



Ports, Coastal and Waterfront
Arts, Recreation and Exhibits
Real Estate Development
Public Infrastructure
Transportation
Government
Healthcare
Education
Industrial
Energy

January 30, 2018

City of Yonkers Fire Department
470 Nepperhan Avenue
Yonkers, NY 10701
914-377-7582

Attn: Kevin Ford

Re: Station 14 Geotechnical
2187 Central Park Avenue
Yonkers, NY 10710
McLaren File No. 160616.04

Dear Chief Ford:

At the request of City of Yonkers, McLaren Engineering Group (McLaren) developed and implemented a geotechnical investigation at Fire Station 14. The project site is located at 2187 Central Park Avenue, Yonkers, New York (See Appendix A, Site Location Plan). This geotechnical investigation consisted of soil borings, a test pit, and identification and classification of soils.

The scope of this investigation was to determine the cause of the floor slab cracking in the truck bays and cracking of the interior wall of the station.

Executive Summary

A visual inspection conducted by a McLaren representative revealed concrete cracking along the left side wall and the floor slab of structure. At the entrance of the garage 3.5 inches of settlement was observed. Numerous other cracks are also present at the floor slab. A major crack is present at the interior side of the garage wall which runs along the wall in the vertical direction. Pictures and measurements were taken and are available upon request.

Three borings were performed on the site, as indicated on the Boring & Test Pit Location Plan (See Appendix B). All three borings were extended to refusal depth at top of rock, which varied from 7.5 feet to 13.5 feet below surface. (See Appendix C, Boring Logs). The soil profile below the 5.5-inch-thick concrete slab floor, consists of 8-inches fine gravel, followed by approximately seven (7) feet of dark to light gray fine silty sand, with some clay and organics. The soil layer changes to red-brown fine to medium sand, some coarse sand and gravel until the maximum depth of exploration. This layer was saturated as the ground water table was encountered at 7.5 feet to 8 feet.

A test pit was performed outside of the fire station adjacent to the garage wall. Asphalt pavement covered the surface with a thickness of 10 inches. Below the surface, the soil consists of light brown

Offices: New York, Maryland, Florida, Connecticut, California, Georgia, Pennsylvania

Licensed in:

Alabama•Alaska•Arizona•Arkansas•California•Colorado•Connecticut• Delaware• District of Columbia• Florida• Georgia• Hawaii• Idaho• Illinois
Indiana•Iowa•Kansas•Kentucky•Louisiana•Maine•Maryland•Massachusetts•Michigan•Minnesota•Mississippi•Missouri•Montana•Nebraska
Nevada•NewHampshire•New Jersey•New Mexico•New York•North Carolina•Ohio•Oklahoma•Oregon•Pennsylvania•Puerto Rico•Rhode Island
So.Carolina•So.Dakota•Tennessee•Texas•Trinidad & Tobago•Utah• USVI• Vermont• Virginia• Washington• West Virginia• Wisconsin• Wyoming

M.G. McLaren P.C.

100 Snake Hill Road
West Nyack, NY 10994
Phone (845) 353-6400

e-mail: mgmclaren@mgmclaren.com
On the web: www.mgmclaren.com

fine to medium sand. The uniform soil layer extends to maximum depth of observation of approximately 6 feet below surface. At a depth of three feet, a 6-inch diameter clay pipe believed to be a footing drain, was encountered adjacent to wall. The test pit was extended to a depth of 6 feet. The bottom of the foundation was not visible and a probe into the soil revealed that the foundation wall appears to be extended to top of rock.

To remediate the settlement that has taken place, McLaren recommends the following three options. The first option would be to remove and replace the fill soils with a structural backfill soil. The structural backfill soil should be compacted and placed in lifts of uniform thickness. The second option would be to use compaction grouting. Compaction grouting is a grouting technique that displaces and densifies below grade soils, reinforces fine grained soils and fills voids related to sinkholes or karst conditions. A third option would be to install mini piles throughout the site and replace the floor with a structural slab.

Project Scope

The City of Yonkers Fire Department has proposed the renovation of the garage of Fire Station 14 located at 2187 Central Park Avenue. The site is an active fire house, and serves as the work station of the fire fighters and where the fire trucks are stationed.

Field Investigation

Three (3) borings and one (1) test pit were performed by Soiltesting Inc. (90 Donovan Road, Oxford CT 06478) at the site. The borings were performed inside the building, in the front area of the garage. The test pit was performed outside of the structure but adjacent to the garage front wall. (See Appendix B, Boring and Test Pit Location Plan). Borings were performed with a skid-mounted rig using hollow-stem auger casing. The test pit was hand dug to full depth with shovels and cutter mattock.

Soil samples were obtained using the Standard Penetration Test (ASTM D-1586-84) using a split spoon sampler with a 2-inch O.D., and a 1^{3/8}-inch I.D., that was driven into the soil with a 140-pound hammer falling freely from a height of 30-inches (See Appendix C, Boring Logs). Soil samples were field classified using the Unified Soil Classification System (USCS).

Boring B-1 was drilled to a depth of 10.5 feet. The top 7 feet of its soil profile consists of fill material. The fill is primarily dark to gray loose silty sand, with trace of organics. This layer is classified as ML. The next 3.5 feet consists of fine to medium brown sand. Weathered bedrock and rock fragments were found at the tip of the split spoon sampler. This layer is classified as SM. Bedrock was encountered at 10.5 feet. The water table was encountered at a depth of 7.5 feet to 8 feet.

Boring B-2, was the deepest boring. Top of bedrock was encountered at approximately 13.5 feet. At this location the fill also extends to 7 feet below the surface. Below the fill, a 3 feet thick layer of brown fine to medium sand was encountered. This layer transitions into a course to medium sand with some gravel and extends to top of bedrock. The ground water table was encountered at 7.5 feet.

At Boring B-3, the fill extends to approximately 2.5 feet below the surface. It consists of gray to light brown fine sand with some silt. Below the fill, light brown to red brown fine to medium sand was encountered. During the drilling operation at this location, the machine started grinding for

approximately 3.5 feet. Rock fragments were present at the tip of the sample spoon obtained in the 2-4-foot sample. The boring was terminated after the sampling refusal.

A test pit was performed adjacent to the exterior garage wall, five feet from the front of the garage. The test pit was performed in order to visually inspect the integrity of the foundation in the area of the crack in the tile façade along the interior garage wall. (See Appendix B, Boring and Test Pit Location Plan). Test Pit 1 (TP-1) was approximately 5 feet long by 4.5 feet wide by 6 feet deep. At the center line of the test pit on the inside wall, there was a vertical crack present. This crack was not visible on the outside wall.

Visual inspection of the property was performed by a McLaren representative. Multiple cracks were present on floor and on the left side wall. There was also an indication of possible differential settlement present at the site. The floor slab settled approximately 3.5 inches at the front of the garage. The settlement problem can most likely be attributed to the weight of the fire trucks and the unsuitable fill soil that is present at the site. It is to our knowledge that the wall with the large crack was hit by a fire truck, which could have caused substantial damaged to the structure. The crack in the wall can possibly be attributed to the settlement that has been occurring on the site or from the impact by the fire truck.

RECOMMENDATIONS

Based on the geotechnical investigation and observation that occurred during the field work, the following recommendations are forwarded for your use:

Remediation of Settlement

Based on the soil encountered at all three borings, the differential settlement is being caused by poorly compacted soil and possible decay of the organic soil used as fill. The soil is not suitable to support the loading exerted by fire trucks on the loose soil.

The first remediation option is to replace the existing 7 feet of fill soil, with suitable backfill soil. The backfill material should be NYS DOT Item 304 or similar compacted to a density of 95%. This will achieve an allowable bearing pressure of 6 kips per square foot. Backfill material shall be of uniform soil characteristic and moisture content and shall be placed in lifts of less than 12 inches. This operation must be done under the supervision of a geotechnical engineer or a qualified inspector with third party testing. A subgrade modulus of 250 kcf should be used for design of the any exterior slabs and sidewalks.

The second remediation option is compaction grouting for remediation of the soils below surface of the existing Fire House Station. Compaction grouting is a grouting technique that displaces and densifies below grade soils, reinforces fine grained soils and fills voids related to sinkholes or karst conditions. For the proposed soil remediation, the injection pipe should be lowered to a depth of 8 feet, and then injected in lifts as the pipe is slowly extracted. By implementing this method in a grid pattern across the proposed area, it will create columns of grout bulbs which will reinforce the surrounding soil. The grid pattern of grout columns should be sequenced in primary and secondary locations for maximum effectiveness.

Final design of the grout mix and sequencing shall be signed and sealed by an Engineer licensed in the state of New York. Soil in areas designated as proposed planters or trees should not be grouted. Compaction grouting locations should be designed with a maximum spacing of 5 feet.

The third remediation option is installation of a structural slab with mini-piles. These mini-piles shall be spaced uniformly across the proposed area and shall be driven to bedrock. The existing slab shall be removed and replaced with a new structural slab supported by the mini-piles. These mini-piles will help to support the structural slab and prevent any settlement issues in the future. An 8 inch mini pile with steel reinforcement should be designed to support a load of 20 tons. Piles over 40 tons will have to be tested as per NYS Building Code.

Settlement of Foundation Wall

It is believed that the foundation wall is bearing on bedrock for the structure. Based on the observation of the foundation wall by the test pit, it does not appear the crack on the interior wall has originated from settlement of the foundation. Verification of this must be performed in the field when the existing floor slab is removed since the foundation wall was observed from the exterior and the crack is present on the interior. Viewing the foundation wall from the interior will give a clear indication of whether settlement of the foundation has occurred. Based on the current observation that McLaren has done, it seems the large crack on the interior wall was caused by the impact of a fire truck into the wall.

Site Preparation

The Contractor shall be responsible at all times for conducting all earthwork operations in a safe and prudent manner such that all workmen and the general public will be protected from hazards. The Contractor shall observe all applicable local, State and/or Federal requirements. The Contractor should protect any utilities that are present under the new slab.

Dewatering

Groundwater was encountered at a depth of 7.5 feet to 8 feet below surface elevation in both borings B-1 and B-2. At location B-3, ground water was not observed. This water elevation may fluctuate seasonally or with rain events. Dewatering may be required if excavations are greater than 7 feet.

This report is respectfully submitted in accordance with our contract, and is to the best of our knowledge accurate and complete. Any questions regarding its content may be directed to the undersigned.

Respectfully submitted by,

The Office of
McLaren Engineering Group
M. G. McLAREN, P.C.



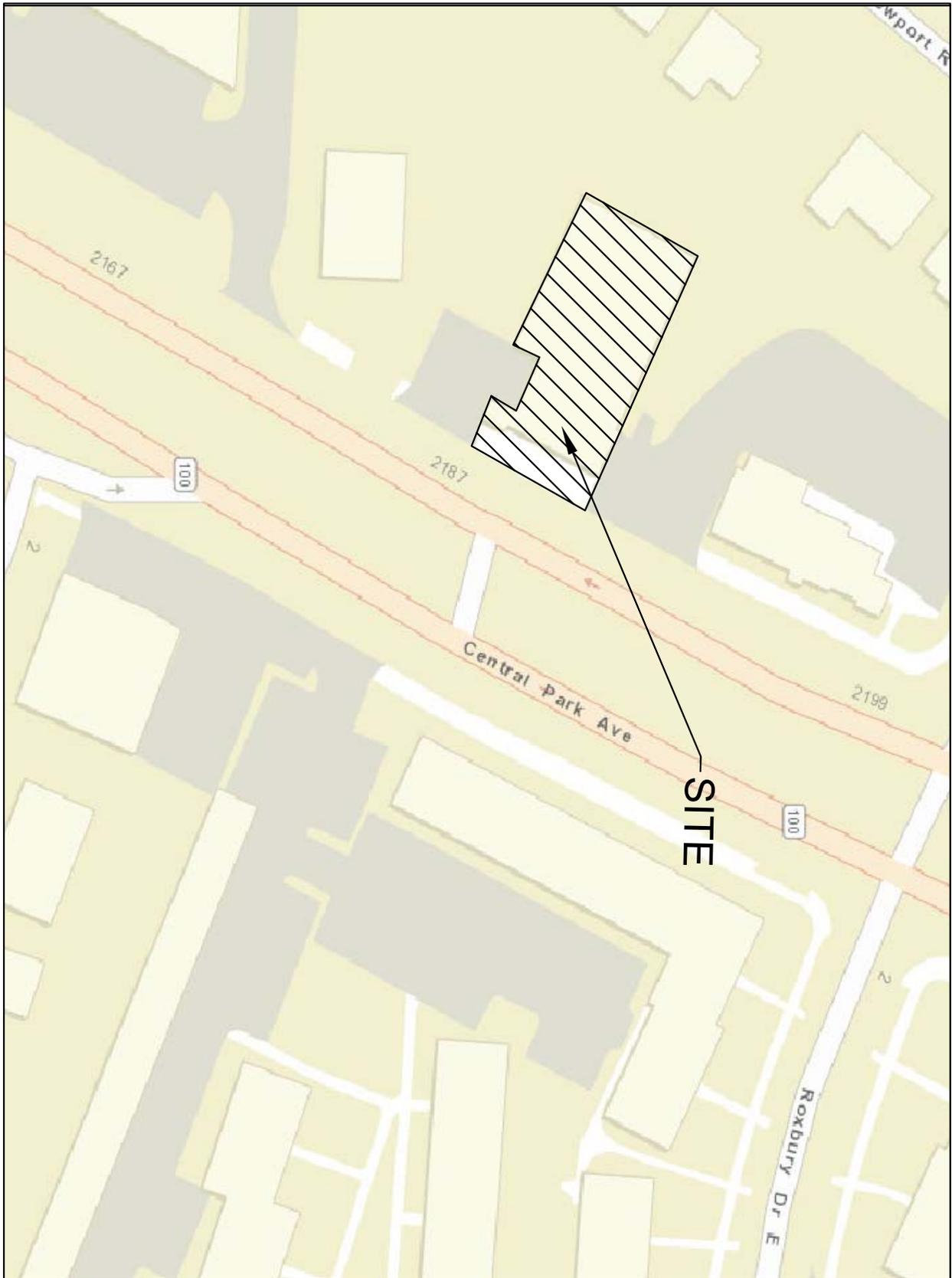
Luke A Daur, P.E.
Sr. Engineer

cc: SLG - Internal
Project #160616.04

Appendix A – Site Location Plan
Appendix B – Boring & Test Pit Location Plan
Appendix C – Boring Logs
Appendix D – Test Pit Logs
Appendix E – Soil Profile

P:\Proj160\160616.04\8_Technical\Reports\Geotechnical\2018-01-30 Yonkers Fire Station 14 - Geo Assessment.docx

Appendix A
Site Location Plan



1 OF 1 SHTS

FIG. 1

DRAWING NO.

PROJ. NO. 160816.04
 SCALE N.T.S.
 DATE 12/18/2017
 DRAWN BY LMF
 CHECKED BY LAD

SHEET TITLE

SITE LOCATION PLAN

PROJECT

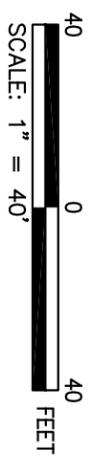
FIRE STATION 14

CITY OF YONKERS, NEW YORK

McLaren
 ENGINEERING GROUP
 applied Ingenuity
 M. G. McLAREN, P.C.
 100 Snake Hill Road, West Nyack, NY 10994
 Tel. (845) 353-6400 Fax. (845) 353-6509 www.mgmlaren.com

Appendix B
Boring Location Plan

WARNING - IT IS A VIOLATION OF NEW YORK STATE EDUCATIONAL LAW, SECTION 7209.2, FOR ANY PERSON, UNLESS HE IS ACTING UNDER THE DIRECTION OF A LICENSED PROFESSIONAL ENGINEER OR LAND SURVEYOR, TO ALTER THIS DOCUMENT IN ANY WAY. IF ALTERED, THE ALTERING PERSON SHALL COMPLY WITH THE REQUIREMENTS OF NEW YORK EDUCATIONAL LAW, SECTION 7209.2



COPYRIGHT © 2017, McLAREN ENGINEERING GROUP

DRAWING NO. FIG. 2 1 OF 1 SHEETS	PROJECT NO. 160616.04	BORING AND TEST PIT LOCATION PLAN	SHEET TITLE	FIRE STATION 14 YONKERS, NEW YORK	M. G. McLAREN, P.C. 100 Snake Hill Road, West Nyack, NY 10994 T. (845) 353-6400 F. (845) 353-6509 www.mgmclaren.com	<table border="1"> <thead> <tr> <th>NO.</th> <th>DATE</th> <th>REVISION</th> <th>BY</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>	NO.	DATE	REVISION	BY																
	NO.						DATE	REVISION	BY																	
SCALE AS NOTED	DATE 12/16/2017	DRAWN BY LMF	CHECKED BY LAD																							

Appendix C

Boring Logs



CLIENT City of Yonkers Fire Department
 PROJECT NUMBER 160616.04
 DATE STARTED 12/13/17 COMPLETED 12/12/17
 DRILLING CONTRACTOR Soiltesting Inc.
 DRILLING METHOD Hollow Stem Auger 2"
 LOGGED BY L. Martinez Frias CHECKED BY L. Daur
 NOTES _____

PROJECT NAME Fire Station 14
 PROJECT LOCATION Yonkers, NY
 GROUND ELEVATION 65 ft NAVD 88 HOLE SIZE 4 inches
 GROUND WATER LEVELS:
 ∇ AT TIME OF DRILLING 7.50 ft / Elev 57.50 ft
 AT END OF DRILLING ---
 AFTER DRILLING ---

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 1/11/18 15:43 - P:\PROJ160\160616.04\8_TechnicalReports\GINT FILE\FIRE STATION 14.GPJ

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
						0.5 5.5 inch thick concrete slab floor	64.5
						1.0 8 inches of gravel below the slab; did not sample, removed to start at the soil surface	64.0
	SS 1	58	8-11-10-10 (21)	ML		(ML) Dark silty sand, loose fine sand, some fine gravel, some clay and organics	
						3.0 (ML) Light gray silt with trace of fine sand, loose material, trace of clay and organics	62.0
5	SS 2	83	8-7-11-10 (18)	ML			
	SS 3	92	13-19-23-55 (42)	SM		∇ (SM) Red to Brown fine sand with some silt, natural soil, saturated.	58.0
10							
	SS 4	67	100			10.0	55.0
						10.5 Rock fragment, decomposed weathered rock	54.5

Refusal at 10.5 feet.
 Bottom of borehole at 10.5 feet.



Historical Boring Data (1959)

CLIENT City of Yonkers Fire Department
PROJECT NUMBER 160616.04
DATE STARTED 12/14/17 **COMPLETED** 12/14/17
DRILLING CONTRACTOR Soiltesting Inc.
DRILLING METHOD Hollow Stem Auger 2"
LOGGED BY L. Martinez Frias **CHECKED BY** L. Daur
NOTES _____

PROJECT NAME Fire Station 14
PROJECT LOCATION Yonkers, NY
GROUND ELEVATION 65 ft NAVD 88 **HOLE SIZE** 4 inches
GROUND WATER LEVELS:
 ∇ **AT TIME OF DRILLING** 7.50 ft / Elev 57.50 ft
AT END OF DRILLING ---
AFTER DRILLING ---

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 1/11/18 15:43 - P:\PROJ160160616.048_TECHNICALREPORTS\GINT FILE\FIRE STATION 14.GPJ

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
						5.5 inch thick concrete slab floor	64.5
				GW		(GW) 6-8 inch of gravel below the floor slab, no sampling. Removed by hand	64.0
						(ML) 8 inch Brown F-M sand. 6 inch gray silty clay, loose.	
	SS 1	58	6-7-3-3 (10)	ML			
						(ML) Gray fine silty sand, with trace of clay & organics.	62.0
	SS 2	75	2-3-3-5 (6)	ML			
5						(ML) 12 inch gray fine silty sand, 6 inch brown fine sand with some silt	60.0
	SS 3	75	6-14-16-10 (30)	ML			
						∇ (SM) Brown fine sand with silt	58.0
	SS 4	67	9-11-13-15 (24)	SM			
						(SM) Dark brown to brown coarse to medium sand, trace of silt, loose, saturated.	56.0
10							
	SS 5	100	11-10-9-9 (19)	SM			
						(SM) Brown fine-medium-coarse sand trace of gravel. Weathered rock & rock fragment at tip	54.0
	SS 6	92	14-24-22-22 (46)	SM			
						Auger refusal	52.0
							51.5

Refusal at 13.5 feet.
 Bottom of borehole at 13.5 feet.



Historical Boring Data (1959)

CLIENT City of Yonkers Fire Department
PROJECT NUMBER 160616.04
DATE STARTED 12/14/17 **COMPLETED** 12/14/17
DRILLING CONTRACTOR Soiltesting Inc.
DRILLING METHOD Hollow Stem Auger 2"
LOGGED BY L. Martinez Frias **CHECKED BY** L. Daur
NOTES _____

PROJECT NAME Fire Station 14
PROJECT LOCATION Yonkers, NY
GROUND ELEVATION 65 ft NAVD 88 **HOLE SIZE** 4 inches
GROUND WATER LEVELS:
AT TIME OF DRILLING ---
AT END OF DRILLING ---
AFTER DRILLING ---

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 1/11/18 15:43 - P:\PROJ160\160616.048_TECHNICALREPORTS\GINT FILE\FIRE STATION 14.GPJ

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
						5.5 inch thick concrete slab floor	64.5
				GW		(GW) 6-8 inch gravel below the slab, removed by hand to sample at the soil surface	64.0
						(ML) Gray to light brown fine sand, with some silt.	
	SS 1	58	13-7-7-9 (14)	ML			
						(ML) Light brown to red brown fine sand. Trace of silt, rock fragments at the tip of the spoon	62.0
	SS 2	75	29-100	ML			
5						Rock fragments.	60.0
	SS 3	8	8-100				
							58.0

Refusal at 7.0 feet.
 Bottom of borehole at 7.0 feet.

Appendix D
Test Pit Log



M. G. McLAREN, P.C.

100 Snake Hill Road, West Nyack, NY 10994

(845) 353-6400 FAX (845) 353-6509

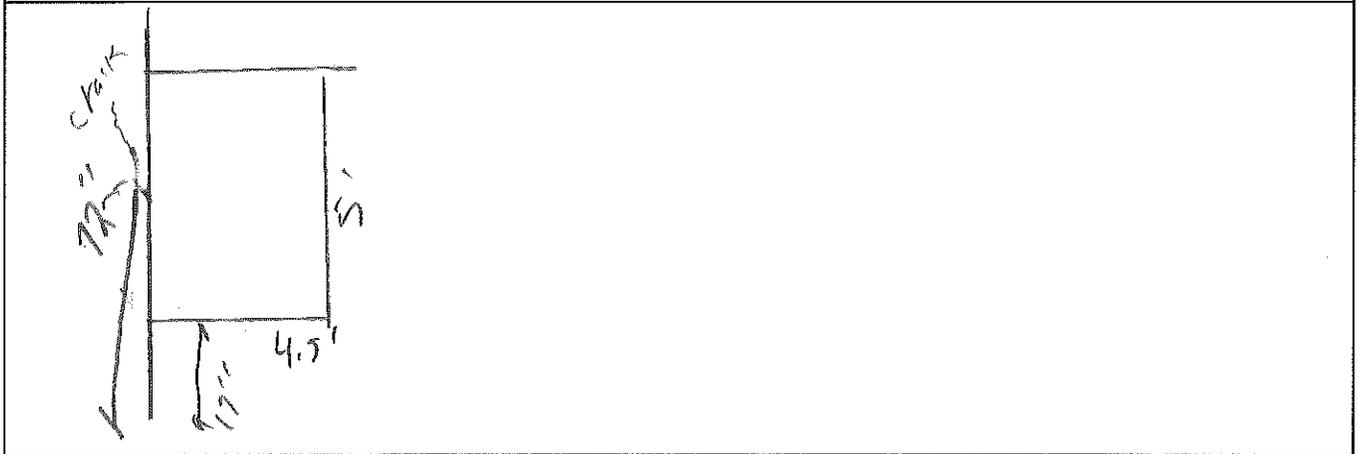
Test Pit Number TP-1
 Project Name _____
 Project Location 1100 ...
 Project Number 160 616.04
 Page No. 1 of _____
 Checked by _____
 Equipment: _____

Excavator Hand Digs
 Foreman Alfred Davis
 Inspector _____
 Date Start 12-13-17 Date End 12-13-17
 Time Start 10:00 AM Time End 3:45 PM
 G.S. Elevation _____ Datum _____

Soil Horizon/Profile:

Depth	Description and Classification	Stratum Description
10'	Asphalt	
3'	light brown - brown fine sand w/ some silt, 3/4" stone	
	6" FOOTING DRAIN - CLAY PIPE	
3'	light brown - brown fine sand.	

Site Sketch:



Remarks
 - Hand dug to 6' - No Foundation Footing reveal
 - Metal Bar was inserted thru the soil, Assume Bed Rock

Notes

Appendix E

Soil Profile



McLaren Engineering Group
 100 Snake Hill Road
 West Nyack, NY 10994
 Telephone: (845) 353-6400
 Fax: (845) 353-6509

SUBSURFACE DIAGRAM Profile A

CLIENT City of Yonkers Fire Department

PROJECT NAME Fire Station 14

PROJECT NUMBER 160616.04

PROJECT LOCATION Yonkers, NY

STRATIGRAPHY & GW - A SIZE - GINT STD US LAB.GDT - 1/11/18 16.02 - P:\PROJ160160616.04\8 TECHNICALREPORTS\GINT FILE\FIRE STATION 14.GPJ

