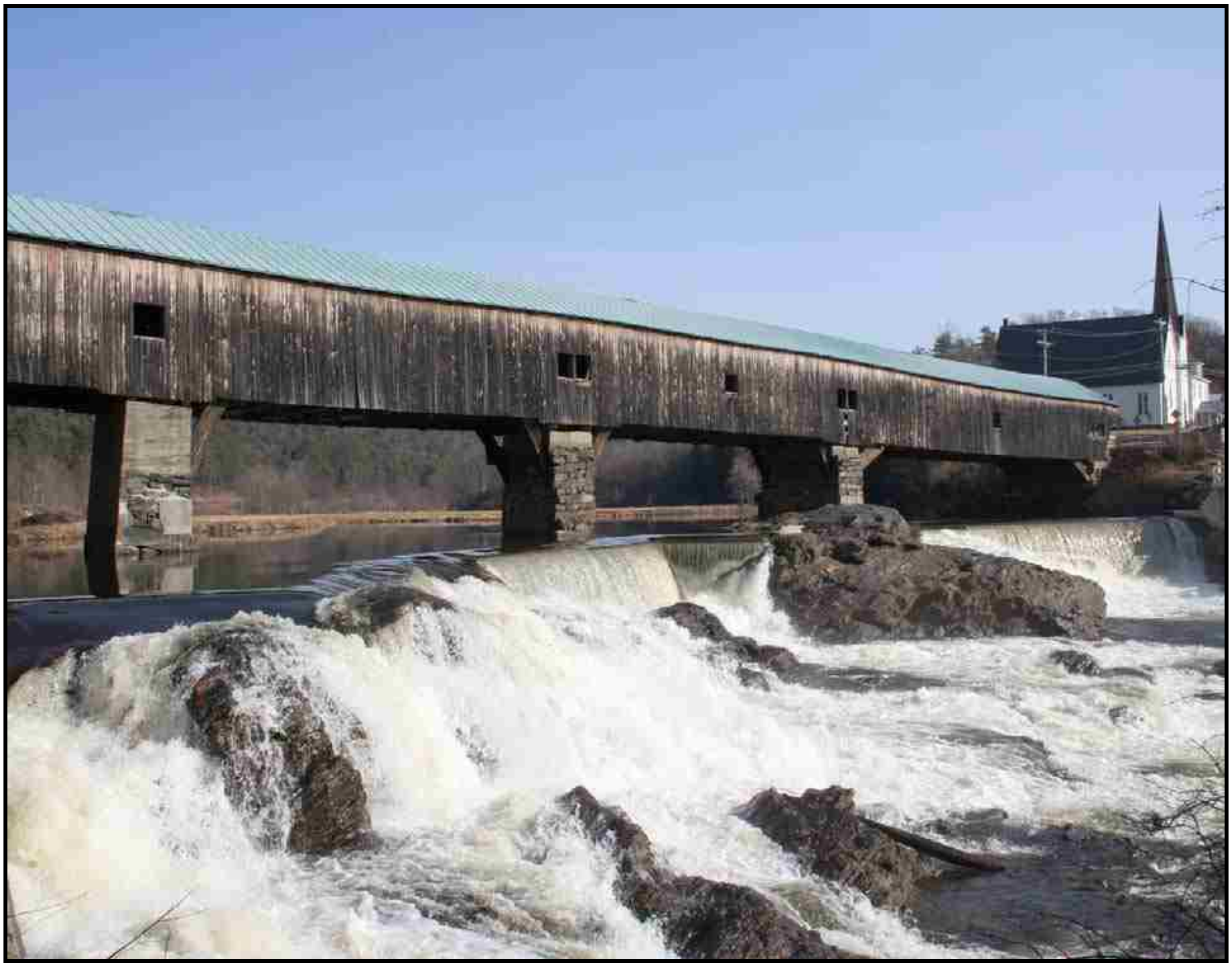
Bath Village Covered Bridge
Bath, New Hampshire

Rehabilitation Project Report



Prepared by:

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Manchester, New Hampshire 0310

November 2011

CONTENTS

1.0 SUMMARY

This report was compiled by Historic Documentation Company, Inc. (HDC) and Hoyle Tanner and Associates, Inc. (HTA) to meet the cultural resource permitting requirements set forth by the NHDOT Cultural Resource Committee (Committee). The Committee members represent the interests of the Federal Highway Administration, New Hampshire Department of Transportation and New Hampshire Division of Historical Resources. Richard M. Casella of HDC and Sean T. James, P.E. of HTA were the report's principal authors.

The purpose of this report is to compile all available past and present engineering studies, historical reports and other information pertaining to the Bath Village Covered Bridge. It is the product of numerous authors and contributors who have studied and reported on the bridge in the past as well as in conjunction with the present project. Additional investigations of the individual components and features of the Bath Village Covered Bridge were conducted by HDC in the effort to answer questions raised by the Committee regarding age, condition and proposed repairs or "treatment." This information is presented in Section 6.0 on forms created for this report called Bridge Feature Inventory & Treatment Forms.

2.0 INTRODUCTION

2.1 Project Purpose and Need

The project purpose and need is stated in the *National Historic Covered Bridge Preservation Project (NHCBPP) Application* (included at the end of this section).

This purpose of this document is to compile all available prior and current information pertaining to the Bath Village Covered Bridge into a single reference volume.

2.2 General Description of Work

A detailed description of the proposed work is presented in the *NHCBPP Application* included in this section.

Also see:

Section 4.4 HTA Engineering Study
Section 6.0 Rehabilitation Treatments

2.3 Assessment of Project Effects

All proposed work is being undertaken with the intent to meet the general provisions of the *Secretary of the Interior's Standards for the Treatment of Historic Properties* (Secretary's Standards) which are followed by the New Hampshire Division of Historical Resources (NHDHR) in the project effects review process. Further guidance in the determination of historically acceptable treatments for covered bridges was obtained from the *Draft Guidelines for the Treatment and Rehabilitation of Historic Covered Bridges* (Covered Bridge Guidelines), however, it is noted that they have not yet been adopted as official federal standards and therefore do not supersede the Secretary's Standards in the Section 106 review process. To determine if the project meets the spirit of the Secretary's Standards, the effects to the property's character-defining features have been identified. The primary character defining features of covered timber truss bridges is generally agreed upon by bridge historians to be the components of the truss frame itself, plus any other components specially designed or fabricated that give the truss or overall bridge design uncommon characteristics. Architectural embellishments and timber arches are examples of special features.

In the case of the Bath Village Covered Bridge, not only are the trusses and the built-in arches important features, but the knee braces, cross beams and upper lateral bracing also possess special characteristics and workmanship that contribute to the historic significance of the structure as a whole. The great width of the bridge required larger than typical cross beams and lateral bracing members that are joined with mortise and tenons or other types of hand-crafted and tree-nailed wood joints. The cross beam-to-lateral joints are post-tensioned with wedges to form an exceptionally rigid horizontal transverse framework. The knee braces are also special, joining not just the posts to the crossbeams as is typical, but extending up to join with the corresponding rafter as well. The knee brace connections have cut and fitted joints fastened with trunnels to form a vertical transverse framework also of exceptional rigidity. These two intricately and precisely fabricated bracing systems have undoubtedly contributed to the survival of the structure by strictly limiting the racking and sway produced by wind and moving loads that can loosen, wear and weaken truss joints by continuous movement.

Also of importance according to the Secretary's Standards, are "changes to a property that have acquired historic significance in their own right." Examples include the nail-laminated arches added to increase the loading created by motorized vehicles, and the timber bents added by the railroad under the west end of the bridge to provide additional clearance for trains passing underneath.

The floor, roof and siding members of a covered bridge are subject to weathering and wear and are typically of simple design with nailed or spiked connections to allow easy renewal at regular intervals. These components of the Bath Bridge have been completely or partially replaced several times. Other covered bridge studies and rehabilitation projects have considered these components to be non-character-defining features unless they are unusual in some way.

Character defining features must also retain physical integrity of original design and materials to be contributing features – those features that contribute to the historical significance of the bridge. Considerable difference of opinion often exists regarding when a feature is damaged or deteriorated to the point that it cannot be *reasonably repaired* in accordance with the Secretary's Standards. Features that all agree cannot be reasonably repaired can be considered to have lost their integrity of materials and design and therefore open to less strict alternative treatments. The Covered Bridge Guidelines (non-regulating) recommend that after stabilization and protection of the bridge from ongoing deterioration or damage, the next levels of *Rehabilitation Practice* are *Repairing* followed by *Replacing*. According to the Guidelines:

> Repairing should be done "with the least degree of intervention possible such as patching-in, piecing in, splicing, consolidating, or otherwise reinforcing or supplementing those features according to recognized preservation methods. Repairing also includes the limited replacement in-kind or with compatible substitute material of extensively deteriorated or missing parts or features."
>
> "Following repair in hierarchy, Rehabilitation guidance is provided for replacing and entire character defining feature with new material because the level of deterioration or damage of materials precludes repair, for example, exterior siding, interior truss members, or a complete floor system or roof. If the essential form and detailing are still evident so that the physical

> evidence can be used to reestablish the feature as an integral part of the rehabilitation, then its replacement is appropriate."

The Guidelines do not specify the exact actions to be taken; the bridge owner, the project engineers and the funding and permitting agencies involved are responsible for defining the steps taken in each historic bridge rehabilitation project. Each step should be considered and adjusted to best solve the unique problems of each bridge and achieve the overall project goals.

For example, general ongoing maintenance and small targeted-repair projects have different objectives than comprehensive rehabilitation projects such as the Bath Village Covered Bridge Rehabilitation Project where the purpose is to provide additional capacity for emergency vehicles and extend the service life of the bridge far into the future. If a truck hits several truss members and renders them structurally deficient, the most practical repair may be splicing and sistering the members, not only in terms of cost, but because it avoids shoring and disassembly of the truss to replace the members which puts the entire structure at risk. Conversely, when the number or type of repairs requires shoring and disassembly of the structure, then splicing or sistering is not the desirable long-term repair: portions of deteriorated members left behind may deteriorate more rapidly than a new member; repairs that introduce metal bolts or straps deteriorate the wood they contact through moisture condensation; a repaired member does not behave the same as a single member of uniform integrity.

It is prudent then to consider the structural systems of the bridge as complete assemblies dependent on the individual integrity and service life of each individual member. Whenever possible, repairs to individual members should be in the manner that insures the longest service while replicating the original design and purpose of the member. If a member was originally spliced, such as a long chord or arch made up of multiple boards spliced together, then splicing-in new members is appropriate. If an original member was designed to be cut from a single piece of wood, such as a post or diagonal, then so should the replacement. The intent of the Bath Village Bridge rehabilitation is to replace *critical structural members* in-kind and not introduce splices or splints that are foreign to the original design or of inferior structural integrity and service life. Splicing, splints or other repairs that preserve part of the fabric of a deteriorated member will be used to the extent practical on non-critical members.

2.4 Discussion of Alternatives

Alternatives to the proposed rehabilitation project consist of building a new bridge in a new location or doing nothing. Doing nothing is not an option since the bridge is structurally degraded and is a critical component of the local road system for public safety reasons.

An Alternative River Crossings Study was conducted by HTA and the findings presented to the NHDOT Cultural Resource Meeting on September 11, 2008. The study is included at the back of this section.

It was determined that there are no practical locations for a new bridge crossing and that rehabilitation of the historic covered bridge for continued service with a load capacity of 10 tons was in the Town's best interests.

Alternatives for the treatment of individual features and components of the bridge are discussed in *Section 6.0 Rehabilitation Treatment* on the *Bridge Feature Inventory & Treatment Forms.*

Section 8 Conclusions and Recommendations (Engineering Study for a New Ammonoosuc River Crossing in Bath, NH – October 2009)

The purpose of this study is to provide a systematic review of potential Ammonoosuc River crossing locations to aid the Town of Bath in their future planning processes. Specialized subconsultants were retained for this project which enabled us to include summary information on permitting, environmental and archaeological issues associated with a new river crossing (see exhibits to this study). Initial scoping meetings were held with representatives from the Town of Bath and the New Hampshire Department of Transportation (NHDOT) to formalize the project scope and to narrow the areas of study. Six study areas were selected and a total of 27 potential crossings were initially reviewed within an area extending from approximately 1.5 miles south of the Bath Lower Village to 2.5 miles north of the village, centered on the Ammonoosuc River. In addition, two options at the Bath Village Covered Bridge were studied. Three of these initial options (2A, 3D and 4C) were studied in more detail and presented at a public information meeting in December 2008. As a result of the feedback received at the public information meeting three additional alignments were examined in areas 3 and 4 (immediately south and north of the Bath Village Covered Bridge respectively).

The two options studied at the existing Bath Village covered bridge site included the addition of steel beams under the bridge and relocation of the covered bridge with a new bridge constructed in its current location (see Section 6.2.4). The NHDOT has previously indicated that they would not participate in the cost of adding steel beams under the covered bridge so this option would require 100% Town funding. Adding steel beams under the covered bridge, which are deeper than the covered bridge structure below the deck, would require raising it and each approach to maintain the existing 16 feet of vertical clearance at the rail trail. If the covered bridge is relocated, it is likely that the NHDOT would require between 19 feet 6 inches and 21 feet of vertical clearance over the rail trail. This, in combination with a deeper bridge structure depth of a new bridge, would raise each approach to the bridge. For both options, the raise in grade would make Railroad Street and the access drive to NH Wood Products, Inc. unusable and require relocation of each.

Each covered bridge option would be subject to a Section 106 review by the New Hampshire Division of Historical Resources (NHDHR). This review would be triggered as part of the wetlands permit required for construction which as part of the permitting process incorporates the US Army Corps of Engineers NH General Programmatic General Permit regardless of the type of funding used for the work (Town, State or Federal). Furthermore, NHDHR may not approve the addition of steel beams under the covered bridge and it is unclear if relocation would be approved.

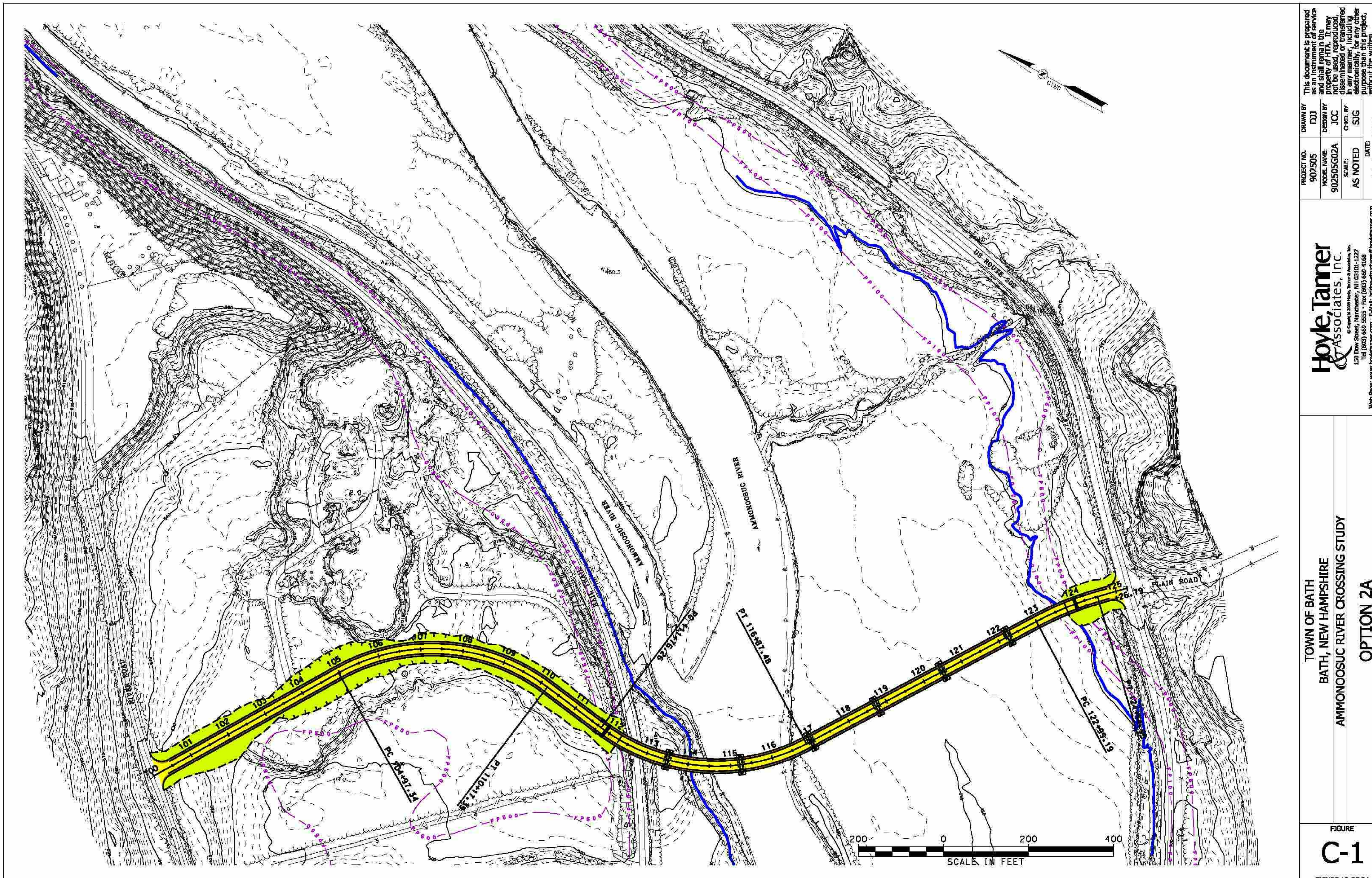
The decision to build a new river crossing is clearly a local decision that must be made within the constraints of state and federal regulations. As part of the December 2008 public information meeting, verbal and written feedback was received for Options 2A, 3D and 4C (see Appendix E). It is clear from the feedback that Option 3 was not preferred by the attendees and there was nearly equal support for Options 2A and 4C. Alternate suggestions were made for variations of alignments 3D and 4C which were subsequently examined (see Section 6.3 and Appendix D). Suggestions were also made that the Town build a duplicate public safety / public works facility on the west side of the Ammonoosuc River and not pursue a new river crossing. While these suggestions may be explored by the Town in the future, it was outside of the scope of this Study.

Based upon our study of the crossing options discussed as well as the input received at the public information meeting, Option 2A and Options in Study Area 4 appear to be reasonable options for a new river crossing. Each Option has advantages and disadvantages as well as physical and regulatory *constraints. The Town must weigh its needs against the Town's collective wants, public acceptance of particular options and financial realities.*

The main advantages to Option 2A appear to be that it may not require acquisition of a home near the west end of the covered bridge and does not have a visual impact on a district that is eligible for the National Register of Historic Places. The biggest disadvantage to Option 2A appears to be that it utilizes River Road for traffic on the west side of the river north of the new bridge. This road is in fair to poor condition with several very narrow or steep sections that would be expensive to upgrade for the potential volume and type of traffic a new bridge could accommodate. It is important to note that River Road is very steep near the Bath Village Covered Bridge. Correcting this roadway deficiency would require rerouting a portion of River Road and may involve acquisition of the previously mentioned home which negates its most apparent advantage.

Several options were reviewed within study area 4 with Option 4C providing the best solution from an engineering perspective. Option 4C has precedence as a similar bypass bridge was recently built just downstream of the Haverhill-Bath Covered Bridge. This study area is particularly advantageous since it is a naturally narrow part of the river, provides good access for emergency and public work vehicles and provides connectivity to the existing road network. Option 4C also has the lowest estimated cost of all options studied. Its cultural disadvantages are that it requires the acquisition of a home and would impair the view some residents have of the covered bridge. It would also affect the viewscape of a district that is eligible for the National Register of Historic Places.

In summary, Option 4C provides the best potential for a new Ammonoosuc River Crossing and is the least expensive option studied in detail. This option is not without its disadvantages, including potential opposition from nearby residents which the Town must weigh against its overall needs and financial constraints. If there are strong public objections to Option 4C, Option 4I could also be considered by the Town. Option 4I would be much more costly than Option 4C but would not require acquisition of an active home and would not block the view of the covered bridge for nearby residents.


TOWN OF BATH
BATH, NEW HAMPSHIRE
AMMONOOSUC RIVER CROSSING STUDY
OPTION 2A
FIGURE
C-1
FIGURE 12 OF 24
Hoyle, Tanner & Associates, Inc.
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150 Dow Street, Manchester, NH 03101-1227
Tel (603) 669-5555 · Fax (603) 669-4168
Web Page: www.hoyletanner.com · E-Mail: bridge-structures@hoyletanner.com
PROJECT NO.
902505
MODEL NAME:
902505G02A
SCALE:
AS NOTED
DATE:
OCTOBER, 2009
DRAWN BY
DJJ
DESIGN BY
JCC
CHKD. BY
SJG
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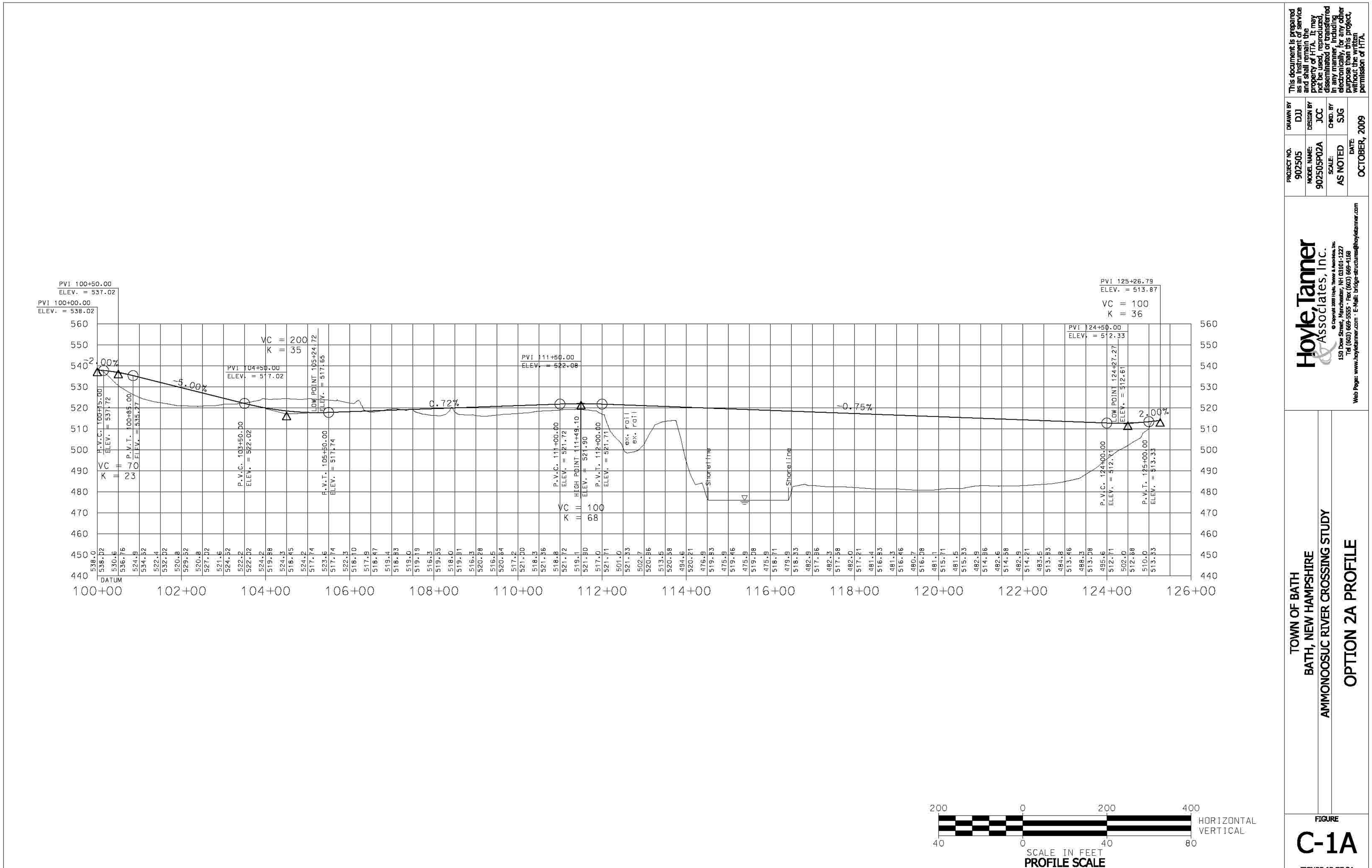
US ROUTE 302
AMMONOOSUC RIVER
PLAIN ROAD
RIVER ROAD
PC 104+87.34
PI 110+11.38
PT 116+87.48
PC 122+98.19
SCALE IN FEET
200
0
200
400


PVI 100+50.00
ELEV. = 537.02
PVI 100+00.00
ELEV. = 538.02
-2.00%
-5.00%
0.72%
-0.75%
2.00%
VC = 70
K = 23
VC = 200
K = 35
VC = 100
K = 68
VC = 100
K = 36
PVI 104+50.00
ELEV. = 517.02
PVI 111+50.00
ELEV. = 522.08
PVI 124+50.00
ELEV. = 512.33
PVI 125+26.79
ELEV. = 513.87
LOW POINT 105+24.72
ELEV. = 517.65
HIGH POINT 111+49.10
ELEV. = 521.90
LOW POINT 124+27.27
ELEV. = 512.61
ex. rail
Shoreline
DATUM
100+00
102+00
104+00
106+00
108+00
110+00
112+00
114+00
116+00
118+00
120+00
122+00
124+00
126+00
HORIZONTAL
VERTICAL
SCALE IN FEET
PROFILE SCALE
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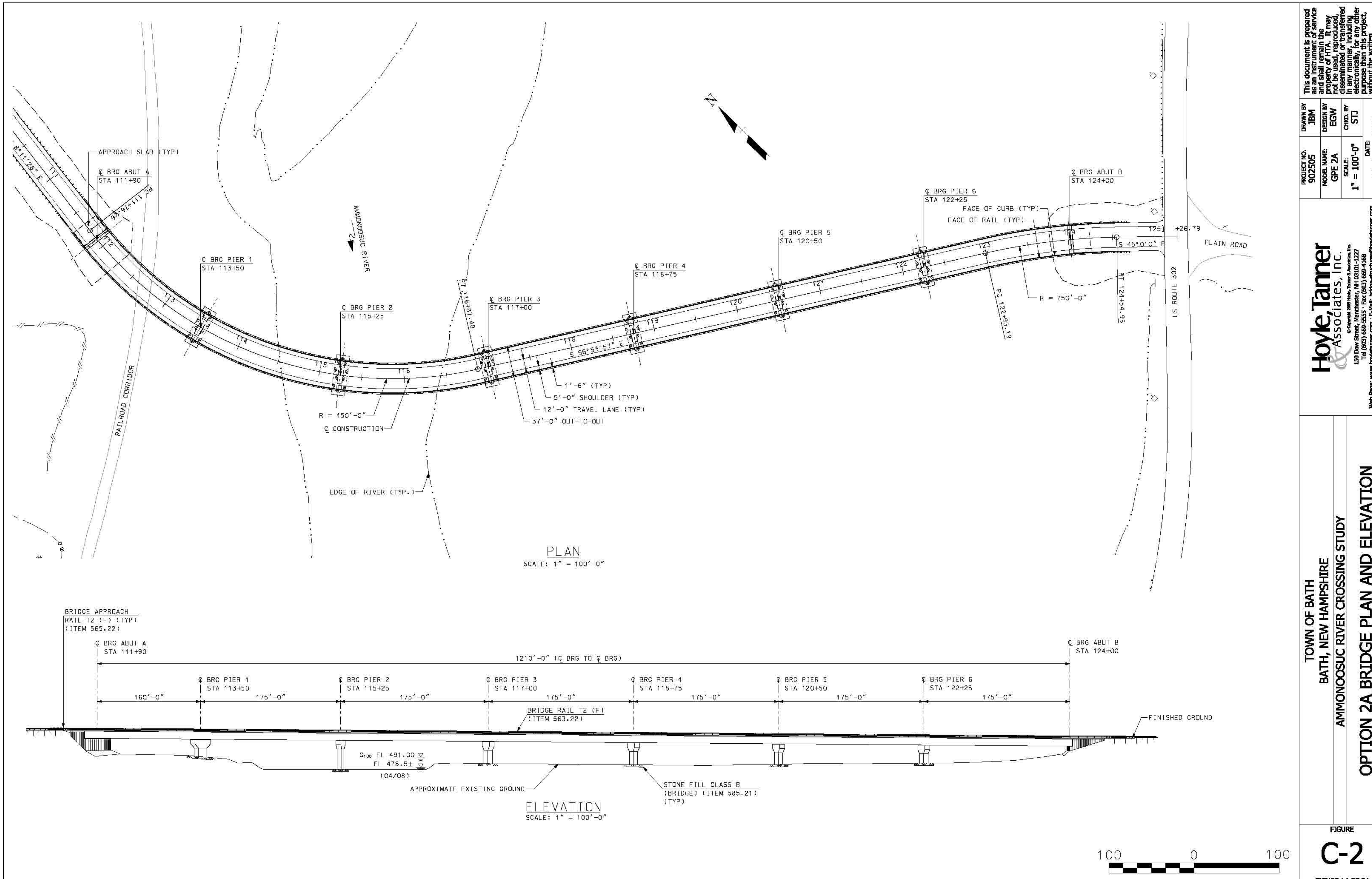
PROJECT NO. 902505
MODEL NAME: 902505P02A
SCALE: AS NOTED
DATE: OCTOBER, 2009
Hoyle, Tanner & Associates, Inc.
TOWN OF BATH
BATH, NEW HAMPSHIRE
AMMONOOSUC RIVER CROSSING STUDY
OPTION 2A PROFILE
FIGURE
C-1A
FIGURE 13 OF 24


APPROACH SLAB (TYP)
℄ BRG ABUT A
STA 111+90
℄ BRG PIER 1
STA 113+50
℄ BRG PIER 2
STA 115+25
℄ BRG PIER 3
STA 117+00
℄ BRG PIER 4
STA 118+75
℄ BRG PIER 5
STA 120+50
℄ BRG PIER 6
STA 122+25
℄ BRG ABUT B
STA 124+00
FACE OF CURB (TYP)
FACE OF RAIL (TYP)
AMMONOOSUC RIVER
RAILROAD CORRIDOR
PLAIN ROAD
US ROUTE 302
S 56°53'57" E
S 45°0'0" E
R = 450'-0"
R = 750'-0"
℄ CONSTRUCTION
1'-6" (TYP)
5'-0" SHOULDER (TYP)
12'-0" TRAVEL LANE (TYP)
37'-0" OUT-TO-OUT
EDGE OF RIVER (TYP.)
PC 122+99.19
PT 124+54.95
PT 116+87.48
PLAN
SCALE: 1" = 100'-0"
BRIDGE APPROACH
RAIL T2 (F) (TYP)
(ITEM 565.22)
1210'-0" (℄ BRG TO ℄ BRG)
160'-0"
175'-0"
BRIDGE RAIL T2 (F)
(ITEM 563.22)
FINISHED GROUND
Q100 EL 491.00
EL 478.5±
(04/08)
APPROXIMATE EXISTING GROUND
STONE FILL CLASS B
(BRIDGE) (ITEM 585.21)
(TYP)
ELEVATION
SCALE: 1" = 100'-0"
100 0 100
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PROJECT NO. 902505
MODEL NAME: GPE 2A
SCALE: 1" = 100'-0"
DATE: OCTOBER, 2009
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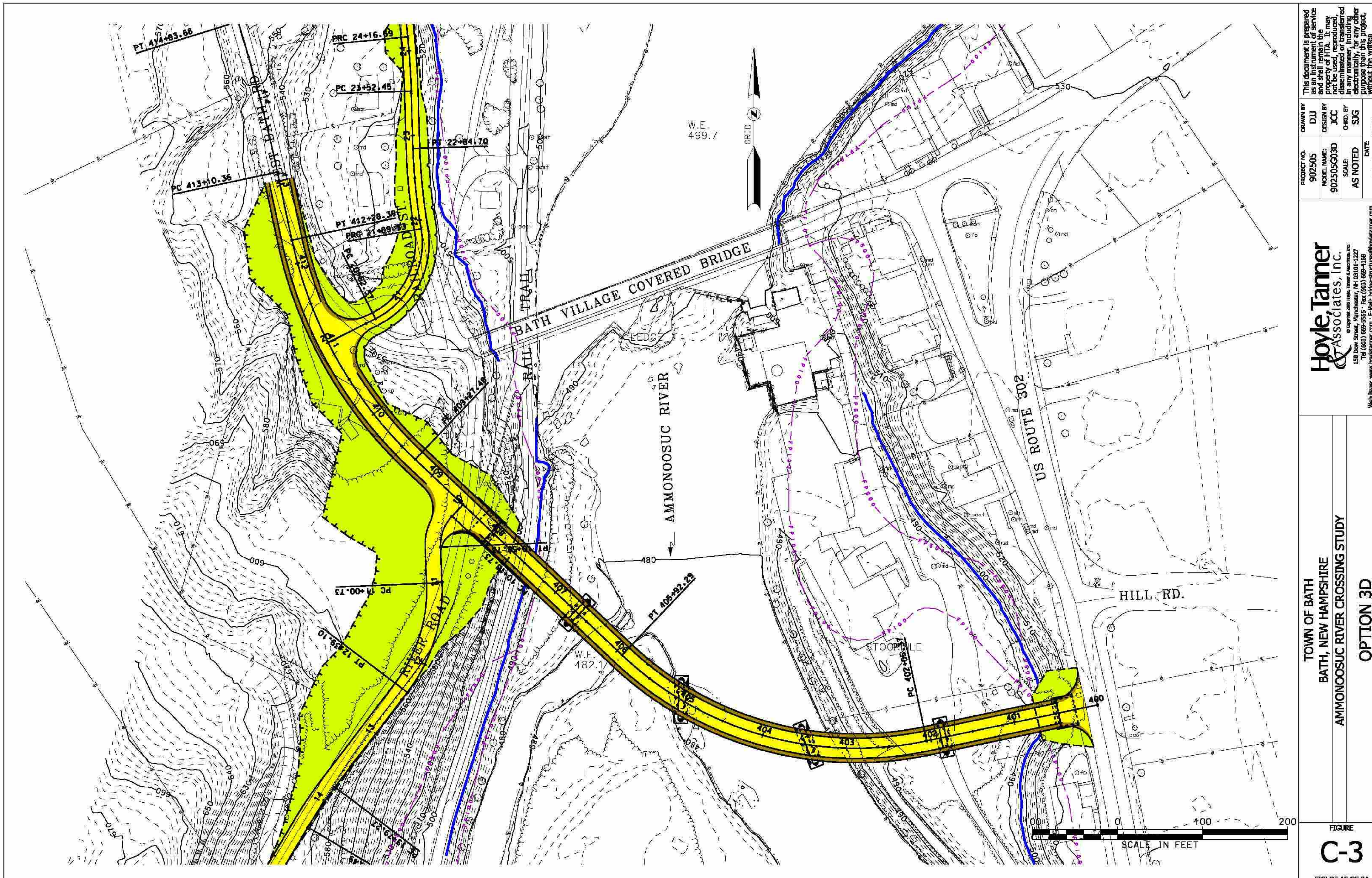
150 Dow Street, Manchester, NH 03101-1227
TOWN OF BATH
BATH, NEW HAMPSHIRE
AMMONOOSUC RIVER CROSSING STUDY
OPTION 2A BRIDGE PLAN AND ELEVATION
FIGURE
C-2
FIGURE 14 OF 24


BATH VILLAGE COVERED BRIDGE
AMMONOOSUC RIVER
US ROUTE 302
HILL RD.
RAIL TRAIL
RIVER ROAD
RAILROAD ST.
W.E. 499.7
W.E. 482.1
LEDGE
STOCKPILE
PT 414+83.68
PRC 24+16.59
PC 23+52.45
PT 22+84.70
PC 413+10.36
PT 412+28.39
PT 405+92.29
PC 402+08.37
PC 11+00.73
GRID N
SCALE IN FEET
100 0 100 200
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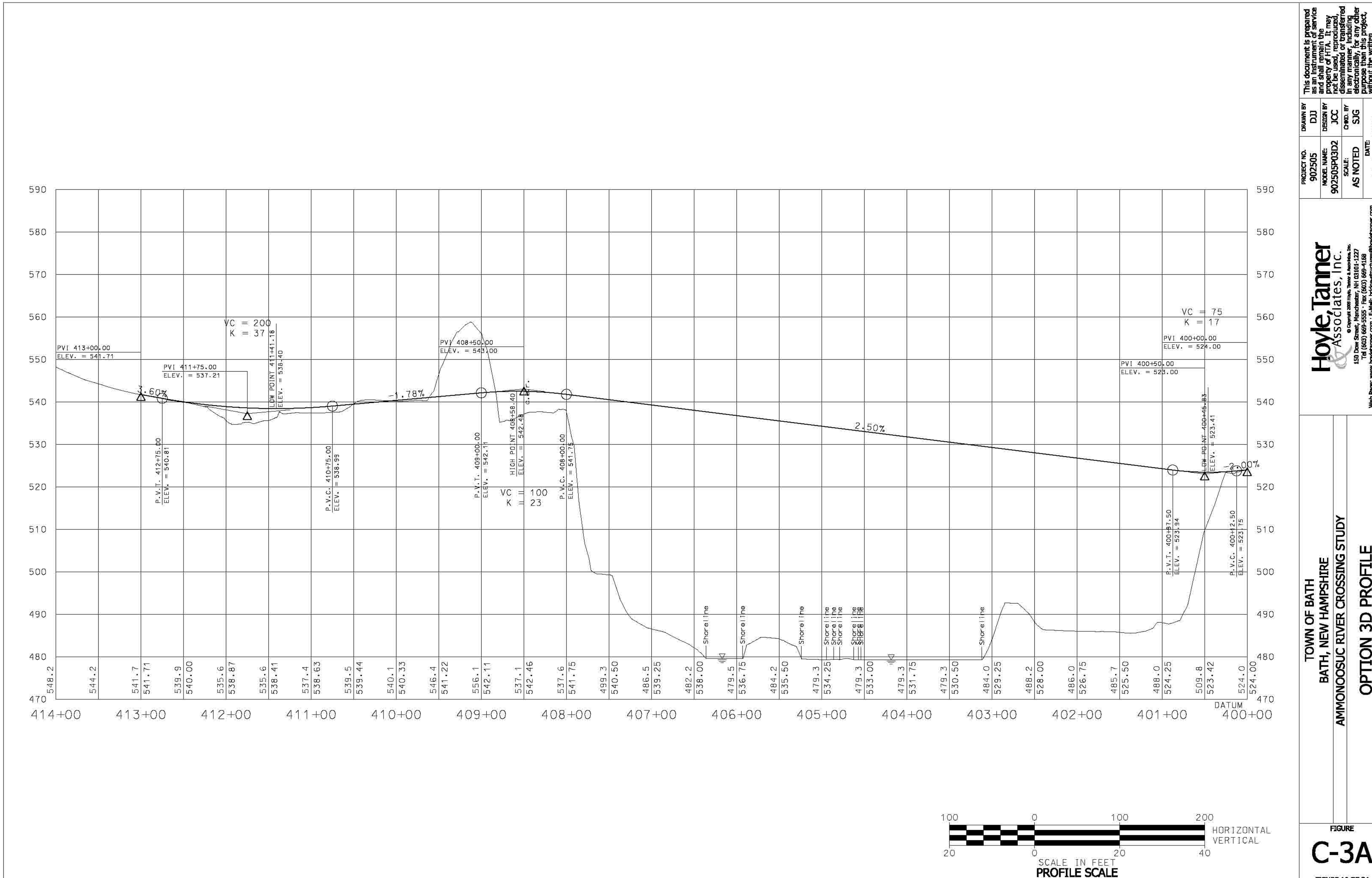
TOWN OF BATH
BATH, NEW HAMPSHIRE
AMMONOOSUC RIVER CROSSING STUDY
OPTION 3D
FIGURE
C-3
FIGURE 15 OF 24


PVI 413+00.00
ELEV. = 541.71
PVI 411+75.00
ELEV. = 537.21
VC = 200
K = 37
LOW POINT 411+41.18
ELEV. = 538.40
PVI 408+50.00
ELEV. = 543.00
-1.78%
P.V.T. 412+75.00
ELEV. = 540.81
P.V.C. 410+75.00
ELEV. = 538.99
P.V.T. 409+00.00
ELEV. = 542.11
HIGH POINT 408+58.40
ELEV. = 542.48
VC = 100
K = 23
P.V.C. 408+00.00
ELEV. = 541.75
2.50%
VC = 75
K = 17
PVI 400+00.00
ELEV. = 524.00
PVI 400+50.00
ELEV. = 523.00
LOW POINT 400+46.83
ELEV. = 523.41
P.V.T. 400+87.50
ELEV. = 523.94
P.V.C. 400+12.50
ELEV. = 523.75
-2.00%
Shoreline
DATUM
414+00
413+00
412+00
411+00
410+00
409+00
408+00
407+00
406+00
405+00
404+00
403+00
402+00
401+00
400+00
HORIZONTAL
VERTICAL
SCALE IN FEET
PROFILE SCALE
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MODEL NAME: 902505P03D2
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DATE: OCTOBER, 2009
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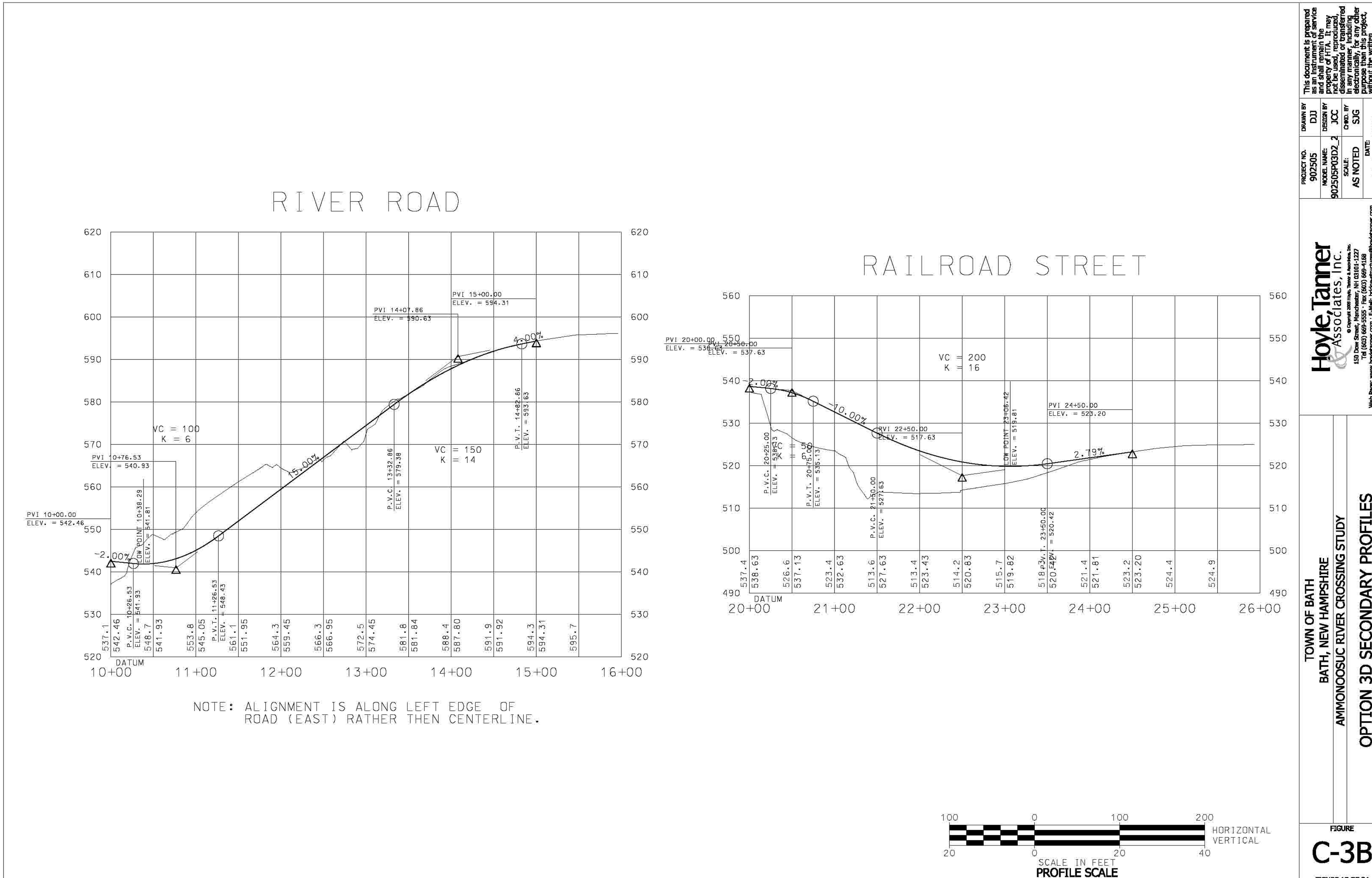
TOWN OF BATH
BATH, NEW HAMPSHIRE
AMMONOOSUC RIVER CROSSING STUDY
OPTION 3D PROFILE
FIGURE
C-3A
FIGURE 16 OF 24


RIVER ROAD
NOTE: ALIGNMENT IS ALONG LEFT EDGE OF ROAD (EAST) RATHER THEN CENTERLINE.
RAILROAD STREET
PROFILE SCALE
SCALE IN FEET
HORIZONTAL
VERTICAL
Hoyle, Tanner & Associates, Inc.
PROJECT NO. 902505
MODEL NAME: 902505P03D2_2
SCALE: AS NOTED
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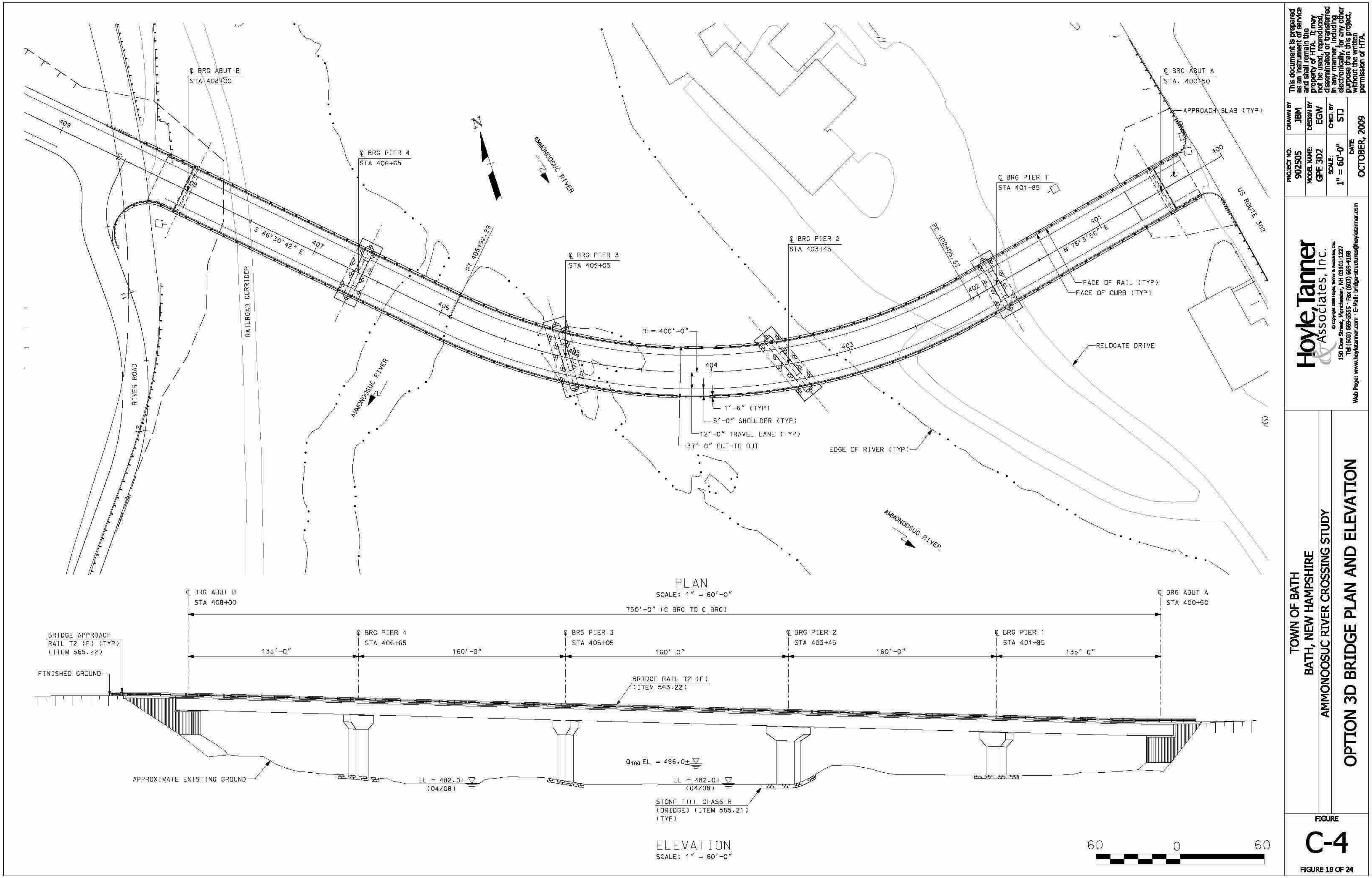
TOWN OF BATH
BATH, NEW HAMPSHIRE
AMMONOOSUC RIVER CROSSING STUDY
OPTION 3D SECONDARY PROFILES
FIGURE
C-3B
FIGURE 17 OF 24


PLAN
SCALE: 1" = 60'-0"
ELEVATION
SCALE: 1" = 60'-0"
℄ BRG ABUT B
STA 408+00
℄ BRG PIER 4
STA 406+65
℄ BRG PIER 3
STA 405+05
℄ BRG PIER 2
STA 403+45
℄ BRG PIER 1
STA 401+85
℄ BRG ABUT A
STA 400+50
750'-0" (℄ BRG TO ℄ BRG)
135'-0"
160'-0"
160'-0"
160'-0"
135'-0"
APPROACH SLAB (TYP)
S 46°30'42" E
N 78°3'56" E
PT 405+92.29
PC 402+05.37
R = 400'-0"
1'-6" (TYP)
5'-0" SHOULDER (TYP)
12'-0" TRAVEL LANE (TYP)
37'-0" OUT-TO-OUT
FACE OF RAIL (TYP)
FACE OF CURB (TYP)
RELOCATE DRIVE
EDGE OF RIVER (TYP)
AMMONOOSUC RIVER
RAILROAD CORRIDOR
RIVER ROAD
US ROUTE 302
BRIDGE APPROACH
RAIL T2 (F) (TYP)
(ITEM 565.22)
FINISHED GROUND
BRIDGE RAIL T2 (F)
(ITEM 563.22)
Q_{100} EL = 496.0±
EL = 482.0±
(04/08)
APPROXIMATE EXISTING GROUND
STONE FILL CLASS B
(BRIDGE) (ITEM 585.21)
(TYP)
60 0 60
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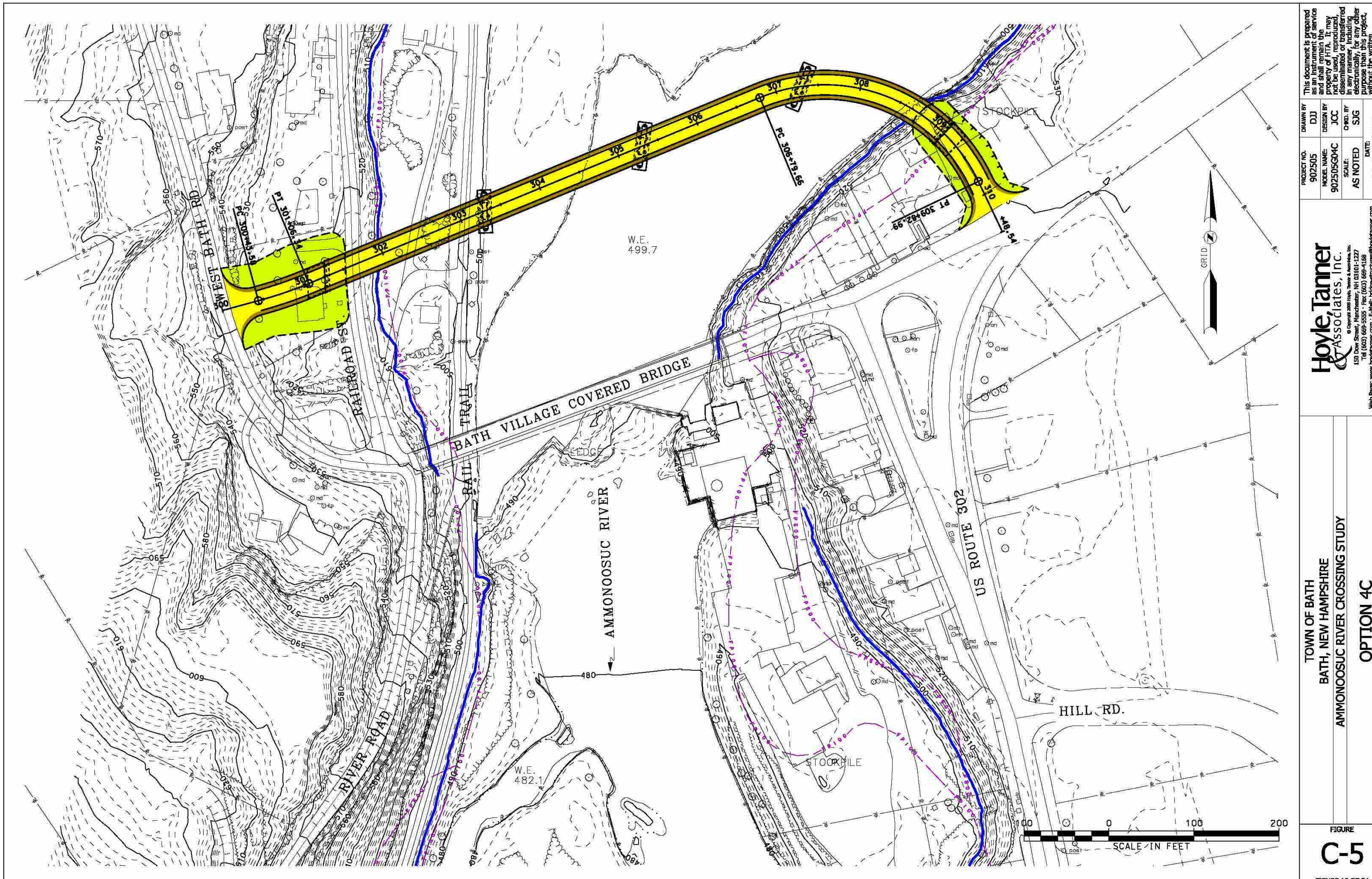
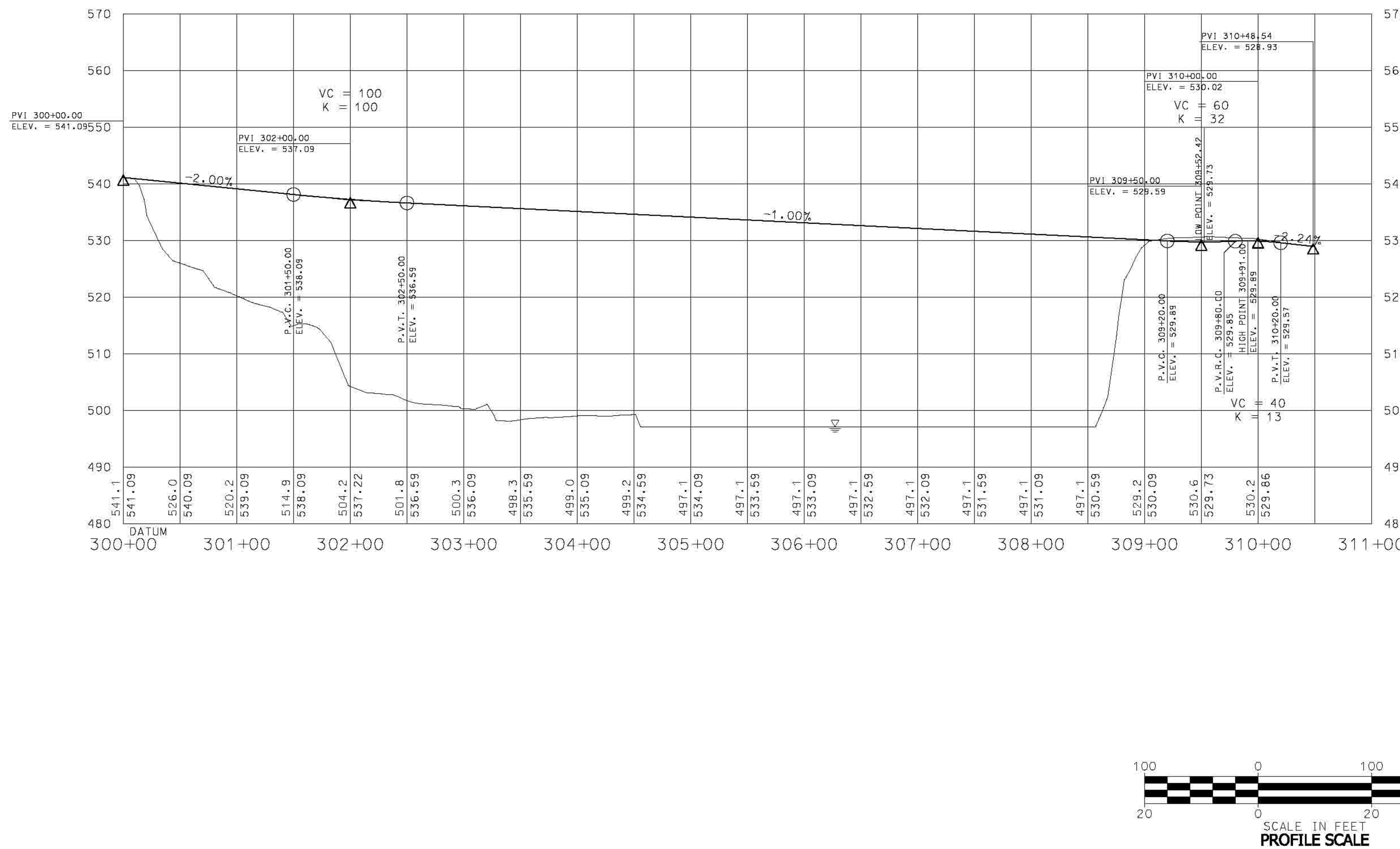
CHKD. BY STJ
PROJECT NO. 902505
MODEL NAME: GPE 3D2
SCALE: 1" = 60'-0"
DATE: OCTOBER, 2009
Hoyle, Tanner & Associates, Inc.
150 Dow Street, Manchester, NH 03101-1227
TOWN OF BATH
BATH, NEW HAMPSHIRE
AMMONOOSUC RIVER CROSSING STUDY
OPTION 3D BRIDGE PLAN AND ELEVATION
FIGURE
C-4
FIGURE 18 OF 24


WEST BATH RD.
RAILROAD ST.
RAIL TRAIL
BATH VILLAGE COVERED BRIDGE
AMMONOOSUC RIVER
RIVER ROAD
US ROUTE 302
HILL RD.
STOCKPILE
LEDGE
W.E. 499.7
W.E. 482.1
PC 306+79.66
PT 309+82.99
PT 301+06.14
SCALE IN FEET
GRID N
TOWN OF BATH
BATH, NEW HAMPSHIRE
AMMONOOSUC RIVER CROSSING STUDY
OPTION 4C
PROJECT NO. 902505
MODEL NAME: 902505G04C
SCALE: AS NOTED
DATE: OCTOBER, 2009
DRAWN BY DJJ
DESIGN BY JCC
CHKD. BY SJG
Hoyle, Tanner & Associates, Inc.
FIGURE
C-5
FIGURE 19 OF 24



DRAWN BY DJJ
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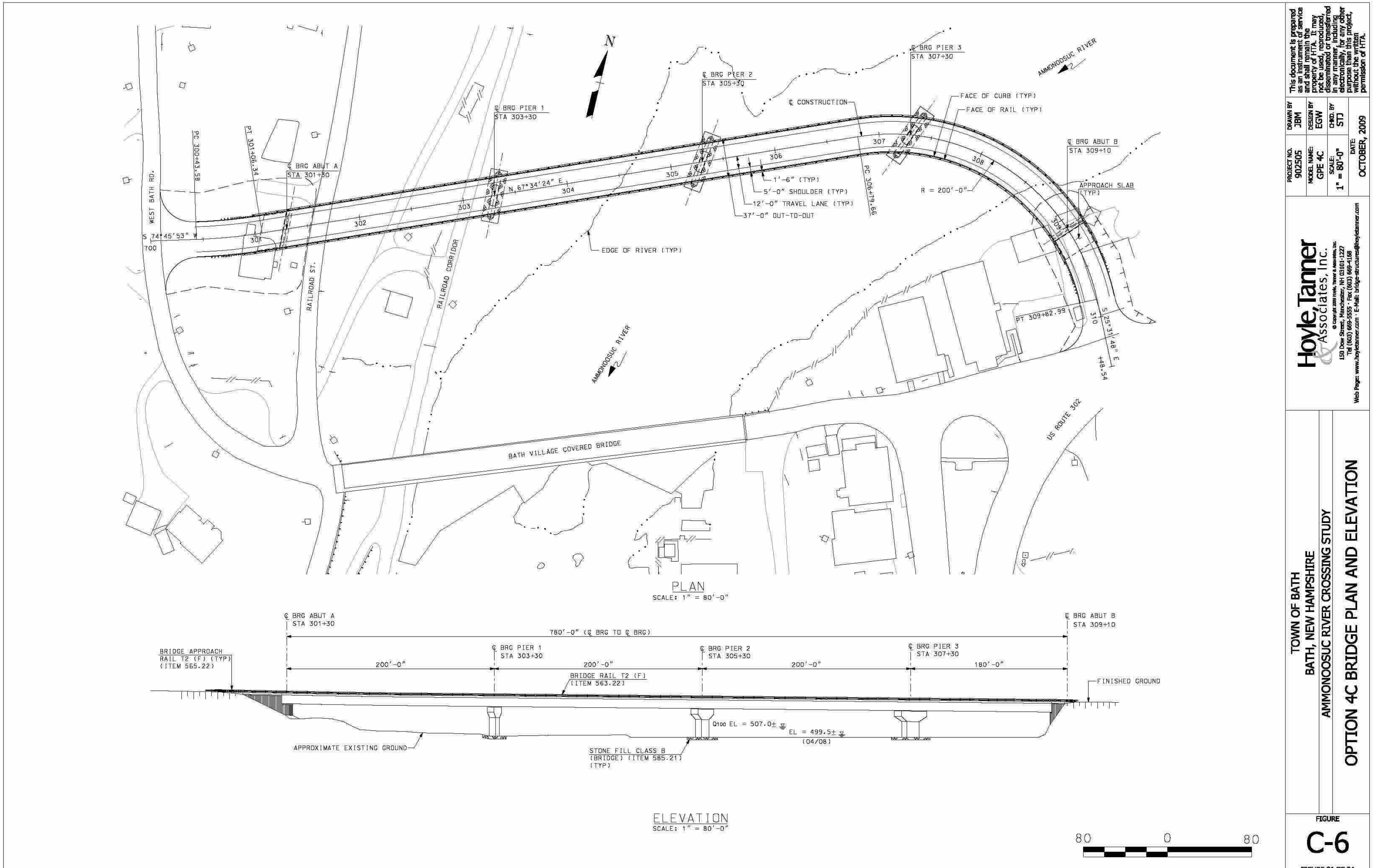
PROJECT NO. 902505
MODEL NAME: 902505P04C
SCALE: AS NOTED
DATE: OCTOBER, 2009

Hoyle, Tanner & Associates, Inc.
150 Dow Street, Manchester, NH 03101-1227
Tel (603) 669-5555 · Fax (603) 669-4168
Web Page: www.hoyletanner.com E-Mail: bridge-structures@hoyletanner.com

TOWN OF BATH
BATH, NEW HAMPSHIRE
AMMONOOSUC RIVER CROSSING STUDY

OPTION 4C PROFILE

FIGURE
C-5A
FIGURE 20 OF 24


PLAN
SCALE: 1" = 80'-0"
ELEVATION
SCALE: 1" = 80'-0"
℄ BRG ABUT A
STA 301+30
℄ BRG PIER 1
STA 303+30
℄ BRG PIER 2
STA 305+30
℄ BRG PIER 3
STA 307+30
℄ BRG ABUT B
STA 309+10
℄ CONSTRUCTION
FACE OF CURB (TYP)
FACE OF RAIL (TYP)
1'-6" (TYP)
5'-0" SHOULDER (TYP)
12'-0" TRAVEL LANE (TYP)
37'-0" OUT-TO-OUT
R = 200'-0"
APPROACH SLAB (TYP)
EDGE OF RIVER (TYP)
N 67°34'24" E
S 74°45'53" W
S 25°31'48" E
PC 300+43.58
PT 301+06.34
PC 306+79.66
PT 309+82.99
WEST BATH RD.
RAILROAD ST.
RAILROAD CORRIDOR
AMMONOOSUC RIVER
BATH VILLAGE COVERED BRIDGE
US ROUTE 302
780'-0" (℄ BRG TO ℄ BRG)
200'-0"
200'-0"
200'-0"
180'-0"
BRIDGE APPROACH RAIL T2 (F) (TYP) (ITEM 565.22)
BRIDGE RAIL T2 (F) (ITEM 563.22)
FINISHED GROUND
APPROXIMATE EXISTING GROUND
STONE FILL CLASS B (BRIDGE) (ITEM 585.21) (TYP)
Q100 EL = 507.0±
EL = 499.5± (04/08)
80 0 80
This document is prepared as an instrument of service and shall remain the property of HTA. It may not be used, reproduced, disseminated or transferred in any manner, including electronically, for any other purpose than this project, without the written permission of HTA.
DRAWN BY JBM
DESIGN BY EGW
CHKD. BY STJ
PROJECT NO. 902505
MODEL NAME: GPE 4C
SCALE: 1" = 80'-0"
DATE: OCTOBER, 2009
Hoyle, Tanner & Associates, Inc.
150 Dow Street, Manchester, NH 03101-1227
TOWN OF BATH
BATH, NEW HAMPSHIRE
AMMONOOSUC RIVER CROSSING STUDY
OPTION 4C BRIDGE PLAN AND ELEVATION
FIGURE
C-6
FIGURE 21 OF 24

3.0 HISTORICAL & DESCRIPTIVE INFORMATION

3.1 Historical Significance Statement

Bath Village Covered Bridge was built in 1832, making it one of the oldest surviving covered bridges in the United States. It is of a rare structural design that combines an intricately crafted wood truss with an integral timber arch and only one other bridge of like design is known to exist in New England. Thanks to the custodianship of the small town of Bath, the bridge has been well maintained over its nearly 170 years of service so that it retains a very large percentage of its original structural members, a remarkable feat of preservation in its own right.

The bridge was recognized for its historical importance and listed in the National Register of Historic Places in 1976. It was further recognized for its great importance to the history of engineering in 2002 when it was documented and entered into the Historic American Engineering Record (HAER). The rarity and importance of the bridge's skeleton is described in the HAER report by covered bridge historian Joseph Conwill:

> Bath Bridge represents the early idiosyncratic craftsman tradition of early wooden truss bridges building, before designs became more standardized under the influence of the major patented truss plans. It is very difficult to classify. It is more like a Burr Truss than anything else, but the standard Burr does not have the braces overlapping the panel points, and it usually has the arch footing directly on the abutments. Because of the overlapping braces, Bath Bridge slightly resembles the Haupt truss, but this was not patented until 1839 and the 1832 date for the Bath Bridge is very well established.

Conwill notes that the mortising of the posts and diagonals into the chord members "is surprisingly similar to the counterbrace treatment developed a decade later by Peter Paddleford of nearby Littleton," and that together with the one other surviving bridge of the type – the Sayle's Bridge in Thetford, Vermont – "these two bridges may be the last remnants of an old regional building tradition."

The rare built-in arch members are exception in design and workmanship as described by James Garvin, New Hampshire State Architectural Historian:

> The arches have been hewn on their upper and lower surfaces to gentle segmental curves that, in the case of the two longer original spans, bring the apex of each arch to the upper chord of the truss. This hewing was done with great skill, producing an even curve and smoothing the upper and lower surfaces of the arch so carefully that the adze marks can hardly be seen. It is apparent the original planks from which these arches were hewn must have been of great depth to permit the curves to be laid out across their faces and to provide for the fourteen inch depth of each arch after the excess wood was hewn away.

Bath Bridge is also exceptional both for the length of its individual spans, its overall length and its uncommon width. The west span with its original length of 175 feet (prior to the much later addition of a support pier) placed it among the longest-span bridges of its day. With an overall length of 375 feet and width of 24'-6", it stands as one of America's monumental covered bridges.

3.2 Timeline Summary of Events Associated with Bridge

The following sections highlight major known events that occurred at the bridge between 1852 and 2010.

1852 – 1853 The White Mountain Railroad constructed a line adjacent to Bath Village on the west side of the Ammonoosuc River. The line passed under the westerly span of the bridge with the R.O.W. still existing today.

1872 The first mill (a pulp mill) was constructed in the area immediately downstream of the west abutment of the bridge.

1893 A dam was built downstream of the bridge to serve mills on both sides of the river. The dam still serves as a hydroelectric facility and is privately owned. Also, prior to 1893 a new stone pier was constructed beneath the westerly span, modifying the bridge from a three (3) span to a four (4) span continuous structure.

1911 John W. Storrs, a noted bridge engineer from Concord, NH visited the bridge and wrote several letters concerning its condition and capacity. In 1911 he noted that 8,000 pound (4 ton) dump carts full of gravel were passing over the bridge (although he recommended the safe capacity was only 2 tons). He also noted at this time that due to the condition of this bridge, he tentatively recommended constructing a new bridge, subject to a thorough inspection of the lower chords of the trusses that were hidden by wainscoting.

1912 John W. Storrs evaluated the bridge at the request of a Mill operator who wanted to transport a new 10-ton boiler over the bridge. Mr. Storrs conclusion was the bridge was in no way safe for such a load.

1914 Mr. Storrs re-inspected the bridge and prepared detailed calculations of its load carrying capacity. He again stated in a 1915 letter that the bridge had a load limit of 2 tons.

1918 At the Town Meeting, funds were raised for repairs to the bridge. Repairs were performed by Mr. Cyrus Batchelder and were completed in 1919. The Town's share of the repairs cost was $7,076.00. Theses repairs consisted of:

- Raising the bridge two (2) feet at the request of the railroad (and paid for by them).
- Adding laminated arches in the easterly three (3) spans.
- Repairs to a flood damaged pier.
- Construction of concrete caps on all piers as part of the bridge raising.
- Installation of new needle beams and new floor timbers.
- Building up the west stone pier to its full height and cementing its face.
- Shingling the north side of the roof.
- Reboarding (residing) the entire bridge.
- Regrading the roadway approaches to match the new bridge height
- Extending the stone wingwalls vertically to hold back the higher roadway fill. It was noted at the time that the floor decking consisted of two (2) layers of 3" plank, one layer running longitudinal through the bridge and one layer running diagonal.

Between 1919 and 1941 Three (3) timber bents were constructed beneath the far westerly span, and straddled the two (2) railroad tracks. Also during this period, an internal sidewalk (platform) was added to the inside adjacent to the upstream truss. Lights were installed on each portal of the bridge.

1939 - 1940 Extensive repairs were made to the bridge. The only work documented was repairs to the corrugated metal roof.

1954 The portals were reconstructed with the bottom of the portal siding modified to follow an elliptical arch curvature. This was probably an attempt to restore this "arch feature" in the portals which previously existed. Partial new siding was installed at the west abutment on the upstream side.

1968 - 1969 Floor planks were replaced and other minor repairs were made.

1976 Steel channels were added to the lower chords of the trusses over the westerly span at the railroad tracks. Repairs were necessitated as a result of severe rot having been discovered in lower chords of the trusses at this location. The bridge was entered in the National Register of Historic Places on September 1, 1976. The application indicated the historical aspects of the bridge, citing it to be the 5th bridge to stand on this site.

August 21, 1979 An oversized railroad car operated by the Boston and Maine Railroad hit the bridge where the line passes under the westerly span. Temporary repairs were made to the bridge shortly thereafter.

1984 The NHDOT Bureau of Bridge Design placed this bridge on their bridge "red list". Placing the bridge on this list indicated the bridge had a load capacity less than the legal load capacity provided by State statues. Also at this time, the State provided the Town with a cost estimate of $3,000,000 to construct a new bridge at this site, and noted that Federal funds were available to pay for 80% of the project costs.

1985 An inspection and report was made by Mr. Wilbur M. Hoxie, P.E. who recommended extensive repairs be made to the bridge. As a result of his report, and the recommendations of the Town's Bridge Committee, which was formed the previous year, extensive repairs and rehabilitation was made in 1987 and 1988. Mr. Milton S. Graton, a noted covered bridge contractor from Ashland, NH was hired to perform the rehabilitation. Repairs that were made to the bridge at that time included removing the wainscoting, reinforcing the laminated arch ends where they bear on the stone piers, installation of a new metal roof, replacement of several truss verticals, new floor decking, sistering some deteriorated truss members, replacement of some of the bearing timbers, installation of riprap in front of the east pier, repairs to the trusses over the railroad, repairs to east end railroad truss chord members on the downstream side, and replacement of arch rods. In 1988 the Town contracted directly with and electrician to install lights within the bridge.

1996 The Town reinstalled the wainscoting on the inside of the bridge that had been removed during the 1988 rehabilitation. Sometime after 1996, the B&M railroad abandoned the line and removed the rails and ties under the west span.

2006 NHDOT completed emergency repairs to the flooring system.

2007-08 Pier stabilization has been completed (at a cost of about $140,000) to ensure structural integrity of the substructure until the complete rehabilitation can be preformed.

2010 Ice from flooding on January 25th damaged bents 1 and 2 while completely removing Bent 3. Bottom chords on both the north truss and south truss sustained moderate damage and twisting between bents 2 and 3. Three members of the south truss between node 15 and 18 were also broken.

3.3 National Register Nomination

This document was prepared by Brian R. Pfeiffer Jun2 20, 1974. The nomination was accepted and recommended for listing in the National Register by the NH SHPO May 12, 1975. Bath (Village) Bridge was listed in the National Register September 1, 1976.

Nomination is included on following pages.

Form 10-300 (Rev. 6-72)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
INVENTORY – NOMINATION FORM

(Type all entries – complete applicable sections)

STATE: New Hampshire
COUNTY: Grafton
FOR NPS USE ONLY
ENTRY DATE

SEE INSTRUCTIONS

1. NAME

COMMON: Bath Covered Bridge (listed 9/1/76)

AND/OR HISTORIC: Bath Bridge

2. LOCATION

STREET AND NUMBER: Unnamed town road west of U.S. 302 and N.H. 10 at Bath Village

CITY OR TOWN: Bath — CONGRESSIONAL DISTRICT: Second

STATE: New Hampshire 03740 — CODE: 33 — COUNTY: Grafton — CODE: 009

3. CLASSIFICATION

CATEGORY (Check One)	OWNERSHIP	STATUS	ACCESSIBLE TO THE PUBLIC
☐ District ☐ Building ☐ Site ☒ Structure ☐ Object	☒ Public ☐ Private ☐ Both Public Acquisition: ☐ In Process ☐ Being Considered	☒ Occupied ☐ Unoccupied ☐ Preservation work in progress	Yes: ☐ Restricted ☒ Unrestricted ☐ No

PRESENT USE *(Check One or More as Appropriate)*

☐ Agricultural	☐ Government	☐ Park	☒ Transportation	☐ Comments
☐ Commercial	☐ Industrial	☐ Private Residence	☐ Other (Specify)	
☐ Educational	☐ Military	☐ Religious		
☐ Entertainment	☐ Museum	☐ Scientific		

4. OWNER OF PROPERTY

OWNER'S NAME: Town of Bath, New Hampshire

STREET AND NUMBER: Selectmen's Office
N.H. 10

CITY OR TOWN: Bath — STATE: New Hampshire 03740 — CODE: 33

5. LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC: Grafton County Registry of Deeds

STREET AND NUMBER: P.O. Box 208
Woodsville, N.H. 03875 — Grafton County Courthouse N.H. 10, North Haverhill, N.H.

CITY OR TOWN: North Haverhill — STATE: New Hampshire 03774 — CODE: 009

6. REPRESENTATION IN EXISTING SURVEYS

TITLE OF SURVEY: See Continuation Sheet 1

DATE OF SURVEY: ☐ Federal ☐ State ☐ County ☐ Local

DEPOSITORY FOR SURVEY RECORDS:

STREET AND NUMBER:

CITY OR TOWN: — STATE: — CODE:

FOR NPS USE ONLY: STATE: COUNTY: ENTRY NUMBER: DATE:

	(Check One)					
CONDITION	[ ] Excellent	[X] Good	[ ] Fair	[ ] Deteriorated	[ ] Ruins	[ ] Unexposed
	(Check One)				(Check One)	
	[X] Altered	[ ] Unaltered			[ ] Moved	[X] Original Site

DESCRIBE THE PRESENT AND ORIGINAL *(if known)* PHYSICAL APPEARANCE

Present Physical Appearance: The Bath Bridge crosses the Ammonoosuc River at Bath Village on an east-west axis, connecting a paved, unnamed town road on either side of the river.

The bridge is a four span variation of the Burr truss system. It consists of ninety-two panels framed by 6" x 4½" posts and braced by members of the same size which pass over the road faces of the posts into which they are recessed and wooden pinned into place. The braces then extend to the next panel on either side, of the panel to which they provide major support, where they are joined to the top and bottom chords in a manner like that by which they are joined to the posts. The top and bottom chords are made up of three boards pinned together with a combined size of 11" x 11". The direction in which the braces lean is oriented about three center points in the spans of the bridge; the first occurs between the eastern abutment and the easternmost pier; the second between the easternmost pier and the center pier; and the third between the center pier and the western abutment. The bracing in each of these segments leans toward the center of its segment. Built into the truss are two pairs of arches, each arch made up of three members joined to each other along a vertical junction by wooden pins; each arch has a measurement of 11½" x 14". These arches spring from the tops of the eastern abutment to the easternmost pier and from the center pier to the western abutment. Existing inside the truss walls are three pairs of laminated arches, each of twelve members laminated and iron bolted together to a combined size of 9" x 34½". These arches spring from the faces of the abutments and piers to which they are attached. They extend from the eastern abutment to the easternmost pier; from the easternmost pier to the center pier; and from the center pier to the westernmost pier. They are also connected to the truss by iron suspension rods which pass from the top side of the arches to timbers beneath the roadbed. The truss walls are laterally braced at intervals of every second panel by beams extending from one top chord to the other. These beams are braced to each other by two sets of crossed diagonal braces.

The truss sits on framing of 15" x 7" timbers on top of two rectangular abutments of split stone and three piers also of split stone. Both abutments are laid up mainly without mortar, but have some mortar on their river faces and concrete footings on top to receive the ends of the truss. The easternmost pier and the center pier are rounded on their north sides, which are mortared, from which direction the current flows. The rest of these two piers is largely without mortar. The westernmost pier is a parallelogram in shape and is almost completely faced in concrete; it sits at the river's edge and is not actually in the river. All three piers are constructed at slightly different angles to the river, resulting in a skewing of some of the truss members (most notably the arches). Between the

Continued on Continuation Sheet 2

SEE INSTRUCTIONS

(July 1969) NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES

INVENTORY - NOMINATION FORM

(Continuation Sheet) 2.

STATE	New Hampshire	
COUNTY	Grafton	
FOR NPS USE ONLY		
ENTRY NUMBER		DATE

(Number all entries)

7. DESCRIPTION, continued

Present Physical Appearance, continued: westernmost pier and the western abutment are three wooden piers set on concrete footings on land. As a railroad line passed under this end of the bridge, it appears that these extra piers provided extra stability against vibration from the railroad.

The bridge has an overall width of 24' and overall length at the north side of the roof of 390'3", with a roadbed of 374'5" length and 22'1½" width. The roadbed is of planks laid diagonally to the direction of the road flanked on either side by boards laid lengthwise in the direction of the road, on the north side the lengthwise planks occupy a width of 4'5", slightly raised from the roadbed, which serves as a walkway. The interior of the truss walls are covered with horizontal boarding to a height of 47" above the roadbed.

The roof is of corrugated metal set on rafters which rise from the top chord and are braced with diagonals which rise from the posts to a point near the peak of the roof. The difference between the roadbed and roof lengths is resolved by cutaway portals at each end. The exterior walls are sheathed in vertical boarding, once painted red, now mostly weathered gray. The bottom of the bridge and it walls directly over the railroad track are covered with tarpaper. The north wall has six window openings, the south has seven; each opening has at least one or more individual windows.

The bridge has been assigned the following numbers: 29-05-03 in the World Guide to Covered Bridges published by the National Society for the Preservation of Covered Bridges; 137-095 by the New Hampshire Department of Public Works and Highways; and 28 by the New Hampshire Department of Resources and Economic Development.

Original Physical Appearance: When originally constructed the bridge was built with only two piers[1] and was only three spans instead of the current four. However, the bridge was raised several feet above its old bed in the 1920's to provide clearance for larger railroad cars[2]. At this point the laminated arches were added[3] and probably the wooden piers as well. In 1939-40 extensive repairs were done to the bridge including the readjusting of a then new corrugated metal roof.[4] In 1968-69 the floor was replanked and several other minor repairs made.[5]

---

[1] Town Clerk's Records, Selectmen's Office, Bath, New Hampshire, Vol 4, p. 300.

[2] Richard Sanders Allen, Covered Bridges of the Northeast (Brattleboro: The Stephen Greene Press, 1957), pp. 46-47.

Continued on Continuation Sheet 3

Form 10-300a
(July 1969)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
INVENTORY - NOMINATION FORM

(Continuation Sheet) 3.

STATE	
New Hampshire	
COUNTY	
Grafton	
FOR NPS USE ONLY	
ENTRY NUMBER	DATE

(Number all entries)

7. DESCRIPTION, continued

3

4 Statement by K. Clyde Church, carpenter, personal interview, South Ryegate, Vermont, June 1, 1974.

5 Statement by Edwin Chamberlain, selectman of Bath, New Hampshire, personal interview, Bath, New Hampshire, June 1, 1974.

Bath-Bath Bridge

Description- Continuation Sheet 3.
footnote #3 should be
Keysworth- p. 54

Bibliography- space between
Allen and Sutherland should
be Keysworth- p. 54.

LW: Call Brian & ask ref. for
Keysworth

8. SIGNIFICANCE

PERIOD (Check One or More as Appropriate)

☐ Pre-Columbian	☐ 16th Century	☐ 18th Century	☐ 20th Century
☐ 15th Century	☐ 17th Century	☒ 19th Century	

SPECIFIC DATE(S) (If Applicable and Known) 1832

AREAS OF SIGNIFICANCE (Check One or More as Appropriate)

Aboriginal	☐ Education	☐ Political	☐ Urban Planning
☐ Prehistoric	☒ Engineering	☐ Religion/Philosophy	☐ Other (Specify)
☐ Historic	☐ Industry	☐ Science	
☐ Agriculture	☐ Invention	☐ Sculpture	
☐ Architecture	☐ Landscape Architecture	☐ Social/Humanitarian	
☐ Art	☐ Literature	☐ Theater	
☐ Commerce	☐ Military	☒ Transportation	
☐ Communications	☐ Music		
☐ Conservation			

STATEMENT OF SIGNIFICANCE

SEE INSTRUCTIONS

Engineering: The present Bath bridge is the fifth bridge to stand on its site. In 1794 the first bridge was erected at this site at a cost of $366.66[1]; after this bridge was demolished by a flood, the town of Bath voted to allot $1,000 in 1806 "to build a new bridge over Ammonoosuc River near Mr. Sargent's mills, at or near where the old one stands."[2] Again, in 1820 the bridge was destroyed by a flood and replaced in the same year by a bridge that was destroyed in the same manner in 1824 and replaced in that year.[3] The discussion of stricter fire laws around buildings and bridges in 1830 at town meeting, indicates that the fourth bridge was destroyed by fire around the winter of 1830.[4] In March 1830 Joseph Fifield was chosen "to take charge of the great Bridge near the village."[5] Nothing seems to have been done on the bridge until March of 1831 when $1,400 was allotted for contracts to build two stone abutments and piers as well as procure other materials.[6] In March 1832 $1,500 more was alloted for the bridge with George Wetherell acting as the town's agent.[7] From the records it appears that the bridge was completed in early 1832.

Transportation: In 1833 at town meeting the residents of Bath voted to accept the law of the General Court for the "Bridge at the Village" and chose William V. Hutchins to prosecute all persons violated the law in crossing the bridge.[8] The descendant of this law survives in a sign a the bridges west portal that reads: "One dollar fine to drive any team faster than a walk on this Bridge."

Built at a time when Bath had some active mills, the bridge has been in continuous usage since 1832, although it now serves mainly a residential population and some farming vehicles. The bridge provides two way traffic and has a posted load limit of six tons with an individual load limit of two tons. The bridge is maintained solely by the town of Bath and has never received any state aid.[9]

[1]David Sutherland, Address Delivered to the Inhabitants of Bath (Boston:George C. Rand & Avery, 1855), p. 72.

[2]Ibid. p. 73.

Continued on Continuation Sheet 4

9. MAJOR BIBLIOGRAPHICAL REFERENCES

Secondary Sources:

Allen, Richard Sanders. Covered Bridges of the Northeast. Brattleboro: The Stephen Greene Press, 1957. pp. 46-47.

Sutherland, David. Address Delivered to the Inhabitants of Bath. Boston: George C. Rand & Avery, 1855. pp. 72-73.

Continued on Continuation Sheet 5

10. GEOGRAPHICAL DATA

LATITUDE AND LONGITUDE COORDINATES DEFINING A RECTANGLE LOCATING THE PROPERTY

CORNER	LATITUDE Degrees Minutes Seconds	LONGITUDE Degrees Minutes Seconds
NW	° ' "	° ' "
NE	° ' "	° ' "
SE	° ' "	° ' "
SW	° ' "	° ' "

OR

LATITUDE AND LONGITUDE COORDINATES DEFINING THE CENTER POINT OF A PROPERTY OF LESS THAN TEN ACRES

LATITUDE Degrees Minutes Seconds	LONGITUDE Degrees Minutes Seconds
44 ° 10 ' 00 "	71 ° 58 ' 02½"

APPROXIMATE ACREAGE OF NOMINATED PROPERTY: 1/4 acres

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

STATE:	CODE	COUNTY	CODE
STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE

11. FORM PREPARED BY

NAME AND TITLE:
Brian R. Pfeiffer

ORGANIZATION

DATE
June 20, 1974

STREET AND NUMBER:
135 Ivy Street

CITY OR TOWN:
Brookline

STATE
Massachusetts 02146

CODE
23

12. STATE LIAISON OFFICER CERTIFICATION

As the designated State Liaison Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service. The recommended level of significance of this nomination is:

National ☐ State ☐ Local ☐

Name [signature]

Title NH State Historic Preservation Officer

Date May 12, 1975

NATIONAL REGISTER VERIFICATION

I hereby certify that this property is included in the National Register.

Director, Office of Archeology and Historic Preservation

Date

ATTEST:

Keeper of The National Register

Date

SEE INSTRUCTIONS

(July 1969) NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES

INVENTORY - NOMINATION FORM

(Continuation Sheet) 4.

New Hampshire	
COUNTY	
Grafton	
FOR NPS USE ONLY	
ENTRY NUMBER	DATE

(Number all entries)

8. SIGNIFICANCE, continued

[3]Ibid.

[4]Town Clerk's Records, Selectmen's Office, Bath, New Hampshire, Vol. 4, p. 257.

[5]Ibid., p. 261.

[6]Ibid., p. 296.

[7]Ibid., pp 300,329.

[8]Ibid., p. 364.

[9]Statement by Floyd Avery, secondary roads engineer, personal interview, Concord, New Hampshire, June 11, 1974.

Form 10-300a
(July 1969)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES

INVENTORY - NOMINATION FORM

(Continuation Sheet) 1.

STATE	
New Hampshire	
COUNTY	
Grafton	
FOR NPS USE ONLY	
ENTRY NUMBER	DATE

(Number all entries)

6. REPRESENTATION IN EXISTING SURVEYS, continued

Historic American Engineering Record
1974, x Federal
Historic American Engineering Record
1100 L Street, NE
Washington, D.C. 20240, 11

New Hampshire's Historic Preservation Plan
1970, x State
State of New Hampshire Department of Resources and Economic Development
P.O. Box 856, State House Annex, 25 Capitol Street
Concord, New Hampshire 03301, 33

Form 10-300a (July 1969) UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
INVENTORY - NOMINATION FORM

(Continuation Sheet) 5.

STATE	
New Hampshire	
COUNTY	
Grafton	
FOR NPS USE ONLY	
ENTRY NUMBER	DATE

(Number all entries)

9. MAJOR BIBLIOGRAPHICAL REFERENCES, continued

Unpublished Sources:

Avery, Floyd. Personal interview. Concord, New Hampshire, June 11, 1974.

Chamberlain, Edwin. Personal interview. Bath, New Hampshire, June 1, 1974.

Church, K. Clyde. Personal interview. South Ryegate, Vermont, June 1, 1974.

Town Clerk's Records, Selectmen's Office, Bath,New Hamphsire, Vol. 4, pp. 257, 261, 296, 300, 329, 364.

1?-?)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

.IONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

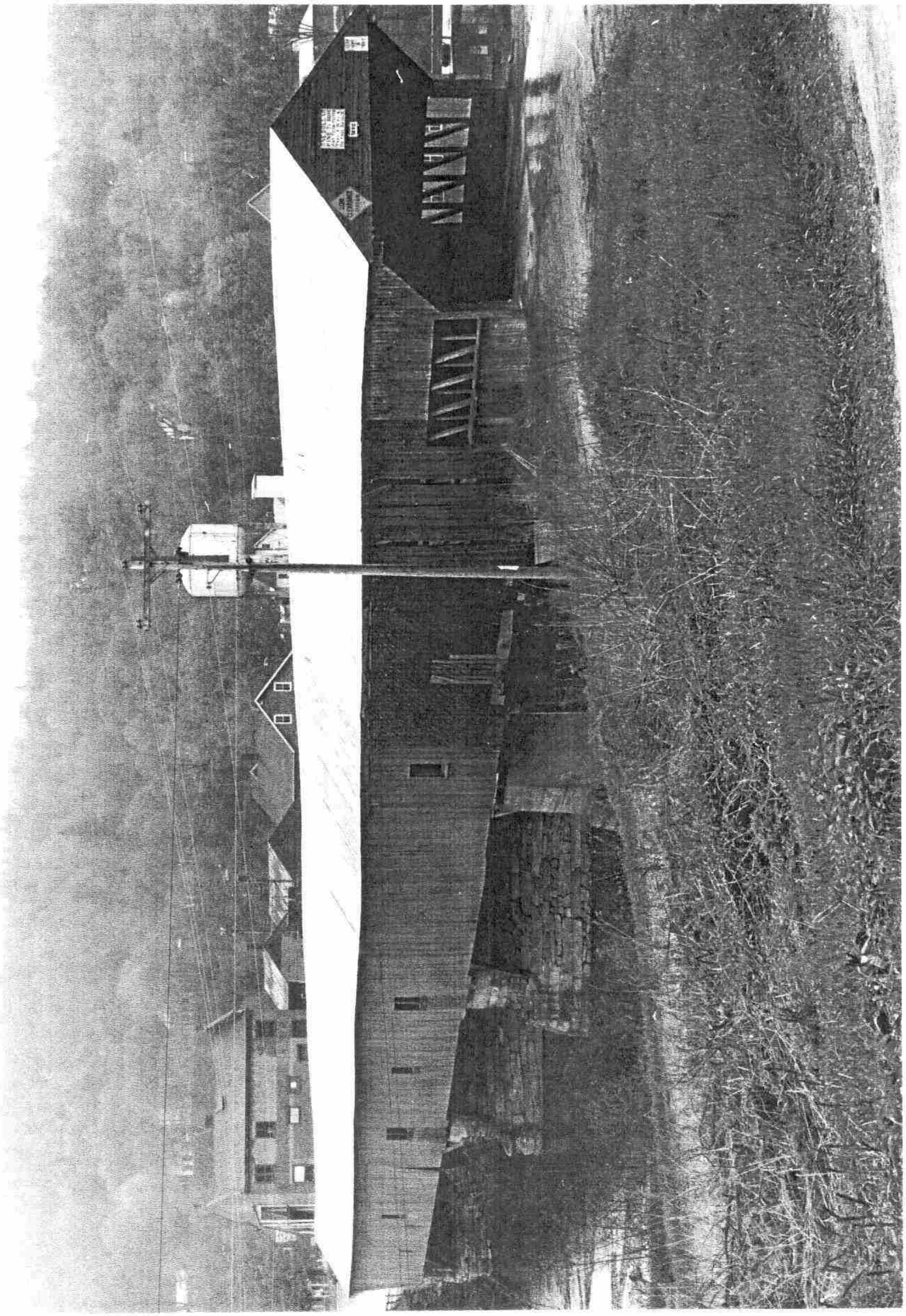
FOR NPS USE ONLY
RECEIVED
DATE ENTERED

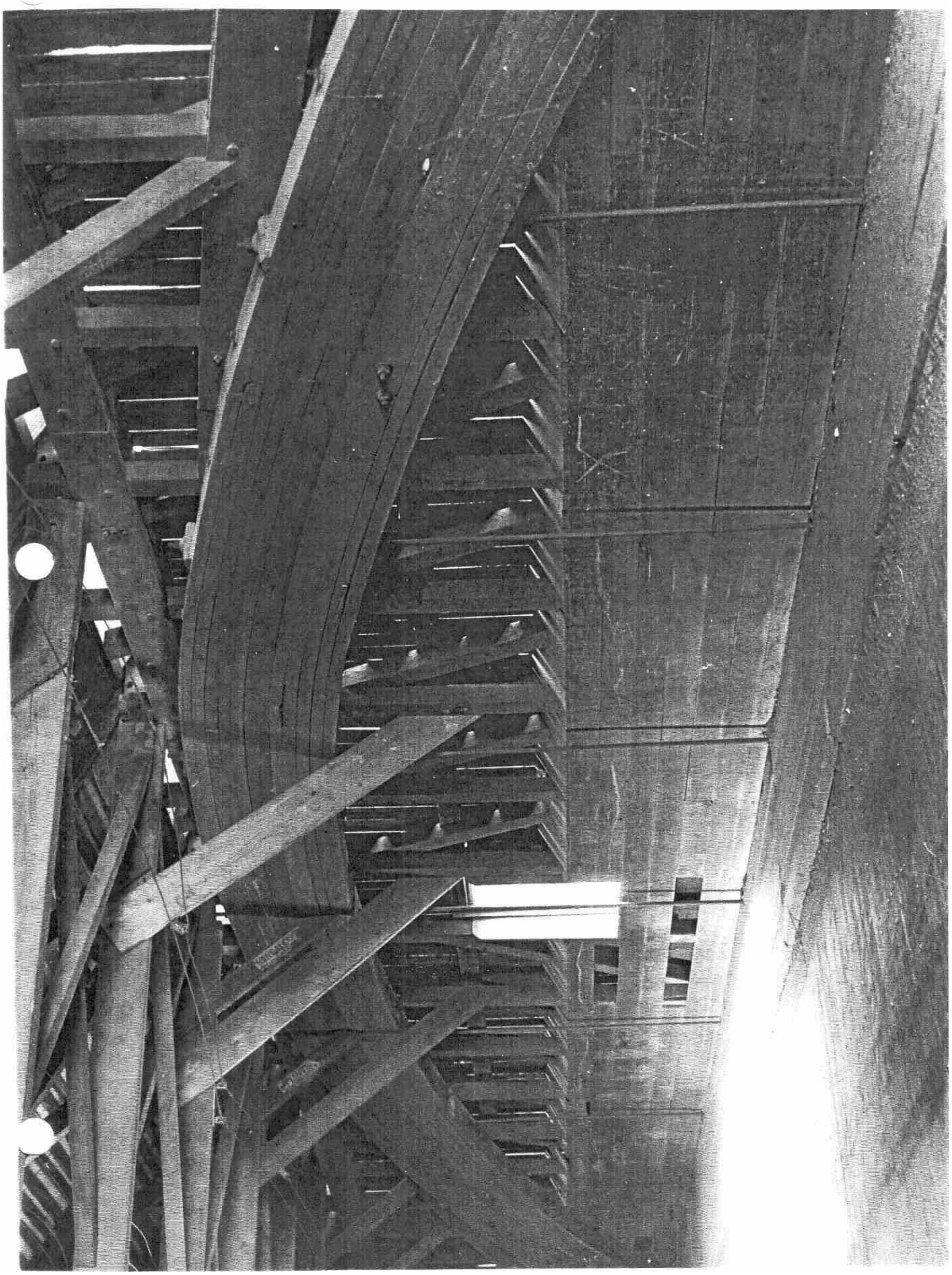
CONTINUATION SHEET | ITEM NUMBER 10 | PAGE 6

Geographical Data, Continued.

10.2 UTM References

ZONE	EASTING	NORTHING
18	2 . 61 . 750	48 . 94 . 475





3.4 HAER Documentation

This document was prepared by Joseph D. Conwill, July 2002, revisions August 2002.

Document included on following pages.

HISTORIC AMERICAN ENGINEERING RECORD

BATH BRIDGE

HAER No. NH-34

LOCATION:	Spanning Ammonoosuc River, Lisbon Road, Bath, Grafton County, New Hampshire UTM: 19.262766.4894683 Moosilauke, NH Quad
DATE OF CONSTRUCTION:	1832
STRUCTURAL TYPE:	Modified Burr truss
DESIGNER/ BUILDER:	Unknown
PRESENT OWNER:	Town of Bath
PREVIOUS & PRESENT USE:	Public road bridge since its construction
SIGNIFICANCE:	Bath Bridge is a rare survivor of the early craftsman tradition of wooden truss bridge construction, before design became standardized into several major types based on patented plans. It is also of interest for its location in the midst of a well-preserved village center.
HISTORIAN:	Joseph D. Conwill, Editor, *Covered Bridge Topics*, July 2002
PROJECT INFORMATION:	The National Covered Bridges Recording Project is part of the Historic American Engineering Record (HAER), a long-range program to document historically significant engineering and industrial works in the United States. HAER is administered by the Historic American Buildings Survey/Historic American Engineering Record, a division of the National Park Service, U.S. Department of the Interior. The Federal Highway Administration funded the project.

Chronology

1794	First bridge at Bath village
1831	Work begins on stonework for the present (fifth) bridge
1832	The covered bridge is completed
1852-53	White Mountain Railroad is constructed under the west end of the bridge
?	An extra pier is added under the long west span, turning the three-span bridge into a four-span bridge
1913	New Hampshire law requires bridges to be upgraded for 10-ton load
1918-19	Bridge is raised about 2', laminated arches are added, other major repairs done
1987-88	Restoration by Milton S. Graton

Bath and Its Early Bridges

Bath, New Hampshire was already a small industrial center in the 1790s before there was any bridge. The town voted in November 1793 to bridge the Ammonoosuc River "over the mill-pond above Mr. Sargent's and Esq. Hurd's mills." Built in 1794, the cost was still given in the British system as 110 pounds total, which equaled $366.66.[1] It lasted until taken out by an ice jam, but the town voted in 1806 to replace it, and this time the cost was quoted in American dollars at $1,000.[2] A third bridge, built in 1820, was washed out in February 1824 and again replaced. By 1827, repairs were already needed, and Caleb Hunt was selected to supervise the project. The fate of this fourth bridge is unknown.[3]

Construction of the Present Bridge

A town meeting in March 1830 discussed rebuilding the bridge at Bath village, but postponed action, probably because of expenses just incurred during construction of the Bath-Haverhill Bridge at Woodsville. In March 1831, the town meeting returned to the question. Voters approved $1,400 to cover contracts for stonework that apparently had already been negotiated and decided to proceed with construction of the two abutments and two center piers. George Wetherell was chosen as town agent for the project, but most regrettably there is no record anywhere of the builder's name. The 1831 meeting also resulted in a vote to procure timber and have it delivered to the site over the upcoming winter. A special meeting later in the year on November 16 voted $400 more towards construction of the stonework; evidently construction was already in progress and the available funds had been used up.[4]

The March 1832 town meeting raised a final $1,500 to complete Bath Bridge, and this was probably for the wooden trusswork. Total cost was therefore around $3,300.[5] The work seems to have been completed to satisfaction, because the March 1833 town meeting chose William V. Hutchins as agent "to prosecute all persons who shall violate the law in crossing said Bridge, & to procure Bords [sic] lettered and placed at the ends of said Bridge giving notice of a fine for those who violate the law in crossing." A sign on the west portal still warns of a ONE DOLAR FINE TO DRIVE ANY TEAM

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[1] Rev. David Sutherland, *Address Delivered to the Inhabitants of Bath…with an Historical Appendix by Rev. Thomas Boutelle* (Boston: Geo. C. Rand & Avery, 1855), pp. 72-73.
[2] In some New England localities, money continued to be quoted in pounds, shillings, and pence even into the early nineteenth century, although dollar decimal coinage had been in circulation since 1794.
[3] Brian R. Pfeiffer, the historian who prepared the National Register nomination, which was approved in 1976, conjectures that fire destroyed the fourth bridge because there was much discussion of fire laws at the 1830 town meeting. This may be true, but this author does not find the evidence compelling, especially since Sutherland makes no mention of a fire.
[4] Bath Town Records, Volume 4. The years 1827-1839 were consulted. Available at the New Hampshire State Library, Concord, New Hampshire.
[5] Some writers have quoted a cost of $2,900, but they missed the $400 expenditure voted on November 16, 1831.

FASTER THAN A WALK ON THIS BRIDGE. Such signs were still common on New England covered bridges well into the twentieth century. The "walk," of course, refers to a horse's gait; a gallop or a trot sets up a regular vibration capable of shaking truss bridge members loose and causing serious damage.

In the nineteenth century, winter transportation was by sleigh or sled over frozen snow. Roads were rolled to make them passable; snow plowing and removal did not begin until the 1920s after automobiles arrived. Covered bridges were obstacles in such a transportation system. They were covered to keep the wooden trusses from rotting, not to keep the snow off in the winter. Bath town meeting minutes of the 1830s show that the highway surveyor (i.e. road commissioner) of the village district had to oversee snow being placed on the bridge deck in winter and cleaned off come spring.[6]

Structural Details

The abutments and two original center piers of Bath Bridge are of dry-laid stone, but their orientation is odd. The two abutments are more or less square to the river, but the two piers are both skewed. This makes the span lengths different from one side of the bridge to the other and presented obvious challenges in framing the trusses. Moreover, the original span lengths were very uneven; the two piers are spaced closely together in the middle of the river. There is no obvious explanation for this peculiarity. Perhaps subsurface conditions for foundations dictated the placement of the piers, or there may have been some special problems regarding the flow of the river's current.

The total truss length of Bath Bridge measures 374'-5 3/4" at the floor. Structure length of the east span is 127'-2 1/4" on the upstream side. The downstream side was not measured, but is two panels longer because of the skewed pier. From the position of the truss center posts in relation to the highest point of the arch, it is evident that the builder intended the upstream truss to be the standard and the downstream truss to be the deviation. The center span is only 71'-10" in structure length, while the long original west span was 175'-5 1/2". Here the downstream truss measures three panels shorter, so this pier appears to be more skewed than the other. Where the short center span meets the long original west span, the builder had trouble fitting his panel lengths to the piers, so there is an odd short panel.

Posts and braces show manufacturing variation, but on average measure 4-1/2" x 5-3/4". The braces do not foot on shoulders on the posts in the same plane. Instead, they are treenailed across the outside of the post frame with a single 1-3/4" treenail at the joint and no mortise. They overlap the panel points and continue on to the chords, where they are mortised through. The chords themselves are built up of three vertical leaves, with posts mortised through the inside joint and braces mortised through the other. This framing

[6] Records from other New England towns describe "snowing" covered bridges in winter, but there are no known photographs of the operation in progress. Two Maine Highway Commission photographs from the early 1920s do show covered bridge interiors with snow on the deck.

detail is surprisingly similar to the counterbrace treatment developed a decade later by Peter Paddleford of nearby Littleton, but there is no evidence connecting him with Bath Bridge.

Bath Bridge also has original timber arches integral with the trusses. Like the chords, they are built up of three vertical leaves of timber placed together with no space; the posts are mortised through the inside joint, and the braces are mortised through the outside joint. The arch ends are tied to the lower chords and do not foot directly on the abutments. Such intricate joinery requires an almost unthinkable amount of custom labor.

Bath Bridge represents the early, idiosyncratic craftsman tradition of wooden truss bridge building, before designs became more standardized under the influence of the major patented truss plans. It is very difficult to classify. It is more like a Burr truss than anything else, but the standard Burr does not have the braces overlapping the panel points, and it usually has the arch footing directly on the abutments. Because of the overlapping braces, Bath Bridge slightly resembles the Haupt truss, but this was not patented until 1839, and the 1832 date for Bath Bridge is very well established.

One other New England covered bridge shares the same truss plan, the Sayres Bridge over Ompompanoosuc River at Thetford Center, Vermont. The framing details are rather similar, but the timber sizes are different, and the brace/post joints are made with two treenails, not one as at Bath. These two bridges may be the last remnants of an old regional building tradition, but neither date nor builder are known for Sayres Bridge.[7] It is often inaccurately listed as a Haupt truss.

Other Framing Details

Bath Bridge is unusually wide inside, measuring 22'. Of this, about 18' is the roadway, and about 4' is a separate raised sidewalk platform along the upstream side. It is impossible to tell whether the bridge had this feature as originally built.

The floor beams measure about 7-1/2" x 15-1/2" but are not original. There are two per panel, and as the panel spacing is only about 4', the floor beams are numerous.

Like other New Hampshire covered bridges, Bath Bridge has been modified over the years, especially during the early twentieth century.

Repair Record

[7] Sayres Bridge also has an extra post at the center, which Bath Bridge does not have. Some believe that the former Pattersonville Bridge of Norwich, Vermont, was a third example of this regional style, but it seems instead to have been a true Haupt truss, and thus a later structure.

In 1852, the White Mountain Railroad was graded along the west bank of Ammonoosuc River underneath Bath Bridge. Rails were laid, and service began in 1853.[8] Apparently the bridge required no structural modifications at the time, but since steam engines passed closely under it for about a century, it is fortunate that it never caught fire. At some unknown time, the railroad installed sheet metal under the bridge in the area of the tracks to prevent parks from lodging.[9]

The addition of a third pier later divided the long west span of Bath Bridge into two, making it a four-span bridge. There is no evidence documenting when this was done, but it was probably during the nineteenth century since the new pier is dry-laid stone and difficult to distinguish from the two originals. Had the pier been added when the laminated arches were installed in 1918-19, it would surely have been of concrete.

By a 1913 act of the New Hampshire legislature, bridges were to be made safe for 10-ton loads after April 1, 1915.[10] The law created a tremendous burden for small towns, and compliance was slow. Bath Bridge at the time was posted for 2 tons. Concerned, the town asked famed bridge engineer John W. Storrs of Concord for an opinion. He said that the bridge had probably carried more than 2 tons but recommended that the posted load not be exceeded.

At a 1918 town meeting, Bath voted funds "for extraordinary repairs on Bath bridge." It was suggested to raise $1,000 by taxation and finance the rest. Mr. C.C. Battey, recommended by engineer Storrs, presented an estimate covering various options. Later, when the work was done, he inspected it, but it is unclear how much he did himself, if any.

By 1919, the bridge straightening project had cost $7,076.61. This was more than foreseen, but more work had been required. Among other things, the railroad decided that the bridge should be raised 2' higher over the tracks and paid for the actual raising, but various expenses such as regrading the road had to be covered by the town.

Work got underway in 1918 when Cyrus Batchelder repaired a flood-damaged pier and cut skewbacks and cut skewbacks into the old piers and abutments to receive laminated arches. The stonework also received concrete caps so that the bridge could be raised. Some 70,000 board feet of lumber of all kinds went into the project. The arch planks appear to have been hemlock. Much red and yellow pine was used, probably for the floor system.

Twelve or thirteen leaf laminated arches went into the easterly three spans, but the west span, over the railroad tracks, did not get a new arch. At some point, wooden horses

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[8] Sutherland, p. 74.
[9] Richard G. Marshall, *New Hampshire Covered Bridges: A Link with our Past* (Concord: New Hampshire Department of Transportation, 1994), p. 53.
[10] *Annual Report of the Town Officers*, 1915, p. 25. Information in the following paragraphs comes from the same source for 1918 and 1919.

were added to either side of the tracks; these may have been part of the same project in lieu of arches. The new arches were connected to needle beams under the lower chords of the truss by means of hanger rods on spacing varying from 8'-0" to 8'-6". The new arches and needle beams relieved some of the load from the trusses, but there is no direct connection to the floor system, as is usually done.[11]

Photographs dating as late as ca. 1950 show the west portal of Bath Bridge with a semi-elliptical arched entry, housed in narrow clapboards, similar to portals found on Peter Paddleford's bridges. Soon thereafter the entry was squared off higher to allow more clearance, and the older configuration has never been restored. The east portal was so modified decades earlier.

Milton S. Graton

By 1987, Bath Bridge was in need of major repairs, and the job went to Milton S. Graton of Ashland, New Hampshire, one of the premier bridge wrights of the twentieth century.[12] There was a low interior boarding like a wainscot, which Graton removed. He found many posts badly gnawed, and several were chewed all the way through. Local legend stated that residents had once used the bridge as a stable to tie up their horses while uphill at the village church or at saloons, and the restless horses had chewed the posts. This practice may have been very old, for the 1834 town meeting entrusted the agent who enforced the speed limit with keeping the bridge clear from "horses or cattle or anything else which shall have a tendency to injure the people who may cross."[13] Graton's preferred practice was to leave original members in place, sistering new ones alongside to preserve the historic fabric.

The interior wainscot was perhaps intended to prevent future horse damage, but this danger was long past and Graton did not replace it. Later the town reinstalled it, although this makes it impossible to inspect and clean around the lower chords. Covered bridges always collect dust, which, by retaining moisture, can cause rot. Old town records throughout New England show small expenditures for ongoing maintenance, including cleaning and sweeping, but in recent decades most towns have neglected this important detail.

Graton completed restoration in early 1988. Other work included reinforcing the arch ends where they are tied to the truss, and reroofing the bridge. Much rot had to be repaired over the former railroad tracks where the spark-arresting layer of sheet metal trapped moisture.

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[11] Some of the laminated arches have extra leaves, apparently added at a later date. It is not known when this was done, but it was not pat of the Graton restoration of 1987-88.
[12] Graton is pronounced with a long "a." Information on the restoration comes from David W. Wright of Westminster, Vermont, president of the National Society for the Preservation of Covered Bridges. He visited Bath regularly while the work was in progress.
[13] Jonathan Smith was agent in 1834. The position seems to have been that of a special constable.

Bath Bridge today is in generally good condition and carries a moderate load of local traffic. There is a small sag in the second span from the west, the cause of which should be investigated.

Bath Village

Old accounts refer to Bath "Lower Village" and "Upper Village." Downtown Bath, with the covered bridge, is the Lower Village. The Upper Village today is a lovely collection of late Federal homes, located about a mile and a half north of downtown. There is no church or store.

In addition to the famous covered bridge, Bath "Lower Village" includes a church with an unusual shingled steeple that usually appears black in photographs and an old brick general store. There were sawmills and gristmills even before the construction of the first bridge and a dam.[14] Early in the nineteenth century, the village also saw the activity of an iron forge, and probably also a woolen mill, later a dye house.

In 1872, Conant and Company built a pulp mill just downstream from the covered bridge. This later became the Bath Lumber Company sawmill. Cushman-Rankin Company built a leather board mill on the site, which a fire destroyed in 1952. In 1953, Bath Fiber Company built a heeling board mill. A fire destroyed this in 1975 after the bridge sat vacant for some time.[15] The power dam is still intact just downstream from the covered bridge and makes for a spectacular view.

Bath Bridge was the last covered bridge in North America to span railroad tracks.[16] The tracks themselves are gone, but the roadbed remains, along with a telltale north of the bridge.[17] On the old roadbed nearby is an old Boston & Maine caboose converted to a residence. The blue enamel sign saying BATH on the portal of the bridge is probably of railroad origin. With some imagination, it is still possible to see Bath as a small industrial village served by the White Mountain Railroad, with a magnificent covered bridge at its heart.

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[14] *Historical Notes of Bath, New Hampshire 1765-1965* (Bath: Town-Bicentennial Committee, 1965), pp. 5 ff.

[15] Christine Schultz, "The Price of History in New Hampshire," *Yankee* (December 2001), pp. 34-38. Thanks to Sarah Dangelas for bringing this source to my attention.

[16] Of course, it mainly served to cross Ammonoosuc River. There were several covered bridges built solely to cross railroad tracks. Notable examples stood at East Deerfield, Massachusetts; Troy, New York; and Allentown, Washington.

[17] A telltale is a row of strips hanging from a frame over the railroad track, intended to warn a brakeman on top of a car of the approach of a low bridge or tunnel entry.

Bibliography

Annual Report of the Town Officers [Bath], 1912-1931.

Bath Town Records, 1827-1839.

Field notes. Bath, New Hampshire, June 18, 2002; Thetford Center, Vermont, June 22, 2002.

Historical Notes of Bath, New Hampshire 1765-1965. Bath: Town Bicentennial Committee, 1965.

Marshall, Richard G. *New Hampshire Covered Bridges: A Link with our Past*. Concord: New Hampshire Department of Transportation, 1994.

Pfeiffer, Brian R. National Register of Historic Places, Nomination Form for Bath Covered Bridge, September 1, 1976.

Schultz, Christine. "The Price of History in New Hampshire." *Yankee* (December 2001), pp. 34-38.

Sutherland, Rev. David. *Address Delivered to the Inhabitants of Bath…With an Historical Appendix by Rev. Thomas Boutelle.* Boston: Geo. C. Rand & Avery, 1855.

Wright, David W., President of the National Society for the Preservation of Covered Bridges, telephone interview, June 16, 2002.

JOSEPH D. CONWILL
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U.S.A.

RES.: HODGKINS FARM,
SANDY RIVER PLTN., MAINE

PHOTOGRAPHY
PHOTOGRAPHIE

August 19, 2002

REVISIONS TO MY REPORTS, HAER COVERED BRIDGE PROJECT

HAER No. NH-33, BATH-HAVERHILL BRIDGE

Page 10, add onto Note 17 so that it reads as follows.

17. Bath Annual Report of the Town Officers for 1922. At some unknown time, the bridge had previously been reinforced with a set of arches, probably lighter than the present ones; John W. Storrs briefly mentions them. Thanks to David W. Wright who pointed out this fact during his review of my report. The cost of materials for the 1921-22 work suggests that the laminated arches were rebuilt completely anew at that time.

HAER No. NH-34, BATH BRIDGE

Page 9, replace Note 11 with the following.

11. The east span (village end) had laminated arches even before 1918. It is not known when they were installed, and they were lighter than the present arches. Thanks to David W. Wright, who found this detail in the John W. Storrs Papers (Files 58 and 106). The current arches in the east span have twelve leaves, of thicker plank than is used in the other arches. During the 1918-19 work, plank was purchased in several different lots, which may account for the difference in thickness. The other laminated arches have thirteen load-bearing leaves, plus a fourteenth on the bottom which appears only to have served as a form for bending the others. There are also some oak bearing blocks on top, which appear to have been added later.

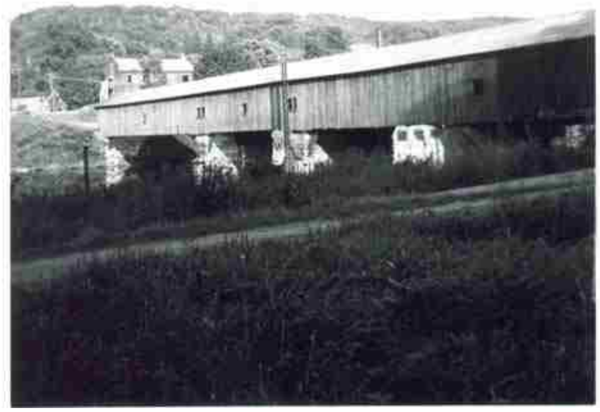
3.5 Historic Photographs

This section contains the following:

- Historic photographs compiled by HTA. Inc

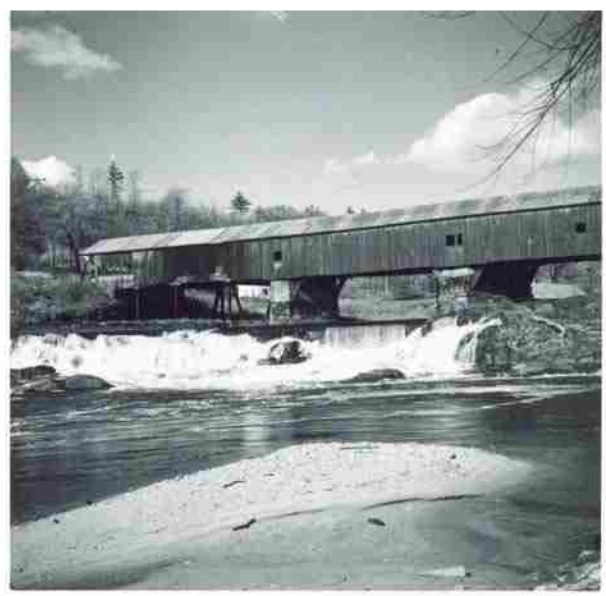
- Images from the Bath Historical Society

September 1954

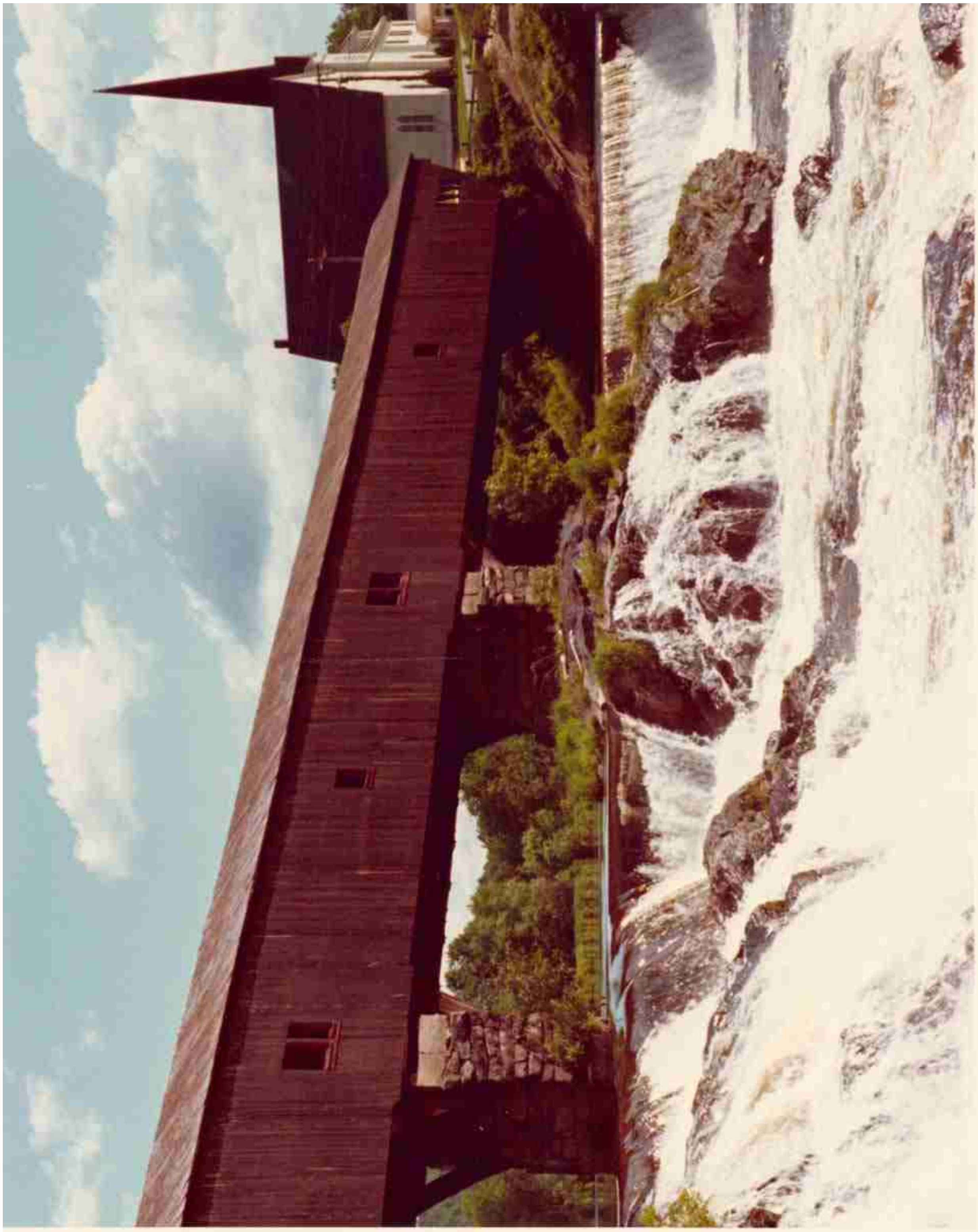


September 1954

September 1954



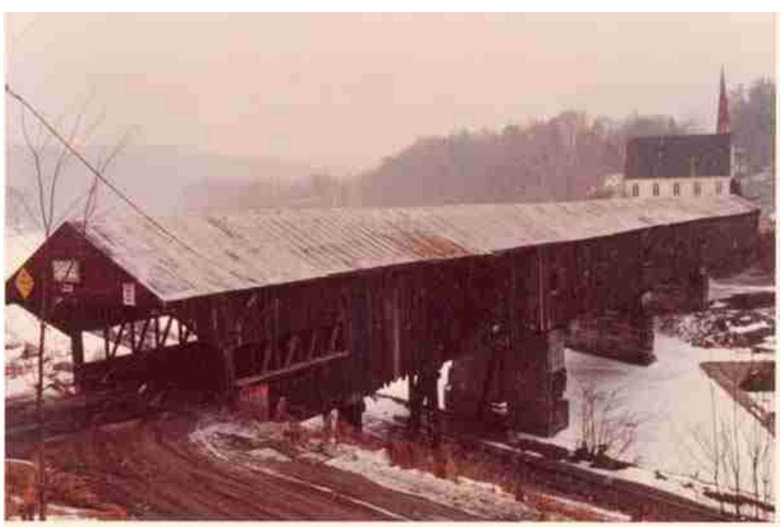
October 17, 1954



July 1968

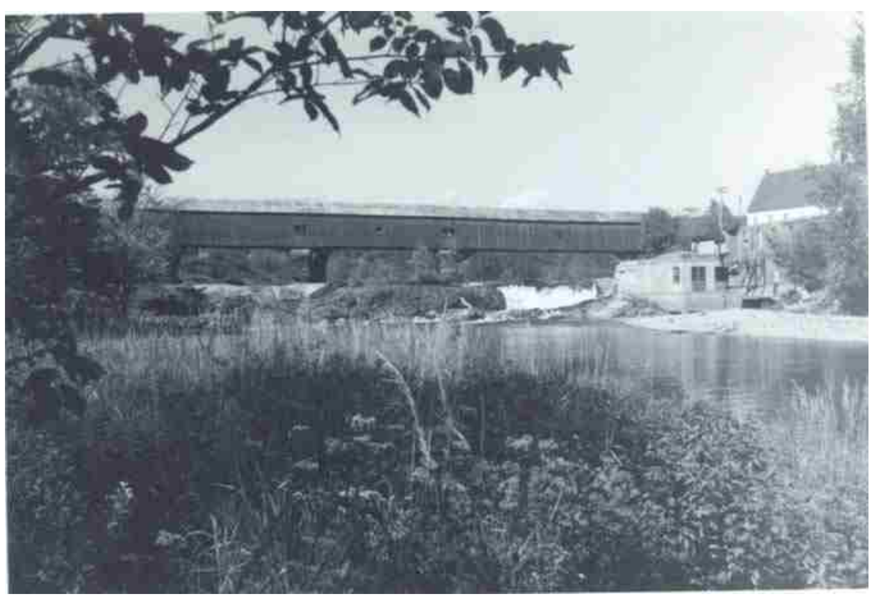
May 1975 by Ted Lord

May 1975 by Ted Lord

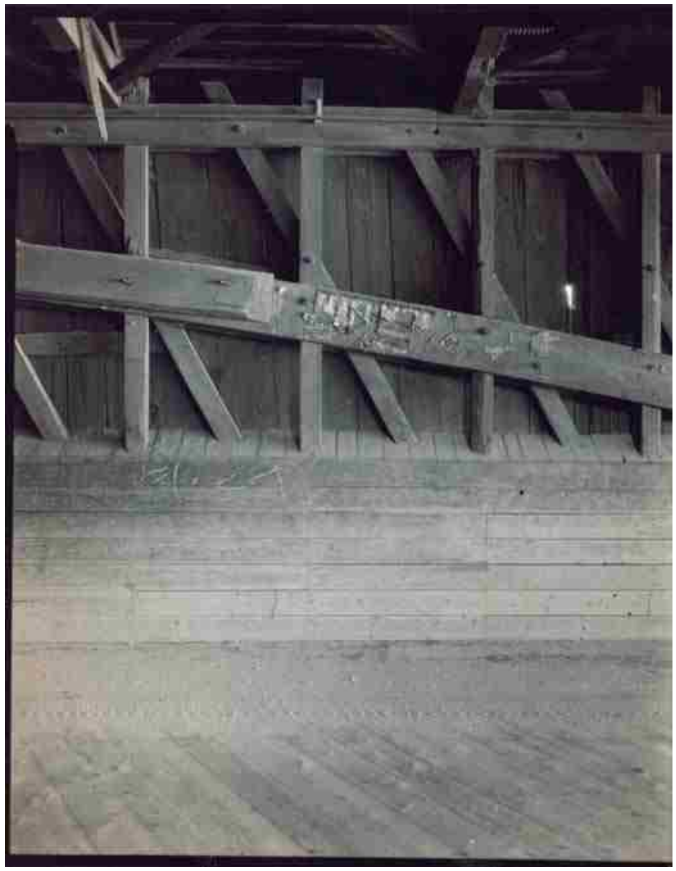


November 1976

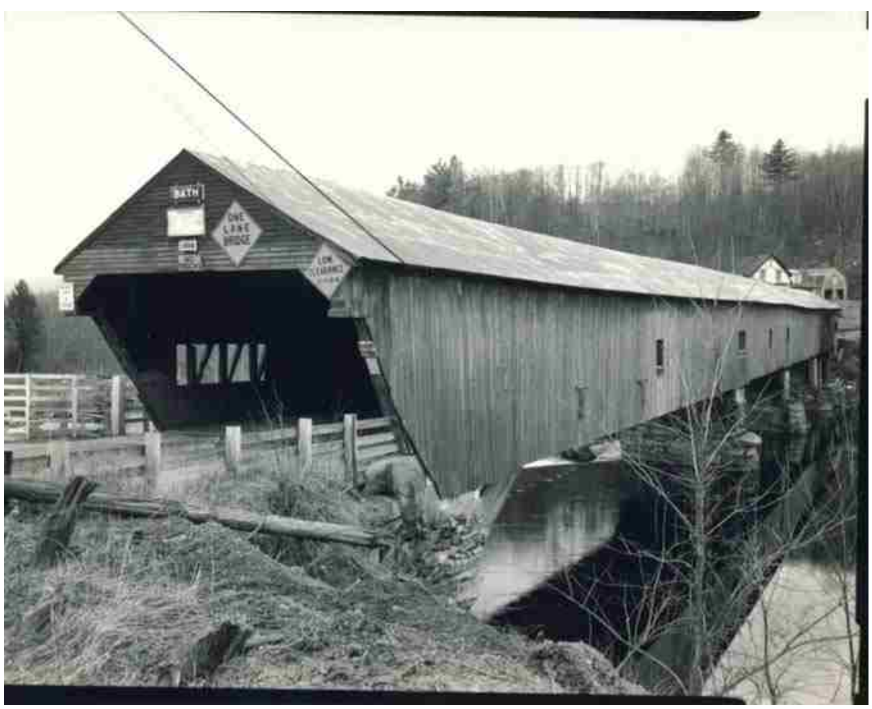
September 1979



September 1979



1987 by Joseph Conwill



1987 by Joseph Conwill

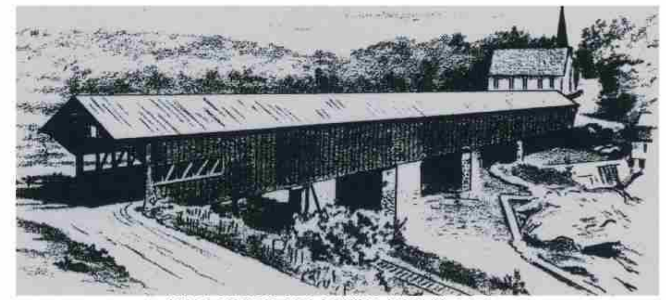
Circa 1940’s
Photo Courtesy – David Wright, NSPCB

1953 - By Jim Shaughnessy from The Call of Trains:
Railroad Photographs by Jim Shaughnessy, W. W. Norton, 2008
Boston & Maine passenger train passing under Bath Village Covered Bridge

3.6 HAER-Format Measured Drawings

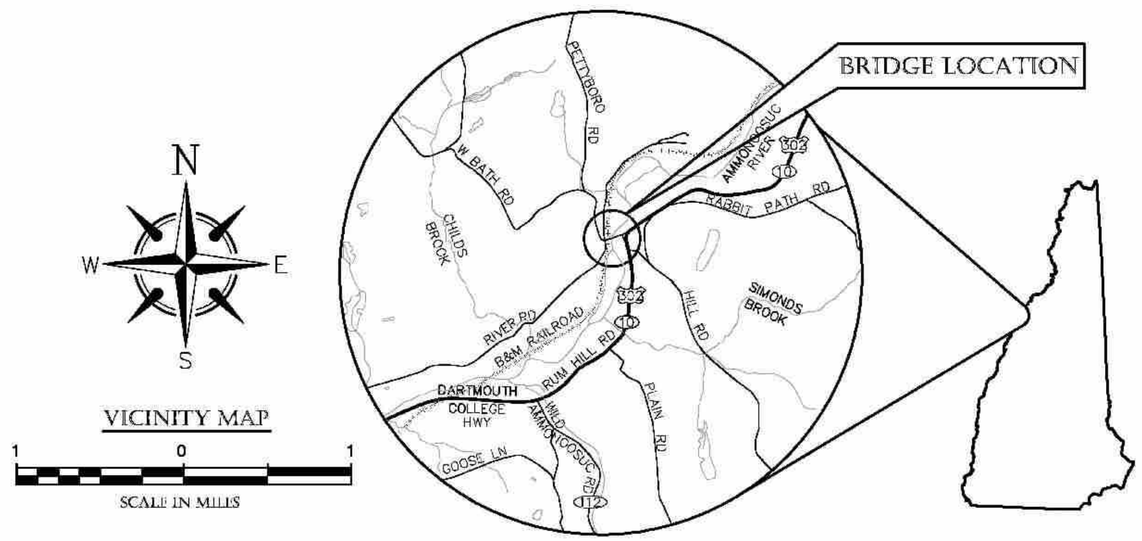
The following drawings were produced by HTA, Inc, April, 2010 at the request of NHDHR as a requirement of the project permitting process. The drawings were done in the format used by the Historic American Engineering Record (HAER).

TOWN OF BATH, NEW HAMPSHIRE



VILLAGE BRIDGE LOOKING NORTHEAST

HISTORIC STRUCTURES REPORT DRAWINGS



BATH VILLAGE COVERED BRIDGE

THE BATH VILLAGE COVERED BRIDGE IS THE FIFTH BRIDGE TO BE CONSTRUCTED AT THIS SITE; THE FIRST BRIDGE BEING CONSTRUCTED IN 1794. THE PREVIOUS FOUR (4) BRIDGES WERE EITHER LOST DUE TO FLOODS OR DESTROYED BY FIRE. PLANNING FOR THE PRESENT BRIDGE FIRST BEGAN AT A BATH TOWN MEETING IN 1830. IN 1831 STONEWORK FOR TWO (2) PIERS AND TWO (2) ABUTMENTS WAS CONSTRUCTED WITH MR. LUTHER BUTLER, A HAVERHILL MASON, PERFORMING THE WORK AT A TOTAL COST OF $1,400.000. IN 1832, A THREE (3) SPAN TIMBER SUPERSTRUCTURE WAS CONSTRUCTED AT A COST OF $1,900.00 BY A GROUP LED BY MR. GEORGE WITHERELL, A BATH CARPENTER. HAND WROUGHT IRON NAILS WERE MADE FOR CONSTRUCTION OF THE SUPERSTRUCTURE BY MR. AMARCO BUCK. AT THE 1833 TOWN MEETING, SELECTMAN AUTHORIZED THE INSTALLATION OF SIGNS ON THE BRIDGE TO READ "ONE DOLLAR FINE TO DRIVE ANY TEAM FASTER THAN A WALK ON THIS BRIDGE".

THE ORIGINAL BRIDGE IS APPROXIMATELY 375' LONG AND BUILT WITH A SINGLE LANE ROADWAY. THE BRIDGE IS CONSTRUCTED USING A UNIQUE TYPE OF TRUSS AND INTEGRAL TIMBER ARCH SYSTEM. THIS FRAMING SYSTEM HAS BEEN DESCRIBED AS EITHER BEING A MODIFIED BURR TRUSS OR MODIFIED HAUPT TRUSS, HOWEVER THERE IS SIGNIFICANT DISAGREEMENT WITHIN THE COVERED BRIDGE COMMUNITY AS TO THE ACTUAL TRUSS DESIGNATION.

IN 1852 - 1853 THE WHITE MOUNTAIN RAILROAD CONSTRUCTED A LINE ADJACENT TO BATH VILLAGE ON THE WEST SIDE OF THE AMMONOOSUC RIVER. THE LINE PASSED UNDER THE WESTERLY SPAN OF THE BRIDGE WITH THE R.O.W. STILL EXISTING TODAY. A DAM WAS LATER BUILT DOWNSTREAM OF THE BRIDGE IN 1893 TO SERVE MILLS ON BOTH SIDES OF THE RIVER. ALSO, PRIOR TO 1893 A NEW STONE PIER WAS CONSTRUCTED BENEATH THE WESTERLY SPAN, MODIFYING THE BRIDGE FROM A THREE (3) SPAN TO A FOUR (4) SPAN CONTINUOUS STRUCTURE.

JOHN W. STORRS, A NOTED BRIDGE ENGINEER FROM CONCORD, NH VISITED THE BRIDGE BETWEEN 1911 AND 1914 AND WROTE SEVERAL LETTERS CONCERNING ITS CONDITION AND CAPACITY. IN 1911 HE NOTED THAT 8,000 POUND (4 TON) DUMP CARTS FULL OF GRAVEL WERE PASSING OVER THE BRIDGE (ALTHOUGH HE RECOMMENDED THE SAFE CAPACITY WAS ONLY 2 TONS). HE ALSO NOTED AT THIS TIME THAT DUE TO THE CONDITION OF THIS BRIDGE, HE TENTATIVELY RECOMMENDED CONSTRUCTING A NEW BRIDGE, SUBJECT TO A THOROUGH INSPECTION OF THE LOWER CHORDS OF THE TRUSSES THAT WERE HIDDEN BY WAINSCOTING.

AT THE 1918 TOWN MEETING, FUNDS WERE RAISED FOR REPAIRS TO THE BRIDGE. REPAIRS WERE PERFORMED BY MR. CYRUS BATCHELDER AND WERE COMPLETED IN 1919. THESES REPAIRS CONSISTED OF: RAISING THE BRIDGE TWO (2) FEET AT THE REQUEST OF THE RAILROAD (AND PAID FOR BY THEM), ADDING LAMINATED ARCHES IN THE EASTERLY THREE (3) SPANS AND MISCELLANEOUS REPAIRS.

BETWEEN 1919 AND 1941 THREE (3) TIMBER BENTS WERE CONSTRUCTED BENEATH THE FAR WESTERLY SPAN, AND STRADDLED THE TWO (2) RAILROAD TRACKS. ALSO DURING THIS PERIOD, AN INTERNAL SIDEWALK (PLATFORM) WAS ADDED TO THE INSIDE ADJACENT TO THE UPSTREAM TRUSS. LIGHTS WERE INSTALLED ON EACH PORTAL OF THE BRIDGE.

THE BRIDGE WAS ENTERED IN THE NATIONAL REGISTER OF HISTORIC PLACES ON SEPTEMBER 1, 1976. EXTENSIVE REPAIRS AND REHABILITATION WERE MADE IN 1987 AND 1988 BY MR. MILTON S. GRATON, A NOTED COVERED BRIDGE CONTRACTOR FROM ASHLAND, NH.

ENGINEER

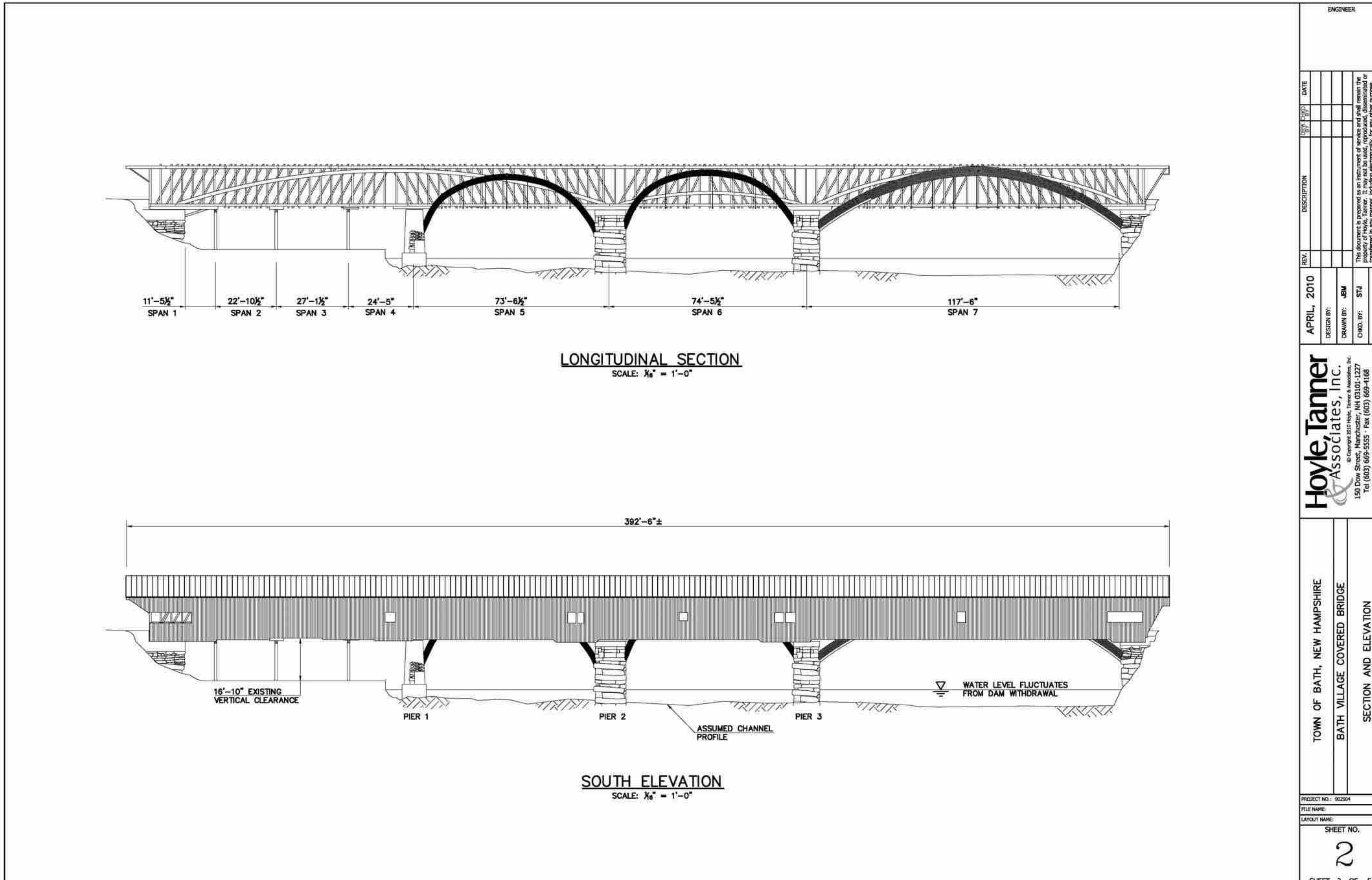
REV.	DESCRIPTION	DSN. BY	CHKD. BY	DATE

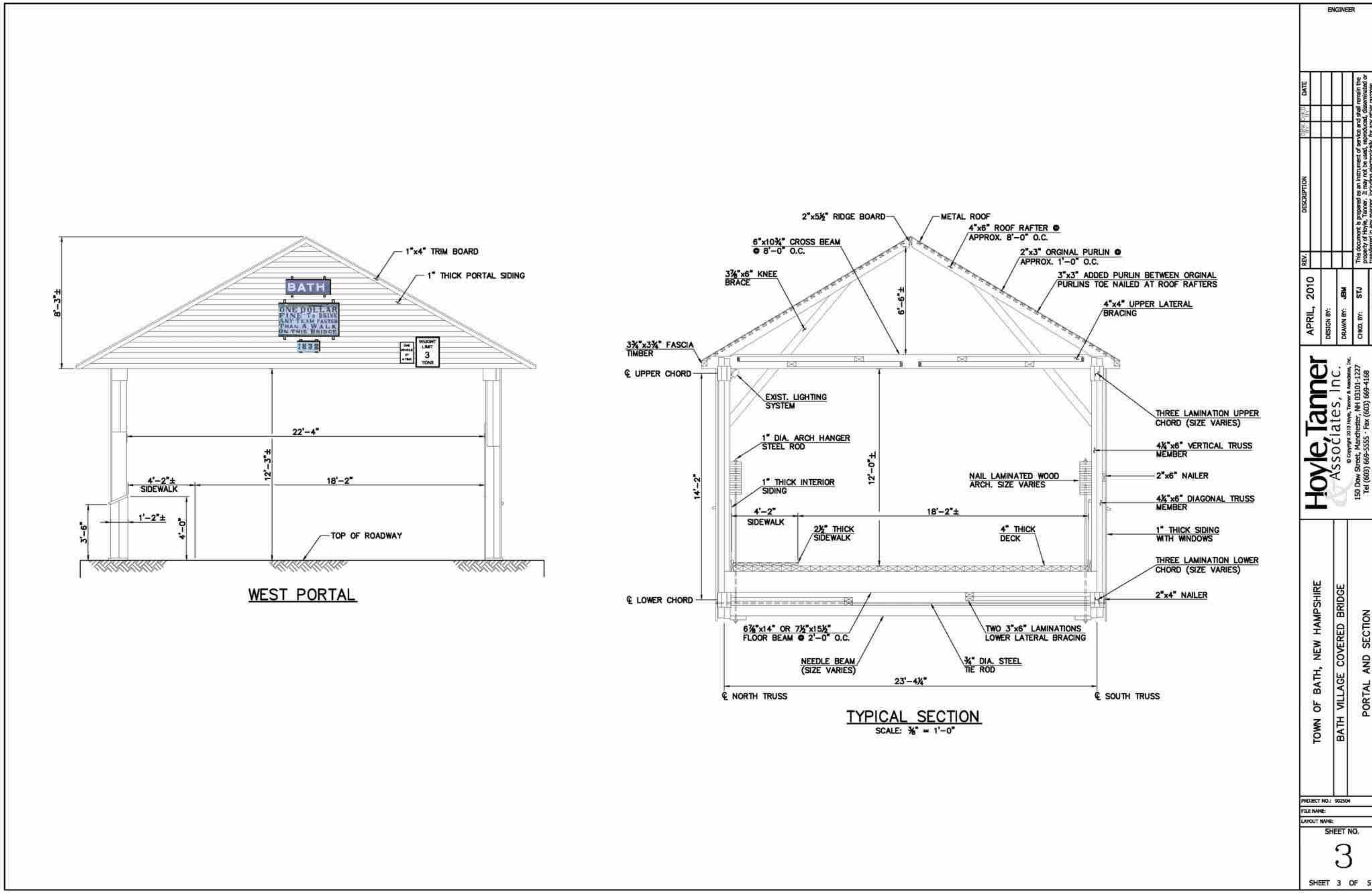
APRIL, 2010
DESIGN BY:
DRAWN BY: JBM
CHKD. BY: STJ
SCALE: AS SHOWN

Hoyle, Tanner & Associates, Inc.
150 Dow Street, Manchester, NH 03101-1227
Tel (603) 669-5555 · Fax (603) 669-4168
Webpage: www.hoyletanner.com

TOWN OF BATH, NEW HAMPSHIRE
BATH VILLAGE COVERED BRIDGE
TITLE SHEET

PROJECT NO.: 902504
FILE NAME:
LAYOUT NAME:
SHEET NO.
1
SHEET 1 OF 5


11'-5½"
SPAN 1
22'-10½"
SPAN 2
27'-1½"
SPAN 3
24'-5"
SPAN 4
73'-6½"
SPAN 5
74'-5½"
SPAN 6
117'-6"
SPAN 7
LONGITUDINAL SECTION
SCALE: 1/16" = 1'-0"
392'-6"±
16'-10" EXISTING VERTICAL CLEARANCE
PIER 1
PIER 2
PIER 3
WATER LEVEL FLUCTUATES FROM DAM WITHDRAWAL
ASSUMED CHANNEL PROFILE
SOUTH ELEVATION
SCALE: 1/16" = 1'-0"
ENGINEER
REV.
DESCRIPTION
DATE
APRIL, 2010
DESIGN BY:
DRAWN BY: JBM
CHKD. BY: STJ
SCALE: AS SHOWN
Hoyle, Tanner & Associates, Inc.
150 Dow Street, Manchester, NH 03101-1227
Tel (603) 669-5555 · Fax (603) 669-4168
Webpage: www.hoyletanner.com
TOWN OF BATH, NEW HAMPSHIRE
BATH VILLAGE COVERED BRIDGE
SECTION AND ELEVATION
FILE NAME:
LAYOUT NAME:
SHEET NO.
2
SHEET 2 OF 5


1"x4" TRIM BOARD
1" THICK PORTAL SIDING
BATH
ONE DOLLAR FINE TO DRIVE ANY TEAM FASTER THAN A WALK ON THIS BRIDGE
WEIGHT LIMIT 3 TONS
8'-3"±
22'-4"
12'-3"±
18'-2"
4'-2"± SIDEWALK
1'-2"±
3'-6"
4'-0"
TOP OF ROADWAY
WEST PORTAL
2"x5½" RIDGE BOARD
METAL ROOF
4"x6" ROOF RAFTER @ APPROX. 8'-0" O.C.
6"x10¾" CROSS BEAM @ 8'-0" O.C.
2"x3" ORGINAL PURLIN @ APPROX. 1'-0" O.C.
3⅞"x6" KNEE BRACE
3"x3" ADDED PURLIN BETWEEN ORGINAL PURLINS TOE NAILED AT ROOF RAFTERS
4"x4" UPPER LATERAL BRACING
6'-6"±
3¾"x3¾" FASCIA TIMBER
℄ UPPER CHORD
EXIST. LIGHTING SYSTEM
THREE LAMINATION UPPER CHORD (SIZE VARIES)
1" DIA. ARCH HANGER STEEL ROD
4⅛"x6" VERTICAL TRUSS MEMBER
12'-0"±
14'-2"
NAIL LAMINATED WOOD ARCH. SIZE VARIES
2"x6" NAILER
1" THICK INTERIOR SIDING
4⅛"x6" DIAGONAL TRUSS MEMBER
4'-2" SIDEWALK
18'-2"±
2½" THICK SIDEWALK
4" THICK DECK
1" THICK SIDING WITH WINDOWS
THREE LAMINATION LOWER CHORD (SIZE VARIES)
℄ LOWER CHORD
2"x4" NAILER
6⅞"x14" OR 7½"x15½" FLOOR BEAM @ 2'-0" O.C.
TWO 3"x6" LAMINATIONS LOWER LATERAL BRACING
NEEDLE BEAM (SIZE VARIES)
¾" DIA. STEEL TIE ROD
23'-4¼"
℄ NORTH TRUSS
℄ SOUTH TRUSS
TYPICAL SECTION
SCALE: ⅜" = 1'-0"
ENGINEER
REV.
DESCRIPTION
DATE
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APRIL, 2010
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DRAWN BY: JBM
CHKD. BY: STJ
SCALE: AS SHOWN
Hoyle, Tanner & Associates, Inc.
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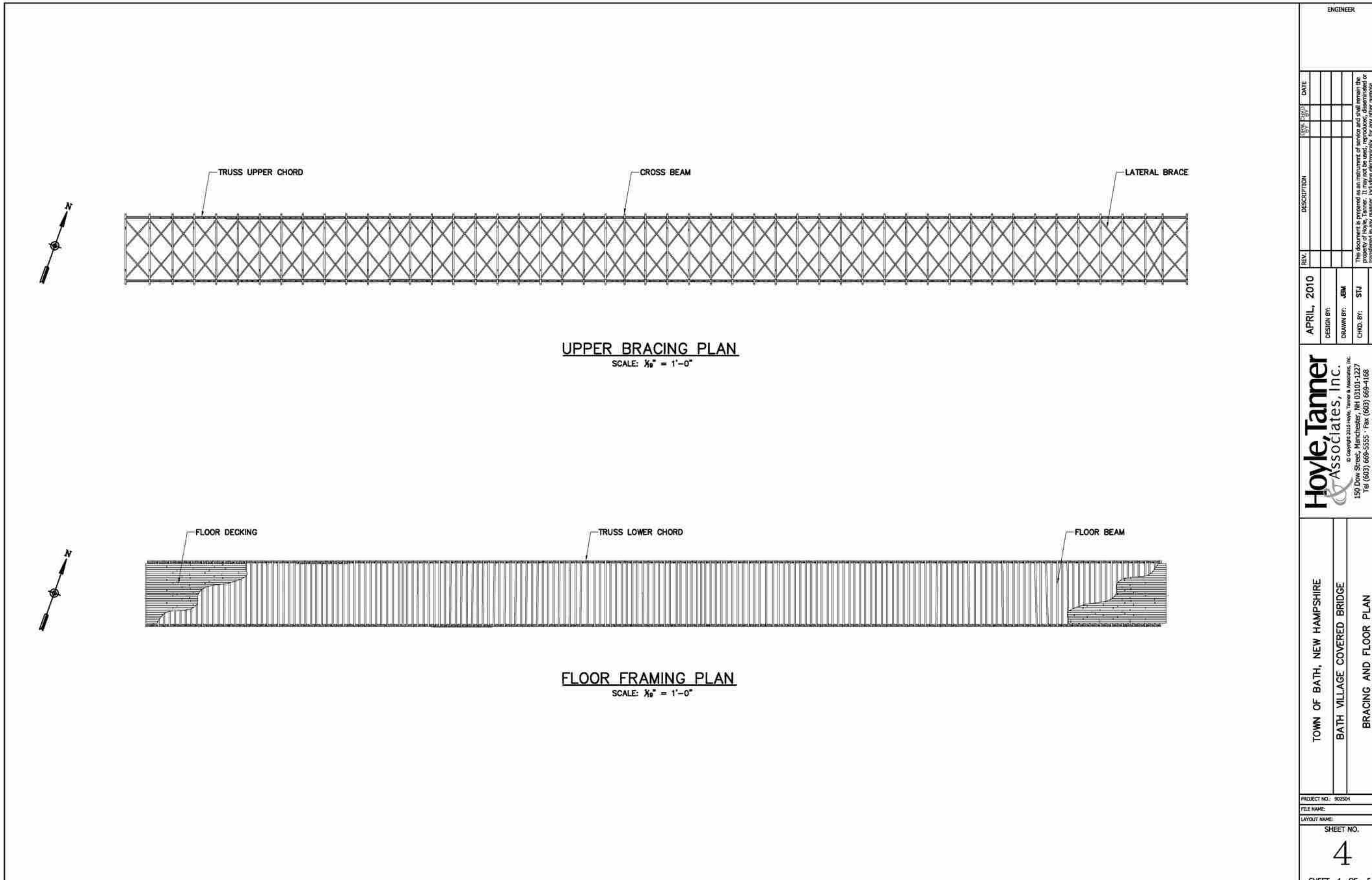
TOWN OF BATH, NEW HAMPSHIRE
BATH VILLAGE COVERED BRIDGE
PORTAL AND SECTION
PROJECT NO.: 902504
FILE NAME:
LAYOUT NAME:
SHEET NO.
3
SHEET 3 OF 5


TRUSS UPPER CHORD
CROSS BEAM
LATERAL BRACE
UPPER BRACING PLAN
FLOOR DECKING
TRUSS LOWER CHORD
FLOOR BEAM
FLOOR FRAMING PLAN
ENGINEER
REV.
DESCRIPTION
DATE
APRIL, 2010
DESIGN BY:
DRAWN BY: JBM
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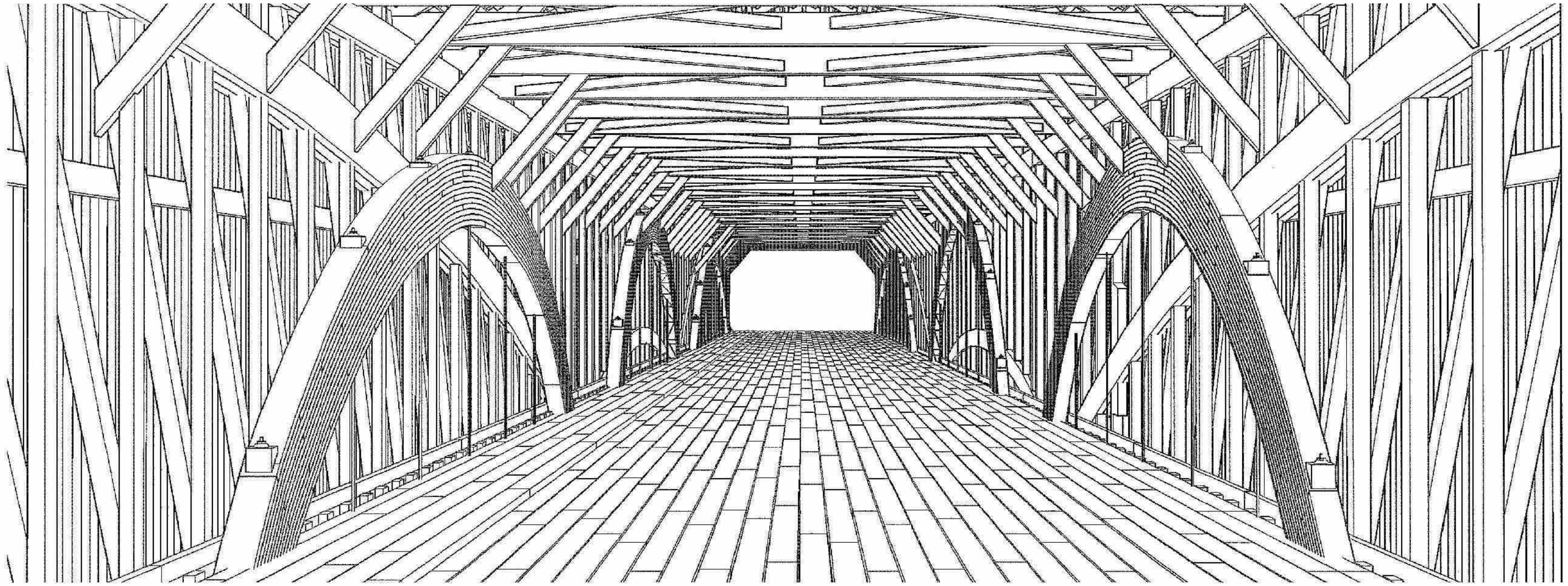
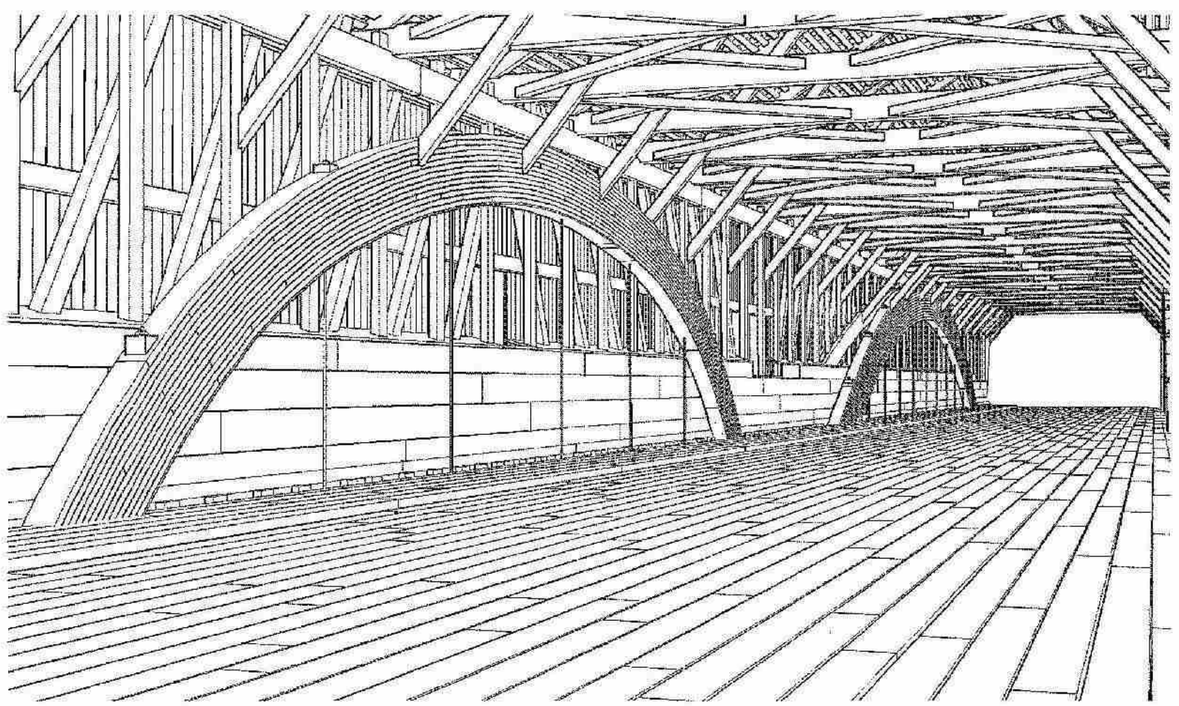
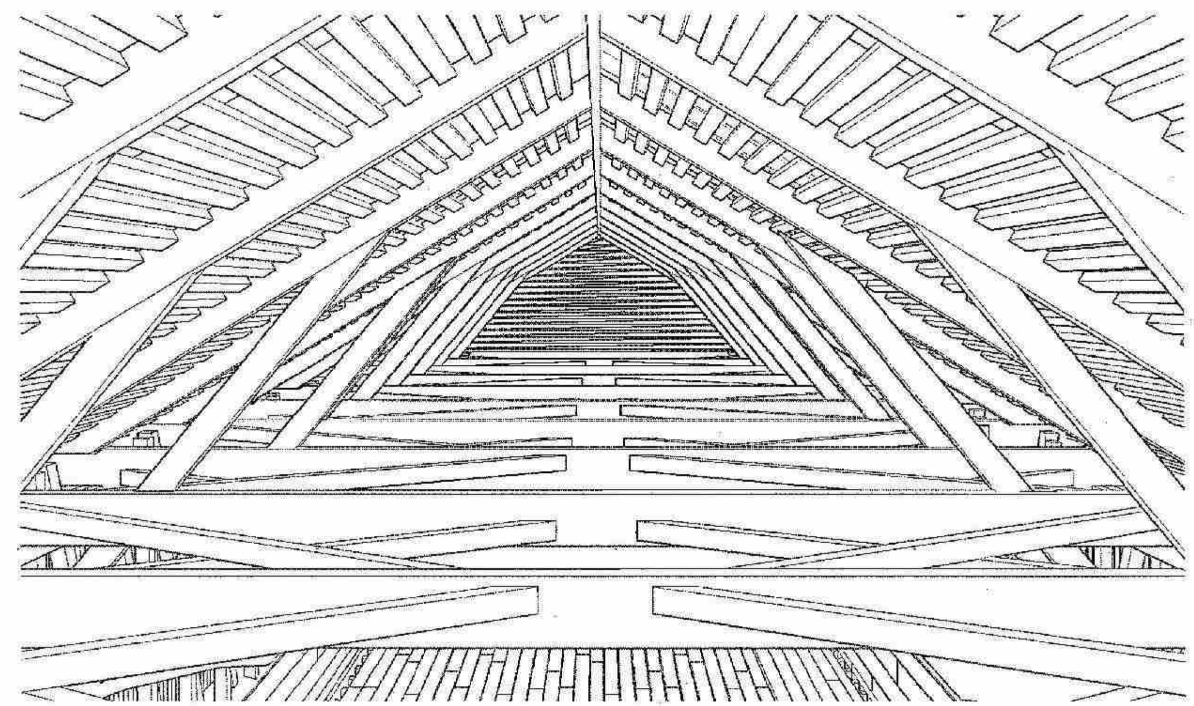
TOWN OF BATH, NEW HAMPSHIRE
BATH VILLAGE COVERED BRIDGE
BRACING AND FLOOR PLAN
PROJECT NO.:
FILE NAME:
LAYOUT NAME:
SHEET NO.
4
SHEET 4 OF 5



LOOKING EAST



NORTH TRUSS



ROOF FRAMING

ENGINEER

REV.	DESCRIPTION	DRW. BY	CHKD. BY	DATE

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TOWN OF BATH, NEW HAMPSHIRE
BATH VILLAGE COVERED BRIDGE
INTERIOR VIEWS

PROJECT NO.: 902504
FILE NAME:
LAYOUT NAME:
SHEET NO.
5
SHEET 5 OF 5

4.0 CONDITION REPORTS

4.1 Hoyle Tanner & Associates, Inc., Engineering Study 2006

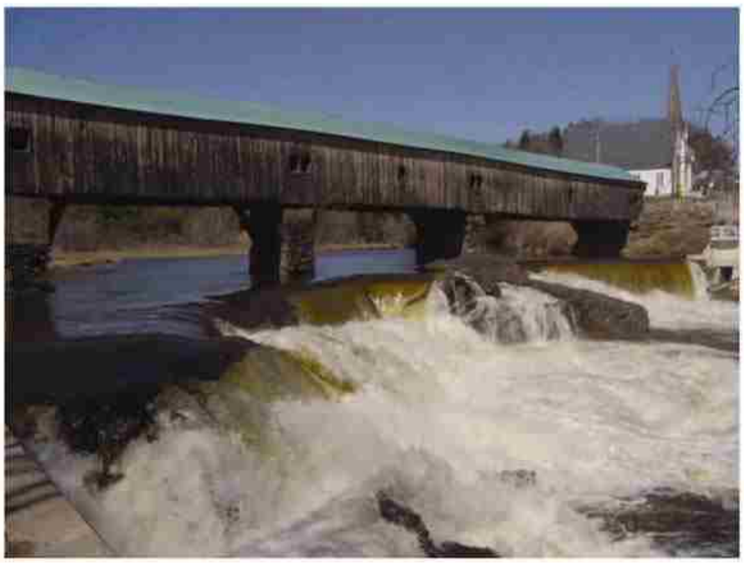
Document included on following pages.

ENGINEERING STUDY

For the

BATH ("VILLAGE") COVERED BRIDGE

NHDOT Bridge No. 137/095
NH State Covered Bridge No. 28
HAER No. NH-34
B&M Railroad Bridge No. 98.29
Covered Bridge World Guide No. 29-05-03



Prepared By:

HTA CONSULTING ENGINEERS
150 Dow Street
Manchester, NH 03101
HTA Project No. 902504

Prepared for:

The Town of
Bath

April 2006

TABLE OF CONTENTS

1 EXECUTIVE SUMMARY

The Town of Bath, NH retained Hoyle, Tanner & Associates, Inc. (HTA) to inspect, analyze, evaluate and provide rehabilitation recommendations for the Bath ("Village") Covered Bridge. The goal of rehabilitating the bridge is to repair and preserve the bridge for future generations with the intended use for the bridge for both pedestrian and vehicular traffic. Rehabilitation of the bridge for a six (6) or ten (10) vehicular loads was investigated. A higher live load evaluation and construction of an unposted bridge at a nearby site were beyond the scope of this study and are not eligible for NHDOT Municipal Bridge Aid funding.

The Bath Covered Bridge, also known as the Village Covered Bridge, is a 375' long, multi-span structure that spans the Ammonoosuc River in the Town of Bath, New Hampshire that was completed in 1832. The bridge is the third oldest remaining covered bridge in New Hampshire and is the longest covered bridge residing entirely in the state. The present structure is the fifth bridge and the only covered bridge to be erected at this site.

An inspection team from HTA visited the bridge site from August 10 to August 12, 2005 to review existing conditions. Wright Construction Company provided access to the lower chord, floor framing and bridge substructure with ladders and floating staging. The bridge is in poor to good condition depending upon the component.

A structural analysis was performed of all key members of the bridge superstructure with the exception of the substructure and top lateral bracing. The roof rafters are overstressed by 80% for the design snow, which is not unexpected due to the small size of the members and large spacing. The trusses and arches combined are adequate for a six (6) ton live load with the existing floor framing and assuming the timber bents in span 1 are removed. If new, higher capacity floor beams and decking are installed along with new timber bents (or a new laminated arch in this span) the bridge can support a ten (10) live load.

An estimate of cost was prepared for a base rehabilitation, which includes repairs to the bridge for a six (6) live load, realignment of the bridge and arches, approach improvements and installation of fire protection systems. Based upon the availability of NHDOT funding for the project, it was assumed that construction will be completed in 2010. The total estimated construction cost including contingencies of the base rehabilitation is $1,610,000 ($2,032,600 in 2010 dollars). Option 1 includes all the work in the base rehabilitation as well as installation of new timber bents or a laminated arch in span 1 and removal and replacement of the existing floor beams and decking. Option 1 including contingencies is estimated to cost $2,060,000 ($2,600,700 in 2010 dollars).

The six (6) and ten (10) ton live load options are not adequate to support all desired Town maintenance and emergency vehicles and require a 9 mile detour. As such, we recommend that the Town pursue construction of a new river crossing through an alternate NHDOT program to meet this goal.

2 INTRODUCTION

The Town of Bath, NH retained Hoyle, Tanner & Associates, Inc. (HTA) to inspect, analyze, evaluate and provide rehabilitation recommendations for the Bath ("Village") Covered Bridge.

The Bath Covered Bridge, also known as the Village Covered Bridge, is a four (4) or seven (7) span structure that spans the Ammonoosuc River in the Town of Bath, New Hampshire. The bridge was completed in 1832 and consists of a unique truss and arch structure that supports the roof framing, roadway deck and sidewalk. This framing system has been referred to as a modified Burr or Haupt truss. The overall length of the bridge is 374'-5" with four (4) span lengths (i.e ignoring timber bents) of 126'-6" (east span), 71'-10", 69'-0" and 90'-6" (west span). Three (3) timber piers (or bents) have been added under the west span, modifying the structure from four (4) to seven (7) spans. New span lengths in the west span are 20'-6", 26'-4", 21'-10" and 13'-0". The stone piers are skewed (not perpendicular) to the trusses or roadway, thus, span lengths very depending on where measurements are taken. All span lengths mentioned in this report are measured along the <u>centerline</u> of the bridge.

The overall width of the bridge is 24'-6" with a distance of 22'- 5½" between the centerline of trusses. A 4' wide sidewalk or raised platform is located inside and adjacent to the upstream truss.

The bridge is the third oldest remaining covered bridge in New Hampshire and is the longest covered bridge residing entirely in the state. The present structure is the fifth bridge and the only covered bridge to be erected at this site.

"The Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings", published by the U.S. Department of the Interior National Park Service, is used as a guide for all rehabilitation options discussed in this study. This text, hereafter referred to as the NPS Standards, outlines acceptable methods for rehabilitating historic structures and is used as a guide by the New Hampshire Division of Historical Resources (NHDHR).

Bath ("Village") Covered Bridge
Engineering Study
Bath, NH

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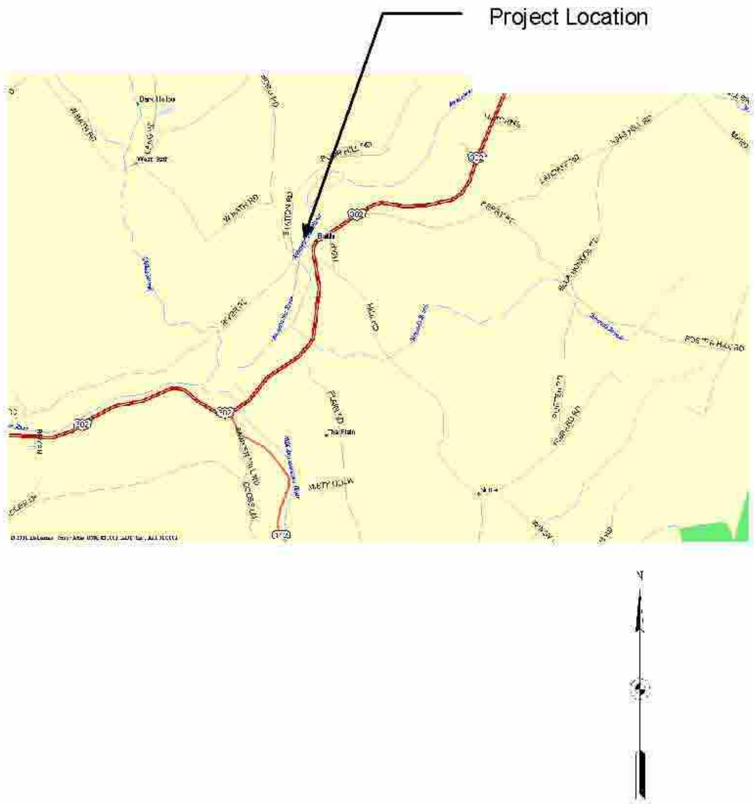
2.1 Location Map



LOCATION MAP **Bath Village Covered Bridge** **Bath, NH**	HTA CONSULTING ENGINEERS	**File Name:** stdwetlandsApp.doc	
		DATE: 12/05	**Figure** 2

4

3 BACKGROUND / HISTORY

As part of this study a through review of available data and documentation on the bridge was obtained from the following sources:

- New Hampshire Department of Transportation (NHDOT), Bureau of Bridge Design, Concord, NH
- NHDOT, Bureau of Bridge Maintenance, Concord, NH
- Town of Bath, NH
- NH State Library, Concord, NH
- NH State Archives, Concord, NH
- NH Historical Society, Concord, NH
- Historic American Engineering Record (HAER), Washington, DC
- National Society for the Preservation of Covered Bridges, Manchester, NH
- New Hampshire Division of Historical Resources (NHDHR), Concord, NH

Also, Mr. Joseph D. Conwill, noted covered bridge historian and author, was consulted relative to the background/history portion of this report.

Upstream Elevation

The Bath Covered Bridge is the fifth bridge to be constructed at this site, the first bridge being constructed in 1794. The previous four (4) bridges were either lost due to floods or destroyed by fire. Planning for the present bridge first began at a Bath Town meeting in 1830. In 1831 stonework for two (2) piers and two (2) abutments was constructed. Mr. Luther Butler, a Haverhill Mason, performed the work. Total cost for the substructure was $1,400.000. In 1832, a three (3) span timber superstructure was constructed at a cost of $1,900.00. Mr. George Witherell, a Bath carpenter, performed the work. Hand wrought iron nails were made for construction of the superstructure by Mr. Amarco Buck. At the 1833 Town Meeting, selectman authorized the installation of signs on the bridge to read "One Dollar Fine to Drive Any Team Faster Than a Walk on this Bridge".

The original bridge was approximately 375' long and built with a single lane roadway. The bridge was constructed using a unique type of truss and integral timber arch system. This framing system has been described as either being a modified Burr Truss or modified Haupt Truss. For the purpose of this report this truss system will be referred as a modified Burr Truss although there is significant disagreement within the covered bridge community as to the actual truss designation.

The bridge remained unaltered for many years (it is assumed that roof shakes, portal shingles, siding, floor beams and decking have routinely been replaced due to rot or damage over the life of the bridge). As early as the mid 1830's, the Town directed an annual maintenance requirement to cover the deck of the bridge with snow in order for horse drawn sleighs to pass through the bridge during the winter months. Records indicate the Town maintained the bridge on an annual basis with the bridge being "snowed" as late as the 1920's.

The following sections highlight major known events that occurred at the bridge between 1852 and 1996.

1852 – 1853 The White Mountain Railroad constructed a line adjacent to Bath Village on the west side of the Ammonoosuc River. The line passed under the westerly span of the bridge with the R.O.W. still existing today.

1872 The first mill (a pulp mill) was constructed in the area immediately downstream of the west abutment of the bridge.

1893 A dam was built downstream of the bridge to serve mills on both sides of the river. The dam still serves as a hydroelectric facility and is privately owned. Also, prior to 1893 a new stone pier was constructed beneath the westerly span, modifying the bridge from a three (3) span to a four (4) span continuous structure.

1911 John W. Storrs, a noted bridge engineer from Concord, NH visited the bridge and wrote several letters concerning its condition and capacity. In 1911 he noted that 8,000 pound (4 ton) dump carts full of gravel were passing over the bridge (although he recommended the safe capacity was only 2 tons). He also noted at this time that due to the condition of this bridge, he tentatively recommended constructing a new bridge, subject to a thorough inspection of the lower chords of the trusses that were hidden by wainscoting.

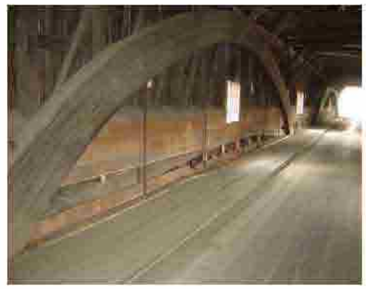
1912 John W. Storrs evaluated the bridge at the request of a Mill operator who wanted to transport a new 10 ton boiler over the bridge. Mr. Storrs conclusion was the bridge was in no way safe for such a load.

1914 Mr. Storrs re-inspected the bridge and prepared detailed calculations of its load carrying capacity. He again stated in a 1915 letter that the bridge had a load limit of 2 tons.

1918 At the Town Meeting, funds were raised for repairs to the bridge. Repairs were performed by Mr. Cyrus Batchelder and were completed in 1919. The Town's share of the repairs cost was $7,076.00. Theses repairs consisted of:

- Raising the bridge two (2) feet at the request of the railroad (and paid for by them).

- Adding laminated arches in the easterly three (3) spans.
- Repairs to a flood damaged pier.
- Construction of concrete caps on all piers as part of the bridge raising.
- Installation of new needle beams and new floor timbers.
- Building up the west stone pier to its full height and cementing its face.
- Shingling the north side of the roof.
- Reboarding (residing) the entire bridge.
- Regrading the roadway approaches to match the new bridge height
- Extending the stone wingwalls vertically to hold back the higher roadway fill. It was noted at the time that the floor decking consisted of two (2) layers of 3" plank, one layer running longitudinal through the bridge and one layer running diagonal.



Typical Added Arch

Timber Bents at West Span

Between 1919 and 1941 Three (3) timber bents were constructed beneath the far westerly span, and straddled the two (2) railroad tracks. Also during this period, an internal sidewalk (platform) was added to the inside adjacent to the upstream truss. Lights were installed on each portal of the bridge.

1939 - 1940 Extensive repairs were made to the bridge. The only work documented was repairs to the corrugated metal roof.

1954 The portals were reconstructed with the bottom of the portal siding modified to follow an elliptical arch curvature. This was probably an attempt to restore this "arch feature" in the portals which previously existed. Partial new siding was installed at the west abutment on the upstream side.

1968 - 1969 Floor planks were replaced and other minor repairs were made.

1976 Steel channels were added to the lower chords of the trusses over the westerly span at the railroad tracks. Repairs were necessitated as a result of severe rot having been discovered in lower chords of the trusses at this location. The bridge was entered in the National Register of Historic Places on September 1, 1976. The application indicated the historical aspects of the bridge, citing it to be the 5th bridge to stand on this site.

August 21, 1979 An oversized railroad car operated by the Boston and Maine Railroad hit the bridge where the line passes under the westerly span. Temporary repairs were made to the bridge shortly thereafter.

1984 The NHDOT Bureau of Bridge Design placed this bridge on their bridge "red list". Placing the bridge on this list indicated the bridge had a load capacity less than the legal load capacity provided by State statues. Also at this time, the State provided the Town with a cost estimate of $3,000,000 to construct a new bridge at this site, and noted that Federal funds were available to pay for 80% of the project costs.

1985 An inspection and report was made by Mr. Wilbur M. Hoxie, P.E. who recommended extensive repairs be made to the bridge. As a result of his report, and the recommendations of the Town's Bridge Committee, which was formed the previous year, extensive repairs and rehabilitation was made in 1987 and 1988. Mr. Milton S. Graton, a noted covered bridge contractor from Ashland, NH was hired to perform the rehabilitation. Repairs that were made to the bridge at that time included removing the wainscoting, reinforcing the laminated arch ends where they bear on the stone piers, installation of a new metal roof, replacement of several truss verticals, new floor decking, sistering some deteriorated truss members, replacement of some of the bearing timbers, installation of riprap in front of the east pier, repairs to the trusses over the railroad, repairs to east end railroad truss chord members on the downstream side, and replacement of arch rods. In 1988 the Town contracted directly with and electrician to install lights within the bridge.

1996 The Town reinstalled the wainscoting on the inside of the bridge that had been removed during the 1988 rehabilitation. Sometime after 1996, the B&M railroad abandoned the line and removed the rails and ties under the west span.

4 FIELD OBSERVATIONS

An inspection team from HTA visited the bridge site from August 10 to August 12, 2005 to review existing conditions. Wright Construction Company provided access to the lower chord, floor framing and bridge substructure with ladders and floating staging. Two (2) NHDOT Bridge Inspectors (Bill Little and Bruce Pepler) were also on site on the 10^{th} to provide insight into the deficiencies that have noted at the bridge.

The following section describes the various portions of the bridge and our observations of them. It should be noted that member sizes vary throughout the bridge. The dimensions listed are the predominant, or average size noted.

4.1 Roof Framing

The roof consists of a metal roof on longitudinal 1-¾"x3" purlins spaced at 12" on center. The purlins in turn are supported by transverse 4"x6" rafters at 8" on center. Approximately one-half of the purlins appear to be in their original locations based on notching patterns. The remaining purlins appear to have been added at a later date and are simply toenailed to the side of the rafters. Several purlins were either missing or loose and many are sagging between rafters with no obvious attachment to the metal roof. Several of the missing purlins have fallen out of place and landed on top of the upper lateral bracing.

Typical Roof Framing with Missing Purlins

The metal roof is in fair to good condition with some leaks noted, however the attachment of the roof to the purlins is poor. During light winds the roof makes a rattling noise as it moves over the purlins. The lack of attachment to the roof will reduce the service life of the roof, however due to the method of installation; it is impossible to add the correct type of additional attachments due to the type of roof. The purlins appear to be in good condition with the attachment at the rafters in poor condition in many locations. The rafters are fair to good condition with some minor rot noted at the rafter tails (lower end).

4.2 Upper Lateral Bracing

Upper Lateral Bracing

The upper lateral bracing between the top chords of the trusses consists of 6"x10-¾" crossbeams at 8' on center, 3-¾"x4" diagonals between crossbeams and two (2) 4"x6" knee braces at each crossbeam spanning between the truss vertical members and roof rafters.

The upper lateral bracing is in fair to good condition. Several of the crossbeams have been scraped on the bottom face from over height vehicles and have mild rot at their ends. Previous repairs have been made to nine (9) crossbeams. The two (2) knee braces at the West portal have been cut off at the crossbeam and do not extend to the truss.

4.3 Trusses

Typical Truss Section

Two (2) trusses provide for the longitudinal support of the bridge and consist of 375'± long, seven (7) span continuous trusses using a unique type of truss system with supplemental arches. Triple upper and lower chord members are provided and consist of two (2) 3"x11" members outside a single 4"x10" center member. Web members pass between the chords and consist of 4"x6" verticals at 4' on center and 4-½"x5-¾" diagonal members. Siding hides the lower portions of the trusses and therefore approximately 30% of it was removed during our field observations so that the lower portions of the truss could be viewed. During removal we noted an additional, built-in arch that is normally hidden by the siding.

The trusses are in good condition above the deck level and in fair to serious condition below the deck level due to rot, member damage or large splits. Three (3) spans exhibit sag (negative camber) of 4" to 7", which has opened up the butt joints in the bottom chord by up to 1½", while the other spans exhibit a slight positive camber. The sag in the chords is especially noticeable when viewing the roofline but not when viewing the deck since most of the floor beams have been shimmed. There is no bridge rail within the bridge.

Span 5, North Lower Chord

The spans between Bent 2 and 3 (Span 3 over the recreational trail) and Pier 1 and 2 (Span 5 over the river) appear to be in the worst condition and exhibit the worst sag. Span 5 has rot and splits in the original chord members visible from below. This span was previously repaired by the addition of steel rods and an extra chord member in this location.

A total of 26 truss web members have been spliced as part of a previous repair program. The splices generally consist of an added member connected with through bolts and trunnels. The connection of the vertical to the chord generally only consists of a single trunnel without the notching usd in the members not repaired.

Bath ("Village") Covered Bridge
Engineering Study
Bath, NH

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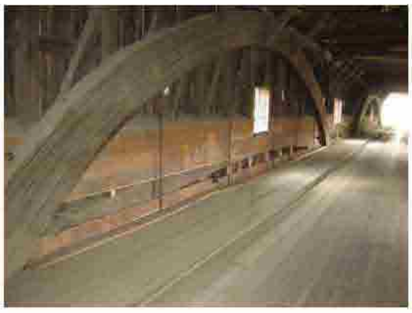
The upper chords of both trusses exhibit excessive deflection at the west end of the bridge where they support the portal. This condition appears to be caused by long term creep and inadequate support of the cantilevered portion of the top chord.

Deflection of South Truss Top Chord at the West Portal

4.4 Arches

There are a total of six (6) arches at each truss; three (3) original arches built into the truss including one (1) completely hidden by the interior wainscoting and three (3) that are added to the inside of the truss. The three (3) original arches bear on the bottom chord of the truss, while the three (3) added arches bear directly on the bridge piers.



Added Arch and Original Arch (Behind Siding)

The arches are in good condition with the exception of the two (2) added arches between Piers 1 and 3 and portions of the integral arches near siding windows. The added arches are weathered on the downstream face, have very poor bearing on the piers and have begun to loose their shape as evidenced by the splitting of the laminations. The arches bearing on Pier one (1) are not well seated and, due to the steep slope of the arch, could slip or potentially fall off the pier. It is very difficult to predict when this may occur, however this condition is serious and we recommend that it be addressed within the next year.

The internal arches connect directly to the truss chord and web members and act to stiffen the truss. The added arches are loaded through steel rods connected to 5" x 10" needle beams, which bear directly on the bottom face of the lower chord. The rods are in fair to good condition with some light rusting noted below the deck level. The needle beams are in fair to poor condition with several members split or twisted.

Southwest Arch Bearing at Pier One

Separation of Arch Laminate at Pier One

4.5 Floor Beams and Decking

The floor framing consists of 4" thick by 8" wide longitudinal wood planks. Deck planking is supported by floor beams spaced approximately 2' on center. Floor beams vary in size, but are typically 7½"x15½" and were largely installed during the 1987-88 repairs.

Typical Floor Framing

Missing Floor Beam Blocking

The floor beams have been shimmed up to 7" at the truss bearings due to the varying sag in the bottom chord of the trusses, however the blocking is missing in 26 locations. It appears that vibration from vehicles has loosened the blocking.

The roadway deck planking is in fair condition; with uneven wearing, loose boards and some spikes protruding above the surrounding deck surface. The sidewalk decking is in good condition. The majority of the floor beams appear to be in good condition with some in fair condition due to large checks or rot. The bottom 'x' bracing appears to be in good to fair condition, however the attachment to the chords does not appear to be adequate.

4.6 Abutments

The abutments consist of dry laid stones with a concrete cap, while the wingwalls consist of dry laid stones; both are in fair to good condition. The abutments appear to have settled unevenly and there are several voids where stones are missing, which has allowed fill behind the abutment wall to spill through. Plow damage to the steel drain at the east abutment was also noted.

Rot and Crushing of Support Beams at Pier 2

The bridge trusses are supported at the abutments and piers by sleeper beams and transverse support beams. Most of the sleeper and transverse support beams are in poor condition with rot and crushing evident. At Pier 1, only the western edge of the sleeper beam is bearing on the pier due to movement of the pier.

4.7 Piers

The three (3) timber bents at the West end of the bridge are not of original construction and consist of timber columns, bracing and cap beam on a concrete footing. The bents are in serious to poor condition with large areas of rot throughout and poor connection details. Several of the bents have been previously repaired, however the repairs do not appear to be appropriate in their use.

Bath ("Village") Covered Bridge
Engineering Study
Bath, NH

HTA CONSULTING ENGINEERS

Tree Growing out of Pier 2

The three (3) river piers consist of largely dry laid stone with concrete caps and concrete toe wall. Piers 3 and 2 (easternmost pier and center pier respectively) are in poor to fair condition, while Pier 1 is in serious condition. Piers 3 and 2 are founded on ledge and Pier 1, which is not of original construction, is founded on partially exposed wood cribbing. All three Piers have varying amounts of vegetation growing in the joints with Pier 2 having a small tree growing out of the downstream face. All three Piers have some large stones and chinking stones missing.

Pier 1 (western most pier) has several serious deficiencies including the following (Note: these deficiencies are to be addressed in a 2006 pier repair project currently under design):

- Scour. Two (2) scour pockets measuring at least 3'x3'x3' and 2' deep by 4' long, which have exposed the wood cribbing under the bridge were noted under the East side of Pier 1. The NHDOT inspection report has noted this scour condition since October 2000. Once the wood cribbing is exposed to the oxygen in the river water, it will begin to rot, which may cause the pier to settle further.

Canoe Paddle Placed into Scour Hole under Pier 1

- Missing stones. A large stone is missing from the south face of the pier which has caused it to shift. Based upon photographic records from the NHDOT, this stone has been missing since at least the time when repairs to the bridge were made in the late 1980's. It is unknown how long this condition existed prior to these repair or why it was not corrected.

14

Stone Missing in South Face of Pier 1 (also note Arch Bearing Conditions

Pier 1 During Repairs made in the 1980's

- Cracked Concrete. The concrete toe wall around the base of the pier is cracked in several locations.
- Arch Bearing. The arches bearing on Pier one (1) are not well seated and, due to the steep slope of the arch, could slip or potentially fall off the pier.

4.8 Approaches

Both roadway approaches to the bridge are paved with the East approach graded down toward the bridge and the West approach graded away. The approach rail to the bridge does not appear to be adequate, with the exception of the Southwest corner at River road.

The approach signage for weight and width restrictions on the bridge is adequate, however the weight limit signs do not meet current standards. There is a sign with a weight restriction on each end of the bridge. The East sign has a 6 ton limit, while the West sign has a 2 ton limit; neither sign meets the current Manual on Uniform Traffic Control Devices (MUTCD) standard. It is our understanding that the Town plow utilizes the bridge during the winter and is heavier than the current six (6) ton limit. Six (6) ton weight limit signs should be installed at each end of the bridge and the limit strictly enforced due to the serious condition of some components of the bridge.

4.9 Fire Protection Systems

The bridge does not currently have a fire detection system (Protectowire) installed and we were unable to find any records that a fire retardant paint has been applied to the bridge.

4.10 Lighting/Utilities

The bridge has recently installed fixtures mounted on the side of the top chord of the truss. The fixtures were not on at the time of our inspection and therefore were not evaluated.

There are overhead electrical and cable utility lines to the north of the bridge, which appear to be a sufficient distance from the bridge. A phone line is run through the bridge near the top chord of the South truss. This line is supported from crossbeams and appears to have moved or rotated several crossbeams from their bearing on the top chord due to the tension on the line. Consideration should be given to having the phone line relocated.

5 TIMBER SPECIES IDENTIFICATION

Six (6) samples, approximately 2" by 4" in size, were removed from various bridge members for the purpose of species identification as a guide to assigning allowable design stress values. Bridge members that were sampled include: the truss diagonals and chords, floor beams, deck, and trunnels. Samples were taken from deteriorated members that will most likely be replaced during the bridge rehabilitation or from locations on the member not visible to the public or detrimental to the structural integrity of the member.

The samples were forwarded to Doug Gardner, Ph.D., at the University of Maine, for identification through examination and testing. From the analysis, Professor Gardner determined that all the samples are local species and are predominately spruce or hemlock. A copy of Dr. Gardner's report is included as Appendix A.

6 HYDRAULICS

The bridge spans over the Ammonoosuc River in Bath, New Hampshire. The Flood Insurance Rate Maps (FIRM) dated April 15, 1992 and produced by the Federal Emergency Management Agency (FEMA) for Bath, New Hampshire places the bridge and the immediate area around the bridge in the 100-year flood plane having a flood elevation of 507 feet. This means the bridge is located in an area that is expected to see a flood event equal to or exceeding that magnitude once every 100 years. A 100-year flood event has a one percent (1%) chance of being equaled or exceeded during any year. The elevation of the lower chord of the bridge is 518 feet, which provides approximately 15 feet of freeboard above the 100-year flood.

7 STRUCTURAL ANALYSIS

A structural analysis was performed of all key members of the bridge superstructure with the exception of the substructure and lateral bracing. These components have performed adequately and were not evaluated due to budgetary constraints. The Service Load (Allowable Stress) design method was used for all members with allowable stress values obtained from the 2002 National Design Specification for Wood Construction and Supplement. The live load goal for this project is a vehicular live load capacity per AASHTO. Two (2) live loads were evaluated; a six (6) ton and ten (10) ton option. The NHDOT has recommended a six (6) ton rating for this bridge. Evaluation of this bridge for higher live loads or construction of a new unposted bridge at a nearby site was beyond the scope of this study.

The wood species used in the superstructure was identified through testing (see Section 5). The grade assigned to each member was based on a visual examination of knots, checks and the growth rate characteristics of the wood. See Section 4 for a description and condition of each member. All superstructure members are wood unless noted otherwise.

7.1 Roof Framing

The roof rafters and purlins were not tested for species and are assumed to be spruce which is consistent with the trusses. All rafters and purlins have been assigned a grade of select structural.

The roof rafters and purlins were analyzed for dead load and a ground snow load of 65 psf per the US Army Corps of Engineers, Ground Loads for New Hampshire. The purlins are adequate for the applied loads, however the rafters were overstressed by 80% bending. This result is not unexpected due to the relatively small size (4" x 6") of the rafters and large spacing (8'-0").

In order to correct the rafter capacity issue two (2) options were evaluated; 1) install intermediate rafters between the existing purlins as was done at the Swiftwater Covered Bridge and 2) adding an additional member at the existing rafters. Rafter option 2) is recommended for the following reasons:

- It does not significantly change the appearance of the bridge and is reversible.
- A wood member added to the side of the existing rafters would support the ends of alternating purlins, which are not adequately supported at their bearings.
- Adds less dead load to the bridge.
- Is the lower cost option.
- The purlins are adequate for the 8' span, therefore intermediate support is not required for structural reasons.

7.2 Floor Beams and Decking

The bridge decking was identified as spruce, while the floor beams were identified as eastern hemlock of hemlock. Both the decking and the floor beams were assigned a grade of No. 1

The decking was found to be adequate for both the six (6) and ten (10) ton live loads with a capacity of H11.3 (11.3 tons). The floor beams however are only adequate for a six (6) ton loading with a capacity of H6.1 (6.1 tons). The floor beam result is consistent with NHDOT recommendations.

A 10¾"x15" glulam floor beam at 4' on center with a select structural Douglas Fir deck was found to have adequate capacity for a ten (10) ton loading. The 4' spacing was selected to significantly reduce the dead load to the trusses and this is the approximate truss vertical spacing. The existing floor beams are not believed to be original to the bridge according to John Storrs, who in 1914 noted the floor beams were 4" x 12" at 1'-4" on center however, it is not known if this is the original configuration. Lacking a historic reason, a 4' spacing was selected for the reasons previously discussed to provide a budgetary figure for the ten (10) ton capacity. If the ten (10) ton option is selected, several floor framing options can be evaulated if historic issues are of concern.

7.3 Trusses

The truss diagonals and chords were identified as spruce a spruce/fir while the trunnels are a white oak species. The spruce/fir sample was treated and clearly not original to the bridge. The chords, lattice and verticals were assigned a grade of select structural.

Live loads are transferred to the truss through integral, or built-in arches, through common floor beams bearing on the truss. The load is shared by the added arches located inside the trusses which are loaded through needle beams located below the bottom chords. The added arches are only in spans 2, 3 & 4.

The six (6) and ten (10) ton live load analysis was preformed using two (2) load combinations and included all arches in the bridge (built-in and added). The first load combination applied only dead load (the weight of the structure itself) and a six (6) or ten (10) live load. The results from this analysis were compared to the inventory stress values. The second load combination applied the dead load, a six (6) or ten (10) live load and a snow load to the structure. The results from this analysis were compared to the operating stress values. Inventory stress levels are used for loadings the bridge is expected to normally see, while the higher operating stress levels are used for less frequent or less likely to occur loadings such as a full pedestrian live load at the same time as a full snow load.

The capacity of the trusses and arches for the dead and live load combination is H10.0 (10.0 tons). The rating is controlled by the shear capacity of the bottom chords, followed closely by the capacity of the diagonals at H10.5 (10.5 tons) and vertical capacity of H13.6 (13.6 tons).

The capacity of the trusses and arches for the dead, live and snow load combination is H8.2 (8.2 tons). The rating is controlled by the diagonal members followed by the bottom chord capacity of H11.3 (11.3 tons). This rating is lower than dead and live load alone due toy the width of the bridge, which can carry a large snow load. This capacity can be increased to H10.0 (10.0 tons) by strengthening selected diagonal members.

The truss load rating assumes all members are in good condition and the present support conditions are retained. We have also explored removal of the timber bents in span 1. The capacity of the trusses would meet a 6 ton capacity for dead and live load but would not meet this capacity for dead, live and snow load, therefore, we recommend the timber bents be retained. As an alternate to the timber bents, a laminated wood arch could be added in span 1 and the bents removed.

7.4 Arches

Both the built-in and added arches were evaluated as part of the truss analysis. Both sets of arches were found to have sufficient capacity to support a ten (10) ton live load assuming repairs are made to them.

8 REHABILITATION OPTIONS

Due to the inclusion of State Funds on this project and the bridge's inclusion on the National Register of Historic Places, a Section 106 Review will be required as part of the National Historic Preservation Act of 1966. This review provides the New Hampshire Division of Historical Resources (NHDHR) and the NHDOT an opportunity to comment on any perceived adverse impacts to historic structures.

"The Secretary of the Interior's Standards for Rehabilitation and Guidelines for Rehabilitating Historic Buildings", published by the U.S. Department of the Interior National Park Service, was used as a guide for all rehabilitation options discussed below. This text outlines acceptable methods for rehabilitating historic structures and is used as a guide by the NHDHR.

Several deficiencies in the bridge need to be corrected in order to bring the bridge up to a "like new" condition. Correcting these deficiencies are identified as being the minimum or base rehabilitation. These deficiencies include broken, rotting or damaged members, replace roof, replace floor system, and repair or improve fire protection systems. The roof replacement is included as a budgetary cost due to its age, poor installation and potential damage to it from contractors rehabilitating the bridge. This recommendation will be evaluated further during the design phase of the project. It was further assumed that the rehabilitation of the bridge would not occur until 2010 at the earliest.

Two (2) rehabilitation options were considered for this study:

- Base Rehabilitation – Rehabilitation for a six (6) ton live load capacity herein referred to as base rehabilitation.
- Option 1 - Rehabilitation of the bridge to a ten (10) ton live load capacity.

9 ESTIMATE OF COST

Estimates of probable construction costs for the Base Rehabilitation and Option 1 were developed (a detailed breakdown for each option is included in Appendix B). Each option has certain items in common and these items are included under the cost of the Base Rehabilitation. The items that are specific to Option 1 are listed separately and a total project cost given.

Base Rehabilitation

A. Remove the existing metal roof and replace it with a standing seam metal roof.
B. Remove and replace deteriorated bridge members including:
   a. Roof purlins (30 purlins estimated)
   b. Roof Rafters (10 estimated)
   c. Cross beams (11 estimated)
   d. Upper lateral bracing (8 estimated)
   e. Knee braces (6 estimated)
   f. Truss chord members
   g. Truss diagonals (21 estimated)
   h. Truss verticals (27 estimated)
   i. Portions of all arches
   j. Floor beams and needle beams (30 & 10 respectively estimated)
   k. 100 feet by 23 feet of decking
   l. All bed timbers at the abutments and piers
   m. Siding (replace all)
   n. Portal siding (replace all)
C. Provide a temporary support structure during member replacement. The support structure will also be used to jack the bridge trusses to restore camber. It is assumed that only one (1) or two (2) spans will be supported at a time (i.e. the entire bridge will not be supported at the same time) with center supports in the other spans.
D. Remove dirt and debris from all areas of the bridge.
E. Rechink both stone abutments and three (3) piers.
F. Apply water repellant to all exposed concrete surfaces.
G. Concrete repairs at the piers and abutments.
H. Install a protectowire fire protection system.
I. Apply a fire retardant paint (NOCHAR) to all wood surfaces.
J. Reconstruct the abutment drainage structure.
K. Remove and repave 50' of the approaches to the bridge.
L. Replace the majority of the lower lateral bracing.
M. Installation of new approach guardrail.
N. Realignment (vertical) of both trusses including shimming truss members. This

also includes removal of the floor beam shims.

O. Realignment of all added arches and replacement of selected portions.
P. Replacement of selected steel arch rods.
Q. Installation of proper signage at each approach.

The estimated cost of the Base Rehabilitation (Items A through Q) including contingencies is approximately $1,610,000 ($2,032,600 in 2010 dollars).

In addition, the following items would be added or removed for Option 1:

Option 1

A. All items listed under the base rehabilitation
B. Removal and replacement of the bents or installation of a laminated timber arch in span 1.
C. Removal and replacement of the existing floor beams and decking.
D. Strengthening of selected truss diagonals

The estimated cost of the Option 1 (Items A through D) including contingencies is approximately $2,060,000 ($2,600,700 in 2010 dollars).

10 SUMMARY AND RECOMMENDATIONS

The Town of Bath, NH retained Hoyle, Tanner & Associates, Inc. (HTA) to inspect, analyze, evaluate and provide rehabilitation recommendations for the Bath ("Village") Covered Bridge. The goal of rehabilitating the bridge is to repair and preserve the bridge for future generations with the intended use for the bridge for both pedestrian and vehicular traffic. Rehabilitation of the bridge for a six (6) or ten (10) vehicular loads was investigated. A higher live load evaluation and construction of an unposted bridge at a nearby site were beyond the scope of this study and are not eligible for NHDOT Municipal Bridge Aid funding.

An inspection team from HTA visited the bridge site from August 10 to August 12, 2005 to review existing conditions. Wright Construction Company provided access to the lower chord, floor framing and bridge substructure with ladders and floating staging. The bridge is in poor to good condition depending upon the component.

A structural analysis was performed of all key members of the bridge superstructure with the exception of the substructure and top lateral bracing. The roof rafters are overstressed by 80% for the design snow, which is not unexpected due to the small size of the members and large spacing. The trusses and arches combined are adequate for a six (6) ton live load with the existing floor framing and assuming the timber bents in span 1 are removed. If new, higher capacity floor beams and decking are installed along with new timber bents (or a new laminated arch in this span) the bridge can support a ten (10) live load.

An estimate of cost was prepared for a base rehabilitation, which includes repairs or replacements of damaged or deteriorated members, temporary support of the bridge during construction, replacement of the metal roof (to be evaluated further in design), cleaning of the bridge, rechinking the piers and abutments, concrete repairs, installation of a protectowire system, application of a fire retardant paint, drainage and pavement improvements to the approaches, and realignment of the trusses and arches. Based upon the availability of NHDOT funding for the project, it was assumed that construction will be completed in 2010. The total estimated construction cost of the base rehabilitation including contingencies is $1,610,000 ($2,032,600 in 2010 dollars).

Option 1 includes all the work in the base rehabilitation as well as installation of new timber bents or a laminated arch in span 1, removal and replacement of the existing floor beams and decking and strengthening of selected diagonals. Option 1 including contingencies is estimated to cost $2,060,000 ($2,600,700 in 2010 dollars).

The six (6) and ten (10) ton live load options are not adequate to support all desired Town maintenance and emergency vehicles and require a 9 mile detour. As such, we recommend that the Town pursue construction of a new river crossing through the an alternate NHDOT program to meet this goal.

APPENDIX A

Wood Species Identification

Memorandum

Date: January 25, 2006

To: Sean James, P.E.
Project Manager
Hoyle, Tanner & Associates
150 Dow Street
Manchester, NH 03101

From: Doug Gardner
Professor of Wood Science
AEWC Center

Subject: Identification of 15 bridge timber wood samples from Bath Village Covered Bridge, E. Fairfield Covered Bridge and Hectorville Covered Bridge.

Following are my findings relative to the identification of the bridge timber wood species samples you sent to me on January 20, 2006. I relied on my background in wood identification, and the Key to Gross Identification found in the Textbook of Wood Technology, 4th Edition by Panshin and De Zeeuw (ISBN 0-07-048441-4) in making my evaluations. Identification of the wood samples was made using a 10x hand lens.

Samples Identified

A summary of the wood species identified are listed in Table 1 along with comments related to the nature of the samples. More details about each sample are described below.

Table 1. Summary of wood species identified comprising wooden bridge members.

Sample Label	Wood Species	Comments
Hutchins C B Deck	Eastern hemlock	
Hutchins C B Chord	Eastern hemlock	Cubical brown rot decay
Hutchins C B Trunnel	Hard Maple	Insect attack (holes)
Hutchins C B Lattice	Spruce	
East Fairfield C B Floor Beam	*Fir/Hemlock*	Superficial insect attack
East Fairfield C B Deck	Eastern Hemlock	Brittle
East Fairfield C B Rafter	*Spruce/Fir*	Slow growth > 40 rings per ½ inch
East Fairfield C B Chord	Spruce	
East Fairfield C B Stringer	Eastern Hemlock	
Bath Village Bridge –Old Floor Beam	Eastern Hemlock	
Bath Village Bridge – Diagonal	Spruce	Creosote Treated
Bath Village Bridge – Deck	Spruce	
Bath Village Bridge – Chord	*Spruce/Fir*	Creosote Treated
Bath Village Bridge – Trunnel	White Oak	
Bath Village Bridge – New Floor Beam	*Hemlock*	Creosote Treated

Wood species in italics are best estimations based on nature of samples.

1. Hutchins C B Deck: Eastern Hemlock (*Tsuga canadensis*): wood tended to be brittle and exhibited an abrupt transition from earlywood to latewood in the growth increments.

2. Hutchins C B Chord: Eastern Hemlock (*Tsuga canadensis*): wood tended to be brittle and exhibited an abrupt transition from earlywood to latewood in the growth increments. Sample also exhibited signs of cubical brown rot wood decay.

3. Hutchins C B Trunnel: Hard Maple (*Acer saccharinum*): wood was diffuse porous hardwood. Outer margin of growth ring was dark brown in color. Wood had some signs of insect attack (holes 1/16th inch in diameter). Possibly powder post beetle attack.

4. Hutchins C B Lattice Spruce (*Picea* spp.). wood yellowish-white-brown and contains resin canals, exhibits a gradual transition between the earlywood and latewood in the growth increment.

5. East Fairfield C B Floor Beam: Either Eastern Hemlock (*Tsuga canadensis*) or Fir (*Abies* spp.): wood did not contain resin canals and the transition from earlywood to latewood tended to be semiabrupt which is characteristic of both species.

6. East Fairfield C B Deck: Eastern Hemlock (*Tsuga canadensis*): wood tended to be brittle and exhibited an abrupt transition from earlywood to latewood in the growth increments.

7. East Fairfield C B Rafter: Either Spruce (*Picea* spp.) or Fir (*Abies* spp.): the slow growth of this sample (greater than 40 rings per ½ inch) precluded positive identification. The transition from earlywood to latewood appeared to be gradual and this is a characteristic of both species.

8. East Fairfield C B Chord: Spruce (*Picea* spp.). wood yellowish-white-brown and contains resin canals, exhibits a gradual transition between the earlywood and latewood in the growth increment.

9. East Fairfield C B Stringer: Eastern Hemlock (*Tsuga canadensis*): wood tended to be brittle and exhibited an abrupt transition from earlywood to latewood in the growth increments.

10. Bath Village Bridge –Old Floor Beam: Eastern Hemlock (*Tsuga canadensis*): wood tended to be brittle and exhibited an abrupt transition from earlywood to latewood in the growth increments.

11. Bath Village Bridge – Diagonal: Spruce (*Picea* spp.). wood contains resin canals, exhibits a gradual transition between the earlywood and latewood in the growth increment. Sample was treated with creosote.

12. Bath Village Bridge – Deck: Spruce (*Picea* spp.). wood yellowish-white-brown and contains resin canals, exhibits a gradual transition between the earlywood and latewood in the growth increment.

13. Bath Village Bridge – Chord: Either Spruce (*Picea* spp.) or Fir (*Abies* spp.): This sample was creosote treated and the small sample size precluded positive identification. The transition from earlywood to latewood appeared to be gradual and this is a characteristic of both species.

14. Bath Village Bridge – Trunnel: White Oak (*Quercus* spp.): Ring porous hardwood with the earlywood vessels containing tyloses.

15. Bath Village Bridge – New Floor Beam: Most likely Eastern Hemlock (*Tsuga canadensis*): wood tended to be brittle and exhibited an abrupt transition from earlywood to latewood in the growth increments. This sample was completely saturated with creosote which precluded positive identification.

My consulting fee is $50 per sample, so the cost for this wood sample identification is $750.00. Payment can be made to

Douglas J. Gardner
484 Day Road
Brewer, ME 04412

APPENDIX B

Estimate of Cost

Hoyle, Tanner & Associates, Inc.
Engineers Estimate of Probable Construction Costs

PROJECT	Bath Village Covered Bridge	SHEET No.	1	of	1
SUBJECT	Engineering Study of Cost - Base Rehabilitation	BY	STJ	Date	4/17/2006
		CHKD BY	RHD	Date	4/17/2006
		HTA Project No.	902504		

ITEM NO	DESIGNATION	Quantity		Cost	
		Unit	Amount	Unit	Total
201.1	Clearing and Grubbing (F)	A	0.05	20,000	$1,000
304.2	Gravel (F)	CY	25	40	$1,000
403.11	Hot Bituminous Pavement, Machine Method	TON	125	130	$16,250
502	Removal of Existing Bridge Structure	U	1	50,000	$50,000
504.1	Common Bridge Excavation (F)	CY	10	50	$500
520.03	Concrete Class AA	CY	20	800	$16,000
525.1	Concrete Repair, Class I	SF	50	50	$2,500
534.1	Water Repellent (Linseed Oil) (F)	SF	2700	0.90	$2,430
544.2	Reinforcing Steel-Epoxy Coated (F)	LB	1250	3.00	$3,750
550.1	Structural Steel (F)	U	1	20,000	$20,000
568.01	Structural Timber (Purlins)	MBM	0.1	7,000	$700
568.02	Structural Timber (Roof Rafters)	MBM	0.3	8,000	$2,400
568.03	Structural Timber (Cross Beams)	MBM	1.8	8,000	$14,400
568.04	Structural Timber (Misc. Repairs)	U	1	25,000	$25,000
568.05	Structural Timber (Knee Braces & Lateral Braces)	MBM	0.3	17,000	$5,100
568.06	Structural Timber (Truss Chord Members)	MBM	2.7	17,000	$45,900
568.07	Structural Timber (Truss Diagonal Members)	MBM	0.7	20,000	$14,000
568.08	Structural Timber (Truss Vertical Members)	MBM	0.8	45,000	$36,000
568.09	Structural Timber (Deck)	MBM	8.8	6,000	$52,800
568.10	Structural Timber (Floor Beams)	MBM	5.5	8,000	$44,000
568.11	Structural Timber (Needle Beams)	MBM	1.3	8,000	$10,400
568.12	Structural Timber (Arches)	MBM	3.0	10,000	$30,000
568.13	Structural Timber (Bed Timbers)	MBM	1.2	18,000	$21,600
568.14	Structural Timber (Siding)	MBM	12.6	5,500	$69,300
568.15	Structural Timber (Trunnel)	EA	50	50	$2,500
568.16	Structural Timber (Rafter Splice)	MBM	2.7	7,000	$18,900
568.2	Bridge Approach Rail	LF	55	110	$6,050
568.7	Realignment of Bridge	U	1	85,000	$85,000
568.71	Realignment of Arches	U	1	55,000	$55,000
568.8	Temporary Support System for Timber Bridge	U	1	300,000	$300,000
568.85	Painting Timber Bridge	U	1	45,000	$45,000
569.1	Metal Roof	U	1	72,000	$72,000
571.1	Chinking Stone Masonry	U	1	10,000	$10,000
585.3	Stone Fill, Class C	CY	15	40	$600
606.417	Portable Concrete Barrier for Traffic Control	LF	60	100	$6,000
628.2	Sawed Bituminous Pavement	LF	60	10	$600
645.51	Haybales for Temporary Erosion Control	EA	130	10	$1,300
645.531	Silt Fence	LF	300	5.00	$1,500
645.7	Erosion and Sediment Control and Stormwater Mgmt Plan	U	1	5,000	$5,000
645.7	Monitoring Erosion and Sediment Control	EA	40	300	$12,000
670.1	Bridge Fire Alarm System (Protectowire)	U	1	45,000	$45,000
692	Mobilization	U	1	130,000	$130,000
699	Temporary Project Erosion & Water Pollution Control	ALLOW	1	10,000	$10,000
1002.1	Repairs or Replacements as Needed	ALLOW	1	50,000	$50,000
	SUBTOTAL CONSTRUCTION COST				$1,341,480
	CONTINGENCIES (20%)				$268,520
	TOTAL ESTIMATED CONSTRUCTION COST				**$1,610,000**
	TOTAL ESTIMATED CONSTRUCTION COST (2010 Dollars)				**$2,032,588**

This cost estimate has been based on the anticipated scope of work, as well as HTA's experience with similar projects and understanding of current industry trends. It should be noted that changes in the project scope could impact the project cost in either direction.

Hoyle, Tanner & Associates, Inc.
Engineers Estimate of Probable Construction Costs

PROJECT	Bath Village Covered Bridge	SHEET No.	1	of	1
SUBJECT	Engineering Study of Cost - Option 1	BY	STJ	Date	4/17/2006
		CHKD BY	RHD	Date	4/17/2006
		HTA Project No.	902504		

ITEM NO	DESIGNATION	Quantity		Cost	
		Unit	Amount	Unit	Total
201.1	Clearing and Grubbing (F)	A	0.05	20,000	$1,000
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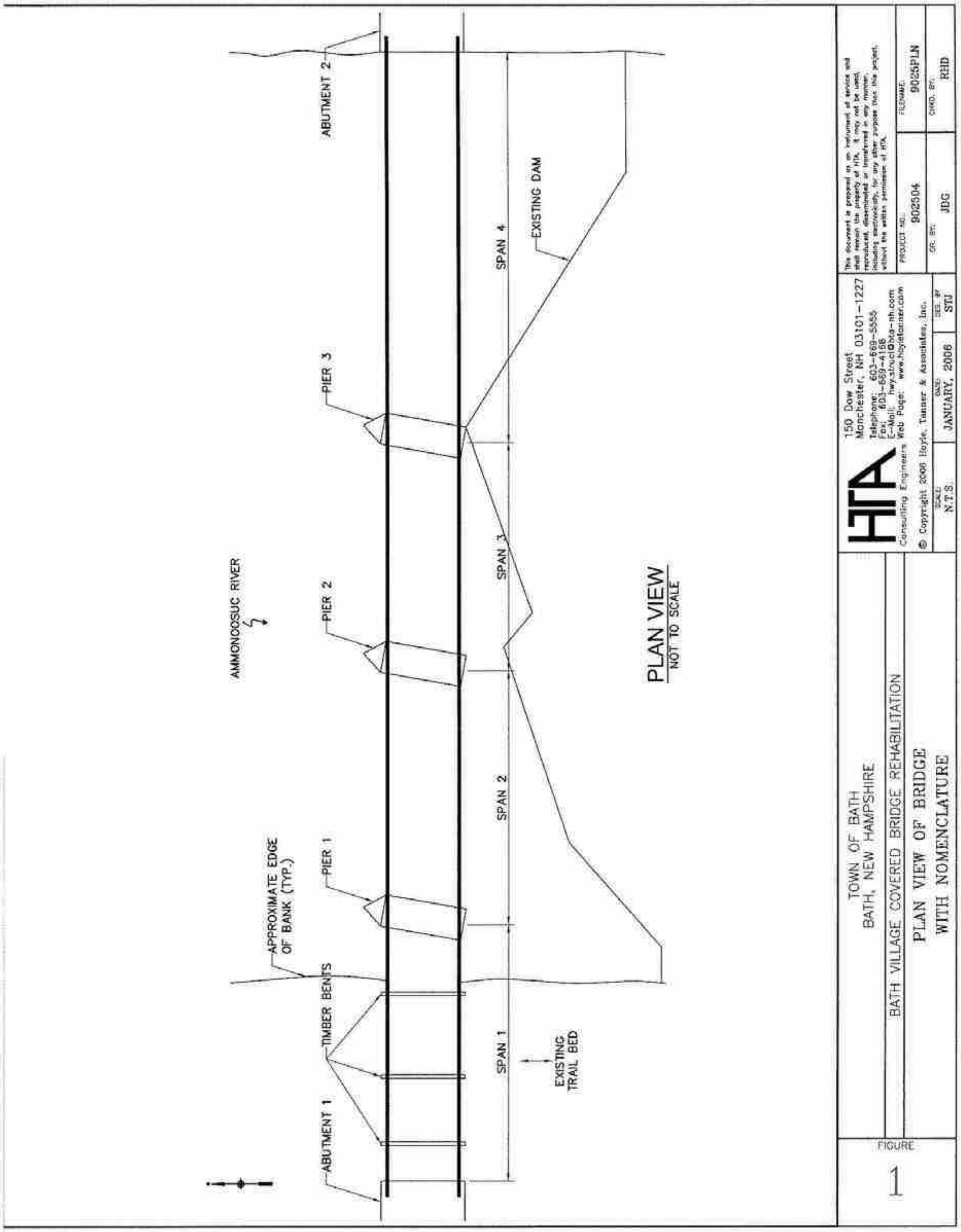
403.11	Hot Bituminous Pavement, Machine Method	TON	125	130	$16,250
502	Removal of Existing Bridge Structure	U	1	50,000	$50,000
504.1	Common Bridge Excavation (F)	CY	10	50	$500
520.03	Concrete Class AA	CY	20	800	$16,000
525.1	Concrete Repair, Class I	SF	50	50	$2,500
534.1	Water Repellent (Linseed Oil) (F)	SF	2700	0.90	$2,430
544.2	Reinforcing Steel-Epoxy Coated (F)	LB	1250	3.00	$3,750
550.1	Structural Steel (F)	U	1	20,000	$20,000
568.01	Structural Timber (Purlins)	MBM	0.1	7,000	$700
568.02	Structural Timber (Roof Rafters)	MBM	0.3	8,000	$2,400
568.03	Structural Timber (Cross Beams)	MBM	1.8	8,000	$14,400
568.04	Structural Timber (Misc. Repairs)	U	1	25,000	$25,000
568.05	Structural Timber (Knee Braces & Lateral Braces)	MBM	0.3	17,000	$5,100
568.06	Structural Timber (Truss Chord Members)	MBM	2.7	17,000	$45,900
568.07	Structural Timber (Truss Diagonal Members)	MBM	0.7	20,000	$14,000
568.08	Structural Timber (Truss Vertical Members)	MBM	0.8	45,000	$36,000
568.09	*Structural Timber (Deck)*	*MBM*	*29.0*	*6,000*	*$174,000*
568.10	*Structural Timber (Floor Beams)*	*MBM*	*28.0*	*8,000*	*$224,000*
568.11	Structural Timber (Needle Beams)	MBM	1.3	8,000	$10,400
568.12	Structural Timber (Arches)	MBM	3.0	10,000	$30,000
568.13	Structural Timber (Bed Timbers)	MBM	1.2	18,000	$21,600
568.14	Structural Timber (Siding)	MBM	12.6	5,500	$69,300
568.15	Structural Timber (Trunnel)	EA	50	50	$2,500
568.16	Structural Timber (Rafter Splice)	MBM	2.7	7,000	$18,900
568.17	*Structural Timber (Diagonal Strengthening)*	*U*	*1*	*15,000*	*$15,000*
569.17	*Structural Timber (Timber Bents)*	*U*	*1*	*30,000*	*$30,000*
568.2	Bridge Approach Rail	LF	55	110	$6,050
568.7	Realignment of Bridge	U	1	85,000	$85,000
568.71	Realignment of Arches	U	1	55,000	$55,000
568.8	Temporary Support System for Timber Bridge	U	1	300,000	$300,000
568.85	Painting Timber Bridge	U	1	45,000	$45,000
569.1	Metal Roof	U	1	72,000	$72,000
571.1	Chinking Stone Masonry	U	1	10,000	$10,000
585.3	Stone Fill, Class C	CY	15	40	$600
606.417	Portable Concrete Barrier for Traffic Control	LF	60	100	$6,000
628.2	Sawed Bituminous Pavement	LF	60	10	$600
645.51	Haybales for Temporary Erosion Control	EA	130	10	$1,300
645.531	Silt Fence	LF	300	5.00	$1,500
645.7	Erosion and Sediment Control and Stormwater Mgmt Plan	U	1	5,000	$5,000
645.7	Monitoring Erosion and Sediment Control	EA	40	300	$12,000
670.1	Bridge Fire Alarm System (Protectowire)	U	1	45,000	$45,000
692	*Mobilization*	*U*	*1*	*160,000*	*$160,000*
699	Temporary Project Erosion & Water Pollution Control	ALLOW	1	10,000	$10,000
1002.1	Repairs or Replacements as Needed	ALLOW	1	50,000	$50,000
	SUBTOTAL CONSTRUCTION COST				$1,717,680
	CONTINGENCIES (20%)				$342,320
	TOTAL ESTIMATED CONSTRUCTION COST				**$2,060,000**
	TOTAL ESTIMATED CONSTRUCTION COST (2010 Dollars)				**$2,600,703**

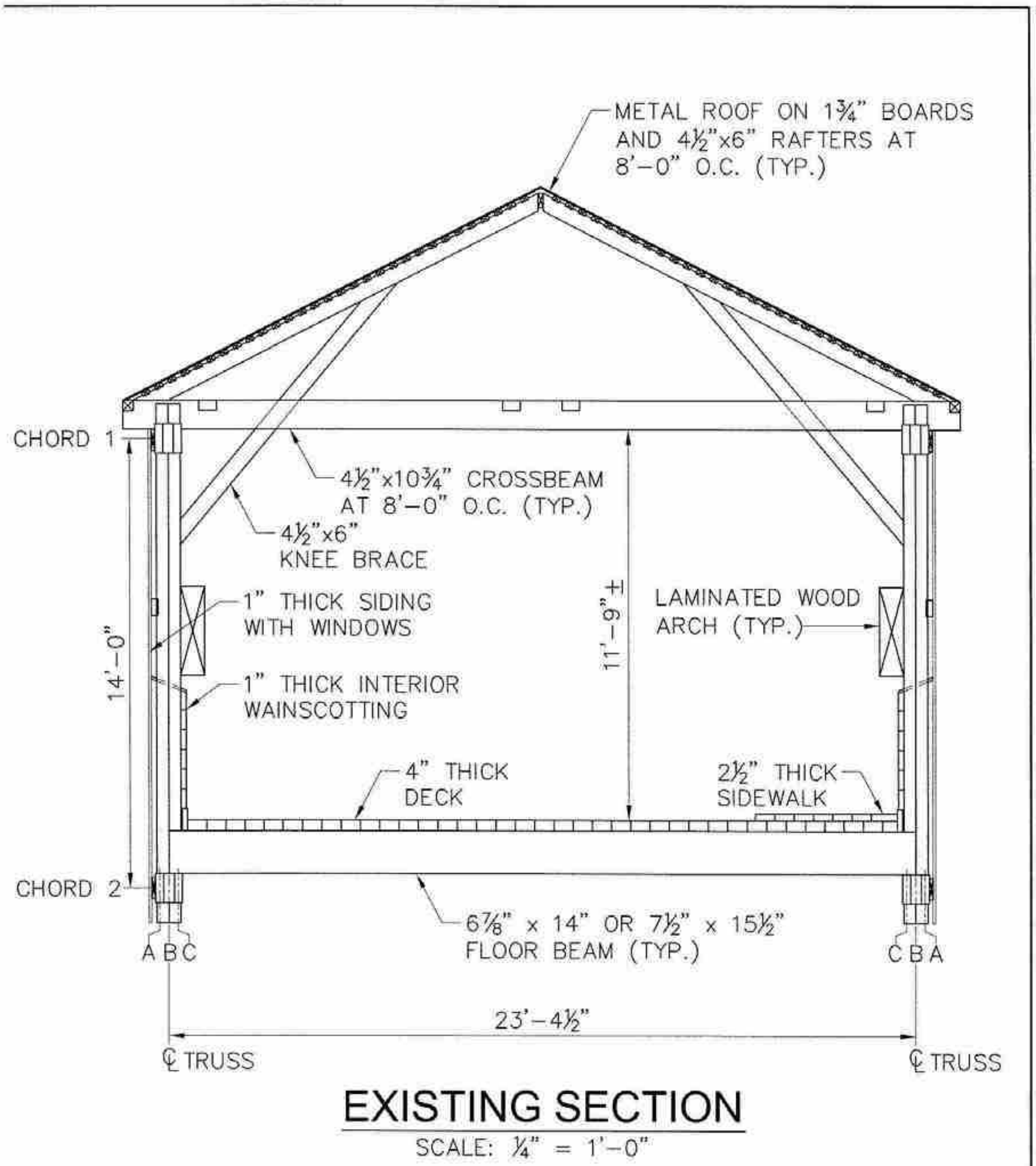
**Pay items in italics are different than the base bid.

This cost estimate has been based on the anticipated scope of work, as well as HTA's experience with similar projects and understanding of current industry trends. It should be noted that changes in the project scope could impact the project cost in either direction.

APPENDIX C

Bridge Cross-Section and Plan Drawings


ABUTMENT 1
TIMBER BENTS
APPROXIMATE EDGE OF BANK (TYP.)
PIER 1
PIER 2
PIER 3
ABUTMENT 2
AMMONOOSUC RIVER
SPAN 1
SPAN 2
SPAN 3
SPAN 4
EXISTING TRAIL BED
EXISTING DAM
PLAN VIEW
NOT TO SCALE
FIGURE
1
TOWN OF BATH
BATH, NEW HAMPSHIRE
BATH VILLAGE COVERED BRIDGE REHABILITATION
PLAN VIEW OF BRIDGE
WITH NOMENCLATURE
HTA
Consulting Engineers
150 Dow Street
Manchester, NH 03101-1227
Telephone: 603-669-5555
Fax: 603-669-4168
E-Mail: hwy.struct@hta-nh.com
Web Page: www.hoyletanner.com
© Copyright 2006 Hoyle, Tanner & Associates, Inc.
SCALE: N.T.S.
DATE: JANUARY, 2006
DES. BY: STJ
PROJECT NO.: 902504
DR. BY: JDG
FILENAME: 9025PLN
CHKD. BY: RHD


METAL ROOF ON 1¾" BOARDS AND 4½"x6" RAFTERS AT 8'–0" O.C. (TYP.)
CHORD 1
4½"x10¾" CROSSBEAM AT 8'–0" O.C. (TYP.)
4½"x6" KNEE BRACE
1" THICK SIDING WITH WINDOWS
1" THICK INTERIOR WAINSCOTTING
14'–0"
11'–9" ±
LAMINATED WOOD ARCH (TYP.)
4" THICK DECK
2½" THICK SIDEWALK
CHORD 2
6⅞" x 14" OR 7½" x 15½" FLOOR BEAM (TYP.)
A B C
C B A
23'–4½"
℄ TRUSS
℄ TRUSS
EXISTING SECTION
SCALE: ¼" = 1'–0"
TOWN OF BATH
BATH, NEW HAMPSHIRE
BATH VILLAGE COVERED BRIDGE REHABILITATION
EXISTING SECTION
HTA
Consulting Engineers
150 Dow Street
Manchester, NH 03101–1227
Telephone: 603–669–5555
Fax: 603–669–4168
© Copyright 2006 Hoyle, Tanner & Associates, Inc.
SCALE: AS SHOWN
DATE: JANUARY, 2006
DES. BY STJ
PROJECT NO.: 902504
FILENAME: 9025TY1
FIGURE 2

APPENDIX D

John Storrs Correspondence

New Hampshire State Archives
Concord, NH

John W. Storrs Collection

Box No.: 3375
File No.: 50
Title: Bath

Concord, N. H. Apr. 17, 1912.

E. P. Cummings Construction Co.,

Henry T. Rowe, Supt.

Woodsville, N. H.

Dear Sir:-

Replying to yours of Apr. 15th. The Bath bridge is not safe for a load equal to a 10-ton boiler or anywhere near it.

Very truly,

Consulting Engineer.

H.P. Cummings Construction Company
General Contractors
Ware, Mass.

WATER POWER DEVELOPMENT
CONCRETE, TIMBER & EARTH DAMS
ALL CLASSES OF CONCRETE WORK
MILL CONSTRUCTION & HEAVY REPAIR WORK
BUILDINGS OF ALL DESCRIPTIONS

BOSTON, MASS., 319 WASHINGTON ST.
PORTLAND, ME., FIDELITY BUILDING
WOODSVILLE, N. H.
BURLINGTON, VT.

Woodsville, N.H. Apr. 15, 1912

John W. Storrs.,

Concord, N.H.

Dear Sir:-

Have you ever looked over the wooden bridge from Bath villiage to Railway station across the Ammoncosuc River.

We are estimating setting a ten ton boiler in the mill there, and wondering if it would be safe to take it across on the bridge.

If you can give me any information it will be appreciated.

Yours truly,

H.P.Cummings Const. Co.

By. Henry T. Rowe

Dic.HTR

Nov. 13, 1911.

Mr. J. P. Snow, C. E.,

Boston, Mass.

Dear Sir:-

Regarding the bridge at Bath, N. H. When it becomes necessary for this bridge to be replaced with a new new one, I hope to have an opportunity to make plans for a new structure.

There is some new bridge sentiment in town, and there are many who wish to repair and strengthen the old bridge. They will not be satisfied with the opinion of any one man.

I looked at the bridge a short time ago, but it is so boarded up inside that I could not get at or even see the bottom chords or web connections. I will try to have them have you up there,and if you wish will go with you, but not till they take off the boards so that we can see something.

If the bridge can be economically repaired and strengthened I want to tell them so, but if not, they should know it.

They tell me they have been drawing gravel(6000 to 8000# in dump carts) for road building over the bridge this fall.

Vert truly,

Consulting Engineer.

J. P. SNOW
CIVIL ENGINEER
ROOM 1120 KIMBALL BLDG.
18 TREMONT ST.
BOSTON, MASS.

November 11th, 1911. Boston, Mass.

Mr. John W. Storrs,

Consulting Engineer, Concord, N. H.

Dear Sir:--

Yours of the 10th inst at hand. I am greatly obliged for your reference to me in regard to the bridge at Bath. That is a line of business which I would like very much to do something in, but in that particular case I think that your judgement is fully as good as mine.

I would like to inquire if you are out of the line in independent work of that class.

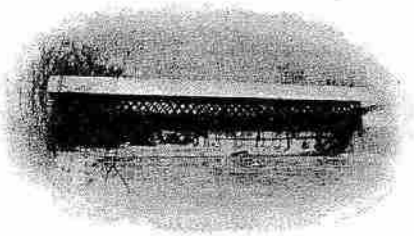
I am quite busy now designing some new bridge work but can spare an occasional day to investigate outside structures.

I learn indirectly that you are connected with the New Hampshire Commission in some way, but I have not yet learned the details.

How did you come to leave Mr. Merrill.

Yours truly,

J. P. Snow.



Office of
John W. Storrs,
Consulting Engineer.

*Subject*__________________

Concord, N. H., Nov. 10, 1911.

Mr. J. P. Snow,
Consulting Engineer,
Boston, Mass.

Dear Sir:-

Enclosed is copy of a letter I have written to Mr. Whitney, Chairman of Selectmen, Bath, N. H.

The gridge referred to is the one over the B. & M. R.R. near the depot, #110. I think the bridge was built in 1832.

Very truly,

Consulting Engineer.

Nov. 10, 1911.

Mr. John G. Whitney,

Chairman of Selectmen,

Bath, N. H.

Dear Sir:-

Regarding the bridge over the Ammonoosuc River at the village. I would advise limiting loads to two tons on a 4-wheel wagon. Of course the fact that you have been hauling up to four tons is evidence that it will carry more than two, but it must be remembered that the bridge is an old structure, having done service for a good many years.

As we were not able to get at the bottom chords and lower panel points when I was there, I do not know their condition and am therefore unable to say just what loads the bridge is good for. When you want a thorough inspection made, have enough of the boarding inside taken off, and the chords and joints cleaned so they can be seen and reached to good advantage.

If I were your board I would have Mr. J. P. Snow, Consulting Engineer, of Boston, examine the bridge. Mr Snow was formerly bridge engineer and afterwards Chief Engineer of the B. & M. R.R. He is expert on bridge work and you may be sure he will tell you conditions as they exist.

Very truly,

Oct. 30, 1911.

Mr. John T. Whitney,

Bath, N. H.

Dear Sir:-

Your favor regarding bridge at Bath village received. I will leave Concord on paper train (due to arrive at Bath at 10.08) Thursday A.M. Nov. 2nd.

Very truly,

Consulting Engineer.

Bath N.H. Oct 28 — 11

John W. Storrs
Concord N.H.

Dear Sir

We desire to have the bridge on the Ammonoosuc River at Bath Vill. inspected and ascertain what repairs will be necessary to make the same safe for public travel. You have been recommended as the proper person to do it.

If you are at liberty and able to come up, let us know what day & what train you will arrive and we will meet you at Bath Station

Respy
J. D. Whitney
Selectmen

Answered Nov [illegible]

New Hampshire State Archives
Concord, NH

John W. Storrs Collection

Box No.: 3376
File No.: 106
Title: Bath - Inspection Reports

March 13, 1915.

Mr. Fred P. Wells,
Chairman Board of Selectmen,
Swiftwater, N. H.

Dear Sir:

The Annual Report of your town, which you so kindly sent to Mr. Storrs, has been received.

Thanking you for your thoughtdulness in this matter, we are

Yours very truly,
STORRS ENGINEERING CO.

Clerk.

BRIDGE #1 BATH VILLAGE BRIDGE.

On account of the age of this bridge and its general condition, we do not advise making any change in the loads which you have insisted should not be exceeded. Your guide board states two tons. The bridge might carry, and probably has within recent times, loads heavier than this load, yet the strains in some of the members run pretty high and the bridge cannot be considered a safe bridge for heavy loads.

[illegible]

Bath N.H. Summary [illegible]

#1- Bath Village Br.

(East Span 127 Ft.)

Top Chord 714# } Whole Dead Load
Bottom " 2470#

Web Ten 2,060# } 1/2 Dead Load
Web Comp 700# (500 : good)

Truss Iron [illegible] 1/2 Dead Load

Inside Arch 1222# Live Load

Hanger Rods 20,000#

(70 Ft span)

Top Chord 615#
Bottom " 2126#

Web Ten 3242# (using Two)
" Com. 1102 " "
Pin Shear 4215 " " } in Verts
" Bearing 3967 " "
" Shear 4650 " " } in Diags
" Bearing 4350 " "

Floor Beam 2,140# for 1/3 Ton Ton Wag.

#1

Bath N.H. "Bath Village Br." 9/19/14

East Span

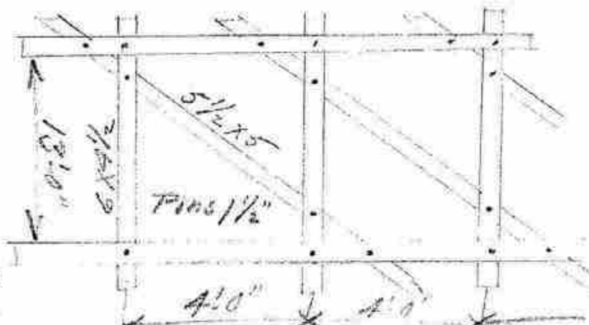
Dead Load 2-Truss

T. Chd 2X127X10X3# = 7,620
B. Chd 2X127X10X3# = 7,620
Verts 2X32X17X2⅓X3# = 7,616
Diags 2X32X19X2⅓X3# = 8,512
Fl. Bms 3X32X25X4X3# = 28,800
Plank 127X22½X6X3# = 25,700
Brackets 2X17X10X2X3# = 2,040
Struts 17X22½X4X3# = 4,600
Lats 2X17X25X1⅓X3# = 3,400
Rafters 2X17X20X3X3# = 6,120
Sp. Pcs 2X127X7X½X3# = 2,700
Roof 2X127X20X3# = 15,240
Shing. " " " " = 15,240
Sides 2X127X10X3# = 7,620
" 2X127X5X3# = 3,800
Sp. Pcs 2X6X127X1½X3# = 6,860

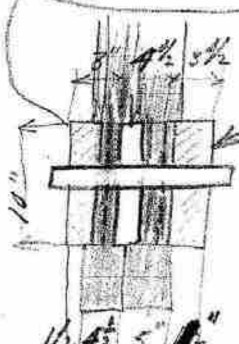
08
28
82
85
6

153,488 Total Span

1,209
127) 153,488
127
264
254
1088
1143



8½ x 4¼ ...



8½X2¼ effective

1½" Pin

1,209 # per lin. Ft. of Span (not including Arches) or 600# per Lin Foot of Truss

Dead Load

Assume Roadway @50# per Sq Ft for 22 Ft. Roadway = 1100# per Lin Foot of Truss

Live Load

Effective Bot Chd
8½X4¼ = 35.0□"

Top Chord
11X11 = 121□"

Inside Arch
8X15 = 120□" Rods
18 Ft Rise 1"⌀ ea. ch.

Middle Arch
12X14 = 168□"
13 Ft Rise

Fl. Bms 4X12 (1'-4" ctrs)
Plank 3" Double

Roadway 22½ Ft Between Trusses

#1

Bath N.H. "Bath Village Br" 9/15/14

Assume Truss to Carry D.L. only
127 Ft Span

$\frac{600 \times 127 \times 127}{8 \times 14} = 86{,}400 \div 35^{\square''} = 2{,}470$ # per Sq. in. on Bot. Chord

$86{,}400 \div 121^{\square''} = 714$ # per Sq. in on Top Chord

End Shear — Assume ½ Web D.L. carried by 12X14 Arch

$63 \times 300\# = 18{,}900$ # on Vert $\quad \frac{L}{d} = \frac{132}{4.5} = 30$ (500 is good)

$Sec = \frac{\sqrt{14^2 + 6^2}}{14} = 1.09 \qquad 27 \,)\, 18{,}900$ (S = 700 # per □")

$18{,}900 \times 1.09 = 20{,}600$ # on Diag

Effective Area of Diag $4 \times 2\frac{1}{2} = 10^{\square''}$ = (2,060 # per Sq. in on Diag)

Assume 12X14 Arch with 12.7Ft Rise for ½ D.L.

$\frac{640\# \times 127 \times 127}{8 \times 127} = 101{,}600$ Hor. St. $\qquad \frac{W}{2} = 40{,}640$

$\sqrt{(101{,}600)^2 + (40{,}640)^2} = 107{,}700 \qquad 168 \,)\, 107{,}700$ (640 # per Sq in for ½ D.L. on Arch)

Assume 8X15 Arch with 18 Ft Rise for Live Load

Arch D.L. $135 \times 10 \times 3\# = 4500$
Rods (?) 500
5000

L.L @ 100# = $127 \times 11 \times 100\# = 139{,}700$
144,700 = W $\qquad \frac{W}{2} = 72{,}350$

$\frac{144{,}700 \times 127}{8 \times 18 = 144} = 127{,}600$ = Hor. Stress

Thrust = → 146,600 (1222 # per Sq in @ 100 # per Sq Ft)

→ $\sqrt{(127{,}600)^2 + (72{,}350)^2} \qquad 120 \,)\, 146{,}600$

#1

Bath N.H. Bath Village Br. 9/21/1?
(70 Ft Span)

Live Load 100# per □ Ft
D. " 600# " Lin Ft of Truss

1700# X 70 X 70 / 8 X 14 = 74,400

35 [74,400 — 8,126# per Sq in on Bot Chd

615 # per sq in on Top Chd

121 [74,400
726
180
121
590

1700# x 35 = 59500 End Shear
500 = 1.07
5355
595
64,855

10 [64,855 — 6,485 #per sq in on Diag

27 [59,500
54
55

2204 #per sq in on Vert.
500 is good

— Shear —
2-1½" ⌀ Pins = 7.06 □" in Shear
7.06 [59,500.00
5648
3020
2824
1960

8,430 # per Sq.in. in Shear on Verts (Pins)

— Bearing —
2-1½" ⌀ Pins = 7.5 □" in Bear.
7.5 [59,500.0
525
700
675
250
225
25

7933.# per sq Bearing on Verts (Pins)

Bearing and Shear on Diag Pins
+ 10% = 9,300 (S) and 8,700 Bearing

#1

Bath N.H. (Bath Village Br.) 9/23/14

Floor Beam

D.L. 22 1/2 X 4 X 3# = 270
22 1/2 X 1 1/3 X 6 X 3# = 540
810

405
810 X 22 1/2 X 12 / 8 = 27,390 D.L.M.
178,170
205,500

(L.L.M. = 534,500 ÷ 3 Bms.)

(2,140 # per sq in for Ten Ton Wag on 3 Beams)

96) 205,500
192
135
96
390

Hanger Rods on 127 Ft Span

8 X 11 X 100# = 8,800# Live Load

1" Φ Rod Notupset = 44□"

(20,000 # per sq in on Rods by 100# per ft Live Load)

44) 8800.00

4.2 NH State Architectural Historian Inspection Report (Garvin 2008)

Document included on following pages.

NEW HAMPSHIRE DIVISION OF HISTORICAL RESOURCES
State of New Hampshire, Department of Cultural Resources 603-271-3483
19 Pillsbury Street, 2nd floor, Concord NH 03301-3570 603-271-3558
Voice/ TDD ACCESS: RELAY NH 1-800-735-2964 FAX 603-271-3433
http://www.nh.gov/nhdhr preservation@nhdhr.state.nh.us

REPORT ON OBSERVATIONS AT THE BATH VILLAGE BRIDGE BATH, NEW HAMPSHIRE

JAMES L. GARVIN
SEPTEMBER 18, 2008

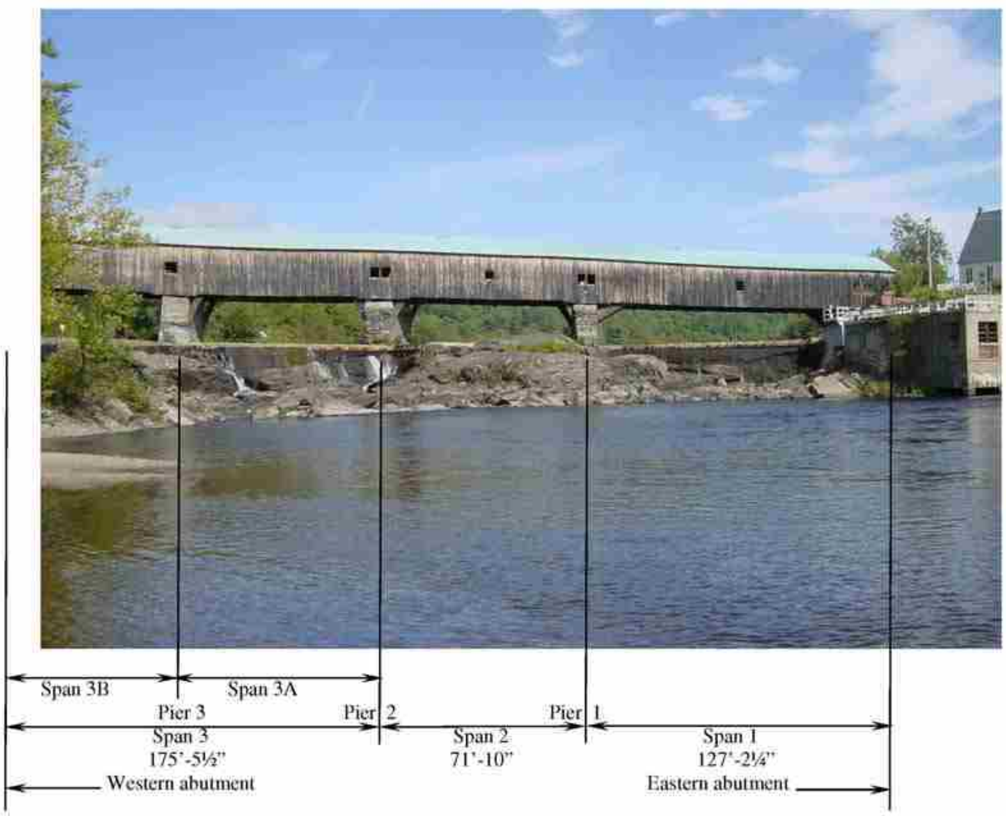
This report is based on observations made at the Bath Village Bridge on September 16, 2008. The inspection was made as part of a broader bridge evaluation by Sean James and Josif Bicja of Hoyle, Tanner & Associates, consulting engineers, assisted by crew members from Wright Constriction Company of Mount Holly, Vermont. The purpose of the Hoyle, Tanner inspection was to provide an update to their submitted in April 2006. The purpose of the Division of Historical Resources' inspection was to determine the condition, integrity, and evolution of the bridge in order to be prepared to apply the *Secretary of the Interior's Standards for the Treatment of Historic Properties* in any future review of proposals for treatment of the bridge.

Brief chronology of the Bath Village Bridge, taken from Joseph D. Conwill, "Historic American Engineering Record, Bath Bridge, HAER No. NH-34" (attached as Appendix 2):

1831	Work begins on stonework for the present (fifth) bridge
1832	The covered bridge is completed
1852-53	White Mountain Railroad is constructed under the west end of the bridge
?	An extra pier is added under the long west span, turning the three-span bridge into a four-span bridge
1913	New Hampshire law requires bridges to be upgraded for 10-ton load
1918-19	Bridge is raised about 2', laminated arches are added, other major repairs done
1987-88	Restoration by Milton S. Graton

Original truss and arch elements

The Bath Village Bridge is composed of three original spans of widely varying lengths. The bridge has apparently not been measured along its centerline, and the different angles of the abutments and the piers causes the upstream and downstream trusses in each span to display differing lengths. The HAER report mentioned above gives the total truss length of Bath Village Bridge as 374'-5¾" at the floor. The length of the east span is 127'-2¼" on the upstream side. The center span is 71'-10" in length, while the long original west span (now subdivided by an added pier at its center) was 175'-5½" long.



The bridge is well documented as having been constructed in 1832, and is therefore among the oldest surviving covered bridges in the United States. Despite its age and the fact that it is exposed to airborne spray during parts of each year, the structure retains a high percentage of its original truss and arch elements. These elements can be distinguished from later materials by the fact that they were sawn on a reciprocating ("up-and-down") sawmill, of which there were several along the Ammonoosuc River from the late 1700s.

According to an appendix in the Hoyle, Tanner "Engineering Study for the Bath 'Village' Covered Bridge" of 2006, a diagonal brace and a chord member of the Bath Village Bridge were identified as spruce (*Picea*), implying that most of the original structure was built of spruce. This finding is in contrast with the nearby Bath-Haverhill Town lattice truss bridge (1829), where the principal original members were identified as eastern white pine (*Pinus strobus*). In both cases, the bridges are located at seemingly unpropitious sites with stream levels close to the floors of the bridges above the adjacent dams, and with large amounts of airborne spray whenever water spills over the crests of these dams onto ledges below. Despite such conditions, the two neighboring bridges have survived not only as two of the oldest covered bridges in the country, but as structures that retain an unusually high amount of original fabric.

The posts and diagonal braces of the Bath Village Bridge are sawn on all four sides. Except where replaced, these members exhibit the parallel striations and torn wood fibers that characterize early mechanical sawing. These members also exhibit the same irregularity in size that was observed at the Bath-Haverhill Bridge; according to Joseph Conwill's Historic American Engineering Record (HAER) report, attached as an appendix, "posts and braces show manufacturing variation, but on average measure 4½" x 5¾"."

The integral arches that form important components of the trusses in each of the three original spans of the bridge were formed from heavy sawn planks pinned together. Only two of the original three arches can be seen; the relatively short and low arch of the original middle span of the bridge is hidden by the four-foot-high wooden "wainscoting" that has been applied to the lower third of the trusses inside the bridge. The saw marks on the sides of the original arches match those of the truss web members.

The arches have been hewn on their upper and lower surfaces to gentle segmental curves that, in the case of the two longer original spans, bring the apex of each arch to the upper chord of the truss. This hewing was done with great skill, producing an even curve and smoothing the upper and lower surfaces of the arches so carefully that the adze marks can hardly be seen. It is apparent that the original planks from which these arches were hewn must have been of great depth to permit the curves to be laid out across their faces and to provide for the fourteen inch depth of each arch after the excess wood was hewn away.

Original sheathing

All of the side boarding or sheathing on the downstream (south) side of the bridge is new, having been replaced in the rehabilitation of 1987-88.

On the upstream or north side of the bridge, sheltered from strong sunlight, a certain percentage of sheathing boards appear to be original, or at least were sawn on a reciprocating sawmill. No attempt was made to survey the entire north side of the bridge, but every effort should be made to identify and preserve any surviving early boards. Other boards on this side of the bridge display circular saw marks, yet are also old and have darkened through oxidation. Still others are clearly much newer.

Original and later bridge piers

One principal effort of this examination was to verify the statement, made in Joseph Conwill's HAER report and elsewhere, that "the addition of a third pier divided the long west span of Bath Bridge [labeled as Span 3 on the photograph above] into two, making it a four-span bridge. There is no evidence documenting when this was done, but it was probably during the nineteenth century since the new pier is dry-laid stone and difficult to distinguish from the two originals."

Particular attention was paid to the splitting marks in the granite of the two easternmost piers and the later western pier. A chronology of splitting marks has been developed that differentiates between splitting methods used before and after circa 1830 (see Appendix 1). Since the Bath Village Bridge dates from 1832, with the stonework having been begun the year before, the substructure dates from the precise time when a transition in granite splitting technology was taking place in New Hampshire. The changes that occurred around 1830 should verify that Piers 1 and 2 are original and of the 1830 period, and that Pier 3 is later.

The fact that flat-wedge granite splitting was still being used in Bath in 1831, the year in which the two original piers were built, is verified by the William Vance Hutchins House, a granite dwelling of 1831 that stands a short distance from the bridge. As seen above the doorway and window in the photograph below, the walls of this building clearly show evidence of flat-wedge splitting.

The same splitting technique is clearly visible in both Pier 1 and Pier 2 of the Bath Village Bridge.

Detail of east face of Pier 2, Bath Village Bridge

By contrast, Pier 3 has fewer large split stones than Piers 1 and 2:

East face of Pier 3, Bath Village Bridge

While Pier 3 shows less evidence of splitting techniques, one of the lowest stones in this pier, clearly original, displays the marks of the plug drill, denoting its later date:

South face of Pier 3, Bath Village Bridge

Although stone splitting evidence confirms the long-held belief that Pier 3 was added beneath the center of Span 3 after completion of the bridge, this physical evidence cannot suggest how much later the pier was added. Because the flat-wedge method of splitting granite was supplanted by the plug-and-feathers method soon after the bridge was built, Pier 3 could date anywhere from a few years after completion of the span up to around 1910, when concrete supplanted stone masonry for most work. Although the stonework of Pier 3 is too crude to suggest railroad construction of the latter nineteenth century, it is possible that this pier was added to the bridge when tracks first passed under the bridge in 1852-3. It is possible that this pier was not originally built to the height of the others, but that it supported a wooden trestle that extended up to the bottom chords of the bridge.

Visible repairs and current floor system

Bath Village Bridge reveals evidence of a number of repairs, many of them apparently predating the Graton rehabilitation. Some of these repairs are alluded to in Joseph Conwill's Historic American Engineering Record report (attached as an appendix). Regrettably, many repairs are probably masked by the replacement in 1996 of the wood-board "wainscoting" that had been removed from the bridge in 1987-88.

A number of tie beams linking the upper chords of the bridge were spliced, evidently in the Graton rehabilitation of 1987-88. A few were wholly replaced. The new work can be differentiated from the old by the color of the wood and by the fact that the replacement wood is circular sawn in contrast to the original members. Presumably, the inspection and evaluation carried out on September 15-17 by Hoyle, Tanner & Associates will enumerate all these earlier repairs and replacements in detail.

The existing floor beams in the bridge are of considerable interest in light of a proposal to raise the live load rating of the bridge from the current six tons to ten tons. Hoyle, Tanner engineers propose to accomplish this upgrade (if it is approved by the town) mainly by replacing the existing floor beams with beams of greater structural capacity.

In applying the *Secretary of the Interior's Standards for Rehabilitation* to this proposal, it will be crucial to evaluate the number of original or early members in the existing floor system.

Inspection of the floor on September 16, 2008, was limited to what could be seen from the ground on the west end of the bridge or from the ledges and the top of the dam in the middle of the bridge. With no boat or floating staging then available, no inspection of the floor at the eastern span of the bridge was possible.

Observations made from the available vantage points suggest that all of the floor beams now in the bridge are of recent date. Some existing beams appear to predate the rehabilitation of 1987-88. Those beams that were found to be sound in 1987-88 appear to have been turned over to allow new floor planking to be nailed into the sound wood of what had been the bottoms of the beams.

The majority of beams now seen in the bridge, however, appear to have been installed in 1987-88 above older needle beams and lower lateral bracing:

The new floor beams of 1987-88 appear to have been band-sawn on their sides, and cut to depth on a circular sawmill, leaving curved saw marks on their soffits, as seen below:

Bottom: re-used floor beam. Middle and top: band-sawn floor beams sawn to depth on a circular saw

Further discussion of future treatments of the Bath Village Bridge must take into consideration the age and condition of the current floor system as well as the loading requirements for the bridge, the budget available for rehabilitation, and other factors. This report is intended to record initial observations made during an inspection of less than a day. If work of an extensive nature is proposed for this bridge, further detailed study of the fabric of the structure will be required in order to place engineers' recommendations within the context of the historical integrity of the structure.

The Bath Village Bridge is one of the oldest covered bridges remaining in the United States. It is also unique in design, perhaps representing, as Joseph Conwill has suggested, "the last remnants of an old regional building tradition." For these reasons, the bridge requires the most detailed examination and the most thoughtful analysis of any treatments that may be proposed in the future.

APPENDIX 1

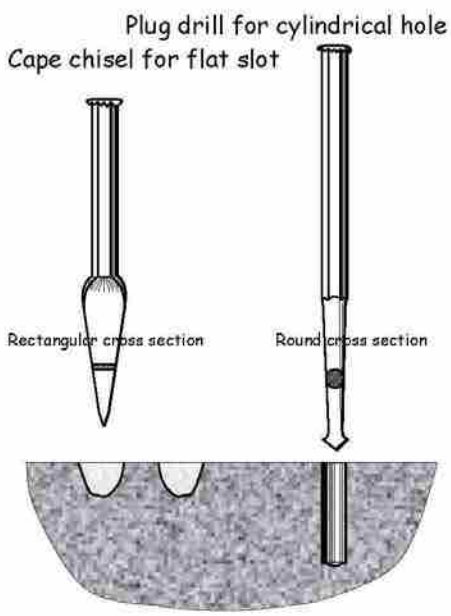
NEW HAMPSHIRE DIVISION OF HISTORICAL RESOURCES
State of New Hampshire, Department of Cultural Resources 603-271-3483
19 Pillsbury Street, 2nd floor, Concord NH 03301-3570 603-271-3558
Voice/ TDD ACCESS: RELAY NH 1-800-735-2964 FAX 603-271-3433
http://www.nh.gov/nhdhr preservation@nhdhr.state.nh.us

GRANITE SPLITTING TOOLS AND TECHNIQUES

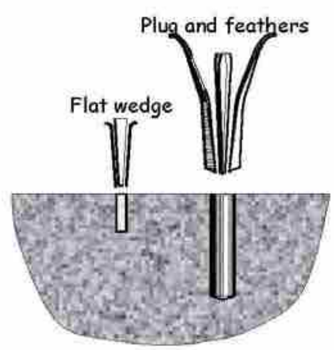
By about 1800, stonecutters in many parts of New England had perfected the basic techniques of finishing and shaping granite. These craftsmen were not only able to split large slabs and posts from boulders, but had also learned to use hammers and chisels to shape the stone to a wide variety of forms, including steps, thresholds, curbs, lintels, columns, watering troughs, and rainwater basins.

In the years just before 1830, a new granite splitting method was introduced. Each method of splitting granite leaves distinctive marks at the edge of the stone, and these marks reveal whether a given piece of granite was quarried or split before or after about 1830—useful knowledge in dating a building or a stone object.

Prior to about 1830, the procedure for splitting granite entailed the cutting of a line of shallow slots in the face of the stone, using a tool called a cape chisel, struck with a heavy hammer. Small, flat steel wedges were placed between shims of sheet iron and driven into these slots, splitting the stone. The new splitting method of circa 1830 used a "plug drill," which had a V-shaped point and was rotated slightly between each blow of the hammer, creating a round hole two or three inches deep.

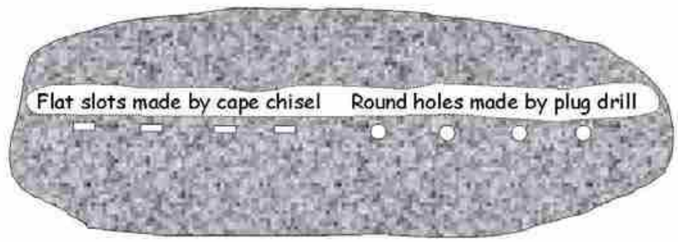


Into this hole were placed a pair of half-round steel shims or "feathers," and between these was driven a wedge or "plug" which exerted outward pressure and split the stone. The advantage of the "plug-and-feathers" method of splitting was the greater depth within the stone at which the wedges exerted their pressure, thus allowing larger pieces to be split more accurately.



The new splitting technology seems to have spread rather rapidly through the granite quarrying centers of New England, although one is likely to find evidence of both old and new methods being used concurrently in stonework of the 1830s, especially in rural areas. The technique employed on a given stone can usually be seen on the split face, and provides some aid in dating granite masonry. The old, flat-wedge method is marked by a series of slot-like depressions which extend inward an inch or so from the edges of the split stone. The plug-and-feathers method leaves a row of rounded holes, two or three inches deep and usually about six inches apart.

When seen on the surface of a stone that was prepared for splitting but never split, these slots or holes appear as shown below:



The use of the plug drill in combination with the plug-and-feathers provided greater force and control in splitting granite. Until the introduction of the new technique, most granite for buildings and posts was split from surface boulders that had been strewn across the New England landscape at the retreat of the glaciers. Such stone had been transported by the ice from many points of origin, and each boulder challenged the stonecutter with different grain and behavior when split.

The introduction of the plug drill and plug-and-feathers seems to have enhanced stonecutters' ability to quarry granite from ledges. Ledge stone was more uniform in nature and predictable in behavior than granite split from surface boulders. With the opening of early quarries at ledges in Quincy, Chelmsford, and Rockport, Massachusetts; Concord, New Hampshire; and many locations in Maine, Vermont, and Rhode Island, New England began to assume its prominent place in the American and international granite industry.

James L. Garvin
State Architectural Historian

Please Note **APPENDIX 2**

Omitted here as it is a duplication
of Section 3.4 of this report.

4.3 HTA Ice Damage Inspection Report 2009

Document included on following pages.

January 29, 2010

Hoyle, Tanner & Associates, Inc.
150 Dow Street
Manchester, New Hampshire 03101
603-669-5555
603-669-4168 fax
www.hoyletanner.com

Town of Bath
Attn. Town of Bath Selectboard
PO Box 88
Bath, NH 03740

Re: Bath Village Covered Bridge
Ice Damage Review
Hoyle, Tanner Project No. 902504

Dear Selectboard:

We are writing at your request to provide our observations of the recent ice damage to the Bath Village Covered Bridge. The damage reportedly occurred on or about January 25th and we visited the site on January 28th. At the time of our observations, the water level had receded below the east retaining wall under the bridge and the ice pieces under the bridge had been cleared away by the road agent. A ladder was provided by the Town to assist with our observations.

The following general comments should be noted by the reader during review of this letter:

- Visual observations were made of the bridge from land and from inside the bridge. No observations were made from the river.
- The only ice damage to the bridge that we observed was limited to the spans between the western-most pier and the west abutment.
- No structural analysis was performed as part of our services related to the ice damage.
- All bridge members are wooden unless otherwise noted.
- In the following sections we utilize several conventions to describe portions of the bridge. We assume that north is perpendicular to the bridge towards upstream. The timber bents are referred to as numbers 1 through 3 with 1 being the closest to the west abutment and 3 being the closest to the river. The node numbers of the truss refer to the center of the truss vertical member and start with 1 at the western-most vertical and increase in number towards the east.

Western Bridge Span at Bents

During our time at the bridge we noted the following related to the recent ice damage:

- Bent 1. The northern vertical member of the bent was shifted west approximately 7 inches with the rest of the bent remaining intact and undamaged.
- Bent 2. The northern vertical and diagonal brace members were missing while the remaining southern members had minor abrasion damage.
- Bent 3. This bent was completely removed by the ice.

K:\902504\Data\Insp Ltr 012910.doc

- North Truss. There was some moderate impact damage to the bottom chord of the truss as well as slight twisting of the truss between bents 2 and 3.
- South Truss.
  - The bottom chord of the truss exhibits impact induced sweep of up to 7" between the western pier to approximately node 8. Despite the bending of the bottom chord, it does not appear that any bottom chord members broke in this area.
  - Three truss web members appear to be broken above the bottom chord. Vertical 15 is broken at the integral arch, the diagonal to the east of node 14 appears to be broken at the bottom chord and the vertical at node 18 appears to be broken at the bottom chord. Node 18 is where the Bent 3 was formerly located.

North Truss Near Node 17

- Floor beams. There are nine floor beams with no bearing at the south truss due to the sweep in the bottom chord. Several other floor beams have reduced bearing areas at the south truss. There appears to be very little, if any, movement of the floor beams relative to the north truss.

We understand that the New Hampshire Department of Transportation (NHDOT) has recommended that the bridge be closed to both vehicular and pedestrian traffic until suitable repairs can be made. Based on our review of the current condition of the bridge, we concur with this recommendation. We understand that the Town will be requesting that the NHDOT make repairs to the bridge so that it can be reopened to traffic. We have been in contact with Mr. Douglas Gosling, Administrator of NHDOT Bureau of Bridge Maintenance and are working with him on repair solutions that do not conflict with future rehabilitation plans. We will continue to keep you updated on our discussions with them regarding upcoming repairs.

If you have any questions regarding the contents of this letter or need additional information, please feel free to contact me at (603) 669-5555 or sjames@hoyletanner.com.

Sincerely,
Hoyle, Tanner & Associates, Inc.

Sean T. James, P.E., SECB
Associate
Project Manager

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4.4 NHDOT Bridge Inspection Report

Document included on following pages.

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Date of Inspection: 10/04/2010
Date Report Sent: 12/10/2010
☑ Picture taken during inspection
Owner: Municipality

WEST BATH ROAD
Over
NHRR(ABD),AMMONOOSUC R
Bath Covered Bridge

REPAIRS MADE BY BOBM OF ICE DAMAGE DONE ON 1/25/10.

Recommended Postings:

Weight: 'Weight Limit 3 Tons' and 'Passenger Cars Only'
ALSO SIGNED: ONE VEHICLE AT A TIME.
☑ Weight Sign OK

Width: Narrow Bridge
POSTED: ONE LANE BRIDGE
☑ Width Sign OK

Primary Height Sign Recommendation: **08'-08"**
Optional Centerline Height Sign Rec: **11'-06"**
ALSO SIGNED FOR CENTER CLEARANCE: 11'-6"

Clearances: (Feet) Over: 8.92 Under: 16.50 Route: 11.75

☑ Height Signs OK

Condition: Municipal Redlist
Deck: 5 Fair
Superstructure: 3 Serious
Substructure: 3 Serious
Culvert: N N/A (NBI)

Structure Type and Materials:
Number of Spans Main Unit: 7
Number of Approach Spans: 0

Main Span Material and Design Type
Timber Through Truss

Sufficiency Rating: 0%
NBI Status: Structurally Deficient

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

NH Bridge Type: Covered Bridge
Deck Type: Timber
Wearing Surface: Timber
Membrane: None
Deck Protection: None
Pavement thickness: 0.0 in
Curb Reveal: Not Applicable
Plan Location: Unknown

Bridge Dimensions:

Length Maximum Span: 87.0 ft
Left Curb/Sidewalk Width: 4.0 ft
Width Curb to Curb: 17.3 ft
Approach Roadway Width (W/ Shoulders): 18.0 ft

Total Bridge Length: 375.0 ft
Right Curb/Sidewalk Width: 0.0 ft
Total Bridge Width: 25.0 ft
Median: No median
Bridge Skew: 0.00 °

Bridge Service:

Type of Service on Bridge: Highway and Pedestrian
Type of Service under: Waterway
Lanes on bridge: 2
Lanes Under: NA

Year Built: 1832
Year Rebuilt: 1987
Detour Length: 9.0 mi

AADT: 500
Future AADT: 740
Percent Trucks: 4%
Year of AADT: 2005
Year of Future AADT: 2032

NHDOT 008 Inspection
Bath 137/095
Fri 9/23/2011 13:13:57
Page 1 of 23

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Federal or State Definition Bridge: Fed. Definition Bridge
Roadway Functional Class: Rural Local
New Hampshire Highway System and Class: Municipal Highway
Eligibility for the National Register of Historic Places: On Register (Historic)
Traffic Direction: Two-way traffic

National Bridge Inventory (NBI) Appraisal Ratings:

Deck Geometry: Intolerable, Replacement
Underclearances: Not Applicable (NBI)
Approach Alignment: Intolerable, Correctable
Structural Evaluation: Intolerable, Replacement
Channel/Channel Protection: Bank Protection Eroded
Waterway Adequacy: Above Desirable Criteria
Bridge Scour Critical Status: Critical during floods
Riprap Condition: Not Applicable
Debris Present: Debris Present

MODERATE SCOUR AND BANK EROSION. LIGHT DRIFT. TREE TRUNK ALONG WEST RIVER PIER ONTO DAM.

Date of Underwater Inspection: Sep. 2007

AASHTO CoRe Element Condition State Data:

No.	Description	Env.	Material Notes and Condition Notes
31	Timber Deck - Bare	Moderate	*4" X 8" UNTREATED PLANK.* *WORN. SEVERAL ENDS SPLIT AND LOOSE. SEVERAL SPIKES PULLING THROUGH AND SPIKES HEADS LIFTED.*
135	Timber Truss and/or Arch	Moderate	*TRUSS MEMBERS SPREADING UP TO 1.75" IN SEVERAL AREAS. LONG SAG UNDER DEAD LOAD ESPECIALLY SPAN #7. SPLITS IN SEVERAL BRACING TIMBERS. COLLISION DAMAGE AT SW PORTAL BRACE. BOTH LOWER ARCH ENDS WORKING OUT OF BEARING AREAS ON EAST SIDE PIER #1. SEVERAL ARCH ENDS DEFORMED WITH SEVERAL PLANK MEMBERS NO LONGER CONTACTING BEARING AREAS. WORST OBSERVED DEFORMATION IN ARCHES AT EAST SIDE OF PIER #1 AND NE END SPAN #7.*
156	Timber Floor Beam	Moderate	*FEW TIPPED, WARPED OR SPLIT, INCLUDING CARRYING BEAMS. BOLTED AND SISTERED REPAIRS TO SPLIT BEAMS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO 1" DRY ROT ON BOTTOMS.*
206	Timber Column or Pile Extension	Low	*SPLIT, CRACKED AND DECAYED. ALL NEW AT BENT #1 AND ONE REPLACED AT BENT #2.*
211	Other Material Pier Wall	Moderate	*VOIDS WITH SHIFTING, MISSING AND CRACKED STONES. CONCRETE CRACKED.*
217	Other Material Abutment	Moderate	*VOIDS, SPLIT, SETTLED AND MISSING STONES; ESPECIALLY IN NE WING AND EAST ABUTMENT. ONE STONE FALLEN OUT OF EAST ABUTMENT FACE AT SE. MODERATE SPALLS IN EAST BACKWALL.*

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

No.	Description	Env.	Material Notes and Condition Notes
234	Reinforced Concrete Cap	Low	*ON RIVER PIERS.* *CRACKED.*
235	Timber Pier Cap	Low	*SPLITS AND DECAY. PARTIAL LOSS OF BEARING AREA AND SHIMMED UP ON UPSTREAM END OF BENT CAP #1 DUE TO HEAVY DECAY AND BASE OF COLUMN PARTIALLY OUT OF POSITION.*
360	Settlement Condition Warning Flag	Moderate	*MANY CRACKED AND SETTLED STONES IN PIERS AND ABUTMENTS WITH LARGE VOIDS; SOME LOOSE AND OR MISSING STONES.*

No.	Description	Env.	Quantity	Units	State 1	State 2	State 3	State 4	State 5
31	Timber Deck - Bare	Moderate	9,375	(SF)	0 %	0 %	100 %	0 %	
135	Timber Truss and/or Arch	Moderate	374	(LF)	55 %	30 %	10 %	5 %	
156	Timber Floor Beam	Moderate	5,089	(LF)	66 %	25 %	9 %	0 %	
206	Timber Column or Pile Extension	Low	6	(EA)	50 %	17 %	33 %	0 %	
211	Other Material Pier Wall	Moderate	89	(LF)	0 %	10 %	90 %	0 %	
217	Other Material Abutment	Moderate	121	(LF)	0 %	35 %	39 %	26 %	
234	Reinforced Concrete Cap	Low	85	(LF)	60 %	40 %	0 %	0 %	
235	Timber Pier Cap	Low	82	(LF)	34 %	33 %	33 %	0 %	
360	Settlement Condition Warning Flag	Moderate	1	(EA)	0 %	0 %	100 %		

Bridge Notes:

Bath Covered Bridge
New Hampshire Covered Bridge Number 28
World Guide to Covered Bridges Number 29-05-03
STAGING INSPECTION OF UNDERSIDE COMPLETED 12/29/2006.
Contact required by Charles Diamond, Bath Electric Power, for dam access at 747-2200.
1/26/2010- INSPECTION EVENT AFTER FLOODING/ICE DAMAGE REPORTED.
10/4/2010 INSPECTION OF FLOODING EVENT OF 10/1-10.

Approach and Roadway Notes: *PAVEMENT CRACKED AND SETTLED. NE SHOULDER SLUMPED DUE TO FILL EROSION.*
HEAVY DAMAGE TO DRAIN GRATE ACROSS EAST APPROACH. (5)
WASHOUTS IN SHOULDERS AND EMBANKMENTS.
WOOD APPROACH RAIL: WEAK. W-BEAM AT SW.

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 10/04/2010 **Inspector:** WBL

Deck: 5 Fair
Super: 3 Serious
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

*WBL inspection comments - *** NO CHANGES EVIDENT TO ANY ELEMENTS FROM 9/17/2010 INSPECTION. PHOTOS ONLY FOR 10-1-10 INSPECTION.****
PICTURES: A287-29 THRU 39.
29: LOOSE AND MISSING STONES IN NE WING; CONCRETE CAP CRACKED AND SPALLED.
30: LEFT HALF (FACING DOWNSTREAM) OF NE WING JUST BELOW MISSING STONES AND SPALLED CAP AREA.
31: RIGHT HALF NE WING / ABUTMENT (FACING DOWNSTREAM).
32: CRACKED, BROKEN AND SHIFTED STONES AT LOWER END OF EAST ABUTMENT.
33: CRACKED, BROKEN AND SHIFTED STONES IN UPSTREAM HALF OF EAST ABUTMENT.

34: CRACKED, BROKEN AND A MISSING STONE IN DOWNSTREAM HALF OF EAST ABUTMENT.
35: BROKEN LOWER STONES IN UPSTREAM END OF EAST ABUTMENT; VOID UNDER BASE STONE UP TO 12 INCHES AT FACE.
36: OVERALL OF OUT POSITION STONES IN NE WING.
37: UPSTREAM ELEVATION OF EAST ABUTMENT AND PIERS FROM ATV TRAIL.
38: DOWNSTREAM ELEVATION OF PIERS AND EAST ABUTMENT FROM ATV TRAIL. LARGE TREE TRUNK CAUGHT UP ON RIVER PIER #3.
39: LARGE TREE TRUNK CAUGHT UP AT RIVER PIER #1. ATV TRAIL ERODED.

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 09/17/2010 **Inspector:** MAH

Deck: 5 Fair
Super: 3 Serious
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

MAH inspection comments -
NO BRIDGE RAIL, SIDEBOARDS ONLY: FEW DAMAGED PLANKS.
DECK: PLANKS WORN, ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THROUGH OR LIFTED.
SUPER: FEW TIPPED AND WARPED FLOORBEAMS, BOLTED AND SISTERED REPAIRS TO SPLIT FLOORBEAMS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO 1" DRY ROT ON BOTTOMS AND SPLITS IN TOPS. DECAY IN LOWER DIAGONAL, CHORD AND ARCH MEMBERS. TRUSS MEMBERS SPREADING UP TO 1.75"+/- IN AREAS; SECTION BOTTOM CLAMPED ON DOWNSTREAM SIDE SPAN #3. HEAVY DECAY IN LOWER DOWNSTREAM ARCH LEAVES AT PIER #2 AND EXCESSIVE DEFORMITIES AT PIER #1. ARCHES DEFORMITIES THROUGHOUT. DAMAGED/MISSING ARCH ROD BEARING BLOCK US WEST SIDE OF SPAN #6 AT ARCH END. LONG SAG UNDER DEAD LOAD WITH DEFORMITIES THROUGH OUT WITH GREATEST NOTICEABLE SAGS IN SPANS #5 AND #7 ALONG UPSTREAM SIDE. DECAY IN TIMBER BEARINGS AND BLOCKS, HEAVY AT NW AND SE. ONE BEARING BLOCK NEAR FACE OF BEARING SUPPORTING BOLSTER BEAM AT NW DUE TO HEAVY DECAY IN BEAM. SPLIT AND WARPED AREAS IN TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL BRACE. SEVERAL PURLINS MISSING OR LOOSE, DECAY EVIDENT IN ENDS OF RAFTERS. FEW PURLINS SUSPENDED AT ONE END; ONE LAYING ACROSS OVERHEAD BRACING. SEVERAL OUTER SIDEBOARDS LOOSE; FEW MISSING.
SUB: VOIDS WITH MISSING STONES AND SETTLEMENT IN ABUTMENTS AND WINGS. NE ABUTMENT CORNER BASE STONE CRACKED WITH SEVERAL OTHERS ABOVE AND SURROUNDING IT CRACKED. NW CORNER OF NE WING VERY UNSTABLE WITH MANY VOIDS AND WHAT APPEARS TO BE A SINGLE SMALL STONE BOLSTERING THE ENTIRE WING. BACKWALLS CRACKED AND SPALLED.
PIERS: VOIDS WITH SHIFTING, MISSING AND CRACKED STONES. CONCRETE CRACKED.

TIMBER BENTS: ALL OF BENT #3 AND UPSTREAM COLUMN AT BENT #2 IN NEW CONDITION. REMAINING POSTS AND CAPS SPLIT, CRACKED AND OR DECAYED. UPSTREAM COLUMN BENT #1 REPOSITIONED.
PICTURES A-285 #64 - #71

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 02/23/2010 **Inspector:** WBL

Deck: 5 Fair
Super: 3 Serious
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

*WBL inspection comments - ***PHOTOS ONLY FOR 2/22/10 INSPECTION.*** PICTURES A266- #23 THRU #42.*
23: TRUSS BOWED LATERALLY TOWARD DOWNSTREAM OVER BENT #2 UP TO 2.25 INCHES MEASURED FROM SPACER BLOCK TO FELLOW GUARD/SIDE BOARD TIMBER.
24: TENSION RODS, AND TWO VERTICAL MEMBERS SISTERED IN TRUSS ON DOWNSTREAM SIDE SPAN #3.
25: BEARING TIMBER MEMBER DECAYED AND CRUSHED APPEARING TO CAUSE TRUSS TO ROLL LATERALLY TOWARD DOWNSTREAM SIDE OVER BENT #2.
26: DECAY AND CRUSHING IN LOWER BEARING TIMBER OVER DOWNSTREAM END OF CAP ON BENT #2.
27: DETAIL OF BLOCKING AND NEW CHORD REPLACEMENT BEAM ON DOWNSTREAM SIDE.
28: SHIMS AND BLOCKING ADDED OVER DECAYED AREA IN CAP ON BENT #1 UPSTREAM SIDE.
29: DAMAGE AND DECAY IN BASE TIMBER UPSTREAM END BENT #2.
30: DETAIL OF NEW TIMBERS IN BENTS #2 AND #3.
31: OVERALL DETAIL OF NEW TIMBER BENTS, CHORD REPLACEMENT TIMBERS AND BLOCKING OVER CAPS.
32: SETTLEMENT IN EAST ABUTMENT; POSSIBLY ADDITIONAL DISPLACED STONES AT BASE.
33: LATERAL BOW IN TRUSS OF REPAIRED AREA AS EVIDENCED BY SIDE BOARDS DOWNSTREAM SIDE SPAN #2 AND #3.
34: SETTLEMENT AND DISPLACED STONES IN NE END OF EAST ABUTMENT/APPROACH RETAINING WALL.
35: SETTLEMENT AND MISSING CHINK STONES IN NE END OF EAST ABUTMENT.
36: SETTLEMENT AND OUTWARD BOW IN STONEWORK AT NE.
37: SETTLEMENT AND MISSING STONE IN EAST ABUTMENT JUST INSIDE OF ARCH AT SE
38: OVERALL SETTLEMENT AND SHIFTING STONEWORK ALONG FACE EAST ABUTMENT; SEVERAL STONES APPEAR SOMEWHAT UNSTABLE.
39: CRACKS AND SETTLEMENT IN PAVEMENT EVIDENT AT NE APPROACH SHOULDER.
40: LATERAL DEFORMATION IN ARCH AT NE END.
41: ARCH ROTATED UP TO 3 INCHES MEASURED FROM FACE OF SIDE BOARDS AND TIGHT TO SIDEWALK TIMBERS AT NE END.
42: ARCH DEFORMATION AS VIEWED FROM WEST END OF UPSTREAM SIDE AT EAST SPAN #7.

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 02/22/2010 **Inspector:** WBL

Deck: 5 Fair
Super: 3 Serious
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

WBL inspection comments -
NO BRIDGE RAIL, SIDEBOARDS ONLY: FEW DAMAGED PLANKS.
DECK: PLANKS WORN, ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THROUGH OR LIFTED.
SUPER: FEW TIPPED AND WARPED FLOORBEAMS, BOLTED AND SISTERED REPAIRS TO SPLIT FLOORBEAMS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO 1" DRY ROT ON BOTTOMS AND SPLITS IN TOPS. DECAY IN LOWER DIAGONAL, CHORD AND ARCH MEMBERS. TRUSS MEMBERS SPREADING UP TO 1.75"+/- IN AREAS: SECTION BOTTOM CLAMPED ON DOWNSTREAM SIDE SPAN #3. HEAVY DECAY IN LOWER DOWNSTREAM ARCH LEAVES AT PIER #2 AND EXCESSIVE DEFORMITIES AT PIER #1. ARCHES DEFORMITIES THROUGHOUT. LONG SAG UNDER DEAD LOAD WITH DEFORMITIES THROUGH OUT WITH GREATEST NOTICEABLE SAGS IN SPANS #5 AND #7 ALONG UPSTREAM SIDE. DECAY IN TIMBER BEARINGS AND BLOCKS, HEAVY AT NW AND SE. ONE BEARING BLOCK NEAR FACE OF BEARING SUPPORTING BOLSTER BEAM AT NW DUE TO HEAVY DECAY IN BEAM. SPLIT AND WARPED AREAS IN TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL BRACE. SEVERAL PURLINS MISSING OR LOOSE DECAY EVIDENT IN ENDS OF RAFTERS. FEW PURLINS SUSPENDED AT ONE END; ONE LAYING ACROSS OVERHEAD BRACING. SEVERAL OUTER SIDEBOARDS LOOSE; FEW MISSING.
SUB: VOIDS WITH MISSING STONES AND SETTLEMENT IN ABUTMENTS AND WINGS. FEW BASE STONES PLACED ATOP SLOPING LEDGE MISSING AT NE WITH SEVERAL UPPER STONES CANTILEVERED AND UNSTABLE AT NE WING; FEW FALLEN OUT. BACKWALLS CRACKED AND SPALLED.
PIERS: VOIDS WITH SHIFTING, MISSING AND CRACKED STONES. CONCRETE CRACKED.

TIMBER BENTS: ALL OF BENT #3 AND UPSTREAM COLUMN AT BENT #2 IN NEW CONDITION. REMAINING POSTS AND CAPS SPLIT, CRACKED AND OR DECAYED. UPSTREAM COLUMN BENT #1 REPOSITIONED.
****ALSO SEE PHOTOS IN NOTES 2/23/10 INSPECTION DATE.****

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 01/26/2010 **Inspector:** WBL

Deck: 1 Closed - Failing
Super: 1 Closed - Failing
Substr: 1 Closed - Failing
Culvert: N N/A (NBI)

Notes:

WBL inspection comments -
NO BRIDGE RAIL, SIDEBOARDS ONLY: FEW DAMAGED PLANKS.
DECK: AREA AT THE SOUTHWEST UNSUPPORTED OVER THE DISLODGED FLOORBEAMS. PLANKS WORN, ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THROUGH OR LIFTED.
SUPER: 6+ FLOOR BEAMS AT THE SOUTH WEST UNSUPPORTED DUE TO LATERAL MOVEMENT OF THE LOWER CHORD. FEW TIPPED AND WARPED FLOORBEAMS, BOLTED AND SISTERED REPAIRS TO SPLIT FLOORBEAMS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO 1" DRY ROT ON BOTTOMS AND SPLITS IN TOPS. DECAY IN LOWER DIAGONAL, CHORD AND ARCH MEMBERS. TRUSS MEMBERS SPREADING UP TO 1.75"+/- IN AREAS. HEAVY DECAY IN LOWER DOWNSTREAM ARCH LEAVES AT PIER #2 AND EXCESSIVE DEFORMITIES AT PIER #1. LONG SAG UNDER DEAD LOAD WITH DEFORMITIES THROUGH OUT. GREATEST NOTICEABLE SAG BETWEEN PIER #1 AND #2 ALONG UPSTREAM SIDE. DECAY IN TIMBER BEARINGS AND BLOCKS, HEAVY AT NW AND SE. ONE BEARING BLOCK NEAR FACE OF BEARING AREA SUPPORTING BOLSTER/CORBEL BEAM AT NW DUE TO HEAVY DECAY IN BEAM. SPLIT AND WARPED AREAS IN TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL BRACE. SEVERAL PURLINS MISSING OR LOOSE DECAY EVIDENT IN ENDS OF RAFTERS. FEW PURLINS SUSPENDED AT ONE END; ONE LAYING ACROSS OVERHEAD BRACING. SEVERAL OUTER SIDEBOARDS LOOSE; FEW MISSING.
SUB: VOIDS WITH MISSING STONES AND SETTLEMENT IN ABUTMENTS AND WINGS. FEW BASE STONES PLACED ATOP SLOPING LEDGE MISSING AT NE WITH SEVERAL UPPER STONES CANTILEVERED AND UNSTABLE AT NE WING. BACKWALLS CRACKED AND SPALLED.
PIERS: VOIDS WITH SHIFTING, MISSING AND CRACKED STONES. CONCRETE CRACKED. PIER #1 REPAIRED.
TIMBER BENTS: #3 BENT DESTROYED BY ICE. #2 PARTIALLY DESTROYED. #1 UPSTREAM VERTICAL DAMAGED. 2 REMAINING CAPS SPLIT AND DECAYED.

PICTURES: A266- 4 THRU 10 (1/26/10)

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 01/26/2010 **Inspector:** WBL

Deck: 1 Closed - Failing
Super: 1 Closed - Failing
Substr: 1 Closed - Failing
Culvert: N N/A (NBI)

Notes:

WBL inspection comments - BRIDGE CLOSED 1/25/10.
NO BRIDGE RAIL, SIDEBOARDS ONLY: FEW DAMAGED PLANKS.
DECK: PLANKS WORN, ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THROUGH OR LIFTED.
SUPER: FEW TIPPED AND WARPED FLOORBEAMS, BOLTED AND SISTERED REPAIRS TO SPLIT FLOORBEAMS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO 1" DRY ROT ON BOTTOMS AND SPLITS IN TOPS. DECAY IN LOWER DIAGONAL, CHORD AND ARCH MEMBERS. TRUSS MEMBERS SPREADING UP TO 1.75"+/- IN AREAS. SEVERAL FLOORBEAMS NO LONGER SUPPORTED AND BOTTOM CHORD BOWED LATERALLY TOWARD DOWNSTREAM DUE TO ICE JAM IMPACT CAUSING LOSS OF BENT #3. HEAVY DECAY IN LOWER DOWNSTREAM ARCH LEAVES AT PIER #2 AND EXCESSIVE DEFORMITIES AT PIER #1. LONG SAG UNDER DEAD LOAD WITH DEFORMITIES THROUGH OUT. GREATEST NOTICEABLE SAG BETWEEN PIER #1 AND #2 ALONG UPSTREAM SIDE. DECAY IN TIMBER BEARINGS AND BLOCKS, HEAVY AT NW AND SE. ONE BEARING BLOCK NEAR FACE OF BEARING AREA SUPPORTING BOLSTER/CORBEL BEAM AT NW DUE TO HEAVY DECAY IN BEAM. SPLIT AND WARPED AREAS IN TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL BRACE. SEVERAL PURLINS MISSING OR LOOSE DECAY EVIDENT IN ENDS OF RAFTERS. FEW PURLINS SUSPENDED AT ONE END; ONE LAYING ACROSS OVERHEAD BRACING. SEVERAL OUTER SIDEBOARDS LOOSE; FEW MISSING.
SUB: VOIDS WITH MISSING STONES AND SETTLEMENT IN ABUTMENTS AND WINGS. FEW BASE STONES PLACED ATOP SLOPING LEDGE MISSING AT NE WITH SEVERAL UPPER STONES CANTILEVERED AND UNSTABLE AT NE WING. BACKWALLS CRACKED AND SPALLED.
PIERS: VOIDS WITH SHIFTING, MISSING AND CRACKED STONES. CONCRETE CRACKED.

TIMBER BENTS: POSTS SPLIT, CRACKED AND DECAYED. BENT#3 REMOVED BY ICE JAM 1/25/10. REMAINING CAPS SPLIT AND DECAYED. LOSS OF UPSTREAM COLUMNS AT BENT #2. UPSTREAM COLUMN ON BENT #1 OUT OF POSITION.
****SEE PHOTOS IN STRUCTURE NOTES.****

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 12/04/2009 **Inspector:** WBL

Deck: 5 Fair
Super: 3 Serious
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

WBL inspection comments -
NO BRIDGE RAIL, SIDEBOARDS ONLY: FEW DAMAGED PLANKS.
DECK: PLANKS WORN, ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THROUGH OR LIFTED.
SUPER: FEW TIPPED AND WARPED FLOORBEAMS, BOLTED AND SISTERED REPAIRS TO SPLIT FLOORBEAMS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO 1" DRY ROT ON BOTTOMS AND SPLITS IN TOPS. DECAY IN LOWER DIAGONAL, CHORD AND ARCH MEMBERS. TRUSS MEMBERS SPREADING UP TO 1.75"+/- IN AREAS. HEAVY DECAY IN LOWER DOWNSTREAM ARCH LEAVES AT PIER #2 AND EXCESSIVE DEFORMITIES AT PIER #1. LONG SAG UNDER DEAD LOAD WITH DEFORMITIES THROUGH OUT. GREATEST NOTICEABLE SAG BETWEEN PIER #1 AND #2 ALONG UPSTREAM SIDE. DECAY IN TIMBER BEARINGS AND BLOCKS, HEAVY AT NW AND SE. ONE BEARING BLOCK NEAR FACE OF BEARING AREA SUPPORTING BOLSTER/CORBEL BEAM AT NW DUE TO HEAVY DECAY IN BEAM. SPLIT AND WARPED AREAS IN TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL BRACE. SEVERAL PURLINS MISSING OR LOOSE DECAY EVIDENT IN ENDS OF RAFTERS. FEW PURLINS SUSPENDED AT ONE END; ONE LAYING ACROSS OVERHEAD BRACING. SEVERAL OUTER SIDEBOARDS LOOSE; FEW MISSING.
SUB: VOIDS WITH MISSING STONES AND SETTLEMENT IN ABUTMENTS AND WINGS. FEW BASE STONES PLACED ATOP SLOPING LEDGE MISSING AT NE WITH SEVERAL UPPER STONES CANTILEVERED AND UNSTABLE AT NE WING. BACKWALLS CRACKED AND SPALLED.
PIERS: VOIDS WITH SHIFTING, MISSING AND CRACKED STONES. CONCRETE CRACKED. PIER #1 REPAIRED.
TIMBER BENTS: POSTS SPLIT, CRACKED AND DECAYED. HEAVY LOSS OF SECTION AT BASE OF DOWNSTREAM POST ON BENT#3. CAPS SPLIT AND DECAYED.
PICTURE A265- (12-09)
56: LARGE VOIDS, FEW UNSTABLE AND ROTTEN STONES IN MIDDLE OF NE WING WITH UP TO 24 INCHES PENETRATION.
57: LARGE VOIDS AT BASE OF NE WING WITH UP TO 36 INCHES PENETRATION.
58: VOIDS; CRACKED AND ROTTEN STONES IN EAST WING/ABUTMENT.

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 09/18/2008 **Inspector:** BEP

Deck: 5 Fair
Super: 3 Serious
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

BEP inspection comments -
NO BRIDGE RAIL, SIDEBOARDS ONLY: FEW DAMAGED PLANKS.
DECK: PLANKS WORN, ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THROUGH OR LIFTED.
SUPER: FEW TIPPED AND WARPED FLOORBEAMS, BOLTED AND SISTERED REPAIRS TO SPLIT FLOORBEAMS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO 1" DRY ROT ON BOTTOMS AND SPLITS IN TOPS. DECAY IN LOWER DIAGONAL, CHORD AND ARCH MEMBERS. TRUSS MEMBERS SPREADING UP TO 1.75"+/- IN AREAS. HEAVY DECAY IN LOWER DOWNSTREAM ARCH LEAVES AT PIER #2 AND EXCESSIVE DEFORMITIES AT PIER #1. LONG SAG UNDER DEAD LOAD WITH DEFORMITIES THROUGH OUT. GREATEST NOTICABLE SAG BETWEEN PIER #1 AND #2 ALONG UPSTREAM SIDE. DECAY IN TIMBER BEARINGS AND BLOCKS, HEAVY AT NW AND SE. ONE BEARING BLOCK NEAR FACE OF BEARING AREA SUPPORTING BOLSTER/CORBEL BEAM AT NW DUE TO HEAVY DECAY IN BEAM. SPLIT AND WARPED AREAS IN TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL BRACE. SEVERAL PURLINS MISSING OR LOOSE WITH DECAY EVIDENT IN ENDS OF RAFTERS. SOME OUTER SIDEBOARDS LOOSE.
SUB: VOIDS WITH MISSING STONES AND SETTLEMENT IN ABUTMENTS AND WINGS. BACKWALLS CRACKED AND SPALLED.
PIERS: VOIDS WITH SHIFTING, MISSING AND CRACKED STONES. CONCRETE CRACKED. PIER #1 REPAIRED. VEGETATION GROWING ON PIER #2.
TIMBER BENTS: POSTS SPLIT, CRACKED AND DECAYED. HEAVY LOSS OF SECTION AT BASE OF DOWNSTREAM POST ON BENT#3. CAPS SPLIT AND DECAYED.

PICTURE A241-
51: GAP BETWEEN INSIDE OF CORBEL AND BEARING TIMBER UNDER UPSTREAM TRUSS, ON EAST SIDE OF WEST PIER.
52: VOID AND ROTTEN STONES IN EAST ABUTMENT.
53: LARGE VOID AND ROTTEN STONES IN MIDDLE OF NE WING.
54: LARGE VOIDS IN BASE OF NE WING.

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 11/30/2007 **Inspector:** BEP

Deck: 4 Poor
Super: 3 Serious
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

FIELD REVIEW FOR COLLISION DAMAGE (12/05/07) NW END POST BROKEN OFF ETC. ROAD AGENT CONTACTED AND TEMPORARY SUPPORTS TO BE PLACED SAME DATE. PHOTOS 231- #9 THROUGH 11.

BEP inspection comments
NO BRIDGE RAIL: SIDEBOARDS ONLY WITH FEW DAMAGED.
DECK: PLANKS WORN UP TO 1.75" AT WEST END. ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THROUGH OR LIFTED.
SUPER: FEW TIPPED AND WARPED FLOORBEAMS, BOLTED AND SISTERED REPAIRS TO SPLIT FLOORBEAMS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO 1" DRY ROT ON BOTTOMS AND SPLITS IN TOPS. DECAY IN LOWER DIAGONAL, CHORD AND ARCH MEMBERS. TRUSS MEMBERS SPREADING UP TO 1.75"+/- IN AREAS. HEAVY DECAY IN LOWER DOWNSTREAM ARCH LEAVES AT PIER #2 AND EXCESSIVE DEFORMITIES AT PIER #1. LONG SAG UNDER DEAD LOAD WITH DEFORMITIES THROUGH OUT. GREATEST NOTICABLE SAG BETWEEN PIER #1 AND #2 ALONG UPSTREAM SIDE. DECAY IN TIMBER BEARINGS AND BLOCKS, HEAVY AT NW AND SE. ONE BEARING BLOCK NEAR FACE OF BEARING AREA SUPPORTING BOLSTER/CORBEL BEAM AT NW DUE TO HEAVY DECAY IN BEAM. SPLIT AND WARPED AREAS IN TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL BRACE. SEVERAL PURLINS MISSING OR LOOSE WITH DECAY EVIDENT IN ENDS OF RAFTERS. A LOT OF OUTER SIDEBOARDS LOOSE.
SUB: VOIDS WITH MISSING STONES AND SETTLEMENT IN ABUTMENTS AND WINGS. BACKWALLS CRACKED AND SPALLED.
PIERS: VOIDS WITH SHIFTING, MISSING AND CRACKED STONES. CONCRETE CRACKED. PIER #1 REPAIRED. VEGETATION GROWING ON PIER #2.
TIMBER BENTS: POSTS SPLIT, CRACKED AND DECAYED. HEAVY LOSS OF SECTION AT BASE OF DOWNSTREAM POST ON BENT#3. CAPS SPLIT AND DECAYED.

PICTURE A241-
51: GAP BETWEEN INSIDE OF CORBEL AND BEARING TIMBER UNDER UPSTREAM TRUSS, ON EAST SIDE OF WEST PIER.
52: VOID AND ROTTEN STONES IN EAST ABUTMENT.
53: LARGE VOID AND ROTTEN STONES IN MIDDLE OF NE WING.
54: LARGE VOIDS IN BASE OF NE WING.

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 09/10/2007 **Inspector:** BEP

Deck: 4 Poor
Super: 3 Serious
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

BEP inspection comments -
NO BRIDGE RAIL: SIDEBOARDS ONLY WITH FEW DAMAGED.
DECK: PLANKS WORN AND DAMAGED UP TO 1.75 INCH IN AREAS. ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THROUGH OR LIFTED.
SUPER: FEW TIPPED AND WARPED FLOORBEAMS, BOLTED AND SISTERED REPAIRS TO SPLIT FLOORBEAMS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO 1 INCH DRY ROT ON BOTTOMS AND SPLITS IN TOPS. DECAY IN LOWER DIAGONAL, CHORD AND ARCH MEMBERS. TRUSS MEMBERS SPREADING UP TO 1.75 INCH +/- IN AREAS. HEAVY DECAY IN LOWER DOWNSTREAM ARCH LEAVES AT PIER #2 AND EXCESSIVE DEFORMITIES AT PIER #1. LONG SAG UNDER DEAD LOAD WITH DEFORMITIES THROUGH OUT. GREATEST NOTICABLE SAG BETWEEN PIER #1 AND #2 ALONG UPSTREAM SIDE. DECAY IN TIMBER BEARINGS AND BLOCKS, HEAVY AT NW AND SE. ONE BEARING BLOCK NEAR FACE OF BEARING AREA SUPPORTING BOLSTER/CORBLE BEAM AT NW DUE TO HEAVY DECAY IN BEAM. SPLIT AND WARPED AREAS IN TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL BRACE. SEVERAL PURLINS MISSING OR LOOSE WITH DECAY EVIDENT IN ENDS OF RAFTERS. ALOT OF OUTER SIDEBOARDS LOOSE.
SUB: VOIDS WITH MISSING STONES AND SETTLEMENT IN ABUTMENTS AND WINGS. BACKWALLS CRACKED AND SPALLED.
PIERS: VOIDS WITH SHIFTING, MISSING AND CRACKED STONES. CONCRETE CRACKED. PIER #1 TIMBER CRIB FOOTING APPEARS TO BE SETTLING. VEGETATION GROWING ON PIER #1.
TIMBER BENTS: POSTS SPLIT, CRACKED AND DECAYED. HEAVY LOSS OF SECTION AT BASE OF DOWNSTREAM POST ON BENT#3. CAPS SPLIT AND DECAYED.

PICTURE A226-
01: WEST PIER VIEWED FROM UPSTREAM. LARGE CRACKS AND SPALL IN FASCIA CONCRETE. ARCH ENDS DEFORMED AND SPREAD.
02: SETTLEMENT IN NE WING WITH LARGE VOIDS WHERE STONES FALLEN OUT.

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 12/29/2006 **Inspector:** WBL

Deck: 4 Poor
Super: 3 Serious
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

WBL inspection comments -
NO BRIDGE RAIL: SIDEBOARDS ONLY; FEW DAMAGED.
DECK: PLANKS WORN UP TO 1.75 INCH IN AREAS. ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THROUGH OR LIFTED. MANY PLANKS FLEXING UNDER LOAD DUE TO GAPS OVER AND UNDER ENDS OF FLOORBEAMS IN AREAS.
SUPER: BEARING BLOCKS MISSING UNDER UPSTREAM TRUSS, CENTER IMPACT BEAM AND UNDER DOWNSTREAM TRUSS ON EAST SIDE OF PIER #1. FEW TIPPED, WARPED OR SPLIT CARRYING BEAMS AND FLOORBEAMS WITH MANY LOOSE OR MISSING SHIMS AND BLOCKS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO 1 INCH DRY ROT ON BOTTOMS AND SPLITS IN TOPS. DECAY IN LOWER DIAGONAL, CHORD AND ARCH MEMBERS. TRUSS MEMBERS SPREADING UP TO 1.75 INCH +/- IN AREAS. HEAVY DECAY IN LOWER DOWNSTREAM ARCH TIMBERS AT PIER #2 AND EXCESSIVE DEFORMITIES AT PIER #1. LONG SAG UNDER DEAD LOAD WITH DEFORMITIES THROUGH OUT; GREATEST NOTICABLE SAG BETWEEN PIER #1 AND #2 ALONG UPSTREAM SIDE. DECAY IN TIMBER BEARINGS AND BLOCKS, HEAVY AT NW AND SE; ONE BEARING BLOCK NEAR FACE OF BEARING AREA SUPPORTING BOLSTER/CORBLE BEAM AT NW DUE TO HEAVY DECAY IN BEAM. MODERATE DEFLECTION UNDER LIGHT LOADS. (EXCESSIVE, 1 TO 2 INCH DEFLECTION IN ENTIRE BRIDGE ESPECIALLY IN FLOORBEAMS NOTED UNDER LOADED TOWN SAND TRUCKS 12/06). SPLIT, WARPED, LOOSE AND/OR OUT OF POSITION TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL BRACE. SEVERAL PURLINS MISSING OR LOOSE WITH DECAY EVIDENT IN ENDS OF RAFTERS. ALOT OF OUTER SIDEBOARDS LOOSE.
SUB: VOIDS WITH MISSING STONES AND SETTLEMENT IN ABUTMENTS AND WINGS. ONE STONE SHIFTED OUT IN NE WING. BACKWALLS CRACKED AND SPALLED.
PIERS: VOIDS WITH SHIFTING, MISSING AND CRACKED STONES. CONCRETE CRACKED. PIER #1 TIMBER CRIB FOOTING APPEARS TO BE SETTLING. VEGETATION GROWING ON PIER #1, TREES GROWING ON PIER #2.
TIMBER BENTS: POSTS SPLIT, CRACKED AND DECAYED. HEAVY LOSS OF SECTION AT BASE OF DOWNSTREAM POST ON BENT#3. CAPS SPLIT AND DECAYED.
PICTURES (A217-39 THRU 51) LISTED SEPARATELY UNDER STRUCTURE NOTES.

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 12/29/2006 **Inspector:** WBL

Deck: 4 Poor
Super: 3 Serious
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

WBL inspection comments -
FIELD REVIEW OF REPAIRS DONE BY BOBM. REPAIRS MADE AS FOLLOWS: SPLIT FLOORBEAMS BOLTED OR SISTERED AND FLOORBEAMS, BEARING AREAS AND BRACING SHIMMED AND BLOCKED. TREE CUT FROM DOWNSTREAM END OF PIER #2.
NO BRIDGE RAIL: SIDEBOARDS ONLY WITH FEW DAMAGED.
DECK: PLANKS WORN UP TO 1.75 INCH IN AREAS. ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THROUGH OR LIFTED.
SUPER: FEW TIPPED AND WARPED FLOORBEAMS; BOLTED AND SISTERED REPAIRS TO SPLIT FLOORBEAMS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO 1 INCH DRY ROT ON BOTTOMS AND SPLITS IN TOPS. DECAY IN LOWER DIAGONAL, CHORD AND ARCH MEMBERS. TRUSS MEMBERS SPREADING UP TO 1.75 INCH +/- IN AREAS. HEAVY DECAY IN LOWER DOWNSTREAM ARCH LEAVES AT PIER #2 AND EXCESSIVE DEFORMITIES AT PIER #1. LONG SAG UNDER DEAD LOAD WITH DEFORMITIES THROUGH OUT. GREATEST NOTICABLE SAG BETWEEN PIER #1 AND #2 ALONG UPSTREAM SIDE. DECAY IN TIMBER BEARINGS AND BLOCKS, HEAVY AT NW AND SE. ONE BEARING BLOCK NEAR FACE OF BEARING AREA SUPPORTING BOLSTER/CORBLE BEAM AT NW DUE TO HEAVY DECAY IN BEAM. SPLIT AND WARPED AREAS IN TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL BRACE. SEVERAL PURLINS MISSING OR LOOSE WITH DECAY EVIDENT IN ENDS OF RAFTERS. ALOT OF OUTER SIDEBOARDS LOOSE.
SUB: VOIDS WITH MISSING STONES AND SETTLEMENT IN ABUTMENTS AND WINGS. ONE STONE SHIFTED OUT IN NE WING. BACKWALLS CRACKED AND SPALLED.
PIERS: VOIDS WITH SHIFTING, MISSING AND CRACKED STONES. CONCRETE CRACKED. PIER #1 TIMBER CRIB FOOTING APPEARS TO BE SETTLING. VEGETATION GROWING ON PIER #1.
TIMBER BENTS: POSTS SPLIT, CRACKED AND DECAYED. HEAVY LOSS OF SECTION AT BASE OF DOWNSTREAM POST ON BENT#3. CAPS SPLIT AND DECAYED.
PICTURES A218- (12-28-06)
33: UNDERSIDE VIEW OF BOLTED REPAIRS TO SPLIT FLOORBEAMS.
34: TYPICAL BLOCKING/SHIMS UNDER ENDS OF FLOORBEAMS.
35: TOPSIDE VIEW OF DECKING AT BOLTED REPAIRS OF FLOORBEAMS.

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 12/08/2006 **Inspector:** WBL

Deck: 4 Poor
Super: 3 Serious
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

WBL inspection comments -
NO BRIDGE RAIL: SIDEBOARDS ONLY; FEW DAMAGED.
DECK: PLANKS WORN UP TO 1.75 INCH IN AREAS. ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THROUGH OR LIFTED. MANY PLANKS FLEXING UNDER LOAD DUE TO GAPS OVER AND UNDER ENDS OF FLOORBEAMS IN AREAS.
SUPER: BEARING BLOCKS MISSING UNDER UPSTREAM TRUSS, CENTER IMPACT BEAM AND UNDER DOWNSTREAM TRUSS ON EAST SIDE OF PIER #1. FEW TIPPED, WARPED OR SPLIT CARRYING BEAMS AND FLOORBEAMS WITH MANY LOOSE OR MISSING SHIMS AND BLOCKS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO 1 INCH DRY ROT ON BOTTOMS AND SPLITS IN TOPS. DECAY IN LOWER DIAGONAL, CHORD AND ARCH MEMBERS. TRUSS MEMBERS SPREADING UP TO 1.75 INCH +/- IN AREAS. HEAVY DECAY IN LOWER DOWNSTREAM ARCH TIMBERS AT PIER #2 AND EXCESSIVE DEFORMITIES AT PIER #1. LONG SAG UNDER DEAD LOAD WITH DEFORMITIES THROUGH OUT; GREATEST NOTICABLE SAG BETWEEN PIER #1 AND #2 ALONG UPSTREAM SIDE. DECAY IN TIMBER BEARINGS AND BLOCKS, HEAVY AT NW AND SE; ONE BEARING BLOCK NEAR FACE OF BEARING AREA SUPPORTING BOLSTER/CORBLE BEAM AT NW DUE TO HEAVY DECAY IN BEAM. MODERATE DEFLECTION UNDER LIGHT LOADS. (EXCESSIVE, 1 TO 2 INCH DEFLECTION IN ENTIRE BRIDGE ESPECIALLY IN FLOORBEAMS NOTED UNDER LOADED TOWN SAND TRUCKS 12/06). SPLIT, WARPED, LOOSE AND/OR OUT OF POSITION TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL BRACE. SEVERAL PURLINS MISSING OR LOOSE WITH DECAY EVIDENT IN ENDS OF RAFTERS. ALOT OF OUTER SIDEBOARDS LOOSE.
SUB: VOIDS WITH MISSING STONES AND SETTLEMENT IN ABUTMENTS AND WINGS. ONE STONE SHIFTED OUT IN NE WING. BACKWALLS CRACKED AND SPALLED.
PIERS: VOIDS WITH SHIFTING, MISSING AND CRACKED STONES. CONCRETE CRACKED. PIER #1 TIMBER CRIB FOOTING APPEARS TO BE SETTLING. VEGETATION GROWING ON PIER #1, TREES GROWING ON PIER #2.
TIMBER BENTS: POSTS SPLIT, CRACKED AND DECAYED. HEAVY LOSS OF SECTION AT BASE OF DOWNSTREAM POST ON BENT#3. CAPS SPLIT AND DECAYED.
PICTURES (A217-39 THRU 51) LISTED SEPARATELY ON 12-7-2006

Inspection Date: 12/07/2006 **Inspector:** WBL

Deck: 4 Poor
Super: 3 Serious
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

multi day inspection pictures A217-
39: UPSTREAM OUTER TOP CHORD MEMBER SPREAD 1-3/4 INCHES WITH WOODEN DOWEL MISALIGNED AND POSSIBLY BROKE, JUST EAST OF MIDDLE RIVER PIER.
40: BLOCK OUT OF POSITION UNDER FLOORBEAM AT BOTTOM CHORD. TYPICAL OF SEVERAL AREAS.
41: THREE FLOORBEAMS SPLIT FROM NOTCH AT DOWNSTREAM CHORD REPLACEMENT BEAM, EAST OF PIER #3.
42: CHORD BEARING TIMBER CRUSHED OVER DOWNSTREAM END OF BENT #2 CAP.
43: HEAVY ROT IN UPSTREAM END OF TIMBER BENT #1 CAP AND IN SHIM BLOCK UNDER TRUSS BEARING.
44: HEAVY ROT IN UPSTREAM TRUSS BEARING AT WEST ABUTMENT WITH NO LOAD BEARING ON REAR BLOCKS.
45: NO SUPPORT BLOCK UNDER EAST SIDE OF FLOORBEAM BOLSTER AT CENTER OF PIER #1.
46: SUPPORT BLOCK MISSING UNDER DOWNSTREAM TRUSS BEARING AT EAST SIDE OF PIER #1. BLOCK ALSO OUT UNDER CHORD REPLACEMENT BEAM.
47: SUPPORT BLOCK MISSING UNDER UPSTREAM TRUSS BEARING AT EAST SIDE OF PIER #1.
48: UPSTREAM ARCH BADLY DISTRESSED AND DEFORMED AT EAST SIDE OF PIER #1.
49: LARGE VOID WITH SEVERAL STONES MISSING IN DOWNSTREAM END OF PIER #1.
50: WEST PIER AS VIEWED FROM UPSTREAM APPEARS TO BE TIPPED TOWARDS EAST.
51: FAIRLY LARGE TREE CLUSTER GROWING FROM DOWNSTREAM END OF PIER #2 WITH SEVERAL STONES MISSING.

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 08/12/2005 **Inspector:** BEP

Deck: 4 Poor
Super: 4 Poor
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

Revised October 25, 2006 to correct data error. BEP inspection comments - -
NO BRIDGE RAIL: SIDEBOARDS ONLY.
DECK: PLANKS WORN UP TO 1 INCH IN AREAS. ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THROUGH. FEW ENDS OF PLANKS FLEXING UNDER LOAD DUE TO GAPS OVER FLOORBEAMS IN AREAS.
SUPER: BEARING BLOCKS MISSING UNDER UPSTREAM TRUSS AND CENTER IMPACT BEAM AND LOOSE BLOCKS WITH GAPS UNDER DOWNSTREAM TRUSS AT RIVER PIER #1. FEW TIPPED, WARPED OR SPLIT CARRYING BEAMS AND FLOORBEAMS WITH MANY MISSING AND LOOSE SHIMS AND BLOCKS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO 1 INCH DRY ROT ON BOTTOMS AND SPLITS IN TOPS. DECAY IN LOWER DIAGONAL, CHORD AND ARCH MEMBERS. TRUSS MEMBERS SPREADING 1/2 INCH +/- IN AREAS. HEAVY DECAY IN LOWER DOWNSTREAM ARCH TIMBERS AT PIER #2. DEFORMITIES THROUGH OUT. DECAY IN TIMBER BEARINGS AND BLOCKS, HEAVY AT NW AND SE. LONG SAG UNDER DEAD LOAD. MODERATE DEFLECTION UNDER LIGHT LOADS. (EXCESSIVE, 1 TO 2 INCH DEFLECTION IN ENTIRE BRIDGE NOTED UNDER LOAD OF TOWN SAND TRUCK 12/01). SPLIT, WARPED, LOOSE AND/OR OUT OF POSITION TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL BRACE. SEVERAL PURLINS MISSING OR LOOSE WITH DECAY EVIDENT IN ENDS OF RAFTERS. ALOT OF OUTER SIDING LOOSE.
SUB: VOIDS WITH MISSING STONES AND SETTLEMENT IN ABUTMENTS AND WINGS. ONE STONE SHIFTED OUT IN NE WING. BACKWALLS CRACKED AND SPALLED.
PIERS: VOIDS WITH SHIFTING, MISSING AND CRACKED STONES. CONCRETE CRACKED. PIER #1 TIMBER CRIB FOOTING APPEARS TO BE SETTLING. VEGETATION GROWING ON PIER #1, TREES GROWING ON PIER #2.
TIMBER BENTS: POSTS SPLIT, CRACKED AND DECAYED. HEAVY LOSS OF SECTION AT BASE OF DOWNSTREAM POST ON BENT#3. CAPS SPLIT AND DECAYED.

PICTURE A202-
17: LARGE VOID WITH SEVERAL MISSING STONES IN DOWNSTREAM END OF PIER #1. VOIDS AND TREES GROWING OUT OF PIER #2.
18: DECAY IN DIAGONAL AND ARCH AT NE END.
19: NE EMBANKMENT HEAVILY ERODED AT WING. LARGE VOIDS IN WING WITH ONE STONE SHIFTED OUT.
20: WASHOUT IN ROAD.

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 11/19/2004 **Inspector:** BEP

Deck: 5 Fair
Super: 5 Fair
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

BEP inspection comments -
NO BRIDGE RAIL: SIDEBOARDS ONLY.
DECK: PLANKS WORN UP TO 1 INCH IN AREAS. ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THROUGH. FEW ENDS OF PLANKS FLEXING UNDER LOAD DUE TO GAPS OVER FLOORBEAMS IN AREAS.
SUPER: BEARING BLOCKS MISSING UNDER UPSTREAM TRUSS AND CENTER IMPACT BEAM AND LOOSE BLOCKS WITH GAPS UNDER DOWNSTREAM TRUSS AT RIVER PIER #1. FEW TIPPED, WARPED OR SPLIT CARRYING BEAMS AND FLOORBEAMS WITH MANY MISSING AND LOOSE SHIMS AND BLOCKS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO 1 INCH DRY ROT ON BOTTOMS AND SPLITS IN TOPS. TRUSS MEMBERS SPREADING 1/2 INCH +/- IN AREAS. HEAVY DECAY IN LOWER DOWNSTREAM ARCH TIMBERS AT PIER #2. DEFORMITIES THROUGH OUT. SOME DRY ROT ON TIMBER BEARINGS. LONG SAG UNDER DEAD LOAD. MODERATE DEFLECTION UNDER LIGHT LOADS. (EXCESSIVE, 1 TO 2 INCH DEFLECTION IN ENTIRE BRIDGE NOTED UNDER LOAD OF TOWN SAND TRUCK 12/01). SPLIT, WARPED, LOOSE AND/OR OUT OF POSITION TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL BRACE. SEVERAL PURLINS MISSING OR LOOSE WITH DECAY EVIDENT IN ENDS OF RAFTERS. ALOT OF OUTER SIDEBOARDS LOOSE.
SUB: VOIDS WITH MISSING STONES AND SETTLEMENT IN ABUTMENTS AND WINGS. ONE STONE SHIFTED OUT IN NE WING. BACKWALLS CRACKED AND SPALLED.
PIERS: VOIDS WITH SHIFTING, MISSING AND CRACKED STONES. CONCRETE CRACKED. APPARENT VOIDS UNDER LOG CRIB FOOTING AT PIER #1. VEGETATION GROWING ON PIER #1, TREES GROWING ON PIER #2.
TIMBER BENTS: POSTS SPLIT, CRACKED AND DECAYED. HEAVY LOSS OF SECTION AT BASE OF DOWNSTREAM POST ON BENT#3. CAPS SPLIT AND DECAYED.

PICTURE A194-
21: NE EMBANKMENT HEAVILY ERODED AT WING. VOIDS IN WING WITH ONE STONE SHIFTED OUT.
22: LARGE VOID WITH SEVERAL MISSING STONES IN DOWNSTREAM END OF PIER #1. TREES GROWING OUT OF PIER #2.

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 08/08/2003 **Inspector:** BEP

Deck: 5 Fair
Super: 5 Fair
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

Sufficiency Rating Calculation Accepted by DEP at 7/12/2004 09:35:14
BEP inspection comments -
NO BRIDGE RAIL: SIDEBOARDS ONLY.
DECK: PLANKS WORN UP TO 1" IN AREAS. ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THROUGH. FEW ENDS OF PLANKS FLEXING UNDER LOAD DUE TO GAPS OVER FLOORBEAMS IN AREAS.
SUPER: BEARING BLOCKS MISSING UNDER UPSTREAM TRUSS AND CENTER IMPACT BEAM AND LOOSE BLOCKS WITH GAPS UNDER DOWNSTREAM TRUSS AT RIVER PIER #1. FEW TIPPED, WARPED OR SPLIT CARRYING BEAMS AND FLOORBEAMS WITH MANY MISSING AND LOOSE SHIMS AND BLOCKS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO 1" DRY ROT ON BOTTOMS; SPLITS IN TOPS. TRUSS MEMBERS SPREADING 1/2" +/- IN AREAS. HEAVY DECAY IN LOWER DOWNSTREAM ARCH TIMBERS AT PIER #2. DEFORMITIES THROUGH OUT. SOME DRY ROT ON TIMBER BEARINGS. LONG SAG UNDER DEAD LOAD. MODERATE DEFLECTION UNDER LIGHT LOADS. (EXCESSIVE, 1" TO 2" DEFLECTION IN ENTIRE BRIDGE NOTED UNDER LOAD OF TOWN SAND TRUCK 12/01). SPLIT, WARPED, LOOSE AND/OR OUT OF POSITION TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL. SEVERAL PURLINS MISSING OR LOOSE WITH DECAY EVIDENT IN ENDS OF RAFTERS.
SUB: VOIDS, MISSING STONES AND SETTLEMENT IN ABUTMENTS AND WINGS. BACKWALLS CRACKED AND SPALLED.
PIERS: VOIDS WITH SHIFTING, MISSING AND CRACKED STONES. CONCRETE CRACKED. APPARENT VOIDS UNDER LOG CRIB FOOTING AT PIER #1. VEGETATION GROWING ON PIER #1, TREES GROWING ON PIER #2.
TIMBER BENTS: POSTS SPLIT, CRACKED AND DECAYED. HEAVY LOSS OF SECTION AT BASE OF DOWNSTREAM POST ON BENT#3. CAPS SPLIT AND DECAYED.

PICTURES: A159-
01: LARGE VOID WITH SEVERAL MISSING STONES IN DOWNSTREAM END OF PIER #1. TREES GROWING OUT OF PIER #2.
02: BASE OF POST #1 ON BENT #3 MOSTLY ROTTED AWAY.

Inspection Date: 12/24/2002 **Inspector:** WBL

Deck: 5 Fair
Super: 5 Fair
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

Sufficiency Rating Calculation Accepted by DEP at 07/08/2003 15:56:24
WBL inspection comments -
NO BRIDGE RAIL: SIDEBOARDS ONLY.
DECK: PLANKS WORN UP TO 1" IN AREAS. ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THRU. FEW ENDS OF PLANKS FLEXING UNDER LOAD DUE TO GAPS OVER FLOORBEAMS IN AREAS.
SUPER: BEARING BLOCKS MISSING UNDER UPSTREAM TRUSS AND CENTER IMPACT BEAM AND LOOSE BLOCKS WITH GAPS UNDER DOWNSTREAM TRUSS AT RIVER PIER #1. FEW TIPPED, WARPED OR SPLIT CARRYING BEAMS AND FLOORBEAMS WITH MANY MISSING AND LOOSE SHIMS AND BLOCKS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO 1" DRY ROT ON BOTTOMS; SPLITS IN TOPS. TRUSS MEMBERS SPREADING 1/2"+/- IN AREAS. HEAVY DECAY IN LOWER DOWNSTREAM ARCH TIMBERS AT PIER #2. DEFORMITIES THROUGH OUT. SOME DRY ROT ON TIMBER BEARINGS. LONG SAG UNDER DEAD LOAD. EXCESSIVE, 1" TO 2" DEFLECTION IN ENTIRE BRIDGE NOTED UNDER LOAD OF TOWN SAND TRUCK. SPLIT, WARPED, LOOSE AND/OR OUT OF POSITION TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL. SEVERAL PURLINS MISSING OR LOOSE WITH DECAY EVIDENT IN ENDS OF RAFTERS.
SUB: VOIDS, MISSING STONES AND SETTLEMENT IN ABUTMENTS AND PIERS. BACKWALLS CRACKED AND SPALLED.

PICTURE: A149-24: TOP OF FLOORBEAM SPLIT OUT AT BENT #3. (12-02)

New Hampshire Department of Transportation ***Existing Bridge Section*** ***Bureau of Bridge Design***

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 12/11/2001 **Inspector:** BEP

Deck: 5 Fair
Super: 5 Fair
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

Sufficiency Rating Calculation Accepted by DEP at 05-14-2002 15:51:58
BEP inspection comments -
NO BRIDGE RAIL: SIDEBOARDS ONLY.
DECK: PLANKS WORN UP TO 1 INCH IN AREAS. ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THRU.
SUPER: BEARING BLOCKS MISSING UNDER UPSTREAM TRUSS AND CENTER IMPACT BEAM AND LOOSE BLOCKS WITH GAPS UNDER DOWNSTREAM TRUSS AT RIVER PIER #1. FEW TIPPED, WARPED OR SPLIT CARRYING BEAMS AND FLOORBEAMS WITH MANY MISSING AND LOOSE SHIMS AND BLOCKS. MANY OLD FLOORBEAMS TURNED OVER WITH UP TO ONE INCH DRY ROT ON BOTTOMS. TRUSS MEMBERS SPREADING 1/2 INCH +/- IN AREAS. HEAVY DECAY IN LOWER DOWNSTREAM ARCH TIMBERS AT PIER #2. DEFORMITIES THROUGH OUT. LONG SAG UNDER DEAD LOAD. EXCESSIVE, ONE TO TWO INCH, DEFLECTION IN ENTIRE BRIDGE NOTED UNDER LOAD OF OIL DELIVERY TRUCK. SPLIT, WARPED, LOOSE AND/OR OUT OF POSITION TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL. SOME DRY ROT ON TIMBER BEARINGS.
SUB: VOIDS, MISSING STONES AND SETTLEMENT IN ABUTMENTS AND PIERS. BACKWALLS CRACKED AND SPALLED. DRAIN GRATE IN EAST BACKWALL.

Inspection Date: 08/29/2001 **Inspector:** WBL

Deck: 5 Fair
Super: 5 Fair
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

WBL inspection comments -
NO BRIDGE RAIL: SIDEBOARDS ONLY.
DECK: PLANKS WORN UP TO 1 INCH IN AREAS: ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THRU.
SUPER: FEW TIPPED OR SPLIT CARRYING BEAMS AND FLOOR BEAMS WITH MISSING SHIMS AND BLOCKS. TRUSS MEMBERS SPREADING 1/2 INCH +/- IN TOP CHORD AND WEB. DEFORMITIES THROUGH OUT. LONG SAG UNDER DEAD LOAD. SPLITS IN TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL. MODERATE VIBRATIONS UNDER LOAD. SOME DRY ROT ON TIMBER BEARINGS.
SUB: VOIDS, MISSING STONES AND SETTLEMENT IN ABUTMENTS AND PIERS. BACKWALLS CRACKED AND SPALLED. PIER TIMBERS AT WEST SPLIT, CRACKED AND DECAYED WITH LOSS OF SECTION. TREES GROWING BETWEEN STONES IN PIERS. TIMBER LOG FOOTING UNDER PIER #1 APPEARS TO BE UNDERMINED AT SE.

PIC. A121-20: TIMBER DECKING SPLIT AND WORN WITH SPIKES PULLING THRU AT EAST END.

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 10/12/2000 **Inspector:** WBL

Deck: 5 Fair
Super: 5 Fair
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

Sufficiency Rating Calculation Accepted by DEP at 04-16-2001 14:10:41
WBL inspection comments -
NO BRIDGE RAIL: SIDEBOARDS ONLY.
DECK: PLANKS WORN UP TO 1 INCH IN AREAS; ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THRU.
SUPER: FEW TIPPED OR SPLIT CARRYING BEAMS AND FLOOR BEAMS WITH MISSING SHIMS AND BLOCKS. TRUSS MEMBERS SPREADING 1/2 INCH +/- IN TOP CHORD AND WEB. DEFORMITIES. LONG SAG UNDER DEAD LOAD. SPLITS IN TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL. MODERATE VIBRATIONS UNDER LOAD. SOME DRY ROT ON TIMBER BEARINGS.
SUB: VOIDS, MISSING STONES AND SETTLEMENT IN ABUTMENTS AND PIERS. BACKWALLS CRACKED AND SPALLED. PIER TIMBERS AT WEST SPLIT, CRACKED AND DECAYED WITH LOSS OF SECTION. EXTERIOR COLUMNS ON BENT #1 ROTTED AWAY AT BASE AND SUSPENDED FROM CAP. BENT #1 BEING SUPPORTED BY INTERIOR DIAGONALS. TREES GROWING BETWEEN STONES IN PIERS. TIMBER LOG FOOTING UNDER PIER #1 APPEARS TO BE UNDERMINED AT SE.

PIC. A108-
11: BASE OF EXTERIOR COLUMN OF BENT #1 ROTTED AWAY ON DOWNSTREAM SIDE. TYPICAL CONDITION AT UPSTREAM.
12: MISSING STONE AND VEGETATION GROWING IN PIER #1 AT SE. LARGE TREE GROWING FROM PIER #2.
13: DAMAGE TO SW PORTAL.

Inspection Date: 03/29/2000 **Inspector:** WBL

Deck: 5 Fair
Super: 5 Fair
Substr: 3 Serious
Culvert: N N/A (NBI)

Notes:

WBL inspection comments -
NO BRIDGE RAIL: SIDEBOARDS ONLY.
DECK: PLANKS WORN UP TO 1 INCH IN AREAS; ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THRU.
SUPER: FEW TIPPED OR SPLIT CARRYING BEAMS AND FLOOR BEAMS WITH MISSING SHIMS AND BLOCKS. TRUSS MEMBERS SPREADING 1/2 INCH +/- IN TOP CHORD AND WEB. DEFORMITIES. LONG SAG UNDER DEAD LOAD. SPLITS IN TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL. MODERATE VIBRATIONS UNDER LOAD. SOME DRY ROT ON TIMBER BEARINGS.
SUB: VOIDS, MISSING STONES AND SETTLEMENT IN ABUTMENTS AND PIERS. BACKWALLS CRACKED AND SPALLED. PIER TIMBERS AT WEST SPLIT, CRACKED AND DECAYED WITH LOSS OF SECTION. TREES GROWING BETWEEN STONES IN PIERS.
PIC. A072-
14: BEARING BLOCK DECAYED AND CRUSHING OVER BENT #2 DOWNSTREAM END.
15: CORBEL ROTTED AT NW.
16: BEARING BLOCK ROTTED UNDER NW CORBEL AT FRONT OF SEAT.
17: TYPICAL OF FLOORBEAM NOTCH AT CHORD IN SPAN #1..
18: BASE OF UPSTREAM COLUMN OF BENT #1 ALMOST COMPLETELY ROTTED THRU, DOWNSTREAM COLUMN SIMILAR.
19: BENT CAP #3 DECAYED ON UPSTREAM END. TYPICAL AT ENDS.
20: FLOORBEAM WEST OF BENT #3 SPLIT OUT.
21: MISSING SHIM UNDER CORBEL AT PIER #1.
22: 75% SECTION LOSS TO BASE OF COLUMN, BENT #3, DOWNSTREAM END.

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 12/06/1999 **Inspector:** BEP

Deck: 5 Fair
Super: 5 Fair
Substr: 4 Poor
Culvert: N N/A (NBI)

Notes:

BEP inspection comments -
NO BRIDGE RAIL: SIDEBOARDS ONLY.
DECK: PLANKS WORN 1/4 TO 1/2 INCH; ENDS OF SEVERAL SPLIT AND LOOSE WITH SPIKES PULLING THRU.
SUPER: FEW TIPPED OR SPLIT CARRYING BEAMS AND FLOOR BEAMS WITH MISSING SHIMS AND BLOCKS. TRUSS MEMBERS SPREADING 1/2 INCH +/- IN TOP CHORD AND WEB. DEFORMITIES. LONG SAG UNDER DEAD LOAD. SPLITS IN TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL. MODERATE VIBRATIONS UNDER LOAD. SOME DRY ROT ON TIMBER BEARINGS.
SUB: VOIDS, MISSING STONES AND SETTLEMENT IN ABUTMENTS AND PIERS. BACKWALLS CRACKED AND SPALLED. PIER TIMBERS AT WEST SPLIT, CRACKED AND DECAYED WITH LOSS OF SECTION. TREES GROWING BETWEEN STONES IN PIERS.

PIC A066-11: WEST APPROACH.
(12/99) -12: UPSTREAM (NW) ELEVATION.

Inspection Date: 10/23/1998 **Inspector:** WBL

Deck: 5 Fair
Super: 5 Fair
Substr: 4 Poor
Culvert: N N/A (NBI)

Notes:

Sufficiency Rating Calculation Accepted by DEP at 06-30-1999 15:58:54
WBL inspection comments -
SIDE BOARDS FOR BRIDGE RAIL: GOOD. APPROACH RAIL- WOOD TIMBER / CABLE RAIL FAIR.
DECK: TIMBER PLANKS WORN, LOOSE, FEW ENDS LIFTING. TIMBER SIDEWALKS- FAIR. STEEL GRATE DRAINS DAMAGED AT WEST.
SUPER: FEW TIPPED OR SPLIT CARRYING BEAMS AND FLOOR BEAMS, WITH MISSING SHIMS AND BLOCKS. TRUSSES SPREADING 1/2 INCHES +/- IN TOP CHORD WEB MEMBERS; DEFORMITIES. SPLITS IN TIMBER BRACING. COLLISION DAMAGE AT SW PORTAL. FAIR ALIGNMENT, MODERATE VIBRATIONS UNDER LOAD. SOME DRY ROT ON TIMBER BEARINGS.
SUB: VOIDS, MISSING STONES, SETTLEMENT IN ABUTMENTS. VOIDS IN WINGS. CONCRETE BACKWALLS CRACKED AND SPALLED; MEDIUM SPALLS IN EAST. PIERS: TIMBER SPLIT, CRACKED AND DECAYED. CONCRETE / STONE CRACKED, SPALLED WITH VOIDS AND MISSING STONES.

PIC. A016-37: BROKEN ROOF PURLIN AT THE EAST END

Inspection Date: 12/01/1997 **Inspector:** Not Available

Deck: 5 Fair
Super: 5 Fair
Substr: 4 Poor
Culvert: N N/A (NBI)

Notes:

Sufficiency Rating Calculation Accepted by dep at 8-19-1998 15:10:14

Inspection Date: 10/01/1996 **Inspector:** Not Available

Deck: 5 Fair
Super: 5 Fair
Substr: 4 Poor
Culvert: N N/A (NBI)

Notes:

Inspection Date: 09/01/1995 **Inspector:** Not Available

Deck: 5 Fair
Super: 5 Fair
Substr: 4 Poor
Culvert: N N/A (NBI)

Notes:

Inspection Date: 12/01/1994 **Inspector:** Not Available

Deck: 6 Satisfactory
Super: 5 Fair
Substr: 4 Poor
Culvert: N N/A (NBI)

Notes:

New Hampshire Department of Transportation

Existing Bridge Section
Bureau of Bridge Design

Bridge Inspection Report

Bath 137/095

Inspection History:

Inspection Date: 09/01/1991 **Inspector:** Not Available

Notes:

Deck: 7 Good
Super: 5 Fair
Substr: 4 Poor
Culvert: N N/A (NBI)

Bridge Lighting and Utilities: *INTERIOR LIGHTING OVER DECK AND SIDEWALK. TELEPHONE CABLE ALONG DOWNSTREAM TOP CHORD.*

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BATH 137/095

WEST BATH ROAD over AMMONOOSUC RIVER

Monday, October 04, 2010

UPSTREAM ELEVATION OF EAST ABUTMENT AND PIERS FROM ATV TRAIL. (MUNICIPAL RED LIST)

A287 37

Monday, October 04, 2010

DOWNSTREAM ELEVATION OF PIERS AND EAST ABUTMENT VIEW FROM ATV TRAIL. LARGE TREE TRUNK CAUGHT UP ON RIVER PIER #3. (MUNICIPAL RED LIST)

A287 38

Monday, October 04, 2010

LARGE TREE TRUNK CAUGHT UP AT RIVER PIER #1. ATV TRAIL ERODING. (MUNICIPAL RED LIST)

A287 39

BATH 137/095

WEST BATH ROAD over AMMONOOSUC RIVER

Monday, October 04, 2010

LOOSE AND MISSING STONES IN NE WING; CONCRETE CAP CRACKED AND SPALLED. (MUNICIPAL RED LIST)

A287 29

Monday, October 04, 2010

LEFT HALF (FACING DOWNSTREAM) OF NE WING JUST BELOW MISSING STONES AND SPALLED CAP AREA. (MUNICIPAL RED LIST)

A287 30

Monday, October 04, 2010

RIGHT HALF NE WING / ABUTMENT (FACING DOWNSTREAM). (MUNICIPAL RED LIST)

A287 31

BATH 137/095

WEST BATH ROAD over AMMONOOSUC RIVER

Monday, October 04, 2010

CRACKED, BROKEN AND SHIFTED STONES AT LOWER END OF EAST ABUTMENT. (MUNICIPAL RED LIST)

A287 32

Monday, October 04, 2010

CRACKED, BROKEN AND SHIFTED STONES IN UPSTREAM HALF OF EAST ABUTMENT. (MUNICIPAL RED LIST)

A287 33

Monday, October 04, 2010

CRACKED, BROKEN AND A MISSING STONE IN DOWNSTREAM HALF OF EAST ABUTMENT. (MUNICIPAL RED LIST)

A287 34

BATH 137/095

WEST BATH ROAD over AMMONOOSUC RIVER

Monday, October 04, 2010

BROKEN LOWER STONES IN UPSTREAM END OF EAST ABUTMENT; VOID UNDER BASE STONE UP TO 12 INCHES AT FACE. (MUNICIPAL RED LIST)

A287 35

Monday, October 04, 2010

OVERALL OF OUT POSITION STONES IN NE WING.(MUNICIPAL RED LIST)

A287 36

BATH 137/095

WEST BATH ROAD over AMMONOOSUC RIVER

Friday, October 01, 2010

UPSTREAM ELEVATION WITH HIGH WATER ENVELOPING PIERS AND SPILLING OVER WEST ATV TRAIL. (10/1/10 FLOODING.) (MUNICIPAL RED LIST)

A287 24

BATH 137/095

WEST BATH ROAD over AMMONOOSUC RIVER

Friday, September 17, 2010

SPAN #1; US TIMBER BENT CAP END DECAYED. RED LIST.

A285 64

Friday, September 17, 2010

DAMAGED ARCH ROD BEARING BLOCK SPAN #6 AT WEST US ARCH END. RED LIST.

A285 65

Friday, September 17, 2010

FALLEN ROOF NAILER MID-SPAN OF #6 DS; TYPICAL IN A FEW AREAS. RED LIST.

A285 66

BATH 137/095
WEST BATH ROAD over AMMONOOSUC RIVER

Friday, September 17, 2010

DAMAGED, TORN DRAIN ARMOR AT EAST DECK END. RED LIST.

A285 67

Friday, September 17, 2010

SE ABUTMENT; LARGE VOID FROM STONE FALLEN OUT. RED LIST.

A285 68

Friday, September 17, 2010

NE ABUTMENT BASE CORNER STONE AND SURROUNDING STONES CRACKED AND SETTLED. RED LIST.

A285 69

BATH 137/095

WEST BATH ROAD over AMMONOOSUC RIVER

Friday, September 17, 2010

VOIDS AND A SINGLE SMALL STONE THAT APPEARS TO BE BOLSTERING THE ENTIRE NE WING AT THE NW CORNER. RED LIST.

A285 70

Friday, September 17, 2010

NE WING; MANY VOIDS AND UNSTABLE BULGED OR OVERHANGING STONES. RED LIST.

A285 71

BATH 137/095

WEST BATH ROAD over AMMONOOSUC RIVER

Monday, February 22, 2010

TRUSS BOWED LATERALLY TOWARD DOWNSTREAM OVER BENT #2 UP TO 2.25 INCHES MEASURED FROM SPACER BLOCK TO FELLOW GUARD TIMBER.

A266 23

Monday, February 22, 2010

TENSION RODS, AND TWO VERTICAL MEMBERS SISTERED IN TRUSS ON DOWNSTREAM SIDE SPAN #3.

A266 24

Monday, February 22, 2010

BEARING TIMBER MEMBER DECAYED AND CRUSHED APPEARING TO CAUSE TRUSS TO ROLL LATERALLY TOWARD DOWNSTREAM SIDE OVER BENT #2.

A266 25

BATH 137/095

WEST BATH ROAD over AMMONOOSUC RIVER

Monday, February 22, 2010

DECAY AND CRUSHING IN LOWER BEARING TIMBER OVER DOWNSTREAM END OF CAP ON BENT #2.

A266 26

Monday, February 22, 2010

DETAIL OF BLOCKING AND NEW CHORD REPLACEMENT BEAM ON DOWNSTREAM SIDE.

A266 27

Monday, February 22, 2010

SHIMS AND BLOCKING ADDED OVER DECAYED AREA IN CAP ON BENT #1 UPSTREAM SIDE.

A266 28

BATH 137/095

WEST BATH ROAD over AMMONOOSUC RIVER

Monday, February 22, 2010

DAMAGE AND DECAY IN BASE TIMBER UPSTREAM END BENT #2.

A266 29

Monday, February 22, 2010

DETAIL OF NEW TIMBERS IN BENTS #2 AND #3.

A266 30

Monday, February 22, 2010

OVERALL DETAIL OF NEW TIMBER BENTS, CHORD REPLACEMENT TIMBERS AND BLOCKING OVER CAPS.

A266 31

BATH 137/095

WEST BATH ROAD over AMMONOOSUC RIVER

Monday, February 22, 2010

SETTLEMENT IN EAST ABUTMENT; POSSIBLY ADDITIONAL DISPLACED STONES AT BASE.

A266 32

Monday, February 22, 2010

LATERAL BOW IN TRUSS AS EVIDENCED BY SIDE BOARDS DOWNSTREAM SIDE SPAN #2 AND #3.

A266 33

Monday, February 22, 2010

SETTLEMENT AND DISPLACED STONES IN NE END OF EAST ABUTMENT/APPROACH RETAINING WALL.

A266 34

BATH 137/095

WEST BATH ROAD over AMMONOOSUC RIVER

Monday, February 22, 2010

SETTLEMENT AND MISSING CHINK STONES IN NE END OF EAST ABUTMENT.

A266 35

Monday, February 22, 2010

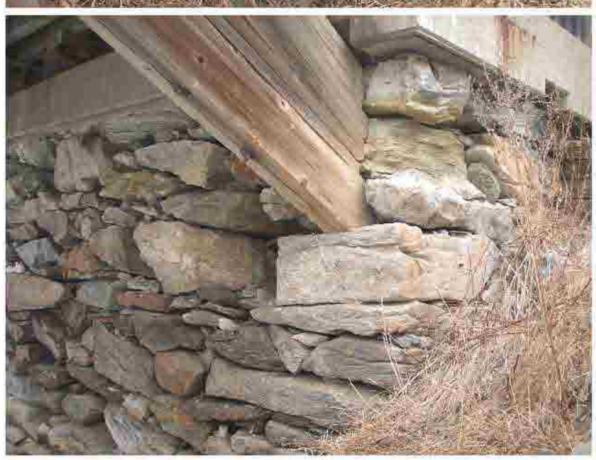
SETTLEMENT AND OUTWARD BOW IN STONEWORK AT NE.

A266 36

Monday, February 22, 2010

SETTLEMENT AND MISSING STONE IN EAST ABUTMENT JUST INSIDE OF ARCH AT SE.

A266 37



BATH 137/095

WEST BATH ROAD over AMMONOOSUC RIVER

Monday, February 22, 2010

OVERALL SETTLEMENT AND SHIFTING STONEWORK ALONG FACE EAST ABUTMENT; SEVERAL STONES APPEAR SOMEWHAT UNSTABLE.

A266 38

Monday, February 22, 2010

CRACKS AND SETTLEMENT IN PAVEMENT EVIDENT AT NE APPROACH SHOULDER.

A266 39

Monday, February 22, 2010

LATERAL DEFORMATION IN ARCH AT NE END.

A266 40

BATH 137/095

WEST BATH ROAD over AMMONOOSUC RIVER

Monday, February 22, 2010

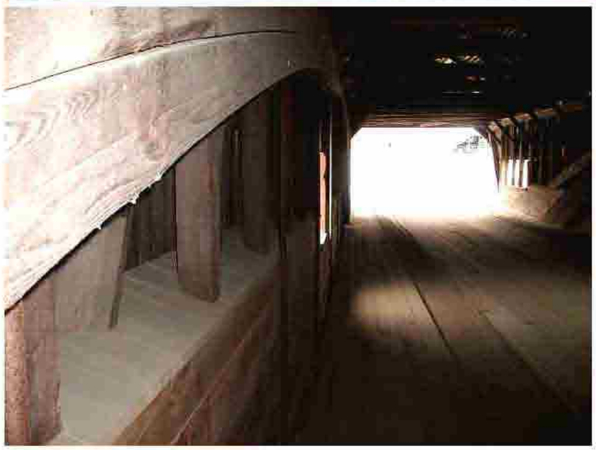
ARCH ROTATED UP TO 3 INCHES MEASURED FROM FACE OF SIDE BOARDS AND TIGHT TO SIDEWALK TIMBERS AT NE END.

A266 41

Monday, February 22, 2010

ARCH DEFORMATION AS VIEWED FROM WEST END OF UPSTREAM SIDE AT EAST SPAN #7.

A266 42



BATH 137/095

WEST BATH ROAD over AMMONOOSUC RIVER

Tuesday, January 26, 2010

MISSING UPSTREAM COLUMNS IN BENT #2.

A266 04

Tuesday, January 26, 2010

BOTTOM CHORD LATERALLY BOWED TOWARD DOWNSTREAM WHERE BENT #3 WAS.

A266 05

Tuesday, January 26, 2010

INNER CHORD REPLACEMENT BEAM AND CHORD DEFLECTING DUE TO LOSS OF BENT #3.

A266 06

BATH 137/095
WEST BATH ROAD over AMMONOOSUC RIVER

Tuesday, January 26, 2010

FLOORBEAMS NO LONGER SUPPORTED AT BOWED CHORD AREA ON DOWNSTREAM SIDE.

A266 07

Tuesday, January 26, 2010

UPSTREAM VIEW OF MISSING COLUMNS ON BENT #2.

A266 08

Tuesday, January 26, 2010

UPSTREAM EXTERIOR COLUMN KNOCKED OUT OF POSITION AT BENT #1.

A266 09

BATH 137/095

WEST BATH ROAD over AMMONOOSUC RIVER

Tuesday, January 26, 2010

TOPSIDE VIEW OF GAP BETWEEN INNER SIDE BOARDS AND DECKING WITH ENDS OF SEVERAL FLOORBEAMS NOT SUPPORTED OVER BOWED CHORD AREA.

A266 10

4.5 Repair Reports

Extensive repairs were made to the bridge in 1918 and 1988. In 1918 the bridge was strengthened and raised about two feet to provide additional clearance for the Boston & Maine Railroad trains. The timber bents at the west end were added then. In 1988 covered bridge contractor Milton S. Graton made extensive repairs to the floor, roof, siding and various structural members. Information on the work undertaken in both projects is discussed in *Section 3.4 HAER Documentation.*

5.0 STRUCTURAL ENGINEERING ANALYSIS

5.1 Trusses and Arches

Hoyle, Tanner & Associates, Inc. (HTA) completed a structural analysis of the Bath Village Covered Bridge (Bridge) during the early phases of a rehabilitation design. The purpose of this analysis is to determine bridge member forces for various loading conditions and compare them to allowable loads. Loadings considered included dead, live, snow and wind loads. The live load used during the analysis is an AASHTO H10 design vehicle, which represents a two-axle truck with a weight of 10 tons.

Loads

The truss and arch analysis included dead, live and snow loads in several different combinations. The dead load was combined with a vehicular live and 20 pounds per square foot (PSF) Pedestrian live load at the AASHTO Inventory stress level. Two load combinations were used at the Operating stress level. The first included dead, vehicular live and snow loads. The second included dead, vehicular live and a 65 PSF pedestrian live load. Inventory stress levels are used for loadings the bridge is expected to normally see, while the higher operating stress levels are used for less frequent or less likely to occur loadings such as a full live load at the same time as a full snow load.

The dead loads were determined with the 2005 National Design Specification and Supplement (NDS) which takes into account the wood species and moisture content. This provides a more realistic (and lower) dead load than the AASHTO Standard Specifications.

Two live loads were included in the analysis; vehicular live and pedestrian. The vehicular live load is a 10-ton, two axle vehicle referred to in the AASHTO Standard Specifications as an H10 design vehicle. The vehicle weight was a requirement of the Town so that select emergency vehicles could use the bridge upon completion of the rehabilitation. The pedestrian load was obtained from the AASHTO Guide Specifications for Design of Pedestrian Bridges. The unreduced pedestrian live load requirement is 85 PSF, which can be reduced to a minimum of 65 PSF. The 65 PSF pedestrian live load was used in combination at an Operating stress level as it appears to be very unlikely that this loading would be reached simultaneously with a full H10 design vehicle crossing the bridge. A lower value of 20 PSF was used at the Inventory stress level as it appears to more accurately model the typical maximum pedestrian loading. The pedestrian loading on the bridge is typically highest in the fall when visitors arrive by tour bus. The snow load was determined using the US Army Corps of Engineers "Ground Snow Loads for New Hampshire" (ERDC/CRREL TR-02-06) and modified to a roof applied load following ASCE 7-02, Minimum Design Loads for Buildings and Other Structures. The elevation corrected ground snow load was 54.9 pounds per square foot (PSF) with a roof applied snow load of 31.9 PSF.

Member Capacities

The capacity of each individual portion of the truss and arches were determined prior to completing the analysis of the Bridge. Detailed field measurements were taken of all members and connections. Member sizes varied from member to member and engineering judgment was used to determine the appropriate member size for design. The Service Load (Allowable Stress) design method was used for all members with allowable stress values obtained from the 2005 National Design Specification for Wood Construction and Supplement.

Prior to performing the structural analysis, six (6) samples, approximately 2” by 4” in size, were removed from various bridge members for the purpose of species identification as a guide to assigning allowable design stress values and determining the bridge dead load. Bridge members that were sampled include: the truss diagonals and chords, floor beams, deck, and trunnels. Samples were taken from deteriorated members that will most likely be replaced during the bridge rehabilitation or from locations on the member not visible to the public or detrimental to the structural integrity of the member. The samples were forwarded to Doug Gardner, Ph.D., at the University of Maine, for identification through examination and testing. From his analysis, Professor Gardner determined that all the samples are local species and are predominately spruce or hemlock. A copy of Dr. Gardner’s report is included as Appendix D. The grade assigned to each member was based on a visual examination of knots, checks and the growth rate characteristics of wood.

Analysis

A two-dimensional, linear, elastic-frame model of the Bridge trusses was created in STAAD.Pro V8i Structural Analysis program. STAAD.Pro features includes visualization tools, and analysis and design engines using stiffness method analysis capabilities. The model was based on field measurements of the bridge and supports and used the centerline of all truss members. The model utilized discrete elements with three degrees of freedom joined at nodes.

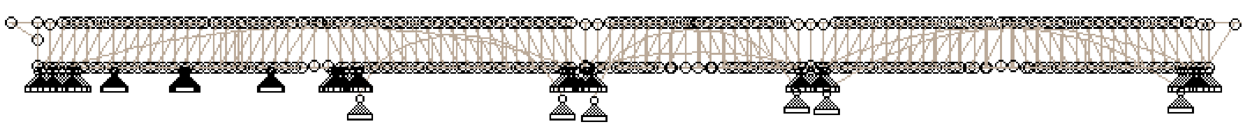


Figure 5.1: Computer Model of the North Truss

The Bath Village Covered Bridge is a very complex structure consisting of eccentric connections at the truss web members, multiple redundant load paths and complicated load sharing interaction of built-in arches, nail laminated added arches and trusses based on their unique geometrical rigidities and stiffnesses. Traditionally, truss type bridges are idealized in order to use the traditional simple static analysis of trusses. With this type of analysis, the bending moments at the truss members are neglected and are assumed to only carry axial forces. In-reality timber trusses behave more like frames than as trusses since they carry bending moment, axial and shear forces. As such, over simplification can often result in inaccurate analyses and conclusions to replace additional members for the required design loads, thus inappropriate rehabilitations of historic covered bridges.

Due to the complex framing of the Bath Village Covered Bridge and its statically indeterminate truss type, the stiffness or displacement/equilibrium methods are used to analyze it, rather than the simple static analysis of trusses method. Since this structure is statically indeterminate it has a tendency to redistribute its load to its redundant supports when overloading occurs as seen on the recent ice damage of January 25th, 2010. When the sudden ice lateral loads destroyed two bents, the structure maintained its stability and collapse did not occur due to redistribution of forces on the redundant load paths. Although statically indeterminate structures have increased stability when compared to statically determinate counterparts, it is important to note that differential displacements of the supports must be prevented in order to not introduce internal stresses in the structure.

The added nail laminated arches are two-hinged arches that bear directly against the abutments or piers. The load sharing between the arches and the trusses is mainly dependent upon the relative stiffness of these structural components. For the vertical loads (dead, pedestrian sidewalk, snow and live loads) to be distributed to the arches, the truss deflects until it engages the hanger rods in tension. Then the vertical loads are proportionally distributed due to the relative stiffness of the arches to the trusses. Due to significant sagging of trusses over time from shrinkage and consistent overloading, the trusses have imparted a higher load to the nail laminated added arches. In return, nail laminated arches are overloaded and have started to deform in reverse curvature.

The live load that is used to analyze the Bath Village Covered Bridge is a single AASHTO Standard Design Truck weighing 10 tons (H10 Design Truck) that is assumed to occupy a width of 10 ft based on the AASHTO Standard Specifications for Highway Bridges. The live load in the STAAD.Pro V8i Structural Analysis program was moved along the span of the bridge in small increments for each load case and the worst effects at all members were determined. The live load was a requirement of the Town as it would allow select emergency vehicles to cross the bridge. The live load was combined with other loads as discussed in earlier sections of this study.

In reviewing the results of our analysis, it became evident that the added arches in three of the bridge spans significantly assisted the truss with resisting loads. The timber bents in the remaining span also increased the carrying capacity of the bridge. The following figures show the bending moments in the north truss and arch members under dead and live loads. The moment values are presented below for presentation purposes as the axial loads are difficult to show for the entire truss due to the large relative difference between the truss and arch members. Please note that the scales of the graphics below are not all the same and have been adjusted for presentation purposes.

Figure 5.2: Bending Moments Under Dead Load for the North Truss

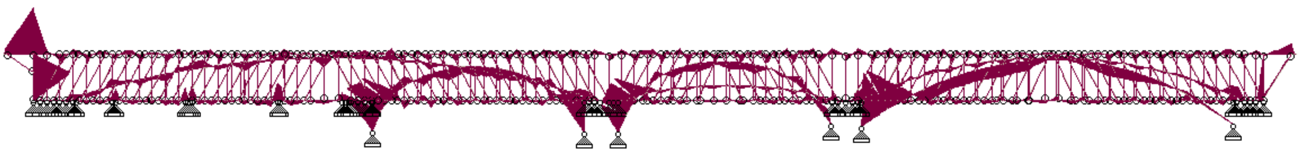


Figure 5.3: Bending Moments Under Snow Load for the North Truss

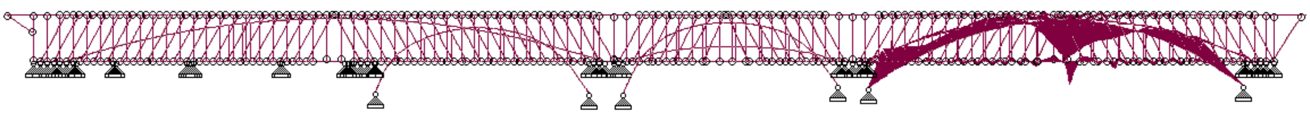


Figure 5.4: Bending Moments Under Live Load at mid-span of Span 7 for the North Truss

The analysis also indicated that the built-in arches assisted the trusses in carrying loads, but not to the degree as the added arches due to their different cross sections and geometry. The built-in arches also provide a secondary benefit of bracing truss web members near the high axial load regions of the spans (near abutments and piers). Two additional analyses were conducted for this study that examined key members of the easternmost span. The first analysis was prepared without the added arches in the bridge and was compared to an analysis where the added arches are included.

The following tables provide the axial loads in key members of the easternmost span of the south truss with and without the effect of the added arches in the bridge. The loads are shown in kips which represents 1,000 pounds and use a convention of negative values for tension loads and positive values for compression loads.

	Dead Load (Kips)	Truck Live Load (Kips)	Pedestrian Live Load (Kips)	Snow Load (Kips)
Top Chord – Midspan	11.00	6.45	0.63	8.05
Bottom Chord – Midspan	-3.77	-5.42	-0.23	-3.44
Truss Vertical at Pier	-2.94	-5.36	-0.20	2.03
Truss Diagonal at Pier	4.76	4.97	0.27	3.57
Built-In Arch	23.48	8.87	1.35	15.63
Added Arch	49.71	17.78	2.82	31.60

Table 5.1 – Member Loads in East Span, South Truss with Added Arches

	Dead Load	Truck Live	Pedestrian Live	Snow Load

	(Kips)	Load (Kips)	Load (Kips)	(Kips)
Top Chord – Midspan	26.50	12.40	1.75	20.00
Bottom Chord – Midspan	-7.21	-7.13	-0.44	-5.87
Truss Vertical at Pier	-8.33	-5.26	-0.57	1.08
Truss Diagonal at Pier	10.90	5.98	0.69	8.22
Built-In Arch	60.77	18.92	3.93	43.96
Added Arch	0	0	0	0

Table 5.2 – Member Loads in East Span, South Truss without Added Arches

Based on the values presented in Tables 5.1 and 5.2, it can be observed that the addition of the added arches to the bridge results in truss member forces being reduced by approximately half. This is a significant reduction in truss member forces that clearly illustrates the contribution that the added arches make to the bridge. This member force reduction can also be observed below in Figures 5.5 through 5.7 (all four figures utilize the same scaling). The thickness of the lines of each member represents the relative amount of load in the member with different colors used for tension and compression loads. It can be observed in Figure 5.6 that the removal of the added arch results in higher loads to the built in arch and truss web members; most notably at near the ends of the span. Figures 5.7 and 5.8 provide similar results for live load in the easternmost span. For these figures, the live load is positioned at mid-span.

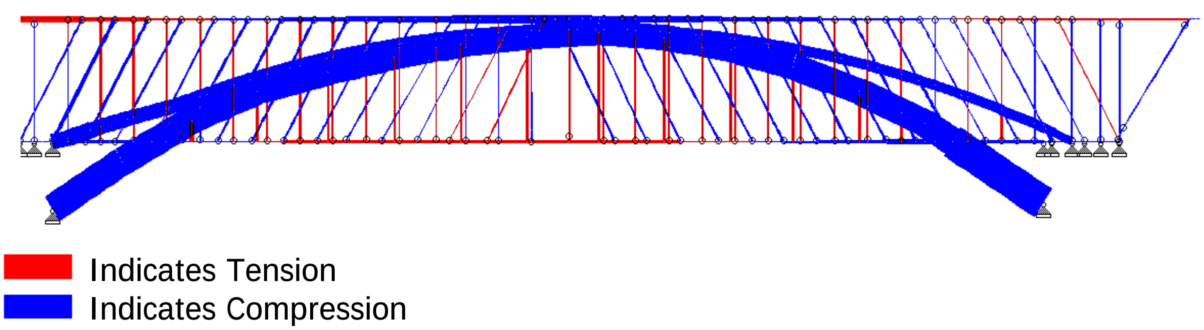


Figure 5.5: Axial Forces Under Dead Load for the East Span, South Truss with Added Arches

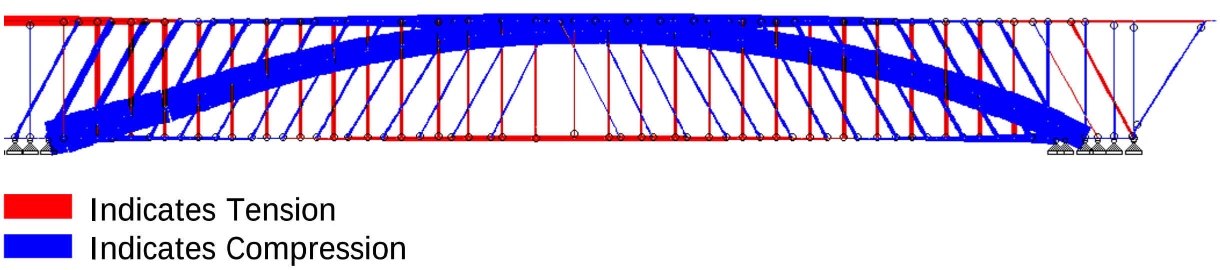


Figure 5.6: Axial Forces Under Dead Load for the East Span, South Truss without Added Arches

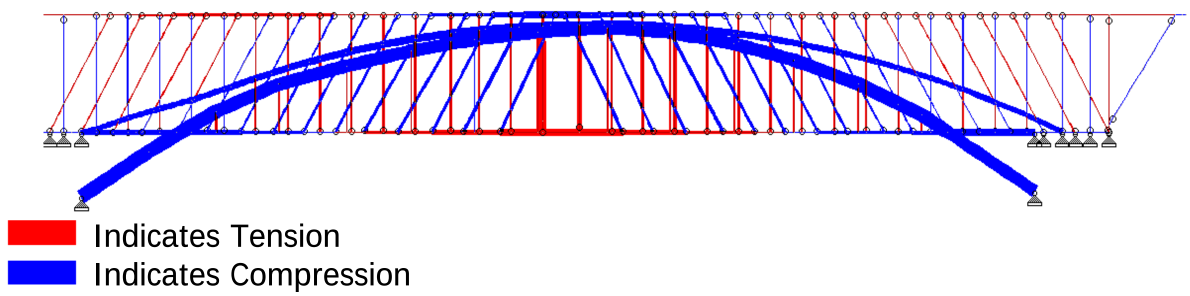


Figure 5.7: Axial Forces Under Live Load for the East Span, South Truss with Added Arches

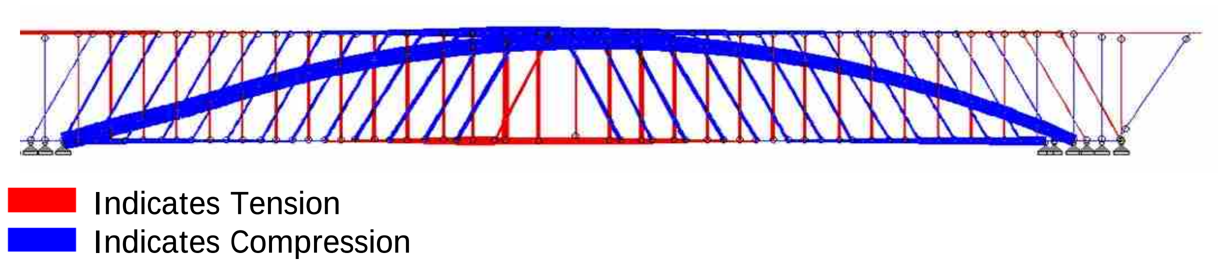


Figure 5.8: Axial Forces Under Live Load for the East Span, South Truss without Added Arches

After a thorough field inspection and correlation with the results of the bridge analysis, recommendations are made for members in the bridge that need attention as part of the Bridge rehabilitation. A detailed summary of the member forces, condition and existing capacity (where applicable) is included in following pages. This information is intended to assist readers of this study with their review of the treatments proposed as part of the Bridge rehabilitation.

5.2 Roof Framing

The roof rafters and purlins were evaluated for dead and snow loads. The roof rafters and purlins were not tested for species and are assumed to be select structural grade spruce which is consistent with the trusses.

There are two distinct sets of purlins in the bridge spaced at 6" on center, the smaller 2"x3" purlins that are notched into the rafters and believed to be original and larger 3"x3' purlins that are toe nailed to the side of the rafters. The later were added during repairs completed in 1988. Due to the poor connection details of the larger purlins, many have fallen down from the roof.

Our structural analysis indicates that the rafters were adequate and that the added, 3"x3" purlins could be removed from the bridge without overstressing the remaining purlins. The removal of the purlins would remove approximately 18,000 pounds of dead load from the bridge. This equates to approximately 2.1 pounds per square foot or 24 pounds per foot along the length of each truss.

5.3 Floor Beams and Decking

The existing floor beams and decking were evaluated for dead and live loads. The bridge decking was identified as spruce, while the floor beams were identified as eastern hemlock or hemlock. Both the decking and the floor beams were assigned a grade of No. 1.
The decking was found to be adequate for a capacity of H11.3 (11.3 tons). The floor beams however are only adequate for a six (6) ton loading with a capacity of H6.1 (6.1 tons). The floor beam result is consistent with NHDOT recommendations.

Several options were evaluated to provide a H10 (10 ton) live load capacity of the floor system. Retaining the existing floor beam spacing of 2’ on center (o.c.) and sawn floor beams would require 10”x15” Douglas Fir select structural floor beams and a 3.5” thick deck. The weight of this floor system would add approximately 70,000 pounds of dead load to the bridge. Several other options were evaluated with an 8¾”x15½” glulam floor beam at 4’ on center and 4” thick select structural Douglas Fir deck determined to have adequate capacity for a ten (10) ton loading.

Summary Table of Truss Member, Condition, Loads and Capacities

Member	Field Observations	As-Built Inv. Axial Capacity (kips)	As-Built Opt. Axial Capacity (kips)	As-Insp. Axial Capacity (kips)	Max. Inv. Load (kips)	Max. Opt. Load 1 (kips)	Max. Opt. Load 2 (kips)	% Utilized at Inv.	% Utilized at Max. Opt.
North Truss Vertical Members									
N2	Splits Lower Half, Upper Tail Missing	-8.5	-11.3	0	-0.7	-2.9	-0.7	8%	26%
N3 *	Upper Tail Missing	-8.5	-11.3	0	-0.7	-2.9	-0.7	8%	25%
N12	Rot and Splits at Lower End, Top Missing	+8.5	+11.3	0	+6.2	+8.5	+7.0	73%	76%
N13	Spliced Member, Tail Broken, Rot at Top	+16.6	+22.1	0	+7.6	+10.9	+8.8	46%	49%
N16	Tail Broken, Splits	-8.5	-11.3	Non-quantifiable	-3.5	-3.2	-3.8	41%	34%
N17	Tail Broken	-8.5	-11.3	0	-2.2	-2.2	-2.2	26%	19%
N18	Tail Broken	-8.5	-11.3	0	-2.8	-2.8	-2.8	33%	25%
N19	Previously Damaged Member	+8.5	+11.3	Non-quantifiable	+7.5	+10.5	+8.5	88%	93%
N22	2" Deep Rot Into Upper Tail of Member	-8.5	-11.3	Non-quantifiable	-5.7	-5.5	-6.4	67%	56%
N40	Lower Tail Missing	-8.5	-11.3	0	-3.9	-3.7	-4.1	46%	36%
N41	Lower Tail Missing	-8.5	-11.3	0	-5.4	-5.0	-5.9	63%	52%
N49	Defect at Arch Joint	-28.5	-37.9	16.1	-4.5	-4.2	-7.5	16%	20%
N56	Splits	-8.5	-11.3	Non-quantifiable	-5.4	-4.8	-5.9	64%	52%
N57	Splits	-8.5	-11.3	Non-quantifiable	-6.2	-6.0	-7.0	73%	62%
N59	Insect Damage, Checking and Splits	-8.5	-11.3	Non-quantifiable	-6.4	-6.4	-7.3	75%	64%
N69	Upper Tail Broken at Trunnel	-8.5	-11.3	0	-3.7	-3.3	-3.9	43%	34%
N71	Split at Base	-8.5	-11.3	Non-quantifiable	-4.4	-4.2	-5.1	52%	45%

Legend:

1 kip = 1,000 pounds

"+" Indicates Compression

"-" Indicates Tension

* Proposed members to be replaced not shown on Preliminary Plans.

** Proposed member to be replaced deteriorated from ice storm of January 2010.

Inv. Capacity = The vehicle load that can safely pass over the bridge an infinite number of times without any detrimental effects to the bridge (AASHTO MCEB 6.3.1).

Opt. Capacity = The maximum permissible vehicle load to which the structure may be subjected. Allowing unlimited number of vehicles to use the bridge at operating level may shorten the life of the bridge (AASHTO MCEB 6.3.2).

Inv. Load = Applied load at inventory level, which includes: Dead Load + Sidewalk Live Load (20 psf) + Design AASHTO H10 Truck

Opt. Load 1 = Applied load at operating level, which includes: Dead Load + Snow Load + Design AASHTO H10 Truck

Opt. Load 2 = Applied load at operating level, which includes: Dead Load + Sidewalk Live Load (65 psf) + Design AASHTO H10 Truck

(yellow) Previously repaired/replaced member

Member	Field Observations	As-Built Inv. Axial Capacity (kips)	As-Built Opt. Axial Capacity (kips)	As-Insp. Axial Capacity (kips)	Max. Inv. Load (kips)	Max. Opt. Load 1 (kips)	Max. Opt. Load 2 (kips)	% Utilized at Inv.	% Utilized at Max. Opt.
North Truss Diagonal Members									
N3L-N4U	Rot Pocket at Base Near Bot. Chord	+19.8	+26.3	Non-quantifiable	+0.5	+0.8	+0.5	3%	3%
N4L-N5U	Rot at End and Exterior Fascia of Member	+19.8	+26.3	Non-quantifiable	+1.5	+2.3	+1.6	8%	9%
N14L-N15U	Lower Tail Missing, Rot Pocket at Base	+19.8	+26.3	Non-quantifiable	+7.6	+10.2	+8.7	38%	39%
N15L-N16U	Lower Tail Missing	+10.5	+14.0	0	+3.3	+4.2	+3.5	31%	30%
N16L-N17U	Lower Tail Missing	-10.5	-14.0	0	-2.9	-2.9	-3.0	28%	21%
N17L-N18U	Previously Damaged Member	-9.8	-13.0	Non-quantifiable	-5.3	-5.8	-5.9	54%	45%
N18L-N19U	Previously Damaged Member	-9.8	-13.0	Non-quantifiable	-7.5	-8.7	-8.6	77%	67%
N19L-N20U	Lower Tail Missing	-10.5	-14.0	0	-6.2	-7.0	-7.0	59%	50%
N28U-N29L	Split at Lower Tail	-10.5	-14.0	Non-quantifiable	-7.9	-9.3	-9.1	75%	67%
N30U-N31L	Split & Rot at Base	-10.5	-14.0	Unknown	-8.2	-9.7	-9.4	78%	69%
N38U-N39L	Splits at Upper Tail	+10.5	+14.0	Non-quantifiable	+6.0	+7.7	+6.9	57%	55%
N56U-N57L	Split at Bottom	-10.5	-14.0	Non-quantifiable	-3.4	+4.1	+3.6	32%	29%
N64L-N65U	Rot at Base	+19.8	+26.3	Non-quantifiable	+3.9	+5.7	+4.5	20%	22%
N66L-N67U	Splits at Upper Tail	+10.5	+14.0	Non-quantifiable	+5.7	+7.8	+6.5	55%	56%
N67L-N68U	Splits at Upper Tail	+10.5	+14.0	Non-quantifiable	+5.0	+6.3	+5.5	47%	45%
N73L-N74U	Split at Base, Waning	+10.5	+14.0	Non-quantifiable	+3.9	+4.9	+4.4	37%	35%
N75L-N76U	Splits	+10.5	+14.0	Non-quantifiable	+3.3	+3.9	+3.6	31%	28%
N87U-N88L	Broken Lower Tail	+10.5	+14.0	0	+4.5	+6.3	+5.3	43%	45%
N91U-N92L	Rot at Base, Waning and Insect Damage at Top	+19.8	+26.3	Non-quantifiable	+9.8	+12.8	+11.4	49%	49%
N92U-N93L	Splits at Base	+19.8	+26.3	Non-quantifiable	+1.7	+2.2	+1.7	8%	9%

Legend:

1 kip = 1,000 pounds

"+" Indicates Compression

"-" Indicates Tension

* Proposed members to be replaced not shown on Preliminary Plans.

** Proposed member to be replaced deteriorated from ice storm of January 2010.

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Opt. Capacity = The maximum permissible vehicle load to which the structure may be subjected. Allowing unlimited number of vehicles to use the bridge at operating level may shorten the life of the bridge (AASHTO MCEB 6.3.2).

Inv. Load = Applied load at inventory level, which includes: Dead Load + Sidewalk Live Load (20 psf) + Design AASHTO H10 Truck

Opt. Load 1 = Applied load at operating level, which includes: Dead Load + Snow Load + Design AASHTO H10 Truck

Opt. Load 2 = Applied load at operating level, which includes: Dead Load + Sidewalk Live Load (65 psf) + Design AASHTO H10 Truck

Previously repaired/replaced member

Member	Field Observations	As-Built Inv. Axial Capacity (kips)	As-Built Opt. Axial Capacity (kips)	As-Insp. Axial Capacity (kips)	Max. Inv. Load (kips)	Max. Opt. Load 1 (kips)	Max. Opt. Load 2 (kips)	% Utilized at Inv.	% Utilized at Max. Opt.
South Truss Vertical Members									
S2	Rot at Base	-16.6	-22.1	Non-quantifiable	-0.6	-2.8	-0.6	4%	13%
S6	Lower Tail Missing	+8.5	+11.3	0	+5.9	+8.2	+6.0	69%	72%
S7	Lower Tail Missing	-8.5	-11.3	0	-4.2	+4.6	-4.2	49%	40%
S13	Lower Tail Missing	-8.5	-11.3	0	-8.5	-9.3	-8.6	100%	82%
S14	Lower Tail Missing	-8.5	-11.3	0	-4.9	-5.0	-4.9	57%	45%
S15 **	Rot at Top, Lower Tail Missing, Broken at Arch	-8.5	-11.3	0	-3.4	-3.4	-3.4	40%	30%
S16 *	Rot at Top of Member & Lower Tail Missing	-8.5	-11.3	0	-3.1	+4.1	+3.1	37%	36%
S17	Lower Tail Missing	+8.5	+11.3	0	+5.3	+7.5	+5.4	62%	66%
S18 **	Broken at Trunnel Connection	+16.6	+22.1	0	+10.9	+15.4	+11.1	66%	70%
S24	Lower Tail Missing	+16.6	+22.1	0	+3.5	+5.4	+3.6	21%	24%
S25	Upper Tail Missing, Rot in Member	+16.6	+22.1	0	+6.2	+8.9	+6.3	38%	40%
S29 *	Upper Tail Missing	+8.5	+11.3	0	+2.7	+5.3	+2.8	32%	47%
S31	Splits at Lower End of Member	+8.5	+11.3	Non-quantifiable	+3.8	+5.2	+3.9	45%	46%
S33 *	Upper Tail Missing	-8.5	-11.3	0	-4.0	-3.4	-4.1	47%	36%
S35	Splits at Lower End of Member	-8.5	-11.3	Non-quantifiable	-6.4	-7.0	-6.5	76%	62%
S36	Top of Vertical Broken at Bot. Face of Top. Chord	-8.5	-11.3	0	-4.2	-5.0	-4.3	50%	44%
S37	Lower Tail Missing	-8.5	-11.3	0	-6.5	-6.9	-6.6	76%	61%
S38	Lower Tail Missing	-8.5	-11.3	0	-3.9	+4.6	+3.9	45%	41%
S39	Lower Tail Missing	-8.5	-11.3	0	-7.0	-7.1	-7.1	82%	63%
S92	Deterioration due to exposure	+16.6	+22.1	Non-quantifiable	+1.6	+2.4	+1.6	9%	11%
S93	Deterioration due to exposure	+16.6	+22.1	Non-quantifiable	+1.5	+3.4	+1.6	9%	15%
S94	Deterioration due to exposure	+16.6	+22.1	Non-quantifiable	+0.5	+1.3	+0.5	3%	6%
S95	Rot in Top of Vertical	+16.6	+22.1	Non-quantifiable	+2.5	+8.8	+2.5	15%	40%

Legend:

1 kip = 1,000 pounds

"+" Indicates Compression

"-" Indicates Tension

* Proposed members to be replaced not shown on Preliminary Plans.

** Proposed member to be replaced deteriorated from ice storm of January 2010.

Inv. Capacity = The vehicle load that can safely pass over the bridge an infinite number of times without any detrimental effects to the bridge (AASHTO MCEB 6.3.1).

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Inv. Load = Applied load at inventory level, which includes: Dead Load + Sidewalk Live Load (20 psf) + Design AASHTO H10 Truck

Opt. Load 1 = Applied load at operating level, which includes: Dead Load + Snow Load + Design AASHTO H10 Truck

Opt. Load 2 = Applied load at operating level, which includes: Dead Load + Sidewalk Live Load (65 psf) + Design AASHTO H10 Truck

(yellow) Previously repaired/replaced member

Member	Field Observations	As-Built Inv. Axial Capacity (kips)	As-Built Opt. Axial Capacity (kips)	As-Insp. Axial Capacity (kips)	Max. Inv. Load (kips)	Max. Opt. Load 1 (kips)	Max. Opt. Load 2 (kips)	% Utilized at Inv.	% Utilized at Max. Opt.
South Truss Diagonal Members									
S2L-S3U	Deterioration due to exposure	+19.8	+26.3	Non-quantifiable	+0.4	+1.1	+0.4	2%	4%
S6L-S7U	Lower Tail Missing	-10.5	-14.0	0	-8.8	-9.4	-8.8	83%	67%
S7L-S8U	Lower Tail Missing	+19.8	+26.3	0	+10.4	+14.0	+10.6	53%	53%
S13L-S14U	Previously Damaged Member	+9.8	+13.0	Non-quantifiable	+5.1	+6.6	+5.1	52%	51%
S14L-S15U **	Lower Tail Missing	-10.5	-14.0	0	-3.6	-3.6	-3.6	35%	26%
S15L-S16U	Lower Tail Missing	-10.5	-14.0	0	-5.2	-5.6	-5.3	50%	40%
S16L-S17U	Lower Tail Missing	-10.5	-14.0	0	-7.8	-9.1	-7.9	74%	65%
S17L-S18U	Lower Tail Missing	-10.5	-14.0	0	-8.7	-10.3	-8.9	83%	74%
S18L-S19U	Lower Tail Missing	+19.8	+26.3	0	+5.0	+6.7	+5.0	25%	25%
S27U-S28L	Rot, Break at Lower Tail	-10.5	-14.0	Non-quantifiable	-7.8	-9.3	-7.9	74%	66%
S29U-S30L	Lower Tail Rotted	-10.5	-14.0	Non-quantifiable	-7.4	-8.5	-7.5	71%	61%
S35U-S36L	Lower Tail Missing	-10.5	-14.0	0	-4.2	+5.8	+4.2	40%	42%
S36U-S37L	Lower Tail Missing	+10.5	+14.0	0	+4.4	+6.2	+4.5	42%	44%
S37U-S38L	Lower Tail Missing	-10.5	-14.0	0	-4.6	-4.6	-4.6	44%	33%
S39U-S40L	Break and Splits at Base	+19.8	+26.3	Non-quantifiable	+3.6	+5.2	+3.7	18%	20%
S41L-S43U	Break, Splits, Rot	+19.8	+26.3	Non-quantifiable	+2.5	+3.8	+2.5	12%	14%
S75L-S76U	Upper Tail Broken	+10.5	+14.0	0	+2.7	+2.9	+2.7	26%	21%
S91U-S92L	Deterioration due to exposure	+19.8	+26.3	Non-quantifiable	+3.6	+5.2	+3.7	18%	20%
S92U-S93L	Rot at Base	+19.8	+26.3	Non-quantifiable	+1.4	+1.9	+1.4	7%	7%
S93U-S95L	Deterioration due to exposure	-10.5	-14.0	Non-quantifiable	-1.3	-0.8	-1.4	12%	10%

Legend:

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** Proposed member to be replaced deteriorated from ice storm of January 2010.

Inv. Capacity = The vehicle load that can safely pass over the bridge an infinite number of times without any detrimental effects to the bridge (AASHTO MCEB 6.3.1).

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Inv. Load = Applied load at inventory level, which includes: Dead Load + Sidewalk Live Load (20 psf) + Design AASHTO H10 Truck

Opt. Load 1 = Applied load at operating level, which includes: Dead Load + Snow Load + Design AASHTO H10 Truck

Opt. Load 2 = Applied load at operating level, which includes: Dead Load + Sidewalk Live Load (65 psf) + Design AASHTO H10 Truck

(yellow) Previously repaired/replaced member

Member	Field Observations	As-Built Inv. Axial Capacity (kips)	As-Built Inv. Moment Capacity (ft-kips)	As-Built Opt. Axial Capacity (kips)	As-Built Opt. Moment Capacity (ft-kips)	As-Insp. Axial Capacity (kips)	As-Insp. Moment Capacity (ft-kips)	Max. Inv. Load (kips)	Max. Inv. Moment (ft-kips)	Max. Opt. Load 1 (kips)	Max. Opt. Moment 1 (ft-kips)	Max. Opt. Load 2 (kips)	Max. Opt. Moment 2 (ft-kips)	% Utilized at Inv.	% Utilized at Max. Opt.
North Truss Top Chord Members															
N0-N3 CHORD A	Inadequate Structural Capacity	-15.6	7.6	-20.8	10.0	-15.6	7.6	-1.0	4.3	-3.9	16.8	-1.0	4.3	63%	186%
N6-N14 CHORD B	Rot at N12, N13	+59.0	14.9	+78.5	19.8	Non-quantifiable	Non-quantifiable	+2.5	1.7	+3.7	2.9	+2.8	1.9	12%	16%
N6-N14 CHORD B	Rot at N12, N13	+59.0	14.9	+78.5	19.8	Non-quantifiable	Non-quantifiable	+3.1	1.5	+4.1	2.4	+3.8	1.7	11%	13%
N9-N16 CHORD A	Rot at N13	+59.0	9.9	+78.5	13.2	Non-quantifiable	Non-quantifiable	+1.2	2.3	+2.0	2.7	+1.2	2.7	24%	21%
N9-N16 CHORD A	Rot at N13	+59.0	9.9	+78.5	13.2	Non-quantifiable	Non-quantifiable	+1.5	1.8	+2.1	2.2	+1.8	2.0	19%	17%
N11-N27 CHORD C	Rot at N12, N22	+59.0	9.9	+78.5	13.2	Non-quantifiable	Non-quantifiable	+4.1	1.9	+6.5	1.7	+4.6	2.1	21%	18%
N22-N30 CHORD B	Rot at N22, N25	+59.0	9.9	+78.5	13.2	Non-quantifiable	Non-quantifiable	+4.1	1.9	+6.5	1.7	+4.6	2.1	21%	18%
N25-N33 CHORD A	Rot at N25	-31.3	9.9	-41.6	13.2	Non-quantifiable	Non-quantifiable	-1.1	0.8	-0.0	0.9	-1.4	1.0	12%	11%
N59-N68 CHORD C	24" Long Split at N60	-31.3	9.9	-41.6	13.2	Non-quantifiable	Non-quantifiable	-5.3	2.9	-8.5	3.7	-6.6	3.3	46%	48%
N59-N68 CHORD C	24" Long Split at N60	-31.3	9.9	-41.6	13.2	Non-quantifiable	Non-quantifiable	-7.4	1.7	-10.5	2.5	-8.7	2.2	41%	44%
North Truss Bottom Chord Members															
N1-N2 CHORD A	Rot Near Node N1	-58.6	18.8	-78.0	25.0	Non-quantifiable	Non-quantifiable	0	0	0	0	0	0	0%	0%
N1-N3 CHORD B	Rot Near Node N1	-58.6	18.8	-78.0	25.0	Non-quantifiable	Non-quantifiable	0	0	0	0	0	0	0%	0%
N8-N20 CHORD C	Twisting, Splits, Breaks	-39.1	12.5	-52.0	16.7	Non-quantifiable	Non-quantifiable	-2.5	7.2	-2.5	7.9	-2.9	7.8	64%	52%
N13-N21 CHORD B	Twisting, Splits, Breaks	-39.1	12.5	-52.0	16.7	Non-quantifiable	Non-quantifiable	-2.5	7.2	-2.5	7.9	-2.9	7.8	64%	52%
N14-N23 CHORD A	Twisting, Splits, Breaks	-39.1	12.5	-52.0	16.7	Non-quantifiable	Non-quantifiable	-2.5	7.2	-2.5	7.9	-2.9	7.8	64%	52%
N62-N71 CHORD A	Rot Near N63 & N70	-39.1	12.5	-52.0	16.7	Non-quantifiable	Non-quantifiable	-4.3	5.7	-3.7	5.9	-4.1	5.9	56%	43%
N62-N71 CHORD A	Rot Near N63 & N70	-39.1	12.5	-52.0	16.7	Non-quantifiable	Non-quantifiable	-5.3	5.1	-5.3	5.1	-5.3	5.1	54%	41%
N93-N95 CHORD A	Rot Int. Face	-58.6	18.8	-78.0	25.0	Non-quantifiable	Non-quantifiable	0	0	0	0	0	0	0%	0%
N93-N95 CHORD B	Rot Int. Face	-58.6	18.8	-78.0	25.0	Non-quantifiable	Non-quantifiable	0	0	0	0	0	0	0%	0%
North Truss Built-In Arch															
N61-N62 Ply A*	Rot	+129.7	10.8	+172.5	14.4	Non-quantifiable	Non-quantifiable	+15.6	1.64	+20.4	2.34	+18.9	1.85	10%	12%
N61-N62 Ply B*	Rot	+129.7	10.8	+172.5	14.4	Non-quantifiable	Non-quantifiable	+15.6	1.64	+20.4	2.34	+18.9	1.85	10%	12%
N61-N62 Ply C*	Rot	+129.7	10.8	+172.5	14.4	Non-quantifiable	Non-quantifiable	+15.6	1.64	+20.4	2.34	+18.9	1.85	10%	12%

Legend:

1 kip = 1,000 pounds

"+" Indicates Compression

"-" Indicates Tension

* Proposed members to be replaced not shown on Preliminary Plans.

** Proposed member to be replaced deteriorated from ice storm of January 2010.

Inv. Capacity = The vehicle load that can safely pass over the bridge an infinite number of times without any detrimental effects to the bridge (AASHTO MCEB 6.3.1).

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Inv. Load = Applied load at inventory level, which includes: Dead Load + Sidewalk Live Load (20 psf) + Design AASHTO H10 Truck

Opt. Load 1 = Applied load at operating level, which includes: Dead Load + Snow Load + Design AASHTO H10 Truck

Opt. Load 2 = Applied load at operating level, which includes: Dead Load + Sidewalk Live Load (65 psf) + Design AASHTO H10 Truck

(yellow) Previously repaired/replaced member

Note: Chord forces and capacities are given for the full chord section, which consists of 3 plies.

Member	Field Observations	As-Built Inv. Axial Capacity (kips)	As-Built Inv. Moment Capacity (ft-kips)	As-Built Opt. Axial Capacity (kips)	As-Built Opt. Moment Capacity (ft-kips)	As-Insp. Axial Capacity (kips)	As-Insp. Moment Capacity (ft-kips)	Max. Inv. Load (kips)	Max. Inv. Moment (ft-kips)	Max. Opt. Load 1 (kips)	Max. Opt. Moment 1 (ft-kips)	Max. Opt. Load 2 (kips)	Max. Opt. Moment 2 (ft-kips)	% Utilized at Inv.	% Utilized at Max. Opt.
South Truss Top Chord Members															
S0-S2 CHORD A	Inadequate Structural Capacity	-15.6	7.6	-20.8	10.0	-15.6	7.6	-1.0	4.3	-3.9	16.8	-1.0	4.3	63%	186%
S9-S17 CHORD A	Rot Near S15	+59.0	9.9	+78.5	13.2	Non-quantifiable	Non-quantifiable	+5.1	2.5	+7.8	2.3	+5.4	1.4	29%	22%
S9-S17 CHORD A	Rot Near S15	+59.0	9.9	+78.5	13.2	Non-quantifiable	Non-quantifiable	+5.3	1.5	+7.6	3.3	+5.8	1.1	18%	30%
S11-S27 CHORD C	Rot Near S15 & S25	+59.0	9.9	+78.5	13.2	Non-quantifiable	Non-quantifiable	+5.1	2.5	+7.8	2.3	+5.4	1.4	29%	22%
S11-S27 CHORD C	Rot Near S15 & S26	+59.0	9.9	+78.5	13.2	Non-quantifiable	Non-quantifiable	+5.3	1.5	+7.6	3.3	+5.8	1.1	18%	30%
S14-S30 CHORD B	Rot Near S15 & S25	+59.0	9.9	+78.5	13.2	Non-quantifiable	Non-quantifiable	+5.1	2.5	+7.8	2.3	+5.4	1.4	29%	22%
S14-S30 CHORD B	Rot Near S15 & S26	+59.0	9.9	+78.5	13.2	Non-quantifiable	Non-quantifiable	+5.3	1.5	+7.6	3.3	+5.8	1.1	18%	30%
S92-S96 CHORD C	24" Long Split at S92	-31.3	9.9	-41.6	13.2	Non-quantifiable	Non-quantifiable	-1.4	1.3	-3.3	2.5	-1.4	1.3	17%	27%
South Truss Bottom Chord Members															
S1-S15 CHORD A	Twisting, Splits, Breaks, Rot Near S2	+92.6	18.8	+123.2	25.0	Non-quantifiable	Non-quantifiable	+1.8	13.9	+2.1	19.0	+1.8	14.3	75%	78%
S1-S15 CHORD A	Twisting, Splits, Breaks, Rot Near S2	-39.1	18.8	-52.0	25.0	Non-quantifiable	Non-quantifiable	-2.1	13.1	-0.1	18.0	-0.1	14.3	75%	72%
S1-S18 CHORD B	Twisting, Splits, Breaks, Rot Near S2	+92.6	18.8	+123.2	25.0	Non-quantifiable	Non-quantifiable	+1.8	13.9	+2.1	19.0	+1.8	14.3	75%	78%
S1-S18 CHORD B	Twisting, Splits, Breaks, Rot Near S2	-39.1	18.8	-52.0	25.0	Non-quantifiable	Non-quantifiable	-2.1	13.1	-0.1	18.0	-0.1	14.3	75%	72%
S7-S20 CHORD C	Twisting, Splits, Breaks	+92.6	18.8	+123.2	25.0	Non-quantifiable	Non-quantifiable	+2.2	14.1	+2.2	18.6	+2.2	14.3	77%	76%
S7-S20 CHORD C	Twisting, Splits, Breaks	-39.1	18.8	-52.0	25.0	Non-quantifiable	Non-quantifiable	-1.7	3.3	-1.7	3.3	-1.7	3.3	22%	16%
South Truss Built-In Arch															
S14-S17 Ply A*	Rot	+153.6	15.2	+204.3	20.2	Non-quantifiable	Non-quantifiable	+4.9	5.5	+6.1	6.9	+4.1	5.6	19%	18%
S14-S16 Ply B*	Rot	+153.6	15.2	+204.3	20.2	Non-quantifiable	Non-quantifiable	+4.9	5.5	+6.1	6.9	+4.1	5.6	19%	18%
S15-S17 Ply C*	Rot	+153.6	15.2	+204.3	20.2	Non-quantifiable	Non-quantifiable	+4.9	5.5	+6.1	6.9	+4.1	5.6	19%	18%

Legend:

1 kip = 1,000 pounds

"+" Indicates Compression

"-" Indicates Tension

* Proposed members to be replaced not shown on Preliminary Plans.

** Proposed member to be replaced deteriorated from ice storm of January 2010.

Inv. Capacity = The vehicle load that can safely pass over the bridge an infinite number of times without any detrimental effects to the bridge (AASHTO MCEB 6.3.1).

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Inv. Load = Applied load at inventory level, which includes: Dead Load + Sidewalk Live Load (20 psf) + Design AASHTO H10 Truck

Opt. Load 1 = Applied load at operating level, which includes: Dead Load + Snow Load + Design AASHTO H10 Truck

Opt. Load 2 = Applied load at operating level, which includes: Dead Load + Sidewalk Live Load (65 psf) + Design AASHTO H10 Truck

Previously repaired/replaced member

Note: Chord forces and capacities are given for the full chord section, which consists of 3 plies.

Member	Field Observations	As-Built Inv. Shear Capacity (kips)	As-Built Opt. Shear Capacity (kips)	As-Insp. Shear Capacity (kips)	Max. Inv. Shear (kips)	Max. Opt. Shear 1 (kips)	Max. Opt. Shear 2 (kips)	% Utilized at Inv.	% Utilized at Max. Opt.
North Truss Bottom Chord Members									
N25-N29 CHORD C	Inadequate Structural Capacity	10.3	13.6	10.3	10.4	13.8	12.4	101%	101%
South Truss Bottom Chord Members									
S24-S28 CHORD C	Inadequate Structural Capacity	6.3	8.3	6.3	9.47	10.5	9.55	151%	126%

Legend:

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"-" Indicates Tension

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Inv. Capacity = The vehicle load that can safely pass over the bridge an infinite number of times without any detrimental effects to the bridge (AASHTO MCEB 6.3.1).

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Inv. Load = Applied load at inventory level, which includes: Dead Load + Sidewalk Live Load (20 psf) + Design AASHTO H10 Truck

Opt. Load 1 = Applied load at operating level, which includes: Dead Load + Snow Load + Design AASHTO H10 Truck

Opt. Load 2 = Applied load at operating level, which includes: Dead Load + Sidewalk Live Load (65 psf) + Design AASHTO H10 Truck

Previously repaired/replaced member

Note: Chord forces and capacities are given for the full chord section, which consists of 3 plies.

6.0 REHABILITATION TREATMENTS

6.1 Summary Discussion

The truss and other character defining components of the bridge are in overall good condition with only a small percentage of members requiring replacement. Wood decay (rot) due to water infiltration from past roof failures or from localized dampness from other sources is a major cause of structural deficiencies.

The majority of the truss members, integral arches, and special bracing members that define the bridge type and constitute the most important character defining features of the bridge, are in remarkably well-preserved condition given the age of the structure. For each type of bridge component, a Bridge Feature Inventory and Treatment Form has been prepared which provides all available physical information about the feature, its condition, the type of repair treatments and the need for them, the impacts and the alternative repair treatments considered. A drawing of the member and photographs are included. A table listing each member to be replaced, reason for replacement and other properties is also provided.

Individual bridge members that do not meet project engineering requirements due to deterioration, damage or structural failure will be treated in accordance with the Secretary's Standards. Those members that can be fully or partly retained and reasonably repaired to fully meet project engineering requirements will be spliced, sistered, consolidated with epoxy, or otherwise restored in a manner consistent with the principles of least intervention and greatest preservation of original material. Members that cannot feasibly be left in-place and restored will be replaced "in-kind" with wood members identical to the original including size, workmanship and species when possible, that meet project engineering requirements. Project engineering requirements include safety, structural integrity, maximum preservation of historic material, least introduction of incompatible materials or features, first cost and life cycle cost.

To assess the impact of the repair work on the overall historic integrity of the bridge, individual member types have been grouped together and considered as a structural assembly or system. As shown in the totals below, all of the individual structural systems to be repaired will retain a minimum of 80 percent of their original members thereby allowing the understanding of their original design, purpose and workmanship.

Percentage of Significant Structural Members to be Replaced:

Upper Chord	18%	Cross Beam	18%
Lower Chord	17%	Upper Lateral Brace	>2%
Built-in Arch	10%	Knee Brace	5%
Verticals	19%	Rafter	10%
Diagonals	20%		

6.2 Bridge Feature Inventory & Treatment Forms

Documents included on following pages.

1 Truss Upper Chord
2 Truss Lower Chord
3 Truss Vertical
4 Truss Diagonal
5 Built-in Arch
6 Cross Beam
7 Upper Lateral Brace
8 Knee Brace
9 Rafter
10 Ridge Board
11 Purlin
12 Trunnels
13 Floor Beam
14 Lower Lateral Brace
15 Flooring
16 Portal Siding, Trim & Signs
17 Siding
18 Roofing
19 Added Arch
20 Needle Beam Hangar Rod
21 Needle Beam
22 Struts and Sleepers
23 Piers
24 Abutments
25 Timber Bents
26 Interior Wainscoting

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 1	**Feature**: Truss Upper Chord	
Total members: 2355 linear feet (LF)	**Members affected**: 436.5 LF	See table below
Date: 1832	**Explain**: Vertical saw marks and no evidence that any original members have been replaced.	

Description:
Built-up timber members, 10"x11" overall, consisting of three sawn timbers, or planks, laminated together side-by-side with pegs (trunnels). The two outside members are 3"x11"; the inside member is 4"x11". Typically the members are 32 feet in length, with joints offset by the use of members of shorter lengths such as approximately 9', 13' , 17', 26' and other lengths. The inside faces of the adjoining chord members (planks) are match-notched to accept the corresponding notched sections of the posts and diagonals, which are all pegged together to form a rigid interlocked joint.

Condition:
In general the chords are in good condition, with only roughly 18 percent identified as structurally deficient. The primary deterioration is rotted members due to water infiltration. Two members are split. Two members lack the necessary structural capacity determined by the engineer's structural analysis. Due to the built-up laminated construction of the chords, it is impossible to inspect all sections of the chord members without disassembly. Additional structural deficiencies may be discovered during rehabilitation.

Describe Work:
Existing bridge shall be jacked and braced as required to straighten, release stresses, plumb and re-align the trusses and arches (RS-3, Sheet 2). Special care shall be taken to avoid damage to members that are to remain and to avoid movement of the truss that could result in distortion or misalignment of the truss and its joints (GC-10, Sheet 2). All joints in replaced members shall match the existing joint, including all nails, bolts or screws required unless noted otherwise (GC-11. Sheet 2). All existing members shown to be replaced are to be replaced "in-kind" with new members identical in dimensions and configurations as the members originally used in the covered bridge (GC-12, Sheet 2).

Project Need:
The chords are primary structural members of the truss that carry the live and dead loads. The members to be replaced do not possess the required structural integrity.

Impacts:
Approximately 18 percent of the total number of upper chord members require replacement.
Members to be replaced will be replaced "in-kind" with wood members of the same size and workmanship.

Alternatives:
Due to the laminated design of the upper chord, there are no other practical treatment alternatives that meet engineering requirements and the Secretary's Standards other than repairing the chords by splicing in new wood members in the place of those determined structurally inadequate.

Drawings: 35, 36, 37, 38, 39, 41, 42	**Photos:** See table below

Drawing No. 37

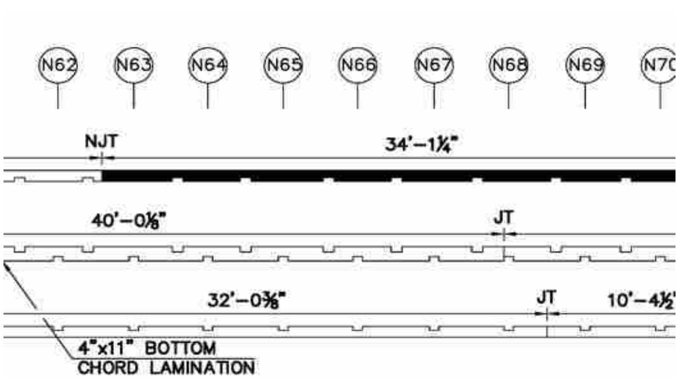


Photo No. 1-1

Table: Upper Chord Members Affected

Member No.	Date	Reason	Reason for Replacement	Photo No.
N0 – N2 A	1832	vertical saw marks	Structural Capacity	no photo
N6 – N14 B	"	"	Rot Near Node N12, N13	1-1, 1-2, 1-3
N9 – N16 A	"	"	Rot Near Node N13	1-1, 1-2, 1-3
N11 – N27 C	"	"	Rot Near Node N12, N22	1-1, 1-2, 1-3
N22 – N30 B	"	"	Rot Near Node N22, N24	1-4
N25 – N33 A	"	"	Rot Near Node N24	1-4
N59 – N68 C	"	"	24” Long Split at N60	1-5
S0 – S02 A	"	"	Structural Capacity	no photo
S9 – S17 A	"	"	Rot Near Node N15	not shown
S11 – S27 C	"	"	Rot Near Node N15	not shown
S14 – S30 B	"	"	Rot Near Node N15	not shown
S92 – S96 C	"	"	24” Long Split at S92	1-6

Photo No. 1-1 Top Chord N6 – N14 B, Rot near Node N12, N13

Photo No. 1-2 Top Chord N6 – N14 B, Rot near Node N12, N13

Photo No. 1-3 Top Chord N6 – N14 B, Rot Near Node N12, N13

Photo No. 1-4 Top Chord N22 – N30 B, Rot near Node N22, N24

Photo No. 1-5 Top Chord N59 – N68 C, 24" Split at N60

Photo No. 1-6 Top Chord S92 – S96 C, 24" Split at S92

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 2 **Feature**: Truss Lower Chord

Total members: 2247 linear feet (LF) **Members affected**: 378.5 LF See table below

Date: 1832 **Explain**: Vertical saw marks and no evidence that any original members have been replaced.

Description:
Built-up timber members, 11"x11" overall, consisting of three sawn timbers, or planks, laminated together side-by-side with pegs (trunnels). The two outside members are 3.5"x11"; the inside member is 4"x11". The members are variable in length with offset joints. Lengths vary from 4' to 63' and include lengths of approximately 16', 24', 32', 40', 55' and other lengths. The inside faces of the adjoining chord members (planks) are match-notched (like the upper chords) to accept the corresponding notched sections of the posts and diagonals, which are all pegged together to form a rigid interlocked joint.

Condition:
Like the upper chords, the lower chords are in good condition, with only roughly 17 percent identified as structurally deficient. The primary deterioration is rotted members due to water infiltration. Some members show twisting, splits and cracks. Two members lack the necessary structural capacity determined by the engineer's structural analysis. Due to the built-up laminated construction of the chords, it is impossible to inspect all sections of the chord members without disassembly. Additional structural deficiencies may be discovered during rehabilitation work.

Describe Work: Same as described for the upper chords: Existing bridge shall be jacked and braced as required to straighten, release stresses, plumb and re-align the trusses and arches (RS-3, Sheet 2). Special care shall be taken to avoid damage to members that are to remain and to avoid movement of the truss that could result in distortion or misalignment of the truss and its joints (GC-10, Sheet 2). All joints in replaced members shall match the existing joint, including all nails, bolts or screws required unless noted otherwise (GC-11, Sheet 2). All existing members shown to be replaced are to be replaced "in-kind" with new members identical in dimensions and configurations as the members originally used in the covered bridge (GC-12, Sheet 2).

Project Need:
The chords are primary structural members of the truss that carry the live and dead loads. The members to be replaced do not possess the required structural integrity.

Impacts:
Approximately 17 percent of the total number of lower chord members require replacement.
Members to be replaced will be replaced "in-kind" with wood members of the same size and workmanship.

Alternatives:
Due to the laminated design of the lower chord, there are no other practical treatment alternatives that meet engineering requirements and the Secretary's Standards other than repairing the chords by splicing in new wood members in the place of those determined structurally inadequate.

Drawings: 35, 36, 37, 38, 39, 41, 42 **Photos:** See table below

Drawing No. 37

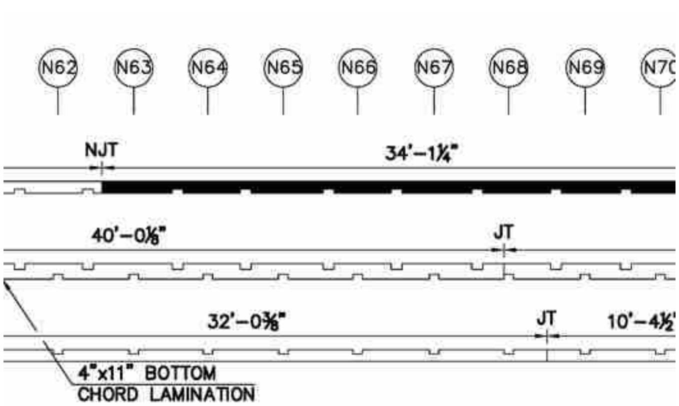


Photo No. 2-1

Table: Lower Chord Members Affected				
Member No.	**Date**	**Reason**	**Reason for Replacement**	**Photo No.**
N1 – N2 A	1832	vertical saw marks	Rot near Node N1	no photo
N1 – N3 B	"	"	Rot near Node N1	no photo
N8 - N20 C	"	"	Twisting, Splits, Breaks	no photo
N13 – N21 B	"	"	Twisting, Splits, Breaks	no photo
N14 – N22 A	1988	Graton Rehab	Twisting, Splits, Breaks	not shown
N25 – N29 C	"	"	Structural Capacity	no photo
N62 – N71 A	"	"	Rot near N63 & N70	2-1, 2-2
N93 – N95 A	"	"	Rot on interior face	2-3
N93 – N95 B	"	"	Rot on interior face	2-3
S1 – S15 A	"	"	Twisting, Splits, Breaks, Rot S93	no photo
S1 – S18 B	"	"	Twisting, Splits, Breaks, Rot S93	no photo
S7 – S20 C	"	"	Twisting, Splits, Breaks	no photo
S24 – S28 C	"	"	Structural Capacity	no photo

Photo No. 2-1 Bottom Chord N62 – N71 A, Rot near N63 & N70

Photo No. 2-2 Bottom Chord N62 – N71 A, Rot near N63 & N70

Photo No. 2-3 Bottom Chord N93 – N95 A, Rot on interior face

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 3	**Feature**: Truss Vertical	
Total members: 190	**Members affected**: 36	See table below
Date: 1832*	**Explain**: Vertical saw marks. *Some members have been splice repaired in 1988.	

Description:
Sawn wood timbers 4.5”x6" approximately 16' long standing vertically, spaced at 4' on center and joining the upper and lower chords and two diagonals. The top and bottom ends of the posts are notched on either side to lock into the matched notches cut in the middle and inside chord members.

Condition:
Identified members have splits or heavy checks that appear to be from either stress or drying. Members also show rot or softening due to water infiltration at the eaves or exposure to weathering at the window opening. Members repaired by splicing during the 1988 rehabilitation were evidently spliced to avoid the expense and/or difficulty of removing the member and replacing it. The tails of some members are missing due to having split off from excessive localized loading; missing lower tails may also be due to ice damage, or were cut off to provide additional clearance over the former railroad tracks.

Describe Work:
Existing bridge shall be jacked and braced as required to straighten, release stresses, plumb and re-align the trusses and arches (RS-3, Sheet 2). Special care shall be taken to avoid damage to members that are to remain and to avoid movement of the truss that could result in distortion or misalignment of the truss and its joints (GC-10, Sheet 2). All joints in replaced members shall match the existing joint, including all nails, bolts or screws required unless noted otherwise (GC-11, Sheet 2). All existing members shown to be replaced are to be replaced “in-kind” with new members identical in dimensions and configurations as the members originally used in the covered bridge (GC-12, Sheet 2).

Project Need:
Verticals are primary structural members of the truss critical to the structural integrity of the bridge. Tails of vertical members assist in holding the chords in place vertically; collapse of the floor is possible if lower tails are broken. The members to be replaced do not possess the required structural integrity.

Impacts:
Roughly 19 percent of the total number of vertical members require replacement.
Members to be replaced will be replaced "in-kind" with wood members of the same size and workmanship.

Alternatives:
Alternative treatments evaluated that meet the Secretary's Standards include: *repair individual vertical members* by removing structurally failed or inadequate sections and splicing-in new wood sections or by epoxy consolidation; *reinforce individual vertical members* by thru-bolting, steel strapping or by sistering new posts or other structural members to the existing post; *replace member in-kind*. The alternative chosen that fully meets project engineering requirements is replacement in-kind.

Drawings: 35, 36, 37, 38, 39, 41, 42

Photos: See table below

Drawing No. 39

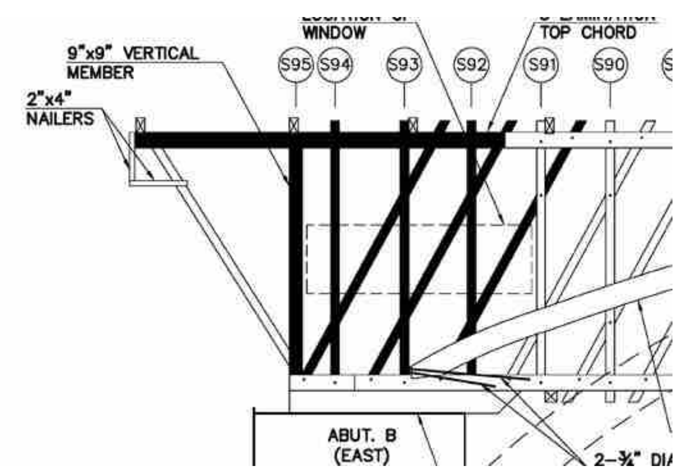


Photo No. 3-1

Table: Vertical Truss Members Affected				
Member No.	**Date**	**Reason**	**Reason for Replacement**	**Photo No.**
S95	1832	vertical saw marks	Rot in Top of Vertical	3-2
S94	"	"	Section loss	3-2
S93	"	"	Section loss	3-2
S92	"	"	Section loss	3-2
S39	"	"	Lower Tail Missing	not shown
S38	"	"	Lower Tail Missing	3-3
S37	"	"	Lower Tail Missing	3-5
S36	"	"	Top of Vertical Broken at Bot. Face of Bot. Chord	3-6
S35	"	"	Splits at Lower End of Member	3-7
S33	"	"	Missing Upper Tail	3-8
S31	"	"	Splits at Lower End of Member	not shown
S29	"	"	Missing Upper Tail	3-8
S25	"	"	Upper Tail Missing, Rot Pocket	3-8
S24	"	"	Lower Tail Missing	no photo
S17	"	"	Lower Tail Missing	no photo
S15	"	"	Rot at top of member	not shown
S14	"	"	Lower Tail Missing	no photo
S13	"	"	Lower Tail Missing	no photo
S7	"	"	Lower Tail Missing	no photo
S6	"	"	Lower Tail Missing	no photo
S2	"	"	Rot at base	not shown
N2	"	"	Splits Lower Half, Upper Tail Missing	3-9
N12	"	"	Rot and Splits at Lower End, Top Missing	not shown
N13	"	"	Spliced Member, Tail Broken, Rot at Top	not shown
N16	" /1988	" /Graton rehab	Tail Broken, Splits, Spliced Member	3-4
N17	" /1988	" /Graton rehab	Tail Broken, Spliced Member	3-4
N18	" /1988	" /Graton rehab	Tail Broken, Spliced Member	3-4
N19	" /1988	" /Graton rehab	Spliced Member	3-4
N22	1832	vertical saw marks	2" Deep Rot Into Upper Tail of Member	3-13
N40	"	"	Lower Tail Missing	not shown
N41	"	"	Lower Tail Missing	not shown
N49	"	"	Large Knot	3-11
N56	"	"	Splits	3-12
N57	"	"	Splits	not shown
N59	"	"	Waning, Insect Damage, Checking and Splits	3-10
N69	"	"	Broken at Trunnel	not shown
N71	"	"	Split at Base	not shown

Photo No. 3-2 Vertical Truss Member S92, Section loss

Photo No. 3-3 Vertical Truss Member S38, Lower Tail Missing

Photo No. 3-4 Vertical Truss Member N16, Spliced Members

Photo No. 3-5 Vertical Truss Member S37, Lower Tail Missing

Photo No. 3-6 Vertical Truss Member S36, Broken Above Bottom Chord

Photo No.3-7 Vertical Truss Member S35, Splits at Lower End

Photo No. 3-8 Vertical Truss Member S33, Missing Upper Tail

Photo No. 3-9 Vertical Truss Member N40, Lower Tail Missing

Photo No. 3-10 Vertical Truss Member N59, Waning

Photo No. 3-11 Vertical Truss Member N49, Large Knot

Photo No. 3-12 Vertical Truss Member N56, Split

Photo No. 3-13 Vertical Truss Member N22, 2" Deep Rot into Upper Tai

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 4	**Feature**: Truss Diagonal	
Total members: 170	**Members affected**: 35	See table below
Date: 1832*	**Explain**: Vertical saw marks. *Some members have been splice repaired	

Description: Sawn wood timbers 4.5”x6" approximately 18' long standing diagonally at a 60-degree angle to the lower chord, spaced at 4' on center and joining the upper and lower chords and two vertical posts. The top and bottom ends of the diagonals are notched on either side to fit and lock into the matched notches cut in the chord members. The 10"± un-notched portion of the verticals that extends beyond the chords is referred to as the tail. The diagonals pass behind the vertical posts and lock into the middle and outside chord members (the vertical posts lock into the middle and inner chord members). The diagonals are pegged to the posts but not notched into them. The diagonals are notched at their midpoint on the outside face to accept a horizontal 4x6" member to which the vertical siding is nailed at its midpoint.

Condition: Identified members have splits appearing to be from either stress or natural drying process. Identified members also show damage from weathering over years of exposure. Identified members have been repaired by method of splicing during the 1988 rehabilitation which was apparently done to avoid the expense and difficulty of properly removing the member and replacing it in-kind. Split members were previously repaired by bolting. The "tails" of some members are missing due to having split off from excessive localized loading, or have been cut off to provide additional underclearance over the former railroad tracks.

Describe Work: Existing bridge shall be jacked and braced as required to straighten, release stresses, plumb and re-align the trusses and arches (RS-3, Sheet 2). Special care shall be taken to avoid damage to members that are to remain and to avoid movement of the truss that could result in distortion or misalignment of the truss and its joints (GC-10, Sheet 2). All joints in replaced members shall match the existing joint, including all nails, bolts or screws required unless noted otherwise (GC-11, Sheet 2). All existing members shown to be replaced are to be replaced “in-kind” with new members identical in dimensions and configurations as the members originally used in the covered bridge (GC-12, Sheet 2).

Project Need: Diagonals are primary structural members of the truss critical to the overall structural integrity of the bridge. The strength of the truss system is dependent on the tight interlock of the chords and diagonals, which is compromised by the loss of the tail section. The members to be replaced do not possess the required structural integrity.

Impacts: Roughly 20 percent of the total diagonal require replacement. Members to be replaced will be replaced "in-kind" with wood members of the same size and workmanship.

Alternatives: Alternative treatments evaluated that meet the Secretary's Standards include: *repair individual members* by removing structurally failed or inadequate sections and splicing-in new wood sections or by epoxy consolidation; *reinforce individual members* by thru-bolting, steel strapping or by sistering new structural members to the existing member; *replace member in-kind*. The alternative chosen that fully meets project engineering requirements is replacement in-kind.

Drawings: 35, 36, 37, 38, 39, 41, 42

Photos: See table below

Drawing No. 39

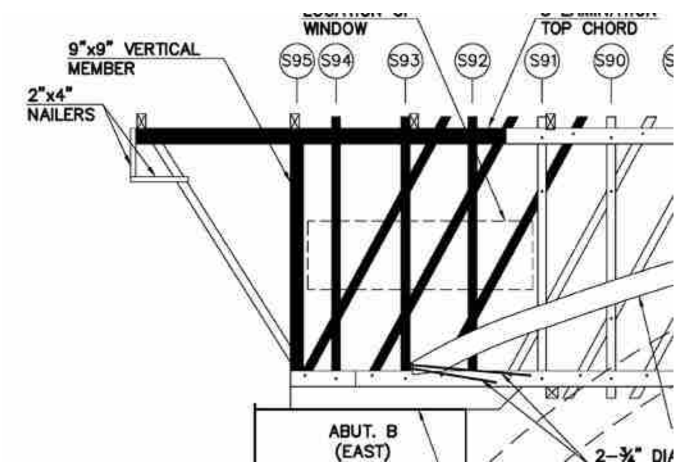


Photo No. 4-1

Table: Diagonal Truss Members Affected				
Member No.	**Date**	**Reason**	**Reason for Replacement**	**Photo No.**
S14L-S15U	1832	vertical saw marks	Lower Tail Missing	no photo
S15L-S16U	"	"	Lower Tail Missing	no photo
S16L-S17U	"	"	Lower Tail Missing	no photo
S17L-S18U	"	"	Lower Tail Missing	no photo
S18L-S19U	"	"	Lower Tail Missing	no photo
S29U-S30L	"	"	Lower Tail Rotted	no photo
S27U-S28L	"	"	Rot, Break at Lower Tail	4-4
S35U-S36L	"	"	Lower Tail Missing	no photo
S36U-S37L	"	"	Lower Tail Missing	4-5
S37U-S38L	"	"	Lower Tail Missing	not shown
S39U-S40L	"	"	Break and Splits at Base, rot at mid-point	4-9
S41L-S43U	"	"	Break, Splits, Rot	4-6
S75L-S76U	"	"	Upper Tail Broken; Popped trunnel @ S77	4-7
S91U-S92L	"	"	Weathered Wood at Window Openings	4-3
S92U-S93L	"	"	Rot at Base; Weathered Wood at Window	not shown
S93U-S95L	"	"	Weathered Wood at Window Openings	4-2
N3L – N4U	"	"	Rot pocket at base near chord, weathering	4-8
N4L-N5U	"	"	Rot at End and Exterior Fascia of Member	4-10
N14L-N15U	"	"	Lower Tail missing	no photo
N15L-N16U	"	"	Lower Tail Missing	no photo
N16L-N17U	"	"	Lower Tail Missing	not shown
N17L –N18U	1988	Graton Rehabilitation	Spliced Member	4-11
N18L – N19U	1988	Graton Rehabilitation	Spliced Member	4-11
N19L-N20U	1832	vertical saw marks	Lower Tail Missing	no photo
N28U-N29L	"	"	Split at Lower Tail	4-12
N30U-N31L	"	"	Split & Rot at Base	not shown
N38U-N39L	"	"	Splits at Upper Tail	4-13
N56U-N57L	"	"	Split	4-14
N64L-N65U	"	"	Rot at Base	not shown
N66L-N67U	"	"	Splits at Upper Tail	4-15
N67L-N68U	"	"	Splits at Upper Tail	not shown
N73L-N74U	"	"	Split at Base, Waning	4-16
N75L-N76U	"	"	Splits	not shown
N87U – N88L	"	"	Broken Lower Tail	no photo
N91U-N92L	"	"	Rot at base under window, Waning and Insect Damage at Top	4-17
N92U-N93L	"	"	Splits at base; Floorbeam cut to fit	4-18
S2L-S3U	"	"	Section loss	not shown
S6L-S7U	"	"	Lower Tail missing	not shown
S7L-S8U	"	"	Lower Tail missing	not shown
S13l-S14U	"	"	Section Loss	4-19

Photo No. 4-2 Diagonal S95L – S93U, Weathering

Photo No. 4-3 Diagonal S92L – S93U, Weathering

Photo No. 4-4 Diagonal S27L – S28U, Rot, break at lower Tail

Photo No. 4-5 Diagonal S36U – S37L, Lower Tail missing

Photo No. 4-6 Diagonal S41L – S43U, Break, Splits, Rot

Photo No. 4-7 Diagonal S75L – S76U, Popped Trunnel @ S77

Photo No. 4-8 Diagonal N3L – N4U, Rot

Photo No. 4-9 Diagonal S40L – S39U, Break, split at base, rot at middle

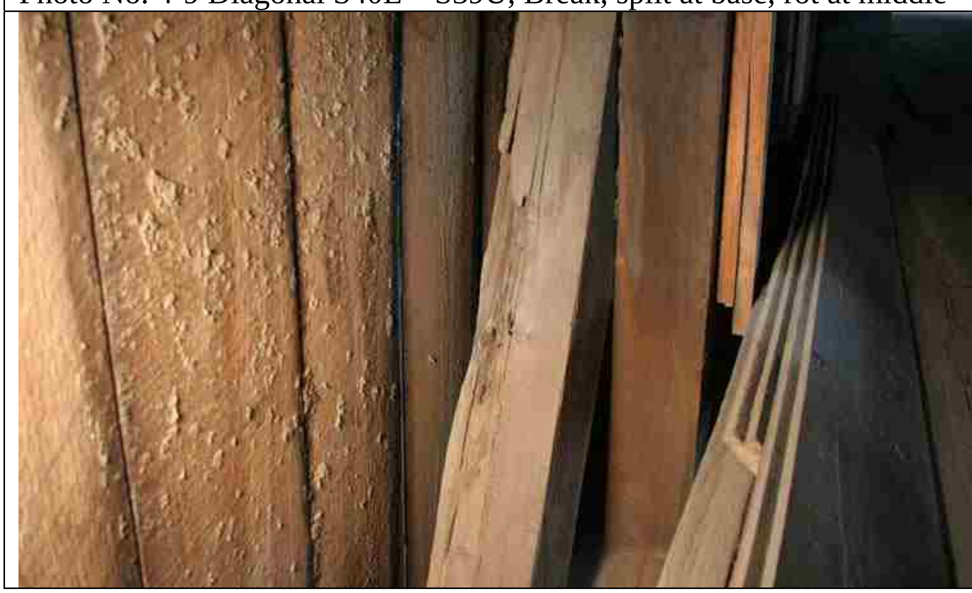


Photo No. 4-10 Diagonal N4L-N5U Rot at end & exterior fascia of member

Photo No. 4-11 Diagonal N17L –N18U, Spliced Member

Photo No. 4-12 Diagonal N28U-N29L, Split at Lower Tail

Photo No. 4-13 Diagonal N38U-N39L, Split at Upper Tail

Photo No. 4-14 Diagonal N56U-N57L, Split

Photo No. 4-15 Diagonal N66L – N67U, Splits in Upper Tail

Photo No. 4-16 N73L-N74U, Split at Base, Waning

Photo No. 4-17 Diagonal N92L – N91U, Rot at base under window

Photo No. 4-18 Diagonal N93L – N92U, Splits at base; cut Floor Beam

Photo No. 4-19 Diagonal S13L – S14U, Section loss; also Spliced Member

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 5	**Feature**: Built-in Arches	
Total members: 2820 Linear Feet (L.F.)	**Members affected**: ~ 200 L.F.	See table below
Date: 1832	**Explain**: Vertical saw marks.	

Description: There are two separate arch systems in the bridge, the Built-in Arches and the Added Arches. The Built-in Arches are original to the bridge, integral with the vertical and diagonal truss members and bearing on the lower chords. (The Added Arches were added during the 1918-1919 raising and reinforcing of the bridge and discussed on a separate sheet). The Built-in Arches are relatively flat due to their long spans: the west arch spans from the west abutment to Pier 2, roughly 160 feet; the center arch spans from Pier 2 to Pier 3, roughly 80 feet; and the east arch spans from Pier 3 to the east abutment, roughly 135 feet. The arches are built-up timber members, 10"x11" overall, consisting of three sawn timbers, or planks, laminated together side-by-side with pegs (trunnels). The east and west arches have 4"x16" members; the center arch has 4"x13.5" members.

Condition: The built-in arches are in good condition with only localized rot due to water infiltration.

Describe Work: Disassemble arches and remove and replace defective members. General conditions the same as specified for other truss members: Existing bridge shall be jacked and braced as required to straighten, release stresses, plumb and re-align the trusses and arches (RS-3, Sheet 2). Special care shall be taken to avoid damage to members that are to remain and to avoid movement of the truss that could result in distortion or misalignment of the truss and its joints (GC-10, Sheet 2). All joints in replaced members shall match the existing joint, including all nails, bolts or screws required unless noted otherwise (GC-11, Sheet 2). All existing members shown to be replaced are to be replaced “in-kind” with new members identical in dimensions and configurations as the members originally used in the covered bridge (GC-12, Sheet 2).

Project Need: The built-in arches are original and integral structural members of the trusses that contribute to the stiffness and load capacity of the bridge. Localized rot due to due to established ambient moisture wood decaying organisms is recommended to be removed to prevent spread of decay. The members identified for replacement are rotted and so not possess the required structural integrity.

Impacts: Less than 10 percent of the total linear feet of members making up the Built-in Arches require replacement. Members to be replaced will be replaced "in-kind" with wood members of the same size and workmanship.

Alternatives:
Due to the laminated design of the arches, there are no other practical repair alternatives that meet engineering requirements and the Secretary's Standards other than "replacement in-kind."

Drawings: 35, 36, 37, 38, 39, 41, 42

Photos: See table below

Drawing No. 38

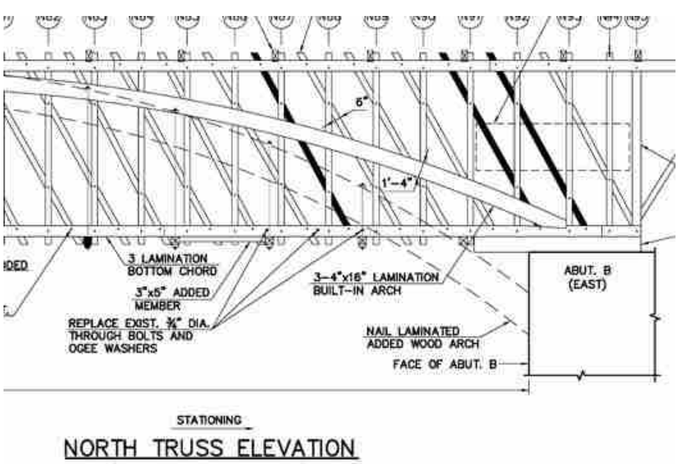


Photo No. 5-1

Table: Built-in Arch Members Affected				
Member No.	**Date**	**Reason**	**Reason for Replacement**	**Photo No.**
N61-N62 Ply A	1832	vertical saw marks	Rot	5-1
N61-N62 Ply B	"	"	"	5-1
N61-N62 Ply C	"	"	"	5-1
S17-S14 Ply A	"	"	"	5-2
S16-S14 Ply B	"	"	"	5-2
S17-S15 Ply C	"	"	"	5-2

ADDITIONAL PHOTOS OF BUILT-IN ARCHES				
S90 – S86				5-3
S40 – S34				5-4
S31 Oblique				5-5
S22 – S18				5-6
S14 – S10				5-7
S10 – S6				5-8
N58 – N54				5-9
N61 – N56				5-10

Photo No. 5-2 Built In Arch S18 – S14

Photo No. 5-3 Built In Arch S90 – S86

Photo No. 5-4 Built In Arch S40 – S34

Photo No. 5-5 Built In Arch S31 Oblique

Photo No. 5-6 Built In Arch S22 – S18

Photo No. 5-7 Built In Arch S14 – S10

Photo No. 5-8 Built In Arch S10 – S6

Photo No. 5-9 Built In Arch N58 – N54

Photo No. 5-10 Built In Arch N56 – N61

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 6	**Feature**: Cross Beams		
Total members: 50	**Members affected**: 9	See table below.	
Date: 1832	**Explain**: Cross beams have vertical saw marks and likely date to the original construction.		

Description:
Vertically sawn timbers, 6” x 10-3/4" x 26’ spaced 8’ on center join the top chords of each truss spanning over the roadway. A component of the upper lateral bracing system, they are located next to the posts and joined to both the posts and the rafters with knee braces. Between the cross beams are crossed diagonal lateral bracing members attached to the cross beams near their ends with wedged mortise and tenon joints.

Condition:
Specific members exhibit a variety of splits and cracks due to stress or drying. Specific members show localized rot due to prior roof leaks. Specific members are notched near the arch. HTA planned for 7 members to be removed with an assumed additional 2 not identified in plan. HDC found 5 damaged members in addition to the 7 identified in plan. Cross Beams at nodes 17, 25, and 95 are Graton splice repairs.

Describe Work:
Several existing cross beams have lifted off their bearings as a result of racking on the bridge. The contractor shall re-align the cross beams to ensure firm bearing on the truss top chords. This work will be paid for as part of realignment of covered bridge (Note 1, Sheet 24). Install ¾” dia. x 10” long galvanized lag screws at end of lateral braces that are not mortised and tenoned at the existing cross beams (Note 4, Sheet 24). Plans call for 7 members to be removed with an assumed additional 2 not identified in plan. Cross Beams at nodes 17, 25, and 95 (Graton splices) require repairs.

Project Need:
Cross beams are structural members of the bridge that join the two trusses together and carry several types of loads; cross beams to be replaced do not possess the required structural integrity.

Impacts:
Roughly 18 percent of the cross beams require replacement. Members to be replaced will be replaced "in-kind" with wood members of the same size and workmanship.

Alternatives: Alternative treatments evaluated that meet the Secretary's Standards include: *repair individual members* by removing structurally failed or inadequate sections and splicing-in new wood sections or by epoxy consolidation; *reinforce individual members* by thru-bolting, steel strapping or by sistering new structural members to the existing member; *replace member in-kind*. The alternative chosen that fully meets project engineering requirements is replacement in-kind.

Drawings: 24, 25, 26

Photos: see table below

Drawing No. 24

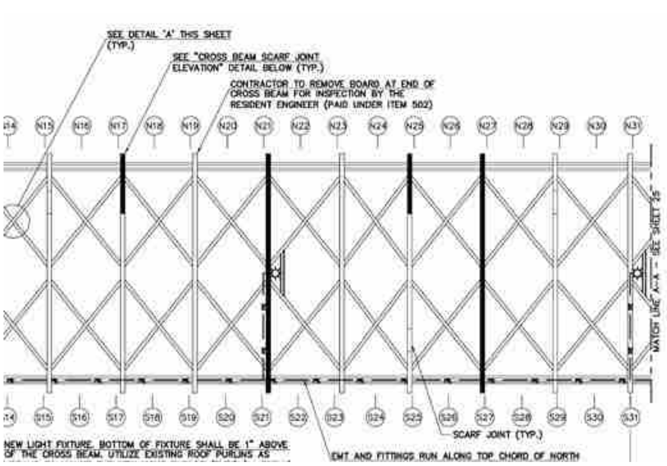


Photo No. 6-1

Cross Beams Affected

Member No.	**Date**	**Reason**	**Reason for Replacement**	**Photo No.**
N93 – S93	1832	vertical saw marks	Split	6-2
N95 – S95	"	"	Split Near Scarf Joint (Graton splice)	6-3
S79-N79	"	"	Notched (not scheduled for replacement)	6-4
N77 – S77	"	"	Cross Beam Notched	6-5
N27 - S27	"	"	Split	6-6
N21 – S21	"	"	Split	6-7
N33 – S33	"	"	Splits	6-8
N37 – S37	"	"	Split and rot (not scheduled for replacement)	6-9

Photo No. 6-2 Cross Beam N93-S93, Split

Photo No. 6-3 Cross Beam N95-S95 Split at scarf joint repair

Photo No. 6-4 Cross Beam S79, Section loss due to notching

Photo No. 6-5 Cross Beam S77, Notched

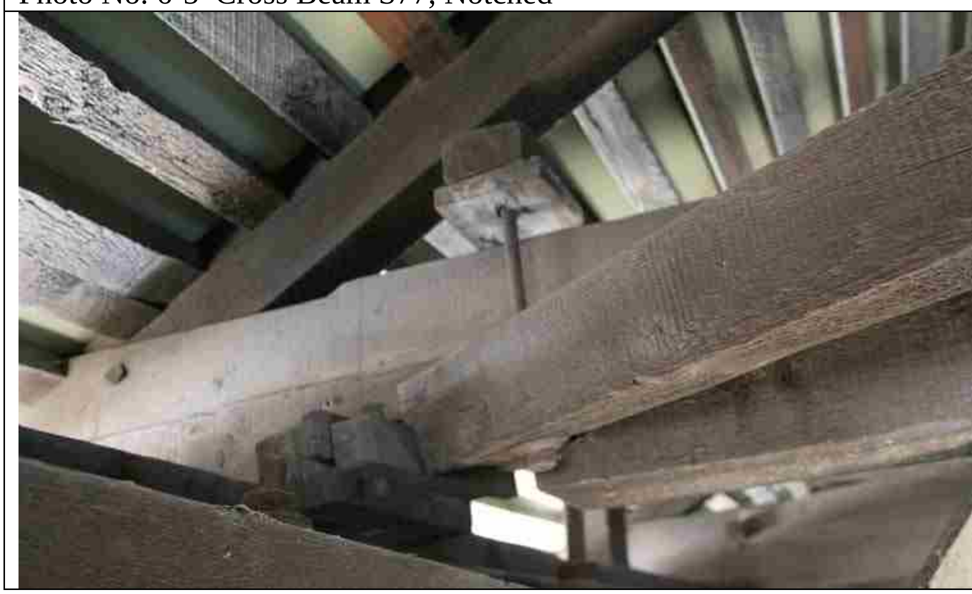


Photo No. 6-6 Cross Beam S27, Split, missing section

Photo No. 6-7 Cross Beam N21 – S21, Split between braces

Photo No. 6-8 Cross Beam N33 – S33, stress splits

Photo No. 6-9 Cross Beam N37 – S37, split and rot

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 7	**Feature**: Upper Lateral Bracing		
Total members: 196	**Members affected**: 3	See table below.	
Date: 1832	**Explain**: Bracing members have vertical saw marks and likely date to the original construction.		

Description: Sawn wood timbers 4"x4"x 12'. There are four in each bay between the cross beams, in the form of two X-braces, on either side of the longitudinal centerline of the bridge. The ends of the braces are cut at an angle with tenons that are locked into mortises on the cross beams with wedges.

Condition: Specific members exhibit a variety of splits and cracks, which appear to result from either stress or drying.

Describe Work:
All existing members shown to be replaced will be replaced “in-kind” with new members identical in dimensions and configurations as the members originally used in the covered bridge. Plans identify 1 lateral brace to be replaced, with bidding provision for replacement of 2 additional braces to be identified during construction (Note 3, Sheet 24). HDC identified 2 additional cross braces as noted that have large cracks.

Project Need:
The Upper Lateral Bracing Members are structural members that "help keep the structure both straight and square, and prevent twisting and torsion. The lateral bracing transfers the lateral wind loading on the upper half of the bridge along the span to the portal framing and then to the abutments. The lateral bracing system provides the resistance against wind loading and helps the top of the bridge to remain straight along its axis” (CBM, p. 14). Lateral bracing to be replaced do not possess required structural integrity.

Impacts:
Less than 2 percent of the total bracing members require replacement.
Members to be replaced will be replaced "in-kind" with wood members of the same size and workmanship.

Alternatives:
Alternative treatments evaluated that meet the Secretary's Standards include: *repair individual members* by removing structurally failed or inadequate sections and splicing-in new wood sections or by epoxy consolidation; *reinforce individual members* by thru-bolting, steel strapping or by sistering new structural members to the existing member; *replace member in-kind*. The alternative chosen that fully meets project engineering requirements is replacement in-kind.

Drawings: 24, 25, 26

Photos: 7-1, 7-2, 7-3, 7-4

Drawing No. 25

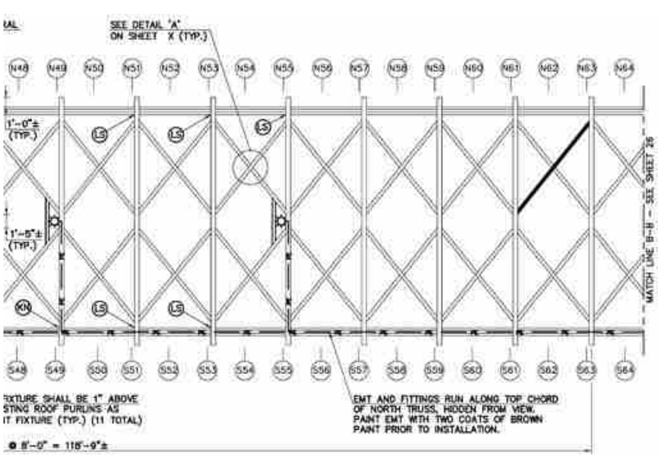


Photo No. 7-1

Table: Upper Lateral Bracing Affected				
Member No.	**Date**	**Reason**	**Reason for Replacement**	**Photo No.**
N63 – N61	1832	vertical saw marks	Split	7-2

Photo No. 7-2 Upper Lateral N63 – N61, Split

Photo No. 7-3 Upper Lateral S27– S29, Laterals joined to cross beam

Photo No. 7-4 Upper Lateral N89 – N87, Split

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 8 **Feature**: Knee Braces

Total members: 96 **Members affected**: 5 See table below.

Date: 1832 **Explain**: Bracing members have vertical saw marks and likely date to the original construction.

Description: Sawn timbers, 4" x 6" x ~12' long that join the posts, cross beam and rafters together to stiffen the bridge against racking and sway. Also called sway braces. The Bath Bridge knee braces are unusual in that they connect not only the posts to the cross beams, as is typical, but are extended up beyond the crossbeam to the rafter thus creating an exceptionally strong transverse frame. The sides of the braces are notched to lap over and lock into the members to which they are attached, to work in both compression and tension without placing all the shearing stress on the trunions. The top end of the braces are further notched to lock around the purlins.

Condition: Specific members exhibit a variety of splits, waning and cracks, which appear to result from either stress or drying.

Describe Work: All joints in replaced members shall match the existing joint, including all nails, bolts or screws required unless noted otherwise. All existing members shown to be replaced are to be replaced "in-kind" with new members identical in dimensions and configurations as the members originally used in the covered bridge (GC-12, Sheet 2). Five members have been identified for replacement.

Project Need:
Knee braces are structural members of the bridge critical to stiffening the bridge and protecting the truss joints from movement and vibration resulting from moving live loads. The members to be replaced do not possess the required structural integrity.

Impacts:
Roughly 5 percent of the total number of bracing members require replacement. Members to be replaced will be replaced "in-kind" with wood members of the same size and workmanship.

Alternatives:
Alternative treatments evaluated that meet the Secretary's Standards include: *repair individual members* by removing structurally failed or inadequate sections and splicing-in new wood sections or by epoxy consolidation; *reinforce individual members* by thru-bolting, steel strapping or by sistering new structural members to the existing member; *replace member in-kind*. The alternative chosen that fully meets project engineering requirements is replacement in-kind.

Drawings: 6, 21, 22, 24, 25, 53

Photos: See table below

Drawing No. 53

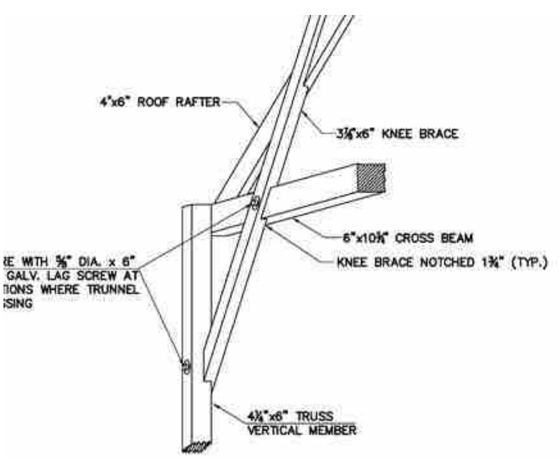


Photo No. 8-1

Table: Knee Braces Affected

Member No.	Date	Reason	Reason for Replacement	Photo No.
S29	1832	vertical saw marks	Split	8-2
N59	"	"	Waning	8-3
N5	"	"	Split	8-4
S0	"	"	Damage	8-5
S49	"	"	Split	8-6, 8-7

Photo No.8-2 Knee Brace S29, Split

Photo No.8-3 Knee Brace N59, Waning

Photo No. 8-4 Knee Brace N5, Split

Photo No. 8-5 Knee Brace S0, Damage

Photo No. 8-6 Knee Brace S49, Split

Photo No. 8-7 Knee Brace S49, Split

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 9 | **Feature**: Rafter

Total members: 100 | **Members affected**: 8 + | See table below.

Date: 1832 | **Explain**: Rafters have vertical saw marks and likely date to the original construction of the bridge.

Description:
Sawn wood timbers 4”x6" spaced at 8' on center. Upper end of rafters are angle cut, butted and toe-nailed to a 2"x6" ridge board. The lower ends of rafters have tenons that drop into mortises cut into the top of the cross ties and are secured with a single trunnel. The rafters provide rigid support for the roof and transfer roof loads down to the truss system.

Condition:
Specific members exhibit splits, checks and cracks that appear to result from overstress or in some cases drying. Specific members exhibit rot at lower end connections with upper chord, apparently the result of leaks in earlier roofing.

Describe Work:
All existing members shown to be replaced will be replaced “in-kind” with new members identical in dimensions and configurations as the members originally used in the covered bridge. (GC-12, Sheet 2). Displaced rafters are to be reset and toe nailed to cross beam. Structural timber (rafters) assumes removal and replacement of 5 additional rafters for bidding purposes that have not been identified in the roof framing plan (Note 4, Sheet 21). This is due to the expectation that during construction additional rot will be found that was hidden from the visual inspection.

Project Need:
Rafters are structural members that must carry roof loads; rafters to be replaced do not possess required structural integrity.

Impacts:
Approximately 10 percent of the total rafters require replacement. Rafters to be replaced will be replaced "in-kind" with wood members of the same size and workmanship.

Alternatives:
Alternative treatments evaluated that meet the Secretary's Standards include: *repair individual members* by removing structurally failed or inadequate sections and splicing-in new wood sections or by epoxy consolidation; *reinforce individual members* by thru-bolting, steel strapping or by sistering new structural members to the existing member; *replace member in-kind*. The alternative chosen that fully meets project engineering requirements is replacement in-kind.

Drawings: 6, 21, 23 | **Photos:** See table below

Drawing No. 23

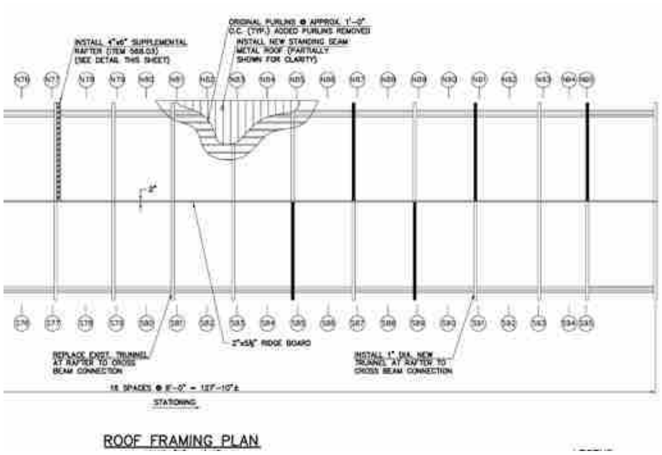


Photo No. 9-1

Table: Rafters Affected				
Member No.	**Date**	**Reason**	**Reason for Replacement**	**Photo No.**
N95	1832?	vertical saw marks	Insect Damage, Rot	9-2
N91	"	"	Rot at Rafter End	not shown
S89	"	"	Rot at Rafter End	9-3
N87	"	"	Rot at Rafter End	not shown
S85	"	"	Rot at Rafter End, Beetle damage	9-4
N77	"	"	Split off, Proposed Sister	9-5
S31	"	"	Rot at Rafter End	9-6
S19	"	"	Crack 3’ up from End	9-7

Photo No. 9-2 Rafter N95, Insect damage and rot

Photo No. 9-3 Rafter S89, Rot at rafter end

Photo No. 9-4   Rafter S85, Rot at rafter end, beetle damage

Photo No. 9-5   Rafter N77, Split off, proposed sister

Photo No. 9-6 Rafter S31, Rot at rafter end

Photo No. 9-7 Rafter S19, Crack 3' up from end

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 10	**Feature**: Ridge Board		
Total members: 392 L.F.		**Members affected**: 0	
Date: 1832		**Explain**: possibly original	

Description: Wood Sawn 2" x 5 ½". The ridge board runs the full length at the peak of the roofline, perpendicular to the rafters, which it receives with toe-nailed butt joints. The ridge board is made of different length boards butted end-to-end

Condition:
Good

Describe Work:
No work specified. Rafters to be re-nailed as need during roofing replacement.

Project Need:
Not applicable

Impacts:
None.

Alternatives:
Not applicable

Drawings. 6, 21, 22, 23	**Photos:** 10-1

Drawing No. 21

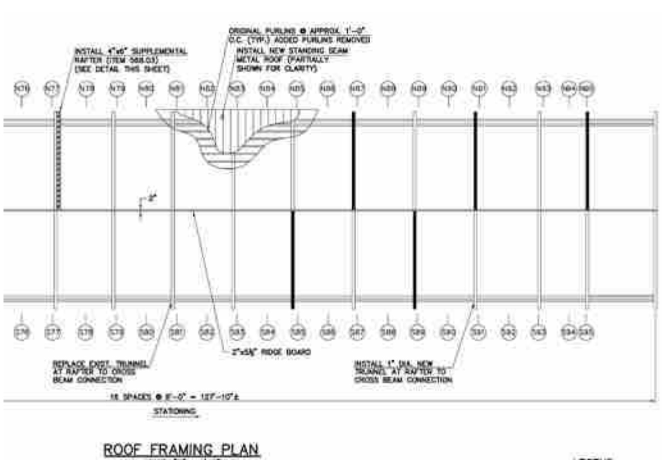


Photo No. 10-1

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 11	**Feature**: Purlin		
Total members: ~1470* Original; ~1372 Added 1987	**Members affected**: ~30*	* Total number is based on a length of 8'. Some purlins may be 16' long spanning two rafters.	
Date: 1832 with later additions	**Explain**: see description		

Description: Wood, sawn 2" x 3” spaced at 12” on center, spanning perpendicular to the rafters, regularly spaced from the ridge board to the lower end of the rafters. Two sets of purlins are present: "Original Purlins," measuring 2"x3" set in notches cut in the top of the rafters spaced 12" on center. Many if not most of these purlins are vertically sawn and apparently date to the original construction; others exhibit circular saw marks and are later replacements. Exact quantification of each was impractical. The second set of purlins, 3"x3" were added during the 1987 rehabilitation between the original purlins and are not set in notches but rather toe-nailed into the sides of the rafters.

Condition: Overall condition of the Original Purlins is very good, with less than 0.2 % preliminarily identified as structurally deficient based on inspection of the three sides visible from underneath. Observed deficiencies include splits and rot, however, additional rot is expected to be found on the top of the purlins after removal of the roofing during repairs. This is due to moisture condensation and penetration at the roof nails. The Added Purlins are in overall good condition except that the toe-nailing has failed in numerous places resulting in loose, partly detached or missing rafters indicating a lack of attachment to the metal roof.

Describe Work: Removal of Added Purlins which are structurally unnecessary and have added undesirable dead load to the structure. Replacement of an estimated 20 percent of the Original Purlins is anticipated due to expected rot and lack of adequate nail holding power on the top face of the purlins. For bidding purposes specific purlins have not been identified for replacement. The contractor and engineer will jointly inspect all original purlins after removal of the existing metal roof. Attachment of purlins to rafters shall match the original members in size and workmanship.

Project Need:
Purlins are structural members that must possess material and structural integrity sufficient to anchor the metal roofing against wind uplift forces and carry wind and snow loads on the roofing down through the rafters to the truss members. Purlins to be replaced do not possess required material or structural integrity.

Impacts: Removal of Added Purlins not original to the bridge and the reduction of dead load is a *restoration treatment*. Approximately 20 percent of the total purlins require replacement. Purlins to be replaced will be replaced "in-kind" with wood members of the same size and workmanship as the original members removed.

Alternatives: Alternative treatments evaluated that meet the Secretary's Standards include: *repair individual members* by removing structurally failed or inadequate sections and splicing-in new wood sections or by epoxy consolidation; *reinforce individual members* by thru-bolting, steel strapping or by sistering new structural members to the existing member; *replace member in-kind*. The alternative chosen that fully meets project engineering requirements is replacement in-kind.

Drawings: 21, 22,23	**Photos:** 11-1, 11-2, 11-3, 11-4

Drawing No. 21

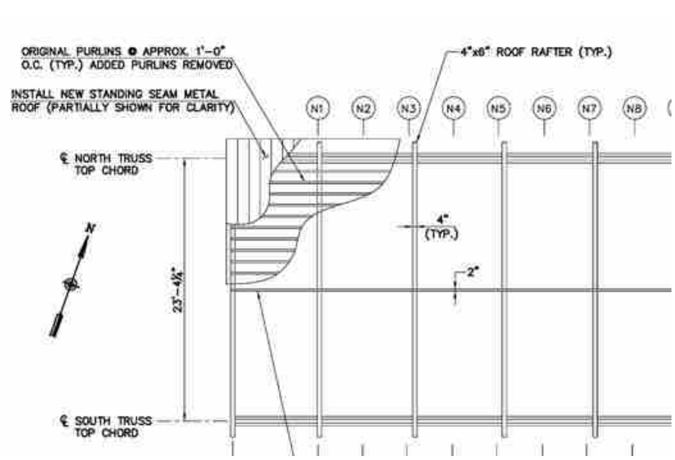


Photo No. 11-1

Photo No. 11-2 Purlin at node S63 – S61, Missing

Photo No. 11-3 Purlin at node S85, Crack

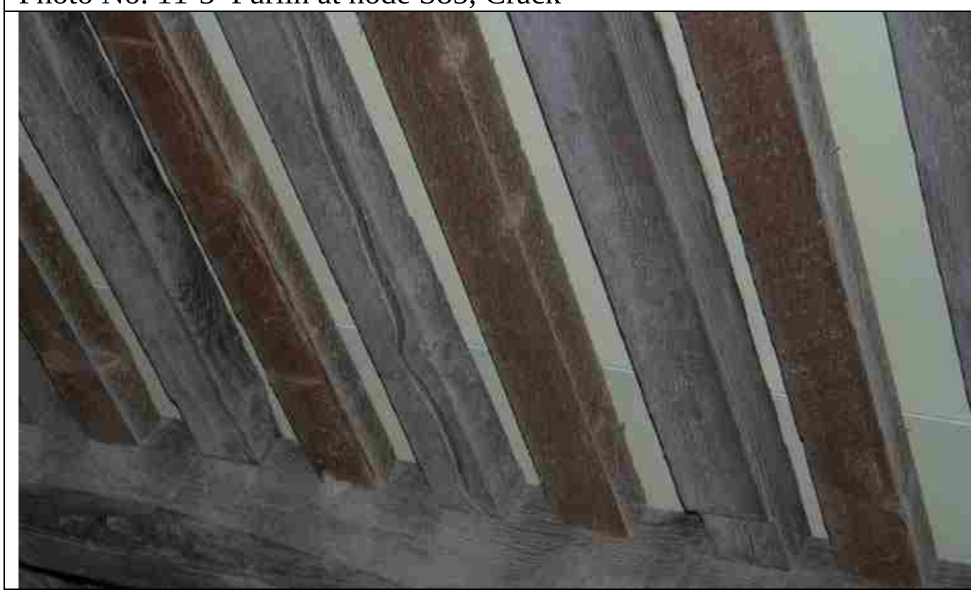


Photo No. 11-4 Purlins at node S39 - S37, Fallen

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 12 | **Feature**: Trunnel

Total members: 2000+ | **Members affected**: estimated 100

Date: 1832 | **Explain**: many trunnels are likely original to bridge; an unknown number have been replaced

Description:
White oak, 1” diameter peg driven in to drilled holes to join multiple timber members, locking the joint together and resisting shear forces.

Condition:
Roughly 10 trunnels have been identified as missing, popped-out or rotted.

Describe Work:
Replace damaged and missing trunnels with new 1” diameter white oak trunnels dipped in boiled linseed oil, mineral oil or an approved wax prior to driving. All new or existing wood trunnels in sound condition that are to be re-used with permission of the resident engineer for connecting new or replaced members. All existing trunnels that are not to be reused shall be salvaged to the Bath Historical Society.

Project Need:
Trunnels are the primary structural fasteners of the bridge, connecting members and carrying shear loads.

Impacts:
Trunnels will be replaced in-kind. Only a small percentage of trunnels require replacement.

Alternatives:
There are no other practical repair alternatives that meet engineering requirements and the Secretary's Standards other than "replacement in-kind."

Drawings: 21, 22, 23, 25, 35, 38, 39 | **Photos:** 12-1, 12-2, 12-3, 12-4

Drawing No. 25

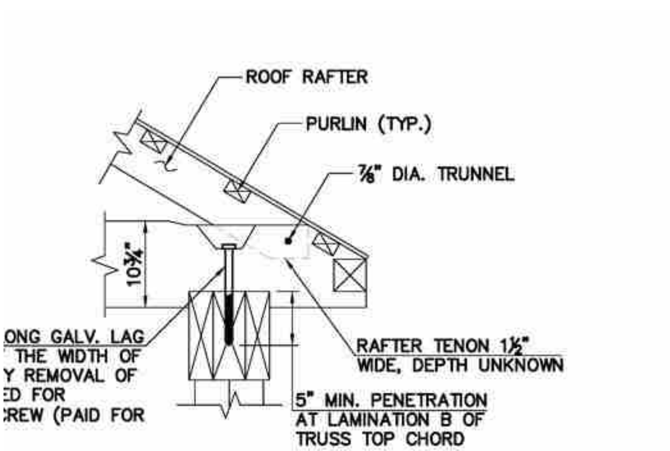


Photo No. 12-1

Photo No. 12-2 Trunnel S75, Popped out

Photo No. 12-3 Trunnel S95, Rotted off; internal rot in rafter joint

Photo No. 12-4 Trunnel S87, Missing

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 13	**Feature**: Floor Beams		
Total members: 190	**Members affected**: All		
Date: 18??; 1987-88	**Explain**: Most floorbeams were replaced during 1988 rehabilitation; see discussion below.		

Description:
Typically 7 ½" x 15 ½" wood sawn timbers spaced 2' on center. The beam ends rest on the bottom chords but are shimmed up on blocking as much as 7" in places to compensate for the sag in the trusses. During the 1988 rehab of the bridge the intention of the contractor was to replace all floor beams, however, 54 of the existing beams were reused, many by inverting them to provide a new nailing surface for the flooring. These older beams are evident from below but it is impossible to determine their date of installation.

Condition:
The floor beams vary in condition from good to poor; those in poor condition are the older reused beams, which exhibit rot and splits. Many of the 1988 beams (over 50%) are being attacked by a fungus that is evident on the surface of the wood. The shim blocking is missing in 26 locations due to inadequate fastening when installed to prevent loosening from vibration.

Describe Work:
Replace existing floor beams with new 8-3/4" x 16-1/2" glue-laminated engineered (glu-lam) beams. Older beams will be retained, treated with waterproofing and relocated over the piers where they will be additionally supported.

Project Need:
A completely new higher strength floor beam system is required in order to achieve the required 10-ton load capacity of the bridge needed to accommodate the required emergency vehicles.

Impacts:
Due to continual wetting and being shaded from drying and from the individual over-stressing to which floor beams are subject, they are not designed as permanent structural members but rather members subject to regular replacement over the life-span of the truss. Glu-lams provide a practical and prudent method to increase the service life of the structure while reducing loads on it, with minimal visual intrusion.

Alternatives:
The use of sawn beams of a high-strength species such as Douglas fir was evaluated but rejected as impractical due to cost but mainly because the beams will add substantial additional dead load to the bridge compared to the glu-lam beams. This in-turn adds undesirable continual long-term stress to the historic members of the truss. Glu-lams are visually compatible with the bridge; other alternatives such as supplemental piers or steel girders are not. Additional alternatives proposed in the consultation process are being evaluated.

Drawings: 32, 33, 34, 36

Photos: 13-1 to 13-7

Drawing No. 29

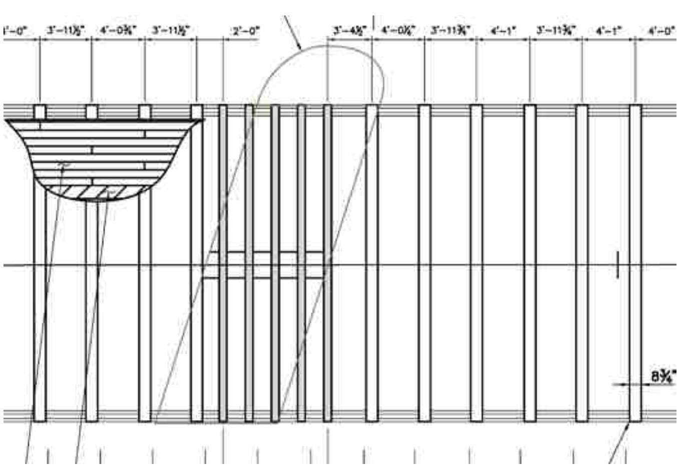


Photo No. 13-1

Photo No. 13-2 (6.17.09) Floor beams, dark new 1988; lighter are older

Photo No. 13-3 Floor Beams, West – Bent 1

Photo No. 13-4 Floor Beams, older beam upside down

Photo No. 13-5 Floor Beams,

Photo No. 13-6 Floor Beams, Bent 3 – Pier 1

Photo No. 13-7 Floor Beams, N24 – N26

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 14	**Feature**: Lower Lateral Bracing	
Total members: 22	**Members affected**: 22	

Date: 1918?

Explain: Lower lateral bracing system apparently installed during 1918 rehab (see discussion below).

Description:
Sawn timbers, 3” x 6”, mounted diagonally in a horizontal plane immediately below the bottom chords, held in compression against thrust blocks by steel tie-rods with turnbuckles. The lower lateral bracing system provides additional lateral stiffness and resistance against wind loading. Early covered bridges typically did not have lower lateral bracing.

Condition:
Members appear in fair to good condition.

Describe Work: Replace existing 2 – 3” x 6” bracing with new 6” x 6” lateral bracing. Secure all lateral bracing at end bays near abutments and piers to bottom of floor beams with ½” x 12” galvanized lag bolts. Install new galvanized tie rods.

Project Need:
The bracing is structurally inadequate for the rehabilitation design requirements.

Impacts:
The lower lateral bracing system is apparently a feature of the 1918-19 bridge rehabilitation and is not associated with the original bridge design. The existing members are to be replaced in-kind. The additional structural bracing rods are necessary for long-term structural stability and will not constitute a destructive or visually intrusive alterations.

Alternatives: There are no other practical repair and reinforcing alternatives that meet the project engineering requirements.

Drawings: 31, 32, 33, 34

Photos: No. 14-1

Drawing No. 32

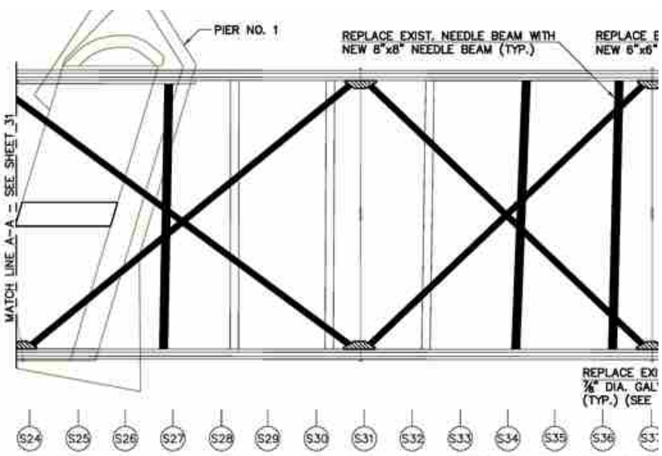


Photo No. 14-1

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 15	**Feature**: Flooring	
Total members: ~8600 S.F.	**Members affected**: All	
Date: 1988	**Explain**: Floor replaced during rehabilitation by Milton S. Graton	

Description:
Roadway decking is made up of 4" thick x 8" wide wood sawn solid wood planks. Sidewalk decking is made up of 2 ½" thick wood sawn planks overlaying the roadway planks.

Condition:
The roadway deck planking is in fair condition; with uneven wearing, loose boards and some spikes protruding above the surrounding deck surface. The sidewalk decking is in good condition.

Describe Work:
Replace existing roadway deck with new 4" thick Douglas fir deck. Replace sidewalk decking with 2" thick Douglas fir deck. Roadway decking no longer to extend under the sidewalk planks. Instead, sidewalk will sit on 2" thick x 10 ¾" wide blocking.

Project Need:
Existing decking is either functionally deficient or does not meet proposed rehab design life. Decking is a regular maintenance item and typically fully replaced during major rehabs due to the need to remove it to effect other repairs and the splits and damage that occurs during removal.

Impacts:
Proposed treatment does not involve or affect the historic fabric of the bridge.

Alternatives:
Not applicable.

Drawings: 6

Photos: 15-1

Drawing No. 6

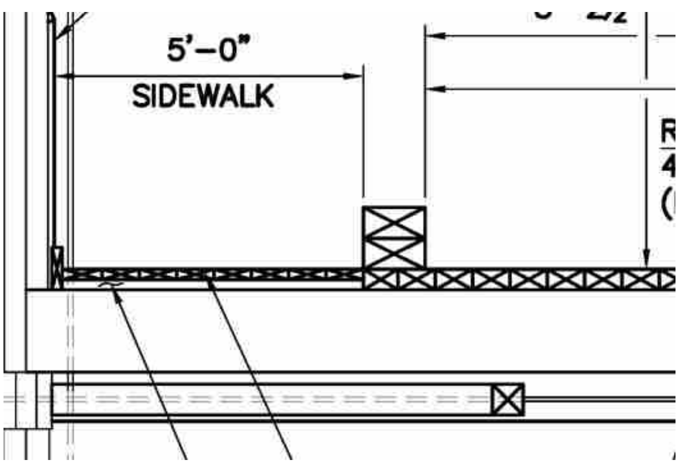


Photo No. 15-1

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 16	**Feature**: Portal Siding, Trim & Signs

Total members: ±400 s.f.	**Members affected**: all

Date: undetermined	**Explain**: Impossible to estimate age of boarding without removal for inspection.

Description:
Wood bevel clapboards, 4-1/2" exposure. Siding provides protection from the elements and prevented weathering of important members and connections.

Condition:
The great percentage of clapboards are split and cracked due to lack of paint and weathering. They are extremely dry and fragile and will be difficult to remove without damaging them beyond repair.

Describe Work:
Remove and replace portal siding and paint red. Replace existing trim boards in kind. Paint trim boards white.

Project Need:
Existing siding and trim does not provide the weather-tight building envelope necessary to protect the portal framing members.

Impacts:
Some historic fabric, if present, may be lost. Siding and trim is to be replaced in-kind in accordance with the Secretary's Standards.

Alternatives:
Renail, caulk, and paint existing clapboards.

Drawings: 5	**Photos:** 16-1 to 16-4

Drawing No. 5

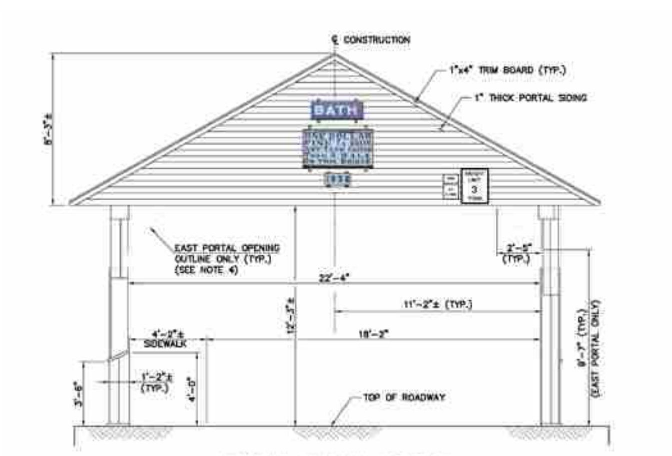


Photo No. 16-1

Photo No. 16-2 West Portal siding, weathering, splits

Photo No. 16-3 East Portal siding, weathering and splits

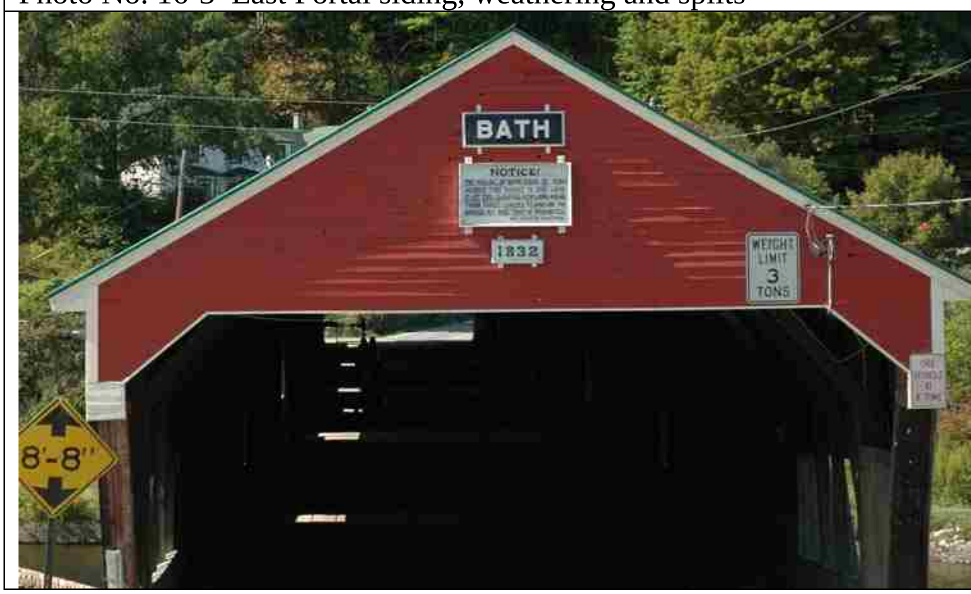


Photo No. 16-4 East Portal detail.

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 17 **Feature**: Siding

Total members: 1200± **Members affected**: all

Date: varies **Explain**: south side replaced during 1988 renovation; north side is mix of boards of different age.

Description: On the south side, all siding boards were replaced in the 1988 rehabilitation with shiplapped wood boards, 1" thick and either 7" or 9" wide. On the north side are a variety of 1" siding boards of various widths and age. Many boards have been removed and reinstalled after being reversed in both directions (inside-out and top-to-bottom) as evidenced by the weathered gray surface inside and old nail holes that do not lined up with the horizontal timber nailer. Boards from four time periods are apparently present, evidenced by two types of vertical saw marks and two types of circular saw marks considered along with the differing board widths, grain and knot patterns. The slight difference in the vertical saw mark patterns may be due to different times, different mills, changes in cutting speed or blade, or simply a sharpening of the same blade. One board, 15-1/2" wide with vertical saw marks, flipped and renailed between posts 10 and 11, is the best candidate for being considered possibly original to the bridge. It is has fine vertical grain indicating it was from a large slow growth tree, which would contribute to its longevity. There are six other boards with vertical saw marks of the following widths: 10-3/4" (3), 10-1/4" (1), 9-3/4" (1), and 9-1/2" (1). They are at the west end of the bridge near posts 8, 11, 25, 26, and 27. Two other 9-3/4" boards have circular saw marks, one with double (cross-hatched) saw pattern also seen on several narrower boards. This is caused by a carbide blade or a standard blade with a deep set (wide kerf) to the teeth or other causes. All of the other boards are circular sawn in widths of 5-3/4" to 8". Circular saw patterns show other subtle differences, but in several cases appear to indicate saw blades of a different diameter. Extensive measurements and data gathering would be necessary to formulate theories; laboratory analysis would be needed to add validity to any conclusions.

Condition: The 1988 replacement siding on the south side is in fair condition; north side siding ranges from poor to fair condition.

Describe Work: All siding is to be removed and replaced in kind (W-17, Sheet 2). Existing boards with vertical saw marks will be preserved and reinstalled.

Project Need: Siding must be removed to effect repairs to truss members. Siding is at the end of its service life.

Impacts: The siding as a whole lacks integrity of original materials, with only seven boards out of approximately 1200 boards showing vertical saw marks that could possibly be original to the bridge. Vertically sawn siding boards will be preserved; other siding will be replaced in-kind with rough sawn boards of varying widths.

Alternatives: There are no other practical repair alternatives that meet engineering requirements and the Secretary's Standards other than "replacement in-kind" and preservation of the presumed historic fabric.

Drawings: 7

Photos: 17-1 to 17-10

Drawing No. 7

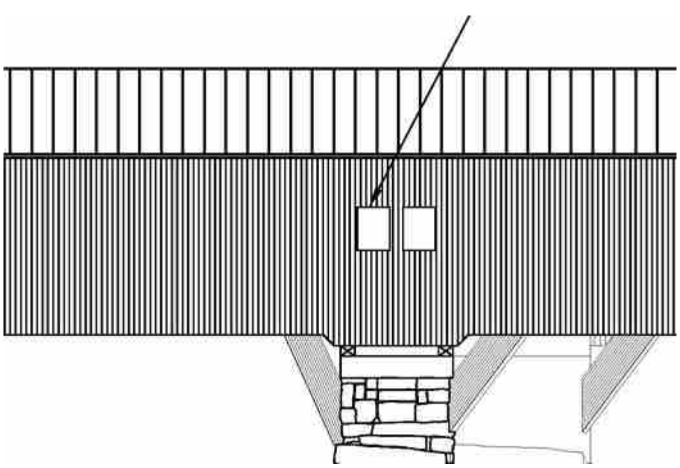


Photo No. 17-1

Photo No. 17-2 Siding S Pier 2 – Pier 3, Weathering

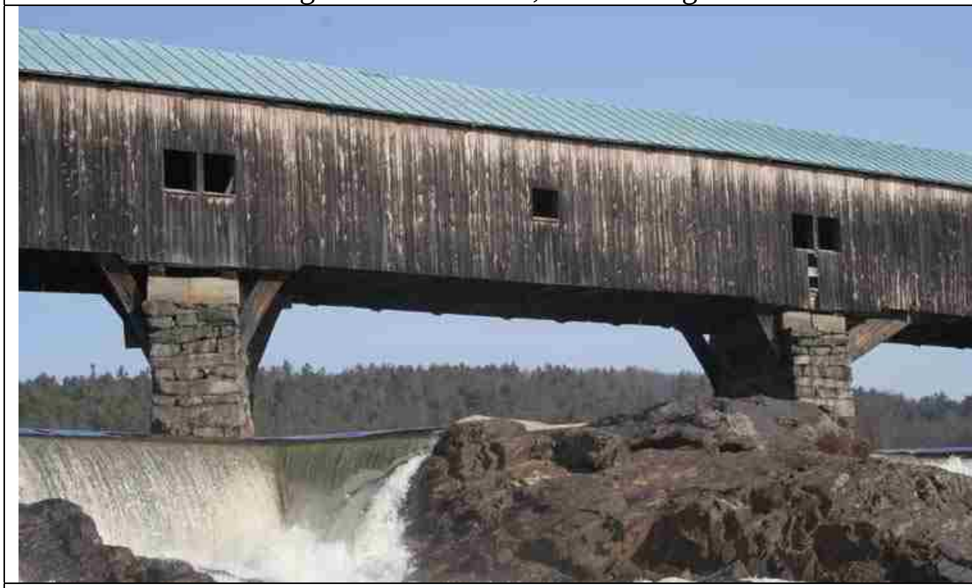


Photo No. 17-3 Siding S Bent 2 – 3, Weathering

Photo No. 17-4 Siding N East – Pier 3, Weathering

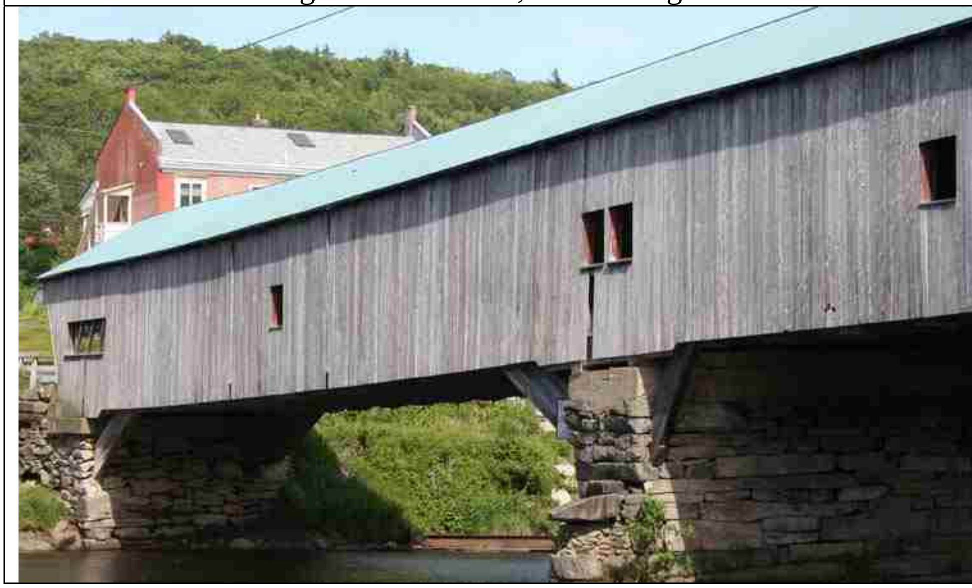


Photo No. 17-5: 15-1/2" & 10-3/4" boards @ Post N10-N11 w/ vertical saw marks

Photo No. 17-6: Detail of 15-1/2" board @ Post N10-N11 showing vertical saw marks

Photo No. 17-7: Post with vertical saw marks; siding board with circular saw marks

Photo No. 17-8: Vertical saw marks on diagonal considered original for comparison

Photo No. 17-9: Double circular saw marks (cross-hatch) on 9-.5" & 7.5" boards

Photo No. 17-10: Detail of cross-hatch saw marks on boards

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 18	**Feature**: Roofing

Total members: n/a	**Members affected**: all

Date: 1985	**Explain**: Installed by Graton in 1985 bridge rehab.

Description:
Modern but traditional-type galvanized steel sheet metal standing-seam roofing.

Condition:
Weathering, minor warping. Attachment to purlins is poor causing rattling noise during light winds. The lack of attachment to the roof will reduce the service life of the roof, however due to the method of installation; it is impossible to add the correct type of additional attachments due to the type of roof (4.1, HTA Engineering Report).

Describe Work:
Install new standing seam metal roof.

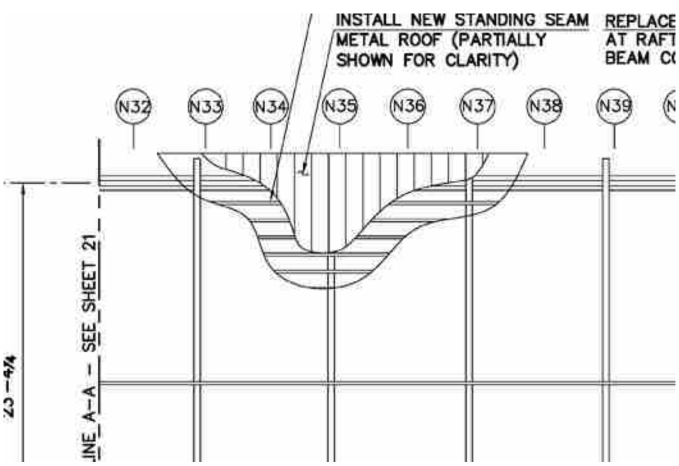
Project Need:
Roofing is approaching end of effective life. Roofing must be removed to effect repairs to roof system structural members and truss top chord members.

Impacts:
No impacts. The metal roof is not historic fabric or an original historic feature.

Alternatives:
A wood shingle roof, original to the bridge, would be impractical due to the additional dead load, cost, and fire hazard.

Drawings: 7, 21, 22, 23	**Photos:** 18-1

Representative Drawing: No. 22



Representative Photo: 18-1

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 19 | **Feature**: Added Arches

Total members: ~7520 Linear Feet (L.F.) | **Members affected**: ~ 1664 L.F. | See drawings noted

Date: 1918-19 | **Explain**: Bridge raised and rehabilitated by Boston & Maine Railroad

Description:
There are two separate arch systems in the bridge, the Built-in Arches and the Added Arches. The built-in arches are original to the bridge, integral with the vertical and diagonal truss members and bearing on the lower chords. The Added Arches were added during the 1918-1919 raising and rehabilitation of the bridge by Cyrus Batchelder, contractor. The Added Arches consist of three pairs of arches that spring from pockets in the three piers and the east abutment. The arches are built-up of horizontally laid, nail-laminated planks, 12 to 14 in number, approximately 9" wide by 2" thick, with some variations. The arches extend up through the floor, against the inside of the trusses, rising nearly to the top chord. Steel hangar rods extend through the arches to carry needle beams spaced roughly 8' apart, that extend under the lower chords to lend support (see separate sheet). The addition of the added arches to the bridge results in truss member forces being reduced by approximately half. This is a significant reduction in truss member forces that clearly illustrates the contribution that the added arches make to the bridge (HTA, Structural Analysis).

Condition:
Good condition with the exception of the two added arches between Piers 1 and 3 and portions of the integral arches near siding windows. The added arches are weathered on the downstream face, have very poor bearing on the piers and have begun to loose their shape as evidenced by the splitting of the laminations. The arches bearing on Pier one (1) are not well seated and, due to the steep slope of the arch, could slip or potentially fall off the pier (see HTA Engineering Report).

Describe Work: Existing bridge shall be jacked and braced as required to straighten, release stresses, plumb and re-align the trusses and arches (RS-3, Sheet 2). All existing members shown to be replaced are to be replaced "in-kind" with new members identical in dimensions and configurations as the members originally used in the covered bridge (GC-12, Sheet 2).

Project Need: As noted, the Added Arches provide important structural support to the trusses. Although not original to the bridge, the Added Arches are notable for their association with the modification of the bridge by the railroad and therefore can be considered a later alteration of historical significance.

Impacts: The Added Arches are features of the 1918-19 bridge rehabilitation but do not have any significant association with the original bridge design but are significant for their association with later strengthening improvements made to the bridge. Approximately 22 percent of the total linear feet of members making up the Added Arches require replacement. Members to be replaced will be replaced "in-kind" with wood members of the same size and workmanship.

Alternatives: Due to the laminated design of the arches, there are no other practical treatment alternatives that meet engineering requirements and the Secretary's Standards other than repairing the arches by splicing in new wood members in the place of those determined structurally inadequate.

Drawings: 47, 48, 49, 50, 51, 52 | **Photos:** See table below

Drawing No. 52

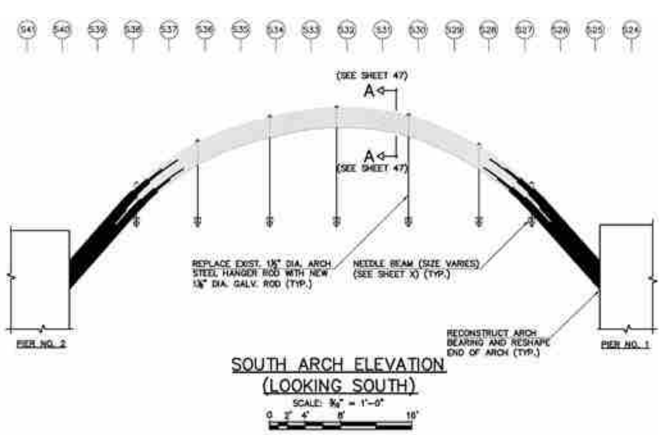


Photo No. 19-1

Table: Added Arch Photographs				
Member No.	**Date**	**Reason**	**Reason for Replacement**	**Photo No.**
S93 – S89	1918	B&MRR Rehab	Rot	not shown
S90 – S86	"	"	"	19-2
S87 – S82	"	"	"	19-3
S79 – S75	"	"	"	19-4
S75 – S70	"	"	"	not shown
S69 – S65	"	"	"	not shown
S61 – S54	"	"	"	not shown
S54 – S49	"	"	"	not shown
S49 – S44	"	"	"	not shown
S40 – S34	"	"	"	not shown
S40 – S34	"	"	"	not shown
S37 – S33	"	"	"	not shown
S33 – S30	"	"	"	19-5
S30 – S25	"	"	"	not shown
N59 – N54	"	"	"	not shown
N75 – N70	"	"	"	not shown
N58 – N54	"	"	"	19-6
N61 – N56	"	"	"	19-7
N36	"	"	"	19-8
S31	"	"	"	19-9
S31 Oblique	"	"	"	19-10

Photo No. 19-2 Added Arch S90 – S86 with flatter Built-in arch behind

Photo No. 19-3 Added Arch S87 – S82, knee braces cut and nailed to arch

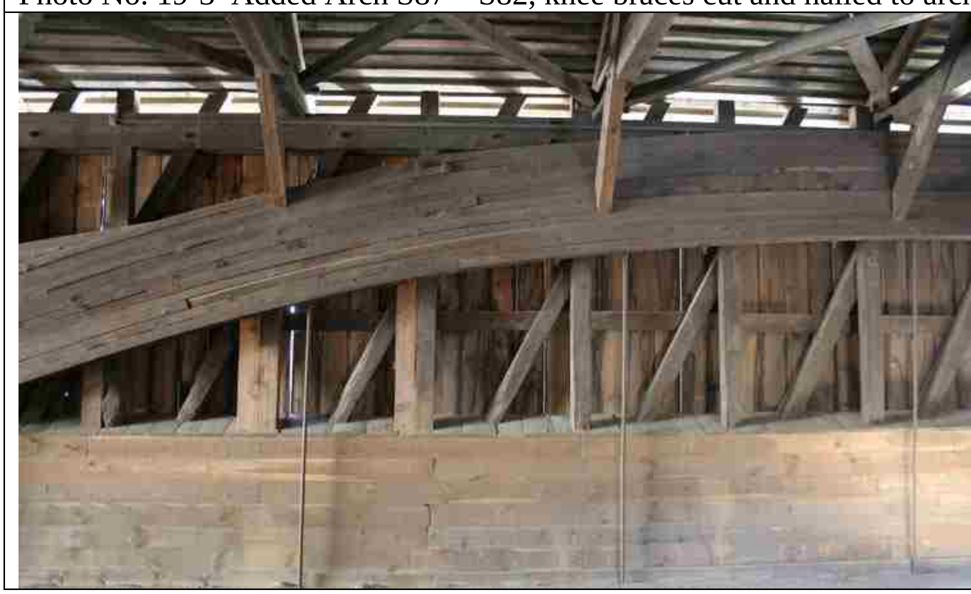


Photo No. 19-4 Added Arch S79 – S75

Photo No. 19-5 Added Arch S33 – S30, arch raduis deformed

Photo No. 19-6 Added Arch N58 – N54 above Built-in arch below

Photo No. 19- 7 Added Arch N61 – N56, arch raduis deformed

Photo No. 19-8 Added Arch N36, cracks in laminations

Photo No. 19-9 Added Arch S31, cracks in laminations

Photo No. 19-10 Added Arch S31 Oblique

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 20 | **Feature**: Needle Beam Hanger Rod

Total members: 52 | **Members affected**: all

Date: 1918-19 | **Explain**: Bridge raised and rehabilitated by Boston & Maine Railroad

Description:
A component of the Added Arch strengthening system added to the bridge during the 1918-1919 rehabilitation (see Added Arches sheet). Steel rod, 1 ½" diameter and of varying lengths, with threaded ends, washer and nuts, that extend vertically through vertical holes drilled through the Added Arches to carry transverse needle beams located below the deck. The needle beams are spaced roughly 8' apart and extend under the lower chords to lend support to the truss frame.

Condition:
Varying section loss due to corrosion.

Describe Work:
Replace with 1-1/8" galvanized steel rod in accordance with specifications.

Project Need:
Present rods do not meet design structural or service life requirements.

Impacts:
The Hangar Rods are features of the 1918-19 bridge rehabilitation. Rods are to be replaced in-kind.

Alternatives:
There are no other practical repair alternatives that meet engineering requirements and the Secretary's Standards other than "replacement in-kind."

Drawings: 36, 37, 38, 39, 40, 41, 47, 48, 49, 50, 51, 52 | **Photos:** 20-1

Drawing No. 50

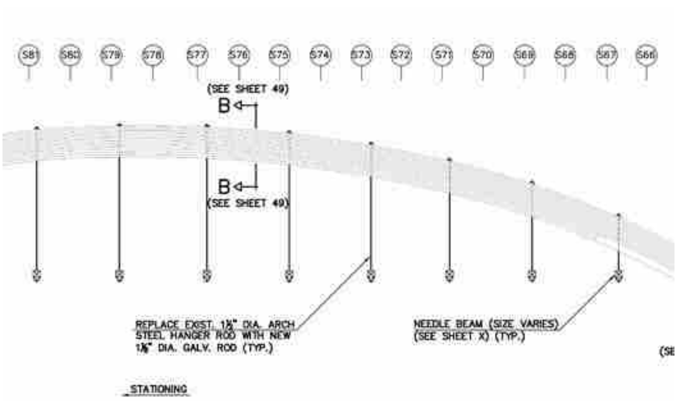


Photo No. 20-1

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 21	**Feature**: Needle Beams

Total members: 31	**Members affected**: 10	

Date: 1918-19	**Explain**: Bridge raised and rehabilitated by Boston & Maine Railroad

Description: A component of the Added Arch strengthening system added to the bridge during the 1918-1919 rehabilitation (see Added Arches sheet). Sawn timbers, 8"x8" suspended below the bridge deck by steel hangar rods attached to the Added Arches. The beams run transversely below the lower lateral bracing to directly support the chords on wood blocking or spacers as required.

Condition:
Needle beams identified for replacement exhibit structural deficiencies including rot and splits due to weathering.

Describe Work:
Replace existing needle beam with new 8” x 8” needle beam. All existing members shown to be replaced are to be replaced “in-kind” with new members identical in dimensions and configurations as the members originally used in the covered bridge (GC-12, Sheet 2).

Members requiring replacement:
N83–S83, N75–S75, N73–S73, N71–S71, N56–S56, N54–S54, N50–S50, N36–S36, N34–S34, N27–S27.

Project Need:
Members to be replaced do not meet project design structural or service life requirements.

Impacts:
The Needle beams are features of the 1918-19 bridge rehabilitation. The beams are to be replaced in-kind.

Alternatives:
There are no other practical repair alternatives that meet engineering requirements and the Secretary's Standards other than "replacement in-kind."

Drawings: 32, 33, 34, 36	**Photos:** 21-1

Drawing No. 32

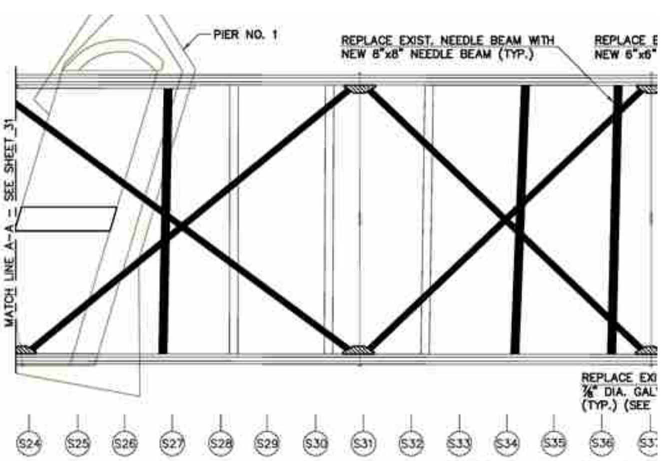


Photo No. 21-1

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 22	**Feature**: Timber Struts and Sleepers		
Total members: ~20	**Members affected**: all		
Date: 1918-19	**Explain**: Bridge raised and rehabilitated by Boston & Maine Railroad		

Description:
The struts are sawn 7 ¾" x 14" timbers at the west abutment acting as knee braces supporting the sleeper beams allowing for further cantilevering of the sleeper beams beyond the abutment. Sleepers are large dimension timbers that rest directly on the masonry abutments and piers. They serve as bearings and typically vary in dimension to accommodate irregularities in the pier. They may cantilever out from the substructure to shorten the span of the members they are supporting. Because they are usually in direct contact with the masonry, they are subject to rot and are considered sacrificial to protect the truss members they carry.

Condition:
The struts show cracking from drying and will be further evaluated for their structural integrity. Sleepers and bedding timbers are all in varying stages of decay, holding moisture and posing a threat of rot to structural members above them.

Describe Work:
Struts will be evaluated for replacement during construction. All Sleeper and bedding timbers are scheduled for replacement in-kind to the extent possible with treated timbers of both soft and hardwood. Low-profile reinforced concrete bearing seats will be installed on top of piers and abutments to provide a uniform and structurally sound bearing for the sleepers.

Project Need:
The bridge members must have structurally sound decay-free bearings.

Impacts:
The struts, bedding and sleeper timbers are assumed to be features of the 1918-19 bridge rehabilitation when the bridge was raised to increase clearance over the railroad tracks. They do not have any significant association with the original bridge design and are sacrificial elements of the design.

Alternatives: There are no other practical repair alternatives that meet engineering requirements and the Secretary's Standards other than "replacement in-kind."
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Drawings: 12, 35, 39 — **Photos:** 22-1 to 22-4

Drawing No. 35

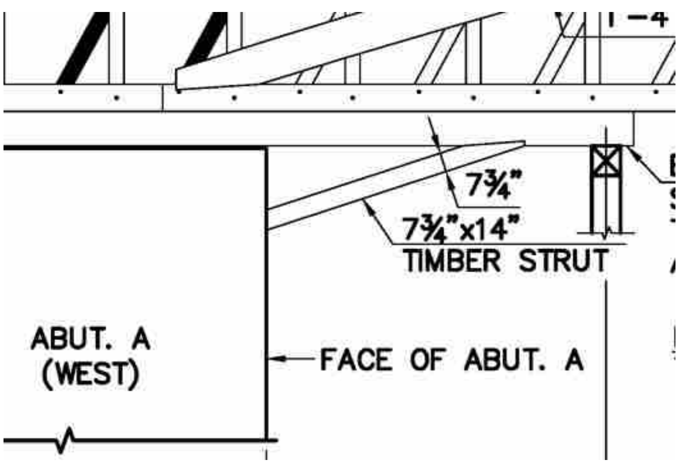

Photo No. 22-1

Photo No. 22-2 Sleeper North West Abutment, Drying Splits

Photo No. 22-3 Sleeper South West Abutment, Drying Splits

Photo No. 22-4 Sleeper North West Bent 1 – Bent 2, Drying Splits

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 23	**Feature**: Piers	
Total members: 3	**Members affected**: 3	
Date: 1831; 1852?	**Explain**: see below	

Description:
The three (3) river piers consist of largely dry laid stone with concrete caps and concrete toe wall. Piers 2 and 3 date to 1831 according to documentary evidence; they were constructed by Luther Butler for $1400. Prior to 1893 a new stone pier (designated Pier 1 for engineering purposes) was constructed under the westerly span. It may have been constructed when the White Mountain Railroad was built, passing under the west end of the bridge. Pier 1 has a concrete face and stone-filled wood cribbing sub-footing, while Piers 2 and 3 are founded on ledge. Concrete facing and caps were added to the piers and abutments when the bridge was raised in 1918-19.

Condition:
Piers 3 and 2 (easternmost pier and center pier respectively) are in poor to fair condition, while Pier 1 is in serious condition. Piers 3 and 2 are founded on ledge and Pier 1, which is not of original construction, is founded on partially exposed wood cribbing. All three Piers have varying amounts of vegetation growing in the joints with Pier 2 having a small tree growing out of the downstream face. All three Piers have some large stones and chinking stones missing. In 2006 Pier 1 was found to have two scour pockets measuring in excess of 8 s.f. that exposed the wood crib footing, missing stones, and cracks in the concrete toe wall around the base. Repairs to Pier 1 were made in 2007 to correct these deficiences. The arches bearing on Pier 1 are not well seated and, due to the steep slope of the arch, could slip or potentially fall off the pier (HTA Engineering Report).

Describe Work:
Remove all vegetation growth from seams of stones and apply herbicide to inhibit their growth. Cut flush all form ties from face of existing concrete. Remove 12"x12" wood support beams. Apply two coats of linseed oil at concrete surface. Chink entire stone face. Remove and replace all sleeper beams and bedding timbers with new 12" sleeper beams and 6 equally spaced 4"x12"x12" hardwood bedding timbers. Create new concrete pedestals for floor beams and truss bearings as part of bridge realignment. Reconstruct arch bearings; remove mortared stones and install new stone as needed.

Project Need:
The piers support the bridge and must have structural repairs to meet project design requirements.

Impacts:
Proposed repairs will be made consistent with the Secretary of the Interior's Standards for Rehabilitation.

Alternatives:
The repair methods will meet the Secretary's Standards therefore other alternatives were not considered.

Drawings: 15, 16, 17, 18, 19, 20	**Photos:** 23-1 to 23-6

Drawing No. 17

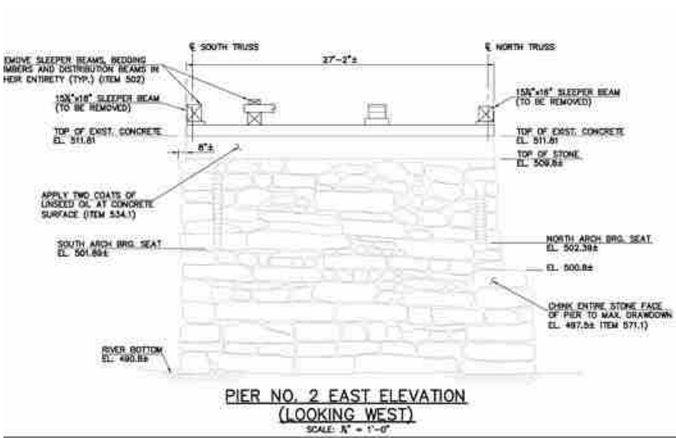

Photo No. 23-1

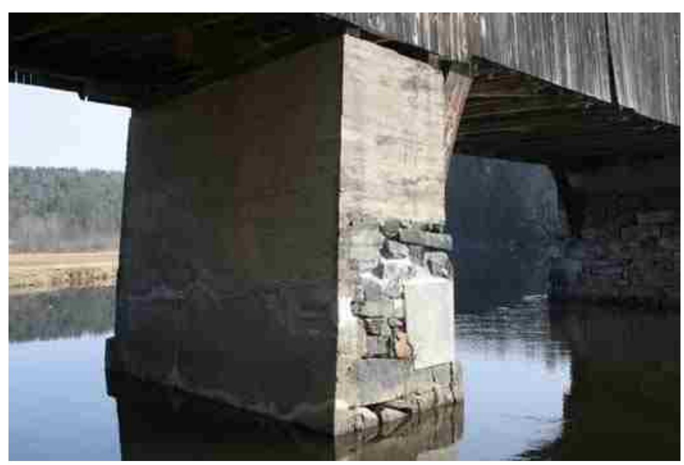

Photo No. 23-2 Pier 1 South (repaired 2007)

Photo No. 23-3 Pier 2 North

Photo No. 23-4 Pier 2 South

Photo No. 23-5 Pier 2 North

Photo No. 23-6 Pier 3 North

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 24	**Feature**: Abutments	
Total members: 2	**Members affected**: 2	
Date: 1831	**Explain**: see below	

Description:
The abutments and wingwalls are built with dry laid random rubble stone and date to the original construction of the bridge in 1831. Documentary evidence indicates they were constructed along with the piers by Luther Butler for $1400. Concrete caps were added to the abutments when the bridge was raised in 1918-19.

Condition:
Fair. Differential settlement, missing stones and evidence of loss of backfill.

Describe Work:
Replace missing stones with similar stones as required. Chink open joints on faces of abutment and wingwalls, compact loose fill behind wall stones. New stones shall closely match the color, texture and pattern of existing stones. Stones shall be approved by the resident engineer prior to use.

Project Need:
Abutments support the bridge and must have structural repairs to meet project design requirements.

Impacts:
Proposed repairs will be made consistent with the Secretary of the Interior's Standards for Rehabilitation.

Alternatives:
The repair methods will meet the Secretary's Standards therefore other alternatives were not considered.

Drawings: 11, 12, 13, 14	**Photos:** 24-1 to 24-6

Drawing No. 11

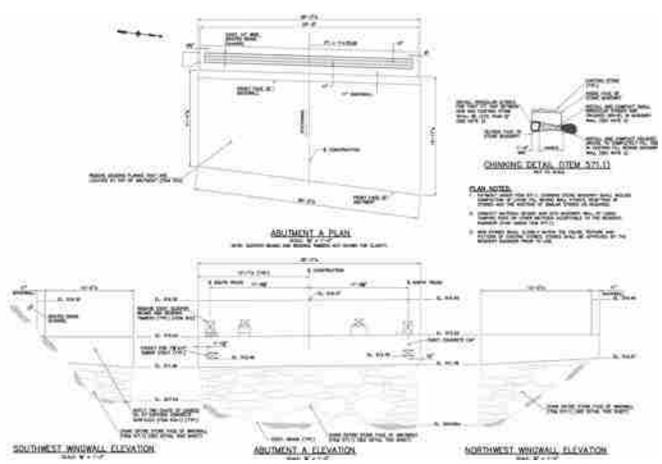

Photo No. 24-1

Photo No. 24-2 Abutment, West

Photo No. 24-3 Abutment, West

Photo No. 24-4 Abutment, East

Photo No. 24-5 Abutment, East

Photo No. 24-6 Abutment, East

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 25 | **Feature**: Timber Bents

Total members: 3 | **Members affected**: 2

Date: 1919 – 1941 | **Explain**: see below

Description:
Three timber framed bents support the west span. They were added during the 1918-1919 rehabilitation and raising of the bridge for the Boston & Maine Railroad. The bents are of typical construction, consisting of timber columns, bracing and cap beams, resting on a concrete footing.

Condition:
Ice from flooding on January 25, 2010 damaged Bents 1 and 2 while completely removing Bent 3 closest to the river. Bent 3 was replaced in-kind; repairs were made to Bent 2 in-kind with new timbers. Bent 1 is in poor condition.

Describe Work:
Bent 3 is new and will be retained. Bent 2 will be evaluated during construction and repaired or replaced. Bent 1 will be replaced in-kind.

Project Need:
The bents serve a structural purpose by adding supplemental support to the long west span.

Impacts:
The Timber Bents are features of the 1918-19 bridge rehabilitation. Members are to be replaced in-kind.

Alternatives:
The repair methods will meet the Secretary's Standards therefore other alternatives were not considered.

Drawings: 31, 35, 42 | **Photos:** 25-1, 25-2, 25-3, 25-4

Drawing No. 31

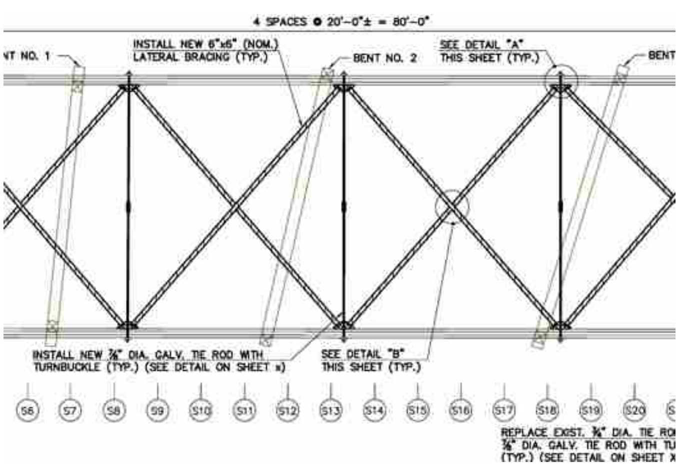

Photo No. 25-1

Photo No. 25-2 Bent 1

Photo No. 25-3 Bent 2

Photo No. 25-4 Bents 2 and 3, elevation

BRIDGE FEATURE INVENTORY & TREATMENT FORM

No. 26 | **Feature**: Interior Siding (or Wainscoting)

Total members: 2730 s.f. | **Members affected**: all

Date: 1996 | **Explain**: Replaced earlier wainscoting removed in 1987 – 1988 in the Graton rehab process.

Description:
1"x8" sawn lumber installed by town after 1988 bridge rehab. Also known as wainscoting or shelter panel. According to the U.S. DOT Covered Bridge Manual of April 2005, “this siding protects the ends of the primary structural members from splashing water from vehicles and windborne rain. The inside siding can effectively protect the timbers, but also makes it difficult to perform routine visual inspections in that portion of the structure. Further, the reduced ventilation around the truss members may actually accelerate rotting of the timbers” (USDOT, p. 69).

Condition:
Good.

Describe Work:
Boards to be removed to effect repairs to truss members. Engineer will likely recommend that wainscoting be left off. Town installed the current boards and may prefer that they be reinstalled.

Project Need:
Wainscoting must be removed to access and repair truss members.

Impacts:
No impacts: interior wainscoting is not historic fabric or a historic feature.

Alternatives: Not applicable.

Drawings: 6 | **Photos:** 6-8, 11, 14-16, 19-21, 24-31

Drawing No. 6

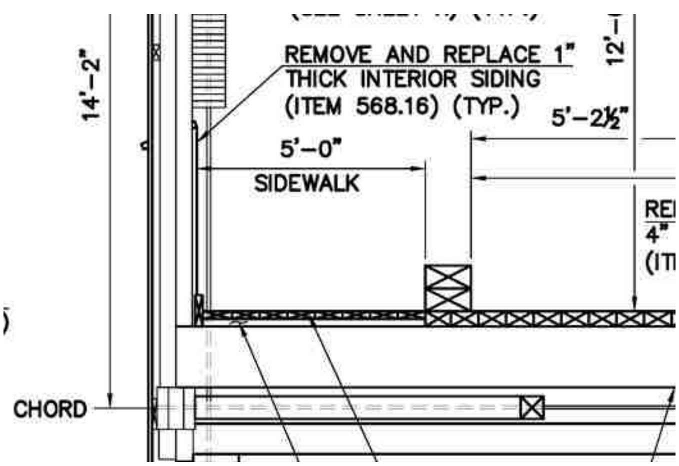

Photo No. 27