



Consulting Engineering
Environmental Services
Construction Inspection

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January 22, 2009

Mr. Michael W. Rebert, P.E.
District Executive
Pennsylvania Department of Transportation
Engineering District 5-0
1002 Hamilton Blvd.
Allentown, PA 18101

Attention: Rodney Rehnert
Project Manager

Subject: TS&L Submission
South Lehigh Avenue and SR 1004 (Race St.) Retaining Wall Rehabilitation
Whitehall Township, Lehigh County
MKA Job No. 01035-01

Dear Mr. Rehnert:

Please find one (1) electronic copy, in PDF format, of the Final TS&L Report and Plan enclosed for your review. In addition, the following information is presented in accordance with DM4 1.9.3.3(a):

- | | | |
|-----|--------------------------------|--|
| 1. | Location: | SR 1004 (Race Street), Segment 0020, Offset 0000
and South Lehigh Avenue
Whitehall Township, Lehigh County |
| 2. | Type: | Unreinforced concrete gravity type retaining wall |
| 3. | Spans: | N/A |
| 4. | Roadway Width: | N/A |
| 5. | Skew: | N/A |
| 6. | Vert. & Horiz. Underclearance: | N/A |
| 7. | Substructure: | N/A |
| 8. | Deck Joints: | N/A |
| 9. | Bearings: | N/A |
| 10. | Drainage: | Existing weepholes are located in the retaining wall,
Type M inlet placed behind retaining wall |
| 11. | Design Methodology: | Load & Resistance Factor Design (LRFD) |

The following data is presented in accordance with DM4 1.9.3.3(e):

1. SR 1004 (Race St.) Section LRW and South Lehigh Avenue
A location map is shown in the report.
2. Type of Funding: 100% State Funded
State Proj. No. 60 1004 02 LRW 0530 311 2
Federal Proj. No. ---
MPMS No. 82010
3. Designer: **McTish, Kunkel & Associates**
4. The proposed structure is a rehabilitation to an existing concrete retaining wall.
Wall stations begin at 0+88S and continues to 4+43N
5. Design Traffic Data: SR 1004 S. Lehigh Ave.
ADT (2007) = 18857 ADT (2007) = 9498
ADTT (2007) = 754 ADTT (2007) = 475
6. Design Speed: N/A
Grade and Typical Section: N/A
7. Material will be removed from the site from the excavation for the Type B repair.
8. Free or Controlled Access: N/A
9. Roadway plans are not included because the roadway will remain unchanged.
10. Waterway Approval: N/A
11. There was no formal design field view conducted.
12. Rehabilitation Project:
 1. The existing structure is approximately 98 years old. The proposed work is to repair the deteriorated concrete on the front face of the retaining wall.
 2. Live load ratings for a retaining wall are not applicable.
 3. Fatigue details are not applicable.
 4. The propose scope of work includes repairing various stages of concrete deterioration. Most areas require concrete patching, however the most severely deteriorated areas require refacing with a buttress wall. Other maintenance items include removing excess vegetation and cleaning existing weepholes.
13. This structure is located adjacent to an abandoned rail line and located on railroad property. P.U.C. coordination with all involved parties is ongoing.
14. Mining has not been performed in the general area. No previous foundation problems have been documented.
15. No pedestrian traffic is expected for this structure.
16. There are no design problems anticipated.
17. There are no structure related safety concerns.

Please contact me at your earliest convenience if you have questions or require additional information.

Very truly yours,
McTish, Kunkel & Associates



Brad Barndt, P.E.
Structural Engineer

DATE: January 22, 2009

SUBJECT: Response to comments dated January 15, 2009
 South Lehigh Ave. Retaining Wall, TS&L Review Comments

COMMENT	RESPONSE
<p align="center">PENNDOT, District 5-0</p>	<p align="center">McTish, Kunkel & Associates</p>
<p>1. As noted in report, ROW is required. Plans do not depict ROW limits or extent of required ROW. Who will be acquiring temporary and permanent ROW and who will pay for it?</p>	<p>The plans now show the Legal ROW line on the typical section of the wall. A preliminary ROW plan will be submitted. It is MKA's understanding that PennDOT will need to acquire the temporary and permanent ROW.</p>
<p>2. Cost of ROW is not included in the TS&L cost (nor should it be.) Costs for retaining wall also do not include MPT or the work that was included in the drainage study.</p>	<p>Correct.</p>
<p>3. Increase the height of the wall to provide more restraint/encapsulation of the upper part of the retaining wall, as it is already showing signs of distress/movement. Also start the Type B repair at station 1+50 to provide increased resistance ahead of the high level of deterioration at station 1+60. Increase the rebar size, as this will provide greater margin of resistance capacity for a small increase in cost.</p>	<p>The height of the Type B repair has been increased and the begin station is now 1+50N. The reinforcing bar sizes have also been increased.</p>
<p>4. Foundation information is required for Type B Concrete repair (Reinforced concrete buttress wall). What are soil conditions for the new footing? Is bedrock shallow? Limestone/Karst geology? Provide details of geology in the area and any previous foundation problems.</p>	<p>Conservative soil information will be assumed as stated in the Technical Proposal. This will prevent the need for lengthy and costly structure borings. The bottom of footing will be inspected at the time of construction to confirm these assumptions. Calculations will be provided during final design to compare the existing and proposed conditions. The proposed condition decreases the existing bearing pressure and increases the factor of safety for overturning and sliding. The underlying rock is the Epler Formations which is a medium gray limestone interbedded with gray dolomite. The depth to bedrock is unknown at this location. There were no local foundation problems evident.</p>
<p>5. Include in recommendations cleaning of blocked weepholes in entire retaining wall and additional drainage measures to preserve the retaining wall.</p>	<p>The cleaning of existing weepholes has been included in the Recommendations.</p>
<p>6. Submit the required components for standard TS&L submission -- submission letter, QA forms and additional details on TS&L plans.</p>	<p>The additional requirements for TS&L submission have been included. There are no applicable QA forms for TS&L stage of a retaining wall rehabilitation. Applicable QA forms will be provided with final design.</p>
<p>7. For Final Plans, design calcs and analysis of Type B repair will be required.</p>	<p>Agreed.</p>

APPLICATION FOR STRUCTURE DESIGN PLAN NUMBERS**Current Date:** January 20, 2009**Designing Agency:** McTish, Kunkel & Associates**State Project Number:** 60 1004 02 LRW 0530 311 2**---- STRUCTURE DATA ---**

<u>County</u>	<u>District</u>	<u>S.R.</u>	<u>L.R.</u>	<u>Section</u>	<u>Segment</u>	<u>System</u>
Lehigh (39)	5-0	SR 1004	39093	LRW	0020	
<u>Station on Structure</u>	<u>Type of Structure</u>		<u>Structure Type Code</u>	<u>Min. Under Clearance</u>		<u>Skew</u>
1+50	Concrete Retaining Wall Rehabilitation		20999	N/A		N/A
<u>No. of Spans</u>		<u>Span Length(s)</u>		<u>Intersection</u>		
N/A		N/A		South Lehigh Avenue		

South Lehigh Avenue Retaining Wall
Whitehall Township, Lehigh County

Type, Size and Location Report

December 10, 2008

REVISED

January 22, 2009

prepared for:



Pennsylvania Department of Transportation
Engineering District 5-0

prepared by:



McTISH, KUNKEL & ASSOCIATES

Allentown ♦ Montoursville ♦ Pittsburgh

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PROJECT DESCRIPTION

This project involves the rehabilitation of an existing concrete retaining wall adjacent to South Lehigh Avenue in Whitehall Township, Lehigh County. The wall is approximately 531 feet long and in need of repair due to advanced concrete deterioration.

EXISTING STRUCTURE

History

The concrete retaining wall was originally constructed around 1910 by the Lehigh Valley Railroad for the purpose of providing room for another rail line. Only one of the rail lines is present today and it is inactive. The retaining wall is located adjacent to the Lehigh River in Whitehall Township, Lehigh County. The wall supports South Lehigh Avenue as it travels parallel with the railroad and the wall also acts as a bridge abutment for south end of the Race Street Bridge. A project location map is provided in Appendix A.

The only plans available for this structure are dated March 9, 1910. These plans are provided in Appendix E and show a gravity type retaining wall to be constructed of unreinforced concrete. Based on the plans and multiple field views, the wall was constructed in lifts providing a construction joint between each lift.

The retaining wall had been modified by PennDOT in 1955 when the Race Street Bridge was reconstructed. The end of the bridge was elevated to gain necessary underclearance to the railroad. South Lehigh Avenue was also raised in order to tie into the modified intersection. The top portion of the retaining wall was modified to support the Race Street Bridge and provide a safety barrier along South Lehigh Avenue. No plans were available that detailed the reconstructed portion of the wall, however the limits of reconstruction are visible. See Photos 2, 3 and 4 of Appendix B. The difference in concrete color and quality are distinct between the time periods in which they were placed.

With the exception of the 1955 Race Street bridge modification, there are no plans or evidence that any additional modifications, repairs or maintenance have ever been performed on the original retaining wall since its construction.

Current Condition

A baseline has been developed along the length of the retaining wall to better reference specific areas. The baseline stationing can be seen on the plans provided in Appendix C. The stationing begins at the intersection of the Race Street Bridge as station 0+00 and proceeds both north and south of the intersection. The stationing is followed by an N or S to depict movement in the northerly or southerly direction respectively.

The original portions of the concrete retaining wall are nearly 100 years old. The wall has varying degrees of concrete deterioration. The findings from on-site inspections are organized by wall stations and presented below:

Wall Station 0+00 to 1+50N

Station 0+00 to 0+40N± is located below the Race Street Bridge. Station 0+40N± corresponds with the outermost edge of the bridge and also the bridge expansion joint. At this station there is excessive water staining on the top of the retaining wall and deep concrete spalling on the lower portions of the wall. Some of the concrete spalling is approximately 15" deep. See Photos 6 and 7 in Appendix B.

At station 0+70N± another area of deep concrete spalling occurs between the concrete construction joints. The depth of spalls in this section varies from 1/2" to approximately 10". There is evidence of minor water staining from the preformed weep holes (Photo 9), however there is not evidence of excessive water staining from the spalled areas.

Wall Station 1+50N to 2+40N

The most severe deterioration occurs between the horizontal construction joints from wall station 1+50N to wall station 2+40N. See Photos 11 through 16 in Appendix B. The photos show that the deterioration is almost entirely in the lower lift of concrete approximately 15 feet from the top of the wall. The deterioration has undermined the upper portion of the retaining wall. This can be seen in Photo 15. This undermining has created a loss of bearing for the upper portion of the wall resulting in the upper portion of the wall rotating outward. This is evident from the expansion joints in the concrete barrier along South Lehigh Avenue. The joint at approximate wall station 1+60N has displaced 2 1/8" from the adjacent barrier. Photos 14, 30 and 31.

The movement of the upper portion of the retaining wall due to its rotation, is a sign of the wall losing stability. It appears that the movement of the wall has recently occurred, most likely as a result of the increased concrete deterioration. The retaining wall, in its current condition, is a safety concern.

The area of the largest concrete deterioration corresponds with the low point in South Lehigh Avenue. Weepholes are provide in the retaining wall approximately every 12 feet to help relieve excess water from behind the wall. Some weepholes appear to be blocked. It is apparent that water has been seeping through the wall primarily at the construction joints. It is typical that the presence of water behind the wall and leaking through existing joints will lead to accelerated concrete deterioration. South Lehigh Avenue is a curbed roadway with inlets located at the low points. A drainage study was conducted on this drainage system to determine the adequacy of the system and the current condition.

A portion of South Lehigh Avenue appears to have settled as much as two inches. The gutter line, adjacent to the top of the retaining wall, from approximately wall station 1+25N to wall station 2+10N, shows signs that it has settled. Freshly paved roadways receive a hot bituminous sealer placed at the joint of the roadway surface and the curb. The curbs on South Lehigh Avenue received this sealer on both sides of the roadway. Next to the retaining wall, the sealer on the curb reveals the previous location of the roadway was approximately two inches higher than it is currently. Photos 35, 36 and 37 in Appendix B show the sealer along the curb. The curb behind wall station 0+75N, along the east side of South Lehigh Avenue, appears as one would expect and

can be seen in Photo 36. There is no evidence that the bituminous sealer had been removed by abrasion from water flow. Also, the pavement next to the curb does not show excessive wear. The cross slope of the roadway was determined from survey points and the cross slope of the north side of the roadway is approximately 6.9% and the cross slope for the south side of the roadway is approximately 2.1%. For a roadway with straight geometry, it is expected that the cross slopes would be similar.

Wall Station 2+40N to 4+43N

This portion of wall also has heavy concrete spalling similar to the other sections of the wall. The spalling in this section, on average, is approximately 12 inches deep, and continues for the majority of the wall. The most severe spalling is usually concentrated at the intersections of construction joints such as at station 2+90N. See Photo 18.

At approximately station 3+45N the barrier at the top of the retaining wall ends while the wall continues to station 4+43N and is protected from motorists by guiderail along South Lehigh Avenue. The surrounding area is heavily vegetated with trees and brush. Large trees on the back side of retaining walls can exert pressure on the wall over time with the growth of their root system. Photo 25 is located at the northwest end of the wall at station 4+43N. This photo of the end of the wall shows the typical shape. It can be assumed that the rest of the wall was built in similar fashion to this configuration.

Wall Station 0+00 to 0+88S

This portion of the wall begins below the Race Street bridge and continues to the south for approximately 88 feet. The first 30± feet of wall provides support for the Race Street bridge. It is visible where a previous bridge had crossed the railroad tracks on a slightly different alignment. Remnants of a prior abutment are visible from wall station 0+15S to 0+65S. The last portion of the wall, from 0+65S to 0+88S, tapers in height and was used as the wing wall from the previous bridge alignment. A smaller concrete retaining wall, approximately 8 feet high, continues to the south and will not be considered in this TS&L report.

This 88 foot section of wall has only some minor deficiencies. There is concrete spalling along most of the construction joints with only one large spalled area at wall station 0+50S. Minor efflorescence is visible along the majority of the wall. Heavy vegetation is located behind the wall with a large tree located at the end of the wall at station 0+88S.

PROPOSED REHABILITATION OPTIONS

The South Lehigh Avenue retaining wall has various stages of concrete deterioration that can be remedied with two types of concrete repairs. Additional measures for the preservation of this retaining wall will be presented.

A Type A repair would consist of a concrete patching which is quite commonly used for the repair of most deteriorated concrete. The depth of the repair can vary. When the repair depths get excessive, such as greater than 3 inches, steel reinforcing mesh is to be used to provide better support and crack resistance. Deep repairs will be required to be filled in lifts to better control the quality and density of the repairs. There are different ways in which to apply the concrete patches and the chosen contractor will

be allowed to choose from two acceptable application methods. The first method is called pressure mortar surfacing or shotcrete. This method pneumatically propels a concrete mortar at high velocities onto the repair area until the desired thickness is achieved. This method produces a high bond between surfaces and provides a dense concrete patch that can be left rough or finished with a trowel. The second type of patch is produced by placing a form along the face of the existing wall and pouring or injecting the concrete into the forms. This process is fairly common and requires a bonding agent to develop good adhesion between surfaces.

Type A repairs are to be made to all the spalled concrete surfaces along the length of the wall with the exception of the most severely deteriorated areas which will receive a Type B repair. The delineated areas of repair are detailed on the plans shown in Appendix C. The areas shown are approximate and will be determined by the Project Engineer during construction.

A Type B repair is required for the most severely deteriorated concrete areas. This repair is more substantial than a standard concrete patch because it needs to provide bearing for the upper portion of retaining wall and prevent any further rotation. A Type B repair consists of a reinforced concrete buttress wall that would be cast in front of the existing retaining wall. A small footing would be placed below the buttress wall approximately 4 feet below the existing ground line. The existing deteriorated concrete will be removed to sound material and dowel bars will be attached to the existing wall. Reinforcing bars for the new wall would then be tied to the dowel bars. Formwork would be constructed and the concrete would be placed. Details of a Type B repair are shown in Appendix C.

Soil nails were also considered as an alternate for the Type B repair. Soil nails would provide restraint for the top of the retaining wall and help prevent any further rotation. Unfortunately, there are circumstances that make this option unfeasible. Soil nailing requires anchors to be drilled through the face of the wall and embedded several feet into the backfill. Several utilities are located behind the retaining wall that would make placement of the anchors very difficult. Any future maintenance or replacement of the utilities could compromise the anchorage zones needed for the retaining wall. Depending on the required anchorage zone, some of the anchors may need to be below private property. Soil nailing was considered unfeasible for this location.

RIGHT-OF-WAY

The proposed repairs will be conducted from the existing railroad bed. A temporary construction easement or a Right of Entry Permit will be required from R.J. Corman Railroad Company in order to do work on the retaining wall. A permanent Right-of-Way take will be required for the construction of the Type B wall repairs because the limits of that repair type extend past the front face of the existing retaining wall.

MAINTENANCE AND PROTECTION OF TRAFFIC

No traffic impacts are anticipated for South Lehigh Avenue due to the retaining wall repairs. Any drainage repairs to the inlets and/or pipes that are located along South Lehigh Avenue would require short term modified traffic patterns or a detour.

UTILITIES

Several utilities are located along or below South Lehigh Avenue. Existing plans show that water, gas and sanitary sewer lines are located below the roadway surface. Overhead electric, cable and telephone wires are also present along the south side of South Lehigh Avenue. A sanitary sewer line is also located to the north between the railroad tracks and the Lehigh River. The proposed wall rehabilitation work does not require the relocation of any of these utilities.

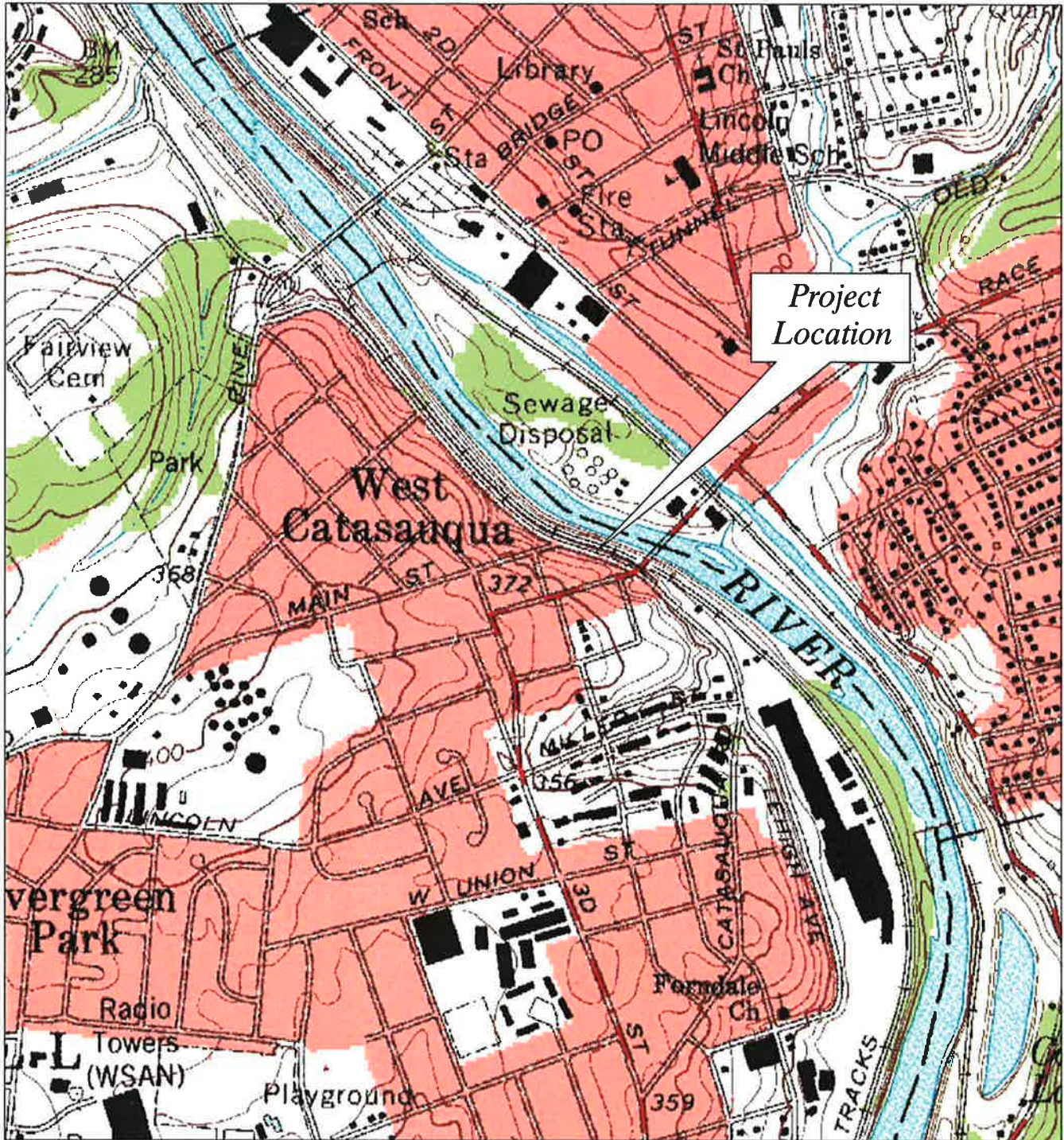
RECOMMENDATIONS

Based on the above discussion it is recommended that the following be performed:

- Provide Type A concrete repairs to all spalled concrete areas as shown on the plans provided in Appendix C and in accordance with the special provision provided in Appendix E.
- Provide Type B repair between wall stations 1+50N and 2+35N as shown on plans provided in Appendix C.
- Clean all existing weepholes located in the retaining wall.
- Remove all large vegetation from behind the retaining wall to prevent root systems from applying additional pressure to the wall.
- Replace roadway inlets located behind the retaining wall and check surrounding backfill when inlets are removed. If loose material is found stabilize with flowable backfill placed in small lifts or other suitable material.

APPENDIX A

PROJECT LOCATION MAP



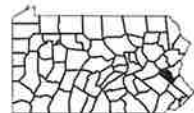
U.S.G.S.
 CATASAUQUA
 PENNSYLVANIA
 7.5 MINUTE SERIES

Project Location Map

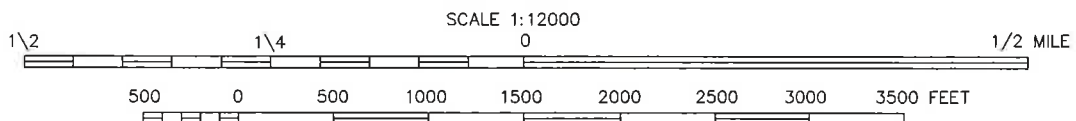
South Lehigh Avenue

Retaining Wall Repair - Drainage Study

Whitehall Township, Lehigh County



PROJECT LOCATION



CONTOUR INTERVAL 20 FEET
 NATIONAL GEODETIC VERTICAL DATUM OF 1929

APPENDIX B

PHOTOS

South Lehigh Avenue Retaining Wall
Whitehall Township, Lehigh County



PHOTO 1 Below Race Street Bridge.



PHOTO 2 Looking north on old railroad bed.