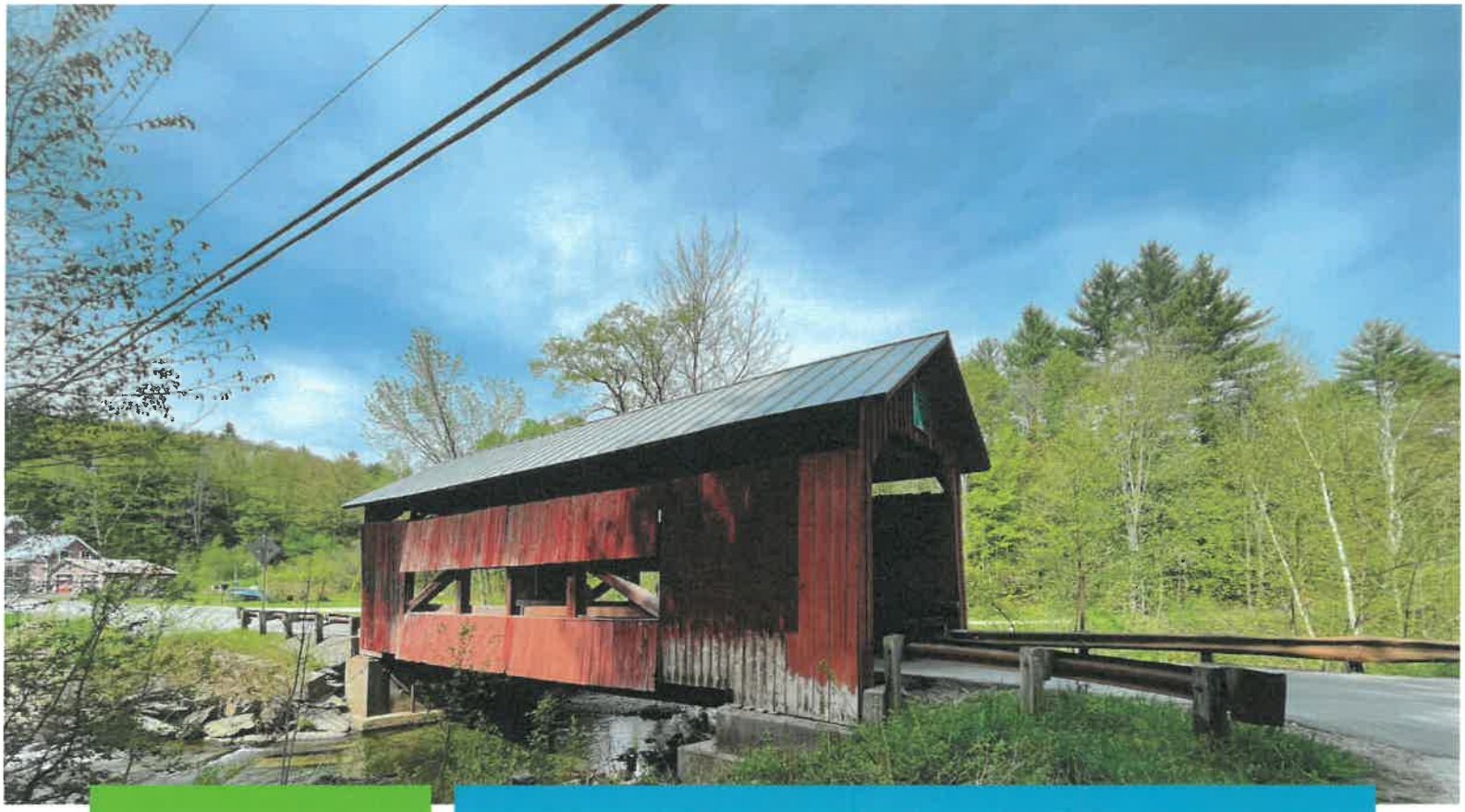

Draft Scoping Report
Upper Cox Brook Covered Bridge
Town Highway 3
Bridge 10 over Cox Brook

Northfield BO CVBR(7)

January 24, 2026

Prepared for:
Vermont Agency of Transportation

HOYLE TANNER

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Location Map

1. SITE INFORMATION

The Upper Cox Covered Bridge (Bridge No. 10) is a Town-owned bridge located on Town Highway 3 (TH-3), Cox Brook Road, located approximately 0.3 miles from the intersection with VT Route 12. The bridge is a 42'-1" long single span queenpost truss which carries one lane alternating traffic over the Cox Brook near the center of the Village of Northfield Falls. Northfield Falls is an unincorporated village in the Town of Northfield, VT. The bridge is one of five covered bridges in the Town of Northfield, the second highest concentration by town of such bridges in Vermont. The sign on the west portal states that the bridge was built in 1872. The VTrans Structure Inspection, Inventory and Appraisal Sheet indicates that the bridge was built in 1900.

Due to its historic and national significance, the bridge is currently listed on the National Register of Historic Places, a federal program that is administered by the National Park Service.

This scoping report was compiled after the review of multiple sources of data including topographic ground survey, lidar scanning, previous rehabilitation plans, VTrans Structure Inspection, Inventory and Appraisal Sheet, field measurements, and photographs taken during site visits by Hoyle Tanner personnel. The intent of this report is to evaluate structural deficiencies and to recommend a solution which best addresses the project's need. For purposes of this report, the substructure units are numbered sequentially from north to south and all members are wood unless noted otherwise.

Upstream Elevation Looking East

Roadway Classification:	Local Road, Class 2 Town Highway
Bridge Type:	Single Span Queenpost Covered Bridge
Bridge Length:	42'-1" feet
Bridge Skew:	17 degrees
Year Built:	1872, Rehabilitated in 1967 and 1979
Ownership:	Town of Northfield

The bridge has undergone numerous changes or additions throughout its history with various degrees of documentation. Two major and documented rehabilitations were completed in 1967 and 1979.

The 1967 rehabilitation plans noted the work shown below. Record drawings of this rehabilitation are not available, and it is not known if all this work was completed at that time.

- Realignment of the bridge by shifting it 4'-0" west at the north end of the bridge from its original location onto new concrete abutments.
- Straightening and plumbing of the trusses.
- Replacing parts of the floor system, including new 2"x6" nail laminated deck and 3"x12" nailing strips, two new 21WF62 interior steel beams, lateral bracing, and intermediate and end diaphragms.
- Installing two new 3"x8" timber guardrail sections on both sides of roadway within the bridge.

- Removing and replacing existing knee braces.
- Removing and replacing bottom chord on the upstream side.
- Removing and replacing two Queen Posts on upstream side.
- Installing new bearings for all beams, including the exterior steel beams.
- Applying wood preservative to flooring, blocking, bottom chord, upper truss, queen posts, barrier planks, and sheathing replacement timbers.
- Removing and reinstalling or replacing the existing siding as required to complete the work noted above.

The 1979 rehabilitation plans noted the work shown below. Record drawings of this rehabilitation are not available, and it is not known if all this work was completed at that time.

- Clean and paint support brackets.
- Clean and paint steel beams.
- Clean and paint steel knee braces.
- Clean and paint metal roof.
- Install new approach guardrail.
- Remove cracked bridge seat at south abutment and bearing caps at north abutment and replace with new concrete and steel reinforcing .
- Reinstall or replace loose or damaged siding.

South Portal Looking North

There is load restriction posted for the bridge of 6-Ton for a Single Axle, 8-Ton for a Tandem, and 11-Ton Gross weight. The bridge provides a horizontal clearance of 13'-7" between the trusses and 12'-6" maximum vertical clearance, with vertical clearance at the edges of the travel lane of approximately 9'-10". The vertical clearance signs on each approach to the bridge indicate a height restriction of 12'-0".

Cox Brook Road (TH-3) is oriented in a north to south direction within the project limits. Pierson Hill is located on the north approach and Horse Lane is located just south of the bridge. Pierson Hill (Private Road) and Horse Lane (Town Highway 87) (TH-87) are oriented north to south. The Upper Cox Covered Bridge is located approximately 0.3 miles west of the intersection of Cox Brook Road and VT Route 12.

Tangent weathering steel w-beam guardrail is used at all four approaches to the bridge. There are no crashworthy end units on the guardrail. Side slopes are generally level off the roadway except in the vicinity of the bridge. The north approach to the bridge intersects with Pierson Hill approximately 150' north of the bridge. There is also a paved driveway apron that splits into two gravel drives directly south of the bridge. There is no curbing on any of the approaches to the bridge. The approach grades to the bridge are relatively flat and stormwater generally sheet flows off the roadway.

a. Need

The Upper Cox Covered Bridge was last inspected by VTrans personnel on August 20, 2024. Hoyle Tanner personnel also inspected the bridge and performed in-depth field measurements and gathered field data for this Scoping Study on November 6 and 12, 2023. The bridge (superstructure, deck, substructure) is considered to be in poor condition, and several deficiencies have been noted. The following is a list of deficiencies of Bridge No. 10 and TH-3 at this location:

Private Drive at South Approach

Roof and Siding Members:

- Metal roof is in fair condition; however, removal and replacement will likely be required to provide access for the roof member replacements.
- There are leaks due to failing screw attachments of the metal roofing to the roof boards.
- The roofboards and rafters exhibit through splits, breaks, and rot. It is estimated that all the roofboards and 14% of the roof rafters will require replacement due to condition.
- The siding boards are in good condition; however, removal and replacement will likely be required to provide access for the truss member replacements.

Upper Lateral Bracing Members:

- The upper lateral bracing members exhibit splits, breaks, rot, and impact damage.
- The crossbeams have been hit by vehicles, causing impact damage and moving them off their vertical post seats.
- The knee braces have been previously damaged from oversized vehicles, and some are not well connected to the cross beams or truss members.

Truss Chord Members:

- Exterior vertical members on both the east and west trusses exhibit extensive rot and splits. Refer to Appendix E for deteriorated vertical members that were identified in need of replacement due to condition.
- Several nailers and vertical members have loose connections.
- End diagonal and bottom chords at the ends exhibit extensive rot, heavy weathering, and checking. Refer to Appendix E for deteriorated diagonal and bottom chord members that were identified in need of replacement due to condition.
- The top chord and vertical member between the two queen posts on the east truss exhibit extensive rot and require replacement due to the deteriorated condition.
- The moisture content of the truss members was measured to be a maximum of 50% in the lower portions of the trusses.
- Debris and dirt accumulate near the bearings between the truss and the siding.

Floor System Members:

- The steel beams have areas of heavy lamination and section losses up to ⅛" along the length of the flanges, and areas of complete section loss up to 18" long by 4" tall on the web at the bottom flange at the bearing.
- There are several locations where steel plates have been welded to the beams to repair areas of heavy corrosion and section loss, including a plate at approximately midspan of one beam. Some of the repair plates do not appear to be welded to the beams.
- Two pipe columns are being used to support one of the exterior and one interior beam at the north abutment.
- The deck is comprised of 2"x6" nail laminated timber and is in fair condition; however, removal and replacement will be required to provide access for the extensive floor member replacements.

Truss Bearing Blocks:

- The wooden bearing blocks exhibit heavy rot and decay at each end of the bridge.

Substructure:

- Both abutments exhibit some areas of concrete spalling, delamination, efflorescence staining, and vertical, horizontal and map cracking.
- The backwall at the south abutment has spalled and reinforcing steel is exposed.
- A section of the footing at the south abutment has spalled and broken off.
- The laid stone at the south abutment has voids at the interface with the concrete abutment and there is also a 6' deep void in the stones at the waterline.

General:

- The bridge lacks fire protection.
- The vertical clearance is substandard and there is evidence of vehicular damage at each portal.

b. Traffic

A traffic study of this site was performed by the Vermont Agency of Transportation. The traffic volumes are projected for the years 2029 and 2049.

Traffic Data	2029	2049
AADT	886	957
DHV	130	130
ADTT	64	82
%T	6.1%	7.2%
%D	50%	50%

c. Design Criteria

The design standards for this bridge project are the Vermont State Design Standards (VSDS), dated October 22, 1997. Minimum standards are based on an ADT of 957, a DHV of 130, and a design speed of 35 mph for a Local Road.

Design Criteria	Source	Existing Condition	Minimum Standard	Comment
Approach Lane and Shoulder Widths	VSDS Table 6.3	Varies (23' to 25' Total Width)	9'/2' (22')	
Bridge Lane and Shoulder Widths	VSDS Table 6.3	13' Between Trusses/0' (13')	9'/2' (22')	Substandard
Clear Zone Distance	VSDS Table 6.5	Varies (No Issues Noted)	12' Fill / 10' Cut	
Banking	VSDS Section 6.12	Varies	Low Speed Road – No Super Elevation Required	
Speed	VSDS Section 6.2	25 mph (Signed)	35 mph (Design)	
Horizontal Alignment	AASHTO Green Book, Table 3.10	R = ∞ over bridge	At e_{max} = 8%: super = 8%, R_{min} = 314' NC, R_{min} = 614'	
Vertical Grade	VSDS Table 6.6	2.54% over bridge	7% (Max) for Level Terrain	
K Values for Vertical Curves	VSDS Table 6.1	No Vertical Curve over Bridge Approach K = 26 Min	40 Crest / 50 Sag	Substandard
Vertical Clearance	VSDS Section 6.7	12'-6" Vertical Clearance Provided	14'-3"	Substandard
Stopping Sight Distance	VSDS Table 6.1	200'	225'	Substandard
Bicycle/Pedestrian Criteria	VSDS Table 6.7	No Shoulders	1' Paved Shoulder	Substandard
Hydraulics	VTrans Hydraulics Manual, Table 6.1	Passes 4% AEP (Q_{25}) storm event with X' of freeboard Clear Span: 39'-9"	Pass 4% AEP (Q_{25}) Storm Event with 1' of Freeboard Bank Full: X'	Surpasses Hydraulic Standards
Structural Capacity	Structures Design Manual, Ch. 3.4.1	Posted: Single Axle = 6 Tons Tandem = 8 Tons Gross = 11 Tons	Design Live Load: HL-93	Substandard

d. VTrans Inspection Report Summary

The ratings provided below are from the most recent inspection performed by VTrans in August 2024. The bridge is on a 24-month inspection frequency.

Deck Rating:	5 Fair
Superstructure Rating:	5 Fair
Substructure Rating:	7 Good
Channel Rating:	8 Very Good

From the Structure Inspection, Inventory and Appraisal Sheet:

The steel beams have rust scale throughout with developing section loss and the deck has moderate saturation throughout with scattered mildew staining. The boards are starting to split and check apart from decaying wood in the surrounding areas of the beams. The beams should be considered for extensive cleaning and painting and the deck will need replacing within the next few years.

e. Hoyle Tanner Field Observations

On November 6 and 12, 2023 a three-person inspection team from Hoyle Tanner visited the covered bridge to perform in-depth field measurements and gather field data for this Scoping Report. The roof framing members, upper lateral bracing, truss members above the deck, interior of the siding, deck, underside of the deck, truss members below the bridge deck, and steel beams were inspected using extension and folding ladders. Field observations were used as a basis for this report and expanded as appropriate. Lumber dimensions referenced throughout this report are nominal unless otherwise noted.

Several small wood samples were removed from the bridge on members that will be replaced for the purpose of species identification (see Appendix D).

Bridge Orientation Conventions

The truss upper chord is referred to as the top chord and the lower chord is referred to as the bottom chord. The bottom chord consists of two plies, which are denoted as plies "A" and "B". Ply "A" is the most exterior ply while ply "B" is the most interior ply. The node points are numbered from north to south with the northern most node point designated as 1 at the northern most end post member. Each consecutive node number is numbered in ascending order at each intersection of vertical members to the top chord.

i. Roof Framing and Siding

The roof framing consists of a standing seam metal roof on 1" thick roof boards with variable width which are supported by roof rafters. The roof rafters are 2" wide x 6" deep and are spaced at 2'-0" on center and supported on a rafter support beam that is 3" deep x 7" wide. The siding is ¾" thick (actual dimension) and is nailed to nailers attached to truss members.

The siding boards were not tested but assumed to be Eastern White Pine. The roof board wood species were also not tested but assumed to be Eastern Spruce and assigned a grade of Common Premium. The roof rafters were identified to be Eastern Spruce and assigned a grade of Select Structural. The grades were selected for structural analysis based on a visual examination of knots, checks, slope of grain of the wood and the growth rate characteristics of the wood.

Roof Ridge Cap

Splits and Breaks in Roof Boards and Rafters

The roof framing is generally considered to be in fair to satisfactory condition with the following deficiencies noted:

- The metal roof ridge cap is attached to the roof boards with nails and screws and is not mechanically field-seamed or watertight. There is some moss growth under the roof ridge cap.
- The roof boards and rafters exhibit through splits, breaks, rot and insect damage. Rafters sit on a 3"x7" rafter support beam.
- The siding boards exhibit areas of faded paint. The siding is in good condition; however, removal and replacement will likely be required to provide access for the extensive superstructure member replacements.

ii. Upper Lateral Bracing

The upper bracing consists of 6"x6" cross beams spaced at each truss vertical, which varies in spacing from 6'-10" to 9'-0", 2"x8" diagonal bracing between cross beams between Nodes 2 East & 2 West, 3 East & 3 West, 6 East & 6 West, 7 East & 7 West, and steel knee braces. Two ½" bolts connect the knee braces to the cross beams.

The upper bracing wood species were identified to be Eastern Spruce and assigned a grade of Select Structural based on a visual examination of knots, checks, slope of grain of the wood and the growth rate characteristics of the wood.

Split in Cross Bream

Broken Connection at Cross Beam and Diagonal

The upper lateral bracing members are generally considered to be in fair to satisfactory condition with the following deficiencies noted:

- Two cross beams exhibit splits. One of the split cross beams is also broken at a connection to a diagonal bracing member.
- Cross beams have been previously damaged from oversized vehicles and are not well connected to the vertical truss members.
- Some of the steel knee braces on the east truss have moderate section loss.

iii. Trusses

West Queenpost Truss

The queenpost truss has a central panel that is comprised of two chords (a single top and single, longer bottom chord), which are connected outside of the queen post vertical members by diagonal members. The bottom chord members have multiple splices along their length. Most of the steel connectors at splices exhibit rusting and section losses.

The top chord is 14'-0" long and the bottom chord is 45'-9" long and support a roof length of 53'-1". The clear span from face of south abutment to face of north abutment is approximately 40' long. Top chord truss members consist of a single member, varying in size from 9⅝"x9⅝" to 9¾"x9¾", and built-up bottom chords consisting of two 6"x12" plies. Truss diagonal members consist of single timbers varying in size from 9⅝"x9⅝" to 9¾"x9¾". Truss vertical members consist of 6"x6" single timber columns.

The truss chord members' wood species were identified to be Eastern Spruce. All truss members have been assigned a grade of Select Structural for the structural analysis based on a visual examination of knots, checks, slope of grain of the wood and the growth rate characteristics of the wood.

The truss members are generally considered to be in poor condition with the following deficiencies noted:

Top Chord Members:

- The top chord of the east truss exhibits extensive rot and needs replacement due to its deteriorating condition. Refer to Appendix E for deteriorated chord members that were identified in need of replacement due to condition.
- The top chord of the west truss is in satisfactory condition with no deficiencies noted at the time of inspection.

East Truss Top Chord Rot

Bottom Chord Members:

- The bottom chord on the west truss had excessive moisture at the north abutment, with readings up to 50% moisture.
- Ply B of the bottom chord of the east truss is split at the notch for the diagonal member bearing on the bottom chord at the south abutment.
- Both plies of the west truss bottom chord at the north abutment are rotted with up to 50% moisture content.
- The through bolt at node 7 West has extensive section loss with a reduced diameter of 0.6" remaining.

North End of the East Truss Bottom Chord to Diagonal

Diagonal Members:

- All of the diagonals exhibit heavy weathering and checking.
- The northwest, northeast, and southeast diagonals have excessive rot and moisture content up to 50% at the end near the connection to the bottom chord.
- The bearing of the diagonal members are notched at the interface with the bottom chord. There is a 4' long x ⅜" wide split in the bottom of the southeast truss diagonal at the bearing location of the bottom chord, resulting a bearing width of only ¾" at the lower notch. There is also a 3" gap between the end of the upper notch of the diagonal and the bottom chord.

Vertical Members:

- The vertical members exhibit rot, heaving checking, and splits. Several cross beams are not bearing on the vertical post members.
- Several vertical members on the east truss have holes up to ¾" and cutouts for an old knee braces.
- Many of the nailers are not connected to the vertical members and are loose.

- Several vertical post members are excessively rotted and need replacement due to their deteriorated condition. Refer to Appendix E for deteriorated chord members that were identified in need of replacement due to condition.

iv. Floor System

The floor framing consists of two exterior 24WF100 and two interior 21WF62 longitudinal steel beams spaced at 3'-8" on center, transverse 2"x6" nail laminated deck boards placed edgewise, and longitudinal 1½" thick runner planks across the entire deck. There are 15W33.9 steel diaphragms at the midspan and beam ends.

The nail laminated deck board wood species was identified to be Southern Pine. The runner planks are not shown in the 1979 plans and are assumed to be Eastern Spruce. The nail laminated deck board members have been assigned a grade of No. 1 for the structural analysis based on a visual examination of knots, checks, slope of grain of the wood, and the growth rate characteristics of the wood.

Interior Beam Rusting

The floor system members are generally considered to be in poor condition with the following deficiencies noted:

- The runner boards are in good condition.
- The flanges are clipped at the abutments to accommodate the skewed centerline of bearing.
- The exterior beam on the west side (B1) has areas of section loss at the north abutment and at midspan that has been repaired using steel plates. The plate at the abutment does not appear to be welded. There is section loss up to ⅛" along the bottom flange for the entire length of the beam.
- The western interior beam (B2) has heavy laminar corrosion at both faces of the bottom flange along the entire length of the beam. There is a hole in the web at the south abutment up to 18" wide x 4" tall.
- The eastern interior beam (B3) has heavy laminar corrosion at both faces of the top and bottom flanges along the entire length of the beam.
- The exterior beam on the east side (B4) has areas of section loss at the north abutment up to ⅛" and has heavy laminar corrosion at both faces of the top and bottom flanges along the entire length of the beam.

f. Truss Bearing Blocks

The truss bearing blocks consist of 6"x10" hardwood blocks with varying length that sit on 2"x6" blocking at each end of the bridge as described in 1967 plans and as measured in the field.

The truss bearing blocks are considered to be in poor condition with the following deficiencies noted:

- The wooden bearing blocks exhibit extensive rot and need to be replaced.

g. Substructure

The bridge substructure consists of two concrete abutments. It is not clear if original abutments were constructed with stone masonry and encased with concrete during previous undocumented rehabilitations. Both bridge abutments have areas of exposed ledge outcrop in front of them and abutments bear on ledge. The channel bed consists of ledge and large cobbles.

North Abutment

The abutments are considered to be in good condition with the following deficiencies noted:

- Both abutments exhibit some areas of concrete spalling, delamination, exposed rebar, efflorescence staining, and vertical, horizontal, and map cracking.
- At the spalled areas the concrete was observed to contain rebar.

h. Wood Species Identification

Eight small wood samples were removed from the bridge for the purpose of species identification. The samples were taken from deteriorated members that will most likely be replaced during the course of potential bridge rehabilitation or from non-critical sections of the members. To identify the wood species, the samples were sent to Doug Gardner, Ph.D., a Professor of Forest Operations, Bioproducts, and Bioenergy, at the University of Maine at Orono. A summary of the species identification can be found in Appendix D.

i. Hydraulics

Upstream Channel with Exposed Bedrock

The bridge crosses over the Cox Brook which flows primarily west to east at the bridge site. A hydraulic study at this location was completed on February X, 2026 by Hoyle Tanner. The preliminary findings indicate that under the current conditions, there is XX.X' and XX.X' of freeboard during the 4% (Q_{25} flood event) and 1% (Q_{100} flood event) storm event, respectively. The Q_{100} storm event is defined as a flood having a one percent (1%) chance of being met or exceeded in any given year (base flood designation Q_{100}). The Q_{25} storm event is defined as a flood having a four percent (4%) chance of being met or exceeded in any given year (base flood designation Q_{25}). The existing bridge opening has sufficient hydraulic capacity to pass the 1% storm event flow with adequate freeboard.

The primary purpose of the hydraulics section is to determine if the rehabilitated covered bridge is at an elevation high enough to provide adequate freeboard during the 100-year flood event. The existing bridge opening has sufficient hydraulic capacity to pass the 1% storm event flow with adequate freeboard.

j. Utilities

The VTrans Utilities and Permits Unit will investigate the required relocation of existing utilities within the project limits during the design phase of project development. The existing utilities identified based on the site visit are as follows:

Aerial Utilities

- Overhead utility lines (power and telecommunication) cross Cox Brook on the upstream (west) side of the bridge.
- A service line runs across the road at the Pierson Hill intersection.

An aerial utility relocation plan will be needed if a temporary bridge is selected for the traffic control.

k. Right-of-Way

The existing Right-Of-Way (ROW) is shown on the Layout sheet in Appendix E. It is anticipated that temporary and permanent easements will be required to construct the proposed project.

l. Resources

The biological, historic, archaeological, hazardous material and stormwater resources present at this project are shown on the Resource Site Plan Sheet in Appendix E and are based on information provided by VTrans. See Appendix E for Resource Site Plan Sheet and Appendix I for Natural Resource ID memo.

i. Biological

Wetlands/Watercourses

Upper Cox Covered Bridge crosses over the Cox Brook, a tributary of the Dog River, and a watercourse regulated by the US Army Corps of Engineers.

There are no wetlands within the review area.

Wildlife Habitat

This area has three habitat blocks adjacent to the project area and ranks high for surface water riparian community connectivity and has a high priority connectivity block adjacent to it. Aquatic Organism Passage (AOP) will be prioritized by the design team.

Rare, Threatened and Endangered Species

The only listed species within the review area is the wood turtle (Glyptemys insculpta). It has not been recorded under Bridge 10, but it has been spotted under Bridge 15 and the watercourses are connected. A wood turtle survey should be conducted.

Also listed within the review area is the federally endangered northern long-eared bat, however it was determined that this location may effect, not likely to adversely effect the northern long-eared bat, and no critical habitat was located near the bridge location.

Agricultural

The review area noted prime statewide and prime agricultural soils were mapped in the vicinity and around the project location.

ii. Historic

One Historic resource was identified within the immediate project area. The historic resource is considered a Section 4(f) property and is as follows:

- Bridge No. 10 (Upper Cox Covered Bridge) which is individually listed in the National Register of Historic Places (NRHP) and it remains significant under Criterion C.

The Upper Cox Covered Bridge was listed on the National Register of Historic Places on October 1, 1974 (National Register of Historic Place Inventory Nomination Form). The project was initially presented at the Historic Covered Bridge Preservation Committee (HCBPC) meeting on September 4th and 12th, 2024. The committee reviewed the proposed project based on the Historic Covered Bridge Preservation Plan and Section 106 review process set forth by the National Historic Preservation Act of 1966, as amended, and the Advisory Council on Historic Preservation's Procedures for the Protection of Historic Properties (36 CFR 800c) and recommended replacing the existing beams with steel beams. They did not recommend an alternative based on live loading.

iii. Archaeological

The VTrans archaeological unit will investigate the project limits during the next phase of project development to determine any archaeologically sensitive areas.

iv. Hazardous Materials

According to the Vermont Agency of Natural Resources (VANR) Vermont Hazardous Sites List, there are no hazardous waste sites or hazardous waste generators related to the vicinity of the project location. See the figure below for a map of Hazardous Sites. The project area also does not show in the VT Hazardous Waste Urban Soils Map.

v. Stormwater

There are no stormwater concerns at this site. The project area is relatively flat with no roadway curbing and stormwater runoff involves overland flow into Cox Brook.

2. SAFETY

There have been no reported crashes along Cox Brook Road in Northfield within the last 5-year period.

There are no High Crash Location segments located within the project area.

3. COMMUNITY NEEDS AND CONSIDERATIONS

A community questionnaire was sent to the Town to fill out. The town noted seasonal visitors to the bridges in the summer months, including bus tours, but the slow season is considered winter and spring. For a long-term closure, emergency services and school buses would take a 4-mile Class 4 town road detour. Cox Brook Road connects Northfield to Berlin and Moretown, so users would need to take the same detour as emergency services, which is a gravel road and not designed for significant traffic. The town noted significant numbers of bicycle and pedestrian users on the bridge, which should be accommodated during construction. There were no known instances of flood waters impacting the bridge.

The Local and Regional Input Questionnaire can be found in Appendix J.

Public involvement for this project included a Local Concerns Meeting and Alternatives Presentation Meeting held in-person and as summarized below.

a. Local Concerns Meeting

A Local Concerns Meeting was held on March 26, 2024, at the Brown Public Library. Attendees included the Northfield Selectboard, VTrans and Hoyle Tanner personnel, and members of the public. The Local Concerns Meeting was regarding three different covered bridges that were inspected by Hoyle Tanner. Many of the discussion topics were applicable to all three bridges. The following were discussed:

- *Oversized Vehicles:* The bridge has substandard vertical clearance. Despite warning signs, oversized vehicles have repeatedly crossed the bridge, hitting and damaging the upper lateral bracing and cross beams. Many residents expressed concern about this and asked about mitigation measures that could be taken to deter oversized vehicles from using the bridge, including an over-height bar, cameras, alerts in map apps, and increasing the vertical clearance in the bridge. Over-height bars can be a safety concern if they are rigid, but a swinging bar could be an option. There are many mapping apps and it is difficult to get alerts in all apps that the traveling public use.
- *Enforcement:* The Town is responsible for enforcing load restrictions on any Town structure currently posted.
- *Guardrail and Signage:* It was noted that the approach guardrail is in poor condition, and the approach signing is covered by foliage. The Town is responsible for maintaining approach guardrail and clearing vegetation.
- *Bridge Closure During Construction:* There was a question about how long the bridge would be closed during construction. The bridge would be closed for an entire construction season. The shortest route around is Cox Brook Road, to VT Route 12, Water Street, Union Street, Union Brook Road, and Aseltine Road, and back to Cox Brook Road which has an end-to-end distance of 6.1 miles. Several concerns were bought up at the meeting about the detour route. Participants

expressed concern that Aseltine Road is not well maintained. It was noted that in the past, Pearson Hill was connected to Dunham Drive as a temporary detour. These will be investigated during the scoping process. Because this is a Town owned structure, the Town would ultimately be responsible for choosing and signing the detour route according to the Manual on Uniform Traffic Control Devices (MUTCD). VTrans often encourages Towns to reach out to our district offices for questions regarding what signs are required and where they should be placed. The Town would also be responsible to obtain permits from VTrans Operations Bureau for any signs that would be placed within the State Right-of-Way. The requirements for the detour will be detailed in the Finance and Maintenance Agreement.

- *Temporary Bridge:* A resident expressed interest in a temporary bridge option. A temporary bridge could be installed for access during construction, but the site conditions would make turning movements difficult to meet design standards.

b. Alternatives Presentation Meeting

An Alternatives Presentation Meeting was held on March X, 2026 at the Brown Public Library. Attendees included the Northfield Selectboard, VTrans and Hoyle Tanner personnel and members of the public. The following were discussed:

- Discussion Topics

4. MAINTENANCE OF TRAFFIC

In accordance with Vermont Agency of Transportation guidance this project was reviewed to determine suitability for the Accelerated Bridge Program which focuses on faster delivery of construction plans, permitting, and Right-of-Way, as well as faster construction of projects in the field. One practice that will help in this endeavor is closing bridges for portions of the construction period, rather than maintaining traffic on a portion of the existing bridge during construction or providing temporary bridges. In addition to minimizing project costs, the intention is to minimize the closure period with accelerated construction techniques and incentives to allow contractors to complete projects sooner. The Agency will consider the closure option on most projects where rapid reconstruction or rehabilitation is feasible.

a. Off-Site Detour

This option would close the bridge and reroute traffic onto an offsite detour. Since the bridge is located on a Class 2 Town Highway, it would be the responsibility of the Town of Northfield to choose the preferred detour route and to sign it according to the MUTCD manual. If the preferred detour route goes through an adjacent Town, it will be the responsibility of the Town of Northfield to coordinate with that Town.

The most likely detour route has an end-to-end distance of 6.1 miles and adds 4.8 miles to the through route. This route is as follows:

- Cox Brook Road, to VT Route 12, Water Street, Union Street, Union Brook Road, and Aseltine Road, and back to Cox Brook Road (6.1 mi end-to-end)

Advantages: This option eliminates the need for a temporary bridge to maintain traffic during construction, significantly reducing both construction time and cost. It also minimizes impacts to adjacent properties and environmental resources. Overall, this approach lowers project expenses and duration during both design and construction phases. Additionally, it provides the safest traffic control method by removing the traveling public from the active construction area.

Disadvantages: Traffic flow would not be maintained through the project site during construction. Additionally, the detour route contains portions of Class 4 Town Highways which typically are narrow, steep, and not well maintained.

Due to the above-mentioned disadvantages of an off-site detour, it is not recommended that this option for maintenance of traffic be utilized for this project.

b. Temporary Bridge

From a constructability standpoint, a temporary bridge could be placed on the upstream side of Upper Cox Covered Bridge. A temporary bridge on the west side would have impact on aerial utilities that would require relocation and would require additional tree clearing.

If a temporary bridge is utilized, borings should be drilled at the temporary abutment locations.

Based on the daily traffic volumes and length of the bridge, a one lane alternating temporary bridge would be recommended.

Advantages: A temporary bridge will maintain traffic flow through the project corridor during construction. A temporary bridge is considered safer during construction than phased construction.

Disadvantages: This traffic control option would be costly and time-consuming, as additional time is needed to construct the temporary bridge and approaches.

Due to the above-mentioned advantages of a temporary bridge, and the disadvantages associated with an off-site detour, it is recommended that this option for maintenance of traffic be utilized for this project. The Cost Matrix, shown in Section 6 below, includes the temporary bridge cost in the Bridge category subtotal and overall project costs. By using a temporary bridge instead of an off-site detour, the Town's share of the construction costs is 5%.

c. Phased Construction

Another method of maintaining traffic along a corridor during construction is to build a new structure one lane at a time, or in phases.

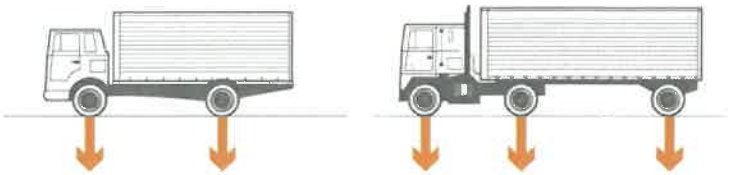
Advantages: This would maintain traffic along the existing corridor during construction.

Disadvantages: Typically, the time required to construct a phased construction project is longer than a project constructed without phasing, because some of the construction tasks must be performed multiple times and cannot be performed concurrently. The costs of construction also increase over unphased work because of this increase in the length of time, the additional inconvenience of working around traffic, and the effort involved in coordinating the joints between the phases.

The existing bridge is a one-lane structure with a 13'-7" width face of truss to face of truss typical. This does not provide enough width to phase construction and the type of construction required for covered bridges does not allow phasing of work. As such, phased construction is not feasible and will not be considered further.

5. ALTERNATIVES DISCUSSION

a. Structural Analysis



H Truck on the left, HS Truck on the Right

A structural analysis and load rating was performed of all primary live load carrying members of the bridge superstructure. Superstructure roof framing members were also checked for the applied wind, snow, and dead loads. The Service Load (Allowable Stress) Rating method was used for all members in accordance with the provisions of the American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Highway Bridges, 17th Edition, AASHTO Manual for Bridge Evaluation Third Edition with 2019 Interim Revisions (MBE), and the 2010 VTrans Structures Design Manual. The bridge was rated to determine the allowable rating vehicle in terms of H Truck, which is a truck with two axles spaced at 14 feet with 20% of the load on the front axle and 80% on the rear axle. Per the scope of services, the bridge was rated for four AASHTO live load: H15 (15 tons), HS15 (27 tons), H20 (20 tons) and HS20 (36 tons). All structural members were rated for single lane loading configurations. The controlling live load force effect for each AASHTO live load was taken as the maximum of the design truck or the lane load. Excel spreadsheets, MIDAS bridge design software, MathCAD computer program, and hand calculations were utilized to calculate the as-inspected section properties, capacities, and load rating values.

Since the timber floor system was previously replaced with steel beams, the timber trusses of the bridge only carry their own self-weight, wind loads, and snow loads. The steel beams support their own self-weight and the vehicular live loads. To differentiate these two different types of loadings in the ratings below, live-load carrying members are reported in terms of Load Factors, while non-live-load carrying members are reported in terms Performance Factors.

For the floor system (steel beams and decking) the inventory rating was determined by combining the maximum effects of live load with the dead load effects compared to the allowable inventory stress levels, while the operating rating was determined by combining the maximum effects of the live load, dead load, and snow load (as applicable) as compared to the higher operating stress levels.

Allowable stress values for wood members were obtained from the 2018 National Design Specification for Wood Construction and Supplement (NDS). The wood species used in the superstructure was identified through testing. The grade assigned to each member was based on a visual examination of knots, checks, slope of grain of the wood, and growth rate characteristics of the wood. All superstructure members are wood unless noted otherwise. The substructure was not analyzed as part of the load rating since it was not expected to control the load rating of the bridge.

The steel beams were analyzed using the Load Factor Method (LFR) per the MBE. A refined analysis using a grillage model was used to account for the variable stiffness of the beams. An as-built and as-inspected model were created and enveloped and the largest dead load moment and live load moment were used for each beam. The inventory rating was determined by combining the maximum effects of the dead and live load effects compared to the allowable inventory stress levels, while the operating rating was determined by combining the maximum effects of the dead and live load (as applicable) as compared to the higher operating stress levels.

Our initial recommendations for repair or replacement of each member are detailed in the following sections. These were reviewed by the Historic Covered Bridge Preservation Committee (HCBPC) so the structural and historical issues could be weighed to determine a rehabilitation live load that met the project goals, while preserving as much of the original fabric of the covered bridge as possible. We have also identified the priority treatment number (PTN) from the Historic Covered Bridge Preservation Plan to aid in review of the recommendations.

It should be noted that not all members to be replaced can be identified based on our inspection due to inaccessible areas (i.e. top-face rafters, etc.). The estimate of cost in this study includes an additional amount of conditional replacement based on Hoyle Tanner's experience with similar structures to determine an appropriate budget for the project.

Roof Framing

Analysis

The roof rafters and roof boards were analyzed for dead load, wind load (8.7 pounds per square foot (psf) upward on the windward roof and 13.8 psf uplift on the leeward roof) and a ground snow load of 60.0 psf (30.8 psf roof applied) per the 2015 Vermont Fire and Building Safety Code snow load and the 2022 ASCE 7 Minimum Design Loads for Buildings and Other Structures. Our structural analyses showed that roof boards and rafters are adequate for the applied dead, wind, and snow loads (22% utilized for the roof boards and 41% utilized for the roof rafters).

Recommendations

The existing standing-seam metal roof is in fair condition, although the ridge cap is attached with nails and screws which allow water to seep into the bridge over time. During rehabilitation, the existing metal roof would most likely be damaged by the removal of certain truss and roof members will need to be replaced. We recommend that the entire metal roof, all roofboards, and 14% of the rafters be replaced in-kind (Priority Treatment No. 2) (PTN 2) due to condition. Roof boards are 1" thick Eastern Spruce and rafters are 2"x6" Eastern Spruce. These roof framing recommendations apply to Alternatives 1 through 5.

Upper Lateral Bracing

Analysis

The existing upper lateral bracing, which consists of diagonal braces, cross beams, and steel knee braces, was analyzed for wind loading in conformance with ASCE 7-22. A grade of Select Structural was assigned to all upper lateral bracing wood members based on a visual examination of the wood. A portion of the lateral wind load based on the tributary area is applied to the existing upper later cross beams. The analysis showed the diagonal bracing system is not adequate to keep the bridge square and plumb and to resist code required wind loads.

Recommendations

The following recommendations are expected to improve and strengthen the upper lateral bracing:

- Replace all seven upper bracing members in-kind (PTN 2).
- Replace two cross beams in-kind due to condition (PTN 2).
- Replace all steel knee braces with timber knee braces (PTN 2).

These upper lateral bracing recommendations apply to Alternatives 1 through 5.

Trusses

Analysis

The Queenpost Truss members were assigned a grade of select structural based on a visual examination of the wood.

The trusses were analyzed to determine their current and proposed dead load capacity. A 2-Dimensional bridge computer model of the Queenpost Trusses was utilized for structural analysis.

To determine the current capacity of all truss members, full dead and snow loads were applied and compared to allowable stress levels. See Table 1 below for a summary of all members rated.

Table 1 – Queenpost Truss Members Rating Summary

Member	No. of Members – Size	Performance Factor[1]
Top Chord	1 – 10"x10"	4.35
Bottom Chord	1 – 12"x12"	1.95
Queenpost (Vertical 2)	2 – 10"x10"	6.06
Diagonals	2 – 10"x10"	3.21
Verticals	5 – 6"x6"	6.90

1. Performance factors greater than 1.0 indicate that the member has sufficient capacity to safely carry the design loads.

To determine the current capacity of all truss member connection details, full dead and snow loads were applied and compared to allowable stress levels. See Table 2 below for a summary of all member connection ratings.

Table 2 – Member Connections Rating Summary

Connection #	Location	Performance Factor[2]
Connection #1	Vertical, Top Chord, and Diagonal	2.41
Connection #2	Diagonal and Bottom Chord	2.13
Connection #3	Vertical and Bottom Chord	1.0
Connection #4	Bottom Chord Splice, East Truss	2.60
Connection #5	Bottom Chord Splice, West Truss	1.0

2. Performance factors greater than 1.0 indicate that the member has sufficient capacity to safely carry the design loads.

Recommendations

Since the truss members are not carrying any live load and all rate over 1.0, the removal and replacement of the truss members is due to condition and the same for all alternatives (PTN 2). See Appendix E for members that are required to be replaced. Some members that do not need to be replaced can be

repaired with epoxy injection into the large splits or to fill in areas where rot has been removed. These recommended repairs can be applied to all alternatives to lessen further splitting and deterioration to these members (PTN 1).

Some connections will require strengthening to meet sufficient capacity to safely carry design loads.

Recommendations for member replacements are detailed below.

East Truss member replacements:

- Replace verticals at nodes 1E and 8E in-kind (PTN 2)
- Replace end portion of diagonal in-kind at node 8E (PTN 2)
- Replace top chord in-kind between nodes 4E and 6E (PTN 2)
- Replace vertical post in-kind at Node 5E between top and bottom chord (PTN 2)
- Replace bottom chord in-kind at node 8E (PTN 2)
- Replace sleeper slab in-kind at node 2E (PTN 2)
- Strengthen vertical to bottom connections (PTN 3)
- Epoxy repair deteriorated members (PTN 1)

Note: E – indicates East Truss, W, indicates West Truss.

West Truss member replacements and repairs:

- Replace verticals at nodes 1W and 8W in-kind (PTN 2)
- Replace end portion of diagonal in-kind at node 1W (PTN 2)
- Replace vertical post in-kind at Node 6W between bottom nailer and bottom chord (PTN 2)
- Replace both plies of the bottom chord between nodes 1W and 4W in-kind (PTN 2)
- Strengthen bottom chord splice (PTN 3)
- Epoxy repair deteriorated members (PTN 1)

Floor System

Analysis

The existing decking and steel stringers were analyzed to determine the live load capacity. The load rating summary for the deck is shown in Table 3. The tire contact area used for the deck load rating varies based on the applied load. As such, the deck rating for each design truck varies and the Rating Factor for each design truck is reported below. The load rating summary (in "H tons") for the stringers is shown in Table 3. The rear axle of the design truck controlled the load rating of all floor system members. The deck has been assigned a grade of No. 1 for the structural analysis based on a visual examination of knots, checks, slope of grain of the wood and the growth rate characteristics of the wood.

Table 3 - Existing Deck Load Rating Summary

Live Load Alternative	Inventory Rating Factor[3]	Operating Rating Factor[3]
Alternative 1 – H15	1.5	2.0
Alternative 2 – HS15	1.5	2.0
Alternative 3 – H20	1.2	1.6
Alternative 4 – HS20	1.2	1.6

3. Rating factors greater than 1.0 indicate that the member has sufficient capacity to safely carry the design live load.

Table 4 - Existing Interior (21WF62) Stringer Load Rating Summary

Live Load Alternative	Inventory Rating Factor[4]	Operating Rating Factor[4]
Alternative 1 – H15	0.54	0.90
Alternative 2 – HS15	0.30	0.50
Alternative 3 – H20	0.41	0.68
Alternative 4 – HS20	0.23	0.38

4. Rating factors greater than 1.0 indicate that the member has sufficient capacity to safely carry the design live load.

Table 5 - Existing Exterior (24WF100) Stringer Load Rating Summary

Live Load Alternative	Inventory Rating Factor[5]	Operating Rating Factor[5]
Alternative 1 – H15	1.24	2.07
Alternative 2 – HS15	0.69	1.15
Alternative 3 – H20	0.93	1.55
Alternative 4 – HS20	0.52	0.86

5. Rating factors greater than 1.0 indicate that the member has sufficient capacity to safely carry the design live load.

Recommendations

Although the existing exterior stringers are adequate for the current posted weight limit, it is recommended that all stringers be replaced due to age and condition for Alternatives 1, 2, 3, and 4 (H15, HS15, H20, and HS20, respectively) (PTN 2). The existing stringers have deteriorated beyond meaningful cleaning and repair work, and given their age, are due for replacement. The existing nail laminated deck is adequate for alternatives H15 and H20; however, the deck will need to be removed to facilitate stringer replacement. This work will likely damage the deck as removal of a nail laminated deck is difficult, requiring a replacement with nail laminated deck (PTN 2) or glue laminated deck (PTN 4) to be installed for the steel stringer alternatives. For all steel stringer alternatives, it is recommended that the existing 1½" Eastern Pine runner boards be replaced with 1½" thick White Oak full-width runner boards (PTN 2). This helps to provide a smoother and wider traffic surface and could help prevent vehicles from losing control if a tire runs off the runner boards.

In addition, we recommend that a new wood curb (PTN 3) be added to the bridge to help keep vehicles from impacting the trusses for the steel stringer alternatives. This curb has previously been used by VTrans on many other covered bridges we have designed the rehabilitations throughout the State.

Alternative-specific recommendations for stringer replacements or strengthening are detailed below in sections 5.d. through 5.g.

A concrete deck beam system was also evaluated as a potential replacement for the existing floor system. This option would improve the bridge's hydraulic capacity and provide a smooth underside that helps prevent debris accumulation during high-flow events. If selected, the concrete deck would remain exposed, eliminating the need for a timber deck, curbing, or running boards. A pigment could be added to the concrete to replicate the appearance of a timber wearing surface, helping to preserve the historic character of the bridge. Alternative-specific recommendations for stringer replacements are provided in Section 5.h.

b. Substructure

The existing abutments have not been analyzed for overturning and sliding per the VTrans structures manual since they appear stable with no signs of distress and there is exposed bedrock at the bridge location.

Overall, the existing abutments appear sound and globally stable with no apparent sign of movement, settlement, or tipping. Some isolated cracks and spalls were found on various surfaces of the existing substructure elements. The scope of work does not include the stability analysis of the existing substructure.

Recommendations

The following recommendations are made for the bridge substructure:

- Modify bridge seat elevation to accommodate steam beam replacement (PTN 1).
- Reconstruct upper portions of both backwalls (PTN 1).
- Conduct minor partial depth concrete repairs to all existing substructure elements (PTN 1).
- Grout and seal the concrete cracks greater than ⅛" in width (PTN 1).
- Stain and seal all exposed concrete surfaces with a water-based sealant in order to provide long-term protection of the concrete (PTN 1).
- Remove all vegetation and small trees at both abutments (PTN 1).

c. No Action

This alternative would leave the bridge as it currently exists. A general guideline for evaluating a "No Action" alternative is determining whether the structure can remain in service for at least the next 10 years without requiring any work. The existing bridge superstructure is in poor condition, with multiple components—including truss members, bearing blocks, and upper lateral bracing—with numerous deficiencies. For safety reasons, maintaining the bridge in its present state is not recommended. No cost estimate is provided for this alternative, as it does not involve any immediate expenditures.

d. Alternative 1: Rehabilitation for H15 (15-Ton) Loading using Steel Beams

This alternative consists of work necessary to extend the useful life of the bridge and to upgrade the bridge live load carrying capacity to carry a 15-ton design vehicle. Refer to Appendix E for replacement members that are required to be replaced for this alternative. This work includes:

- Steel Beams
    - Replacement of all steel beams with galvanized W21x62 steel stringers (PTN 2)

e. Alternative 2: Rehabilitation for HS15 (27-Ton) Loading using Steel Beams

This alternative consists of work necessary to extend the useful life of the bridge and to upgrade the bridge live load carrying capacity to carry a 27-ton design vehicle. Refer to Appendix E for replacement members that are required to be replaced for this alternative. This work includes:

- Steel Beams
    - Replacement of all steel beams with galvanized W21x93 steel stringers (PTN 2)

f. Alternative 3: Rehabilitation for H20 (20-Ton) Loading using Steel Stringers

This alternative consists of work necessary to extend the useful life of the bridge and to upgrade the bridge live load carrying capacity to carry a 20-ton design vehicle. Refer to Appendix E for replacement members that are required to be replaced for this alternative. This work includes:

- Steel Beams
    - Replacement of all steel beams with galvanized W21x83 steel stringers (PTN 2)

g. Alternative 4: Rehabilitation for HS20 (36-Ton) Loading using Steel Stringers

This alternative consists of work necessary to extend the useful life of the bridge and to upgrade the bridge live load carrying capacity to carry a 36-ton design vehicle. Refer to Appendix E for replacement members that are required to be replaced for this alternative. This work includes:

- Steel Beams
    - Replacement of all steel beams with galvanized W21x111 steel stringers (PTN 2)

h. Alternative 5: Rehabilitation for Hs20 (36-Ton) Loading using Concrete Deck Beams

This alternative consists of work necessary to extend the useful life of the bridge and to upgrade the bridge live load carrying capacity to carry a 36-ton design vehicle. Refer to Appendix E for replacement members that are required to be replaced for this alternative. This work includes:

- Concrete Deck Beams
    - Replacement of all steel stringers with four 18" deep x 36" wide interior concrete deck beams and closure pours between the beams (PTN 10).

i. Proposed Roadway Improvements

Along the northern approach, the roadway will mimic existing conditions and transition approximately 100' before the bridge to a 11'-8" paved roadway at the bridge. The proposed roadway typical paved section north of the bridge will consist of removal of existing pavement and existing subbase material to provide suitable draining roadway fill beneath the pavement. Final pavement design will be provided by VTrans.

The southern approach roadway width will mimic measuring 11'-8"at the bridge and gradually widening to match the existing width at the end of the project limits. The proposed roadway typical section between the bridge and project limits will match the proposed paved typical section north of the bridge.

Stormwater flow patterns will mimic existing conditions with sheet flow of the roadway to vegetated side slopes. New steel backed timber guardrail is proposed on both approaches and will closely match existing guardrail lengths.

It is recommended that tree removal and trimming take place on both sides of the bridge as many of the nearby tree branches have potential to grow over the bridge and could fall and damage the bridge and are also promoting insect infestation of the bridge.

j. Fire Protection

As part of this Scoping Report, the bridge was assessed for improvements against the potential for loss or damage from fire. There are no known fire detection or protection systems at the covered bridge site. Three fire detection/protection systems are generally used for covered bridges, each of which was evaluated for this project.

Intumescent or Fire-Retardant Coatings (Nochar/Polaseal)

These coatings are water-based, water repellent treatments that are specifically designed to protect exterior and interior wood surfaces. They penetrate the wood and then cure by reaction with air to lock into the pore structure of the wood. These coatings work by raising the flashpoint of the wood making it difficult to start a fire. The fire-retardant coatings contain a proven fire retardant *to reduce* flame spread in the event of a fire and a blend of special preservatives to fight against the causes of decay. The coatings are available in colored and clear versions that are applied to the wood by brush or spray. The coatings do not affect the strength of the wood. It is also recommended the application of a fungicide to the bridge members to defend against fungal growth. Infestation by fungi causes the wood to rot, lowering the capacity of affected members.

The application of fire-retardant coatings is recommended for all alternatives considered.

Fire Detection System (Protectowire)

If a fire is started, it is advantageous to notify the local fire department as soon as possible. The "Protectowire" is a proprietary alert system that works by running a small wire through key locations in the bridge. The sensor cable is comprised of steel conductors individually insulated with a heat sensitive polymer. The insulated conductors are twisted together to impose a spring pressure between them and wrapped with a protective tape. If a rapid rise in temperature is detected or if a wire is cut, the system alerts the local mutual aid or fire department. This advanced warning can greatly reduce fire damage to a bridge and hopefully prevent the fire from making the bridge a total loss.

It should be noted that there is an annual maintenance cost associated with this system. The system requires power and a phone line (land or cell) to contact mutual aid. In addition, the control box contains batteries that have small electric strip heaters on them to prevent damage from freezing during cold weather. The control box is typically hidden at the end of the bridge in the siding and can be well insulated to reduce electrical costs.

The fire detection system will be discussed with the Town at the alternatives presentation meeting.

Dry Deluge Sprinkler System

The purpose of a deluge sprinkler system is to prevent the spread of fire by wetting down the entire fire area. The sprinkler system typically used includes dry pipes with a fire department connection away from

the ends of the bridge. During a fire, the fire department feeds the system which directs water to the source of the fire. The majority of the piping and heads are in the roof; however, coverage is also provided under the bridge at the abutments. These systems are typically used on long or multi-span bridges where the fire department cannot effectively fight the fire near the center of the bridge.

The sprinkler system will be discussed with the Town at the alternatives presentation meeting.

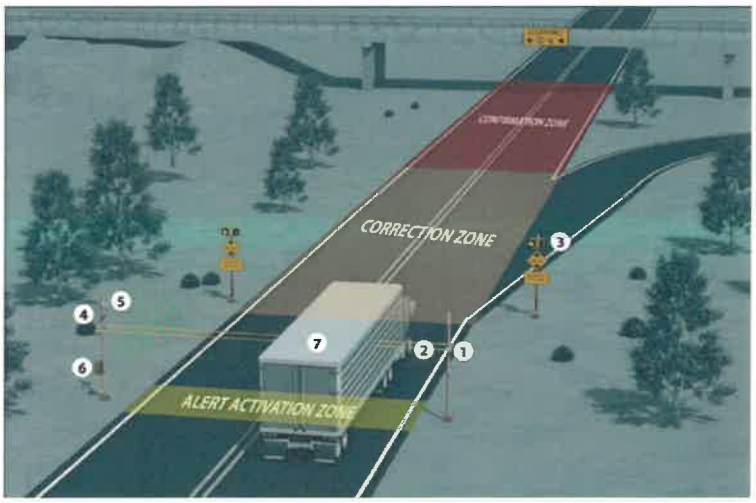
k. Lighting

There is currently no lighting on the bridge or immediate approaches to it. Lighting can be an effective means to deter vandalism and improve visibility. The decision to add lighting to the bridge should be made by the Town. Interior lighting in the form of high-pressure sodium lights controlled by photocells may be added if desired. This type of lighting provides a light brown color and is the type preferred by state historic resource agencies. The fixtures proposed in this study have a good long-term performance record, are unobtrusive as they are installed in between the upper lateral bracing, and are reasonably vandal proof. The photocell is specified to help ensure that the lights are only on when needed.

The lighting system will be discussed with the Town at the alternatives presentation meeting.

l. Vertical Clearance

The existing vertical clearance on the bridge is approximately 12'-6", which is substandard and causing impact damage to the portals, cross braces, upper lateral bracing, and knee braces due to oversized vehicles. The same is true of the other two covered bridges on Cox Brook Road. It is proposed to increase the vertical clearance of all three bridges to a uniform 13'-0". At the Upper Cox Covered Bridge, this would be done by replacing the existing steel lateral bracing with a new bottom chord assembly and blocking that would raise the truss members enough to achieve the desired vertical clearance. The siding will extend down enough to cover this assembly unit, so it is not visible on the exterior. Curbing and deck widening on the inside would cover the assembly unit from view on the inside of the truss. This option was presented to the HCBPC and was approved as an acceptable modification to the existing structure.



Additionally, early detection and vehicle warning systems can be incorporated into the project. These systems use sensors within an "activation zone" to identify vehicles that exceed the clearance height of an upcoming structure and alert drivers to the restriction. Drivers are then guided toward a safe alternate route within the "correction zone". The system also collects data, such as license plate information, for vehicles that trigger the warning and notifies local authorities when a vehicle enters the "confirmation zone". A potential layout of this system for the three covered bridges along Cox Brook Road is shown below. The associated cost, estimated at approximately $125,000, is not included in the Cost Matrix in Section 6, as the system is proposed as an optional enhancement.

m. Construction Schedule

Upper Cox Covered Bridge is one of three bridges on Cox Brook Road scheduled for rehabilitation. The rehabilitation of this bridge is expected to take approximately one construction season (about eight months). Lower Cox Covered Bridge, located 0.1 miles to the south, is also anticipated to require one construction season, while Northfield Falls Covered Bridge, located 0.3 miles to the south, will likely require two construction seasons.

Because these projects are in close proximity, there may be opportunities for cost and schedule savings by bundling two or all three bridges into a single contract. Temporary bridge alternatives for Bridges 10 and 11 share the same span length and width requirements, allowing the same temporary structure to be reused at both sites. Bridge 15 has a short local detour available for traffic maintenance.

Covered bridge rehabilitation is a highly specialized type of construction, and contractors often have limited crews with the required expertise. For this reason, the Town may consider bundling Bridges 10 and 11 into a single contract. Under this approach, one contractor could complete both projects over two construction seasons, using the same specialized crew and the same temporary bridge at each site. Bridge 15 could then be bid separately and constructed over the same two seasons, allowing all three bridges to be completed within a two-year period.

Alternatively, all three bridges could be bid together as one project and completed over four years, or they could be bid individually, giving contractors the flexibility to pursue one, two, or all three projects.

6. COST MATRIX

Northfield BO CVBR(7)		Do Nothing	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
			Steel Beam Alternatives				Concrete Deck Beam
			Rehabilitation for H15 (15-Ton, 2 Axle) Loading	Rehabilitation for HS15 (27-Ton, 3 Axle) Loading	Rehabilitation for H20 (20-Ton, 2 Axle) Loading	Rehabilitation for HS20 (36-Ton, 3 Axle) Loading	Rehabilitation for HS20 (36-Ton, 3 Axle) Loading
COST[1]	Roadway	$0	$381,170.00	$391,170.00	$391,170.00	$391,170.00	$381,170.00
	Erosion Control	$0	$50,000.00	$50,000.00	$50,000.00	$50,000.00	$50,000.00
	Bridge[2]	$0	$995,930.00	$1,046,930.00	$1,029,930.00	$1,072,430.00	$938,230.00
	Full CE Items	$0	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
	Construction Costs	$0	$1,468,000.00	$1,529,000.00	$1,512,000.00	$1,555,000.00	$1,411,000.00
	Construction Engineering & Contingencies (CEC)	$0	$367,000.00	$383,000.00	$378,000.00	$389,000.00	$353,000.00
	Accelerated Premium	$0	$0	$0	$0	$0	$0
	Total Construction Costs with CEC	$0	$1,835,000.00	$1,912,000.00	$1,890,000.00	$1,944,000.00	$1,764,000.00
	Preliminary Engineering	$0	$367,000.00	$383,000.00	$378,000.00	$389,000.00	$353,000.00
	Right of Way	$0	$20,000.00	$20,000.00	$20,000.00	$20,000.00	$20,000.00
	Total Project Costs	$0	$2,222,000.00	$2,315,000.00	$2,288,000.00	$2,353,000.00	$2,137,000.00
	Annualized Costs	$0	$55,550.00	$57,875.00	$57,200.00	$58,825.00	$53,425.00
	TOWN SHARE[3]	$0	$111,100.00	$115,750.00	$114,400.00	$117,650.00	$106,850.00
	TOWN %[3]	0%	5.0%	5.0%	5.0%	5.0%	5.0%
SCHEDULING	Project Development Duration	N/A	3 years	3 years	3 years	3 years	3 years
	Construction Duration	N/A	8 to 12 months	8 to 12 months	8 to 12 months	8 to 12 months	8 to 12 months
	Closure Duration (If Applicable)	N/A	8 months	8 months	8 months	8 months	8 months
ENGINEERING	Typical Section - Roadway (feet)	23'	23'	23'	23'	23'	23'
	Typical Section - Bridge (feet)	13'-7"	11'	11'	11'	11'	11'
	Geometric Design Criteria	Substandard Width	Substandard Width	Substandard Width	Substandard Width	Substandard Width	Substandard Width
	Traffic Safety	No Change	Improved	Improved	Improved	Improved	Improved
	Alignment Change	No Change	No Change	No Change	No Change	No Change	No Change
	Bicycle Access	Substandard	Substandard	Substandard	Substandard	Substandard	Substandard
	Pedestrian Access	Substandard	Substandard	Substandard	Substandard	Substandard	Substandard
	Hydraulics	Meets Minimum Standard	Meets Minimum Standard	Meets Minimum Standard	Meets Minimum Standard	Meets Minimum Standard	Meets Minimum Standard
	Utilities	No Change	No Change	No Change	No Change	No Change	No Change
OTHER	ROW Acquisition	No	Yes	Yes	Yes	Yes	Yes
	Road Closure	No	No	No	No	No	No
	Design Life (years)[4]	<10	40	40	40	40	40

[1] Costs are estimates only, used for comparison purposes.

[2] Bridge subtotal includes the cost of a temporary bridge.

[3] The Town Share and Town % of projects using a temporary bridge is 5%. Town Share and Town % decreases to 2.5% if an off-site detour is used.

[4] A design life of 40 years will be assumed for the deck and superstructure rehabilitation options. Substructure rehabilitation is assumed to have a design life of 50 years.

7. CONCLUSION

The Upper Cox Covered Bridge (Bridge No. 10), built in 1872, is a Town-owned bridge located on Town Highway 3 (Cox Brook Road) located approximately 0.3 miles from the intersection with VT Route 12. It is a 42'-1" long single span queenpost truss which carries one lane alternating traffic over the Cox Brook near Northfield Falls, an unincorporated village in the Town of Northfield. The bridge has undergone numerous changes and additions throughout its history with various degrees of documentation.

A detailed inspection and load rating of the bridge was completed to determine if the bridge can meet the project purpose and need. The roof framing was determined to be adequate for code required dead, wind, and snow loads. The bridge lateral bracing system was determined to not be adequate for code required wind loads and modifications to the bracing system are recommended. The truss members were determined to be adequate for code required dead, wind, and snow loads, however modifications are recommended to repair some select members due to their deteriorated condition. The floor system was determined to not be adequate for H15 (15-ton) loading at inventory or operating level. The substructure shows no sign of distress and appears to be adequate with minor repairs recommended.

Based upon our inspection and analysis of the Upper Cox Covered Bridge, it appears feasible to rehabilitate the bridge for vehicular loading to meet the project's purpose and need. Several alternatives were considered and studied as described above in Section 5.

The Town Selectboard and public at the March DATE, 2026 meeting approved Alternative X – Rehabilitation for HXX (XX-ton) loading. Alternative X promotes a safe transportation system, increases the load carrying capacity of the crossing for the emergency responses vehicles, promotes economic development and growth of the Town of Northfield, and maintains the historic character of the covered bridge.

The total estimated construction cost of all recommended work items for Alternative X, in 2026 dollars, is $X,XXX,XXX.

This Scoping Report has been completed utilizing information available as of March 2026. This information may include the Design Criteria listed above, permitting requirements, field data obtained by Hoyle Tanner, and reports or survey information prepared by others, which are subject to change. The condition of an existing bridge can change rapidly, or the bridge be damaged through manmade or natural events that could alter the conclusions reached herein. Therefore, the conceptual design, estimate of probable construction costs, and conclusions reached in this Scoping Report should not be relied upon for an extended period.

APPENDIX A

VTrans Bridge Inspection Report

VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
Structure #00010 / (Routine)
C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024

Town: 155 - NORTHFIELD

District 6, 23 - WASHINGTON County

Owner: 3 - Town or Township Highway Agency

Maintenance Responsibility: 3 - Town or Township Highway Agency

VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
Structure #00010 / (Routine)
C2003 over COX BROOK
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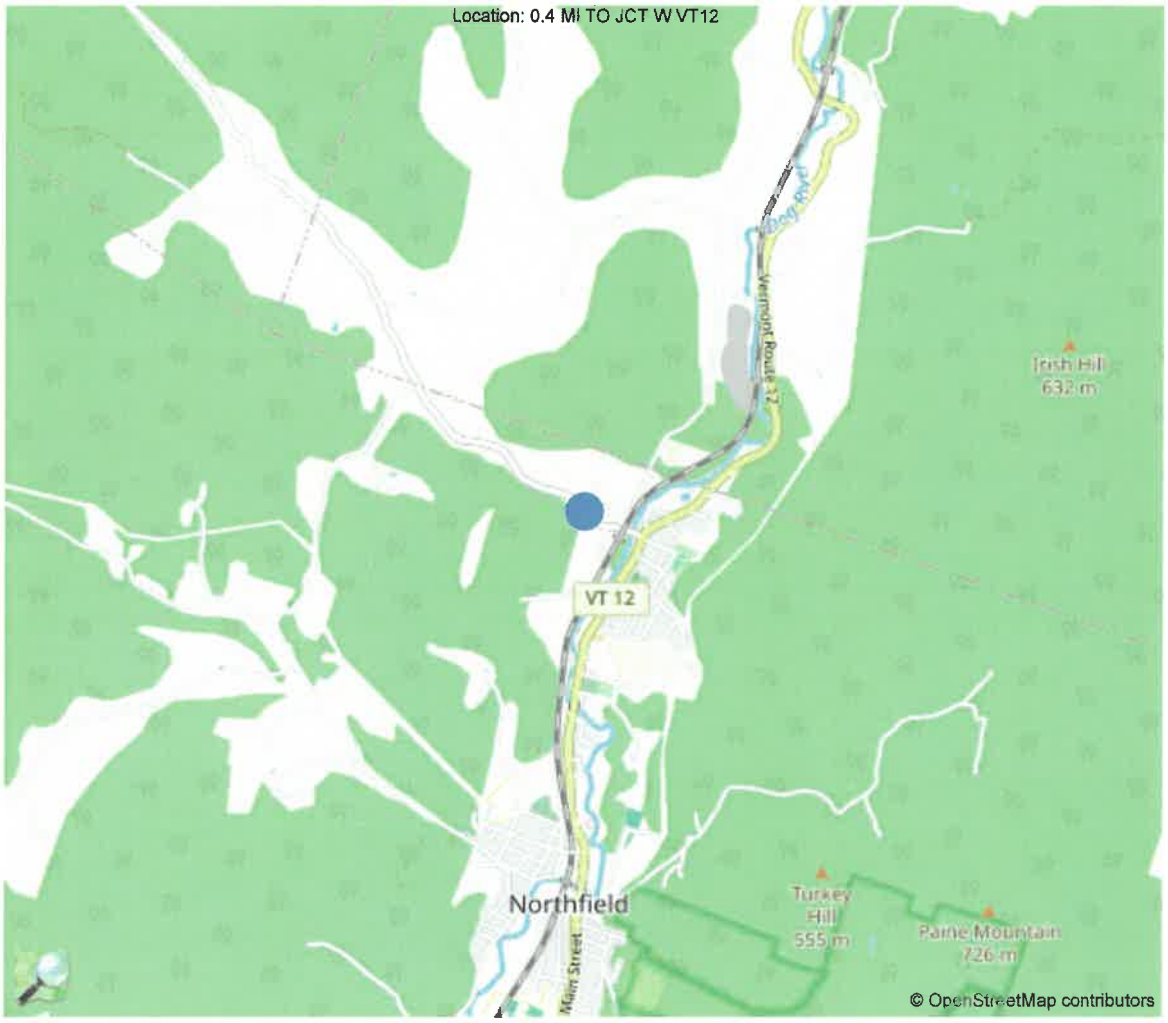

44.17371, -72.65558

VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
Structure #00010 / (Routine)
C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024

IDENTIFICATION	
(1) State Names	50 - Vermont
(8) Structure Number	101213001012131
(5) Inventory Route	1
(2) Highway Agency District	6 - District 6
(3) County Code	23 - WASHINGTON
(4) Place Code	50275
(6) Features Intersected	COX BROOK
(7) Facility Carried	C2003
(9) Location	0.4 MI TO JCT W VT12
(11) Mile Point	0 mi
(12) Base Highway Network	No
(13) LRS Inventory Rte & Subrte	
(16) Latitude	44.1737111111111
(17) Longitude	-72.6555833333333
(98) Border Bridge State Code	
(99) Border Bridge Structure No.	
STRUCTURE TYPE AND MATERIAL	
(43) Main Structure Type	32
Material	3 - Steel
Type	2 - Stringer/Multi-beam or girder
(44) Approach Structure Type	00
Material	0 - Other
Type	0 - Other
(45) No. of Spans in Main Unit	1
(46) No. of Approach Spans	0
(107) Deck Structure Type	8 - Wood or Timber
(108) Wearing Surface/Protective System	
Type of Wearing Surface	7 - Wood or Timber
Type of Membrane	0 - None
Type of Deck Protection	7 - Internally Sealed
AGE AND SERVICE	
(27) Year Built	1900
(106) Year Reconstructed	1967
(42) Type of Service	15
On	1 - Highway
Under	5 - Waterway
(28) Lane	
On	1
Under	0
(29) Average Daily Traffic	1200
(30) Year of ADT	2019
(109) Truck ADT	3 %
(19) Bypass, Detour Length	6 mi
GEOMETRIC DATA	
(48) Length of Maximum Span	43 ft
(49) Structure Length	54 ft
(50) Curb or Sidewalk Width	
Left	0 ft
Right	0 ft
(51) Bridge Roadway Width Curb to Curb	13.3 ft
(52) Deck Width Out to Out	14.2 ft
(32) Approach Roadway Width (W/Shoulders)	20 ft
(33) Bridge Median	0 - No median
(34) Skew	17 Deg
(35) Structure Flared	0 - No flare
(10) Inventory Route Min Vert Clear	11.83 ft
(47) Inventory Route Total Horiz Clear	13.3 ft
(53) Min Vert Clear Over Bridge Rdwy	10.83 ft
(54) Min Vert Underclear	0 ft
Ref:	
(55) Min Lat Underclear RT	0 ft
Ref:	
(56) Min Lat Underclear LT	0 ft
NAVIGATION DATA	
(38) Navigation Control	0 - No navigation control on w
(111) Pier Protection	
(39) Navigation Vertical Clearance	0 ft
(116) Vert-Lift Bridge Nav Min Vert Clear	0 ft
(40) Navigation Horizontal Clearance	0 ft

CLASSIFICATION	
(112) NBIS Bridge Length	Y
(104) Highway System	0
(26) Functional Class	8 - Rural Minor Collector
(100) Defense Highway	0 - The inventory route is not
(101) Parallel Structure	N - No parallel structure exis
(102) Direction of Traffic	3 - One lane bridge for 2 - way traffic
(103) Temporary Structure	
(105) Federal Lands Highways	0 - N/A
(110) Designated National Network	0 - The inventory route is not
(20) Toll	3 - On free road. The structu
(21) Maintain	3 - Town or Township Highway A
(22) Owner	3 - Town or Township Highway A
(37) Historical Significance	1 - Bridge is on the National
CONDITION	
(58) Deck	5
(59) Superstructure	5
(60) Substructure	7
(61) Channel & Channel Protection	8
(62) Culverts	N
LOAD RATING AND POSTING	
(31) Design Load	2 - M 13.5 / H 15
(63) Operating Rating Method	2
(64) Operating Rating	
Type	2 - Allowable Stress(AS)
Rating	17
(65) Inventory Rating Method	2 - Allowable Stress(AS)
(66) Inventory Rating	
Type	
Rating	10
(70) Bridge Posting	5 - Equal to or above legal loads
(41) Structure Open/Posted/Closed	P - Posted for load (may inclu
APPRAISAL	
(67) Structural Evaluation	2
(68) Deck Geometry	2
(69) Clearances, Vertical/Horizontal	N
(71) Waterway Adequacy	6
(72) Approach Roadway Alignment	6
(36A) Bridge Railings	0 - Inspected feature does not meet
(36B) Transitions	0 - Inspected feature does not meet
(36C) Approach Guardrail	0 - Inspected feature does not meet
(36D) Approach Guardrail Ends	0 - Inspected feature does not meet
(113) Scour Critical Bridges	8 - Bridge foundations determined t
PROPOSED IMPROVEMENTS	
(75) Type of Work	31 - Replacement of bridge or
(76) Length of Structure Improvement	76 ft
(94) Bridge Improvement Cost (Multiply value by 1000)	$ 360
(95) Roadway Improvement Cost (Multiply value by 1000)	$ 150
(96) Total Project Cost (Multiply value by 1000)	$ 510
(97) Year of Improvement Cost Estimate	2020
(114) Future ADT	1260
(115) Year of Future ADT	2029

INSPECTIONS *			
(90) Inspection Date			08/20/2024
(91) Frequency			24
(92) Critical Feature Inspection	Done	Freq. (Mon)	Date
A: Fracture Critical Detail	No		
B: Underwater Inspection	No		
C: Other Special Inspection			

* The inspection date and frequency information in this box contains the current NBI date and frequency information. Please refer to the report header for the date this inspection was conducted.

VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
Structure #00010 / (Routine)
C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024

Maintenance Needs

Date Reported: 08/18/2022

Priority:

Status: Open

Type of Work: 21 - Superstructure - Superstructure replacement

Component: Superstructure

Deficiency Description

Rust scale and deep pitting throughout with moderate section loss. The grease coating has bubbled and is no longer adhered to much of the surface area of the beams allowing for saturation to stay trapped along the now bare steel. Beams 1 and 2 have had steel plate repairs made in the past and there is a steel post support under beam 1 where the beam previously had crushed. An additional steel post has been installed under beam 2 as there is visible crushing in the beam end over the bearing.

Remarks

Due to the continued section loss across the length of the beams a future project to replace the beams should be considered.

Superstructure

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Route C2003 /
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Abutment 2 beam ends

Beam 2 abutment 2 end

VERMONT
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Route C2003 /
Structure #00010 / (Routine)
C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024

Deck

ELEMENTS	DESCRIPTION	UNITS	TOTAL	CS1	CS2	CS3	CS4
31	Timber Deck	SF	767	0	0	767	0
1140	Decay/Section Loss	SF	767	0	0	767	0
510	Wearing Surfaces	SF	767	747	20	0	0
7000	Damage	SF	20	0	20	0	0

58 - Deck (5 - FAIR CONDITION - all primary structural elements are sound but may have minor section loss, cracking, spalling or scour.)
Heavy saturation throughout with mildew staining and fuzzy mold. The boards are starting to split and check apart from decaying wood in the surrounding areas of the beams.

200 - Existing Wearing Surface Depth (2")

A21 - Deck Wearing Surface Condition (Very Good)

A39 - Deck Fascia Condition (Fair)

B.C.05 Bridge Railing Condition Rating (FAIR - Some moderate defects; strength and performance of the component are not affected.)
Minor checks and splits scattered throughout. Upstream rail has been impacted by the plow and has splintered and broken ends.

B.C.08 Bridge Joints Condition Rating (NOT APPLICABLE - Bridge does not have deck joints.)

APPROACH

72 - Approach Roadway Alignment (6 - Equal to present minimum criteria)

A13 - Approach Rail Condition (Fair)
Perforations and minimal section remaining in some of the guardrail ends and surrounding some of the anchor points. Timber posts have advanced weathering with wide splits and checks and moss growth in some ends.

A16 - Approach Post Condition (Fair)
Wide splits and checks throughout with areas of dry rot and some moss growth in the ends. Some areas of the rail have been impacted with broken offset blocks.

A18 - Approach Erosion/Settlement (Moderate)
Deep wheel line depressions at the abutment 2 approach measuring 1.5"- 2.5" deep.

B.C.06 Bridge Railing Transitions Condition Rating (POOR - Widespread moderate or isolated major defects; strength and/or performance of the component is affected.)
Heavy rust scale and section loss with varying sized perforations at the connecting bridge ends in the abutment 2 rails and upstream abutment 1 rail.

VERMONT
AGENCY OF TRANSPORTATION

Route C2003 /
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C2003 over COX BROOK
Team Lead: Justin White, **Inspection Date:** 08/20/2024

Superstructure

ELEMENTS	DESCRIPTION	UNITS	TOTAL	CS1	CS2	CS3	CS4
107	Steel Open Girder/Beam	LF	172	0	0	166	6
1000	Corrosion	LF	172	0	0	166	6
515	Steel Protective Coating	SF	838	0	0	0	838
3440	Effectiveness (Steel Protective Coatings)	LF	838	0	0	0	838
311	Movable Bearing	EA	4	0	0	4	0
1000	Corrosion	EA	4	0	0	4	0
313	Fixed Bearing	EA	4	0	0	4	0
1000	Corrosion	EA	4	0	0	4	0

59 - Superstructure (5 - FAIR CONDITION - all primary structural elements are sound but may have minor section loss, cracking, spalling or scour.)
Rust scale and deep pitting throughout with moderate section loss. The grease coating has bubbled and is no longer adhered to much of the surface area of the beams allowing for saturation to stay trapped along the now bare steel. Beams 1 and 2 have had steel plate repairs made in the past and there is a steel post support under beam 1 where the beam previously had crushed. An additional steel post has been installed under beam 2 as there is visible crushing in the beam end over the bearing.

A50 - Super Verticals/Diagonals Condition (Good)
Minor checks and splits scattered throughout. *The covered potion of the bridge does not structurally support the bridge.

A51 - Top Chords Condition (Good)
Minor checks and splits scattered throughout. *The covered potion of the bridge does not structurally support the bridge.

A52 - Bot. Chords Condition (Good)
Minor checks and splits scattered throughout. *The covered potion of the bridge does not structurally support the bridge.

A55 - Lateral Bracing Condition (Satisfactory)
Paint peel and rust scale throughout with pitting and minor section loss.
The upper timber lateral bracing of the covered bridge have had many impacts with some displaced members that no longer sit squarely on the verticals.

A65 - Roof/Siding Condition (Satisfactory)
The roof is in good condition. The siding over the abutment ends have areas of minor rot in the lower ends. The portals have been impacted with splintered/broken siding and framing

B.C.07 Bridge Bearings Condition Rating (FAIR - Some moderate defects; strength and performance of the component are not affected.)
Heavy rust scale deep pitting and moderate section loss throughout.

B.C.14 NSTM Inspection Condition (NOT APPLICABLE - Component does not exist.)

VERMONT
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Substructure

ELEMENTS	DESCRIPTION	UNITS	TOTAL	CS1	CS2	CS3	CS4
215	Reinforced Concrete Abutment	LF	40	28	12	0	0
1120	Efflorescence/Rust Staining	LF	6	0	6	0	0
1130	Cracking (RC and Other)	LF	6	0	6	0	0

60 - Substructure (7 - GOOD CONDITION - some minor problems.)
Abutment 1 has scattered shrinkage cracks throughout with small areas of rust stains. Abutment 2 small surface spall in the downstream end and fine vertical shrinkage crack in the upstream end with minor rust staining

A71 - Abutment End Walls Condition (Good)
The exposed upper end at abutment 2 has minor to moderate abrasion due to tire wear

A78 - Abutment Footings Condition (Satisfactory)
Moderate abrasion throughout with minor section loss.

CHANNEL

61 - Channel Condition (8 - Banks are protected or well vegetated. River control devices such as spur dikes and embankment protection are not required or are in a stable condition.)

B.C.10 Channel Protection Condition Rating (VERY GOOD - Some inherent defects.)

B.C.11 Scour Condition Rating (Insignificant scour.)

GENERAL OBSERVATION

The steel beams have rust scale throughout with developing section loss and the deck has moderate saturation throughout with scattered mildew staining. The boards are starting to split and check apart from decaying wood in the surrounding areas of the beams. The beams should be considered for extensive cleaning and painting and the deck will need replacing with in the next few years.

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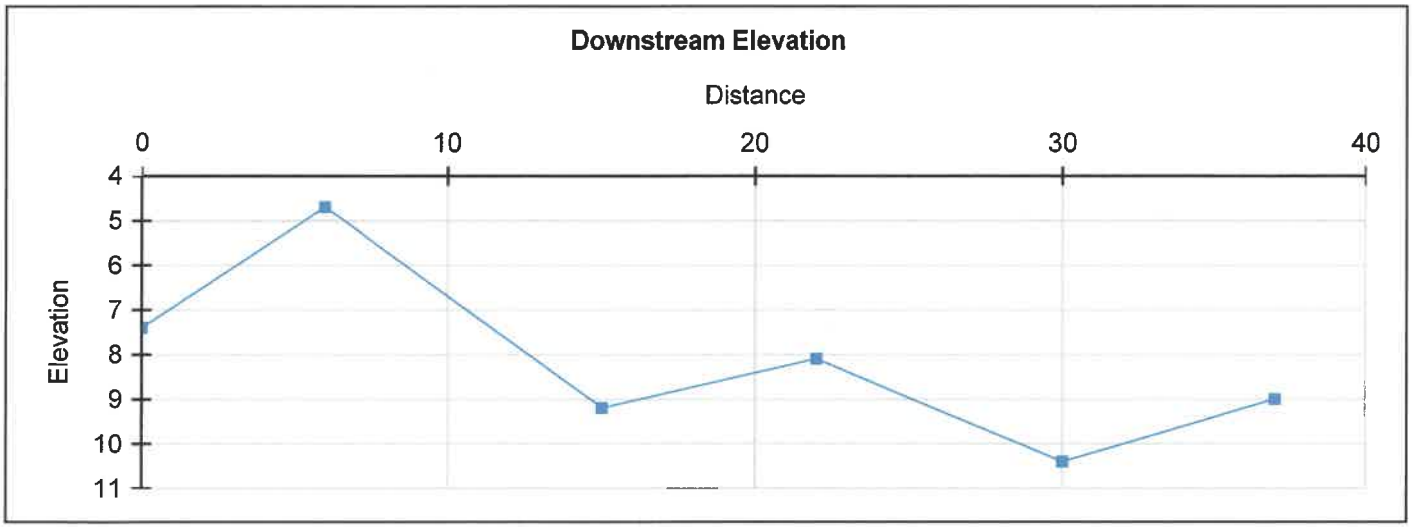
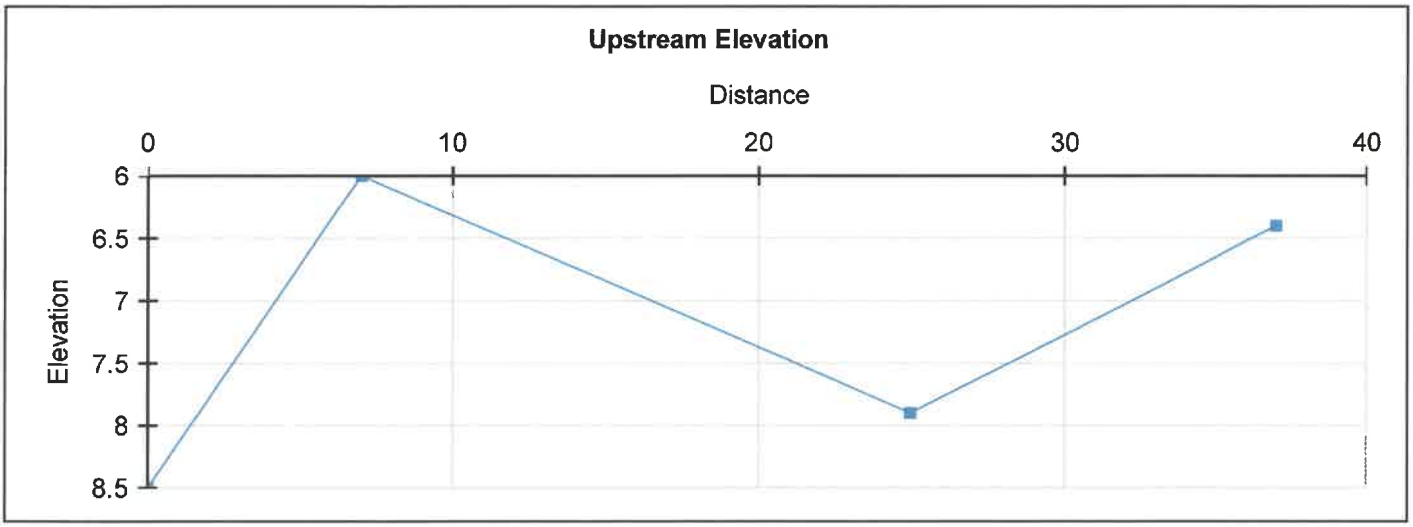
Channel Profile

Waterway Flow:	Left to right	Top of Water:	
Origin:	Deck soffit	Bottom of Beam:	

Station	Distance	Downstream	Upstream
Abutment 2	0	7.4	8.5
EOW	6	4.7	
	7		6
	15	9.2	
EOW	22	8.1	
EOW	25		7.9
	30	10.4	
	30	10.4	
Abutment 1	37	9	6.4





VERMONT
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Abutment 1 approach

Abutment 2 approach

Abutment 2 transition rail

Abutment 2 transition rail

VERMONT
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Downstream elevation

Upstream elevation

Span

Deck

VERMONT
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Route C2003 /
Structure #00010 / (Routine)
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Superstructure

Beam 2 abutment 2 end

Beam 2 abutment 2 end

Abutment 2

VERMONT
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Abutment 1

Downstream

Upstream