

Radnor Township
Stormwater Management Advisory Committee (SWMAC)
Agenda
7:00pm, Thursday, March 10, 2016



1. Call to Order.
2. Pledge of Allegiance.
3. Review / approve meeting minutes of February 11, 2016 SWMAC Meeting.
(5 minutes)
4. Public comment.
(10 minutes)
5. Recap of February 22, 2016 Board of Commissioners meeting: CH2M Township Wide Assessment approval.
(10 minutes)
6. Discussion of Gannett Fleming's Five Bridge/Culvert Inspections and Evaluations: South Devon Avenue, Chamounix Road, Earles Lane, Eagle Road and Sawmill Road.
(30 minutes)
7. Discussion of repair budget prioritization.
(15 minutes)
8. Old/New Business – Roberts Road/Sacred Heart/Clark School drainage issue, Banbury Francis Draft RFP (CH2M), update on current Repair Projects, Storm Sewer Inspection/TV, SWM Ordinance Revisions, RMS Connector.
(50 minutes)
9. Set the date and time for the next meeting and adjourn.

ATTENDEES: SWMAC: Paige Maz, Regina Majercak, Charles Boschen, Paul Burgmayer
CH2M: Daniel Wible

PREPARED BY: CH2M
MEETING DATE: February 11, 2016
SUBJECT: February 2016 meeting

YouTube link: <https://www.youtube.com/watch?v=KlbzdDTffjU>

Review of Previous Meeting Minutes

- January 14, 2016 SWMAC meeting minutes – approved

Introduction of New SWMAC Member

- Tim Sass, an engineer who has lived in north Wayne for around 20 years, named as new SWMAC member; Tim runs his own engineering firm (Author note: Tim's firm is SassCo Engineering, which specializes in structural design and forensics)
- Public comment: Maya van Rossum noted that the vacant SWMAC seat was in Commissioner Elaine Paul Shaefer's district (not north Wayne)
 - Paul noted that at the 12/21/15 Board of Commissioners (BOC) meeting, the commissioners voted to eliminate the ward-specific requirement for SWMAC membership

Public Comment

- No public comment

Recap of February 8, 2016 Board of Commissioners (BOC) Meeting

- Paul gave a recap of his presentation to the BOC on 2/8/16
 - Paul presented the SWMAC's following proposed percentage goals for the four key categories, which the BOC agreed with:
 - Repair/Maintenance/MS4: 20%
 - Capital Improvements: 67%
 - Admin/Eng: 8%
 - Rebate/Credit/Grants: 5%
 - Paul also discussed the SWMAC's proposed process for adding new stormwater projects to the list
 - Paul gave a brief summary of the SWMAC's 5-year stormwater budget
 - 2019 is expected to be the first year that the above percentage goals will be realized
 - All of the expenditures for 2016 have been accounted for
 - As each project moves forward, the SWMAC will ask the BOC for approval at each step; costs will be updated/tracked as they get refined
 - Newly identified repairs / emergencies will be either funded from other sources (i.e. Township general funds rather than stormwater funds) or delayed until future years
 - In the fall, the SWMAC will present a prioritized list of projects for the following year
 - Regina noted that the Banbury/Francis/Windsor project budget was arbitrarily split over 2 years, but that it will be paid for when it is constructed

- Regina also noted that the SWMAC will diligently seek grant funding to help fund additional stormwater projects
- Paul noted that Commissioner Shaefer had asked about the north Wayne field project as it was not listed in the 5-year budget
 - As currently configured (open outlet gate), is this an imminent safety concern? If so, should this be considered a repair item?
 - Paul had told the BOC that the proposed north Wayne basin would be analyzed as part of the Township-wide assessment
 - Regina asked if the pipe at the field could be inspected and televised as part of that upcoming work
- Paige noted that the BOC passed a resolution making rebates for SFR retroactive to 1/1/15; the BOC encouraged residents to apply for SFR rebates; Paige encouraged the SWMAC to think of ways to increase public awareness about the SFR rebates

Discussion of Repair Budget Prioritization

- Paul discussed the need for a general process for classifying and prioritizing repair projects
 - Repair projects should be classified as either “emergency” or “non-emergency”

Proposal for Township Wide Assessment (CH2M)

- Daniel relayed Steve Norcini’s thoughts on the proposal for the Township-wide assessment
 - In general, Steve agreed with the overall approach
 - Steve’s main comment was that the assessment should focus on *addressing* the known flooding locations throughout the Township rather than *identifying* them; Township staff has a good understanding of where the flooding occurs based on first-hand knowledge and previous studies; from Steve’s perspective, Task 1 of the assessment could be reduced in scope, if not eliminated (Note: this sentiment was also discussed at the BOC meeting on 2/8/16)
 - Daniel noted that the proposed assessment would utilize existing studies in order to not duplicate previous work
 - Daniel noted that Task 1 of the assessment is really a two-part task: “1A” entails an effort to create a definitive list of the known flood locations through a review of previous studies and meetings with key sources/stakeholders (emergency services, etc.); “1B” involves refining the previously developed flood model for the entire Township in order to rank/prioritize the areas that will be further analyzed in subsequent tasks
 - Paul asked how the assessment would be validated; Daniel responded that the results would be anecdotally validated (i.e. results would be compared to known flooding locations)
 - Charles asked about the purpose of Task 1; Daniel responded that Task 1 is a good starting point for this assessment and will yield a definitive list of flood locations throughout the entire Township and will establish a foundation for the more detailed analysis; Charles urged the SWMAC to not eliminate Task 1 and to accept the proposal as is
 - Regina noted that the data associated with previous studies has been difficult to access and that there was value in further exploring that data as part of this effort
 - Paul asked about the overlap between Task 2 (data collection) of the proposed assessment and the storm sewer cleaning / televising task; Daniel noted that the efforts will be coordinated to the extent possible: assuming the timing works out, the assessment will help to prioritize the areas covered in the cleaning / televising task, as well as determine / verify pipe diameters for the model; additional data, such as pipe inverts, beyond the cleaning / televising scope will likely be needed for the model

- Regina noted that it might be better to inspect a greater length of storm sewer than would be inspected and cleaned; Daniel suggested waiting until seeing the prices for the cleaning / televising work before deciding how to proceed
- Daniel noted that the purpose of Task 3 is to model existing conditions and to provide a foundation for Task 4; Daniel noted that EPA SWMM will be utilized and that this was not directed by Township; SWMM was also used for the Ithan Creek assessment
- Daniel discussed Task 4, which entails modeling potential flood mitigation efforts in the areas modeled in Task 3; this would include sensitivity analysis
 - Regina was concerned about focusing on only 7-8 problem areas; Daniel responded that this was based on discussions with Steve about the number of known highest risk flood locations and acknowledged that there was some flexibility in this number
- Daniel discussed Task 5, which entails ranking project selection criteria and prioritizing conceptual flood mitigation projects
 - Examples of prioritization criteria: flood reduction, social benefits, constructability, maintenance needs, etc.
 - Daniel briefly discussed the prioritization process, which is envisioned to include a workshop with the SWMAC, Township staff, and, as appropriate, other stakeholders
 - Regina noted that the prioritization process will require the support of the BOC
 - General consensus that this was important and should be kept in the scope
- Public comment: Maya van Rossum stated that she is in support of the Township-wide assessment and will be writing a letter urging the BOC to approve it
 - Maya noted that any data associated with previous studies does not exist, or at least was not provided as part of the information request made by the Delaware Riverkeeper Network
 - Maya expressed strong support of the prioritization task in particular and noted that the criteria development / ranking part of it could and should happen early on in the process
- SWMAC voted in favor of recommending the Township-wide assessment proposal to the BOC

Old/New Business

- Banbury/Francis/Windsor project RFP – Daniel discussed the various components of the draft RFP that CH2M prepared and distributed previously
 - Regina asked if the bioretention feasibility verification task could also include consideration of additional walkability / green street improvements (e.g. sidewalks)
 - Regina also asked about public involvement during the concept verification task; the public, especially those residents / businesses in the vicinity of the proposed project, should be given an opportunity to weigh in on the design
 - General SWMAC consensus that there should be a public meeting on this project once the geotechnical and surveying work has been completed and the selected design engineer has verified the concept plan
 - Regina noted that all models / analyses developed for the Township should be provided to the Township as deliverables (hard copies and electronic copies)
 - Charles suggested that task 2B not be considered “optional” since it was specifically requested by Commissioner Shaefer; Paige suggested that task 2B be reworded so that it is clear it is for a high-level feasibility assessment of a road closure and implementation of some type of green infrastructure stormwater control and that it will not entail detailed, complex engineering analysis
 - General SWMAC consensus that the RFP should be open to all interested and qualified engineering firms

- Daniel provided the following updates:
 - N. Wayne train station – still on-hold as site access issues get sorted out with SEPTA
 - Stormwater Management Ordinance (SWMO) updates – Gannett Fleming still working on it
 - Regina noted that the SWMO updates are long overdue and would like to see them completed soon
 - Clarke School (455 S. Roberts Road, Bryn Mawr) – runoff from Roberts Road is causing erosion; Steve and Daniel to investigate further
 - Charles asked about the process for adding new “repair” projects to the list
 - Daniel noted that, at Steve’s request, he wrote a brief memo about the purpose of the new storm sewer connection to the Radnor Middle School stormwater system
 - Regina expressed an interest in exploring ways (e.g. partnerships with other committees) to get the word out about the SFR rebates; Regina also stated that the SWMAC should consider increasing the rebate amounts in the future

Next SWMAC meeting: 3/10/16 (location to be determined as the Radnorshire room is unavailable)

Action Items

- **CH2M** to update RFP for design of Banbury/Francis/Windsor flood mitigation project based on SWMAC comments
- **CH2M** to send Radnor Middle School memo to SWMAC members
- **SWMAC** to write memo about SWMO updates

DRAFT



Gannett Fleming

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February 4, 2016

Stephen F. Norcini, P.E.
Public Works Director
Radnor Township
301 Iven Avenue
Wayne, PA 19087

Dear Steve:

Bridge/Culvert Inspections and Evaluations

In accordance with the scope of work and cost proposal to provide engineering services for the evaluation of five (5) bridges/culverts submitted to Radnor Township on July 1, 2015, Gannett Fleming completed the field view and prepared a summary report for each bridge. The reports summarize the findings from field view and recommend the appropriate option to replace or rehabilitate the deteriorated structures. A conceptual construction cost estimate and estimate of engineering cost for the recommended work is prepared for each structure for your budgeting purposes. Actual engineering costs will be developed based on the final scope of services for each task.

The recommended Replacement/Rehabilitation for each bridge and associated costs are summarized below:

South Devon Avenue

Based on the field assessment and finding, it is recommended to replace the deteriorated superstructure and substructure of the north pedestrian bridge and rehabilitate the remaining structure. Major work includes the following:

- Replace superstructure and substructure of north pedestrian bridge.
- Repoint missing mortar joints in remaining abutments and wingwalls.
- Repair/Repaint the south pedestrian bridge, update railing to meet the current standards.
- Fill the scour hole at outlet and in front of concrete apron of wingwalls B & C with riprap.
- We will discuss with the township about the need for updating safety features of roadway bridge and pedestrian bridges.
- Install the missing hazard marker at northwest corner.

The cost of engineering services:	\$84,300
<u>The estimated construction cost:</u>	<u>\$116,000</u>
Total Cost:	\$200,300

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Chamounix Road

Based on the field assessment and finding, it is recommended to rehabilitate the existing culvert and replace the entire downstream retaining wall. Major work includes the following:

- Replace the existing masonry spandrel walls and barriers at both ends of the culvert to meet current PennDOT Standards.
- For consistency with roadway cross section with nearby newly constructed bridge, extend the existing arch barrels to accommodate a 5'-0" wide sidewalk.
- Provide formliner on headwalls and barriers to aesthetically blend with the newly constructed adjacent bridge.
- Remove and rebuild the downstream retaining wall.
- Underpin the footings and fill the scour hole at the inlet with riprap.
- Remove the tree at northeast corner.
- Install guide rail on non-sidewalk side if directed by the Township.
- Install Type M inlet and drainage.

The cost of engineering services:	\$100,500
<u>The estimated construction cost:</u>	<u>\$233,000</u>
Total Cost:	\$333,500

Earles Lane

Based on the field assessment and finding, it is recommended to rehabilitate the existing culvert. Major work includes the following:

- Underpin the undermined footings on the original structure.
- Repoint masonry abutments on the original structure.
- Remove railing and pillars on the east fascia and provide curbing and signing.
- Remove the inlet and associated structure and extend the original slab bridge to satisfy the minimum lane width requirement and construct upstream wingwalls.
- Relocate drainage inlet behind the bridge abutment
- Fill the scour hole at the inlet with riprap.

The cost of engineering services:	\$83,900
<u>The estimated construction cost:</u>	<u>\$124,000</u>
Total Cost:	\$207,900



Eagle Road

Based on the field assessment and finding, it is recommended to replace the existing twin-cell corrugated pipe culvert. Major work includes the following:

- Replace the deteriorated corrugated pipe with a single cell precast box culvert.
- Install structure mounted guide rail.

The cost of engineering services:	\$98,300
<u>The estimated construction cost:</u>	<u>\$168,000</u>
Total Cost:	\$266,300

Sawmill Road

Based on field assessment and findings, it is recommended to rehabilitate the structure as follows:

- Repair spalls/cracks in fascia of arch ring
- Remove trees and provide riprap protection at downstream left bank to prevent further bank erosion.
- Relocate the pedestrian crosswalk to the west, away from the structure, to the intersection with Earles Lane. The trails within the parks could be reconfigured with minimal earth disturbance to affect this change. This will allow vehicles to better observe pedestrians in the crosswalk and will allow pedestrians to see oncoming traffic from the bridge.
- Provide painted yield bars on the roadway at both bridge approaches with adjacent signing "YIELD TO ONCOMING TRAFFIC". This will allow vehicles on either approach to yield to a vehicle already on the structure.
- Provide guide rail or crash worthy end treatments on all four corners of the structure.

The cost of engineering services:	\$28,100
<u>The estimated construction cost:</u>	<u>\$27,000</u>
Total Cost:	\$55,100

If you have any questions concerning this information, please contact me.

Very truly yours,

GANNETT FLEMING, INC.



Roger A. Phillips, P.E.
Senior Project Manager



GANNETT FLEMING MEMORANDUM

Date: January 27, 2016

To: Radnor Township

From: Gannett Fleming

Re: South Devon Avenue Culvert Field View

A field view was performed on November 23, 2015 of the above-referenced culvert located just South of Bo Connor Park and Warren Filipone Memorial Park which carries South Devon Avenue over Little Darby Creek in Radnor Township, Delaware County. The field view was performed to determine the need for the structure's repair, rehabilitation, or replacement. The field view was limited to observation of the above ground, visible and accessible elements. Elements below the water line or ground line were not assessed. Load ratings and structural plans of the existing bridge were not available at the time of field viewing.

Structure Description

The creek crossing is comprised of three independent superstructures supported on common abutments. The main superstructure is a concrete slab bridge that carries two 13'-0" lanes, with a 12" wide concrete curb and 9" wide brick barrier on each side with a 29'-6" out-to-out and 11'-0" clear span. The other two superstructures are 5'-0" out-to-out steel pedestrian bridges carrying the north and south sidewalks.

Little Darby Creek flows generally north to south in the vicinity of the culvert. Its alignment entering the culvert is generally tangent with a gradual transition from the natural streambed into paved streambed. The culvert is on a 90 degree skew.



*General View of Roadway and Pedestrian Bridges
Looking West*



North Pedestrian Bridge (South Pedestrian similar)

Structure Findings

The condition of the slab bridge, pedestrian bridges, as well as grouted stone masonry abutments and wingwalls were viewed to determine if any deficiencies could compromise the structure's integrity. Findings on the structure are summarized as follows:

Slab Bridge

The concrete slab superstructure of the main structure is in good condition with localized honeycombing and exposed aggregate. No spalls or exposed reinforcing steel is noted.



Under Deck View (H.C. in middle width)



Honeycombing and Exposed Aggregate

Both abutments and wingwalls are stone masonry, all are in good condition except for Wing A and Wing D.



Typical Masonry Abutment



Wing B (Wing C similar)

At Wing D, stones are missing from below the 12" diameter drainage pipe with more than 12" undermining; Wing A exhibits missing stone, missing mortar joints and water leakage at the groundline.



Missing Stones and Undermining in Wing D



Missing Stones and Mortar Joints in Wing A

Note that concrete aprons of varying width are present at both Wing B and Wing C (downstream wings). It is assumed that the aprons serve the purpose of splash block for ground water flows into the creek through drainage pipes. Both aprons are undermined up to 2'-0". Streambed under the bridge is paved with concrete and in good condition; water flow over the streambed is approximately 1" deep. A waterfall is formed at end of the paved streambed and a 2'-3" deep scour hole beyond the paved streambed between Wing B and Wing C is noticeable. There is no noticeable bank erosion.



2' Undermining under Wing B Apron



Large Scour Hole at end of Culvert

Pedestrian Bridges

The south pedestrian bridge features two (2) W12 stringers with five (5) W5 floor beams and a pressure-treated plywood stay-in-place form. Both stringers and floor beams exhibit heavy rust and delamination with minor section loss throughout; the plywood form is in fair condition.



South Pedestrian Bridge Elevation View



South Pedestrian Bridge Underdeck View

The north pedestrian bridge is composed of two (2) W8 stringers, concrete deck and plywood form, and is also supported by a built-up auxiliary timber T-beam (2x6 flange and stem). The W8 stringers are heavily rusted with 100% loss of webs and more than 50% loss of bottom flanges and are losing their carrying capacities. A Large hole is noticeable in the concrete deck and plywood form. The stem of the built-up timber T-beam splits at middle depth from the end notch.



North Pedestrian Bridge Elevation View



North Pedestrian Bridge Underdeck View



100% Loss in Web of North Stringer



Large Hole in Deck and Horizontal Split in Stem of T-Beam

Railing posts for the north pedestrian bridge are either broken or rusted with total section loss. Railing and posts for the south pedestrian bridge are in fair condition.



Section Loss in N. Railing Post of North Pedestrian Bridge



Broken Railing Post in N. Railing of North Pedestrian Bridge

Conclusions

Both superstructure and substructure of the main structure carrying South Devon Avenue are in good condition, with no apparent defects noted in the paved streambed.

Both downstream wingwalls (Wing B and Wing C) that support the south pedestrian bridge are in fair condition with a few missing mortar joints and undermining of concrete aprons. The Superstructure of the south pedestrian bridge is in fair condition with heavy rust in stringers and floor beams.

The Superstructure of the north pedestrian bridge and Wing D are in poor condition. Wing A is in fair condition.

Two of five railing posts of the north pedestrian bridge are ineffective due to either excessive damage or 100% section loss at the base. The rest of the railing posts are in fair condition with heavy rust at the base.

Safety Features

The lane width and alignment is adequate for the roadway type and posted speed limit. Brick parapets for the roadway bridge are not crashworthy or compliant with PennDOT standards. If the brick parapets are to remain, then they should be positively protected with guide rail on all four approaches. In order to install the guide rail, the curb line may have to be straightened on the "park" side of the street to accommodate post placement. At a minimum, hazard markers need to be placed at all four approach corners.

The pedestrian bridges railings are a hazard and should be replaced with the PennDOT Standard Aluminum Pedestrian Railing in BC-716M or approved equivalent.

Environmental

South Devon Avenue crosses Little Darby Creek which supports protected water uses for Cold Water and Migratory Fishes (CWF/MF) according to Title 25, Chapter 93 of Pennsylvania State Code. The stream is an approved Pennsylvania Fish and Boat Commission Trout Stocked Fishery and does not support a naturally reproducing trout population. Therefore, seasonal construction restrictions will be required and no instream work may occur between March 1 and June 15. A PNDI database search was conducted and no state or federal endangered species were identified as a result of the search. No known historic or archaeological sites are known to exist at or near the site of the bridge according to the Pennsylvania State Historic Preservation Office's Cultural Resources GIS website.

It appears that rehabilitation of the bridge, including the addition of scour protection would require a PADEP General Permit #11 for Maintenance, Testing, Repair, Rehabilitation or Replacement of Water Obstructions and Encroachments. It is assumed that federal authorization for this activity can be authorized by PASPGP-4 that will be issued by PADEP.

If wetlands are present, and greater than 0.05 acres of impacts are expected, GP-11 does not apply and A Joint Chapter 105/Section 404 Permit may be required

Geotechnical

The existing bridge and south pedestrian bridge will be rehabilitated and therefore no Geotechnical Investigation is necessary. However, the replacement of the deteriorated superstructure of North Pedestrian Bridge and rebuild of Wings A & D that supports the pedestrian bridge is recommended.

A Site Geology Map, extracted from the Geologic Quadrangle Maps of Pennsylvania, indicates that the South Devon Avenue structure is underlain by Mafic Gneiss (mgp). According to *Engineering Characteristics of the Rocks of Pennsylvania*, the Mafic Gneiss (mgp) is described as medium to fine grained with up to 30% quartz. The geotechnical investigation will consist of drilling two borings to a maximum depth of 30 ft below the ground surface. Rock will be cored for 5 ft if encountered. Laboratory testing will be conducted on the recovered samples as necessary. Following the subsurface investigation and the laboratory testing GF will prepare a brief memo with recommendations.

Recommendations

Based on the field assessment and finding, it is recommended to replace the deteriorated superstructure and substructure of the north pedestrian bridge and rehabilitate the remaining structure. The major works are listed below:

- Replace superstructure and substructure of north pedestrian bridge.
- Repoint missing mortar joints in abutments and wingwalls.
- Repair/Repaint the south pedestrian bridge, update railing to meet the current standards.
- Fill the scour hole at outlet and in front of concrete apron of wingwalls B & C with riprap.
- We will discuss with the township about the need for updating safety features of roadway bridge and pedestrian bridges.
- Install the missing hazard marker at northwest corner.

A conceptual construction cost estimate and estimate of engineering cost is provided for the recommended work.

South Devon Avenue over Little Darby Creek Culvert Rehabilitation

Construction Item Estimate:

		Unit	Qty	Unit \$	Item Cost
Bridge					
1	Bypass Pumping	LS	1	\$3,000	\$3,000
2	Removal of Existing N. Pedestrian Bridge (Superstructure and Substructures - Wings A & D)	LS	1	\$4,000	\$4,000
3	Class A Cement Concrete Abutments/Wings A & D	CY	15	\$1,000	\$15,000
4	Reinforcement Bars, Epoxy Coated	LB	3000	\$1.5	\$4,500
5	#2A or AASHTO #8	CY	16	\$100	\$1,600
6	Install Prefabricated New North Pedestrian Bridge (16' long x 5' wide)	LS	1	\$16,000	\$16,000
7	Update South Pedestrian Bridge Railings	LF	40	\$65	\$2,600
8	Repair/Repaint South Pedestrian Bridge	LS	1	\$4,375	\$4,375
9	Riprap at Outlet and Inlet	CY	20	\$85	\$1,700
10	Class 3 Excavation	CY	95	\$65	\$6,175
11	Structure Backfill	CY	60	\$55	\$3,300
12	Temporary Excavation Support and Protection System	LS	1	\$6,000	\$6,000
13	Repoint Masonry Abutment and Wingwalls	LF	180	\$15	\$2,700
14	Replace Drainage Pipes in Wings A & D	EA	2	\$1,000	\$2,000
15	Replace Segments of Removed sidewalk	EA	10	\$100	\$1,000
				Total Str. Cost:	<u>\$73,950</u>
Roadway					
1	Curb and approach roadway work	LS	1	\$9,400	\$9,400
2	Guide rail and end treatments	LS	1	\$9,250	\$9,250
				Total Roadway Cost:	<u>\$18,650</u>

Total Construction Cost: **\$92,600**

Total Construction Cost:	\$92,600
+ 5% Mobilization	
+ 20% Contingency	
Construction Total:	\$116,000
Engineering Fee:	\$84,300
Total Project Cost:	\$200,300

GANNETT FLEMING MEMORANDUM

Date: January 27, 2016

To: Radnor Township

From: Gannett Fleming

Re: Chamounix Road Culvert Field View

A field view was performed on November 23, 2015 of the above-referenced culvert located just west of Fenimore Woods Park which carries Chamounix Road, over Gulph Creek in Radnor Township, Delaware County. The field view was performed to determine the need for the structure's repair, rehabilitation, or replacement. The field view was limited to observation of the above ground, visible and accessible elements. Elements below waterline or ground line were not assessed. Load ratings and structural plans of the existing bridge were not available at the time of field viewing.

Structure Description

The twin concrete arch barrel culvert with masonry spandrel walls carries Chamounix Road over Gulph Creek. Chamounix Road is on a slight curve over the culvert and carries one 9'-0" northbound lane and one 11'-0" southbound lane. The clear span of each concrete barrel is approximately 6'-3". The stone masonry spandrel walls act as bridge barriers and are approximately 1'-6" (min) wide x 2'-4" (min) tall (above roadway), there is no guide rail treatment at any of the bridge corners. The curb-to-curb distance is approximately 20'-0" and there is a 5" diameter gas line attached to west (upstream) fascia of the culvert.

Gulph Creek flows west to east through the culvert with a change of alignment at both upstream and downstream. The upstream and downstream natural embankments are stable and well vegetated. A long 1'-0" wide stone retaining wall is located along the downstream south quadrant that define the edge of the channel.



General View of Culvert – Looking North



Downstream Elevation (upstream similar)

Just north of this structure along Chamounix Road is a newly constructed bridge. The newly constructed bridge has a 5' sidewalk on the east side and features PennDOT standard bridge barrier with formliner.



Sidewalk on a Newly Constructed Bridge along Chamounix Road over Branch of Gulph Creek



Bridge Barrier on a Newly Constructed Bridge along Chamounix Road over Branch of Gulph Creek

Structure Findings

The concrete arch barrels are in fair condition with minor honeycombing occasionally. Scour and undermining are noticed along the north barrel footings about 10' total length. In addition, there is a large scour hole about 2'-6" deep at the inlet of culvert. Heavy debris accumulation is present in both barrels. Findings on the culvert and the retaining wall are summarized as follows:

Culvert

The concrete arch barrels are in fair condition with localized honeycombing and exposed aggregate. No signs of distress, spalls, cracks or exposed reinforcing steel are noted within the concrete arch barrels. Heavy scale is observed along the waterline in both concrete arch barrels. The end 2 feet of each arch barrel consist of the masonry spandrel walls (headwalls) and masonry barriers. There are large areas of missing stones and mortar present within the masonry spandrel walls.



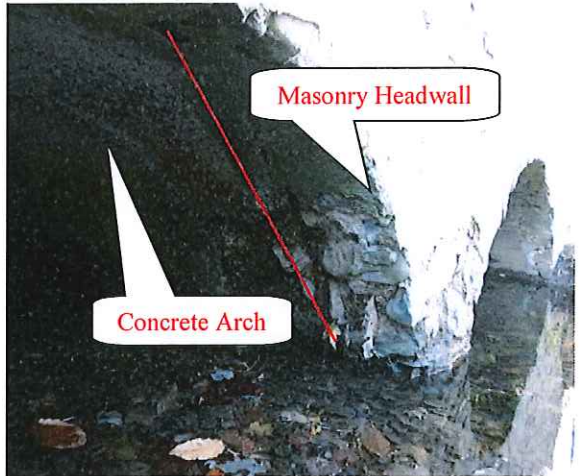
View of Concrete Arch South Barrel



View of Concrete Arch North Barrel



1'-0" Undermining at Outlet



View of Downstream Pier End



Spall and Missing Stones in Upstream Masonry Headwall of North Barrel



Spall and Missing Stones in Upstream Masonry Headwall of South Barrel



Undermining and Spall in Upstream Pier Footing



Failing Upstream Headwall in South Barrel



Scour and Exposed Footing at Upstream North Barrel



Large Scour Hole/Pond formed at Culvert Inlet

Downstream Retaining Wall

There is a stone masonry retaining wall that defines the edge of channel on the downstream south quadrant. The top width of retaining wall is 1'-0" wide and the height of retaining wall measured from streambed is approximately 4'-6" tall. The bottom 2'-6" of the wall has advanced deterioration with large area of undermining and missing stone and jointing along the length.



Downstream Retaining Wall – Looking Upstream



Downstream Retaining Wall – Looking Downstream



Retaining Wall Elevation - 1



Retaining Wall Elevation - 2

Conclusions

The concrete portions of twin arch barrels are in fair condition. There is undermining up to 1'-0", along north barrel with a total length of 10'. Heavy scaling is noted along the water surface line and there is heavy debris accumulation in both barrels. There is a large scour hole at inlet of the culvert.

The masonry headwalls are in poor condition. The upstream headwall has large areas of missing stones and mortar.

The masonry retaining wall along the downstream embankment is in serious condition with large areas of undermining and missing stone and jointing along the length.

Safety Features

No guide rail is present in the vicinity of the bridge, the stone masonry barriers do not meet current PennDOT's standards. Positive protection for the blunt ends of the bridge barrier is not provided. Only hazard markers denote the location on each of the four approaches.

The trunk of the large tree on the northeast corner of the bridge is currently protruding into the roadway.

Environmental

Chamounix Road crosses Gulph Creek which supports protected water uses for Warm Water and Migratory Fishes (WWF/MF) according Title 25, Chapter 93 of Pennsylvania State Code. The stream is not trout-stocked nor does it support a naturally reproducing trout population. A PNDI database search was conducted and no state or federal endangered species were identified as a result of the search. No known historic or archaeological sites are known to exist at or near the site of the bridge according to the Pennsylvania State Historic Preservation Office's Cultural Resources GIS website.

It appears that rehabilitation of the bridge, including the addition of scour protection would require a PADEP General Permit #11 for Maintenance, Testing, Repair, Rehabilitation or Replacement of Water Obstructions and Encroachments. It is assumed that federal authorization for this activity can be authorized by PASPGP-4 that will be issued by PADEP.

If wetlands are present, and greater than 0.05 acres of impacts are expected, GP-11 does not apply and A Joint Chapter 105/Section 404 Permit may be required.

Geotechnical

A Site Geology Map, extracted from the Geologic Quadrangle Maps of Pennsylvania, indicates that the Chamounix Road structure is underlain by mica schist of the Wissahickon Formation (Xw). According to *Engineering Characteristics of the Rocks of Pennsylvania*, the Wissahickon Formation (Xw) is described as an oligoclase-mica schist that is coarsely crystalline.

The existing twin concrete arch barrel culvert will be rehabilitated and therefore no geotechnical investigation is necessary for the bridge. However, the retaining wall adjacent to the downstream side of the culvert is recommended to be replaced and will require geotechnical investigation. The geotechnical investigation will consist of drilling two borings to a maximum depth of 25 ft below the ground surface. Rock will be cored for 5 ft if encountered. Laboratory testing will be conducted on the recovered samples as necessary. Following the subsurface investigation and the laboratory testing GF will prepare a brief memo with recommendations.

Recommendations

Based on the field assessment and finding, it is recommended to rehabilitate the existing culvert and replace the entire downstream retaining wall. The major works are listed below:

- Replace the existing masonry spandrel walls and barriers at both ends of the culvert to meet current PennDOT Standards.
- For consistency with roadway cross section with nearby newly constructed bridge, extend the existing arch barrels to accommodate a 5'-0" wide sidewalk.
- Provide formliner on headwalls and barriers to aesthetically blend with the newly constructed adjacent bridge.
- Remove and rebuild the downstream retaining wall.
- Underpin the footings and fill the scour hole at the inlet with riprap.
- Remove the tree at northeast corner.
- Install guide rail on non-sidewalk side if directed by the Township.
- Install Type M inlet and drainage.

A conceptual construction cost estimate and estimate of engineering cost is provided for the recommended work.

Chamounix Road over Gulph Creek Culvert Rehabilitation

Construction Item Estimate:

		Unit	Qty	Unit \$	Item Cost
Bridge					
1	Bypass Pumping	LS	1	\$7,000	\$7,000
2	Remove Existing Spandrel Walls/Headers	LS	1	\$2,000	\$2,000
3	Class A Cement Concrete for New Spandrel Wall/Headers	CY	15	\$1,000	\$15,000
4	Class AA Cement Concrete for Barriers and Moment Slabs	CY	42	\$650	\$27,300
5	Reinforcement Bars, Epoxy Coated	LB	11400	\$2	\$17,100
6	Formliner	SF	515	\$15	\$7,725
7	Class 3 Excavation (culvert)	CY	95	\$65	\$6,175
8	Structure Backfill	CY	45	\$50	\$2,250
9	Under Pin Undermined Footings.	CY	3	\$1,500	\$4,500
10	Riprap at Inlet	CY	50	\$80	\$4,000
11	Temporary Excavation Support and Protection System	LS	1	\$0	\$0
1	Remove Existing Retaining Wall	LS	1	\$5,000	\$5,000
2	Class 3 Excavation (Retaining Wall)	CY	262	\$35	\$9,170
3	Structure Backfill (Retaining Wall)	CY	130	\$55	\$7,150
4	Redi-Rock Wall Material (Quote) (Per 100 ft)	LS	1	\$16,186	\$16,186
5	Redi-Rock Wall Construction	LS	1	\$24,279	\$24,279
				Total Str. Cost:	<u>\$154,835</u>
Roadway					
1	Clearing and Grubbing (incl 1 large tree removal)	LS	1	\$5,000	\$5,000
2	Class 1 Excavation	CY	75	\$25	\$1,875
3	Approach Pavement	SY	150	\$55	\$8,250
4	Type M inlet and drainage	LS	1	\$4,600	\$4,600
5	Guide rail (on non-sidewalk side)	LS	1	\$9,250	\$9,250
6	Traffic Control	LS	1	\$2,500	\$2,500
				Total Roadway Cost:	<u>\$31,475</u>
Total Construction Cost:					\$186,310
Total Construction Cost:					\$186,310
					+ 5% Mobilization
					+ 20% Contingency
Construction Total:					\$233,000
Engineering Fee:					\$100,500
Total Project Cost:					\$333,500

GANNETT FLEMING MEMORANDUM

Date: January 27, 2016

To: Radnor Township

From: Gannett Fleming

Re: Earles Lane Culvert Field View

A field view was performed on November 23, 2015 on the above-referenced culvert located just west of Saw Mill Park which carries Earles Lane over Saw Mill Run in Radnor Township, Delaware County. The field view was performed to determine the need for the structure's repair, rehabilitation, or replacement. The field view was limited to observation of the above ground, visible and accessible elements. Elements below the waterline or ground line were not assessed. Load ratings and structural plans of the existing bridge were not available at the time of field viewing.

Structure Description

The structure is composed of an original concrete slab bridge supported by two stone masonry abutments. The structure was previously widened on the west side to accommodate and support a 2'x6' inlet. The bridge is on an approximately 60 degree skew, and carries two 10'-0" minimum lanes/shoulder. There is a single 3 ½" diameter pipe railing supported by two masonry pillars along the east fascia with no guide rails present along west fascia.

The slab bridge has a 6'-9" clear span; the slab thickness measured from the east fascia is 18".

Sawmill Run flows generally west to east in the vicinity of the culvert. Its alignment entering the culvert is on a 45 degree skew.



General View of Culvert – Looking South. Note Inlet Structure in West Shoulder



Upstream Elevation. Note Stream Flow Entering the Culvert with a Sharp Skew and Skew of the Culvert

Structure Findings

The condition of the original portion of slab superstructure is in good condition, and the existing stone masonry abutments are in fair condition with some missing mortar joints and undermining.

The widened portion of the structure and inlet are in serious condition. Both abutment extensions are undermined by more than 4 feet.

Original Concrete Slab Bridge

The original slab bridge shows no spalls or sign of water leakage and in good condition. Both stone masonry abutments are generally in fair condition with voids and missing mortar joints occasionally at various locations along the base.



View of Original Concrete Slab Superstructure (underside)



View of Original North Stone Masonry Abutment



2' Deep Void in North Abutment



View of Original South Stone Masonry Abutment



*East End of South Stone Masonry Abutment,
Note Large Stones with Missing Mortar Joints*



East Fascia

Widened Inlet Structure

The widened inlet structure is in poor condition; both abutments are severely undermined.



*North Abutment of Inlet Structure – Looking
Northwest*



*North Abutment of Inlet Structure – Looking
Southwest*



4' Undermining under North Abutment of Inlet Structure



South Abutment of Inlet Structure – Looking Southwest



Inlet Structure



West Fascia - Inlet Structure

Conclusions

The original concrete slab superstructure is in good condition with no noticeable spalls, cracks or distress. The original stone masonry abutments are in fair condition with some undermining, missing stones and voids.

The inlet structure is in poor condition, with both abutments undermined about 4 feet.

Safety Features

The roadway in this area has adequate lane width. Due to the relatively shallow drop from the roadway to the stream and the low traffic volumes on Earles Lane, guide rail is not required at this location. To clearly highlight the stream location, a consistent 8" reveal barrier curb should be provided over and approaching the stream. The curbing will serve to warn motorists traveling within the speed limit to keep on the roadway at this location. The hazard markers are present on all four approaches. The culvert should be extended or the proposed headwalls buried to prevent them from being an obstruction within the roadway clear zone. Curb openings should be provided to allow for drainage off of the road surface in lieu of the existing inlet on the structure. The existing inlet on the structure should be removed.

Environmental

Earles Lane crosses Saw Mill Run which supports protected water uses for Cold Water and Migratory Fishes (CWF/MF) according to Title 25, Chapter 93 of Pennsylvania State Code. The stream is not trout-stocked nor does it support a naturally reproducing trout population. However, it is within a half-mile of Darby Creek, which is trout-stocked. Therefore, seasonal construction restrictions will be required and no instream work may occur between March 1 and June 15. A PNDI database search was conducted and the results indicated that a Pennsylvania rare plant, puttyroot, may occur at this location and may be impacted. Coordination with the Pennsylvania Department of Conservation and Natural Resources may be required in order to gain authorization to construct the project. No known historic or archaeological sites are known to exist at or near the site of the bridge according to the Pennsylvania State Historic Preservation Office's Cultural Resources GIS website.

It appears that rehabilitation of the bridge, including the addition of scour protection would require a PADEP General Permit #11 for Maintenance, Testing, Repair, Rehabilitation or Replacement of Water Obstructions and Encroachments. It is assumed that federal authorization for this activity can be authorized by PASPGP-4 that will be issued by PADEP.

If wetlands are present, and greater than 0.05 acres of impacts are expected, GP-11 does not apply and A Joint Chapter 105/Section 404 Permit may be required.

Geotechnical

A Site Geology Map, extracted from the Geologic Quadrangle Maps of Pennsylvania, indicates that the Earles Lane structure is underlain by Felsic Gneiss (fgp). According to *Engineering Characteristics of the Rocks of Pennsylvania*, the Felsic Gneiss (fgp) is described as medium to fine grained with up to 30% quartz.

The geotechnical investigation will consist of drilling two borings to a maximum depth of 30 ft below the ground surface. Rock will be cored for 5 ft if encountered. Laboratory testing will be conducted on the recovered samples as necessary. Following the subsurface investigation and the laboratory testing GF will prepare a brief memo with recommendations

Recommendations

Based on the field assessment and finding, it is recommended to rehabilitate the existing culvert. The major work are listed below:

- Underpin the undermined footings on the original structure.
- Repoint masonry abutments on the original structure.
- Remove railing and pillars on the east fascia and provide curbing and signing.
- Remove the inlet and associated structure and extend the original slab bridge to satisfy the minimum lane width requirement. The proposed curb-to-curb distance is 22'-0".
- Construct upstream wingwalls.
- Relocate drainage inlet behind the bridge abutment
- Fill the scour hole at the inlet with riprap.

A conceptual construction cost estimate and estimate of engineering cost is provided for the recommended work.

Earles Ln over Sawmill Run Culvert Rehabilitation

Construction Item Estimate:

		Unit	Qty	Unit \$	Item Cost
Bridge					
1	Bypass Pumping	LS	1	\$7,000	\$7,000
2	Remove Existing Inlet Structure	LS	1	\$5,000	\$5,000
3	Class AAA Cement Concrete	CY	4	\$2,000	\$8,000
4	Class A Cement Concrete	CY	30	\$1,000	\$30,000
5	Reinforcement Bars, Epoxy Coated	LB	8500	\$2	\$12,750
6	Riprap at Inlet	LS	50	\$80	\$4,000
7	Class 3 Excavation	CY	20	\$100	\$2,000
8	Structure Backfill	CY	20	\$55	\$1,100
9	Temporary Excavation Support and Protection System	SF	375	\$20	\$7,500
10	Repoint Masonry Abutment and Wingwalls	LF	150	\$5	\$750
11	Under Pin Undermined Footings.	CY	5	\$1,500	\$7,500
				Total Str. Cost:	\$85,600
Roadway					
1	Clearing and Grubbing	LS	1	\$500	\$500
2	Class 1 Excavation	CY	50	\$25	\$1,250
3	Approach Pavement	SY	120	\$55	\$6,600
4	Curb	LF	48	\$40	\$1,920
5	Traffic Control	LS	1	\$2,000	\$2,000
6	Rock Class R-4	SY	4	\$150	\$600
				Total Roadway Cost:	\$12,870
				Total Construction Cost:	\$98,470
<hr/>					
				Total Construction Cost:	\$98,470
				+ 5% Mobilization	
				+ 20% Contingency	
				Construction Total:	\$124,000
				Engineering Fee:	\$83,900
				Total Project Cost:	\$207,900

GANNETT FLEMING MEMORANDUM

Date: January 27, 2016

To: Radnor Township

From: Gannett Fleming

Re: Eagle Road Culvert Field View

A field view was performed on November 4, 2015 of the above-referenced culvert located just west of its intersection with North Wayne Avenue which carries Eagle Road over Gulph Creek in Radnor Township, Delaware County. The field view was performed to determine the need for the structure's repair, rehabilitation, or replacement. The field view was limited to observation of the above ground, visible and accessible elements. Elements below water line or ground line were not assessed. Load ratings and structural plans of the existing bridge were not available at the time of field viewing.

Structure Description

The at-grade dual corrugated metal pipe culvert is approximately 25' long and carries two (2) 10'-0" lanes of vehicular traffic. The dual corrugated metal pipe structure has a skew of approximately 70 degrees, an approximate rise of 40", and a span of 6'-3". The headwall is comprised of grouted stone masonry.

Gulph Creek flows from northwest to southeast. The waterway alignment entering the culvert is generally straight with a gradual transition from the streambed into the pipes.

There is a 4' wide (out-to-out) pedestrian concrete slab bridge located approximately 13' downstream from the edge of roadway, the pedestrian bridge features 48" high steel railing on both sides.



General View of Culvert and Pedestrian Bridge



Underdeck View of Pedestrian Bridge

Structure Findings

The condition of the culvert, grouted stone masonry headwalls, as well as structure-mounted guiderail were viewed to determine if any deficiencies could compromise the structure's functionality. Findings on the culvert are summarized as follows:

Culvert

Both steel pipes are heavily corroded with rust laminations throughout. Water flow is diverted to the east pipe only. There is significant silt deposits throughout the west pipe and at the inlet. Water depth in the east pipe at the time of field investigation was approximately 6 inches.



West Pipe with Heavy Silt Built-up



East Pipe with Apparent Heavy Rust

The dual corrugated metal pipes appear to be misaligned at the un-spliced abutting joints and have areas of distortion due to differential movement. The misalignment of the joint in the west pipe has resulted in the loss of fill behind the pipe wall. The crown of the east pipe for a distance of approximately 12 feet from the inlet appears to have excessive deformation. The location of the misalignment and deformation falls within the roadway travel lane.



Misaligned/Distorted West Pipe Shows Loss of Fill Material



Upstream portion of East Pipe shows Excessive Deformation & Separation from Abutting Section

Grouted Masonry Headwalls

The south headwall is comprised of piled and grouted stones and has a few locations of missing grout joints and is in overall fair condition. The north headwall has areas of voids and loose stones above and between the corrugated pipes.



South Grouted Masonry Headwall



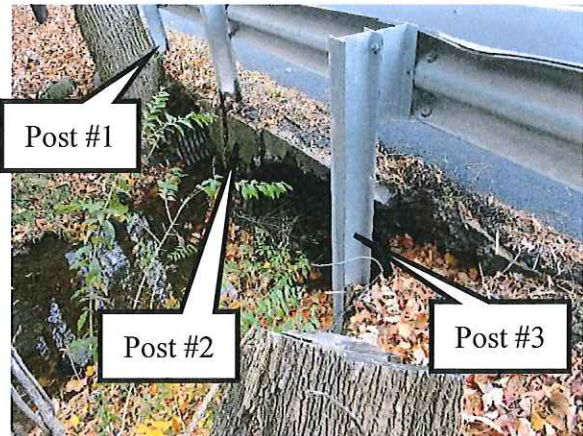
North Grouted Masonry Headwall

Structure Mounted Guiderail

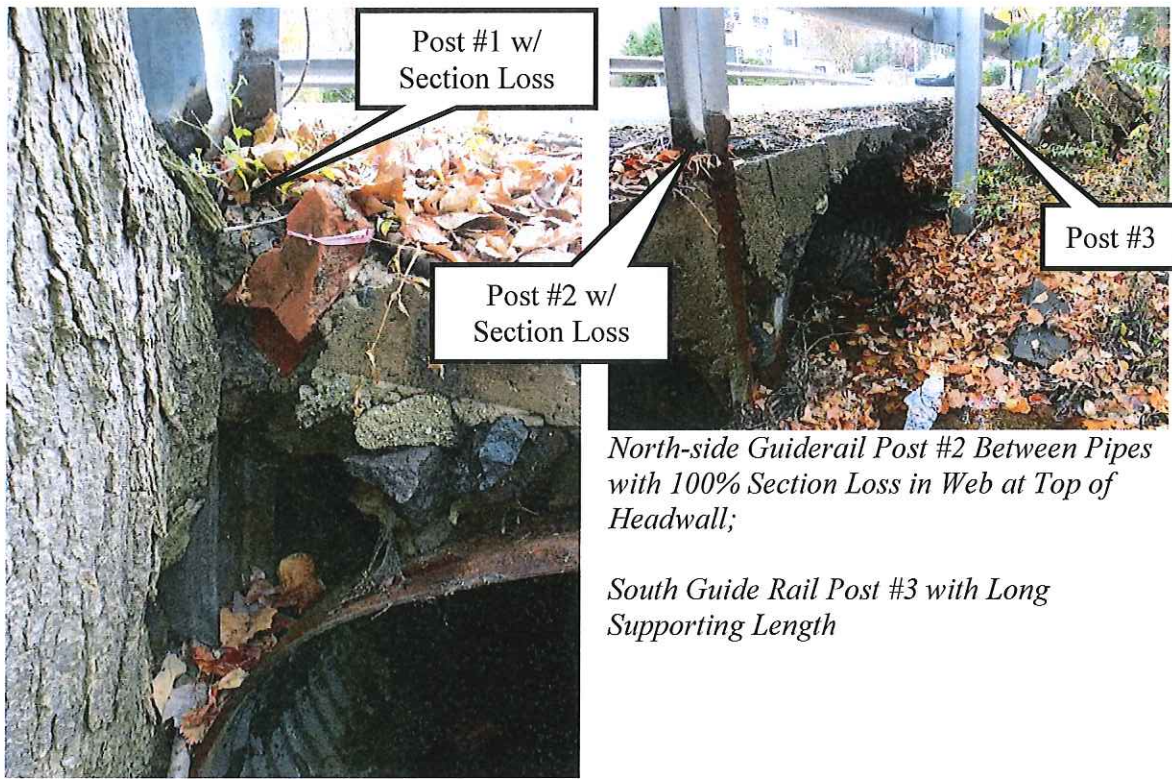
Guiderail extends across the culvert on both sides with railing posts engage each structure headwall. For the south headwall, the three posts are mounted to the headwall with baseplates and anchor bolts, these post and anchor bolt connections are in good condition, however the load carrying capacity of the headwall is questionable. For the north headwall, only the middle post (post #2) engages the headwall. There is severe section loss in posts #1 & #2. Post #1 is supported by a tree, post #2 is cast in the headwall and post #3 is supported from streambed, posts and guiderail are displaced.



Guiderail Posts at South Fascia



Guiderail Posts at North Fascia



North-side Guiderail Post #1 Behind Tree

North-side Guiderail Post #2 Between Pipes with 100% Section Loss in Web at Top of Headwall;

South Guide Rail Post #3 with Long Supporting Length

Conclusions

The corrugated metal pipes have extensive surface rust throughout. The pipes are misaligned at the un-spliced abutting joints with the east pipe showing signs of distortion. There is extensive silt build up in the west pipe and inlet with stream flow diverted primarily to the east pipe. The north grouted masonry headwall has areas of voids and loose stone, the headwall does not have capacity to provide anchorage for guiderail posts.

Safety Features

The north edge of the roadway is deteriorating and subsiding. Posts of guiderail system along north side are deteriorated and substandard. A large tree adjacent to north end of culvert does not allow for adequate guiderail deflection. Guiderail along south side of the roadway is in better condition and does contain end treatments, but is substandard.

Environmental

Eagle Road crosses Gulph Creek which supports protected water uses for Warm Water and Migratory Fishes (WWF/MF) according Title 25, Chapter 93 of Pennsylvania State Code. The stream is not trout-stocked nor does it support a naturally reproducing trout population. A PNDI database search was conducted and no state or federal endangered species were identified as a result of the search.

According to the Pennsylvania State Historic Preservation Office's Cultural Resources GIS website, the North Wayne Historic District is located southeast of the bridge. We assume that the proposed work will not impact this Historic District.

It appears that replacement of the bridge would require a PADEP General Permit #11 for Maintenance, Testing, Repair, Rehabilitation or Replacement of Water Obstructions and Encroachments. It is assumed that federal authorization for this activity can be authorized by PASPGP-4 that will be issued by PADEP.

If wetlands are present, and greater than 0.05 acres of impacts are expected, GP-11 does not apply and A Joint Chapter 105/Section 404 Permit may be required.

Geotechnical

A Site Geology Map, extracted from the Geologic Quadrangle Maps of Pennsylvania, indicates that the Eagle Road structure is underlain by mica schist of the Glenarm Wissahickon Formation (Xgw). According to *Engineering Characteristics of the Rocks of Pennsylvania*, the Glenarm Wissahickon Formation (Xgw) is described as an oligoclase-mica schist that is coarsely crystalline.

For a replacement structure, the geotechnical investigation will consist of drilling four borings to a maximum depth of 30 ft below the ground surface. Rock will be cored for 5 ft if encountered. Laboratory testing will be conducted on the recovered samples as necessary. Following the subsurface investigation and the laboratory testing GF will prepare a brief memo with recommendations.

Recommendations

Based on the field assessment and finding, it is recommended to replace the deteriorated corrugated pipes.

The following short-term recommendations are made in order to extend the serviceability of this structure:

- Repack grouted north head wall to avoid continue undermining of pavement material.
- Replace guide rail and posts along north fascia per RC-52M.

A conceptual construction cost estimate and estimate of engineering cost is provided for the recommended work.

Eagle Road over Gulph Creek Culvert Replacement

Construction Item Estimate:

Structure:		Unit	Qty	Unit \$	Item Cost
1	Bypass Pumping	LS	1	\$7,000	\$7,000
2	Removal of Existing Structures	LS	1	\$10,000	\$10,000
3	Class 3 Excavation	CY	170	\$60	\$10,200
4	Structure Backfill	CY	89	\$50	\$4,450
5	#2A or AASHTO #8 Aggregate under Culvert	CY	45	\$100	\$4,500
6	#57 Aggregate	CY	2	\$100	\$200
7	Class AA Concrete for Headers	CY	2	\$2,000	\$4,000
8	Reinforcement Bars, Epoxy Coated	LB	200	\$3	\$600
9	Riprap	CY	50	\$80	\$4,000
10	Precast Box Culvert	LS	1	\$45,000	\$45,000
11	Precast Box Culvert Outlet Section	LS	1	\$6,000	\$6,000
12	Alternate Grouted Cutoff Wall	CY	12	\$100	\$1,200
13	Bridge Railing	LF	36	\$200	\$7,200
				Total Str. Cost:	\$104,350

Roadway		Unit	Qty	Unit \$	Item Cost
1	Clearing and Grubbing (incl removal of large tree)	LS	1	\$5,000	\$5,000
2	Class 1 Excavation	CY	75	\$25	\$1,875
3	Approach Pavement	SY	160	\$55	\$8,800
4	Precast Concrete Curb	LS	1	\$2,000	\$2,000
5	Traffic Control	LS	1	\$2,400	\$2,400
6	Guide Rail (incl 4 turn downs)	LS	1	\$9,250	\$9,250
				Total Roadway Cost:	\$29,325

Total Construction Cost: \$133,675

Total Construction Cost: \$133,675

+ 5% Mobilization

+ 20% Continency

Construction Total: **\$168,000**

Engineering Fee: **\$98,300**

Total Project Cost: \$266,300

GANNETT FLEMING MEMORANDUM

Date: January 27, 2016

To: Radnor Township

From: Gannett Fleming

Re: Sawmill Road Arch Bridge Field View

A field view was performed on November 23, 2015 of the above-referenced arch bridge located just west of the intersection with Darby Paoli Road which carries Sawmill Road over Darby Creek in Radnor Township, Delaware County. The field view was performed to determine the need for the structure's repair, rehabilitation, or replacement. The field view was limited to observation of the above ground, visible and accessible elements. Elements below the water line or ground line were not assessed. Load ratings and structural plans of the existing bridge were not available at the time of field viewing.

Structure Description

The bridge carrying Sawmill Road over Darby Creek consists of a single span closed spandrel concrete arch with U-shaped stone masonry wing/retaining walls. The barrier atop the arch is vertical wall/faced concrete. The barriers on the approaches are a stone masonry vertical wall/face (an extension of the stone masonry wing/retaining wall) with a concrete cap and concrete end sections.

The 54'-0" long arch bridge carries two unmarked substandard lanes with a curb-to-curb distance of 18'-4". The 10" wide vertical wall barrier is 3'-0" high measured from the top of a 6" high by 5" wide steel armored concrete curb. The 3'-6" U-wall masonry barriers are 1'-6" wide topped with 1'-10" x 4" concrete caps.

Darby Creek flows north to south on a curved alignment through the bridge and occupies only eastern half of the span due to a sediment deposit that has accumulated along the western half of the span.



General View of Arch Bridge – Looking East



Downstream (South) Elevation

Structure Findings

The arch barrel is in good condition with no major defects, except a large spall is noticeable at the bottom of the southeast wingwall, and two small spalls and a few fine map cracks with efflorescence on the southern side of the arch barrel. The arch barriers are in fair condition with small spalls at various locations. All masonry U-shape wingwalls are in good condition.

There is severe bank erosion with exposed tree roots at southeast corner of the bridge.

Arch Barrel

No major defects excepted as noted.



Concrete Arch Barrel – Looking at West Abutment



Concrete Arch Barrel – Looking at East Abutment



Large Spall at Bottom of Southeast Wingwall



Surface Spall in South Fascia of Arch Barrel



Surface Spall in South Fascia of Arch Barrel



Small Spall in South Spandrel Wall and Fine Map Cracks with Efflorescence in South Fascia of Arch Barrel



View of Pavement – Cracks throughout



Spalls in Bridge Barrier



Spalls in Concrete Cap of Wingwall Barrier



Cracks in Wingwall Barrier



Bank Erosion with Exposed Tree Roots in Bank of Southeast Corner of the Bridge



Upstream Right Bank at West Abutment

Conclusions

The concrete arch bridge and stone masonry wingwalls are in good condition, except a few spalls as noted. The concrete barriers of the arch bridge and masonry stone barriers of the wingwalls are in good condition, except a few spalls and cracks at various locations.

There is a large sediment deposit under the arch blocking half the waterway channel. Water flows along the east abutment and causes severe bank erosion.

Safety Features



West Approach, Note Pedestrian Cross Walk was Previously Relocated Once



East Approach, Note Sign of Pedestrian Crossing

The lane widths of this roadway are substandard across the structure. Lane widths of 9' to 9'-4" are provided whereas the minimum allowable is 10' plus 1' offset to the bridge barrier for a total

lane width of 11'.

A pedestrian cross walk is located on the west approach between Skunk Hollow Park and Saw Mill Park. Pedestrians in the crosswalk do not have a clear view to the east over the structure.

Sight distance across the structure is also restrictive due to the vertical curve on the structure and a horizontal curve on the west approach to the bridge, there is no speed limit posting on either approach of the bridge. This creates a situation where pedestrian in the crosswalk and vehicles approaching the structure at the same time from opposite directions have difficulty seeing each other.

Positive protection for the blunt ends of the bridge barrier is not provided. Only hazard markers denote the location on each of the four approaches.

Environmental

Sawmill Road crosses Darby Creek which supports protected water uses for Cold Water and Migratory Fishes (CWF/MF) according Title 25, Chapter 93 of Pennsylvania State Code. The stream is trout-stocked but does not support a naturally reproducing trout population. Therefore, seasonal construction restrictions will be required and no instream work may occur between March 1 and June 15. A PNDI database search was conducted and the results indicated that a Pennsylvania rare plant, puttyroot, may occur at this location and may be impacted. Coordination with the Pennsylvania Department of Conservation and Natural Resources may be required in order to gain authorization to construct the project. The bridge is not eligible for listing on the National Register of Historic Places according to the Pennsylvania State Historic Preservation Office's Cultural Resources GIS website. Note, Darby-Paoli Road, located immediately northeast of the bridge, was assessed to determine its historical significance and the Pennsylvania SHPO indicated that there was insufficient evidence to determine if it is eligible for listing on the National Register of Historic Places.

It appears that rehabilitation of the bridge, including the addition of scour protection would require a PADEP General Permit #3 for Bank Rehabilitation, Bank Protection and Gravel Bar Removal. It is assumed that federal authorization for this activity can be authorized by PASPGP-4 that will be issued by PADEP.

If wetlands are present, and greater than 0.05 acres of impacts are expected, GP-3 does not apply and A Joint Chapter 105/Section 404 Permit may be required.

Geotechnical

No geotechnical investigation is necessary.

Recommendations

Based on field assessment and findings, it is recommended to rehabilitate the structure as follows:

- Repair spalls/cracks in fascia of arch ring.
- Remove trees and provide riprap protection at downstream left bank to prevent further bank erosion.
- Relocate the pedestrian crosswalk to the west, away from the structure, to the intersection with Earles Lane. The trails within the parks could be reconfigured with minimal earth disturbance to affect this change. This will allow vehicles to better observe pedestrians in the crosswalk and will allow pedestrians to see oncoming traffic from the bridge.
- Provide painted yield bars on the roadway at both bridge approaches with adjacent signing "YIELD TO ONCOMING TRAFFIC". This will allow vehicles on either approach to yield to a vehicle already on the structure.
- Provide guide rail or crash worthy end treatments on all four corners of the structure.

A conceptual construction cost estimate and estimate of engineering cost is provided for the recommended work.

Sawmill Road over Darby Creek Arch Rehabilitation

Construction Item Estimate:

	Unit	Qty	Unit \$	Item Cost
1 Sandbag Cofferdam	LS	1	\$1,000	\$1,000
2 Spall Repair in fascia of Arch Ring	SF	15	\$300	\$4,500
3 Riprap Protection at Downstream Left Bank	CY	20	\$150	\$3,000
4 Yield to oncoming traffic signage and striping	LS	1	\$2,000	\$2,000
5 Relocate ped crossing to Earles Ln intersection	LS	1	\$1,800	\$1,800
6 Protect blunt end of parapets	Each	4	\$2,200	\$8,800

Total Construction Cost: **\$21,100**

Total Construction Cost: \$21,100
+ 5% Mobilization
+ 20% Contingency

Construction Total: **\$27,000**

Engineering Fee: **\$28,100**

Total Project Cost: **\$55,100**