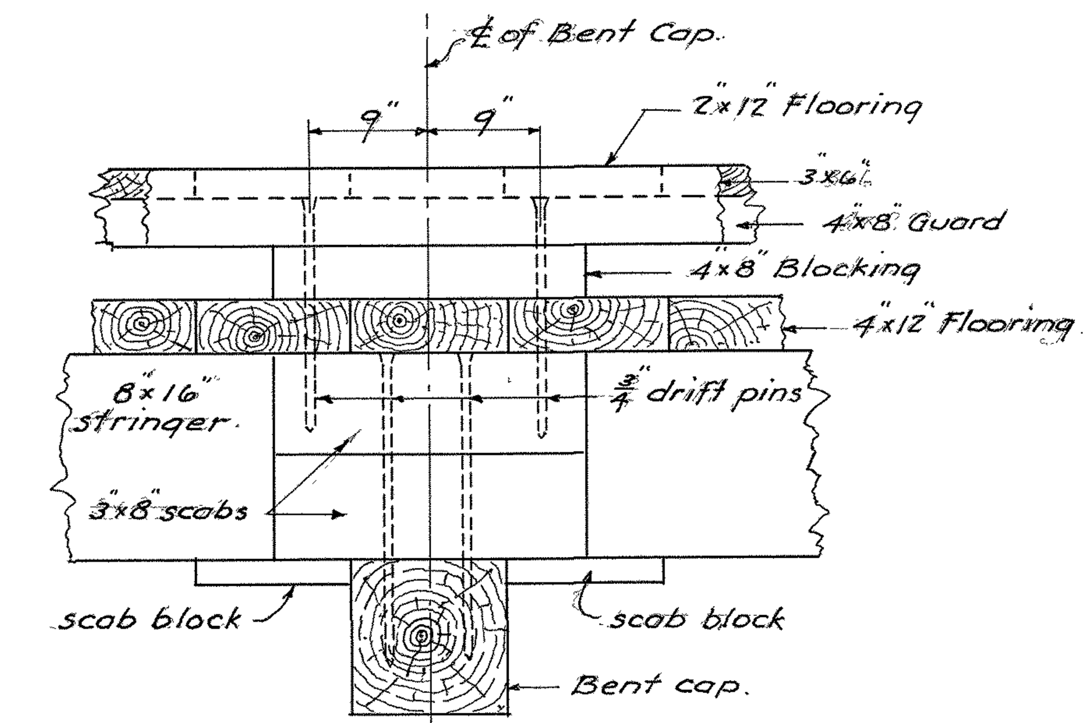


DETAIL OF COPPER CAP AT END BENT

Scale 1" = 1'-0"

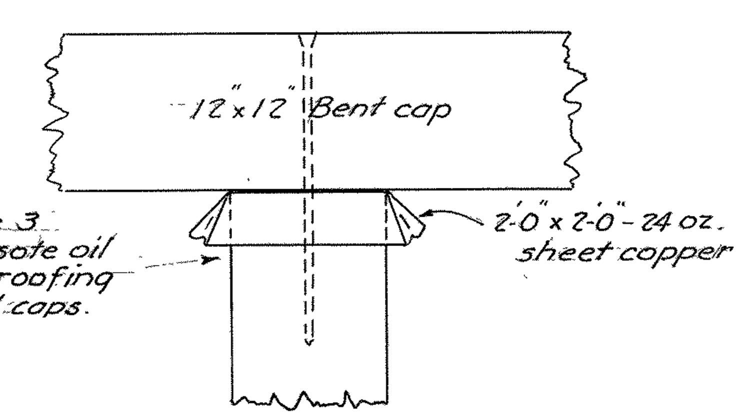


SECTION C-C



SECTION D-D

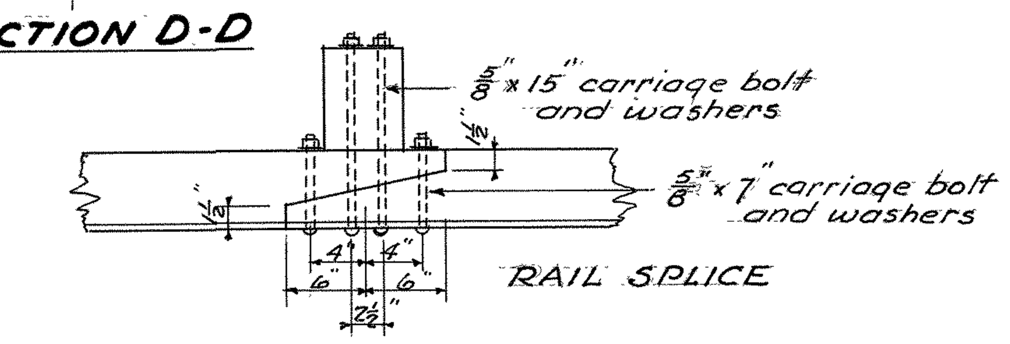
Scale 1" = 1'-0"



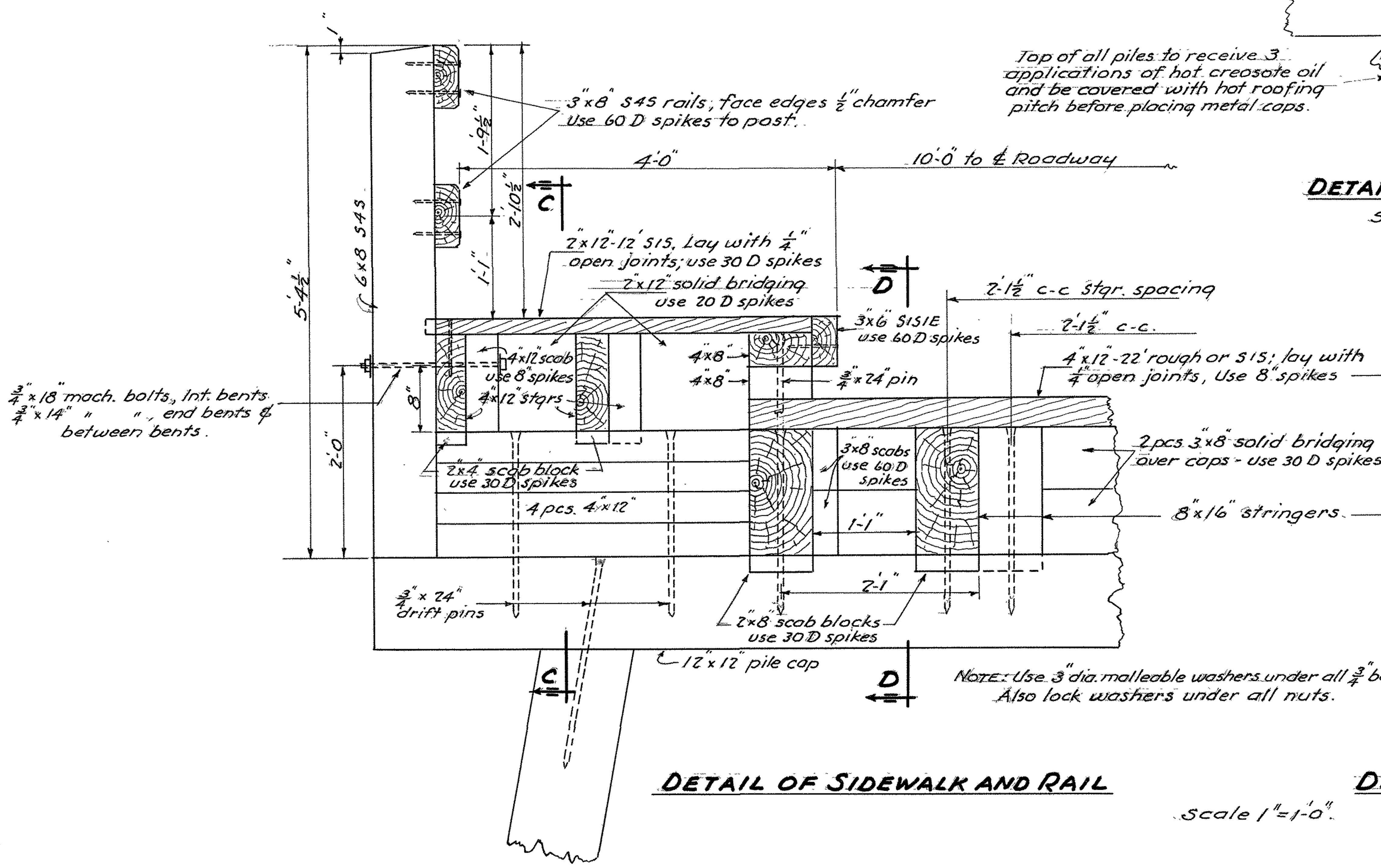
Top of all piles to receive 3 applications of hot creosote oil and be covered with hot roofing pitch before placing metal caps.

DETAIL METAL PILE CAP

Scale 1" = 1'-0"

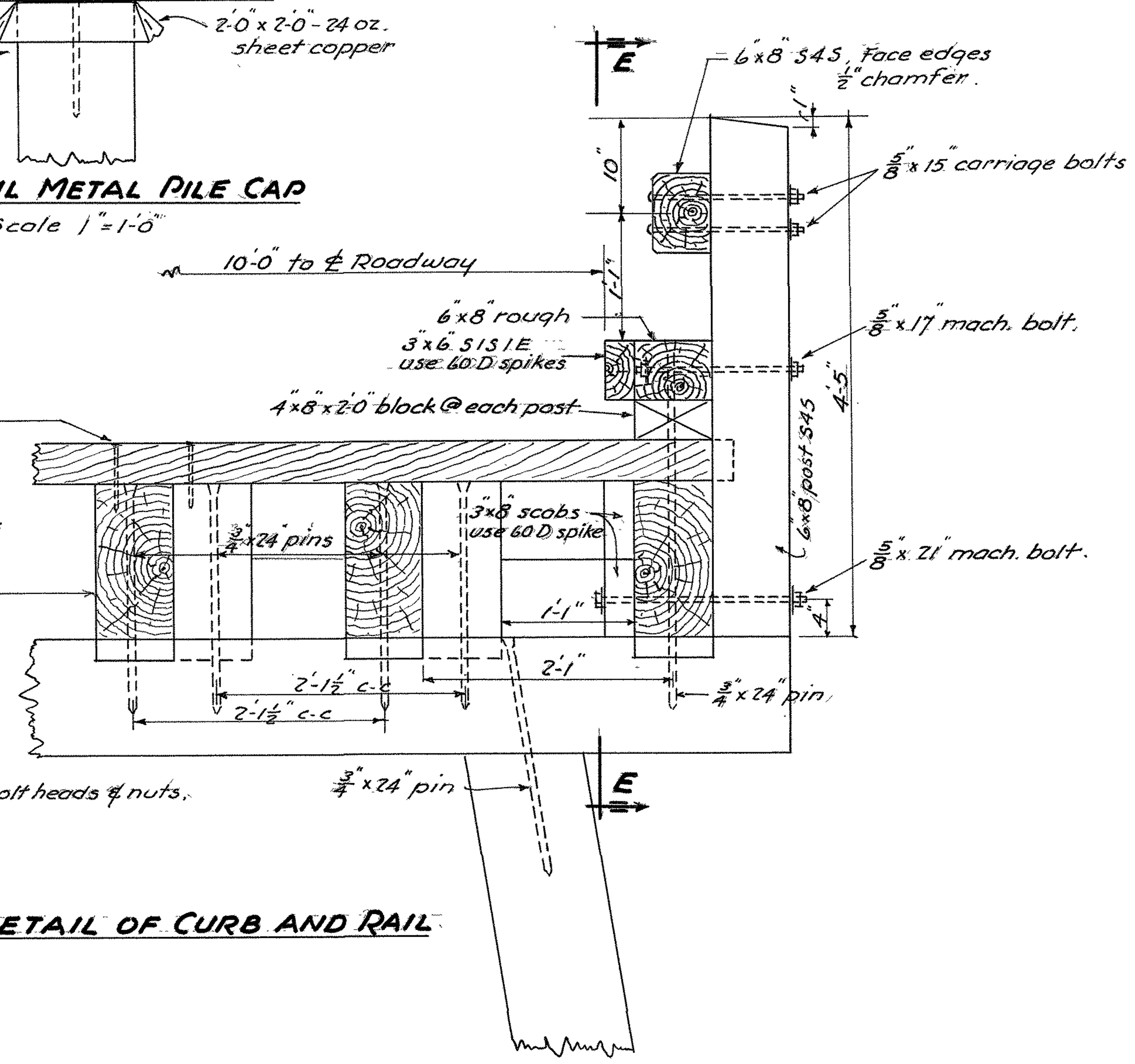


RAIL SPLICE



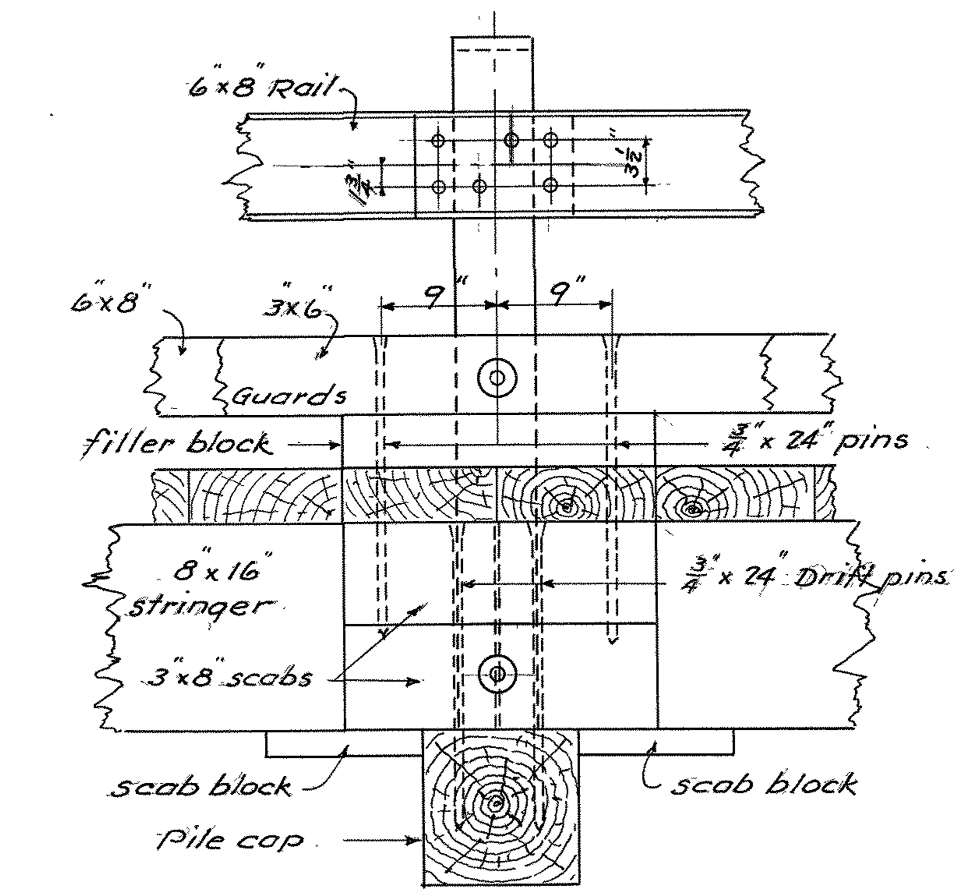
NOTE: Use 3" dia. malleable washers under all ¾" bolt heads & nuts. Also lock washers under all nuts.

DETAIL OF SIDEWALK AND RAIL



DETAIL OF CURB AND RAIL

Scale 1" = 1'-0".



SECTION E-E

Scale 1" = 1'-0"

STATE OF NEW HAMPSHIRE
HIGHWAY DEPARTMENT BRIDGE DIVISION

TOWN MILTON, N.H. - LEBANON, ME. BRIDGE NO. 168/152
FEDERAL PROJECT ___ STATE PROJECT Y-1033
ROUTE NO. ___ OVER SALMON FALLS RIVER
LOCATION CTR. LEBANON RD. 1.1 MI. ± EAST OF RT. N.H. 16

SUPERSTRUCTURE DETAILS

	BY	DATE		BY	DATE	
DESIGNED	R.W.H.	Nov. 47	CHECKED	F.S.	Nov. 47	BRIDGE SHEET NO. 3 OF 3
DRAWN	E.S.	"	CHECKED	R.H.	"	
TRACED	W.H.P.	"	CHECKED	F.C.S.	Nov. 47	FILE NUMBER 2-9-2-3
QUANTITIES	R.W.H.		CHECKED	F.S.	"	

△	DESCRIPTION	BY	DATE
	REVISIONS		

PROJ. NO.	SHEET NO.	TOTAL SHEETS
Y-1033		

APPENDIX C
August 2021 Inspection Report

Bridge Inspection Report

NBI Structure Number: 017301680015200

Milton 168/152

Date of Inspection: 08/25/2021
Date Report Sent: 11/29/2021
Owner: Municipality
Bridge Inspection Group: C-Team
Bridge Maintenance Crew: OTHER
Bridge also in: Lebanon, Maine

TOWNHOUSE ROAD
over
NORTHEAST POND
New Bridge

CRUSHED PIER CAP. BRIDGE NOW CLOSED & BARRICADED AND FENCED.

Recommended Postings:

Weight: **'Bridge Closed' and barricaded at both ends** — ☑ Weight Sign OK

SIGNED "BRIDGE CLOSED", BARRICADED AND FENCED.

Width: **Not Required** — ☑ Width Sign OK

Primary Height Sign Recommendation: *None*
Optional Centerline Height Sign Rec: *None*

Clearances: (Feet)

Over:	99.99
Under:	0.00
Route:	99.99

☑ Height Sign OK

Condition:

Red List Status:	Municipal Redlist
Deck:	0 Failed - Closed
Superstructure:	0 Failed - Closed
Substructure:	0 Failed - Closed
Culvert:	N N/A (NBI)
Sufficiency Rating:	11 %

Structure Type and Materials:

Number of Main Spans:	4
Number of Approach Spans:	0

Main Span Material and Design Type

Wood or Timber/Stringer/Girder

Bridge Rail:	Substandard
Rail Transition:	Substandard
Bridge Approach Rail:	Substandard
Approach Rail Ends:	Substandard

NH Bridge Type:	TB (Timber Bridge)
Deck Type:	Wood or Timber
Wearing Surface:	Wood or Timber
Membrane:	None
Deck Protection:	None
Curb Reveal:	Not Measured
Plan Location:	2-9-3-2
Total Bridge Length:	94.0 ft
Right Curb/Sidewalk Width:	4.0 ft
Total Bridge Width:	26.2 ft
Median:	No median
Bridge Skew:	0.00 °
Year Built/Rebuilt:	1948

Bridge Dimensions:

Length Maximum Span:	22.0 ft
Left Curb/Sidewalk Width:	0.5 ft
Width Curb to Curb:	20.0 ft
Approach Roadway Width: (W/Shoulders)	17.0 ft

Bridge Service:

Type of Service on Bridge: Highway and Pedestrian
Type of Service Under: Waterway
Lanes on Bridge: 2
Lanes Under: 0
AADT: 452 Percent Trucks: 4 % Year of AADT: 2020
Future AADT: 668 Year of Future AADT: 2042

Federal or State Definition Bridge: Fed-Definition Bridge
National Highway System: Bridge does not carry NHS
Roadway Functional Class: Urban, Local
New Hampshire Bridge Tier: 5
Eligibility for the National Register of Historic Places: Possibly eligible for
Traffic Direction: 2-way traffic

National Bridge Inventory (NBI) Appraisal Ratings:

Deck Geometry: 3 Intolerable - Correct
Underclearances: N Not applicable (NBI)
Approach Alignment: 6 Equal Min Criteria
Structural Evaluation: 0 Closed
Channel/Channel Protection: 8 Protected
Waterway Adequacy: 9 Above Desirable
Bridge Scour Critical Status: Not Applicable (P)
Riprap Condition: Poor Condition
Debris Present: No Debris Present
Channel Notes: EROSION AT WINGS.
Scour Critical, CHA study, 8' embedment

Bridge Inspection Report

NBI Structure Number: 017301680015200

Element Details

No.	Description	Material Notes and Condition Notes:
216	Timber Abutment	BOTTOM TIMBERS ARE DECAYED, BULGING AND SETTLED. FILL PASSING THROUGH. BACKWALLS ARE CRACKED, TIPPING AND DECAYED. SETTLED WITH FILL PASSING THROUGH. BRIDGE SEATS ARE CRACKED, DECAYED AND SETTLED. WINGS - STONEWORK IS IN POOR CONDITION. TIMBER IS CRACKED, DECAYED AND SETTLED.

Element States

No.	Description	Quantity	Units	State 1	State 2	State 3	State 4
216	Timber Abutment	72	ft	0%	0%	50%	50%

Bridge Notes:

UNDERWATER INSPECTION 6/28/2010
BRIDGE CLOSED 12/14/10 due to Winter Maintenance concerns.
RECOMMENDED TO STAY CLOSED ON 4/13/11 BY MEDOT AND NHDOT DUE TO FURTHER DECAY.
DECK AND SUPERSTRUCTURE REMOVED 8/20/2013.
PIERS REMOVED 8/6/2015.

Inspection Notes: 08/25/2021

KJT - inspection comments -
DECK: DECK ELEMENTS HAVE BEEN REMOVED.
SUPERSTRUCTURE: SUPERSTRUCTURE ELEMENTS HAVE BEEN REMOVED.
SUBSTRUCTURE: ABUTMENTS - CRACKED, DECAYED, BULGING AND SETTLED; FILL PASSING THROUGH. PIERS - PIER ELEMENTS HAVE BEEN REMOVED.

Previous Inspection Notes: 12/03/2020

MAS - inspection comments -
DECK: DECK ELEMENTS HAVE BEEN REMOVED.
SUPERSTRUCTURE: SUPERSTRUCTURE ELEMENTS HAVE BEEN REMOVED.
SUBSTRUCTURE: ABUTMENTS - CRACKED, DECAYED, BULGING AND SETTLED; FILL PASSING THROUGH. PIERS - PIER ELEMENTS HAVE BEEN REMOVED.

Approach and Roadway Notes:

ASPHALT - (7) GOOD CONDITION, FEW CRACKS.
W- BEAM RAIL - DAMAGED.

Unusual or experimental features:

Bridge Inspection Report

NBI Structure Number: 017301680015200

Inspection History

Inspection Date	Inspector Initials	Inspection Type(s) Performed				Major Element Ratings				Red list	Posting
		NBI	Elem	FCM	U/W	Deck	Super	Sub	Culvert		
08/25/2021	KJT	✓	✓			0	0	0	N	✓	Bridge Closed
12/03/2020	MAS	✓	✓			0	0	0	N	✓	Bridge Closed
08/14/2019	KJT	✓	✓			0	0	0	N	✓	Bridge Closed
12/03/2018	MAS	✓	✓			0	0	0	N	✓	Bridge Closed
08/07/2017	KJT	✓	✓			0	0	0	N	✓	Bridge Closed
12/05/2016	KJT	✓	✓			0	0	0	N	✓	Bridge Closed
08/06/2015	MAS	✓	✓			0	0	0	N	✓	Bridge Closed
12/01/2014	KJT	✓	✓			0	0	0	N	✓	Bridge Closed
08/20/2013	TDC	✓	✓			0	0	0	N	✓	Bridge Closed
12/11/2012	MAS	✓	✓			0	0	0	N	✓	Bridge Closed
08/09/2011	MAS	✓	✓			0	0	0	N	✓	Bridge Closed
12/14/2010	DPC	✓	✓			3	5	2	N	✓	Bridge Closed
06/28/2010	DMB	✓	✓		✓	3	5	2	N	✓	Bridge Closed
06/12/2010	DEP	✓	✓			5	6	4	N	✓	3 Tons PCO
07/29/2009	DPC	✓	✓			5	6	4	N	✓	No Posting Req'd
10/06/2008	KJT	✓	✓			5	6	4	N	✓	No Posting Req'd
09/24/2008	DMB	✓	✓		✓	5	6	4	N	✓	No Posting Req'd
10/11/2007	DPC	✓	✓			5	6	4	N	✓	No Posting Req'd
12/15/2006	DPC	✓	✓			5	6	4	N	✓	No Posting Req'd
10/31/2005	RLM	✓	✓			6	6	4	N	✓	No Posting Req'd
09/16/2004	RLM	✓	✓			6	6	4	N	✓	No Posting Req'd
09/04/2003	DPC	✓	✓			6	6	4	N	✓	No Posting Req'd
07/11/2002	DPC	✓	✓			7	6	4	N	✓	No Posting Req'd
08/15/2001	DPC	✓	✓			7	6	4	N	✓	No Posting Req'd
12/16/1998	DPC	✓	✓			7	7	6	N		No Posting Req'd
09/01/1997		✓	✓		✓	7	7	6	N	✓	No Posting Req'd
08/01/1996		✓	✓		✓	7	7	6	N	✓	No Posting Req'd
10/01/1995		✓	✓		✓	7	6	6	N	✓	6 Tons
02/01/1994		✓	✓		✓	7	7	5	N	✓	6 Tons
12/01/1992		✓	✓		✓	8	7	5	N	✓	6 Tons

Inspection Frequency (mo.)			
NBI	Elem	FCM	U/W
16	16	N/A	N/A

APPENDIX D
Existing Alignment Plans

TOWNHOUSE RD ALIGNMENT
CURVE NO.3
PI 108+28.27
Δ 32.960° LT
D 10.811°
T 156.79'
L 304.89'
R 530.00'
PC 106+71.48
PT 109+76.37

TOWNHOUSE RD ALIGNMENT
CURVE NO.2
PI 104+34.70
Δ 64.673° RT
D 32.740°
T 110.79'
L 197.53'
R 175.00'
PC 103+23.91
PT 105+21.44

TOWNHOUSE RD ALIGNMENT
CURVE NO.1
PI 101+85.62
Δ 23.695° RT
D 8.815°
T 136.35'
L 268.81'
R 650.00'
PC 100+49.27
PT 103+18.08

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED	NHDOT	DATE	10/2022
NEW DESIGN	HAB	DATE	7/2023
SHEET CHECKED	AGB	DATE	7/2023
AS BUILT DETAILS		DATE	

HDR

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ⋄ BUREAU OF HIGHWAY DESIGN

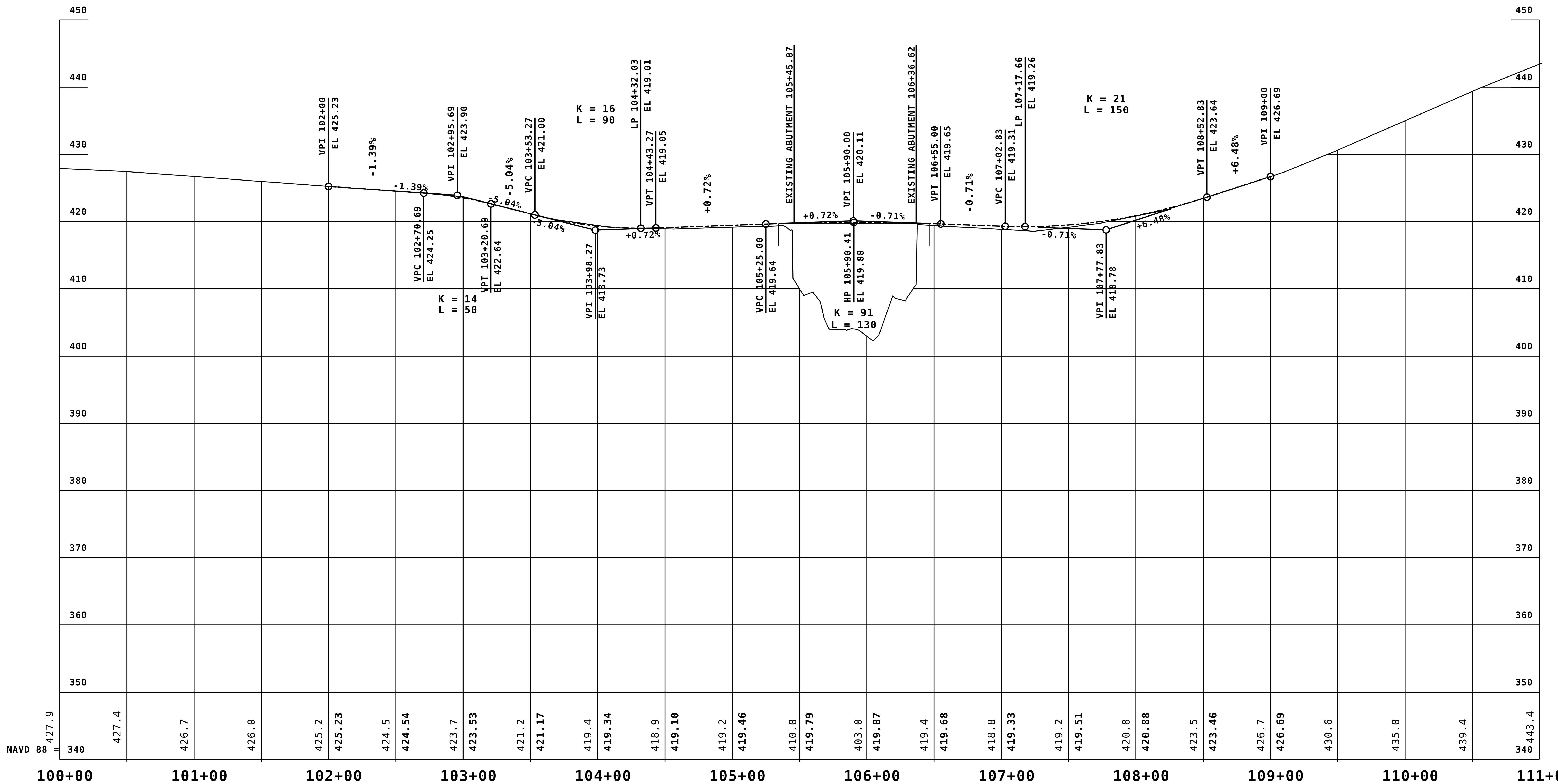
EXISTING CONDITIONS

DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
40658-GenPlans	40658	8	9

REVISIONS AFTER PROPOSAL

NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED NHDOT	DATE 10/2023	
NEW DESIGN HAB	DATE 7/2022	
SHEET CHECKED AGB	DATE 7/2022	
AS BUILT DETAILS	DATE	

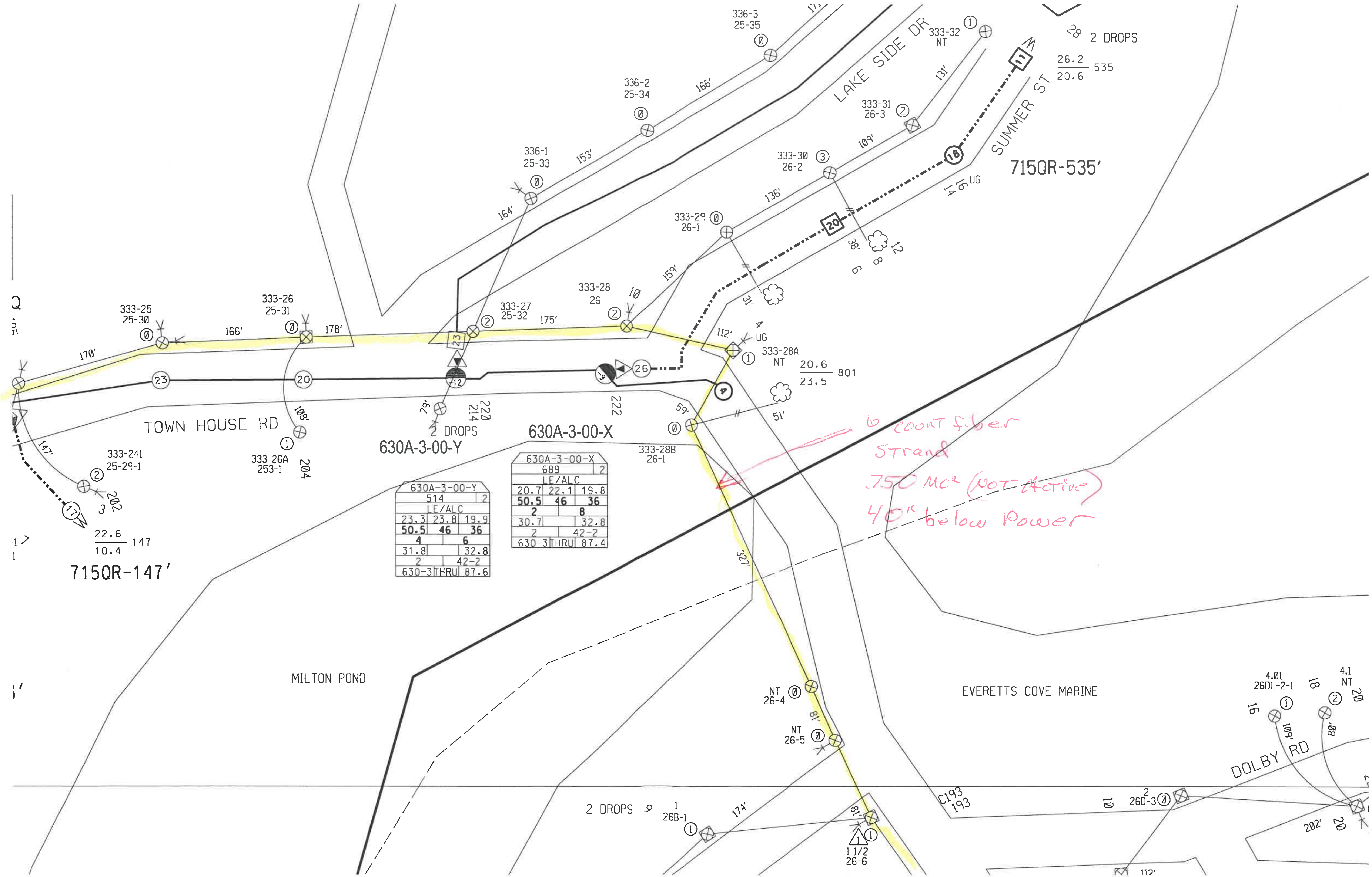


SCALE:
1"= 50' HORIZ.
1"= 10' VERT.

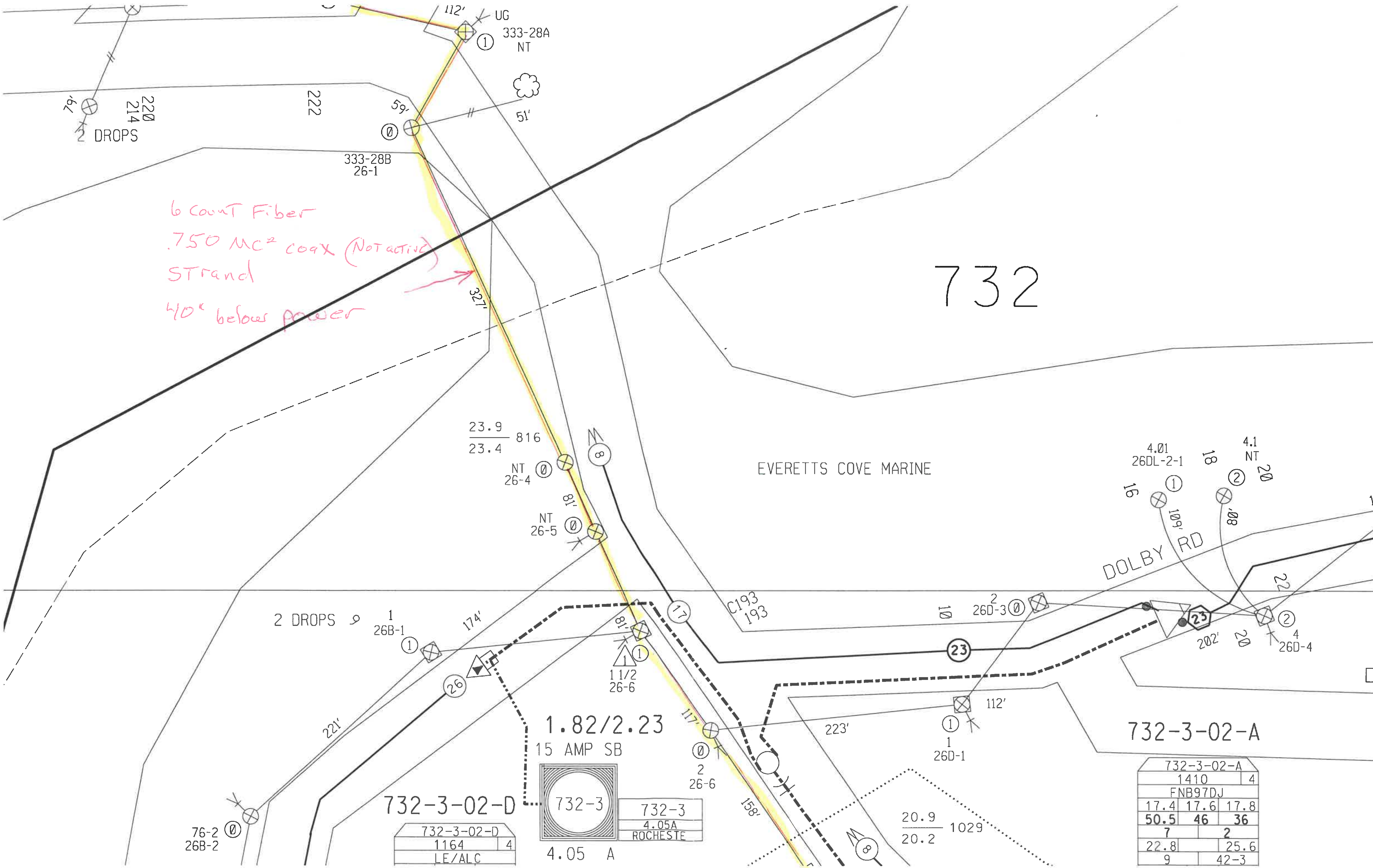
STATE OF NEW HAMPSHIRE			
SEABROOK-HAMPTON			
DEPARTMENT OF TRANSPORTATION ∘ BUREAU OF HIGHWAY DESIGN			
PROFILE - EXISTING CONDITIONS			
DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
PROEX 40658-Geometry-Existing	40658	9	9

APPENDIX E
Existing Utility Information

40658bd.dgn Default 7/11/2022 1:14:50 PM "n34sel"



TOWN HOUSE RD
LAKE SIDE DR
SUMMER ST
DOLBY RD
MILTON POND
EVERETTS COVE MARINE
715QR-535'
715QR-147'
630A-3-00-Y
630A-3-00-X
336-3 25-35
336-2 25-34
336-1 25-33
333-32 NT
333-31 26-3
333-30 26-2
333-29 26-1
333-28 26
333-27 25-32
333-26 25-31
333-25 25-30
333-28A NT
333-28B 26-1
333-241 25-29-1
333-26A 253-1
NT 26-4
NT 26-5
26B-1
1 1/2 26-6
26D-3
4.01 26DL-2-1
4.1 NT
C193 193
2 DROPS
26.2 / 20.6 535
20.6 / 23.5 801
22.6 / 10.4 147
630A-3-00-Y
514 2
LE/ALC
23.3 23.8 19.9
50.5 46 36
4 6
31.8 32.8
2 42-2
630-3 THRU 87.6
630A-3-00-X
689 2
LE/ALC
20.7 22.1 19.8
50.5 46 36
2 8
30.7 32.8
2 42-2
630-3 THRU 87.4
6 count fiber Strand
.750 MC² (Not Active)
40" below Power



732
EVERETTS COVE MARINE
DOLBY RD
6 Count Fiber
.750 MC² coax (Not active)
Strand
40" below power
333-28A
NT
UG
112'
333-28B
26-1
59'
51'
2 DROPS
220
214
222
79'
327'
23.9
23.4
816
NT
26-4
81'
NT
26-5
2 DROPS
1
26B-1
174'
81'
1 1/2
26-6
221'
1.82/2.23
15 AMP SB
732-3
732-3
4.05A
ROCHESTE
4.05 A
732-3-02-D
732-3-02-D
1164 4
LE/ALC
76-2
26B-2
117'
2
26-6
158'
C193
193
2
26D-3
223'
112'
1
26D-1
20.9
20.2
1029
4.01
26DL-2-1
4.1
NT
109'
80'
202'
4
26D-4
732-3-02-A
732-3-02-A
1410 4
FNB97DJ
17.4 17.6 17.8
50.5 46 36
7 2
22.8 25.6
9 42-3

WR# 10522351
222 TOWN HOUSE RD, MILTON
ANY QUESTION IN REGARDS TO THE MAP MARKUP PLEASE REACH OUT TO PIERRE BOUGIE @ 603-332-7507 OR EMAIL
pierre.bougie@eversource.com

LEGEND

- = OH PRIMARY CABLE
- = OH SECONDARY & SERVICE CABLE
- = OH TRANSFORMER
- 1-PHASE PRI+SEC CABLE = OH SINGLE PHASE OH PRIMARY & SECONDARY CABLE
- PRI+N CABLE = OH SINGLE PHASE OH PRIMARY & NEUTRAL CABLE

MILTON, NH
LEBANON, ME
40658

PLAN PREPARATION RECORD PLAN

MX SDR FILES PROCESSED BY : SEL
MS DATA ANNOTATED BY : SEL
FIELD INSPECTED BY : SEL, JN
PLAN PREP COMPLETION DATE : 7-11-22
SURVEY COMPLETION DATE : 5-10-22
SURVEY BOOK NUMBERS : 13070

+ N. H. D. O. T. +
SCALE IN FEET

APPENDIX F
Existing Right-Of-Way Abstract

REVISIONS AFTER PROPOSAL			
NUMBER	DATE	STATION	STATION	DESCRIPTION

SDR PROCESSED	NHDOT	DATE 10/2022
NEW DESIGN	HAB	DATE 7/2023
SHEET CHECKED	AGB	DATE 7/2023
AS BUILT DETAILS		DATE

HDR

STATE OF NEW HAMPSHIRE

DEPARTMENT OF TRANSPORTATION ◇ BUREAU OF HIGHWAY DESIGN

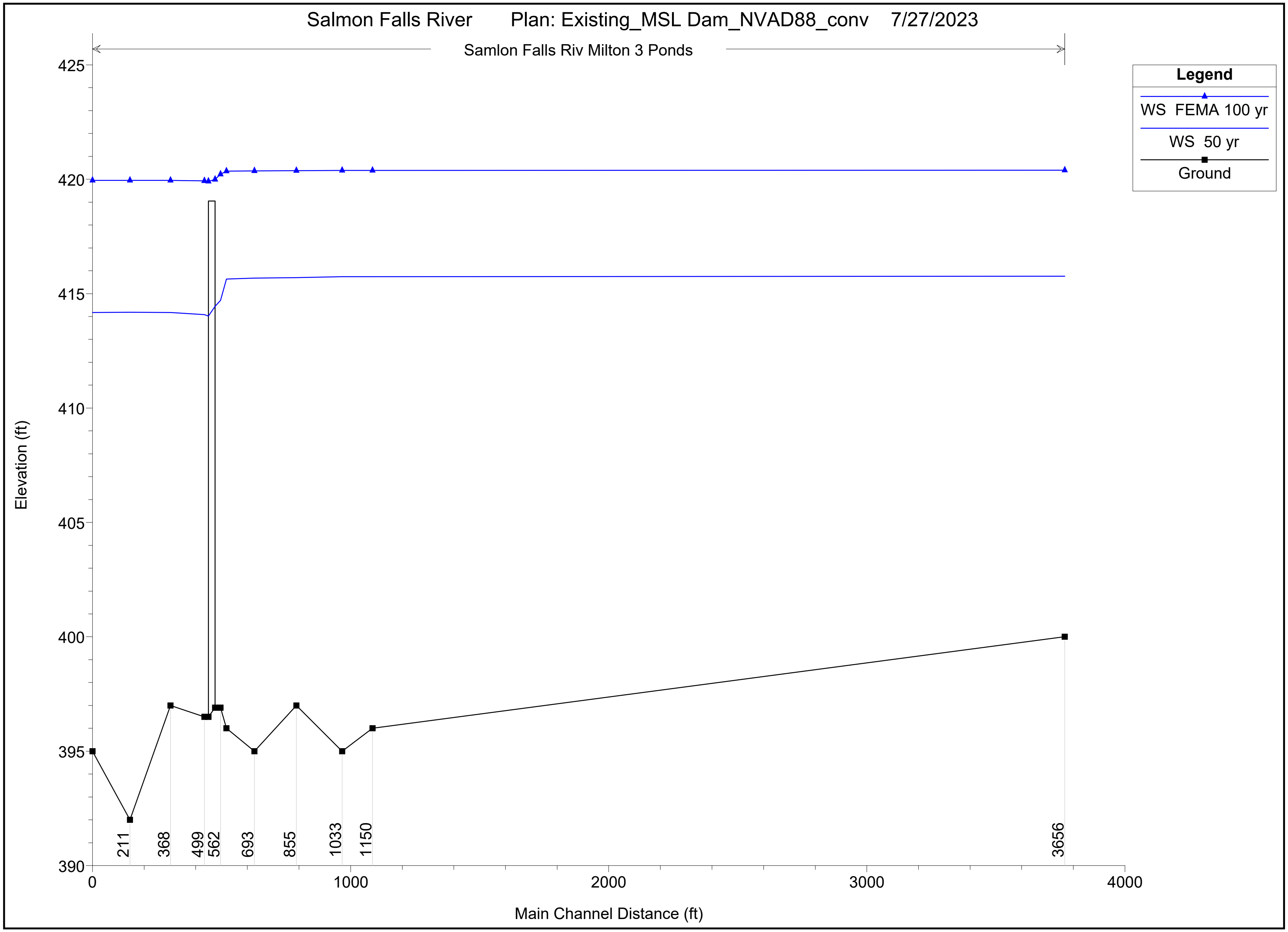
EXISTING RIGHT-OF-WAY ABSTRACT

	DGN	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
ROW01	40658-ROWPlans	40658	7	9

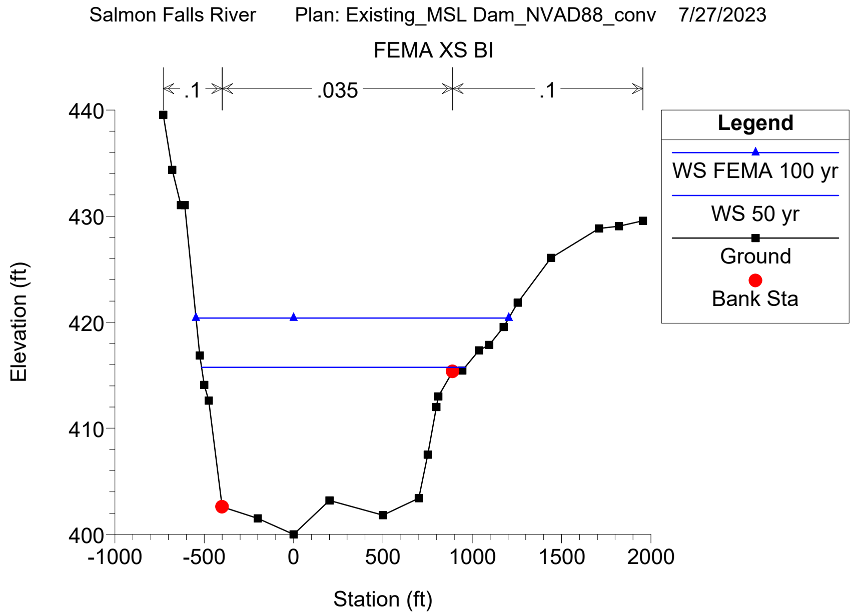
APPENDIX G
Existing Hydraulic Data

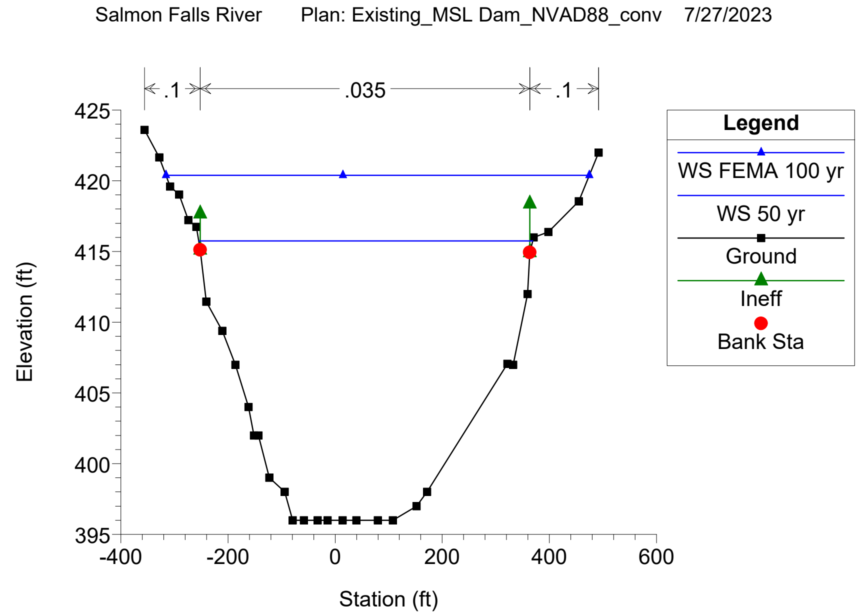
HEC-RAS Plan: Ex_MSL to NAVD88 River: Samlon Falls Riv Reach: Milton 3 Ponds

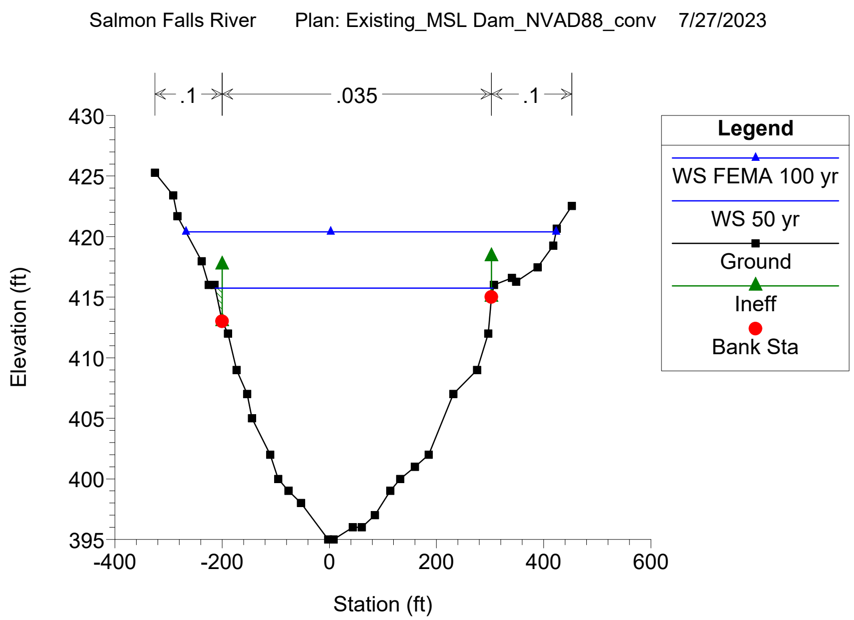
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Milton 3 Ponds	3656	50 yr	5070.00	400.00	415.76		415.76	0.000002	0.31	16863.94	1475.09	0.02
Milton 3 Ponds	3656	FEMA 100 yr	5290.00	400.00	420.40		420.40	0.000001	0.23	24390.92	1750.62	0.01
Milton 3 Ponds	1150	50 yr	5070.00	396.00	415.75	398.54	415.75	0.000005	0.56	9109.70	623.42	0.03
Milton 3 Ponds	1150	FEMA 100 yr	5290.00	396.00	420.39	398.60	420.39	0.000002	0.44	12444.22	790.08	0.02
Milton 3 Ponds	1033	50 yr	5070.00	395.00	415.74	399.54	415.75	0.000009	0.72	6998.18	518.73	0.03
Milton 3 Ponds	1033	FEMA 100 yr	5290.00	395.00	420.39	399.63	420.39	0.000004	0.56	9938.84	690.71	0.02
Milton 3 Ponds	855	50 yr	5070.00	397.00	415.70	403.26	415.74	0.000051	1.50	3375.10	411.66	0.08
Milton 3 Ponds	855	FEMA 100 yr	5290.00	397.00	420.37	403.39	420.39	0.000016	1.01	6042.13	634.11	0.05
Milton 3 Ponds	693	50 yr	5070.00	395.00	415.68	402.33	415.73	0.000051	1.68	3017.84	381.32	0.08
Milton 3 Ponds	693	FEMA 100 yr	5290.00	395.00	420.37	402.44	420.39	0.000016	1.11	5682.36	535.57	0.05
Milton 3 Ponds	585	50 yr	5070.00	396.00	415.63	402.96	415.71	0.000080	2.22	2281.57	289.11	0.10
Milton 3 Ponds	585	FEMA 100 yr	5290.00	396.00	420.35	403.11	420.38	0.000026	1.32	4449.37	425.33	0.06
Milton 3 Ponds	562	50 yr	5070.00	396.90	414.71	406.10	415.36	0.000689	6.49	781.79	226.47	0.30
Milton 3 Ponds	562	FEMA 100 yr	5290.00	396.90	420.22	406.36	420.33	0.000108	3.18	3362.48	423.56	0.12
Milton 3 Ponds	525		Bridge									
Milton 3 Ponds	499	50 yr	5070.00	396.50	414.08	405.53	414.80	0.000735	6.80	745.49	250.17	0.30
Milton 3 Ponds	499	FEMA 100 yr	5290.00	396.50	419.93	405.72	420.09	0.000146	3.70	3285.97	426.66	0.14
Milton 3 Ponds	368	50 yr	5070.00	397.00	414.18	402.69	414.26	0.000092	2.30	2207.47	305.78	0.11
Milton 3 Ponds	368	FEMA 100 yr	5290.00	397.00	419.95	402.80	419.97	0.000021	1.21	4800.35	410.31	0.05
Milton 3 Ponds	211	50 yr	5070.00	392.00	414.18	399.08	414.21	0.000039	1.44	3509.61	352.96	0.07
Milton 3 Ponds	211	FEMA 100 yr	5290.00	392.00	419.95	399.23	419.96	0.000011	0.96	6073.86	452.73	0.04
Milton 3 Ponds	66	50 yr	5070.00	395.00	414.18	401.64	414.20	0.000045	1.24	4086.04	487.53	0.07
Milton 3 Ponds	66	FEMA 100 yr	5290.00	395.00	419.95	401.76	419.96	0.000010	0.79	7141.19	551.26	0.04

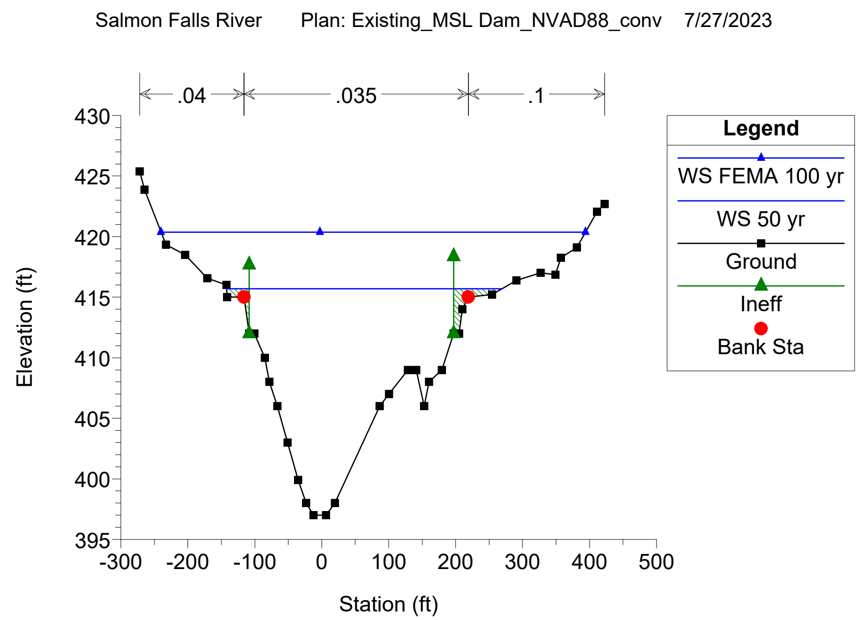


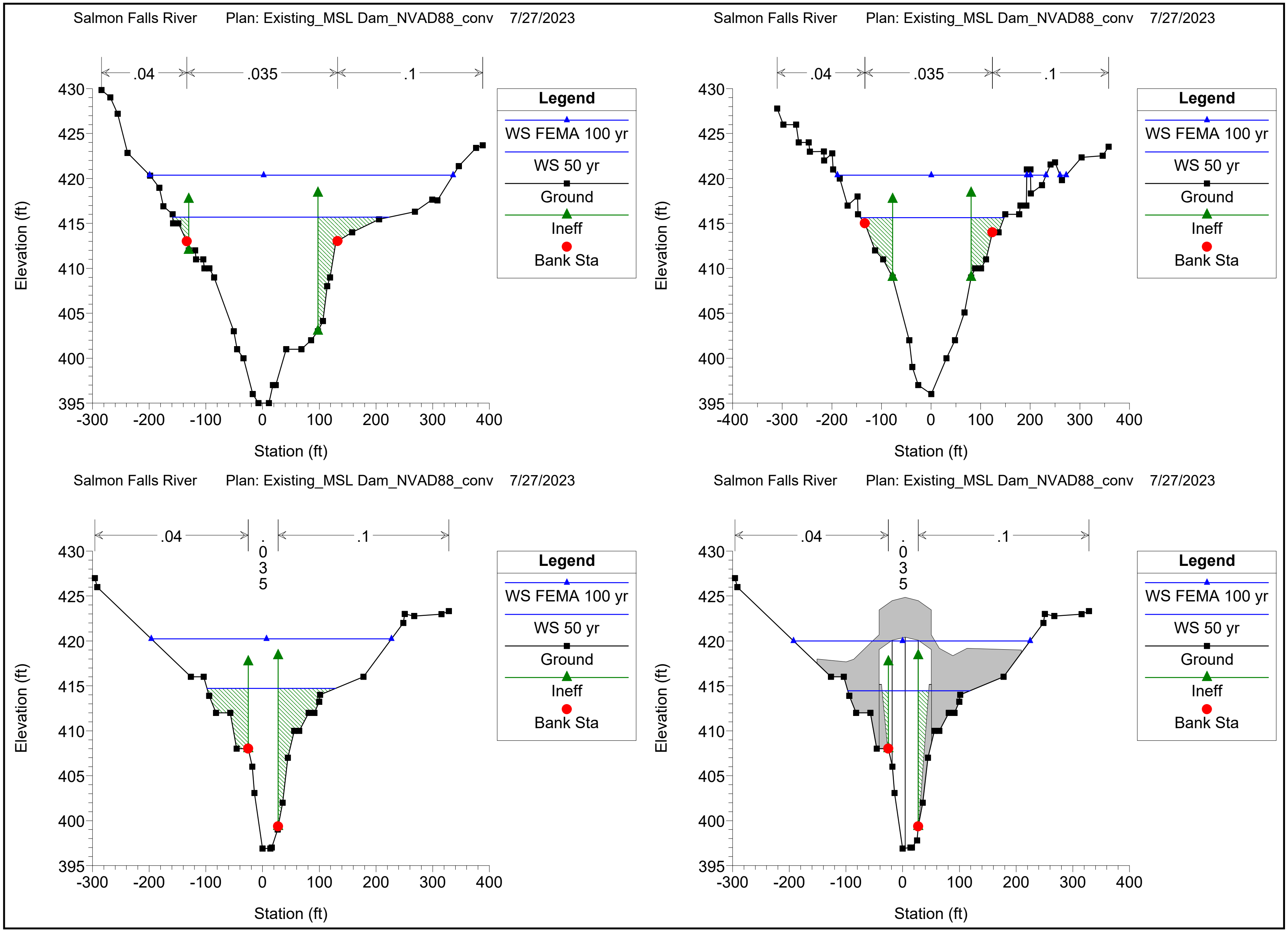
Salmon Falls River Plan: Existing_MSL Dam_NVAD88_conv 7/27/2023
Samlon Falls Riv Milton 3 Ponds
Legend
WS FEMA 100 yr
WS 50 yr
Ground
Elevation (ft)
425
420
415
410
405
400
395
390
211
368
499
562
693
855
1033
1150
3656
0
1000
2000
3000
4000
Main Channel Distance (ft)

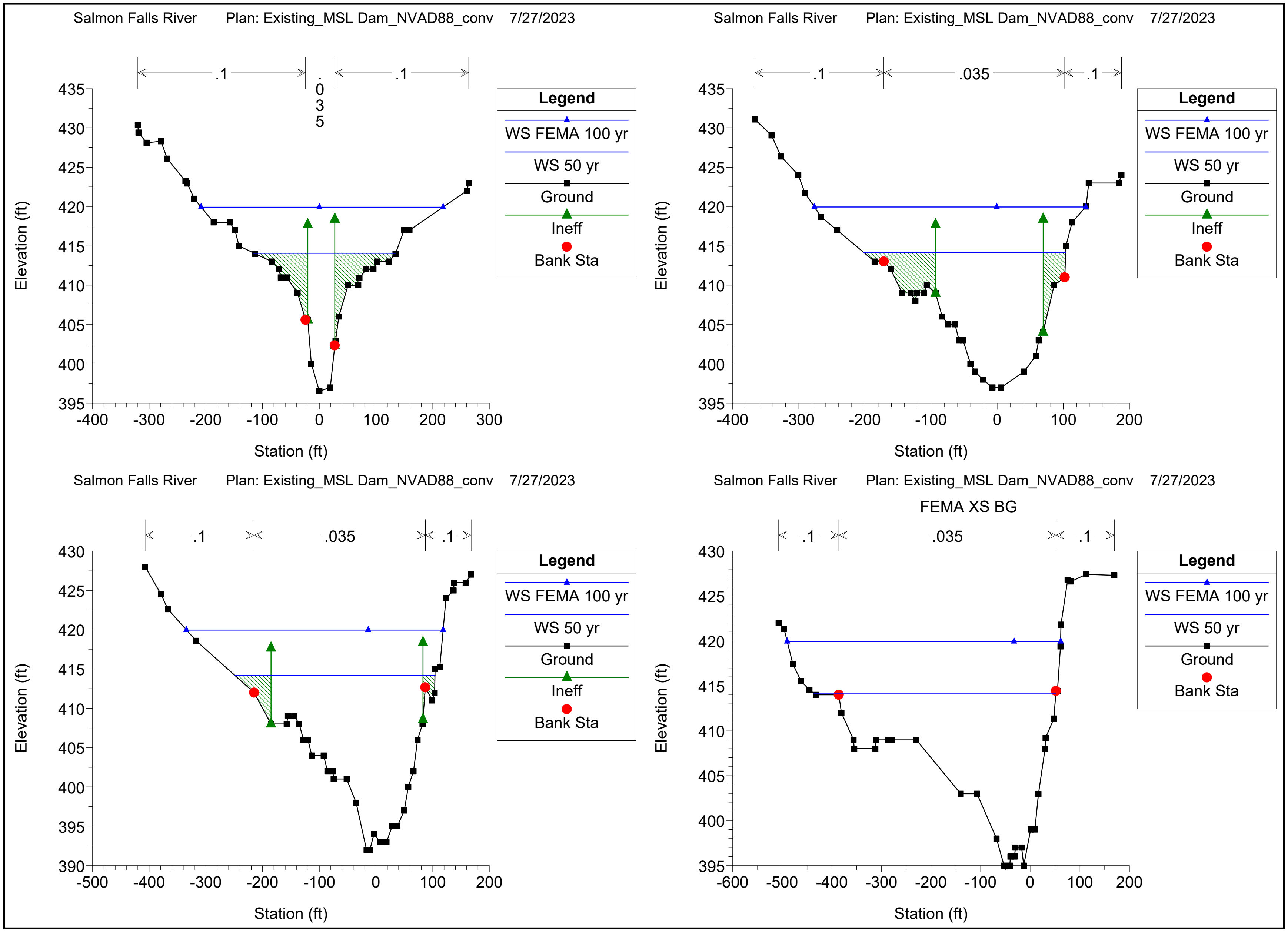

Salmon Falls River Plan: Existing_MSL Dam_NVAD88_conv 7/27/2023
FEMA XS BI
.1 .035 .1
Elevation (ft)
Station (ft)
440
430
420
410
400
-1000
-500
0
500
1000
1500
2000
Legend
WS FEMA 100 yr
WS 50 yr
Ground
Bank Sta


Salmon Falls River Plan: Existing_MSL Dam_NVAD88_conv 7/27/2023
.1 .035 .1
Elevation (ft)
Station (ft)
425
420
415
410
405
400
395
-400
-200
0
200
400
600
Legend
WS FEMA 100 yr
WS 50 yr
Ground
Ineff
Bank Sta


Salmon Falls River Plan: Existing_MSL Dam_NVAD88_conv 7/27/2023
.1 .035 .1
Elevation (ft)
Station (ft)
430
425
420
415
410
405
400
395
-400
-200
0
200
400
600
Legend
WS FEMA 100 yr
WS 50 yr
Ground
Ineff
Bank Sta


Salmon Falls River Plan: Existing_MSL Dam_NVAD88_conv 7/27/2023
.04 .035 .1
Elevation (ft)
Station (ft)
430
425
420
415
410
405
400
395
-300
-200
-100
0
100
200
300
400
500
Legend
WS FEMA 100 yr
WS 50 yr
Ground
Ineff
Bank Sta


Salmon Falls River Plan: Existing_MSL Dam_NVAD88_conv 7/27/2023
.04
.035
.1
Legend
WS FEMA 100 yr
WS 50 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Salmon Falls River Plan: Existing_MSL Dam_NVAD88_conv 7/27/2023
.04
.035
.1
Legend
WS FEMA 100 yr
WS 50 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Salmon Falls River Plan: Existing_MSL Dam_NVAD88_conv 7/27/2023
.04
.035
.1
Legend
WS FEMA 100 yr
WS 50 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Salmon Falls River Plan: Existing_MSL Dam_NVAD88_conv 7/27/2023
.04
.035
.1
Legend
WS FEMA 100 yr
WS 50 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)


Salmon Falls River Plan: Existing_MSL Dam_NVAD88_conv 7/27/2023
.1
.035
.1
Legend
WS FEMA 100 yr
WS 50 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Salmon Falls River Plan: Existing_MSL Dam_NVAD88_conv 7/27/2023
.1
.035
.1
Legend
WS FEMA 100 yr
WS 50 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Salmon Falls River Plan: Existing_MSL Dam_NVAD88_conv 7/27/2023
.1
.035
.1
Legend
WS FEMA 100 yr
WS 50 yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
Salmon Falls River Plan: Existing_MSL Dam_NVAD88_conv 7/27/2023
FEMA XS BG
.1
.035
.1
Legend
WS FEMA 100 yr
WS 50 yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

PLEASE NOTE

This page is scheduled to be decommissioned and will no longer be available after January 2023.

Please visit the new NHDES Real-Time Data Web Portal at https://nhdes.rtiamanzi.org/

Operations Information

List of Specific Station Operations

Current Watershed Operations Information - Mascoma, Suncook, Salmon Falls, Powwow, Soucook, Lamprey, Exeter and Piscataquog

Station: Milton 3-Ponds

This station is located at the Milton 3-Ponds Dam, which is located at the southern end of the lake in Milton. The following parameters are currently being measured at this station:

Milton 3-Ponds Stage (Lake Elevation)
Salmon Falls River Stage / Flow
Precipitation
Air Temperature

Summer Operations
The lake level is managed by bringing it up to full summer recreation level by June 1st. Summer level corresponds to an elevation of 413.87 m.s.l. or 15.25 on the staff gage located at the dam's right abutment. Over the course of the summer months the pond tends to ebb, so that by Columbus Day the level is between 6 and 12 inches lower.

assume full lake level with peak storm events

Seasonal Fall Drawdown
After Columbus Day the lake is slowly lowered to a target drawdown of 12.0 on the gage, or about 3.25 feet below the June 1st target level, to allow shorefront maintenance to occur and to prepare for spring runoff. The drawdown is accomplished by operating the dam's floodgates or spillway crest gate.

Spring Refill
The lake is raised to its summer recreation level between mid late April and early June.

Note: Water levels generally fluctuate in response to precipitation, snowmelt, drought or other meteorological conditions. Target water levels are mantained by the adjustment of flows at the dam in response to these conditions.

Related Information

- Real-Time Data Home
- Historic Data
- Radar Data
- Useful Links
- Operations Info
- Snow Sampling

NH Department of Environmental Services | 29 Hazen Drive | PO Box 95 | Concord, NH 03302-0095
(603) 271-3503 | TDD Access: Relay NH 1-800-735-2964 | Hours: M-F, 8am-4pm

NH.gov | privacy policy | accessibility policy
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Project:	Milton Lebanon Part A	Computed:	SAE	Date:	7/24/22
Subject:	Project Hydrology	Checked:	AJS	Date:	8/10/22
Task:	25-Year Peak Flow Interpolation	Page:	1	of:	1
Job #:	1034193	No:			

= Data Entry Cells

Recurrence Interval, yrs[1]	Exceedance Frequency	Peak Flow, cfs[1]
10	10%	2,930
50	2%	4,500
100	1%	5,290
500	0.2%	7,490

1. From FIS Report

Recurrence Interval, yrs	Exceedance Frequency	Peak Flow, cfs
25	4%	3840

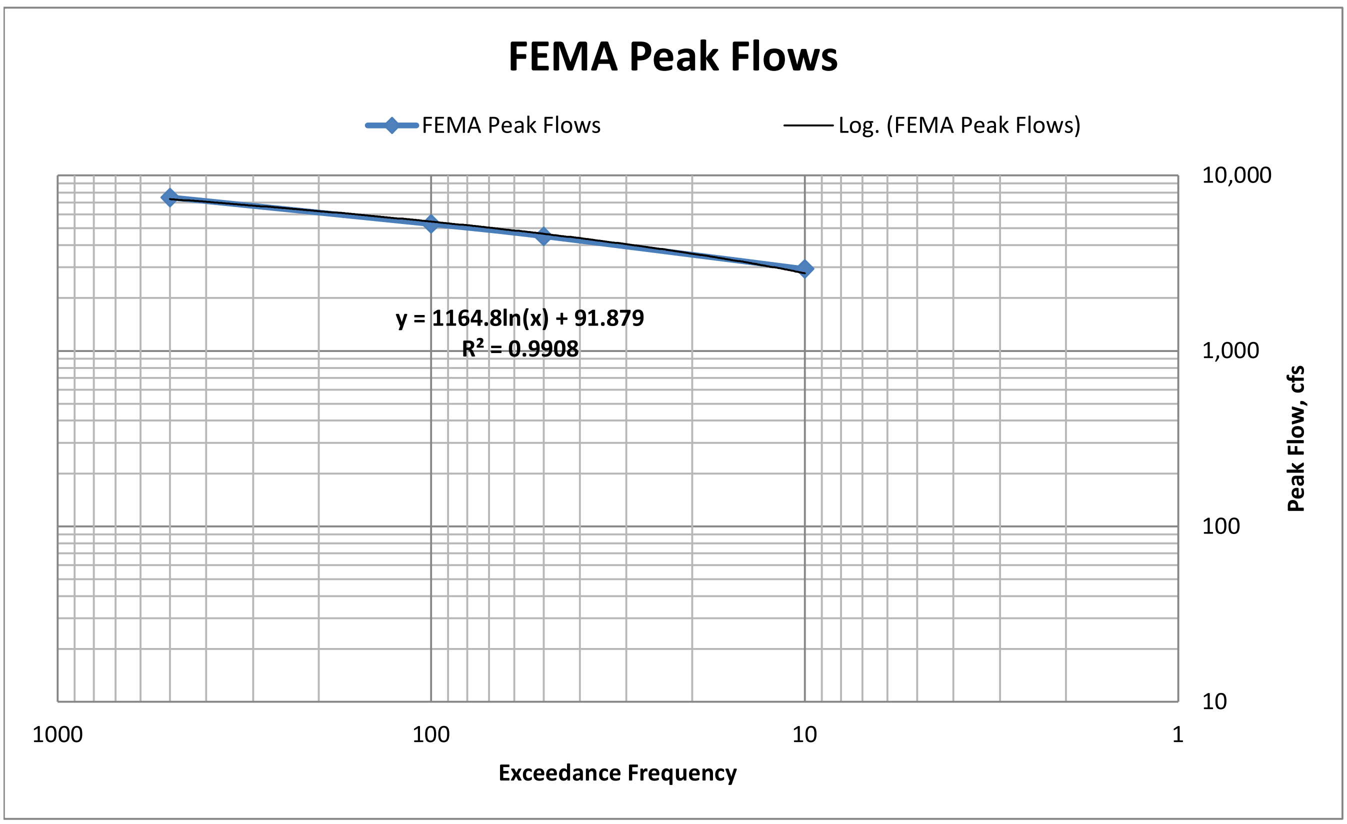


TABLE 4 – SUMMARY OF DISCHARGES – continued

Flooding Source and Location	Drainage Area (sq. miles)	Peak Discharges (cfs)			
		10-Year	50-Year	100-Year	500-Year
OYSTER RIVER					
At Route 108 Bridge	20.4	1,060	1,720	2,050	2,960
At confluence with College Brook	20.3	1,060	1,710	2,030	2,940
At confluence with Long Marsh Brook	19.0	990	1,600	1,910	2,750
At Durham Reservoir Dam	17.0	890	1,430	1,700	2,460
At confluence with Chesley Brook	15.6	810	1,310	1,560	2,260
At Lee/Durham town boundary	13.9	730	1,170	1,400	2,020
At USGS Streamgage No. 01073000	12.3	640	1,030	1,230	1,780
PETTEE BROOK					
Above Edgewood Road	0.80	60	90	105	145
Above UNH Parking Lot "A"	0.66	50	80	90	125
SALMON FALLS RIVER					
At Buffumsville Road	234.7	4,600	7,460	9,000	13,800
At Walnut Grove Road	148.6	3,360	5,450	6,570	10,080
At Spaulding Avenue	130.5	3,050	4,940	5,960	9,150
At Milton-Rochester corporate limits	117.3	3,030	4,700	5,500	7,960
At USGS gage (01072100) in Milton downstream of Milton Three Ponds Dam	108.0	2,930	4,500	5,290	7,490
Upstream of confluence of Branch River	41.5	1,430	2,200	2,580	3,660
Upstream of confluence of Miller Brook	28.7	1,080	1,660	1,960	2,770

The stillwater elevations for the 10-, 50-, 100-, and 500-year floods have been determined for all detailed studied ponds and tidal areas and are summarized in Table 5, "Summary of Stillwater Elevations." For a description of the methodologies used to compute elevations for Bow Lake, Little Bay, and Oyster River, please refer to Section 3.2, Hydraulic Analyses, in this text.

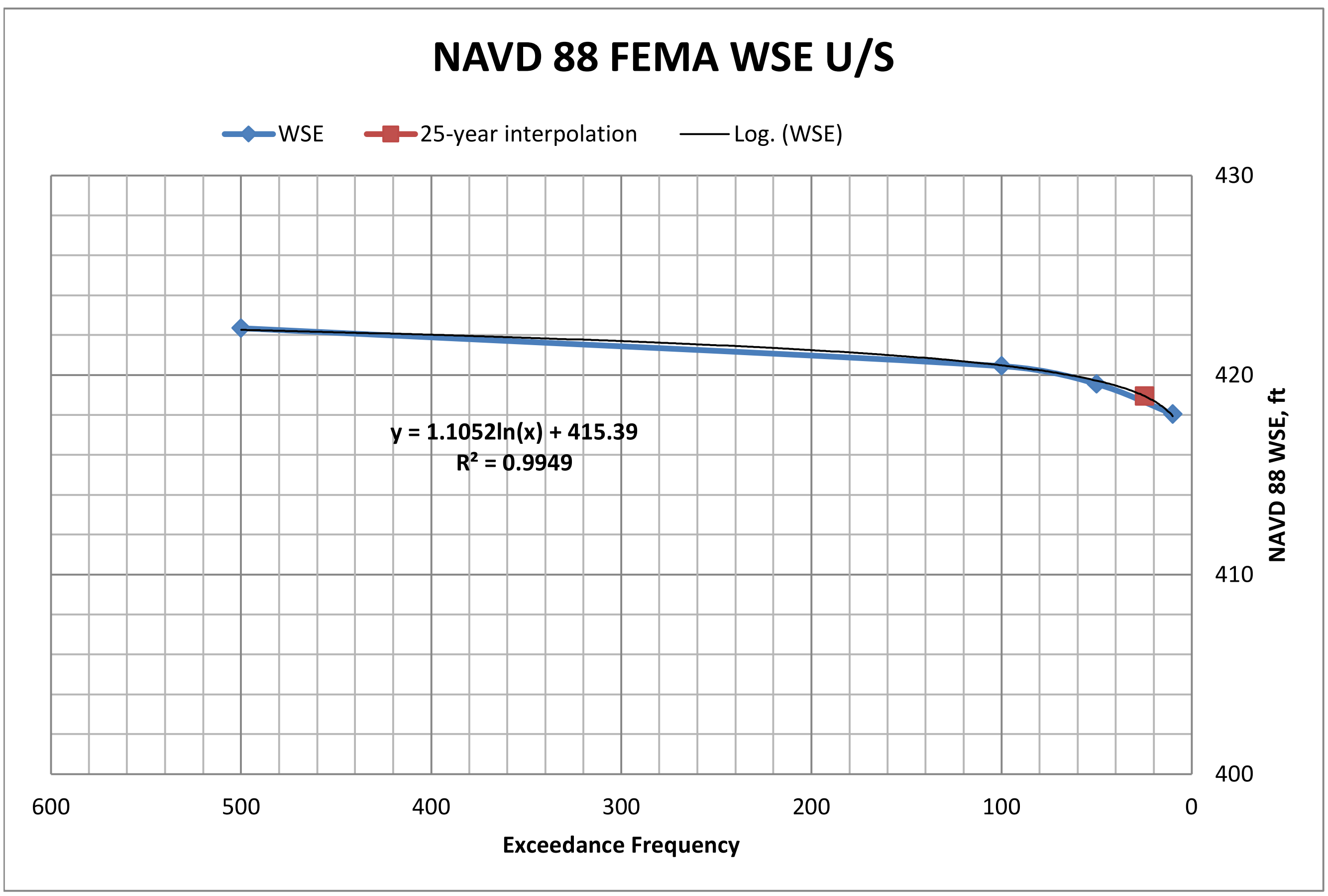
Project:	Milton-Lebanon Part A	Computed:	SAE	Date:	7/27/22
Subject:	Project Hydrology	Checked:	AJS	Date:	8/10/22
Task:	25-Year WSE Interpolation U/S	Page:	1	of:	1
Job #:	10341903	No:			

= Data Entry Cells

Recurrence Interval, yrs[1]	Exceedance Frequency	NGVD 29 WSE, ft[1]	NAVD 88 WSE, ft[2]
10	10%	418.50	418.05
50	2%	420.00	419.55
100	1%	420.90	420.45
500	0.2%	422.80	422.35

1. From FEMA FIS Report, cross section BI
2. Conversion from NGVD29 to NAVD88 at the bridge is -0.449 ft (per NOAA Vdatum tool)

Recurrence Interval, yrs	Exceedance Frequency	NAVD 88 WSE, ft
25	4%	418.95



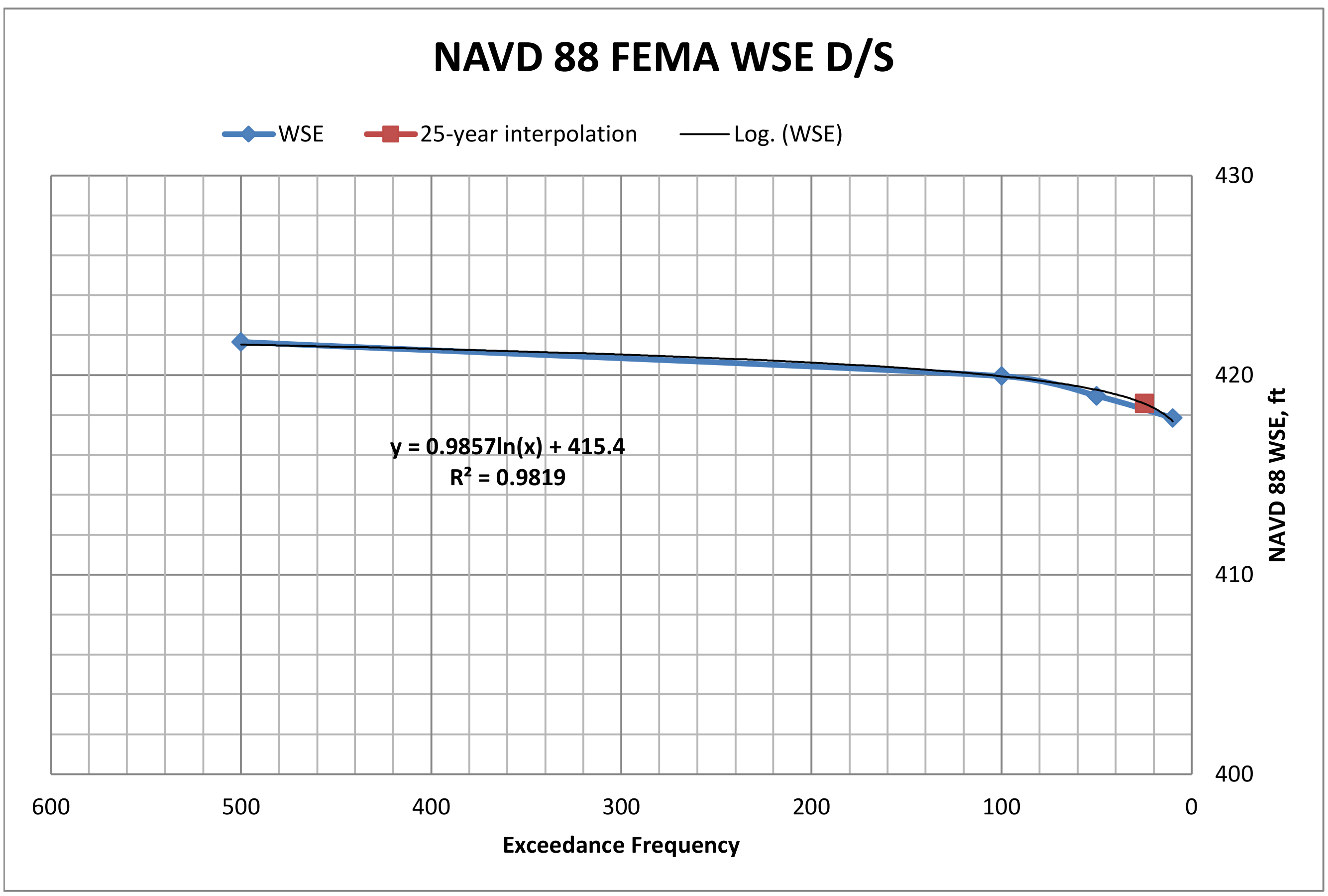
Project:	Milton-Lebanon Part A	Computed:	SAE	Date:	8/9/22
Subject:	Project Hydrology	Checked:	AJS	Date:	8/10/22
Task:	25-Year WSE Interpolation D/S	Page:	1	of:	1
Job #:	10341903	No:			

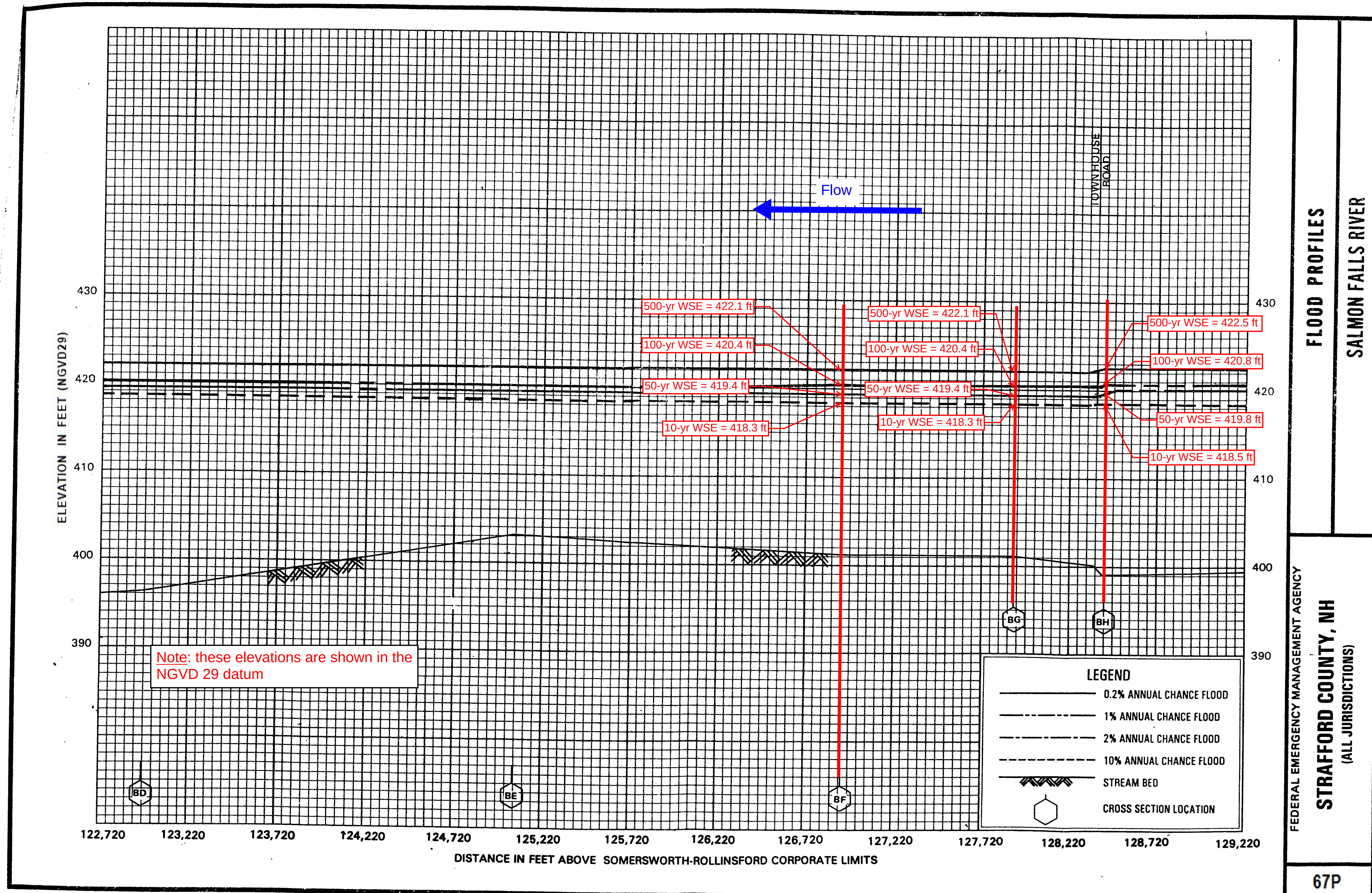
= Data Entry Cells

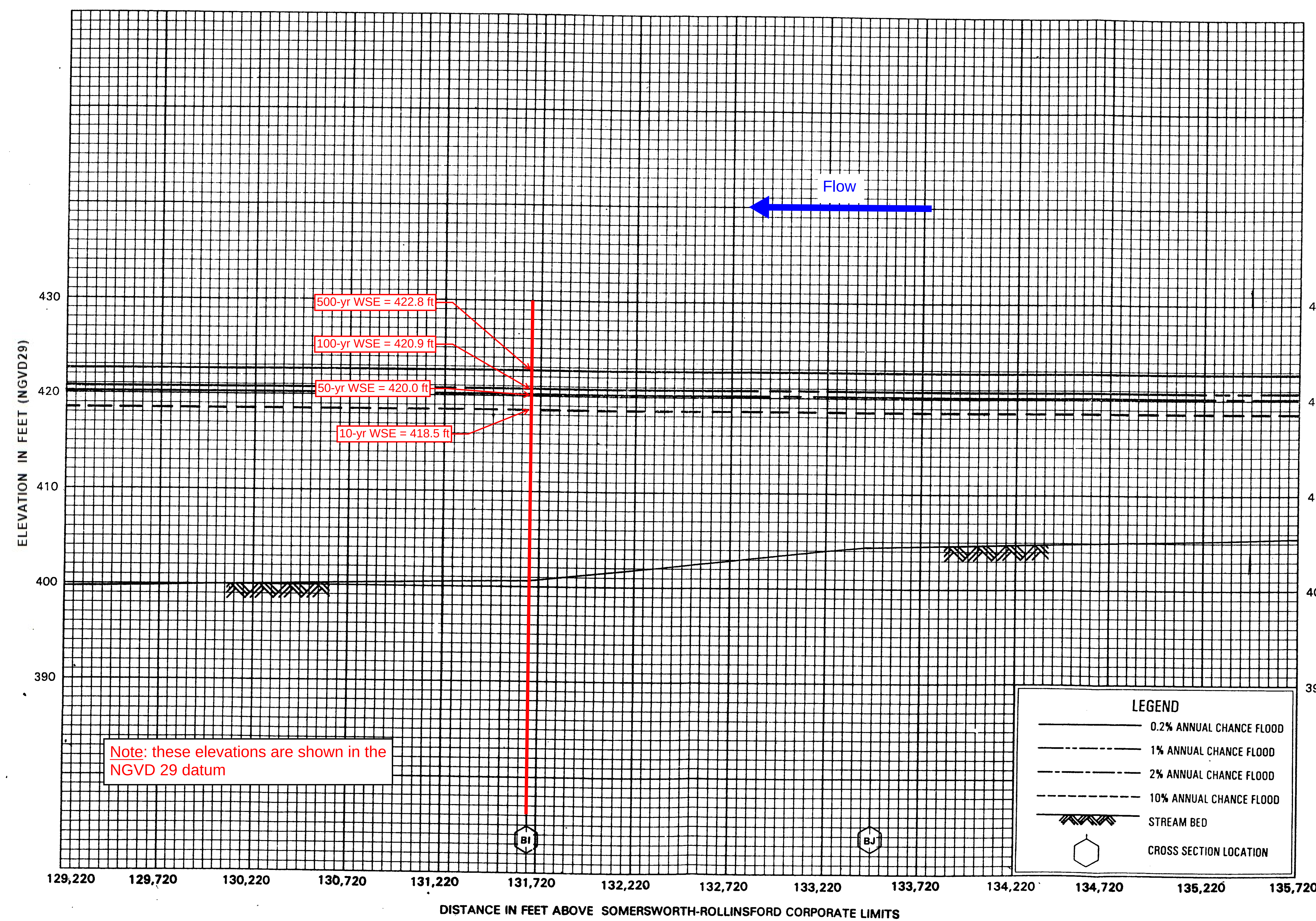
Recurrence Interval, yrs[1]	Exceedance Frequency	NGVD 29 WSE, ft[1]	NAVD 88 WSE, ft[2]
10	10%	418.30	417.85
50	2%	419.40	418.95
100	1%	420.40	419.95
500	0.2%	422.10	421.65

1. From FEMA FIS Report, cross section BG
2. Conversion from NGVD29 to NAVD88 at the bridge is -0.449 ft (per NOAA Vdatum tool)

Recurrence Interval, yrs	Exceedance Frequency	NAVD 88 WSE, ft
25	4%	418.57




FLOOD PROFILES
SALMON FALLS RIVER
FEDERAL EMERGENCY MANAGEMENT AGENCY
STRAFFORD COUNTY, NH
(ALL JURISDICTIONS)
67P
ELEVATION IN FEET (NGVD29)
DISTANCE IN FEET ABOVE SOMERSWORTH-ROLLINSFORD CORPORATE LIMITS
122,720
123,220
123,720
124,220
124,720
125,220
125,720
126,220
126,720
127,220
127,720
128,220
128,720
129,220
390
400
410
420
430
TOWNHOUSE ROAD
Flow
500-yr WSE = 422.1 ft
100-yr WSE = 420.4 ft
50-yr WSE = 419.4 ft
10-yr WSE = 418.3 ft
500-yr WSE = 422.1 ft
100-yr WSE = 420.4 ft
50-yr WSE = 419.4 ft
10-yr WSE = 418.3 ft
500-yr WSE = 422.5 ft
100-yr WSE = 420.8 ft
50-yr WSE = 419.8 ft
10-yr WSE = 418.5 ft
BD
BE
BF
BG
BH
Note: these elevations are shown in the NGVD 29 datum
LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
CROSS SECTION LOCATION



FLOOD PROFILES

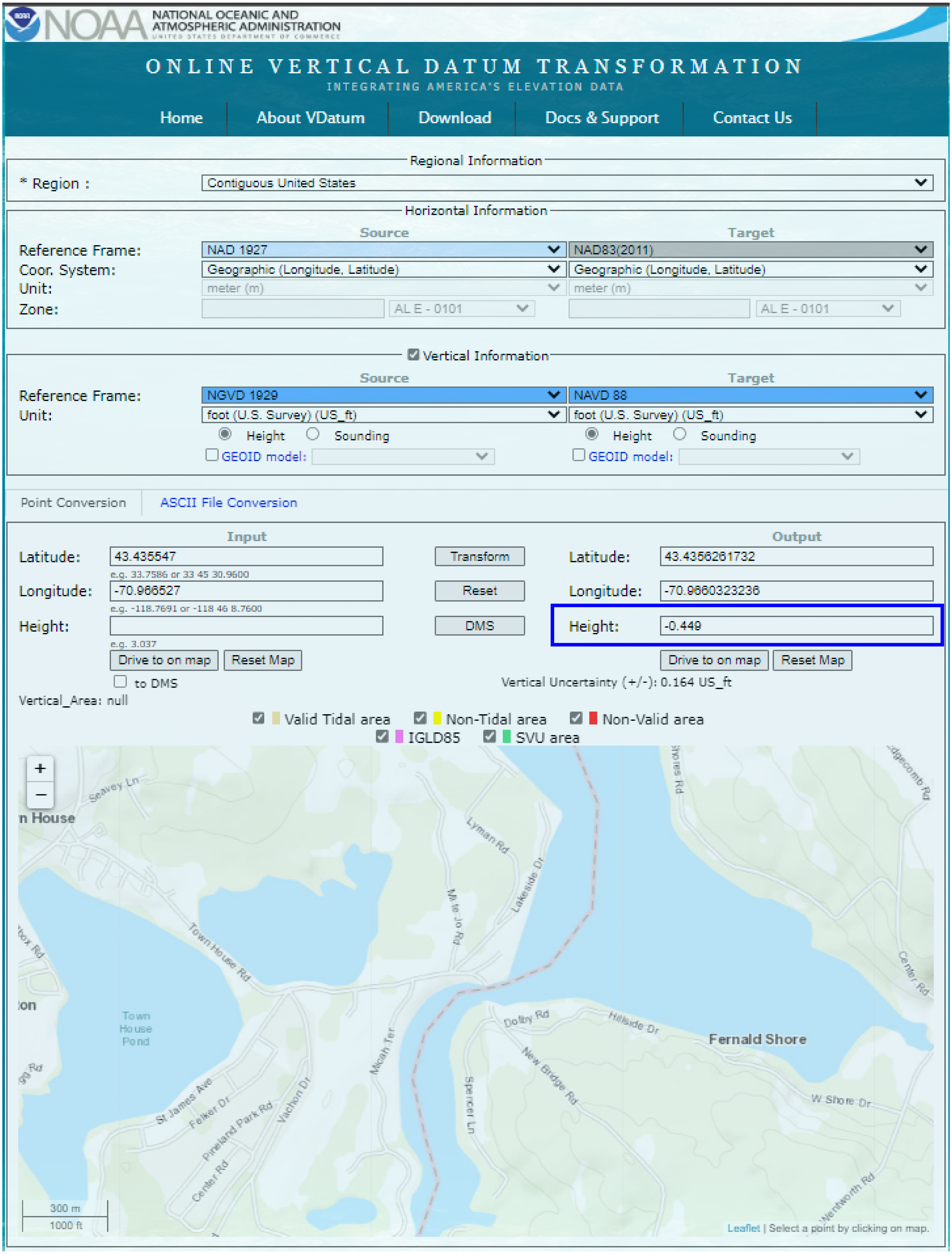
SALMON FALLS RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

STRAFFORD COUNTY, NH

(ALL JURISDICTIONS)

124486


NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
UNITED STATES DEPARTMENT OF COMMERCE
ONLINE VERTICAL DATUM TRANSFORMATION
INTEGRATING AMERICA'S ELEVATION DATA
Home
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Docs & Support
Contact Us
Regional Information
* Region :
Contiguous United States
Horizontal Information
Source
Target
Reference Frame:
NAD 1927
NAD83(2011)
Coor. System:
Geographic (Longitude, Latitude)
Geographic (Longitude, Latitude)
Unit:
meter (m)
meter (m)
Zone:
AL E - 0101
AL E - 0101
Vertical Information
Source
Target
Reference Frame:
NGVD 1929
NAVD 88
Unit:
foot (U.S. Survey) (US_ft)
foot (U.S. Survey) (US_ft)
Height
Sounding
Height
Sounding
GEOID model:
GEOID model:
Point Conversion
ASCII File Conversion
Input
Output
Latitude:
43.435547
e.g. 33.7586 or 33 45 30.9600
Longitude:
-70.966527
e.g. -118.7691 or -118 46 8.7600
Height:
e.g. 3.037
Transform
Reset
DMS
Latitude:
43.4356261732
Longitude:
-70.9660323236
Height:
-0.449
Drive to on map
Reset Map
to DMS
Drive to on map
Reset Map
Vertical Uncertainty (+/-): 0.164 US_ft
Vertical_Area: null
Valid Tidal area
Non-Tidal area
Non-Valid area
IGLD85
SVU area
Seavey Ln
n House
Lyman Rd
Lakeside Dr
Town House Rd
Town House Pond
Micah Ter
Dolby Rd
Hillside Dr
Fernald Shore
New Bridge Rd
Spencer Ln
W Shore Dr
St James Ave
Felker Dr
Pineland Park Rd
Vachon Dr
Center Rd
Wentworth Rd
300 m
1000 ft
Leaflet | Select a point by clicking on map.

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NGVD29)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Salmon Falls River (continued)								
BA	117,700	234	3,371	1.6	420.2	420.2	420.8	0.6
BB	118,440	197	2,520	2.1	420.3	420.3	420.9	0.6
BC	120,440	2,088	46,821	0.1	420.3	420.3	420.9	0.6
BD	122,970	610	9,603	0.6	420.3	420.3	420.9	0.6
BE	125,070	333	4,158	1.3	420.3	420.3	420.9	0.6
BF	126,935	705	9,177	0.6	420.4	420.4	421.0	0.6
BG	127,900	550	7,198	0.7	420.4	420.4	421.0	0.6
BH	128,420	273	4,312	1.2	420.8	420.8	421.5	0.7
BI	131,670	1,390	24,230	0.2	420.9	420.9	421.6	0.7
BJ	133,470	1,971	30,716	0.2	420.9	420.9	421.6	0.7
BK	135,770	1,584	21,746	0.2	420.9	420.9	421.6	0.7
BL	137,995	1,645	21,542	0.2	420.9	420.9	421.6	0.7
BM	139,745	2,150	26,769	0.1	420.9	420.9	421.6	0.7
BN	142,175	450	4,179	0.6	420.9	420.9	421.6	0.7
BO	143,645	692	7,016	0.4	420.9	420.9	421.6	0.7
BP	145,185	160	1,714	1.5	420.9	420.9	421.6	0.7
BQ	147,320	299	2,454	1.1	421.0	421.0	421.8	0.8
BR	148,620	200	1,593	1.6	421.0	421.0	421.8	0.8
BS	149,850	400	2,854	0.9	421.1	421.1	422.0	0.9
BT	151,370	551	3,783	0.7	421.2	421.2	422.2	1.0
BU	153,170	400	2,085	1.2	421.3	421.3	422.3	1.0
BV	155,120	571	2,695	1.0	421.6	421.6	422.6	1.0
BW	157,320	400	1,963	1.3	422.6	422.6	423.5	0.9
BX	158,720	450	2,574	1.0	423.0	423.0	424.0	1.0
BY	160,120	80	503	5.1	423.5	423.5	424.3	0.8
BZ	161,990	273	1,417	1.8	425.4	425.4	426.4	1.0

'Feet above Somersworth-Rollinsford corporate limits

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

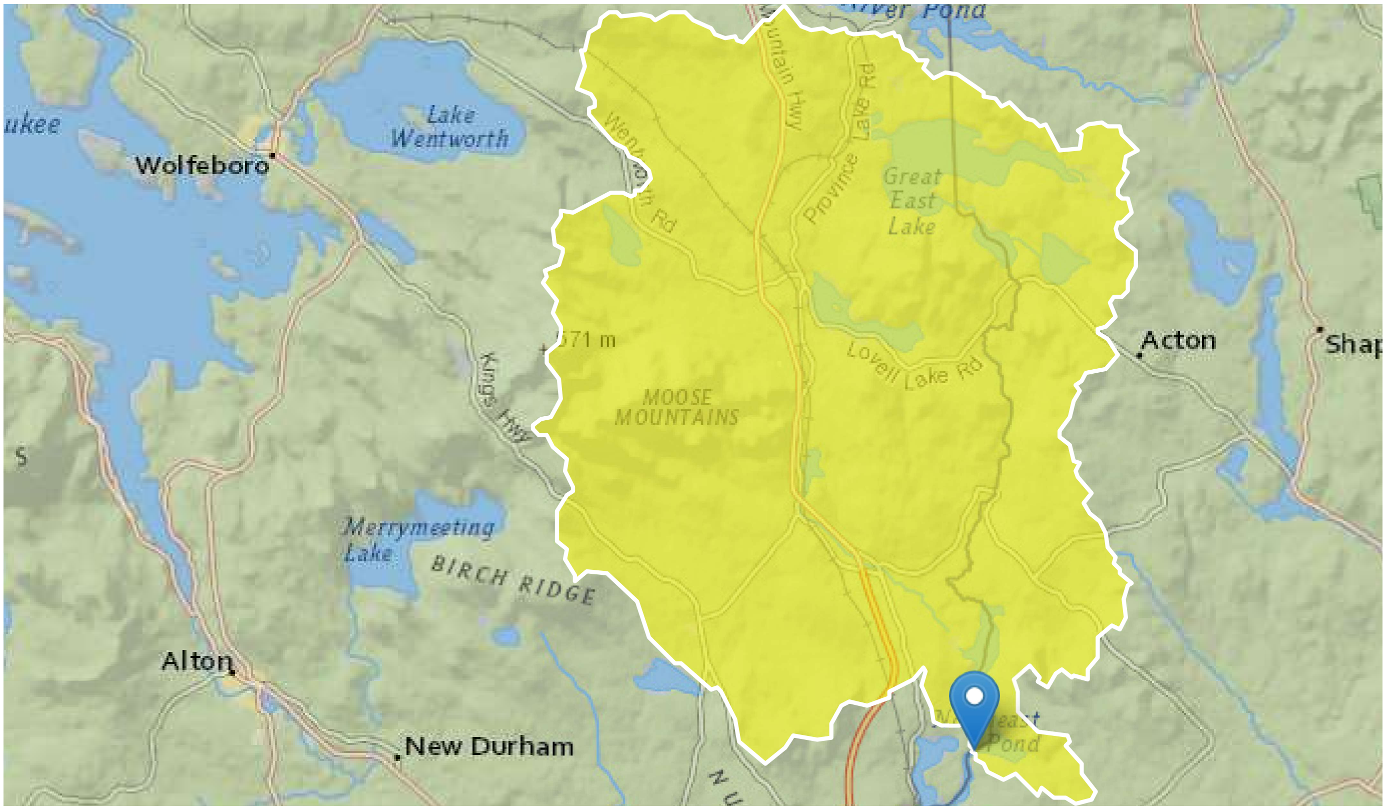
STRAFFORD COUNTY, NH (ALL JURISDICTIONS)

FLOODWAY DATA

SALMON FALLS RIVER

StreamStats Report

Region ID: NH
Workspace ID: NH20220724140901811000
Clicked Point (Latitude, Longitude): 43.43535, -70.96672
Time: 2022-07-24 10:09:30 -0400



Collapse All

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
APRAVPRE	Mean April Precipitation	4.299	inches
BSLDEM30M	Mean basin slope computed from 30 m DEM	8.447	percent
CONIF	Percentage of land surface covered by coniferous forest	16.9886	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	12.3	feet per mi

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	101.42	square miles
ELEVMAX	Maximum basin elevation	1824.955	feet
MINTEMP_W	Mean winter minimum air temperature over basin surface area	14.644	degrees F
MIXFOR	Percentage of land area covered by mixed deciduous and coniferous forest	34.9213	percent
PREBC0103	Mean annual precipitation of basin centroid for January 1 to March 15 winter period	9.06	inches
PREBC_1112	Mean annual precipitation of basin centroid for November 1 to December 31 period	9.76	inches
PRECIPCENT	Mean Annual Precip at Basin Centroid	47.9	inches
PRECIPOUT	Mean annual precip at the stream outlet (based on annual PRISM precip data in inches from 1971-2000)	50.7	inches
PREG_03_05	Mean precipitation at gaging station location for March 16 to May 31 spring period	10.7	inches
PREG_06_10	Mean precipitation at gaging station location for June to October summer period	19.6	inches
SNOFALL	Mean Annual Snowfall	85.423	inches
TEMP	Mean Annual Temperature	45.257	degrees F
TEMP_06_10	Basinwide average temperature for June to October summer period	61.612	degrees F
WETLAND	Percentage of Wetlands	11.2453	percent

General Disclaimers

The delineation point is in an exclusion area. WARNING! This river is regulated. The regression equations may not apply.

Peak-Flow Statistics

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

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	101.42	square miles	0.7	1290
APRAVPRE	Mean April Precipitation	4.299	inches	2.79	6.23
WETLAND	Percent Wetlands	11.2453	percent	0	21.8
CSL10_85	Stream Slope 10 and 85 Method	12.3	feet per mi	5.43	543

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

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

Statistic	Value	Unit	PIl	PIu	ASEp	Equiv. Yrs.
50-percent AEP flood	1720	ft^3/s	1060	2790	30.1	3.2
20-percent AEP flood	2650	ft^3/s	1610	4350	31.1	4.7
10-percent AEP flood	3390	ft^3/s	2030	5670	32.3	6.2
4-percent AEP flood	4320	ft^3/s	2500	7460	34.3	8
2-percent AEP flood	5070	ft^3/s	2850	9010	36.4	9
1-percent AEP flood	5980	ft^3/s	3250	11000	38.6	9.8
0.2-percent AEP flood	8060	ft^3/s	4050	16000	44.1	11

Note: StreamStats flows are used for HEC-RAS modeling because they are higher and thus more conservative.

Peak-Flow Statistics Citations

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

Low-Flow Statistics

Low-Flow Statistics Parameters [Low Flow Statewide]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	101.42	square miles	3.26	689

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
TEMP	Mean Annual Temperature	45.257	degrees F	36	48.7
PREG_06_10	Jun to Oct Gage Precipitation	19.6	inches	16.5	23.1

Low-Flow Statistics Flow Report [Low Flow Statewide]

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

Statistic	Value	Unit	PIl	PIu	SE	ASEp
7 Day 2 Year Low Flow	14.5	ft^3/s	5.08	31.6	55.7	55.7
7 Day 10 Year Low Flow	8.31	ft^3/s	1.88	22.6	79.4	79.4

Low-Flow Statistics Citations

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

Flow-Duration Statistics

Flow-Duration Statistics Parameters [Low Flow Statewide]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	101.42	square miles	3.26	689
PREG_06_10	Jun to Oct Gage Precipitation	19.6	inches	16.5	23.1
TEMP	Mean Annual Temperature	45.257	degrees F	36	48.7

Flow-Duration Statistics Flow Report [Low Flow Statewide]

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

Statistic	Value	Unit	PIl	PIu	SE	ASEp
60 Percent Duration	86.8	ft^3/s	63.6	115	18	18

Statistic	Value	Unit	PIl	PIu	SE	ASEp
70 Percent Duration	58.3	ft^3/s	40	82	20.6	20.6
80 Percent Duration	37.7	ft^3/s	22.5	59.2	28	28
90 Percent Duration	21.2	ft^3/s	10.6	38.1	37.5	37.5
95 Percent Duration	13.9	ft^3/s	6.14	27.1	44.1	44.1
98 Percent Duration	9.93	ft^3/s	3.63	21.8	54.3	54.3

Flow-Duration Statistics Citations

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

Seasonal Flow Statistics

Seasonal Flow Statistics Parameters [Low Flow Statewide]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	101.42	square miles	3.26	689
CONIF	Percent Coniferous Forest	16.9886	percent	3.07	56.2
PREBC0103	Jan to Mar Basin Centroid Precip	9.06	inches	5.79	15.1
BSLDEM30M	Mean Basin Slope from 30m DEM	8.447	percent	3.19	38.1
MIXFOR	Percent Mixed Forest	34.9213	percent	6.21	46.1
PREG_03_05	Mar to May Gage Precipitation	10.7	inches	6.83	11.5
TEMP	Mean Annual Temperature	45.257	degrees F	36	48.7
TEMP_06_10	Jun to Oct Mean Basinwide Temp	61.612	degrees F	52.9	64.4
PREG_06_10	Jun to Oct Gage Precipitation	19.6	inches	16.5	23.1
ELEVMAX	Maximum Basin Elevation	1824.955	feet	260	6290

Seasonal Flow Statistics Flow Report [Low Flow Statewide]

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

Statistic	Value	Unit	PII	PIu	SE	ASEp
Jan to Mar15 60 Percent Flow	97.6	ft^3/s	67.5	136	21.2	21.2
Jan to Mar15 70 Percent Flow	84.8	ft^3/s	59.3	117	20.7	20.7
Jan to Mar15 80 Percent Flow	69.3	ft^3/s	50.6	92.3	18.2	18.2
Jan to Mar15 90 Percent Flow	53.6	ft^3/s	38.3	72.5	19.3	19.3
Jan to Mar15 95 Percent Flow	42.5	ft^3/s	29.7	58.6	20.7	20.7
Jan to Mar15 98 Percent Flow	32.4	ft^3/s	20.2	48.8	27.1	27.1
Jan to Mar15 7 Day 2 Year Low Flow	67.7	ft^3/s	50.4	88.3	17.2	17.2
Jan to Mar15 7 Day 10 Year Low Flow	41.6	ft^3/s	28.8	57.5	21.5	21.5
Mar16 to May 60 Percent Flow	211	ft^3/s	171	258	12.2	12.2
Mar16 to May 70 Percent Flow	169	ft^3/s	139	203	11.4	11.4
Mar16 to May 80 Percent Flow	128	ft^3/s	103	156	12.4	12.4
Mar16 to May 90 Percent Flow	91.4	ft^3/s	72.1	114	13.7	13.7
Mar16 to May 95 Percent Flow	68	ft^3/s	52.7	86.1	14.8	14.8
Mar16 to May 98 Percent Flow	48	ft^3/s	35	64	18.1	18.1
Mar16 to May 7 Day 2 Year Low Flow	92.7	ft^3/s	71.8	117	14.5	14.5
Mar16 to May 7 Day 10 Year Low Flow	55.1	ft^3/s	41.3	71.7	16.2	16.2
Jun to Oct 60 Percent Flow	30	ft^3/s	15.1	54	36.7	36.7
Jun to Oct 70 Percent Flow	22.2	ft^3/s	10.5	41.7	39.9	39.9
Jun to Oct 80 Percent Flow	16.7	ft^3/s	7.22	33.4	44.5	44.5
Jun to Oct 90 Percent Flow	10.8	ft^3/s	4.15	23.3	50.7	50.7
Jun to Oct 95 Percent Flow	8.31	ft^3/s	2.84	19.2	57	57
Jun to Oct 98 Percent Flow	5.46	ft^3/s	1.72	13.3	61.1	61.1
Jun to Oct 7 Day 2 Year Low Flow	12.4	ft^3/s	4.23	27.8	55.6	55.6
Jun to Oct 7 Day 10 Year Low Flow	6.82	ft^3/s	1.53	18.8	78.5	78.5
Nov to Dec 60 Percent Flow	84.1	ft^3/s	56.2	120	23.3	23.3
Nov to Dec 70 Percent Flow	66.1	ft^3/s	42.2	97.9	25.9	25.9
Nov to Dec 80 Percent Flow	50.3	ft^3/s	31.1	76.3	27.8	27.8
Nov to Dec 90 Percent Flow	34.6	ft^3/s	19.9	55.2	31.6	31.6

Statistic	Value	Unit	PIl	PIu	SE	ASEp
Nov to Dec 95 Percent Flow	25.8	ft^3/s	13.2	44.7	38.3	38.3
Nov to Dec 98 Percent Flow	18.8	ft^3/s	7.7	37.3	50.6	50.6
Oct to Nov 7 Day 2 Year Low Flow	51	ft^3/s	33.9	72.7	23.3	23.3
Oct to Nov 7 Day 10 Year Low Flow	23.6	ft^3/s	12.4	39.7	36.6	36.6

Seasonal Flow Statistics Citations

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

Bankfull Statistics

Bankfull Statistics Parameters [Appalachian Highlands D Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	101.42	square miles	0.07722	940.1535

Bankfull Statistics Parameters [New England P Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	101.42	square miles	3.799224	138.999861

Bankfull Statistics Parameters [USA Bieger 2015]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	101.42	square miles	0.07722	59927.7393

Bankfull Statistics Flow Report [Appalachian Highlands D Bieger 2015]

Statistic	Value	Unit
Bieger_D_channel_width	103	ft
Bieger_D_channel_depth	4.22	ft
Bieger_D_channel_cross_sectional_area	446	ft^2

Bankfull Statistics Flow Report [New England P Bieger 2015]

Statistic	Value	Unit
Bieger_P_channel_width	92.1	ft
Bieger_P_channel_depth	3.8	ft
Bieger_P_channel_cross_sectional_area	365	ft^2

Bankfull Statistics Flow Report [USA Bieger 2015]

Statistic	Value	Unit
Bieger_USA_channel_width	63	ft
Bieger_USA_channel_depth	3.22	ft
Bieger_USA_channel_cross_sectional_area	207	ft^2

Bankfull Statistics Flow Report [Area-Averaged]

Statistic	Value	Unit
Bieger_D_channel_width	103	ft
Bieger_D_channel_depth	4.22	ft
Bieger_D_channel_cross_sectional_area	446	ft^2
Bieger_P_channel_width	92.1	ft
Bieger_P_channel_depth	3.8	ft
Bieger_P_channel_cross_sectional_area	365	ft^2
Bieger_USA_channel_width	63	ft
Bieger_USA_channel_depth	3.22	ft
Bieger_USA_channel_cross_sectional_area	207	ft^2

Bankfull Statistics Citations

Bieger, Katrin; Rathjens, Hendrik; Allen, Peter M.; and Arnold, Jeffrey G.,2015, Development and Evaluation of Bankfull Hydraulic Geometry Relationships for the Physiographic Regions of the United States, Publications from USDA-ARS / UNL Faculty, 17p. (https://digitalcommons.unl.edu/usdaarsfacpub/1515?utm_source=digitalcommons.unl.edu%2Fusdaarsfacpub%2F1515&utm_medium=PDF&utm_

› Recharge Statistics

Recharge Statistics Parameters [Groundwater Recharge Statewide 2004 5019]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
PRECIPOUT	Mean Annual Precip at Gage	50.7	inches	35.83	53.11
TEMP	Mean Annual Temperature	45.257	degrees F	36.05	48.69
MINTEMP_W	Mean Winter Min Temperature	14.644	degrees F	0.8	19.88
CONIF	Percent Coniferous Forest	16.9886	percent	3.07	56.18
PREG_03_05	Mar to May Gage Precipitation	10.7	inches	6.83	11.54
SNOFALL	Mean Annual Snowfall	85.423	inches	54.46	219.07
PREG_06_10	Jun to Oct Gage Precipitation	19.6	inches	16.46	23.11
MIXFOR	Percent Mixed Forest	34.9213	percent	6.21	46.13
PREBC_1112	Nov to Dec Basin Centroid Precip	9.76	inches	6.57	15.2
PRECIPCENT	Mean Annual Precip at Basin Centroid	47.9	inches	37.44	75.91

Recharge Statistics Flow Report [Groundwater Recharge Statewide 2004 5019]

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

Statistic	Value	Unit	ASEp
GW_Recharge_Jan_to_Mar15	6.39	in	15.5
GW_Recharge_Mar16_to_May	9.47	in	12.4
GW_Recharge_Jun_to_Oct	3.5	in	26.5
GW_Recharge_Nov_to_Dec	4.43	in	15.8
GW_Recharge_Ann	23.3	in	12.4

Recharge Statistics Citations

Flynn, R.H. and Tasker, G.D.,2004, Generalized Estimates from Streamflow Data of Annual and Seasonal Ground-Water-Recharge Rates for Drainage Basins in New Hampshire, U.S. Geological Survey Scientific Investigations Report 2004-5019, 67 p. (http://pubs.usgs.gov/sir/2004/5019/)

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USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Application Version: 4.10.1
StreamStats Services Version: 1.2.22
NSS Services Version: 2.2.1

APPENDIX H
Effective Flood Insurance Rate Map

National Flood Hazard Layer FIRMette

FEMA

70°58'19"W 43°26'22"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

70°57'42"W 43°25'55"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- B 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/7/2022 at 10:43 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX I

Environmental Summary Memorandum

- Attachment A – Representative Photographs
- Attachment B – Environmental Constraints Map
- Attachment C – Wetland Back-up Questions used to Evaluate Functions and Values
- Attachment D – 2020 NH Wildlife Habitat Land Cover Map
- Attachment E – 2020 Highest-Ranked Wildlife Habitat by Ecological Condition

Memo

Date:	Tuesday, August 08, 2023
Project:	Milton, NH – Lebanon, ME Townhouse Road and New Bridge Road over Northeast Pond (Br. No. 168/151)
To:	Jason Tremblay, PE, New Hampshire Department of Transportation
From:	Brett Battaglia, Senior Environmental Scientist, HDR Engineering Inc.
Subject:	Environmental Summary Memorandum

Introduction

HDR Engineering, Inc. (HDR) has prepared this Environmental Summary Memorandum to document the existing conditions of the proposed project area, provide environmental resource information to support an assessment of potential project impacts, and document the physical and the biological characteristics of the wetlands, waterbodies, and surrounding lands in the vicinity of the proposed project area (Figure 1). Sources of information used in identifying resources within the project study area are based on available sources of information, desktop review, applicable resource databases, preliminary agency coordination, and field review. Additional studies may be necessary if proposed project plans change or as identified through permitting activities associated with the project. The results of background research and a field investigation are summarized in this Environmental Summary Memorandum.

An on-site investigation was performed by HDR on September 29, 2022, to delineate the boundaries of wetlands in the vicinity of the proposed bridge, identify and delineate the Ordinary High Water Mark (OHWM) and the Top of Bank (TOB) adjacent to Northeast Pond within the study area, to observe the characteristics of the wetlands and the upland portion of the surroundings, evaluate invasive plants, and identify potential bat roost trees in the immediate area of the proposed bridge. The study area included lands within approximately 25 feet of New Bridge Road and Townhouse Road in Maine and New Hampshire, respectively, from just south of the intersection of Dolby Road and New Bridge Road in Maine to just west of the Summer Street and Townhouse Road intersection in New Hampshire, as well as portions of Northeast Pond between the existing bridge abutments (see Figure 1 and Attachment A).

The on-site investigation was performed by a New Hampshire Certified Wetland Scientist (No. 25) in accordance with both New Hampshire and Maine regulatory requirements. The potential wetland boundaries were evaluated according to the U.S. Army Corps of Engineers (USACE) Wetlands Delineation Manual (Environmental Laboratory 1987) and *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region, Version 2.0* (Regional Supplement) (USACE 2012), which utilize the three parameter approach (i.e., evaluating the site for the presence of hydric soils, hydrophytic vegetation and wetland hydrology) for identifying wetlands and determining their jurisdictional limits.

Figure 1. Location Map

The 1987 Corps Wetlands Delineation Manual and the Regional Supplement describe the methodology that is required for jurisdictional wetland determinations. The observations made during this field effort, along with the following information, form the basis for this environmental resource assessment:

- U.S. Geological Survey (USGS) Milton Quadrangle New Hampshire - Maine, 7.5-minute series topographic map;
- Aerial photographs from Google Earth and other sources;
- United States Department of Agriculture (USDA)- Natural Resource Conservation Service (NRCS) Custom Soil Resource Report for Strafford County, New Hampshire, and York County, Maine (via Web Soil Survey);
- U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) map;
- New Hampshire Natural Heritage Program Datacheck Program;

- 2020 New Hampshire Wildlife Habitat Land Cover Map for Milton, New Hampshire;
- 2020 Highest Ranked Wildlife Habitat by Ecological Condition Map for Milton, New Hampshire;
- Maine Department of Inland Fisheries and Wildlife's (MDIFW) Environmental Review Tool;
- New Hampshire Wildlife Action Plan 2020 Aquatic Habitat Map;
- Maine Natural Areas Program (MNAP) project review; and
- MDIFW project review.

Site Characterization

Proposed Project Area. The proposed project area encompasses approximately one acre of land and water associated with the Salmon Falls River corridor in Strafford County, New Hampshire, and York County, Maine (Figure 1). Notable aquatic features within and/or adjacent to the proposed project area include Northeast Pond and a small area of Submerged Aquatic Vegetation (SAV) (Attachment B). The areas to the west and east of the proposed bridge within Northeast Pond are mainly lacustrine. Terrestrial areas located to the north and south of the proposed bridge consist of scattered forested lands and developed areas.

New Bridge Marina borders the proposed project area to the southeast in Maine (Figure 1). New Bridge Marina offers a wide array of services, including pontoon boat and fishing boat rentals, slip rentals, a paved boat ramp, a gas dock, boat repair, storage and winterization, and a small cafe. During the site investigation, several boats were observed traversing through the proposed project area in Northeast Pond and several fishermen were observed fishing within/adjacent to the proposed project area. Kayakers were also observed paddling through and in the vicinity of the proposed work area.

Uplands. The upland areas in the vicinity of the survey area are a mixture of commercial and residential-use, maintained grass areas, small areas of forested lands southwest of the proposed bridge, and narrow bands of roadside vegetation bordering Townhouse Road in New Hampshire and New Bridge Road in Maine. Evidence of anthropogenic disturbances in the form of development and past and present uses of the area (e.g., fill slopes, roadways, utilities, etc.) generally dominates the survey area. The upland forested areas bordering the former bridge location to the west and east are predominantly roadside vegetated areas with scattered trees, shrubs, and herbaceous vegetation dominated by the following trees: white pine (*Pinus strobus*), pitch pine (*Pinus rigida*), red oak (*Quercus rubra*), paper birch (*Betula papyrifera*), and red maple (*Acer rubrum*). Shrub cover in the upland areas is moderately dense and consists primarily of saplings of the overstory species with scattered areas of sweet fern (*Comptonia peregrina*) bordering roadway margins. Additional shrub species observed adjacent to Northeast Pond consisted of red osier dogwood (*Cornus alba*), broadleaf meadowsweet (*Spiraea latifolia*), speckled alder (*Alnus incana* subsp. *rugosa*), American elm (*Ulmus americana*), and scattered buttonbush (*Cephalanthus occidentalis*). Oriental bittersweet (*Celastrus orbiculatus*), an invasive vine, is common to abundant throughout the uplands in the vicinity of the proposed bridge in Maine. Dominant upland soils in the vicinity of the survey area include HeC—Hermon sandy loam, 8 to 15 percent slopes in Maine and HaA—Hinckley loamy sand, 0 to 3 percent slopes in New Hampshire (USDA/NRCS 2022).

Jurisdictional Resources. Wetland resources in the study area were demarcated with colored flagging and field located using an EOS Positioning Systems Arrow Gold™ GNSS receiver linked to an iPad™ Air 2 operating Field Maps for ArcGIS™. Overall, the field surveys were used to identify, map, classify and characterize the wetland resources occurring within and immediately adjacent to the study area. For wetlands, data collection followed the "routine on-site determination method" outlined by the USACE (Environmental Laboratory 1987) and, where pertinent, the Regional Supplement (USACE 2012). The wetland delineation approach set forth in these delineation manuals requires the presence of wetland hydrology, hydric soil, and hydrophytic vegetation. The USACE technical guidelines for wetlands require that a positive wetland indicator be present for each of the three parameters, except in specialized cases identified in the regional supplement.

In addition to identifying wetlands, the site was also assessed for stream channels that would likely be considered jurisdictional. Stream channels are identified by the presence of a defined bed and bank, as well as a defined OHWM. OHWM features were identified using Regulatory Guidance Letter 05-05 (USACE 2005). The TOB within the survey area was identified with the definitions of bank at NH Env-Wt 102.15 and Maine Department of Environmental Protection (MDEP) 2019.

The principal jurisdictional wetland feature within the survey area consists of Northeast Pond (Figure 1; Attachments A and B) located between the existing bridge abutments. At the time of the site investigation, water depths adjacent to the existing bridge abutments within Northeast Pond measured approximately two feet in depth. A palustrine forested floodplain wetland (Wetland 1) also exists in the survey area and is located on the west side of New Bridge Road in Maine. The wetland is located at the toe of slope of the roadway near the proposed bridge work area and is adjacent to Northeast Pond (Figure 1; Attachments A and B). The hydrologic indicators present in the area include a high-water table (depth: six inches) and saturated soils (saturated to surface). The hydrology of the wetland is driven by overland drainage from the adjacent landscape and high-water events within Northeast Pond. Hydric soils were determined to be present in the form of hydric soil indicator A2-Histic Epipedon (USACE 2012). The boundary of the wetland was delineated based on the dominance of hydrophytic vegetation, hydric soils, its landscape position, and the presence of saturated soils throughout the wetland. The dominant plant species included yellow birch (*Betula alleghaniensis*) and red maple trees, speckled alder and red osier dogwood shrubs, and sensitive fern (*Onoclea sensibilis*), royal fern (*Osmunda regalis*), and field horsetail (*Equisetum arvense*) herbaceous species.

Although the field assessment did not include detailed surveys of SAV and/or aquatic invasive species, areas of SAV were observed on the east side of the existing bridge abutments in New Hampshire and Maine and their approximate boundaries are shown in Attachment B. The boundaries were manually digitized using the GPS work tablet and transferred to the project area base map. The observed SAV was generally sparse to moderate density, with all observations noted on the eastern side of the proposed bridge in New Hampshire and Maine (Attachment B). Generally, the mapped SAV areas were located within sandy substrates in New Hampshire and within coarse gravel/rubble substrates in Maine (Figure 2; Attachments A and B). These areas consisted of sparse to moderate density SAV consisting of Robbin's Pondweed (*Potamogeton* *robbinsii*) (in NH) and an unidentified area of SAV that is believed to be tape-grass (*Vallisneria americana*). Water depths in these areas ranged from approximately 12 inches to four feet (Attachment A).

Waterbodies. The only waterbody observed in the study area consisted of Northeast Pond. The classification of Northeast Pond, in accordance with the U.S. Fish and Wildlife Service's Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979), is Lacustrine, Limnetic, Unconsolidated Bottom, Permanently Flooded, Diked/Impounded (L1UBHh) (Attachment B).

Wetland vegetation colonizing exposed substrate areas along the banks of Northeast Pond at the time of the site investigation was dominated by woolgrass (*Scirpus cyperinus*), blue flag iris (*Iris versicolor*), fringed sedge (*Carex crinita*), red osier dogwood, red maple, speckled alder, American elm, buttonbush, and highbush blueberry (*Vaccinium corymbosum*). According to Beginning with Habitat Primary Map 2, High Value Plant and Animal Habitats for Lebanon, ME, the project vicinity is known for Vasey's pondweed (*Potamogeton vaseyi*), a species of special concern in Maine. According to the Maine Natural Areas Program (2021), this species prefers quiet muddy or calcareous waters (open water, non-forested wetland).

The majority of observed substrate in Northeast Pond in the survey area is dominated by coarse gravel, rubble, small to medium cobble, and scattered small boulders. Less coarse sandy substrates were observed both to the west and east of the proposed bridge crossing along exposed beaches (see Attachment A). Sections of riprap exist along the edges of each existing bridge abutment. Water depths increased gradually from the shorelines and it appears that the center of the proposed work area between the existing bridge piers is the deepest portion of Northeast Pond in the survey area.

The proposed bridge generally separates Northeast Pond from Milton and Town House Ponds (to the south and west); aka Milton Three Ponds. According to GranitView, Milton Three Ponds covers an area of approximately 1,040 acres and is classified as a warm/cool fishery in New Hampshire. This waterbody is classified as a warm to cool, oligo-mesotrophic, acidic pond, where warm to cool, somewhat oxygenated water is present year-round. Water alkalinity is low, supporting biota tolerant of acidic waters and these waterbodies may support beds of SAV. Waterbodies of this type are relatively shallow compared to colder lakes in the region, and generally support warmwater fish like largemouth bass (*Micropterus salmoides*) and sunfish (*Lepomis*).

Vernal Pools. No vernal pools were observed within the vicinity of the proposed bridge, applying the following definitions and methodologies:

- New Hampshire Department of Environmental Service definition of vernal pool at Env-Wt 104.44; and guidelines for identifying and documenting vernal pools given in *Identifying and Documenting Vernal Pools in New Hampshire* published by the New Hampshire Fish and Game Department (NHFG) (NHFG 2016).
- Maine Department of Environmental Protection definition of Significant Vernal Pool in Chapter 335, Significant Wildlife Habitat.

Wetland Assessment. Based on the field observations and appropriate reference materials, evaluative descriptions of representative wetlands identified within the study area were performed in general accordance with *Wetlands Functions and Values: A Descriptive Approach* described in *The Highway Methodology Workbook Supplement* (Supplement) (USACE 1999). This descriptive approach to wetland evaluation uses a series of questions relating to the qualitative characteristics of a wetland to determine if a wetland effectively provides up to eight key functions and five values as described below. Evaluators identify if a function or value is present, and if present, determine if the characteristic serves as a principal component of the wetland ecosystem or special value to society.

Functions - are properties within the wetland ecosystem that are present in the absence of humans and occur without regard to subjective human values. Functions are a result of the interactions between the living and nonliving components of a specific wetland and are necessary for the self-maintenance of the wetland, including nutrient cycling and primary production. The wetland functions assessed included:

- Groundwater Recharge/Discharge;
- Flood Flow Alteration (Storage and Desynchronization);
- Fish and Shellfish Habitat;
- Sediment/Toxicant/Pathogen Retention;
- Nutrient Removal/Retention/Transformation;
- Production Export (Nutrient);
- Sediment/Shoreline Stabilization; and
- Wildlife Habitat

Values - are perceived benefits (to humans) that derive from one or more wetland functions and/or the physical characteristics. The value of a wetland function is based on societal judgment of the worth, quality, or importance of the function. The primary wetland values assessed included:

- Recreation (Consumptive and Non-Consumptive);
- Educational/Scientific Value;
- Uniqueness/Heritage;
- Visual Quality/Aesthetics; and
- Endangered Species Habitat.

A basic concept presented by the Supplement is an identification of “Considerations/Qualifiers” that can be used as indicators or descriptors of the presence of particular functions or values. The “Considerations/Qualifiers” used as part of the assessment are identified in Attachment C for each of the respective wetland functions and values. Wetland functions and values that can be readily attributed to the wetland types in the study area are identified below.

Function and values assessments were performed for Wetland 1 and Northeast Pond identified in the study area to determine the principal functions and values provided by each of these habitats. Study area wetlands provide almost all of the 13 functions and values evaluated by the Supplement; however, not all of them occurred at a principal level (Table 1). Commonly occurring principal functions consisted of sediment/toxicant retention and nutrient removal. The educational/scientific, uniqueness/heritage, and endangered species habitat values were not determined to occur at a principal level in any of the study area wetlands. Northeast Pond provides the most functions and values at a principal level in the study area.

Table 1. Wetland Functions and Values Provided by Wetlands Identified in the Study Area

	Wetland 1	Northeast Pond
Wetland Functions		
Groundwater Recharge/Discharge		✓
Flood Flow Alteration		✓
Fish and Shellfish Habitat		✓
Sediment/Toxicant Retention	✓	✓
Nutrient Removal	✓	✓
Production Export		✓
Sediment/Shoreline Stabilization	✓	
Wildlife Habitat		✓
Wetland Values		
Recreation		✓
Educational/Scientific Value		
Uniqueness/Heritage		
Visual Quality/Aesthetics		✓
Endangered Species Habitat		

The portion of Northeast Pond watershed that drains to the study area is generally heavily forested, but also includes some agricultural lands, as well as urban and suburban lands. Together, these land uses and associated impervious surfaces result in a potential increase volume of surface water runoff. These same land uses occur within the projects vicinity and are the justification for the wetlands having a principal rating for the sediment/toxicant retention and nutrient removal functions.

All of the identified study area wetlands provide some degree of wildlife habitat, especially as part of the larger surrounding upland/wetland habitat complexes, however, this function was not considered a principal function for Wetland 1. Peak flows from runoff, surface flow, and precipitation are mitigated by the wetlands, and Northeast Pond has the ability to retain relatively large quantities of water. The shoreline of Northeast Pond within the survey area was generally stable and no indications of accelerated erosion were observed. Offsite sediment and toxicants can be attenuated within the wetlands, and potential for nutrient removal exists. Northeast Pond is known to provide fish habitat.

Northeast Pond provides wildlife habitat for both terrestrial and aquatic species. Although no endangered species are known to occur in the wetlands, the wetlands provide suitable habitat for a host of species and the forested areas within and bordering the project area may provide habitat for bats. Additionally, Northeast Pond is known to contain a Maine Special Concern plant species, Vasey's pondweed (*Potemogeton vayesi*) which is known to occur at the boat launch at the marina in Maine approximately 100-feet from the proposed bridge (see below for additional details). This species prefers quiet muddy, or calcareous waters (open water habitat).

The location and conditions of the site provide active recreation opportunities (e.g., boating, fishing), but those opportunities are somewhat limited due to the relatively small size of the project area. However, there is an abundance of similar recreation activities in the immediate project vicinity. This function is provided, is available to the public, and is considered a principal function of Northeast Pond.

Of the 13 functions and values commonly attributed to wetlands, a total of eight functions and two values are associated with wetlands at the site. In general, the dominant community types are characterized as primarily forested dominated by trees and saplings and primary successional growth and lacustrine habitat associated with Northeast Pond.

Wildlife Habitat. According to the 2020 New Hampshire Wildlife Habitat Land Cover map (Attachment D), developed impervious, Appalachian oak-pine, and Hemlock-hardwood-pine habitats are present along the banks of Northeast Pond on the northern side of the project location in New Hampshire. Mapped highest-ranked wildlife habitats in the biological region are located adjacent to the survey area within Northeast Pond in New Hampshire essentially extending from the Maine/New Hampshire border to the edge of water (Attachment E). As part of the Wildlife Action Plan (WAP), the New Hampshire Fish and Game has identified wildlife species at risk, especially those with a low and declining population. The wildlife habitat includes the resources that native species need to survive: food, shelter, water, and other resources for safe reproduction and travel between areas of critical resources. According to Beginning with Habitat Primary Map 3, Undeveloped Habitat Blocks & Connectors and Conserved Lands for Lebanon, ME, the project area does not contain undeveloped natural areas likely to provide core habitat blocks and habitat connections that facilitate species movements between habitat blocks.

A preliminary online environmental review utilizing the MDIFW's Environmental Review Tool was performed to assess the potential for the presence of threatened and endangered wildlife and fish habitat, inland waterfowl and wading bird habitat (IWWH), and significant vernal pools in the project vicinity. This data check resulted in a negative finding of potential occurrences of those habitats in the project's vicinity. Additionally, an inquiry and summary description of the project was sent to MDIFW on October 12, 2022, and a response was received on November 10, 2022, indicating no known locations of State-listed Endangered, Threatened, or Special Concern species within the project area that would be affected by the project.

The NHB DataCheck Tool did not identify any known or potential occurrences of threatened or endangered species or important habitat in the vicinity of the proposed project area. The official NHB DataCheck letter was received on March 14, 2023. The NHB DataCheck resulted in no recorded occurrences for sensitive species in the vicinity of the proposed project area (NHB File ID: NHB23-0803).

The MNAP was contacted on July 17th 2023 regarding the location of known rare and exemplary botanical features in the project vicinity. MNAP responded on July 25th 2023 indicating that a Special Concern species, Vasey's pondweed was recorded near the proposed bridge location near a boat launch at a marina approximately 100-feet from the proposed bridge on the Maine side. MNAP indicated that if any construction activities or other disturbance will impact the submerged substrate greater than a 50-foot distance from the northeast side of the current bridge, MNAP would like to visit the site to mark off the area so that impacts to the sensitive plant can be avoided.

Invasive Plant Species. Invasive species were observed and noted within the study area during the September 29, 2022, site assessment. Invasive plant species mapping was conducted by foot from the shoreline within the survey area and by walking in shallow areas along the edges of Northeast Pond. HDR mapped the location of invasive plant species using the aforementioned global navigation satellite system receiver. The boundaries of invasive plant species were delineated or characterized as defined by the dominant canopy cover of the invasive plant(s). Areas containing only occasional invasive species were geo-located with a GPS center point and radius necessary to enclose the population. In areas where invasive species were ubiquitous or impractical to map, surveyors characterized the invasive species population using estimates of aerial coverage and percent of species present. In areas where dense stands of invasive species have formed, infestations were photo-documented and geo-referenced.

Four plant species designated as invasive or non-native species were documented in the study area as a result of the site investigation. Only five areas of discrete stands of invasive plant species were mapped/documented because the majority of species occurred in more than one area and most species were commonly found growing together in varying densities (Table 2). A GIS dataset collected during the site investigation was used to produce invasive species occurrences and distribution within the study area (Attachment B).

The invasive species observed in the study area generally exhibit two patterns of occurrence—localized and widespread. The following are descriptions of these occurrence patterns:

- **Localized Species (Japanese barberry and thistle species)**: These invasive species were documented/observed as individual infestations, and their distribution is considered to be more restricted in the study area. In some cases, the larger infestations of these species were mapped. These species have the propensity to occur as small to relatively large, dense infestations and as individual plants or as groups of thinly dispersed plants, which made detailed mapping infeasible.
- **Widespread Species (Oriental bittersweet and bush honeysuckles)**: These species are described by their general range of distribution in the study area and are considered to be a widespread invasive species within the study area and the region. These invasive plant species have the propensity to occur as relatively large, dense infestations and can occur as individual plants or as groups of thinly dispersed plants, which made detailed mapping infeasible. The presence of these species in the survey area was most notable along New Bridge Road in Maine.

Table 2. Invasive and Non-Native Plants Observed in the Study Area

Common Name	Scientific Name	Location[1]	Growth Form
Oriental bittersweet	*Celastrus orbiculatus*	U/W	Vine
Bush honeysuckles	*Lonicera morrowii/tartarica*	U	Shrub
Japanese barberry	*Berberis thunbergii*	U	Shrub
Bull thistle	*Cirsium vulgare*	U	Herb

[1] U = Upland
W = Wetland

Bat Roosting Habitat Survey. On September 29, 2022, HDR biologists conducted a habitat assessment for suitable summer habitat for the northern long-eared bat (*Myotis septentrionalis*) (NLEB) within the survey area, with a focus at the approach locations for the proposed bridge. The habitat assessment was conducted similarly to the procedures identified in the USFWS Range-wide Survey Guidelines for Indiana Bat & NLEB, Appendix A: Phase 1 Habitat Assessments for suitable summer habitat (USFWS 2023). For each tree greater than three inches diameter at breast height (dbh) in the vicinity of the proposed bridge approaches the HDR team mapped the location with a GPS and recorded the following information: species, condition (live or dead), dbh, and suitability as NLEB habitat (i.e., presence of furrows, crevices, holes, exfoliating bark).

The HDR assessment team identified small roadside wooded areas on the west and east sides of the survey area within the anticipated bridge approach work areas in Maine and New Hampshire containing 61 trees. The information on the trees that were surveyed is included in Table 3. Site photographs are included in Attachment A.

Of the 61 trees surveyed, all were living with the exception of four snags (one unidentified snag, two white pine [*Pinus strobus*], and one yellow birch [*Betula alleghaniensis*]). All four snags exhibited some exfoliating bark and are potentially considered suitable summer roosting habitat for the NLEB. The remaining 57 trees, ranging from 3 to 26 inches dbh, consisted of red maple (12), yellow birch (2), white birch (2), American beech (1), pitch pine (5), white pine (23), black cherry (1), and red oak (11). One of the live red maple trees possesses minimal exfoliating bark with some cracks. This tree has a dbh of 11 inches and is considered potential suitable summer roosting habitat for the NLEB. A live yellow birch tree possesses peeling/exfoliating bark with a few crevices. This tree has a dbh of 16 inches and is also considered potential suitable summer roosting habitat for the NLEB. The remaining 55 trees have minimal to no exfoliating bark, minimal cracks and crevices, and are not considered suitable roost trees.

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Table 3. Information on Trees Assessed During Site Survey on September 29, 2022.

Point ID	Scientific Name	Tree Condition	DBH (inches)[1]	Potential Suitable Summer Habitat[2]	Habitat Notes
Maine					
T1	*Acer rubrum*	Alive	5,7	No	No exfoliating bark, cracks, crevices, or holes
T2	*Acer rubrum*	Alive	7	No	No exfoliating bark, cracks, crevices, or holes
T3	*Pinus strobus*	Alive	9	No	No exfoliating bark, cracks, crevices, or holes
T4	*Pinus strobus*	Alive	9	No	No exfoliating bark, cracks, crevices, or holes
T5	*Pinus strobus*	Alive	7	No	No exfoliating bark, cracks, crevices, or holes
T6	*Pinus strobus*	Alive	4	No	No exfoliating bark, cracks, crevices, or holes
T7	*Pinus strobus*	Alive	26	No	Few small holes near base of tree
T8	*Pinus strobus*	Alive	5	No	No exfoliating bark, cracks, crevices, or holes
T9	*Pinus strobus*	Alive	5,5	No	No exfoliating bark, cracks, crevices, or holes
T10	*Quercus rubra*	Alive	10	No	No exfoliating bark, cracks, crevices, or holes
T11	*Pinus strobus*	Alive	11	No	No exfoliating bark, cracks, crevices, or holes
T12	*Acer rubrum*	Alive	10	No	No exfoliating bark, cracks, crevices, or holes
T13	*Pinus strobus*	Alive	7	No	No exfoliating bark, cracks, crevices, or holes
T14	*Pinus strobus*	Alive	10	No	No exfoliating bark, cracks, crevices, or holes; top of tree broken off
T15	*Pinus strobus*	Alive	11	No	No exfoliating bark, cracks, crevices, or holes
T16	*Betula papyrifera*	Alive	5	No	No cracks, crevices, or holes; minimal exfoliating bark near base
T17	*Acer rubrum*	Alive	6,4,7	No	No exfoliating bark, cracks, crevices, or holes
T18	*Pinus strobus*	Alive	5	No	No exfoliating bark, cracks, crevices, or holes
T19	*Acer rubrum*	Alive	10	No	No exfoliating bark, cracks, or holes; few crevices near upper portion
T20	**Unidentified**	**Dead**	**6**	**Yes**	**No cracks or crevices; scattered minimal exfoliating bark**
T21	*Acer rubrum*	Alive	5	No	No exfoliating bark, cracks, crevices, or holes
T22	*Prunus serotina*	Alive	4	No	No exfoliating bark, cracks, crevices, or holes
T23	*Quercus rubra*	Alive	6,4	No	No exfoliating bark, cracks, crevices, or holes
T24	*Betula alleghaniensis*	Alive	7	No	No cracks or crevices; minimal exfoliating bark up the tree to approx. 8ft.
T25	*Quercus rubra*	Alive	5	No	No exfoliating bark, cracks, crevices, or holes
T26	***Pinus strobus***	**Dead**	**13**	**Yes**	**No cracks or crevices; contains exfoliating bark**
T27	***Pinus strobus***	**Dead**	**10**	**Yes**	**No cracks; some holes near base and contains exfoliating bark**

Point ID	Scientific Name	Tree Condition	DBH (inches)[1]	Potential Suitable Summer Habitat[2]	Habitat Notes
T28	***Betula alleghaniensis***	**Alive**	**16**	**Yes**	**No cracks or holes; some peeling/exfoliating bark with few crevices near top**
T29	*Acer rubrum*	Alive	15	No	No exfoliating bark, cracks, crevices, or holes
T30	***Betula alleghaniensis***	**Dead**	**21**	**Yes**	**Exfoliating bark**
T31	***Acer rubrum***	**Alive**	**11**	**Yes**	**Minimal exfoliating bark; some cracks**
T32	*Quercus rubra*	Alive	22,20	No	No exfoliating bark, cracks, crevices, or holes; 20 dbh portion is a cut stump approx. 8ft. tall
New Hampshire					
NH1	*Betula papyrifera*	Alive	11	No	No cracks, crevices, or holes; some peeling bark
NH2	*Pinus rigida*	Alive	9	No	No exfoliating bark, cracks, crevices, or holes
NH3	*Pinus strobus*	Alive	17	No	No exfoliating bark, cracks, crevices, or holes
NH4	*Quercus rubra*	Alive	13	No	No exfoliating bark, cracks, crevices, or holes
NH5	*Fagus grandifolia*	Alive	10	No	No exfoliating bark, cracks, crevices, or holes
NH6	*Pinus strobus*	Alive	7	No	No exfoliating bark, cracks, crevices, or holes
NH7	*Quercus rubra*	Alive	12	No	No exfoliating bark, cracks, crevices, or holes
NH8	*Pinus rigida*	Alive	16	No	No exfoliating bark, cracks, crevices, or holes
NH9	*Quercus rubra*	Alive	6	No	No exfoliating bark, cracks, crevices, or holes
NH10	*Pinus strobus*	Alive	6	No	No exfoliating bark, cracks, crevices, or holes
NH11	*Pinus strobus*	Alive	6	No	No exfoliating bark, cracks, crevices, or holes
NH12	*Pinus rigida*	Alive	8	No	No exfoliating bark, cracks, crevices, or holes
NH13	*Quercus rubra*	Alive	4	No	No exfoliating bark, cracks, crevices, or holes
NH14	*Pinus strobus*	Alive	19	No	No exfoliating bark, cracks, crevices, or holes
NH15	*Pinus strobus*	Alive	14	No	No exfoliating bark, cracks, crevices, or holes
NH16	*Pinus strobus*	Alive	5	No	No exfoliating bark, cracks, crevices, or holes
NH17	*Quercus rubra*	Alive	9	No	No exfoliating bark, cracks, crevices, or holes
NH18	*Pinus strobus*	Alive	7	No	No exfoliating bark, cracks, crevices, or holes
NH19	*Pinus rigida*	Alive	10	No	No exfoliating bark, cracks, crevices, or holes
NH20	*Quercus rubra*	Alive	9	No	No exfoliating bark, cracks, crevices, or holes
NH21	*Acer rubrum*	Alive	8	No	No exfoliating bark, cracks, crevices, or holes
NH22	*Pinus strobus*	Alive	15	No	No exfoliating bark, cracks, crevices, or holes
NH23	*Acer rubrum*	Alive	8	No	No exfoliating bark, cracks, crevices, or holes
NH24	*Pinus strobus*	Alive	10	No	No exfoliating bark, cracks, crevices, or holes
NH25	*Quercus rubra*	Alive	15	No	No exfoliating bark, cracks, crevices, or holes
NH26	*Acer rubrum*	Alive	8,12	No	No exfoliating bark, cracks, crevices, or holes; top broken off from larger trunk
NH27	*Acer rubrum*	Alive	3,3,3,7	No	No exfoliating bark, cracks, crevices, or holes
NH28	*Pinus strobus*	Alive	7	No	No exfoliating bark, cracks, crevices, or holes

Point ID	Scientific Name	Tree Condition	DBH (inches)[1]	Potential Suitable Summer Habitat[2]	Habitat Notes
NH29	*Pinus rigida*	Alive	8	No	No exfoliating bark, cracks, crevices, or holes

[1]Multiple dbh measurements are shown where a multiple-stemmed tree was observed.

[2]Individuals shown in bold indicate trees with potential suitable habitat.

Additional Observations

- Several open mussel shells were observed during the study along the western side of the existing bridge abutment in New Hampshire and are believed to be Eastern ellliptio (*Elliptio complanata*) (photos are provided in Attachment A).

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ATTACHMENT A

REPRESENTATIVE PHOTOGRAPHS

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
NHDOT	Milton, NH – Lebanon, ME Townhouse Road and New Bridge Road over Northeast Pond (Br. No. 168/151) Environmental Summary Memorandum Milton, NH – Lebanon, ME	N/A

Photo No.	Date:
1	9/29/2022

Direction Photo Taken:
Westerly

Description:

Representative view of Ordinary High Water Mark and Bank on eastern side of the New Bridge Road.

Photo No.	Date:
2	9/29/2022

Direction Photo Taken:
N/A

Description:

View of aquatic substrate adjacent to existing bridge abutment in Maine.

PHOTOGRAPHIC LOG

Client Name: NHDOT	**Project Name/Site Location:** Milton, NH – Lebanon, ME Townhouse Road and New Bridge Road over Northeast Pond (Br. No. 168/151) Environmental Summary Memorandum Milton, NH – Lebanon, ME	**Project No.** N/A

Photo No. 3

Date: 9/29/2022

Direction Photo Taken: N/A

Description:

View of aquatic substrate adjacent to existing bridge abutment in New Hampshire.

Photo No. 4

Date: 9/29/2022

Direction Photo Taken: Northerly

Description:

View of New Bridge Road at southern extents of survey area in Maine.

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
NHDOT	Milton, NH – Lebanon, ME Townhouse Road and New Bridge Road over Northeast Pond (Br. No. 168/151) Environmental Summary Memorandum Milton, NH – Lebanon, ME	N/A

Photo No. 5

Date: 9/29/2022

Direction Photo Taken:
Northerly

Description:

View of proposed bridge work area, wooded areas, and adjacent boat ramp in Maine.

Photo No. 6

Date: 9/29/2022

Direction Photo Taken:
Southeast

Description:

View of Townhouse Road at western extent of survey area in New Hampshire.

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
NHDOT	Milton, NH – Lebanon, ME Townhouse Road and New Bridge Road over Northeast Pond (Br. No. 168/151) Environmental Summary Memorandum Milton, NH – Lebanon, ME	N/A

Photo No.	Date:
7	9/29/2022

Direction Photo Taken:
Southerly

Description:

View of Townhouse Road at proposed work area and adjacent forested habitat.

Photo No.	Date:
8	9/29/2022

Direction Photo Taken:
Easterly

Description:

View of palustrine forested wetland adjacent to New Bridge Road in Maine.

Client Name:	Project Name/Site Location:	Project No.
NHDOT	Milton, NH – Lebanon, ME Townhouse Road and New Bridge Road over Northeast Pond (Br. No. 168/151) Environmental Summary Memorandum Milton, NH – Lebanon, ME	N/A

Photo No. 9

Date: 9/29/2022

Direction Photo Taken: Southwest

Description:

View of Oriental bittersweet and Japanese barberry (invasive species) growing along New Bridge Road in Maine.

Photo No. 10

Date: 9/29/2022

Direction Photo Taken: Easterly

Description:

View of Thistle species (invasive) adjacent to Townhouse Road in New Hampshire.

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
NHDOT	Milton, NH – Lebanon, ME Townhouse Road and New Bridge Road over Northeast Pond (Br. No. 168/151) Environmental Summary Memorandum Milton, NH – Lebanon, ME	N/A

Photo No.	Date:
11	9/29/2022

Direction Photo Taken:
N/A

Description:

View of mussel shells observed near western corner of the bridge abutment in New Hampshire.

Photo No.	Date:
12	9/29/2022

Direction Photo Taken:
Northerly

Description:

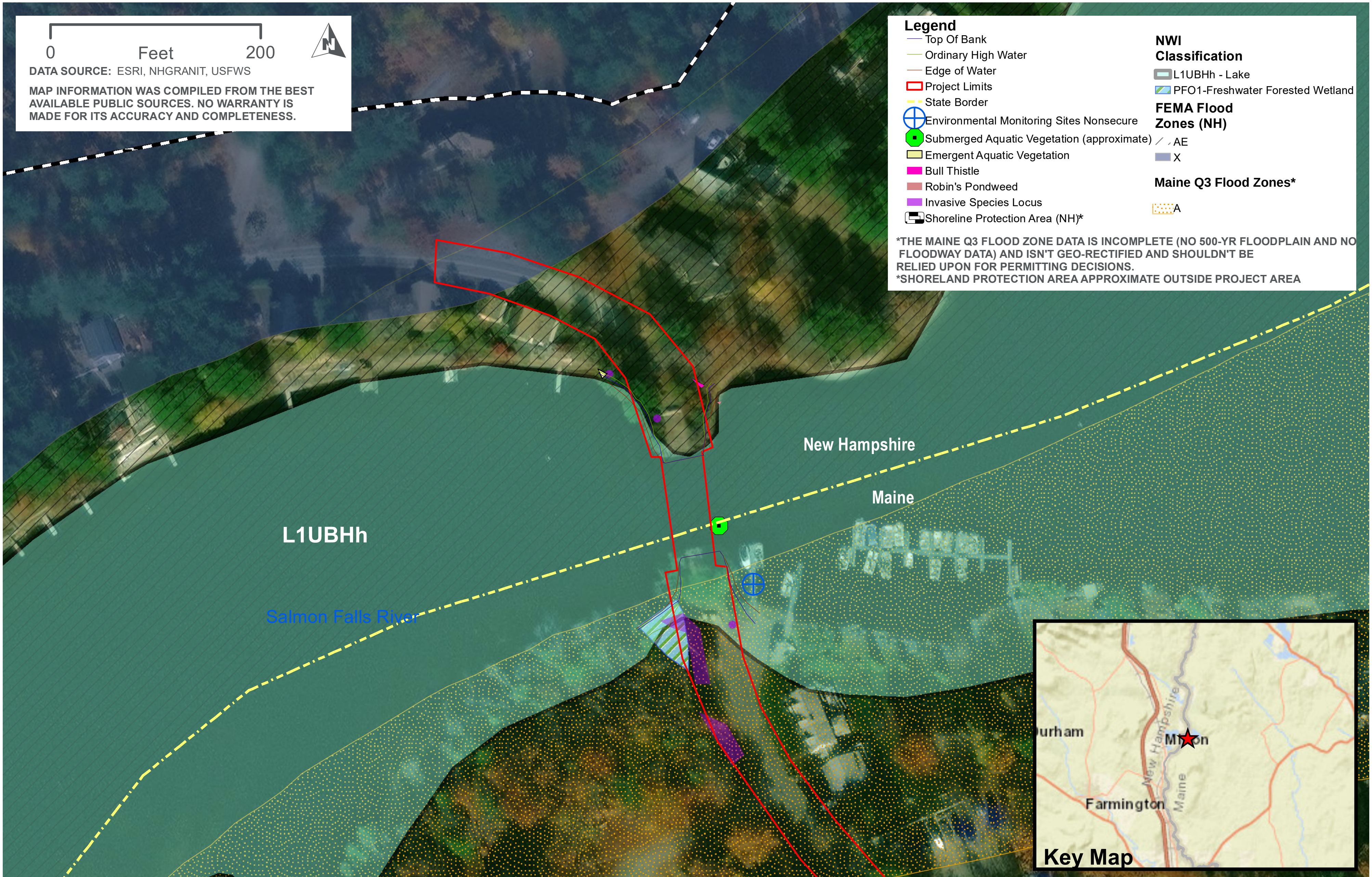
View of proposed work area in New Hampshire taken from bridge abutment in Maine.

PHOTOGRAPHIC LOG

Client Name:		Project Name/Site Location:	Project No.
NHDOT		Milton, NH – Lebanon, ME Townhouse Road and New Bridge Road over Northeast Pond (Br. No. 168/151) Environmental Summary Memorandum Milton, NH – Lebanon, ME	N/A
Photo No. 13	**Date:** 9/29/2022		
Direction Photo Taken: N/A			
Description: Submerged aquatic vegetation consisting of Robbin's Pondweed (*Potamogeton robbinsii*) (in NH) and an unidentified area of SAV that is believed to be tape-grass (*Vallisneria americana*).			

ATTACHMENT B

ENVIRONMENTAL CONSTRAINTS MAP



HDR

New Hampshire DOT Department of Transportation

ENVIRONMENTAL CONSTRAINTS MAP

TOWNHOUSE ROAD AND NEW BRIDGE ROAD OVER NORTHEAST POND - BRIDGE NO.168/151

ATTACHMENT C

WETLAND BACK-UP QUESTIONS

USED TO EVALUATE WETLAND FUNCTIONS AND VALUES

WETLAND BACK-UP QUESTIONS
USED TO EVALUATE WETLAND FUNCTIONS AND VALUES

FOR THE

MILTON, NH – LEBANON, ME TOWNHOUSE ROAD AND NEW BRIDGE ROAD
OVER NORTHEAST POND (BR. NO. 168/151)

MILTON, NH – LEBANON, ME TOWNHOUSE ROAD AND NEW BRIDGE ROAD OVER NORTHEAST POND (BR. NO. 168/151)
WETLAND FUNCTION EVALUATION

FUNCTION: GROUNDWATER INTERCHANGE (Recharge-Discharge)

Considers the potential for the wetland to serve as a groundwater recharge/discharge area.

1. Public or private wells occur downstream of wetland.

2. Potential for public or private wells downstream of wetland exists.

3. Wetland is underlain by stratified drift.

4. Gravel or sandy soils present in or adjacent to wetland.

5. Fragipan does not occur in wetland.

6. Fragipan, impervious soils or bedrock, occur in wetland.

7. Wetland is associated with a perennial or intermittent watercourse.

8. Signs of groundwater recharge present.

9. Wetland is associated with a watercourse but lacks a defined outlet or contains a constricted outlet.

10. Wetland contains outlet only.

11. Groundwater quality of stratified drift aquifer within or downstream of wetland meets drinking water standards.

12. Quality of water associated with wetland high.

13. Signs of groundwater discharge present.

14. Temperature of water suggests discharge.

15. Wetland shows signs of variable water levels.

MILTON, NH – LEBANON, ME TOWNHOUSE ROAD AND NEW BRIDGE ROAD OVER NORTHEAST POND (BR. NO. 168/151)
WETLAND FUNCTION EVALUATION

FUNCTION: FLOODFLOW ALTERATION (Storage & Desynchronization)

Considers the effectiveness of the wetland in reducing flood damages and retaining water over prolonged periods, adding to the stability of the wetland ecological system or buffering features of social or economic value situated in erosion prone areas.

CONSIDERATIONS / QUALIFIERS

1. Area of wetland is large relative to its watershed.
2. Wetland occurs in upper watershed.
3. Effective flood storage small or non-existent upslope or above wetland.
4. Wetland watershed contains a high degree of impervious surfaces.
5. Wetland contains hydric soils which are able to absorb and detain water.
6. Wetland exists in a relatively flat area that has storage potential.
7. Wetland has an intermittent outlet, ponded water, or variable water level signs present.
8. During flood events, wetland can retain higher volumes of water than under normal or average rainfall conditions.
9. Wetland receives and retains overland or sheet flow runoff from surrounding uplands.
10. In the event of large storm, wetland may receive and detain excessive floodwater from a nearby watercourse.

IF WETLAND IS NOT ASSOCIATED WITH A WATERCOURSE, STOP HERE.

11. Wetland is associated with one or more watercourses.
12. Wetland watercourse is sinuous or diffuse.
13. Wetland outlet constricted.
14. Channel flow velocity is affected by wetland.
15. Land uses downstream protected by wetland.
16. Wetland contains high vegetation density.

MILTON, NH – LEBANON, ME TOWNHOUSE ROAD AND NEW BRIDGE ROAD OVER NORTHEAST POND (BR. NO. 168/151)
WETLAND FUNCTION EVALUATION

FUNCTION: SEDIMENT / SHORELINE STABILIZATION

Considers the potential and the effectiveness of the wetland in preventing stream bank or shoreline erosion.

CONSIDERATIONS / QUALIFIERS

1. Erosion indications, siltation present.

2. Topographical gradient in wetland present.

3. Potential sediment sources present upslope.

   IF WETLAND IS NOT ASSOCIATED WITH A WATERCOURSE, STOP HERE.

4. No distinct shoreline or bank evident between waterbody and wetland or upland.

5. A distinct step between the open water body or stream and the adjacent land exists (sharp bank) with dense roots throughout.

6. Wide wetland (>10') bordering watercourse, lake, or pond.

7. High water velocities in wetland.

8. Potential sediment sources present upstream.

9. The watershed is of sufficient size to produce channelized flow.

10. Open water fetch present.

11. Boating activity present.

12. Dense vegetation bordering watercourse, lake, or pond.

13. High percentage of energy absorbing emergents and/or shrubs bordering watercourse, lake, or pond.

14. Vegetation comprised of large trees and shrubs which withstand major flood events or erosive times and stabilize the shoreline on a large scale (feet).

15. Vegetation comprised of dense resilient herbaceous layer which stabilizes sediments and the shoreline on a small scale (inches) during minor flood events or potentially erosive times.

MILTON, NH – LEBANON, ME TOWNHOUSE ROAD AND NEW BRIDGE ROAD OVER NORTHEAST POND (BR. NO. 168/151)
WETLAND FUNCTION EVALUATION

FUNCTION: SEDIMENT/TOXICANT RETENTION

Considers the effectiveness of the wetland as a trap for sediment in runoff water from surrounding uplands, or upstream eroding wetland areas.

CONSIDERATIONS/QUALIFIERS

1. Potential sources of excess sediment in the watershed above the wetland.

2. Potential or known sources of toxicants in watershed above the wetland.

3. Opportunity for sediment trapping by slow moving water or deepwater habitat in wetland present.

4. Mineral, fine grained, or organic soil present.

5. High water retention time present in wetland.

   IF WETLAND IS NOT ASSOCIATED WITH A WATERCOURSE, STOP HERE.

6. Wetland associated with intermittent or perennial stream, or a lake.

7. Channelized flows have visible velocity decrease in wetland.

8. Effective floodwater storage of wetland occurring. Areas of impounded open water present.

9. No indicators of erosive forces present. No high water velocities present.

10. Diffuse water flow through the wetland.

11. Wetland has high degree of water, and vegetation interspersion.

12. Dense vegetation provides opportunity for sediment trapping and/or signs of sediment accumulation by dense vegetation present.

MILTON, NH – LEBANON, ME TOWNHOUSE ROAD AND NEW BRIDGE ROAD OVER NORTHEAST POND (BR. NO. 168/151)
WETLAND FUNCTION EVALUATION

FUNCTION: NUTRIENT REMOVAL/RETENTION/TRANSFORMATION

Consider the effectiveness of the wetland as a trap for nutrients in runoff water from surrounding uplands or contiguous wetlands, and the wetlands ability to process these nutrients into other forms or trophic levels.

CONSIDERATIONS / QUALIFIERS

1. Wetland large relative to size of watershed.
2. Deep water or open water habitat exists.
3. Overall potential for sediment trapping in the wetland exists.
4. Potential sources of excess nutrients present in the watershed above wetland.
5. Wetland saturated for most of the season. Ponded water present in wetland.
6. Deep organic/sediment deposits present.
7. Slowly drained mineral, fine grained or organic soils present.
8. Dense vegetation present.
9. Emergent vegetation and/or dense woody stems dominant.
10. Aquatic diversity/abundance sufficient to utilize nutrients.
11. Opportunity for nutrient attenuation exists.
12. Vegetation diversity/abundance sufficient to utilize nutrients.

IF WETLAND IS NOT ASSOCIATED WITH A WATERCOURSE, STOP HERE

13. Waterflow through wetland diffuse.
14. Water retention/detention time in wetland increased by constricted outlet or thick vegetation.
15. Water moves slowly through wetland.

MILTON, NH – LEBANON, ME TOWNHOUSE ROAD AND NEW BRIDGE ROAD OVER NORTHEAST POND (BR. NO. 168/151)
WETLAND FUNCTION EVALUATION

FUNCTION: PRODUCTION EXPORT (Nutrient)

Evaluates the suitability or ability of the wetland to produce food or usable products for people or other living organisms.

CONSIDERATIONS / QUALIFIERS

1. Wildlife food sources grow within wetland.
2. Detritus development present within wetland.
3. Economically or commercially used products found in wetland.
4. Evidence of wildlife use within wetland present.
5. Higher trophic level consumers utilizing the wetland.
6. Fish or shellfish developing or occurring in the wetland.
7. High vegetation density present.
8. Wetland exhibits high degree of plant community structure/species diversity.
9. High aquatic diversity/abundance present.
10. Nutrients exported in wetland watercourses (permanent outlet present).
11. Flushing of relatively large amounts of organic plant material occurs from wetland.
12. Wetland contains flowering plants which are used by nectar-gathering insects.
13. Indications of export present.
14. High production levels occurring however, no visible signs of export (assumes export is attenuated).

MILTON, NH – LEBANON, ME TOWNHOUSE ROAD AND NEW BRIDGE ROAD OVER NORTHEAST POND (BR. NO. 168/151)
WETLAND FUNCTION EVALUATION

FUNCTION: FISH & SHELLFISH HABITAT

Considers the suitability of watercourses associated with the wetland for fish and shellfish habitat.

CONSIDERATIONS / QUALIFIERS

1. Forest land dominant in watershed above wetland.

2. Abundance of cover objects present.

IF WETLAND IS NOT ASSOCIATED WITH A WATERCOURSE, STOP HERE.

3. Size of wetland able to support large fish/shellfish populations.

4. Wetland is part of a larger, contiguous watercourse.

5. Wetland has sufficient size and depth in open water areas so as to not freeze solid and retains some open water during winter.

6. Stream width (bank to bank), more than 30 feet.

7. Quality of the watercourse associated with the wetland able to support healthy fish/shellfish populations.

8. Streamside vegetation provides shade for watercourse.

9. Spawning areas present (submerged vegetation or gravel beds).

10. Food available to fish/shellfish populations within wetland.

11. Barrier(s) to anadromous fish (such as dams {including beaver dams}, waterfalls, road crossing, etc.) along the stream reach associated with the wetland absent.

12. Evidence or occurrence of fish sited within wetland.

13. Wetland is stocked with fish.

14. Watercourse is persistent.

15. Man-made streams absent.

16. Water velocities not excessive for fish usage.

17. Defined stream channel present.

MILTON, NH – LEBANON, ME TOWNHOUSE ROAD AND NEW BRIDGE ROAD OVER NORTHEAST POND (BR. NO. 168/151)
WETLAND FUNCTION EVALUATION

FUNCTION: WILDLIFE HABITAT

Considers the suitability of the wetland as habitat for those animals typically associated with wetlands and the wetland edge. Also the use of the wetland as habitat for migrating species and species dependent upon the wetland at some time in their life cycle.

CONSIDERATIONS/QUALIFIERS

1. Wetland not degraded by human activity.
2. Water quality of the watercourse, pond, or lake associated with the wetland meets or exceeds class A or B standards.
3. Wetland not fragmented by development.
4. Upland surrounding wetland is undeveloped.
5. More than 40% of wetland edge bordered by upland wildlife habitat (brushland, woodland, active farmland, or idle land) at least 500 feet in width.
6. Wetland contiguous with other wetland systems via watercourse or lake.
7. Wildlife access to other wetlands (overland) present.
8. Wildlife food sources within wetland or nearby.
9. Wetland exhibits high degree of interspersion of vegetation classes and/or open water.
10. Two or more islands or inclusions of upland within wetland present.
11. Dominant wetland class includes deep or shallow marsh or wooded swamp.
12. More than three acres of shallow permanent open water (less than 6.6 feet deep), including streams in or adjacent to wetland present.
13. Density of wetland vegetation high.
14. Wetland exhibits high degree of plant species diversity.
15. Wetland exhibits a high degree of diversity in plant community structure (tree/shrub/vine/herb/grasses/mosses/etc.).
16. Plant/animal indicator species present.

FUNCTION: WILDLIFE HABITAT (Continued)

17. Animal signs (tracks, scats, nesting areas, etc.) observed.

18. Seasonal uses vary for wildlife, wetland appears to support varied population diversity/abundance during different seasons.

19. Wetland contains or has potential to contain a high population of insects.

20. Wetland contains or has potential to contain large amphibian population.

21. Wetland has high avian utilization or potential.

22. Indications of less disturbance-tolerant species present.

23. Signs of wildlife habitat enhancement present (birdhouses, nesting boxes, food sources, etc.).

FUNCTION: ENDANGERED SPECIES HABITAT

Considers the suitability of the wetland to support threatened or endangered species because of specialized habitat requirements.

CONSIDERATIONS/QUALIFIERS

1. Wetland contains or is known to contain threatened or endangered species.

2. Wetland contains critical habitat for a state or federally listed threatened or endangered species.

3. Wetland is a national natural landmark or recognized by the State of **Maine/New Hampshire** as an exemplary natural community.

4. Wetland has local significance because it has biological, geological, or other features which are locally rare or unique.

5. Wetland is known to be a study site for scientific research.

6. Little disturbance has occurred in and around the wetland.

7. A large area of undeveloped land surrounds wetlands.

MILTON, NH – LEBANON, ME TOWNHOUSE ROAD AND NEW BRIDGE ROAD OVER NORTHEAST POND (BR. NO. 168/151)
WETLAND FUNCTION EVALUATION

FUNCTION: VISUAL QUALITY/AESTHETICS

Considers the visual and aesthetic quality or usefulness of the wetland.

CONSIDERATIONS/ QUALIFIERS

1. Multiple wetland classes visible from primary viewing locations(s).
2. Emergent marsh and/or open water visible from primary viewing locations(s),
3. Diversity of vegetative species visible from primary viewing location(s).
4. Wetland dominated by flowering plants, or plants which turn vibrant colors in different seasons.
5. Surrounding land use visible from primary viewing locations undeveloped.
6. Visible surrounding landform contrasts with wetland.
7. Wetland views absent of trash, debris, and signs of disturbance.
8. Wetland is considered to be a valuable wildlife habitat.
9. Wetland is easily accessed.
10. Low noise level at primary viewing locations.
11. Unpleasant odors absent at primary viewing locations.
12. Relatively unobstructed sight line through wetland exists.

MILTON, NH – LEBANON, ME TOWNHOUSE ROAD AND NEW BRIDGE ROAD OVER NORTHEAST POND (BR. NO. 168/151)
WETLAND FUNCTION EVALUATION

FUNCTION: EDUCATIONAL/SCIENTIFIC VALUE

Considers the suitability of the wetland as a site for an "outdoor classroom" or as a location for scientific study or research.

CONSIDERATIONS/QUALIFIERS

1. Wetland contains or is known to contain threatened, rare, or endangered species.
2. Little/no disturbance occurring in wetland.
3. Potential educational site contains a diversity of wetland classes which are accessible or potentially accessible.
4. Potential educational site undisturbed and natural.
5. Wetland is considered to be a valuable wildlife habitat.
6. Wetland is located within a nature preserve or wildlife management area.
7. Signs of wildlife habitat enhancement present (bird houses, nesting boxes, food sources, etc.).
8. Off-road parking at potential educational site suitable for school buses within or near wetland.
9. Potential educational site is within safe walking distance or short drive to schools.
10. Potential educational site within safe walking distance to other plant communities.
11. Direct access to perennial stream at potential educational site available.
12. Direct access to pond or lake at potential educational site available.
13. No known safety hazards within potential educational site.
14. Public access to potential educational site controlled.
15. ADA accessibility available.
16. Site is currently used for educational or scientific purposes.

MILTON, NH – LEBANON, ME TOWNHOUSE ROAD AND NEW BRIDGE ROAD OVER NORTHEAST POND (BR. NO. 168/151)
WETLAND FUNCTION EVALUATION

FUNCTION: RECREATION (Consumptive and Non-Consumptive)

Considers the suitability of the wetland and associated watercourses for canoeing, boating, fishing, hunting and other active or passive recreational activities.

1. Wetland is part of a recreation area, park, forest, or refuge.
2. Fishing available within or from wetland.
3. Hunting is permitted in wetland.
4. Hiking occurs or has potential to occur within wetland.
5. Wetland is a valuable wildlife habitat.
6. Watercourse, pond, or lake associated with the wetland unpolluted.
7. High visual/aesthetic quality of potential recreation site.
8. Access to water available at potential recreation site for boating, canoeing, or fishing.
9. Watercourse associated with wetland is wide and deep enough to accommodate canoeing and/or non-powered boating.
10. Off-road public parking available at potential recreation site.
11. Accessibility and travel ease occurs within the system.
12. Wetland is within short drive or walk from highly populated public and private areas.

MILTON, NH – LEBANON, ME TOWNHOUSE ROAD AND NEW BRIDGE ROAD OVER NORTHEAST POND (BR. NO. 168/151)
WETLAND FUNCTION EVALUATION

FUNCTION: UNIQUENESS

Considers the wetland for certain special values such as archaeological sites, critical habitat for endangered species, its overall health and appearance, its role in the ecological system of the area, its relative importance as a typical wetland class for this geographic location.

CONSIDERATIONS/QUALIFIERS

1. Upland surrounding wetland primarily urban.
2. Upland surrounding wetland developing rapidly.
3. More than 3 acres of shallow permanent open water (less than 6.6 feet deep) including streams occurring within wetlands.
4. Three or more wetland classes present.
5. Deep and/or shallow marsh, or wooded swamp dominant.
6. High degree of interspersion of vegetation and/or open water occurring in wetland.
7. Well-vegetated stream corridor (15 feet on each side of stream) occurs in wetland.
8. Potential educational site is within a short drive or safe walk from schools.
9. Off-road parking at potential educational site suitable for school buses.
10. No known safety hazards exist within potential educational site.
11. Direct access to perennial stream or lake at potential educational site.
12. Two or more wetland classes visible from primary viewing locations.
13. Low-growing wetlands (marshes, scrub/shrub, bogs, open water) visible from primary viewing locations.
14. 0.5 acres of open water or 200 feet of stream visible from primary viewing locations.
15. Large area of wetland dominated by flowering plants, or plants which turn vibrant colors in different seasons.
16. General appearance of the wetland visible from primary viewing locations unpolluted and/or undisturbed.

FUNCTION: UNIQUENESS (Continued)

17. Overall view of wetland available from surrounding upland.

18. Quality of water associated with wetland high.

19. Opportunities for wildlife observation available.

20. Historical buildings occur within wetland.

21. Presence of pond or pond site and remains of dam occur within wetland.

22. Wetland within 50 yards of nearest perennial watercourse.

23. Visible stone or earthen foundations, berms, dams, standing structures or associated features occur within wetland.

24. Wetland contains critical habitat for a state or federally listed threatened or endangered species.

25. Wetland is known to be a study site for scientific research.

26. Wetland is a national natural landmark or recognized by the **Maine DEP, New Hampshire DES, Maine IF&W, New Hampshire Fish and Game, Maine DOC Natural Areas Program, or New Hampshire Natural Heritage** as an exemplary natural community.

27. Wetland has local significance because it serves several Functional Values.

28. Wetland has local significance because it has biological, geological, or other features which are locally rare or unique.

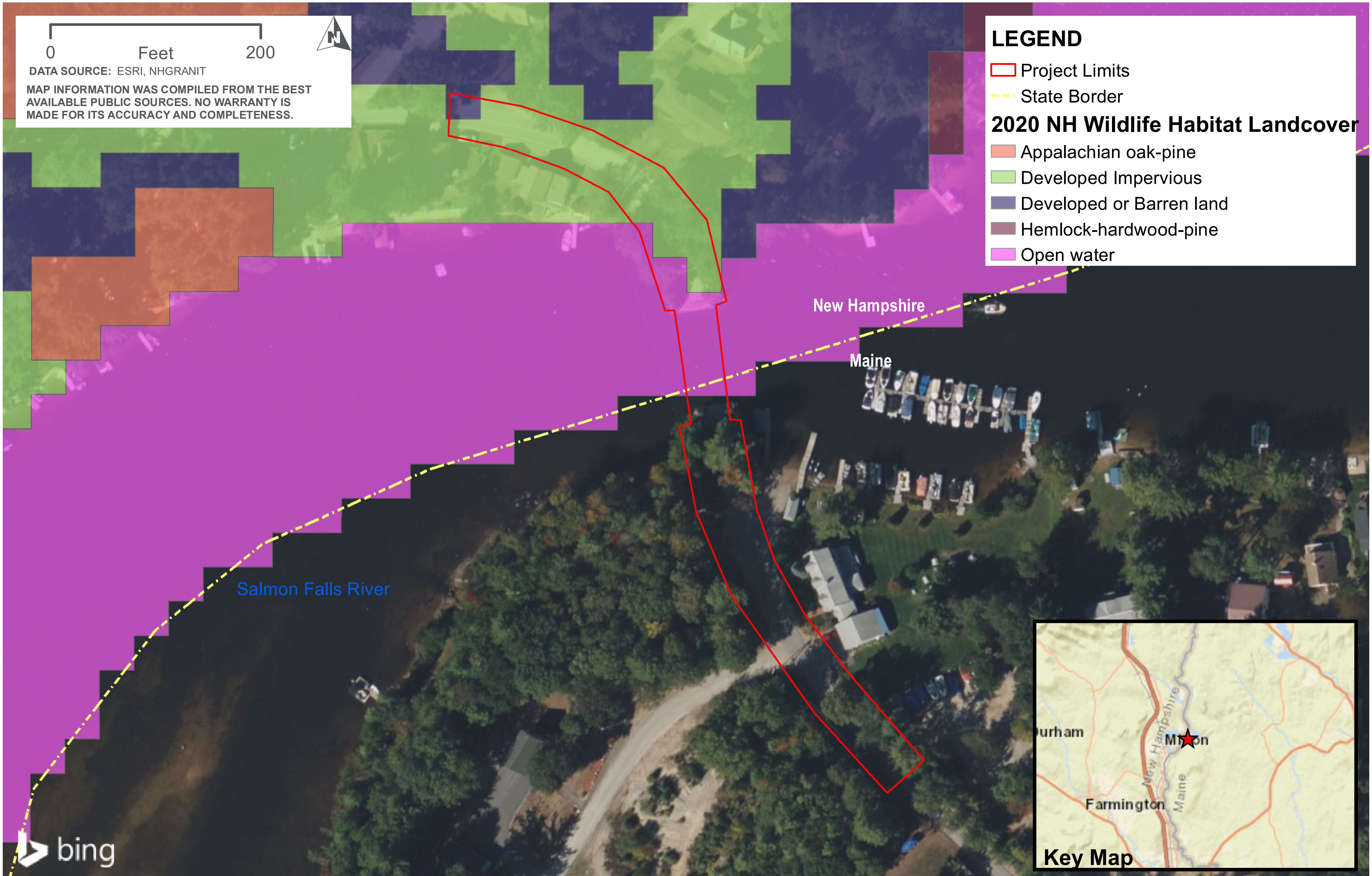
29. Wetland is known to contain an important archaeological site.

30. Wetland is hydrologically connected to a state or federally designated scenic river.

31. Wetland is located in an area experiencing a high wetland loss rate.

ATTACHMENT D

2020 NH WILDLIFE HABITAT LAND COVER MAP

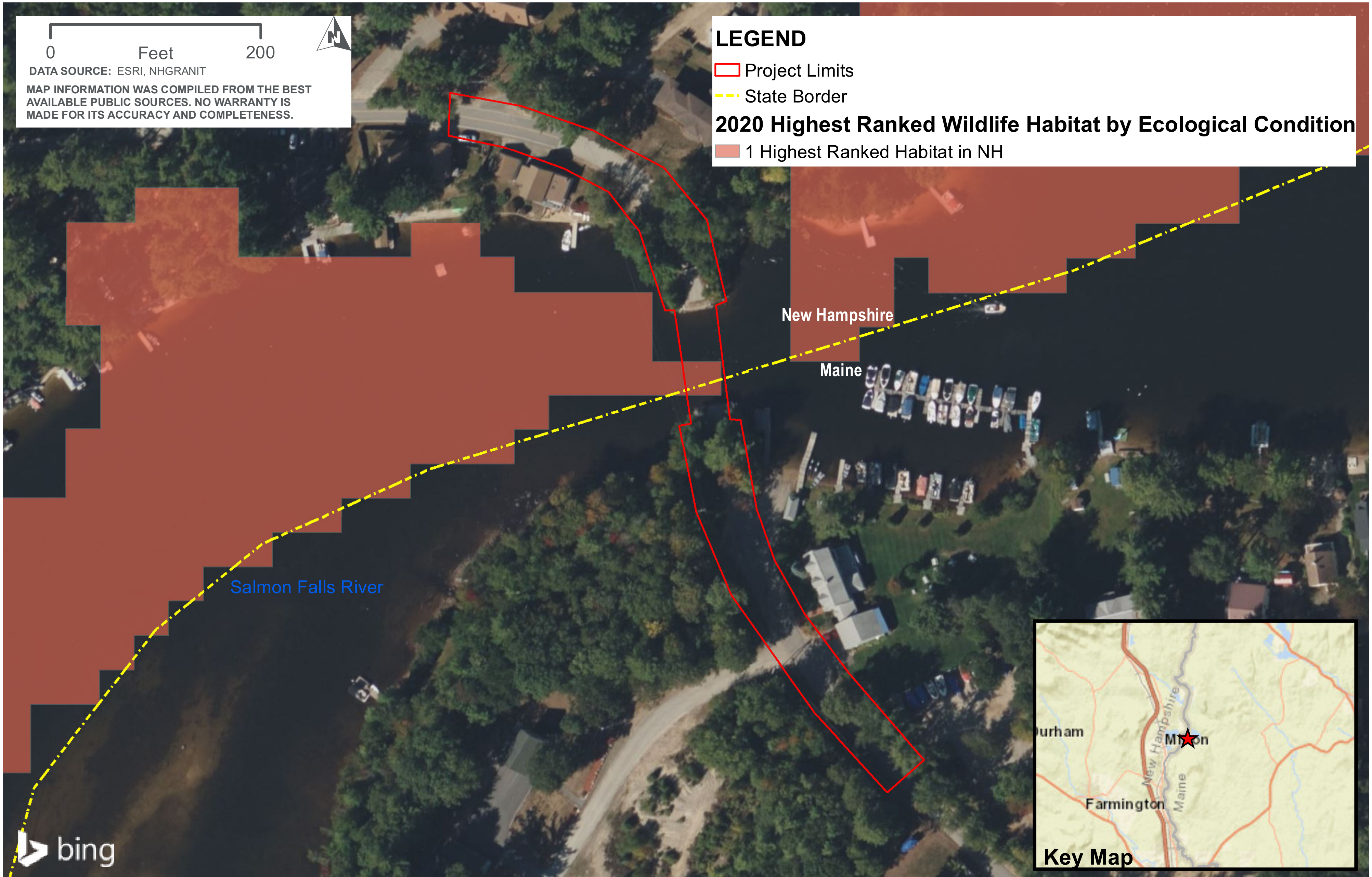


2020 NH WILDLIFE HABITAT LAND COVER MAP

TOWNHOUSE ROAD AND NEW BRIDGE ROAD OVER NORTHEAST POND BRIDGE NO. 1681/151

ATTACHMENT E

2020 HIGHEST-RANKED WILDLIFE HABITAT BY ECOLOGICAL CONDITION



HDR

New Hampshire DOT Department of Transportation

2020 HIGHEST-RANKED WILDLIFE HABITAT BY ECOLOGICAL CONDITION

TOWNHOUSE ROAD AND NEW BRIDGE ROAD OVER NORTHEAST POND - BRIDGE NO. 168/151

APPENDIX J

Phase 1A Archeological Sensitivity Assessment/Phase 0 Archeological Survey

IAC Report No. 1598
Authors: Crystina Friese and Jacob Tumelaire
Date: September 7, 2022

Phase IA Archaeological Sensitivity Assessment/Phase 0 Archaeological Survey Milton, NH – Lebanon, ME (NHDOT 40658) Salmon Falls Bridge Replacement Project, Milton (Strafford County), New Hampshire and Lebanon (York County), Maine

Abstract

IAC conducted a Phase IA sensitivity assessment for the Salmon Falls Bridge Replacement Project in Milton, NH and Lebanon, ME. Archaeologists completed a field inspection of the project area that revealed widespread ground disturbance and resulted in an assessment of low sensitivity for Pre-Contact archaeological resources. Review of historic maps found no Euroamerican resources in or near the project limits, with no visual evidence of Post-Contact occupation observed during the survey. Based on the disturbance within the project limits and absence of proximal Euroamerican resources, IAC recommends no further archaeological survey for the project.

Methodology

IAC conducted a Phase IA Archaeological Sensitivity Assessment/Phase 0 Archaeological Survey for the Salmon Falls Bridge Replacement Project (NHDOT 40658) in Milton (Strafford County), New Hampshire and Lebanon (York County), Maine in the summer of 2022 (Figure 1). Project plans include the replacement of the Salmon Falls bridge located along the New Hampshire-Maine border that will connect Townhouse Road in Milton to New Bridge Road in Lebanon (Figure 2). IAC conduced the Phase IA/0 Assessment to identify area of Pre-Contact Native American and/or Post-Contact Euroamerican archaeological sensitivity within the project limits that could be affected by the proposed impacts.

IAC utilized several survey components to establish the project area's archaeological sensitivity. To evaluate the potential for Pre-Contact cultural deposits, IAC used a combination of soil information, topography, proximity to water (or other natural resources such as stone-tool raw material or clay beds for pottery), data from the distribution of known archaeological sites as inventoried in the New Hampshire Division of Historical Resources (NHDHR) online database EMMIT and Maine Historic Preservation Commission (MHPC) site files, background research, and a walkover inspection of the project area to refine the desktop assessment based on real-world ground conditions. The Euroamerican sensitivity assessment involved the same steps but included analysis of historic maps (Chace 1856; Hurd 1892; Sanford, Everts & Co. 1872) to identify proximal Post-Contact resources.

The site file search conducted on June 6, 2022, revealed no previously recorded Pre-Contact or Post-Contact archaeological sites within 2.0 km (1.2 mi) of the project footprint (Figure 3) and the MHPC database similarly revealed no proximal known archaeological sites. Nineteenth-century maps of Milton (Chace 1856; Hurd 1892) and Lebanon (Sanford, Everts & Co. 1872) portray no Euroamerican residential or industrial resources within the project limits (Figures 4-6).

IAC Principal Investigator Jacob Tumelaire and Field Supervisor Roxanne Pendleton conducted a comprehensive walkover inspection on July 22, 2022. The survey crew documented the inspection results with photographs and detailed notes corresponding to each geographic region of the bridge, i.e. the New

Hampshire portion and Maine portion, and results will be discussed accordingly. The field survey revealed widespread ground disturbance in the form of fill mounds, graded surfaces and artificial landforms across the project area with a low potential for intact or informative cultural deposits related to Native American or Euroamerican activity.

Milton, New Hampshire

Artificial landforms and graded surfaces dominate much of the project footprint on the New Hampshire side of the bridge. Most landforms within the project footprint appear to be either completely artificial, graded to subsoil, or otherwise disturbed to such a degree as to compromise the archaeological integrity of the natural landscape (Figures 7-10). The edges of the project area are lined with cut banks, fill deposits and graded surfaces with a low potential for archaeological deposits (Figures 11 and 12). Archaeologists observed the disturbances described above across the project limits, conditions that indicate a low to nonexistent potential for informative archaeological deposits related to Native American land use. As a result of these conditions, IAC recommends no further archaeological survey for project impacts in Milton.

Lebanon, Maine

The Maine portion of the project area displayed similar conditions to the New Hampshire side, with cut banks, graded surfaces and other widespread disturbances across the project footprint (Figures 13-16). The bridge location itself includes steep fill slopes that extend across the width of the project footprint (Figures 17 and 18). Prior to the field survey, Principal Investigator Jacob Tumelaire corresponded with Dr. Arthur Spiess, Senior Archaeologist with MHPC, regarding the Maine portion of the project area. Dr. Spiess indicated that MHPC's review of the project area resulted in a recommendation of no further survey (Dr. Arthur Spiess, personal communication 2022). Based on this correspondence and the field survey results that revealed significant disturbance across the project footprint, IAC also recommends no further archaeological survey for project impacts in Lebanon.

Explanation

Although located along the resource base and travel corridor of the Salmon Falls River, the field inspection revealed widespread past ground disturbance across the extent of the Salmon Falls Bridge Replacement Project area. Construction and maintenance of the previous bridge along with roads, homes and other Post-Contact features has reduced or eliminated any potential for informative cultural deposits related to Pre-Contact land use. In addition, background research and field observations indicate a similarly low potential for Post-Contact resources. IAC therefore recommends no further archaeological survey for the Salmon Falls Bridge Replacement Project as currently defined.

References Cited

Chace, J., Jr.
1856 *A Map of Strafford County, New Hampshire*. J. Chace, Publisher, Philadelphia.

Hurd, D. H.
1892 *Town and City Atlas of the State of New Hampshire*. D. H. Hurd, Boston.

United States Geological Survey
1983 Milton, New Hampshire, Quadrangular Map. 7.5' minute series. United States Geological Survey, Washington D.C

Sanford, Everts & Co.
1872 *The Old Maps of York County, Maine, in 1872.* 1980 Reprint of Atlas of York County, Maine, Sanford, Everts & Co., Fryburg, Maine.

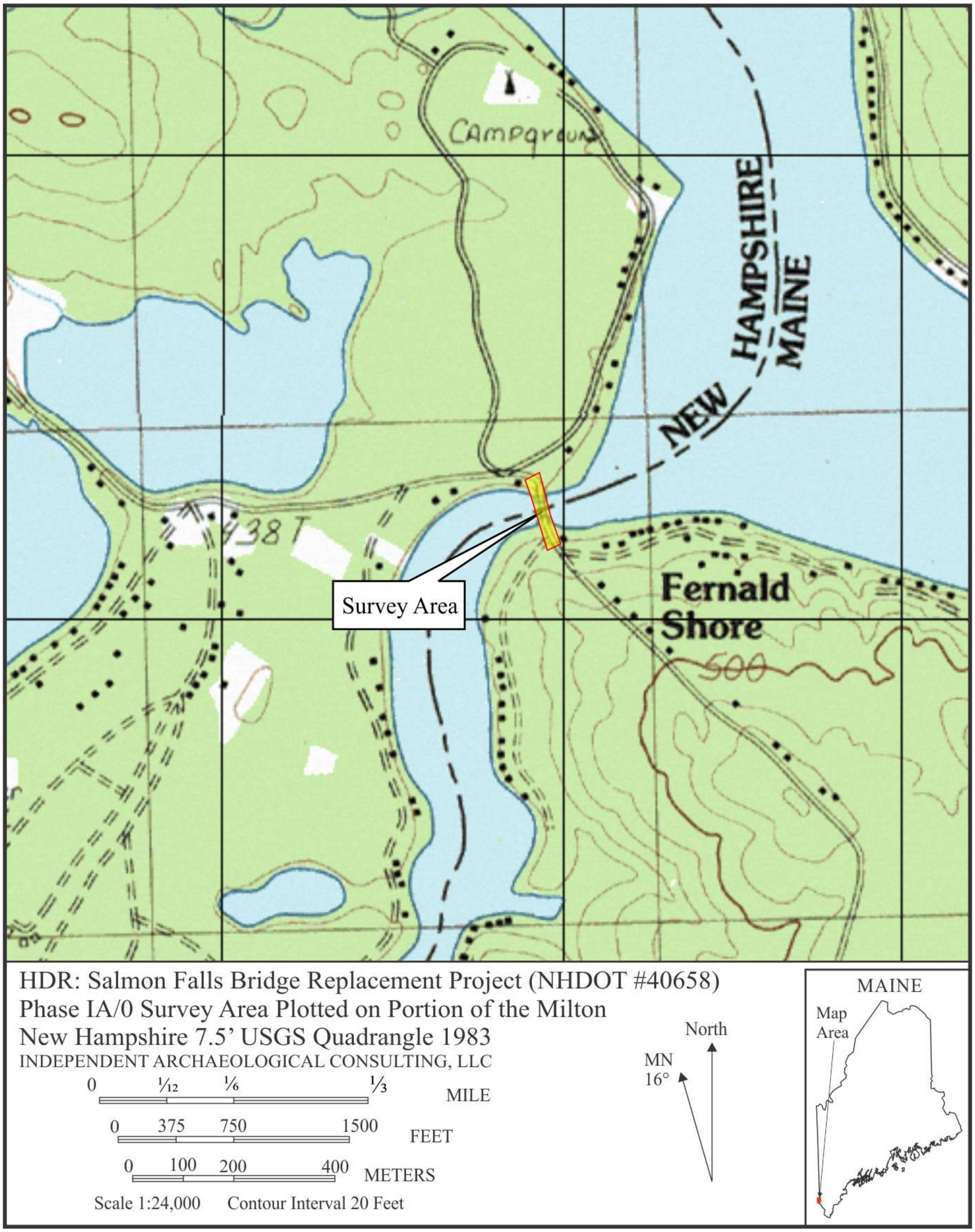


Figure 1. Project location illustrated on USGS map of Milton (after USGS 1983).

Figure 2. Survey limits for the Salmon Falls Bridge Replacement Project shown in red.

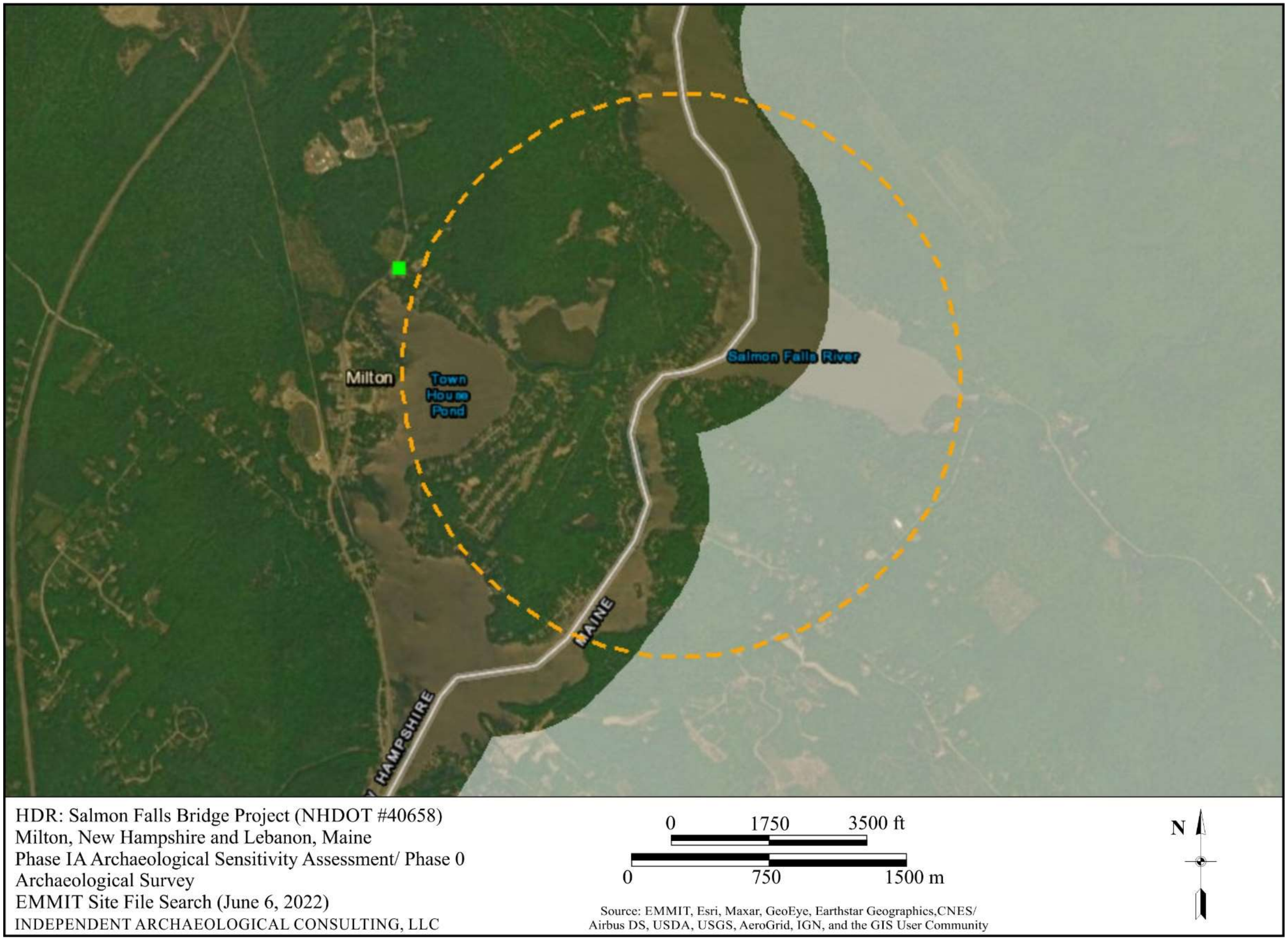


Figure 3. EMMIT site file search results showing no known archaeological sites within a 2.0-km radius of the project area.

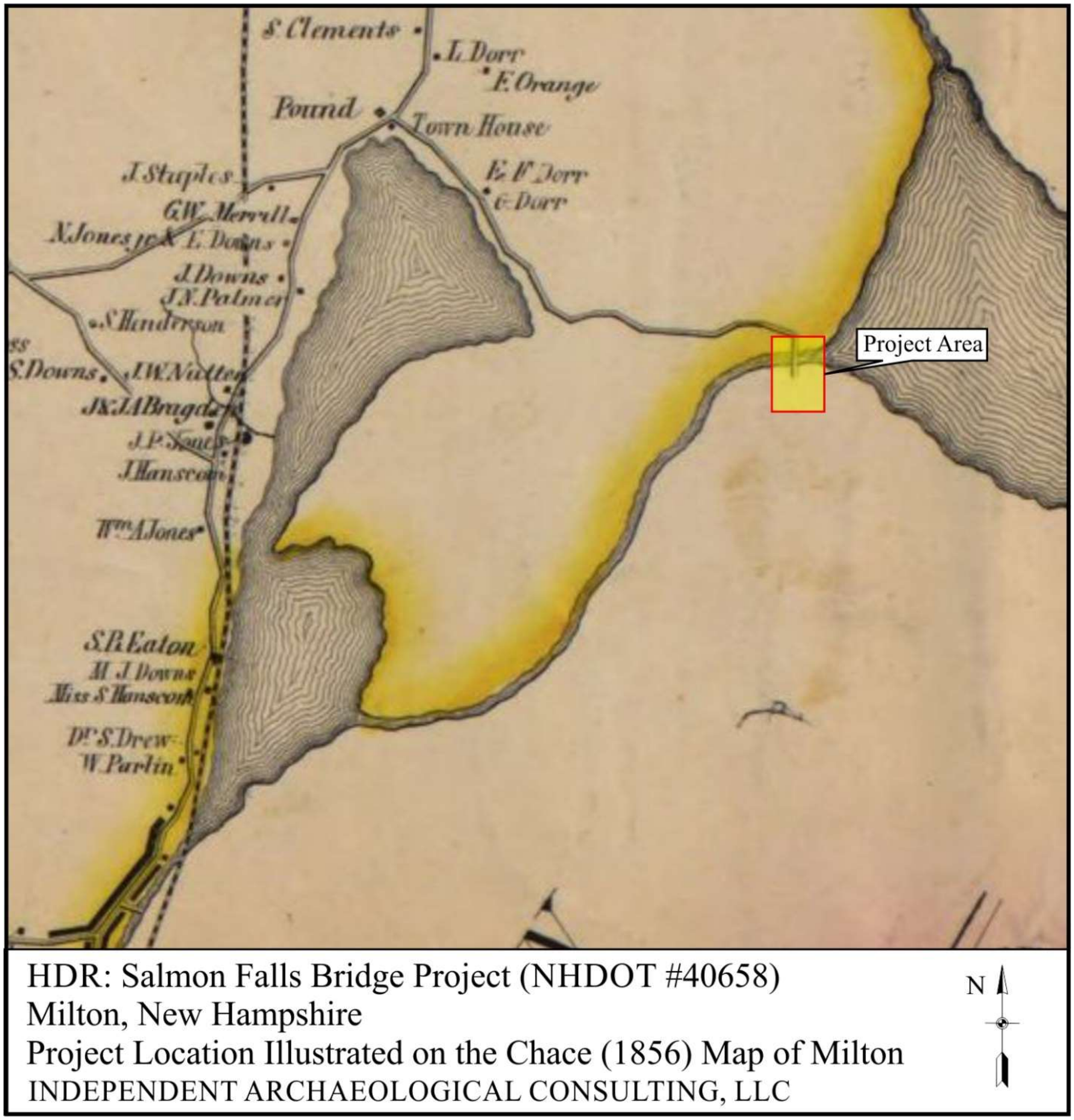


Figure 4. Project area illustrated on Chace (1856) map of Milton.

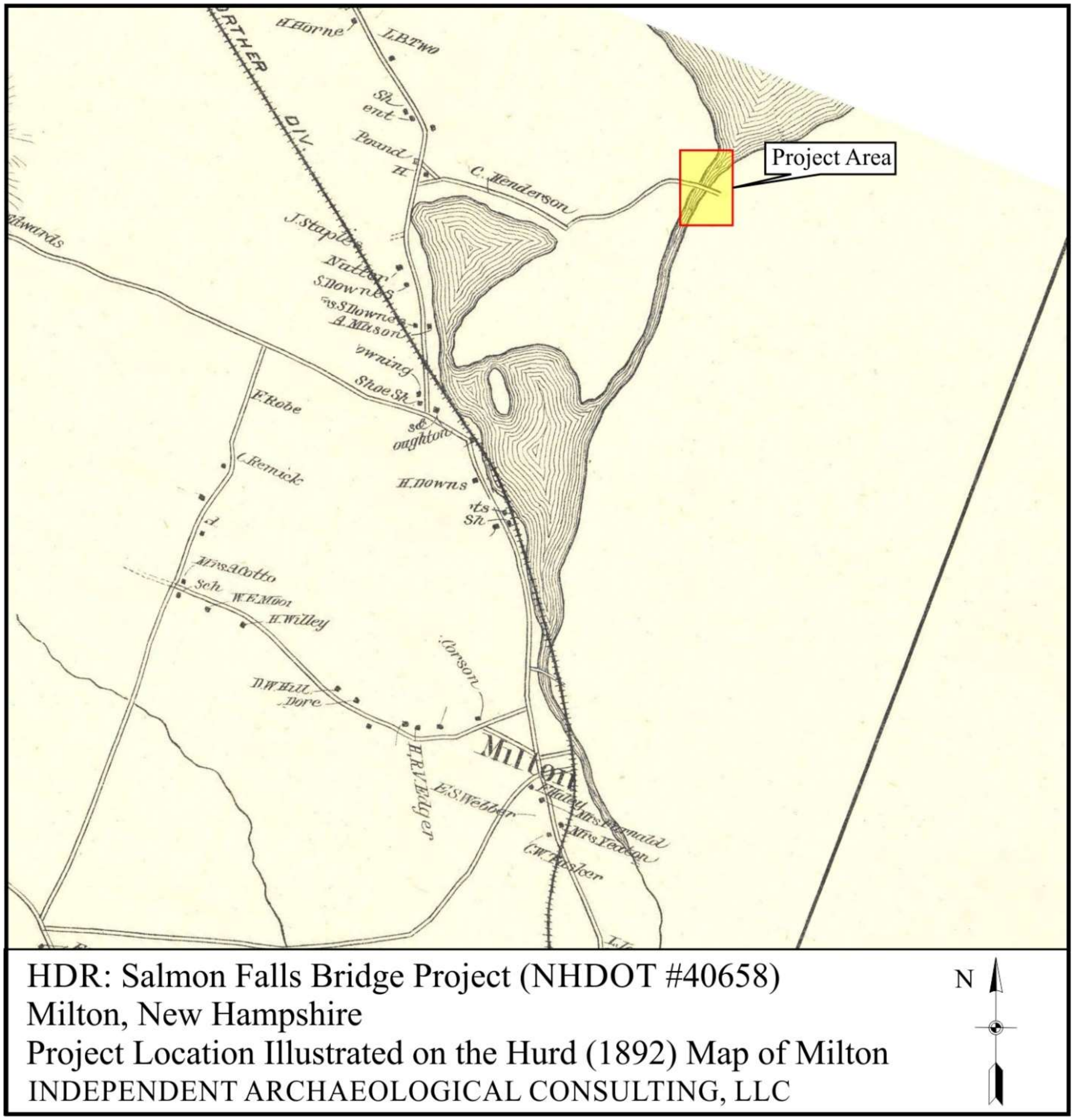


Figure 5. Project area overlaid onto the Hurd (1892) map of Milton.

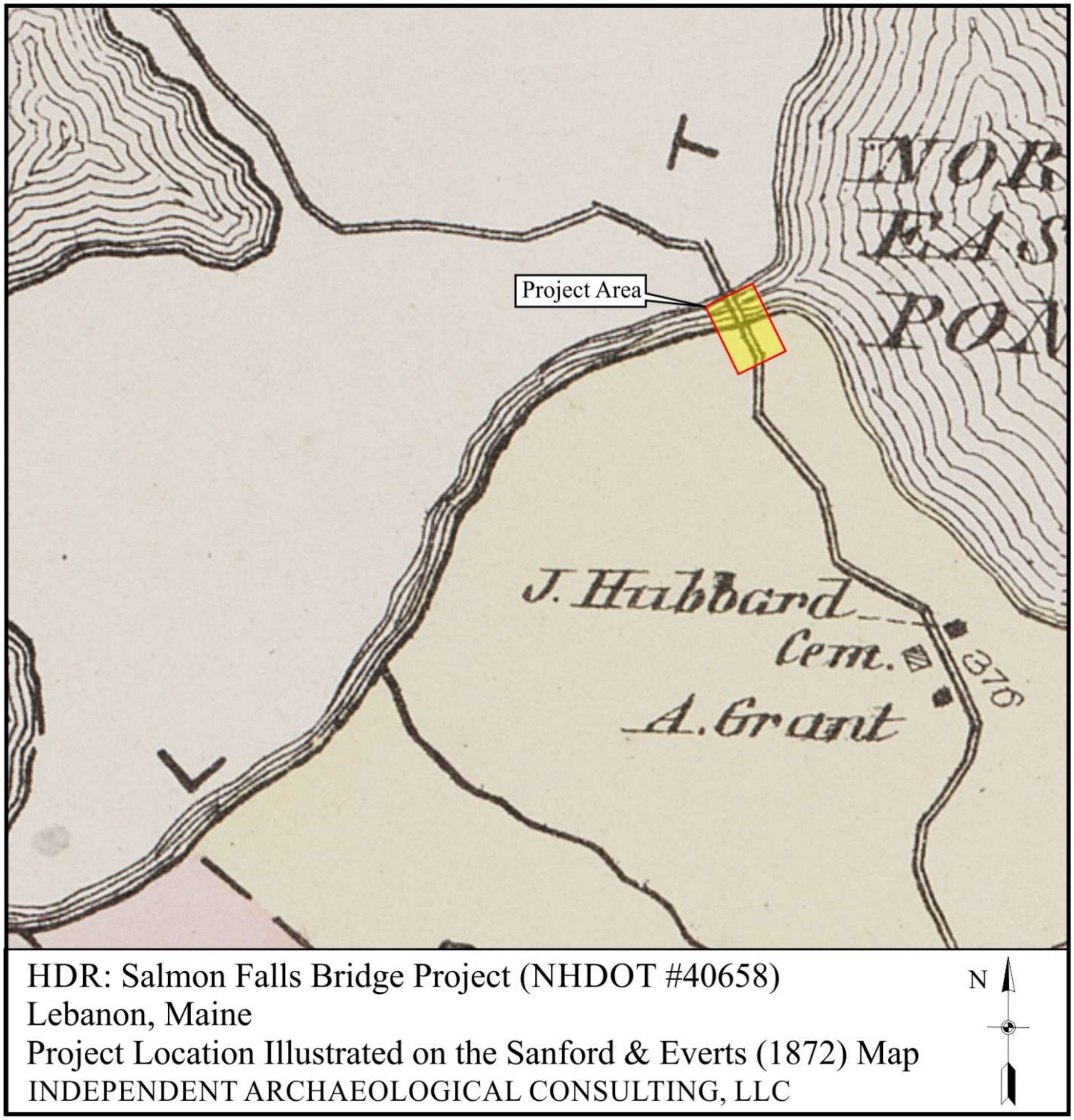


Figure 6. Project area overlaid onto the Sanford and Everts (1872) map.

Figure 7. Overview of the Milton portion of the project area, view northwest.

Figure 8. Conditions around the bridge location in Milton, view south.

Figure 9. Example of sloped landforms and fill south of the road, view southeast.

Figure 10. Example of an artificial elevated landform north of the road, view southeast.

Figure 11. An example of surface subsoil visible in graded areas along the roadways within the project area, view east.

Figure 12. Example of an elevated fill landform (base outlined) around roadside utility poles, view north.

Figure 13. General conditions around the bridge (circled) in Lebanon, view north-northwest.

Figure 14. Roadside conditions dominated by cut banks, graded surfaces and artificial landforms, view northwest.

Figure 15. Cut bank along the western road edge, view northwest.

Figure 16. An example of graded surfaces along the road edge, view northwest.

Figure 17. Steep fill slope slong the eastern road edge near the bridge, view northwest.

Figure 18. Steep fill slope slong the western road edge near the bridge, view northwest.

APPENDIX K
Roadway Design Criteria

TOWNHOUSE ROAD OVER SALMON FALLS RIVER (BR. NO. 168/152)

Route Name: TOWNHOUSE ROAD (NH) / NEW BRIDGE ROAD (ME)

Limits:

Computed by: A. Beaulac 7/14/2023

Checked by: K. Howe 7/25/2023

Design Criteria (Rec. = Recommended)

NOTE: This form is intended to document the recommended design criteria per the references cited. Deviation from the criteria shown on this form is allowable, and should be documented as a Design Exception or in the Design Report. The designer is encouraged to be flexible, and consider project-specific, context-sensitive criteria, with consideration for all users of the facility. Refer to the Design Criteria Form (DCF) Suppport Document for additional information.

List References Below - Verify most current

1. Functional Classification: *(ex. Urban Principal Arterial)* — Rural Local

NH DOT Roads and Projects Viewer (unh.edu)
NHDOT Functional Class Map
NHDOT Urban Map
NHDOT NHS Map

2. NHS or non-NHS? — non-NHS

3. DOS Route Authorized for Legal Use For Semi-Trailers 53 Feet In Length Or Less? — No

Department of Safety Trailer List (see section under "Inspection Desk")

4. AADT

	Year	AADT	% Trucks	Comments
Current	2021	502	unknown	From NH TDMS on Townhouse Road at Bridge
Opening				Grown from 2014 counts
Design				Two-Way

NH TDMS (or use data provided by BOT)

5. Speed (mph)

Posted (PS)	30	Post speed from Google Earth 9/2019 image
* Design (DS)	35	HDM Ch. 5 recommends 5-10 mph greater than posted

6. Typical Section

	Rec.	
* Lane Width (ft)	10	AASHTO 2018 Table 5-5 recommends 3' graded shldr each side
* Travelway Cross Slope (%)	2%	AASHTO 2011 Table 5-5 recommends 5' graded shldr each side
* Shoulder Width (ft)	3	Latest AASHTO guidance will be used as ROW is of concern
Shoulder Cross Slope (%)	2%	Use 3' paved shoulder
Sidewalk Width (ft)	5	Cross Slopes based on 10-4 and 9-1 NHDOT Draft Typical Section
Barrier Offset (ft)	1	Barrier Offset based on 9-1 NHDOT Draft Typical Section

(ex. "AASHTO 2018, Table 7-3")

7. Superelevation

	Rec.	
* e_{max}	4	Emax from HDM 1999, p. 3-13 (urban highways/rural int.)
Super Runoff Distribution (tan/curve)	70/30	Runoff Distribution per NHDOT HDM p-4-15

TOWNHOUSE ROAD OVER SALMON FALLS RIVER (BR. NO. 168/152)

Route Name: TOWNHOUSE ROAD (NH) / NEW BRIDGE ROAD (ME)

Limits:

Computed by: A. Beaulac 7/14/2023

Checked by: K. Howe 7/25/2023

Design Criteria (Rec. = Recommended)

List References Below - Verify most current

8. Max. Relative Gradient

Rec.	
0.62	AASHTO 2018 p. 3-62 (interpolated for 35 mph)

9. Clear Zone (CZ)

DS (MPH)	35
ADT Range (VPD)	Under 750

Condition	Slope Range	CZ
Foreslope 1	6:1	10
Foreslope 2	4:1	10
Backslope 1	N/A	N/A
Backslope 2	N/A	N/A

2011 RDG, Table 3-1

10. Horizontal Alignment

	Rec.
* Min Radius (ft)	371
Min. Radius w/RC (ft)	2490
Min Radius w/ NC (ft)	3730
Min Curve Length (ft)	525

AASHTO 2018, emax = 4%, 35 mph
Minmum Curve Length from AASHTO 2018 p. 3-120 (15V) V = Design Speed

11. Vertical Alignment

Assumed Terrain	Terrain Description
Level	

	Rec.
Min Grade	0.4%
* Max Grade	10.0%

HDM - p 4-26 (minimum) 2018 AASHTO, Table 5-2 (Max grade)

	Rec.
Min. K Crest (SSD) (K value)	29
Min K Sag (K value)	49
Min. Length Vertical Curve (ft)	105

AASHTO 2018 Table 3-35 (Crest)
AASHTO 2018 Table 3-37 (Sag)
AASHTO 2018 p.3-168 and 3-176 (Length = 3V)

TOWNHOUSE ROAD OVER SALMON FALLS RIVER (BR. NO. 168/152)

Route Name: TOWNHOUSE ROAD (NH) / NEW BRIDGE ROAD (ME)

Limits:

Computed by: A. Beaulac 7/14/2023

Checked by: K. Howe 7/25/2023

Design Criteria (Rec. = Recommended)

* 12. Minumum Vertical Clearance (ft)

Rec.	Bridge over water
N/A	

* 13. Stopping Sight Distance (ft)

Level	250			AASHTO 2018, Table 3-1 (Level)
3% Downgrade	257	3% Upgrade	237	AASHTO 2018, Table 3-2 (On Grades)
6% Downgrade	271	6% Upgrade	229	
9% Downgrade	287	9% Upgrade	222	

14. Decision Sight Distance (DSD) (ft)

Rec.	AASHTO 2018, Table 3-3
275	Avoidance Maneuver A

15. Passing Sight Distance (PSD) (ft)

550	AASHTO 2018, Table 3-4

16. Intersection Deceleration Length (ft)

N/A	No intersections within project limits

17. Design Vehicles Used (i.e. WB - 67, Aerial Fire Truck, SU 40, etc.):

SU

* Denotes FHWA controlling criteria, verify if a design exception/deviation is required.

18. Notes or Other Justifications:

A design exception is required for Horizontal Alignment (Min. Radius). The existing radius is 175 ft. The design proposes to match existing. This radius meets current AASHTO design criteria for a 25 mph design speed.

List References Below - Verify most current

Approved By:

Geometrics Expert, Name and Date

Reviewed By:

Project Manager, Name and Date

Project:	Milton-Lebanon	Computed:	HAB	Date:	12/8/2022
Project ID:	40658	Checked:	AGB	Date:	12/8/2022
HDR Job #:	10341903	Page:	1	Of:	2

EXISTING CONDITIONS DESIGN CRITERIA

HORIZONTAL GEOMETRY

Townhouse Road, New Hampshire

CURVE #1 Radius = 650 ft
$e_{existing}$ = NC

Meets low speed urban table (Table 3-13, AASHTO 2018) for 35 mph. Does not meet e_{max} = 4% superelevation table for any design speed.

CURVE #2 Radius = 175 ft
$e_{existing}$ = 2.5 %

Meets low speed urban table (Table 3-13, AASHTO 2018) for 25 mph. Does not meet e_{max} = 4% superelevation table for any design speed.

New Bridge Road, Maine

CURVE #3 Radius = 530 ft
$e_{existing}$ = 5.7 %

Meets e_{max} = 6% superelevation table (Table 3-9, AASHTO 2018) for 35 mph.

Summary:

Controlling curve in NH is Curve #2, which meets current AASHTO design criteria for a 25 mph design speed.

Controlling curve in ME is Curve #3, which meets current AASHTO design criteria for a 35 mph design speed.

Table 3-8. Minimum Radii for Design Superelevation Rates, Design Speeds, and e_{max} = 4%

U.S. Customary										
e (%)	V_d = 15 mph	V_d = 20 mph	V_d = 25 mph	V_d = 30 mph	V_d = 35 mph	V_d = 40 mph	V_d = 45 mph	V_d = 50 mph	V_d = 55 mph	V_d = 60 mph
	R (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)	*R* (ft)
NC	796	1410	2050	2830	3730	4770	5930	7220	8650	10300
RC	506	902	1340	1880	2490	3220	4040	4940	5950	7080
2.2	399	723	1110	1580	2120	2760	3480	4280	5180	6190
2.4	271	513	838	1270	1760	2340	2980	3690	4500	5410
2.6	201	388	650	1000	1420	1930	2490	3130	3870	4700
2.8	157	308	524	817	1170	1620	2100	2660	3310	4060
3.0	127	251	433	681	982	1370	1800	2290	2860	3530
3.2	105	209	363	576	835	1180	1550	1980	2490	3090
3.4	88	175	307	490	714	1010	1340	1720	2170	2700
3.6	73	147	259	416	610	865	1150	1480	1880	2350
3.8	61	122	215	348	512	730	970	1260	1600	2010
4.0	42	86	154	250	371	533	711	926	1190	1500

Reference: AASHTO 2018

EXISTING CONDITIONS DESIGN CRITERIA

VERTICAL GEOMETRY

Townhouse Road, New Hampshire

CURVE #1	L = 50 ft		**Meets 15 mph design speed based on page 3-176**
	K Crest = 14		Meets 25 mph design speed based on Table 3-35
CURVE #2	L = 90 ft		Meets 30 mph design speed based on page 3-176
	K Sag = 16		**Meets 15 mph design speed based on Table 3-37**
CURVE #3	L = 130 ft		**Meets 40 mph design speed based on page 3-176**
	K Crest = 91		Meets 50 mph design speed based on Table 3-35

New Bridge Road, Maine

CURVE #4	L = 150 ft		Meets 50 mph design speed based on page 3-176
	K Sag = 21		**Meets 20 mph design speed based on Table 3-37**

Summary:

Controlling curve in NH is Curve #2, which meets current AASHTO design criteria for a 15 mph design speed.

Controlling curve in ME is Curve #4, which meets current AASHTO design criteria for a 20 mph design speed.

Table 3-35. Design Controls for Crest Vertical Curves

U.S. Customary			
Design Speed (mph)	Stopping Sight Distance (ft)	Rate of Vertical Curvature, Ka	
		Calculated	Design
15	80	3.0	3
20	115	6.1	7
25	155	11.1	12
30	200	18.5	19
35	250	29.0	29
40	305	43.1	44
45	360	60.1	61
50	425	83.7	84
55	495	113.5	114
60	570	150.6	151
65	645	192.8	193
70	730	246.9	247
75	820	311.6	312
80	910	383.7	384

Table 3-37. Design Controls for Sag Vertical Curves

U.S. Customary			
Design Speed (mph)	Stopping Sight Distance (ft)	Rate of Vertical Curvature, K^a	
		Calculated	Design
15	80	9.4	10
20	115	16.5	17
25	155	25.5	26
30	200	36.4	37
35	250	49.0	49
40	305	63.4	64
45	360	78.1	79
50	425	95.7	96
55	495	114.9	115
60	570	135.7	136
65	645	156.5	157
70	730	180.3	181
75	820	205.6	206
80	910	231.0	231

p. 3-176 Minimum lengths of vertical curves for flat gradients also are recognized for sag conditions. The values determined for crest conditions appear to be generally suitable for sags. Lengths of sag vertical curves, shown as vertical lines in Figure 3-37, are equal to three times the design speed in mph [0.6 times the design speed in km/h].

Reference: AASHTO 2018

APPENDIX L
Public Meeting Notes

Town of Milton
BOARD OF SELECTMEN WORKSHOP MEETING
May 22, 2023

ATTENDANCE:

Members: Humphrey Williams (Chair), Claudine Burnham, Andy Rawson

Staff: Chris Jacobs -Town Administrator, Chief Richard Krauss- Police Department, Bruce Woodruff- Planning, Pat Smith- Public Works, Chief Nick Marique- Fire Department.

Lebanon Selectmen: Chip Harlow, Paul Philbrick

Presenters: Matt Lampron – NHDOT, Ron L. Kleiner, Jr – NHDOT, Nick Caron, PE - HDR, Audrey G Beaulac, PE – HDR, Devan C. Eaton – Maine DOT.

Public: Norman & Melissa Albecht, Kevin Murray, Yvonne Manning, Mike Bergeron, Mark Cruzer, B. Mahoney, Susan Bishop, Dan Scott, Ron Curtis, Deb Chase, Roxane Weymouth, Corinna Cole.

Humphrey Williams, Chair, opened the public session at 6:00PM.

1.) Pledge of Allegiance: Humphrey Williams, Chair, led the meeting in the Pledge of Allegiance.

2.) Workshop Session with Lebanon, ME Selectmen, NH DOT and ME DOT:

The purpose of the meeting is for the Selectmen from both boards to meet with the Transportation Departments to see the progress on the preliminary plan.

Mr. Williams explained the workshop is for the Lebanon and Milton Selectmen to receive updates to the concept drawing for the bridge replacement. Matt Lampron from NHDOT is currently serving as a project manager and the Departments of Transportation from New Hampshire and Maine are involved, along with design consultants from HDR. The bridge is a locally owned bridge vs. a state-owned bridge; the interstate bridge is jointly owned by Lebanon, ME and Milton, NH. Ron Kleiner, also with NHDOT, said they are currently at the engineering study phase.

The goal for the bridge replacement would be to connect Townhouse Road and New Bridge Road. The bridge has been closed since 2010 and all structure was removed by 2015.

Options were presented.

Alternative 1: - single span girder allowing 1'1" clearance
Alternative 2: - pony truss with 3' clearance
Both Alt 1 & 2 match the existing roadway guides limiting the impact on abutter's driveways, marina, etc.
Alternative 3: single span, pony truss with 5'6" clearance (would have to raise the road)
Alternative 4: 4-span girder
Both Alt 3 & 4 match the pre-existing clearances
Alternative 5: single span girder – the impacts are not considered good so there is no provided profile
Alternative 6: 4-span girder as requested by Milton PD to increase the clearance to 7'6"

The environmental impact to local resources will depend on which option is ultimately selected. In addition, wetlands permits will be required as there may be two species which are considered threatened or endangered.

The project schedule was then presented with the final design to be selected by summer/fall 2024 and scheduled to go out to bid by March 2025. DOT asked for input from both boards.

Mr. Rawson asked which alternative would be the best to meet the PD boat clearance of 7'6". To best meet this would require raising the roadway to come up to the bridge. Mr. Rawson said the impact of Rt. 16 on the community was very hard. Getting the bridge back open would have a positive impact on the town. The safety aspect also needs consideration.

Chip Harlow – the 4-span option with 5'6" clearance would impact the ramp. Who incurs any of the "add-on" costs? DOT response: All costs to erect the bridge will be the responsibility of the towns. To relocate a fuel tank, changes to the boat ramp and roadway, etc. are not currently in the budget. The towns need to consider what they can support financially. There has been no impact study on the marina by the 4-span option.

Mr. Williams said because the add-on costs are not known, there is difficulty in selecting an alternative. Is the plan to have all projected costs by the time of the public meeting held in the summer? DOT – yes, the plan is to have the towns determine which alternative is selected by this time.

Chip Harlow – if there are project delays, who bears the cost of any delays as a result of increased prices? For Maine, the state is responsible for 80% and the town the remaining 20%.

Mr. Jacobs noted the original assumptions for Alternatives 1 & 2 are not valid:
1.) NH & ME DOTs will have to bear some of the costs;
2.) Safety aspect regarding the location of the marina vs. the bridge location – the boat ramp will need to be moved (at the owner's expense). Bridge replacement should not proceed with the boat ramp's current location;
3.) Bridge should include fencing on both sides to prevent jumping-off – there is a definite safety/traffic hazard;
4.) With alternatives 4 or 5 is a balancing act between function and form, taking cost, required clearance, etc. into consideration.

Public comment: There has been no mention of salt run-off. The lake is already over-salted. In addition, it's not wise to erect a steel structure and should be pre-cast concrete with special additives for salt prevention. Matt Lampron – coatings can now be used on steel structures which help to minimize negative mineral impacts.

Ms. Burnham continued on safety aspect and the need for additional height – the PD have indicated they need a higher clearance to accommodate the top of the light bar on their patrol boat. Mr. Williams said the 5'6" option will fit the majority of boats. The PD clearance requirement is 7'6". Chief Krauss said they would work with whichever alternative is ultimately selected understanding which alternative has the least amount of impact and is already budgeted for by both states. The bridge is not planned for replacement before 2025. That gives enough time to determine the kind of boat to use and will work for emergency responses. If the alternative selected only allows for 5'6" clearance, the town will work to figure out the boat situation. Mr. Williams – we need an understanding of any impacts and cost increases associated with final alternative selection. Based on discussion it sounds like alternative 4 may be the target range to focus on.

Bruce Woodruff:
1.) Question on why the 12ft lane design – a design exception could be requested and make the road 20ft instead of 24ft.
2.) There is nothing wrong to ask for vertical design exceptions – this was discussed about 8 years ago with the state.
3.) 80/20 meaning the town has to increase the 20%? This is addressed in the municipal agreement which puts a cap on the 20% match, plus 10-20% increases. If the municipal agreement is not re-negotiated, both states will have to find some other money.
This is over-engineered – costs and other impacts to properties. He recommended looking at this logically for what the road is, has been and what it should continue to be; get the design exceptions to help bring the overall costs down.
Mr. Williams said he doesn't understand why options 1 & 2 were even brought forward as they have been very clear on what the clearances need to be; definitely need to be looking at an option that includes the 4-span girder; make the span 20 ft instead of 24 ft which should help lessen the impact on neighboring properties.

MaineDOT: We understand the frustrations and can see why people may think they are not being listened to. The baselines are provided for comparison of estimate purposes. We are not trying to ignore anyone; this is a process that can take a long time. Municipal projects can take a long time, especially when working with the state.

There are state, federal and municipal minimums for roadway width. 24ft is a typical state minimum. It is tough since there are roadway curves on both sides of the bridge. Vertical is important from a clearance perspective; however, horizontal curves are really tough. We are trying to address all issues; it is tough. We don't want this to drag out and want to move forward. Mr. Williams – the frustration is felt by the public as well; they have been waiting for a long time and we all thought we would have the concept drawing information by February and by now the public meeting would be occurring. Everything was pushed back and now the public meeting is to be this summer. Whatever happens, it has to meet the needs of those on the lake and those who use the bridge.

Chip Harlow asked why isn't the baseline to the clearance to the water? Baseline is clearance, not grade. MaineDOT: baseline is a generic term. The previous structure did not meet the new required criteria because of the age and materials used. Every project is different; because of the curves and proximities the process has taken longer to generate the alternatives.

Maine public comment: The width of the Maine road – the standard is 50ft wide. All properties are pinned for that. No one should lose any property.

DOT: Bruce Woodruff is correct about the municipal agreements and because of all of them it did take longer than they would have liked. Every phase has a 10% cap. Example: if the engineering phase is to go over the 10% cap, they have to bring it back so everyone has an opportunity to discuss.

Mr. Rawson said it seems like alternative 4 is the closest to fitting our needs and wants. If we would move forward with alternative 4, seems like the way to go. Ms. Burnham asked about the existing boat ramp. It has been there since 1919 and was never designed for what is needed today. Chief Krauss – if alternative 4 is the one that gives the required height and the least impact to roads, residents and the budget, which would be the one to look at the hardest.

Lebanon/Milton BOS, Chris Jacobs, Chief Krauss, Bruce Woodruff all indicated alternative 4 seems at this point to be the best option.

DOT recommended possibly looking at both alternatives 3 & 4, especially if clearance and cost are the most important issues. Chief Krauss said to build the grade to accommodate the road speed; if the speed is 30MPH, build the grade based on that; however, the road was not originally built with 30MPH in mind. The current designs meet the existing grades. Mr. Rawson said there has previously been a speed and traffic study on the roadway. Bruce Woodruff's comments also need to be taken into consideration – 24ft down to 20ft; the 24ft can accommodate pedestrian and bicycle traffic.

Mr. Williams thanked everyone for their time.

Matt Lampron – if anyone has comments or concerns, they should let him know. They will advance alternatives 3 & 4.

Meeting Adjournment:

Meeting adjourned at 7:20PM.

Given under our hands this 5th day of June 2023.

Humphrey Williams – Chairman BOS

Claudine Burnham - Board Member

Andrew Rawson - Board Member

END OF MINUTES – May 22, 2023

APPENDIX M
Project Cost Estimates

Preliminary Cost Estimate

1 Span Truss

PROJECT: Town House Rd and New Bridge Rd over Northeast Pond				**NHDOT Project No. 40658**		
Alternative 1: 1 Span Prefabricated Truss (112' c-c brg)						
Deck Area: 29' x 115' = 3,335 SF				**ESTIMATED BY:** JPJ		
				CHECKED BY: PJL - 7/12/2023		
PREFABRICATED TRUSS	3,335	**SF**	×	$143.93	=	$576,000
DECK CONCRETE	103	**CY**	×	$1,300.00	=	$134,000
PILE SUPPORTED ABUTMENT	2	**EA**	×	$300,000.00	=	$600,000
T-3 BRIDGE RAIL	330	**LF**	×	$190.00	=	$63,000
T-3 BRIDGE APPROACH RAIL	4	**Ea**	×	$8,000.00	=	$32,000
BEARINGS	4	**EA**	×	$5,500.00	=	$22,000
MISCELLANEOUS				10%	=	$143,000
MOBILIZATION				10%	=	$157,000
				STRUCTURE SUBTOTAL	=	**$1,727,000**
APPROACHES, INCLUDING RETAINING WALLS	750	**LF**	×	$400.00	=	$300,000
MISCELLANEOUS				25%	=	$75,000
MOBILIZATION				10%	=	$30,000
				APPROACHES SUBTOTAL	=	**$405,000**
				TOTAL CONSTRUCTION COST	=	**$2,132,000**
PRELIMINARY ENGINEERING				10%	=	$214,000
CONSTRUCTION ENGINEERING				10%	=	$214,000
RIGHT OF WAY					=	$500,000
UTILITY RELOCATION					=	$0
				TOTAL PROJECT COST	=	**$3,060,000**

Preliminary Cost Estimate
2 Span Tub Girder

PROJECT: Town House Rd and New Bridge Rd over Northeast Pond				**NHDOT Project No. 40658**		
Alternative 1: 2 Span Tub Girder (112' c-c brg) Deck Area: 29' x 115' = 3,335 SF				**ESTIMATED BY:** JPJ **CHECKED BY:** PJL - 7/12/2023		
U18 STEEL TUB GIRDER + METAL DECKING + BEARINGS	3,335	**SF**	×	$102.55	=	$410,400
CONCRETE DECK	103	**CY**	×	$1,300.00	=	$134,000
PILE SUPPORTED ABUTMENT	2	**EA**	×	$300,000.00	=	$600,000
PIERS	1	**EA**	×	$290,000.00	=	$290,000
T-3 BRIDGE RAIL	330	**LF**	×	$190.00	=	$62,700
T-3 BRIDGE APPROACH RAIL	4	**EA**	×	$8,000.00	=	$32,000
MISCELLANEOUS				15%	=	$230,000
MOBILIZATION				10%	=	$176,000
				STRUCTURE SUBTOTAL	=	**$1,936,000**
APPROACHES, INCLUDING RETAINING WALLS	600	**LF**	×	$397.00	=	$239,000
MISCELLANEOUS				25%	=	$60,000
MOBILIZATION				10%	=	$24,000
				APPROACHES SUBTOTAL	=	**$323,000**
				TOTAL CONSTRUCTION COST	=	**$2,259,000**
PRELIMINARY ENGINEERING				10%	=	$226,000
CONSTRUCTION ENGINEERING				10%	=	$226,000
RIGHT OF WAY					=	$8,000
UTILITY RELOCATION					=	$0
				TOTAL PROJECT COST	=	**$2,719,000**

Preliminary Cost Estimate
3 Span Deck Slab

PROJECT: Town House Rd and New Bridge Rd over Northeast Pond				**NHDOT Project No. 40658**		
Alternative 1: 3 Span Deck Slab (112' c-c brg)						
Deck Area: 29' x 115' = 3,335 SF				**ESTIMATED BY:** JPJ		
				CHECKED BY: PJL - 7/12/2023		
PRECAST PRESTRESSED DECK BEAMS	3,335	**SF**	×	$130.00	=	$434,000
CONCRETE DECK	87	**CY**	×	$1,300.00	=	$113,100
PILE SUPPORTED ABUTMENT	2	**EA**	×	$300,000.00	=	$600,000
PIERS	2	**EA**	×	$290,000.00	=	$580,000
T-3 BRIDGE RAIL	330	**LF**	×	$190.00	=	$63,000
T-3 BRIDGE APPROACH RAIL	4	**EA**	×	$8,000.00	=	$32,000
BEARINGS	42	**EA**	×	$1,500.00	=	$63,000
MISCELLANEOUS				15%	=	$283,000
MOBILIZATION				10%	=	$217,000
				STRUCTURE SUBTOTAL	=	**$2,386,000**
APPROACHES, INCLUDING RETAINING WALLS	600	**LF**	×	$397.00	=	$239,000
MISCELLANEOUS				25%	=	$60,000
MOBILIZATION				10%	=	$24,000
				APPROACHES SUBTOTAL	=	**$323,000**
				TOTAL CONSTRUCTION COST	=	**$2,709,000**
PRELIMINARY ENGINEERING				10%	=	$271,000
CONSTRUCTION ENGINEERING				10%	=	$271,000
RIGHT OF WAY					=	$0
UTILITY RELOCATION					=	$0
				TOTAL PROJECT COST	=	**$3,251,000**

APPENDIX N
Life Cycle Cost Estimate

Project:	40658 Swanzey Milton/Lebanon	Computed: JPJ		Date:	7/14/2023
Subject:	Alternative 1 - Single Span Steel Truss Bridge	Checked:	PJL	Date:	7/17/2023
Task:	Life Cycle Cost Analysis				
Job:					

40658 Milton/Lebanon - Townhouse Rd over Northeast Pond
Alternative 1 - Single Span Steel Truss Bridge

Life Cycle Cost Analysis Input

Discount Rate	4%	Typically between 3% and 5%, per FHWA LCCA Primer. Enter number as integer.
Start Year - Bridge Replacement	2025	Input start year.
Useful Life (Years)	99	Between 0 and 100 years. Useful life is counted from Start Year, not Discount Year.
Discount Year	2023	Year 0 if counted years are utilized. Enter build year if calendar years are utilized.
Deck Area (sq.ft.)	3335	(Sq. ft. of deck plan area, (115' * 26'-0" width))
Bridge Type	Truss	
Roadway Tier	Tier 5	

Base Costs and Preservation Multipliers

(ref: NHDOT Bridge Program Recommended Network Funding, 7/31/2018)

Work Type	Tier 5 Truss Multiplier
Maintenance	1.0
Preservation	1.2
Rehabilitation	1.2

1.1 **Base Costs for Work Activity by Bridge Type**

Activity*		Costs per Sq. Ft. for each Bridge Type: Girder	Truss	Moveable	Timber	Culvert
Maintenance	Clean and Seal Substructure	$0.10	$0.10	$0.10	$0.10	$0.10
Preservation	Crack Seal Pavement (Highway Design task)	$0.07	$0.07	$0.07	$0.07	N/A
	Pavement In-lay (Highway Design task)	$1.60	$1.60	$1.60	N/A	N/A
	Install Concrete Invert (Culverts)	N/A	N/A	N/A	N/A	$50.00
	Patch Deck, Replace Membrane & Expansion Joints, Rehab Bearings	$50.00	$100.00	$200.00	$50.00	$100.00
Rehabilitation	Rehabilitate Bridge	$100.00	$250.00	$350.00	$100.00	N/A

1.2 **Tier / Cost / Activity Multipliers by Bridge Type**

Tier	Cost Multipliers based on Bridge Type: Girder			Truss			Moveable			Timber			Culvert	
	P	Rh	Rp	P	Rh	Rp	P	Rh	Rp	P	Rh	Rp	P	Rp
HIB	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	N/A	N/A	N/A	N/A	N/A
Tier 1	1.0	1.0	1.0	1.0	1.0	1.0	N/A			N/A	N/A	N/A	1.5 - 2.0	1.5 - 2.0
Tier 2	2.0	1.5	1.4	2.0	1.2	1.3	N/A			N/A	N/A	N/A	2.0	2.0
Tier 3	1.5	1.5	1.4	1.3	1.3	1.3	N/A			1.1	1.1	1.1	1.8	1.8
Tier 4	1.5	1.5	1.4	1.1	1.1	1.2	N/A			1.0	1.0	1.0	1.2	1.2
Tier 5	1.5	1.5	1.3	1.2	1.2	1.2	N/A			1.1	1.1	1.1	1.0	1.0
Tier 6	1.5	1.5	1.3	1.2	1.2	1.2	N/A			1.1	1.1	1.1	1.1	1.1

P = Preservation; Rh = Rehabilitation; Rp = Replacement;

Life Cycle Cost Analysis Summary

	Total Cost (Constant Year 2023$)			Total Cost (Present Value $)
Initial Capital Costs	$ 3,060,000			$ 3,060,000
Regular Maintenance, Inspection and Bridge Operation	$ 131,017			$ 32,151
Maintenance and Rehabilitation of Structural Components	$ 2,321,160			$ 406,810
Total	**$ 5,512,177**			**$ 3,498,961**

Life Cycle Cost Analysis Breakdown

No.	Description	Multiplier	Cost/SF	Cost Per Occurrence (Constant Dollars)	Recurrence Interval	Start Year	Subsequent Years of Occurance through 2124									Total Cost (Constant Year 2023$)	Total Cost (Present Value $)
Capital Costs																	
1	Replacement of Bridge (TS&L Estimate)	-	-	$ 3,060,000	100	2025	-	-	-	-	-	-	-	-	-	$ 3,060,000	$ 3,060,000
Regular Maintenance, Inspection and Bridge Operation																	
2	Bridge Cleaning, Seal Substructure, and Clear Vegetation	1.0	$ 0.10	$ 334	1	2026	2027	2028	2029	2030	2031	2032	2033	2034	>>>>	$ 33,017	$ 8,166
3	Bridge Inspection	-	-	$ 2,000	2	2027	2029	2031	2033	2035	2037	2039	2041	2043	>>>>	$ 98,000	$ 23,985
Bridge Preservation and Rehabilitation Activities																	
4	Crack Seal Pavement @ year 5, Pavement Inlay @ year 10 (1)	1.2	$ -	$ -	10	2035	2045	2055	2065	2075	2085	2095	2105	2115	>>>>	$ -	$ -
5	Patch deck, replace joints, rehab bearings, minor coatings repair (2)	1.2	$ 110.00	$ 440,220	20	2045	2065	-	2105	-	-	-	-	-	-	$ 1,320,660	$ 311,702
6	Replace deck, joints, bearings, bridge rail, bridge approach rail. Repair superstructure and substructure	1.2	$ 250.00	$ 1,000,500	60	2085	-	-	-	-	-	-	-	-	-	$ 1,000,500	$ 95,108

(1) Bare deck, no pavement this alternative

(2) Cost/SF increased from 100 to 110 since exposed decks are likely to incur more damage than paved decks

	CONSTANT $	PRESENT VALUE
Total	$ 5,512,177	$ 3,498,961

Project:	40658 Swanzey Milton/Lebanon	Computed: JPJ	Date:	7/14/2023
Subject:	Alternative 2 - Two-Span Steel Tub Girder Bridge	Checked: PJL	Date:	7/17/2023
Task:	Life Cycle Cost Analysis			
Job:				

40658 Milton/Lebanon - Townhouse Rd over Northeast Pond
Alternative 2 - Two-Span Steel Tub Girder Bridge

Life Cycle Cost Analysis Input

Discount Rate	4%	Typically between 3% and 5%, per FHWA LCCA Primer. Enter number as integer.
Start Year - Bridge Replacement	2025	Input start year.
Useful Life (Years)	99	Between 0 and 100 years. Useful life is counted from Start Year, not Discount Year.
Discount Year	2023	Year 0 if counted years are utilized. Enter build year if calendar years are utilized.
Deck Area (sq.ft.)	3335	(Sq. ft. of deck plan area, (115' * 26'-0" width))
Bridge Type	Girder	
Roadway Tier	Tier 5	

Base Costs and Preservation Multipliers

(ref: NHDOT Bridge Program Recommended Network Funding, 7/31/2018)

Work Type	Tier 5 Girder Multiplier
Maintenance	1.0
Preservation	1.5
Rehabilitation	1.5

1.1 **Base Costs for Work Activity by Bridge Type**

Activity*		Costs per Sq. Ft. for each Bridge Type				
		Girder	Truss	Moveable	Timber	Culvert
Maintenance	Clean and Seal Substructure	$0.10	$0.10	$0.10	$0.10	$0.10
Preservation	Crack Seal Pavement (Highway Design task)	$0.07	$0.07	$0.07	$0.07	N/A
	Pavement In-lay (Highway Design task)	$1.60	$1.60	$1.60	N/A	N/A
	Install Concrete Invert (Culverts)	N/A	N/A	N/A	N/A	$50.00
	Patch Deck, Replace Membrane & Expansion Joints, Rehab Bearings	$50.00	$100.00	$200.00	$50.00	$100.00
Rehabilitation	Rehabilitate Bridge	$100.00	$250.00	$350.00	$100.00	N/A

1.2 **Tier / Cost / Activity Multipliers by Bridge Type**

Tier	Cost Multipliers based on Bridge Type													
	Girder			Truss			Moveable			Timber			Culvert	
	P	Rh	Rp	P	Rh	Rp	P	Rh	Rp	P	Rh	Rp	P	Rp
HIB	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	N/A	N/A	N/A	N/A	N/A
Tier 1	1.0	1.0	1.0	1.0	1.0	1.0	N/A			N/A	N/A	N/A	1.5 - 2.0	1.5 - 2.0
Tier 2	2.0	1.5	1.4	2.0	1.2	1.3	N/A			N/A	N/A	N/A	2.0	2.0
Tier 3	1.5	1.5	1.4	1.3	1.3	1.3	N/A			1.1	1.1	1.1	1.8	1.8
Tier 4	1.5	1.5	1.4	1.1	1.1	1.2	N/A			1.0	1.0	1.0	1.2	1.2
Tier 5	1.5	1.5	1.3	1.2	1.2	1.2	N/A			1.1	1.1	1.1	1.0	1.0
Tier 6	1.5	1.5	1.3	1.2	1.2	1.2	N/A			1.1	1.1	1.1	1.1	1.1

P = Preservation; Rh = Rehabilitation; Rp = Replacement;

Life Cycle Cost Analysis Summary

	Total Cost (Constant Year 2023$)	Total Cost (Present Value $)
Initial Capital Costs	$ 2,719,000	$ 2,719,000
Regular Maintenance, Inspection and Bridge Operation	$ 131,017	$ 32,151
Maintenance and Rehabilitation of Structural Components	$ 1,400,700	$ 260,078
Total	**$ 4,250,717**	**$ 3,011,229**

Life Cycle Cost Analysis Breakdown

No.	Description	Multiplier	Cost/SF	Cost Per Occurrence (Constant Dollars)	Recurrence Interval	Start Year	Subsequent Years of Occurance through 2124									Total Cost (Constant Year 2023$)	Total Cost (Present Value $)
Capital Costs																	
1	Replacement of Bridge (TS&L Estimate)	-	-	$ 2,719,000	100	2025	-	-	-	-	-	-	-	-	-	$ 2,719,000	$ 2,719,000
Regular Maintenance, Inspection and Bridge Operation																	
2	Bridge Cleaning, Seal Substructure, and Clear Vegetation	1.0	$ 0.10	$ 334	1	2026	2027	2028	2029	2030	2031	2032	2033	2034	>>>>	$ 33,017	$ 8,166
3	Bridge Inspection	-	-	$ 2,000	2	2027	2029	2031	2033	2035	2037	2039	2041	2043	>>>>	$ 98,000	$ 23,985
Bridge Preservation and Rehabilitation Activities																	
4	Crack Seal Pavement @ year 5, Pavement Inlay @ year 10 (1)	1.5	$ -	$ -	10	2035	2045	2055	2065	2075	2085	2095	2105	2115	>>>>	$ -	$ -
5	Patch deck, replace joints, rehab bearings, minor coatings repair (2)	1.5	$ 60.00	$ 300,150	20	2045	2065	-	2105	-	-	-	-	-	-	$ 900,450	$ 212,524
6	Replace deck, joints, bearings, bridge rail, bridge approach rail. Repair superstructure and substructure	1.5	$ 100.00	$ 500,250	60	2085	-	-	-	-	-	-	-	-	-	$ 500,250	$ 47,554

(1) Bare deck, no pavement this alternative

(2) Cost/SF increased from 100 to 110 since exposed decks are likely to incur more damage than paved decks

	Total Cost (Constant Year 2023$)	Total Cost (Present Value $)
Total	**$ 4,250,717**	**$ 3,011,229**
	CONSTANT $	**PRESENT VALUE**

Project:	40658 Swanzey Milton/Lebanon	Computed: JPJ	Date: 7/14/2023
Subject:	Alternative 3 - Three Span Precast Deck Slab Br.	Checked: PJL	Date: 7/17/2023
Task:	Life Cycle Cost Analysis		
Job:			

40658 Milton/Lebanon - Townhouse Rd over Northeast Pond
Alternative 3 - Three Span Precast Deck Slab Br.

Life Cycle Cost Analysis Input

Discount Rate	4%	Typically between 3% and 5%, per FHWA LCCA Primer. Enter number as integer.
Start Year - Bridge Replacement	2025	Input start year.
Useful Life (Years)	99	Between 0 and 100 years. Useful life is counted from Start Year, not Discount Year.
Discount Year	2023	Year 0 if counted years are utilized. Enter build year if calendar years are utilized.
Deck Area (sq.ft.)	3335	(Sq. ft. of deck plan area, (115' * 26'-0" width))
Bridge Type	Girder	
Roadway Tier	Tier 5	

Base Costs and Preservation Multipliers

(ref: NHDOT Bridge Program Recommended Network Funding, 7/31/2018)

Work Type	Tier 5 Girder Multiplier
Maintenance	1.0
Preservation	1.5
Rehabilitation	1.5

1.1 **Base Costs for Work Activity by Bridge Type**

Activity*		Costs per Sq. Ft. for each Bridge Type				
		Girder	Truss	Moveable	Timber	Culvert
Maintenance	Clean and Seal Substructure	$0.10	$0.10	$0.10	$0.10	$0.10
Preservation	Crack Seal Pavement (Highway Design task)	$0.07	$0.07	$0.07	$0.07	N/A
	Pavement In-lay (Highway Design task)	$1.60	$1.60	$1.60	N/A	N/A
	Install Concrete Invert (Culverts)	N/A	N/A	N/A	N/A	$50.00
	Patch Deck, Replace Membrane & Expansion Joints, Rehab Bearings	$50.00	$100.00	$200.00	$50.00	$100.00
Rehabilitation	Rehabilitate Bridge	$100.00	$250.00	$350.00	$100.00	N/A

1.2 **Tier / Cost / Activity Multipliers by Bridge Type**

Tier	Cost Multipliers based on Bridge Type													
	Girder			Truss			Moveable			Timber			Culvert	
	P	Rh	Rp	P	Rh	Rp	P	Rh	Rp	P	Rh	Rp	P	Rp
HIB	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	N/A	N/A	N/A	N/A	N/A
Tier 1	1.0	1.0	1.0	1.0	1.0	1.0	N/A			N/A	N/A	N/A	1.5 - 2.0	1.5 - 2.0
Tier 2	2.0	1.5	1.4	2.0	1.2	1.3	N/A			N/A	N/A	N/A	2.0	2.0
Tier 3	1.5	1.5	1.4	1.3	1.3	1.3	N/A			1.1	1.1	1.1	1.8	1.8
Tier 4	1.5	1.5	1.4	1.1	1.1	1.2	N/A			1.0	1.0	1.0	1.2	1.2
Tier 5	1.5	1.5	1.3	1.2	1.2	1.2	N/A			1.1	1.1	1.1	1.0	1.0
Tier 6	1.5	1.5	1.3	1.2	1.2	1.2	N/A			1.1	1.1	1.1	1.1	1.1

P = Preservation; Rh = Rehabilitation; Rp = Replacement;

Life Cycle Cost Analysis Summary

	Total Cost (Constant Year 2023$)			Total Cost (Present Value $)
Initial Capital Costs	$ 3,251,000			$ 3,251,000
Regular Maintenance, Inspection and Bridge Operation	$ 131,017			$ 32,151
Maintenance and Rehabilitation of Structural Components	$ 1,325,813			$ 241,543
Total	**$ 4,707,829**			**$ 3,524,694**

Life Cycle Cost Analysis Breakdown

No.	Description	Multiplier	Cost/SF	Cost Per Occurrence (Constant Dollars)	Recurrence Interval	Start Year	Subsequent Years of Occurance through 2124									Total Cost (Constant Year 2023$)	Total Cost (Present Value $)
Capital Costs																	
1	Replacement of Bridge (TS&L Estimate)	-	-	$ 3,251,000	100	2025	-	-	-	-	-	-	-	-	-	$ 3,251,000	$ 3,251,000
Regular Maintenance, Inspection and Bridge Operation																	
2	Bridge Cleaning, Seal Substructure, and Clear Vegetation	1.0	$ 0.10	$ 334	1	2026	2027	2028	2029	2030	2031	2032	2033	2034	>>>>	$ 33,017	$ 8,166
3	Bridge Inspection	-	-	$ 2,000	2	2027	2029	2031	2033	2035	2037	2039	2041	2043	>>>>	$ 98,000	$ 23,985
Bridge Preservation and Rehabilitation Activities																	
4	Crack Seal Pavement @ year 5, Pavement Inlay @ year 10	1.5	$ 1.67	$ 8,354	10	2035	2045	2055	2065	2075	2085	2095	2105	2115	>>>>	$ 75,188	$ 16,886
5	Patch deck, replace joints, rehab bearings, minor coatings repair	1.5	$ 50.00	$ 250,125	20	2045	2065	-	2105	-	-	-	-	-	-	$ 750,375	$ 177,104
6	Replace deck, joints, bearings, bridge rail, bridge approach rail. Repair superstructure and substructure	1.5	$ 100.00	$ 500,250	60	2085	-	-	-	-	-	-	-	-	-	$ 500,250	$ 47,554

Total	**$ 4,707,829**	**$ 3,524,694**
	CONSTANT $	**PRESENT VALUE**