

# Headquarters Road Bridge

(a.k.a Burnt Mill Bridge)

## Preliminary Condition Assessment and Proposed Rehabilitation

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Prepared for: the Delaware Riverkeeper  
FINAL REPORT March 6, 2012



Prepared by:



McMullan & Associates, Inc.

## Background

McMullan & Associates was retained by the Delaware Riverkeeper Alliance in June 2011 to investigate the condition of the Headquarters Road Bridge (aka Burnt Mills Bridge) located in Tinicum Township, Bucks County, Pennsylvania. This included a brief inspection of the bridge, a review of available documentation, and a report of our initial findings and recommendations.

The bridge was originally constructed in 1812 with stone masonry piers and abutments and a wooden beam and deck superstructure. It carries S.R. 1012 (Headquarters Road) across the Tinicum Creek and originally was a principal east-west route to a nearby mill site.

In 1919, the bridge was rehabilitated with the original stone piers and abutments and a steel beam and concrete slab deck. Sixteen feet clear was provided between the curbs. Noted Architect and Engineer Oscar Martin, who served as the County Bridge Engineer, provided a simple bridge design using the original 1812 piers and abutments that was compatible with the surrounding countryside.

Sometime prior to 2001, the original bridge railing was replaced with a new more substantial railing with posts bolted to the edges of the concrete deck. The railing on the south side of the bridge was heavily damaged, reportedly by a truck trailer, and subsequently concrete jersey barriers were placed on the bridge, resulting in a significantly narrowing of the curb to curb width to its present 10'-11".

The bridge was identified as a contributing resource to the Ridge Valley Rural Historic District, listed in the National Register of Historic Places July 24, 1992. On April 28, 2006, the Keeper of the National Register of Historic Places identified the bridge as being "historically significant in the context of the development of the township, regional transportation, and the operation of local mills, and its engineering significance both for its early 19<sup>th</sup> century construction and its sensitive modernization in 1919".

In August 2006, a consultant to PennDOT performed a thorough inspection of the bridge and detailed several deficiencies in their report. After the report, repairs were made to the bridge. The bridge was closed to traffic in March 2010 due to concerns about deterioration deck.

In April 2011, PennDOT conducted a public meeting and exhibited plans for replacing the bridge with an entirely new structure.

Until its recent closure, the bridge reportedly was used by school buses, fire and rescue vehicles, contractors, trash collection vehicles, and the general public.

## Field Investigation and Observations

On June 13, 2011, McMullan & Associates visited the bridge. Present at the bridge were:

- Elizabeth Koniers-Brown, Delaware Riverkeeper Alliance
- Damon Aherne, Woodtiger Fund
- Kathryn Auerbach (and a student), Preservation Consultant
- Abba Lichtenstein, McMullan & Associates

- Douglas Bond, PE, McMullan & Associates

A general discussion ensued of the history of the bridge, its condition, and ideas for saving the bridges historic features. A brief inspection of the bridge was conducted involving observation, photographs, measurements, and some probing. This was followed by further discussion offsite. Photographs taken during the inspection are included as Appendix A.

The bridge is currently closed to traffic. There is a sign for a 10 ton load limit. The bridge crosses Tinicum Creek along an East-West axis. At the time of our visit, water flowed under the center and west spans of the three span bridge. The clear distance between piers and abutments is approximately 21 feet and the piers are about 5'-4" feet wide.

The stone piers and abutments are constructed using a squared rubble coursing with larger stones at the base and smaller stones near the top. It is evident that repairs have been made to the stone piers as evidenced by the variety of mortar color in the joints between the stones. Mortar or shotcrete has been applied to the surface of the stones in many areas. In some cases this layer is very thin, about ¼ inch in thickness. No large open cracks were observed, although there are a number of minor cracks, which have been repaired with mortar. The stone coursing appeared regular and no large displacements or settlements were noted. There is a minor bulge on the west face of the west pier and a few stones that have deteriorated but these conditions appear to be repairable.

The abutments appear to be in good condition, with no large cracks, missing stones, or other signs of significant deterioration. There are some minor cracks that have been repaired with mortar or shotcrete. The stones appear to be a form of silt stone or shale.

No large scour holes were observed at the bottom of the piers and abutments. Remedial grout bags were present around the upstream nose of each pier and the West Abutment, presumably as a scour countermeasure.

The stone masonry wing-walls at each end of the bridge are in fair condition with some minor cracks and displacements and plant growth in mortar joints. Some of the cracks have been repaired with mortar.

Little remains of the 2001 W-Beam railing on the downstream (south) edge of the bridge slab. The exposed edge of the remaining concrete contains large rounded aggregate. The railing post anchor bolts are exposed. There is significant spalling at the bolt locations.

On the underside of the deck, many of the original concrete encased steel beam stringers are exposed and exhibit significant corrosion. The concrete encasement below remaining stringers has delaminated as a result of the corrosion at other stringers. There are several spalls in the concrete slab itself, leaving the original expanded wire reinforcement exposed. There are three significant holes in the slab.

Jersey barriers have been placed inside the railing and allow a 10'-11" curb to curb width. There are three steel plates on the bridge deck that have been placed over holes in the concrete slab.

## Documents Reviewed and Comments

The following documents were provided to McMullan for review:

1. Plans for the Bridge Repairs, 1919, by Oscar Martin
2. Presentation Handout by PennDOT, April 27, 2011
3. Engineering Inspection Report, 2006, Urban Engineering Inc.
4. 2008 Guidelines for Stonework, Headquarter Bridge, Kathryn Auerbach
5. Determination of Eligibility Notification, 2 pages, Department of Interior, April 28, 2006.

The 1919 Repair plans (Appendix D) indicate that the bridge, known as "Hockmans Bridge", was to be built on the existing stone masonry substructure. Parapets were added to the original wing walls and concrete posts added as a termination for a 2" diameter galvanized pipe railing. The pipe railing was supported by steel posts set on concrete curbs. The 16 foot wide bridge between curbs was supported by 12 inch deep steel stringers encased in concrete. The concrete deck was a 6" slab reinforced with expanded wire. The slab was crowned with asphalt. A concrete cap was placed on the piers and the abutments.

The PennDOT 2011 preliminary bridge plans indicate removing the original stone masonry piers and abutments and 1919 superstructure with replacing them with a new 24 foot wide 2 lane structure supported by concrete piers faced with the original stones "where possible". It is likely that some of the larger stones at the base of the pier may be thicker than what would be needed for facing a concrete pier. Also, additional right of way may be needed for this design.

The 2006 Urban Engineering Report noted several deficiencies. Many of these had been repaired at the time of our inspection. A list of the defects noted in the report in with a comparison to their present condition is included as Appendix B. The report also made reference to a "Foundation Report" from June 2005 that contains logs of test borings. For the Stone Masonry Properties, the Uniaxial Compressive Strength of the stone is listed as 814.9 TSF (about 11,000 psi) "...per Foundation Report Testing...", and the stone type is identified as Siltstone. Bedrock properties are indicated to have an Average Rock Quality Designation (RQD) of 53%.

The 2008 Guidelines for Stonework contain a detailed description of the stone masonry piers and abutments and recommendations for mortar.

The 2006 Eligibility Notification, from the office of the Secretary of the Interior, indicated that the Headquarters Road Bridge is eligible for the National Register of Historic Places as a contributing property in the National Register listed Ridge Valley Rural Historic District.

## Recommendations for Rehabilitation

The condition of the stringers and deck is such that replacement of the superstructure is the logical alternative. The stone piers and abutments, although exhibiting some minor cracks, can be rehabilitated to support a new superstructure. The stresses in the stone masonry are low in comparison to their compression capacity. The piers and abutments should be repaired using historically compatible materials and techniques. Given the historical age and significance of the stone piers and abutments,

these are the key features of the structure which should be the focal point of any scheme for rehabilitation.

The new superstructure will be built in a similar configuration as the original using steel beams and concrete.

For the rehabilitation of the bridge, we recommend the following:

- A new 7" concrete slab with epoxy coated reinforcement
- New structural steel wide flange stringers at the same spacing as the original
- The outside stringers will be encased in concrete
- The interior stringers will be painted
- A new concrete curb and bridge railing similar to the original
- Repairing the top of the stone piers and abutment and replacement of the concrete cap
- Repairing the stone masonry piers and abutments by using a suitable mortar and by grouting.
- Reconstructing the stone masonry wing-walls as needed
- Replacing the concrete posts at the ends of the bridge railing
- For scour protection, the bottoms of the piers and abutments may be encased in concrete.

A sketch of a proposed cross section for the rehabilitated bridge is attached as Appendix C.

The bridge railing posts will be anchored to the concrete curb. The exterior stringers would be encased in concrete and support the curb. Encasement would also provide an elevation view of the bridge consistent with its 1919 design. The interior stringers would be painted.

The existing concrete cap on the piers will be replaced with a new concrete cap. Some repair of the stone masonry is anticipated when the cap is removed, and this may involve removing and resetting some stones or grouting. The new concrete cap will be appropriately reinforced to distribute the bearing loads of the stringers.

Local stone masonry repairs of the piers and abutments would include raking mortar joints, pointing with an appropriate mortar, and replacement of damaged stones where needed. Some of the mortar coating on the surface of the stones would be removed where needed in order to lessen the entrapment of water in the masonry. The latter would also improve the historical appearance of the coursed stone. The stone masonry parapets on the wing-walls can be rebuilt using the original stones or repaired in a manner similar to the piers and abutments.

### Recommendations for future work

This initial report is based on our preliminary field investigation and review of the documents provided. For a detailed development of rehabilitation method, a more in-depth inspection of the bridge is required, as well as review of other documents such as the 2005 Foundation Report.

A detailed inspection of the bridge would include measuring of cracks in the stonework and measurements and probing around each of the piers and abutments to determine if there is any undermining as a result of scour.

From the information given in PennDOT's April presentation of the bridge replacement scheme, it appears that soil borings were taken, stone compression tests performed, and some preliminary drawings of the existing layout of the site developed. This information would be useful to us in developing the rehabilitation plans.

In addition, any photographs that may have been taken during the repairs of the piers and abutments would be helpful.

Plans for rehabilitation of the bridge should follow the AASHTO Guidelines for Historic Bridge Rehabilitation and Replacement and follow the Secretary of the Interior Standards for Historic Rehabilitation and Restoration. A proposal for Part 2 of our assessment will be submitted.

Respectfully Submitted,

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#### Attachments

Appendix A - Photographs

Appendix B - Comparison of Conditions

Appendix C – Sketch of Proposed Cross Section

Appendix D – Original Oscar Martin 1919 Repair Drawings

Appendix E – Existing Condition Drawings by Katheryn Auerbach