Submitted by:
TranSystems Corporation
March 15, 2024

Trail Feasibility Study for Repurposing
THE MULE BRIDGE
OVER SCHUYLKILL RIVER

City Of Philadelphia, Philadelphia County and
Lower Merion Township, Montgomery County

TRANSYSTEMS

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Executive Summary

The purpose of this study is to investigate the feasibility of repurposing the Mule Bridge as a trail facility connecting the Schuylkill River Trail in Philadelphia with the Pencoyd and Cynwyd Heritage Trails in Lower Merion Township. The study describes the level of effort necessary to rehabilitate the bridge for use as a trail bridge.

This study included research of existing bridge construction plans and details, hands-on inspection of the primary load carrying members, underwater inspection to determine foundation conditions, a structural analysis and rating to determine the bridge's safe load carrying capacity, and development of a summary of anticipated repair/rehabilitation items with budgeting cost estimates to permit the bridge to serve as a trail crossing.

The original fabrication, construction, and repair drawings were located from the Reading Railroad and Technical Museum collection and used to facilitate the inspection and rating.

The existing tracks are inactive, and a discontinuance has been filed with Surface Transportation Board (STB) in 2019 by Norfolk Southern Railroad Corporation.

The bridge was found to be in overall poor condition with more notable areas of deterioration at the timber deck ties with wood rot and splitting throughout; at the lattice truss and plate girder superstructure with various cracking, pack rust, collision bends, and cracked bearing plates; at the masonry pier substructure with upper pier bulging and bearing cap deterioration; and at Pier 4 upstream nose with a large masonry void at the water line.

The structural analysis and rating demonstrated that the bridge superstructure, even in considering current conditions and sections losses, will more than sufficiently carry pedestrian and emergency vehicle loads expected as a repurposed multiuse trail bridge.

Cost-effective repair/rehabilitation recommendations have been developed that will address the current deterioration, preserve the bridge, and provide extended service life for repurposing the bridge. Overall results from this study show a bridge rehabilitation can be efficiently and effectively performed and that the bridge is capable of being repurposed as a multiuse trail.

Public Engagement

On Wednesday October 25, 2023, the City of Philadelphia and Lower Merion Township held a virtual public meeting to discuss the ongoing feasibility study for converting the Mule Bridge into a multi-use trail. The Mule Bridge is a former rail bridge that spans the Schuylkill River connecting Lower Merion Township with Venice Island in the Manayunk Neighborhood of Philadelphia. The proposed connection would link the Pencoyd and Cynwyd Heritage Trails in Lower Merion Township with the Manayunk Towpath and Schuylkill River Trail in Philadelphia. It is listed as a proposed segment on both the Circuit Trail and the 9/11 National Memorial Trail. Fifty-four members of the public attended the meeting and heard from Lower Merion Township and City of Philadelphia staff presentations on the history of the Mule Bridge, past plans and studies that support the proposed trail connection, and next steps for the project. Transystems presented the results of the inspection of the bridge and its potential conversion into a trail. Throughout the meeting, the public were provided a series of poll questions regarding the proposed trail and their connection to the area. The poll questions and results are provided in Appendix A (page 19).

Funding

Funding for this study comes from the Regional Trails Program, administered by the Delaware Valley Regional Planning Commission with funding from the William Penn Foundation.

Bridge Description

The Mule Bridge over the Schuylkill River was built in 1889 for freight trains to replace a wooden structure built in 1818 used for the Manayunk Canal towpath. The Mule Bridge was rehabilitated in 1943 to remove the cantilevered foot walk (see typical cross section on page 6). The bridge has one track on a curved horizontal alignment carrying the out of service Venice Branch Line owned by Norfolk Southern Railroad (NSRR). This owner indicated that a discontinuance for this rail line was filed with Surface Transportation Board (STB) in 2019.

Existing historic photos, documents, and drawings were located from the Reading Railroad and Technical Museum collection and Historic American Engineering Record. Original drawings consisted of superstructure fabrication details, tie and track plan, construction layouts, and various repair and rehabilitation plans. Drawings were dated 1889 to 1953. Copies of the documents are provided in Appendix I (page 116).

The bridge is an eight (8) span riveted wrought iron structure with an open tie deck with an overall length of 623'-0". There are two (2) spans of through plate girders, one (1) span of deck plate girders, and five (5) spans of lattice deck girders. The bridge is supported on six (6) stone masonry piers and two (2) stone masonry abutments. The deck consists of wooden ties resting on the girders which support the train rails. On both edges there is a handrail and narrow open grid walkway sections (varying widths, 3' minimum).

Bridge Layout

- The Lower Merion Abutment, Pier 1, and Pier 2/3 are on land.
- Span 1 is over open ground and Span 2 is over the Pencoyd Trail (former Pennsylvania Railroad ROW).
- Span 3 is over the length of the oversized Pier 2/3 from the south face to the riverbank face.
- Spans 4 to 7 are over the Schuylkill River with Piers 4 through 6 located in the channel proper.
- Span 7A is a short span over the width of Pier 6.
- Span 8 is over open ground with Pier 7 and the Manayunk Abutment on land.

Bridge Piers

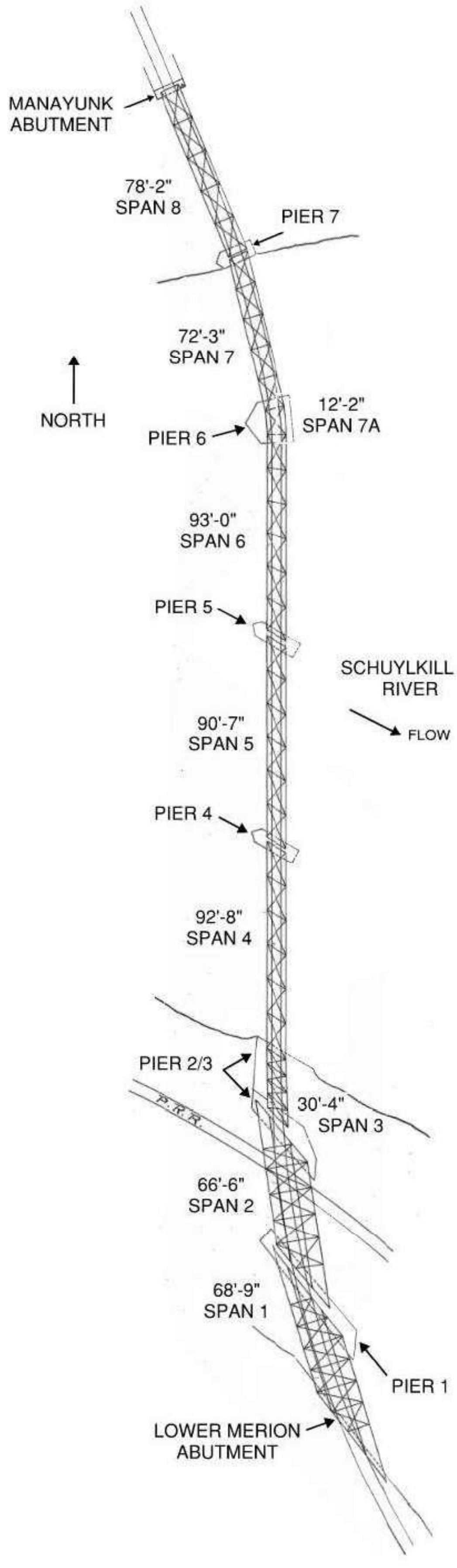
- The piers are masonry perimeter cut stones with a rubble fill.
- Piers 1 and 2 measure 26'-0" in length along the near face and 22'-0" in length along the far face at the waterline.
- Both piers 4 and 5 measured 10'-0" in width at the waterline. The upstream noses are angled.
- Pier 3 is polygonal shaped and measured 21'-0" along the near face and 19'-0" along the far face. Pier 3 measured 18'-6" wide at its widest location.
- Piers 1, 2 and 3 were visibly bearing on bedrock. Foundation plans are not available for this structure, but due to the bedrock foundation, it is assumed that the footing was exposed since the time of construction.

Known Flood History

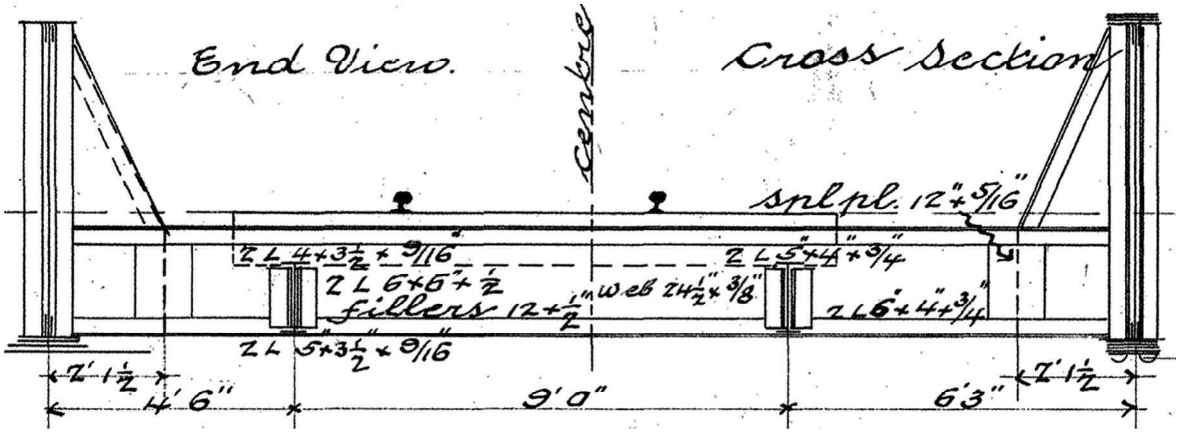
- The exact flood history of the structure is not fully known, however water levels have come up to the bottom chord elevations from extreme high-water events.
- September 2021 - Flood water associated with Tropical Storm Ida reached the bridge superstructure (timber flood debris on top of the pier stems and lodged in the superstructure). It is unknown if the deck (railbed) was overtopped during that event.

- June 1972 – Flood waters from Hurricane Agnes appear to have been the cause for emergency repairs performed to the bridge in July 1972 for bottom chord damage in Span 6 from the drawing documents. It is also unknown if the deck (railbed) was overtopped during that event.

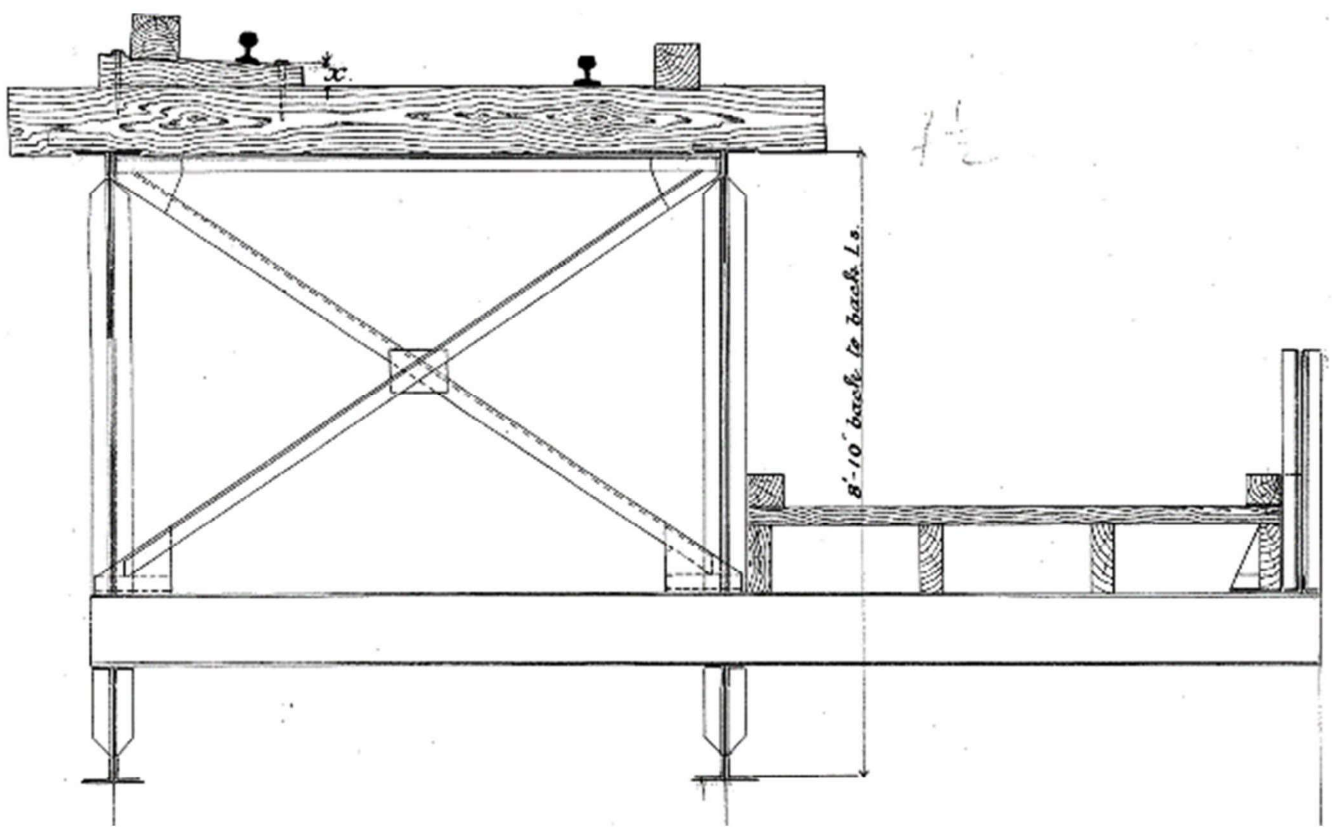
GENERAL BRIDGE PLAN



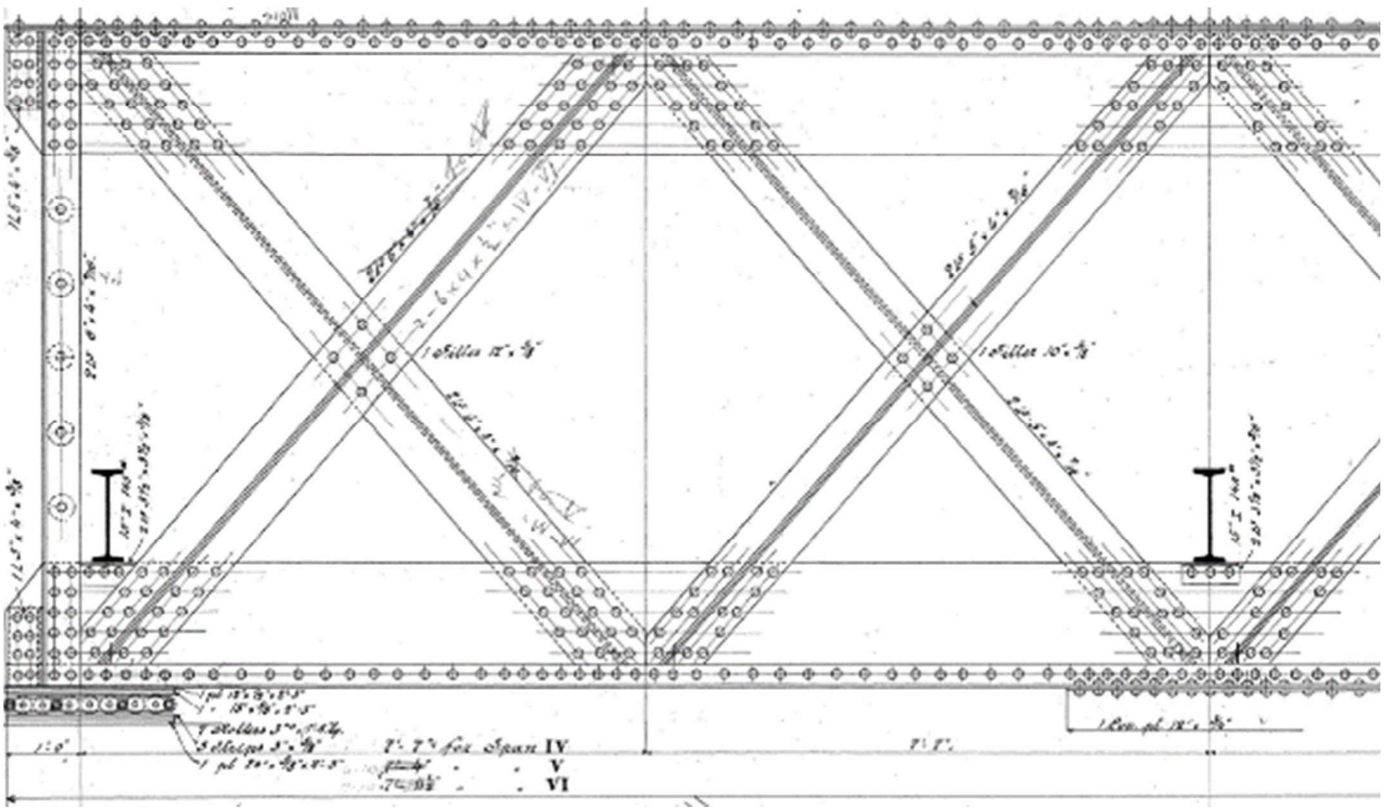
TYPICAL SECTION THRU PLATE GIRDERS SPANS 1 TO 2



TYPICAL SECTION LATTICE GIRDERS SPANS 4 TO 8
(Cantilever Foot Walk Removed 1943)

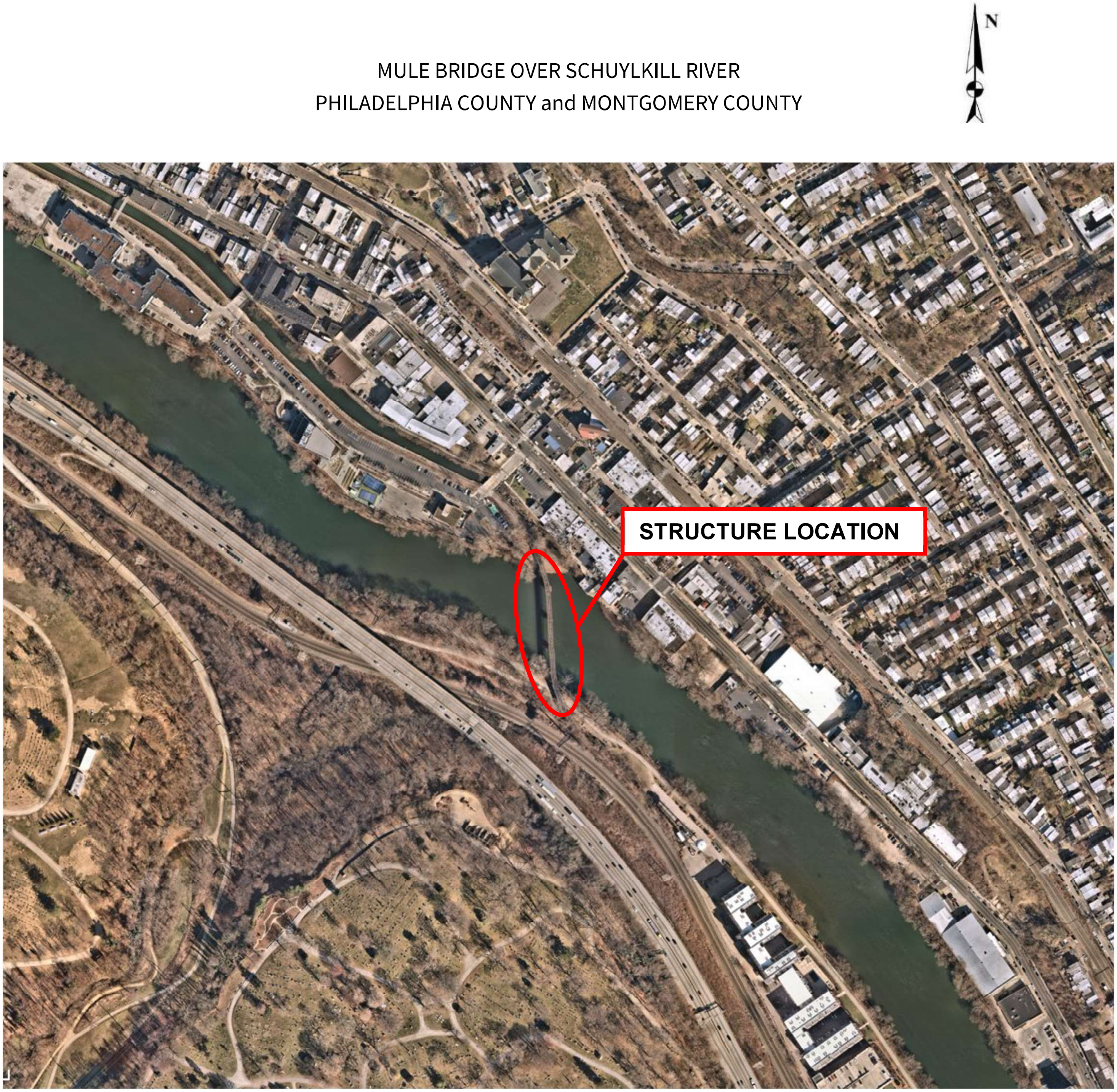


TYPICAL LATTICE GIRDER DETAIL (SPANS 4-8)



Location Map

MULE BRIDGE OVER SCHUYLKILL RIVER
PHILADELPHIA COUNTY and MONTGOMERY COUNTY



Inspection Procedures

The bridge inspection was performed utilizing a qualified inspection team, including a professional engineer and PennDOT certified bridge inspectors from June 28th to 30th, 2023. All inspection operations and safety practices complied with OSHA regulations. Inspections for the bridge were performed using hands-on techniques to gain access to the primary load carrying elements. Inspections of the track ties and upper portions of the superstructure were performed from above, walking along the tracks. Inspection of the superstructure and substructure units located over or on open land were performed with ladder access. Above water inspection of superstructure and substructure units located on the Schuylkill River were inspected using a water-based mobile lift (bucket boat).

Track access was obtained through a Right of Entry (ROE) agreement obtained by TranSystems (TS) from Norfolk Southern Railroad (NSRR). ROE extents were limited to the tracks above and the immediate areas below the bridge and substructure. As the rail line on the bridge is inactive, NSRR waived the need for flagging operations.

The underwater inspection of piers located in the Schuylkill River were performed utilizing a qualified dive team, including a professional engineer and commercial diver who are PennDOT certified bridge inspectors. All operations were governed by the OSHA regulations for Commercial Diving-29 CFR Part 1910 Subpart T. All diving was performed with constant, direct communication between the engineer and the diver. All soundings and elevations were referenced to a common datum and stream cross sections were taken along each bridge fascia and at certain distances upstream and downstream. A stripchart fathometer was used to obtain a hard copy of the stream cross sections if water depths were sufficient.

Spans for the bridge are labeled sequentially south to north from the Lower Merion side in Montgomery County heading to the Manayunk side in Philadelphia and are designated consistent with the historic record drawings. Girders are labeled from west (Girder 1) to east (Girder 2). Floorbeams are labeled sequentially from south to north within each span.

Bridge inspections utilized definitions and terminology based on Bridge Safety Inspection practices detailed in current PennDOT Publication 238 and Publication 100A. Structural condition descriptions were used in this report to describe the existing structure components compared to the original as-built structure components. Accordingly, condition descriptions for each structure component is defined based on the following range of terminologies:

Excellent Condition – New condition with no problems noted

Very Good Condition – No problems noted

Good Condition – Some minor problems

Satisfactory Condition – Structure components show some minor deterioration

Fair Condition – All primary structure components are sound but may have minor section loss, cracking, spalling or scour

Poor Condition – Advanced material section loss, deterioration, spalling or scour

Serious Condition – Loss of section, deterioration, spalling or scour may have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.

Critical Condition – Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored, it may be necessary to close the bridge until corrective action is taken.

Imminent Failure Condition – Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed, but corrective action may put back in light service.

Failed Condition – Bridge closed and beyond corrective action.

Inspection Findings

The overall condition of the bridge is POOR.

Deck

The condition of the deck is SERIOUS**.**

- Approximately half of the wood ties are rotted and splitting.
- The handrail, train rails, and open grid walkways have minor to moderate surface corrosion.

Superstructure

The condition of the superstructure is POOR.

- **Spans 1 & 2 –** Through Girders **–** The through girder superstructure is in poor condition. The through girders in Spans 1 and 2 have moderate to heavy surface rust and graffiti throughout. There is moderate section loss to the girder ends at the Lower Merion Abutment. Several end diaphragms exhibit full section fracture. Floorbeam 7 in Span 1 exhibits significant bottom flange distortion at Pier 1. The far intermediate brace in Span 1 has heavy corrosion with up to 100 percent section loss.
- **Span 3 –** Deck Girders - The deck plate girder superstructure is in satisfactory condition. The deck plate girders in Span 3 have moderate to heavy surface rust.
- **Spans 4 through 8 –** Lattice Deck Girder – The lattice girder superstructure is in poor condition.
- In all spans the double angle diagonal bracing has pack rust up to 1 ½" thick, resulting in bending of the angles. Flood debris is suspended randomly throughout the superstructure in Spans 4-7. There is minor to moderate surface rust of the members throughout.
    - **Span 4:** There is flood impact damage to the bottom cross bracing. On the bottom of the top beam of Girder 1, there is a shallow surface defect on the outer face approximately 18" long x 1" high. There is another shallow surface defect on the outer face of Girder 1 near the third cross bracing from Pier 4, 2" long x 1" high.
    - **Span 5:** There are two plate weld repairs on the bottom flange of Girder 1, near mid-span and one weld repair to the bottom flange of Girder 2 near mid-span. The fifth diagonal cross brace from Pier 4 in Girder 1 is cracked approximately 7" near the bottom connection (single angle). Also, the ninth diagonal cross bracing from Pier 4 in Girder 1 is cracked approximately 6" near the bottom connection (double angle). There are weld repairs to Floorbeams 2, 3, and 4 connections to Girder 1. Girder 1 deflects up to 1 ½" at floorbeam connections. There is a 6" long x ½" high shallow surface defect to Girder 2 top beam near the sixth cross bracing from Pier 4. There are 2 shallow surface defects on the outer face the bottom beam of Girder 2: 2" long x 1" high x 1/8" deep near Pier 5, and 14" long x 1 ¾" high x 1/16" deep near the first cross bracing from Pier 4. On the inner face of the bottom beam in Girder 2 near mid span there is another shallow surface defect approximately 30" long x 1" high.
    - **Span 6:** Over the length of Span 6, Girder 2 is bent approximately 3" out of plane. The bottom of Girder 2, near Pier 5 on the inner and outer faces has a large, welded box repair. On the downstream face of the girder the vertical plate extends out beyond the bottom plate and there

are 2 cracked welds. The first crack is approximately 34" long starting near the third cross bracing from Pier 5. The second crack is approximately 46" long starting near the midpoint of the 4th cross bracing from Pier 5. The girder webs are deflected up to 2" at the floorbeam connections. There is a cracked weld 3.5" long at the first floorbeam from Pier 5 at the connection to Girder 2. There is flood impact damage to the bottom cross bracing. The floorbeam nearest Pier 6 has been removed.

  - **Span 7:** There is a 2" x 2" surface defect on the bottom upstream face of Girder 1 near the third cross bracing from Pier 7 with up to 1/16" section loss.
  - **Span 8:** End members at the Manayunk Abutment exhibit previously repaired cracked members and few areas of pack rust between angle legs.

- **Bearings at Lower Merion Abutment** – The sliding bearing supporting Girder 1 exhibits moderate section loss. Heavy water and debris accumulation is present at all girders and floorbeam bearings, worse at the west end.
- **Bearings at Pier 1 –** The girder and floorbeam bearing exhibit moderate rust, and debris accumulation.
- **Bearings at Pier 2/3 –** The northwest bearing has a full height vertical crack on the north side. Girder 2 bearing at the southeast exhibits bent anchor bolts.
- **Bearings at Pier 4 –** The northeast bearing on Pier 4 has approximately 53% of its original bearing area due to undermining from loss of stone in the west face of the pier. The northeast and southeast roller bearings are missing some pin caps. The southeast bearing has a full height vertical crack on the south side.
- **Bearings at Pier 5 –** The northwest and northeast bearings are missing anchor bolts. All bearings at this pier are expanded ½" north.
- **Bearings at Pier 6 –** The anchor bolts on the southwest bearing are sheared off and missing nuts. The bearing is expanded approximately 4" to the east. The connections at the bearing are heavily corroded. The northwest bearing is missing nuts at the connection of Girder 2 to the bearing base. The northeast bearing has sheared and bent anchors. The southeast bearing has an 11" crack in the cross-bracing connection plate and bent anchors.
- **Bearings at Pier 7 –** The northeast (Girder 2, Span 8) bearing exhibits a vertical crack through the bearing plate. The southwest (Girder 1 Span 7) bearing is lifted from the bearing under dead load only and the intermediate plate between the girder and sliding plate is rotated clockwise. All bearings at the pier exhibit minor to moderate corrosion.
- **Bearings at Manayunk Abutment –** Bearings both exhibit minor corrosion and debris accumulation.

Substructure:

The condition of the substructure is POOR.

- **General Findings –** The condition of the underwater portion of the elements inspected is poor. The footings were exposed around the perimeter of the river piers. Given the exposed bedrock foundation, it is assumed that the footing was exposed since the time of construction. A comparison of the streambed cross sections indicates that the streambed is generally uniform with the exception of the minor scour at the piers.

- **Lower Merion Abutment:** The backwall is not accessible below due to end diaphragms. The southwest wingwall has large voids at the base of wall with vegetation growth at the top (Photo 41).
- **Pier 1:** There is vegetation growth on and around Pier 1, including trees originating from gaps in the stone. Graffiti is present on both pier faces.
- **Pier 2/3:** There is vegetation growth on and around Pier 2/3, including large vines completely covering the east end and extending onto the deck. Graffiti is present on the south pier wall. The top of the pier masonry bulged out causing the tie rod channel assembly members to bend out. There is heavy vegetation growth on and around the pier.
- **Pier 4:** Pier sits in the river near the Lower Merion bank. Severe storm damage has removed a large area of stone near the water level on the upstream end. Debris wraps around the upstream end of the pier trapped in this location. The void in the stones measures about 4' high (above water line) x 12'-6" long x 5' deep. Another void in stones appears on the top upstream north corner of the pier approximately 3' long x 2' wide x 1' deep. There are an additional 2 stones missing from the top of the pier on the downstream side. Storm debris rests on the top of the pier on the upstream end. A 10' long section on the south face near the top exhibits up to 100% mortar loss.

  An area of missing stones was observed at the upstream end of the far face (Photos 4 to 6). The void measured 12'-6"' long x 7'-11" high (4'-0" above the waterline and 3'-11" below the waterline) x up to 5'-0" laterally max. The stones in the back of this void were observed to be loose. Below the waterline, the stone masonry pier stem and footing exhibited up to 70% mortar loss with up to 1'-0" lateral penetrations into several of the joints. The footing was exposed around the entire perimeter of the pier and the maximum height of exposure measured 7'-9" at the downstream end. A small void between the footing and the bedrock was detected in this area. The void measured 1'-0" long x 3" high x 3" laterally. The footing stones above these voids are tight and sound. The streambed in the vicinity of the element consists of sand and gravel over bedrock. Probing the streambed resulted in penetrations of up to 5". Soundings indicate minor scour at the element. The channel flow was parallel with the pier.
- **Pier 5:** Pier sits near the middle of the river. Tie rod channel assembly sections on the north and south side of the pier reinforces the upper pier masonry. The nuts on the tie rods are loose or missing in several locations and the channels are not tight around the pier. There is heavy storm debris on the upstream end of the pier cap including 2 large tree branches that extend on to the superstructure in Span 6.

  Below the waterline, the stone masonry pier stem and footing exhibited up to 70% mortar loss with up to 0'-5" lateral penetrations into several of the joints. The footing was exposed around the entire perimeter of the pier and is exposed for its full height of 8'-6" at the upstream end. Gaps between the footing and bedrock were detected in several places, but the largest voids were at the upstream end (Underwater Photo 9). A void along the upstream angle of the near face measured 4'-0" long x 10" high x 4'-6" laterally (max.). A void at the upstream nose measured 2'-0" long x 3'-6" high x 2'-2" laterally (max.). A void at the upstream angle of the far face measured 4'-0" long x 1'-0" high x 2'-6" laterally (max.). A void located 6'-0" from the upstream end on the near face 4'-6" long x 1'-3" high x 5'-0" laterally (max.). Additionally, a large gap between the stones was detected in the footing at the upstream nose. This gap measured 1'-0" wide x 1'-2" high x 10" laterally (max.). The footing stones above these voids are tight and sound. The streambed in the vicinity of the element consists of sand and gravel over bedrock. Probing the streambed resulted in penetrations of up to 4". Soundings indicate minor scour at the element. The channel flow was parallel with the pier.

- **Pier 6:** Pier sits in the river near the Manayunk bank. Near the top of the pier, vegetation is growing from the gaps in the stone at several locations, including a bigger tree on the north face that appears to be pushing out adjacent stone blocks. Tie rod channel assembly sections on the north and south side of the pier reinforces the upper pier masonry. The nuts on these tie rods are loose or missing in several locations and the channels are not tight around the pier. A ¼" wide vertical crack on the middle of the east face extends for approximately 10'.

  Below the waterline, the stone masonry pier stem and footing exhibited up to 70% mortar loss with typical 4" to 6" lateral penetrations between the stones. A localized lateral penetration of 3'-0" was detected in the near face. The footing was exposed around the entire perimeter of the pier and is exposed for its full height of 6'-0" at the upstream end. Gaps between the footing and bedrock were detected in several places, but the largest voids were at the upstream end. Voids at the upstream nose measured 3'-6" long x 5" high x 4'-6" laterally (max.), 1'-6" long x 6" high x 4'-6" laterally (max.), and 2'-0" long x 4" high x 1'-6" laterally (max.). These voids are due to missing stones. Additionally, above this void, a gap between the stones was detected. The gap measured 3'-0" high x 6" wide x 2'-4" laterally (max.). The footing stones above these voids are tight and sound. The streambed in the vicinity of the element consists of sand, gravel, cobbles, and boulders over bedrock. Probing the streambed resulted in penetrations of up to 2". Soundings indicate minor scour at the element. The channel flow was parallel with the pier.
- **Pier 7:** Pier has minor vegetation growth on the top and graffiti on both walls.
- **Manayunk Abutment:** The abutment consists of a stone backwall and cast in place concrete stem. A few stones at the west end of the stem wall are rotated and displaced up to 4". Debris is present on the bridge seat. There are several missing stones with an area of erosion and vegetation growth at the northwest wingwall.

Structural Analysis and Rating

A load rating was performed using PennDOT program BAR 7.15.0.0 and STAAD.PRO 21.00.02.30. AASHTO MANUAL Year 2000 and AASHTO SPECS Year 1996 were used. Plans used in rating were original design and fabrication drawings from the Reading Railroad Museum which were verified by field measurements.

The bridge consists of 8 simple spans: Spans 1 & 2 (Through Girders/Floorbeams/Stringers); Span 3 (Deck Girders); Spans 4-8 (Lattice Girders). The controlling members were the stringers (Spans 1 & 2) with no loss. An H20 (Maintenance Vehicle) (AASHTO 3.14.1.4) loading or an 85 psf pedestrian load were considered in the analysis. The lattice girders (Spans 4-8) were conservatively modelled as rolled steel I-beams by calculating equivalent beam properties based on the top chord and bottom chord sections connected by the diagonals/web. The steel area of the diagonals was not included in the equivalent section. The top chord alone was also checked as spanning between panel points. Preliminary STAAD analysis was done for span 4 which confirms the BAR7 model was conservative.

The analysis assumes the existing timber ties, hand railings, and tracks will be removed. It also assumes repairs to existing superstructure & substructure will be completed as needed. Additionally for analysis purposes, the rating assumes installation of a new non-composite reinforced concrete deck (14' wide x 8.5" thick) with new concrete barriers 12" wide x 42" high and a clear pathway of 12'. Resultant DL = 1.27 K/FT.

Based on the modeling performed the following is a summary of the controlling H20 ratings. For comparison the minimum pedestrian load (85 psf) inventory rating factor is 1.47 for the Girder in Span 4(5). See Appendix G (page 90) for analysis and rating report.

H20 LOAD FACTOR RATING

LOCATION	I.R. Factor	Inventory Ratings (TONS)		O.R. Factor	Operating Ratings (TONS)		SLC 100% OR (TONS)
SPAN 1 (STRINGER)	1.43	28	M	2.38	47	M	47
SPAN 2 (STRINGER)	1.43	28	M	2.39	47	M	47
SPAN 3 (LEFT GIRDER)	2.91	58	S	4.85	97	S	97
SPAN 4 (5) (GIRDER)	1.45	29	M	2.42	48	M	48
SPAN 6 (GIRDER)	1.56	31	M	2.60	52	M	52
SPAN 7 (8) (BAY 1 TOP CHORD)	2.21	44	M	3.68	73	M	73

M = MOMENT CONTROLS, S = SHEAR CONTROLS

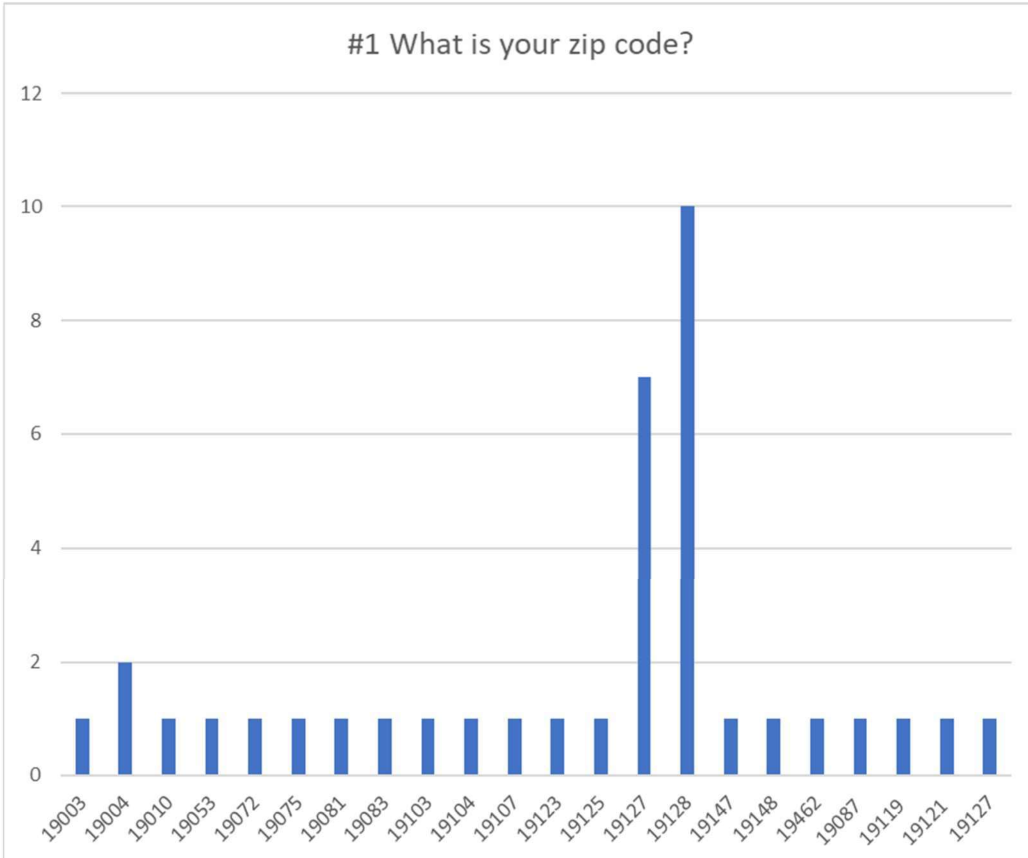
Recommendations

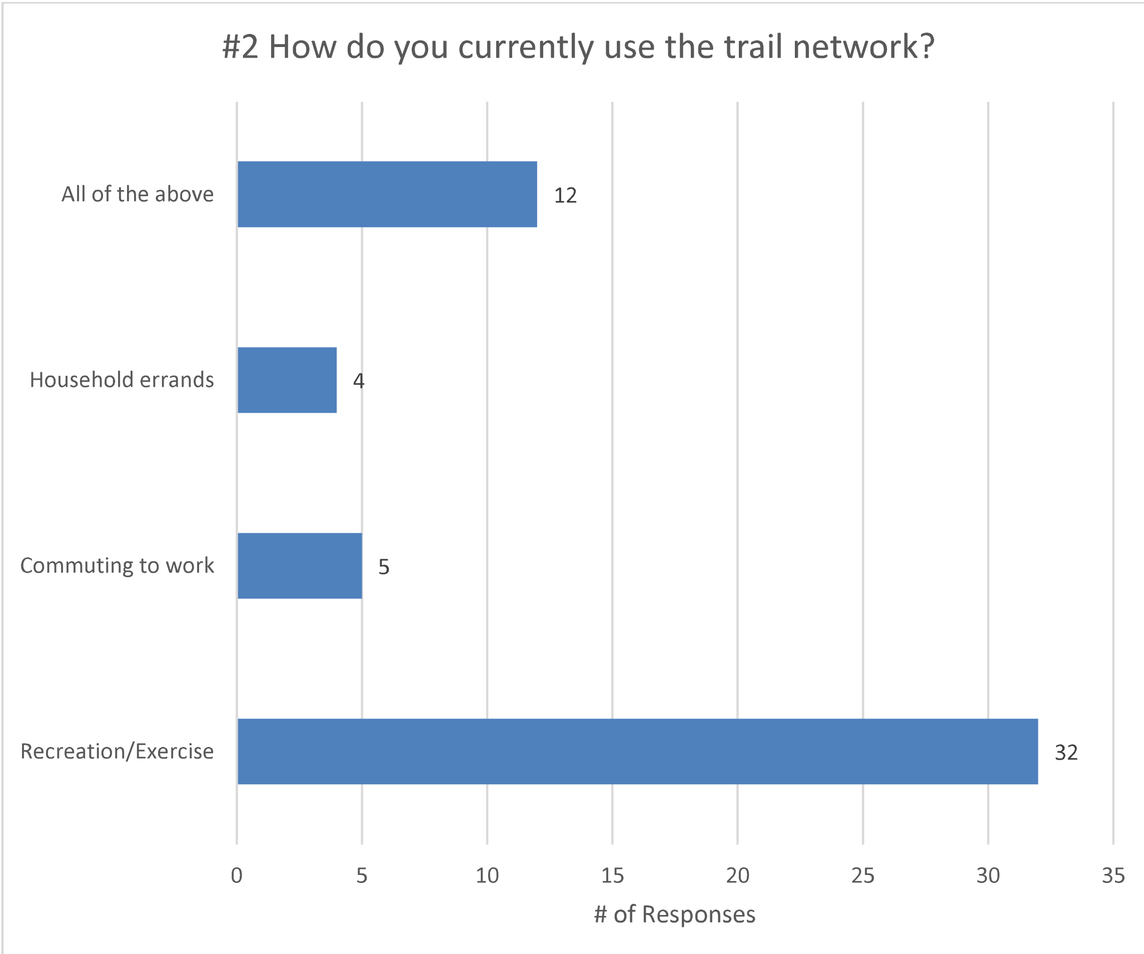
Overall, the bridge is amply capable of being repurposed for a multiuse trail. Based on bridge and underwater inspection findings, there are cost-effective repair/rehabilitation recommendations that will preserve the bridge, arrest current deterioration, and provide extended service life that will justify a bridge rehabilitation versus a full replacement.

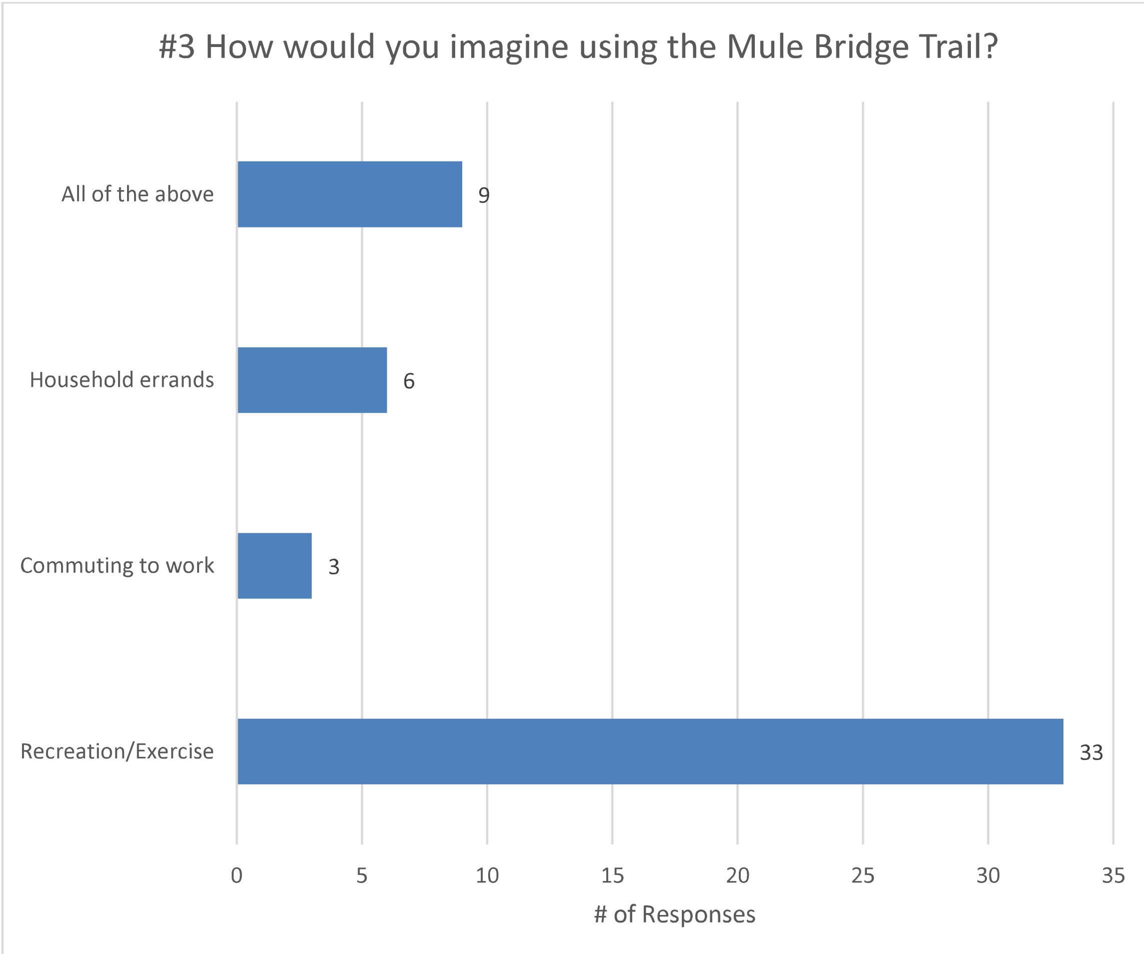
The structural analysis and rating performed for this study demonstrate that the bridge, even in considering current conditions and sections losses, will carry expected pedestrian and emergency vehicle loads as a repurposed multiuse trail bridge.

- **Recommendation 1** – The existing timber ties, hand railing, and tracks are recommended to be removed and replaced. The new deck recommended is a new non-composite reinforced concrete deck 14' wide x 8.5" thick with a clear pathway of 12' with new pedestrian trail use barriers or railing. The barrier for rating purposes was preliminarily designed as 12" wide x 42" high vertical concrete barriers.
- **Recommendation 2** – The existing lattice truss and plate girder superstructure is recommended to remain in place with structural repairs to be performed at critical cracked, bent, and damaged areas where additional crack growth and or additional collisions may impair the bridge's structural capacity. Expansion bearing repairs are recommended to reset or replace critical broken plates. A new coating system is recommended on the entire superstructure to protect the existing members and to arrest further corrosion, pack rust bending/damage, and section loss.
- **Recommendation 3** – The stone masonry substructure is recommended to remain in place with masonry repointing and repairs at all abutments, wingwalls, and piers; resetting displaced wingwall stones; reconstructing Pier 4 masonry void at upstream nose and far face at the waterline; repairing loose stones behind the Pier 4 void as feasible; and reconstructing Pier 2/3, Pier 4, Pier 5, and Pier 6 upper masonry and bearing caps. Undermine repairs between stone masonry and bedrock foundation gaps at Piers 5 and 6 are recommended along with installing rock protection around all piers in river and pier faces adjacent to the riverbanks.

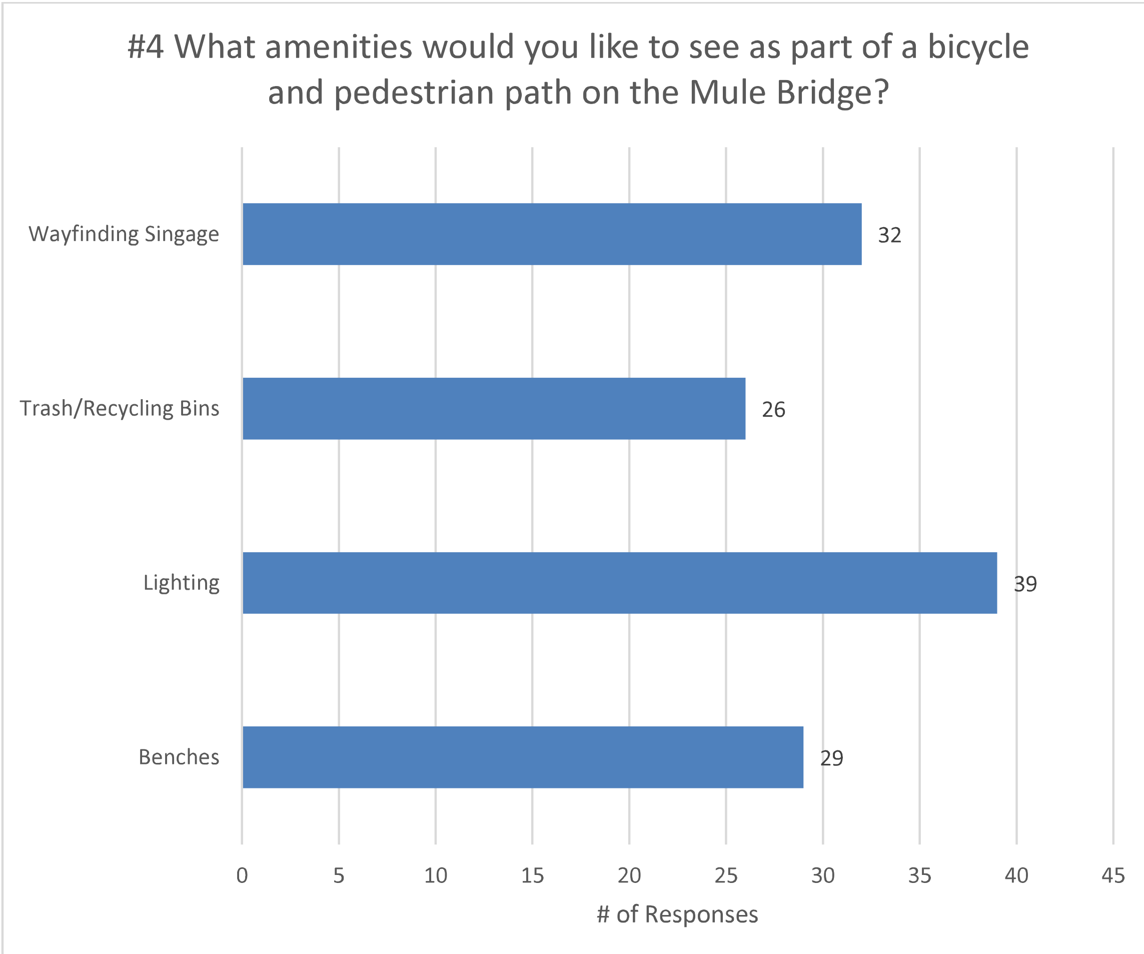
Appendix A
Virtual Public Meeting & Poll Questions

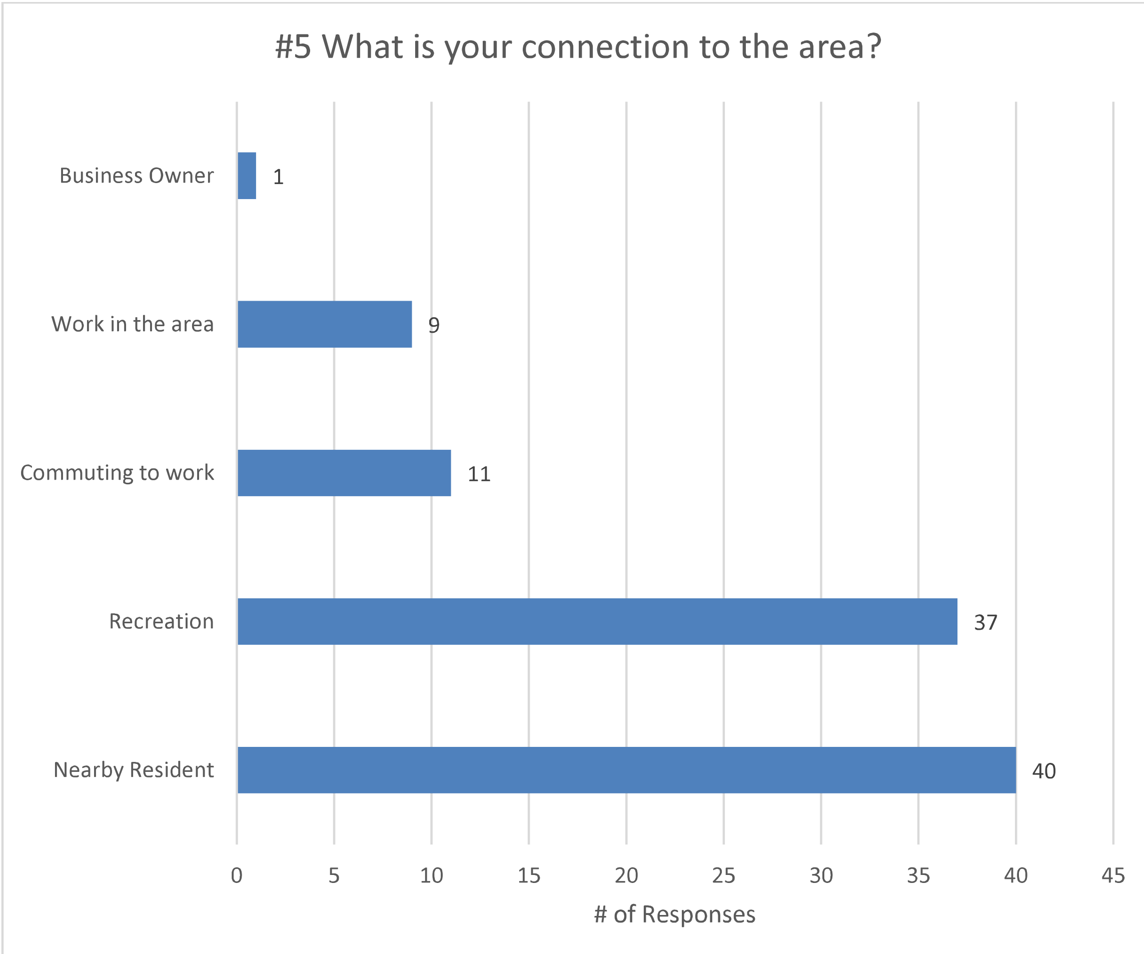

#1 What is your zip code?
12
10
8
6
4
2
0
19003
19004
19010
19053
19072
19075
19081
19083
19103
19104
19107
19123
19125
19127
19128
19147
19148
19462
19087
19119
19121
19127


#2 How do you currently use the trail network?
All of the above
12
Household errands
4
Commuting to work
5
Recreation/Exercise
32
0
5
10
15
20
25
30
35
# of Responses



#3 How would you imagine using the Mule Bridge Trail?
All of the above
9
Household errands
6
Commuting to work
3
Recreation/Exercise
33
0
5
10
15
20
25
30
35
# of Responses


#4 What amenities would you like to see as part of a bicycle and pedestrian path on the Mule Bridge?
Wayfinding Singage
32
Trash/Recycling Bins
26
Lighting
39
Benches
29
0
5
10
15
20
25
30
35
40
45
# of Responses


#5 What is your connection to the area?
Business Owner
1
Work in the area
9
Commuting to work
11
Recreation
37
Nearby Resident
40
0
5
10
15
20
25
30
35
40
45
# of Responses

Rendering presented on 10/25/23 for Potential Mule Bridge Rehabilitation as a Multi-use Trail

Appendix B
Photographs

Photo 1	Upstream elevation, Spans 4-7, looking east.

Photo 2	Downstream elevation, Spans 4-7, looking west.

Photo 3	Lower Merion approach, looking north. Heavy vegetation growth.

Photo 4	Lower Merion approach, looking south. Heavy vegetation growth.

Photo 5	Manayunk approach, looking south.

Photo 6	Manayunk approach, looking north.

	
Photo 7	Upstream channel, looking west.
	
Photo 8	Downstream channel, looking east.

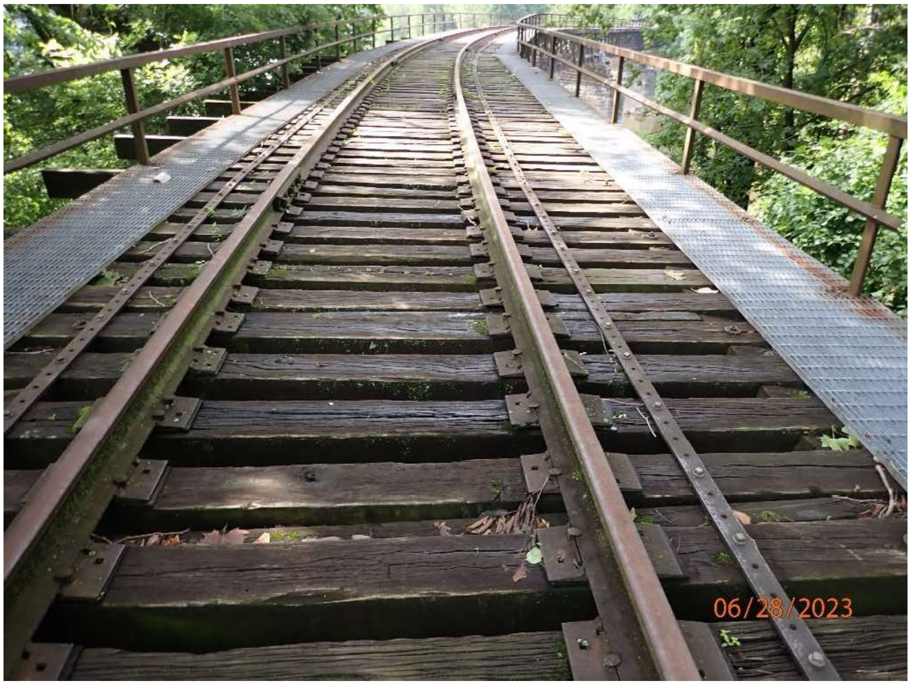


Photo 9	Typical view of the top of deck at Span 8, looking south. Moderate to wide splits and cracks in the ties.

Photo 10	Deck ties, Span 2, looking southwest. Wide splits, severe decay, and section loss in the ties.

Photo 11	Deck ties, Span 6, looking southeast. Wide splits, moderate to severe decay, and moss growth in the ties.

Photo 12	Typical view of the underside of the deck and superstructure in the through-girder spans, Span 1, looking northwest.

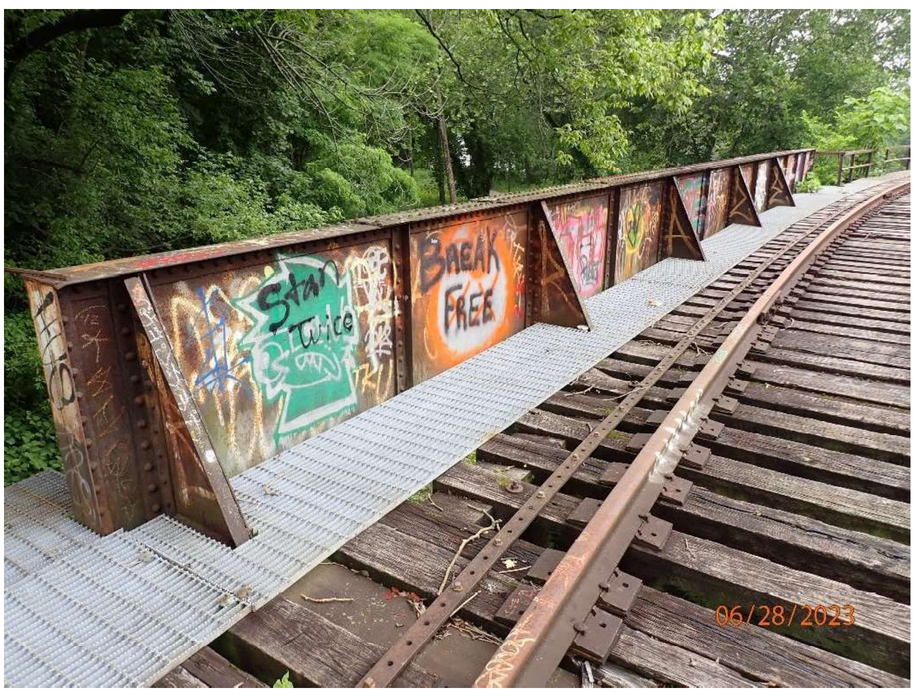
	
Photo 13	Typical view of the underside of the deck and superstructure in the lattice-girder spans, Span 7, looking north.
	
Photo 14	General view of through Girder 1, Span 2, looking northwest. Surface rust and graffiti.

Photo 15	General view of through Girder 2, Span 2, looking northeast. Surface rust and graffiti.

Photo 16	General view of lattice deck Girder 1, Span 6, looking northeast. Note the flood debris on Pier 5 bridge seat.

	
Photo 17	General view of lattice deck Girder 2, Span 5, looking northwest. Surface rust throughout. Note the stone loss at top of the downstream nose of Pier 4 (no undermining to girder bearing). Note Piers 5 and 6 tie rod channel assemblies.
	
Photo 18	Girder 1, Span 5, looking north. Flood debris between the diagonal angles.

Photo 19	Girder 1, Span 3, looking east. Pack rust (up to 1½”) between the diagonal angles.

Photo 20	Girder 1, Span 4, looking east. 9” long crack at the base of the horizontal leg of the diagonal angle.

Photo 21	Girder 1, Span 4, looking east. Diagonal angles cracked and bent (7” long) at base.

Photo 22	Girder 1, Span 4, looking east. Bent diagonal angles with pack rust along length. Note the welded plate at bottom of the girder (unknown post construction repair or jacking location).

Photo 23	Girder 1, Span 4, looking northeast. Minor pitting throughout. Welded bearing bracket at the connection with the floorbeam (unknown post construction repair). Pack rust between diagonal angles.

Photo 24	Girder 1, Span 5, looking west. Welded repair at the connection with the cross section. Vertical leg of the angle is bent and impacted by the repair plates.

Photo 25	Girder 1, Span 5, looking southwest. 30” long steel defect in the bottom web plate.

Photo 26	Girder 1, Span 6, looking north. Lower cross bracing is bent due to flood impact damage.

Photo 27	Girder 2, Span 6, looking northwest. Welded repair plates to the web and the bottom flange of girder.

Photo 28	Girder 2, Span 6, looking west. Crack along the welded repair plates at the bottom flange of girder.

Photo 29	Span 6, floorbeam at connection with Girder 2, looking southwest. Floorbeam end is slightly bent.

Photo 30	Span 6, floorbeam at connection with Girder 2, looking northeast. Full length weld crack at the connection.

	
Photo 31	Lower west connection beam to Girder 1 at Pier 5, looking southeast. Bottom flange is bent at north end.
	
Photo 32	Span 8, floorbeam connection with the north intermediate brace, looking east. Partial width hole in the floorbeam.

Photo 33	Girder 2 bearing at Pier 2/3, looking south. Side angle is cracked. Note reinforcing tie plate and anchors below on side of concrete pedestal.

Photo 34	Girder 1 bearing at Pier 4, Span 5, looking southwest. Pack rust and section loss to the bearing plate. Undermining to bridge seat.

Photo 35	Girder 2 bearing at Pier 4, Span 4, looking northeast. The bearing plate is cracked.

Photo 36	Girder 1 bearing at Pier 4, looking north. Unseated/bent anchor bolt. Note the fine cracks with efflorescence in the pedestal, and the flood debris accumulation.

Photo 37	Girder 1 bearing at Pier 5, looking southeast. Bent top bearing plate.

Photo 38	Span 5, Girder 1 bearing at Pier 6, looking west. Cracked connection to top bearing plate. Severe pitting to angles with up to 100% section loss to the rivet heads.

Photo 39	Span 6, Girder 1 bearing at Pier 5, looking right. Anchor bolts are sheared off with missing nuts.

Photo 40	General view of the Lower Merion Abutment, looking west. Moss growing throughout the stem wall. Heavy vegetation growth and graffiti.

	
Photo 41	Southwest Wingwall, Lower Merion Abutment looking south. Large voids at the base of the base of the wall with vegetation growth at the top.
	
Photo 42	Northwest Wingwall, Manayunk Abutment looking east. Several missing stones with erosion and vegetation growth. Note the rotated and displaced stones at the west corner of the abutment stem wall.

Photo 43	General view of Pier 2/3 east face, looking south. Note the tie rod channel assembly repair using additional vertical members around the pier cap. Moderate efflorescence throughout stem.

Photo 44	Pier 2/3 north face, looking south and up. The top of the pier masonry bulged out causing the tie rod channel assembly members to bend out.

Photo 45	Pier 4 upstream nose, looking back. Large area of stone loss causing undermining of the pier. Flood debris accumulation.

Photo 46	Pier 4 cap, looking southeast. Large masonry loss in the perimeter cut stone exposing rubble fill and undermining the girder bearing. Flood debris accumulation/vegetation growth.

Photo 47	Pier 5 cap, south face, looking north. Minor to moderate efflorescence throughout. Flood debris at the upstream side of the bridge seat. Tie rod channel assembly typically loose.

Photo 48	Pier 5 cap, south face, looking east. Tie rod channel assembly with nuts not fully tightened.

Photo 49	Bridge seat under Girder G2 bearing at Pier 6, looking northeast. Wide crack in the bridge seat under the bearing.