2.0 Bridge Assessment

As part of this feasibility study, B&L also completed a rehabilitation needs assessment for the four existing bridges. The bridges were likely built in the late 1800's alongside the construction of the former railroad that ran along the corridor. The corridor was abandoned by the railroad in the 1970's, and the bridge structures appear to be unmaintained since that time.

Structural engineers from Barton & Loguidice completed a field inspection of the bridges on October 19, 2020 in order to assess the existing conditions, the feasibility of reuse, and the general repair needs for each structure. The integrity of the remaining bridges for re-use was taken into consideration, evaluating the extent of the repairs required to retrofit the bridges to be able to carry the loads of the proposed multi-use path, as well as site conditions and limitations where full structure replacement may be recommended.

This section discusses alternatives for repair or replacement as they apply to each individual bridge, and approximate total costs for the construction of each alternative. All of the bridges inspected will require a new deck to carry the trail. The materials considered for the decks include precast concrete, cast-in-place concrete or timber. Each material offers its own set of benefits or limitations to be considered during the selection process. Timber decking is the least expensive and more easily repaired by local forces but has a much shorter life span than concrete options, typically 20 to 30 years. Precast concrete deck panels will have a higher cost, but will allow for quicker construction and enhanced durability, with a designed lifespan of approximately 75 years. The use of precast concrete will require appropriate construction access at each location along the corridor and adequate clearances for equipment to deliver and set the panels in place. Cast-in-place concrete will typically have slightly higher costs than precast concrete, requiring longer construction time and on-site labor needs, but is similarly durable and designed for a lifespan of approximately 75 years.

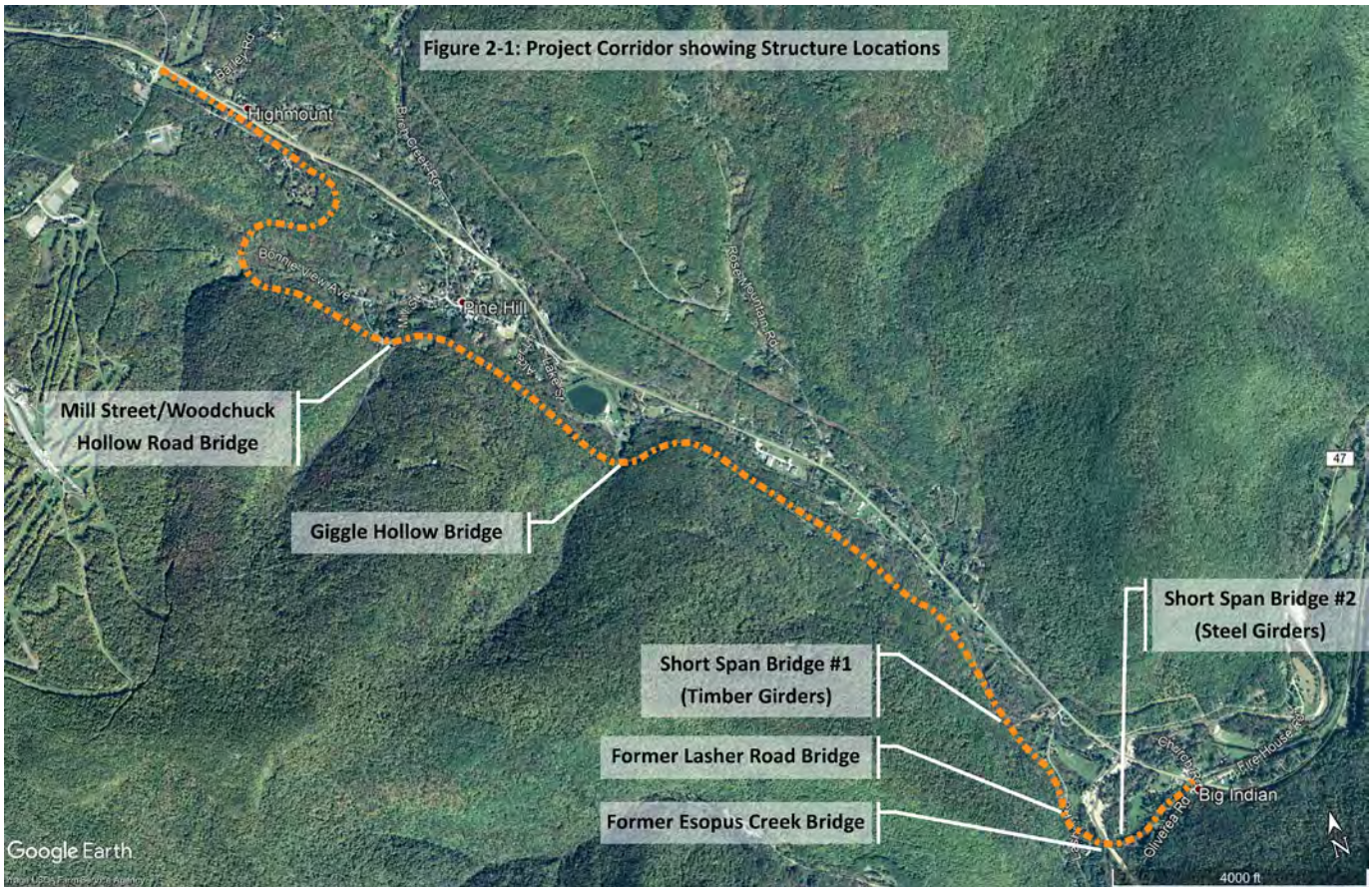

Figure 2-1: Project corridor showing structure locations

During the preliminary design phase, the rehabilitation alternative chosen for each bridge should be presented to SHPO for an effect determination as required by the State Environmental Quality Review Act ("SEQRA") and Section 106. Review was initiated on the Cultural Resource Information System ("CRIS") and coordination is ongoing. The bridge structures included in this segment of the railroad corridor are approximately 120 years old and appear to be in their original condition from when the railroad was constructed.

2.1 Woodchuck Hollow Bridge (Milepost K39.75)

The existing bridge (BIN 7713410) was originally built in 1896 (as evidenced from the date on the cornerstone) and carries the railroad corridor over Mill Street and an unnamed stream. The structure consists of a two-span continuous steel girder superstructure, supported by stone masonry abutments and one pier. Span 1 is approximately 23 feet in length with two steel girders spaced at 8 feet on center and are 28 inches deep. The Span 1 girders haunch down to a depth of 6 feet at the pier, where 6 feet deep girders are carried over Span 2. The length of Span 2 is approximately 64 feet. The steel girders appear to be in good condition, with no apparent signs of deterioration or section loss.

Figure 2-2: Elevation view of Woodchuck Hollow Bridge, Span 1

Figure 2-3: View of Span 2 looking toward the West Abutment looking south

NYSDOT classifies Mill Street as a Local Rural road. The NYSDOT Bridge Design Manual and Highway Design Manual state the minimum vertical clearance for a roadway with no Vertical Clearance Posting is 14 feet, and the minimum roadway width for a Local Rural Road is 24 feet, with 10 foot travel lanes and 2 foot shoulders. The existing vertical clearance of 12 feet, between the roadway and the underside of the Span 1 girders, and the horizontal clearance of 16.5 feet, between the east abutment and the pier, do not meet the NYSDOT minimum requirements. The horizontal clearance restricts Mill Street to one lane of traffic to be carried under the bridge at a time.

There is a crack at the mortar joint between the begin abutment and begin right wingwall. The northeast wingwall also has deterioration to the stone masonry in the form of two additional full height cracks, up to 1" wide. The southeast wingwall has collapsed behind the abutment and will require reconstruction. Overall, the stone masonry joint mortar is in fair condition. Approximately 30% of the surface areas of all substructures require repointing.

Figure 2-4: Separation between East Abutment and Right Wingwall

Figure 2-5: Displacement of East Left Wingwall

Recommended Rehabilitation:
At this bridge, B&L recommends the existing substructures and steel girders remain in place, and the existing steel rails and timber rails are removed and replaced with a timber deck, precast concrete bridge deck panels, or a cast-in-place concrete deck. Rehabilitation of the substructures will include repointing the deteriorated areas of the stone masonry, repair to the full height cracks of the northeast wingwall, joint repair between the right wingwall and the begin abutment stem, and reconstruction of the collapsed begin left wingwall.

The approximate rehabilitation cost to address the deteriorations noted above and restore the substructure surfaces by repointing all grout lines is $170,000, with the addition of one of the following deck replacement options.

Deck Replacement Options:

A. Timber Deck – $200,000 (approximate total cost $370,000)
B. Precast Concrete Panels – $300,000 (approximate total cost $470,000)
C. Cast-in-Place Concrete Deck – $260,000 (approximate total cost $430,000)

Of these options, B&L recommends the existing steel girders remain in place and the stone abutments and pier be rehabilitated by repointing the entire surface area of the stone masonry, repairing cracks and joints in and between the stones, and reconstruction of the collapsed wingwall. The timber rail ties will be removed and replaced with a cast-in-place concrete deck. The approximate total construction cost for this alternative is $430,000.

2.2 Giggle Hollow Bridge (Milepost K38.91)

The existing bridge at this site carries the railroad corridor over the Giggle Hollow Creek. The structure consists of stone masonry abutments and wingwalls and a 65 foot single span steel girder superstructure. The steel girders consist of two riveted plate girders spaced 8 feet on center and 8 feet in depth. The steel girders appear to be in good condition, with no signs of deterioration or section loss.

The masonry abutments appear in good condition, with localized areas of deterioration. The most significant areas exist at the west abutment and west wingwalls. There are locations at both west wingwalls where a joint crack exists through multiple layers of grout. The stone masonry in these locations appears to be tipping away from the embankment. There are also signs of joint separation at the northwest cheekwall between the

Figure 2-6: Giggle Hollow Bridge East Abutment

Figure 2-7: Superstructure, looking toward West Abutment

backwall and the wingwall at the west abutment, seen in the photo below. This is causing the stones in this location to tip and rotate away from the backwall. Overall, approximately 20% of the abutment and wingwall surface area has missing mortar between the stones.

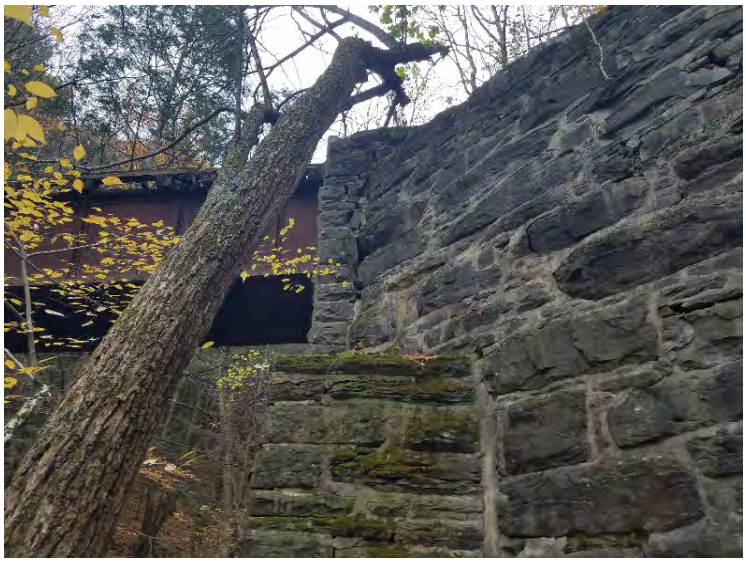

Figure 2-8: Separation beginning at the joint between the cheekwall, backwall, and northwest wingwall at the West Abutment

Recommended Rehabilitation:

At this bridge, B&L recommends the substructures and steel girders remain in place and be rehabilitated. The existing steel rails and rail ties will be removed and replaced with a new timber deck, concrete deck panels, or a cast-in-place concrete deck. The areas of displaced stone will be removed and reset and all areas requiring mortar repointing will be repaired.

The approximate rehabilitation cost to address the rotating stones and restore the substructure surfaces by repointing all grout lines is $310,000, with the addition of one of the following deck replacement options.

Deck Replacement Options:

A. Timber Deck – $140,000 (approximate total cost $450,000)
B. Precast Concrete Panels – $230,000 (approximate total cost $540,000)
C. Cast-in-Place Concrete Deck – $200,000 (approximate total cost $510,000)

Of these options, B&L recommends the existing stone abutments and steel girders be rehabilitated and the existing steel rails and rail ties be replaced with a cast-in-place concrete deck. The stone abutments will be repointed and mortar repairs performed between the stones. The approximate total construction cost for this alternative is $510,000.

2.3 Short-Span Bridge #1 (Milepost K37.34)

This structure consists of a timber girder superstructure founded on stone masonry abutments and wingwalls. The two timber girders are spaced approximately 6 feet apart on center, measuring 24 3/4" in depth. Steel rails and timber rail ties exist over the girders. The timber beams and rail ties are heavily rotted and loose in multiples locations.

The stone masonry shows signs of deterioration, in the form of loose and missing mortar between adjacent stones, on approximately 50% the total surface area of each abutment and wingwall. The clear span between abutments is 8'-6".

Figure 2-9: View of the rails across the structure, looking south

Figure 2-10: Elevation view of Short Span Structure #1

Rehabilitation Alternatives:

Alternative 1 – New Pipe Structure

This alternative consists of removing the entire superstructure, leaving the stone substructures as is, and installing a new steel plate pipe culvert and backfilling to carry the trail over the crossing. The intent would be to use as large of a culvert pipe as possible that would fit between the abutments.

The crossing itself does not appear to pass over a stream; however, a watershed analysis should be performed to ensure the proposed culvert pipe does not negatively affect the drainage characteristics of the area and that the new pipe is sized accordingly. The feature crossed by the bridge structure appears to be an old abandoned roadway, a trail, or potentially be a cattle pass that was used when this area used to be farmed, when the railroad still used this corridor.

The approximate total cost of this alternative is $50,000.

Alternative 2 – Structure Rehabilitation

Under this alternative, the existing substructures will remain in place and would be repointed across approximately 50% of the abutment and wingwall surfaces. The timber girders and rail ties would be removed and would be replaced with new timber or steel girders, a new deck, and pedestrian bridge railings. Steel girders have an approximate lifespan of 75 years, while timber girders have an approximate lifespan of 20 to 30 years. An additional option at this structure would be to construct a glue laminated timber beam and deck structure. This type of structure would be delivered to the site in one piece, with the timber girders and timber deck glued together into a composite section. The advantage of this option is faster construction times when compared to a standard timber deck where the boards are fastened together one at a time.

The approximate cost for rehabilitation of the substructures is $30,000, plus the addition of one of the beam replacement and deck replacement options, or the timber beam/deck system.

Beam Replacement Options:

A. Steel Beams – $40,000
B. Timber Beams – $15,000

Deck Replacement Options:

C. Timber Deck – $35,000
D. Precast Concrete Bridge Deck Panel – $50,000
E. Cast-in-Place Concrete Deck– $45,000
F. Glulam Timber Beam/Deck System – $45,000

Recommended Alternative:

For this structure, B&L recommends Alternative 1, full removal and replacement with a new steel plate pipe culvert and backfilling the gap to carry the trail over the crossing. The approximate total construction cost of this alternative is $50,000.

2.4 Lasher Road Crossing (Milepost K36.90)

The existing structure at the Lasher Road crossing consists of stone-block masonry abutments with no existing superstructure. The masonry stones at each abutment and wingwall are in fair condition; however, there is missing mortar between the masonry stones across nearly the entire surface area.

Figure 2-11: Deterioration of the grout between the stone blocks

Figure 2 12: Elevation view, showing non-standard horizontal clearance

The face-to-face distance between the abutments is 10'-6", allowing only one lane of traffic to pass through. The narrow constriction created by the abutments and the current roadway geometry result in poor sight distances for vehicles travelling in both directions on Lasher Road in the vicinity of this crossing.

Rehabilitation Alternatives:

Alternative 1 – New Superstructure on Existing Abutments

This alternative consists of rehabilitating the existing substructures and constructing a new 12' span superstructure. Under this alternative the non-standard horizontal clearance between the abutments will be maintained, allowing only one lane of traffic to pass under the bridge at one time. Placement of the new superstructure would also create a non-standard vertical clearance, limiting the height for vehicles passing under the bridge to approximately 7'-6". Substructure repairs would include removal of deteriorated grout lines and vegetation and repointing.

The approximate cost for rehabilitation of the substructures will be $65,000, in addition to the one of the following beam options and deck options.

Beam Replacement Options:

A. Steel Beams – $40,000
B. Timber Beams – $15,000

Deck Replacement Options:

C. Timber Deck – $25,000
D. Precast Concrete Bridge Deck Panel – $35,000
E. Cast-in-Place Concrete Deck – $30,000
F. Glulam Timber Beam/Deck System – $60,000

Alternative 2 – Full Replacement

This alternative involves the complete removal and reconstruction of the existing bridge structure crossing over Lasher Road, increasing the span length to approximately 25 feet. The existing stone abutments and wingwalls would be completely removed so that standard horizontal clearance can be obtained and allow for two lanes of traffic on Lasher Road. The trail elevation would be raised and the new superstructure would be designed to provide 14 feet of vertical clearance for vehicles on Lasher Road.

The approximate base cost for construction will be $450,000, in addition to the costs below for steel or timber beams and a timber, precast, or cast-in-place concrete deck, or the combined timber beam/deck system.

Beam Replacement Options:

A. Steel Beams – $65,000
B. Timber Beams – $45,000

Deck Replacement Options:

C. Timber Deck – $55,000
D. Precast Concrete Bridge Deck Panel – $100,000
E. Cast-in-Place Concrete Deck– $85,000
F. Glulam Timber Beam/Deck System – $60,000

Alternative 3 – At-Grade Crossing

Under this alternative, the existing structure would be completely removed and an at-grade crossing would be constructed between the trail and Lasher Road.

In order to meet the maximum allowable grade of 4.5% for the trail, the excavation limits along the trail will need to extend 275 feet or more behind each of the existing abutments. The limits of excavation may extend into the properties adjacent to the crossing. Access will be maintained to driveways adjacent to the crossing and temporary utility pole relocations will be necessary during construction. Removing the existing abutments and increasing the width of the roadway at the crossing will significantly improve the sight distance, thereby improving the safety for vehicles on Lasher Road.

The most recent Traffic Volume data available by NYSDOT, collected in May 2013, shows the average daily traffic to be 43 vehicles per day. Because of the low daily vehicle volume, and improved sight distance proposed by this alternative, it is not anticipated that this at-grade crossing would contribute to conflicts between the travelling public and pedestrians on the trail.

Alternative 3 will have an approximate total construction cost of $200,000.

Alternative 4 – New Superstructure, Replace One Abutment

This alternative involves removing and replacing the existing north abutment while keeping the south abutment in place, and constructing a new superstructure with an increased span length of approximately 25 feet. The proposed north abutment would be constructed approximately 10 feet behind existing. This would allow for better sight distance, standard horizontal clearance through the bridge, and room for two lanes of traffic on Lasher Road. The remaining south abutment would be modified using stones from the north abutment. The bridge seat elevation would be increased to provide the standard 14 feet of vertical clearance between Lasher Road and the new superstructure.

The approximate base cost for construction will be $360,000, in addition to the costs below for steel or timber beams and a timber, precast, or cast-in-place concrete deck, or the combined timber beam/deck system.

Beam Replacement Options:

A. Steel Beams – $65,000
B. Timber Beams – $45,000

Deck Replacement Options:

C. Timber Deck – $55,000
D. Precast Concrete Bridge Deck Panel – $100,000
E. Cast-in-Place Concrete Deck– $85,000
F. Glulam Timber Beam/Deck System – $60,000

Recommended Alternative:

B&L recommends Alternative 3, full removal of the existing abutments and construction of an at-grade crossing between the trail and Lasher Road. The approximate total construction cost of this alternative is $200,000.

2.5 Esopus Creek Crossing (Milepost K36.78)

The previous bridge that carried the Ulster and Delaware Railroad over the Esopus Creek sustained substantial damage in 2011 during Hurricane Irene and Tropical Storm Lee, and was later removed by the County. All Desithat remains of the crossing today is the west abutment. The timber piles on which the west abutment was founded are exposed and show signs of severe scour. Based on the vegetation and sediment patterns on the shoreline, it appears that the former abutment locations were constricting stream flows through the bridge opening, resulting in the severe scour which can be seen in following photos. The existing span length of the previous bridge was measured to be approximately 90 feet. This was measured from the face of the west abutment to where the east abutment was assumed to be located.

Figure 2-13: West abutment deterioration due to scour

Figure 2-14: Looking east toward missing east abutment

Replacement Alternatives:

Each of the proposed alternatives for reconstruction consist of improving the hydraulic capacity of the bridge and reducing the potential for scour by increasing the clear span of the proposed bridge.

The proposed abutments would be constructed behind the existing abutments and located away from the edges of the stream banks and away from the direct flows of the Esopus Creek.

A proposed span length of 150 feet was assumed based on data obtained from the Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP) Flood Rate Insurance Map (FIRM) (see Appendix B). The mapping shows a significant portion of the stream banks and adjacent land to be located within a Special Flood Hazard Area subject to inundation by the 100-year storm. The mapping shows an approximate 150 length along the railroad corridor that is not inundated by the 100-year storm, thus, the proposed span length. A complete hydraulic analysis of the crossing will need to be completed during final design in order to determine an exact span length and superstructure low chord to pass the 100-year storm and to meet the necessary freeboard criteria for the 50 year storm of 2 feet. It is important to note that a replacement bridge is feasible in this location and can meet current design standards.

Alternative 1 – New Bridge with Steel Girders

This alternative consists of constructing a 150 foot span, steel girder bridge. The base cost for the substructures and steel girders, is approximately $1,400,000, in addition to the one of the following deck options.

1A.	Timber Deck – $300,000	(approximate total cost $1,700,000)
1B.	Precast Concrete Deck Panels – $450,000	(approximate total cost $1,850,000)
1C.	Cast-in-Place Concrete – $400,000	(approximate total cost $1,800,000)

Alternative 2 – New Bridge with Prefabricated Steel Truss

This alternative consists of a 150 foot span, prefabricated truss superstructure. The base cost of substructures and truss is approximately $2,700,000, in addition to the one of the following deck options.

2A.	Timber Deck – $300,000	(approximate total cost $3,000,000)
2B.	Precast Concrete Deck Panels – $450,000	(approximate total cost $3,050,000)
2C.	Cast-in-Place Concrete – $400,000	(approximate total cost $3,100,000)

One advantage of using a truss instead of steel girders is the total depth of a truss is typically shallower than steel girders. Thus, with the same span length assumed, the truss low chord would be higher than the low chord of steel girders. This results in improved hydraulic conditions. Results of a hydraulic analysis may require the trail to be raised to a greater extent for Alternative 1 than Alternative 2 in order to meet a minimum low chord elevation to satisfy hydraulic requirements.

Recommended Alternative:

B&L recommends Alternative 1C, increasing the span length to improve hydraulic capacity, constructing a 150 foot span, steel girder bridge with a cast-in-place concrete deck. The approximate total construction cost of this alternative is $1,800,000.

2.6 Short-Span Bridge #2 (Milepost K36.70)

This structure consists of a steel girder superstructure founded on stone masonry abutments and wingwalls. The steel girders consist of two girders spaced approximately 6 feet apart on center. Each girder is composed of two side-by-side riveted I-beams, measuring 22 1/8" in depth. Steel rails and timber rail ties exist over the girders. The rail ties are heavily rotted and loose in multiple locations. The steel girders appear to be in good condition and show no visible signs of section loss or deterioration.

The stone masonry substructures show signs of deterioration in the form of loose and missing mortar between adjacent stones on nearly the total surface area of each abutment and wingwall. Most notably, there is missing mortar between the stones directly below the girders, resulting in a loss of bearing area at three of the four bearing location areas. The clear span between abutments is 12'-8".

Rehabilitation Alternatives:

Alternative 1 – New Pipe Structure

This alternative will be identical to Alternative 1 of Short Span Structure #1, and will consist of removing the entire superstructure, installing a new steel plate pipe culvert and backfilling to carry the trail over the crossing. The intent would be to use as large of a culvert pipe as possible that would fit between the abutments. There is a small impoundment immediately downstream of the crossing which was partially filled with water during the site visit. The crossing itself does not pass over a NYSDEC mapped stream; however, the crossing does appear to be within the 100-year floodway of the Esopus Creek according to FEMA Mapping. Should this alternative be selected, a hydraulic study should be performed to ensure the proposed culvert pipe does not negatively affect water surface elevations upstream of the crossing.

Figure 2-15: Elevation view of Short Span Structure #2

Figure 2-16: Deterioration at the bearing area of the east abutment #2

The approximate total cost of this alternative is $50,000.

Alternative 2 – Structure Rehabilitation

Under this alternative, the existing substructures and steel girders will remain in place. Each abutment will require repointing to nearly the total surface area of the structure. Concrete repairs will be needed at the bearing areas under each steel girders to restore full contact between the bearings and the abutment. The existing timber rail ties will be removed and replaced with a timber deck or concrete bridge deck and pedestrian bridge railing.

The approximate substructure rehabilitation cost is $50,000, plus the addition of one of the following deck replacement options.

Deck Replacement Options:

2A. Timber Deck – $40,000	(approximate total cost $90,000)
2B. Precast Concrete Bridge Deck Panel – $50,000	(approximate total cost $100,000)
2C. Cast-in-Place Concrete Deck – $45,000	(approximate total cost $95,000)

Recommended Alternative:

For this structure, B&L recommends Alternative 1, full superstructure removal and installation of a new steel plate pipe culvert to carry the trail over the crossing. The approximate total construction cost of this alternative is $50,000.