GEOTECHNICAL ENGINEERING REPORT
for
RIVERSIDE CENTER BUILDING 4
NEW YORK, NEW YORK

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INTRODUCTION

This report presents our geotechnical engineering evaluation and report for the proposed Riverside Center Building 4 of the Riverside Center development project at Block 1171, Lot 157. The report summarizes the results of our subsurface investigation and presents our geotechnical recommendations related to foundation design and construction of the proposed development. Specific recommendations include seismic parameters, foundation system and allowable capacities, settlement ranges, permanent control of groundwater, applied earth loads on the floor slabs and the foundation walls, and excavation issues.

All services were performed in general accordance with our revised proposal, dated 9 March 2015. Our understanding of the project, building layout, and structural systems is based on drawings provided by the project structural engineer (WSP Building Structures -WSP) and the project architect (GHWA Architects, LLP – GHWA). Analyses and recommendations presented in this document are in accordance with the 2014 New York City Building Code 2014 effective 31 December 2014 (Building Code).

All elevations presented herein are referenced to the North American Vertical Datum of 1988 (NAVD88) and were obtained from a Topographical Boundary and Utility Survey, prepared by Langan, dated 9 February 2015.

SITE DESCRIPTION

The Riverside Center development is located on the West Side of Midtown Manhattan and is bordered by West 61st Street to the north, West End Avenue on the east, West 59th Street to the south and West Side Highway and Riverside Drive to the west. A site location map is included as Drawing No. 1.

The Building 4 (or Site 4) project proposes to develop the parcel which is south and mid-span of New York City Block 1171, Lot 157. The site has a footprint area of about 57,400 square feet, with a frontage of about 202 feet along West 59th Street to the south.

The site is currently used for field offices, storage for materials and equipment, and asphalt/gravel parking area for other Riverside Center development parcels. The field offices lie on the western and eastern parts of the site. Site grades range from about 8.5 to 17. Two ramps exist at the northeast corner. The one ramp is to access the Riverside Center Building 2 development with the ramp elevations ranging from about 17 to 24 (sloping up towards Building 2) and the other ramp is access for the Riverside Center Building 5 development with ramp elevations ranging from about 11 to 4 (sloping down towards Building 5). Sidewalk

elevations range between about 12 and 17 (sloping up from the west to east) along West 59th Street.

ADJACENT STRUCTURES AND UTILITIES

The following sections briefly discuss the existing buildings and pertinent existing site improvements in proximity to the proposed development.

Riverside Center Building 1

Directly north of the project site is Riverside Center Building 1. This site will be under construction. The construction consists of a new two-tower structure with one podium connecting the towers below the 12th floor. The western tower will be 39 stories with an overall height of about 460 feet, and the eastern tower will be 27 stories with an overall height of about 300 feet. Both structures will house residential units above the first floor, which will provide a lobby and retail space in each tower. The structure will have a cellar and subcellar level, each with a footprint of about 92,000 square feet. Based off the latest architectural drawings, the subcellar is anticipated to have a finished-floor elevation of about 3.65.

Riverside Center Building 2

At the northeast property line of the project site is Riverside Center Building 2. This site is currently and will be under construction. The construction consists of a new 42-story mixed use educational, residential and commercial building with a footprint area of about 50,000 square feet. The building spans over the Amtrak and light rail easements. One cellar level with a footprint area of about 84,000 square feet has been constructed with the top of the cellar slab at about elevation 4.65.

Riverside Center Building 3

Directly west of the project site will be Riverside Center Building 3. The proposed development will consist of a 39-story mixed-use residential and commercial building with two cellar levels. The finished floor slab of the lowest cellar level will extend about 22.5 feet below the first floor level, corresponding to about el -5.85.

Riverside Center Building 5

Directly east of the project site is Riverside Center Building 5. This site is currently and will be under construction. The construction consists of a new 42-story mixed use residential and commercial building with a footprint area of about 45,000 square feet. Parts of the east end of the building span the Amtrak and light-rail easements. The building will have a cellar and

subcellar level, each with a footprint area of about 65,000 square feet. The subcellar has a finished floor elevation of about el -0.5.

Utilities

Along West 59st Street to the south of the site, sanitary and storm sewers, electric lines, gas lines, and water lines are located within the road embankment. The sewers are located at 13 to 18.5 feet below grade along West 59st Street from west to east, corresponding to el -1.5 to el -1.3. Actual elevations of other utility are unknown at the time of this report. Contractor should confirm utility locations and elevations before excavation and construction.

In addition, a new steam line is proposed for Riverside Center Buildings 1, 3 and 4. The high pressure steam line will connect from the ConEd Building and run along West 59th Street in the east-west direction (connect to Buildings 3 and 4) and turn to run along Riverside Boulevard in the north-south (connect to Building 1).

SITE DEVELOPMENT HISTORY

We have reviewed several historical maps to identify potential construction impacts. The maps indicate that the project site has undergone several cycles of development. Historical maps depicting the site conditions circa 1865, 1860, and 1879 are attached as Drawing Nos. 2 through 4, respectively.

According to "Sanitary & Topographical Map of the City and Island of New York" published in 1865, the proposed building will be situated outboard of the original 17th century shoreline within land reclaimed from the Hudson River. The 1860 Buckhout Map shows an engineered edge along the west and north side of the site. Our conclusion is that the greatest risk for timber cribbing and bulkheads is along the west and north perimeter of the site. Additional waterfront structures may be present within the site.

In addition, the site was occupied by railroad tracks that were part of the larger Union Stock Yard and Market Company and N.Y. Central System R.R. Rail Yard from as early as 1879 and through 1951. The site was later occupied at different times by a stockyard, lumber yard, slaughterhouse, and parking lot.

LOCAL GEOLOGY

The site is on Manhattan Island, within the south terminus of the Manhattan Prong of the New England Upland province. Bedrock in the vicinity of the site generally consists of schist, amphibolite, serpentinite, granite, and pegmatite overlain by glacial and fluvial soil, and

extensive fill. Although urban development has altered the original topography, typically within Manhattan the topography mimics the contours of the underlying bedrock. According to Baskerville (1994), bedrock stratigraphy in the vicinity of the site is part of the Hartland Formation and serpentinite, with rock of the Lower Cambrian age (about 500 to 520 million years ago) to the Middle Ordovician age (about 461 to 472 million years ago) and intrusive rock presumably of the Silurian age (about 417 to 443 million years ago), consisting of granite and megacrystalline pegmatite. The geologic map for the site is included as Drawing No. 8. A large sill of intrusive granite is mapped south of the site from West 50th to West 51th Street. Boundaries between the intrusive granite and schist are not well-defined within the literature as evidenced by intrusive units observed in rock cores throughout the area.

The following list offers generalized descriptions of rocks mapped in the vicinity of the site:

- Hartland Formation – Interbedded units of (1) gray, fine-grained quartz-feldspar granulite containing minor biotite and garnet; (2) fine- to coarse-grained, gray to tan weathering, quartz-feldspar-muscovite-biotite-garnet schist (mica schist); and (3) dark greenish-black quartz-biotite-hornblende amphibolite. Intrusions of granite and pegmatite are common (Baskerville 1994). Foliation is typically oriented either northwest or southeast and dips steeply within Manhattan, as discussed by Baskerville, but may be altered locally as a result of folding.
- Serpentinite – Very dark green to light green serpentinite. The darker rock is magnetic and contains magnetite, chromite, actinolite, and traces of olivine. The lighter colored rock is generally the weathered near-surface part of the rock mass. The rock may be massive or highly fractured and is associated with the surrounding Hartland Formation.
- Granite and Pegmatite – Gray-white-pink medium- to coarse-grained, biotite-muscovite-microcline-quartz granite and megacrystalline pegmatite in dikes less than 3 feet thick and sills greater than 3 feet thick. Accessory minerals include tourmaline, pyrite, garnet, and epidote. A thick sill cuts across the rock of the Hartland Formation as shown in Drawing No. 5.

FEMA Flood Maps

In December 2013, FEMA released preliminary Flood Insurance Rate Maps (FIRM), which incorporate updated flood-hazard models. Select panels were further updated in January 2015 to reflect revised models. However, the parcel for the Riverside Center site was not updated; therefore the 2013 map applies. Effective January 2014, local law 96/2013 from the New York City Department of Buildings (DOB) allows the base flood elevation to be designated from the worst case of the FEMA FIRM 2007 or preliminary FIRM. The preliminary FIRM panel for the Riverside Center site indicates the site partially is within the limits of Flood Hazard Zone AE,

"areas of inundation by the 1 percent annual chance flood (100-year flood)," which has a corresponding Base Flood Elevation (BFE) of about el 11. The preliminary FIRM is shown in Drawing No. 6.

PROPOSED CONSTRUCTION

The proposed Riverside Center Building 4 construction consists of a 33-story mixed use residential and commercial building with two cellar levels. The top of the first floor slab will be about el 21.65 and the lowest cellar level will extend about 27.5 feet, corresponding to about el -5.85.

Limited structural information was available at the time of this report. The structure will be constructed with cast-in-place concrete floors and reinforced concrete columns and shear walls. We have based our recommendations on a total building load of 300 pounds per gross square foot, a lateral base shear of 3 percent of the gravity load, and a hydrostatic uplift head of about 20 feet acting on the underside of the subcellar slab.

SUBSURFACE INVESTIGATION

A series of geotechnical test borings was performed between 28 January 2015 and 3 March 2015 to evaluate the subsurface conditions within the footprint of Riverside Center Building 4. Our investigation included (1) drilling borings with insitu testing- and sampling- of soil and rock; (2) performing cone penetration tests and seismic cone penetration tests (CPT/SCPT); (3) testing recovered soil samples in a laboratory; and (4) reviewing available historical boring data. A brief summary of the investigation follows.

Test Borings

Twenty borings (LB-35 through LB-40, LB-45 through LB-48, LB-52 through LB-54, LB-55, LB-56, LB-58, LB-59, and LB-66 through LB-68) were drilled within the vicinity and footprint of Riverside Center Building 4. In addition, four cone penetration tests (CPT) were predrilled through existing fill soils to bypass potential obstructions. The borings and CPT locations were drilled by Warren George Inc. of Jersey City, New Jersey, between 28 January 2015 and 3 March 2015. All drilling was performed under the full-time special inspection of Langan geotechnical engineers. A plan depicting the locations of the borings and SCPTs is attached as Drawing No. 7.

The inferred borings LB-45, LB-48, LB-52, and LB-58 were drilled to assumed top of rock based off field observations. The other sixteen borings were drilled at least 10 feet into rock to

retrieve rock cores and evaluate rock quality. The SCPT locations were drilled through existing fill soils to depths of about 15 feet below existing grade.

The borings were advanced through soil overburden using mud-rotary drilling techniques with tri-cone roller bits, and a bentonite and water drilling fluid. Temporary flush-joint steel casing was installed through fill and native overburden soils, as required, to stabilize the boreholes and prevent fluid loss during drilling.

The Standard Penetration Test (SPT)[1] was performed in general accordance with ASTM D1586. Penetration values (N-values)[2] and visual soil classifications were recorded by Langan's inspecting engineers. Soils were sampled using a standard 2-inch-diameter split-spoon sampler. In addition, undisturbed thin-walled tube samples were obtained from soft silt-clay soils in accordance with ASTM D1587; 2 undisturbed samples were recovered from 3 attempts. Rock was cored in 13 borings in accordance with ASTM D2113 to assist in determining bedrock depth, type, and quality. All soil and rock samples were visually examined and classified in the field in accordance with ASTM D2487 and the Building Code. Rock core recovery (REC)[3] and rock-quality designation (RQD)[4] were also logged in the field by our inspecting engineers.

Groundwater monitoring wells were installed as part of a Langan environmental investigation of the site. Aquifer Drilling and Testing installed four permanent groundwater wells at the site. Permanent wells were capped and a flush-mount cover was concreted at the ground surface. The locations of the permanent wells are shown in Drawing No. 7.

Copies of the test boring logs are attached as Appendix C.

Cone Penetration Testing and Seismic Cone Penetration Testing

Four cone penetration tests (CPT) were attempted as part of our investigation. Shear-wave velocity measurements were taken at three of the cone penetration tests (SCPT). The SCPT locations are denoted as SCPT-10, SCPT-11, SCPT-13, and SCPT-15. The CPT locations were

1 The Standard Penetration Test is a measure of soil density and consistency. The testing involves driving a 2-inch OD split-spoon sampler a distance of 2-ft, using a 140-lb hammer free falling from a height of 30-inches.
2 N-value – The number of blows required to drive a 2-inch diameter split-spoon sampler 12-inches after an initial "seating" penetration of 6-inches, using a 140-pound hammer falling freely from a drop height of 30-inches.
3 Rock core recovery (REC) is defined as the length of all core pieces recovered divided by the total core run length.
4 Rock Quality Designation (RQD) is defined as the sum of all recovered sound rock core pieces measuring 4-inches or more in length (for type NX, NQ or PQ cores) divided by the total core run length. RQD is a relative indicator of rock quality.

predrilled through existing fill soils and backfilled with sand to bypass potential obstructions. The SCPTs were pushed to depths ranging from about 25 feet to about 45 feet below existing grade. All cone penetration testing was performed in accordance with ASTM D5778 by ConeTec, Inc. of West Berlin, New Jersey, on 25 March 2015.

Cone penetration testing consists of pushing an instrumented stainless steel cone through soil overburden using hydraulic pressure, while continuously collecting data. Field data including cone penetration tip resistance, side friction, pore water pressure, and shear-wave velocities are recorded by ConeTec during the testing. Seismic testing to measure shear-wave velocity (V_s) was performed at about 3.25-foot intervals and consisted of generating vibrations at the ground surface and recording seismic signals at a geophone mounted within the cone apparatus. A copy of the ConeTec CPT/SCPT data is provided as Appendix D.

Previous Subsurface Investigations

August 2011 Langan Investigation for Riverside Center Building 2 (17-29 West End)

Six borings were performed for the proposed Riverside Building 2, which lies northeast of the site. We also reviewed rock elevation data contained in reports on foundation installation at the Riverside Building 2 site. The boring location plan and logs are included in Appendix A.

March and April 2013 Langan Investigation for Riverside Center Building 5 (1-15 West End)

Twenty-four borings were performed for the proposed Riverside Building 5, which lies directly east of the site. We also reviewed rock elevation data contained in reports on foundation installation at the Riverside Building 5 site. The boring location plan and logs are included in Appendix A.

December 2014 and January 2015 Langan Investigation for Riverside Center Building 1

Twenty-nine borings were performed for the proposed Riverside Building 1, which abuts the site directly to the north. We used the information from these borings to develop a better understanding of the bedrock geometry below the site and the anticipated subsurface conditions at the site. The boring location plan and logs are included in Appendix A.

January 2015 Langan Investigation for Riverside Center Building 3

Twenty borings were performed for the proposed Riverside Building 3 which abuts the site directly to the west. We used the information from these borings to develop a better understanding of the bedrock geometry below the site and the anticipated subsurface conditions at the site. The boring location plan and logs are included in Appendix A.

Borings by Others

As part of our subsurface investigation, we also reviewed historical boring data performed in the vicinity of the proposed development. This data included borings and testing performed for the original design of: Riverside Center Building 1, Riverside Center Building 2, Riverside Center Building 3, Building K1, and Building K2. This data was reviewed to evaluate the consistency of the subsurface conditions observed during our field investigation. The historical data documents subsurface stratigraphy and blow counts. Copies of the historical boring logs are provided in Appendix A. In general, the subsurface conditions observed in the Langan investigation correlated well with those of historical borings.

LABORATORY TESTING

Laboratory testing listed below was performed on select soil samples to evaluate the engineering characteristics of the soils within the site and to confirm field classifications. It should be noted that the laboratory testing data presented in this appendix is from samples obtained during the investigation of Riverside Center Building 1.

- Atterberg Limits Determinations – ASTM D4318 (6 tests)
- Organic Content Tests – ASTM D2974 (6 tests)
- Unconsolidated Undrained Triaxial Tests – ASTM D2850 (4 tests)
- Natural Water Content – ASTM D2216 (6 tests)

A copy of the laboratory test results are provided as Appendix E.

SUBSURFACE CONDITIONS

The subsurface conditions presented herein are based on borings performed to date by Langan and review of available historical boring data. A plan indicating the approximate top of rock at each boring is attached as Drawing No. 8. Subsurface profiles drawn in the north-south and east-west orientations of the proposed building footprint are presented in Drawing Nos. 9 and 10.

Uncontrolled Fill [Class 7][5]

A layer of uncontrolled fill is present beneath the entire footprint of the Riverside Center Building 4. The fill is generally consists of heterogeneous mixtures of sand, gravel, and silt with variable concentrations of brick-, asphalt-, and concrete- fragments. Timber was encountered at borings LB-35, LB-36, LB-37, LB-38, LB-40, LB-45, LB-46, LB-52, LB-53, LB-56, and LB-58 (11 borings out of 20 borings) within the fill layer. Based off observations and historic maps, where timber was encountered from about el 5 to el 0 within the fill layer are likely remnants of the railroad ties from the larger Union Stock Yard and Market Company and N.Y. Central System R.R. Rail Yard.

The fill layer extends to depths varying between about 10 and 25 feet, corresponding to elevations of between about -1 and -14 feet. The boring data indicate that the density of the fill varies from loose to very dense, as evidenced by SPT N-values that varied from WOH[6] to greater than 100 blows per foot (bpf); however, in many instances the higher N-values can be attributed to the presence of obstructions (boulders, timber, construction debris, etc); therefore, these N-values are generally not considered a representative indicator of in situ density. Shear wave velocities recorded in this layer varied from about 353 to 664 feet per second.

The fill is generally considered to be in a loose to medium-dense condition. The fill layer is designated as Class 7 – Controlled or Uncontrolled Fill per the New York City Building Code.

Clay [Class 4b, Class 6]

A layer of clay was encountered directly below the fill layer in all borings except LB-48, LB-56, LB-61, and LB-68. This clay layer is generally considered to be a natural soil layer that represents the former riverbed of the Hudson River. The layer predominantly consists of black to gray clay with traces of some silt, fine sand and organic matter. In some cases, the recovered timber, silt or fine sand comprised the predominant portion of the recovered sample.

5 Numbers in brackets indicate classification of soil and rock materials in accordance with the New York City Building Code (2014).

6 WOH = Weight of hammer is penetration of split-spoon sampler under the static weight of a 140 lb hammer in addition to the weight of drilling rods.

The timber could be related to old waterfront structure. The timber was encountered from about el -5 to el -17.

The clay soil typically varies in thickness between about 5 and 16 feet where it is encountered. Where encountered, the top of the clay layer generally dips toward the river. The bottom of the clay layer was observed at elevations between about -10 and -24.

SPT N-values within the clay layer generally varied from weight of hammer (WOR)[7] to 100 bpf. The higher recorded N-values can be attributed to the presence of obstructions (timber) and are not considered representative of in situ density. In general, the clay layer was observed to have SPT N-values less than 5 bpf, indicating that the stratum is very soft to soft.

Six representative samples of the clay layer were tested in a laboratory. Natural moisture contents ranged between 21 and 54 percent. Liquid Limit (LL) ranged between about 48 and 81. The Plastic Limit (PL) ranged between about 21 and 37, and the Plasticity Index (PI) ranged between 9 and 44. Organic content ranged between 1 and 5 percent. Four samples were tested for unconsolidated-undrained triaxial compressive strength (UU). The UU tests show that the undrained shear strength (s_u) of the samples varied between about 474 and 1340 pounds per square foot. Shear wave velocities in this layer varied from about 371 to 613 feet per second.

This clay layer generally is classified as CL-OL or CH-OH, and is designated as Class 6 or Class 4b per the New York City Building Code.

Sand [Class 3b]

A discontinuous thin layer of brown to reddish-brown medium to fine sand with variable concentrations of silt is present beneath the clay at 5 of the 20 boring locations. Where encountered, the sand layer varies in thickness between about 4 and 10 feet and appears at depths between about 22 and 31 feet below existing grade. The bottom of sand layer was observed at elevations between about -16 and -32 feet.

7 WOH = Weight of hammer is penetration of split-spoon sampler under the static weight of a 140 lb hammer in addition to the weight of drilling rods.

SPT N-values varied between 9 and 100 bpf within the sand stratum. The higher recorded N-values can be attributed to the presence of timber or boulder obstructions and are not considered representative of in situ density. In general, the sand is considered to be medium-dense with representative blow counts between 10 and 30 bpf. Shear wave velocities in this layer varied from about 880 to 1,110 feet per second.

The sand layer is classified as SM and SP – silty sand to poorly graded sand and is designated as Class 3b per the New York City Building Code.

Weathered Decomposed Bedrock [Class 1d]

A discontinuous weathered, decomposed rock layer was present in borings LB-48 and LB-68. The deposit maintains the grain structure of the parent bedrock but has weathered such that it breaks down to sand and silt under finger pressure. The material has no apparent unconfined strength and was readily sampled by standard penetration testing. The thickness of the weathered rock layer varied between 3 and 9 feet where it is encountered. The top of the stratum varies between about 19 and 41 feet below existing grade, corresponding to elevations between about -4 and -33. Field SPT N-values in the weathered rock ranged from 28 bpf to greater than 100 bpf.

The weathered rock layer classified as Class 1d – soft rock/weathered rock per the New York City Building Code.

Bedrock [Classes 1a – 1c]

Bedrock was cored in 14 borings during our study. The top of the bedrock layer was observed at depths varying between about 20 and 46 feet below existing grade, corresponding to elevations between about -5 and -37. The bedrock surface is irregular at Riverside Center Building 4, but generally slopes downward from south to north and east to west.

Bedrock consists of dark gray-tan mica schist with sills and dikes of granitic rock. The bedrock is typically comprised of biotite, muscovite, quartz, hornblende, plagioclase feldspar, garnet. Schist has a higher concentration of mica minerals, while granite has higher concentrations of quartz and feldspar. The schist appears to be complexly folded, often with steeply dipping angles greater than 45 degrees from horizontal, while the granite is phaneritic to porphyritic with coarse mineral grains. Weathering of the bedrock was variable ranging from fresh to slightly weathered. Increased weathering was often noted at contacts between schist and pegmatite and at zones of increased fracturing. Most fractures in the schist are parallel to the foliation. Fracture spacing varied from close to wide. In general, fracture spacing was observed

to vary from very close to close. Some fractures in rock are filled with silty and clayey materials. The bedrock was typically moderately hard to very hard, but was observed to be softer in more weathered zones. The granite rock is usually harder than schist.

Rock core recovery (REC) varied between 38 and 100 percent for the standard NX cores. Rock-quality designations (RQD) varied between 35 and 100 percent. In general, the rock is of a competent nature with RQD values exceeding 50 percent.

The bedrock is designated as Class 1a – hard rock, 1b – medium rock, and 1c – intermediate, per the New York City Building Code.

Groundwater

Groundwater levels were measured using a water-level indicator in the four existing Langan environmental wells identified as MW-100, MW-117, MW-136, and MW-138. All wells are situated within the site boundary except for MW-117 and MW-138, which are situated approximately 15 to 20 feet from the western property line of the project site. All monitoring-well locations are shown on Drawing No. 7. Groundwater was measured at elevations within the wells between -5.0 and 2.0.

SEISMIC DESIGN PARAMETERS

The project seismic design parameters were developed as part of a site-specific seismic study. The 24 April 2015 Langan site-specific seismic study is attached as Appendix E. A summary of the site-specific seismic study results is as follows:

- The project Site Class is ***E***.
- The short and 1-second-period design accelerations (***S_{DS}*** and ***S_{D1}***) were obtained from the project site-specific recommended design response spectrum in accordance with the Building Code and ASCE 7-10 seismic design provisions. The recommended design accelerations are as follows:

  S_{DS} = 0.390 g……at period of 0.2 second

  S_{D1} = 0.136 g……at period of 1.0 second

  The full acceleration response spectrum is provided as Figure 10 in Appendix F.
- The Seismic Design Category for the project was determined to be ***C*** for Risk Category Groups I and II.
- There is an adequate margin of safety against soil liquefaction; liquefaction need not be considered when designing the structure.

FOUNDATION RECOMMENDATIONS

The proposed development will include two cellar levels with the lower cellar top of slab elevation at about -5.85. The bottom of slab elevation is at about -8.35. Approximately half of the proposed foundation level of the building is within the uncontrolled fill and soft clay river sediment layer. Both these deposits are not suitable for foundation support.

Two foundation types are recommended because of the sloping rock surface: (1) shallow foundations consisting of concrete piers bearing on bedrock, and (2) deep foundations consisting of either driven piles bearing on competent bedrock or drilled caissons socketed into competent bedrock. Details of each system are presented below.

Shallow Foundations

Concrete piers, footings, or a mat bearing on rock are recommended to support loads in areas where competent bedrock is within 7 feet of the foundation subgrade level. Bedrock that is Building Code Class 1c or better is a nominally satisfactory bearing material and is suitable to support the anticipated column loads. Refer to Drawing No. 8 for approximate location of shallow foundations. We recommend an allowable bearing capacity of 20 tons per square foot (tsf), and an inherent factor of safety of at least 3.

We recommend an ultimate frictional coefficient of 0.70 for mass concrete poured on clean sound rock for footings bearing directly on rock. Lateral loads can be resisted by friction in the bottom of the footing. We recommend a minimum factor of safety of 1.5 when evaluating friction resistance. If additional resistance is needed, footings may be embedded into rock. We should be contacted to evaluate passive pressure on embedded footings, if needed.

We recommend that individual footings have a minimum area of 9 square feet and that column footings have a minimum width of 2 feet.

Subgrade Preparation

For rock bearing surfaces, use compressed air to clean all rock-bearing surfaces. The rock bearing surface should be clean and dry until concrete is placed. All bearing surfaces must be level and clear of debris, standing or frozen water, and other deleterious material. Protect the approved subgrade surface until the footing construction is completed if concrete is not placed within 24 hours. Methods of protection include sealing with lean concrete (mud-slab).

A geotechnical engineer from an accredited Special Inspection Agency must verify bearing material during the excavation, in accordance with Building Code requirements. The foundation

subgrade should be inspected and approved by a professional geotechnical engineer to assure that the subgrade material is adequate to provide the recommended allowable bearing pressure.

Estimated Settlement

The estimated maximum settlement for the piers bearing on the bedrock is 0.5 inches with a maximum differential settlement between adjacent columns of 0.375 inches. The settlement will occur as the foundation load is applied.

Deep Foundations

We recommend driven piles end bearing on competent bedrock or drilled caissons socketed into competent bedrock to support loads in areas where bedrock is greater than 7 feet below the bottom of the pier/pile cap.

Driven H-Piles

The basic maximum allowable capacity given in the Building Code for piles end-bearing on bedrock is 150 tons. H-piles driven to Class 1-c (or better) rock could achieve an allowable capacity of about 150 tons per pile. To obtain the 150 ton-capacity, we recommend the use of an HP 14x89. The steel section shall conform to ASTM A572 Grade 50 (minimum F_y = 50ksi). All H-piles should be fitted with protective points, such as the Hard-Bite manufactured by Associated Pile Fitting Corp., or equivalent. The final pile-driving resistance will be determined based on the results of pile static and dynamic testing (see subsequent section). The pile contractor should submit the final selected pile size and a wave-equation analysis for the proposed pile-driving hammer assembly prior to the start of construction. The estimated pile lengths of piles bearing on Class 1-c or better rock are between about 9 and 27 feet.

The estimated spring constant for compression is 1050 kips/in. The estimated lateral load capacity for the 150 ton-capacity driven pile is 1 ton for the free head condition for piles with lengths less than 15 feet and 4 tons for piles with lengths greater than 15 feet. These values should be verified in the field by load tests.

The Contractor should perform and submit a wave equation analysis (WEAP), including driving stresses in the pile once a final pile section and driving hammer are selected to ensure that the pile is not overstressed during installation and to develop driving criteria. The analysis is necessary to help evaluate whether the proposed pile can achieve the allowable capacity without damaging the pile.

Caisson Piles - Drilled into rock

Caissons drilled into rock are a feasible alternative to H-piles. The caissons provide higher compression than driven H-piles and have significant tension capacity.

A caisson consists of an open-ended steel pipe drilled to the top of rock and an uncased rock socket. After drilling, the entire shaft is filled with concrete or grout and steel reinforcement bars or structural steel. Caissons develop axial load capacity through peripheral shear resistance between the concrete and bedrock.

We have considered a nominal 13-3/8-inch-diameter or 18-inch-diameter steel caisson piles socketed into Class 1-c rock or better bedrock to achieve several loading conditions. Different caisson options are summarized in Table 1 below. The rock socket should be sized using a peripheral shear resistance of 200 psi for compressive strength and 100 psi for tension strength. The Building Code does not require load tests for the caisson piles; however, each caisson must be inspected using a down-the-hole video camera.

TABLE 1 – Drilled Caisson into rock – Estimated Capacities

Casing Diameter (inches)	Socket Diameter (inches)	Axial Capacity (tons)	Uplift Capacity (tons)	Spring Constants (kip/in)		*Rock Socket Length (ft)	Reinforcement (Grade 75)
				compression	tension		
13.375	11	150	75	5,600	1,500	5	1 - #18
		300	150	6,500	2,500	11	3 - #18
		400	200	7,000	3,000	14	4 - #18
18.000	17	750	375	13,000	5,700	12	12 - #18

(*) The rock socket lengths include a sacrificial 2-feet-length to account for fractures close to the top of rock.

The estimated lateral load capacity for each caisson is 5 tons for the free head condition. This value should be verified in the field by lateral load tests.

Pile Spacing

We recommend maintaining a minimum center-to-center spacing of 2.5 times the pile diameter or a minimum of 4 feet, and a pile-driving sequence that starts from the middle of the pile group and proceeds toward the edge.

Pile Installation Issues

Obstructions including timber, brick, boulders, and historical waterfront structures may be encountered during pile installation throughout the site. Spudding or predrilling during pile driving will likely be needed to bypass the obstructions. A higher than usual pile rejection rate may result. Alternatively, the driven piles can be replaced with caissons, which can typically penetrate obstructions.

Individual piles in a pile group should be installed in a sequence so the soil surrounding the piles is not densified to the extent that other piles in the group cannot be installed properly. Pile driving may also cause previously installed piles to heave because of dilatency (volume expansion) of the dense granular soils. Thus, all piles must be surveyed immediately after installation, and all piles that have heaved more than ¼ inch must be retapped to the required level and resistance.

Index Piles and Load Tests

Compression

We recommend installing about 5 percent of proposed piles within the building footprint as index piles when pile-driving begins. The index piles allow for determining pile lengths, confirming capacities, identifying unusual driving conditions, and identifying the need for spudding or predrilling to bypass obstructions. Dynamic pile-testing (Pile Driving Analyzer or PDA testing) should be performed while driving index piles to monitor driving-induced stresses in the piles and to confirm driven capacities. The pile-driving records and the PDA results will be used to select the piles to be load-tested. The index piles may be used as production piles, if properly installed.

The use of driven piles as a foundation element will require static pile-load testing in accordance with the Building Code. The load tests should be performed before installing the production piles. The compression load test must be applied in seven increments to a proof load of twice the design load, and sustained for a period of not less than 12 hours. The building footprint area of the site is about 57,400 square feet; therefore, three load tests would be required to satisfy Building Code requirements (Section 1808.4.1.1).

Lateral Capacity

The Building Code allows a maximum lateral load of 1 ton per pile. For greater loads, the pile or caisson capacity must be demonstrated by lateral load tests. We recommend two lateral load test for each deep foundation element (6 lateral load tests). The allowable lateral movement for

the pile head is 3/8 inches at the design load, and 1 inch at twice the design load. The lateral load test should be performed in accordance with ASTM D3966-90 and the Building Code.

Estimated Settlement

We estimate the pile-cap settlements to be less than 0.5 inches plus the elastic shortening of the pile for end-bearing. Differential settlement between adjacent columns is estimated at 0.5 inches or less for end-bearing piles and should be confirmed after the results of the pile load tests are available. The majority of the settlement is expected to occur during construction as the dead weight of the structure is applied.

Permanent Tie-down Anchors

If supplemental tension capacity is required at columns or between columns, we recommend permanent tie-down anchors. Permanent tie-down anchors should consist of a steel casing advanced to the top of Class 1-c or better rock and a rock socket drilled into the rock. The steel reinforcement should consist of double corrosion-protected Dywidag or SAS threaded bars meeting ASTM A-22 requirements. The free stress (unbounded) length should be at least 15 feet long, but additional length may be required to transfer load below existing or proposed foundations and increase rock stability. The anchor bond length should be proportioned using an allowable peripheral shear resistance in uplift of 100 psi. The free stressing length of bar should be proportioned such that the dead weight of the engaged rock mass is greater than the individual anchor load or the sum of the group anchor loads. Estimated permanent tie-down anchor capacities are summarized in Table 2.

TABLE 2 –Permanent Tie-Down Anchors – Estimated Capacities

Anchor Name	Threaded Bar Diameter (inches)	Threaded Bar Grade	Design Load (kips)	Minimum Drill Hole Diameter (inches)	Minimum Bond Length (feet)	Minimum Free Length (feet)
A	2-1/4	150	300	5	16	15
B	3		500	6	22	
C	3		600		27	

The actual design capacity of the anchors should be evaluated once the building design loads are finalized. Ten percent of the tie-down anchors should be performance tested (creep) to 133 percent of their design load. The remaining anchors should be proof-tested to 133 percent of

their design load. Successfully tested anchors should be locked off at a load exceeding the sum of the design load, seating loss, and long-term losses.

OTHER GEOTECHNICAL RECOMMENDATIONS

The following section provides our recommendations geotechnical-related design parameters including permanent groundwater control; slab support; permanent below-grade walls; and utility support.

Permanent Groundwater Control

Design Flood Elevation

Executive Order No. 203, issued by Mayor Bloomberg, dated 31 January 2013, the minimum lowest floor elevation for Structural Occupancy Category II buildings - the design flood elevation (DFE) - is equal to the base flood elevation plus 1 foot. For this site, the DFE is el 12 NAVD88.

Flood-zone requirements pertaining to the building use, occupancy, finishes, location of mechanical and electrical utilities and related service equipment are covered in Appendix G (Flood-Resistant Construction; Building Code and ASCE 24 (Flood Resistant Design and Construction). The project architect must confirm that the building design complies with these requirements.

Flood-zone insurance premiums may govern the use of a higher slab elevation or more stringent flood-zone compliance than stated herein. Flood-zone code compliance does not necessarily exempt flood-zone insurance premiums for the development.

Our recommendations are based on the current Preliminary FIRM Map, dated 5 December 2013, prepared by FEMA. While the Building Code and insurance requirements can guide design, consideration for future sea level rise above and beyond the currently required Design Flood Elevation is an ownership risk-management decision weighing additional capital costs and aesthetic impact against potential loses during a flood.

Waterproofing

To limit seepage and water-vapor infiltration (through the concrete, cold joints, shrinkage cracks, and utility penetrations), we recommend that the lower slab and the foundation walls be fully waterproofed to the DFE, el 12. In addition, any building section or component (openings, doors, etc.) constructed below the floodplain should be equipped with flood barriers to prevent water infiltration.

We recommend using a membrane-type waterproofing, such as products by W.R. Grace, for below the cellar slab, pile caps and along the exterior of foundation walls to the design flood elevation. The foundation waterproofing should connect to the above grade waterproofing. The use of bentonite waterproofing or negative-side crystalline waterproofing is not recommended. For horizontal applications, we recommend that the waterproofing membrane be installed on a 2-inch concrete working surface (mud slab). For vertical applications, the foundation walls should be protected with drainage panels.

Quality control is critical to a successful waterproofing project. Careful installation, diligent protection, and close oversight are critical to produce a final product that limits the potential for seepage. We recommend that warranties be obtained from the manufacturer and installer to cover materials and workmanship. Only certified installers should be used to perform the work. Detailed inspections should be performed to document any damage resulting from the contractor's activities and any repairs performed immediately. A representative of the manufacturer should perform a final inspection of the waterproofing in coordination with the geotechnical engineer, and should approve all waterproofing work prior to concrete pours.

Cellar Slab

A slab-on-grade is not considered a feasible option for the cellar slab. The top of the lowest-level cellar slab will be at about el -8.35 and will be constructed partially within variable soils including uncontrolled fill, a compressible clay layer and below the water table. The cellar floor slab must be designed as a structural slab and must be designed to resist a hydrostatic uplift pressures resulting from the groundwater level at the DFE of el 12.

Permanent Below-Grade Walls

Permanent below-grade walls should be designed to resist static earth pressures, surcharge loads, and hydrostatic pressures. The sidewalk elevation along West 59th street ranges from about 12 to 17. Our recommended lateral earth-pressures diagram is presented in Drawing No. 11.

Dynamic lateral loads need not be considered because the site is ***SDC C*** (Building Code Section 1802.2).

Utility Support

Utilities constructed below the structural slab may be subjected to settlements caused by consolidation of the compressible and loose alluvial layers and inconsistent uncontrolled fill. Therefore, we recommend that the below-slab utilities be located in utility chases cast within

the structural slab. Where the utility pipes transition from the pile-supported building to on-grade support, flexible connections should be used.

SITE PREPARATION AND GENERAL CONSTRUCTION RECOMMENDATIONS

The following sections present our recommendations related to earthwork; excavations; temporary below-grade walls; construction dewatering; special inspections; fill materials, placement, and compaction; and construction documents.

Excavation

According to the schematic design, the top of the proposed cellar level will be at about el -5.85 and the general subgrade excavation will be at about el -8.35. Therefore, the cellar-level construction will require a general excavation of between about 20 and 27 feet below existing grades. The excavation for the pile caps and the elevator pits/core will likely extend between 4.5 and 14 feet deeper than the cellar-level depths, respectively.

Site excavation can likely be performed using conventional earth-moving equipment (e.g. backhoes, excavators, etc.). Some obstructions and timber should be anticipated. All excavation operations should be performed in accordance with the Occupational Safety and Health Administration (OSHA) requirements, including but not limited to, use of temporary shoring, trench boxes, and proper benching.

The eastern and south portion of the site will likely require excavation within competent bedrock. See Drawing No. 8 for an estimated top of rock contour plan. Rock excavation will require very sensitive and careful removal techniques due to the close proximity of the adjacent buildings in construction and street utilities. The bedrock will likely be difficult to excavate, requiring rock chipping and splitting techniques. Line or channel drilling should be considered to minimize rock overbreak during subsequent chipping and splitting work. Line drilling consists of closely spaced drill holes (say 4 to 6 inches) drilled along the line of excavation. Channel drilling consists of overlapping drill holes such that a continuous channel is constructed along the excavation line. Localized support of rock wedges with bolts should be expected in the elevator pit/core. A formal design should be provided by the contractor's professional engineer registered in the state of New York.

Additionally, the adjacent structures to the north and east must not be undermined by the proposed excavation. Measures should be taken to prevent raveling of soil from around and beneath the adjacent structure foundation, and slab elements.

Temporary Support of Excavation

We have evaluated temporary excavation and support systems and our recommendations are provided below:

Concrete Pier "Buttons"

Temporary excavation support and earth retention would be necessary to provide lateral support for the soil and to prevent raveling of soil from beneath slab elements. This may be true along property lines where:

- Adjacent buildings are founded on pier or piles extending to bedrock (along the east side of the site)

For these situations, we recommend that the soil be retained with a temporary excavation support system consisting of concrete pier "buttons" and timber lagging extending from the bottom of the adjacent grade or floor slab to the bottom of the excavation for the proposed building. External lateral support should be provided as necessary in the form of drilled tiebacks at each concrete pier.

Sheet Piles

An interlocking sheet pile system is a feasible option for the temporary retaining system. The sheet pile would be beneficial since the excavation extends below the water table. Sheet pile would serve as a cut off and significantly reduce temporary dewatering effort. The north wall and south wall for the site will already consist of sheet pile wall systems from the temporary support systems from Riverside Center Buildings 1 and 3 respectively.

External lateral support should be provided as necessary in the form of drilled tiebacks, steel rakers, or corner braces as needed.

The contractor must evaluate that the entire temporary excavation system works; the temporary dewatering and the cost/risk factors associated with this system.

Temporary Groundwater Control (During Construction)

Based on the review of the proposed construction, temporary construction dewatering is anticipated to be limited to the pile caps and elevator pits. Groundwater was measured between el -5.0 and 2.0. Dewatering should be assumed for any excavations extending below the high groundwater table. The Contractor's dewatering system should be adequate for maintaining a "dry" subgrade during normal operating conditions.

Dewatering within the site will require permits from the New York City Department of Environmental Protection (DEP). Confirmation with the DEP should be done that the existing sewers around the site are of adequate size to handle the projected groundwater discharge volumes.

Fill Materials, Placement, and Compaction

Structural fill placed to establish the finished subgrade beneath pile caps and floor slabs or as backfill behind walls should consist of a granular material having no more than 10 percent fines passing the No. 200 sieve. All fill materials should be free of trash, debris, roots, vegetation, peat, or other deleterious materials and should be approved by the Geotechnical Engineer prior to placement. Lean concrete or controlled low strength material (CLSM) may be substituted for structural fill.

Where wet subgrades are present resulting from excavating below groundwater, we recommend that initial placement fill consist of free draining gravel or crushed stone in an effort to stabilize the subgrade. Free draining gravel or crushed stone should conform to the requirements of New York State Department of Transportation Item 605.0901, Underdrain Filter Type I or AASHTO No 57 stone.

Fill should be placed in uniform loose lifts not exceeding 8-inches in open areas and 4-inches in confined areas. All fill should be compacted to at least 92% of its maximum dry density as determined by ASTM D1557. Compaction within 5-ft of foundation walls should be performed using hand operated equipment. The water content at the time of compaction should be within a two percent of the optimum value determined by ASTM D 1557.

Fill should not be placed on subgrades not inspected and approved by the Geotechnical Engineer. All imported fill must meet standards by the Office of Environmental Remediation (OER) and the approved Remedial Action Work Plan (RAWP) requirements.

Preconstruction Conditions Documentation and Monitoring

Preconstruction-conditions documentation of the neighboring buildings should be performed. The documentation would provide the owner with documentation of the existing conditions as a baseline in the event of a future damage claim. On the basis of this documentation, an observational and instrumentation program should be designed for monitoring the performance of adjacent structures and evaluating construction procedures.

During excavation-support construction and active pile installation, an optical-survey program should be implemented to monitor for vertical and horizontal movements of surrounding structures and the excavation-support system. The survey should be performed every other week, with measurements taken to the nearest 0.01 feet. The survey should be performed by a licensed surveyor. The recommended allowable lateral movement of the perimeter walls is 3/4 inches, and the allowable ground settlement behind the wall is 3/4 inches. Work should be temporarily stopped if movements (vertical or horizontal) exceed about 1/4 inches over two readings or a movement trend develops over several readings. Criteria for allowable movements of structures should be finalized after a building's preconstruction conditions documentation is completed. The status of the excavation support system should be reviewed when the vertical or lateral movements reach one-half the threshold limits.

SERVICES DURING DESIGN, CONSTRUCTION DOCUMENTS, AND CONSTRUCTION QUALITY ASSURANCE

During final design we should consult with the design team as geotechnical questions arise. Technical specifications and design drawings should incorporate Langan's recommendations. Langan will assist the design team in preparing specification sections related to geotechnical issues such as earthwork, ground improvement, foundations, backfill and excavation support. Langan should also review the project plans, as well as contractor submissions relating to materials and construction procedures for geotechnical work, to confirm the designs incorporate the intent of our recommendations.

Langan has investigated and interpreted the site subsurface conditions and developed the foundation design recommendations contained herein, and is, therefore, best suited to perform quality-assurance observation and testing of geotechnical-related work during construction. The work requiring quality assurance confirmation or special inspections per the Building Code includes, but is not limited to, earthwork, backfill, ground improvement, foundations, and excavation support.

Recognizing that construction observation is the final stage of geotechnical design, quality-assurance observation during construction by Langan is necessary to confirm the design assumptions and design elements, to maintain our continuity of responsibility on this project and allow us to make changes to our recommendations, as necessary. The foundation system and general geotechnical construction methods recommended herein are predicated upon Langan assisting with the final design and providing construction observation services for the owner. If Langan is not retained for these services, we cannot assume the role of geotechnical

engineer of record, and the entity providing the final design and construction observation services must serve as the engineer of record

OWNER AND CONTRACTOR RESPONSIBILITIES

The contractor is responsible for construction quality control, which includes satisfactorily constructing the foundation system and any associated temporary works to achieve the design intent while not adversely impacting or causing loss of support to neighboring property, structures, utilities, roadways, etc. Construction activities that can alter the existing ground conditions such as excavation, fill placement, foundation construction, ground improvement, pile driving and drilling, dewatering, and other activities can also induce stresses, vibrations, and movements in nearby structures and utilities, and can disturb occupants. Contractors are solely responsible for ensuring that their activities will not adversely affect the structures and utilities and will not disturb occupants. Contractors must also take all necessary measures to protect the existing structures, utilities, during construction. By using this report, the owner agrees that Langan will not be held responsible for any damage to adjacent structures, utilities, etc.

The preparation and use of this report is based on the condition that the project construction contract between the owner and their contractors will include (1) Langan being added to the Project Wrap and Contractor's General Liability insurance as an additional insured, and (2) language specifically stating the foundation contractor will defend, indemnify, and hold harmless the owner and Langan against all claims related to disturbance or damage to adjacent structures, utilities, etc or properties.

LIMITATIONS

The conclusions and recommendations provided in this report result from our interpretation of the geotechnical conditions existing at the site inferred from a limited number of borings, SCPT tests, and other explorations, as well as architectural and structural information provided by GHWA, and WSP. Actual subsurface conditions may vary. Recommendations provided are dependent upon one another and no recommendation should be followed independent of the others.

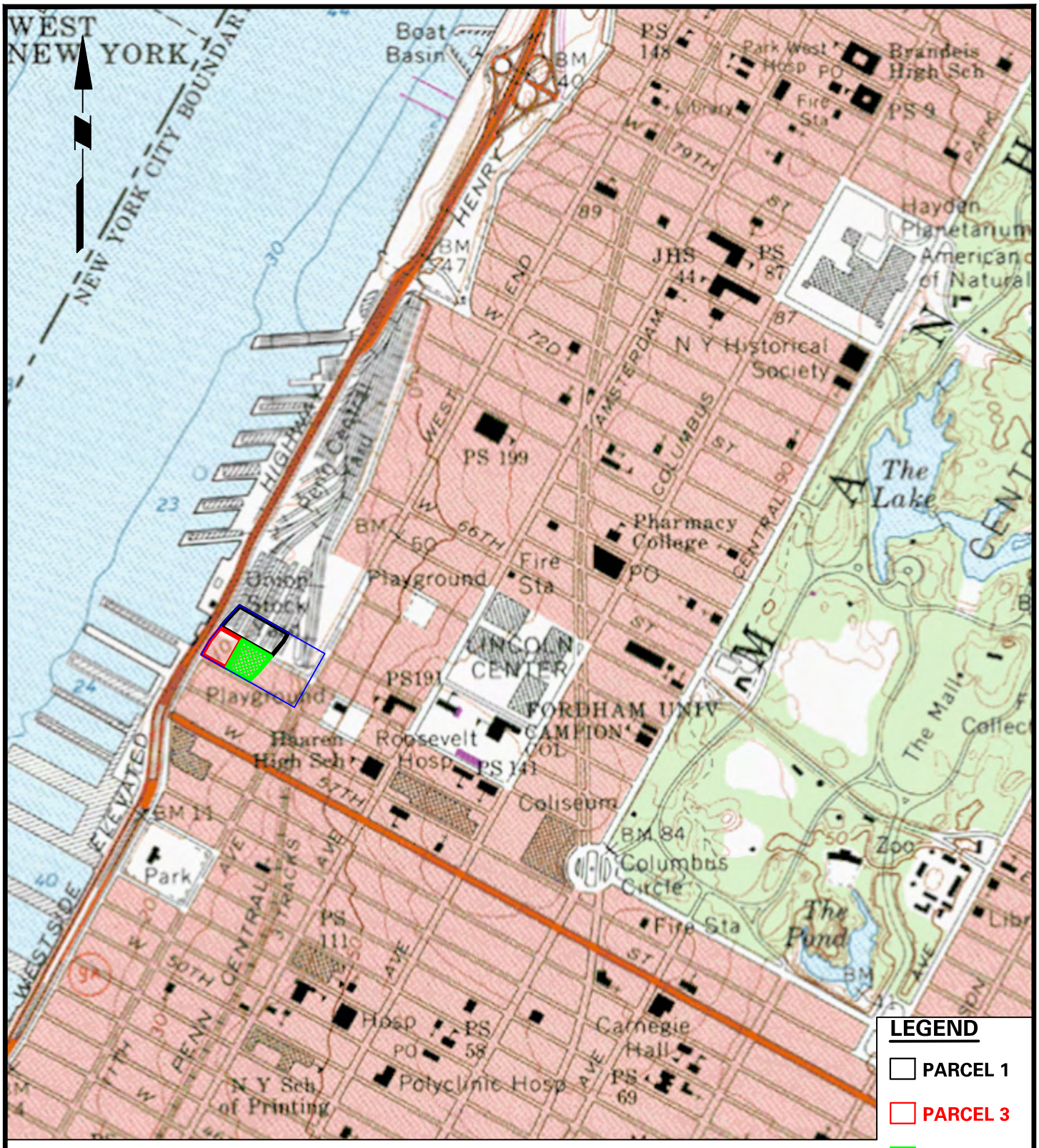
Any proposed changes in structures or their locations should be brought to Langan's attention as soon as possible so that we can determine whether such changes affect our recommendations. Information on subsurface strata and groundwater levels shown on the logs represent conditions encountered only at the locations indicated and at the time of investigation. If different conditions are encountered during construction, they should

immediately be brought to Langan's attention for evaluation, as they may affect our recommendations.

This report has been prepared to assist the owner, architect, and structural engineer in the design process and is only applicable to the design of the specific project identified. The information in this report cannot be utilized or depended on by engineers or contractors who are involved in evaluations or designs of facilities (including underpinning, grouting, stabilization, etc.) on adjacent properties which are beyond the limits of that which is the specific subject of this report.

Environmental issues (such as obtaining or satisfying permits, or potentially contaminated soil and groundwater) are outside the scope of this study and are addressed in a separate evaluation.

Drawings



SOURCE: U.S. GEOLOGICAL SURVEY. CENTRAL PARK Quandrangle Map.1967. Photorevised 1979.

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Project

RIVERSIDE CENTER: BUILDING 4

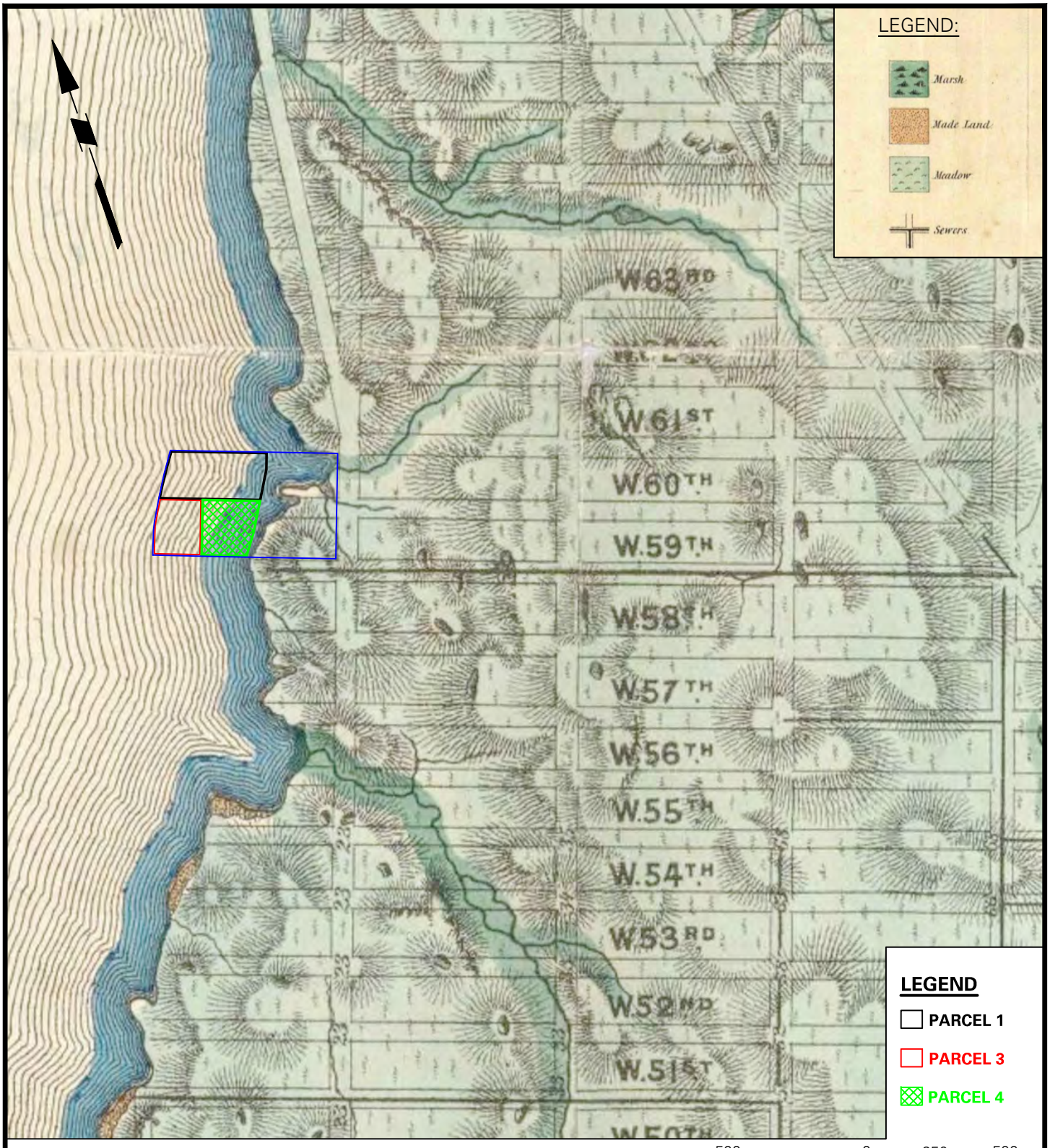
BLOCK No. 1171, LOT No. 157
MANHATTAN
NEW YORK NEW YORK

Drawing Title

SITE LOCATION MAP

Project No. 170275404	Drawing No. 1
Date 04/24/2015	
Scale 1" = 500'	
Drawn By JSH	
Submission Date 04/24/2015	Sheet 1 of 11

Filename: \\langan.com\data\NY\data4\170275401\Cadd Data - 170275401\SheetFiles\2015_ Geotechnical Report_R4\DWG01- Site Location Map.dwg Date: 4/24/2015 Time: 21:40 User: zwu Style Table: Langan.stb Layout: ANSIA-BP



SOURCE: "SANITARY & TOPOGRAPHICAL MAP OF THE CITY AND ISLAND OF NEW YORK", VIELE, 1865.

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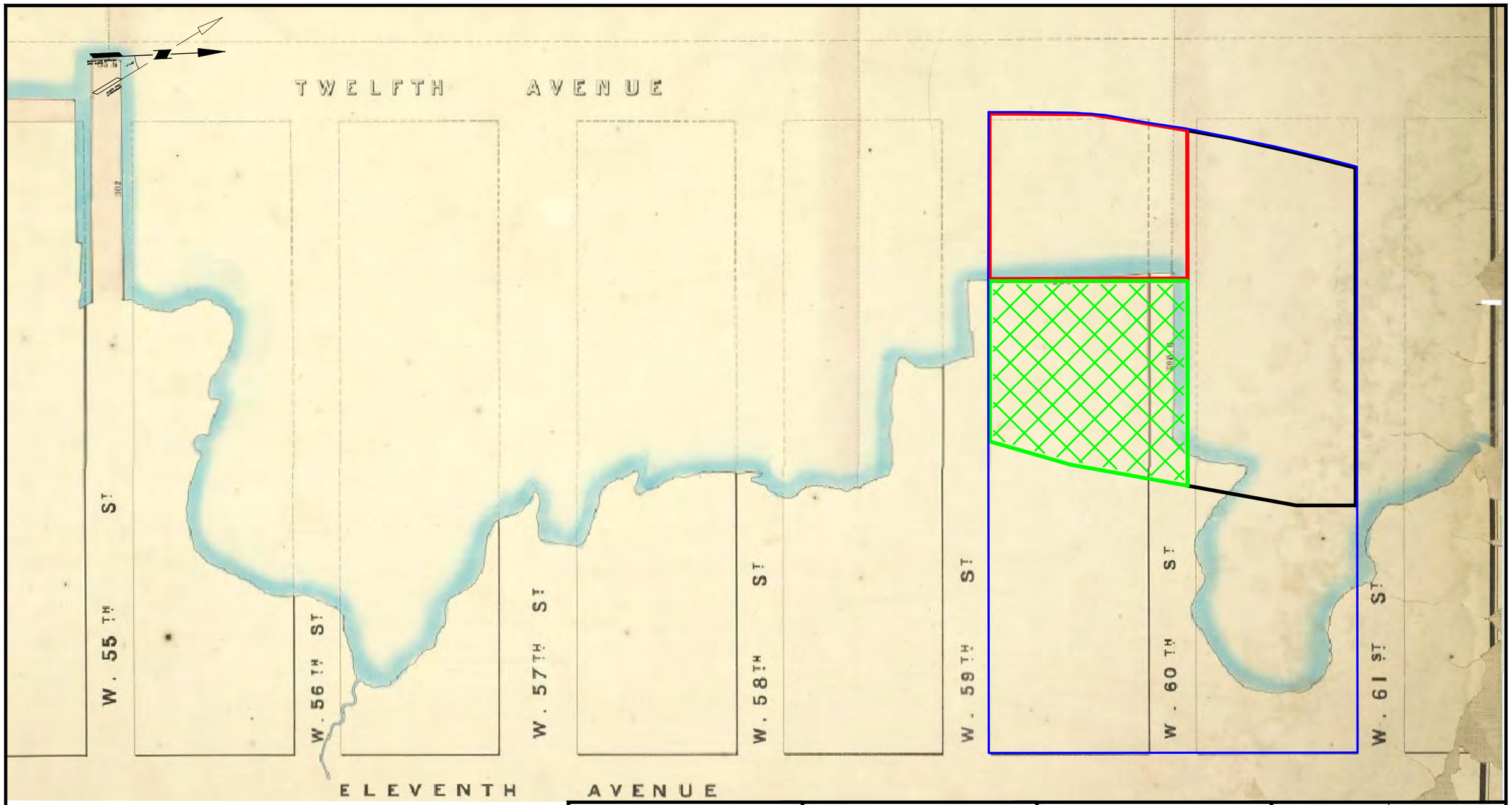
Drawing Title

HISTORICAL SITE MAP (1865 VIELE)

Project No. 170275404	Drawing No. 2
Date 04/24/2015	
Scale 1" = 500'	
Drawn By JSH	
Submission Date 04/24/2015	Sheet 2 of 11

Filename: \\langan.com\data\NY\data4\170275401\Cadd Data - 170275401\SheetFiles\2015_ Geotechnical Report_R4\DWG02 – Viele Map.dwg Date: 4/24/2015 Time: 21:41 User: zwu Style Table: Langan.stb Layout: ANSIA-BP



REFERENCE:

ATLASES OF NEW YORK CITY, MAPS OF THE WHARVES & PIERS FROM THE BATTERY TO 61ST STREET ON THE HUDSON RIVER AND FROM THE BATTERY TO 41ST STREET ON THE EAST RIVER, NEW YORK. SURVEYED BY I.C. BUCKHOUT, CITY SURVEYOR, 1860

LEGEND

- PARCEL 1
- PARCEL 3
- PARCEL 4

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RIVERSIDE CENTER: BUILDING 4

BLOCK No. 1171 LOT No. 157
MANHATTAN
NEW YORK **NEW YORK**

Drawing Title

HISTORICAL SITE MAP (1860 BUCKHOUT)

Project No. 170275404	Drawing No. 3
Date 04/24/2015	
Scale N.T.S	
Drawn By JSH / Checked By JD/JMG	
Submission Date 04/24/2015	Sheet 3 of 11

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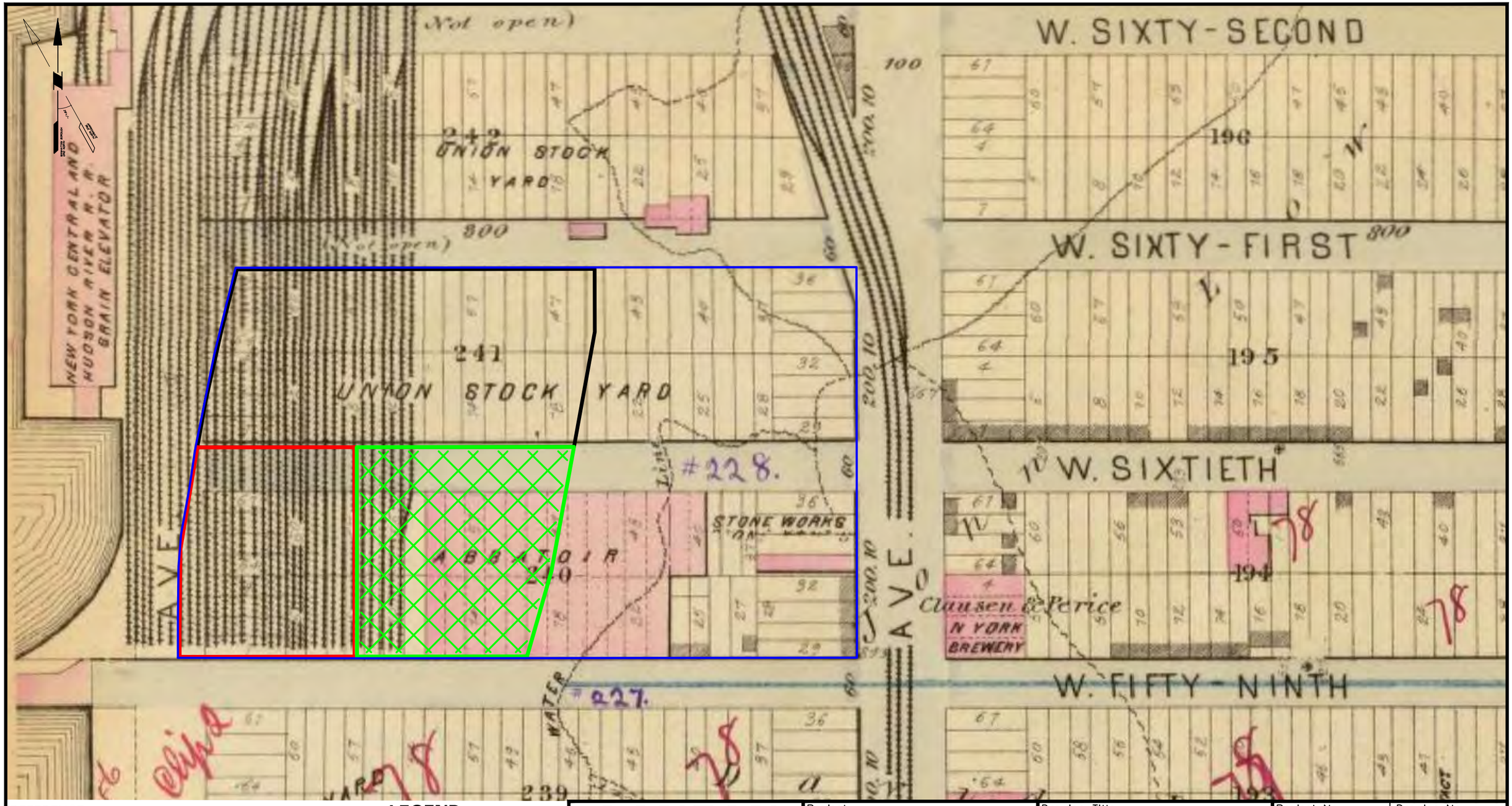

REFERENCE:
OUTLINE AND INDEX MAP OF NEW YORK CITY, NEW YORK, PLATE 16. (G.W. BROMLEY & CO., CIVIL ENGINEERS.) PUBLISHED BY GEO. W. BROMLEY & E. ROBINSON, 1879)

LEGEND

- PARCEL 1
- PARCEL 3
- PARCEL 4

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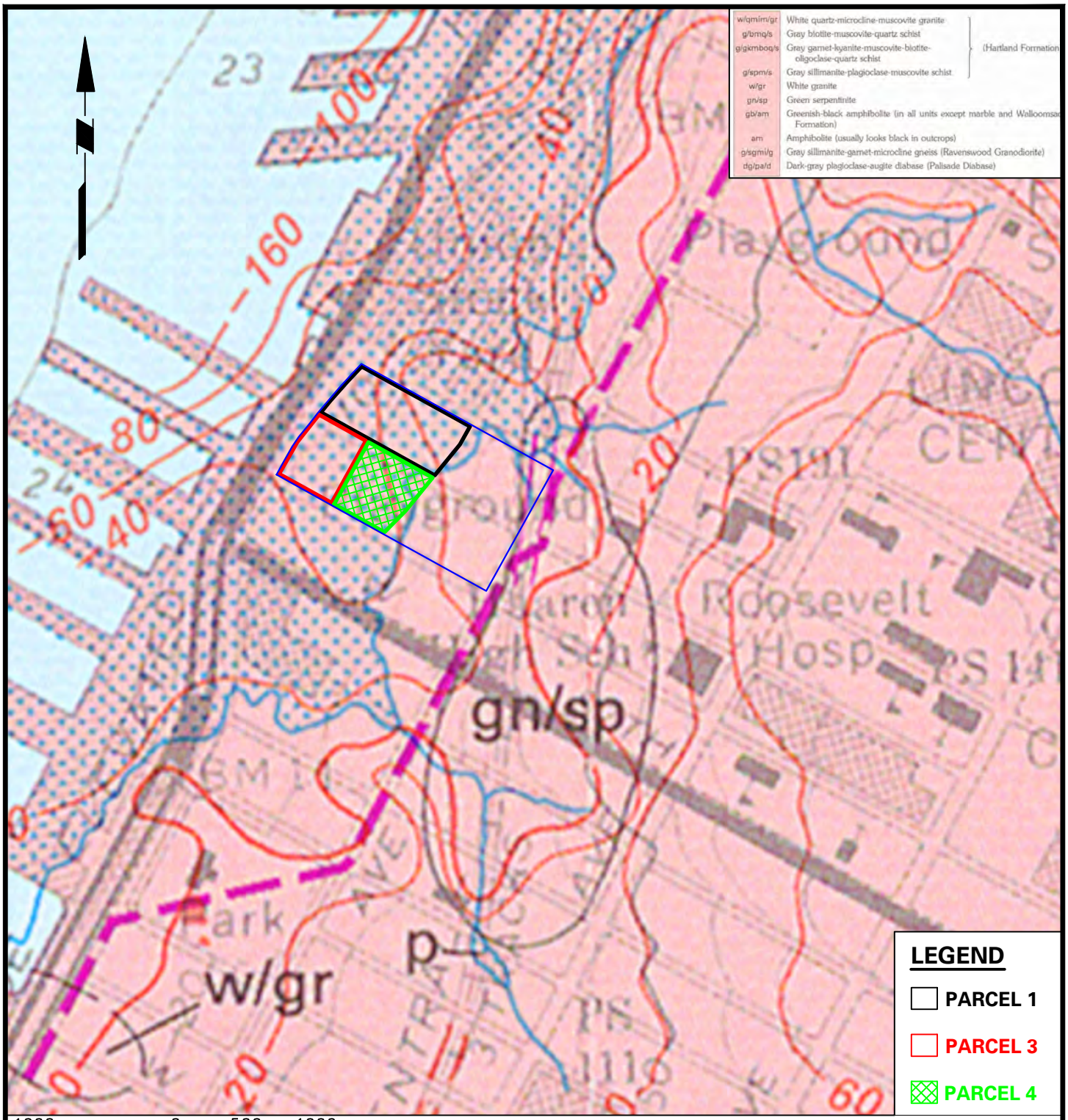
BLOCK No. 1171 LOT No. 157
MANHATTAN
NEW YORK **NEW YORK**

Drawing Title
HISTORICAL SITE MAP (1879 BROMLEY)

Project No. 170275404	Drawing No. 4
Date 04/24/2015	
Scale N.T.S	
Drawn By JSH / Checked By JD/JMG	
Submission Date 04/24/2015	Sheet 4 of 11



1000 0 500 1000

SCALE IN FEET

NOTE: ELEVATIONS ARE REFERENCED TO THE NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD 29), WHICH IS 1.1 FEET BELOW NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD 88).

SOURCE: "BEDROCK AND ENGINEERING GEOLOGIC MAPS OF NEW YORK COUNTY AND PARTS OF KINGS AND QUEENS COUNTIES, NEW YORK, AND PARTS OF BERGEN AND HUDSON COUNTIES, NEW JERSEY", BASKERVILLE,1994

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RIVERSIDE CENTER: BUILDING 4

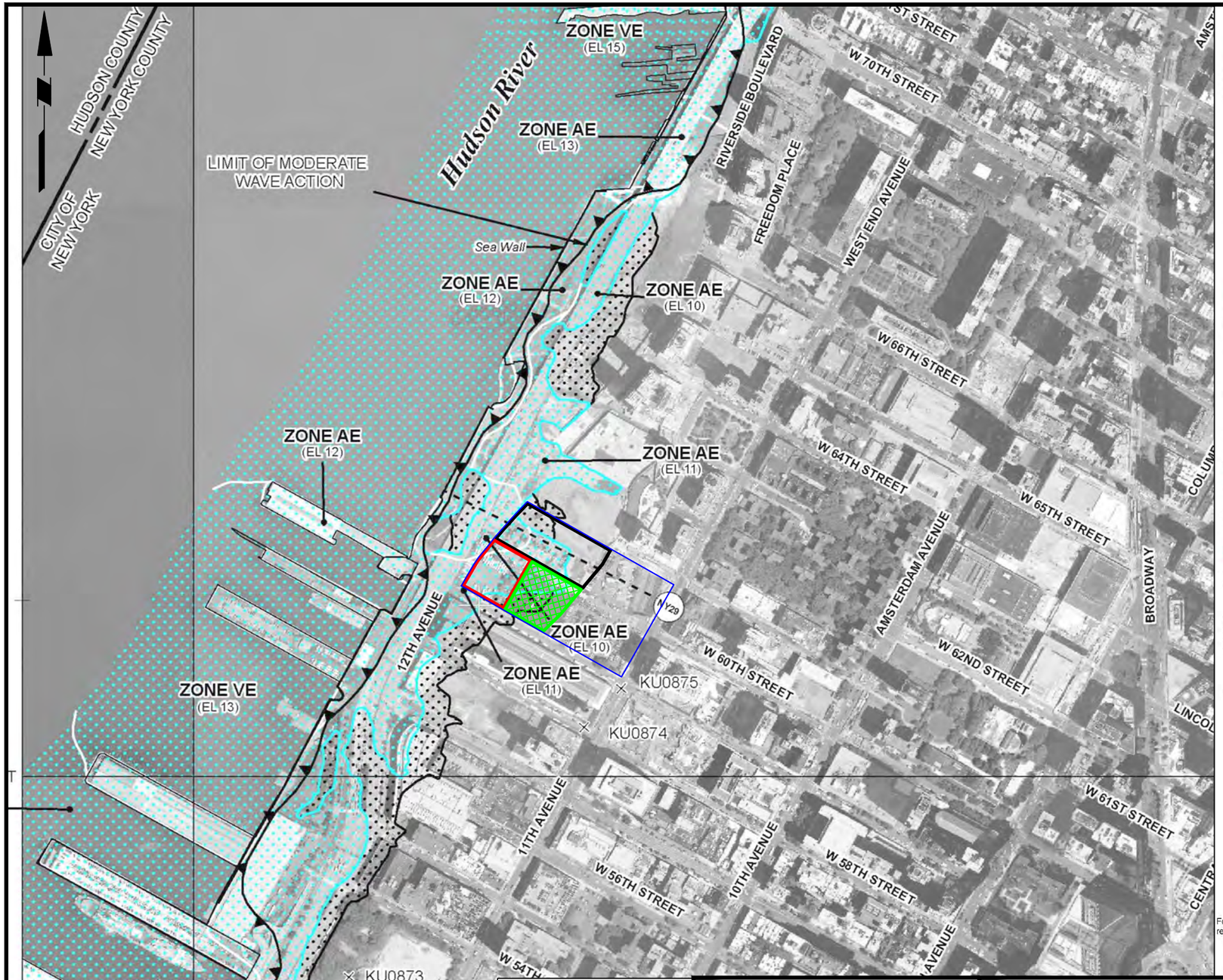
BLOCK No. 1171, LOT No. 157
MANHATTAN
NEW YORK NEW YORK

Drawing Title

GEOLOGIC MAP

Project No. 170275404	Drawing No. 5
Date 04/24/2015	
Scale 1" = 500'	
Drawn By JSH	
Submission Date 04/25/2015	Sheet 5 of 11

Filename: \\langan.com\data\NY\data4\170275401\Cadd Data - 170275401\SheetFiles\2015_ Geotechnical Report_R4\DWG05 - USGS Bedrock Map Manhattan and Kings County.dwg Date: 4/24/2015 Time: 21:47 User: zwu Style Table: Langan.stb Layout: ANSIA-BP



LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- Limit of Moderate Wave Action
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

- Cross section line
- Transect line
- Culvert, Flume, Penstock or Aqueduct
- Road or Railroad Bridge
- Footbridge
- 87°07'45", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
- 5476000 N — 1000-meter Universal Transverse Mercator grid values, zone 18
- 600000 FT — 5000-foot grid values: New York State Plane coordinate system, Long Island zone (FIPSZONE 3104), Lambert Conformal Conic projection
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

INITIAL NFIP MAP DATE
June 28, 1974

FLOOD HAZARD BOUNDARY MAP REVISIONS
June 11, 1976

FLOOD INSURANCE RATE MAP EFFECTIVE
November 16, 1983

FLOOD INSURANCE RATE MAP REVISIONS

For descriptions of revisions see Notice to Users page in the Flood Insurance Study report.

To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

NOTES:

1. ELEVATIONS CONTAINED WITHIN THIS MAP REFERENCE THE UNITED STATES GEOLOGICAL SURVEY NATIONAL GEODETIC VERTICAL DATUM OF 1929 (NGVD29).

DATUM CONVERSIONS:
NGVD29 = BPMD + 2.75'
NAVD88 = BPMD + 1.65'

2. REFERENCE: FIRM FLOOD RATE INSURANCE MAP FOR THE CITY OF NEW YORK, NEW YORK PANEL 88 OF 457 [3604970088G] MAP REVISED PRELIMINARY DECEMBER 5, 2013.

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0088G

FIRM

FLOOD INSURANCE RATE MAP

CITY OF,
NEW YORK
NEW YORK
BRONX, RICHMOND, NEW YORK, QUEENS, AND KINGS COUNTIES

PANEL 88 OF 457

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
NEW YORK, CITY OF	360497	0088	G

PRELIMINARY
DECEMBER 5, 2013

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
3604970088G

MAP REVISED

Federal Emergency Management Agency

LEGEND

- PARCEL 1
- PARCEL 3
- PARCEL 4

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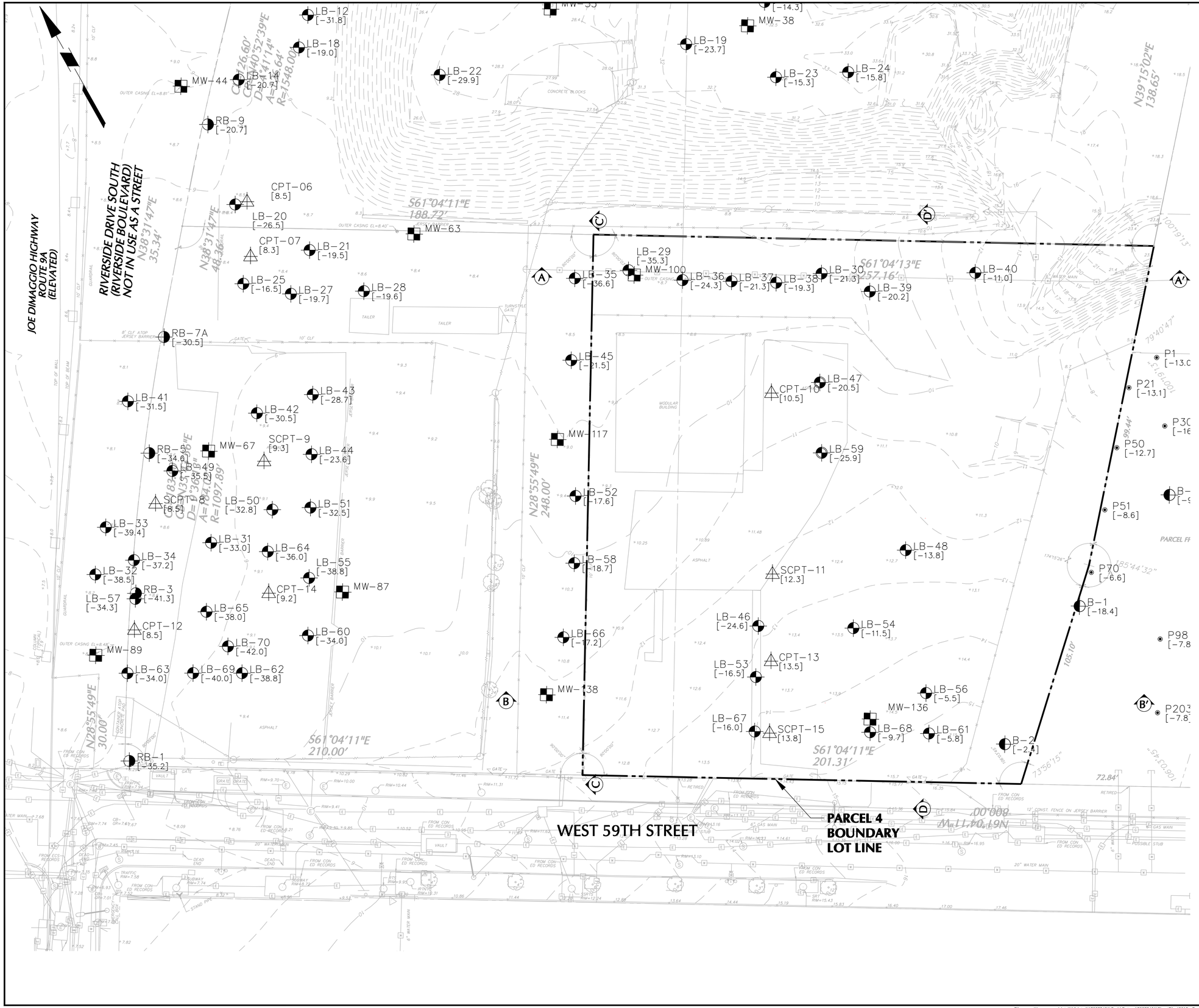
Langan Engineering and Environmental Services, Inc.
Langan CT, Inc.
Langan International LLC

Collectively known as Langan

Project
RIVERSIDE CENTER: BUILDING 4
BLOCK No. 1171 LOT No. 157
MANHATTAN
NEW YORK NEW YORK

Drawing Title
PRELIMINARY FLOOD RATE INSURANCE MAP

Project No. 170275404	Drawing No. 6
Date 04/24/2015	
Scale N.T.S	
Drawn By JSH / Checked By JD/JMG	
Submission Date 04/24/2015	Sheet 6 of 11



GENERAL NOTES:

1. EXISTING CONDITIONS INFORMATION TAKEN FROM PRELIMINARY DRAFT TOPOGRAPHIC & BOUNDARY DRAFT SURVEY PREPARED BY LANGAN ENGINEERING, ENVIRONMENTAL, SURVEYING AND LANDSCAPE ARCHITECTURE, D.P.C. DATED 20 JANUARY 2015..
2. ALL ELEVATIONS CONTAINED WITHIN THIS DRAWING REFERENCE THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAVD88).

DATUM CONVERSIONS:
NAVD88 = BPMD + 1.65'
NGVD29 = BPMD + 2.75'

3. ALL LANGAN BORING LOCATIONS WERE SURVEYED BY LANGAN. ALL OTHER BORING LOCATIONS SHOULD BE CONSIDERED APPROXIMATE.
4. DRILLING OF BORINGS LB-1 THROUGH LB-30 WAS PERFORMED BY WARREN GEORGE INC OF JERSEY CITY, NEW JERSEY BETWEEN 16 DECEMBER 2014 AND 10 JANUARY 2015.
5. CONE PENETRATION TESTING AT SCPT-01 THROUGH SCPT-07 WAS PERFORMED BY CONETEC, INC OF WEST BERLIN, NEW JERSEY ON 10 JANUARY 2015.
6. ALL DRILLING WAS PERFORMED UTILIZING MUD ROTARY DRILLING TECHNIQUES.
7. DISTURBED SOIL SAMPLES WERE OBTAINED USING A STANDARD 2-INCH OUTSIDE DIAMETER SPLIT-SPOON SAMPLER FREE FALLIN AT A HEIGHT OF 30-INCHES.
8. UNDISTURBED SAMPLES WERE OBTAINED USING 2.7-INCH OUTSIDE DIAMETER THIN WALLED TUBES.
9. ROCK CORING WAS PERFORMED UTILIZING TYPE NQ DOUBE WALL CORE BARRELS.
10. BORINGS SHOWN HEREON WERE USED IN DEVELOPING ROCK EVALUATION; SOME HISTORICAL BORINGS WERE OMITTED AS LACKING INFO.

LEGEND:

- LB-15 [-28.2] — LANGAN BORING 2015 APPROXIMATE ELEVATION (TOP OF ROCK)
- RB-1 [-35.2] — BORINGS BY OTHERS APPROXIMATE ELEVATION (TOP OF ROCK)
- P21 [-13.1] — DRIVEN PILES (FROM RIVERSIDE CENTER BUILDING 5) APPROXIMATE ELEVATION OF PILE TIP (TOP OF ROCK)
- SCPT-01 [11.5] — LANGAN SEISMIC CONE PENETROMETER TESTS APPROXIMATE ELEVATION (GROUND SURFACE)
- CPT-03 [16.9] — LANGAN CONE PENETROMETER TESTS APPROXIMATE ELEVATION (GROUND SURFACE)
- MW-26 — LANGAN GROUNDWATER MONITORING WELLS 2015
- 13 — EXISTING GROUND SURFACE CONTOURS

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Project

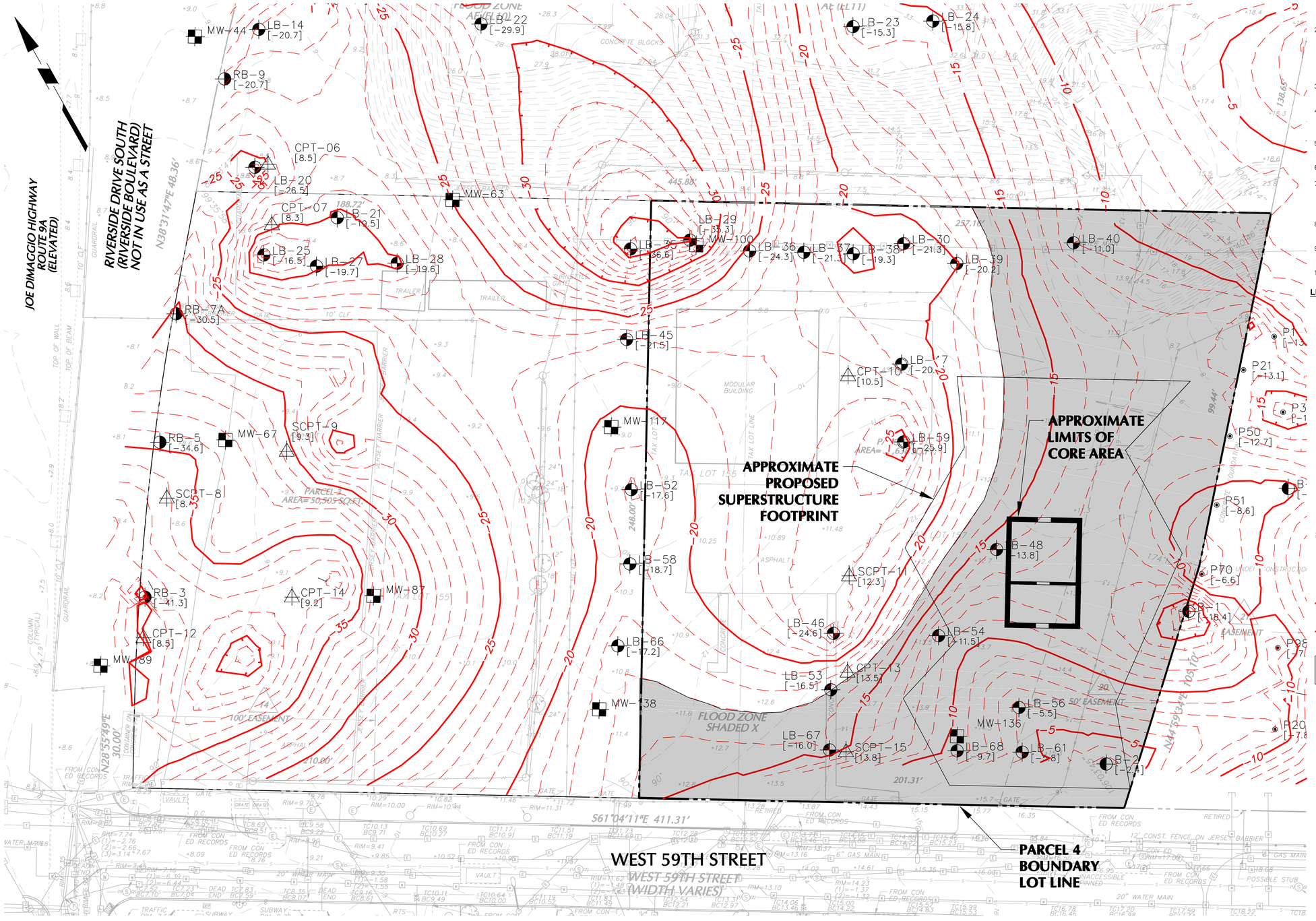
RIVERSIDE CENTER: BUILDING 4

BLOCK No. 1171, LOT No. 157
MANHATTAN
NEW YORK NEW YORK

Drawing Title

SUBSURFACE INVESTIGATION PLAN

Project No. 170275404	Drawing No. 7
Date 04/24/2015	
Scale 1" = 20'	
Drawn By JSH / Checked By JD	
Submission Date 04/24/2015	Sheet 7 of 11



FOR REFERENCE ONLY

GENERAL NOTES:

1. EXISTING CONDITIONS INFORMATION TAKEN FROM PRELIMINARY DRAFT TOPOGRAPHIC & BOUNDARY DRAFT SURVEY PREPARED BY LANGAN ENGINEERING, ENVIRONMENTAL, SURVEYING AND LANDSCAPE ARCHITECTURE, D.P.C. DATED 20 JANUARY 2015..
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NGVD29 = BPMD + 2.75'

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4. BEDROCK ELEVATIONS CONTAINED HEREIN HAVE BEEN DETERMINED USING MULTIPLE DATA SOURCES. LANGAN MAKES NO WARRANTY AS TO THE ACCURACY OF DATA COMPILED AND DOCUMENTED BY OTHERS
5. BORINGS SHOWN HEREON WERE USED IN DEVELOPING ROCK EVALUATION; SOME HISTORICAL BORINGS WERE OMITTED AS LACKING INFO.
6. ROCK CONTOURS WERE DETERMINED BY LINEAR INTERPOLATION BETWEEN BOREHOLES.
7. ROCK CONTOURS ARE BASED ON A LIMITED NUMBER OF BORINGS THAT PROVIDED INFORMATION ONLY AT THE DRILLED LOCATIONS. ROCK CONTOURS ARE CONSIDERED APPROXIMATE AND ARE SHOWN FOR REFERENCE PURPOSES ONLY. ACTUAL SUBSURFACE CONDITIONS MAY VARY FROM THOSE SHOWN.
8. BORINGS SHOWN HEREON WERE USED IN DEVELOPING ROCK EVALUATION; SOME HISTORICAL BORINGS WERE OMITTED AS LACKING INFORMATION.
9. THE ROCK CONTOURS SHOWN ON THIS PLAN INDICATE THE APPROXIMATE TOP OF NEW YORK CITY BUILDING CODE CLASS 1C ROCK OR BETTER.
10. REFER TO DRAWINGS 9 AND 10 FOR SUBSURFACE CROSS SECTIONS.

LEGEND:

- LB-15 [-28.2] — LANGAN BORING 2015 APPROXIMATE ELEVATION (TOP OF ROCK)
- B/LB-1 [-11.3] — LANGAN BORINGS 2013 (FROM RIVERSIDE CENTER BUILDING 5) APPROXIMATE ELEVATION (TOP OF ROCK)
- RB-7A [-15.3] — BORINGS BY OTHERS APPROXIMATE ELEVATION (TOP OF ROCK)
- P21 [-13.1] — DRIVEN PILES (FROM RIVERSIDE CENTER BUILDING 5) APPROXIMATE ELEVATION OF PILE TIP (TOP OF ROCK)
- SCPT-01 [6.8] — LANGAN SEISMIC CONE PENETROMETER TESTS APPROXIMATE ELEVATION (GROUND SURFACE)
- CPT-03 [16.9] — LANGAN CONE PENETROMETER TESTS APPROXIMATE ELEVATION (GROUND SURFACE)
- MW-26 — LANGAN GROUNDWATER MONITORING WELLS 2015
- 30 — MAJOR CONTOUR LINE (5-FOOT INTERVALS) APPROXIMATE ELEVATION (TOP OF NYCBC CLASS 1C ROCK OR BETTER)
- MINOR CONTOUR LINE (1-FOOT INTERVALS) APPROXIMATE ELEVATION (TOP OF NYCBC CLASS 1C ROCK OR BETTER)
- APPROXIMATE LIMITS OF SHALLOW FOUNDATION

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Project

RIVERSIDE CENTER: BUILDING 4

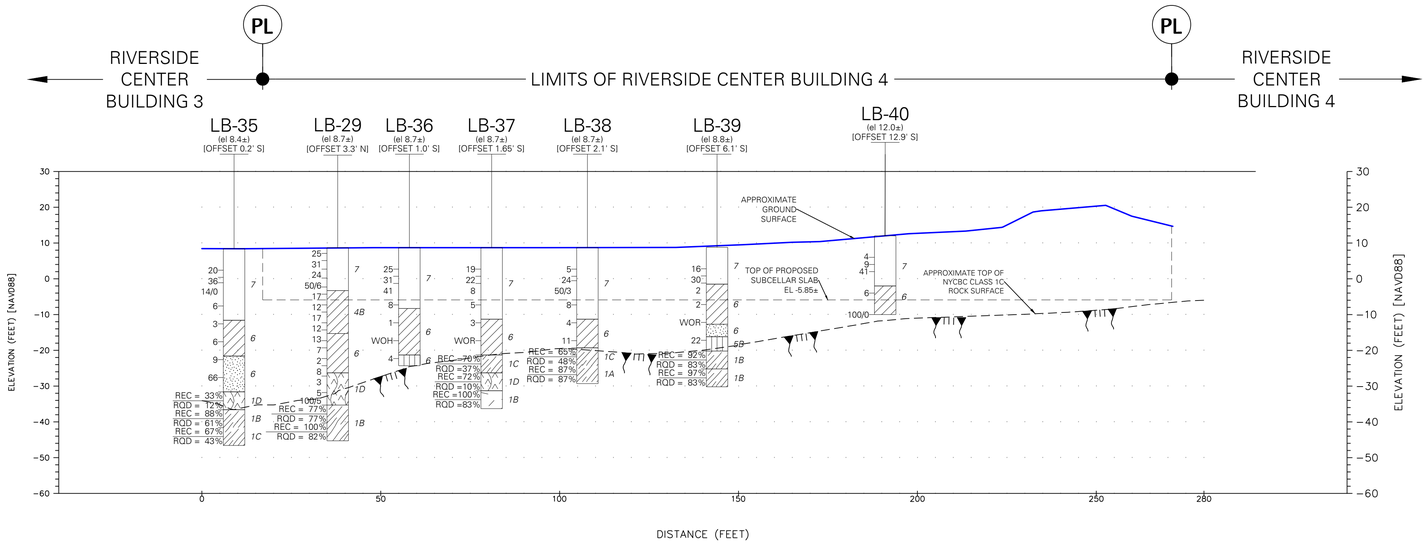
BLOCK No. 1171, LOT No. 157
MANHATTAN

NEW YORK NEW YORK

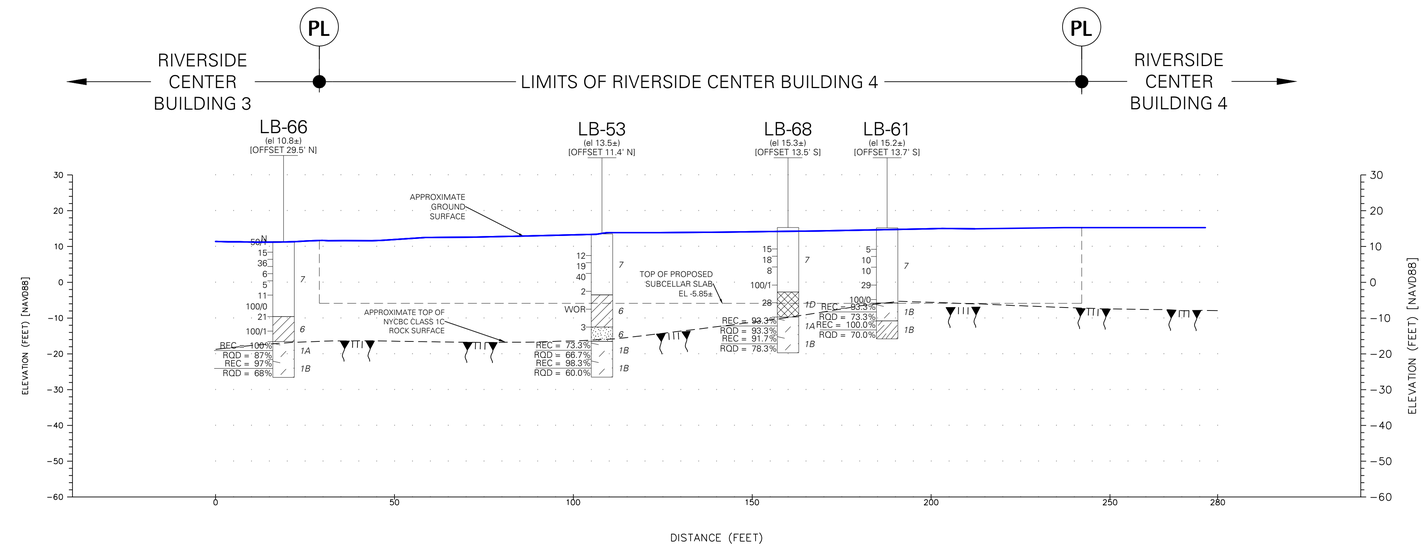
Drawing Title

ESTIMATED TOP OF ROCK ELEVATION PLAN

Project No. 170275404	Drawing No. 8
Date 04/24/2015	
Scale 1" = 20'	
Drawn By JSH / Checked By JD	
Submission Date 04/24/2015	Sheet 8 of 11

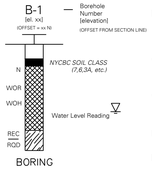


SUBSURFACE PROFILE A-A' (BUILDING 4) FACING NORTH



SUBSURFACE PROFILE B-B' (BUILDING 4) FACING NORTH

BORING FENCE KEY DIAGRAM AND LITHOLOGY NOTES



N	STANDARD PENETRATION RESISTANCE; NUMBER OF BLOWS OF A 140 LB HAMMER FREE FALLING 30 IN TO DRIVE A 2 IN O.D. SPLIT SPOON SAMPLER 12 IN, AFTER 6 IN OF INITIAL PENETRATION
WOR	2 FT PENETRATION OF THE SPLIT SPOON SAMPLER UNDER THE WEIGHT OF DRILL RODS
WOH	2 FT PENETRATION OF THE SPLIT SPOON SAMPLER UNDER THE STATIC WEIGHT OF THE DRIVING HAMMER
U	UNDISTURBED SAMPLE
REC	(LENGTH OF ROCK RETRIEVED) / (LENGTH OF ROCK CORED) * 100%
RQD	(LENGTH OF ROCK 4 IN OR LONGER) / (LENGTH OF ROCK CORED) * 100%

MATERIAL SYMBOLS

FILL · SILT · CLAY · SAND · ORGANIC SILT/CLAY · CONCRETE · GRAVELLY SAND · ROCK: GRANITE · GRAVEL · WEATHERED SCHIST · ROCK: SCHIST · WEATHERED GRANITE

LITHOLOGY GRAPHICS AND NOTES:

NEW YORK CITY BUILDING CODE MATERIAL CLASSIFICATION NOTES:

BEDROCK
- 1A (HARD SOUND ROCK) - RQD > 85% W/ SIZE NX CORE OR REC > 85% W/ SIZE BX CORE.
- 1B (MEDIUM ROCK) - 50 < RQD < 85% W/ SIZE NX CORE OR 50% > REC < 85% W/ SIZE BX CORE.
- 1C (INTERMEDIATE ROCK) - 35% < RQD < 50% W/ SIZE NX CORE OR 35% < REC 50% W/ SIZE BX CORE.
- 1D (SOFT ROCK) - RQD LESS THAN 35% W/ SIZE NX CORE OR REC < 35% W/ SIZE BX CORE, OR SPT N-VALUE > 50 BPF. APPLIES ONLY TO ROCK WITH COMPLETELY WEATHERED ZONES OF LESS THAN 3-INCHES THICK.

SANDY GRAVEL AND GRAVELS (GW, GP)
- 2A (DENSE) - MATERIAL HAVING SPT N-VALUE > 30 BPF.
- 2B (MEDIUM) - MATERIAL HAVING SPT N-VALUES BETWEEN 10 AND 30 BPF.

GRANULAR SOILS (GM, GC, SM, SC, SP, SW)
- 3A (DENSE) - MATERIAL HAVING SPT N-VALUE > 30 BPF.
- 3B (MEDIUM) - MATERIAL HAVING SPT N-VALUES BETWEEN 10 AND 30 BPF

CLAYS (CL, CH)
- 4A (HARD) - MATERIAL HAVING SPT N-VALUE > 30 BPF, UNCONFINED COMPRESSIVE STRENGTH (UCS) > 4TSF
- 4B (STIFF) - MATERIAL HAVING SPT N-VALUES BETWEEN 8 AND 30 BPF, UCS BETWEEN 1 AND 4 TSF
- 4C (MEDIUM) -MATERIAL HAVING SPT N-VALUES BETWEEN 4 AND 8 BPF, UCS BETWEEN 0.5 AND 1 TSF

CLASS 5 - SILTS AND CLAYEY SILTS (ML, MH)
- 5A (DENSE) - MATERIAL HAVING SPT N-VALUE > 30 BPF
- 5B (MEDIUM) - MATERIAL HAVING SPT N-VALUES BETWEEN 10 AND 30 BPF

CLASS 6 - NOMINALLY UNSATISFACTORY BEARING MATERIALS
- LOOSE SANDY GRAVEL AND GRAVELS, GRANULAR SOILS, AND SILTS OF CLASSES 2, 3, OR 5, RESPECTIVELY HAVING SPT N-VLAUES < 10 BPF
- SOFT CLAYS OF CLASS 4 HAVING SPT N-VLAUES < 4 BPF, UNCONFIEND COMPRESIVE STRENGTHS LESS THAN 0.5 TSF.

CLASS 7 - CONTROLLED AND UNCONTROLLED FILL
- ALL FILLS HAVING BEEN PLACED IN EITHER CONTROLLED OR UNCONTROLLED SETTINGS.

GENERAL NOTES:

1. EXISTING CONDITIONS INFORMATION TAKEN FROM PRELIMINARY DRAFT TOPOGRAPHIC & BOUNDARY DRAFT SURVEY PREPARED BY LANGAN ENGINEERING, ENVIRONMENTAL, SURVEYING AND LANDSCAPE ARCHITECTURE, D.P.C. DATED 20 JANUARY 2015..
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   DATUM CONVERSIONS:
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9. THE ROCK CONTOURS SHOWN ON THIS PLAN INDICATE THE APPROXIMATE TOP OF NEW YORK CITY BUILDING CODE CLASS 1C ROCK OR BETTER.
10. BEDROCK ELEVATIONS EAST OF PARCEL 1 (WITHIN PARCEL 2 AREA) WERE DETERMINED FROM DRIVEN PILE TIP ELEVATIONS FROM DRIVEN PILES INSPECTED BY LANGAN (POINTS NOT SHOWN FOR CLARITY).
11. SUBSURFACE LITHOLOGY INTERPRETED FROM RECOVERED SOIL AND ROCK CORE SAMPLES AND FROM AVAILABLE HISTORICAL BORING LOGS. REFER TO BORING LOGS FOR ADDITIONAL INFORMATION. HISTORICAL BORING DATA IS PROVIDED FOR REFERENCE TO GENERALIZED LITHOLOGY ONLY
12. THE APPROXIMATE TOP OF ROCK SURFACE LINE DISPLAYED IN THE SUBSURFACE PROFILES IS GENERATED FROM A 3D ROCK CONTOUR SURFACE USING AUTOCAD CIVIL3D. IN ADDITION, OFFSET DISTANCES FROM THE CLOSEST BORINGS TO THE PROFILE SECTION ARE PROVIDED UNDER EACH BORING STICK FOR REFERENCE.
13. REFER TO DRAWING NO. 7 FOR LOCATION OF SECTIONS.

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Project

RIVERSIDE CENTER: BUILDING 4

BLOCK No. 1171, LOT No. 157
MANHATTAN

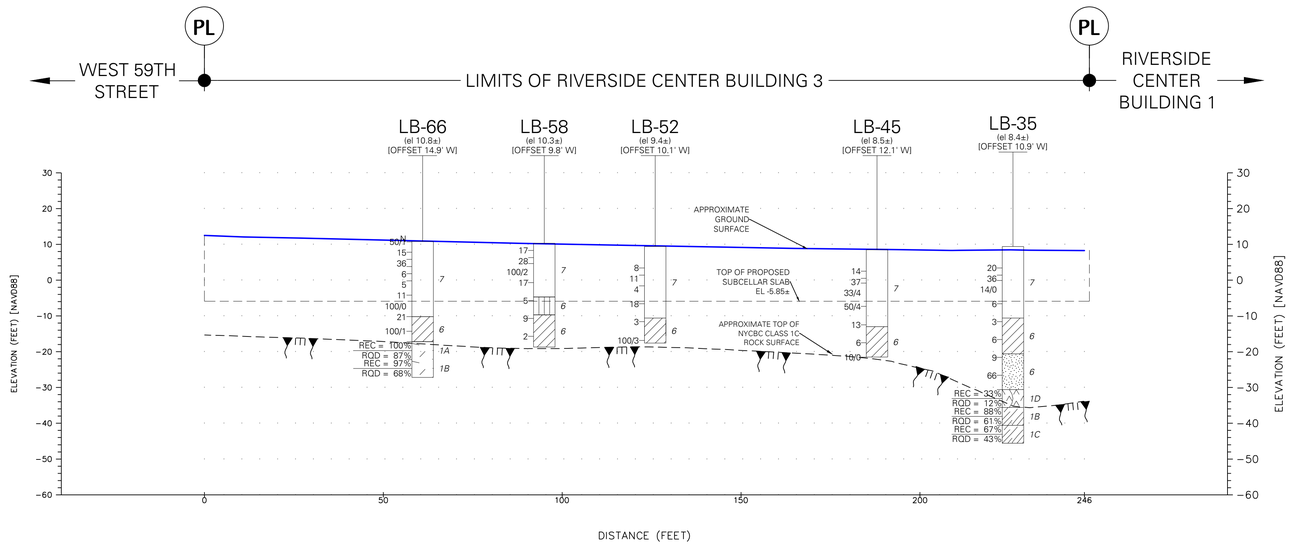
NEW YORK **NEW YORK**

Drawing Title

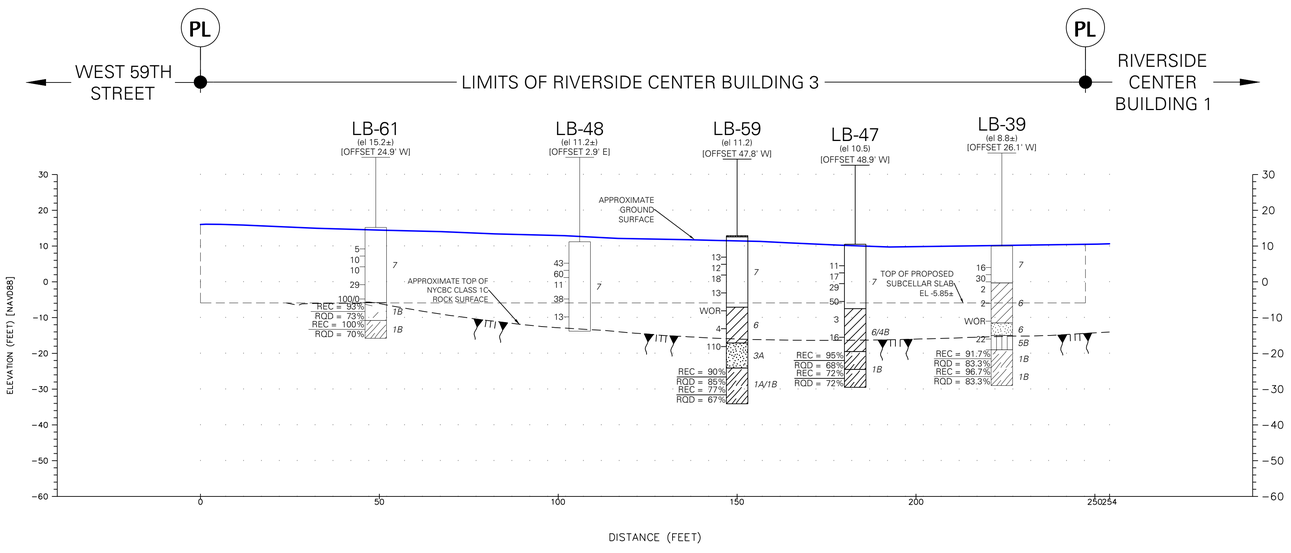
SUBSURFACE PROFILES A-A' AND B-B'

Project No. **170275404**	Drawing No. **9**
Date **04/24/2015**	
Scale **1" = 20'**	
Drawn By **JSH** / Checked By **JD**	
Submission Date **04/24/2015**	Sheet 9 of 11

Filename: \\langan.com\data\NY\data4\170275401\Cadd Data - 170275401\SheetFiles\2015_ Geotechnical Report_R4\DWG\09-10 - SUBSURFACE PROFILES.dwg Date: 4/24/2015 Time: 22:19 User: zwu Style Table: Langan.stb Layout: A-A

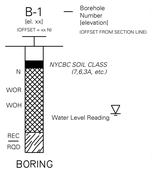


SUBSURFACE PROFILE C-C' (BUILDING 4) FACING WEST



SUBSURFACE PROFILE D-D' (BUILDING 4) FACING WEST

BORING FENCE KEY DIAGRAM AND LITHOLOGY NOTES



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REC	(LENGTH OF ROCK RETRIEVED) / (LENGTH OF ROCK CORED) * 100%
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MATERIAL SYMBOLS

FILL · SILT · CLAY · SAND · ORGANIC SILT/CLAY · CONCRETE · GRAVELLY SAND · ROCK: GRANITE · GRAVEL · WEATHERED SCHIST · ROCK: SCHIST · WEATHERED GRANITE

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- 4C (MEDIUM) -MATERIAL HAVING SPT N-VALUES BETWEEN 4 AND 8 BPF, UCS BETWEEN 0.5 AND 1 TSF

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GENERAL NOTES:

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T: 212.479.5400 F: 212.479.5444 www.langan.com
NEW JERSEY NEW YORK CONNECTICUT PENNSYLVANIA OHIO
VIRGINIA WASHINGTON DC FLORIDA NORTH DAKOTA CALIFORNIA
ABU DHABI ATHENS DOHA DUBAI ISTANBUL
Langan Engineering, Environmental, Surveying and Landscape Architecture, D.P.C.
Langan Engineering and Environmental Services, Inc.
Langan CT, Inc.
Langan International LLC
Collectively known as Langan

Project

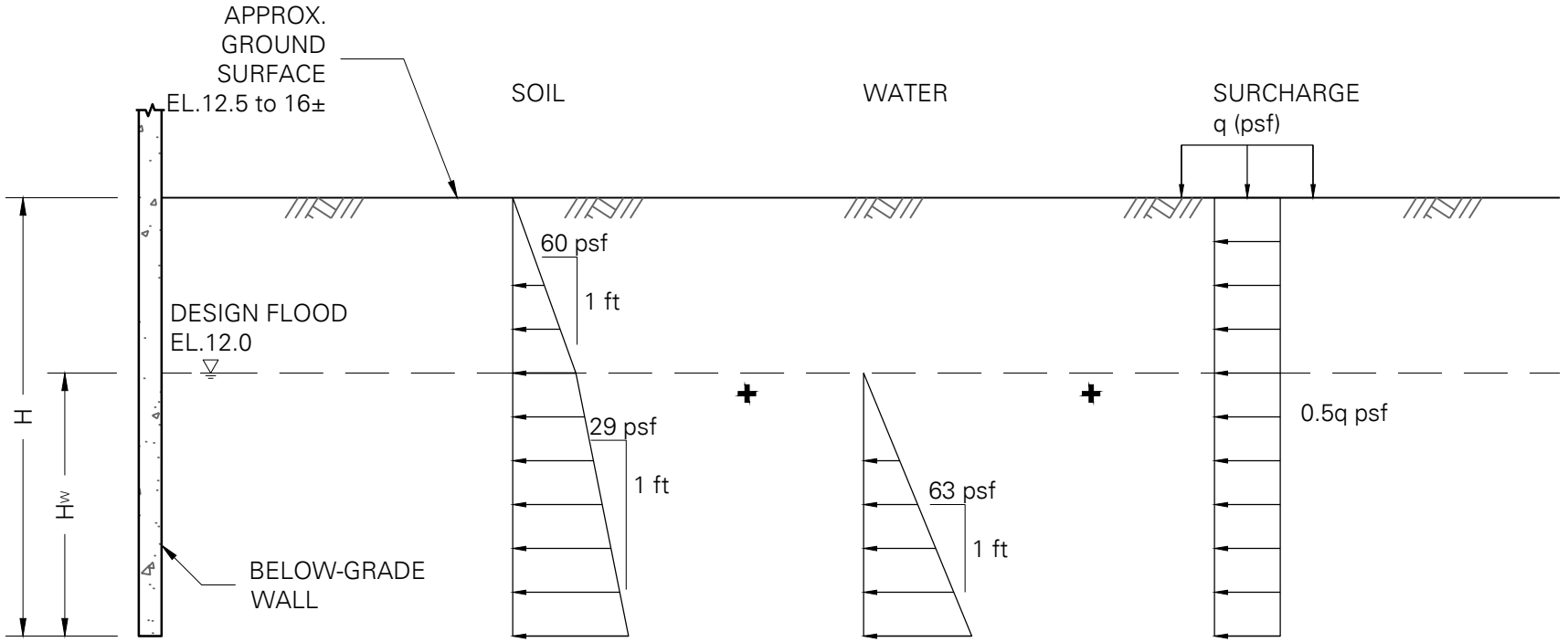
RIVERSIDE CENTER: BUILDING 4

BLOCK No. 1171, LOT No. 157
MANHATTAN
NEW YORK **NEW YORK**

Drawing Title

SUBSURFACE PROFILES C-C' AND D-D'

Project No. **170275404**	Drawing No. **10**
Date **04/24/2015**	
Scale **1" = 20'**	
Drawn By **JSH** / Checked By **JD**	
Submission Date **04/24/2015**	Sheet 10 of 11



LEGEND:

H = HEIGHT OF BELOW GRADE WALL (FT)
H_W = DEPTH TO DESIGN FLOOD ELEVATION (FT)

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Project
RIVERSIDE CENTER: BUILDING 4
BLOCK No. 1171, LOT No. 157
MANHATTAN
NEW YORK NEW YORK

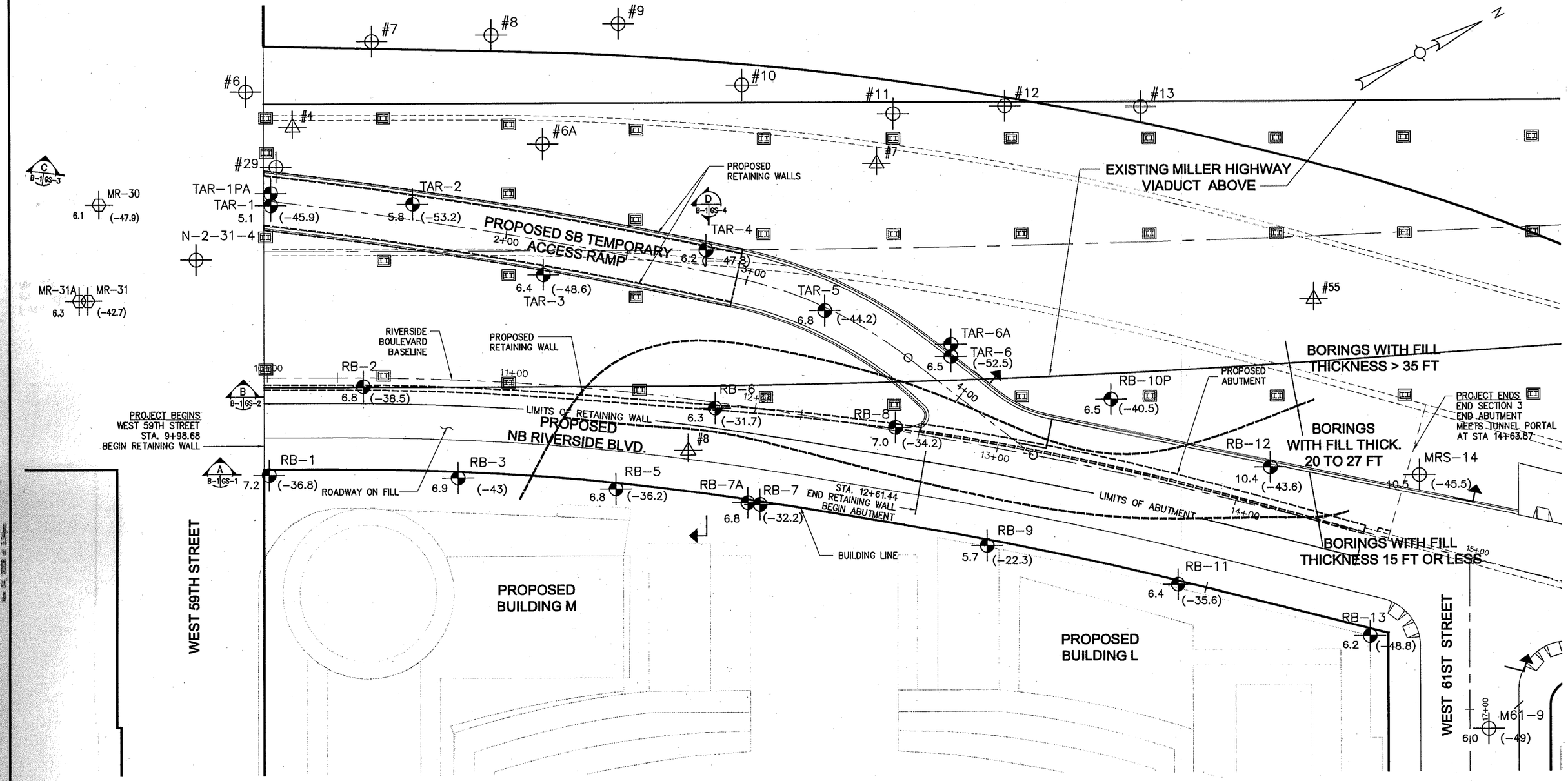
Drawing Title
LATERAL EARTH PRESSURE DIAGRAM

Project No. 170275404	Drawing No. 11
Date 04/24/2015	
Scale 1" = 500'	
Drawn By JSH	
Submission Date 04/24/2015	Sheet 11 of 11

Filename: \\langan.com\data\NY\data4\170275401\Cadd Data - 170275401\SheetFiles\2015_ Geotechnical Report_R4\DWG11 - Lateral Earth Pressure Diagram.WIP.dwg Date: 4/24/2015 Time: 22:20 User: zwu Style Table: Langan.stb Layout: DWG 11

APPENDIX A

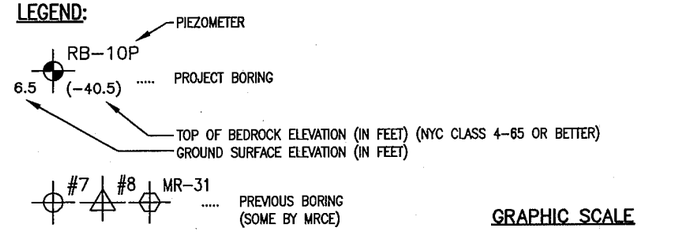
HISTORIC BORING INFORMATION



GENERAL NOTES:

1. BASE PLAN PROVIDED BY PHILIP HABIB & ASSOCIATES.
2. ALL ELEVATIONS HEREIN REFER TO BOROUGH PRESIDENT OF MANHATTAN DATUM WHICH IS 2.75 FEET ABOVE MEAN SEA LEVEL (M.S.L.) AT SANDY HOOK, NEW JERSEY, IN 1929.
3. PROJECT BORING LOCATIONS AND GROUND SURFACE ELEVATIONS ARE BASED ON OCTOBER 22, 2007 SURVEY BY MANHATTAN SURVEYING.
4. PROJECT BORINGS WERE MADE BY TESTWELL LABS, INC, BETWEEN NOVEMBER 2, 2007 AND JANUARY 7, 2008, UNDER CONTINUOUS INSPECTION OF MRCE. ALL BORINGS WERE MADE IN ACCORDANCE WITH STANDARD SPECIFICATIONS FOR SUBSURFACE BORINGS AND SAMPLING BY MRCE.
5. FOR GEOLOGIC SECTIONS A TO D SEE DRAWINGS NOS. GS-1 TO GS-4. FOR CONTOUR PLAN OF TOP OF ROCK ELEVATIONS SEE DRAWING NO. R-1.
6. NOTES FOR GEOLOGIC SECTIONS AND GENERAL STRATA DESCRIPTIONS ARE SHOWN ON DRAWING NO. GS-1.
7. ORIGINALLY PLANNED BORING RB-4 WAS NOT DRILLED DUE TO SITE OBSTRUCTIONS.
8. GROUND SURFACE ELEVATIONS AND TOP OF BEDROCK ELEVATIONS ARE SHOWN FOR MRCE BORINGS ONLY.

LEGEND:



GRAPHIC SCALE

20' 10' 0 20' 40'

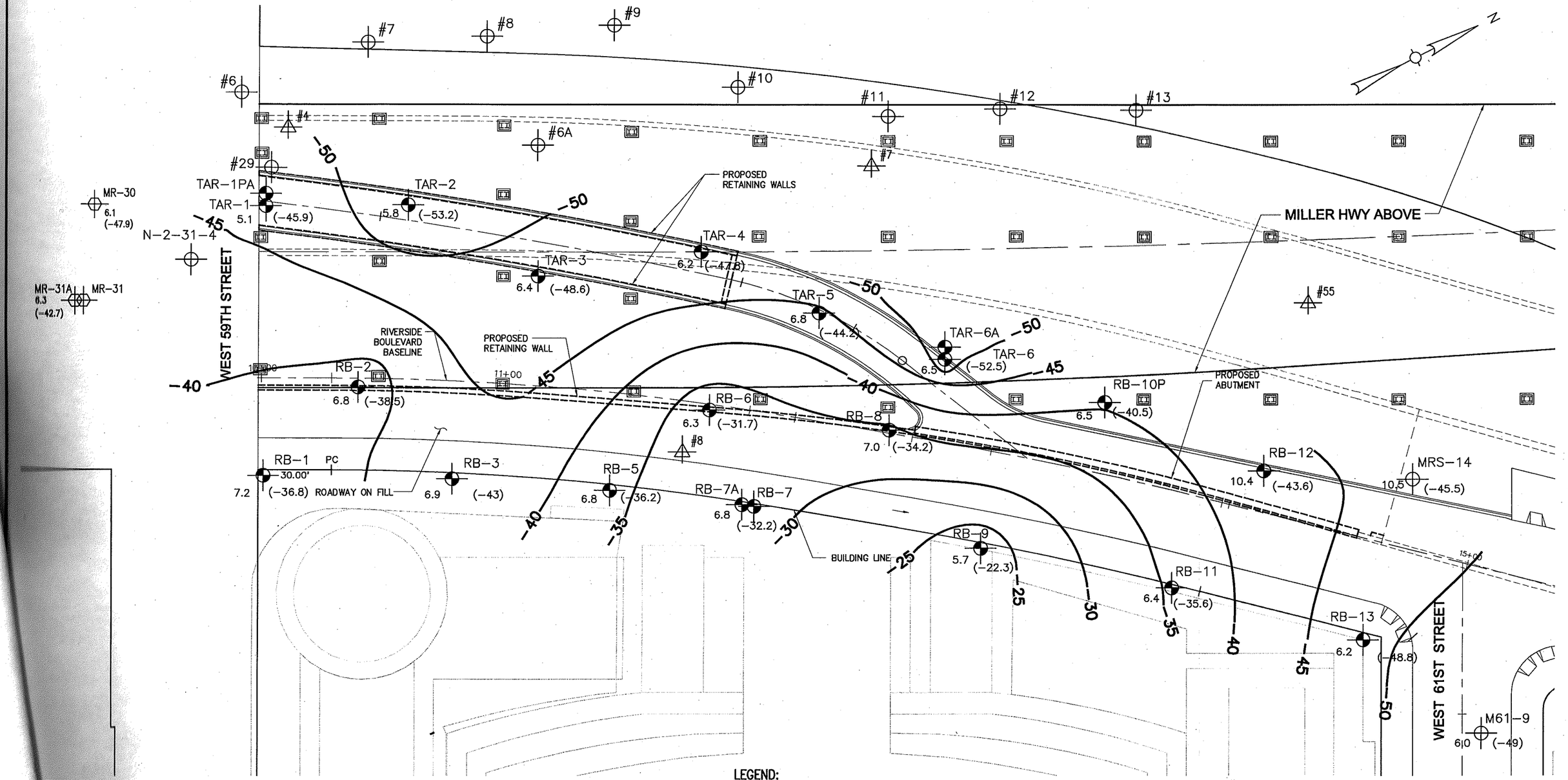
RIVERSIDE SOUTH
RIVERSIDE BLVD. W59 ST. to W61 ST.
NEW YORK NY

EXTELL/CRP
NEW YORK NY

MUESER RUTLEDGE CONSULTING ENGINEERS
14 PENN PLAZA – 225 W. 34TH STREET, NY, NY 10122

SCALE	MADE BY C.P.J.	DATE 02-29-08	FILE NO. 10164C
GRAPHIC	CH'KD BY R.A.	DATE 02-29-08	DRAWING NO. B-1

BORING LOCATION PLAN



LEGEND:

RB-10P ..... PIEZOMETER

6.5 (-40.5) ..... PROJECT BORING

TOP OF BEDROCK (NYC CLASS 4-65 OR BETTER) ELEVATION (IN FEET)

GROUND SURFACE ELEVATION (IN FEET)

#7 #8 MR-31 ..... PREVIOUS BORING

-55 ..... CONTOUR OF TOP OF BEDROCK ELEVATION (IN FEET)

GRAPHIC SCALE

20' 10' 0 20' 40'

NOTES:

1. FOR GENERAL NOTES SEE DRAWING NO. B-1.
2. TOP OF BEDROCK CONTOURS ARE BASED ON SHOWN PROJECT BORINGS AND MAY OR MAY NOT REPRESENT ACTUAL SUBSURFACE CONDITIONS.

RIVERSIDE SOUTH
RIVERSIDE BLVD. W59 ST. to W61 ST.
NEW YORK NY

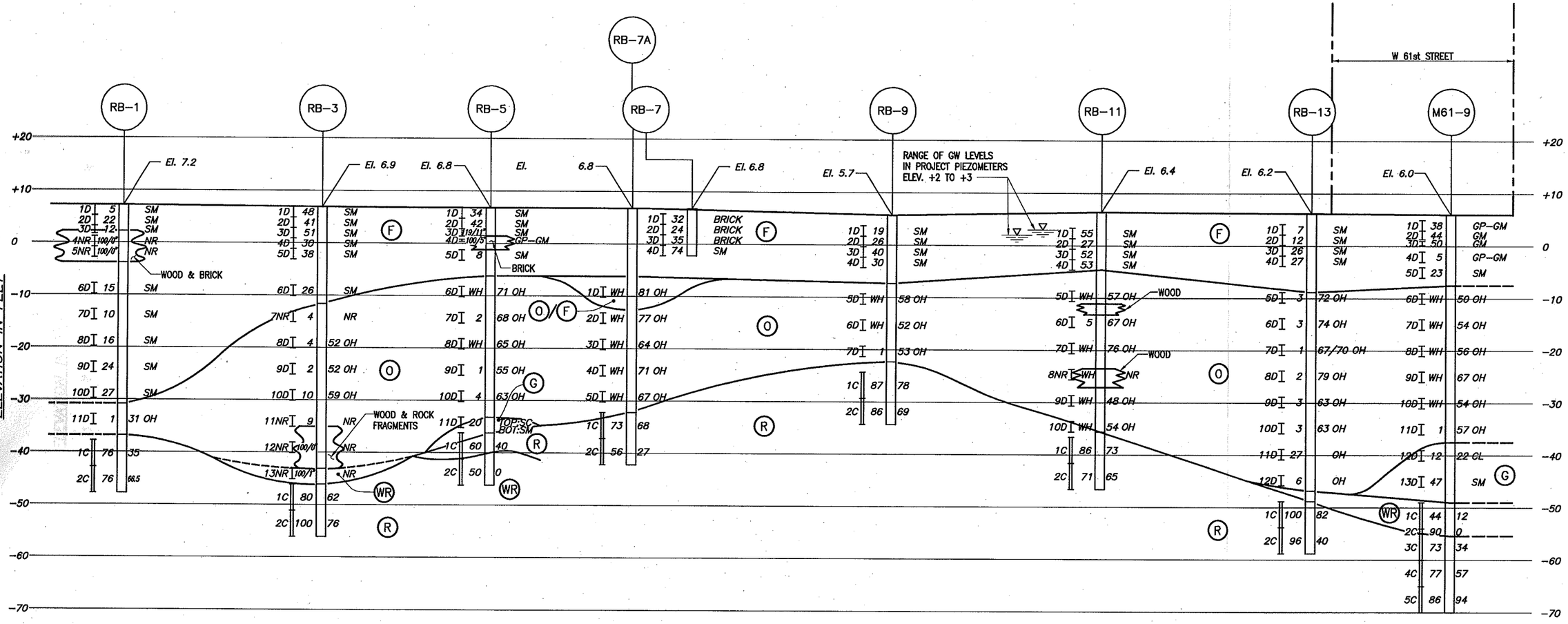
EXTELL/CRP
NEW YORK NY

MUESER RUTLEDGE CONSULTING ENGINEERS
14 PENN PLAZA - 225 W. 34TH STREET, NY, NY 10122

SCALE	MADE BY C.P.J.	DATE 02-29-08	FILE NO.
GRAPHIC	CH'KD BY R.A.	DATE 02-29-08	10164C

TOP OF BEDROCK CONTOUR PLAN

DRAWING NO. R-1



GENERAL STRATA DESCRIPTIONS:

- (F) FILL
- (O) ORGANIC SILTY CLAY
- (G) GRANULAR DEPOSITS
- (DR) DECOMPOSED ROCK
- (WR) WEATHERED ROCK
- (R) BEDROCK

GEOLOGIC SECTION NOTES:

1. FOR GENERAL NOTES AND BORING LOCATION PLAN SEE DRAWING NO. B-1.
2. BORINGS ILLUSTRATED ON GEOLOGIC SECTIONS ARE IN SOME CASES PROJECTED TO THE SECTION AND/OR OFFSET FOR CLARITY. STRATIFICATIONS SHOWN ON GEOLOGIC SECTIONS ARE BASED ON BORINGS AND ARE NECESSARY INTERPOLATIONS BETWEEN AND BEYOND BORINGS AND MAY NOT REPRESENT ACTUAL SUBSURFACE CONDITIONS.
3. SEE DRAWING NO. GS-R FOR BORING LEGEND AND SUMMARY OF UNIFIED SOIL CLASSIFICATION SYSTEM.
4. DRILLING MUD LEVELS MEASURED IN BORINGS MAY NOT REPRESENT ACTUAL GROUNDWATER LEVELS AND ARE NOT SHOWN ON SECTIONS. SEE PIEZOMETER LEVELS FOR ACTUAL GROUNDWATER LEVELS.
5. FOR COMPLETE SOIL SAMPLE AND ROCK CORE DESCRIPTIONS SEE BORING LOGS IN APPENDIX A.
6. ELEVATIONS ARE IN FEET AND REFER TO BOROUGH PRESIDENT OF MANHATTAN DATUM WHICH IS 2.75 FEET ABOVE M.S.L. AT SAND HOOK, NJ IN 1929.
7. CONCRETE, ASPHALT OR GRAVEL AT GRADE NOT SHOWN ON SECTIONS. SEE BORING LOGS FOR DETAILS.
8. SEE DRAWING NO. RC-1 FOR ROCK CORE CLASSIFICATION CRITERIA.

GRAPHIC SCALES

HORIZONTAL: 40' 20' 0 40' 80'

VERTICAL: 10' 5' 0 10' 20'

RIVERSIDE SOUTH
RIVERSIDE BLVD. W59 ST. to W61 ST.
NEW YORK NY

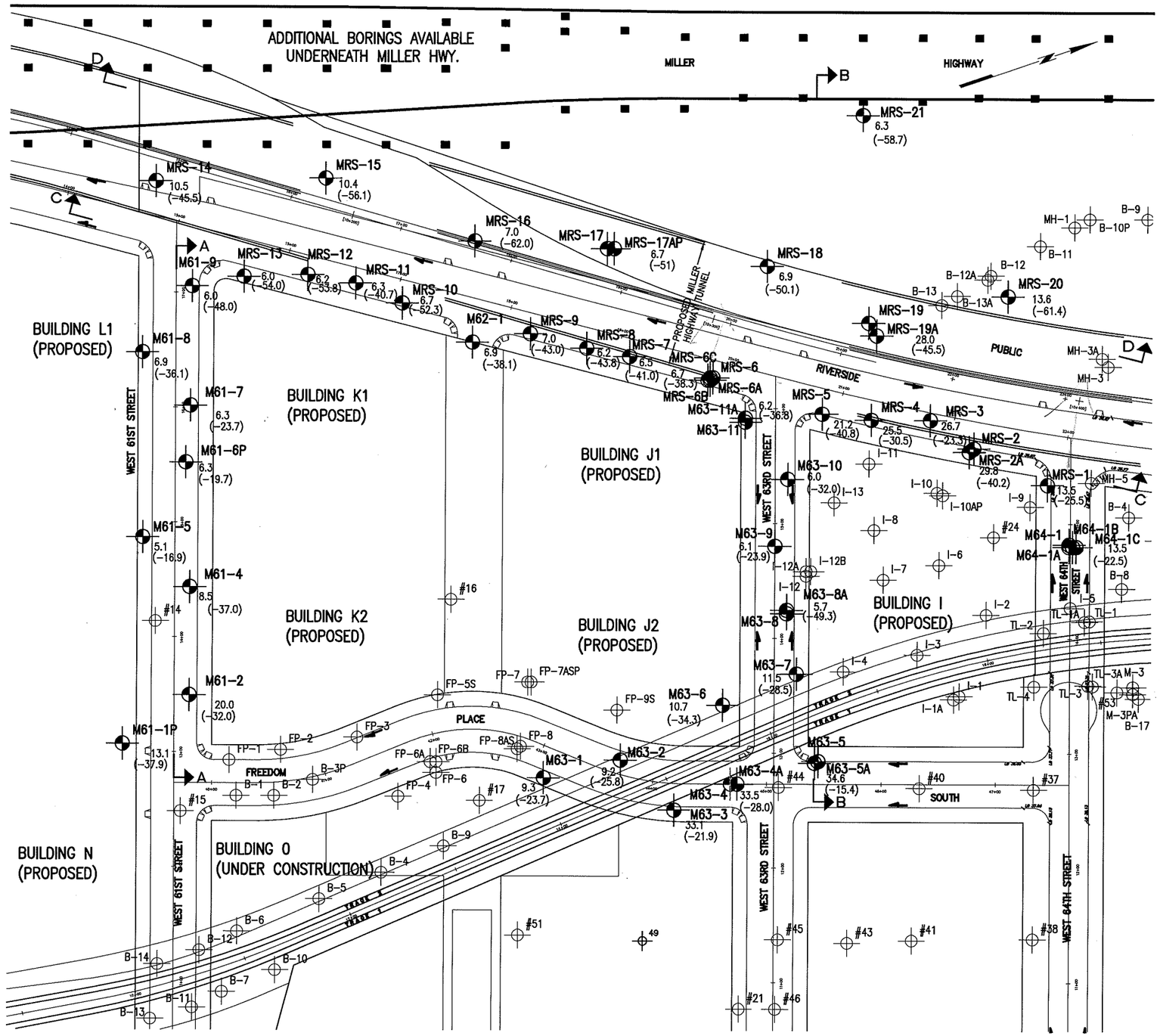
EXTELL/CRP
NEW YORK NY

MUESER RUTLEDGE CONSULTING ENGINEERS
14 PENN PLAZA – 225 W. 34TH STREET, NY, NY 10122

SCALE	MADE BY C.P.J.	DATE 02-29-08	FILE NO. 10164C
GRAPHIC	CH'KD BY R.A.	DATE 02-29-08	

GEOLOGIC SECTION A-A

DRAWING NO. GS-1



NOTES:

1. BASE PLAN PROVIDED BY RBA GROUP AND PHA ASSOCIATES.
2. ELEVATIONS ARE IN FEET AND REFER TO BOROUGH PRESIDENT OF MANHATTAN DATUM, WHICH IS 2.75 FEET ABOVE M.L.S. AT SANDY HOOK, NJ IN 1929.
3. BORING LOCATIONS AND GROUND SURFACE ELEVATIONS HAVE BEEN DETERMINED BY NYS LICENSED LAND SURVEYOR.
4. BORINGS WERE MADE BY TESTWELL LABS, INC., UNDER CONTINUOUS INSPECTION OF MRCE. ALL BORINGS WERE MADE IN ACCORDANCE WITH STANDARD SPECIFICATIONS FOR SUBSURFACE BORINGS AND SAMPLING BY MRCE.
5. FOR GEOLOGIC SECTIONS A–A THROUGH D–D SEE DRAWINGS NOS. GS–1, GS–2, GS–3 AND GS–4.
6. GENERAL NOTES FOR GEOLOGIC SECTIONS AND GENERAL STRATA DESCRIPTIONS ARE SHOWN ON DRAWING NO. GS–1.
7. GROUND SURFACE AND TOP OF WEATHERED ROCK/BEDROCK ELEVATIONS ARE SHOWN FOR PROJECT BORINGS ONLY.

LEGEND:

M63–6 — PROJECT BORINGS
9.3 (–23.7) — GROUND SURFACE ELEVATION (FT) / TOP OF WEATHERED ROCK/BEDROCK ELEVATION (FT) (APPROXIMATE)
B–11 — PREVIOUS BORINGS

GRAPHIC SCALE
50' 0 50' 100'

RIVERSIDE SOUTH – INFRASTRUCTURE
NEW YORK NEW YORK

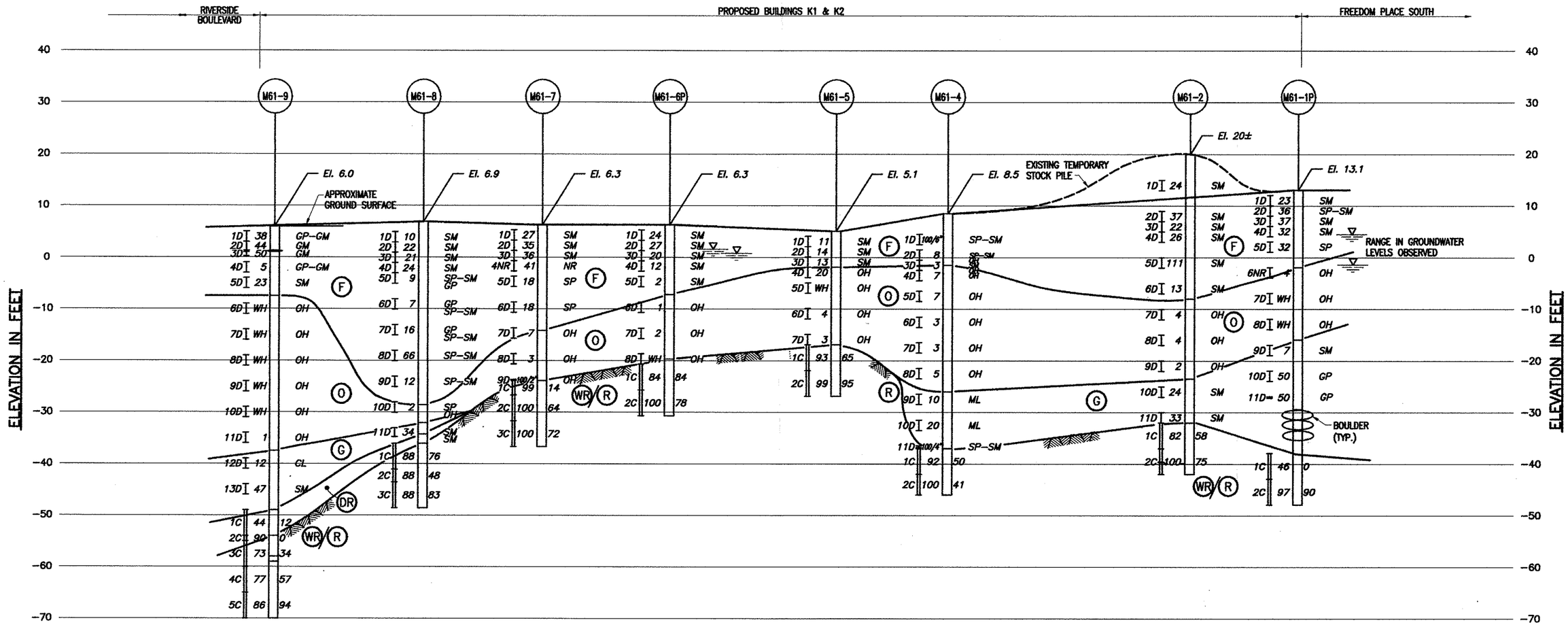
CRP/EXTELL RIVERSIDE, L.P.
NEW YORK NY

MUESER RUTLEDGE CONSULTING ENGINEERS
14 PENN PLAZA – 225 W. 34TH STREET, NY, NY 10122

SCALE	MADE BY A.H.	DATE 08–01–06	FILE NO. 10164
GRAPHIC	CH'KD BY C.L.H.	DATE 08–02–06	DRAWING NO. B–1

BORING LOCATION PLAN

Aug 06, 2006 at 5:14pm
G:\DWGS\101\10164\W61 TO W63\GEOLOGIC SECTIONS\B–1.dwg



GEOLOGIC SECTION A–A

GENERAL NOTES:

1. FOR BORING LOCATION PLAN AND ITS NOTES SEE DRAWING NO. B–1.
2. BORINGS ILLUSTRATED ON GEOLOGIC SECTIONS ARE IN SOME CASES PROJECTED TO THE SECTION OR OFFSET FOR CLARITY. STRATIFICATIONS SHOWN ON GEOLOGIC SECTIONS ARE NECESSARY INTERPOLATIONS BETWEEN AND BEYOND BORINGS AND MAY NOT REPRESENT ACTUAL SUBSURFACE CONDITIONS.
3. FOR COMPLETE SOIL SAMPLE AND ROCK CORE DESCRIPTIONS SEE BORING LOGS IN APPENDIX A.
4. SEE DRAWING NO. GS–R FOR BORING LEGEND AND SUMMARY OF UNIFIED SOIL CLASSIFICATION SYSTEM. SEE DRAWING NO. RC–1 FOR ROCK CORE CLASSIFICATION CRITERIA.
5. ELEVATIONS ARE IN FEET AND REFER TO BOROUGH PRESIDENT OF MANHATTAN DATUM WHICH IS 2.75 FEET ABOVE M.S.L. AT SANDY HOOK, NJ IN 1929.
6. DRILLING FLUID LEVELS WERE MEASURED IN SOME BORINGS BUT ARE NOT SHOWN AS THEY MAY NOT REPRESENT ACTUAL GROUNDWATER CONDITIONS. REFER TO PIEZOMETER RECORDS FOR REPRESENTATIVE GROUNDWATER LEVEL OBSERVATIONS.

GENERAL STRATA DESCRIPTIONS:

(F) FILL –OLD RAILROAD YARD FILL. TYPICALLY SANDY MATERIAL WITH VARIOUS AMOUNTS OF GRAVEL AND SILT MIXED WITH MISCELLANEOUS DEBRIS.

(O) ORGANIC SILTY CLAY – FORMER RIVER BOTTOM SEDIMENTS. GENERALLY SOFT TO MEDIUM SILTY CLAY SOMETIMES INTERMIXED WITH FILL.

(G) GRANULAR DEPOSITS: ALLUVIAL AND GLACIAL DEPOSITS. COMPOSITION RANGES FROM SANDS WITH VARIOUS AMOUNTS OF SILTS AND GRAVEL, TO SANDY TO CLAYEY SILTS (INCLUDING VARVED DEPOSITS)

(DR) DECOMPOSED ROCK – TYPICALLY CONSISTS OF SAND MIXED WITH SILT AND ROCK FRAGMENTS.

(WR)/(R) ROCK MICA SCHIST TO GNEISSIC SCHIST, WITH GRANITIC INTRUSIONS OF SCHISTOSE GNEISS, GRANITE AND QUARTZ PEGMATITE. WEATHERED TO HARD.

GRAPHIC SCALES

VERTICAL: 10' 5' 0 10' 20'

HORIZONTAL: 20' 10' 0 20' 40'

RIVERSIDE SOUTH DEVELOPMENT
NEW YORK NEW YORK

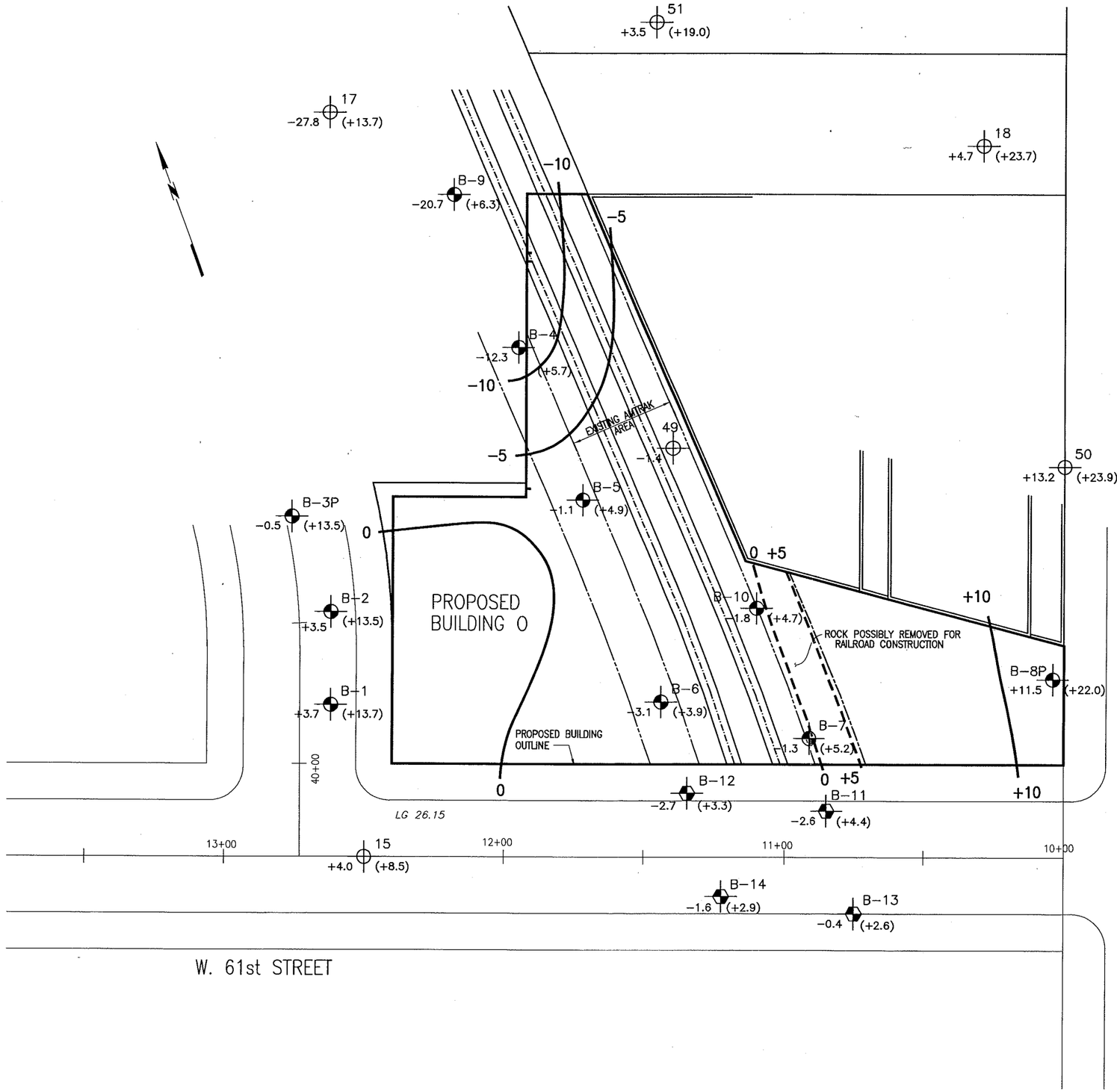
CRP/EXTELL RIVERSIDE, L.P.
NEW YORK NEW YORK

MUESER RUTLEDGE CONSULTING ENGINEERS
14 PENN PLAZA – 225 W. 34TH STREET, NY, NY 10122

SCALE	MADE BY C.P.J./A.H. DATE 08–01–05	FILE NO.
GRAPHIC	CH'KD BY C.L.H. DATE 08–02–06	10164

GEOLOGIC SECTION A–A
WEST 61st STREET

DRAWING NO. GS–1



NOTES:

1. FOR GENERAL NOTES SEE DRAWING NO. B−1.

LEGEND:

B−1 — BORING NUMBER (P−PIEZOMETER)
−10.0 (+8.2) — GROUND SURFACE ELEVATION (FT) / TOP OF BEDROCK ELEVATION (FT)

−10 — ELEVATION OF INTERPRETED CONTOUR OF TOP OF ROCK (WHERE CONTOUR LINE IS DASHED, ITS LOCATION IS BASED ON HISTORIC SOURCES AND IS VERY APPROXIMATE)

GRAPHIC SCALE
20' 10' 0 20' 40'

PRELIMINARY
05−26−04

RIVERSIDE SOUTH − BUILDING O
NEW YORK NEW YORK

TRUMP NEW WORLD
NEY YORK NEW YORK

MUESER RUTLEDGE CONSULTING ENGINEERS
14 PENN PLAZA − 225 W. 34TH STREET, NY, NY 10122

SCALE	MADE BY E.C. DATE 05−26−04	FILE NO.
GRAPHIC	CH'KD BY T.C.M./J.C. DATE 05−26−04	10164

TOP OF BEDROCK CONTOUR PLAN

DRAWING NO. B−2

Mueser Rutledge Consulting Engineers

14 Penn Plaza • 225 W. 34th Street • New York, NY 10122
Tel: (917) 339-9300 • Fax: (917) 339-9400
www.mrce.com

May 12, 2005 **CONFIDENTIAL**

The Carlyle Group
US Real Estate
1001 Pennsylvania Avenue, NW
Washington, DC 20004-2505

Attention: Mr. Avner A. Husen

Re: Review of Available Subsurface Information
Due Diligence Study
Riverside South Development - South
New York, NY
MRCE File No. 10432 (P05-147)

Gentlemen:

At your request, we have completed our review of the general subsurface information available for the referenced site. We understand that our review will provide information to be used in your due diligence study to evaluate the costs and feasibility of the site development. This letter summarizes our interpretation of the site's general subsurface conditions and provides geotechnical recommendations for the proposed development.

PROJECT DESCRIPTION

The Riverside South Development project is a high-rise residential development on the site of the former New York Central Railroad Yard on the west side of Manhattan, New York City. The development extends from West 59th Street to West 72th Street, between West End Avenue and the Hudson River. The elevated Miller Highway structure traverses the west side of the site.

The northern portion of the development above West 65th Street including Buildings A through G has been mostly completed. The southern portion of the development, south of West 65th Street, is either under construction (Building O) or planned. Building H between West 64th Street and West 65th Street, W64th Street Bridge and W61st Bridge have already been designed. Sheets Nos. 1 through 5 show the project area between West 59th Street and West 64th Street.

Similarly to the northern portion, development of the development's southern portion will include construction of new high-rise structures (Building H through N), extending the city street grid west of West End Avenue to meet the proposed Riverside Boulevard, and, possibly, developing a park west of the high-rise buildings. The existing grades north of West 59th Street are up to about 25 feet lower than the proposed street grid. Hence, the new street will need to be supported either on earth fill or be constructed as an elevated structure.

We understand that you may decide to construct the Miller Highway tunnel underneath the proposed Riverside Boulevard or a portion of it as part of your development. The tunnel is planned by New York State Department of Transportation.

Ground surface elevations within the site generally range between about Elev. +5 and Elev. +15. All elevations herein refer to Borough President of Manhattan (City) Datum which is 2.75 feet above Mean Sea Level (M.S.L.) at Sandy Hook, New Jersey.

BRIEF SITE HISTORY

Most of the site was previously occupied by railroad tracks and railroad yard structures. The 1899 Robinson's Atlas and 1916 Bromley's Land Book (Sheet No 2) indicate extensive trackage within the site. Aside from numerous one-story structures north of West 60th Street, a three-story hotel was located north of West 61st Street as shown on Sheet No.2. Mostof the tracks dead ended at West 60th Street and the block between West 60th Street and West 59 was developed. Building on that block included industrial warehouses up to six-story high some with basements. An above grade portion of the up to three-story Stock Pens warehouse on that block still remains at the site.

Through the 20th century, the layout of the railroad trackage changed. For instance, the 1956 Bromley's Land Book (Sheet No. 3) shows that the structures north of West 60th street were by that time demolished and new tracks with platforms were constructed in their place. Some of the buildings south of West 60th Street were also demolished.

At present, the Amtrak Empire Corridor easement with two active tracks along the eastern edge of the site is the remnant of the original railroad trackage. Building N will need to span the existing Amtrak Empire Corridor tracks and future light-rail easement to the west of the tracks.

Recently, most of the site has been used for parking and temporary stockpiling of fill materials. We assume that any existing structures at the southern protion of the site will be demolished.

SUMMARY OF GEOLOGIC CONDITIONS

The site lies on the west border of a resistant ridge of the bedrock forming the backbone of Manhattan. Most pre-glacial soils in this area were removed during a succession of glacial ice advances that swept across southeastern New York State. The remaining soils are of recent origin, and date their deposition to the last glacial period, the Wisconsin, which ended about 12,000 years ago.

A significant portion of the site lies west of the pre-colonial shoreline of the Hudson River. The railroad yard previously present over most of the site to the west of the pre-colonial shoreline is all filled land. The 1874 Viele Map (Sheet No. 4) shows the location of the pre-colonial shoreline and land features present within the site area. Note the presence of a stream between West 60th Street and West 61st Street. The original shoreline is also shown on Sheet No. 1. Shorelines shown on Sheets Nos. 1 and 4 do not necessarily coincide with each other as they were obtained from different sources. Mapping at the time the shorelines were mapped was rather rough.

The Rock Data Map of Manhattan included data from borings drilled within the site in the 1930's. Additionally, our in-house files contain more recent boring information from investigations performed as a part of the Riverside South development and other nearby investigations.

General soil conditions at the site consist of a surficial layer of fill covering irregular deposits of organic silty clay and glacial granular deposits underlain by bedrock. Some previous borings encountered a layer of decomposed rock overlying bedrock. Boulders may be encountered within the glacial deposits. The old railroad yard fill is a sandy material locally mixed with miscellaneous debris (such as cinders, fragments of concrete, brick, wood, and glass). The portions of the fill layer below the groundwater table are often loose due to the method of fill placement. The lower, loose fill was dumped into water, while the upper fill was deposited above water table and benefitted from railroad construction and compaction. The lower fill may be susceptible to liquefaction during an earthquake. It is possible that remnants of former structures, including foundations, tracks and old utilities are buried in the fill.

The organic silty clay deposits are the former river bottom sediments that now underlie the fill. This stratum typically is typically a soft to medium silty clay and is highly compressible. After placing the fill, the river sediments compressed, and in some areas displaced under the weight of fill. Fill materials sometimes intermixed with or penetrated into the organic deposits which may explain why some previous borings did not encounter the organic layer. Typically, the organic deposits are present west of the original shoreline and their thickness increases westwards. Near the elevated Miller highway structures the stratum may be as much as 50 feet thick.

The glacial deposits consist of the former glacial lake bottom deposits and glacial till deposits. The composition ranges from sandy and clayey silts to sand, with various amounts of silt and mica and traces of rock fragments. Boulders may be present within the glacial layer.

The bedrock encountered in previous borings typically consists of mica and gneissic schist, with granitic intrusions of schistose gneiss, granite and quartz pegmatite. The hardness of the rock ranges from weathered to hard, typically improving with depth except at boundaries of granitic intrusions. A discontinuous layer of decomposed rock may be present above the bedrock. The top of bedrock surface slopes down westerly toward the Hudson River with elevations sloping from about Elev.0 to Elev.-60 across the site as indicated on a contour plan on Sheet No. 5.

Based on groundwater observations in the area, typical groundwater levels in the soil west of the Amtrak easement range from about Elev. -2 to Elev. +4. The groundwater levels are influenced by the sloping bedrock surface and distance from the Hudson River. Excavations in the western portion of the site may encounter groundwater higher typically at about the top of bedrock surface.

Our review of the recent flood insurance rate map for the site indicates the 100-year flood level in the area is at Elev. +7.25.

GEOTECHNICAL AND FOUNDATION ISSUES

We anticipate that geotechnical issues and foundation systems for future development at the site will be similar to those of the completed northern portion of the development:

Buildings

- ***Foundations*** Due to the presence of miscellaneous fill and organic deposits we anticipate that most of the proposed buildings will be supported on piles driven to bedrock. The glacial deposits, if present, are typically too thin to provide adequate bearing. Typically, driven steel H-piles or pipe piles provide the most economical foundation system. The design of driven piles should consider possible obstructions to driving (i.e., obstructions in fill, boulders in glacial deposits, and decomposed and weathered rock layers). Heavier pile sections with driving tips will likely be required. Liquefaction of lower loose fill may need to be considered in the investigation of lateral pile capacities. The presence of cinders and possible stray currents may lead to corrosion of steel foundations. Hence, measures should be taken to account for corrosion in the pile design.

  Where bedrock is near ground surface at the southeast corner of the site (the east portion of Building N), shallow foundations or pier bearing directly on bedrock

may be used. Shallow foundations in other areas will be feasible only if deep basements are constructed.

- ***Basements*** The buildings completed have typically one basement below the raised street grid but typically above the groundwater table. If more than one basement is needed, excavation below groundwater table may be required. Such an excavation would require an adequate excavation support system combined with construction dewatering. Contamination of fill and groundwater will need to be considered. Also, extensive dewatering may cause increase in overburden stresses leading to consolidation of the organic stratum and ground settlement. Ground settlement may induce undesirable down-drag forces on any adjacent existing piles.

- **Buildings N and M** Building N at the southeast corner of the site will need to span the existing Amtrak and light rail easements similarly to the existing buildings to the north. The rail easements will restrict the size of foundations used.

  Some of the former structures within the footprint of Buildings N and M had basement space. It is not clear if the basements were filled in or not. Any remnants of the basement structures may obstruct installation of new foundation. On the other hand, if they are not filled in they may be incorporated into the new structure.

  The effect of the new foundation installation and loading conditions on the Amtrak tracks and Miller Highway piers will need to be considered.

Park Development West of Buildings and New Streets

As part of the development West 61st Street, West 63rd Street, and 64th Street will be extended west of West End Avenue to the new Riverside Boulevard Extension (Sheet No. 1). Additionally, Freedom Place South between West 63rd Street and West 61st Street will be constructed. West of the new buildings and Riverside Boulevard, a park may be constructed with a side slope from the street level to the existing grade near Miller Highway as shown on Sheet No. 6. A tunnel or a portion of a tunnel may be built below Riverside Boulevard within the park embankment. Schematic sections through the new park fill with and without the tunnel are shown on Sheet No. 6.

The new streets and park will need to match elevations of the existing street grid and will be up to about 30 feet above the existing grade at W 65th Street. Southwards, the difference between

the existing grade and adjacent street decreases (e.g., it is about 15 feet at West 61st Street). At the southern end of the site, the proposed Riverside Boulevard will descend and meet the existing W 59th Street under the elevated Miller Highway structure.

As a result of the grade differences, the new streets and park will either have to be supported on new fill placed on top of the existing grade or supported on an elevated concrete or steel structure.

New Fill Embankment Assuming the original shoreline coincides with the easternmost limit of the compressible organic stratum, all new streets to the east of that line can be supported on fill placed directly over the existing grade. To the west of the shoreline, where compressible organic stratum is present, new fill placed directly over the existing grade would likely induce consolidation of the organic soil and potentially cause significant ground settlement. In addition to ground settlement, new fill placed near the Miller Highway structure may induce lateral consolidation of the subsoils leading to excessive lateral pressures on the highway foundation piers.

There are two options on how to mitigate the potential risk of ground settlement and vertical consolidation (near highway piers):

- Support the new fill on a relieving platform. This platform would be supported on piles driven to bedrock. Most of the fills for the streets and park of the completed northern portion of the development are supported on relieving platforms. West of the existing buildings the platform extends close to the toe of the park embankment slopes (Sheet No.5). As an alternative to the relieving platform other means of directly supporting the new fill may be investigated including ground improvement methods (e.g., soil-cement columns).

- At locations where the organic stratum is relatively thin (say less than 10 feet), pre-loading with surcharge fill may be employed to improve the compressibility of the organic stratum and eliminate the need for a relieving platform. The pre-loading technique consists of placing 2 to10 feet of surcharge fill on top of the proposed grade for a substantial time typically ranging from 6 to 18 months. The amount of surcharge fill and duration of pre-loading depends on the thickness and consolidation characteristics of the organic stratum If the pre-loading time need to be shorten to only several months wick drains may be installed.

  If pre-loading with surcharge fill is selected, the effect of ground settlement induced by pre-loading on adjacent structures should be considered (including downdrag forces on adjacent piles).

We trust that this letter provides information you need in the performance your due diligence study. Please, do not hesitate to contact with any further questions.

Very truly yours,

MUESER RUTLEDGE CONSULTING ENGINEERS

By:_____
Jan Cermak

By:_____
For James L. Kaufman

JC:JLK

PIER 103

PIER 102

179.10 LINE

320.10

463.5⅛

1171
Lot 1

BULKHEAD

HENRY HUDSON

ELEVATED

U. S.

W 64TH ST

137.1⅝

201.10¾

204.1⅜

256.4⅛

Bldg. I

140

272.5½

W 63RD ST

268.2

462⅛

1171
Lot 1

Bldg. J

241.3⅝

71.11¾

64.1⅛

68.5½

145

303.5½

RIVERSIDE BLVD.

Bldg. K

222.2⅛

68.5½

54.7⅛

70.1¾

180

10

395.9⅞

40.2⅞

Bldg. O

160

240

W 61ST ST

128.7½

548.10¾

ORIGINAL SHORELINE

Bldg. M

Bldg. N

458.8

48.4¼

125.7⅛

76.4

184.0¼

1171

WAREHOUSE

1171

PARKING

PARK

155

165

251.1¼

649

641

1567.4

548.10¾

605

P.R. EASEMENT

W. 59TH

80

RAMP

18

1

700

63

PARKING

AVE.

WEST END TOWERS

W 62nd ST

WEST END AVE.

THELON

W. 6

W 61ST

W 60TH

GAS STA

CONDO. 1001-1

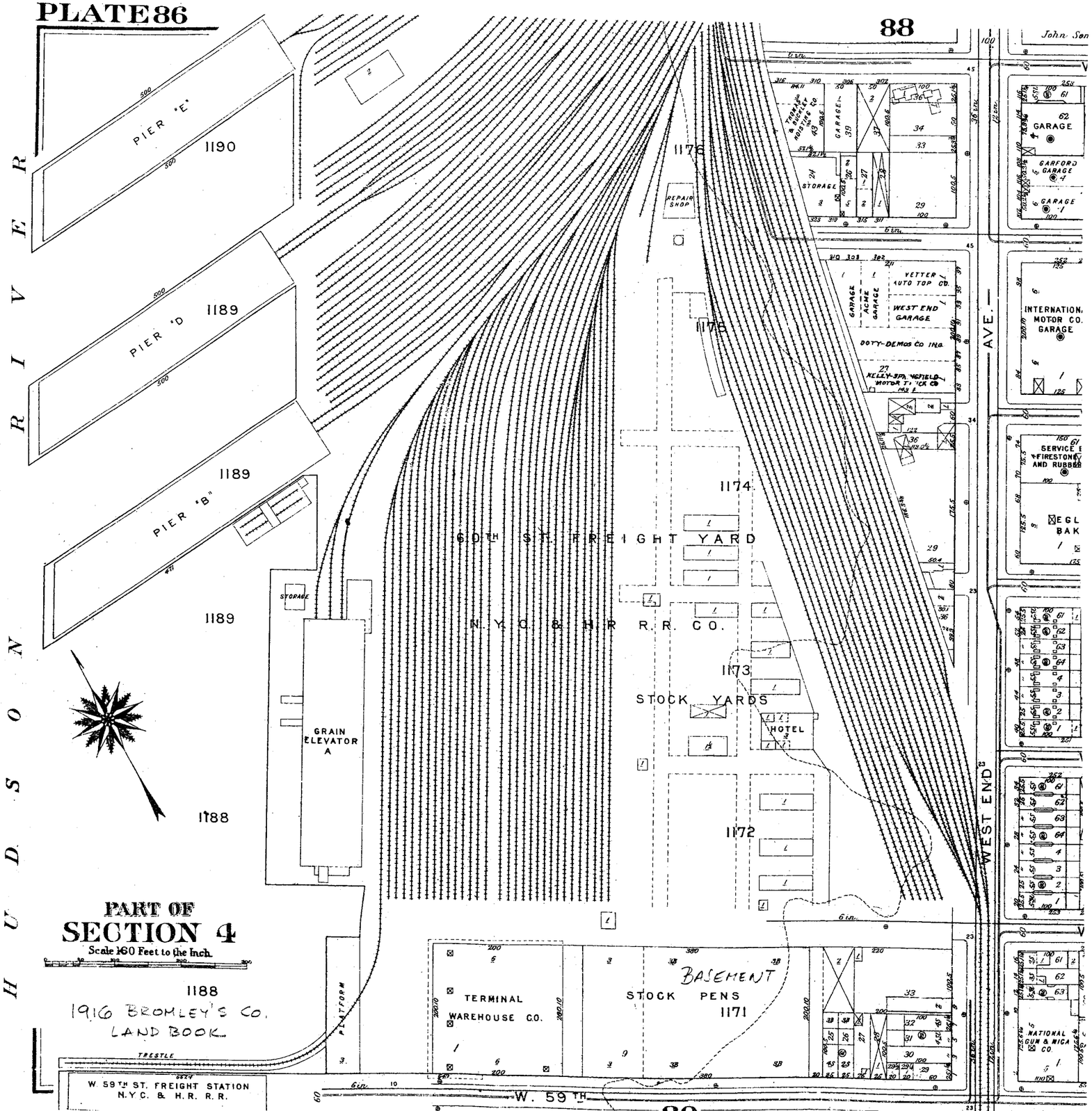
PART OF
SECTION 4

SCALE OF FEET
120 60 0 120

2002-3 MANHATTAN
LANDBOOK

Sheet No. 1

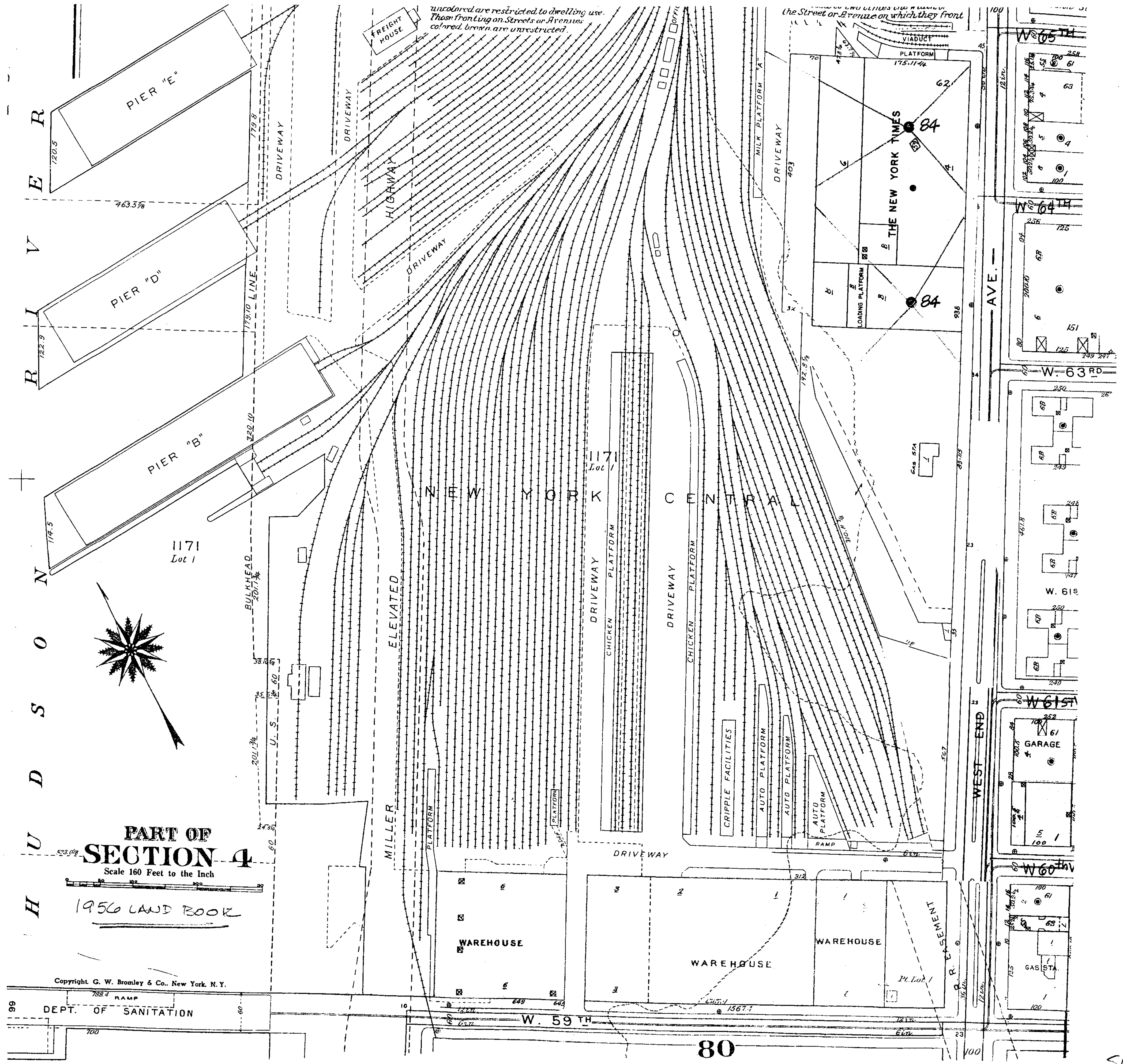
PLATE 86



PART OF
SECTION 4
Scale 160 Feet to the Inch.

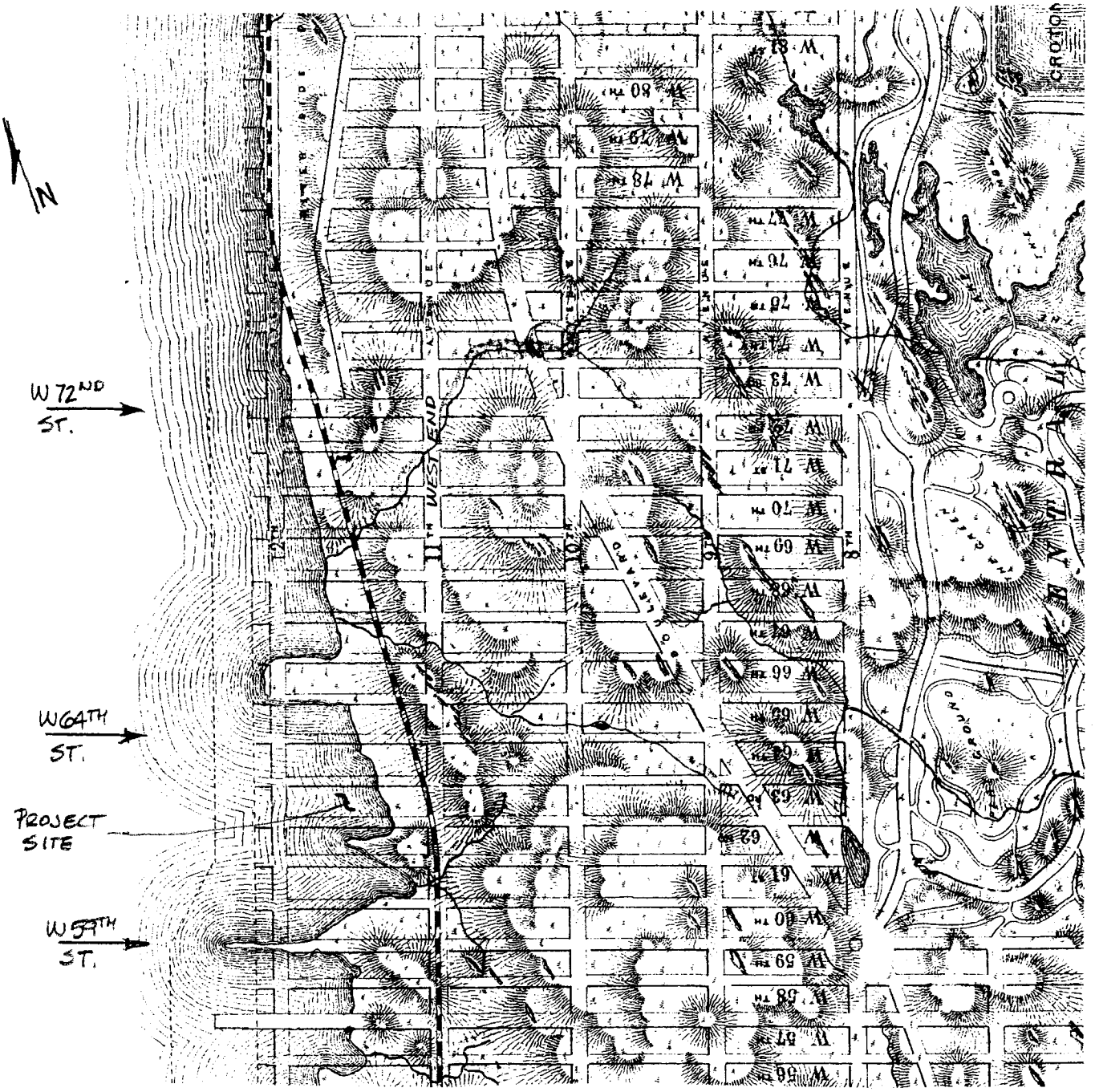
1916 BROMLEY'S CO.
LAND BOOK

Sheet No. 2



uncolored are restricted to dwelling use. Those fronting on Streets or Avenues colored brown are unrestricted.
the Street or Avenue on which they front
FREIGHT HOUSE
PIER "E"
PIER "D"
PIER "B"
HUDSON RIVER
DRIVEWAY
HIGHWAY
MILK PLATFORM "A"
VIADUCT
PLATFORM
THE NEW YORK TIMES
84
LOADING PLATFORM
W. 65TH
W. 64TH
W. 63RD
W. 61ST
W. 60TH
W. 59TH
WEST END AVE.
GAS STA.
GARAGE
1171
Lot 1
NEW YORK CENTRAL
BULKHEAD
U. S. LINE
MILLER ELEVATED HIGHWAY
CHICKEN PLATFORM
CRIPPLE FACILITIES
AUTO PLATFORM
RAMP
WAREHOUSE
R. R. EASEMENT
DEPT. OF SANITATION
PART OF
SECTION 4
Scale 160 Feet to the Inch
1956 LAND BOOK
Copyright G. W. Bromley & Co., New York, N.Y.
80

Sheet No. 3



RIVERSIDE SOUTH

NEW YORK NY

MUESER RUTLEDGE CONSULTING ENGINEERS

225 West 34th Street • 14 Penn Plaza
New York, NY 10122

SCALE	MADE BY JC	DATE 5-05	FILE NO.
–	CH'KD BY	DATE	

1874 VIELE MAP

DRAWING NO. 4

PIER 103

PIER 102

175.10 LINE

320.10

1171
Lot 1

BULKHEAD
201.1¾

463.5⅞

HI

-60

-60

ELEVATED

U.S.

HENRY HUDSON

W 64TH ST

137.1⅝

201.10¾

Bldg. I

140

272.5½

WG3RD ST

-40

-20

268.2

1171
Lot 1

Bldg. J

241.3⅜

145

303.5½

68.5½

54.7⅛

68.5⅛

Bldg. K

222.2⅞

180

10

395.9⅞

WG1ST ST.

128.7½

548.10¾

-40

-20

ORIGINAL SHORELINE

Bldg. M

Bldg. N

1171

WAREHOUSE

1171

PARKING

PARK

155

165

251.¼

649

64:

1567.4

548.10¾

605

R. EASEMENT

W. 59TH

80

AVE.

WEST END

WG2ND ST

WEST END TOWERS

GARAGE

Bldg. O

240

160

42.4

WG1ST

WG60TH

GAS STA

THELON

CONDO. 1001-1

W. 6

PART OF
SECTION 4

SCALE OF FEET
120 60 0 120

2002-3 MANHATTAN
LANDBOOK

LEGEND

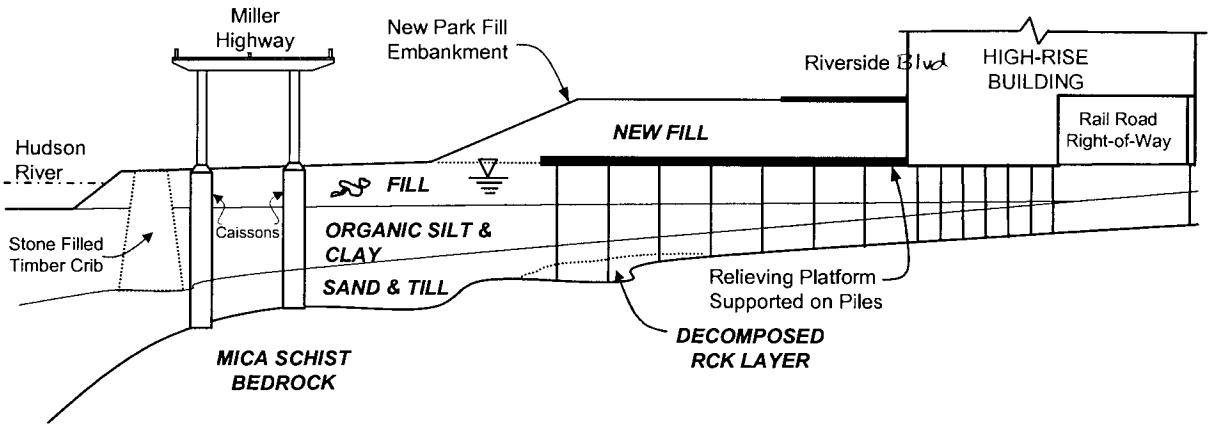
-20 CONTOUR OF TOP OF BEDROCK ELEVATION (FT)

(BOROUGH PRES. OF MANHATTAN DATUM)

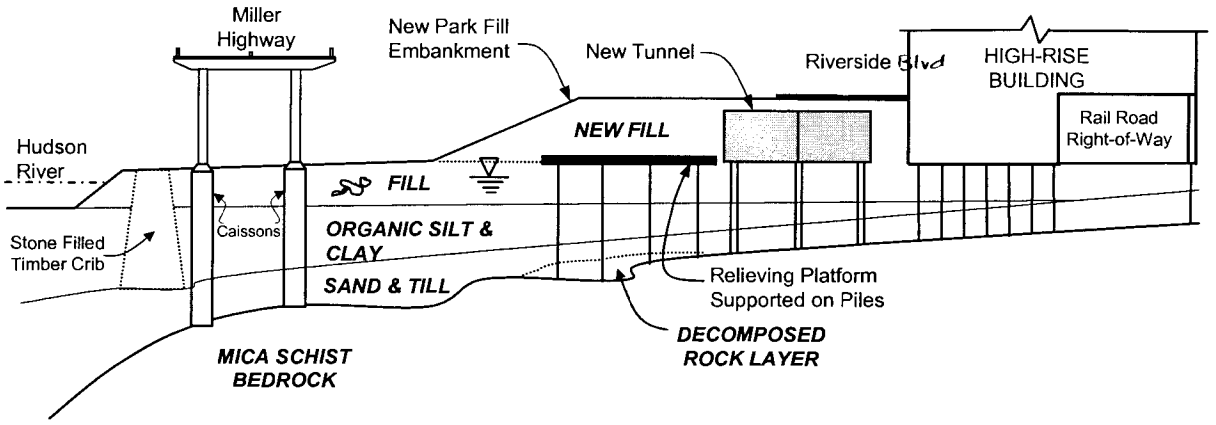
Sheet No. 5

RIVERSIDE SOUTH - W 66TH STREET

(a) Typical Section without Tunnel (NTS)



(b) Typical Section with Tunnel (NTS)



MRCE
5/6/05

Sheet No. 6

WSP CANTOR SEINUK
STRUCTURAL ENGINEERS.
228 EAST 45TH STREET NEW YORK, NEW YORK 10017
TEL. 212-687-9888 FAX. 646-487-5501 WWW.CANTORSEINUK.COM

STRUCTURE: Riverside Center - Buildings 1, 2, 3, 4 & 5

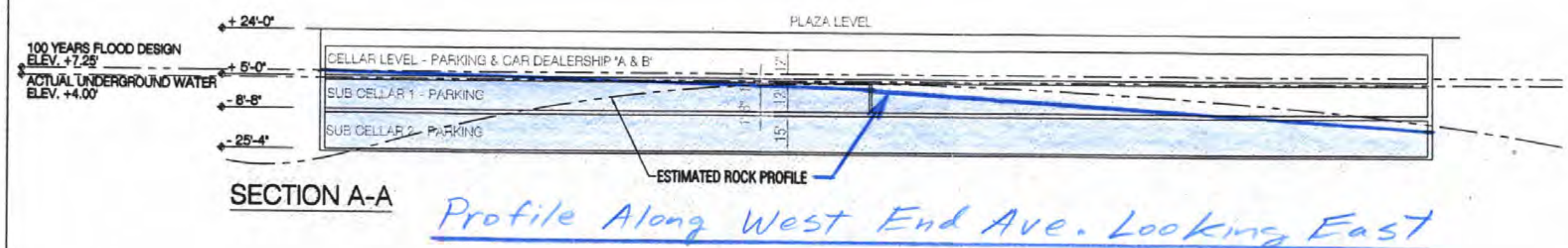
SUBJECT: Site Plan with Estimated Rock Countour Lines

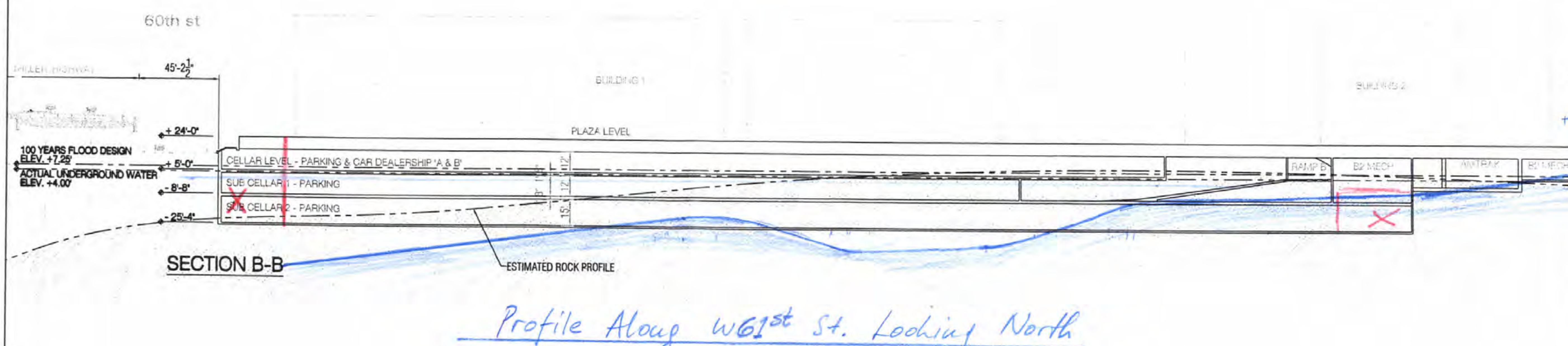
ARCHITECT: GHW Architects, LLP.

DATE: 01/15/10

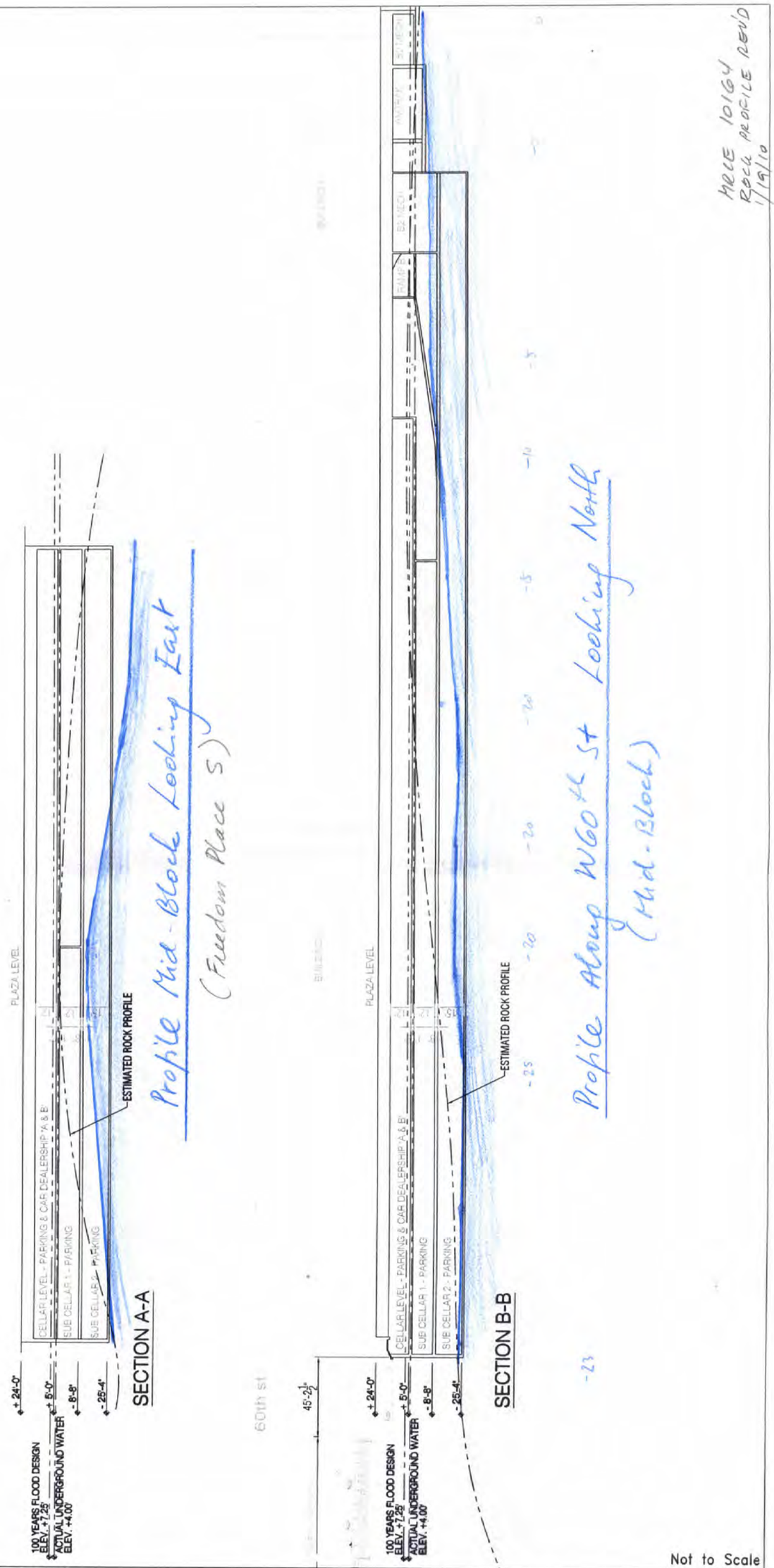
SKETCH: SK-01.15.10-02

Not to Scale





MRCE 10/64
ROCK PROFILE REVISED 1/19/10



MELE 10164
ROCK PROFILE REVD
1/19/10

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TEL. 212-687-9888 FAX. 646-487-5501 WWW.CANTORSEINUK.COM

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SUBJECT: Site Plan with Estimated Rock Countour Lines			
ARCHITECT: GHW Architects, LLP.	DATE: 01/15/10	SKETCH: SK-01.15.10-02	

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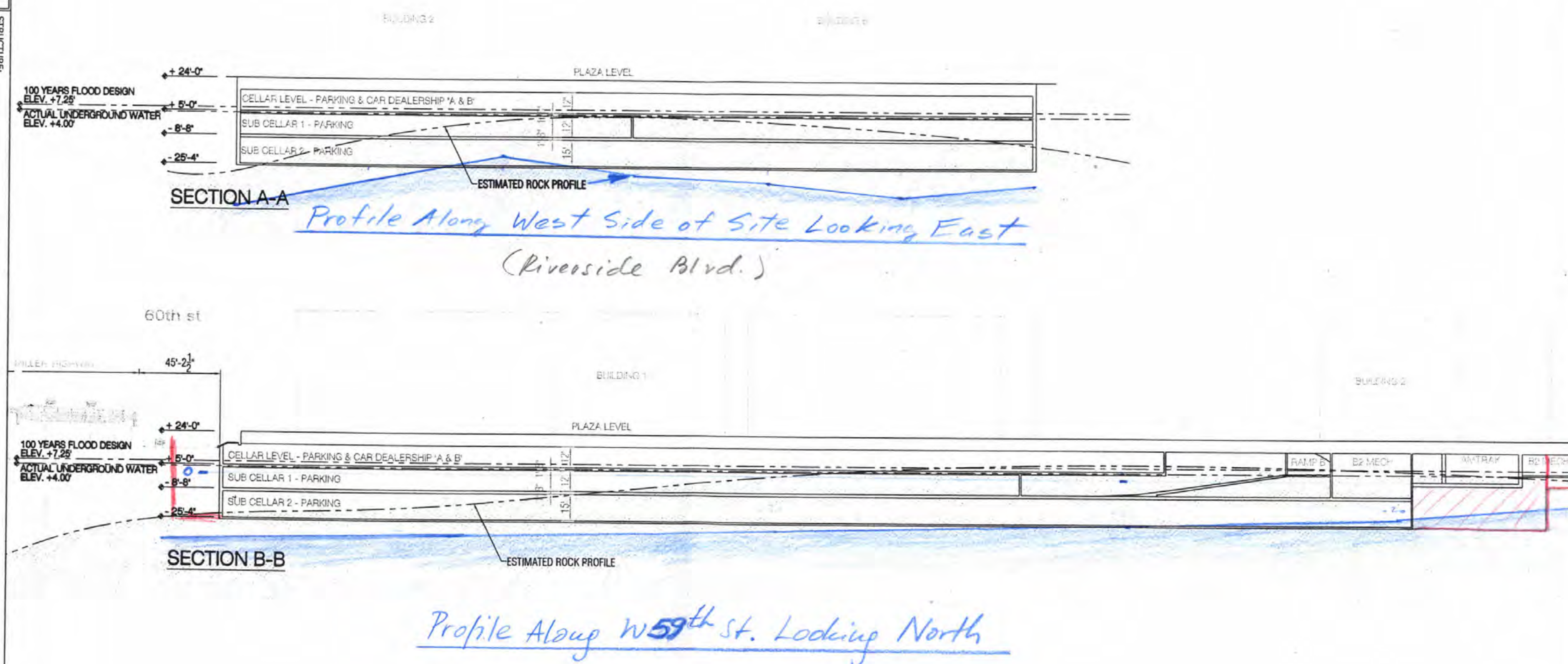
ARCHITECT: GHW Architects, LLP.

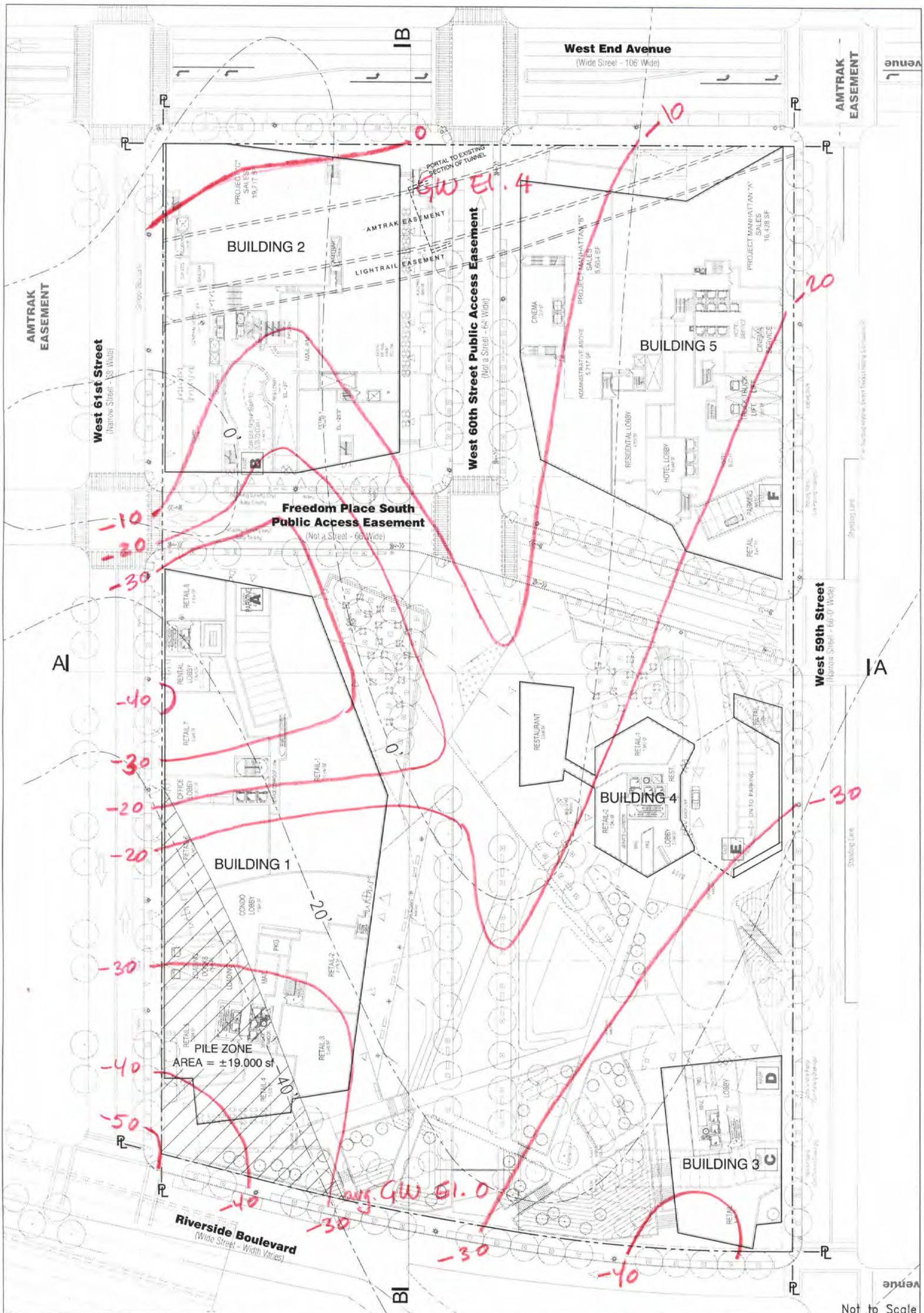
DATE: 01/15/10

SKETCH: SK-01.15.10-02

Not to Scale



MRCE 10164
ROCK PROFILE REV'D
1/19/10



Not to Scale

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TEL. 212-687-9888 FAX. 646-487-5501 WWW.CANTORSEINUK.COM

STRUCTURE: Riverside Center - Buildings 1, 2, 3, 4 & 5

SUBJECT: Site Plan with Estimated Rock Countour Lines
FOR REVISED BY MRCE

ARCHITECT: GHW Architects, LLP.

DATE: 01/15/10
REV. 1/19/09

SKETCH: SK-01.15.10-01

APPENDIX B

LANGAN BORING AND WELL CONSTRUCTION LOGS

LANGAN

Log of Boring **LB-35**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project: Riverside 4	Project No.: 170275404	East:	
Location: Riverside Parcel 4	Elevation and Datum: Approx. 8.4	North:	
Drilling Company: Warren George,Inc	Date Started: 1/28/15	Date Finished: 1/29/15	
Drilling Equipment: Acker 65 Truck Mounted Drill Rig	Completion Depth: 55 ft	Rock Depth: 40 ft	
Size and Type of Bit: 2-7/8" / 3-7/8" / 4-7/8" / 5-7/8" Diameter Tri-Cone Roller Bit	Number of Samples: Disturbed 8	Undisturbed -	Core 3
Casing Diameter (in): 3" / 5" Inner-Diameter Flush Steel Casing	Casing Depth (ft): 40	Water Level (ft.): First -	Completion -	24 HR. -
Casing Hammer: Donut	Weight (lbs): 300 lbs	Drop (in): 30"	Drilling Foreman: Mike Kelly	
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel			Inspecting Engineer: Douglas Spitzer	
Sampler Hammer: Safety	Weight (lbs): 140 lbs	Drop (in): 30"		

Material Symbol	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40
	+8.4				0					
	+8.2	Asphalt	3" Asphalt Pavement		1					
	+7.2	Concrete	12" Concrete Pavement, Steel beam		2					
			ROLLER BIT TO 5'	PUSH	3					
					4					
			Brown-to-red brown coarse-to-fine grain SAND, gravel, concrete and brick fragments [FILL] (moist) NYCBC Class 7		5	S-1	SS	12	10 11 9 11	20
			Gray-Brown-Black medium-to-fine grain SAND, some coarse gravel and silt, some brick fragments [FILL] (moist) NYCBC Class 7	281	6 7 8	S-2	SS	6	10 19 17 19	36
			Dark Gray GRAVEL, some timber fragments, some sand, trace silt [FILL] (wet) NYCBC Class 7		9	S-3	SS	5	13 14/0"	14/0"
				PUSH	10 11 12 13					
				86	14					
			Brown-Gray medium-to-fine grain SAND, some brick fragments, some wood fragments (wet) NYCBC Class 7		15 16	S-4	SS	12	5 3 3 4	6
				PUSH	17 18 19 20					

Remarks

(Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)

1/28/2015
8:00 AM - Set up drill rig at LB-35
8:48 AM - Begin spinning bit
10:00 AM - FDNY made drillers disconnect hoses from fire hydrant. Water in disconnected hoses froze by 10:14 AM. No drilling production.

1/29/2015
8:48 AM - Roller bit to 5' with 5-7/8" tri-cone roller bit
- Bit bouncing, hard drill
- Gray wash return
9:50 AM - Take S-1 from 5' to 7'
9:55 AM- Take S-2 from 7' to 9'
- Hole deflected off obstruction, offset borehole ~1' east
10:08 AM - Roller bit to 9' in offset hole
10:30 AM- Pushed 5" casing to 5' then drove casing to 10' (281 blows)
10:42 AM- Roller bit to 9' with 4-7/8" tri-cone roller bit
10:44 AM - Take S-3 from 9' to 11'
- Roller bit to 15'
- Rig bouncing on probable timber

10:53 AM - Take S-4 from 15' to 17'
- Push 5" casing
- Roller bit to 20' with 4-7/8" tri-cone roller bit
- Gray wash return
- Push 3" casing to 20'

Log of Boring **LB-35**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 8.4	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
			Gray low plasticity CLAY, trace fine gravel, trace fine grain sand, trace mica, some silt [CL-OL] (moist) NYCBC Class 6		20–22	S-5	SS	6	2 2 1 1	3	
		Class 6	Gray-to-Dark Gray high plasticity CLAY, tarce fine sand, trace shell fragments, trace silt [CH-OH] (moist) NYCBC Class 6	PUSH	25–27	S-6	SS	18	4 3 3 WOR	6	11:34 AM - Take S-6 from 25' to 27' - Dropped sample to 25' 11:37 AM - Roller bit to 30' with 2-7/8" tri-cone roller bit - Push 3" casing to 30'
	-21.6				30						
		Class 6	Red-Brown silty fine grain SAND, trace (~5") high plasticity clay [SM] (moist) NYCBC Class 6		30–32	S-7	SS	24	3 4 5 8	9	11:48 AM - Take S-7 from 30' to 32' - Push 3" casing to 35' - Roller bit to 30' with 2-7/8" tri-cone roller bit
			Red-Brown TIMBER and ROCK fragments (moist) NYCBC Class 6	PUSH	33–35						11:31 AM - Bit refusal at 33', possible top of rock - Completed drilling at 33' below existing grade
					35–37	S-8	SS	1	38 34 32 47	66	12:00 AM - Take S-8 from 35' to 37' - Roller bit to 40', light brown wash - Top of rock at 40', finished casing hole with 3" casing to 40'
	-31.6				40						
		Class 1d	Black mica SCHIST, medium-to-fine grain size. Mechanical fracture at 40.5'. Weak. Weathered-to-slightly weathered. Fractures almost vertical. Fractures are weathered with iron staining. Close-to-very close fracture spacing. Decomposed rock, washed out of core barrel NYCBC Class 1d		41–45	C-1	NX CORE BARREL	REC=20"/60" =33%	RQD=7.2"/60" =12%		1:10 PM - Start coring C-1 from 40' - White wash return - Losing water from 42.5' to 45'
	-36.6				45						

LANGAN

Log of Boring **LB-35**

Station Number _____ Station Offset _____

Structure type _____

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 8.4	

MATERIAL SYMBOL	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Class 1b	Black mica SCHIST, Biotite-Muscovite, medium-to-fine grain size. Mechanical fracture at 48', 48.4' and 49.4'. Medium hard. Weathered-to-slightly weathered. Fractures are 45 to 60 degrees along foliation. Fractures are weathered with iron staining and filled with mica, sand, and clay. Close fracture spacing. NYCBC Class 1b		45–50	C-2	NX CORE BARREL	REC=53"/60" =88%	RQD=37"/60" =62%		1:40 PM - Start coring C-2 from 45' -No wash-to-white wash return
	-41.6										
		Class 1c	Black mica SCHIST, Biotite-Muscovite-Quartz, medium-to-fine grain size. Mechanical fracture at 51'. Medium hard-to-Hard. Slightly weathered-to-Fresh. Fractures are vertical-to-60 degrees along foliation. Fractures have iron staining. Close fracture spacing. NYCBC Class 1b		50–55	C-3	NX CORE BARREL	REC=40"/60" =67%	RQD=26"/60" =43%		2:00 PM - Start coring C-3 from 50'
	-46.6		END OF BORING at 55 feet below existing grade		55						2:15 PM - Completed drilling at 55' below existing grade
					56–70						

Log of Boring **LB-36**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project: Riverside 4		Project No.: 170275404	East:
Location: Riverside Parcel 4		Elevation and Datum: Approx. 8.7	North:
Drilling Company: Warren George,Inc		Date Started: 1/30/15	Date Finished: 1/30/15
Drilling Equipment: Acker 65 Truck Mounted Drill Rig		Completion Depth: 33 ft	Rock Depth: 33 ft
Size and Type of Bit: 4-7/8" / 5-7/8" Diameter Tri-Cone Roller Bit		Number of Samples: Disturbed 7	Undisturbed - Core -
Casing Diameter (in): 5" Inner-Diameter Flush Steel Casing	Casing Depth (ft): 15	Water Level (ft.): First -	Completion - 24 HR. -
Casing Hammer: Donut	Weight (lbs): 300 lbs Drop (in): 30"	Drilling Foreman: Mike Kelly	
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel		Inspecting Engineer: Douglas Spitzer	
Sampler Hammer: Safety	Weight (lbs): 140 lbs Drop (in): 30"		

Material Symbol	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+8.7		Ground surface is dark brown medium-to- fine grained SAND, trace silt, some medium-to-coarse gravel, some medium-to- fine red brick [FILL] [moist] NYCBC Class 7		0						1/30/2015 8:40 AM - Breaking rods at LB-35 and moving to LB-36 9:28 AM - Set up at LB-36 9: 54 AM - Clearing first 5', light gray-brown wash return
				PUSH	1						
					2						
					3						
					4						
			Dark Brown medim-to- fine grained SAND, trace silt, trace medium-to- fine gravel, trace red brick, trace schist fragments [FILL] [wet] NYCBC Class 7		5	S-1	SS	12	7 10 15 6	25	9:59 AM - Take S-1 from 5' to 7' - Take S-2 from 7' to 9' -Drilling to 9', heavy rig chatter
					6						
			Black coarse SAND and fine grave, some silt. (Tip of split spoon had medium sand and silt material) [FILL] [wet] NYCBC Class 7	PUSH	7	S-2	SS	24	24 13 18 18	31	
		Class 7			8						
			Gray fine-to-coarse grain SAND and fine gravel, abundant brick fragments (~2") [FILL] [wet] NYCBC Class 7		9	S-3	SS	13	24 21 20 13	41	10:12 AM - Take S-3 from 9' to 11' - Push 4" casing from 0' to 5' then 5' to 10' 10:22 AM - Drilling to 15' - Switched to 4-7/8" tri-cone roller bit - Heavy rig chatter
					10						
				658	11						
					12						
					13						10:30 AM - Drove 5' of casing to 15' (658 blows) -Cleaning hole to 15' with 4-7/8" tri-cone roller bit -Tan-gray wash return -Bouncing bit -Wash turns gray then tan to clear then tan-gray then gray again
					14						
			TIMBER fragments [FILL] [moist] NYCBC Class 7		15	S-4	SS	4	12 3 5 8	8	10:52 AM - Take S-4 from 15' to 17' - Drilling to 20' with 4-7/8" tri-cone roller bit - Dark gray wash return
					16						
	-8.3				17						
		Class 6			18						
					19						
					20						

Log of Boring **LB-36**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 8.7	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
			Gray-to-Dark Gray low plasticity CLAY, some silt, trace fine sand, trace wood fragments, trace coarse gravel [CL-OH] [moist] NYCBC Class 6		20	S-5	SS	17	WOR WOR 1 1		11:00 AM - Take S-5 from 20' to 22' - Drilling to 25' with 4-7/8" tri-cone roller bit - Dark gray wash return
					21						
					22						
					23						
					24						
		Class 6	Gray-to-Dark Gray high plasticity CLAY, trace silt, trace shell fragments [CH-OH] [moist] NYCBC Class 6		25	S-6	SS	14	WOH WOH WOH WOH		11:08 AM - Take S-6 from 25' to 27' - Drilling to 30' with 3-7/8" tri-cone roller bit - Dark gray wash return
					26						
					27						
					28						
					29						
	-21.3				30	S-7	SS	11	WOH WOH 4 7		11:17 AM - Take S-7 from 30' to 32' - Drilling to 35' with 3-7/8" tri-cone roller bit - Dark gray wash return
		CLASS 6	Red-Brown fine grain SILTY SAND, trace fine gravel, abundant silt [SM] [moist] NYCBC Class 6		31						
					32						
	-24.3		Possible Top of Rock at 33' END OF BORING at 33'		33						11:31 AM - Bit refusal at 33', possible top of rock - Completed drilling at 33' below existing grade
					34						
					35						
					36						
					37						
					38						
					39						
					40						
					41						
					42						
					43						
					44						
					45						

LANGAN

Log of Boring **LB-37**

Station Number _____ Station Offset _____

Structure type _____

Project: Riverside 4	Project No.: 170275404	East:	
Location: Riverside Parcel 4	Elevation and Datum: Approx. 8.7	North:	
Drilling Company: Warren George,Inc	Date Started: 2/10/15	Date Finished: 2/11/15	
Drilling Equipment: Acker 65 Truck Mounted Drill Rig	Completion Depth: 45 ft	Rock Depth: 30 ft	
Size and Type of Bit	Number of Samples	Disturbed	Undisturbed / Core
Casing Diameter (in) / Casing Depth (ft)	Water Level (ft.)	First -	Completion - / 24 HR. -
Casing Hammer / Weight (lbs) / Drop (in)	Drilling Foreman: Mike Kelly		
Sampler	Inspecting Engineer: Douglas Spitzer		
Sampler Hammer / Weight (lbs) / Drop (in)			

Material Symbol	Elev. (ft)	Building Code	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+8.7		2" Asphalt	0						
			ROLLER BIT TO 5'	1						
				2						
				3						
				4						
			Dark Gray medium-to-fine GRAVEL, some silt, abundant red brick fragments [FILL] (wet) NYCBC Class 7	5	S-1	SS	6	2 9 10 5	19	
			Dark Gray-Red-Brown medium-to-fine grained GRAVEL, some silt, some sand, some red brick fragments [FILL] (moist) NYCBC Class 7	6						
				7	S-2	SS	14	19 12 10 14	22	
				8						
		Class 7	One rock fragment then 10" of horizontal timber grain (laying perpendicular to split spoon) [FILL] (moist) NYCBC Class 7	9	S-3	SS	11	4 4 4 14	8	
				10						
				11						
				12						
				13						
				14						
			NO RECOVERY [FILL] NYCBC Class 7	15	S-4	SS	0	4 3 2 1	5	
				16						
	-11.3			17						
				18						
				19						
				20						

Log of Boring **LB-37**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 8.7	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Class 6	Gray low plasticity CLAY, trace silt, trace shell fragments [CL-OL] (moist) NYCBC Class 6	20–22	S-5	SS	24	2 1 2 2	3	
		Class 6	Gray low plasticity CLAY, possibly cuttings [CL-OL] (wet) NYCBC Class 6	25–27	S-6	SS	6	WOR WOR WOR WOR		
	-21.3	Class 1c	Gray mica SCHIST, Biotite-Muscovite-Quartz, medium-to-fine grain size. Foliation is wavy and ranges from 60 degrees to vertical. Fresh-to-slightly weathered. Fractures are greater than 60 degrees along foliation. Close-to-very close fracture spacing. NYCBC Class 1c	30–34	C-1	BX CORE BARREL	REC=42"/60" =70%	RQD=22"/60" =37%		
	-26.3	Class 1d	Gray mica SCHIST, Biotite-Muscovite-Quartz, medium-to-fine grain size. Highly fractured. Weak Rock. Weathered-to-slightly weathered. Fractures are near 45 degrees from horizontal. Close-to-very close fracture spacing. NYCBC Class 1d	35–39	C-2	BX CORE BARREL	REC=43"/60" =72%	RQD=6"/60" =10%		
	-31.3	Class 1b	White-Light Gray GRANITE. Quartz-Muscovite-Feldspar-Biotite-Garnet, medium-to-coarse grain size. Foliation is wavy and almost vertical. Medium hard to hard. Slightly weathered to Fresh. Fracture angles near 60 degrees along foliation. Moderate fracture space. NYCBC Class 1b	40–45	C-3	BX CORE BARREL	REC=60"/60" =100%	RQD=50"/60" =83%		
	-36.3									

LANGAN

Log of Boring **LB-37**

Station Number _____ Station Offset _____

Structure type _____

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 8.7	

MATERIAL SYMBOL	Elev. (ft)	Building Code	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
			END OF BORING at 45'	45						
				46						
				47						
				48						
				49						
				50						
				51						
				52						
				53						
				54						
				55						
				56						
				57						
				58						
				59						
				60						
				61						
				62						
				63						
				64						
				65						
				66						
				67						
				68						
				69						
				70						

LANGAN

Log of Boring **LB-38**

Station Number _____ Station Offset _____

Structure type _____

Project: Riverside 4	Project No.: 170275404	East:	
Location: Riverside Parcel 4	Elevation and Datum: Approx. 8.7	North:	
Drilling Company: Warren George,Inc	Date Started: 2/11/15	Date Finished: 2/11/15	
Drilling Equipment: Acker 65 Truck Mounted Drill Rig	Completion Depth: 38 ft	Rock Depth: 28 ft	
Size and Type of Bit: 2-7/8" / 4-7/8" Diameter Tri-Cone Roller Bit	Number of Samples: Disturbed 6	Undisturbed -	Core 2
Casing Diameter (in): 3" / 5" Inner-Diameter Flush Steel Casing	Casing Depth (ft): 28	Water Level (ft.): First -	Completion -	24 HR. -
Casing Hammer: Donut	Weight (lbs): 300 lbs	Drop (in): 30"	Drilling Foreman: Mike Kelly	
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel			Inspecting Engineer: Douglas Spitzer	
Sampler Hammer: Safety	Weight (lbs): 140 lbs	Drop (in): 30"		

Material Symbol	Elev. (ft)	Building Code	Sample Description	Depth Scale	Sample Number	Sample Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+8.7		ROLLER BIT TO 5'	0						
				1						
				2						
				3						
				4						
			Gray coarse-to-fine silty SAND, some fine gravel [FILL] [moist] NYCBC Class 7	5	S-1	SS	6	4 2 3 2	5	
			Dark Gray medium-to-fine GRAVEL and coarse-to-fine sand, some silt [FILL] [moist] NYCBC Class 7	6						
				7	S-2	SS	14	10 12 12 16	24	
			NO RECOVERY [FILL] [wet] NYCBC Class 7	8						
				9	S-3	SS	0	50/3"	50/3"	
		Class 7		10						
				11						
				12						
				13						
				14						
			Black silty GRAVEL, trace wood and brick fragments and possibly ceramic [FILL] [wet] NYCBC Class 7	15						
				16	S-4	SS	10	4 5 3 9	8	
				17						
				18						
				19						
	-11.3			20						

Sample Data

N-Value (Blows/ft) 10 20 30 40

Log of Boring **LB-38**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 8.7	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
				20					10 20 30 40	
			Gray low plasticity CLAY, trace shell fragments, trace timber fragments [CL-OL] [moist] NYCBC Class 6	21	S-5	SS	15	WOH 2 2 1	4	
				22						
		Class 6		23						
				24						
			Gray low plasticity CLAY, abundant shell fragments [CL-OL] [moist] NYCBC Class 6	25						
				26	S-6	SS	4	2 6 5 8	11	
				27						
	-19.3			28						
			Dark gray mica SCHIST, Biotite-Muscovite-Quartz, medium-to-fine grain size. Medium hard-to-weak. Fresh-to-slightly weathered. Fractures are almost vertical to 60 degrees along foliation. Fractures are weathered with iron staining and filled with clay. Close fracture spacing. NYCBC Class 1c	29	C-1	NX CORE BARREL	REC=39"/60" =65%	RQD=29"/60" =48%		
		Class 1c		30						
				31						
				32						
	-24.3			33						
			Dark gray mica SCHIST, Biotite-Muscovite-Quartz-Feldspar, medium-to-fine grain size. Hard. Fresh. Fractures are near 45 degrees along foliation. Fractures are weathered with iron staining and filled with clay. Close fracture spacing. NYCBC Class 1a	34	C-2	NX CORE BARREL	REC=52"/60" =87%	RQD=52"/60" =87%		
				35						
				36						
				37						
	-29.3			38						
			END OF BORING at 38'	39						
				40						
				41						
				42						
				43						
				44						
				45						

Log of Boring **LB-39**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project: Riverside 4	Project No.: 170275404	East:	
Location: Riverside Parcel 4	Elevation and Datum: Approx. 8.8	North:	
Drilling Company: Warren George,Inc	Date Started: 2/12/15	Date Finished: 2/12/15	
Drilling Equipment: Acker 65 Truck Mounted Drill Rig	Completion Depth: 39 ft	Rock Depth: 29 ft	
Size and Type of Bit: 2-7/8" / 3-7/8" / 4-7/8" / 5-7/8" Diameter Tri-Cone Roller Bit	Number of Samples: Disturbed 6	Undisturbed -	Core 2
Casing Diameter (in): 3" / 5" Inner-Diameter Flush Steel Casing; Casing Depth (ft): 30	Water Level (ft.): First -	Completion -	24 HR. -
Casing Hammer: Donut; Weight (lbs): 300 lbs; Drop (in): 30"	Drilling Foreman: Mike Kelly		
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel	Inspecting Engineer: Douglas Spitzer		
Sampler Hammer: Safety; Weight (lbs): 140 lbs; Drop (in): 30"			

Material Symbol	Elev. (ft)	Building Code	Sample Description	Depth Scale	Sample Number	Sample Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+8.8		ROLLER BIT TO 5'	0–5						
		Class 7	Black-tan-white coarse-to-fine silty GRAVEL, some sand [FILL] [moist] NYCBC Class 7	5–6	S-3	SS	8	18 11 5 6	16	
			Gray coarse-to-fine GRAVEL, some silt, trace wood fragments [FILL] [moist] NYCBC Class 7	6–8	S-6	SS	4	12 15 15 9	30	
			Gray medium-to-coarse GRAVEL, some shell fragments [FILL] [wet] NYCBC Class 7	8–10	S-1	SS	10	3 2 WOH 1		
	-1.5		Dark Gray low plasticity CLAY, trace shell fragments	10–15						
		Class 6	NO RECOVERY [CL-OL] [moist] NYCBC Class 6	15–17	S-4	SS	0	WOH 1 2 1 WOH	2	
				17–20						

Log of Boring **LB-39**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 8.8	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Class 6	Dark Gray low plasticity CLAY, some shell fragments [CL-OL] [moist] NYCBC Class 6	20	S-5	SS	20	WOR WOR WOH 14		
	-12.7	Class 6	Gray-Maroon clayey medium SAND, trace shell fragments [SC] [moist] NYCBC Class 6	21						
				22						
				23						
				24						
	-16.2	Class 5b	Red-Brown elastic SILT, abundant schist rock fragments (up to 1") [MH] [moist] NYCBC Class 5b	25	S-6	SS	10	WOR WOR 22 29		
				26						
				27						
	-20.2	Class 1d	Black mica SCHIST, medium-to-fine grain size. Mechanical fracture at 40.5'. Weak. Weathered-to-slightly weathered. Fractures almost vertical. Fractures are weathered with iron staining. Close-to-very close fracture spacing. Decomposed rock, washed out of core barrel NYCBC Class 1d	28						
				29	C-1	NX CORE BARREL	REC=55"/60" =92%	RQD=50"/60" =83%		
				30						
				31						
				32						
				33						
	-25.2	Class 1b	Dark gray mica SCHIST, Biotite-Muscovite-Quartz, medium-to-fine grain size. Schistocity is wavy. Fresh. Fractures are 60 to 90 degrees along foliation. Fractures have iron staining. Close-to-moderate fracture spacing. NYCBC Class 1b	34						
				35	C-2	NX CORE BARREL	REC=58"/60" =97%	RQD=50"/60" =83%		
				36						
				37						
				38						
	-30.2		END OF BORING at 39'	39						
				40						
				41						
				42						
				43						
				44						
				45						

Log of Boring **LB-40**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project: Riverside 4	Project No.: 170275404	East:	
Location: Riverside Parcel 4	Elevation and Datum: Approx.	North:	
Drilling Company: Warren George,Inc	Date Started: 2/12/15	Date Finished: 2/25/15	
Drilling Equipment: Acker 65 Truck Mounted Drill Rig	Completion Depth: 22 ft	Rock Depth: 22 ft	
Size and Type of Bit: 4-7/8" / 5-7/8" Diameter Tri-Cone Roller Bit	Number of Samples: Disturbed 5	Undisturbed 1	Core -
Casing Diameter (in): 5" Inner-Diameter Flush Steel Casing	Casing Depth (ft): 13	Water Level (ft.): First -	Completion -	24 HR. -
Casing Hammer: Donut	Weight (lbs): 300 lbs	Drop (in): 30"	Drilling Foreman: Mike Kelly	
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel			Inspecting Engineer: Douglas Spitzer	
Sampler Hammer: Safety	Weight (lbs): 140 lbs	Drop (in): 30"		

Material Symbol	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40
			ROLLER BIT TO 5'	SPIN	0–4					
		Class 7	Black low plasticity CLAY, trace sand, timber and gravel [FILL] (moist) NYCBC Class 7	SPIN	5–6	S-1	SS	16	8, 3, 1, 2	4
		Class 7	Black low plasticity organic soil, some sand, gravel, silt, trace wood fragments, organic odor [FILL] (wet) NYCBC Class 7	SPIN	7–8	S-2	SS	13	3, 5, 4, 5	9
		Class 7	Cobbles (~1"), trace timber fragments, gravel, brick fragments, shell fragments, one small srew [FILL] (wet) NYCBC Class 7	SPIN	9–11	S-3	SS	3	50/3"	50/3"
		Class 6	Black low plasticity CLAY, trace sand, timber and gravel [FILL] (moist) NYCBC Class 7		15–17	S-4	SS	14	6, 3, 3, 3	6

Remarks

(Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)

2/12/2015 12:58 PM
- Set up at LB-40

1:06 PM - Roller bit to 5' with 5-7/8" tri-cone roller bit
- Brown wash return
- Rig chatter

1:20 PM - Take S-1 from 5' to 7'
- Take S-2 from 7' to 9'
- Spin 5" casing from 0' to 4'
- Change to 4-7/8" tri-cone roller bit
- Roller bit to 9', brown wash return turning gray
- Rig chatter

1:39 PM - Take S-3 from 9' to 11'
- Spin 5" casing from 4' to 9'
- Roller bit to 15', No wash return
- Heavy rig chatter changing to no rig chatter
- Losing water
- Light gray to clear wash briefly when it rises to top of casing
- Timber fragments
- White wash return with timber fragments
- Gray wash turning dark gray just before 15'

2:05 PM - Completed drilling for the day

2/23/2015 8:24 AM
- Take S-4 from 15' to 17'
- Change to 3-7/8" tri-cone roller bit
- Spin 5" casing from 9' to 13'

Log of Boring **LB-40**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx.	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Class 5	Brown SILT [ML] (moist) NYCBC Class 5a		20	UD-1	SH	24			2/25/2015 8:40 PM - Continued advancing 5" casing - Changed to 4-7/8" tri-cone roller bit - Cleaning hole/ drilling to 20' - Clear wash return turning dark gray, timber fragments in wash - Completed drilling at 22' below existing grade
			END OF BORING at 22 feet		21						
					22	S-5	SS	0	13/0"	13/0"	
					23						
					24						
					25						
					26						
					27						
					28						
					29						
					30						
					31						
					32						
					33						
					34						
					35						
					36						
					37						
					38						
					39						
					40						
					41						
					42						
					43						
					44						
					45						

LANGAN

Log of Boring **LB-45**

Station Number _____ Station Offset _____

Structure type _____

Project: Riverside 4	Project No.: 170275404	East:	
Location: Riverside Parcel 4	Elevation and Datum: Approx. 8.5	North:	
Drilling Company: Warren George,Inc	Date Started: 1/30/15	Date Finished: 2/4/15	
Drilling Equipment: Acker 65 Truck Mounted Drill Rig	Completion Depth: 30 ft	Rock Depth: 30 ft	
Size and Type of Bit: 2-7/8" / 3-7/8" / 4-7/8" / 5-7/8" Diameter Tri-Cone Roller Bit	Number of Samples: Disturbed 7	Undisturbed -	Core -
Casing Diameter (in): 3" / 5" Inner-Diameter Flush Steel Casing	Casing Depth (ft): 20	Water Level (ft.): First -	Completion -	24 HR. -
Casing Hammer: Donut	Weight (lbs): 300 lbs	Drop (in): 30"	Drilling Foreman: Mike Kelly	
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel			Inspecting Engineer: Douglas Spitzer	
Sampler Hammer: Safety	Weight (lbs): 140 lbs	Drop (in): 30"		

Material Symbol	Elev. (ft) +8.5	Building Code	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
			ROLLER BIT TO 5'	0–5						
			Brown coarse-to-fine grain SAND, some coarse-to-fine gravel, some brick fragments [FILL] [moist] NYCBC Class 7	5–7	S-1	SS	12	7, 8, 6, 9	14	
			Tan Brown fine grain SAND, trace silt, some coarse-to-fine gravel [FILL] [moist] NYCBC Class 7	7–9	S-2	SS	20	14, 17, 20, 17	37	
		Class 7	Brown coarse-to-fine grain SAND and gravel, some rock and brick fragments [FILL] [wet] NYCBC Class 7	9–15	S-3	SS	4	33/4"	33/4"	
			Gray medium-to-fine grain SAND, trace timber fragments [FILL] [moist] NYCBC Class 7	15–20	S-4	SS	7	15, 50/4"	50/4"	

LANGAN

Log of Boring **LB-45**

Station Number _____ Station Offset _____

Structure type _____

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 8.5	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Class 7	Brown coarse-to-fine grain GRAVEL, abundant timber fragments [FILL] [moist] NYCBC Class 7	20	S-5	SS	7	5, 6, 7, 7	13	
	-13.0		Dark Gray low plasticity CLAY, slight organic odor [CL-OL] [moist] NYCBC Class 6	21						
				22						
				23						
				24						
		Class 6	Gray-to-dark gray low plasticity CLAY, trace wood fragments (vertical grain), trace fine sand, trace silt, trace shell fragments [CL-OL] [moist] NYCBC Class 6	25	S-6	SS	24	3, 3, 3, 3	6	
				26						
				27						
				28						
				29						
	-21.5		Splitspoon refusal, assumed bedrock END OF BORING at 30'	30	S-7	SS	0	10/0"	10/0"	
				31						
				32						
				33						
				34						
				35						
				36						
				37						
				38						
				39						
				40						
				41						
				42						
				43						
				44						
				45						

N-Value (Blows/ft) scale: 10 20 30 40

Log of Boring **LB-46**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project: Riverside 4		Project No.: 170275404	East:
Location: Riverside Parcel 4		Elevation and Datum: Approx. 12.4	North:
Drilling Company: Warren George, Inc		Date Started: 2/5/15	Date Finished: 2/6/15
Drilling Equipment: Mobile B-58 Truck-Mounted Drill Rig		Completion Depth: 47 ft	Rock Depth: 37 ft
Size and Type of Bit: 3-7/8" / 2-7/8" Diameter Tri-Cone Roller Bit		Number of Samples: Disturbed 7	Undisturbed - Core 2
Casing Diameter (in): 4" Inner-Diameter Flush Steel Casing	Casing Depth (ft): 10	Water Level (ft.): First -	Completion - 24 HR. -
Casing Hammer: Donut	Weight (lbs): 300 lbs Drop (in): 30"	Drilling Foreman: Jim Wilson	
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel		Inspecting Engineer: Andi Sicwebu	
Sampler Hammer: Safety	Weight (lbs): 140 lbs Drop (in): 30"		

Material Symbol	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40
	+12.4		Ground surface is red brick amd medium-to-coarse gravel, trace dark brown medium-to-fine sand [FILL] (dry) NYCBC Class 7 ROLLER BIT TO 5'		0					
				DROP	1					
					2					
					3					
					4					
			Dark brown medium-to-fine grain SAND, trace silt, some medium-to-fine gravel, trace red brick, trace concrete fragments [FILL] (wet) NYCBC Class 7		5	S-1	SS	4	100/2"	100/2"
					6					
				SPIN	7					
					8					
					9					
		Class 7	Dark brown-to-Greenish fine grain SAND, some silt, trace fragments of quartz and schist [FILL] (moist) NYCBC Class 7		10	S-2	SS	11	13 12 18 14	30
					11					
					12					
					13					
					14					
			Gray-Greenish fine grain SILTY SAND, trace timber fibers [FILL] (moist-to-wet) NYCBC Class 7		15	S-3	SS	14	1 1 2 3	3
					16					
	-7.6				17					
					18					
					19					
					20					

Remarks
(Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)

2/5/2015 7:45 AM
- Start drilling
- Roller bit to 5', No wash return
- Rig chatter from 1' to 3'
- Heavy rig chatter from 3' to 4'

8:30 AM - Refusal at 5'
- Take S-1 from 5' to 7'
- Roller bit to 7', no wash return
- Heavy rig chatter from 5' to 6', hard drill
- Could not sample at 7', split spoon could not go through due to obstruction (possibly concrete or brick wall)
- Roller bit to 10', no wash return
- Rig chatter from 7' to 8', hard drill

9:15 AM - Drop 4" casing to 4' then spin from 4' to 10'

10:00 AM - Switch to 2-7/8" tri-cone roller bit then continue roller bit from 8' to 10'
- Brown-to-white wash return
- Hard drill, schist fragment return with wash

11:20 AM - Take S-2 from 10' to 12'
- Roller bit to 15'
- Dark brown wash return, gravel and schist return
- Dark brown wash return turning gray at ~13.5', sudden smooth drill

11:30 AM - Take S-3 from 15' to 17'
- Roller bit to 20', Gray wash return
- Smooth drill

Log of Boring **LB-46**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 12.4	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Class 6	Gray low plasticity CLAY, trace medium-to-fine grain mica, trace silt, trace shells [CL-OL] (moist) NYCBC Class 6		20–22	S-4	SS	24	1 1 2 1 2	2	11:40 AM - Take S-4 from 20' to 22' - Roller bit to 25', Gray wash return - Rig chatter at 23', hard drill
	-10.6				23						
			Light gray-to-white Boulder		24						11:55 AM - Start coring C-1 from 23' - Gray wash return - Core barrel broke through at 25'
	-12.6				25						
		Class 6	Gray-to-Brown low plasticity CLAY, trace silt, trace shells [CL-OL] (moist) NYCBC Class 6		25–27	S-5	SS	6	2 2 1 1	3	12:40 AM - Take S-5 from 25' to 27' - Roller bit to 30', Gray wash return - Smooth drill - Gray wash return turning brown at 29'
					28–29						
	-18.6				30						
		Class 3a	Brown medium-to-fine grain SAND, trace silt, trace gray-black decomposed biotite-schist [SP] (moist) NYCBC Class 3a		30–32	S-6	SS	24	18 20 31 15	51	1:23 PM - Take S-6 from 30' to 32' - Roller bit to 35', No wash return - Slight rig chatter at 32'
					33–34						
	-22.6				35	S-7	SS	3	100/0"	100/0"	1:45 PM - Refusal at 35' 2:00 PM - Completed drilling for the day
		Class 1d	Gray-Black decomposed biotite-schist [SCHIST] (moist) NYCBC Class 1d		36						
	-24.6				37						2/6/2015 7:40 AM - Drillers defrosting fire hydrant and hose pipes
		Class 1a	White-Light Gray-Pink GRANITE. Quartz-Muscovite-Feldspar-Biotite-Garnet, medium-to-coarse grain size, trace medium-to-fine grain mica. Medium hard to hard. Slightly weathered to Fresh. Fractures nearly horizontal. Moderate fracture space. NYCBC Class 1a		37–40	C-1	NX CORE	REC=56"/60" =93%	RQD=54"/60" =90%		9:00 AM - Take S-7 from 35' to 37' - Roller bit to 40', Gray wash return - Hard drill at 37' 10:00 AM - Start coring C-1 from 37' - Gray-to-white wash return
	-29.6				41						
		Class 1b	White-Light Gray-Pink GRANITE. Quartz-Muscovite-Feldspar-Biotite-Garnet, medium-to-coarse grain size, trace medium-to-fine grain mica. Intrusions of gray-black schist at 44' to 45'. Medium hard. Slightly weathered to Fresh. Fractures near 20 to		42–45	C-2	NX CORE	REC=55"/60" =92%	RQD=50"/60" =83%		11:05 AM - Changed core barrel - Start coring C-2 from 42' - Light gray-to-white wash return

Log of Boring **LB-46**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 12.4	

MATERIAL SYMBOL	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	-34.6	Class 1b	30 degrees from horizontal. Close-to-moderate fracture space. NYCBC Class 1b		45 46 47	C-2	NX CORE				
			END OF BORING at 47'		48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70						11:45 AM - Completed drilling at 47' below existing grade

Log of Boring **LB-47**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project: Riverside 4	Project No.: 170275404	East:	
Location: Riverside Parcel 4	Elevation and Datum: Approx. 10.5	North:	
Drilling Company: Warren George, Inc	Date Started: 3/2/15	Date Finished: 3/2/15	
Drilling Equipment: Mobile B-58 Truck-Mounted Drill Rig	Completion Depth: 40 ft	Rock Depth: 30 ft	
Size and Type of Bit: 2-7/8" / 4-7/8" Diameter Tri-Cone Roller Bit	Number of Samples: Disturbed 6	Undisturbed -	Core 2
Casing Diameter (in): 4" Inner-Diameter Flush Steel Casing	Casing Depth (ft): 10	Water Level (ft.): First ▽	Completion ▼	24 HR. ▼
Casing Hammer: Donut	Weight (lbs): 300 lbs	Drop (in): 30"	Drilling Foreman: Jim Wilson	
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel			Inspecting Engineer: Andi Sicwebu	
Sampler Hammer: Safety	Weight (lbs): 140 lbs	Drop (in): 30"		

Material Symbol	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+10.5		4" concrete		0						3/2/2015 7:40 AM - Set up drill rig and start drilling - Roller bit to 5' - Brown wash return from 0' to 2' - Hard drill from 0' -No wash return from 2' to 3', Brown wash return from 3' - Heavy rig chatter at 3'
			ROLLER BIT TO 5'		1						
					2						
					3						
					4						
			Brown medium-to-coarse grain SAND, some silt, trace medium-to-fine gravel, some decomposed mica schist [FILL] (moist) NYCBC Class 7	SPIN	5	S-1	SS	6	9 7 4 3	11	9:30 AM - Take S-1 from 5' to 7' - Spin 4" casing from 0' to 10' - Switch from 4-7/8" to 2-7/8" tri-cone roller bit - Roller bit to 7' - Take S-2 from 7' to 9'
					6						
			Brown medium-to-fine grain SAND, trace silt, some decomposed mica schist [FILL] (moist) NYCBC Class 7		7	S-2	SS	10	5 7 10 15	17	
		Class 7			8						10:00 AM - Roller bit to 10', Gray-Brown wash return
					9						
			Brown medium-to-fine grain SAND, trace silt, some decomposed mica schist, trace medium quartz [FILL] (moist) NYCBC Class 7		10	S-3	SS	4	18 10 19 11	29	10:20 AM - Take S-3 from 10' to 12' - Roller bit to 15' - No wash return
				SPIN	11						
					12						
					13						
					14						
			Brown medium-to-fine grain SAND, some medium-to-fine mica, trace black low plasticity clay [FILL] (wet) NYCBC Class 7		15	S-4	SS	8	40 35 15 13	50	10:39 AM - Take S-4 from 15' to 17' - Spin 4" casing from 10' to 15' - Roller bit to 20', No wash return - Slight rig chatter at 17' - Wash return turning black at 18', sudden smooth drill
					16						
				PUSH	17						
	-7.5				18						
		Class 6			19						
					20						

Log of Boring **LB-47**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 10.5	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Class 6	Gray-Black low plasticity CLAY, trace silt, trace shell fragments, trace medium-to-fine mica [CL-OL] (moist) NYCBC Class 6		20–21	S-5	SS	22	WOH 2 1 1	3	11:12 AM - Take S-5 from 20' to 22' - Roller bit to 25', Gray-Black wash return - Add drilling mud - Push 4" casing from 15' to 20' - Rig chatter at 24'
	-14.5				21–25						
		Class 4	Gray-Black low plasticity CLAY, trace silt, trace shell fragments [CL-OL] (moist) NYCBC Class 4b		25–26	S-6	SS	18	2 7 9 11	16	11:27 AM - Take S-6 from 25' to 27' - Roller bit to 30', Gray-Brown wash return - Hard drill from 29'
	-19.5				26–30						
		Class 1b	Gray mica SCHIST, Biotite-Muscovite-Quartz-Garnet, medium-to-fine grain size. Medium hard-to-Hard. Slightly weathered (at 33' -33.5')-to-Fresh. Fractures are 45 degrees along foliation. Moderate-to-wide fracture spacing. NYCBC Class 1b		30–35	C-1	NX CORE BARREL	REC=57"/60" =95%	RQD=41"/60" =68%		12:10 PM - Start coring C-1 from 30' - Light Gray wash return - Change gear at 32' and increase coring speed
	-24.5				35–40	C-2	NX CORE BARREL	REC=43"/60" =72%	RQD=43"/60" =72%		12:50 PM - Start coring C-2 from 35' - Light Gray wash return
	-29.5	Class 1b	Gray mica SCHIST, Biotite-Muscovite-Quartz-Garnet, medium-to-fine grain size. Medium hard-to-Hard. Fresh. Fractures are 30 to 45 degrees along foliation. Mechanical fractures at 37', 38', and 38.5'. Close fracture spacing. NYCBC Class 1b								
			END OF BORING at 40 feet		40						1:30 PM - Completed drilling at 40' below existing grade
					41–45						

Log of Boring **LB-48**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project: Riverside 4	Project No.: 170275404	East:	
Location: Riverside Parcel 4	Elevation and Datum: Approx. 11.2	North:	
Drilling Company: Warren George, Inc	Date Started: 2/4/15	Date Finished: 2/5/15	
Drilling Equipment: Acker 65 Truck Mounted Drill Rig	Completion Depth: 25 ft	Rock Depth: 30 ft	
Size and Type of Bit	Number of Samples	Disturbed	Undisturbed / Core
Casing Diameter (in) / Casing Depth (ft)	Water Level (ft.)	First -	Completion - / 24 HR. -
Casing Hammer / Weight (lbs) / Drop (in)	Drilling Foreman: Mike Kelly		
Sampler	Inspecting Engineer: Douglas Spitzer		
Sampler Hammer / Weight (lbs) / Drop (in)			

Material Symbol	Elev. (ft) +11.2	Building Code	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
			ROLLER BIT TO 5'	0–5						
			Brown-Gray-Red fine-to-coarse grain SAND and gravel, some brick fragments [FILL] (wet) NYCBC Class 7	5–7	S-1	SS	12	5, 23, 20, 14	43	
			Yellow-Brown-Red-Gray coarse grain SAND, some silt, some gravel, some brick and rock fragments [FILL] (moist) NYCBC Class 7	7–9	S-2	SS	20	20, 30, 30, 31	60	
		Class 7	Tan-Black silty SAND and rock fragments, some gravel and brick fragments, slight organic odor [FILL] (moist) NYCBC Class 7	9–11	S-3	SS	18	8, 3, 8, 35	11	
			Black silty GRAVEL, abundant mica, abundant silt [FILL] (moist) NYCBC Class 7	15–17	S-4	SS	6	18, 17, 21, 20	38	

Log of Boring **LB-48**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 11.2	

MATERIAL SYMBOL	Elev. (ft)	Building Code	Sample Description	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
			Dark Gray medium-to-coarse grain silty SAND, trace gravel [FILL] (moist) NYCBC Class 7	20						
				21	S-5	SS	12	5 5 8 6	13	
		Class 7		22						
				23						
				24						
	-13.8		END OF BORING at 25'	25						
				26						
				27						
				28						
				29						
				30						
				31						
				32						
				33						
				34						
				35						
				36						
				37						
				38						
				39						
				40						
				41						
				42						
				43						
				44						
				45						

N-Value (Blows/ft) scale: 10 20 30 40

LANGAN

Log of Boring **LB-52**

Station Number _____ Station Offset _____

Structure type _____

Project: Riverside 4	Project No.: 170275404	East:	
Location: Riverside Parcel 4	Elevation and Datum: Approx. 9.4	North:	
Drilling Company: Warren George,Inc	Date Started: 2/4/15	Date Finished: 2/4/201515	
Drilling Equipment: Mobile B-58 Truck-Mounted Drill Rig	Completion Depth: 27 ft	Rock Depth: 27 ft	
Size and Type of Bit: 3-7/8" Diameter Tri-Cone Roller Bit	Number of Samples: Disturbed 6	Undisturbed -	Core -
Casing Diameter (in): 4" Inner-Diameter Flush Steel Casing	Casing Depth (ft): 20	Water Level (ft.): First -	Completion -	24 HR. -
Casing Hammer: Donut	Weight (lbs): 300 lbs	Drop (in): 30"	Drilling Foreman: Jim Wilson	
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel			Inspecting Engineer: Andi Sicwebu	
Sampler Hammer: Safety	Weight (lbs): 140 lbs	Drop (in): 30"		

Material Symbol	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40
	+9.4		Ground surface is dark brown medium-to-fine grain SAND, trace silt, some medium-to-coarse gravel, some medium-to-fine red brick [FILL] (moist) NYCBC Class 7	DROP	0					
			Dark Brown medim-to-fine grain SAND, trace silt, trace medium-to-fine gravel, trace red brick, trace schist fragments [FILL] (wet) NYCBC Class 7		5	S-1	SS	8	4 3 5 3	8
			Red BRICK, trace light brown medium-to-fine grain sand, trace fine gravel [FILL] (wet) NYCBC Class 7	PUSH	7	S-2	SS	6	7 5 6 7	11
		Class 7	Dark Brown medium-to-fine grain SAND, some silt, trace medium-to-fine mica, some fine red brick, trace fine gravel [FILL] (wet) NYCBC Class 7	PUSH	10	S-3	SS	4	5 1 3 4	4
				32	14					
			Gray-Black decomposed SCHIST, medium-to-fine mica, trace medium-to-fine gray gravel and rock fragments [FILL] (wet) NYCBC Class 7	SPIN	15	S-4	SS	5	7 11 7 12	18
	-10.6				20					

Remarks

(Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)

1/20/2015
2:15 PM - Set up drill rig at boring location LB-52

2/2/15
Drillers not on site due to inclement weather (road closures, mass transit delays)

2/3/15
Drillers could not drill due to frozen fire hydrant and drill rig gear box. After 2 hours of trying to defrost, drillers left the site

2/4/2015
8:00 AM - Start drilling
- Roller bit to 5', Brown wash return
-Rig chatter at 1'

9:30 AM - Take S-1 from 5' to 7'
- Take S-2 from 7' to 9'
- Take split spoon from 3' to 5' but did not sample. Confirmed FILL from 3' to 5'
- Roller bit to 5', Brown wash return
- Hard drill at 4'

10:00 AM - Take S-3 from 10' to 12'
- Push 4" casing from 10' to 14' then hammer with 140 lb weight from 14' to 15' (32 blows)
- Roller bit to 15', No wash return
- Hard drill at 14' and slight rig chatter

10:40 AM - Take S-4 from 15' to 17'
- Spin 4" casing from 15' to 20'
- Roller bit to 20', No wash return
- Hard drill at 18', drilled through boulder and broke through at 20'

LANGAN

Log of Boring **LB-52**

Station Number _____ Station Offset _____

Structure type _____

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 9.4	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
			Gray low plasticity CLAY, trace silt, trace medium-to-fine mica [CL] [moist] NYCBC Class 6		20	S-5	SS	3	1 2 1 1	3	11:40 AM - Take S-5 from 20' to 22' - Roller bit to 25', No wash return - Smooth Drill
		Class 6			21						
					22						
					23						
					24						
	-15.6		Chunk of TIMBER (laying parallel to split spoon), trace gray low plasticity clay [CL] [moist] NYCBC Class 6		25	S-6	SS	4	5 7 100/3"	100/3"	12:03 PM - Refusal at ~26' - Take S-6 from 25' to 27' - Roller bit to 30', Gray wash return -Rig chatter at 26'
	-17.6		Possible Top of Rock at 27' END OF BORING at 27'		26						12:15 PM -Hard drill at 27', possible top of rock - Completed drilling at 27' below existing grade
					27						
					28						
					29						
					30						
					31						
					32						
					33						
					34						
					35						
					36						
					37						
					38						
					39						
					40						
					41						
					42						
					43						
					44						
					45						

LANGAN

Log of Boring **LB-53**

Station Number _____ Station Offset _____

Structure type _____

Project: Riverside 4	Project No.: 170275404	East:	
Location: Riverside Parcel 4	Elevation and Datum: Approx. 13.5	North:	
Drilling Company: Warren George, Inc	Date Started: 2/6/15	Date Finished: 2/9/15	
Drilling Equipment: Mobile B-58 Truck-Mounted Drill Rig	Completion Depth: 40 ft	Rock Depth: 30 ft	
Size and Type of Bit: 3-7/8" / 2-7/8" Diameter Tri-Cone Roller Bit	Number of Samples: Disturbed 7	Undisturbed -	Core 2
Casing Diameter (in): 4" Inner-Diameter Flush Steel Casing	Casing Depth (ft): 10	Water Level (ft.): First -	Completion -	24 HR. -
Casing Hammer: Donut	Weight (lbs): 300 lbs	Drop (in): 30"	Drilling Foreman: Jim Wilson	
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel			Inspecting Engineer: Andi Sicwebu	
Sampler Hammer: Safety	Weight (lbs): 140 lbs	Drop (in): 30"		

Material Symbol	Elev. (ft)	Building Code	Sample Description
	+13.5		
	+13.1	Concrete	5" Concrete Pavement
			ROLLER BIT TO 5'
		Class 7	Dark Brown medium-to-fine grain SAND, trace silt, some medium-to-fine gravel, trace red brick, fragments of boulder [FILL] (moist-to-wet) NYCBC Class 7
			Dark Gray GRAVEL, trace brown medium-to-fine grain SAND, some silt, trace fine gravel [FILL] (moist) NYCBC Class 7
			Light Brown fine SAND, some silt, trace fine gravel [FILL] (moist) NYCBC Class 7
			Light Brown fine grain SAND, some silt, trace fine gravel [FILL] (moist) NYCBC Class 7
	-3.5	Class 6	

Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)
DROP	0					
	1					
	2					
	3					
	4					
SPIN	5	S-1	SS	6	7 6 6 2	12
	6					
	7	S-2	SS	11	4 8 11 15	19
	8					
	9					
	10	S-3	SS	8	13 24 16 14	40
	11					
	12					
	13					
	14					
	15	S-4	SS	9	1 1 1 2	2
	16					
	17					
	18					
	19					
	20					

Remarks

(Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)

2/6/2015 1:00 PM
- Set up at LB-53 and start drilling

1:15 PM - Roller bit to 5', White wash return turning light brown at 1'
- Hard drill from 0'
- No wash return from 3' to 5'

2:00 PM - Take S-1 from 5' to 7'
- Take S-2 from 7' to 9'
- Drop 4" casing to 5' then spin from 5' to 10'

2:45 PM - Completed driling for the day

2/9/2015 8:00AM
- Start drilling
- Roller bit 10', Brown wash return

8:25 AM - Take S-3 from 10' to 12'
- Roller bit to 15', Brown wash return
- Smooth drill

8:35 AM - Take S-4 from 15' to 17'
- Roller bit to 20', Brown wash return
- Gravel return
- Smooth drill

Log of Boring **LB-53**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 13.5	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Class 6	Gray-Black low plasticity CLAY, trace silt, trace shells [CL-OL] (moist) NYCBC Class 6		20	S-5	SS	20	WOR WOR WOR WOR		8:48 AM - Take S-5 from 20' to 22' - Roller bit to 25', Gray-Brown wash return - Smooth drill
					21						
					22						
					23						
					24						
			Gray-Black low plasticity CLAY, trace silt, trace shells [CL-OL] (moist) NYCBC Class 6		25	S-6	SS	18	WOH WOH 3 5		8:55 AM - Take S-6 from 25' to 27' - Roller bit to 30' - Gray wash and rock fragments return - Rig chatter at 28', Hard drill from 28' to 30' - Heavy rig chatter at 29'
	-12.5				26						
		Class 6	Gray-to-Brown medium-to-fine grain SAND, trace medium-to-fine gravel, trace low plasticity clay, trace timber fibers [SP] (wet) NYCBC Class 6		27						
					28						
					29						
	-16.5				30						9:40 AM - Refusal at 30' - No recovery
		Class 1b	White-Light Gray-Pink GRANITE. Quartz-Muscovite-Feldspar-Biotite-Garnet, medium-to-coarse grain size, trace mica. Fracture angles near 45 degrees from horizontal. Moderate fracture space. Hard. Slightly weathered-to-Fresh. NYCBC Class 1b	8.38	31	C-1	NX CORE BARREL	REC=44"/60" =73%	RQD=40"/60" =67%		10:00 AM - Start coring C-1 from 30' - Gray wash return - Switch gear and increase coring speed at 31'
				7.27	32						
				8.0	33						
				7.5	34						
				6.0	35						
	-21.5										
		Class 1b	White-Light Gray-Pink GRANITE. Quartz-Muscovite-Feldspar-Biotite-Garnet, medium-to-coarse grain size. Fractures almost horizontal. Wide fracture space. Hard. Slightly weathered-to-Fresh. NYCBC Class 1b	4.51	36	C-2	NX CORE BARREL	REC=59"/60" =98%	RQD=36"/60" =60%		10:55 AM - Start coring C-2 from 35' - Gray-to-White wash return
				5.06	37						
				5.81	38						
				5.0	39						
				4.19	40						
	-26.5										
			END OF BORING at 40 feet		41						11:35 AM - Completed drilling at 40' below existing grade
					42						
					43						
					44						
					45						

LANGAN

Log of Boring **LB-54**

Station Number _____ Station Offset _____

Structure type _____

Project: Riverside 4	Project No.: 170275404	East:	
Location: Riverside Parcel 4	Elevation and Datum: Approx. 11.3	North:	
Drilling Company: Warren George, Inc	Date Started: 2/26/15	Date Finished: 2/26/15	
Drilling Equipment: Mobile B-58 Truck-Mounted Drill Rig	Completion Depth: 35 ft	Rock Depth: 25 ft	
Size and Type of Bit: 2-7/8" / 4-7/8" / 5-7/8" Diameter Tri-Cone Roller Bit	Number of Samples: Disturbed 5	Undisturbed -	Core 2
Casing Diameter (in): 4" Inner-Diameter Flush Steel Casing	Casing Depth (ft): 10	Water Level (ft.): First -	Completion -	24 HR. -
Casing Hammer: Donut	Weight (lbs): 300 lbs	Drop (in): 30"	Drilling Foreman: Jim Wilson	
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel			Inspecting Engineer: Andi Sicwebu	
Sampler Hammer: Safety	Weight (lbs): 140 lbs	Drop (in): 30"		

Material Symbol	Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+11.3		Ground surface is brown medium-to-fine grain SAND, medium-to-coarse gravel, coarse rock and brick fragments [FILL] (moist) NYCBC Class 7 ROLLER BIT TO 5'	DROP	0 1 2 3 4						2/26/2015 7:15 AM - Drillers defrosting fire hydrant and fixing flat tire 9:25 AM - Start drilling -Roller bit to 5', No wash return -Hard drill - Rig chatter from 4' to 5'
			Dark Brown medium-to-coarse grain SAND, trace silt, trace medium-to-fine gravel, some fine red brick, some medium boulder/rock fragment [FILL] (moist-to-wet) NYCBC Class 7	SPIN	5	S-1	SS	10	18 19 41 24	60	9:50 AM- Take S-1 from 5' to 7' - Take S-2 from 7' to 9' - Drop 4" casing to 5' then spin from 0' to 10' - Roller bit to 10', No wash return
			Dark Gray medium GRAVEL, trace brown medium-to-fine grain sand, trace silt [FILL] (wet) NYCBC Class 7		6 7 8 9	S-2	SS	12	17 16 20 39	36	
		Class 7	NO RECOVERY (Tip of split spoon had one medium boulder fragment) [FILL] NYCBC Class 7		10 11 12 13 14	S-3	SS	0	50/1"	50/1"	11:00 AM - Refusal at 10' - Take S-3 from 10' to 12' - Roller bit to 15' - Add drilling mud - White wash return turning brown - Hard drill from 11' - Heavy rig chatter at 11' and losing water
	-8.7		Brown-Green medium-to-fine SILTY SAND, some medium rock/boulder fragmets, trace fine gravel [FILL] (moist) NYCBC Class 7		15 16 17 18 19 20	S-4	SS	4	1 2 2 4	4	11:50 AM - Take S-4 from 15' to 17' - Roller bit to 20' - No wash return - Add drilling mud - Smooth drill

Log of Boring **LB-54**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 11.3	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Class 6	Gray-Black low plasticity CLAY, trace silt, some shell fragments, trace medium-to-fine grain mica [CL-OL] (moist) NYCBC Class 6		20	S-5	SS	4	1 WOH 1 1	10 20 30 40	12:00 PM - Take S-5 from 20' to 22' - Roller bit to 25', No wash return - Hard drill from 22'
	-13.7				21						
					22						
					23						
					24						
		Class 1b	White-Light Gray-Green-Pink GRANITE. Quartz-Muscovite-Feldspar-Biotite-Garnet, medium-to-coarse grain size. Iron staining from 26' to 28'. Mechanical fractures at 28.5' and 29.5'. Medium hard. Slightly weathered-to-fresh. NYCBC Class 1b	4.36 5.0 4.48 5.0 4.38	25	C-1	NX CORE BARREL	REC=56"/60" =93%	RQD=50"/60" =83%		12:30 PM - Start coring C-1 from 25' - No wash return
					26						
					27						
					28						
					29						
	-18.7				30						
		Class 1a	White-Light Gray-Green-Pink GRANITE. Quartz-Muscovite-Feldspar-Biotite-Garnet, medium grain size. Mechanical fractures at 31.6', 33', 33.8' and 34.5'. Hard-to-very hard. Fresh. NYCBC Class 1a	5.99 4.0 4.0 3.75 4.23	31	C-2	NX CORE BARREL	REC=56"/60" =93%	RQD=54"/60" =90%		1:00 PM - Start corning C-2 from 30' - No wash return
					32						
					33						
					34						
	-23.7				35						
			END OF BORING at 35 feet		36						1:40 PM - Completed drilling at 35' below existing grade
					37						
					38						
					39						
					40						
					41						
					42						
					43						
					44						
					45						

LANGAN

Log of Boring **LB-56**

Station Number _____ Station Offset _____

Structure type _____

Project: Riverside 4	Project No.: 170275404	East:	
Location: Riverside Parcel 4	Elevation and Datum: Approx. 13.1	North:	
Drilling Company: Warren George, Inc	Date Started: 2/12/15	Date Finished: 2/25/15	
Drilling Equipment: Mobile B-58 Truck-Mounted Drill Rig	Completion Depth: 30 ft	Rock Depth: 20 ft	
Size and Type of Bit: 2-7/8" / 5-7/8" Diameter Tri-Cone Roller Bit	Number of Samples: Disturbed 4	Undisturbed -	Core 2
Casing Diameter (in): 3" / 4" Inner-Diameter Flush Steel Casing	Casing Depth (ft): 17	Water Level (ft.): First -	Completion -	24 HR. -
Casing Hammer: Donut	Weight (lbs): 300 lbs	Drop (in): 30"	Drilling Foreman: Jim Wilson	
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel			Inspecting Engineer: Andi Sicwebu	
Sampler Hammer: Safety	Weight (lbs): 140 lbs	Drop (in): 30"		

Material Symbol	Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+13.1		Surface is dark brown medium-to-fine grain SAND, coarse gravel, medium-to-coarse red brick fragments [FILL] (dry) NYCBC Class 7 ROLLER BIT TO 5'		0						2/12/2015 1:35 PM - Set up at LB-56 and start drilling - Roller bit to 5', Dark Brown wash return -Hard drill from 0' 1:55 PM - Completed drilling for the day
					1						
					2						
					3						
					4						02/13/2015 - Drilling cancelled due to inclement weather
			NO RECOVERY [FILL] NYCBC Class 7	SPIN	5						
					6	S-1	SS	0	23 18 13 5	31	2/23/2015 7:30 AM - Drillers defrostiong hose pipes and fire hydrant 9:00 AM - Start drilling
			Dark Brown medium-to-fine grain SAND, trace silt, some medium gravel, trace timber fibers [FILL] (moist) NYCBC Class 7		7						9:55 AM - Take S-1 from 5' to 7'
					8	S-2	SS	8	7 7 10 9	17	- Take S-2 from 7' to 9' - Spin 4" casing from 0' to 10'
					9						
		Class 7	Dark brown-black medium-to-fine grain SAND, trace silt, decomposed black-gray boulder fragments, trace timbers [FILL] (wet-to-moist) NYCBC Class 7		10						- Switch to 2-7/8" roller bit - Roller bit to 10' - Take S-3 from 10' to 15' - Completed drilling for the day
					11	S-3	SS	5	5 4 4 3	8	
				SPIN	12						
					13						
					14						
			Brown medium-to-fine grain SAND, trace silt, some medium-to-fine mica, some coarse quartz and schist-biotite [FILL] (wet) NYCBC Class 7		15						2/25/2015 7:40 AM - Drillers defrosting hose pipes and fire hydrant - Roller bit to 15' - Dark Brown-Gray wash return - Smooth drill
				SPIN	16	S-4	SS	7	17 30 39 12	69	
					17						
					18						8:40 AM - Take S-4 from 15' to 17' - Roller bit to 20', No wash return - Add drilling mud
					19						
	-6.9				20						

LANGAN

Log of Boring **LB-56**

Station Number _____ Station Offset _____

Structure type _____

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 13.1	

MATERIAL SYMBOL	Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
					20						- Hard drill from 17' - Spin 3" diameter casing to 15', then 15' to 17' 10:15 AM - Start coring C-1 from 20' - No wash return
		Class 1b	White-Light Gray GRANITE. Quartz-Muscovite-Feldspar-Biotite-Garnet, medium-to- coarse grain size, trace medium-to-fine mica. Iron staining at mechanical fracture at 20.5'. Fractures greater than 45 degrees from horizontal. Close-to-very close fracture spacing. Medium hard-to-hard. Fresh. NYCBC Class 1b	2.27	21	C-1	NX CORE BARREL	REC=59"/60" =98%	RQD=49"/60" =82%		
				8.0	22						
				11.2	23						
				10	24						
				9.01	25						11:00 AM - Start coring C-2 from 25' - No wash return
	-11.9	Class 1b	White-Light Gray GRANITE. Quartz-Muscovite-Feldspar-Biotite-Garnet, medium-to- coarse grain size, trace medium-to-fine mica. Fractures near 30 degrees-to-almost horizontal. Moderate fracture spacing. Medium hard-to-hard. Slightly weathered-to-Fresh. NYCBC Class 1b	5.8	26	C-2	NX CORE BARREL	REC=59"/60" =98%	RQD=49"/60" =82%		
				7.0	27						
				6.08	28						
				4.99	29						
				5.2	30						
	-16.9		END OF BORING at 30 feet		31						11:50 AM - Completed drilling at 30 feet
					32						
					33						
					34						
					35						
					36						
					37						
					38						
					39						
					40						
					41						
					42						
					43						
					44						
					45						

Log of Boring **LB-58**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project: Riverside 4	Project No.: 170275404	East:	
Location: Riverside Parcel 4	Elevation and Datum: Approx. 10.3	North:	
Drilling Company: Warren George,Inc	Date Started: 1/29/15	Date Finished: 1/30/15	
Drilling Equipment: Mobile B-58 Truck-Mounted Drill Rig	Completion Depth: 29 ft	Rock Depth: 29 ft	
Size and Type of Bit: 3-7/8" / 2-7/8" Diameter Tri-Cone Roller Bit	Number of Samples: Disturbed 7	Undisturbed -	Core -
Casing Diameter (in): 3" / 4" Inner-Diameter Flush Steel Casing; Casing Depth (ft): 20	Water Level (ft.): First -	Completion -	24 HR. -
Casing Hammer: Donut; Weight (lbs): 300 lbs; Drop (in): 30"	Drilling Foreman: Jim Wilson		
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel	Inspecting Engineer: Andi Sicwebu		
Sampler Hammer: Safety; Weight (lbs): 140 lbs; Drop (in): 30"			

Material Symbol	Elev. (ft)	Building Code	Sample Description	Casing blws/ ft Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40
	+10.3				0					
			Dark Brown medium-to-fine grain SAND, trace silt, trace asphalt, trace medium-to-fine gravel [FILL] (moist) NYCBC Class 7		1	S-1	SS	7	7 7 10 13	17
			Dark Brown medium-to-fine grain SAND, trace silt, trace timber, trace medium-to-fine red brick [FILL] (moist) NYCBC Class 7		2 3 4	S-2	SS	5	15 17 11 6	28
			NO RECOVERY (End of split spoon had m-f GRAVEL, trace red brick) [FILL] NYCBC Class 7	SPIN	5 6	S-3	SS	0	2 100/2"	100/2"
		Class 7			7 8 9					
			Dark Brown medium-to-fine grain SAND, trace red brick, some medium-to-fine gravel, trace mica, fragments of gray boulder/rock [FILL] [wet] NYCBC Class 7	SPIN	10 11 12 13 14	S-4	SS	3	12 10 7 41	17
	-4.7				15					
		Class 6	Dark Gray- Black SILT, trace medium-to-fine gravel, trace medium-to-fine dark brown sand (Tip of split spoon had timber laying perpendicular to spoon) [ML] (wet-to-moist) NYCBC Class 6		16 17 18 19	S-5	SS	9	5 2 3 4	5
	-9.7				20					

Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)

1/29/2015
2:15 PM - Set up drill rig at boring location LB-58
1/30/2015
7:30 AM - Start drilling
- Could not take sample at 0', roller bit to 1'
- Hard drill

7:55 AM - Take split spoon from 1' to 3' but did not sample. Confirmed FILL from 1' to 3'
- Take split spoon from 3' to 5' but did not sample. Confirmed FILL from 3' to 5'
- Roller bit to 5', Brown wash return
- Hard drill at 4'
9:00 AM - Refusal at 5'
- Take S-3 from 5' to 7'
- Drilled through boulder from 5' to 7'
- Heavy rig chatter from 5' to 8'
- Brown wash return
9:35 AM - Spin 4" casing from 0' to 10'
- Roller bit to 10', Brown wash return
- Add drilling mud
10:15 AM - Take S-4 from 10' to 12'
- Broke casing threads. Drop 3" casing to 10', then spin from 10' to 15'
- Change to 2 7/8" roller bit
- Roller bit to 15', no wash return
- Rig chatter from 13' to 15'
11:11 AM - Take S-5 from 15' to 17'
- Roller bit to 20'
- No wash return

Log of Boring **LB-58**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 10.3	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Class 6	Dark Gray- Black SILTY CLAY, trace medium-to-fine grain mica, trace timber [CL-ML] [moist] NYCBC Class 6		20	S-6	SS	16	6 5 4 5	9	11:46 AM - Take S-6 from 20' to 22' - Remove 5 ft of the 3" casing then spin 3" casing from 10' to 20' - Roller bit to 25', Dark Gray-Black wash return - Smooth Drill
					21						
					22						
					23						
					24						
					25	S-7	SS	20	1 1 1 1	2	12:40 PM - Take S-7 from 25' to 27' - Roller bit to 30' - Gray- Black wash return
					26						
					27						
					28						
	-18.7		Possible Top of Rock at 29'		29						1:15 PM - Hard drilling at 29', possible top of rock - Completed drilling at 29' below existing grade
			END OF BORING at 29 feet		30						
					31						
					32						
					33						
					34						
					35						
					36						
					37						
					38						
					39						
					40						
					41						
					42						
					43						
					44						
					45						

Log of Boring **LB-59**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project: Riverside 4	Project No.: 170275404	East:	
Location: Riverside Parcel 4	Elevation and Datum: Approx. 11.2	North:	
Drilling Company: Warren George,Inc	Date Started: 3/3/15	Date Finished: 3/3/15	
Drilling Equipment: Mobile B-58 Truck-Mounted Drill Rig	Completion Depth: 47 ft	Rock Depth: 37 ft	
Size and Type of Bit: 2-7/8" / 4-7/8" Diameter Tri-Cone Roller Bit	Number of Samples: Disturbed 8	Undisturbed -	Core -
Casing Diameter (in): 4" Inner-Diameter Flush Steel Casing; Casing Depth (ft): 20	Water Level (ft.): First -	Completion -	24 HR. -
Casing Hammer: Donut; Weight (lbs): 300 lbs; Drop (in): 30"	Drilling Foreman: Jim Wilson		
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel	Inspecting Engineer: Andi Sicwebu		
Sampler Hammer: Safety; Weight (lbs): 140 lbs; Drop (in): 30"			

Material Symbol	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+11.2				0						3/3/2015 7:15 AM - Set up drill rig and start drilling - Roller bit to 5' - No wash return - Hard drill from 0' to 5'
	+10.9	Concrete	4" Concrete Pavement								
			ROLLER BIT TO 5'		1						
					2						
					3						
					4						
			Brown medium-to-coarse grain SAND, trace medium-to-fine gravel, trace red brick, fragments of clay pipe (possibly from old sewer line) [FILL] (moist) NYCBC Class 7	SPIN	5	S-1	SS	12	8 6 7 10	13	9:50 AM - Take S-1 from 5' to 7' - Take S-2 from 7' to 9' - Spin 4" casing from 0' to 10' - Roller bit to 10' with 2-7/8" tri-cone roller bit - Add drilling mud - White wash return - Slight rig chatter at 9'
					6						
			Light Brown medium-to-fine grain SAND and medium GRAVEL, trace silt [FILL] (moist) NYCBC Class 7		7	S-2	SS	10	7 6 6 9	12	
					8						
					9						
		Class 7	Light Brown medium-to-fine grain SAND, trace silt, medium-to-fine mica, trace medium-to-coarse gravel [FILL] (wet-to-moist) NYCBC Class 7		10	S-3	SS	4	15 12 6 8	18	10:40 AM - Take S-3 from 10' to 12' - Roller bit to 15' -Brown wash and gravel return - No wash return from 11' - Hard drill from 12'
					11						
				SPIN	12						11:00 AM - Roller bit not breaking through at 12' 11:15 AM - Start coring from 12' - Sudden drop of rods at 14', possible boulder at 12' to 14' - Roller bit to 15', No wash return 11:45 AM - Take S-4 from 15' to 17' - Roller bit to 20', No wash return - Heavy rig chatter at 18' 11:50 AM - Spin 4" casing from 10' to 15' then 15' to 20'
					13						
					14						
			Gray-Black SILTY SAND, trace fine gravel, trace medium-to-fine grain mica [FILL] (wet-to-moist) NYCBC Class 7		15	S-4	SS	5	7 8 5 12	13	
					16						
				SPIN	17						
					18						
					19						
	-8.8				20						

Log of Boring **LB-59**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 11.2	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Class 6	Gray low plasticity CLAY, some silt, trace shell fragments, trace medium-to-fine grain mica [CL-OL] (moist) NYCBC Class 6		20	S-5	SS	12	WOR WOR WOR WOR		12:20 PM - Take S-5 from 20' to 22' - Roller bit to 25', Gray wash return - Smooth drill
					21						
					22						
					23						
					24						
		Class 6	Gray low plasticity CLAY, trace silt, trace shell fragments, trace medium-to-fine mica [CL-OL] (moist) NYCBC Class 6		25	S-6	SS	22	WOR WOR 4 6		12:30 PM - Take S-6 from 25' to 27' - Roller bit to 30', Gray-Brown wash return - Smooth drill
					26						
					27						
					28						
					29						
	-18.8				30						
		Class 3a	Brown medium-to-fine SAND, some silt, trace decomposed black schist-biotite, medium-to-fine grain mica [SP] (moist) NYCBC Class 3a		31	S-7	SS	20	34 50 60 43	110	12:50 PM - Take S-7 from 30' to 32' - Roller bit to 35', Brown wash return - Heavy rig chatter at 32'
					32						
					33						
					34						
					35	S-8	SS	0			- Refusal at 35' - Take S-8 from 35' to 37', No recovery - Roller bit to 40', Brown wash return - Rig chatter from 35' to 37' - Hard drill from 37', possible top of rock - Start coring C-1 from 37' - LIght Gray wash return
	-25.8				36						
		Class 1b	Gray mica SCHIST. Quartz-Biotite-Muscovite-Garnet, medium-to-fine grain size. Wavy foliation. Mechanical fractures at 3.5' and 15.5'. Fracture is at 45 degrees along foliation at 33'. Brown silty sand in fractures. Close fracture spacing. Medium hard. Slightly weathered-to-Fresh. NYCBC Class 1b		37	C-1	NX CORE BARREL	REC=54"/60" =90%	RQD=51"/60" =85%		
					38						
					39						
					40						
					41						
	-30.8				42						- Start coring C-2 from 42' - LIght Gray wash return
		Class 1c	Gray mica SCHIST. Quartz-Biotite-Muscovite-Garnet, medium-to-fine grain size. Wavy foliation. Mechanical fractures at 26.5'. Fracture at 45 degrees along foliation at 15'. Close fracture spacing. Medium hard. Slightly weathered. NYCBC Class 1c		43	C-2	NX CORE BARREL	REC=46"/60" =77%	RQD=40"/60" =67%		
					44						
					45						

Log of Boring **LB-59**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 11.2	

MATERIAL SYMBOL	Elev. (ft)	Building Code	Sample Description	Casng blws/ ft Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	-35.8	Class 1c	END OF BORING at 47 Feet		45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70	C-2					- Completed drilling at 47 feet

Log of Boring **LB-61**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project: Riverside 4		Project No.: 170275404	East:
Location: Riverside Parcel 4		Elevation and Datum: Approx. 15.2	North:
Drilling Company: Warren George,Inc		Date Started: 2/10/15	Date Finished: 2/11/15
Drilling Equipment: Mobile B-58 Truck-Mounted Drill Rig		Completion Depth: 31 ft	Rock Depth: 21 ft
Size and Type of Bit: 3-7/8" / 2-7/8" Diameter Tri-Cone Roller Bit		Number of Samples: Disturbed 4	Undisturbed - Core 2
Casing Diameter (in): 4" Inner-Diameter Flush Steel Casing	Casing Depth (ft): 10	Water Level (ft.): First -	Completion - 24 HR. -
Casing Hammer: Donut	Weight (lbs): 300 lbs Drop (in): 30"	Drilling Foreman: Jim Wilson	
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel		Inspecting Engineer: Andi Sicwebu	
Sampler Hammer: Safety	Weight (lbs): 140 lbs Drop (in): 30"		

Material Symbol	Elev. (ft) +15.2	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40
			Ground surface is medium-to-coarse GRAVEL underlain by dark brown medium-to-fine grained SAND, trace silt, medium- to-coarse rock and brick fragments [FILL] (dry-to-moist) NYCBC Class 7	DROP	0 1 2 3 4					
			Red BRICK, trace medium- to -fine GRAVEL, rock fragments [FILL] (moist) NYCBC Class 7	SPIN	5 6 7 8 9	S-1	SS	3	5 2 3 7	5
			Dark brown medium-to-fine grain SAND, trace silt, trace medium-to-fine gravel, some red fine red brick [FILL] (moist-to-wet) NYCBC Class 7			S-2	SS	6	6 5 5 4	10
		Class 7	Brown to gray-black medium-to-fine SAND and medium-to-fine GRAVEL, trace red brick [FILL] (wet) NYCBC Class 7	PUSH	10 11 12 13 14	S-3	SS	8	7 4 6 5	10
			Dark brown medium-to-fine SAND and black-gray decomposed mica SCHIST, trace silt, trace fine gravel [FILL] (wet-to-moist) NYCBC Class 7	SPIN	15 16 17 18 19 20	S-4	SS	11	21 16 13 23	29

Remarks
(Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)

2/10/2015
12:35 PM - Set up drill rig at boring location LB-61

1:15 pm- Start drilling
- Roller bit to 1' and then hand cleared to ~1.5'
- Hard obstruction (brick wall and stone/boulder) at ~1.5'

2:30PM - Completed drilling for the day
2/11/2015
7:35 AM - Drillers defrosting hose pipes and fire hydrant

8:00 AM - Start drilling
- Roller bit to 5', no wash return
- Hard drill from 1.5' to 4'
9:00 AM - Take S-1 from 5' to 7'
- Drop 4" casing to 5' then spin from 5' to 10'
- Take S-2 from 7' to 9' but did not sample. Confirmed fill from 7' to 9'

9:27 AM - Roller bit to 10', Brown wash return
- Add drilling mud
- Hard drill at 14'
10:08 AM - Take S-3 from 10' to 12'
- Roller bit to 15'
- Gray wash return
- Smooth drill

10:17 AM - Take S-4 from 15' to 17'
- Roller bit to 20'
- No wash return
- Losing water at 18'
- Hard drill from 19'

10:55 AM - Push 4" casing from 10' to 15' then spin from 15' to 20'

Log of Boring **LB-61**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 15.2	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Class 7	NO RECOVERY		20	S-5	SS	0	100/0"	100/0"	11:20 AM - Refusal at 20' - Take S-5 from 20' to 22' - Roller bit to 25', white-to-brown wash, gravel and rock fragments return - Add drilling mud - Heavy rig chatter at 21' - Hard drill at 21, possible top of rock 11:35 AM - Start coring C-1 from 21' - White wash return
	-5.8				21						
		Class 1b	White-Light Gray-Pink GRANITE. Quartz-Muscovite-Feldspar-Biotite-Garnet, medium-to-coarse grain size, intrusions of gray-black schist at 22' and 24', medium-to-fine mica. Iron staining from 24' to 26'. Hard to very hard. Fresh. NYCBC Class 1b	3.0	22	C-1 NX CORE		REC=56"/60" =93%	RQD=44"/60" =73%		
				3.0	23						
				2.5	24						
				2.46	25						
				3.2	26						12:15 PM - Start coring C-2 from 26' - White to light gray wash return
	-10.8										
		Class 1b	Black-Light Gray mica SCHIST. Biotite-Muscovite-Quartz-Feldspar, medium-to-fine grain size. Fracture angles near 20 degrees. Close fracture space. Medium hard. Slightly weathered-to-Fresh NYCBC Class 1b	2.0	27	C-2 NX CORE		REC=60"/60" =100%	RQD=42"/60" =70%	
				1.89	28						
				2.21	29						
				2.5	30						
				2.0	31						12:50 PM - Completed drilling at 31' below existing grade
	-15.8		END OF BORING at 31 feet		32						
					33						
					34						
					35						
					36						
					37						
					38						
					39						
					40						
					41						
					42						
					43						
					44						
					45						

Log of Boring **LB-66**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project: Riverside 4		Project No.: 170275404	East:
Location: Riverside Parcel 4		Elevation and Datum: Approx. 10.8	North:
Drilling Company: Warren George,Inc		Date Started: 1/23/15	Date Finished: 1/29/15
Drilling Equipment: Mobile B-58 Truck-Mounted Drill Rig		Completion Depth: 38 ft	Rock Depth: 28 ft
Size and Type of Bit: 3-7/8" / 2-7/8" Diameter Tri-Cone Roller Bit		Number of Samples: Disturbed 9	Undisturbed - Core 2
Casing Diameter (in): 3" / 4" Inner-Diameter Flush Steel Casing	Casing Depth (ft): 25	Water Level (ft.): First -	Completion - 24 HR. -
Casing Hammer: Donut	Weight (lbs): 300 lbs Drop (in): 30"	Drilling Foreman: Jim Wilson	
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel		Inspecting Engineer: Andi Sicwebu	
Sampler Hammer: Safety	Weight (lbs): 140 lbs Drop (in): 30"		

Material Symbol	Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)
	+10.8		NO RECOVERY (Ground surface is dark brown medium- to-fine grain SAND, medium-to-coarse gravel, medium-to-coarse red brick)		0	S-1	SS	0	50/1"	50/1"
			Dark Brown medium- to-fine grain SAND, trace silt, trace medium- to- fine gravel, trace asphalt, trace timber [FILL] (dry) NYCBC Class 7		1 2 3	S-2	SS	11	5 5 10 9	15
			Dark Brown medium-to-fine grain SAND, trace silt, some fine gravel, trace asphalt, trace timber, trace red brick fragments [FILL] (dry-to-moist) NYCBC Class 7	SPIN	4 5	S-3	SS	12	4 17 19 21	36
			Dark-to-light brown medium- to-fine grain SAND, trace silt, trace medium-to- fine gravel, trace gray boulder/rock fragments [FILL] (dry-to-moist) NYCBC Class 7		6 7 8	S-4	SS	8	4 4 2 3	6
		Class 7			9	S-5	SS	6	3 3 2 1	5
			Gray medium-to-fine GRAVEL, trace medium-to-fine mica schist [FILL] (wet) NYCBC Class 7		10 11	S-6	SS	1	3 5 6 12	11
				SPIN	12 13 14					
			NO RECOVERY (Tip of split spoon had dark brown medium-to-fine SAND, coarse gravel) [FILL] NYCBC Class 7	SPIN	15 16 17 18	S-7	SS	0	100/0"	100/0"
					19 20					

Remarks

(Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)

1/23/2015 7:50 AM
- Tishman gave Langan approval to start drilling in Parcel 4 and showed us utility/power line locations

10:30 AM - Setup at LB-66 and start drilling
11:00 AM - Refusal at 0', roller bit to 2'
- Brown wash return
- Add drilling mud
-Slight rig chatter at 1' and heavy rig chatter at 1.5'
11:23 AM - Take S-2 from 2' to 4'
- Take S-3 from 4' to 6'
- Roller bit to 6', Dark Brown wash return
- Smooth drill
11:36 AM - Take S-4 from 6' to 8'
- Take S-5 from 8' to 10'
- Roller bit to 10', Dark Brown wash return
- Smooth drill

12:14 PM - Take S-6 from 10' to 12'
- Roller bit to 15', No wash return
- Rig chatter at 13', hard drill
- Drilled through boulder at 13'
- Spin 4" casing from 0' to 10' then 10' to 15'

1:00 PM - Roller bit to 20'
- Dark brown wash return
- Drilled through boulder and broke through at 19'

2:05PM - Spin 3" casing to 10', then 10' to 15', then 15' to 17'
2:45PM - Completed drilling for the day
1/28/2015 07:50 AM
-Drillers defrosting fire hydrant and drill rig gear box

10:00 AM - FDNY told drillers they cannot run water from the fire hydrant when

Log of Boring **LB-66**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 10.8	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40
		Class 7	Dark Brown medium-to-fine grain SAND, trace silt, some medium-to-fine gravel (Tip of split spoon had black low plasticity clay) [FILL] (moist) NYCBC Class 7		20					
	-10.2				21	S-8	SS	6	6 12 9 10	21
				PUSH	22					
		Class 6			23					
					24					
			NO RECOVERY (Tip of split spoon had hard rock, trace black low plasticity clay) [CL] NYCBC Class 6		25	S-9	SS	0	100/1"	100/1"
					26					
					27					
	-17.2				28					
			White-Pink GRANITE, Quartz-Muscovite-Feldspar-Biotite-Garnet, medium-to- coarse grain size, minor intrusions of gray-black schist. Iron staining in hairline cracks. Hard to very hard. Fresh. NYCBC Class 1a	7.0	29	C-1	NX CORE	REC=60"/60" =100%	RQD=52"/60" =87%	
		Class 1a		5.02	30					
				4.8	31					
				3.32	32					
				4.41	33					
	-22.2			3.92	34					
			White-Pink GRANITE. Quartz-Muscovite-Feldspar-Biotite-Garnet, medium grain size, 7" intrusion of gray-black schist with iron staining from 28'. Fracture angles range from nearly horizontal to 30 degrees. Close fracture space. Hard. Slightly fractured-to-Fresh. NYCBC Class 1b	3.46	35	C-2	NX CORE	REC=58"/60" =97%	RQD=41"/60" =68%	
		Class 1b		3.38	36					
				4.37	37					
				4.0	38					
	-27.2		END OF BORING at 38 feet		39					
					40					
					41					
					42					
					43					
					44					
					45					

Remarks
(Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)

the weather is below freezing point. Informed Jimmy D of the situation.
- Drilling discontinued for the day

1/29/2015 7:40 AM
-Roller bit to 20', no wash return
-losing water at 18'

9:20 AM - Take S-8 from 20' to 22'
- Remove 7 ft of the 3" casing from 10' to 20'
- Roller bit to 25'
- Black wash return from 21'

10:14 AM - Refusal at 25'
Take S-9 from 25' to 27'
- Push 3" casing from 20' to 25'
- Roller bit to 30'
- Black wash return from 21'
- Hard drill from 25'

11:45 AM - Start coring C-1 from 28'
- White to light gray was return

12:40 PM - Start coring C-2 from 33'
- White to light gray was return

2:00 PM - Completed drilling at 38' below existing grade

LANGAN

Log of Boring **LB-67**

Station Number _____ Station Offset _____

Structure type _____

Project: Riverside 4	Project No.: 170275404	East:	
Location: Riverside Parcel 4	Elevation and Datum: Approx. 14	North:	
Drilling Company: Warren George, Inc	Date Started: 2/9/15	Date Finished: 2/10/15	
Drilling Equipment: Mobile B-58 Truck-Mounted Drill Rig	Completion Depth: 40 ft	Rock Depth: 30 ft	
Size and Type of Bit: 3-7/8" / 2-7/8" Diameter Tri-Cone Roller Bit	Number of Samples: Disturbed 5	Undisturbed -	Core 2
Casing Diameter (in): 4" Inner-Diameter Flush Steel Casing	Casing Depth (ft): 10	Water Level (ft.): First -	Completion -	24 HR. -
Casing Hammer: Donut	Weight (lbs): 300 lbs	Drop (in): 30"	Drilling Foreman: Jim Wilson	
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel			Inspecting Engineer: Andi Sicwebu	
Sampler Hammer: Safety	Weight (lbs): 140 lbs	Drop (in): 30"		

Material Symbol	Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
	+14.0				0						2/9/2015 11:55 AM - Set up at LB-67 and start drilling - Roller bit to 5', No wash return -Hard drill from 0' to 1'
	+13.6	Concrete	5" Concrete Pavement								
			ROLLER BIT TO 5'		1						
					2						
					3						
					4						
			Dark Brown medium-to-fine grained SAND, trace silt, trace concrete and rock/boulder fragments, trace red brick [FILL] (moist-to-wet) NYCBC Class 7	SPIN	5	S-1	SS	4	48 39 16 11	55	12:24 PM - Take S-1 from 5' to 7' - Spin 4" casing from 0' to 10' - Take split spoon (S-2) from 7' to 9' but did not sample. Confirmed fill from 7' to 9'
			Dark Brown medium-to-fine grained SAND, trace silt, trace medium-to-fine gravel, trace medium red brick [FILL] (wet) NYCBC Class 7		6						
					7	S-2	SS	8	10 18 11 15	29	12:50 PM - Switch to 2-7/8" roller bit - Advance roller bit to 10', clean water return Take S-3 from 4' to 6' - Roller bit to 6', Dark Brown wash return - Smooth drill
		Class 7			8						
			Light Brown fine grain SAND, some silt, trace fine gravel [FILL] (moist) NYCBC Class 7		9						
					10	S-3	SS	10	6 7 6 11	13	1:00 PM - Take S-3 from 10' to 12' - Roller bit to 15', light brown wash return - Smooth drill
					11						
					12						
					13						
					14						
					15						
			Light Brown-Gray-Green SILTY SAND, trace fine gravel [FILL] (moist) NYCBC Class 7		16	S-4	SS	15	1 2 2 2	4	1:15 PM - Take S-4 from 15' to 17' - Roller bit to 20', Brown wash return - Wash return turning gray-black at 18' - Smooth drill
					17						
	-4.0				18						
		Class 6			19						
					20						

Log of Boring **LB-67**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 14	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Class 6	Gray-Black low plasticity CLAY, trace silt, trace shells, trace medium-to-fine grain mica [CL-OL] (moist) NYCBC Class 6		20	S-5	SS	18	WOR WOR WOR WOR		1:26 PM - Take S-5 from 20' to 22' - Roller bit to 25' - Gray-Black wash return - Smooth
					21						
					22						
					23						
					24						
		Class 6	Gray-Black low plasticity CLAY and decomposed white-gray granite, trace medium-to-fine grain mica, trace shells [CL-OL] (moist) NYCBC Class 6		25	S-6	SS	10	3 5 100/1"	100/1"	10:14 AM - Refusal at 26' Take S-6 from 25' to 27' - Roller bit to 30' - Gray wash return, rock fragment return - Slight rig chatter at 29' - Hard drill at 30', possible top of rock 2:40 PM - Completed drilling for the day
					26						
					27						
					28						
					29						
	-16.0				30						
		Class 1a	White-Light Gray-Pink GRANITE. Quartz-Muscovite-Feldspar-Biotite-Garnet, medium-to- coarse grain size, trace pigmitite at 31', 34' to 35'. No fractures. Hard to very hard. Fresh. NYCBC Class 1a	4.34	31	C-1	NX CORE BARREL	REC=57"/60" =95%	RQD=57"/60" =95%		2/10/2015 7:30 AM - Drillers defrosting drill rig and fire hydrant 9:00 AM - Start coring C-1 from 30' - White-to-Light Gray was return
				6.33	32						
				3.06	33						
				4.19	34						
				3.16	35						
	-21.0			3.09	36						10:00 AM - Start coring C-2 from 35' - White-to-Light Gray wash return
		Class 1b	White-Light Gray-Pink GRANITE. Quartz-Muscovite-Feldspar-Biotite-Garnet, medium grain size, trace pigmitite at 38' to 40'. Iron staining in hairline cracks. Fracture angles greater than 45 degrees from horizontal. Close-to-moderate fracture space. Medium hard. Slightly fractured-to-Fresh. NYCBC Class 1b	3.46	37	C-2	NX CORE BARREL	REC=54"/60" =90%	RQD=50"/60" =83%		
				3.38	38						
				2.26	39						
				2.89	40						
	-26.0		END OF BORING at 40 feet		41						10:40 AM - Completed drilling at 40 feet
					42						
					43						
					44						
					45						

Log of Boring **LB-68**

Station Number _____ Station Offset _____

Structure type _____

LANGAN

Project: Riverside 4		Project No.: 170275404	East:
Location: Riverside Parcel 4		Elevation and Datum: Approx. 15.3	North:
Drilling Company: Warren George, Inc		Date Started: 2/11/15	Date Finished: 2/12/15
Drilling Equipment: Mobile B-58 Truck-Mounted Drill Rig		Completion Depth: 35 ft	Rock Depth: 25 ft
Size and Type of Bit: 3-7/8" Diameter Tri-Cone Roller Bit		Number of Samples: Disturbed 5	Undisturbed - Core 2
Casing Diameter (in): 4" Inner-Diameter Flush Steel Casing	Casing Depth (ft): 20	Water Level (ft.): First -	Completion - 24 HR. -
Casing Hammer: Donut	Weight (lbs): 300 lbs Drop (in): 30"	Drilling Foreman: Jim Wilson	
Sampler: 2" O.D. Split Spoon sampler / NX Core Barrel		Inspecting Engineer: Andi Sicwebu	
Sampler Hammer: Safety	Weight (lbs): 140 lbs Drop (in): 30"		

Material Symbol	Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft) 10 20 30 40
	+15.3		Surface is well compacted dark brown medium-to-fine SAND, fine-to-coarse gravel, meduim-to-coarse red brick [FILL] (dry) NYCBC Class 7 ROLLER BIT TO 5'		0					
					1					
					2					
					3					
					4					
			Red BRICK, trace rock fragments, trace medium-to-fine grain sand, trace silt [FILL] (moist) NYCBC Class 7	SPIN	5	S-1	SS	4	14 8 7 9	15
					6					
			Dark Brown medium-to-fine grained SAND, trace silt, some medium-to-coarse gravel, trace red brick [FILL] (moist-to-wet) NYCBC Class 7		7	S-2	SS	6	7 8 10 5	18
		Class 7			8					
					9					
			Gray medium-to-coarse GRAVEL, trace medium-to-fine brown sand [FILL] (wet) NYCBC Class 7		10	S-3	SS	3	5 4 4 4	8
				SPIN	11					
					12					
					13					
					14					
			Dark Brown-Gray medium-to-fine grained SAND, trace silt, some gray-black decomposed mica schist [FILL] (wet) NYCBC Class 7		15	S-4	SS	6	3 4 100/1"	100/1"
					16					
					17					
	-2.7				18					
		Class 1d			19					
					20					

Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)

2/11/2015 1:35 PM
- Set up at LB-68 and start drilling
- Roller bit to 5', Brown wash return
- Hard drill
- Heavy rig chatter from 3' to 4'

2:00 PM - Take S-1 from 5' to 7'
- Take S-2 from 7' to 9'
- Spin 4" casing from 0' to 10'

2:45 PM - Completed driling for the day
2/12/2015 7:40AM
- Drillers fixing broken drill rig

9:00 PM - Roller bit to 10'

9:26 AM - Take S-3 from 10' to 12'
- Roller bit to 15', Gray wash return
- Gray wash return turning gray-brown at 13'

10:00 AM - Refusal at 16'
- Take S-4 from 15' to 17'
- Roller bit to 20', Gray-Brown wash return
- Losing water at 17'
- Slight rig chatter at 17', hard drill
- Wash return turning gray-black at 18', decompsoed schist return
- Heavy rig chatter at 18'

LANGAN

Log of Boring **LB-68**

Station Number _____ Station Offset _____

Structure type _____

Project	Project No.	East
Riverside 4	170275404	
Location	**Elevation and Datum**	**North**
Riverside Parcel 4	Approx. 15.3	

Material Symbol	Elev. (ft)	Building Code	Sample Description	Coring (min)	Depth Scale	Sample Data: Number	Type	Recov. (in)	Penetr. resist BL/6in	N-Value (Blows/ft)	Remarks (Drilling Fluid, Depth of Casing, Fluid Loss, Drilling Resistance, etc.)
		Class 1d	Gray-Black decomposed SCHIST, medium-to-fine grain mica, trace dark brown medium-to-fine grain sand, chunks of timber (~0.5") laying parallel to split spoon [SCHIST] (moist) NYCBC Class 1d		20–25	S-5	SS	8	24 15 13 18	28	10:25 AM - Take S-5 from 20' to 22' - Roller bit to 25', Gray wash return - Hard drill from 22' to 25' 11:00 PM - Spin 4" casing from 15' to 20'
	-9.7										
		Class 1a	White-Light Gray-Pink GRANITE. Quartz-Muscovite-Feldspar-Biotite-Garnet, medium-to- coarse grain size, iron staining at mechanical fracture at 28'. Hard to very hard. Fresh. NYCBC Class 1a	4.52 3.62 3.08 2.23 4.29	25–30	C-1	NX CORE BARREL	REC=56"/60" =93%	RQD=56"/60" =93%		11:40 AM - Start coring C-1 from 25' - White-to-light gray wash return - Change gear and increase coring speed at 26'
	-14.7										
		Class 1b	White-Light Gray-Pink GRANITE. Quartz-Muscovite-Feldspar-Biotite-Garnet, medium-to-coarse grain size. Fracture angles range from about 45 degrees to vertical. Close to moderate fracture space. Medium hard to hard. Slightly weathered to Fresh. NYCBC Class 1b	8.0 5.21 5.1 4.0 4.5	30–35	C-2	NX CORE BARREL	REC=55"/60" =92%	RQD=47"/60" =78%		12:15 PM - Start coring C-2 from 30' - White-to-Light Gray was return
	-19.7		END OF BORING at 35 feet								10:00 AM - Start coring C-2 from 35' - White-to-Light Gray wash return 1:15 PM - Completed drilling at 35' below existing grade
					35–45						

WELL CONSTRUCTION SUMMARY

Well No. MW63

PROJECT Riverside Parcel 3	**PROJECT NO.** 170275403
LOCATION New York, New York	**ELEVATION AND DATUM** 8.22 feet (NAVD88)
DRILLING AGENCY ADT	**DATE STARTED** 1/6/2015 **DATE FINISHED** 1/6/2014
DRILLING EQUIPMENT Geoprobe 6620DT	**DRILLER** Chris Iodicie
SIZE AND TYPE OF BIT Macro-Core®	**INSPECTOR** David Hannam

METHOD OF INSTALLATION

Geoprobe 6620DT with an auger attachment was used to advance to 13 feet . A two-inch PVC monitoring well was installed. The well were finished with a flush mounted road box and concrete pad.

METHOD OF WELL DEVELOPMENT

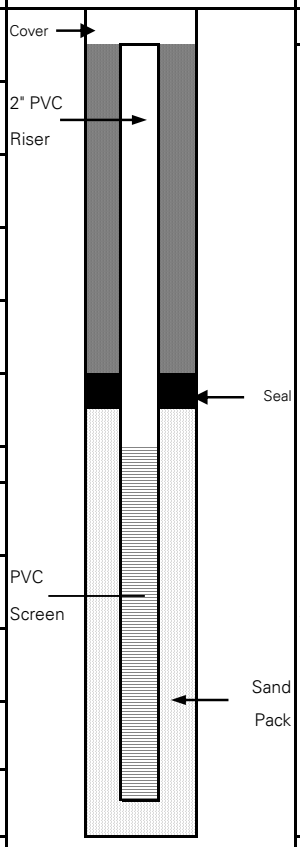
Monsoon pump for 1 hour.

TYPE OF CASING PVC **DIAMETER** 2 inch	**TYPE OF BACKFILL MATERIAL** No. 2 Sand and clean drill cuttings
TYPE OF SCREEN 0.02-inch slotted **DIAMETER** 2 inch	**TYPE OF SEAL MATERIAL** Bentonite
BOREHOLE DIAMETER 4.5 inch	**TYPE OF FILTER MATERIAL** No. 2 Sand

TOP OF CASING **ELEVATION**	**DEPTH (ft)**	0.54
TOP OF SEAL **ELEVATION**	**DEPTH (ft)**	1
TOP OF FILTER **ELEVATION**	**DEPTH (ft)**	2.5
TOP OF SCREEN **ELEVATION**	**DEPTH (ft)**	3
BOTTOM OF BORIN **ELEVATION**	**DEPTH (ft)**	13
SCREEN LENGTH		10
SLOT SIZE		0.02 inch

GROUNDWATER ELEVATIONS

ELEVATION	DATE	DEPTH TO WATER
2.86	1/19/2015	5.36



SUMMARY SOIL CLASSIFICATION	DEPTH (FT)
Fill	0 to 7
Sand	7 to 13

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WELL CONSTRUCTION SUMMARY

Well No. MW67

PROJECT Riverside Parcel 3	**PROJECT NO.** 170275403
LOCATION New York, New York	**ELEVATION AND DATUM** 8.53 feet (NAVD88)
DRILLING AGENCY ADT	**DATE STARTED** 1/5/2015 **DATE FINISHED** 1/5/2015
DRILLING EQUIPMENT Geoprobe 6620DT	**DRILLER** Chris Iodicie
SIZE AND TYPE OF BIT Macro-Core®	**INSPECTOR** David Hannam

METHOD OF INSTALLATION

Geoprobe 6610DT was advanced to 13 feet with Macro-Core®. A 1.5 inch diameter prepack temporary well was installed. The well was sealed with 2 feet of bentonite and backfilled with sand and clean drill cuttings.

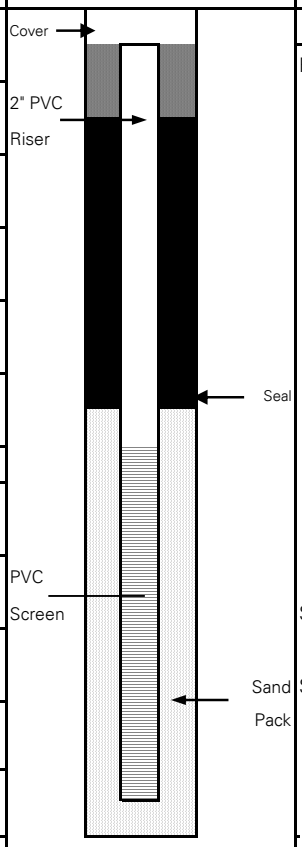
METHOD OF WELL DEVELOPMENT

Temporary well - no development.

TYPE OF CASING PVC **DIAMETER** 1.5 inch	**TYPE OF BACKFILL MATERIAL** No. 2 Sand and clean drill cuttings
TYPE OF SCREEN Prepacked 0.02-inch slotted **DIAMETER** 1.5 inch	**TYPE OF SEAL MATERIAL** Bentonite
BOREHOLE DIAMETER 3 inch	**TYPE OF FILTER MATERIAL** No. 2 Sand and prepacked screen

TOP OF CASING ELEVATION	**DEPTH (ft)**	
TOP OF SEAL ELEVATION	**DEPTH (ft)** 1	
TOP OF FILTER ELEVATION	**DEPTH (ft)** 2	
TOP OF SCREEN ELEVATION	**DEPTH (ft)** 3	
BOTTOM OF BORINC ELEVATION	**DEPTH (ft)** 13	
SCREEN LENGTH	10	
SLOT SIZE	0.02 inch	

WELL DETAILS



SUMMARY SOIL CLASSIFICATION	**DEPTH (FT)**
Fill	0 to 6.5
Sand	8 to 9
Silt and Clay	12 to 13

GROUNDWATER ELEVATIONS

ELEVATION	DATE	DEPTH TO WATER
2.66	1/19/2015	5.87

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WELL CONSTRUCTION SUMMARY

Well No. MW87

PROJECT Riverside Parcel 3	**PROJECT NO.** 170275403
LOCATION New York, New York	**ELEVATION AND DATUM** 9.4 feet (NAVD88)
DRILLING AGENCY ADT	**DATE STARTED** 2/4/2015 **DATE FINISHED** 2/4/2015
DRILLING EQUIPMENT Geoprobe 6620DT	**DRILLER** Chris Iodicie
SIZE AND TYPE OF BIT Macro-Core®	**INSPECTOR** Barbara Ang

METHOD OF INSTALLATION

Geoprobe 6610DT was advanced to 15 feet with Macro-Core®. A 1.5 inch diameter prepack temporary well was installed. The well was sealed with 2 feet of bentonite and backfilled with sand and clean drill cuttings.

METHOD OF WELL DEVELOPMENT

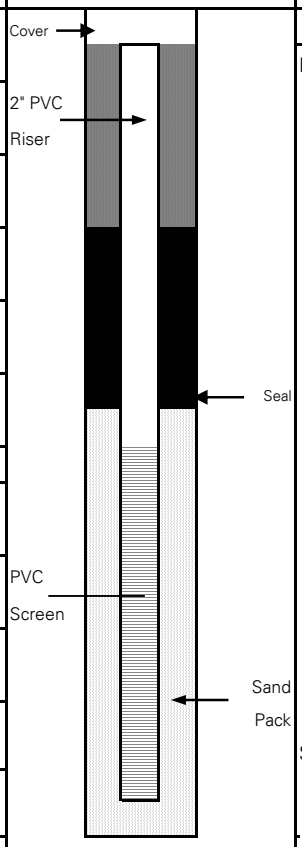
Temporary well - no development.

TYPE OF CASING PVC **DIAMETER** 1.5 inch	**TYPE OF BACKFILL MATERIAL** No. 2 Sand and clean drill cuttings
TYPE OF SCREEN Prepacked 0.02-inch slotted **DIAMETER** 1.5 inch	**TYPE OF SEAL MATERIAL** Bentonite
BOREHOLE DIAMETER 3 inch	**TYPE OF FILTER MATERIAL** No.2 Sand with prepacked screen

TOP OF CASING ELEVATION		**DEPTH (ft)**
TOP OF SEAL ELEVATION		**DEPTH (ft)** 2
TOP OF FILTER ELEVATION		**DEPTH (ft)** 4
TOP OF SCREEN ELEVATION		**DEPTH (ft)** 5
BOTTOM OF BORINC ELEVATION		**DEPTH (ft)** 15
SCREEN LENGTH		10
SLOT SIZE		0.02 inch

GROUNDWATER ELEVATIONS

ELEVATION	DATE	DEPTH TO WATER
2.2	2/6/2015	7.2



SUMMARY SOIL CLASSIFICATION	DEPTH (FT)
Fill	0 to 14
Silt	14 to 15

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WELL CONSTRUCTION SUMMARY

Well No. MW89

PROJECT Riverside Parcel 3	**PROJECT NO.** 170275403
LOCATION New York, New York	**ELEVATION AND DATUM** 8.47 feet (NAVD88)
DRILLING AGENCY ADT	**DATE STARTED** 1/6/2015 **DATE FINISHED** 1/6/2015
DRILLING EQUIPMENT Geoprobe 6620DT	**DRILLER** Chris Iodicie
SIZE AND TYPE OF BIT Macro-Core®	**INSPECTOR** David Hannam

METHOD OF INSTALLATION

Geoprobe 6620DT with auger attachment was used to advance to 13 feet. A two-inch PVC monitoring well was installed. The well was finished with a flush mounted road box and concrete pad.

METHOD OF WELL DEVELOPMENT

Whale pump for 1 hour.

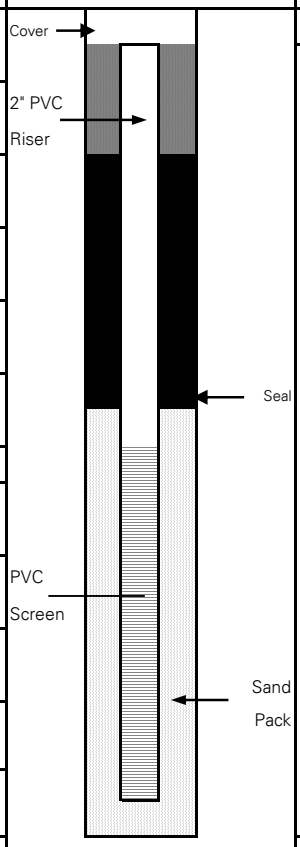
TYPE OF CASING PVC	**DIAMETER** 2 inch	**TYPE OF BACKFILL MATERIAL**	No. 2 Sand and clean drill cuttings
TYPE OF SCREEN 0.02-inch slotted	**DIAMETER** 2 inch	**TYPE OF SEAL MATERIAL**	Bentonite
BOREHOLE DIAMETER 4.5 inch		**TYPE OF FILTER MATERIAL**	No. 2 Sand

TOP OF CASING ELEVATION	**DEPTH (ft)** 0.96	
TOP OF SEAL ELEVATION	**DEPTH (ft)** 1	
TOP OF FILTER ELEVATION	**DEPTH (ft)** 2.5	
TOP OF SCREEN ELEVATION	**DEPTH (ft)** 3	
BOTTOM OF BORINC ELEVATION	**DEPTH (ft)** 13	
SCREEN LENGTH	10	
SLOT SIZE	0.02 inch	

GROUNDWATER ELEVATIONS

ELEVATION	DATE	DEPTH TO WATER
1.32	1/19/2015	7.15

WELL DETAILS



SUMMARY SOIL CLASSIFICATION	DEPTH (FT)
Fill	0 to 8.5
Sand	10 to 13

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WELL CONSTRUCTION SUMMARY

Well No. 100

PROJECT Riverside Parcel 4	**PROJECT NO.** 170275404
LOCATION New York, New York	**ELEVATION AND DATUM** 8.7 feet (NAVD88)
DRILLING AGENCY ADT	**DATE STARTED** 1/13/2015 **DATE FINISHED** 1/13/2015
DRILLING EQUIPMENT Geoprobe 6622DT	**DRILLER** Chris Iodice
SIZE AND TYPE OF BIT Macrocore	**INSPECTOR** Dave Hannam

METHOD OF INSTALLATION

Geoprobe 6620DT with auger attachment was used to advance to 13 feet. A two-inch PVC monitoring well was installed. The well was finished with a flush mounted road box and concrete pad.

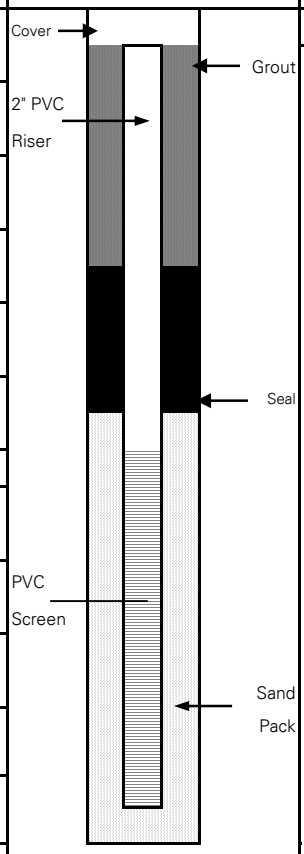
METHOD OF WELL DEVELOPMENT

Whale pump for 1 hour.

TYPE OF CASING PVC **DIAMETER** 2 inch	**TYPE OF BACKFILL MATERIAL** No. 2 Sand and clean cuttings
TYPE OF SCREEN 0.02-inch slotted **DIAMETER** 2 inch	**TYPE OF SEAL MATERIAL** Bentonite
BOREHOLE DIAMETER 4.5 inch	**TYPE OF FILTER MATERIAL** No. 2 Sand

TOP OF CASING ELEVATION	**DEPTH (ft)**	
TOP OF SEAL ELEVATION	**DEPTH (ft)** 1	
TOP OF FILTER ELEVATION	**DEPTH (ft)** 2.5	
TOP OF SCREEN ELEVATION	**DEPTH (ft)** 3	
BOTTOM OF BORING ELEVATION	**DEPTH (ft)** 13	
SCREEN LENGTH	10	
SLOT SIZE	0.02 inch	

WELL DETAILS



SUMMARY SOIL CLASSIFICATION	DEPTH (FT)
Fill	0 to 8
Silt/Clay	8 to 13

GROUNDWATER ELEVATIONS

ELEVATION	DATE	DEPTH TO WATER
2.51	1/20/2015	6.19

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WELL CONSTRUCTION SUMMARY

Well No. MW117

PROJECT Riverside Parcel 4	**PROJECT NO.** 170275404
LOCATION New York, New York	**ELEVATION AND DATUM** 9 feet (NAVD88)
DRILLING AGENCY ADT	**DATE STARTED** 1/15/2015 **DATE FINISHED** 1/15/2015
DRILLING EQUIPMENT Geoprobe 6620DT	**DRILLER** Chris Iodicie
SIZE AND TYPE OF BIT Macro-Core®	**INSPECTOR** David Hannam

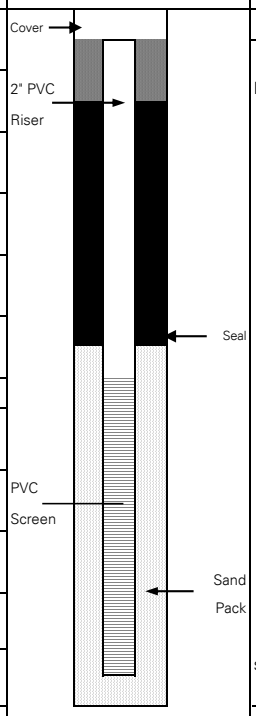
METHOD OF INSTALLATION

Geoprobe 6610DT was advanced to 17 feet with Macro-Core®. A 1.5 inch diameter prepack temporary well was installed. The well was sealed with 1.5 feet of bentonite and backfilled with sand and clean drill cuttings.

METHOD OF WELL DEVELOPMENT

Temporary well - no development.

TYPE OF CASING PVC	**DIAMETER** 1.5 inch	**TYPE OF BACKFILL MATERIAL** No. 2 Sand and clean drill cuttings	
TYPE OF SCREEN Prepacked 0.02-inch slotted	**DIAMETER** 1.5 inch	**TYPE OF SEAL MATERIAL** Bentonite	
BOREHOLE DIAMETER 3 inch		**TYPE OF FILTER MATERIAL** No. 2 Sand and well sand prepack	
TOP OF CASING **ELEVATION**	**DEPTH (ft)**	**WELL DETAILS**	**SUMMARY SOIL CLASSIFICATION** / **DEPTH (FT)**
TOP OF SEAL **ELEVATION**	**DEPTH (ft)** N/A	Cover	
TOP OF FILTER **ELEVATION**	**DEPTH (ft)** Prepack	2" PVC Riser	Fill — 0 to 12
TOP OF SCREEN **ELEVATION**	**DEPTH (ft)** 3		
BOTTOM OF BORING **ELEVATION**	**DEPTH (ft)** 13		
SCREEN LENGTH 10			
SLOT SIZE 0.02 inch		Seal	



silty Sand — 12 to 13

GROUNDWATER ELEVATIONS

ELEVATION	DATE	DEPTH TO WATER
2.5	1/26/2015	6.5

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WELL CONSTRUCTION SUMMARY

Well No. MW136

PROJECT Riverside Parcel 4	**PROJECT NO.** 170275404
LOCATION New York, New York	**ELEVATION AND DATUM** 14.78 feet (NAVD88)
DRILLING AGENCY ADT	**DATE STARTED** 2/4/2015 **DATE FINISHED** 2/4/2015
DRILLING EQUIPMENT Geoprobe 6620DT	**DRILLER** Chris Iodicie
SIZE AND TYPE OF BIT Macro-Core®	**INSPECTOR** Barbara Ang

METHOD OF INSTALLATION

Geoprobe 6610DT was advanced to 17 feet with Macro-Core®. A 1.5 inch diameter prepack temporary well was installed. The well was sealed with 2 feet of bentonite and backfilled with sand and clean drill cuttings.

METHOD OF WELL DEVELOPMENT

Temporary well - no development.

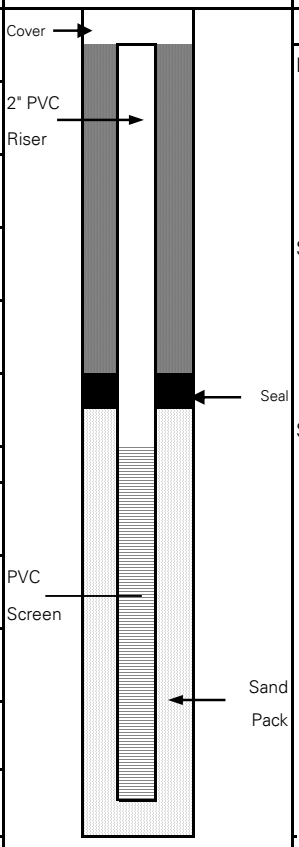
TYPE OF CASING PVC **DIAMETER** 1.5 inch	**TYPE OF BACKFILL MATERIAL** No. 2 Sand and clean drill cuttings
TYPE OF SCREEN Prepacked 0.02-inch slotted **DIAMETER** 1.5 inch	**TYPE OF SEAL MATERIAL** Bentonite
BOREHOLE DIAMETER 3 inch	**TYPE OF FILTER MATERIAL** No. 2 Sand and prepacked screen

TOP OF CASING **ELEVATION**	**DEPTH (ft)**	
TOP OF SEAL **ELEVATION**	**DEPTH (ft)** 9	
TOP OF FILTER **ELEVATION**	**DEPTH (ft)** 10	
TOP OF SCREEN **ELEVATION**	**DEPTH (ft)** 12	
BOTTOM OF BORINC **ELEVATION**	**DEPTH (ft)** 17	
SCREEN LENGTH	5	
SLOT SIZE	0.02 inch	

GROUNDWATER ELEVATIONS

ELEVATION	DATE	DEPTH TO WATER
-0.42	2/5/2015	15.2

WELL DETAILS



SUMMARY SOIL CLASSIFICATION	DEPTH (FT)
Fill	0 to 6.5
Sand	8 to 9
Silt	12 to 17

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WELL CONSTRUCTION SUMMARY

Well No. 138

PROJECT Riverside Parcel 4	**PROJECT NO.** 170275404
LOCATION New York, New York	**ELEVATION AND DATUM** 11.18 feet (NAVD88)
DRILLING AGENCY ADT	**DATE STARTED** 1/13/2015 **DATE FINISHED** 1/13/2015
DRILLING EQUIPMENT Geoprobe 6622DT	**DRILLER** Chris Iodice
SIZE AND TYPE OF BIT Macrocore	**INSPECTOR** Dave Hannam

METHOD OF INSTALLATION

Geoprobe 6620DT with an auger attachment was used to advance to 17 feet. A two-inch PVC monitoring well was installed. The well were finished with a flush mounted road box and concrete pad.

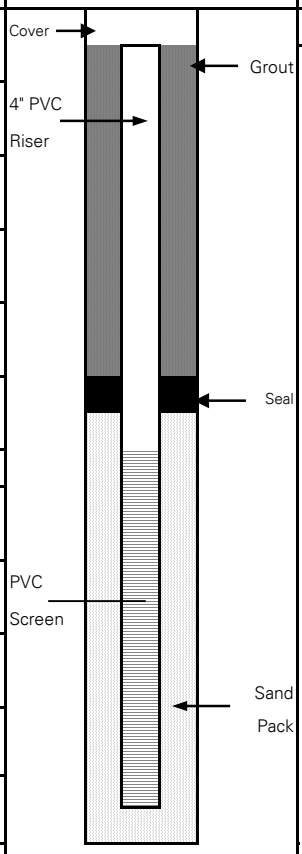
METHOD OF WELL DEVELOPMENT

Whale pump for 1 hour.

TYPE OF CASING PVC **DIAMETER** 2 inch	**TYPE OF BACKFILL MATERIAL** No. 2 Sand and clean drill cuttings
TYPE OF SCREEN 0.02-inch slotted **DIAMETER** 2 inch	**TYPE OF SEAL MATERIAL** Bentonite
BOREHOLE DIAMETER 4.5 inch	**TYPE OF FILTER MATERIAL** No. 2 Sand

TOP OF CASING ELEVATION	**DEPTH (ft)**	
TOP OF SEAL ELEVATION	**DEPTH (ft)** 4.5	
TOP OF FILTER ELEVATION	**DEPTH (ft)** 6.5	
TOP OF SCREEN ELEVATION	**DEPTH (ft)** 7	
BOTTOM OF BORING ELEVATION	**DEPTH (ft)** 17	
SCREEN LENGTH	10	
SLOT SIZE	0.02 inch	

WELL DETAILS



SUMMARY SOIL CLASSIFICATION	DEPTH (FT)
Fill	0 to 17

GROUNDWATER ELEVATIONS

ELEVATION	DATE	DEPTH TO WATER
2.68	1/20/2015	8.5

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APPENDIX C

CONE PENETROMETER TESTING RESULTS

LANGAN

PRESENTATION OF SITE INVESTIGATION RESULTS

Riverside One, Block 1171, Parcel 3, Lots 155 & 158, and Parcel 4, Lot 157, Project

Prepared for:

Langan Engineering and Environmental Services

ConeTec Job No.: 15-53004-1

Project Start Date: 25-Mar-2015
Project End Date: 25-Mar-2015
Report Date: 1-Apr-2015

Prepared by:

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www.conetecdataservices.com

Introduction

The enclosed report presents the results of a piezocone penetration testing (CPTu or CPT) program carried out at the site of the proposed new building to be constructed between W 59th St. and W 61st St. and just east of Route 9A, the West Side Highway, in Manhattan, New York. The site investigation program was conducted by ConeTec Inc., under contract to the Langan Engineering & Environmental Services (Langan or Langan Engineering) of New York, New York.

A total of eight cone penetration tests were completed at eight locations. The CPT program was performed to evaluate the subsurface soil conditions in the area of the new construction. CPT sounding locations were selected and numbered under the supervision of Langan personnel (Ms. Shreya Bhat and Messrs. Doug Spitzer and James Delimitros).

Project Information

Project	
Client	Langan Engineering & Environmental Services
Project	Riverside One, Block 1171, Parcel 3, Lots 155 & 158, and Parcel 4, Lot 157, Manhattan, NY
ConeTec project number	15-53004-1

A map from Google earth including the CPT test locations is presented below.

Rig Description	Deployment System	Test Type
CPT truck rig	25 ton truck mounted (twin cylinders)	CPT

Coordinates		
Test Type	Collection Method	EPSG Number
CPT	GPS (GlobalSat MR-350)	32618 (WGS 84 / UTM North)

Cone Penetration Test (CPT)	
Depth reference	Ground surface at the time of the investigation.
Tip and sleeve data offset	0.1 meter. This has been accounted for in the CPT data files.
Pore pressure dissipation (PPD) tests	Two pore pressure dissipation tests were completed primarily to determine phreatic surface depths.
Additional Comments	Shear wave velocity (Vs) testing was completed in four soundings.

Cone Description	Cone Number	Cross Sectional Area (cm^2)	Sleeve Area (cm^2)	Tip Capacity (bar)	Sleeve Capacity (bar)	Pore Pressure Capacity (psi)
301:T1500F15U500	301	15	225	1500	15	500

Limitations

This report has been prepared for the exclusive use of Langan Engineering (Client) for the project titled "Riverside One". The report's contents may not be relied upon by any other party without the express written permission of ConeTec, Inc. (ConeTec). ConeTec has provided site investigation services, prepared the factual data reporting, and provided geotechnical parameter calculations consistent with current best practices. No other warranty, expressed or implied, is made.

The information presented in the report document and the accompanying data set pertain to the specific project, site conditions and objectives described to ConeTec by the Client. In order to properly understand the factual data, assumptions and calculations, reference must be made to the documents provided and their accompanying data sets, in their entirety.

The cone penetration tests (CPTu) are conducted using an integrated electronic piezocone penetrometer and data acquisition system manufactured by Adara Systems Ltd. of Richmond, British Columbia, Canada.

ConeTec's piezocone penetrometers are compression type designs in which the tip and friction sleeve load cells are independent and have separate load capacities. The piezocones use strain gauged load cells for tip and sleeve friction and a strain gauged diaphragm type transducer for recording pore pressure. The piezocones also have a platinum resistive temperature device (RTD) for monitoring the temperature of the sensors, an accelerometer type dual axis inclinometer and a geophone sensor for recording seismic signals. All signals are amplified down hole within the cone body and the analog signals are sent to the surface through a shielded cable.

ConeTec penetrometers are manufactured with various tip, friction and pore pressure capacities in both 10 cm^2 and 15 cm^2 tip base area configurations in order to maximize signal resolution for various soil conditions. The 15 cm^2 penetrometers do not require friction reducers as they have a diameter larger than the deployment rods. The 10 cm^2 piezocones use a friction reducer consisting of a rod adapter extension behind the main cone body with an enlarged cross sectional area (typically 44 mm diameter over a length of 32 mm with tapered leading and trailing edges) located at a distance of 585 mm above the cone tip.

The penetrometers are designed with equal end area friction sleeves, a net end area ratio of 0.8 and cone tips with a 60 degree apex angle.

All ConeTec piezocones can record pore pressure at various locations. Unless otherwise noted, the pore pressure filter is located directly behind the cone tip in the "u_2" position (ASTM Type 2). The filter is 6 mm thick, made of porous plastic (polyethylene) having an average pore size of 125 microns (90-160 microns). The function of the filter is to allow rapid movements of extremely small volumes of water needed to activate the pressure transducer while preventing soil ingress or blockage.

The piezocone penetrometers are manufactured with dimensions, tolerances and sensor characteristics that are in general accordance with the current ASTM D5778 standard. ConeTec's calibration criteria also meet or exceed those of the current ASTM D5778 standard. An illustration of the piezocone penetrometer is presented in Figure CPTu.

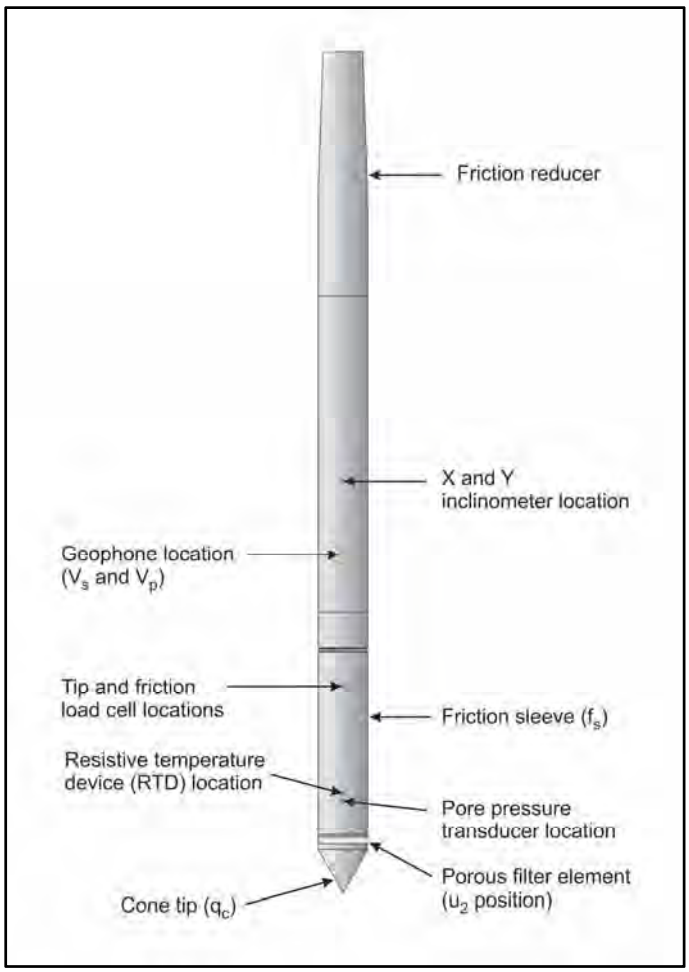


Figure CPTu. Piezocone Penetrometer (15 cm^2)

The ConeTec data acquisition systems consist of a Windows based computer and a signal conditioner and power supply interface box with a 16 bit (or greater) analog to digital (A/D) converter. The data is recorded at fixed depth increments using a depth wheel attached to the push cylinders or by using a spring loaded rubber depth wheel that is held against the cone rods. The typical recording intervals are either 2.5 cm or 5.0 cm depending on project requirements; custom recording intervals are possible. The system displays the CPTu data in real time and records the following parameters to a storage media during penetration:

- Depth
- Uncorrected tip resistance (q_c)
- Sleeve friction (f_s)
- Dynamic pore pressure (u)
- Additional sensors such as resistivity, passive gamma, ultra violet induced fluorescence, if applicable

All testing is performed in accordance to ConeTec's CPT operating procedures which are in general accordance with the current ASTM D5778 standard.

Prior to the start of a CPTu sounding a suitable cone is selected, the cone and data acquisition system are powered on, the pore pressure system is saturated with either glycerin or silicone oil and the baseline readings are recorded with the cone hanging freely in a vertical position.

The CPTu is conducted at a steady rate of 2 cm/s, within acceptable tolerances. Typically one meter length rods with an outer diameter of 1.5 inches are added to advance the cone to the sounding termination depth. After cone retraction final baselines are recorded.

Additional information pertaining to ConeTec's cone penetration testing procedures:

- Each filter is saturated in silicone oil or glycerin under vacuum pressure prior to use
- Recorded baselines are checked with an independent multi-meter
- Baseline readings are compared to previous readings
- Soundings are terminated at the client's target depth or at a depth where an obstruction is encountered, excessive rod flex occurs, excessive inclination occurs, equipment damage is likely to take place, or a dangerous working environment arises
- Differences between initial and final baselines are calculated to ensure zero load offsets have not occurred and to ensure compliance with ASTM standards

The interpretation of piezocone data for this report is based on the corrected tip resistance (q_t), sleeve friction (f_s) and pore water pressure (u). The interpretation of soil type is based on the correlations developed by Robertson (1990) and Robertson (2009). It should be noted that it is not always possible to accurately identify a soil type based on these parameters. In these situations, experience, judgment and an assessment of other parameters may be used to infer soil behavior type.

The recorded tip resistance (q_c) is the total force acting on the piezocone tip divided by its base area. The tip resistance is corrected for pore pressure effects and termed corrected tip resistance (q_t) according to the following expression presented in Robertson et al, 1986:

$$q_t = q_c + (1\text{-}a) \bullet u_2$$

where: q_t is the corrected tip resistance
q_c is the recorded tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the piezocone (0.8 for ConeTec probes)

The sleeve friction (f_s) is the frictional force on the sleeve divided by its surface area. As all ConeTec piezocones have equal end area friction sleeves, pore pressure corrections to the sleeve data are not required.

The dynamic pore pressure (u) is a measure of the pore pressures generated during cone penetration. To record equilibrium pore pressure, the penetration must be stopped to allow the dynamic pore pressures to stabilize. The rate at which this occurs is predominantly a function of the permeability of the soil and the diameter of the cone.

The friction ratio (Rf) is a calculated parameter. It is defined as the ratio of sleeve friction to the tip resistance expressed as a percentage. Generally, saturated cohesive soils have low tip resistance, high

friction ratios and generate large excess pore water pressures. Cohesionless soils have higher tip resistances, lower friction ratios and do not generate significant excess pore water pressure.

A summary of the CPTu soundings along with test details and individual plots are provided in the appendices. A set of interpretation files were generated for each sounding based on published correlations and are provided in Excel format in the data release folder. Information regarding the interpretation methods used is included in an appendix.

For additional information on CPTu interpretations, refer to Robertson et al. (1986), Lunne et al. (1997), Robertson (2009), Mayne (2013, 2014) and Mayne and Peuchen (2012).

References

ASTM D5778-12, 2012, "Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils", ASTM, West Conshohocken, US.

Lunne, T., Robertson, P.K. and Powell, J. J. M., 1997, “Cone Penetration Testing in Geotechnical Practice”, Blackie Academic and Professional.

Mayne, P.W., 2013, “Evaluating yield stress of soils from laboratory consolidation and in-situ cone penetration tests”, Sound Geotechnical Research to Practice (Holtz Volume) GSP 230, ASCE, Reston/VA: 406-420.

Mayne, P.W. and Peuchen, J., 2012, “Unit weight trends with cone resistance in soft to firm clays”, Geotechnical and Geophysical Site Characterization *4,* Vol. 1 (Proc. ISC-4, Pernambuco), CRC Press, London: 903-910.

Mayne, P.W., 2014, “Interpretation of geotechnical parameters from seismic piezocone tests”, CPT’14 Keynote Address, Las Vegas, NV, May 2014.

Robertson, P.K., Campanella, R.G., Gillespie, D. and Greig, J., 1986, “Use of Piezometer Cone Data”, Proceedings of InSitu 86, ASCE Specialty Conference, Blacksburg, Virginia.

Robertson, P.K., 1990, “Soil Classification Using the Cone Penetration Test”, Canadian Geotechnical Journal, Volume 27: 151-158.

Robertson, P.K., 2009, “Interpretation of cone penetration tests – a unified approach”, Canadian Geotechnical Journal, Volume 46: 1337-1355.

Shear wave velocity testing is performed in conjunction with the piezocone penetration test (SCPTu) in order to collect interval velocities. For some projects seismic compression wave (Vp) velocity is also determined.

ConeTec's piezocone penetrometers are manufactured with a horizontally active geophone (28 hertz) that is rigidly mounted in the body of the cone penetrometer, 0.2 meters behind the cone tip.

Shear waves are typically generated by using an impact hammer horizontally striking a beam that is held in place by a normal load. In some instances an auger source or an imbedded impulsive source maybe used for both shear waves and compression waves. The hammer and beam act as a contact trigger that triggers the recording of the seismic wave traces. For impulsive devices an accelerometer trigger may be used. The traces are recorded using an up-hole integrated digital oscilloscope which is part of the SCPTu data acquisition system. An illustration of the shear wave testing configuration is presented in Figure SCPTu-1.

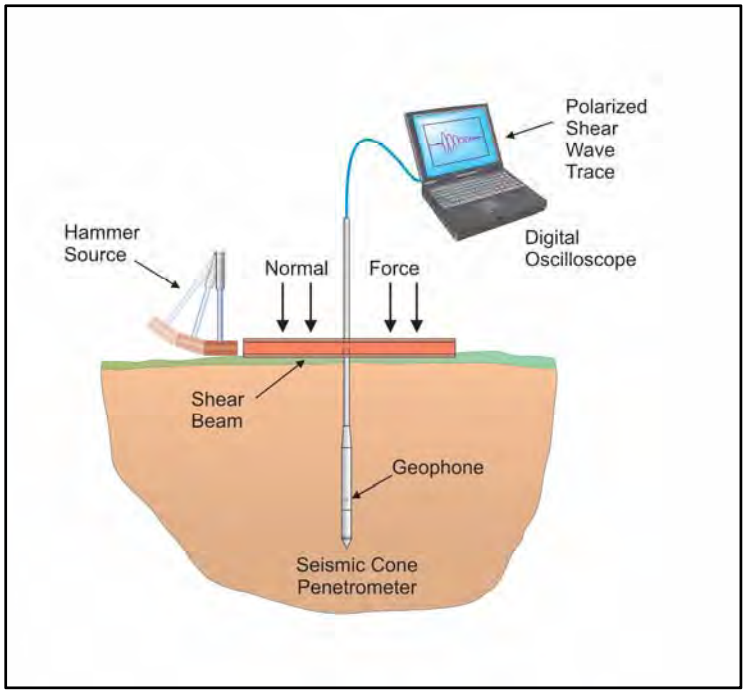


Figure SCPTu-1. Illustration of the SCPTu system

All testing is performed in accordance to ConeTec's SCPTu operating procedures.

Prior to the start of a SCPTu sounding, the procedures described in the Cone Penetration Test section are followed. In addition, the active axis of the geophone is aligned parallel to the beam (or source) and the horizontal offset between the cone and the source is measured and recorded.

Prior to recording seismic waves at each test depth, cone penetration is stopped and the rods are decoupled from the rig to avoid transmission of rig energy down the rods. Multiple wave traces are recorded for quality control purposes. After reviewing wave traces for consistency the cone is pushed to the next test depth (typically one meter intervals or as requested by the client). Figure SCPTu-2 presents an illustration of a SCPTu test.

For additional information on seismic cone penetration testing refer to Robertson et.al. (1986).

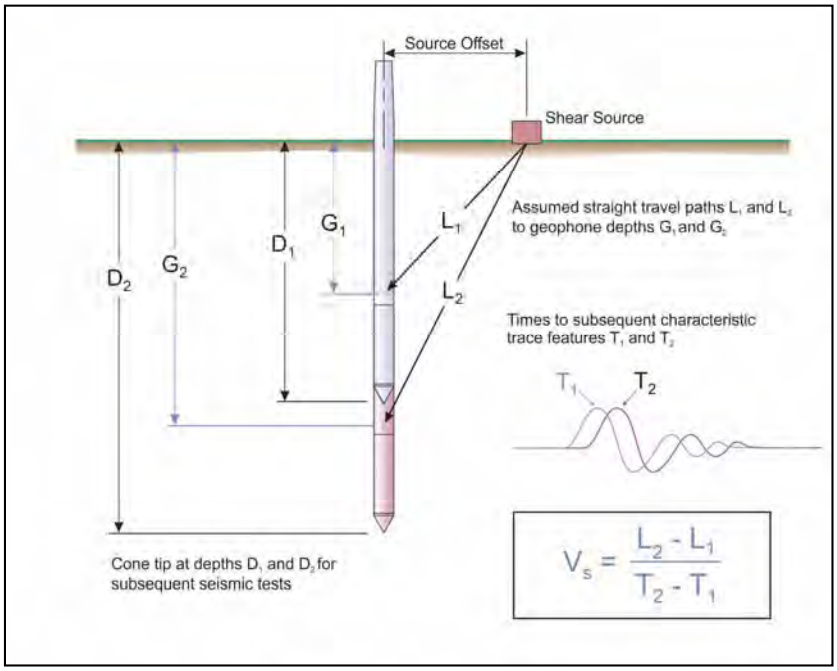


Figure SCPTu-2. Illustration of a seismic cone penetration test

Calculation of the interval velocities are performed by visually picking a common feature (e.g. the first characteristic peak, trough, or crossover) on all of the recorded wave sets and taking the difference in ray path divided by the time difference between subsequent features. Ray path is defined as the straight line distance from the seismic source to the geophone, accounting for beam offset, source depth and geophone offset from the cone tip.

The average shear wave velocity to a depth of 100 feet (30 meters) ($\bar{v}_s$) has been calculated and provided for all applicable soundings using the following equation presented in ASCE, 2010.

$$\bar{v}_s = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{v_{si}}}$$

where: $\bar{v}_s$ = average shear wave velocity ft/s (m/s)
d_i = the thickness of any layer between 0 and 100 ft (30 m)
v_{si} = the shear wave velocity in ft/s (m/s)
$\sum_{i=1}^{n} d_i$ = 100 ft (30 m)

Average shear wave velocity, $\bar{v}_s$ is also referenced to V_{s100} or V_{s30}.

The layer travel times refers to the travel times propagating in the vertical direction, not the measured travel times from an offset source.

Tabular results and SCPTu plots are presented in the relevant appendix.

References

American Society of Civil Engineers (ASCE), 2010, “Minimum Design Loads for Buildings and Other Structures”, Standard ASCE/SEI 7-10, American Society of Civil Engineers, ISBN 978-0-7844-1085-1, Reston, Virginia.

Robertson, P.K., Campanella, R.G., Gillespie D and Rice, A., 1986, “Seismic CPT to Measure In-Situ Shear Wave Velocity”, Journal of Geotechnical Engineering ASCE, Vol. 112, No. 8: 791-803.

The cone penetration test is halted at specific depths to carry out pore pressure dissipation (PPD) tests, shown in Figure PPD-1. For each dissipation test the cone and rods are decoupled from the rig and the data acquisition system measures and records the variation of the pore pressure (u) with time (t).

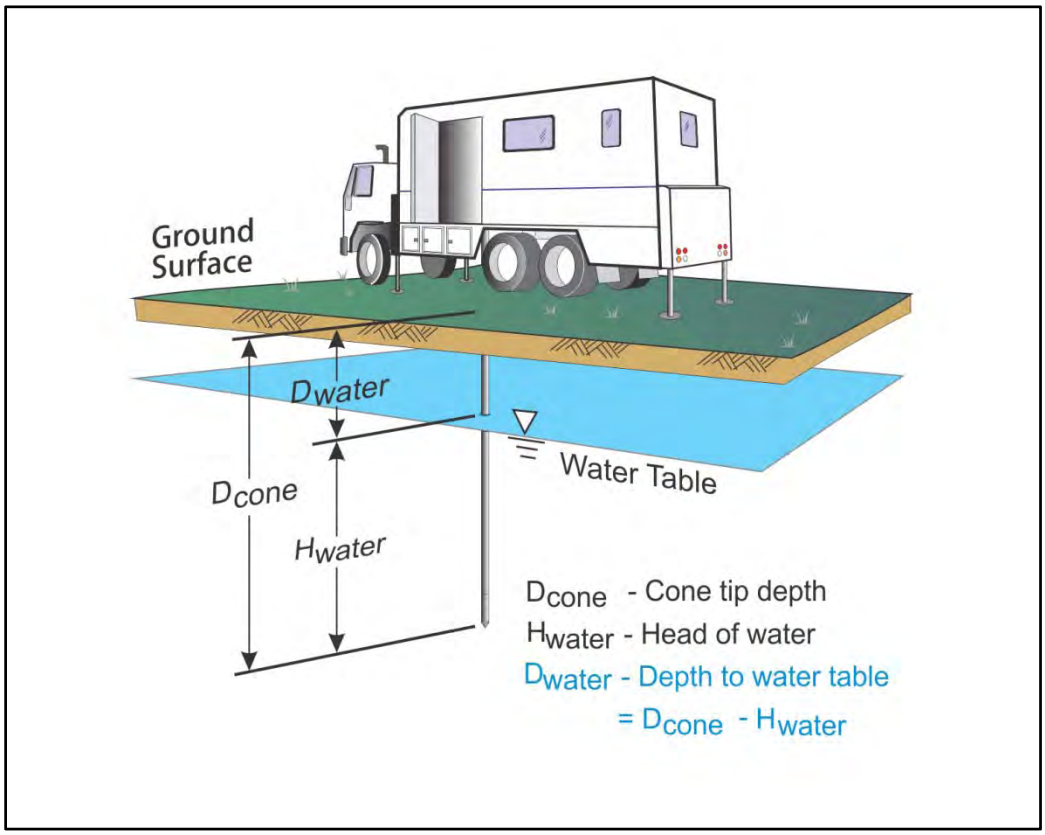


Figure PPD-1. Pore pressure dissipation test setup

Pore pressure dissipation data can be interpreted to provide estimates of ground water conditions, permeability, consolidation characteristics and soil behavior.

The typical shapes of dissipation curves shown in Figure PPD-2 are very useful in assessing soil type, drainage, in situ pore pressure and soil properties. A flat curve that stabilizes quickly is typical of a freely draining sand. Undrained soils such as clays will typically show positive excess pore pressure and have long dissipation times. Dilative soils will often exhibit dynamic pore pressures below equilibrium that then rise over time. Overconsolidated fine-grained soils will often exhibit an initial dilatory response where there is an initial rise in pore pressure before reaching a peak and dissipating.

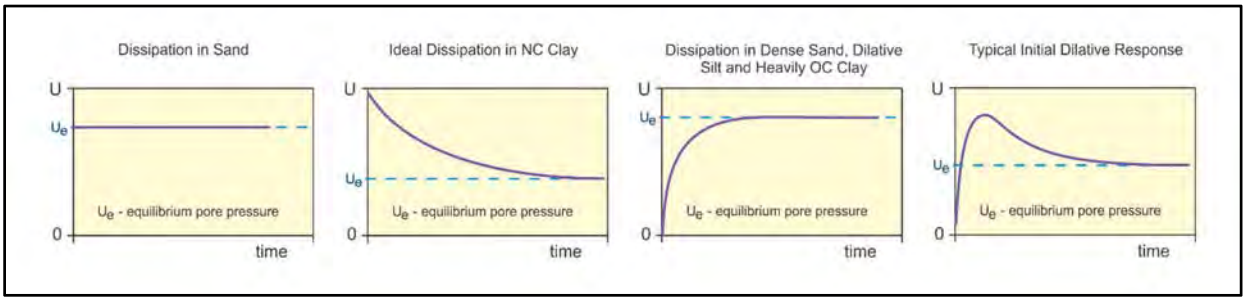


Figure PPD-2. Pore pressure dissipation curve examples

In order to interpret the equilibrium pore pressure (u_{eq}) and the apparent phreatic surface, the pore pressure should be monitored until such time as there is no variation in pore pressure with time as shown for each curve of Figure PPD-2.

In fine grained deposits the point at which 100% of the excess pore pressure has dissipated is known as t_{100}. In some cases this can take an excessive amount of time and it may be impractical to take the dissipation to t_{100}. A theoretical analysis of pore pressure dissipations by Teh and Houlsby (1991) showed that a single curve relating degree of dissipation versus theoretical time factor (T*) may be used to calculate the coefficient of consolidation (c_h) at various degrees of dissipation resulting in the expression for c_h shown below.

$$c_h = \frac{T^* \cdot a^2 \cdot \sqrt{I_r}}{t}$$

Where:

T* is the dimensionless time factor (Table Time Factor)
a is the radius of the cone
I_r is the rigidity index
t is the time at the degree of consolidation

Table Time Factor. T* versus degree of dissipation (Teh and Houlsby, 1991)

Degree of Dissipation (%)	20	30	40	50	60	70	80
T* (u_2)	0.038	0.078	0.142	0.245	0.439	0.804	1.60

The coefficient of consolidation is typically analyzed using the time (t_{50}) corresponding to a degree of dissipation of 50% (u_{50}). In order to determine t_{50}, dissipation tests must be taken to a pressure less than u_{50}. The u_{50} value is half way between the initial maximum pore pressure and the equilibrium pore pressure value, known as u_{100}. To estimate u_{50}, both the initial maximum pore pressure and u_{100} must be known or estimated. Other degrees of dissipations may be considered, particularly for extremely long dissipations.

At any specific degree of dissipation the equilibrium pore pressure (u at t_{100}) must be estimated at the depth of interest. The equilibrium value may be determined from one or more sources such as measuring the value directly (u_{100}), estimating it from other dissipations in the same profile, estimating the phreatic surface and assuming hydrostatic conditions, from nearby soundings, from client provided information, from site observations and/or past experience, or from other site instrumentation.

For calculations of c_h (Teh and Houlsby, 1991), t_{50} values are estimated from the corresponding pore pressure dissipation curve and a rigidity index (I_r) is assumed. For curves having an initial dilatory response in which an initial rise in pore pressure occurs before reaching a peak, the relative time from the peak value is used in determining t_{50}. In cases where the time to peak is excessive, t_{50} values are not calculated.

Due to possible inherent uncertainties in estimating I_r, the equilibrium pore pressure and the effect of an initial dilatory response on calculating t_{50}, other methods should be applied to confirm the results for c_h.

Additional published methods for estimating the coefficient of consolidation from a piezocone test are described in Burns and Mayne (1998, 2002), Jones and Van Zyl (1981), Robertson et al. (1992) and Sully et al. (1999).

A summary of the pore pressure dissipation tests and dissipation plots are presented in the relevant appendix.

References

Burns, S.E. and Mayne, P.W., 1998, "Monotonic and dilatory pore pressure decay during piezocone tests", Canadian Geotechnical Journal 26 (4): 1063-1073.

Burns, S.E. and Mayne, P.W., 2002, "Analytical cavity expansion-critical state model cone dissipation in fine-grained soils", Soils & Foundations, Vol. 42(2): 131-137.

Jones, G.A. and Van Zyl, D.J.A., 1981, "The piezometer probe: a useful investigation tool", Proceedings, 10th International Conference on Soil Mechanics and Foundation Engineering, Vol. 3, Stockholm: 489-495.

Robertson, P.K., Sully, J.P., Woeller, D.J., Lunne, T., Powell, J.J.M. and Gillespie, D.G., 1992, "Estimating coefficient of consolidation from piezocone tests", Canadian Geotechnical Journal, 29(4): 551-557.

Sully, J.P., Robertson, P.K., Campanella, R.G. and Woeller, D.J., 1999, "An approach to evaluation of field CPTU dissipation data in overconsolidated fine-grained soils", Canadian Geotechnical Journal, 36(2): 369-381.

Teh, C.I., and Houlsby, G.T., 1991, "An analytical study of the cone penetration test in clay", Geotechnique, 41(1): 17-34.

The following appendices listed below are included in the report:

- Cone Penetration Test Summary and Standard Cone Penetration Test Plots
- Seismic Cone Penetration Test Plots
- Seismic Cone Penetration Test Tabular Results
- Pore Pressure Dissipation Summary and Pore Pressure Dissipation Plots

Cone Penetration Test Summary and Standard Cone Penetration Test Plots

CONETEC

Job No:	15-53004-1
Client:	Langan Engineering
Project:	Riverside Parcel 3, Lots 155 & 158, and Parcel 4, Lot 157, Manhattan, NY
Start Date:	25-Mar-2015
End Date:	25-Mar-2015

CONE PENETRATION TEST SUMMARY

Sounding ID	File Name	Date	Cone	Assumed Phreatic Surface[1] (ft)	Final Depth (ft)	Shear Wave Velocity Tests	Northing[2] (m)	Easting (m)
SCPT15-08	15-53004_SP08	25-Mar-2015	301:T1500F15U500	9.0	42.81	11	4514067	584997
SCPT15-09	15-53004_SP09	25-Mar-2015	301:T1500F15U500	9.0	38.55	11	4514060	585012
CPT15-10	15-53004_CP10	25-Mar-2015	301:T1500F15U500	9.0	33.63		4514027	585080
SCPT15-11	15-53004_SP11	25-Mar-2015	301:T1500F15U500	9.0	29.36	8	4514013	585068
CPT15-12	15-53004_CP12	25-Mar-2015	301:T1500F15U500	9.0	26.08		4514039	584983
CPT15-13	15-53004_CP13	25-Mar-2015	301:T1500F15U500	9.0	27.72		4514007	585064
CPT15-14	15-53004_CP14	25-Mar-2015	301:T1500F15U500	9.0	23.13		4514030	584991
SCPT15-15	15-53004_SP15	25-Mar-2015	301:T1500F15U500	9.0	24.77	7	4513989	585056
Totals	8 soundings				246.06	37		

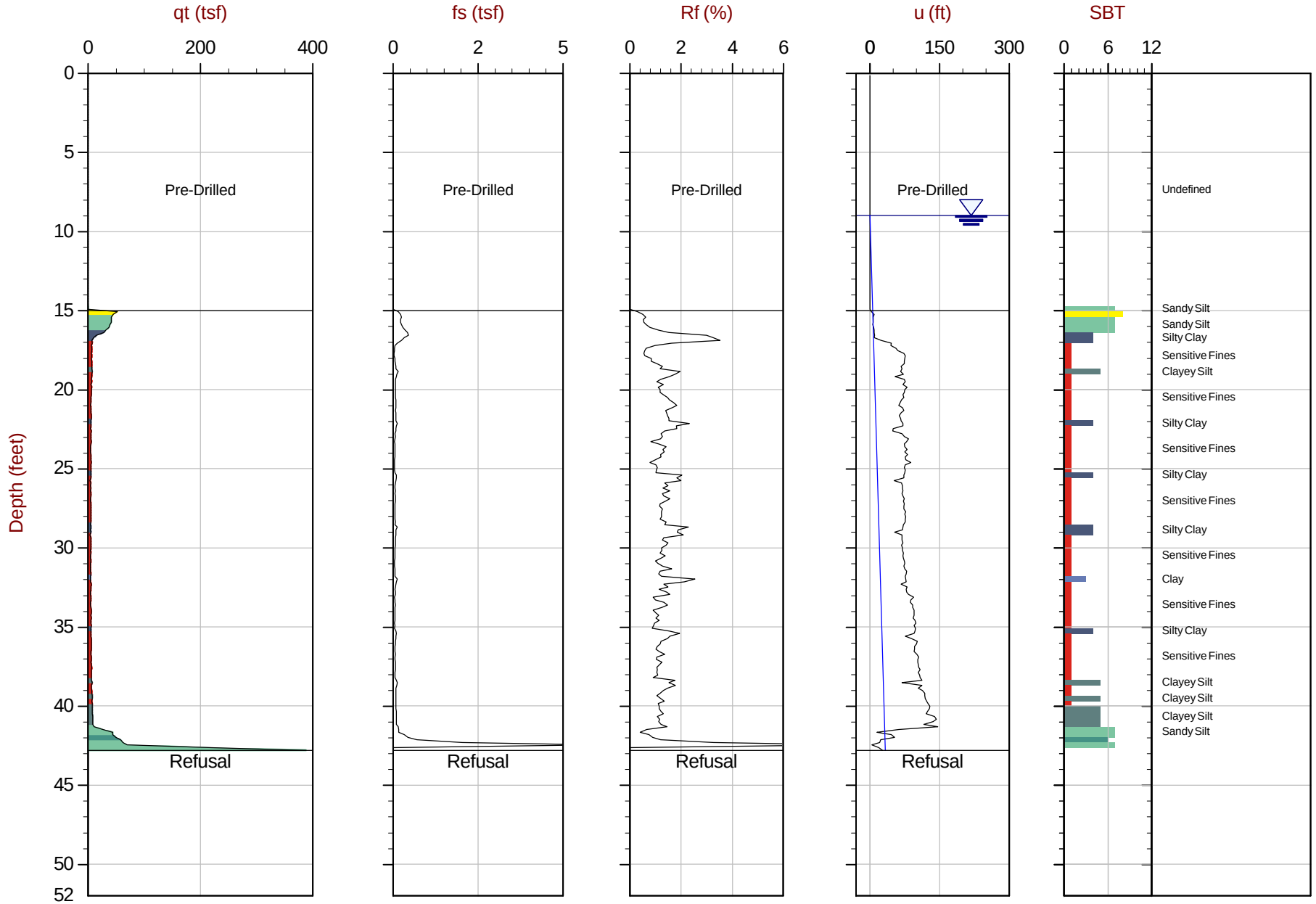
1. Phreatic surface assumed from pore pressure dissipation test data. Hydrostatic profiles were used for the interpretation tables.
2. Coordinates are WGS 84 / UTM Zone 18 and were collected using MR350 GlobalSat GPS Receiver.

CONETEC

Langan Engineering

Job No: 15-53004
Date: 03:25:15 13:35
Site: Riverside One, Parcel 3, Lots 155 & 158, Manhattan, NY

Sounding: SCPT15-08
Cone: 301:T1500F15U500



Max Depth: 13.050 m / 42.81 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53004_SP08.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 18 N: 4514067 E: 584997

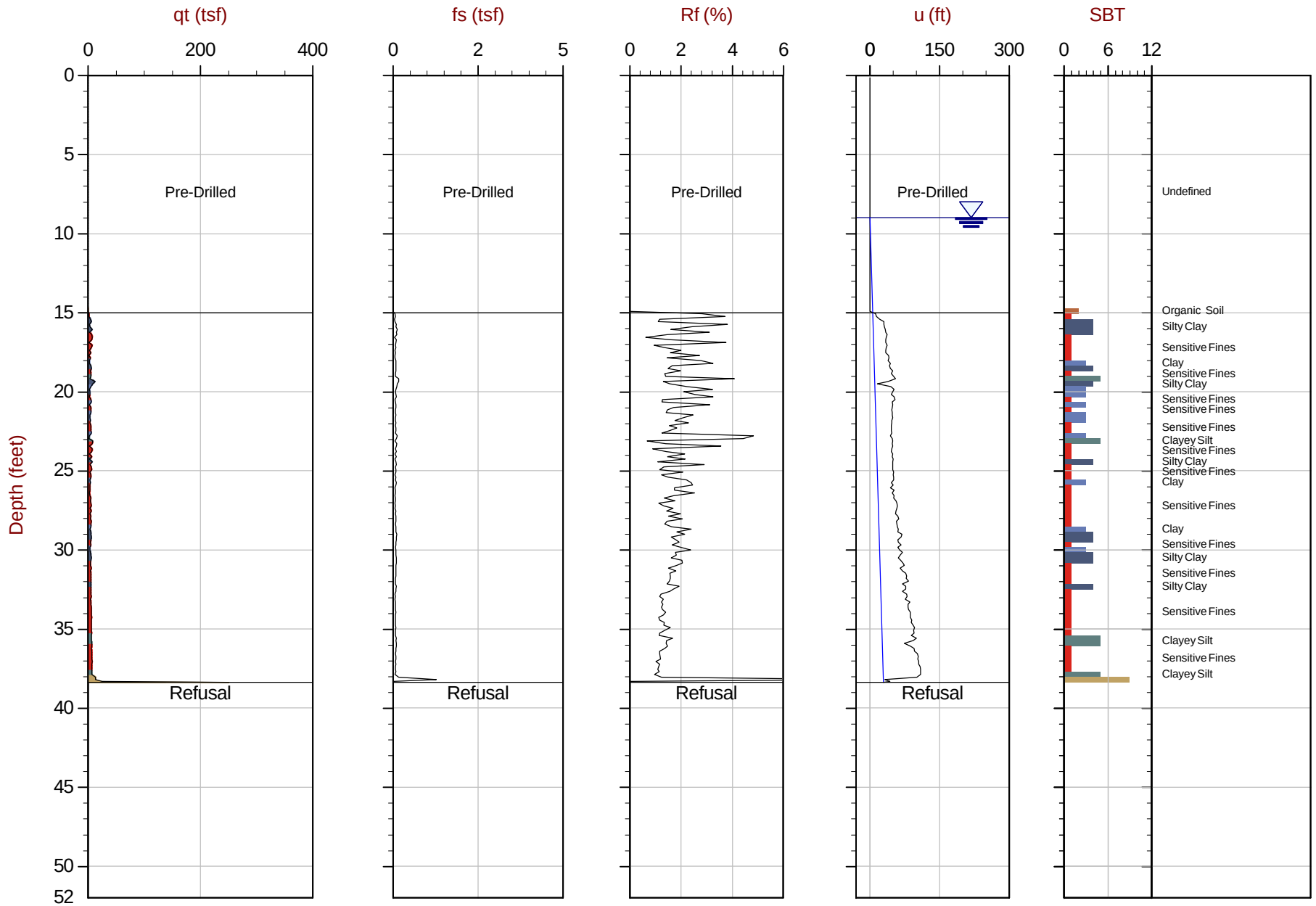
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 15-53004
Date: 03:25:15 08:12
Site: Riverside One, Parcel 3, Lots 155 & 158, Manhattan, NY

Sounding: SCPT15-09
Cone: 301:T1500F15U500



Max Depth: 11.700 m / 38.39 ft
Depth Inc: 0.050 m / 0.163 ft
Avg Int: 0.100 m

File: 15-53004_SP09.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 18 N: 4514060 E: 585012

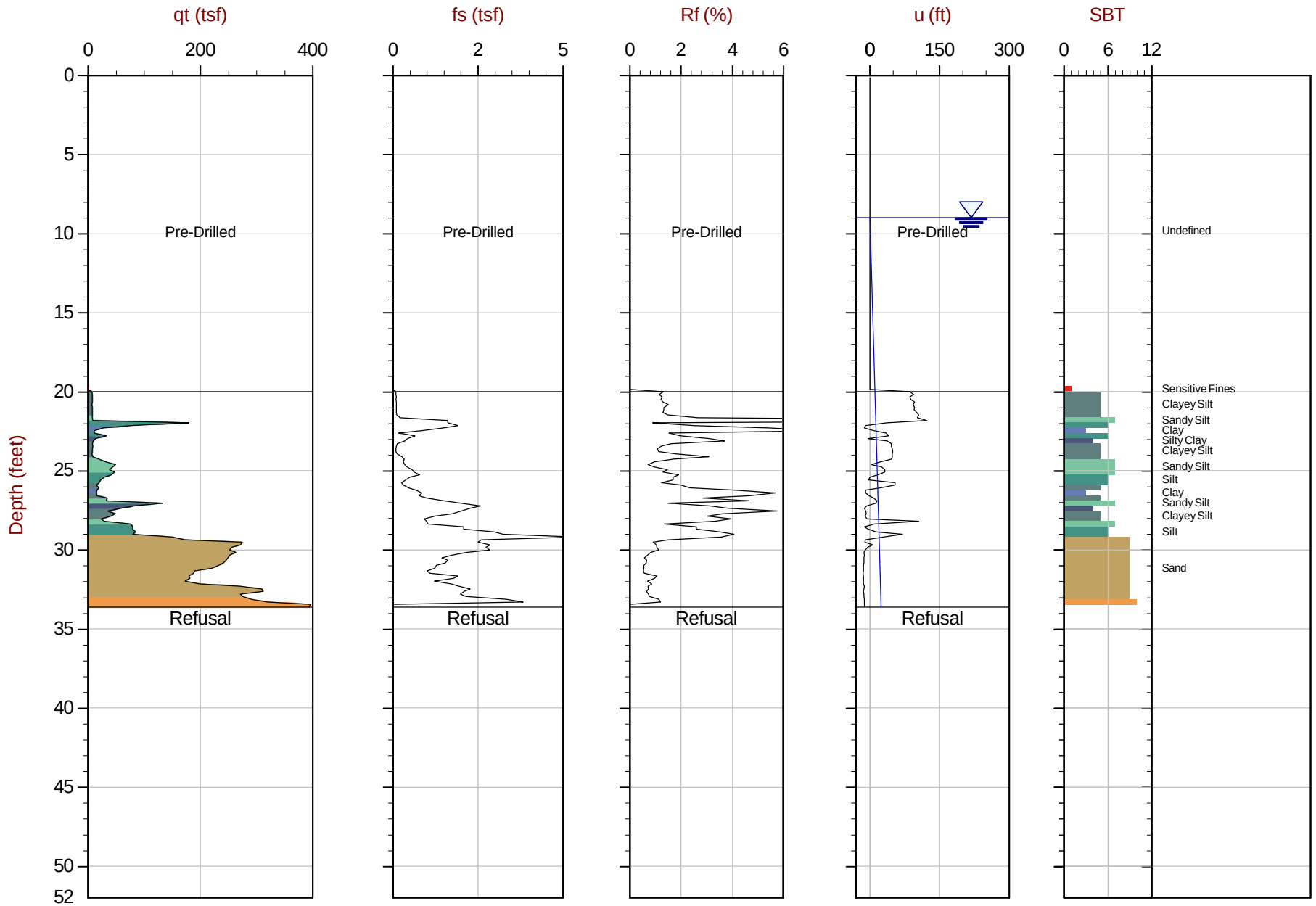
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 15-53004
Date: 03:25:15 12:32
Site: Riverside One, Parcel 4, Lot 157, Manhattan, NY

Sounding: CPT15-10
Cone: 301:T1500F15U500



Max Depth: 10.250 m / 33.63 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53004_CP10.COR

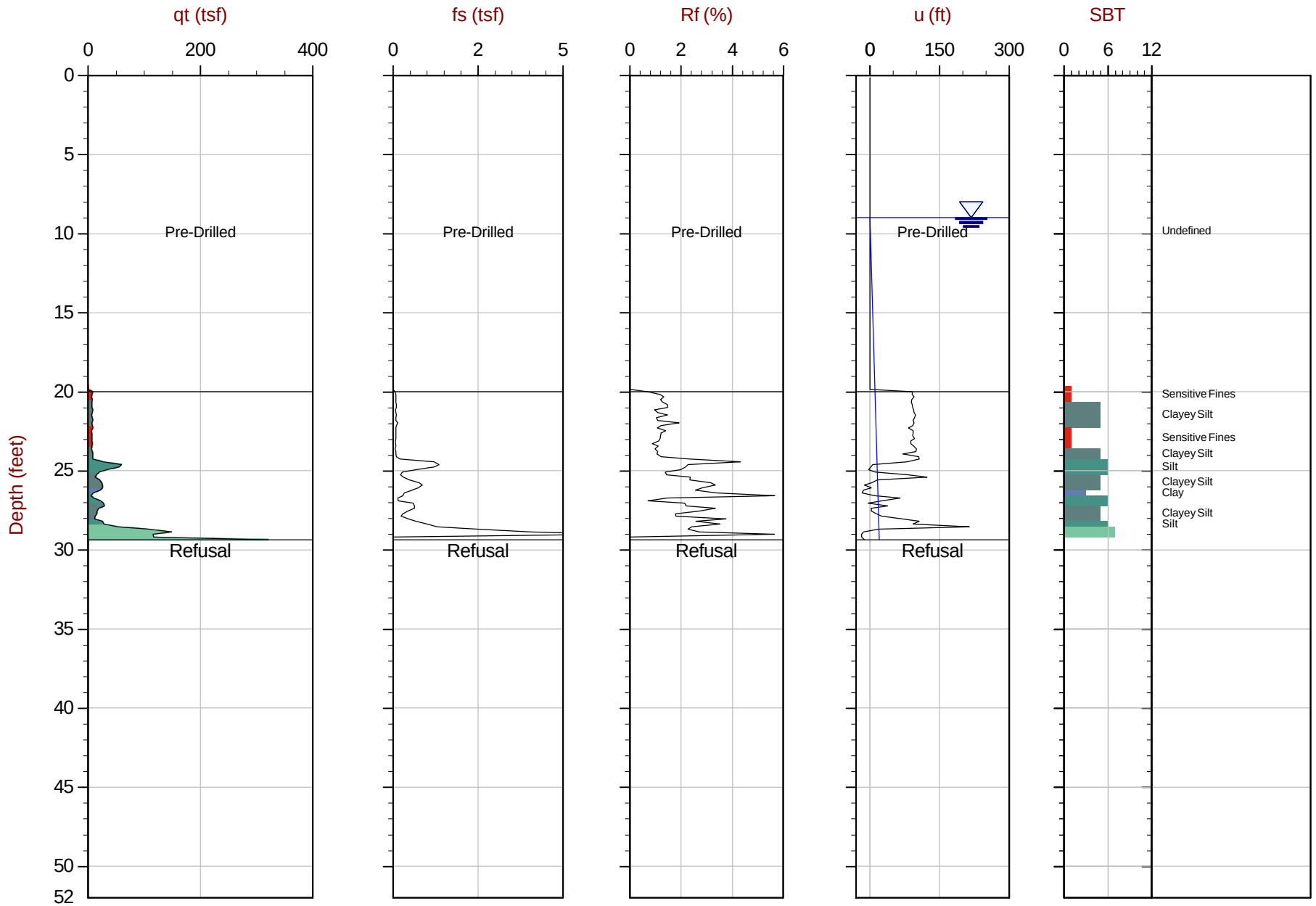
SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 18 N: 4514027 E: 585080

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Langan Engineering

Job No: 15-53004
Date: 03:25:15 11:48
Site: Riverside One, Parcel 4, Lot 157, Manhattan, NY

Sounding: SCPT15-11
Cone: 301:T1500F15U500



Max Depth: 8.950 m / 29.36 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53004_SP11.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 18 N: 4514013 E: 585068

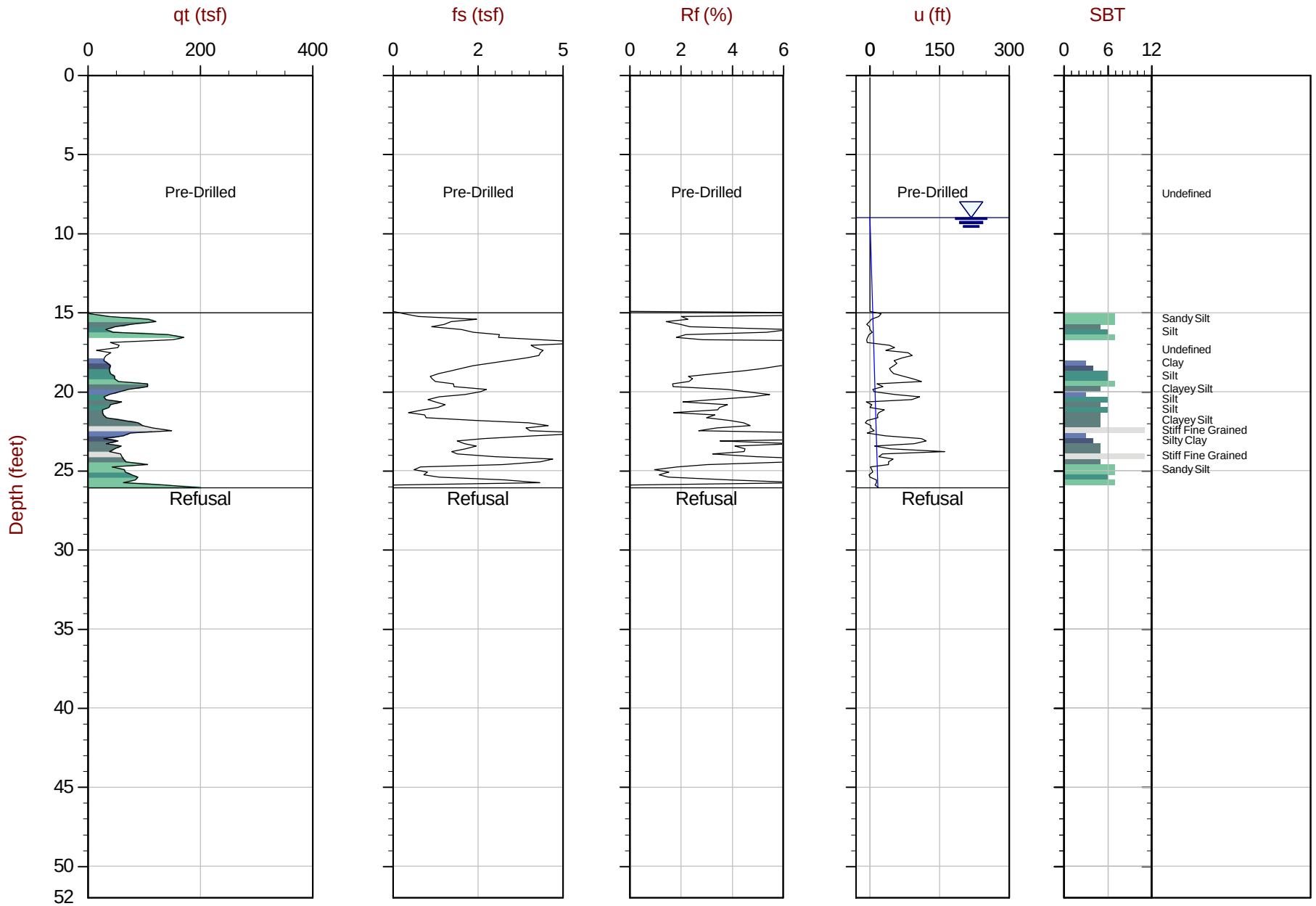
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 15-53004
Date: 03:25:15 14:17
Site: Riverside One, Parcel 3, Lots 155 & 158, Manhattan, NY

Sounding: CPT15-12
Cone: 301:T1500F15U500



Max Depth: 7.950 m / 26.08 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53004_CP12.COR

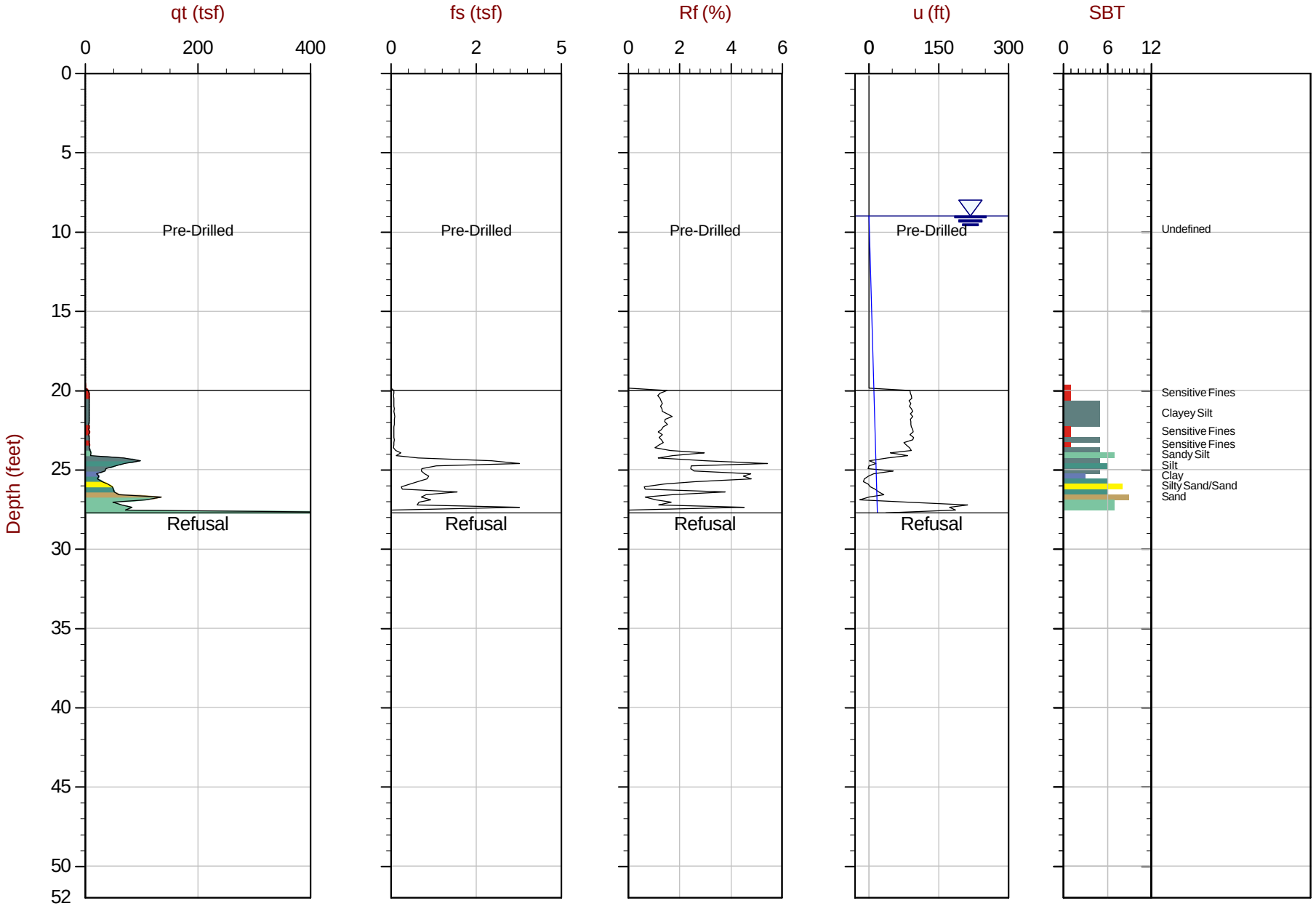
SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 18 N: 4514039 E: 584983

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Langan Engineering

Job No: 15-53004
Date: 03:25:15 13:02
Site: Riverside One, Parcel 4, Lot 157, Manhattan, NY

Sounding: CPT15-13
Cone: 301:T1500F15U500



Max Depth: 8.450 m / 27.72 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53004_CP13.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 18 N: 4514007 E: 585064

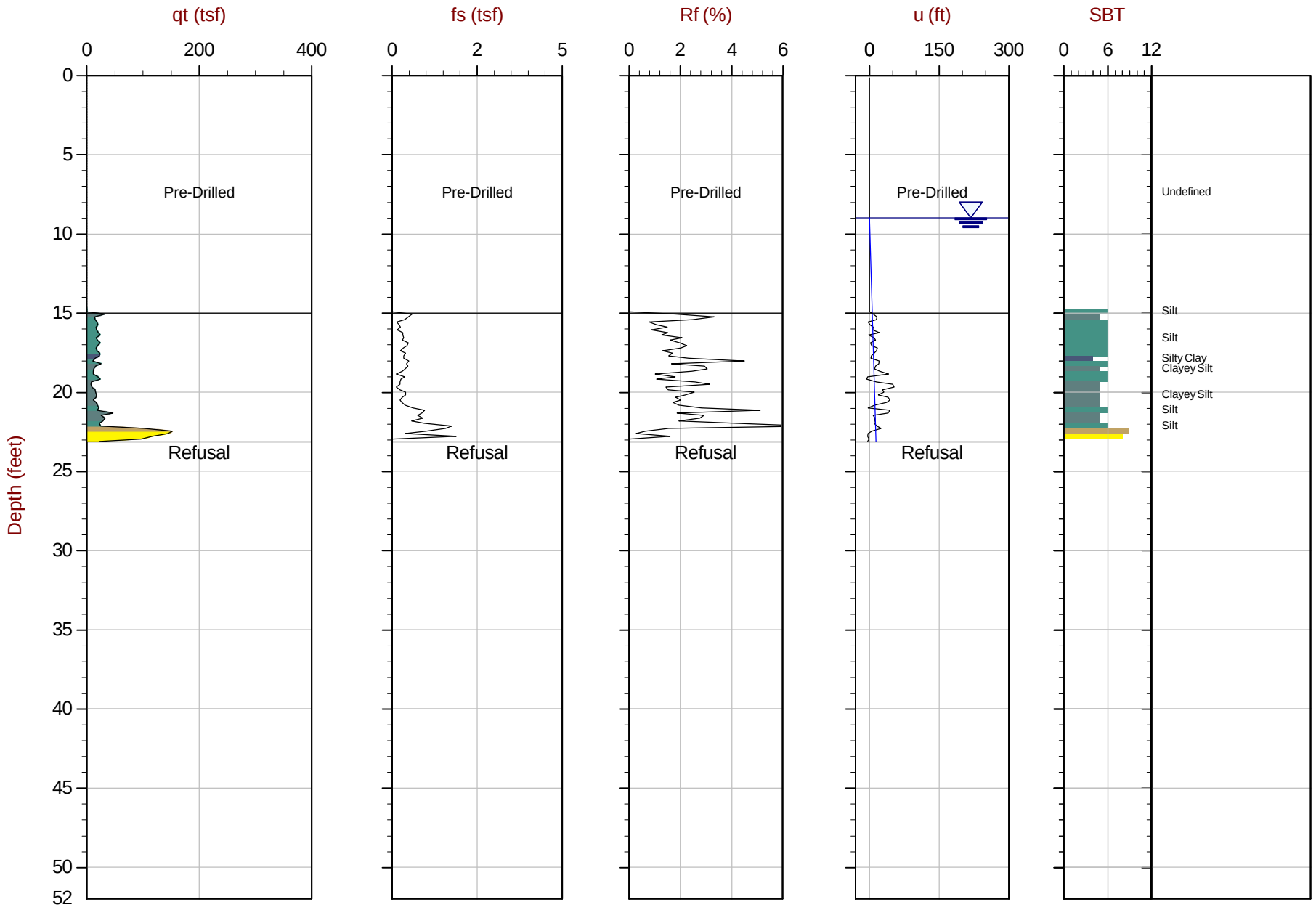
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 15-53004
Date: 03:25:15 09:12
Site: Riverside One, Parcel 3, Lots 155 & 158, Manhattan, NY

Sounding: CPT15-14
Cone: 301:T1500F15U500



Max Depth: 7.050 m / 23.13 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53004_CP14.COR

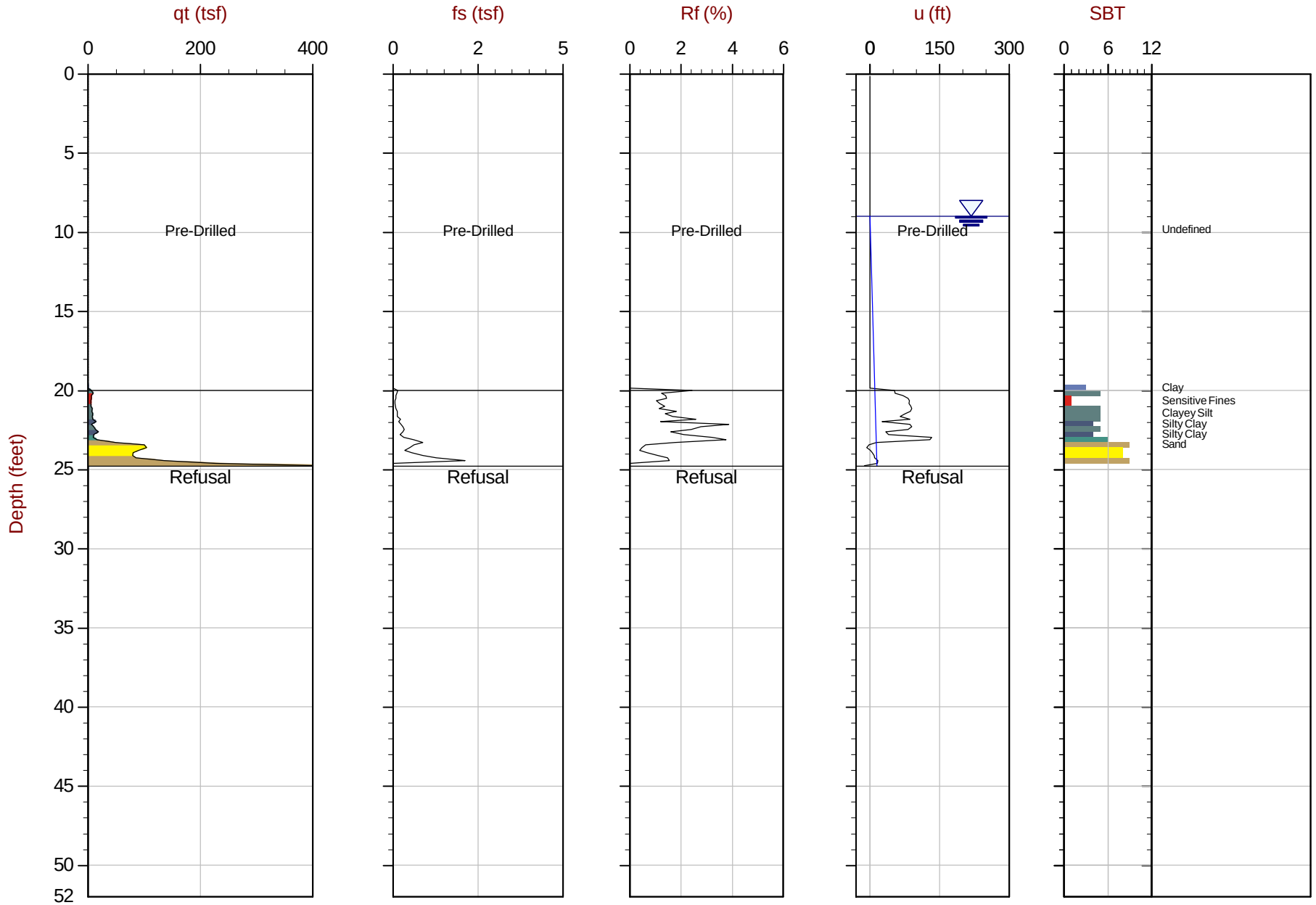
SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 18 N: 4514030 E: 584991

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Langan Engineering

Job No: 15-53004
Date: 03:25:15 13:35
Site: Riverside One, Parcel 4, Lot 157, Manhattan, NY

Sounding: SCPT15-15
Cone: 301:T1500F15U500



Max Depth: 7.550 m / 24.77 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53004_SP15.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 18 N: 4513989 E: 585056

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

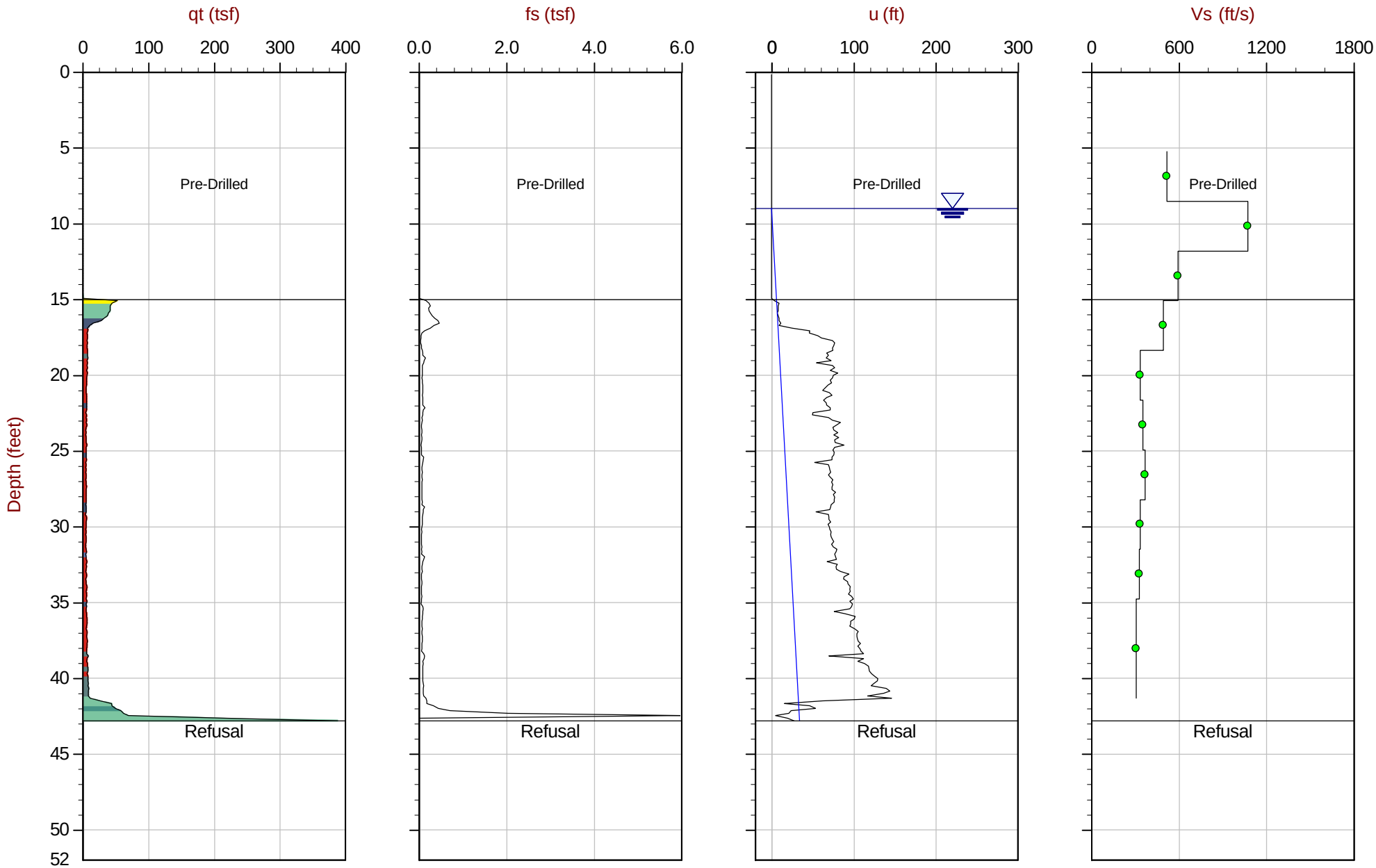
Seismic Cone Penetration Test Plots

CONETEC

Langan Engineering

Job No: 15-53004
Date: 03:25:15 13:35
Site: Riverside One, Parcel 3, Lots 155 & 158, Manhattan, NY

Sounding: SCPT15-08
Cone: 301:T1500F15U500



Max Depth: 13.050 m / 42.81 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53004_SP08.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 18 N: 4514067 E: 584997

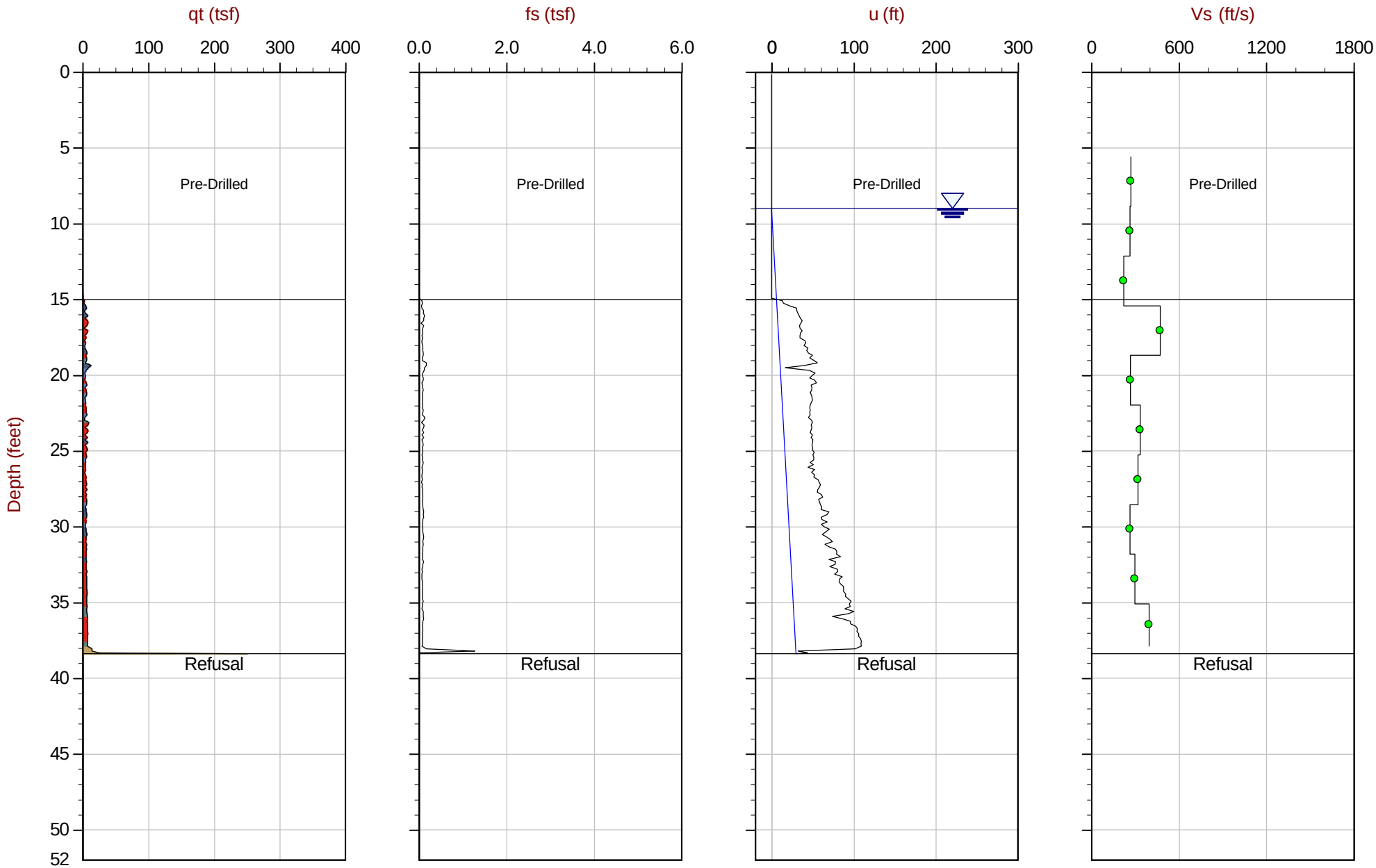
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 15-53004
Date: 03:25:15 08:12
Site: Riverside One, Parcel 3, Lots 155 & 158, Manhattan, NY

Sounding: SCPT15-09
Cone: 301:T1500F15U500



Max Depth: 11.700 m / 38.39 ft
Depth Inc: 0.050 m / 0.163 ft
Avg Int: 0.100 m

File: 15-53004_SP09.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 18 N: 4514060 E: 585012

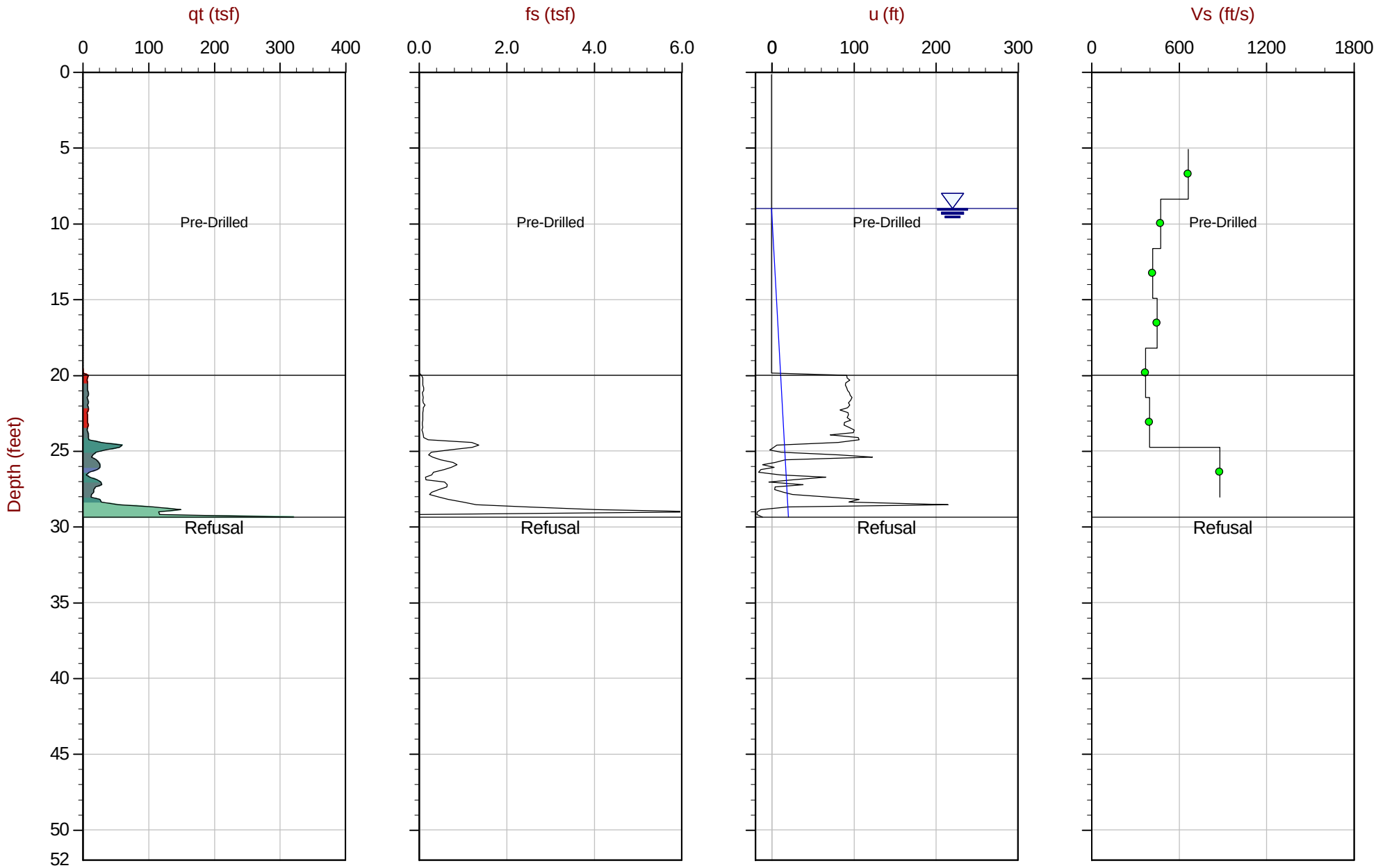
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Langan Engineering

Job No: 15-53004
Date: 03:25:15 11:48
Site: Riverside One, Parcel 4, Lot 157, Manhattan, NY

Sounding: SCPT15-11
Cone: 301:T1500F15U500



Max Depth: 8.950 m / 29.36 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53004_SP11.COR

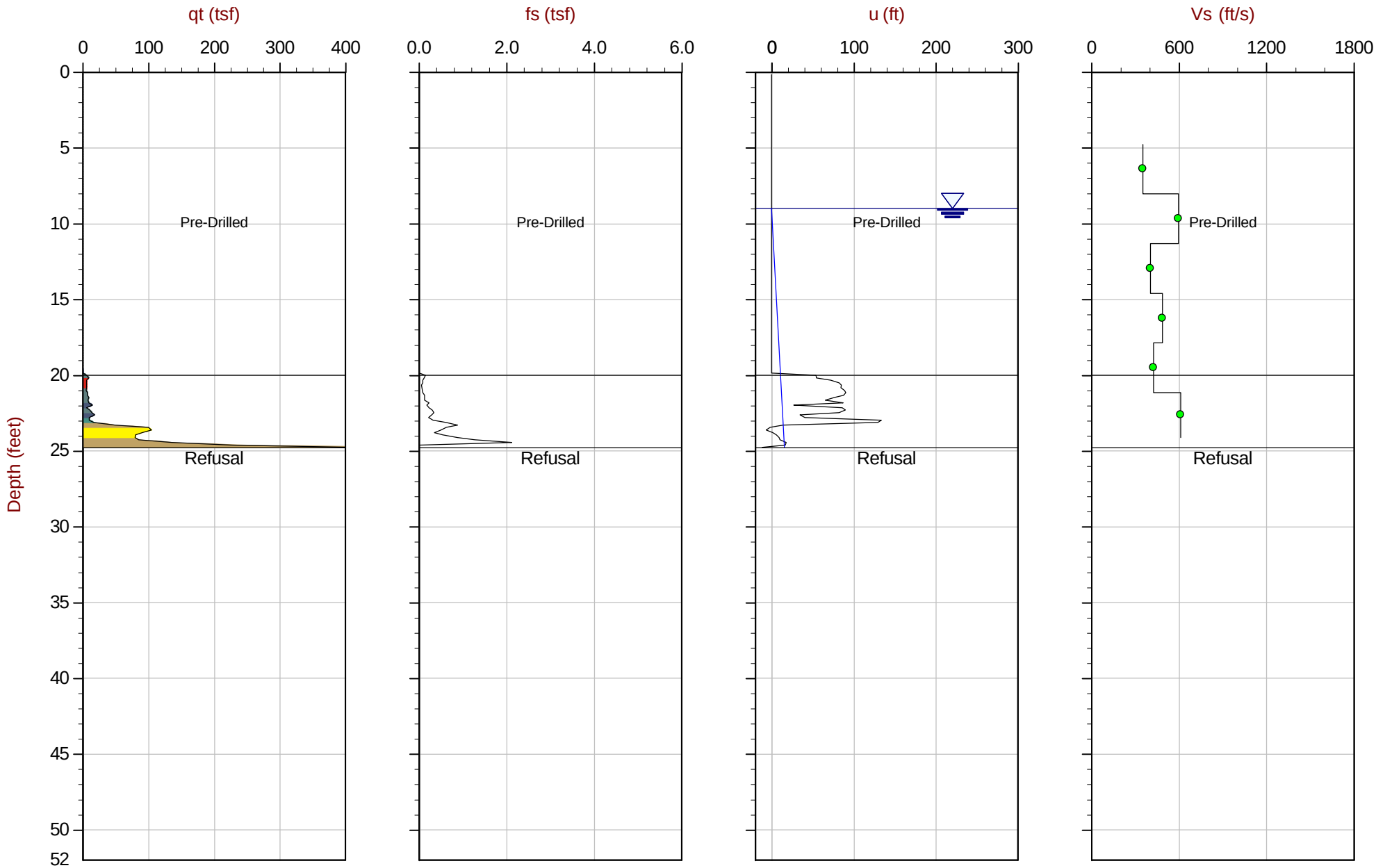
SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 18 N: 4514013 E: 585068

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Langan Engineering

Job No: 15-53004
Date: 03:25:15 13:35
Site: Riverside One, Parcel 4, Lot 157, Manhattan, NY

Sounding: SCPT15-15
Cone: 301:T1500F15U500



Max Depth: 7.550 m / 24.77 ft
Depth Inc: 0.050 m / 0.164 ft
Avg Int: 0.100 m

File: 15-53004_SP15.COR

SBT: Lunne, Robertson and Powell, 1997
Coords: UTM Zone 18 N: 4513989 E: 585056

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Seismic Cone Penetration Test Tabular Results

CONETEC

Job No:	15-53004
Client:	Langan Engineering
Project:	Riverside Parcel 3, Block 1171, Lots 155 & 158, Manhattan, NY
Sounding ID:	SCPT15-08
Date:	25-Mar-2015

Seismic Source:	Beam
Source Offset (ft):	1.97
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
5.91	5.25	5.61			
9.19	8.53	8.75	3.15	6.09	517
12.47	11.81	11.97	3.22	3.00	1073
15.75	15.09	15.22	3.25	5.49	592
19.03	18.37	18.48	3.26	6.60	493
22.31	21.65	21.74	3.26	9.77	334
25.59	24.93	25.01	3.27	9.26	353
28.87	28.22	28.28	3.27	8.92	367
32.15	31.50	31.56	3.27	9.77	335
35.43	34.78	34.83	3.28	9.95	329
41.99	41.34	41.39	6.55	21.26	308

Job No:	15-53004
Client:	Langan Engineering
Project:	Riverside Parcel 3, Block 1171, Lots 155 & 158, Manhattan, NY
Sounding ID:	SCPT15-09
Date:	25-Mar-2015

Seismic Source:	Beam
Source Offset (ft):	1.97
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
6.23	5.58	5.91			
9.51	8.86	9.07	3.16	11.65	271
12.80	12.14	12.30	3.22	12.24	263
16.08	15.42	15.55	3.25	14.71	221
19.36	18.70	18.80	3.26	6.94	470
22.64	21.98	22.07	3.27	12.24	267

Job No:	15-53004
Client:	Langan Engineering
Project:	Riverside Parcel 4, Block 1171, Lot 157, Manhattan, NY
Sounding ID:	SCPT15-11
Date:	25-Mar-2015

Seismic Source:	Beam
Source Offset (ft):	1.97
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
5.74	5.09	5.45			
9.02	8.37	8.59	3.14	4.73	664
12.30	11.65	11.81	3.22	6.79	474
15.58	14.93	15.06	3.24	7.73	420
18.86	18.21	18.31	3.26	7.25	449
22.15	21.49	21.58	3.26	8.80	371
25.43	24.77	24.85	3.27	8.24	397
28.71	28.05	28.12	3.27	3.72	880

Job No:	15-53004
Client:	Langan Engineering
Project:	Riverside Parcel 4, Block 1171, Lot 157, Manhattan, NY
Sounding ID:	SCPT15-15
Date:	25-Mar-2015

Seismic Source:	Beam
Source Offset (ft):	1.97
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
5.41	4.76	5.15			
8.69	8.04	8.28	3.13	8.87	353
11.98	11.32	11.49	3.21	5.40	596
15.26	14.60	14.73	3.24	8.02	405
18.54	17.88	17.99	3.26	6.68	487
21.82	21.16	21.25	3.26	7.69	425
24.77	24.11	24.19	2.94	4.80	613

Pore Pressure Dissipation Summary and

Pore Pressure Dissipation Plots

CONETEC

Job No:	15-53004-1
Client:	Langan Engineering
Project:	Riverside Parcel 3, Lots 155 & 158, and Parcel 4, Lot 157, Manhattan, NY
Start Date:	25-Mar-2015
End Date:	25-Mar-2015

CPTu PORE PRESSURE DISSIPATION SUMMARY

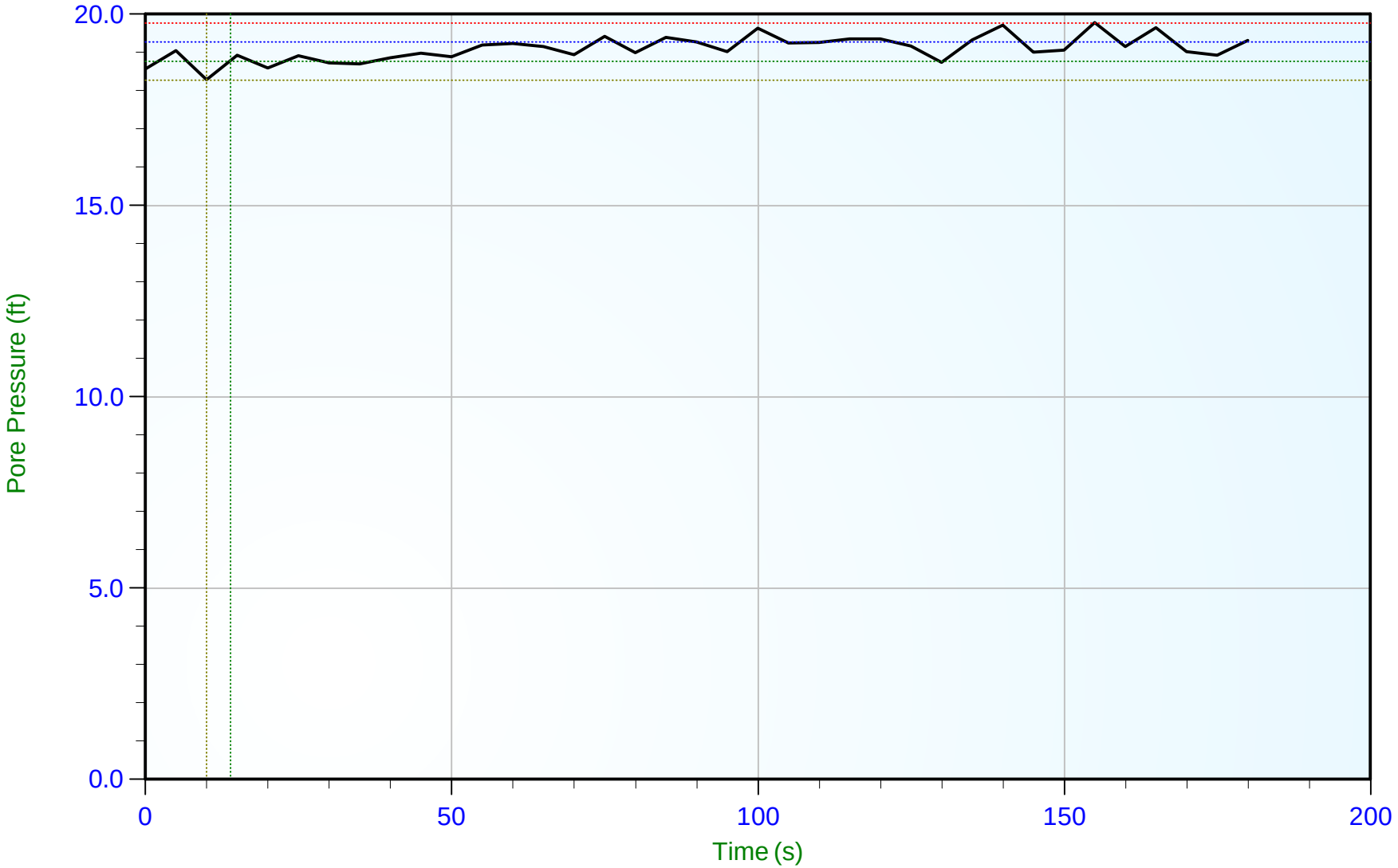
Sounding ID	File Name	Cone Area (cm^2)	Duration (s)	Test Depth (ft)	Estimated Equilibrium Pore Pressure U_{eq} (ft)	Calculated Phreatic Surface (ft)
CPT15-12	15-53004_CP12	15	180	26.08	19.3	6.8
CPT15-13	15-53004_CP13	15	305	27.72	14.2	13.5
Totals			8.1 min			

CONETEC

Langan Engineering

Job No: 15-53004
Date: 03/25/2015 14:17
Site: Riverside One

Sounding: CPT15-12
Cone: 301:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53004_CP12.PPD
Depth: 7.950 m / 26.082 ft
Duration: 180.0 s

U Min: 18.3 ft
U Max: 19.8 ft

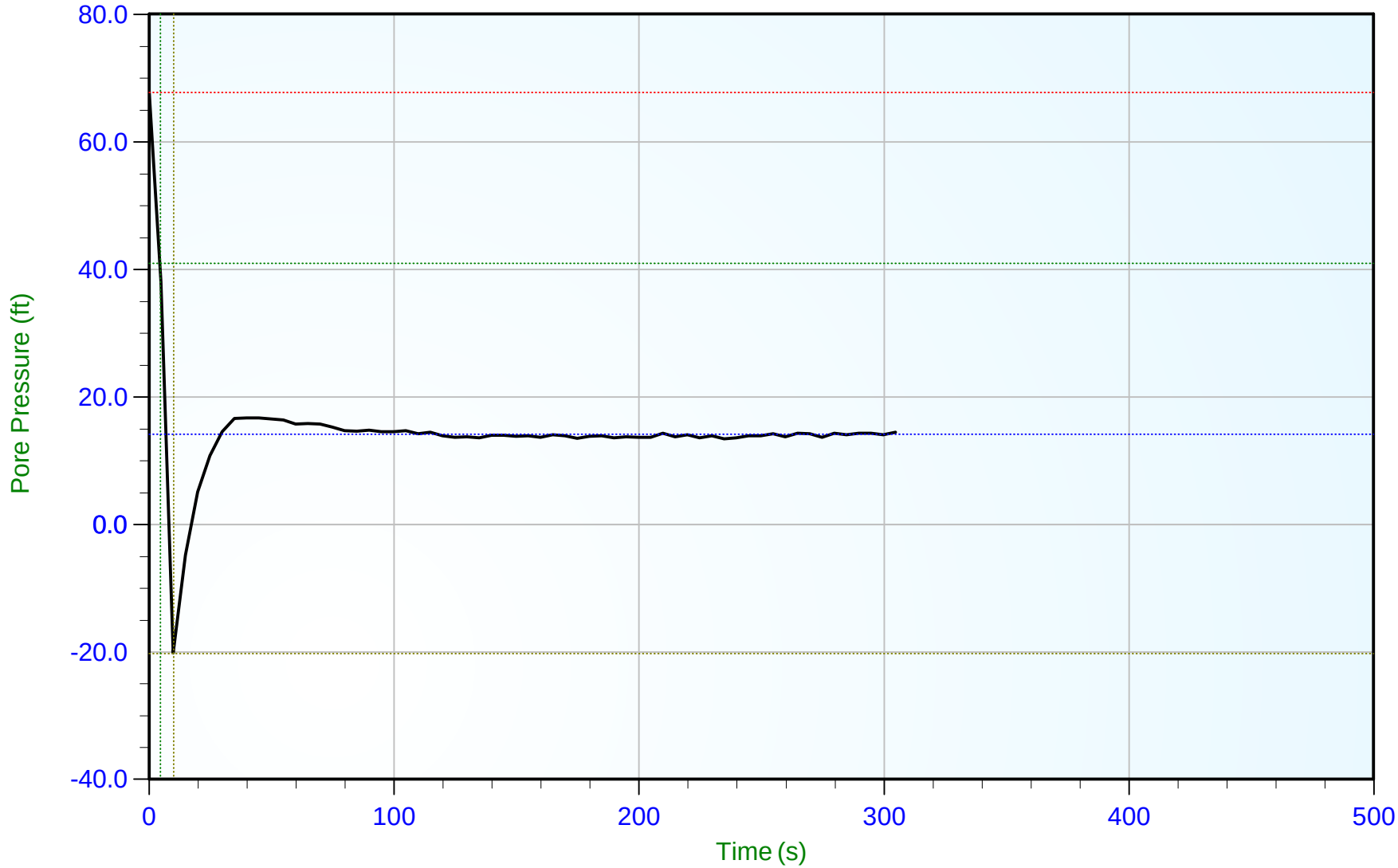
WT: 2.074 m / 6.804 ft
Ueq: 19.3 ft

CONETEC

Langan Engineering

Job No: 15-53004
Date: 03/25/2015 13:02
Site: Riverside One

Sounding: CPT15-13
Cone: 301:T1500F15U500
Cone Area: 15 sq cm



Trace Summary:

Filename: 15-53004_CP13.PPD
Depth: 8.450 m / 27.723 ft
Duration: 305.0 s

U Min: -20.2 ft
U Max: 67.8 ft

WT: 4.127 m / 13.540 ft
Ueq: 14.2 ft

APPENDIX D
LABORATORY TESTING RESULTS

Client:	Langan Engineering				
Project:	Riverside Parcel 1				
Location:	---			Project No:	GTX-302775
Boring ID:	---	Sample Type:	---	Tested By:	dln
Sample ID:	---	Test Date:	01/22/15	Checked By:	jdt
Depth :	---	Test Id:	320673		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content, %
LB-1	- --	30-32 ft	Moist, very dark gray clay	54.4
LB-2	- --	37-39 ft	Moist, dark olive gray clay	36.3
LB-3	- --	25-27 ft	Moist, very dark gray clay	51.7
LB-6	- --	45-47 ft	Moist, dark reddish brown clay with sand	20.8
LB-25	- --	23-25 ft	Moist, very dark gray silt with organics	63.3
LB-30	- --	18-20 ft	Moist, very dark gray clay	52.7

Notes: Temperature of Drying : 110° Celsius

Client:	Langan Engineering				
Project:	Riverside Parcel 1				
Location:	---			Project No:	GTX-302775
Boring ID:	---	Sample Type:	---	Tested By:	dln
Sample ID:	---	Test Date:	01/21/15	Checked By:	jdt
Depth :	---	Test Id:	320679		

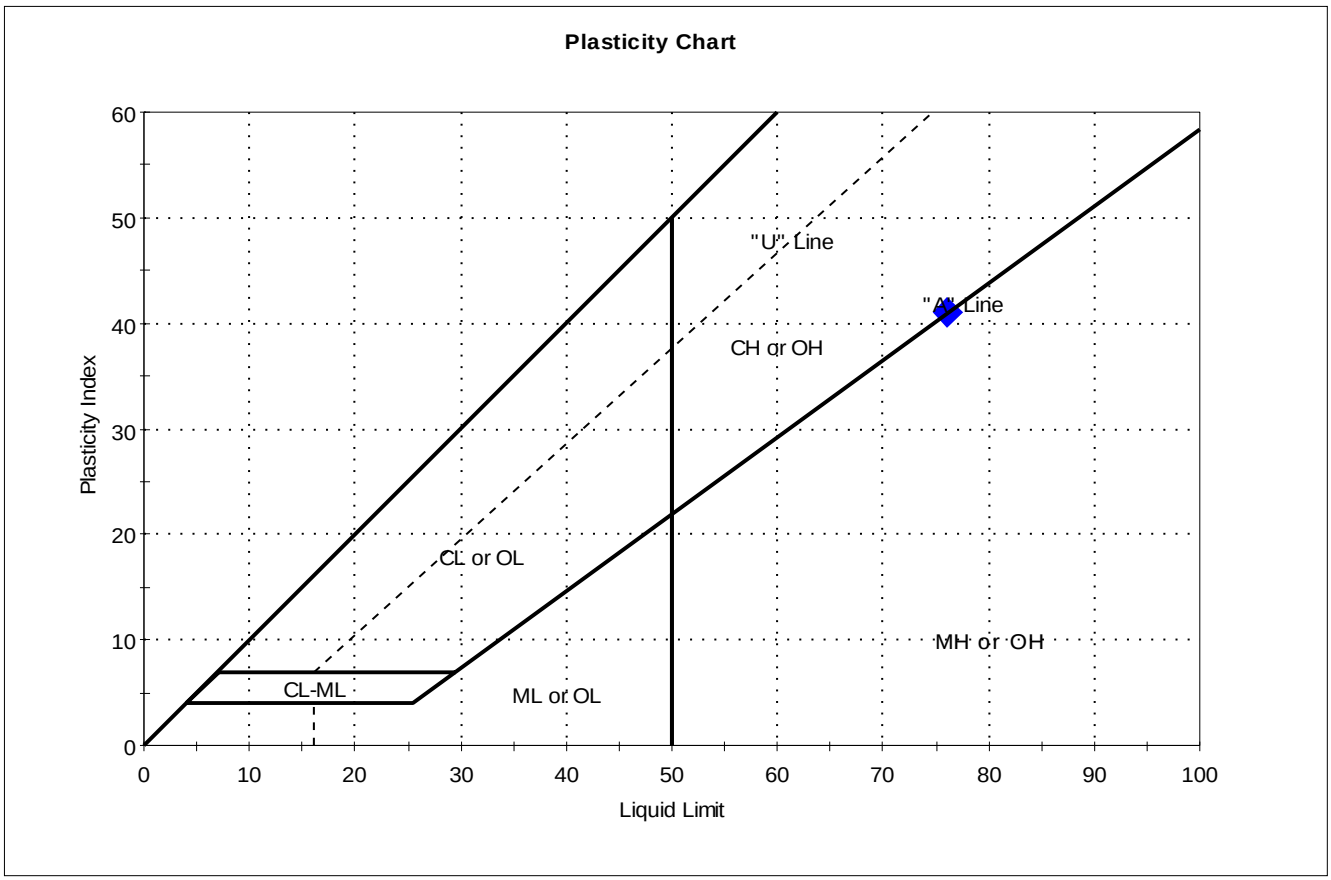
Moisture, Ash, and Organic Matter - ASTM D2974

Boring ID	Sample ID	Depth	Description	Moisture Content, %	Ash Content, %	Organic Matter, %
LB-1	---	30-32 ft	Moist, very dark gray clay	54	95.4	4.6
LB-2	---	37-39 ft	Moist, dark olive gray clay	36	97.4	2.6
LB-3	---	25-27 ft	Moist, very dark gray clay	52	96.0	4.0
LB-6	---	45-47 ft	Moist, dark reddish brown clay with sand	21	98.7	1.3
LB-25	---	23-25 ft	Moist, very dark gray silt with organics	63	94.7	5.3
LB-30	---	18-20 ft	Moist, very dark gray clay	53	97.0	3.0

Notes: Moisture content determined by Method A and reported as a percentage of oven-dried mass; dried to a constant mass at temperature of 105º C
Ash content and organic matter determined by Method C; dried to constant mass at temperature 440º C

Client:	Langan Engineering				
Project:	Riverside Parcel 1				
Location:	---			Project No:	GTX-302775
Boring ID:	LB-1	Sample Type:	tube	Tested By:	cam
Sample ID:	---	Test Date:	01/22/15	Checked By:	jdt
Depth :	30-32 ft	Test Id:	320662		
Test Comment:	---				
Sample Description:	Moist, very dark gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	---	LB-1	30-32 ft	54	76	35	41	0.5	

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: MEDIUM

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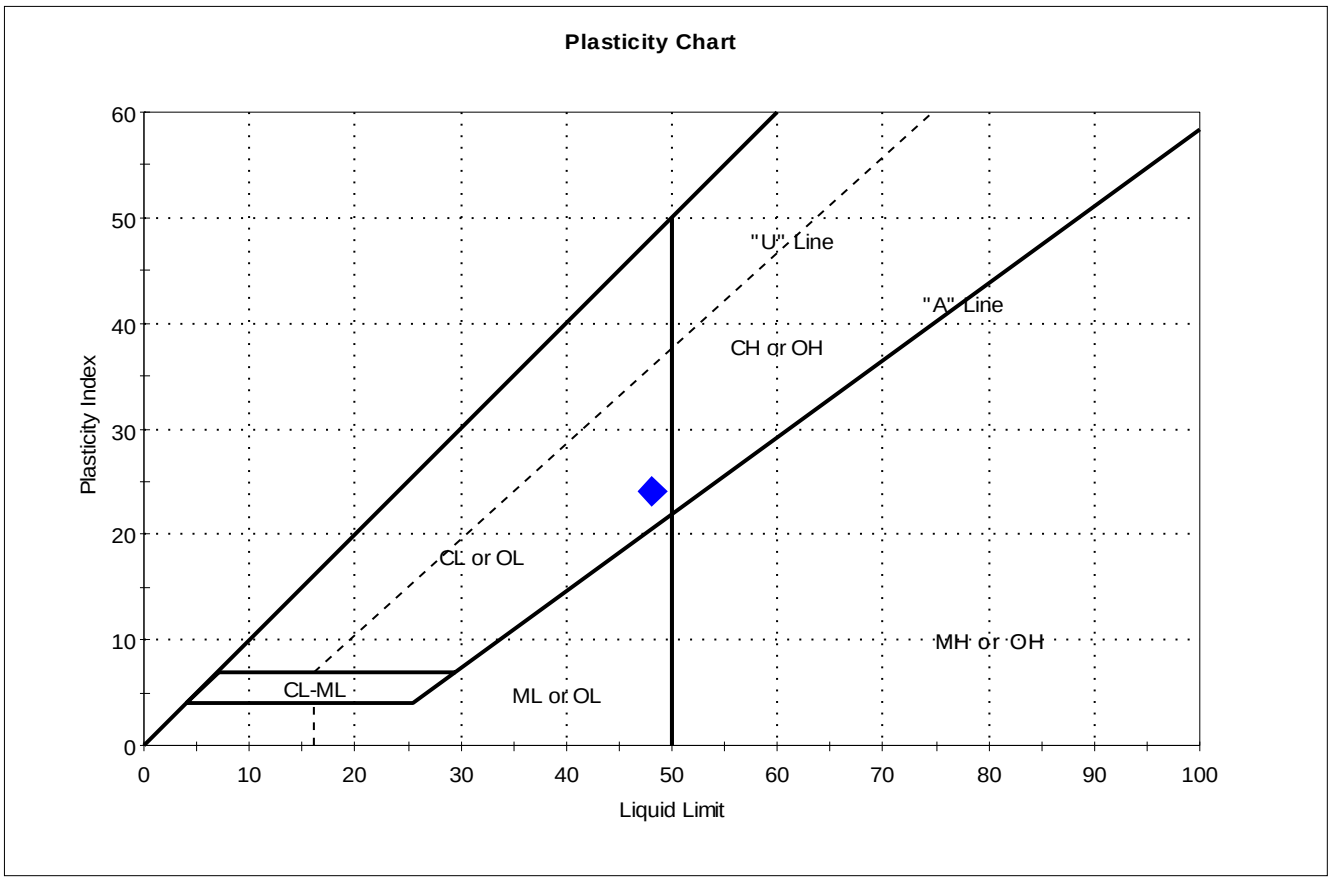
Client:	Langan Engineering				
Project:	Riverside Parcel 1				
Location:	---			Project No:	GTX-302775
Boring ID:	LB-2	Sample Type:	tube	Tested By:	cam
Sample ID:	---	Test Date:	01/22/15	Checked By:	jdt
Depth :	37-39 ft	Test Id:	320663		
Test Comment:	---				
Sample Description:	Moist, dark olive gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	---	LB-2	37-39 ft	36	48	24	24	0.5	

Sample Prepared using the WET method

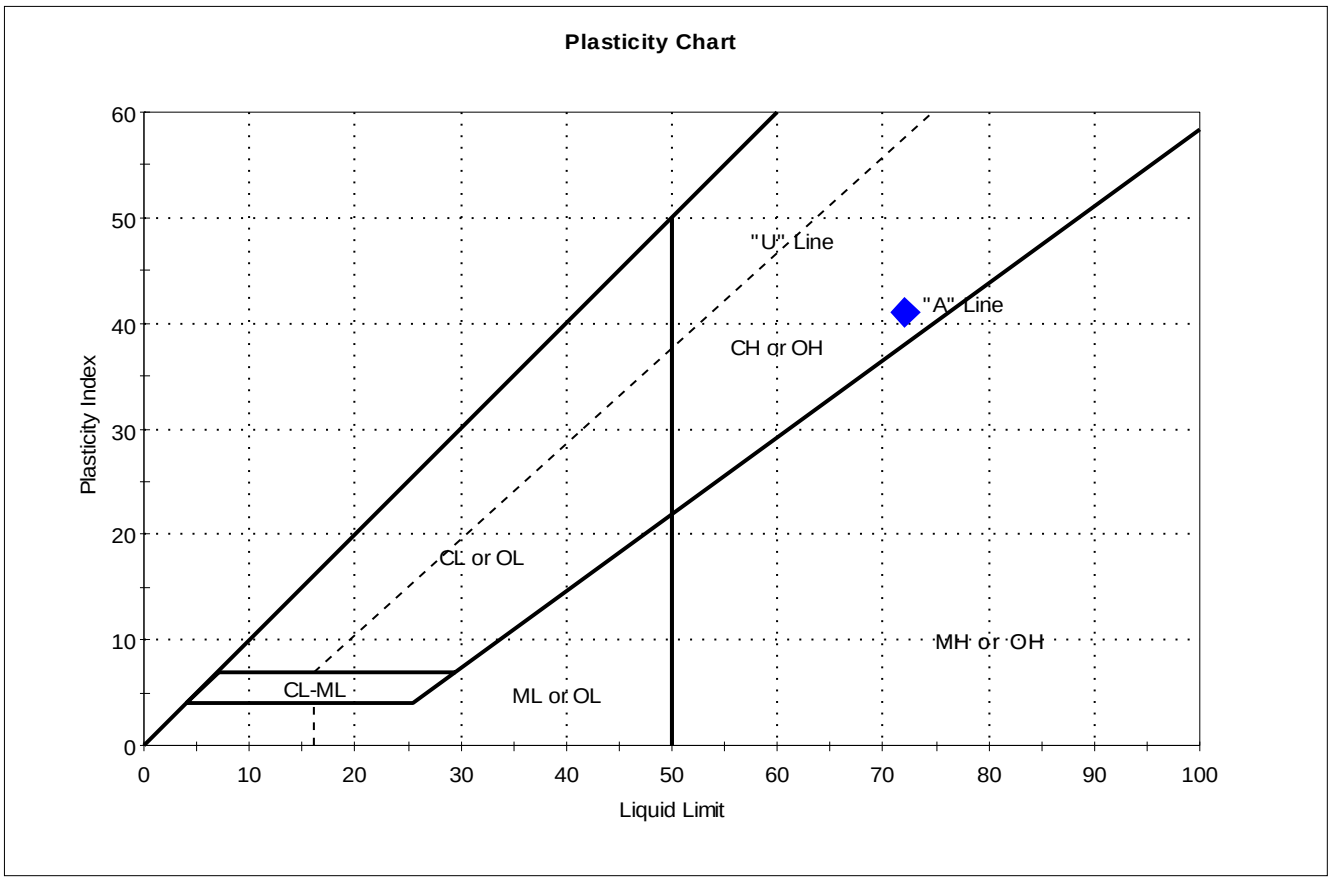
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Langan Engineering				
Project:	Riverside Parcel 1				
Location:	---			Project No:	GTX-302775
Boring ID:	LB-3	Sample Type:	tube	Tested By:	cam
Sample ID:	---	Test Date:	01/22/15	Checked By:	jdt
Depth :	25-27 ft	Test Id:	320664		
Test Comment:	---				
Sample Description:	Moist, very dark gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	---	LB-3	25-27 ft	52	72	31	41	0.5	

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

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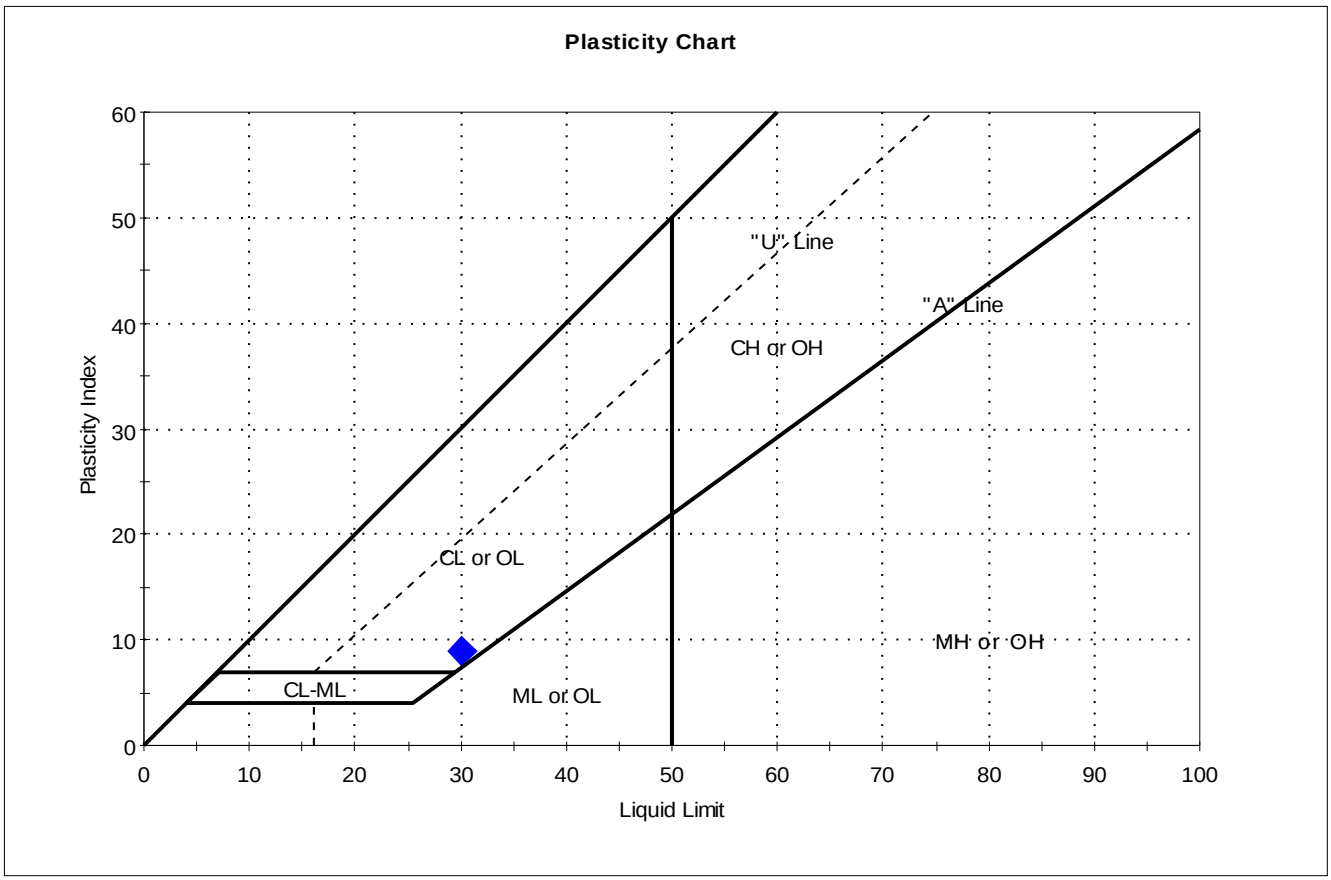
Client:	Langan Engineering				
Project:	Riverside Parcel 1				
Location:	---			Project No:	GTX-302775
Boring ID:	LB-6	Sample Type:	tube	Tested By:	cam
Sample ID:	---	Test Date:	01/22/15	Checked By:	jdt
Depth :	45-47 ft	Test Id:	320665		
Test Comment:	---				
Sample Description:	Moist, dark reddish brown clay with sand				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	---	LB-6	45-47 ft	21	30	21	9	0	

Sample Prepared using the WET method

Dry Strength: HIGH

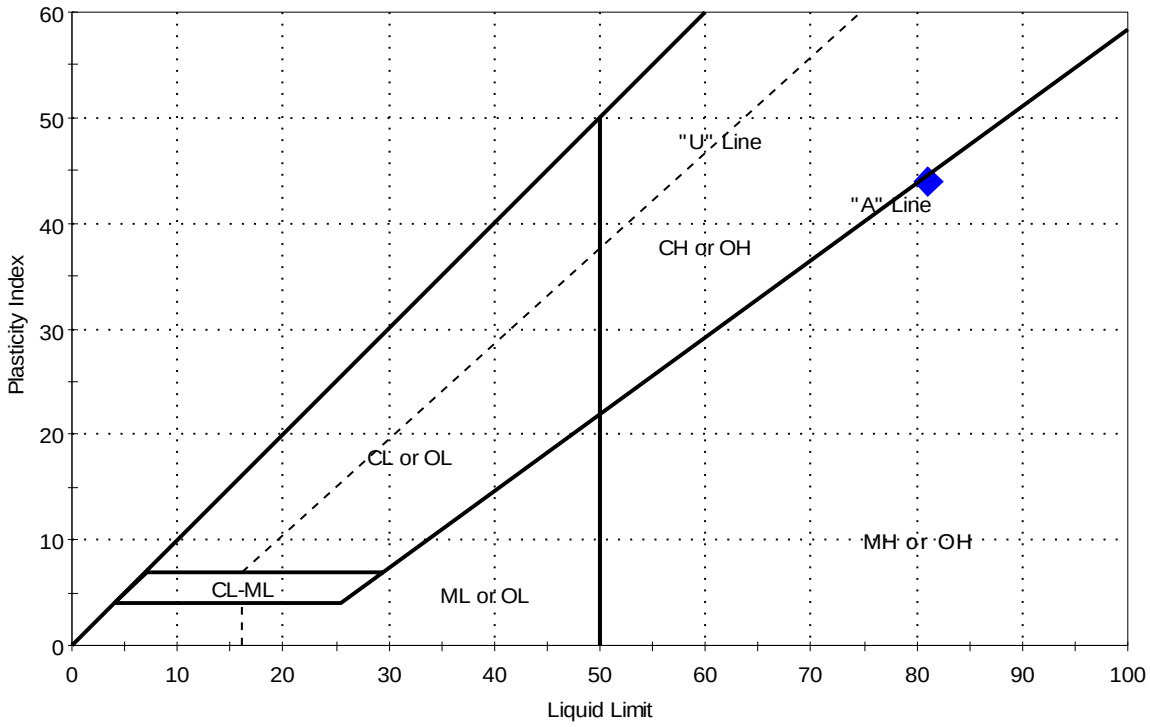
Dilatancy: SLOW

Toughness: LOW

Client:	Langan Engineering				
Project:	Riverside Parcel 1				
Location:	---			Project No:	GTX-302775
Boring ID:	LB-25	Sample Type:	tube	Tested By:	cam
Sample ID:	---	Test Date:	01/22/15	Checked By:	jdt
Depth :	23-25 ft	Test Id:	320666		
Test Comment:	---				
Sample Description:	Moist, very dark gray silt with organics				
Sample Comment:	---				

Atterberg Limits - ASTM D4318

Plasticity Chart



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	---	LB-25	23-25 ft	63	81	37	44	0.6	

Sample Prepared using the WET method

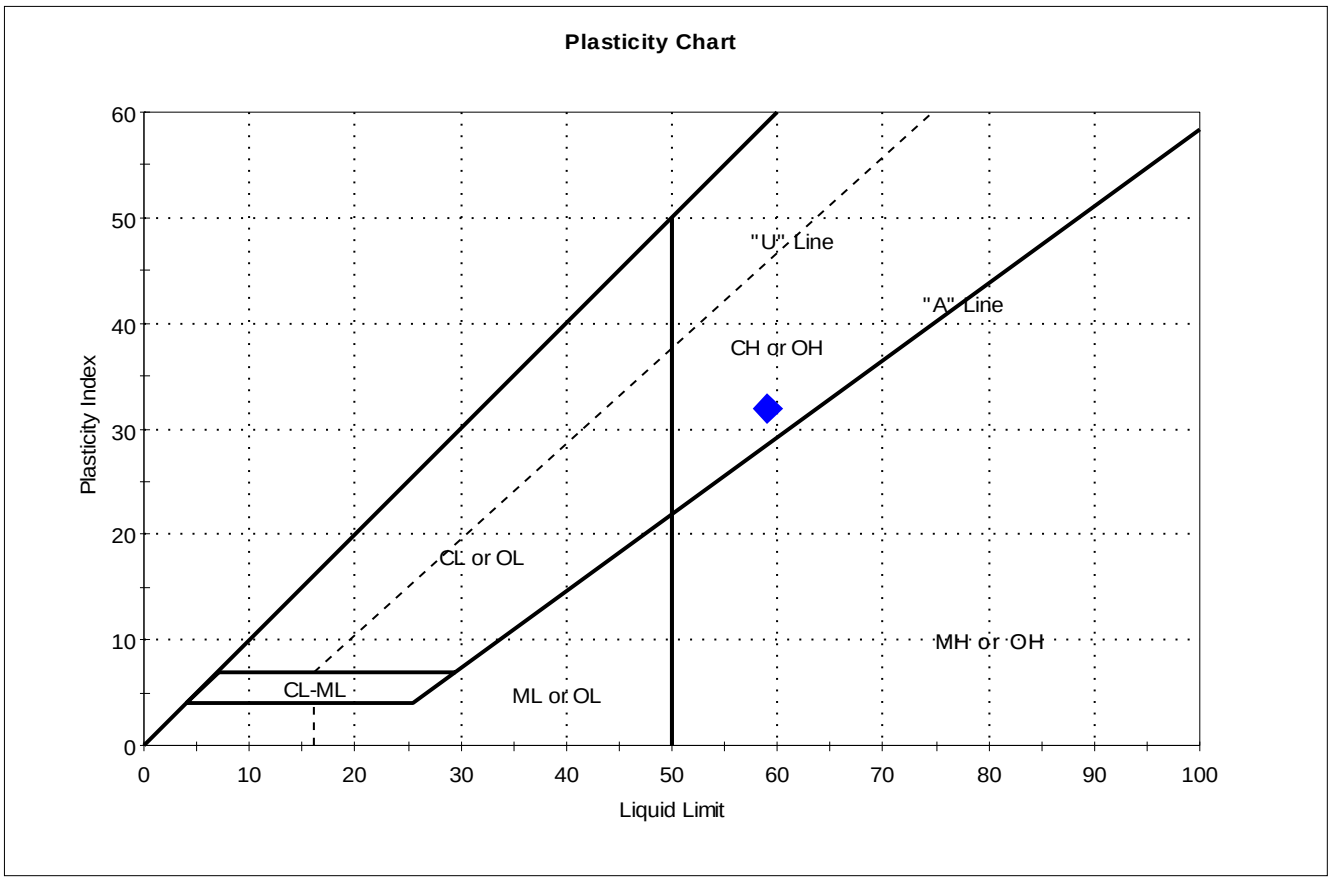
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client:	Langan Engineering				
Project:	Riverside Parcel 1				
Location:	---			Project No:	GTX-302775
Boring ID:	LB-30	Sample Type:	tube	Tested By:	cam
Sample ID:	---	Test Date:	01/22/15	Checked By:	jdt
Depth :	18-20 ft	Test Id:	320667		
Test Comment:	---				
Sample Description:	Moist, very dark gray clay				
Sample Comment:	---				

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	---	LB-30	18-20 ft	53	59	27	32	0.8	

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

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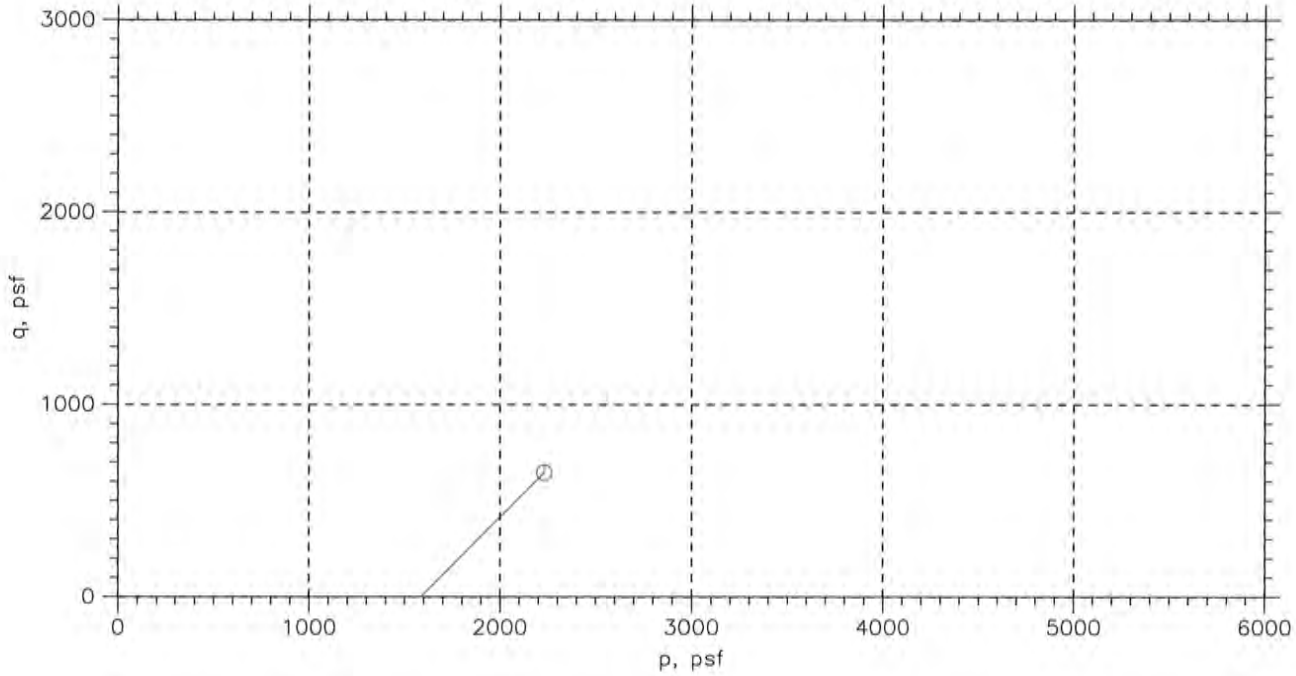
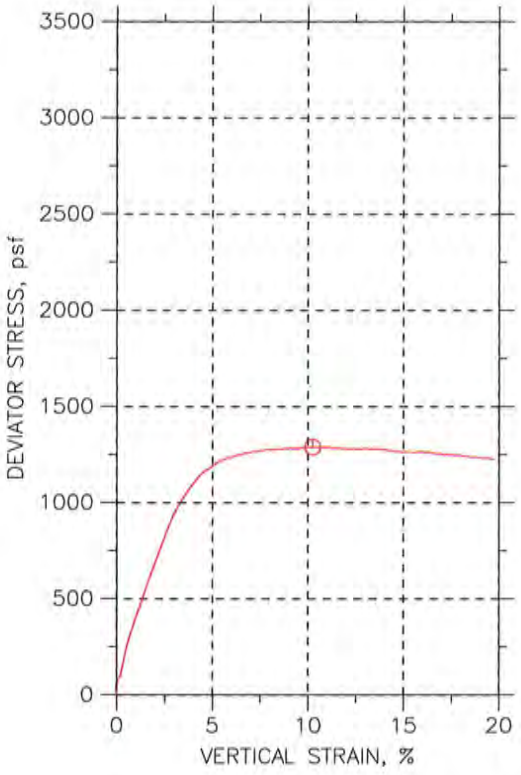
UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850

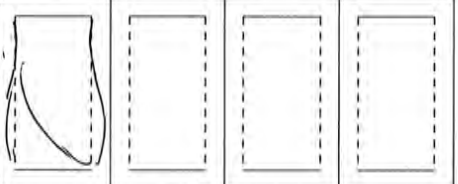




Symbol	⏀			
Sample No.	---			
Test No.	UU-4			
Depth	30-32 ft			
Tested by	md			
Test Date	01/20/15			
Checked by	jdt			
Check Date	**01/22/15**			
Diameter, in	2.87			
Height, in	6.02			
Water Content, %	57.4			
Dry Density, pcf	64.27			
Saturation, %	95.5			
Void Ratio	1.62			
Confining Stress, psf	1588			
Undrained Strength, psf	644.5			
Max. Dev. Stress, psf	1289			
Strain at Failure, %	10.3			
Strain Rate, %/min	1			
Estimated Specific Gravity	2.7			
Liquid Limit	76			
Plastic Limit	35			
Plasticity Index	41			

GeoTesting EXPRESS

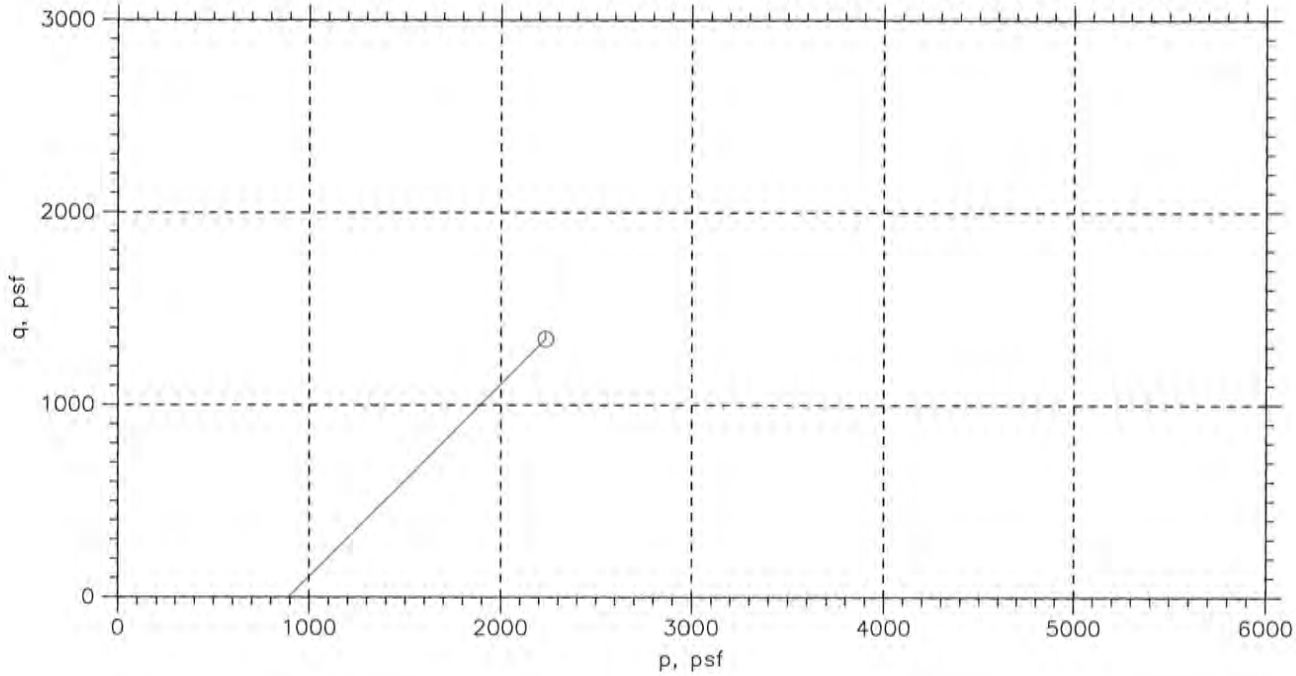
Project: Riverside Parcel 1	
Location: ---	
Project No.: GTX-302775	
Boring No.: LB-1	
Sample Type: intact	
Description: Moist, very dark gray clay	
Remarks: System R	

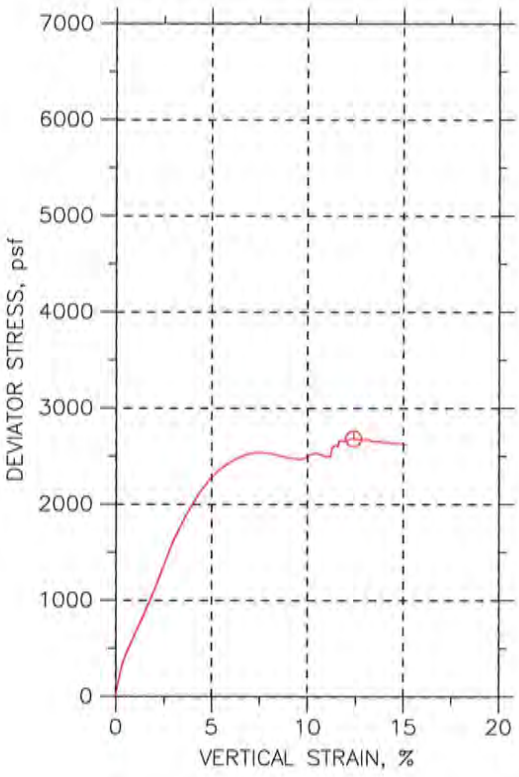


Phase calculations based on start and end of test.

Thu, 22-JAN-2015 08:45:24

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850





Symbol	⏀			
Sample No.	---			
Test No.	UU-2			
Depth	37-39 ft			
Tested by	md			
Test Date	01/20/15			
Checked by	jdt			
Check Date	01/22/15			
Diameter, in	2.87			
Height, in	6.1			
Water Content, %	33.6			
Dry Density, pcf	86.5			
Saturation, %	95.6			
Void Ratio	0.949			
Confining Stress, psf	895			
Undrained Strength, psf	1340			
Max. Dev. Stress, psf	2681			
Strain at Failure, %	12.4			
Strain Rate, %/min	1			
Estimated Specific Gravity	2.7			
Liquid Limit	48			
Plastic Limit	24			
Plasticity Index	24			

GeoTesting EXPRESS

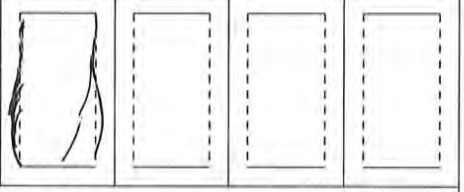
Project: Riverside Parcel 1

Location: ---

Project No.: GTX-302775

Boring No.: LB-2

Sample Type: intact



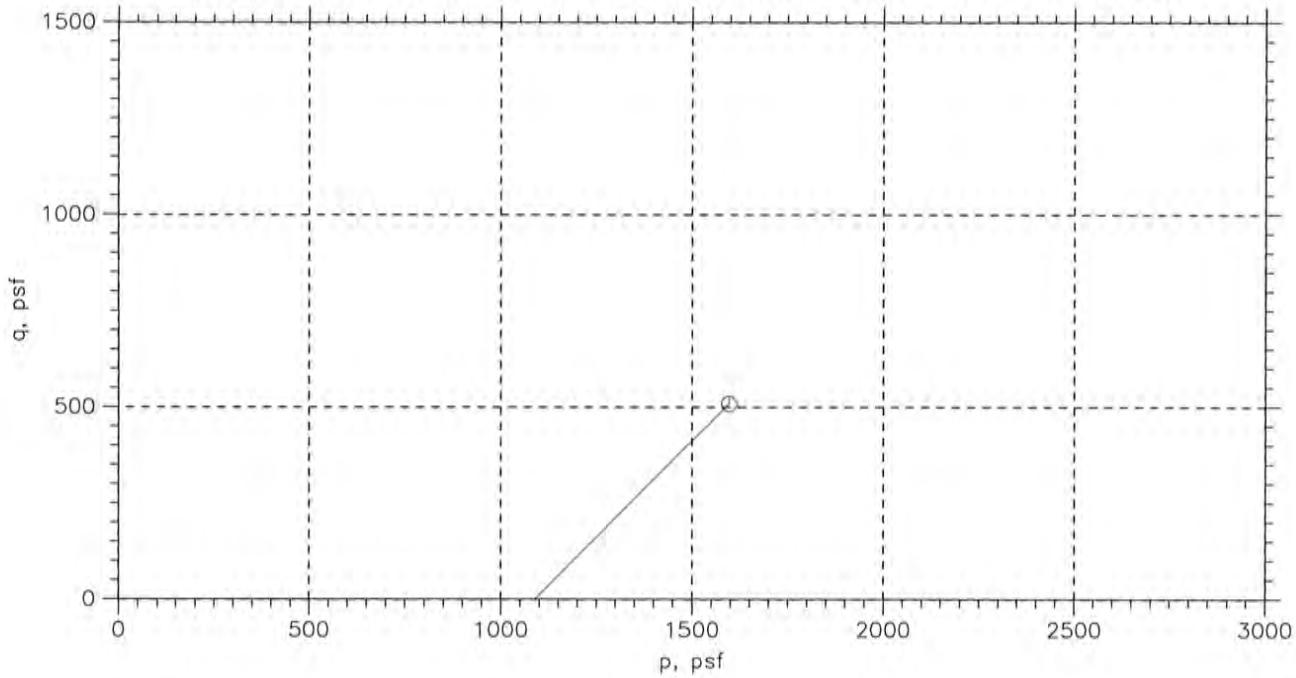
Description: Moist, dark olive gray clay

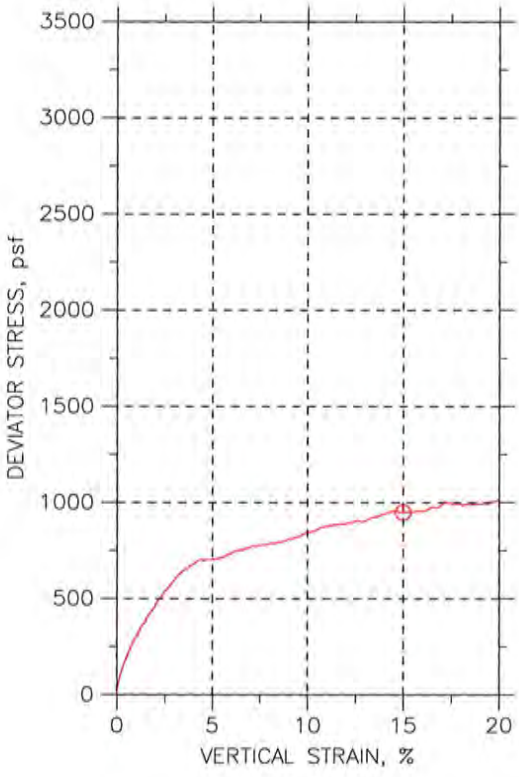
Remarks: System R

Phase calculations based on start and end of test.

Thu, 22-JAN-2015 08:50:03

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850





Symbol	⏀			
Sample No.	---			
Test No.	UU-3			
Depth	45-47 ft			
Tested by	md			
Test Date	01/20/15			
Checked by	jdt			
Check Date	**01/22/15**			
Diameter, in	2.87			
Height, in	5.95			
Water Content, %	24.8			
Dry Density, pcf	101.			
Saturation, %	100.0			
Void Ratio	0.67			
Confining Stress, psf	1090			
Undrained Strength, psf	474.2			
Max. Dev. Stress, psf	948.5			
Strain at Failure, %	15			
Strain Rate, %/min	1			
Estimated Specific Gravity	2.7			
Liquid Limit	30			
Plastic Limit	21			
Plasticity Index	9			

GeoTesting EXPRESS

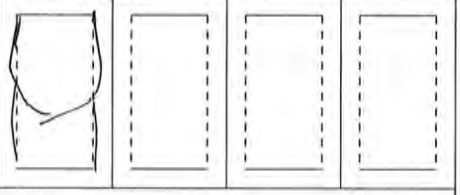
Project: Riverside Parcel 1

Location: ---

Project No.: GTX-302775

Boring No.: LB-6

Sample Type: intact



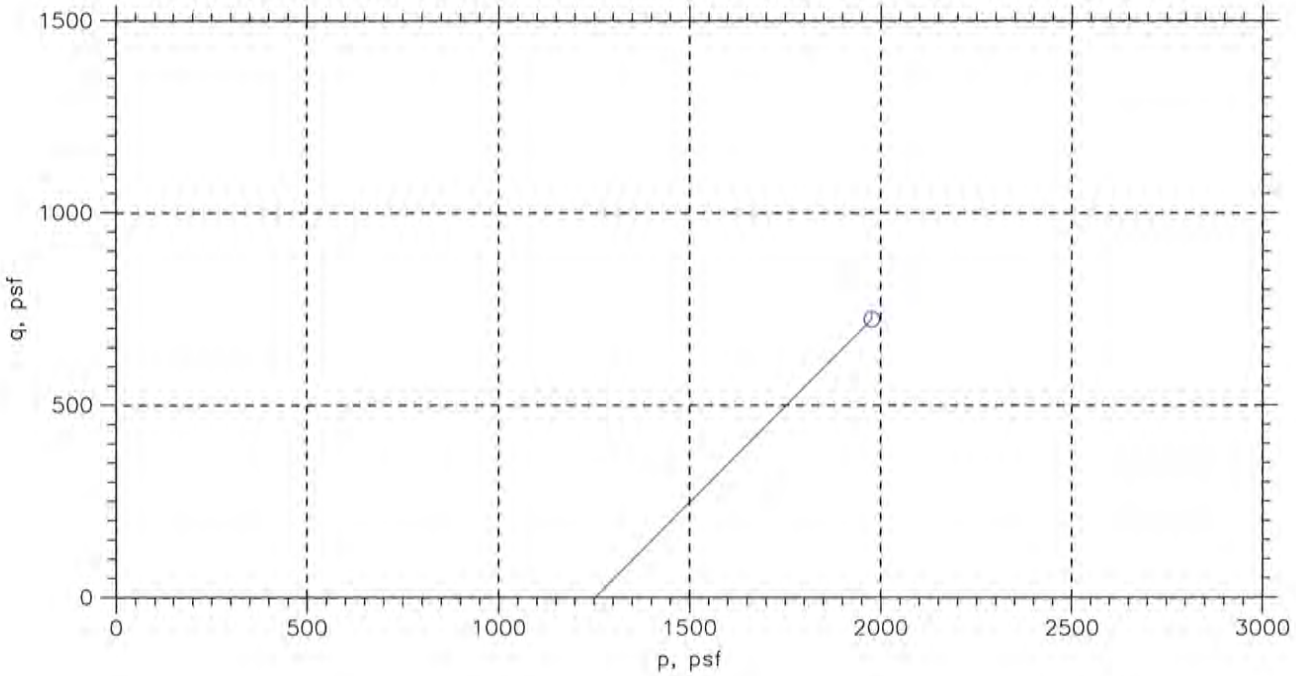
Description: Moist, dark reddish brown clay with sand

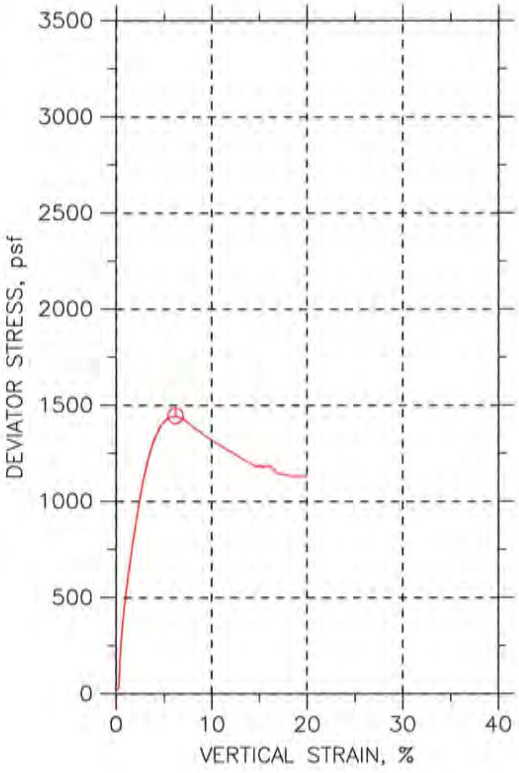
Remarks: System R

Phase calculations based on start and end of test.

Thu, 22-JAN-2015 08:47:48

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST by ASTM D2850





Symbol	⏲			
Sample No.	---			
Test No.	UU-1			
Depth	23-25 ft			
Tested by	md			
Test Date	01/20/15			
Checked by	jdt			
Check Date	**01/22/15**			
Diameter, in	2.87			
Height, in	6.01			
Water Content, %	60.3			
Dry Density, pcf	61.36			
Saturation, %	93.2			
Void Ratio	1.75			
Confining Stress, psf	1255			
Undrained Strength, psf	722.4			
Max. Dev. Stress, psf	1445			
Strain at Failure, %	6.23			
Strain Rate, %/min	1			
Estimated Specific Gravity	2.7			
Liquid Limit	81			
Plastic Limit	37			
Plasticity Index	44			

GeoTesting EXPRESS

Project: Riverside Parcel 1

Location: ---

Project No.: GTX-302775

Boring No.: LB-25

Sample Type: intact

Description: Moist, very dark gray silt with organics

Remarks: System R

Phase calculations based on start and end of test.

Thu, 22-JAN-2015 11:43:03