GEOTECHNICAL ENGINEERING INVESTIGATION REPORT

PYRITE REMEDIATION
for
COURTHOUSE PARKING GARAGE
WASHINGTON, PENNSYLVANIA

Prepared for

WASHINGTON COUNTY

SEPTEMBER 2016

Prepared by

GEO-MECHANICS, INC.
ELIZABETH, PENNSYLVANIA

GMI PROJECT NO. 16051

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September 22, 2016

Washington County
100 West Beau Street, Suite C-2
Washington, PA 15301

Attention: Mr. Justin Welsh
Director of Building and Grounds

Re: Ground Floor Heaving
Courthouse Parking Garage
Washington, PA

Gentlemen:

GeoMechanics, Inc. is pleased to present the ***Geotechnical Engineering Investigation Report*** for the above-referenced project located in Washington, Pennsylvania.

The attached report documents the information obtained during our site-specific subsurface investigation and laboratory testing program, summarizes our evaluation of both the current and previous data and presents our conclusions regarding strategy for future remediation.

We wish to extend our appreciation for this opportunity to be of service to you on this interesting and challenging project. Should you have any questions or require additional information, please contact us.

Very truly yours,

GEO-MECHANICS, INC.

Jahangir J. Kabir, Ph.D., P.E.
Sr. Geotechnical Engineer

Robert P. Babyak
Geotechnical Specialist

Javaid M. Alvi, Ph.D., President

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1.0 INTRODUCTION

1.1 Authority

This geotechnical engineering investigation has been performed in order to determine the cause(s) of ground floor heaving and to assist in the development of a remediation program at the distressed ground floor of the Courthouse Parking Garage in Washington, Pennsylvania. A Request for Proposal for geotechnical engineering services was solicited by Mr. Justin Welsh, Director of Building and Grounds, Washington County on August 4, 2016. GeoMechanics, Inc. presented a Proposal for Geotechnical Engineering Services to Mr. Welsh on August 5, 2016 that identified the scope and associated costs of services to be provided by GeoMechanics, Inc. This proposal was accepted by Mr. Welsh followed by a Purchase Order and a notice to proceed with the investigation by an email dated August 8, 2016.

1.2 Objective

The objective of this geotechnical engineering investigation was to obtain sufficient information regarding the subsurface soils, bedrock and ground water conditions at the distressed ground floor area of the Courthouse Parking Garage in order to identify their spatial distribution and relative contribution to the observed floor slab distress and to assess the potential for future distress. This information then formed the basis for developing appropriate remedial solution.

1.3 Scope of Work

The scope of work completed by GMI during this investigation consisted of the following:

- Review of the previous investigation performed by ACA (2010) and GeoMechanics, Inc. (1977);
- Drilling and logging of six (6) shallow test borings;

- Performance of a laboratory testing program to identify the spatial distribution and concentration of potentially expansive pyritic sulfur minerals within the subsurface soils and bedrock;

- Evaluation of all data obtained, both current and historical; and

- Preparation of a geotechnical engineering investigation report that documents the information obtained and/or reviewed, summarizes our evaluation of this information, and presents our conclusions regarding the cause of floor slab distress along with remedial recommendations.

2.0 GENERAL SITE AND STRUCTURE HISTORY

2.1 Project Location

The Courthouse Parking Garage is located in the city of Washington, Washington County, Pennsylvania. It is bounded by West Beau Street along the north, South Franklin Street along the west, West Cherry Avenue along the south and the Washington County Courthouse along the east side (see Figure 1). The ground floor of the parking garage that is affected the most lies along the west side of the structure.

2.2 General Geology

Based on the available geologic information, the rocks of the Monongahela Group of Pennsylvanian age lie underneath the site (See Figure 3). The Pittsburgh coal seam that separates the Monongahela Group from the underlying Conemaugh Group lies at an approximate elevation 810± in the general vicinity of the site (see Figure 4). The Pittsburgh coal seam is of high quality and has been extensively mined using both surface and deep mining methods. A review of Figure 5 clearly shows the extensive mining that has been carried out in the recent past both in the area of the plant site. However, approximately 230± feet of rock cover is present above the mined out coal seam below the building. Therefore, there is "slight" risk to the proposed floor due to future mine subsidence caused by the Pittsburgh coal seam based on the National Coal Board Classification of Subsidence Damage Scale of *Negligible, Slight, Appreciable, Severe and Very Severe*.

The bedrock available within the depth of sampling belongs to the Pittsburgh Formation (most likely the Benwood Limestone Member of the Monongahela Group). It consists of interbedded layers of sandstone, limestone and shale. As a result the rock units available for foundation support will likely consist of reasonably competent bedrock.

2.3 Previous Investigations

Visual observation of the garage floor indicated a considerable amount of heaving that has resulted in tension cracks in the floor slab and distress to the elevator lobby. A review of the structural contours on the garage floor provided in ACA's report of 2010 shows that the floor slab had heaved as much as 6 inches in some areas. However, the cause of the apparent heave has not been clearly defined in ACA's report. The depth of the soil samples taken in the six (6) borings drilled by ACA has not been provided in their report, no chemical tests have been conducted on the subbase or the subgrade soils that would indicate the presence of minerals that are causing the expansion of the subsurface material. ACA report mentions the "presence of gray clay soils and ground water" as the cause of heaving. However, no ground water was encountered in the six (6) borings drilled by ACA. The gray color mentioned by ACA may be due to the presence of carbonaceous shale fragments that would suggest the presence of pyrite minerals. These minerals have been known to experience expansion on oxidation and cause heaving of floor slabs and lightly loaded structures.

A review of the geotechnical engineering investigation report by GeoMechanics, Inc. for the parking garage structure prepared in 1977 indicated that both a layer of gray carbonaceous shale and bony coal was present at the ground floor elevation (see drawings included in Appendix C of this report). The recommendations presented in that report called for overexcavation of the carbonaceous shale/coal to a depth of 5 feet below the floor subgrade and backfill with suitable inert material. Proceeding towards the east, the depth of the bony coal and carbonaceous shale becomes deeper and no undercut-backfill was needed. It is not known whether the recommended undercut to remove the potentially expansive carbonaceous shale/bony coal was performed. The black clay referred to ACA's report is most likely the weathered carbonaceous shale.

3.0 SUBSURFACE EXPLORATION PROGRAM

The subsurface exploration program for the present study consisted of drilling a total of six (6) shallow test borings. These borings were drilled at the same locations, and offset by about one (1) foot, where six (6) previously drilled borings by ACA were located because these locations represent the maximum floor heave areas.

The overall objectives of the subsurface exploration program completed during the present investigation were as follows:

- to estimate the origin, classification, spatial distribution and physical properties of the various in-place soils forming the floor slab subgrade;
- to ascertain the local ground water conditions; and
- to obtain representative soil and rock samples for subsequent laboratory testing.

The exploratory borings were drilled by GMI using in-house personnel and equipment on August 16 and 17, 2016, and the logs are included in Appendix A. The locations of the test borings drilled during the current investigation are shown on the Test Boring Location Plan, Figure 8 along with the drafted logs.

Each boring was advanced using minute man. After initially coring the concrete floor slab using a 3-inch diameter diamond bit and then sampling the subbase and subgrade soils. The depth of these borings ranged from a minimum of 3.0 to a maximum of 5.5 feet. In general, the soil samples were obtained at depths of 1.5, 2.5, 3.5, 4.5 and 5.5 feet unless spoon refusal was encountered at a shallower depth. Each sample was carefully wrapped in a plastic bag and brought to Milltech Analytical Services, Inc. laboratory for chemical testing, as further described in Section 4.0. The description of the soil samples retrieved by our geologist is recorded on the boring logs included in Appendix A of this report.

Due to the site constraints, use of a larger drilling rig capable of obtaining rock core samples was not possible, therefore, bedrock could not be sampled. Efforts were made to record ground water in each boring, however, all borings were dry.

4.0 LABORATORY TESTING PROGRAM

Based on the previous as well as the current subsurface data collected, it becomes apparent that the observed distress to floor slab has been caused by the heaving of floor slab due to the expansion of the subgrade material which is comprised of weathered carbonaceous shale. Carbonaceous shales associated with coal horizons contain iron sulfide (pyrite) which, when exposed to moisture and air, undergoes oxidation and results in volume increase. This chemical reaction has apparently been continuing on under the floor slab for a long time. The extent of floor slab heaving depends upon the relative concentration of pyritic sulfur, thickness of the pyritic shale and depth below the floor slab. In order to verify the presence of pyritic sulfur initially, an indicator test was conducted on the samples obtained from boring GM-5. The results indicated very high concentration of pyritic sulfur below about one (1) foot depth (see Appendix B). Consequently, all twenty-one (21) soil samples collected from the six (6) borings were used to conduct sulfur from analysis. The percentage of pyritic sulfur obtained from these tests is recorded in Table No. 1.

The forms of sulfur analyses were performed by Milltech Analytical Services, Inc. at its testing facility in Hunker, Pennsylvania. Pyritic sulfur concentration is measured indirectly by determining iron concentration in a separated fraction by flame atomic absorption spectrometry. Total sulfur and sulfate sulfur concentrations are determined by infrared absorption of the sulfur dioxide (SO_2) produced by combustion in an oxygen atmosphere. Organically-bound sulfur is calculated by subtraction of the pyritic sulfur and sulfate sulfur concentrations from the total sulfur concentration.

The pyritic sulfur concentrations varied from 0.01 to as much as 2.15 percent, with an average of 0.79 percent for all samples. Currently, a 0.1 percent sulfide sulfur concentration is considered as the threshold for sulfide-induced heave. A review of Table No. 1 indicates that seventeen (17) of twenty-one (21) soil samples tested resulted in pyritic sulfur concentration more than 0.1 percent.

5.0 DISCUSSION AND EVALUATION OF DATA COLLECTED

Based on the field exploration and laboratory test results presented in the previous sections, it becomes clear that the distress to ground floor parking lot has been the result of a slow continuous heaving. The heaving is the direct result of oxidation of sulfide sulfur present in the carbonaceous shale that forms the floor slab subgrade. In spite of the past oxidation, the potential for further heaving is very likely because of the high concentration of the unspent sulfide sulfur, which eventually will be oxidized to sulfate and other byproducts with time. This process, however, will take a long time to complete. The weathering of sulfidic material is a continuing process that builds upon itself. The rate of expansion will likely increase as the grain-size decreases and relative surface area increases, thus allowing more air and aerated water to interact with the weathered pyritic material. Therefore, remedial action should be taken immediately to eliminate safety concerns of the garage users, as well as to reduce potential damage to the elevator entrance lobby which is supported on the distressed floor slab.

Several remedial solutions have been adopted in the industry to prevent or minimize sulfide induced heave of floor slabs. These include:

1. Use of tie-downs to provide counter-acting forces.

2. Undercutting the expansive material to a suitable depth to create a crawl space below the floor slab and allow the material to expand.

3. Undercutting the expansive material to a suitable depth (typically 5 feet), seal the exposed material with a bituministic coating and backfill with suitable, inert soils to provide a relatively compressible cushion and retard the oxidation process.

At the garage site the most practical corrective option seems to be the third method that involves cutting and removing the existing concrete floor slab, undercutting and removing the carbonaceous shale and its weathered product, applying a bituministic coasting on the exposed surface and backfilling the excavation with a suitable inert material such as PENNDOT 2A coarse aggregate under compaction control and constructing a new floor slab.

6.0 RECOMMENDATIONS

Based upon the discussion and evaluation of the data presented in the previous sections, GeoMechanics, Inc. presents the following corrective option to alleviate the floor heaving of the garage.

6.1 Site Preparation

- Remove the non-load bearing structural elements that are supported on the concrete floor slab such as elevator lobby. Also cut/break the existing distressed floor slab and remove it to expose the subgrade. The extent of the recommended subgrade modification area, based on higher measured heaving, is shown in Figure 6 but can be modified based on the County's discretion.

- Undercut the existing sulfide rich carbonaceous shale and its weathered product to a depth of 4 feet below the desired finished floor slab subgrade. Leave a minimum 8±-foot wide berm of slab/subgrade along the perimeter retaining walls during the excavation as shown in Figure 7. This is necessary to provide passive resistance to the grade beams and caisson head that are subjected to lateral loads from the outside retained ground.

- Subsequent to backfilling of the excavation, remove the previously undisturbed berm slab adjacent to the wall and excavate an additional 1 foot of subgrade in sections not longer than 10 feet along the length of the wall. Backfill the overexcavation similar to the previous mass backfill to the subgrade level. Place the new slab on compacted subgrade.

- Hire a structural engineer to evaluate the impact of increase of lateral stress on the perimeter wall, grade beam and caisson head due to the temporary excavation, and ensure that the temporary overstressing remains with an acceptable limit. Note that the excavation will start at least 8 feet from the wall (Figure 5).

- Apply two (2) layers of bituministic coating as described in the special provision included in Appendix D of this report in order to seal the exposed expansive material and minimize the availability of air and aerated water and, in turn, retard the oxidation reaction.

- Backfill the excavated area with a suitable inert material such as PENNDOT 2A coarse aggregate or equivalent. Place this material in 9-inch thick loose layers and compact each layer to 95 percent maximum dry density at a moisture content within 2± percent of optimum moisture content based on modified proctor compaction tests. Use a smooth-drum minimum 10-ton roller to compact the backfill material. In confined areas, use a smaller compactor can be used but reduce the lift the thickness to 4 to 6 inches depending upon the size of the roller as approved by the Engineer.

- If granular material other than PENNDOT 2A material is used for backfill, the soil must be free from excessively clayey or organic-rich materials with the finer reaction (-#200 sieve) exceeded 30 percent. Larger pieces should not exceed 3 inches in diameter.

- Maintain the compacted fill in a satisfactory manner until final completion of the project. Replace any sections which become damaged or disturbed due to any construction activities such as movement of construction vehicles installation of utilities.

6.2 Floor Slab

- Immediately prior to the floor slab construction, the entire (newly prepared) subgrade should be proof-rolled and compacted, in order to re-densify the previously placed fill which may have been disturbed during construction activities.

- Place the floor slabs on grade with a minimum 8-inch thick granular base of PENNDOT 2A stone. For slab with heavier concentrated loads, the thickness of the base course should be increased to 10 inches of PENNDOT 2A stone. This will provide both structural strength and a "capillary break".

- Provide expansion joints between the floor slabs on grade and the grade beams and column foundations in order to allow independent settlement of the floor slab.

- Place a minimum of 15-mil polyethylene or equivalent vapor retarder between the base course and the concrete slab to preclude the floor dampness and minimize loss of concrete water to porous base.

- Use subgrade modulus of 150 PCI in designing the concrete floor slab placed on engineered fill.

6.3 Limitations

- The subsurface evaluation of the site is based on a limited number of borings spread across the garage area. Considerable extrapolation among borings was needed to prepare the generalized geologic cross-sections. The recommendations presented in this report are general in nature and should be modified, if necessary, based on the actual field conditions encountered.

- During the site preparation and construction, if subsurface conditions encountered differ significantly from those reported herein, this office should be notified immediately so that the analyses and recommendations can be reviewed and/or revised accordingly.

- In preparing this report, our professional services have been performed, our data has been obtained and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied. GeoMechanics, Inc. assumes no responsibility for interpretations made by others based upon work or evaluations made by GeoMechanics, Inc.

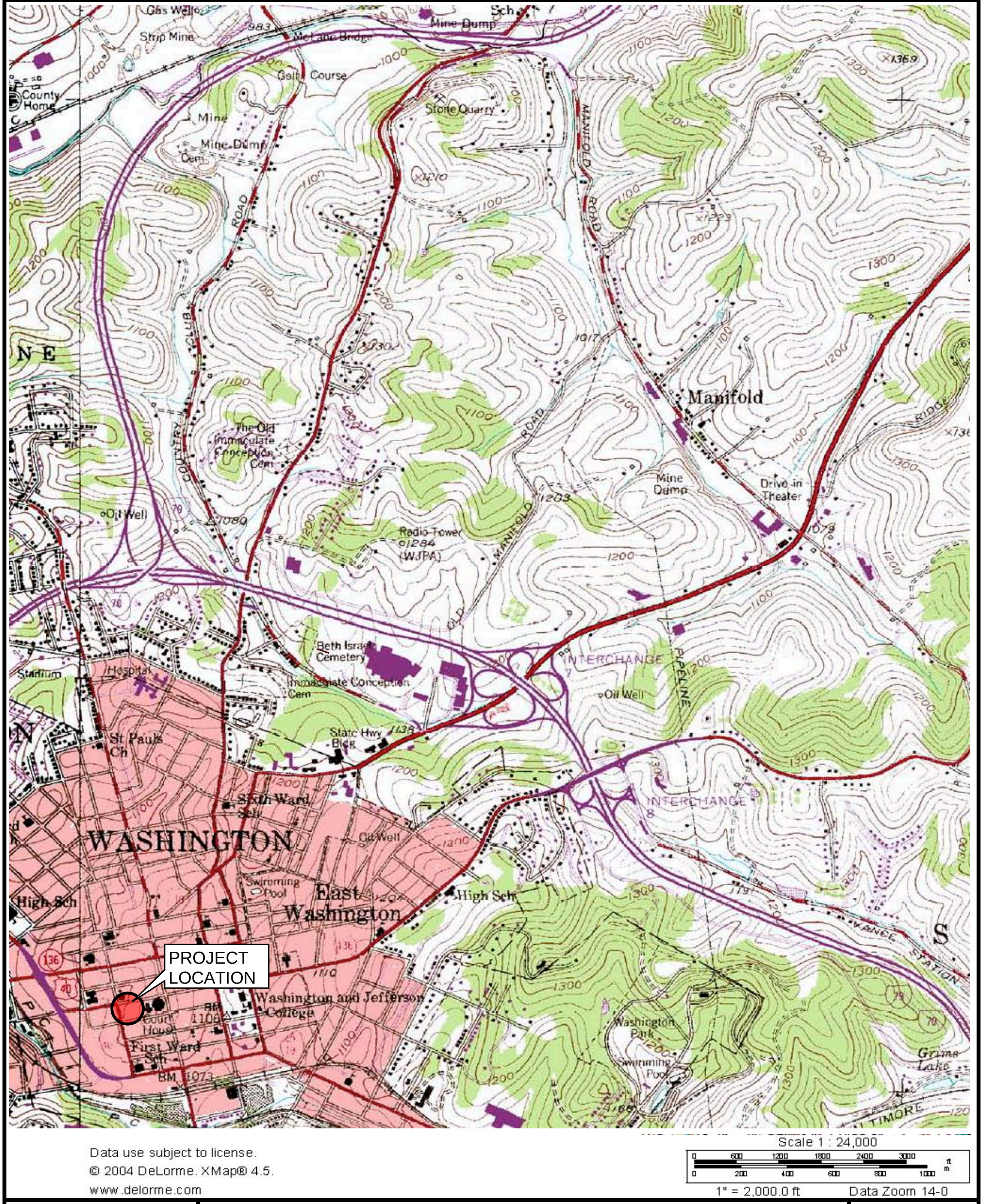
TABLES

TABLE NO. 1:

PYRITIC SULFUR ANALYSIS

Boring No.	Surface Elevation (ft).	Sample Depth (ft.)	Sample Description	Percentage Pyritic Sulfur	Above 0.1%	Below 0.1%
GM-1	980.6	0.4 - 1.5	Clayey Sand / Clayey Gravel	0.07		X
		1.5 - 2.5		0.02		X
		2.5 - 3.0		0.38	X	
GM-2	980.6	0.4 - 1.5		1.87	X	
		1.5 - 2.5		2.15	X	
GM-3	980.6	0.4 - 1.5		0.27	X	
		1.5 - 2.5		0.01		X
		2.5 - 3.4		1.43	X	
GM-4	980.6	0.4 - 1.5		1.27	X	
		1.5 - 2.5		0.77	X	
		2.5 - 3.5		0.53	X	
GM-5	980.3	0.5 - 1.0		0.98	X	
		1.5 - 2.0		0.85	X	
		2.0 - 3.0		0.98	X	
		3.0 - 4.0		0.84	X	
		4.0 - 5.0		1.19	X	
GM-6	980.5	0.4 - 1.5		0.97	X	
		1.5 - 2.5		0.77	X	
		2.5 - 3.5		0.01		X
		3.5 - 4.5		0.59	X	
		4.5 - 5.5		0.69	X	
TOTALS			21	Average = 0.79	17	4

FIGURES



Date:	Sept. 2016
Scale:	As Shown
Drn. By:	M.E.H.
Chk. By:	R.P.B.
Job No.	16051

USGS LOCATION MAP

WASHINGTON COUNTY COURTHOUSE PARKING GARAGE

WASHINGTON, WASHINGTON COUNTY, PA

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600 Munir Drive, P.O. Box 386
Elizabeth, PA 15037-0386
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Fax: (724) 379-4242
E-Mail: gmi@geo-mechanics.com

FIGURE

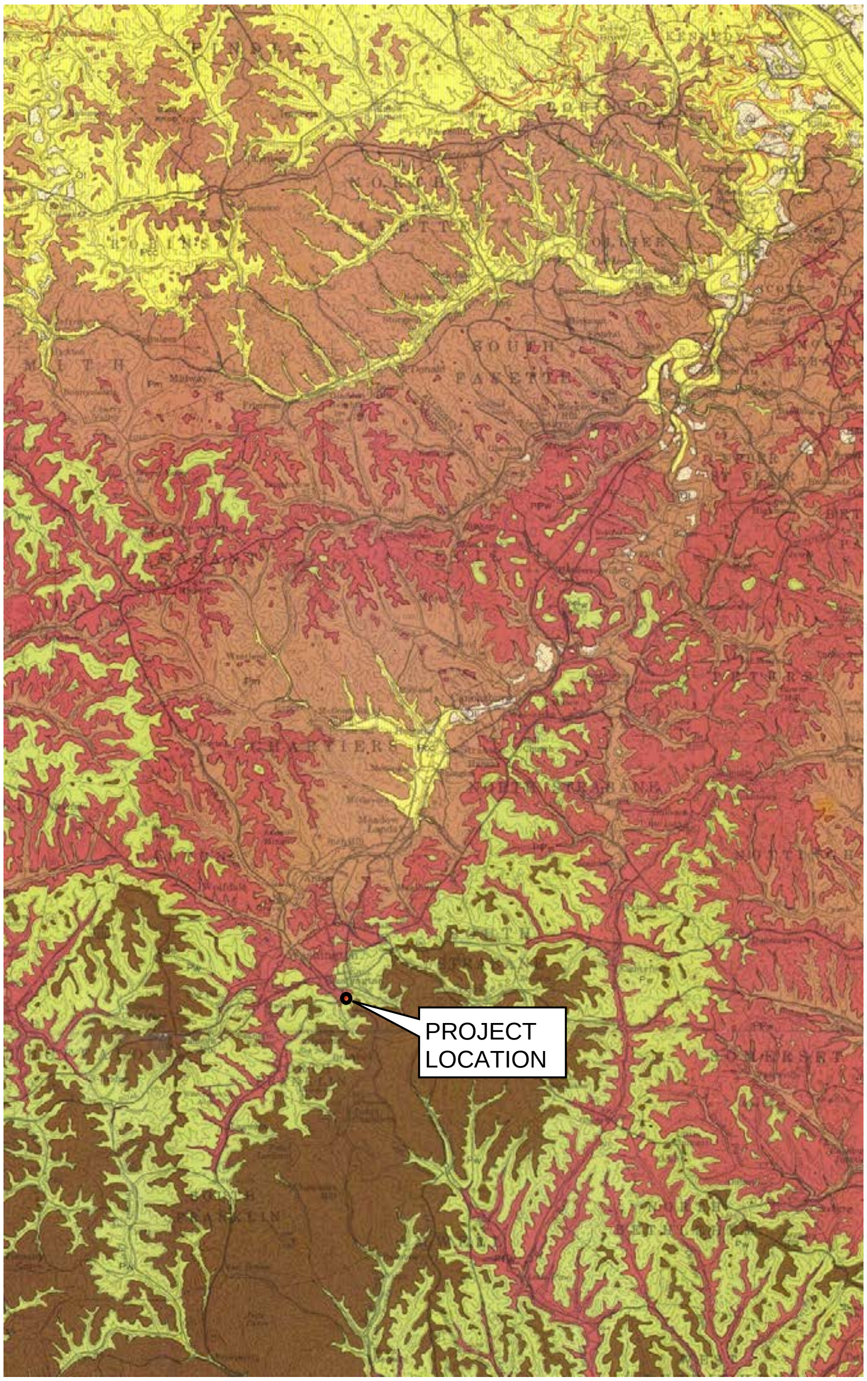
1

Date: Sept. 2016	AERIAL PHOTOGRAPH OF SITE **WASHINGTON COUNTY COURTHOUSE PARKING GARAGE** WASHINGTON, WASHINGTON COUNTY, PA		FIGURE 2
Scale: As Shown			
Drn. By: M.E.H.	GeoMechanics, inc Consulting Engineers / Scientists	600 Munir Drive, P.O. Box 386 Elizabeth, PA 15037-0386 Phone: (724) 379-6300 Fax: (724) 379-4242 E-Mail: **gmi@geo-mechanics.com**	
Chk. By: R.P.B.			
Job No. 16051			

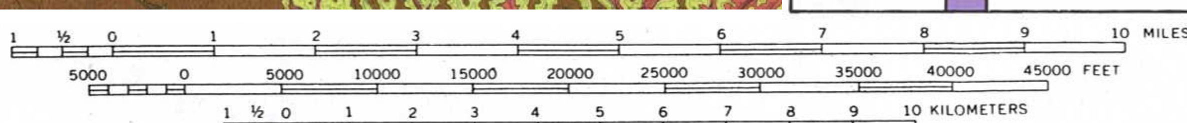
GREATER PITTSBURGH REGION GEOLOGIC MAP

COMPILED BY W. R. Wagner, J. L. Craft, L. Heyman and J. A. Harper

1975



GROUP	FORMATION		DESCRIPTION
	Alluvium	Ql	Sand, gravel, clay.
	Terrace deposits		Sand, clay, gravel on terraces above present rivers; includes Carmichaels Formation.
DUNKARD	Greene	Pg	Cyclic sequences of sandstone, shale, red beds, thin limestones and coals.
	Washington	Pw	Cyclic sequences of sandstone, shale, limestone, and coal; contains Washington coal bed at base.
	Waynesburg	PPw	Cyclic sequences of sandstone, shale, limestone and coal; contains Waynesburg coal bed at base.
MONONGAHELA		Pm	Cyclic sequences of shale, limestone, sandstone and coal; contains Pittsburgh coal bed at base.
Pc CONEMAUGH	Casselman	Pcc	Cyclic sequence of sandstone, shale, red beds and thin limestone and coal.
	Ames		
	Glenshaw	Pcg	Cyclic sequences of sandstone, shale, red beds and thin limestone and coal; several fossiliferous limestone; Ames limestone bed at top.
ALLEGHENY	Vanport	Pa	Cyclic sequences of shale, sandstone, limestone, and coal; contains Brookville coal at base and Upper Freeport coal at top; within group are the commercial Vanport limestone and Kittanning and Clarion coals.
POTTSVILLE		Pp	Sandstone and shale; contains some conglomerate and locally mineable coal.
	Mauch Chunk	Mmc	Red and green shale with some sandstone; contains Wymps Gap and Loyalhanna limestones.
	Pocono	Mp	Sandstone and shale with Burgoon sandstone at top.



Date:	Sept. 2016
Scale:	As Shown
Drn. By:	M.E.H.
Chk. By:	R.P.B.
Job No.	16051

GEOLOGY MAP

WASHINGTON COUNTY COURTHOUSE PARKING GARAGE

WASHINGTON, WASHINGTON COUNTY, PA

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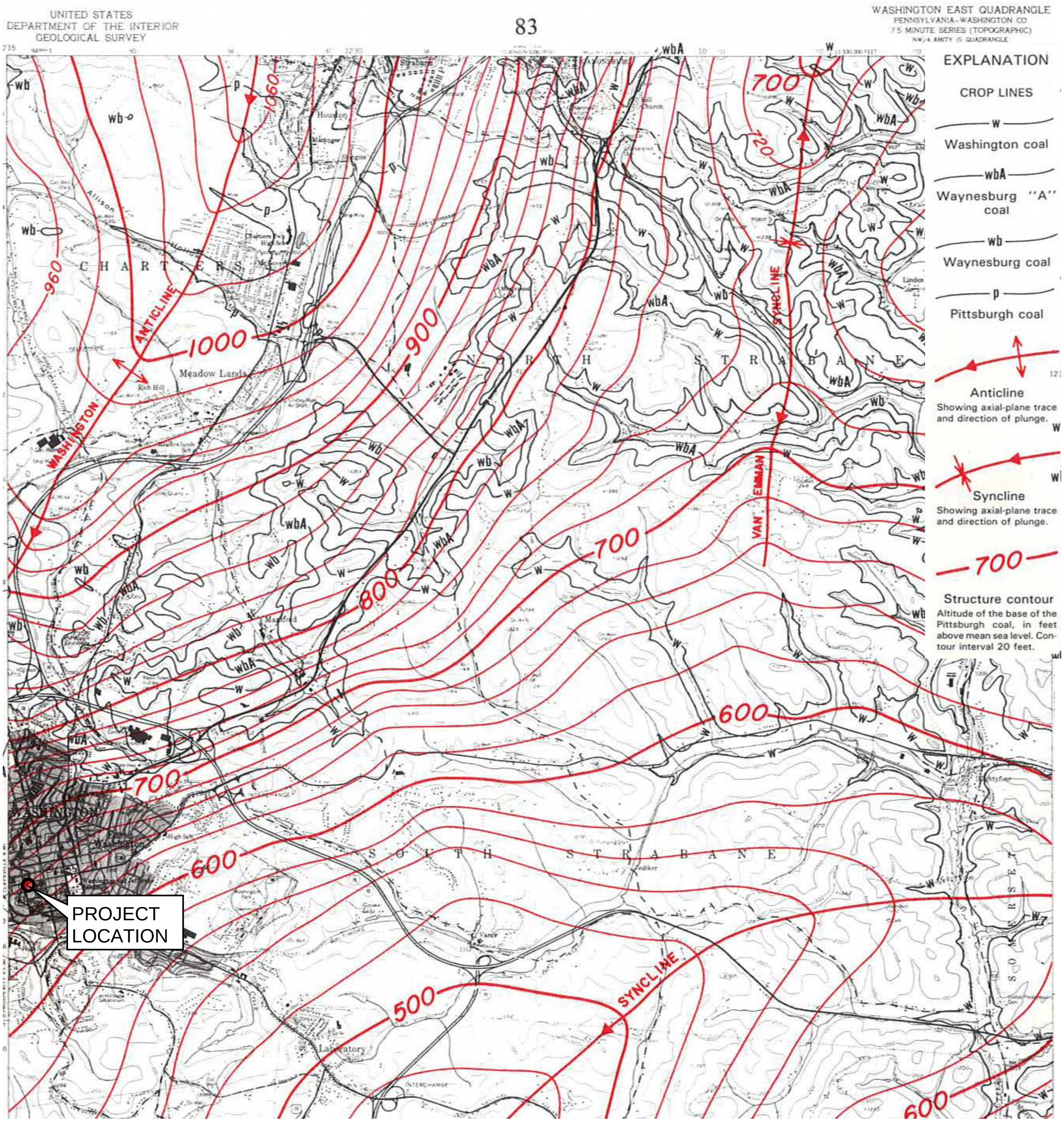
FIGURE 3



SOURCES

Crop lines slightly modified by V. W. Skema from Swanson, V. E., and Berryhill, H. L., Jr. (1964), *Geology of the Washington East quadrangle, Pennsylvania*, U.S. Geological Survey Geologic Quadrangle Map GQ-334, scale 1:24,000.
Structure contours from Berryhill, H. L., Jr., Schweinfurth, S. P., and Kent, B. H. (1971), *Coal-bearing Upper Pennsylvanian and Lower Permian rocks, Washington area, Pennsylvania—Part 1, Lithofacies; Part 2, Economic and engineering geology*, U.S. Geological Survey Professional Paper 621, Plate 1.

SCALE ~1:62500

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

ROAD CLASSIFICATION

WASHINGTON EAST

COAL CROP LINES AND STRUCTURE CONTOURS

Date:	Sept. 2016	COAL CROP LINES AND STRUCTURE CONTOURS **WASHINGTON COUNTY COURTHOUSE PARKING GARAGE** WASHINGTON, WASHINGTON COUNTY, PA	FIGURE 4
Scale:	As Shown		
Drn. By:	M.E.H.	GeoMechanics, inc Consulting Engineers / Scientists	
Chk. By:	R.P.B.		
Job No.	16051		

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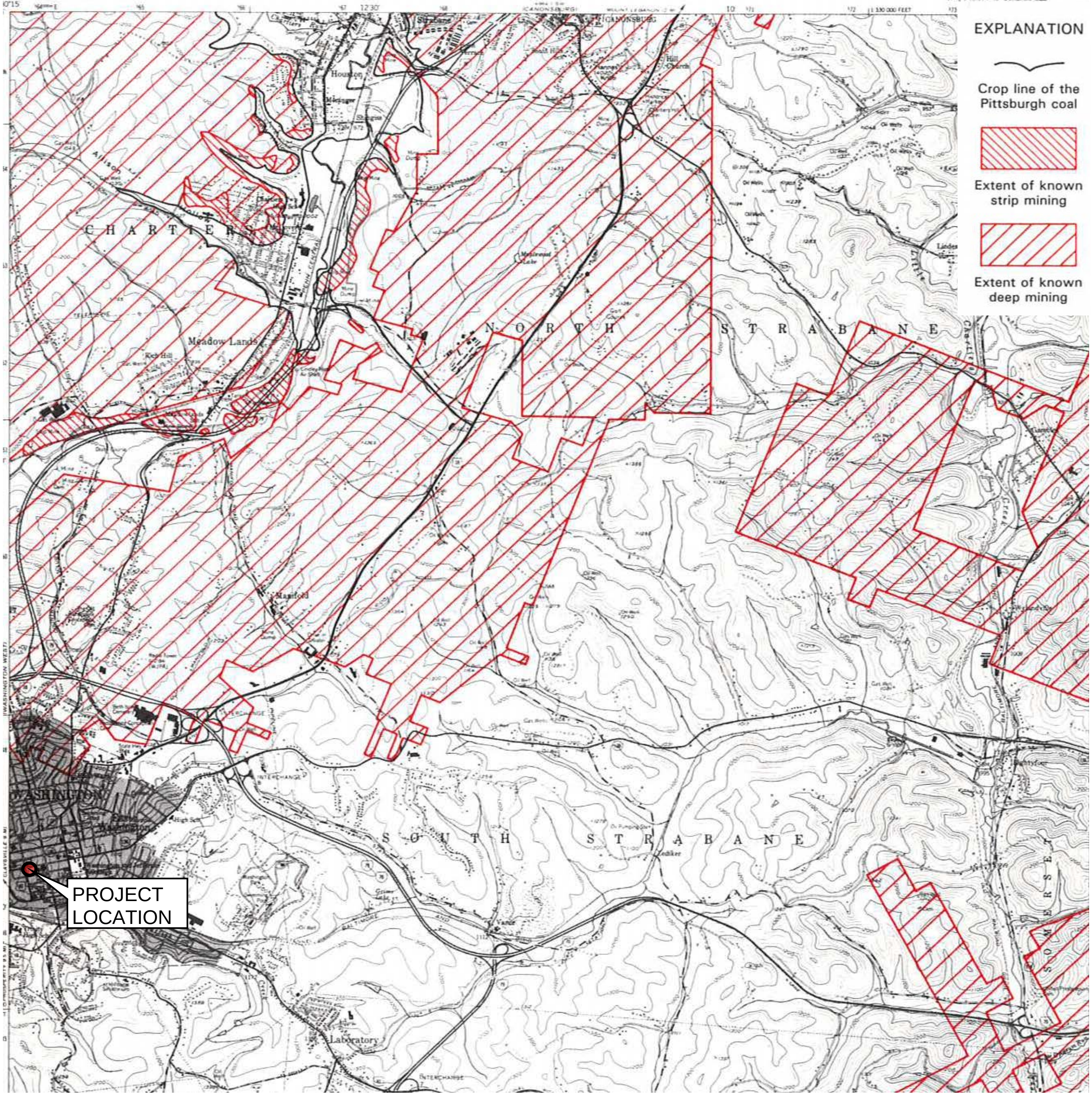
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

81

WASHINGTON EAST QUADRANGLE
PENNSYLVANIA–WASHINGTON CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
NW/4 AMITY 15' QUADRANGLE



SOURCES

Crop line slightly modified by V. W. Skema from Swanson, V. E., and Berryhill, H. L., Jr. (1964), *Geology of the Washington East quadrangle, Pennsylvania*, U.S. Geological Survey Geologic Quadrangle Map GQ–334, scale 1:24,000.
Limits of strip mining from Swanson and Berryhill (1964) and interpretation of topographic map.
Limits of deep mining modified by V. W. Skema from Pennsylvania Department of Environmental Resources, Bureau of Mining and Reclamation (1978), unpublished map.

SCALE ~1:62500

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

WASHINGTON EAST

CROP LINE AND MINED-OUT AREAS OF THE
PITTSBURGH COAL

Date:	Sept. 2016	CROP LINE AND MINED-OUT AREAS OF THE PITTSBURGH COAL **WASHINGTON COUNTY COURTHOUSE PARKING GARAGE** WASHINGTON, WASHINGTON COUNTY, PA	FIGURE
Scale:	As Shown		
Drn. By:	M.E.H.	GeoMechanics, inc Consulting Engineers / Scientists	5
Chk. By:	R.P.B.		
Job No.	16051		

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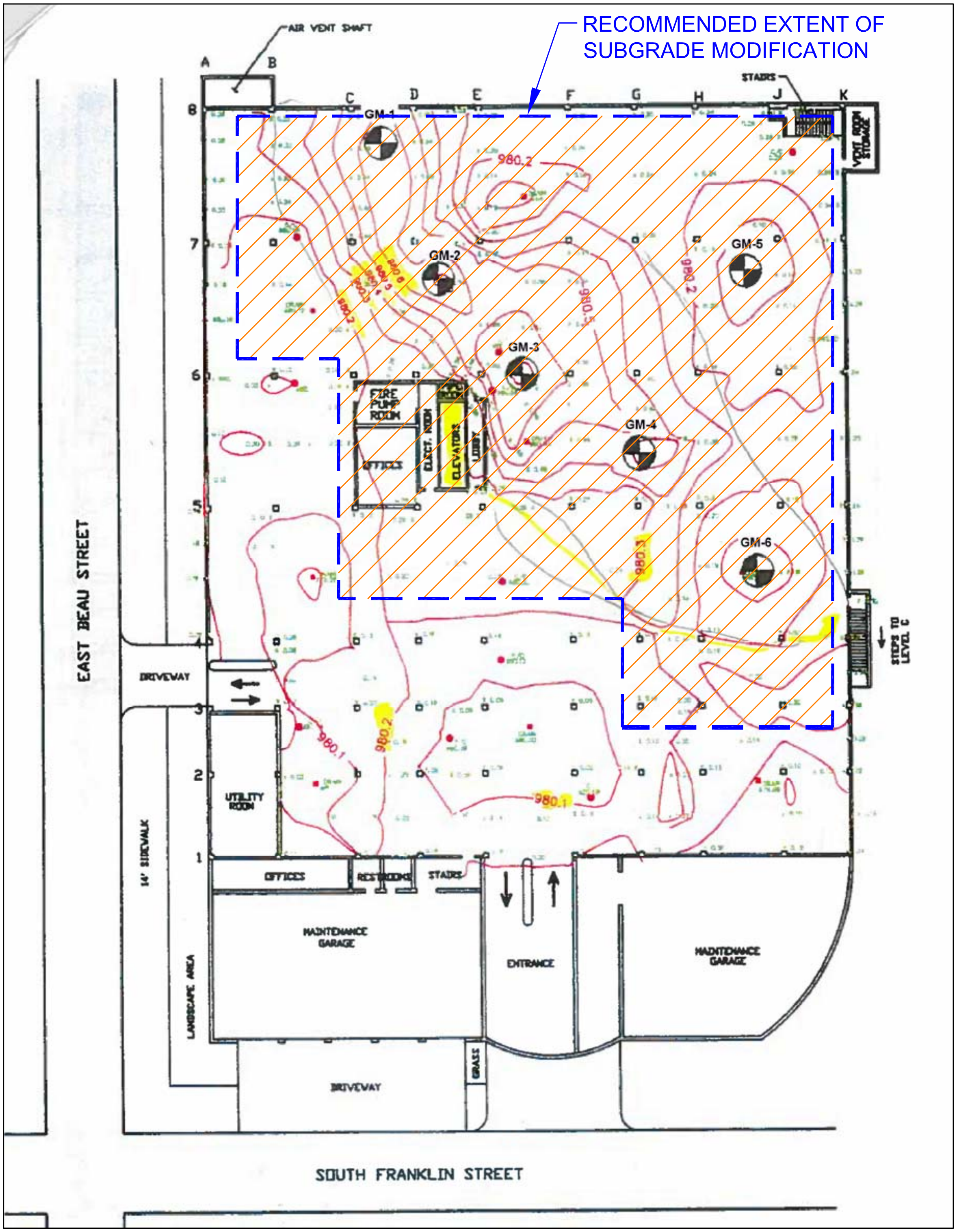
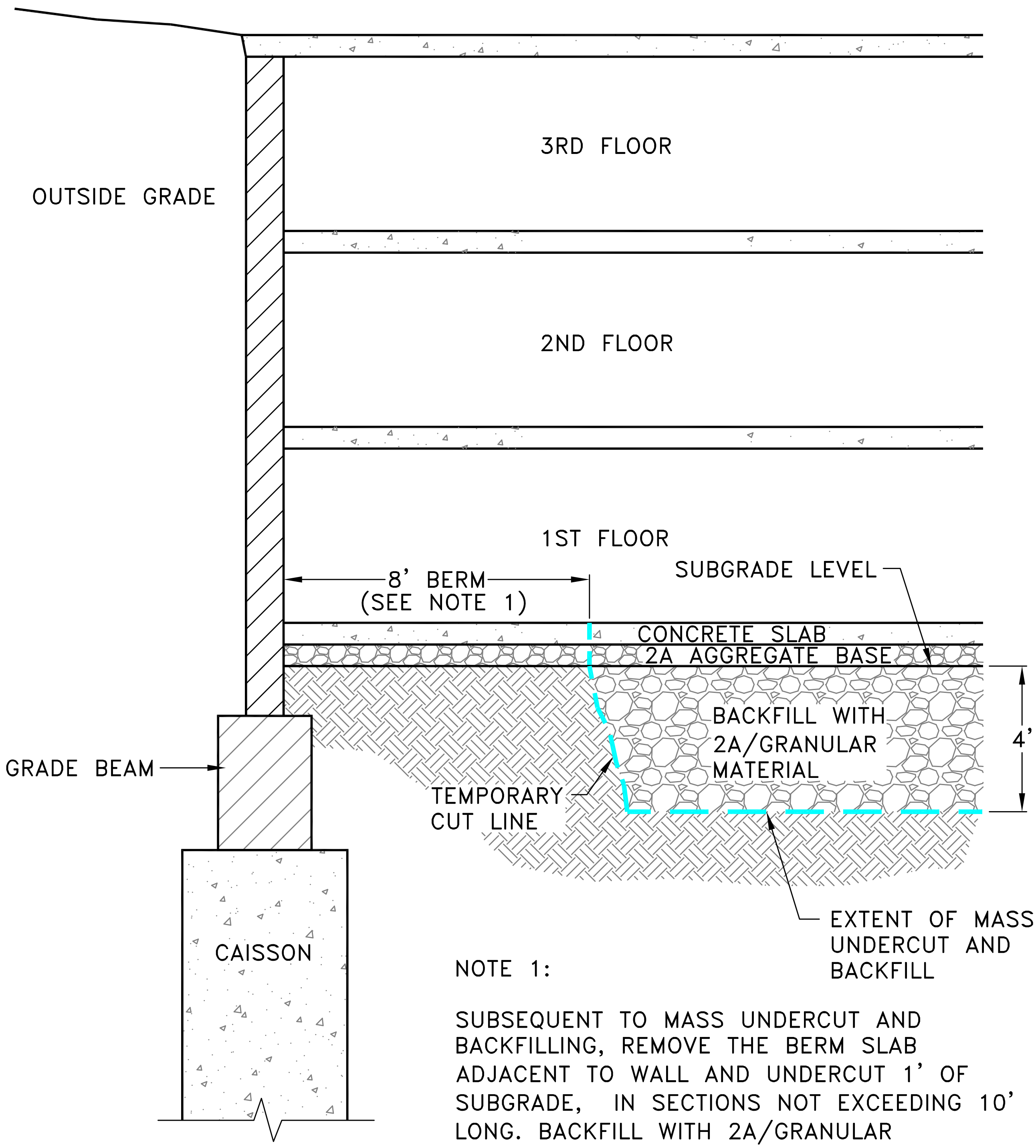


RECOMMENDED EXTENT OF SUBGRADE MODIFICATION

Date: Sept. 2016	WASHINGTON COUNTY COURTHOUSE PARKING GARAGE WASHINGTON, WASHINGTON COUNTY, PA		FIGURE 6
Scale: None			
Drn. By: M.E.H.	GeoMechanics, inc Consulting Engineers / Scientists	600 Munir Drive, P.O. Box 386 Elizabeth, PA 15037–0386 Phone: (724) 379–6300 Fax: (724) 379–4242 E–Mail: gmi@geo–mechanics.com	
Chk. By: J.J.K.			
Job No. 16051			



NOTE 1:

SUBSEQUENT TO MASS UNDERCUT AND BACKFILLING, REMOVE THE BERM SLAB ADJACENT TO WALL AND UNDERCUT 1' OF SUBGRADE, IN SECTIONS NOT EXCEEDING 10' LONG. BACKFILL WITH 2A/GRANULAR MATERIAL.

TYPICAL DETAILS: FOUNDATION/PERIMETER WALL UNDERCUT & BACKFILL

Date: Sept. 2016	WASHINGTON COUNTY COURTHOUSE PARKING GARAGE WASHINGTON, WASHINGTON COUNTY, PA	FIGURE 7
Scale: None		
Drn. By: M.E.H.	GeoMechanics, inc Consulting Engineers / Scientists	
Chk. By: J.J.K.		
Job No. 16051		

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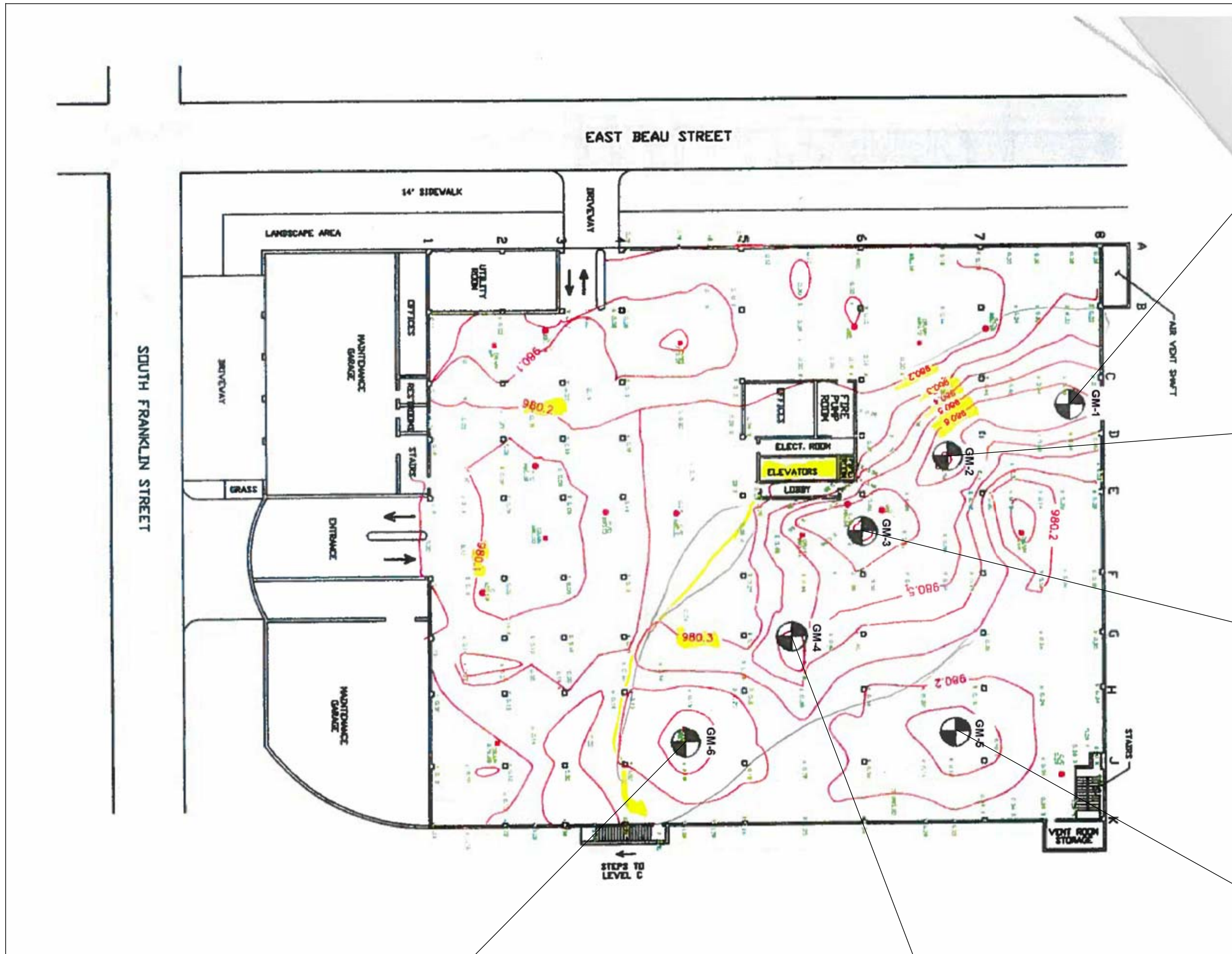
VERTICAL BORING SCALE IN FEET

0

5

10



GM-1
ELEV. 981±
CONCRETE
0.4' Brown CLAYEY SAND With Gravel
2.5' Gray Decomposed Carbonaceous SHALE FRAGMENTS With Sand
3.0'
END OF BORING AT 3.0'
DRY HOLE, 0-HR.

GM-2
ELEV. 981±
CONCRETE
0.4' Brown CLAYEY GRAVEL With Sand (RESIDUAL)
2.5'
END OF BORING AT 2.5'
DRY HOLE, 0-HR.

GM-3
ELEV. 981±
CONCRETE
0.4' Brown CLAYEY SAND
2.5' Gray CLAYEY GRAVEL With Sand (DECOMPOSED CARBONACEOUS SHALE)
3.4'
END OF BORING AT 3.4'
DRY HOLE, 0-HR.

GM-5
ELEV. 980±
CONCRETE
0.5' Gray SILTY CLAY With Sand
2.0' Gray CLAYEY SAND With Gravel (DECOMPOSED CARBONACEOUS SHALE)
5.0'
END OF BORING AT 5.0'
DRY HOLE, 0-HR.

GM-6
ELEV. 981±
CONCRETE
0.4' Gray-Brown CLAYEY GRAVEL With Sand
3.5' Gray CLAYEY SAND With Sand (DECOMPOSED CARBONACEOUS SHALE)
5.5'
END OF BORING AT 5.5'
DRY HOLE, 0-HR.

GM-4
ELEV. 980±
CONCRETE
0.4' Brown CLAYEY SAND With Decomposed Carbonaceous Shale Fragments
3.5'
END OF BORING AT 3.5'
DRY HOLE, 0-HR.

Date: Sept. 2016	WASHINGTON COUNTY COURTHOUSE PARKING GARAGE WASHINGTON COUNTY, PA	FIGURE: 8
Scale: As Shown		
Drn. By: J.P.B.	GeoMechanics, inc — Consulting Engineers / Scientists	
Chk. By: J.M.A.		
Project No. 16051		

600 Munir Drive, P.O. Box 386
Elizabeth, PA 15037-0386
Phone: (724) 379-6300
Fax: (724) 379-4242
E-Mail: gmi@geo-mechanics.com

APPENDIX A
Test Boring Logs

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller: Matt Guterry
Drill Rig: Minute Man
Water Level: O-Hr. Dry 24 Hrs. ______
Casing Hammer: Wt. ______ lbs. Drop ______ in.
Sampler Hammer: Wt. N/A lbs. Drop N/A in.
Sampler Size ______ in. O.D. Casing Size ______ in. I.D.
Core Bit Size: N/A
Orientation: Vertical

Boring No. GM-1 Surface Elevation ______ Sheet No. 1 of 1 sheets
For Washington County
Washington Parking Garage
Location: Washington, PA
Started 08/17/16 Completed 08/17/16 Project No. 16051
Driller's Log ☐ ______
Geologist's Log ☒ JMA
Drilling Fluid: N/A

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
0						0.0	CONCRETE	
-0.4						0.4	Brown CLAYEY SAND With GRAVEL	
-2.5						2.5		
-3						3.0	Gray Decomposed Carbonaceous SHALE FRAGMENTS With SAND	
							Bottom of Boring @ 3.0'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller Matt Guterry
Drill Rig Minute Man
Water Level: O-Hr. Dry 24 Hrs. ____
Casing Hammer: Wt. ____ lbs. Drop ____ in.
Sampler Hammer: Wt. N/A lbs. Drop N/A in.
Sampler Size ____ in. O.D. Casing Size ____ in. I.D.
Core Bit Size N/A
Orientation Vertical

Boring No. GM-2 Surface Elevation ____ Sheet No. 1 of 1 sheets
For Washington County
Washington Parking Garage
Location Washington, PA
Started 08/17/16 Completed 08/17/16 Project No. 16051
Driller's Log ☐ ____ Drilling Fluid N/A
Geologist's Log ☒ JMA

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.		SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
0							0.0	CONCRETE	
-0.4							0.4	Gray CLAYEY GRAVEL With SAND (Residual)	
-2.5							2.5		
								Bottom of Boring @ 2.5'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller: Matt Guterry
Drill Rig: Minute Man
Water Level: O-Hr. Dry 24 Hrs.
Casing Hammer: Wt. lbs. Drop in.
Sampler Hammer: Wt. N/A lbs. Drop N/A in.
Sampler Size in. O.D. Casing Size in. I.D.
Core Bit Size: N/A
Orientation: Vertical

Boring No. GM-3 Surface Elevation Sheet No. 1 of 1 sheets
For Washington County
Washington Parking Garage
Location: Washington, PA
Started 08/18/16 Completed 08/18/16 Project No. 16051
Driller's Log ☐
Geologist's Log ☒ JMA
Drilling Fluid: N/A

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
0						0.0	CONCRETE	
-0.4						0.4	Brown CLAYEY SAND	
-2.5						2.5	Gray CLAYEY GRAVEL With SAND (Decomposed Carbonaceous Shale)	
-3.4						3.4	Bottom of Boring @ 3.4'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller: Matt Guterry
Drill Rig: Minute Man
Water Level: O-Hr. Dry 24 Hrs.
Casing Hammer: Wt. lbs. Drop in.
Sampler Hammer: Wt. N/A lbs. Drop N/A in.
Sampler Size in. O.D. Casing Size in. I.D.
Core Bit Size: N/A
Orientation: Vertical

Boring No. GM-4 Surface Elevation Sheet No. 1 of 1 sheets
For Washington County
Washington Parking Garage

Location: Washington, PA
Started 08/17/16 Completed 08/17/16 Project No. 16051
Driller's Log ☐ Drilling Fluid N/A
Geologist's Log ☒ JMA

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
0						0.0	CONCRETE	
-0.4						0.4	Gray CLAYEY SAND With Decomposed Carbonaceous SHALE FRAGMENTS (Residual)	
-3.5						3.5		
							Bottom of Boring @ 3.5'	

GEO-MECHANICS, INC.

TEST BORING RECORD

Driller: Matt Guterry
Drill Rig: Minute Man
Water Level: O-Hr. Dry 24 Hrs.
Casing Hammer: Wt. lbs. Drop in.
Sampler Hammer: Wt. N/A lbs. Drop N/A in.
Sampler Size in. O.D. Casing Size in. I.D.
Core Bit Size: N/A
Orientation: Vertical

Boring No. GM-5 Surface Elevation Sheet No. 1 of 1 sheets
For Washington County
Washington Parking Garage
Location Washington, PA
Started 08/16/16 Completed 08/17/16 Project No. 16051
Driller's Log ☐
Geologist's Log ☒ JMA
Drilling Fluid N/A

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
0						0.0	CONCRETE	
-0.5						0.5	Gray SILTY CLAY With SAND	
-2						2.0	Gray CLAYEY SAND With GRAVEL (Decomposed Carbonaceous Shale)	
-5						5.0	Bottom of Boring @ 5.0'	

TEST BORING RECORD

GEO-MECHANICS, INC.

Driller: Matt Guterry
Drill Rig: Minute Man
Water Level: O-Hr. Dry 24 Hrs. ____
Casing Hammer: Wt. ____ lbs. Drop ____ in.
Sampler Hammer: Wt. N/A lbs. Drop N/A in.
Sampler Size ____ in. O.D. Casing Size ____ in. I.D.
Core Bit Size N/A
Orientation Vertical

Boring No. GM-6 Surface Elevation ____ Sheet No. 1 of 1 sheets
For Washington County
Washington Parking Garage
Location Washington, PA
Started 08/17/16 Completed 08/17/16 Project No. 16051
Driller's Log ☐ ____
Geologist's Log ☒ JMA
Drilling Fluid N/A

ELEVATION	In-Situ Tests and Instrumentation	RQD %	RUN-REC.	SPOON BLOWS / INTERV.	BOTTOM DEPTH OF SAMPLE	DEPTH (Ft.)	DESCRIPTION	REMARKS
0 -0.4						0.0 0.4	CONCRETE	
-3.5						3.5	Gray-Brown CLAYEY GRAVEL With SAND	
-5.5						5.5	Gray CLAYEY GRAVEL With SAND (Decomposed Carbonaceous Shale)	
							Bottom of Boring @ 5.5'	

APPENDIX B
Laboratory Test Results

GMI
GeoMechanics, Inc.
ELIZABETH, PA 15037
Phone: 724/379-6300
Fax: 724/379-4242

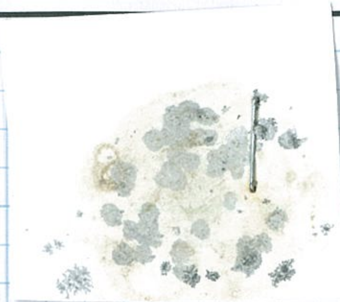
Subject ____

Job. No. 16051

By TS Date 08-16-16

Checked By ____ Date ____

Sheet No. ____ Of ____

GM-5 0.5–1.0  NONE

GM-5 — 1.5–2.0  VERYHIGH

GM-5 — 2.0–3.0  VERYHIGH

GM-5 — 3.0–4.0  VERYHIGH

GeoMechanics, Inc.
ELIZABETH, PA 15037
Phone: 724/379-6300
Fax: 724/379-4242

Subject ______

Job. No. 16051

By TS Date 08-16-16

Checked By ______ Date ______

Sheet No. ______ Of ______

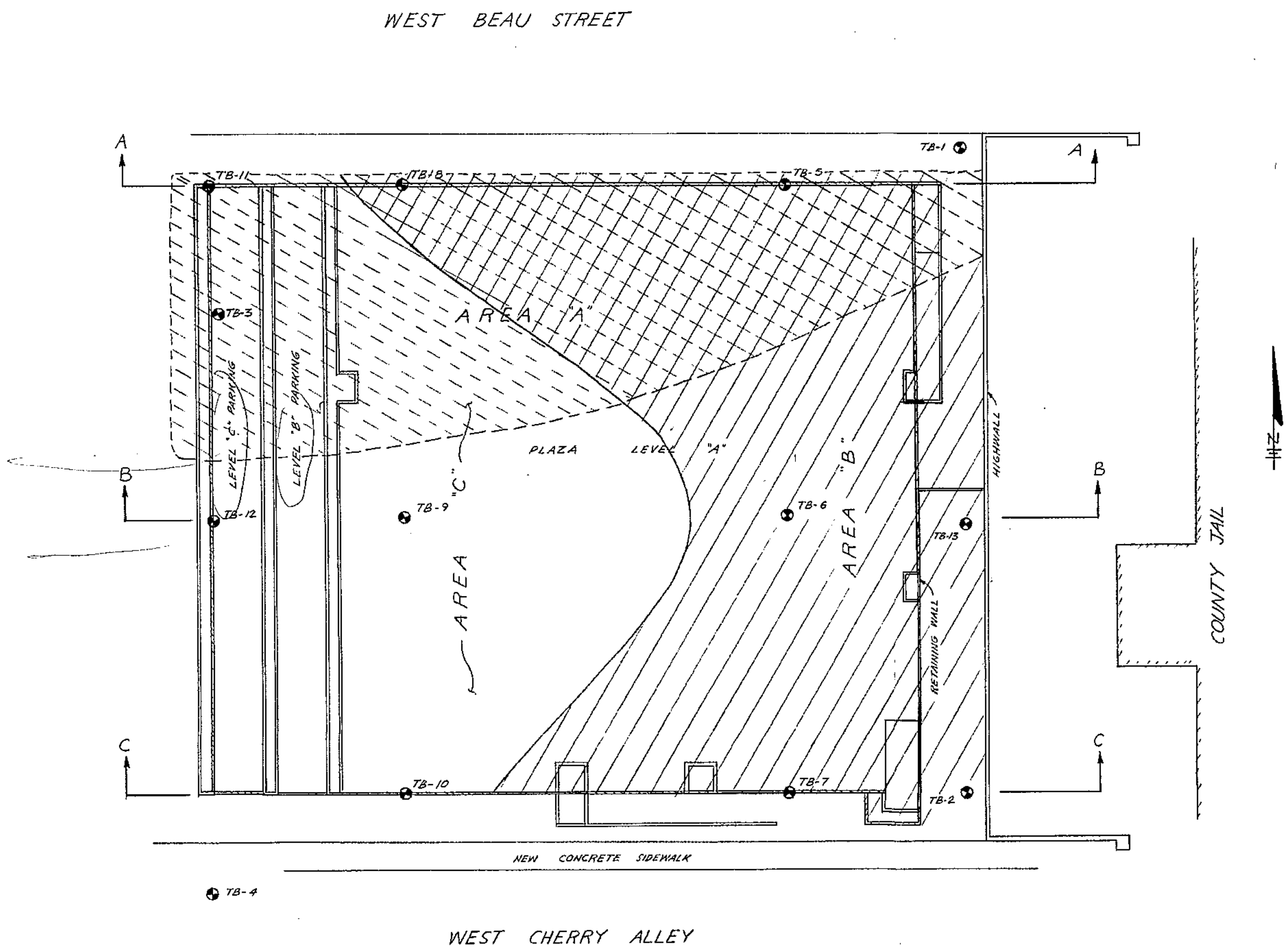
GM-5 - 40-50

VeRY HIGH

CleanUP CUTTING

VeRY HIGH

APPENDIX C
Test Boring Location Plan
and Geologic Cross-Sections



TEST BORING SCHEDULE

BORING No.	SURFACE ELEV.	DEPTH	REMARKS
TB-1.	60.0	35.0'	Previously drilled
TB-2.	75.5	42.0'	" "
TB-3.	43.0	20.0'	" "
TB-4.	49.4	25.0'	" "
TB-5.	55.2	30.0'	
TB-6.	62.2	23.0'	
TB-7.	66.2	48.5'	
TB-8	45.9	17.0'	
TB-9.	53.5	27.5'	
TB-10	55.6	33.5'	
TB-11	38.9	32.0'	
TB-12.	43.5	17.5'	
TB-13.	74.5	39.5'	

LEGEND

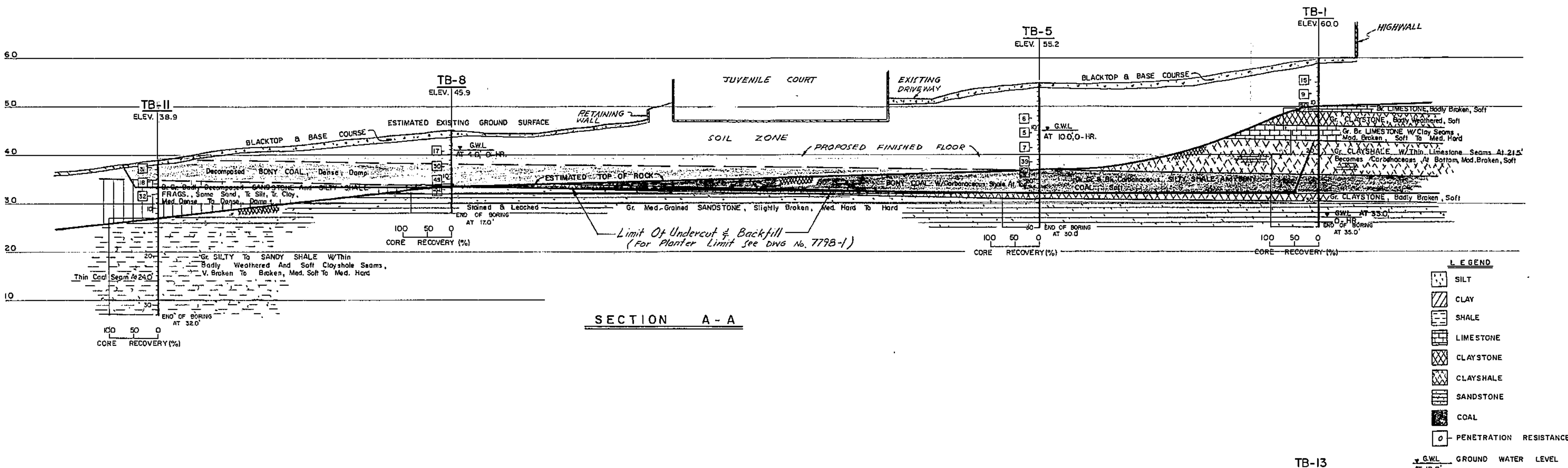
- AREA "A" = ESTIMATED LIMITS OF UNDERCUT AND BACKFILL
- AREA "B" = SHALLOW FOUNDATION
- AREA "C" = CAISSONS

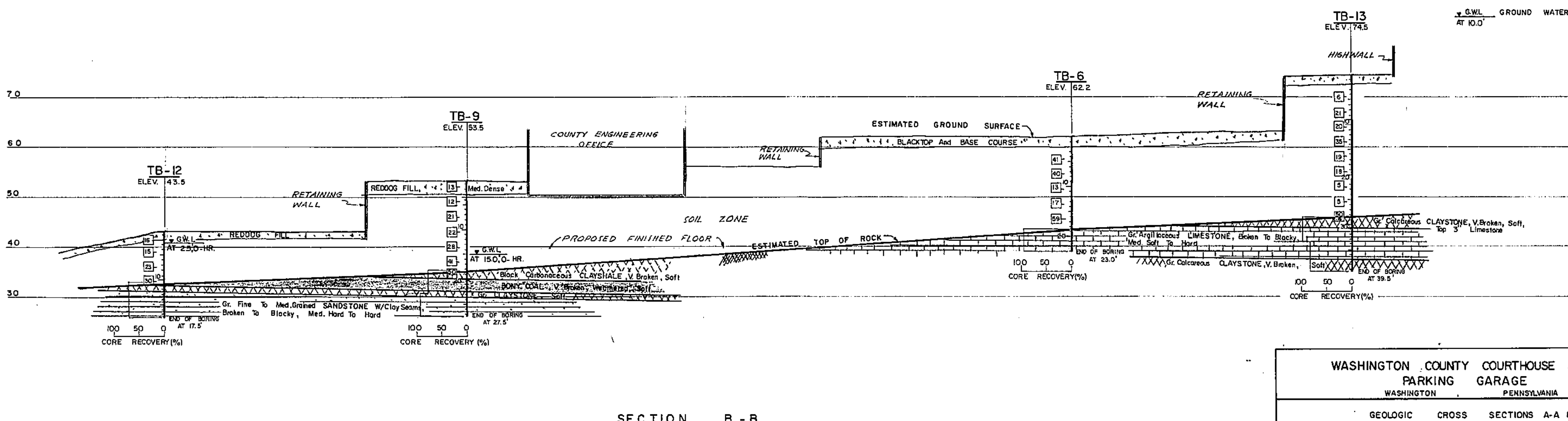
WASHINGTON COUNTY COURTHOUSE SQUARE
PARKING GARAGE
WASHINGTON, PENNSYLVANIA

TEST BORING LOCATION PLAN

Revision	Date	Scale	Drawn By	Checked By	Job No.	Sheet No.
	Oct.,	1" = 20'	S.K	W.L	7798	1 of 3

GEO-MECHANICS, INC.
GEOTECHNICAL CONSULTANTS BELLE VERNON, PENNSYLVANIA





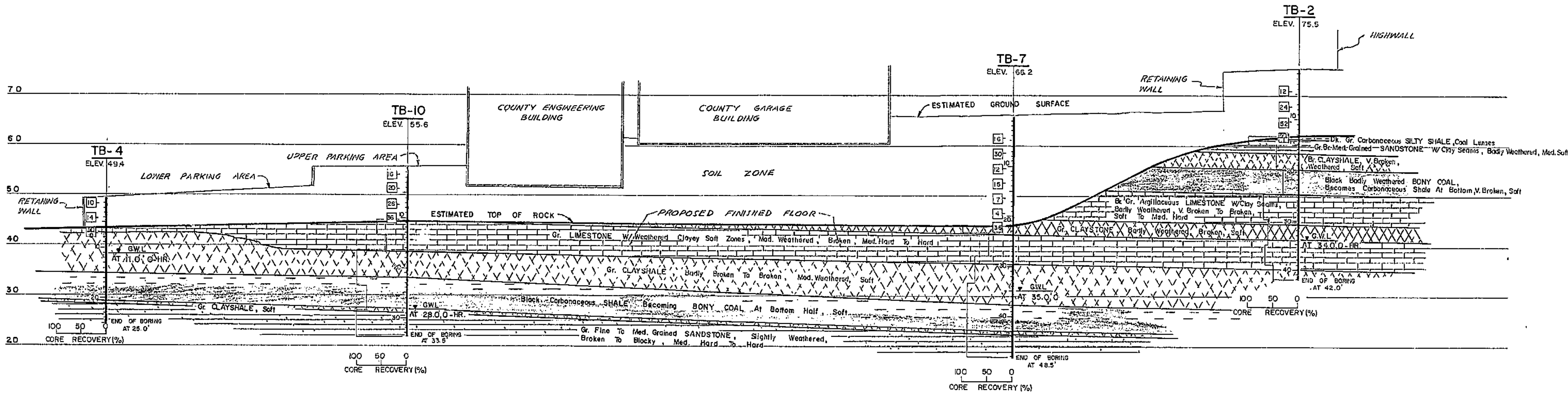
The depths and thicknesses of the soil and rock strata indicated on these geologic sections are generalized from and interpolated between the test borings. Information on actual subsurface conditions exist only at the location of the test borings. It is possible that surface conditions between the test borings may vary from those shown.

WASHINGTON COUNTY COURTHOUSE SQUARE
PARKING GARAGE
WASHINGTON, PENNSYLVANIA

GEOLOGIC CROSS SECTIONS A-A & B-B

Revision No.	Date	Scale	Drawn By	Checked By	Job No.	Sheet No.
	Oct., 1977	Ver. 1" = 10' Hor. 1" = 10'	S.K	W.L	7798	2 OF 3

GEO - MECHANICS, INC.
GEOTECHNICAL CONSULTANTS BELLE VERNON, PENNSYLVANIA



SECTION C-C

LEGEND

- SILT
- CLAY
- ROCK FRAGS.
- SHALE
- SANDSTONE
- CLAYSTONE
- CLAYSHALE
- LIMESTONE
- COAL
- PENETRATION RESISTANCE
- GWL AT 10.0' — GROUND WATER LEVEL

The depths and thicknesses of the soil and rock strata indicated on these geologic sections are generalized from and interpolated between the test borings. Information on actual subsurface conditions exist only at the location of the test borings. It is possible that surface conditions between the test borings may vary from those shown.

WASHINGTON COUNTY COURTHOUSE SQUARE PARKING GARAGE
WASHINGTON, PENNSYLVANIA

GEOLOGIC CROSS SECTION C - C

Revision No.	Date	Scale	Drawn By	Checked By	Job No.	Sheet No.
	Oct., 1977	Ver. 1"=10' Hor. 1"=10'	S. K	W.L	7798	3 OF 3

GEO - MECHANICS, INC.
GEOTECHNICAL CONSULTANTS BELLE VERNON, PENNSYLVANIA

APPENDIX D
Special Provision

SPECIAL PROVISION

TREATMENT OF PYRITIC MATERIALS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

A. This work is the treatment of pyritic materials located directly under the ground floor slab of parking garage with the application of bituminous materials and, if required, blotter materials.

PART 2 – PRODUCTS

2.1 BITUMINOUS MATERIAL

A. One of the following, as specified in PENNDOT Publication 408/2000, Section 702:

		Application Temperature ºC (ºF)	
Class of Material	**Type of Material**	**Minimum**	**Maximum**
MC-30	Cut-back Petroleum Asphalt	20 (70)	50 (100)
MC-70	Cut-back Petroleum Asphalt	40 (100)	65 (150)

B. If, due to time of year, the above materials are not available, then the following alternative materials can be used:

1. HYDROCIDE 600 asphalt emulsion, as manufactured by Sonneborn Building Products of Minneapolis, Minnesota.

2. HYDROCIDE 700B SEMI-MASTIC asphalt emulsion, as manufactured by Sonneborn Building Products of Minneapolis, Minnesota.

2.2 BLOTTER MATERIALS

A. Fine Aggregate – PENNDOT Publication 408/2000, Section 703.1.

PART 3 – EXECUTION

3.1 CONSTRUCTION

A. Overexcavate the in-place pyritic soils and/or bedrock to the predetermined depth below the distressed floor slab and footing. Treat the exposed surface including the side walls of cut in the floor slab area with sprayed bitumen as follows:

1. Apply an initial layer of cut-back petroleum asphalt MC-30, distributed at a rate of 0.20 to 0.50 gallon per square yard, at an application temperature of between 70 and 120°F.

2. Allow the initial layer to cure completely (minimum time = 24 hours, possibly as great as 48 hours or longer, depending on ambient air temperature and weather).

3. Apply a final layer of cut-back petroleum asphalt MC-70, distributed at a rate of 0.20 to 0.50 gallon per square yard, at an application temperature of between 100 and 150°F.

4. Allow the final layer to cure completely (minimum curing time similar to that for MC-30).

5. If necessary, a fine aggregate "blotter" material can be used to reduce curing time; however, the minimum curing time should not be less than 24 hours for either application.

B. If HYDROCIDE products are used, follow the manufacturer's recommended application procedures for "exterior surfaces below grade – porous surfaces".

C. After curing, backfill the overexcavation to the floor slab subgrade elevation with well-compacted, inert soils consisting of PENNDOT 2A aggregate or equivalent. Place the backfill material directly on the treated surfaces.

END OF SPECIAL PROVISION