

# Mass Central Rail Trail Evaluation of Existing Bridges

## Wayside Branch - Waltham to Berlin

### Summary of Evaluation

Ten existing bridge structures are included in this evaluation; five steel structures and five timber structures. Four of the five steel bridges are recommended National Register Eligible; 2 lattice thru trusses and 2 deck plate girder bridges. The fifth steel bridge, a thru-plate girder constructed in 1960 is not National Register Eligible, however is in the best condition of all the structures and can be converted for the rail trail use with minor modifications. None of the timber bridges are eligible for the national register. All are multi-bent timber pile trestle bridges with timber beams supporting either an open tie/track deck or a wood deck supporting ballast, ties and track.

#### Steel Structures:

One of the deck plate girder bridges is partially submerged and will require raising the bridge and approach profiles unless the water level under the bridge can be lowered (this wetland area could possibly be flooded due to a beaver dam obstruction downstream from the bridge). For this bridge an alternative option to rehabilitation of the existing superstructure is proposed; installation of a new superstructure that would allow for adequate freeboard under the span, with a comparable cost to rehabilitation of the existing superstructure.

The paint on the four older structures is virtually gone with the steel covered with a rust patina. It is recommended that any necessary steel repairs be made and the bridges completely cleaned and repainted before retrofitting the bridges with new decks and bridge railings. It is noted that cleaning and painting these structures will require a significant portion of the rehabilitation costs.

The 1960 thru-plate girder bridge over I95/ Route 128 was last painted in 1988, and complete cleaning and painting of this bridge could be postponed for several years. The north elevation of this bridge is accessible by a catwalk, and consequently has been tagged with graffiti along with the interior faces of the girders. Cleaning and painting these areas is being recommended for cosmetic purposes. Conversion of this bridge to a rail trail will eliminate the need for the catwalk, and it is recommended that it be removed from the bridge.

Typically a new timber deck with timber bridge railings would be proposed for these steel structures. The 1960 thru-plate girder bridge has a steel plate deck with ballast, so this bridge will only require paving of the trail over the bridge (along with some upgrading of the deck drainage). For the lattice truss bridge over Linden Street in Waltham, a reinforced concrete bridge deck is proposed versus a timber deck, to minimize ice formation hazards to pedestrians and vehicles passing under the bridge. For the other three steel bridges, cost estimates assume the use of pressure treated timber for the decking and railings. If funding is available to upgrade the lumber to IPE, the lifespan of the timber components would be significantly increased.

The cost estimates for the steel structures includes miscellaneous steel repairs, cleaning and painting the steel, new transverse timber beams/ties to support a new timber deck and bridge railings on three of the bridges, construction of a new reinforced concrete deck and bridge railings on one bridge, and paving and drainage improvements to the ballasted deck thru-girder bridge. Repairs and modifications

to the substructure elements are also included. As previously noted, for one of the deck plate girder bridges, a cost estimate for an alternative replacement superstructure is provided.

#### Timber Structures:

All five bridges are located over water ways. Two of these bridges (located over the Sudbury and Assabet Rivers) should be further evaluated for hydraulic requirements and adequacy, before consideration is given to investing capital to rehabilitate these bridges for the proposed rail trail. Both bridges have multiple timber pile bents within the waterways and have some damage due to debris collision. It is also noted that adjacent highway bridges have been recently reconstructed as single span structures eliminating piers in the waterways near both bridge locations.

The other three bridges are located over smaller brooks, and although hydraulic studies may not be required, the multi-span bent configurations result in the buildup of debris against the pile bents impeding the stream flows. At one of these bridges where what appears to be a beaver dam, the obstruction resulted in the washout of the approach backfill behind the end pier and timber backwall.

Ideally all five bridges should be replaced with new bridges to eliminate the multiple pier configurations within the waterways. The age of these structures is unknown, and all will require significant repairs to retrofit the bridges for the proposed rail trail use.

If budget constraints do not permit the complete replacement of these bridges and hydraulic analysis results do not dictate the need to replace the structures, reusing the timber pile bents and as many other elements as possible will greatly reduced construction costs and construction impact on the wetland environments would be limited. Despite the weathered state of the timber pile bents and some isolated decay/damage that would need to be repaired and reinforced, these pile bents have sufficient structural integrity to support the proposed rail trail bridge retrofits. Some pile caps with advanced decay will need to be replaced, as well as some of the diagonal pile bracing. All bridges have end timber pile bents with timber backwalls supporting the approach backfill. These timber backwalls are generally decayed and will need to be removed and replaced. Widening of the approaches to provide for the proposed 14 feet wide trail, will also require u-wing walls adjacent to the new backwalls. The replacement backwalls and the new wingwalls should be constructed with a material other than timber such as; precast concrete, cast in- place concrete or concrete block.

The retrofitting these bridges for the proposed rail trail will require replacement of, and/or additional longitudinal timber beams, a new timber deck and timber bridge railings. The cost estimates for retrofitting these bridges assumes the use of pressure treated timber for the replacement and additional beams, new decking and bridge railings. Upgrading of the lumber to IPE is not recommended, since the lifespan of the re-used substructure components is expected to be less than that of the IPE deck and bridge railings.

The cost estimates for the timber bridges includes any repairs to substructure elements, replacement of or additional timber bridge beams, and the cost to construct new timber bridge decks and railings.

### Steel Bridges Recommended for Rehabilitation:

Linden Street, Waltham: 1894 Riveted Lattice Thru Truss on Stone Abutments

Single span: 122 ft. (backwall to backwall)

Width: 15' – 3" clear between truss elements

Deficiencies:

- Some minor impact damage to secondary bracing members under the deck
- No paint remaining on the steel
- Cracked, loose and missing mortar in the stone abutments

Proposed Rehabilitation:

- Remove and dispose of existing timber ties and steel rails
- Repair bent, cracked/ broken gusset plates and bracing angles
- Clean and paint steel
- Replace mortar joints in the abutments
- Construct new concrete bridge deck, curbs and bridge railings (a concrete slab with curbs is recommended since this bridge is over roadway and pedestrian traffic to prevent ice hazards below)

Cost Estimate for Rehabilitation:

• Demolition – remove and dispose of existing track and ties:	\$ 12,000.00
• Miscellaneous steel repairs:	\$ 10,000.00
• Clean and paint steel:	\$500,000.00
• New reinforced concrete deck:	\$230,000.00
• New Bridge Railings:	\$ 40,000.00
• Replace mortar joints in abutments:	\$ 20,000.00
• Police Details (Allowance):	<u>\$ 75,000.00</u>

Total:	\$887,000.00
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## Route 128, Waltham: 1960 Two Span Thru Plate Girder on Concrete Abutments and Pier

Two Spans: 118'-6" (each span)

Transverse floor beams and longitudinal diaphragms support a steel plate deck and curbs with ballast

Width: 14 feet clear between steel plate curbs

### Deficiencies:

- Paint is in fair condition, except for graffiti on the inside face of the both girders and on the outside face of the north girder (accessible by a catwalk). The underside of floor beams, diaphragms and deck plate has peeling paint. Bridge was last painted in 1988.
- Verify adequacy of existing bridge drainage, make upgrades as required.

### Proposed Rehabilitation:

- Remove and dispose of existing timber ties and steel rails
- Clean and paint steel (cover graffiti surfaces only), entire structure will require future painting
- Upgrade bridge drainage system
- Pave pathway over the bridge
- Install a timber guardrails along the inside face of the girders
- Remove the catwalk along the north side of the bridge (potential safety hazard)

### Cost Estimate for Rehabilitation:

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| • Demolition – remove and dispose of track and ties and catwalk: | \$50,000.00        |
| • Clean and paint steel (cover graffiti surfaces only):          | \$100,000.00       |
| • Upgrade bridge drainage (Allowance):                           | \$40,000.00        |
| • Timber guardrails:   | \$10,000.00        |
| • Police Details (Allowance):                                    | \$75,000.00        |
| • Grade and pave pathway over bridge:                            | <u>\$25,000.00</u> |

Total: \$300,000.00







## Over MBTA Fitchburg Line, Weston: 1896 Riveted Lattice Thru Truss on Stone Abutments

Truss Span: 98 feet, Approach decks built on granite U-wingwalls: East End 15 feet, West End 24 feet

Width: 15' – 6" clear between truss elements

### Deficiencies:

- No paint remaining on the steel
- Cracked, loose and missing mortar in the stone abutments and wingwalls
- Timber ties are in fair condition, but will need to be replaced to widen the bridge deck

### Proposed Rehabilitation:

- Remove and dispose of existing timber ties and steel rails
- Clean and paint steel
- Replace mortar joints in the abutments
- Construct new timber bridge deck and railings
- Construct new backwalls/wingwalls to facilitate widening of the bridge deck to 14 feet

### Cost Estimate for Rehabilitation:

• Demolition – remove and dispose of existing track and ties:	\$20,000.00
• Clean and paint steel:	\$500,000.00
• New timber transverse beams:	\$65,000.00
• New timber deck and bridge railings:	\$75,000.00
• New backwalls/wingwalls at approaches:	\$25,000.00
• Replace mortar joints in abutments:	\$20,000.00
• Temporary Protective Shielding:	\$20,000.00
• MBTA Flagmen (Allowance):	<u>\$75,000.00</u>

Total: \$800,000.00







## #127 Hop Brook, Sudbury: 1881 Riveted Plate Deck Girder, Stone Abutments, Timber Piers

Total Length: 47'-3" (abutment to abutment)\*

\*Bottom of girders was submerged 12 inches at time of field visit. Previous study indicates this bridge is identical to #128 Hop Brook, Sudbury, which has three continuous spans supported on two intermediate timber bents.

Width: 12 feet out to out of timber tie deck, girder spacing 5'-9" center to center

### Deficiencies:

- Bottom of Girders are submerged (possibly due to flooding of wetland from beaver dams)
- No paint remaining on the steel
- Timber ties are in poor condition, and will need to be replaced to widen the bridge deck
- Condition of abutments and intermediate piers cannot be determined due to flooding

### Option 1: Proposed Rehabilitation

- Investigate the cause of flooding and rectify if possible
- If water level cannot be lowered, the bridge seats need to be raised and the girders reset (this will require considerable additional costs for raising the approach pathway profiles to meet the new bridge deck elevation)
- Remove and dispose of existing timber ties and steel rails
- Complete miscellaneous repairs to steel as required
- Clean and paint steel
- Install new timber transverse beams
- Construct new timber bridge deck and railings
- Replace mortar joints in the abutments
- Construct new backwalls/wingwalls to facilitate widening of the bridge deck and approaches to the proposed 14 feet trail width and raising of the bridge deck elevation and approaches
- Repairs/ replacement of intermediate piers

### Cost Estimate for Rehabilitation:

• Demolition – remove and dispose of existing track and ties:	\$ 5,000.00
• Miscellaneous steel repairs:	\$15,000.00
• Clean and paint steel:	\$75,000.00
• New timber transverse beams:	\$16,000.00
• New timber deck and bridge railings:	\$20,000.00
• New backwalls/wingwalls, adjust approach profiles:	\$50,000.00
• Replace mortar joints in abutments:	\$ 4,000.00
• Rebuild/raise bridge seats:	\$20,000.00
• Repair/ replace intermediate piers:	\$20,000.00
• Lift and reset steel girders:	\$10,000.00
• Water control for substructure repairs:	<u>\$15,000.00</u>

Total: \$250,000.00

## Option 2: Superstructure Replacement:

For this bridge an alternative option to rehabilitation of the existing superstructure is proposed; installation of a new superstructure that would allow for adequate freeboard under the span, with a comparable cost to rehabilitation of the existing superstructure.

### Cost Estimate for Rehabilitation:

• Demolition – remove and dispose entire superstructure:	\$10,000.00
• New steel beams:	\$150,000.00
• New timber transverse beams:	\$16,000.00
• New timber deck and bridge railings:	\$20,000.00
• New backwalls/wingwalls:	\$20,000.00
• Replace mortar joints in abutments:	\$ 4,000.00
• Rebuild/raise bridge seats:	\$20,000.00
• Water control for substructure repairs:	<u>\$15,000.00</u>

Total: \$255,000.00







## #128 Hop Brook, Sudbury: 1881 Riveted Plate Deck Girder, Stone Abutments, Timber Piers

Total Length: 43'-6" (abutment to abutment)

Three continuous spans supported on two intermediate timber bents

Width: 10 feet out to out of timber tie deck, girder spacing 5'-9" center to center

### Deficiencies:

- No paint remaining on the steel, graffiti on inside faces of girders
- Timber ties are in poor condition, and will need to be replaced to widen the bridge deck
- Damp debris on bridge seats
- Missing, loose mortar joints in the stone abutments
- Ends of timber pier caps display some decay

### Proposed Rehabilitation:

- Remove and dispose of existing timber ties and steel rails
- Complete miscellaneous steel repairs as required
- Clean and paint steel
- Replace mortar joints in the abutments
- Repair/replace pier caps
- Modify backwall to facilitate widening of bridge and approach to the proposed 14 feet trail width
- Construct new timber bridge deck and railings

### Cost Estimate for Rehabilitation:

• Demolition – remove and dispose of existing track and ties:	\$ 4,500.00
• Miscellaneous steel repairs:	\$ 5,000.00
• Clean and paint steel:	\$60,000.00
• Replace mortar joints in abutments:	\$ 3,000.00
• Repair/replace timber pier caps (includes temporary shoring):	\$10,000.00
• Modify backwalls for widening of the bridge:	\$20,000.00
• New timber transverse beams:	\$15,000.00
• New timber deck and bridge railings:	\$17,500.00
• Water control for substructure repairs:	<u>\$ 5,000.00</u>

Total: \$140,000.00









### Timber Bridges Recommended for Rehabilitation or Replacement:

#### Clematis Brook, Waltham: Timber Pile Trestle (open timber tie deck)

Total length: 126 feet, 12 spans (vary from 10 feet to 11 feet)

Width: 10 feet out to out of timber ties, 12 feet out to out of pile bent caps

Superstructure: Timber ties supported on 4 timber beams

Substructure: 11 Intermediate pile bents and 2 end pile bents with timber backwalls

#### Deficiencies

- Timber ties are in poor condition, and need to be replaced to widen the bridge deck
- Timber backwalls have decay and need to be replaced
- Ends of timber pile caps display some decay
- Accumulating debris in stream is against the upstream side of the timber pile bents

#### Proposed Rehabilitation:

- Remove and dispose of existing timber ties and steel rails
- Remove timber backwalls and reconstruct new backwalls and wingwalls to support backfill
- Repair/ replace timber pile caps as required
- Clear stream bed of accumulated debris against the pile bents
- Install new additional longitudinal timber beams and construct new timber deck and railings

#### Cost Estimate for Rehabilitation:

• Demolition – remove and dispose of existing track and ties:	\$12,500.00
• Remove timber backwalls and construct new backwalls/wingwalls:	\$20,000.00
• Repair/ replace timber pile caps:	\$25,000.00
• Additional new timber beams:	\$42,500.00
• New timber deck and bridge railings:	\$51,000.00
• Clear debris from stream:	<u>\$ 500.00</u>

Total: \$151,500.00







## Bruce's Pond, Hudson: Timber Pile Trestle (open timber tie deck)

Total length: 109 feet, 9 spans (vary 12 feet +/-)

Width: 12 feet out to out of timber ties, every 4<sup>th</sup> tie extends 5 feet to support a catwalk on the north side of the bridge, 16 feet out to out of pile bent caps

Superstructure: Timber ties supported on 4 timber beams

Substructure: 8 Intermediate pile bents and 2 end pile bents with timber backwalls

### Deficiencies

- Timber ties are in poor condition, and need to be replaced to widen the bridge deck
- Timber backwalls have decay and need to be replaced
- One timber pile displays some decay
- Minor fire damage to timber ties and beams (damage to beams not significant)

### Proposed Rehabilitation:

- Remove and dispose of existing timber ties, steel rails, remains of timber catwalk and fencing
- Remove timber backwalls and reconstruct new backwalls and wingwalls to support backfill
- Repair deteriorated timber pile (cut out decay/ splice/plate and bolt repair section)
- Install additional longitudinal beams and construct new timber deck and railings

### Cost Estimate for Rehabilitation:

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| • Demolition – remove and dispose of existing track and ties:    | \$13,500.00        |
| • Remove timber backwalls and construct new backwalls/wingwalls: | \$20,000.00        |
| • Additional new timber beams:                                   | \$37,000.00        |
| • New timber deck and bridge railings:                           | \$44,000.00        |
| • Repair timber pile:  | <u>\$ 1,500.00</u> |

Total: \$116,000.00







## Assabet River, Hudson: Timber Pile Trestle (timber deck with ballast)

Total length: 97 feet, 8 spans (vary 12 feet +/-)

Width: 14 feet out to out of timber deck curbs

Superstructure: 9 Timber beams, timber deck and curbs, ballasted timber ties/track

Substructure: 7 Intermediate pile bents and 2 end pile bents with timber backwalls/wingwalls

### Deficiencies

- Ballasted timber deck supports significant vegetation growth (trees up to 8 inch in diameter); the condition of the wood deck is suspect to decay, will likely need replacement
- Timber beams appear to be sound, some decay at top of beams can be expected
- Timber backwalls and wingwalls have decay and need to be replaced
- Some cross bracing on the timber pile bents is split, cracked and weathered, and at two locations has been cut off near the waterline on the upstream side of the bridge (possibly damaged from floating debris)
- Condition of piles below the waterline could not be determined

### Proposed Rehabilitation:

Further in depth evaluation of this bridge should include an underwater inspection of timber piles and a hydraulic analysis of the bridge before consideration is given to investing capital to rehabilitate this bridge for the proposed rail trail. If it is determined that this structure warrants rehabilitation, the following is required:

- Remove and dispose of trees, timber ties, steel rails, and ballast
- Remove and dispose of timber curbs and timber decking
- Replace any deteriorated timber beams
- Remove timber backwalls and wingwalls; reconstruct new backwalls and wingwalls to support backfill
- Repair deteriorated timber pile cross bracing
- Construct new timber deck and railings

### Cost Estimate for Rehabilitation:

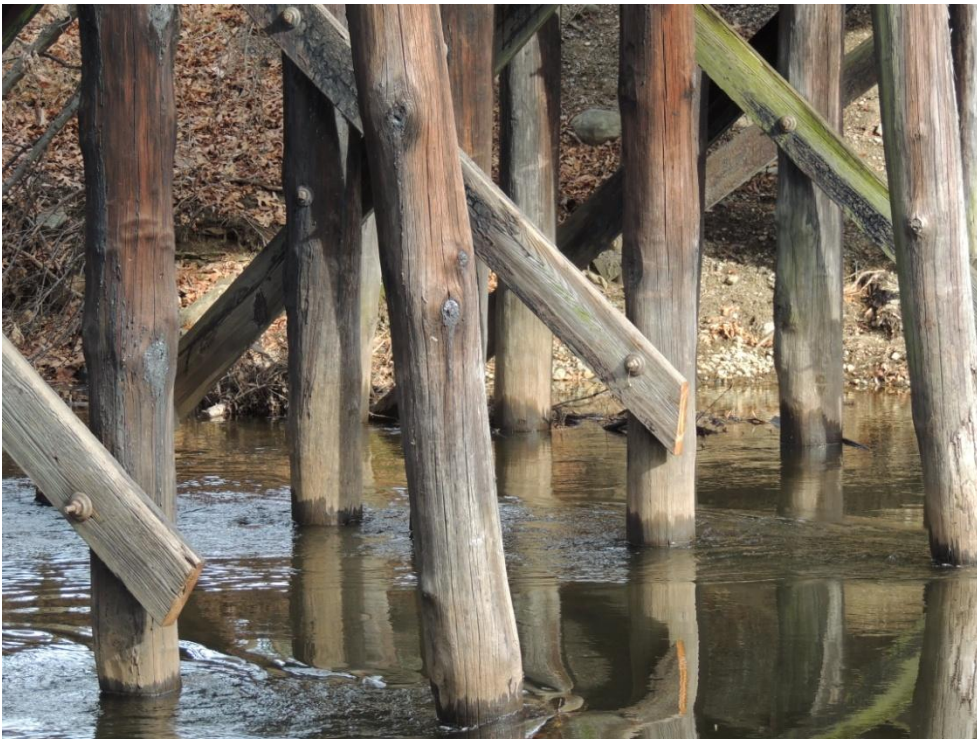
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| • Demolition – remove/ dispose of existing track, ties, ballast and trees: | \$19,000.00        |
| • Remove/ dispose of timber curbs and decking:                             | \$13,500.00        |
| • Replace deteriorated beams as required:                                  | \$15,000.00        |
| • Remove timber backwalls and construct new backwalls/wingwalls:           | \$20,000.00        |
| • New timber deck and bridge railings:                                     | \$39,000.00        |
| • Repair timber pile cross bracing:  | <u>\$ 3,500.00</u> |

Total: \$110,000.00









## Great Meadows Wildlife Refuge Sudbury River, Sudbury: Timber Pile Trestle (timber deck with ballast)

Total length:	118 feet, 10 spans (vary 12 feet +/-)
Width:	14 feet out to out of timber deck curbs
Superstructure:	9 Timber beams, timber deck and curbs, ballasted timber ties/track
Substructure:	9 Intermediate pile bents and 2 end pile bents with timber backwalls/wingwalls

### Deficiencies

- Ballasted timber deck, the condition of the wood deck is suspect to decay, will likely need replacement
- Timber beams have some decay, expect some will require replacement
- Timber pile caps display some decay, with splits, cracks and weathering, suspect some may require repair or replacement
- One timber pile at mid span on the upstream side of the bridge is severed possibly damaged by floating debris, and will need to be spliced/reinforced
- Condition of piles below the waterline could not be determined
- Cross bracing on the timber pile bents is split, cracked and weathered

### Proposed Rehabilitation:

Further in depth evaluation of this bridge should include an underwater inspection of timber piles and a hydraulic analysis of the bridge before consideration is given to investing capital to rehabilitate this bridge for the proposed rail trail. If it is determined that this structure warrants rehabilitation, the following is required:

- Remove and dispose timber ties, steel rails, and ballast
- Remove timber curbs and timber decking
- Repair severed timber pile
- Repair deteriorated timber pile cross bracing
- Repair/ replace deteriorated timber pile caps as required
- Replace deteriorated timber beams as required
- Construct new timber deck and railings

### Cost Estimate for Rehabilitation:

• Demolition – remove/ dispose of existing track, ties, ballast:	\$ 9,000.00
• Remove/ dispose of timber curbs and decking:	\$ 6,000.00
• Remove timber backwalls and construct new backwalls/wingwalls:	\$20,000.00
• Repair timber pile:	\$ 5,000.00
• Repair timber pile cross bracing:	\$ 5,000.00
• Repair/ replace timber pile caps:	\$ 10,000.00
• Replace deteriorated timber beams:	\$20,000.00
• New timber deck and bridge railings:	<u>\$47,500.00</u>

Total: \$122,500.00









## Fort Meadow Brook, Hudson: Timber Pile Trestle (open timber tie deck)

Total length: 50 feet, 4 spans (12'-6" each)

Width: 12 feet out to out of timber ties

Superstructure: Timber ties supported on 4 timber beams

Substructure: 3 Intermediate pile bents and 2 end pile bents with timber backwalls

### Deficiencies

- Entire structure is in poor condition; timber ties, beams, pile caps and backwalls (timber piles may be able to be re-used)
- Heavy debris built up against the pile bents on the upstream side of the bridge (possibly a beaver dam) is obstructing the flow and the west approach has washed out behind the end pile bent and backwall.
- An attempt has been made to divert the flow around the obstruction using flexible drainage conduits

Proposed Rehabilitation: As noted above, the timber piles are the only elements that could possibly be re-used for rebuilding of this bridge. The current multiple pile bent configuration has facilitated the collection of debris, and the removal of these pile bents and a complete replacement of this bridge with a new single span structure would be the ideal option for this bridge location. If budget considerations dictate reusing of the existing timber piles and rebuilding of the bridge, the following items with estimated costs will be necessary:

- Remove and dispose of existing timber ties and steel rails, timber beams and timber pile caps
- Remove timber backwalls and reconstruct new backwalls and wingwalls to support backfill
- Restore west approach embankment
- Replace timber pile caps
- Install new timber beams, new timber deck and railings
- Obtain approval to design and install water level control devices (WLCD) to regulate the water level behind the beaver dam obstruction to avoid future washouts of the adjacent embankments

### Cost Estimate for Rehabilitation:

• Demolition – remove and dispose track, ties beams and pile caps:	\$10,000.00
• Remove timber backwalls and construct new backwalls/wingwalls:	\$30,000.00
• Restore west approach embankment:	\$ 3,000.00
• Replace timber pile caps:	\$ 7,000.00
• Install new timber beams:	\$25,000.00
• Install new timber decking and railings:	\$20,000.00
• Water control for substructure repairs:	\$20,000.00
• Install water level control devices:	<u>\$ 5,000.00</u>

Total: \$120,000.00







