ERICKSON ENGINEERING

FEASIBILITY REPORT

on Improvements to the Cannon Valley Trail

Presented to the
Cannon Valley Trail
Joint Powers Board

January 13, 2017

Prepared by

Diego Santos-Noble, E.I.T

I hereby certify that this Report was prepared by me or under my direct supervision and that I am a duly licensed Professional Engineer under the laws of the State of Minnesota.

Ronald L. Dokken License No. 13931

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Date

ERICKSON ENGINEERING CO., LLC
9330 JAMES AVE S
BLOOMINGTON, MN 55431

PH 952-929-6791
800-545-8020
FX 952-929-2909

INFO@ERICKSON-ENG.COM
WWW.ERICKSON-ENG.COM

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Introduction

Erickson Engineering is providing the Cannon Valley Trail Joint Powers Board with this Feasibility Report on repair vs. replacement of 20 bridges along the Cannon Valley Trail (CVT), and also an evaluation of the trail's bituminous surface and the feasibility of widening it from 8 ft to 10 ft.

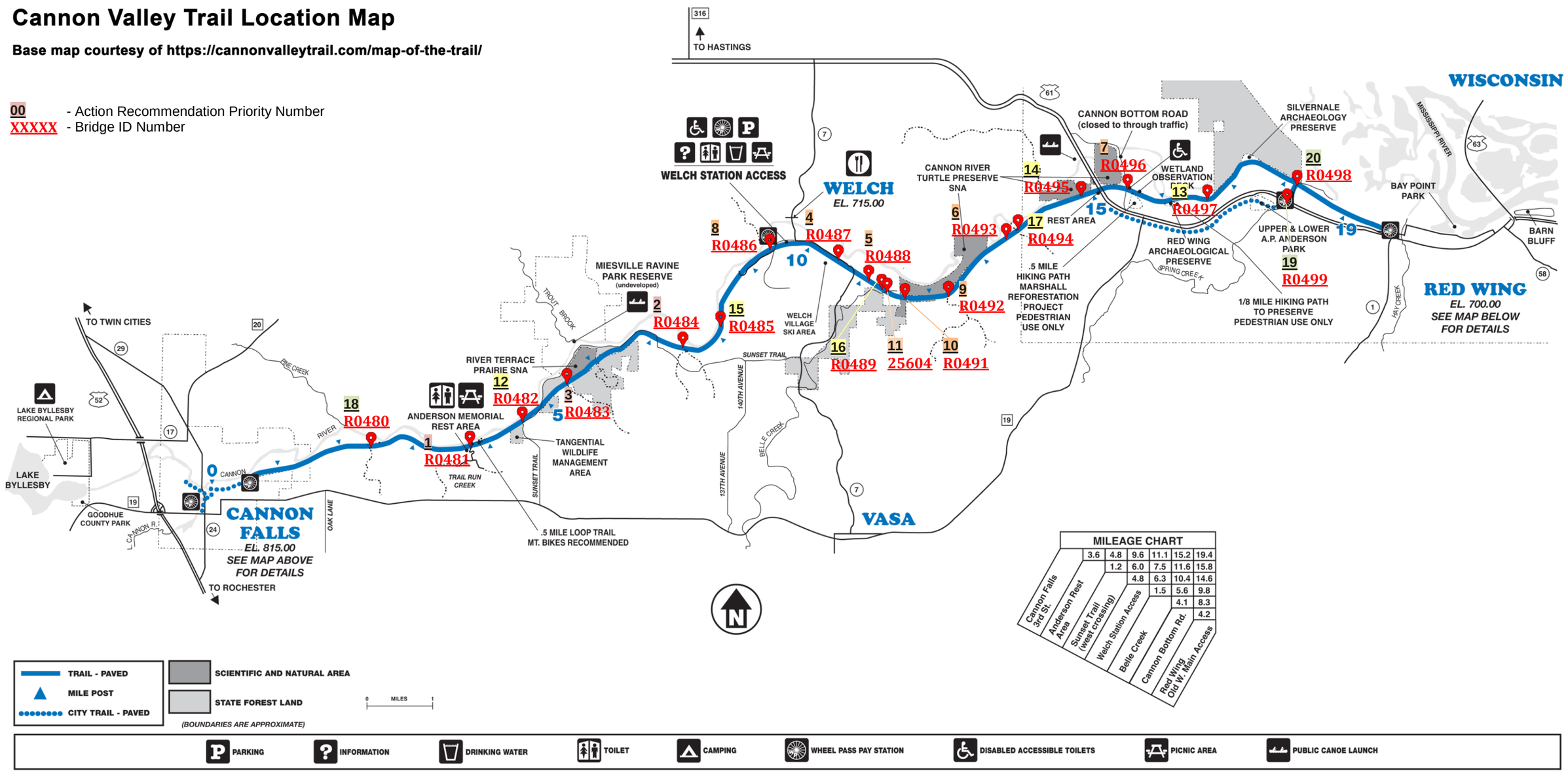
The CVT is a 20-mile trail along a former railroad line that connects Cannon Falls to Red Wing, passing through Welch, MN. Erickson Engineering inspected the bridges and trail in October 2016.

The purpose of this Feasibility Report is to present the findings from our inspections regarding the condition of each bridge along the CVT, options for repair or replacement of the bridges, and costs associated with these options. In addition, we have addressed trail widening feasibility, methodology and approximate cost.

Cannon Valley Trail Location Map

Base map courtesy of https://cannonvalleytrail.com/map-of-the-trail/

00 - Action Recommendation Priority Number
XXXXX - Bridge ID Number



MILEAGE CHART

Cannon Falls 3rd St.	3.6	4.8	9.6	11.1	15.2	19.4
Anderson Rest Area		1.2	6.0	7.5	11.6	15.8
Sunset Trail (west crossing)			4.8	6.3	10.4	14.6
Welch Station Access				1.5	5.6	9.8
Belle Creek					4.1	8.3
Cannon Bottom Rd.						4.2
Red Wing Old W. Main Access						

Bridge Inspections and Evaluations

The following is a list of all the bridges on the CVT. Some need complete replacement, others need to be rehabilitated and / or widened, and others only need continuing routine inspections. This report includes a detailed description of the deterioration noted for each bridge. Also included are suggestions and costs for rehabilitation and widening options for the bridges that do not need a full replacement. For the bridges marked for rehabilitation, it might be in the best interests of the CVT Board to opt for a replacement option based on the cost of replacement versus rehabilitation and the ongoing deterioration each bridge will endure until its potential rehabilitation. For the bridges that do need a full replacement, the most economical and / or practical replacement options and associated costs are discussed. Some bridges needing a full replacement may be candidates for a precast box culvert. In some instances, bridges that could be rehabilitated are also candidates for a box culvert replacement. This option is discussed when pertinent.

One aspect of the suggested replacements and rehabilitations to which Erickson Engineering has assigned high priority is providing the bridges with a deck surface that is low maintenance for CVT and safe for the users. For timber bridges this is accomplished with laminated decks that can be paved with a bituminous wear course, and for steel bridges by including the reinforced concrete deck option. This was decided after CVT expressed to Erickson Engineering the issue of bare timber decks being too slippery and uneven for trail users, which was confirmed during inspections, and labor-intensive to maintain.

Another aspect of the suggested replacements and rehabilitations is providing a 25-ton loading capacity. Where a rehabilitation option is provided, Erickson Engineering believes the existing components of the structure that would remain in place meet the 25-ton capacity.

Additionally, top priority is given to ensuring that all changes done to the bridges comply with safety standards set by MnDOT and the DNR.

Table 1. Action Recommendations Summary Table

BRIDGE	ACTION PRIORITY (1=HIGHEST PRIORITY)	ACTION RECOMMENDATION	REPLACEMENT OR REHABILITATION TIME FRAME (YR)
R0481	1	Replace	1-2
R0484	2	Replace	2-3
R0483	3	Replace	3-4
R0487 *	4	Replace (not urgent)	4-5
R0488	5	Replace (not urgent)	4-5
R0493 *	6	Replace (not urgent)	5-8
R0496 *	7	Replace (not urgent)	5-8
R0486 *	8	Replace (not urgent)	8-10
R0492	9	Replace (not urgent)	8-10
R0491 *	10	Replace (not urgent)	8-10
25604	11	Monitor / Rehabilitate	2-3
R0482 *	12	Rehabilitate	4-5
R0497	13	Rehabilitate	8-10
R0495	14	Rehabilitate	8-10
R0485	15	Rehabilitate	8-10
R0489	16	Rehabilitate	8-10
R0494	17	Rehabilitate	8-10
R0480	18	Monitor	-
R0499	19	Monitor	-
R0498	20	Monitor	-

*Potential replacement with a culvert

Note that the replacement and rehabilitation time frames may vary as ongoing inspections are performed.

Action Recommendations

1 R0481

- Ten-span timber bridge with pile bent piers and abutments
- Total length is 134 ft, with an 8 ft deck
- Located at Sta. 4091+70

This structure has extensive damage and decay to many of the superstructure and substructure components. The damage is too widespread to recommend rehabilitation and therefore replacement within one or two years is strongly advised.

This bridge is located at the Anderson Memorial rest area. There are steps on the south side allowing access to the creek below, and a small board-walk type bridge on the north side crossing the same creek.

The approaches have been recently patched due to settlement of the bituminous at the abutments. The deck planks have moderate deterioration but are holding well, there are patches where the ends of some deck planks have been replaced near the curbs. A few curb sections are splitting and / or are loose. The railing is in relatively good condition with minor weathering and staining. The floor beams are splitting and failing throughout.

Figure 1.1 Floor Beams - Splitting and failing floor beams throughout the structure.

Figure 1.2 West Abutment - South pile rotting and becoming hollow.

The two lines of timber beams are composed of clusters of four stringers. Several of the beams are showing minor to moderate deterioration and section loss at the bearings, to the point of becoming hollow. This decay is most significant at pier seven. Most beams also have minor splits.

The west abutment is in relatively good condition. It appears that the backing planks have large enough gaps between them to allow finer sand and material to escape from behind the abutment; this could be a contributing factor to the bituminous settlement above. The south most pile is rotting and becoming hollow.

The east abutment is also allowing finer material to escape from behind the backing planks. The doubled pile cap is splitting at the ends and is rotating west creating a 2 inch gap. This gap between the caps and the backing planks has been filled with a 2x4 inch plank. Most of the piles at this abutment exhibit up to 10% section loss along ground line; all piles are rotting and splitting.

From west to east:

Pier 1

The ends of the cross bracing are rotting away.

Splitting of the pier cap is severe and there is local crushing under both beams.

Figure 1.3 East Abutment - Rotting and splitting pile with section loss at ground line.

Figure 1.4 East Abutment - Splitting and rotating cap with 2x4 inch insert.

Figure 1.5 Pier 1 - Severe split running the entire length of the pier cap.

Figure 1.6 Pier 2 - Wood block installed to fill the gap between top of pile and cap.

Pier 2

South most pile has moderate splitting and it sounds hollow.

North most pile is not making contact with the pier cap and a wood block was installed to fill the gap.

Pier 3

North-most column has major section loss.

Minor splitting of the piles, but generally in good condition.

Pier 4

Most columns are splitting.

Pier 5

Most columns are splitting.

Top pier cap is splitting.

Bottom pile cap is getting buried.

Figure 1.7 Pier 3 - Severe section loss and splitting of the north column.

Figure 1.8 Pier 6 - Most columns and bracing are splitting.

Figure 1.9 Pier 7 - Beam section loss and rot at bearing.

Figure 1.10 Pier 7 - Pile rotting through.

Pier 6

Most columns are splitting as well as the cross bracing between them.

Pier 7

Most piles are splitting and exhibit minor section loss at ground level. One pile is rotting through.

The center section of the bottom pile cap is hollow.

Most columns are splitting.

Pier 8

Most piles are weathered and splitting. There is major section loss of approximately 80% at the south most pile; the second pile from the south has approximately 20% section loss.

Some columns have minor splitting, and the north most column has a moderate split.

The ends of the bottom pile cap are rotting and getting hollowed out.

Pier 9

The north beam has locally crushed the pier cap.

The south end of the pier cap is splitting

Most columns from the lower pile cap to the upper pier cap are splitting.

The bottom pile cap has major section loss and rot throughout.

Figure 1.11 Pier 7 - Rot and significant section loss of bottom pile cap.

Figure 1.12 Pier 8 - Severe section loss inside the south pile.

Figure 1.13 Pier 9 - Rot and severe section loss of bottom pile cap.

Figure 1.14 Pier 9 - Local crushing of the pier cap under beam.

There are several options for replacement alternatives. A single-span or two-span steel truss bridge with a reinforced concrete deck can be used. In addition, a multi-span longitudinally-laminated timber panel bridge that can be paved with a smooth bituminous wear course is also a feasible option. The recommended options can include different rail configurations depending on the preference of the CVT Board. Regardless, ongoing repairs may become necessary and therefore routine inspections should be performed to monitor this structure until its replacement.

2 R0484

- Nine-span timber bridge with pile bent piers and abutments
- Total length is 115 ft, with an 8 ft deck
- Located at Sta. 4275+69

This structure has extensive damage and decay to many of the superstructure and substructure components. The damage is too widespread to recommend rehabilitation and therefore replacement within two or three years is strongly advised.

Figure 2.1 Beams - Section loss and rot at bearing area.

Figure 2.2 Beams - Section loss and rot at bearing areas.

Figure 2.3 Piers - Splitting and decay of pile caps.

Both approaches have been patched due to settlement of the bituminous at the abutments. Some of the deck planks have moderate deterioration but in general the deck is holding well. There is minor damage to a few curb sections. The railing is in relatively good condition with minor weathering and staining. Several floor beams are splitting and exhibit minor rot.

The two lines of timber beams are composed of clusters of four stringers. On the west abutment, the north stringer of the south beam has severe decay and section loss at the bearing, the south stringer of the north beam displays similar yet more moderate decay at the bearing area. Also severe is the decay of the south stringer of the north beam at pier 1. On pier 2 the second and forth stringers of the south beam have section loss at the bearings. In general, the stringers along the west side of this bridge have to be closely monitored for bearing areas rotting and becoming hollow.

The west abutment has a split backing plank on the north side. All piles have minor splitting. The pile cap ends are becoming hollow and splitting, with the top portion rotting.

Several of the east abutment's backing planks are rotting. Piles two, four, and six from the south are becoming hollow, with pile six being almost completely hollow.

From west to east:

Pier 1

The top portion of the ends of the pile cap is rotting and display section loss.

Pile three from the south is rotting and becoming hollow at the top.

The bottom portion of both cross braces is getting crushed by the excess rock around the pier.

Pier 2

Minor splitting of all piles.

Figure 2.4 Pier 1 - Pile rotting and becoming hollow.

Figure 2.5 Pier 1 - Rip-rap crushing ends of cross bracing.

Figure 2.6 Pier 1 - Rocks stacked against piles and cross braces.

Piers 3, 4 and 5

Minor splitting of the piles and pier caps.

Pier 6

The cap is splitting.

Second pile from the north has minor damage at ground line and 2-3 feet up the pile.

There is a significant accumulation of debris around the pier.

Piers 7 and 8

The cross braces have failed at the south side.

Caps are splitting.

There are several options for replacement alternatives. A single-span or two-span steel truss bridge with a reinforced concrete deck can be used. In addition, a multi-span longitudinally-laminated timber panel bridge that can be paved with a smooth bituminous wear course is also a feasible option. The recommended options can include different rail configurations depending on the preference of the CVT Board. Regardless, ongoing repairs may become necessary and therefore routine inspections should be performed to monitor this structure until its replacement.

3 R0483

- Four-span timber bridge with pile bent piers and abutments
- Total length is 55 ft, with a 13 ft deck
- Located at Sta. 4179+10

This structure has extensive damage and decay to many of the superstructure and substructure components. The damage is too widespread to recommend rehabilitation and therefore replacement within three or four years is strongly advised.

The east approach has been patched due to settlement of the bituminous at the abutment. The deck planks have moderate deterioration but are holding well, there are a few wood plank patches at the ends of the deck and some planks are starting to rot. The railing is in relatively good condition with minor weathering and staining. Several floor beams are splitting and rotting.

A few center stringers have moderate to mildly severe longitudinal splits at the west span and are starting to decay. There is also minor decay along bearing areas.

The pile cap at the west abutment is rotting and has locally crushed under the center stringers. The planks are allowing granular material to escape from under them. Most piles are splitting and rotting.

Figure 3.1 Pile cap - The cap is rotting and starting to crush under the center stringers of the west abutment. Also note the longitudinal splits and decay on the stringers.

Figure 3.2 Piles - On the west abutment piles are rotting and splitting.

The top three backing planks at the east abutment have rotated behind the cap resulting in a 1 inch gap between the third and fourth plank. All piles have moderate splitting, and the cross brace is also splitting near the ground line. The north end of the cap exhibits decay and the south wingwall has shifted.

From west to east:

Pier 1

Top portion of the ends of the pile cap are rotting and have minor splitting.

Piles are splitting and rotting.

Pier 2

The south most pile and south portion of the pier cap have rotted through and failed.

The center piles have moderate splitting and decay at the center.

The cross brace on the south side is splitting and failing.

Pier 3

Moderate splitting of the piles.

Minor splitting of the pier cap.

Figure 3.3 Beams - Longitudinal splits and decay on beams.

Figure 3.4 East abutment - Rotation of the baking planks.

Figure 3.5 East abutment - Most piles are splitting and have internal decay.

Figure 3.6 Pier 2 - North portion of pile cap and north pile have severe decay and have failed.

There are several options for replacement alternatives. A single-span steel truss bridge with a reinforced concrete deck can be used. In addition, a two-span longitudinally-laminated timber panel bridge that can be paved with a smooth bituminous wear course is also a feasible option. The recommended options can include different rail configurations depending on the preference of the CVT Board. Regardless, ongoing repairs may become necessary and therefore routine inspections should be performed to monitor this structure until its replacement.

4 R0487

- Single span timber bridge with pile bent abutments
- Total length is 14 ft, with an 8 ft deck
- Located at Sta. 4447+30

This structure has moderate to severe decay throughout but does not need immediate replacement.

Figure 4.1 Approach - Wood plank used to patch bituminous approach.

Figure 4.2 Deck - Floor beams failing and splitting.

Figure 4.3 Abutments - Deteriorated and splitting piles.

There is minor patching at the east bituminous approach; the patch is a timber plank embedded in the bituminous. The deck planks have minor deterioration throughout but are holding well. The south rail has a long horizontal split along the lower 2x12 inch board, and the northwest corner of the lower board has a 6x5 inch piece missing. The floor beams are showing signs of deterioration especially at the center, where a couple beams have failed.

The visible portions of the beams appear in good condition with minor weathering.

Both abutments have decay at the top of the pile caps towards the ends. The piles are decaying, splitting, and becoming hollow at the top on both abutments. At the west abutment the first pile from the south has completely failed, and the second has about 80% section loss.

Widening or rehabilitating this bridge beyond minor localized deck and rail repairs is not recommended. The floor beams and abutment piles need to be monitored for decay. When it is determined that the decaying piles and floor beams are no longer adequate, a full replacement is recommended. This bridge could be replaced by a 12x4 ft precast box culvert. A longitudinally-laminated timber slab bridge is also a good option since it has a thin structure depth and can be paved with a smooth bituminous wear course. Different rail configurations can be installed depending on the preference of the CVT Board if a bridge option is desired. Regardless, ongoing repairs may become necessary and therefore routine inspections should be performed to monitor this structure until its replacement.

Figure 4.4 West abutment - Piles with major section loss.

5 R0488

- Five-span timber bridge with pile bent piers and abutments
- Total length is 70 ft, with an 8 ft deck
- Located at Sta. 4472+70

This structure has moderate to severe decay throughout but does not need immediate replacement.

Figure 5.1 Deck - Moderate deterioration throughout and patches.

Figure 5.2 Floor beams - Failed floor beams throughout.

Figure 5.3 West abutment - decay and / or movement of bearing spacers, pile cap and backing planks.

Both approaches are in good condition. The deck planks have moderate deterioration throughout with some planks damaged and / or loose and others patched at the ends. A couple curb sections are loose. Most of the floor beams are heavily decayed and starting to fail due to rot, it appears that several floor beams have failed along the east span. The railings show minor weathering and decay, with one vertical member split in half towards the northwest corner between posts.

The two lines of timber beams are composed of clusters of four stringers. There are a couple areas with minor impact damage along the south side of the east spans (4 & 5). The rest of the beams appear in good condition with some minor staining and weathering.

The pile cap at the west abutment is splitting and has section loss at the ends; the north end is becoming hollow. The bearing spacers on the cap are decaying, splitting and shifting away from the backing planks. All piles are decaying and showing signs of section loss; the south pile has 80% section loss.

At the east abutment the pile cap has minor section loss at the ends and the bearing spacers are decaying. All piles are decaying and showing signs of section loss and rot.

From west to east:

Piers 1 and 4

The pile cap is splitting at both ends and becoming hollow, but mostly on the south side where rot is more severe.

Bearing spacers are deteriorating and shifting

Most piles are decaying and becoming hollow with at least 20% section loss.

Piers 2 and 3

The pier caps have been replaced with I-beams. There is surface rust throughout.

Figure 5.4 East abutment - Rotting and splitting piles becoming hollow.

Figure 5.5 Pier 4 - Rotting pier cap and pile. Note minor impact damage on both fascia stringers.

Figure 5.6 Pier 4 - Bearing spacers shifting. Note minor impact damage on fascia stringer.

Most piles are decaying and becoming hollow with at least 20% section loss.

Widening or rehabilitating this bridge beyond minor localized deck and rail repairs is not recommended, since most piles are showing section loss, the abutments are moving, bearing spacers are shifting, and the pile caps are rotting. When it is determined that the decaying components are no longer adequate, a full replacement is recommended. The main beams can be salvaged for other projects after close inspection to verify their apparent good condition. A single-span steel truss bridge with a reinforced concrete deck can be used. A multi-span longitudinally-laminated timber slab bridge is also a good option since it has a thin structure depth and can be paved with a smooth bituminous wear course. Different rail configurations can be installed depending on the preference of the CVT Board. Regardless, ongoing repairs may become necessary and therefore routine inspections should be performed to monitor this structure until its replacement.

6 R0493

- Two-span timber bridge with pile bent pier and abutments
- Total length is 28 ft, with an 8 ft deck
- Located at Sta. 4574+30

This structure has minor to moderate decay throughout but does not need immediate replacement.

Figure 6.1 Floor beams - Typical floor beam failure due to rot.

Figure 6.2 West abutment - Cap partially buried and starting to decay.

Figure 6.3 Pier - Cap decaying and rotting, and piles becoming hollow.

Both approaches have been patched due to settlement of the bituminous at the abutments. The deck planks have minor deterioration throughout with some planks damaged and others patched at the ends. There is damage to a couple curb sections near the northwest corner. Most of the floor beams are deteriorating and starting to split and fail due to rot. There is minor damage to the lower railing on the north side; otherwise the railings are in good condition with minor weathering.

The two lines of timber beams are composed of clusters of four stringers. The beams appear in good condition with some minor weathering.

The west abutment piles are mostly buried; the exposed portions of the piles exhibit decay and splitting. The backing plank pile on the north side is hollowed out. The cap is getting buried, and has moderate decay and rot on the north side.

At the east abutment the piles are also mostly buried and exhibit decay and minor section loss at the top. The pile cap has minor decay.

The pile cap at the pier is decaying throughout, with more severe decay and splitting at the exposed ends where vegetation is growing on the top side. The south three piles have extensive decay and rot and the north three piles have moderate decay. The center two piles have minor decay and weathering.

Since all the components of the substructure and superstructure are deteriorated, a complete replacement is advised since the lifespan of the existing components will not be adequate for the lifespan of a possible retrofit. Widening or rehabilitating this bridge beyond minor localized deck and rail repairs is therefore not recommended. The main beams can be salvaged for other projects after close inspection to verify their apparent good condition. We recommend this bridge be replaced with a two-line 12x4 ft precast box culvert. A single-span longitudinally-laminated timber slab bridge is also a good option since it has a thin structure depth

Figure 6.4 Pier - Piles becoming hollow.

and can be paved with a smooth bituminous wear course. Different rail configurations can be installed depending on the preference of the CVT Board. Regardless, ongoing repairs may become necessary and therefore routine inspections should be performed to monitor this structure until its replacement.

7 R0496

- Single span timber bridge with timber caps acting as spread footings at the abutments
- Total length is 15 ft, with an 8 ft deck
- Located at Sta. 4701+90

This structure has minor to moderate decay throughout but does not need immediate replacement.

Figure 7.1 Deck - Bituminous and deck patches. Note how the southeast corner is slightly lower.

The east approach has a bituminous patch; this patch and the west approach have minor deterioration where the bituminous meets the deck. The deck planks have minor deterioration throughout, with some planks displaying moderate splits at the ends. The northeast corner of the deck has a patch that is holding well. The curbs and railings have minor deterioration and weathering. The floor beams have extensive decay and rot and have failed, in turn this is allowing the deck to flex, more so on the southeast corner of the deck.

The beams appear in good condition with minor weathering.

The abutment footings are partially buried. The exposed areas have moderate to severe rot and decay. A backing plank on the southeast corner has a large split.

Figure 7.2 Floor beams - Typical floor beam failure due to rot.

Figure 7.3 Looking north - Buried abutments and failed floor beams.

Widening or rehabilitating this bridge beyond minor localized deck and rail repairs is not recommended. Primarily the floor beams and substructures need to be monitored for decay. When it is determined that the decaying substructures and floor beams are no longer adequate, a full replacement is recommended. The main beams can be salvaged for other projects after close inspection to verify their apparent good condition. We recommend this bridge be replaced with a partially buried 12x4 ft precast box culvert with a distribution slab over it in order for the grade to not have to be raised. A single-span longitudinally-laminated timber slab bridge is also a good option since it has a thin structure depth and can be paved with a smooth bituminous wear course. Different rail configurations can be installed

depending on the preference of the CVT Board. Due to the site characteristics there is going to be ongoing issues with sand settling under and around the bridge no matter what replacement option is used and therefore a culvert would be more practical to maintain. Routine inspections should be performed to monitor this structure until its replacement.

8 R0486

- Single span timber bridge with timber caps acting as spread footings at the abutments
- Total length is 16 ft, with an 8 ft deck
- Located at Sta. 4317+70

This structure has minor to moderate decay throughout but does not need immediate replacement.

Figure 8.1 Beam - Deterioration and section loss of north stringer.

Figure 8.2 Beam - Deterioration and section loss of north stringer.

Figure 8.3 Footings - Section loss at the top on all corners.

There is a minor bituminous patch at the east approach. The deck planks have minor deterioration and splits but are holding well. Some of the planks have been repaired and have patches at the ends; a few planks are becoming loose at the northwest corner. All corners of the bridge have decaying curb end sections.

The timber stringers are not clustered on this bridge. The north most stringer is the only one showing noticeable deterioration with moderate longitudinal splitting and moderate section loss along the lower center portion.

All four corners of the timber footings are rotting and have minor section loss at the top and front. The northwest corner also shows minor splitting.

Widening or rehabilitating this bridge beyond minor localized deck and rail repairs is not recommended. Primarily the north-most beam and the abutment caps need to be monitored for decay. When the time comes to replace the beam and / or caps, a full replacement is recommended. This bridge could be replaced by a precast 14x4 ft box culvert. A longitudinally-laminated timber slab bridge is also a good option since it has a thin structure depth and can be paved with a smooth bituminous wear course. Different rail configurations can be installed depending on the preference of the CVT Board if a bridge option is desired. Regardless, ongoing repairs may become necessary and therefore routine inspections should be performed to monitor this structure until its replacement.

Figure 8.4 Footings - Section loss at the front on all corners.

9 R0492

- Six-span timber bridge with pile bent piers and abutments
- Total length is 83 ft, with a 9 ft deck
- Located at Sta. 4537+30

Figure 9.1 Floor beams - Typical floor beam failure due to rot.

This structure has minor to moderate decay on a few piles and pile caps, and extensive decay to the floor beams, but does not need immediate replacement.

This bridge was built with a cross slope down towards the north. The deck planks show moderate deterioration and decay throughout. There are planks that are rotting and exhibit section loss while others have been patched at the ends. There is damage and decay at the ends of the curbs. The railing is in good condition with some minor splits at the posts. Most of the floor beams are splitting and exhibit significant rot and decay.

Figure 9.2 East abutment - Cap splitting and decaying.

The two lines of timber beams are composed of clusters of four stringers. The stringers are weathered but appear in good condition with some minor longitudinal splitting noted at the abutments.

The west abutment pile cap has splits at the ends, with the north side starting to rot. All piles have minor section loss at ground line. The pile on the north wingwall is leaning away from the backing planks and the top portion sounds hollow. The south wingwall pile is also showing decay.

The east abutment pile cap is showing decay at the ends, with a severe split and generalized rot on the north end. The north most pile holding the planks is hollow and rotted. The second pile from the south has advanced decay.

Figure 9.3 Pier 1 - Decay on pile cap ends.

From west to east:

Pier 1

The cap is splitting along the ends.

Minor splitting and weathering of all piles.

Pier 2

The cap is severely deteriorated along the north side, with extensive rot and section loss.

Minor splitting and weathering of all piles, with moderate section loss of the north most pile at ground line.

Figure 9.4 Pier 2 - Major decay and section loss on pile cap.

Figure 9.5 Pier 3 - Major splitting of the pile cap.

Pier 3

The cap is splitting along its length.

The cross brace on the east side of the pier is split.

Minor to moderate splitting and weathering of all piles, with the north most pile sounding hollow.

Pier 4

Minor splitting of the north most pile

Pier 5

Minor splitting of the pile cap

Widening or rehabilitating this bridge beyond minor localized deck and rail repairs is not recommended. Primarily the floor beams and substructures need to be monitored for decay. When it is determined that the decaying substructures and floor beams are no longer adequate, a full replacement is recommended. There are several options for replacement alternatives. A single-span steel truss bridge with a reinforced concrete deck can be used. In addition, a multi-span longitudinally-laminated timber panel bridge that can be paved with a smooth bituminous wear course is also a feasible option. The recommended options can include different rail configurations depending on the preference of the CVT Board. Regardless, ongoing repairs may become necessary and therefore routine inspections should be performed to monitor this structure until its replacement.

10 R0491

- Single span timber bridge with timber caps acting as spread footings at the abutments
- Total length is 15 ft, with an 8 ft deck
- Located at Sta. 4505+60

This structure has minor to moderate decay throughout but does not need immediate replacement.

Figure 10.1 Floor beams - Typical floor beam failure due to rot.

Figure 10.2 Beam - Active moss on beam. Note the buried footing.

There is minor settlement at the northeast corner of the bridge and approach. The deck planks have minor deterioration and splits but are holding well. Some of the planks have been repaired and have patches at the ends. The curbs are splitting and all corners of the bridge have decaying curb end sections. The rails have minor weathering and deterioration. The floor beams show cracking and decay throughout, with some beams crushing and failing due to rot.

The beams have minor weathering throughout.

The abutment footings are mostly silted in. The exposed areas of the caps appear in good condition. The backing planks at the west abutment are rotting away. The top section of the northeast wingwall is tipped in slightly; the remainder of it as well as the southwest wingwall is buried.

Widening or rehabilitating this bridge beyond minor localized deck and rail repairs is not recommended. Primarily the deck floor beams and backing planks need to be monitored for decay. When the time comes to replace the floor beams, a full replacement is recommended. This bridge could be replaced by a 14x4 ft precast box culvert. A single-span longitudinally-laminated timber slab bridge is also a good option since it has a thin structure depth and can be paved with a smooth bituminous wear course. Different rail configurations can be installed depending on the preference of the CVT Board. Routine inspections should be performed to monitor this structure until its replacement.

11 25604

- Two-span steel truss bridge with concrete abutments and piers
- Total length is 180 ft, with a 10 ft deck
- Located at Sta. 4491+20

Figure 11.1 Southwest bearing - Bent anchor rods and spalled grout.

Both approaches have been patched due to settlement of the bituminous at the abutments. The deck planks have minor normal weathering throughout.

The bearings at the west abutment have extensive damage. The grout between the concrete abutment seat and the leveling plates has almost completely spalled off, and the 1 inch anchor rods are bent towards the west. After close inspection it appears the problem, beyond water intrusion and freezing, is that the abutment and consequently the anchor rods are rotating forward (east) towards the superstructure. This movement has maxed out the slots in the bearing plates to the extent that the rods are being pressed against the plates themselves, which in turn has bent the rods; it has also contributed to spalling the grout, and significantly reduced the gap from the back wall to the bearing plates.

Figure 11.2 Northwest bearing - Bent anchor rods and spalled grout.

The bearings at the east abutment have minor deterioration. The damage to the grout is not nearly as severe at this abutment due to the lack of movement of the abutment.

The concrete pier is in good condition and the grout at the bearings is holding well.

This structure is in good condition. The bearings on the west abutment should be rehabilitated soon in order for them to function as intended. Monitoring the movement of the abutment should be done routinely.

Figure 11.3 Southeast bearing - Grout with minor deterioration.

Figure 11.4 Pier bearing - Grout in good condition.

Rehabilitating the bearings includes rehabilitating the west abutment. The west end of the truss needs to be jacked up off the anchor rods. Then the back side of the abutment will have to be excavated so a dead man with tie backs can be installed. If the abutment does not spring back into its original position after the excavation it will have to be pulled back. An appropriate drainage system and free draining soil should be placed behind the abutment. Finally, the bridge can be placed back on the abutment seat and the bearings re-grouted.

12 R0482

- Three-span timber bridge with pile bent piers and abutments
- Total length is 43 ft, with a 15 ft deck
- Located at Sta. 4133+80

This structure has minor damage and decay throughout but does not need a full replacement.

Figure 12.1 Deck - Minor deck plank splitting.

The approaches have been patched due to minor settlement of the bituminous at the abutments. The deck planks have minor deterioration but are holding well, a few planks have moderate splits with section loss and some are loose along the east end. The ends of the curb planks are rotting. A 5 ft section of railing along the northeast corner is loose. Several railing posts are rotting and becoming hollow. The remaining railing sections are in relatively good condition with minor weathering and staining. The floor beams are weathered but are holding well, excluding the floor beam used to support the railing kicker at the southeast corner which is rotting.

Figure 12.2 Deck - Overlay experiment with some material loss.

The continuous timber stringers are not clustered on this bridge. Several of the stringers are showing minor fire damage along the center span. There are longitudinal splits along the north stringer at the center span, and the south stringer in span three is becoming hollow and rotting. Several stringers are rotting and becoming hollow at the bearings of both the abutments and the piers, so far the deterioration is minor.

At the west abutment the center two piles are hollowed out and have significant section loss. Most piles also have minor splits. There is damage to the backing planks at the northwest corner. At the east abutment most piles also have splits throughout and the wingwall pile at the southeast corner has severe rot.

Figure 12.3 Deck - Floor beam at southeast corner rotting.

Figure 12.4 Stringers - Minor fire damage.

Figure 12.5 Stringers - Minor section loss at pier bearing.

Figure 12.6 Piles - South pile of the east pier becoming hollow and rotting.

Figure 12.7 Piles - West abutment center piles are becoming hollow and rotting.

From west to east:

Pier 1

Minor section loss of the piles along the ground line.

The pier cap is weathered with minor staining.

Pier 2

Minor splitting of the piles throughout, with the south pile becoming hollow due to severe rot and section loss.

Both ends of pier cap are splitting and rotting.

A couple piles lost contact with the pier cap and have been shimmed.

CVT is experimenting with applying bituminous binder with pea gravel to the south side of the deck, the binder is holding well with minor areas losing the material. This solution will help with grip, but due to the gaps between deck planks it will not alleviate the bumpiness for bicycles and rollerblades. A solution to this is to install a transversely-laminated timber deck that can be paved with a smooth bituminous wear course. For this to be a long term solution and to ensure that the existing components are adequate for the design life span of the retrofit, removing the deck, rails, curbs and floor beams is necessary. Then, some piles at the piers and abutments would have to be repaired and the east pier cap replaced. The remaining substructures and the main beams can be reused with the proposed timber deck placed on top. Different rail configurations can be installed depending on the preference of the CVT Board.

Figure 12.8 Piles - Rotting shims between piles and cap.

Since the rehabilitation efforts will be extensive for this bridge, there are several full replacement alternatives that might be desired instead. Full replacement options include a three-line 14x8 ft box culvert, a single-span steel truss with a reinforced concrete deck, or a two-span longitudinally-laminated timber slab that can be paved with a smooth bituminous wear course. Regardless, routine inspections should be performed to monitor this structure.

13 R0497

- Three-span timber bridge with pile bent piers and abutments
- Total length is 42 ft, with an 8 ft deck
- Located at Sta. 4763+48

This structure has minor to severe decay throughout but does not need immediate replacement.

Figure 13.1 Deck - Moderate deterioration of the deck planks.

Figure 13.2 Floor beams - Typical floor beam failure due to rot.

Figure 13.3 Rail - Deterioration of the rail posts at the south side.

Both approaches have been patched due to minor settlement of the bituminous at the abutments. A recent flood ruined the patch on the east side since the bridge got uplifted about 8" at the east end, since then the beams have been secured to the substructures with brackets. The deck planks have moderate deterioration throughout with some planks damaged at the ends. The planks at the end of deck are failing due to damage. The curbs have minor weathering, with a couple sections being loose. Most of the floor beams have minor cracking and decay, a few have moderate cracking and some have failed. The railings show minor weathering and staining. There is damage to the forth rail post kicker from the west on the south side. Several posts on the south side a deteriorating, with the fourth from the east rotted through.

The two lines of timber beams are composed of a cluster of four stringers. The beams appear in good condition with minor weathering. The bearing spacer for the north beam at the east pier has shifted slightly.

The abutment caps have minor cracking and weathering. The backing plank piles at the ends of the abutments at all four corners are rotted through, and the backing planks themselves are also rotting.

The pier caps appear in relatively good condition, with the east pier cap exhibiting some splits. The exposed portions of the piles also appear in good condition with minor decay.

Rehabilitating this bridge and widening it is possible since the piles are in good condition. The recommended option is to install a transversely-laminated deck that can be paved with a smooth bituminous wear course. For this to be a long term solution and to ensure that the existing components are adequate for the design life span of the retrofit, removing the deck, rails, curbs and floor beams is necessary, then all the wingwalls will have to be completely replaced and potentially also the east pier cap. The rest of the substructures and the main beams can be reused with the proposed timber deck

Figure 13.4 Beams - Beams in good condition. Note how the north beam bearing spacer has shifted slightly at Pier 2.

on top. Since the rehabilitation efforts will be extent for this bridge, there are several full replacement alternatives that might be desired instead. A single-span steel truss bridge with a reinforced concrete deck can be used. In addition, a two-span longitudinally-laminated timber panel bridge that can be paved with a smooth bituminous wear course is also a feasible option. Different rail configurations can be installed depending on the preference of the CVT Board. Regardless, routine inspections should be performed to monitor this structure since it often experiences flood events.

14 R0495

- Four-span timber bridge with pile bent piers and abutments
- Total length is 43 ft, with an 8 ft deck
- Located at Sta. 4665+56

This structure has minor decay throughout but does not need a full replacement.

Figure 14.1 Floor Beam - Failed floor beam and patch.

Figure 14.2 Beams - Minor decay along the inside of interior stringers.

Figure 14.3 East abutment - Minor undermining under backing planks.

The west approach has been recently patched due to settlement of the bituminous at the abutment. There is minor to moderate decay of the deck planks, there are some patches where the ends of some planks have been replaced near the curbs. The curbs have moderate decay, with a couple sections exhibiting splits and becoming loose. The railings are in good condition with some minor weathering and staining; one lower section plank is broken at the end. The floor beams are splitting and exhibit moderate to severe decay throughout, a floor beam at the center of the bridge has failed, an attempt was made to patch it but it is failing also.

The two lines of timber beams are composed of clusters of four stringers. The beams are weathering and the inner most stringers exhibit some minor decay.

The west abutment is in relatively good condition. The cap has minor weathering and is splitting. The backing planks have minor decay. The piles have minor decay and splits throughout.

The east abutment has minor undermining at its center where soil is coming out from under the backing planks. The pile cap is splitting along its entire length. The north wingwall is rotating forward and failing. The piles have minor decay and splits throughout.

All pier caps have minor to moderate splits at the ends. The piles have minor decay and splits throughout.

Most of the decay and damage is affecting the floor beams, pile caps, and northeast wingwall. A solution for rehabilitating this bridge and widening it at the same time is to install a transversely-laminated timber deck that can be paved with a smooth bituminous wear course. For this to be a long-term solution and to ensure that the existing components are adequate for the design life span of the retrofit, removing the deck, rails, curbs and floor beams is necessary, also replacing the pile caps as needed and the northeast wingwall. The rest of the substructures and the main beams can be reused with the proposed timber deck placed on top.

Figure 14.4 Pier cap - Moderate split at pile cap.

Since the rehabilitation efforts will be extensive for this bridge, there are several full replacement alternatives that might be desired instead. A single-span steel truss bridge with a reinforced concrete deck can be used. In addition, a two-span longitudinally-laminated timber panel bridge that can be paved with a smooth bituminous wear course is also a feasible option.

The single-span option is preferred due to the site characteristics and soil accumulation around the bridge. It is recommended to remove the existing soil accumulated on the south and north sides of the bridge and then riprap the north side towards the Cannon River. Different rail configurations can be installed depending on the preference of the CVT Board. Regardless, routine inspections should be performed to monitor this structure.

Figure 14.5 Northeast wingwall - the wall is rotating forward and failing.

Figure 14.6 North side - Berm affecting water flow.

15 R0485

- Four-span timber bridge with pile bent piers and abutments
- Total length is 56 ft, with an 8 ft deck
- Located at Sta. 4290+00

This structure has minor damage and decay throughout but does not need a full replacement. Most of the decay and damage is affecting the floor beams and the deck.

Both approaches have been patched due to settlement of the bituminous at the abutments. The deck planks have moderate deterioration throughout with some planks damaged and others patched at the ends. There is damage to a couple curb sections along the southwest corner and north side. A few floor beams are deteriorating and starting to fail due to rot. The northeast floor beam has completely failed; this longer floor beam supports the rail post and kicker which is causing the railing to deflect outwards at that location. The remainder of the railing is in relatively good condition with minor weathering and staining.

Figure 15.1 Deck - Damage to curb section.

Figure 15.2 Rail - Failed floor beam supporting rail and kicker allowing for railing deflection.

Figure 15.3 West abutment - Rotting and hollow backing plank spacer.

The two lines of timber beams are composed of clusters of four stringers. The north stringer of the north beam is splitting longitudinally. The rest of the beams appear in good condition with some minor staining and weathering.

The piles at the west abutment are mostly buried, the exposed portion of the piles appear in good condition. The cap has minor deterioration at the ends. The spacer between the pile and the backing planks of the northwest wingwall is hollow.

At the east abutment the piles are also mostly buried. The north most pile is rotting and a couple other piles are starting to exhibit minor decay.

From west to east:

Piers 1 and 2

The pile cap has minor splitting at both ends.

A solution for rehabilitating this bridge and widening it at the same time is to install a transversely-

Figure 15.4 East abutment - Top of pile rotting and becoming hollow.

laminated deck that can be paved with a smooth bituminous wear course. For this to be a long term solution and to ensure that the existing components are adequate for the design life span of the retrofit, removing the deck, rails, curbs and floor beams will be necessary, also replacing the backing planks as needed. The rotting pile can be repaired; the rest of the substructures and the main beams can be reused with the proposed timber panels placed on top.

Since the rehabilitation efforts will be extensive for this bridge, there are several full replacement alternatives that might be desired instead. A single-span steel truss bridge with a reinforced concrete deck can be used. In addition, a two-span longitudinally-laminated timber panel bridge that can be paved with a smooth bituminous wear course is also a feasible option.

Different rail configurations can be installed depending on the preference of the CVT Board. Regardless, routine inspections should be performed to monitor this structure.

16 R0489

- Three-span timber bridge with pile bent piers and abutments
- Total length is 43 ft, with an 8 ft deck
- Located at Sta. 4485+70

This structure has minor decay throughout the substructures and severe decay throughout the floor beams. Rehabilitating this bridge and widening it would be possible since the piles are in good condition.

Figure 16.1 Floor beam - Typical floor beam failure due to rot.

Both approaches have been patched due to minor settlement of the bituminous at the abutments. The deck planks have moderate deterioration throughout with a few planks damaged or patched at the ends. The curbs are starting to decay, with a couple sections damaged and / or loose. Most of the floor beams are heavily decayed and starting to fail due to rot. The railings show minor weathering and staining.

The two lines of timber beams are composed of clusters of four stringers. The beams appear in good condition with minor weathering.

The pile cap at the west abutment has moderate decay with signs of crushing under the beams. The backing planks are starting to decay. The piles have minor splitting and weathering.

Figure 16.2 Deck - Decaying curb sections.

At the east abutment the pile cap has minor decay and splitting. The backing planks have failed and have been patched, the patches have also failed and soil is washing through. The south most pile has minor decay.

From west to east:

Piers 1 and 2

The pile cap has minor to moderate decay.

The piles have moderate weathering but doing well.

A solution for rehabilitating this bridge and widening it at the same time is to install a transversely-laminated timber deck that can be paved with a smooth bituminous wear course. For this to be a long term solution and to ensure that the existing components are adequate for the design life span of the retrofit, removing the deck, rails, curbs and floor beams is necessary. In addition, the pile cap on the west abutment and the damaged backing planks will have to be replaced. The remaining substructures and the main beams can be reused with the proposed timber deck placed on top.

If a full replacement option is preferred, a single-span steel truss with a reinforced concrete deck or a two-span longitudinally-laminated timber span with a bituminous wear course can be used.

Different rail configurations can be installed depending on the preference of the CVT Board.

Figure 16.3 Looking West - Piers and beams in good condition. Note the generalized failure of the floor beams.

Figure 16.4 East abutment - failed backing planks and patches.

17 R0494

- Four-span timber bridge with pile bent piers and abutments
- Total length is 56 ft, with an 8 ft deck
- Located at Sta. 4610+83

This structure has minor to moderate decay throughout but does not need a full replacement.

The approaches have been recently patched due to settlement of the bituminous at the abutments. The last deck planks along the west end of deck are rotting. There are patches where the ends of several deck planks have been replaced near the curbs; the rest of the deck has minor deterioration. The curb sections at the corners are deteriorated while the rest of the curb sections have minor decay. The railing is in relatively good condition with minor weathering and staining. The floor beams are splitting and exhibit moderate decay throughout.

The two lines of timber beams are composed of clusters of four stringers. The beams are weathered but in good condition.

Figure 17.1 Deck - Planks rotting towards the end of deck.

Figure 17.2 West abutment - Piles and cap are partially buried.

The west abutment is in relatively good condition. The cap has minor weathering. The piles are buried, but the exposed portions exhibit minor weathering and cracking.

The east abutment is partially buried and has soil over the cap between the beams. The piles are completely buried.

From west to east:

Piers 1 and 2

The pile caps have minor splitting and weathering at the ends.

The piles have minor weathering and splitting throughout.

Pier 3

The south end of the cap is splitting significantly.

The piles have minor weathering and splitting throughout.

Most of the decay and damage is affecting the floor beams and pile caps. A solution for rehabilitating this bridge and widening it at the same time is to install a transversely-laminated timber deck that can be paved with a smooth bituminous wear course. For this to be a long term solution and to ensure that the existing components are adequate for the design life span of the retrofit, removing the deck, rails, curbs and floor beams will be necessary, also replacing the pile caps. The rest of the substructures and the main beams can be reused with the proposed timber deck placed on top. Since the rehabilitation efforts will be extent for this bridge, there are several full

Figure 17.3 East abutment - Piles are completely buried and cap is partially buried.

replacement alternatives that might be desired instead. A single-span steel truss bridge with a reinforced concrete deck can be used. In addition, a multi-span longitudinally-laminated timber panel bridge that can be paved with a smooth bituminous wear course is also a feasible option. Different rail configurations can be installed depending on the preference of the CVT Board. Regardless, routine inspections should be performed to monitor this structure.

18 R0480

- Three lines of CIP concrete culvert
- Total length is 24 ft, with barrel lengths of 132 ft
- Located at Sta. 4011+01

Figure 18.1 South Head Wall - Extensive damage to headwall with exposed rebar, and spalling of the barrel ceiling.

This structure has extensive damage to the south head wall and the center barrel. Even with the damage noted, it does not need replacement.

There is major delamination with efflorescence along the east barrel ceiling and major efflorescence along the south side of the center barrel. There is also significant cracking and pop-outs throughout. The head wall on the south side (upstream) has major deterioration and exposed rebar; on the north side the head wall is in good condition with only one moderate spall. The center barrel has debris accumulation from fallen trees and branches on the south side, and the east barrel has about one foot of sand and gravel. The deterioration of the south head wall seems mostly due to it being located on the upstream side, the healthy amount of vegetation around the head wall appears to be keeping erosion under control.

Figure 18.2 South Head Wall - Extensive damage to headwall with exposed rebar, and debris accumulation along center and east barrels.

The excessive amount of debris accumulating on the center and east barrels can be a contributing factor for faster deterioration and should be cleared to ensure free flow. Routine inspections should be performed to monitor this structure.

Figure 18.3 North Head Wall - Headwall in good condition.

Figure 18.4 North Head Wall - Moderate spall over center barrel.

19 R0499

- Twelve-span timber bridge with piers and abutments on circular concrete footings
- Total length is 196 ft, with a 9 ft deck
- Located on Anderson Park trail

This structure is generally in good condition and does not need replacement.

Figure 19.1 Beams - Minor weathering throughout. Note the staining due to rusting of the beam brackets.

Figure 19.2 Piers - Riprap placed at the base of the posts holding well.

Figure 19.3 Footing brackets - Several footing brackets have active corrosion and section loss.

Both approaches have been patched due to minor settlement of the bituminous at the abutments. The deck planks, curbs, and railings have minor deterioration and weathering throughout. The area below the gap between the highway bridges running above this bridge is more weathered than the areas directly below the highway bridges.

The timber beams are in good condition. There is some minor staining and weathering throughout.

The abutments are in good condition. There is some paint failure and superficial rust on the brackets attaching the beams to the abutment caps.

The piers are in good condition. There is significant corrosion and moderate section loss of the brackets connecting the posts to the footings at the second and third pier from the east; minor corrosion on the other piers. These brackets do not need immediate replacement but their condition should be monitored closely. Some posts have minor splitting. The riprap placed around some of the footings on the north side is holding well and performing as it should, avoiding scour around the footings.

This bridge is not a candidate for widening since it is still in good condition and widening it would virtually require the replacement of the entire structure. This

Figure 19.4 Pier posts - Minor splitting on some pier posts.

structure does not qualify for a 25-ton loading. Routine inspections should be performed to monitor this structure.

20 R0498

- Two-span steel beam bridge with concrete abutments and piers
- Total length is 109 ft, with a 9 ft deck
- Located at Sta. 4846+99

This structure is generally in good condition and does not need replacement.

Figure 20.1 East approach - Extensive patching of the bituminous approach.

Figure 20.2 Beam - Construction joint separating.

Figure 20.3 Beam - Typical localized paint system failure.

Both approaches have been extensively patched due to settlement of the bituminous at the abutments. There is a 6 inch concrete transition from the bituminous trail to the timber deck built into the abutment. The deck planks have moderate deterioration and weathering throughout. Some of the planks on the southeast corner are loose. There is minor decay and cracking throughout the railings and curbs.

The steel beams appear in good condition. There is minor surface rust and localized paint system failure throughout. There is a construction joint that is separating along the bottom flange of the south girder near the east abutment. There is one diaphragm that appears to have been slightly bent during construction.

The abutments appear in good condition. There is minor staining and debris on the beam seats. There are trees all around the abutments, and a slight lack of riprap.

The pier is also in good condition. The bearing assembly anchors are slightly bent to the east, and the south bearing is missing the north dowel

Due to the uniqueness of the concrete abutment corners and piers, as well as the overhang support system, it is recommended not to widen this bridge deck at this time, and to do minor localized repairs to the deck and rails as needed. For informational purposes, a cost is included in Table 2 for a 10 ft wide deck. Routine inspections should be performed to monitor this structure.

Figure 20.4 Diaphragms - Note the slight bending of the diaphragm at the center of the picture.

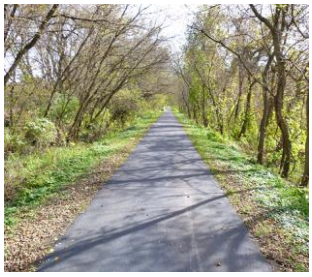
Trail Inspections and Evaluations

Bituminous Trail Widening

Erickson Engineering was requested to evaluate the existing condition of the trail, and to determine the feasibility of converting the trail from 8 feet wide to 10 feet. The following is a summary of the findings after inspecting CVT's bituminous surface and a trail widening method together with a cost estimate.

The trail surface condition varies greatly along its length. There are small areas that have a new bituminous surface, areas where the bituminous surface has recently been seal coated, areas where cracks have been sealed and / or local failures patched, but most areas have not been touched. In general the bituminous surface is in fair condition; the severity of the cracks is minor to moderate except in localized sections where flood events and / or slope failures have caused more severe damage.

The cracking noted along the CVT is due to several factors. The area where CVT resides gets large amounts of rain and discharge water from surrounding land, mostly from the south; it is also seasonally exposed to a wide variety of temperatures that cause freezing and thawing cycles. This, together with the prevalence of sandy soils in the area, aids the constant ongoing natural movement and settlement of the soil and base materials, which will produce cracks of the bituminous surface, and also result in localized slope failures along the trail that induce additional bituminous failures. Other factors to take into consideration are the low-temperature contraction of the bituminous itself, and deterioration of the asphalt binder due to oxidation when exposed to the sun and wind. Areas exposed to the sun all day can start cracking as a result of the contrast with evening low temperatures. In addition, high daytime temperatures and wind accelerate the deterioration process due to the effects of oxidation on the binding oils. Shaded areas can experience less cracking due to the above mentioned reasons.



There are long stretches of the trail that can easily be widened from 8 feet to 10 feet. Numerous other short sections will require fill for the widening while ensuring the integrity of the slopes of a widened trail, and therefore the bituminous. A few areas will also need riprap in order to keep the fill from eroding away, and in some cases they might need some sort of containment wall (blocks, boulders, sheet pile, etc.). Other minor areas will need rock excavation to obtain a 10 foot wide trail with 2 foot shoulders. Reliable subgrade and base materials need to be used to avoid movement that may cause localized failures and cracks of the bituminous. Along the sides of the trail, quarry run lime stone or similar should be used to keep the shoulders from washing away.

After inspecting the trail, Erickson Engineering believes that widening the full length of the trail is possible. Some maintenance will still be necessary to maintain the long term integrity of the slopes and bituminous after widening. Regardless, it is suggested that when repairing the trail, effort should be put into using reliable fill materials when performing localized fixes of the slopes and bituminous. The general condition of the bituminous, beyond local failures, is normal based on the environment in which the trail is located and the age of the trail. CVT should assess if generalized resurfacing of the trail is needed based on customer feedback and safety of the users.

The basic methodology for widening the trail includes repaving the entire surface of the sections that are to be widened. As a first step, a tiller is used to loosen the soil at the shoulders. A motor grader is then used to cut the shoulders to subgrade. Excess material will be moved to areas that need fill. Additional fill will be required in some areas and culvert extensions will have to be installed as necessary. The old bituminous surface is reused as base material after it is rubblized with a reclaimer. After all the base material is in place, a 2.5 inch bituminous layer is placed followed by 2 ft of aggregate shoulders on both sides of the new 10 ft bituminous trail. Please see Table 3 for an estimated cost; note that this cost is based on a single mobilization charge and that it will increase if the trail is widened in stages.

Sediment Control

Erickson Engineering observed two areas where there is significant sediment being washed on to the trail from the south. These areas, located approximately at mile marker 15.8 and 16.8, would greatly benefit from sediment retention structures.

The suggested sediment retention ponds consist on a sheet pile weir driven parallel to the trail, with berms on either side going up slope as necessary around the water way. The sediment will mostly settle on the south side of the weir along the sediment basin and the water will spill over to a plunge pool on the north side. This plunge pool and the berm side slopes will be covered with riprap as necessary. The sediment basins need to have clean cut access in order to maintain the berms and remove excess material.

For the location at mile marker 15.8 the current ditch will be maintained parallel to the trail towards the west in order to discharge the water to a nearby culvert. At the mile marker 16.8 location, a culvert will have to be added to the plunge pool in order for the water to get over to the north side of the trail. In order for a culvert with adequate downward slope to be installed at this location, a significant amount of sediment from the north side of the trail will have to be excavated and removed. This sediment is good granular material that can be used for bridge and culvert construction. Please see Table 3 for an estimated cost.

Preliminary Cost Estimates for Bridges and Trail

Table 2. Bridge Costs (2017 Pricing)

Bridge	Action Priority (1=Highest Priority)	Action Recommendations	Replacement or Rehabilitation Time Frame (yr)	Inplace Length (ft)	Steel Truss Bridge Replacement			Concrete Box Culvert Replacement		Timber Panel-Lam Replacement		Rehabi-litation
					No. of Spans	Length (ft)	Cost ($)	No. & Size	Cost ($)	No. of Spans	Cost ($)	Cost ($)
R0481	1	Replace	1-2	134	2	135	392,565	-	-	5	387,162	-
R0484	2	Replace	2-3	115	2	116	322,325	-	-	4	339,713	-
R0483	3	Replace	3-4	55	1	56	213,555	-	-	2	206,271	-
R0487	4	Replace (not urgent)	4-5	14	-	-	-	1-12'x4'	40,582	1	96,812	-
R0488	5	Replace (not urgent)	4-5	70	1	70	244,660	-	-	3	246,223	-
R0493 ^	6	Replace (not urgent)	5-8	28	-	-	-	2-12'x4'	69,244	1	131,222	-
R0496	7	Replace (not urgent)	5-8	15	-	-	-	1-12'x4'	40,582	1	97,915	-
R0486	8	Replace (not urgent)	8-10	16	-	-	-	1-14'x4'	44,195	1	99,812	-
R0492 ^	9	Replace (not urgent)	8-10	83	1	84	278,705	-	-	3	274,514	-
R0491 ^	10	Replace (not urgent)	8-10	15	-	-	-	1-14'x4'	44,195	1	97,915	-
25604 ^	11	Monitor / Rehabilitate	2-3	180	-	-	-	-	-	-	-	27,770
R0482	12	Rehabilitate	4-5	43	1	44	186,640	3-14'x8'	169,435	2	182,977	116,037
R0497	13	Rehabilitate	8-10	42	1	42	188,645	-	-	2	181,902	92,933
R0495	14	Rehabilitate	8-10	43	1	44	186,640	-	-	2	181,827	105,729
R0485	15	Rehabilitate	8-10	56	1	56	207,195	-	-	2	206,093	116,938
R0489 ^	16	Rehabilitate	8-10	43	1	44	186,640	-	-	2	181,252	100,650
R0494 ^	17	Rehabilitate	8-10	56	1	56	207,195	-	-	2	208,065	133,236
R0480	18	Monitor	-	24	-	-	-	-	-	-	-	-
R0499	19	Monitor	-	196	-	-	-	-	-	-	-	-
R0498	20	Monitor	-	109	-	-	-	-	-	-	-	190,695

^ No direct access from a road. Will have to drive over another bridge to access.

Truss bridges include concrete decks and approach panels.

Panel-Lam bridges & rehabilitated bridges include bituminous wear course on decks. No approach panels.

Table 3. Trail Costs (2017 Pricing)

ITEM	
Trail Widening and Repaving	COST ($) / MILE
	* 100,715
Sediment Retention Structures	COST ($) / EACH
	51,400

* Trail widening and repaving cost includes:

1) necessary non-erodible fill in numerous areas to facilitate trail widening
2) riprap at locations where the trail abuts the Cannon River and the possibility of damage to the trail exists
3) extension of all culverts necessary to create safe slopes for the new widened trail including culverts, fill, and riprap

Conclusion

This Feasibility Report is an outline of the findings that Erickson Engineering considers to be most important to convey to the CVT Board after inspecting the bridges, bituminous surface, and the general area where the trail is located. The CVT Board will be able to use this Feasibility Report to make informed decisions regarding the assessment of the future of the CVT. This report can also be used as a tool by the CVT Board to prioritize the work that needs to be performed to keep the CVT safe and comfortable for the users.

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