Report of Geotechnical Investigation

Proposed Mixed-Use Development
147-151 Academy Street
City of Jersey City
Hudson County, New Jersey

By

JZN Engineering, PC.
Springfield, New Jersey

Prepared For

Gupta Development
Jersey City, New Jersey

File No. 21850-000 **March 2019**

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March 12, 2019
File No. 21850-000

GUPTA DEVELOPMENT
2449 Kennedy Boulevard
Jersey City, New Jersey 07304

Attention: Mr. Raj Gupta
President

REGARDING: REPORT OF GEOTECHNICAL INVESTIGATION
Proposed Mixed-Use Development
147-151 Academy Street
Block 12309; Lot 3
City of Jersey City, Hudson County, New Jersey

Dear Mr. Gupta:

The enclosed report summarizes the results of our geotechnical investigation and recommendations conducted on behalf of Gupta Development in support of the Proposed Mixed-Use Development. This work was undertaken in accordance with our proposal dated February 8, 2019 and your subsequent authorization on February 19, 2019.

We appreciate the opportunity to work with you on this project. Please contact us if you wish to discuss this report or any aspect of the project.

Sincerely,
JZN ENGINEERING, PC.

Nejm E. Jundi, P.E.
President

Enclosures

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EXECUTIVE SUMMARY

This report summarizes our geotechnical study and provides our geotechnical engineering recommendations for the Proposed Mixed-Use Development to be located at 147-151 Academy Street in the City of Jersey City, Hudson County, New Jersey.

The study included the performance of a total of five (5) exploration borings (identified as B-1 through B-5). Boring B-4 was offset due to shallow refusals. The exploration borings were drilled within the proposed building footprint in the existing parking lot area to refusal depths which ranged between approximately 2.1 feet and 11.0 feet below the existing ground surface. A five foot rock core run was obtained at soil exploration boring B-5 which was drilled within the proposed elevator pit area. Engineering analyses were performed to evaluate the foundation system for the structure and to develop recommendations for foundation design and construction, utility support and earthwork. A description of site conditions and our evaluation is presented in the following report. The principal conclusions are described below:

- The field exploration revealed a surficial cover at the site consisting of asphaltic pavement. At soil boring exploration B-3, fill materials consisting of coarse to fine sand with little gravel and debris (brick) were encountered to a depth of approximately two (2) feet below existing ground surface elevation. Underlying the surficial cover and fill materials (where encountered), sand deposits consisting of medium dense to very dense coarse to fine sand with varying amounts of gravel and silt were encountered to the soil boring termination depths of between approximately 2.1 feet and 11.0 feet below the existing ground surface elevation. Diabase bedrock was cored at exploration boring B-5. Based on the presence of diabase bedrock at exploration boring B-5, it is anticipated that refusal at all boring locations was due to the presence of diabase bedrock. Groundwater conditions were not encountered during this investigation; however, perched water conditions may be encountered at the soil/rock interface.

- We recommend that the building be supported on shallow footings bearing on bedrock or dense sand deposits. While the bedrock depths are generally shallow, due to adjacent buildings, roadways, and utilities, excavation to bedrock may not be feasible without the use of a support of excavation and underpinning sytem. The lowest building slab be supported on a conventional slab-on-grade bearing on soil or bedrock overlain with 12 inches of ¾" crushed clean stone to mitigate the potential of hinge points where rock is shallow.

- Limited rock chipping and excavation within the vicinity of boring locations B-4 may be required to allow for the construction of the building foundations. Based on local experience, we expects that only the upper few inches of weathered rock can be excavated with large excavation equipment with rock teeth. Excavation depths beyond refusal depths and in confined excavations, such as for footings and utility trenches, will require ripping tools and/or pneumatic hammers.

- Due to the proximity of existing structures, including public roadways, commercial developments, existing utilities, every effort to protect these structures during and after construction should be taken. We recommend that a pre/post construction conditions survey, optical monitoring, and vibration-monitoring program be undertaken to document possible effects of the construction.

Detailed recommendations are presented in the following report.

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1. INTRODUCTION

1.1 General

This report summarizes our geotechnical study and provides our geotechnical engineering recommendations for the Proposed Mixed-Use Development to be located at 147-151 Academy Street in the City of Jersey City, Hudson County, New Jersey. This report was prepared based on the information provided to us including the following documents:

- An April 5, 2016 *Architectural Set of Plans* prepared by GRO Architects, PLLC.

1.2 Scope of Services

This geotechnical investigation was undertaken to obtain information on subsurface soil and groundwater conditions, and to provide recommendations for the Proposed Mixed-Use Development's foundations and related earthwork. The scope of this geotechnical engineering services included:

- Explore the subsurface conditions at the site by means of drilling exploration borings and obtaining rock cores;
- Estimate the engineering characteristics of the bedrock;
- Provide geotechnical criteria for use by the design engineers in preparing the foundation design; and
- Provide recommendations for earthwork and construction.

1.3 Existing Site Conditions

The site of the proposed development is located at the corner of Academy Street and Gray Street in the city of Jersey City, Hudson County, New Jersey. The project site is bounded by Academy Street to the north east; Gray Street to the south east; and existing 4-story residential building (153 Academy Street) to the north west; and two 4-story residential buildings (2-4 & 6 Vroom Street) to the south west.

The subject site is presently occupied with a paved parking lot with some vegetation to the rear of the property. The lot generally slopes down from west to east. The location of the project site is shown on the *Project Locus Map* included as Figure 1 in this report.

1.4 Report Datum

Topographic information was not available at the time of this report. Once a site reference benchmark is provided, the ground surface elevation at the soil exploration boring locations can be estimated, or alternatively they can be surveyed by a licensed land surveyor. All depths in the report are referenced from top of the existing ground surface at the time of the field investigation.

1.5 Proposed Development

We understand that the proposed development will include the construction of an eight-story mixed-use building with no below grade cellar level. The proposed building will have a footprint area of 4,920 square foot.

2. Geotechnical Investigation

2.1 Regional Geology Review

The subject site is situated within the Piedmont Physiographic Province of New Jersey. Specifically, the site is underlain by the Jurassic Aged, Diabase. The formation contains concordant to discordant, predominantly sheet like intrusions of medium to fine grained diabase and dikes of fine grained diabase, dark greenish-gray to black, subophitic texture. Dense, hard, sparsely fractured rock composed mostly of plagioclase, clinopyroxene, and magnetite ilmenite. Orthopyroxene is locally abundant in the lower part of the sheets. Accessory minerals include apatite, quartz, alkali feldspar, hornblende, sphene, zircon, and rare olivine. Diabase in the area was derived primarily from high-titanium, quartz-tholeiitic magma. Sedimentary rocks below major diabase sheets are thermally metamorphosed. Red mudstone is typically altered to indurated, bluish-gray hornfels with clots or crystals of tourmaline or cordierite. Gray argillitic siltstone is typically altered to brittle, black, very fine grained hornfels.

The information presented above was based on the review of published geological data as reported in the Surficial Geologic Map of Hudson County New Jersey prepared by United States Geological Survey (USGS).

2.2 Field Exploration

Field exploration for this project was conducted by means of drilling five (5) exploration borings. The exploration borings (identified as B-1 through B-5) were drilled within the proposed structures footprint in the existing paved parking lot area to refusal depths that ranged between approximately 2.1 feet and 11.0 feet below the existing ground surface. Boring location B-4 was offset due to shallow refusals. A five-foot rock core samples was obtained at soil exploration boring B-5. The locations of the exploration borings are shown on the accompanying *Boring Location Plan* included as Figure 2, and records of the soil exploration logs are provided in Appendix A.

The soil exploration borings were drilled with a truck-mounted drill rig in areas accessible to a truck rig using 3.25 inch-diameter hollow stem augers (ASTM D6151). Soil samples were obtained by the Standard Penetration Test (SPT) method in general accordance to ASTM D1586 with a 1-3/8-inch inside diameter (I.D.) split spoon sampler driven by a 140-pound hammer free-falling 30 inches. Blows for each six-inches of penetration were recorded on the soil exploration boring logs. Depth to groundwater was estimated from visual observation of moisture content of split spoon soil samples and from direct measurement after the completion of the borings. The soil matrix was classified in accordance to Unified Soil Classification System (USCS).

Bedrock was cored using a double wall core barrel of NQ-size diamond bit, recovering a nominal 1.88-inch diameter core (ASTM D2113). Rock core descriptions, core recoveries, and Rock Quality Designations (RQD) are provided on the Rock Core Boring Logs in Appendix A. Rock recovery (Rec.) is defined as the length of core recovered divided the length of core run and is expressed as a percentage. RQD (ASTM D6032) is defined as the sum of the length of core fragments four inches or greater between natural breaks divided by the length of the core run and is expressed as a percentage. RQD is an indication of the relative frequency of jointing or natural fracturing of the bedrock.

The field exploration program was monitored, planned, and logged by a JZN Engineer. The soil exploration locations were determined in the field by a JZN Engineer using normal taping procedures and estimated right angles from existing site features and are presumed to be accurate within a few feet.

The soil exploration boring was drilled by Environmental Technical Drilling, Inc. of Farmingdale, New Jersey in the presence of a JZN Engineer on March 5, 2019. All soil exploration borings were backfilled with soil cuttings generated from the investigation and the soil boring was surficially restored using cold patch asphalt.

The boring exploration logs and related information depict subsurface conditions only at the specific exploration locations and at the particular time designated on the logs. Subsurface conditions at other locations may differ from conditions occurring at the soil exploration locations. Also, the passage of time may result in a change in the subsurface conditions at these soil exploration locations.

2.2.1 Subsurface Conditions

Details of the subsurface materials encountered are presented on the Soil Exploration Records presented in Appendix A of this report. The stratification lines designating the interface between soil types on the boring logs represent approximate boundaries. The transition between materials may be gradual, and one or more strata may be absent at specific locations. In general, the subsurface soils conditions are consistent with the regional geology of the area. The soil exploration borings revealed the following generalized strata in order of increasing depth below ground surface:

Surface Cover: The surface cover at the boring locations consisted of approximately two (2) to three (3) inches of asphaltic pavement within the existing parking lot area.

Stratum I – Fill Materials: At soil boring exploration B-3, fill materials consisting of coarse to fine sand with little gravel and debris (brick) were encountered to a depth of approximately two (2) feet below existing ground surface elevation.

Stratum II – Natural Sand Deposits (USCS- SP & SM) : Underlying the surficial cover and fill materials (where encountered), sand deposits consisting of medium dense to very dense coarse to fine sand with varying amounts of gravel and silt were encountered to the soil boring termination depths of between approximately 2.1 feet and 11.0 feet below the existing ground surface elevation.

Stratum III – Refusal Materials (Probable Diabase Bedrock): The rock core sample recovered from soil exploration boring location B-5 indicated that the surficial bedrock is hard, slightly weathered grey Diabase. Core recovery was 73 percent and an RQD value of 63 percent was recorded. Based on the presence of diabase bedrock at exploration boring B-5, it is anticipated that refusal at all boring locations was due to the presence of diabase bedrock.

2.2.2 Groundwater Conditions

Groundwater conditions were not encountered at the site during our investigation. However, perched water conditions maybe encountered during construction at the overburden soil/ bedrock interface.

Groundwater observations in completed test borings do not necessarily represent the true, stabilized groundwater conditions. It should be noted that fluctuations in the level of groundwater may occur due to variations in season, rainfall, snow melt, surface infiltration, temperature, construction activities, pumping of dewatering systems, leakage from utilities, and other factors not evident at the time measurements were made and reported herein. As a result, water levels observed during and after construction may vary from those observed in the test borings during drilling.

3. Site Preparation, Earthwork, and Construction Consideration

3.1 General

The following sections of the report include comments on items related to excavation, dewatering, earthwork, and related geotechnical engineering aspects of the proposed construction. This section is written primarily for the engineer responsible for preparation of plans and specifications. Since this section identifies potential construction problems related to foundations and earthwork, it will also aid personnel who monitor the construction activity and contractors performing the earthwork.

The field exploration revealed a surficial cover at the site consisting of asphaltic pavement. At soil boring exploration B-3, fill materials consisting of coarse to fine sand with little gravel and debris (brick) were encountered to a depth of approximately two (2) feet below existing ground surface elevation. Underlying the surficial cover and fill materials (where encountered), sand deposits consisting of medium dense to very dense coarse to fine sand with varying amounts of gravel and silt were encountered to the soil boring termination depths of between approximately 2.1 feet and 11.0 feet below the existing ground surface elevation. Diabase bedrock was cored at exploration boring B-5. Based on the presence of diabase bedrock at exploration boring B-5, it is anticipated that refusal at all boring locations was due to the presence of diabase bedrock. Groundwater conditions were not encountered during this investigation; however, perched water conditions may be encountered at the soil/rock interface.

We recommend that the building be supported on shallow footings bearing on bedrock or dense sand deposits. While the bedrock depths are generally shallow, due to adjacent buildings, roadways, and utilities, excavation to bedrock may not be feasible without the use of a support of excavation and underpinning sytem. The lowest building slab be supported on a conventional slab-on-grade bearing on soil or bedrock overlain with 12 inches of ¾” crushed clean stone to mitigate the potential of hinge points.

Limited rock chipping and excavation within the vicinity of boring locations B-4 may be required to allow for the construction of the building foundations. Based on local experience, we expect that only the upper few inches of weathered rock can be excavated with large excavation equipment with rock teeth. Excavation depths beyond refusal depths and in confined excavations, such as for footings and utility trenches, will require ripping tools and/or pneumatic hammers.

Due to the proximity of existing structures, including public roadways, commercial developments, existing utilities, every effort to protect these structures during and after construction should be taken.

We recommend that a pre/post construction conditions survey, optical monitoring, and vibration-monitoring program be undertaken to document possible effects of the construction.

3.2 Earthwork

The subsurface materials that may be encountered during construction will include the existing fill materials and natural silty sand deposits. In the southwestern portion of the site, limited rock excavation may be required due to the presence of shallow bedrock.

We anticipate that soil excavation of the overburden soils (existing fill materials and sand deposits) can be accomplished using conventional earth-moving equipment. A temporary cut slope within the fill materials and natural sand deposits will be difficult to maintain if excavated steeper than about 1.5H:1V, and protected from erosion due to surface water and freeze/ thaw. Some sloughing and raveling should be anticipated in such temporary earth slopes. Temporary excavation slopes should be constructed to comply with all OSHA and other applicable regulations.

Based on the anticipated proposed construction, the south western portion of the proposed building will require limited rock excavation to allow for the construction of the proposed building foundations and lowest building slab. As a result, rock removal within that area is expected to be required to achieve design elevations of the lowest building slab and foundations. Based on local experience, we expects that only the upper few inches of weathered rock can be excavated with large excavation equipment with rock teeth. Excavation depths beyond refusal depths and in confined excavations, such as for footings and utility trenches, will require ripping tools and/or pneumatic hammers. Heavy excavating equipment with ripping tools may be effective in removing only the uppermost decomposed rock and uppermost weathered rock during site excavation. The speed and ease of excavation will depend on the type of grading equipment, the skill of the equipment operators, and the geologic structure of the material itself, such as the direction of bedding, planes of weakness, and spacing between discontinuities. Below the upper few inches on top of rock, hard rock excavation methods will be necessary. The site is situated in a heavily populated area, as such rock blasting is not recommended at this time. Another method of hard rock excavation would be the use of hydraulic fracture utilizing pecker or hydraulic breaks. This method, however, is very slow and requires specialty contractors and equipment.

Care must be exercised during excavations within 15 feet next to adjacent existing developments (roads, building, and utilities) and neighing buildings foundations zone of influence (ZOI). These excavations must be conducted in such a manner not to undermine these existing buildings foundation elements and disturb the bearing services and under the direction and system design of a professional engineer licensed in the State of New Jersey.

The site should be sealed on a daily basis using a smooth drum roller at the completion of each workday or if rainfall is imminent, work areas should be graded & smooth-wheel rolled to permit runoff of rainfall. Care must be exercised during excavations in areas next to adjacent existing developments (roads, and commercial buildings). Excavations must be conducted in such a manner not to undermine these existing buildings foundation elements and disturb the bearing services.

3.3 Earthwork During Freezing Weather

The moisture within the soil matrix may freeze when temperatures fall below freezing. Frozen soil or soil containing snow or ice should not be used as fill. Placement of fills should not be conducted when air temperatures are low enough to cause freezing of the moisture in the fill during or before placement.

Fill materials should not be placed on water, snow, ice or frozen soil. No fill should be allowed to freeze prior to compaction. At the end of each work day, the last lift of fill, after compaction, should be rolled by a smooth-wheeled roller to eliminate ridges of un-compacted soil. Soils with high fine content (silt deposits) with high moisture content are susceptible to disturbance by freezing, especially in the presence of water and construction traffic.

Soil bearing surfaces below completed foundations and slabs must be protected against freezing before and after foundation construction. If construction is performed during freezing weather, foundations and grade beams should be backfilled to a sufficient depth (up to four feet) as soon as possible after they are constructed. Alternatively, insulating blankets, heating or other means may be used for protection against freezing.

Placement and compaction of fill materials should be conducted only when ambient air temperatures are above 30 degrees Fahrenheit.

3.4 Bearing Surfaces Preparation

3.4.1 General

Prior to placing any fill materials to raise or restore grades, the exposed soils should be compacted to a firm and unyielding surface with several passes of a minimum five ton roller. In confined areas, hand-guided equipment such as a sheep's foot trench compactor imparting a dynamic force of at least 5,000-lbs should be used and the loose lift thickness should not exceed six inches.

The Zone Of Influence (ZOI) is defined as the area below the footings and below imaginary lines that extend two feet laterally beyond the footing outer bottom edges and down on a one horizontal to one vertical (1H:1V) slope to the naturally deposited bearing soils.

3.4.1 Shallow Foundations/Slab-on-Grade

All unsuitable materials (asphalt, existing fill materials, brick and/or concrete debris, remnant foundation elements, and any encountered site utilities) should be removed from within the zone of influence (ZOI) beneath proposed foundations down to the suitable bearing stratum. Following the excavation to the suitable bearing stratum, the exposed surface should be compacted to an unyielding surface. Based on the proposed basement at a minimum depth of 11 feet below existing site grades, we do not anticipate that overexcavation will be required. The contractor should be prepared to overexcavate areas where the existing fill materials are located at greater than 11 feet depths and replace it with controlled manner. Final determination of suitability for shallow foundation support shall be made by a qualified Geotechnical Engineer during earthwork activities.

The exposed subgrade should be observed in the field by the Geotechnical Engineer's representative to confirm the assumed foundation bearing conditions. Use of the allowable bearing pressures recommended in this report is contingent upon such observation and documentation that the field conditions are consistent with the assumptions made within this report.

It is necessary to overexcavate and replace disturbed or otherwise unacceptable foundation bearing materials. Following overexcavation to a suitable subgrade material, the exposed surfaces should be re-compacted prior to placing Compacted Granular Fill (CGF) or constructing foundations with a minimum of two passes with a heavy vibratory plate compactor or vibratory roller. If weaving or other disturbance is noticed during re-compaction, vibratory re-compaction should be discontinued.

For the footings bearing on rock, the exposed rock bearing surface should be excavated such that the entire footing bears on bedrock and the bedrock should be free of debris or loose materials. To avoid non-uniform bearing, a single footing should not bear partially on soil and partially on bedrock. Where bedrock is exposed at the bearing elevation for a part of footing, the excavation should be extended at least 12 inches deeper and backfilled with ¾-inches crushed stone. The final bearing surface on crushed stone should be compacted with a single pass of a vibratory plate or roller only. Footing subgrades in bedrock should be prepared as flat as practical, with all areas of the subgrade flatter than 10 horizontal to 1 vertical.

Care should be taken to prevent surface water from collecting on exposed soil bearing surfaces. Worker and equipment traffic over bearing surfaces should be minimized. When exposed, it may be difficult to prepare soil subgrades in cold and wet weather.

Soil bearing surfaces below completed foundations must be protected against freezing before and after foundation construction. If construction is performed during freezing weather, foundations should be backfilled to a sufficient depth (up to three feet) as soon as possible after they are constructed. Alternatively, insulating blankets, heating or other means may be used for protection against freezing.

3.5 Backfilling

Compacted Granular Fill (CGF) should be used for filling within the proposed building footprint area, foundation zone of influence (ZOI), and pavement areas. Fill materials should be placed in lifts not to exceed 12 inches in loose thicknesses. Compaction equipment in open areas should consist of self-propelled minimum 10-tons vibratory drum rollers. In confined areas, hand-guided equipment such as a trench compactor imparting a dynamic force of at least 5,000 lbs. should be used and the loose lift thickness should not exceed six inches. Areas within 15 feet of existing structures should be compacted using lighter compaction equipment (two tons or less) with an increased number of passes to achieve required compaction. Subgrades with high fines content (silt or clay) should not be proof-compacted using vibratory equipment; final excavations in high fines content subgrades should be made by hand or smooth-bladed excavation equipment to create a stable, undisturbed bearing surface. Lift thickness should be reduced to a minimum of six inches where lighter compaction equipment is used.

A minimum of four perpendicular passes of the compaction equipment should be used to compact each lift. Cobbles or boulders having a size exceeding three inches in size should be removed prior to compaction. The minimum recommended compaction requirements are summarized in Table 1.

Table 1: Minimum Recommended Compaction Requirements

Location	Compaction Requirement[1]
Building Foundation, Slab-on-Grade, and Structural Elements	95%
Landscape and Non-Structural Areas	90%

Notes:
1 As determined in accordance with ASTM D1557

3.6 Backfill Materials

3.6.1 Compacted Granular Fill (CGF)

Compacted Granular Fill (CGF) should consist of clean, well-graded sand and gravel, free of organic material, clay clumps, snow, ice, or other deleterious materials & should meet the criteria in Table 2:

Table 2: Compacted Granular Fill Gradation	
Sieve Size	Percent Finer by Weight
3-in.	100
No. 4	30 – 90
No. 40	10 – 50
No. 200	0 – 5

3.6.2 Common Fill

Common Fill may be used to raise grades in sidewalk and landscape areas, subject to design and drainage requirements and is suitable for general landscape grading. Common Fill should be granular soil free from organic material, clay clumps, snow, ice, or other deleterious materials. Common Fill should not contain stones larger than 3-in, and have a maximum of 80 percent passing the No. 40 sieve and a maximum of five percent passing the No. 200 sieve.

Additionally, inorganic soil including soils with higher percentages of fine material may be considered during favorable weather periods subject to the Geotechnical Engineer's approval, provided that the required moisture content and compaction controls are met.

3.6.3 Onsite Soil

The granular portions of the existing fill materials and natural sand deposits may be suitable for reuse contingent on any weather-related compaction limitations and removal of over-sized particles and deleterious materials (wood, brick, asphalt, etc.), and on the Geotechnical Engineer visual observation during construction. These materials may be used as fill materials beneath the slab-on-grade, and other areas subject to the Geotechnical Engineer's approval. Existing fill materials containing deleterious materials or excessive amounts of debris are not suitable for use and if excavated should be stockpiled for offsite disposal.

Soils containing high fines content will be difficult to re-use as backfill materials and will degrade rapidly during periods of precipitation and when subjected to repeated construction traffic. These materials, if excavated, should be stockpiles for off-site disposal.

Final determination of suitability of onsite soils for reuse as CGF and/or Common Fill will have to be made during construction when the materials are exposed during excavation. Reuse of onsite materials should be observed and documented in the field by the Geotechnical Engineer.

Moisture conditioning (drying), particularly during periods of wet weather, and removal of any oversized and deleterious materials may be required to permit placement in lifts to the required compaction. If the fill materials or natural soils are to be used below slabs, it is recommended that the placement and compaction of the material be observed and documented in the field by a Geotechnical Engineer.

We recommend the following be considered when evaluating the use of the on-site soils in lieu of CGF:

- Soil moisture content, weather conditions and placement procedures are very important to the successful use of till soils as engineered fill.
- Generally, the use of the natural soils in lieu of CGF may be difficult or impossible during the period between late September through mid-June area due to difficulties of moisture control and/or freezing temperatures. Precipitation and/or lack of dry weather may inhibit its use during other periods also. Even if the natural soils can be used, careful control of moisture content will be required to achieve the necessary compaction. Moisture conditioning by drying or adding water may be necessary.
- Placement and compaction of the on-site soils should be conducted only when ambient air temperatures are above 30 degrees Fahrenheit.
- Fill which is placed during the day should be fully compacted and smooth-rolled at the end of the work day.
- Any soils used in lieu of CGF which freeze overnight should be removed from the construction areas prior to placing additional fill, or recompacted after thawing.

Rainfall or melting snow can readily saturate stockpiled till soils. Providing drainage from or covering a stockpile can help limit this potential problem. However, it has been our experience that these soils will probably require considerable drying if left in an unprotected stockpile for an extended period of time, especially over winter and spring seasons.

Cobble/boulder and rock fragments greater than three inches in diameter will need to be separated from on-site soils to be placed as Compacted Granular. Rock fragments between three to 12 inches may be crushed or individually placed in fill layers deeper than two feet below proposed slab subgrade levels. Care must be taken to individually seat any large particles and to compact soil around large particles with hand operated equipment to minimize the risk of void formation. Rock fragments larger than approximately 12 inches in diameter may be crushed into smaller sizes adequate for use as fill or backfill or removed from the site.

3.6.4 Crushed Stone Fill

Crushed stone is recommended within the underslab and foundation drainage systems. It should consist of 3/4-inch size crushed stone in accordance to AASHTO No. 57.

3.6.5 Geotextile Fabric

A filtration-type geotextile is recommended between submerged fill and surrounding soil. It should consist of Mirafi 500X, or equivalent. The filtration fabric should be placed on all sides (top, bottom, and side) of all excavations, any fill areas being backfilled with submerged fill or granular fill, and/or where ever groundwater is present to help reduce the amount of infiltration of fines due to groundwater fluctuation/movement.

3.6.6 Geogrid

If the soil softens due to weather conditions or construction traffic, a reinforcing geogrid (such as Tensar TX130S, or engineering equivalent) may be used to distribute load and reinforce the soil / backfill matrix subject to further design and construction considerations. If the contractor elects to use geogrid to stabilize disturbed site soils, we request notifications to provide further recommendations.

3.7 Fill and Backfill Testing

A sample of any material scheduled for use as Compacted Granular Fill (CGF) should be submitted to the geotechnical laboratory for testing and analysis and approval prior to its use. The placement of all fill and backfill should be monitored by a qualified Geotechnical Engineer to ensure that the specified material and lift thicknesses are properly installed.

The samples should be tested to determine the maximum dry density, optimum moisture content, natural moisture content, gradation, organic content, and plasticity of the soil prior to construction in order to avoid construction delays. These tests are needed for quality control during compaction and also to determine if the fill material is acceptable as CGF. The minimum frequency of in-place density tests indicated in Table 3 should be performed to ensure that the specified compaction is achieved throughout the height of the fill or backfill:

Table 3: Compaction Frequency Testing	
Structural Elements	One test per 500 square feet per lift (minimum five tests per lift)
Non-Structural Areas	One test per each 2,500 square feet per lift (minimum five tests per lift)

3.8 Groundwater Control/ Dewatering

Groundwater conditions were not encountered at the time of the field investigation. However perched water conditions are anticipated at the overburden soil/ bedrock interface. Final excavation, subgrade preparation, filling, and foundation construction should be conducted "in the dry". We anticipate that most of the earthwork activities required will be conducted above the groundwater level.

Construction dewatering requirements are anticipated to be minor, consisting primarily of control of surface water runoff into excavations. It is anticipated that dewatering can typically be accomplished by open pumping from sumps, temporary ditches, and trenches within and around excavations. More proactive dewatering, such as bedrock depressurizing or use of deeper wells, is not anticipated.

Dewatering systems should be designed and operated to prevent pumping of fines, disturbance to subgrades and undermining of previous construction. Excavations should be performed to direct accumulated water away from work areas to sump locations. Subgrades which become disturbed due to water infiltration should be re-excavated and stabilized. Stabilization methods may include placement of crushed stone with filter fabric with approval of the Geotechnical Engineer's representative. The silty sand subgrade soils are expected to be easily disturbed in the presence of water.

Preferably, dewatering effluent should be discharged offsite such as into the municipal systems. Any water discharge into the municipal system must be discharged in accordance with regulatory requirements, and may require various discharge permits depending on where the discharge is routed.

Surface water runoff during construction should controlled and directed away from excavations, as on-site soils are highly erodible and susceptible to disturbance due to water and frost action. When exposed, it may be difficult to prepare and maintain soil subgrades in cold and wet weather.

3.9 Excavation and Shoring

Excavation at the site may require the use of temporary excavation support system depending on the purpose of the excavation (i.e. requires personal presence inside the excavation, protection of neighboring structures, etc.). The temporary excavation support design and construction is typically left to a specialty engineer and contractor. All excavation, excavation support, and backfilling must be performed in accordance with OSHA and all other applicable local, state, and federal regulatory requirements.

Generally, the site near surface soils encountered during the investigation (fill materials, natural sand deposits) are consistent with Type C Soil Conditions as defined by 29 CFR Part 1926 (OSHA) which require a maximum unbraced excavation angle of 1.5H:1V. However, this safe angle will require slopes that extend beyond the property line, as such considerations for temporary shoring system should be considered. Actual conditions encountered during construction should be evaluated by a competent person (as defined by OSHA) to ensure that safe excavation methods and/or shoring and bracing requirements are implemented.

3.10 Vibration Induced During Rock Excavation

The subject site is situated within a well-developed area. The surrounding development includes structures such as existing relatively old residential and commercial buildings, public utilities, and public roadways. As such, care should be maintained during rock excavation.

During the rock excavation operation, the use of heavy machinery may induce vibrations which typically may be transmitted to varying distances from the point of impact. When performing rock excavation within the interior of a large site, the offsite effects of the ground vibrations are usually negligible. However, when rock excavation are conducted near the edges of the property in a developed area, or at a small site, such as the subject site, ground vibrations can be transmitted into the adjacent facilities and in some instances may cause annoyance or structural damage. Based on the site layout in relation to the adjacent structures, and our understanding of the proposed construction, we anticipate that vibrations can be properly controlled to prevent structural damage to the adjacent structures. However, due to the proximity of the adjacent residential buildings, we recommend monitoring vibrations during construction, especially during rock excavation to demonstrate that vibrations do not affect the adjacent sensitive structures.

3.11 Adjacent Structures

Due to the proximity of existing structures, including existing buildings, public roadways, utilities, every effort to protect these structures during and after construction should be taken. The design of such protection systems is beyond the scope of this report. If underpinning and support of excavation systems are required to allow for the construction of the below grade space, these systems should be design to protect the neighboring properties. As such, it is the SOE design engineer responsibility to protect these structures by employing such measures during design and taking into account the subsurface soils and groundwater information and the neighbors building foundation setting and conditions. The SOE contractor should demonstrate to the owner, the completion of five recent successful similar SOE projects and have comprehensive experience with SOE and underpinning construction.

Buried utilities and other structures observed at the site may need to be moved or supported so as not to interfere or be damaged by the new construction.

We recommend that a pre/post construction conditions surveys, vibration-monitoring program, and optical monitoring programs be undertaken to document possible effects of the construction. These monitoring program shall be designed by a qualified professional engineer licensed in the State of New Jersey. Optical monitoring shall be undertaken by a licensed professional surveyor in the State of New Jersey.

4. Geotechnical Design Recommendations

4.1 General

This section of the report provides recommendations for design of the Proposed Mixed-Use Development's foundations for the subject site. Foundations should be designed and constructed in accordance with the applicable International Building Code- New Jersey 2015 edition (NJBC-2015), and the recommendations provided in the following sections.

This foundation investigation has been prepared for the proposed development taking into consideration the layout, site grading, and structural configuration as understood at the time this report was prepared. When and if further information is developed by the project team concerning final design column loadings, building configuration, etc., for the structure, the recommendations and design criteria presented herein should be reviewed by JZN. If any changes to our recommendations should result from this review, we will confirm these changes in writing.

4.2 Suggested Soil Parameters for Analysis and Design

Soil properties for engineering evaluation have been developed based on visual soil classification, penetration test data, published data, laboratory test results, and our experience with similar formations in the area of the project. The suggested soil properties are provided in Table 4. These properties have been used to develop the evaluation and recommendations contained in this report.

Table 4: Suggested Density and Strength Parameters for Design

Soil Stratum	Unit Weight (pcf[1])		Strength Parameters			
			Drained Strength		Undrained Strength	
	Total	Submerged	c (psf)[2]	ϕ°	S_u (psf)	ϕ°
Compacted Granular Fill (CGF)[3]	125	63	0	34	0	34
Natural Sand Deposits	120	58	0	34	0	34
Intact Diabase Rock	145	145	522,000	45	522,000	45

Notes:
1- Pounds per cubic feet (pcf)
2- Pounds per square foot (psf)
3- Based on attaining the minimum required compaction as recommended requirements recommended in Section 3.5

4.3 Suggested Soil Parameters for Seismic Load Evaluation

The subject site area is considered to be an area of low to moderate seismic risk. The applicable design standard selected for seismic load evaluation is based on the NJBC-2015.

Published data for the USGS Seismic Hazard Website provides seismic acceleration criteria for Site Class "B" or rock with shear wave velocity greater than 5,000 feet per second. The seismic site characteristics are based on average blow counts and undrained shear strength in the upper 100 feet of the profile and under. In our opinion, the conditions at the site subsurface profile indicate that the site characteristics correspond to Site Class "B". The parameters as indicated in Table 5 below have been modified for Site Class "B" characteristics which are representative of the appropriate design class using procedures contained in the NJBC-2015. Code loadings are generally based on the two percent probability of exceedance event with modifying factors.

Table 5: Seismic Response Criteria for Site Class "B" Based on the NJBC-2015

Spectral Response Acceleration at 0.2 Sec. Period	Spectral Response Acceleration at 1.0 Sec. Period
S_s= 0.279g	S_1= 0.072g
F_a= 1.0	F_v= 1.0

Based on the site soil profile, groundwater, and soil relative densities the potential for liquefaction is considered unlikely.

4.4 Foundations

4.5 Shallow Foundations

All unsuitable materials should be removed from within the zone of influence (ZOI) beneath foundations down to the suitable bearing strata as discussed above as recommended in Section 3.4 of this report. Following the removal of the existing fill materials and any unsuitable materials, the proposed building columns and bearing walls can be supported on conventional reinforced concrete isolated spread footings and continuous wall footing foundations bearing on bedrock or very dense sand deposits provided the subgrade has been prepared as outlined in Section 3.4 of this report. If boulders or outcropped rock are encountered within the footings ZOI it should be entirety removed and the resulting excavation should be backfilled with CGF in controlled manner. We recommend that the building columns and bearing walls be supported on footings designed in accordance with the following:

The ZOI is defined as the area below the footings and below imaginary lines that extend two feet laterally beyond the footing outer bottom edges & down on a one horizontal to one vertical (1H:1V) slope.

We recommend that foundations be designed using an allowable bearing pressure of 20 kips per square foot (ksf) for axial loading conditions on bedrock. To avoid non-uniform bearing, a single footing should not bear partially on soil and partially on bedrock. Refer to Section 3.4.2 for more detail on preparation of rock under a footing. Foundation bearing directly on bedrock have no frost coverage requirements.

In areas where excavation to rock is not feasible due to adjacent properties, the footings in that area can be designed and constructed to bear directly on natural dense sand deposits or CGF following the subgrade preparation as recommended in Section 3.4.2. In this case, and in order to limit the building differential settlement, the footing bearing on soil may be sized using an allowable bearing capacity of six (6) kips per square foot (ksf) for axial loading conditions. A maximum footing contact pressure of seven (7) ksf is acceptable for eccentric loading conditions as long as the maximum contact pressure acts over less than 33 percent of the footing contact area and the average contact pressure over the entire footing does not exceed six (6) ksf. We recommend that the continuous wall footings should be sized no less than minimum dimensions of 24 inches and isolated foundations be sized no less than 36 inches. Bottoms of exterior footings should be located a minimum of three (3) feet below adjacent grade and bottoms of interior footings should be located a minimum of two (2) feet below adjacent grade.

Lateral loads can be resisted by a combination of friction along the base of the footings and passive pressure on the vertical faces of footings. Frictional resistance should be computed using an ultimate base friction coefficient (tan δ) between the footing concrete & subgrade equal to 0.35.

The passive pressure of the soil between the gorundsurface and the bottom of the footing should be ignored unless it is confined by a slab or bituminous concrete. If the horizontal distance between adjacent footings or walls is less than twice the height of the subject structural element (measured from bottom of element to bottom of slab/ground surface), the passive pressure must be discounted proportionately to the distance (full pressure at twice the height away) to accommodate for interaction of the elements.

At the recommended allowable bearing pressure, we anticipate that the maximum post construction settlement of isolated shallow foundation under static loading conditions, constructed as recommended herein, will not exceed one inch, and differential settlement between adjacent foundation elements will be less than 1/2 inch. Our settlement estimate is based on the design column loads for similar structures. Most of the settlement should occur during construction, shortly after structure dead loads are placed on the foundations and during the initial snow loading of the roof.

4.6 Lowest Building Slab/ Slab-on-Grade

Following the subgrade preparation outlined in Section 3.4, the proposed building lowest level slab may be designed as a concrete slab-on-grade bearing on Compacted Granular Fill (CGF). Any areas that become softened or disturbed as a result of wetting and/or repeated construction traffic should be removed and replaced with CGF. Where bedrock is encountered at the slab bearing subgrade, bedrock should be overexcavated at least 12-inches below the bottom of the slab and the resulting excavation should be backfilled with compacted crushed stone.

It is recommended that the lowest building slab be placed on a minimum 12-inch thick layer of compacted crushed stone. The resulting excavations below slab-on-grade, such as those for foundations and utilities, should be backfilled with CGF below the crushed stone. Slab subgrade soils should consist of CGF placed following the subgrade preparation as outlined in Section 3.4.

Designs of slabs typically require a modulus of subgrade reaction (Winkler spring) or a similar elastic analysis method to determine thickness and reinforcing requirements for the concrete slab-on-grade. We recommend that a modulus of subgrade reaction (k_s) of 200 pounds per square inch per inch (psi/in) be used for slab-on-grade constructed on natural soil deposits and/or CGF. The recommended modulus value provided is for a one-foot square plate and must be corrected for slab size.

Post-construction settlements of slab-on-grade designed and installed in accordance with the recommendations outlined in this report are estimated to be on the order of 1/2-inch.

4.7 Foundation Rock Dowels

We understand that foundation rock dowels maybe used to reduce the sliding shear stress between the bottom of the foundation and intact rock. Typically the bond strength between dowels and rock will depend on many factors such as bonding agent strength, method of installation, rebar yield strength, and other factors. For a grout bonding agent attaining a minimum of 5,000 psi 28-day compressive strength and confirming to ASTM C150 with a w/c 0.4 to 0.55 by weight Type I, we recommend that an allowable pullout dowel strength of 10 kips per square feet (surface dowel bond area) with a factor of safety of 3.0.

4.8 Lateral Earth Pressures

Design of below grade walls, loading docks, and temporary shoring system and/or any wall that will act as a retaining wall using recommendations for restrained or unrestrained walls as appropriate. Earth pressures for restrained walls should be computed considering at rest conditions, and unrestrained walls should be designed considering active conditions. Typically, restrained walls are braced at the top, and unrestrained below-grade walls are not braced at the top. The following recommendations assume grades are level to a distance equal to the wall height behind the wall, the walls are backfilled with Compacted Granular Fill, and that the walls are drained (i.e. hydrostatic pressures are not considered). The parameter values presented in Table 6 can be used to calculate earth pressures.

Table 6: Lateral Earth Pressure Parameters

Material	Internal Friction Angle (deg)	Undrained Cohesion (psf)	Moist Unit Weight (pcf)	Active Earth Pressure Coefficient K_a[1]	Passive Earth Pressure Coefficient K_p[1]	At-Rest Earth Pressure Coefficient K_o[1]	Earthquake Induced Active Earth Pressure K_{ae}
Compacted Granular Fill (CGF)[3]	34	0	125	0.283	3.537	0.441	0.429
Overburden Soils	34	0	120	0.283	3.537	0.441	0.429

Notes:
1- Lateral Earth Pressure Parameters are Based on Coulomb Theory
2- Based on attaining the minimum required compaction as recommended requirements recommended in Section 3.4

The effect of surcharge pressure should be included in earth pressure calculations, including the loads imposed by adjacent foundations, structures, and traffic.

Hydrostatic pressures are not considered if the walls will be drained. If the drainage system is not installed, hydrostatic pressures should be included in the design with a design groundwater depth at existing ground surface elevation. For seismic loading conditions, walls should be designed to resist static plus seismic earth pressures. Surcharge loading does not need to be considered for seismic design unless the surcharge will be applied over an extended time.

Retaining structures should be designed for a minimum factor of safety against sliding and overturning of 1.5.

4.9 Utilities

We recommend that utilities beneath the building be soil-supported bearing on prepared subgrade soils. Utilities should be located above foundation bearing levels or outside the foundation zone of influence.

Buried site utilities may be soil-supported (with suitable bedding), bearing on undisturbed, natural sand deposits, existing site fill soils that are stable under proof-compaction, or on compacted Common Fill/ CGF placed following the removal of exposed unsuitable bearing materials.

If obstructions, oversized soil particles are encountered, and/or bedrock is encountered it should be removed to at least 12 inches below the utility invert elevations in order to reduce the potential for damage to utility conduits and pipes.

5. Additional Considerations

5.1 Specification and Plan Review

This report was prepared without the benefit of reviewing the project plans and design. As such, this report should be considered preliminary in nature and should not be used for final design. JZN requests notification once a building design was completed to revise this report accordingly. The recommendations presented herein are contingent on the assumed grading and foundation layouts. We request notification upon completion of a final grading plan.

5.2 Pre and Post Construction Conditions Surveys

Due to the proximity of the adjacent structures (existing buildings, utilities, & roadways), we recommend that a pre and construction conditions surveys of adjacent structures and right-of ways be conducted to document conditions relevant to potential damage claims prior to commencement of constriction.

5.3 Construction Testing and Monitoring

The recommendations contained in this report are based on known and reasonably predictable behavior of properly engineered and constructed foundations and other facilities. A Geotechnical Engineer should perform quality control, testing, and consultation during construction as described in previous sections of this report. Monitoring and testing also should be performed to verify that the recommendations contained in this report are implemented. Geotechnical construction monitoring should include:

- removal of unsuitable soil materials;
- preparation of slab, footing, and fill subgrades prior to concrete placement;
- vibration monitoring;
- construction of building foundations; and
- suitability of backfill materials as Controlled Fill.

6. LIMITATION

The recommendations contained in this report represent our best professional judgment based on soils conditions encountered in the limited number of test borings performed for this study, and the structural and grading design criteria described in the report. Variations in the types of structures and design grading may change from the criteria assumed in preparation of the report. JZN should be advised of changes in the design criteria so that an evaluation can be made to determine if design recommendations should be revised. The nature and extent of variations in subsurface conditions between explorations may not become evident until construction. If variations appear, it may be necessary to reevaluate the information presented in this report. Conditions may be encountered during construction beyond and between borings that vary from the conditions reported herein. We recommend that foundation construction, earthwork and subgrade preparation be observed by a qualified Geotechnical Engineer familiar with the anticipated conditions and the basis of the foundation design recommendations. Any variations encountered should be brought to our attention so that their effect on the recommendations presented herein can be reevaluated and modified if necessary. Our work has been performed in accordance with current standards of practice for geotechnical engineering for buildings based on the conditions encountered in the explorations. No other warranty is made, either expressed or implied.

FIGURES

GOOGLE MAPS 2019

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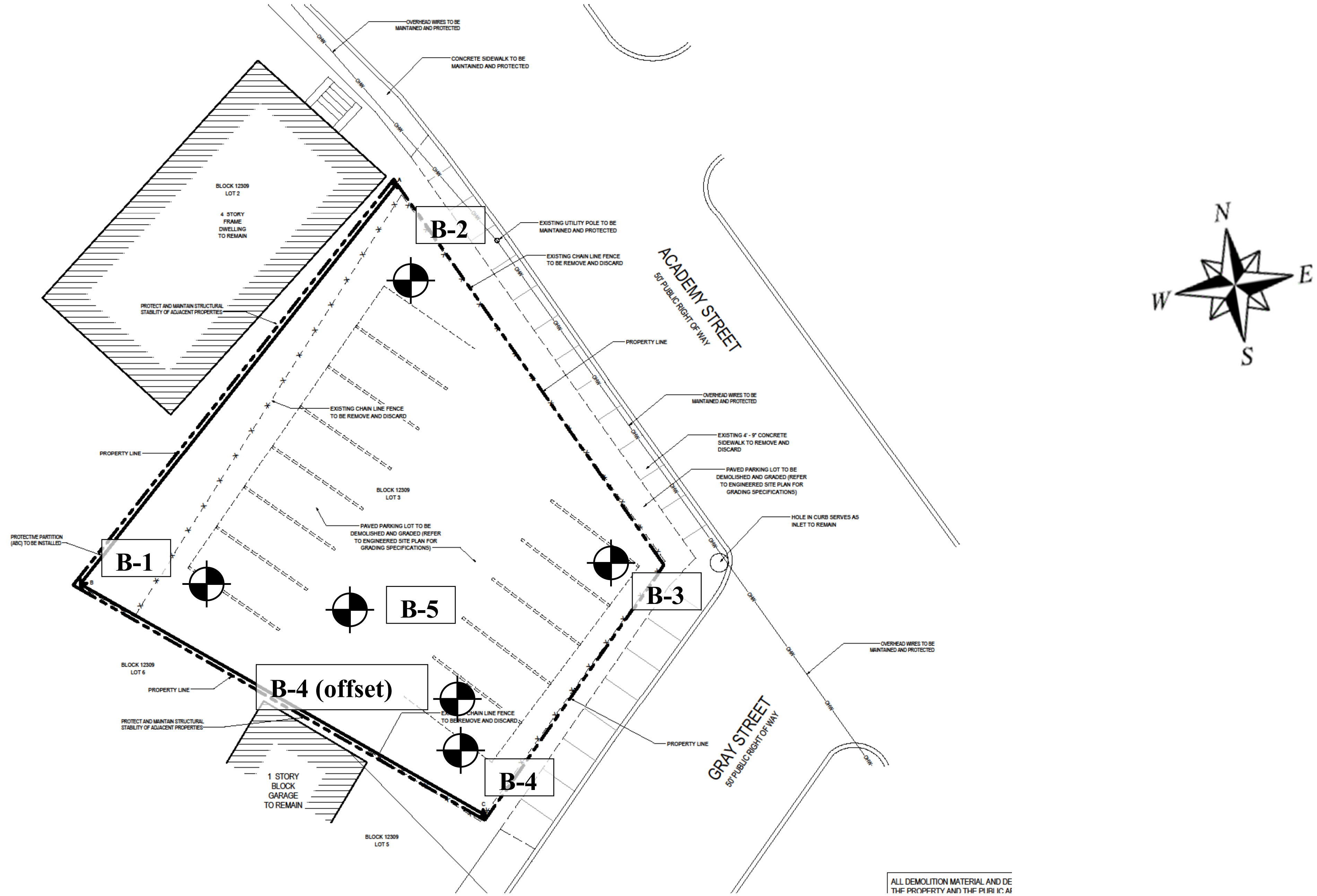
PROPOSED MIXED-USE DEVELOPMENT
147-151 ACADEMY STREET
CITY OF JERSEY CITY, HUDSON COUNTY, NEW JERSEY
21850-000

PROJECT SITE LOCUS

FIGURE 1



LEGEND

B-1: APPROXIMATE SOIL EXPLORATION BORING LOCATION

NOTES

BASE PLAN OBTAINED FROM A MAY 3, 2016 *DEMOLITION PLAN* PREPARED BY GRO ARCHITECTS, PLLC.

SOIL EXPLORATIONS WERE LOCATED IN THE FIELD BY A REPRESENTATIVE OF JZN ENGINEERING, PC. USING NORMAL TAPING PROCEDURES AND ESTIMATED RIGHT ANGLES FROM EXISTING SITE FEATURES AND ARE PRESUMED ACCURATE WITHIN FEW FEET.

THE SOIL EXPLORATION BORINGS WERE DRILLED BY ENVIRONMENTAL TECHNICAL DRILLING, INC. OF FARMINGDALE, NEW JERSEY IN THE PRESENCE OF A JZN ENGINEER ON MARCH 5, 2019.

SOIL BORING LOCATIONS WERE BACKFILLED TO THE SURFACE WITH SOIL CUTTING GENERATED FROM THE INVESTIGATION AND SURFICIALLY RESTORED WITH COLD PATCH ASPHALT.

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PROPOSED MIXED-USE DEVELOPMENT
147-151 ACADEMY STREET
CITY OF JERSEY CITY, HUDSON COUNTY, NEW JERSEY
21850-000

BORING LOCATION PLAN

SCALE: NOT TO SCALE

FIGURE 2

APPENDIX A

SOIL EXPLORATION RECORDS

SOIL BORINGS: B-1 THROUGH B-5

JZN Engineering, PC. — TEST BORING LOG

Boring No.	B-1	**Page**	1 of 1
Project Name	Proposed Mixed-Use Development	**Project No.**	21850-000
Client	Gupta Development	**Representative**	T. Robinski
Project Location	147-151 Academy Street; Block 12309, Lot 3	**Contractor**	ETD, Inc.
	City of Jersey City, Hudson County, New Jersey	**Driller**	M. Ryan
Boring Location	Western corner of parking lot	**Date Started**	03/05/2019
Ground Surface Elev.	+/-5.0' above Academy St & Gray St Sidewalk **Datum** Not Surveyed	**Date Finished**	03/05/2019

Item	Casing	Sampler	Core Barrel	Rig Type
Type	H.S.A.	S.S.	--	Truck-Mounted
Inside Diameter (in)	3.25	1.4	--	CME 45
Hammer Weight (lb)	--	140		**Drill Mud**
Hammer Fall (in)	--	30		--
Hammer Type	--	Auto		--

Water Level Data

Date	Time	Bottom of Casing (ft.)	Bottom of Boring (ft.)	Water (ft.)	Cave In (ft.)
03/05/19	9:55 AM	--	6.8	N/E	--

Depth (ft.)	Sample No. & Rec. (in)	Sample Depth (ft.)	Sampler Blows per 6 inches	USCS Symbol	Visual Classification	Remarks
0				A.P.	2" Asphaltic Pavement +/- 0.2'	
	S-1 14 in.	0- 2 ft.	3 3 3 2	SM	Light grey and brown fine SAND, some Silt, little Gravel, trace roots, loose, dry	
	S-2 12 in.	2- 4 ft.	3 4 7 8	SP	Brown coarse to fine SAND, little Gravel, trace Silt, medium dense, moist to dry	
5	S-3 11 in.	4- 6 ft.	10 11 13 16	SP	Brown coarse to fine SAND, little Gravel, trace Silt, medium dense, moist	
	S-4 5 in.	6- 6.8 ft.	14 50/4"	SM	Brown coarse to fine SAND, some Gravel, little Silt, very dense, moist	
	S-5 0 in.	6.8- 6.8 ft.	50/0"	N.R.	No Recovery +/- 6.8'	-S-5 bouncing when struck by hammer at 6.8'
					Soil Boring B-1 Terminated Approximately 6.8 feet Below Existing Ground Surface due to Auger and Split Spoon Sampler Refusals on Probable Bedrock	-Auger refusal at 6'
10						

Summary	Overburden (Linear ft.)	6.8	Rock Cored (Linear ft.)	--	No. of Samples	5

JZN Engineering, PC.	TEST BORING LOG	Boring No. B-2 Page 1 of 1

Project Name	Proposed Mixed-Use Development	**Project No.**	21850-000
Client	Gupta Development	**Representative**	T. Robinski
Project Location	147-151 Academy Street; Block 12309, Lot 3	**Contractor**	ETD, Inc.
	City of Jersey City, Hudson County, New Jersey	**Driller**	M. Ryan
Boring Location	Northern corner of parking lot	**Date Started**	03/05/2019
Ground Surface Elev.	+/-2.0' above Academy St & Gray St Sidewalk **Datum** Not Surveyed	**Date Finished**	03/05/2019

Item	**Casing**	**Sampler**	**Core Barrel**	**Rig Type**	**Water Level Data**					
Type	H.S.A.	S.S.	--	Truck-Mounted	**Date**	**Time**	**Bottom of Casing (ft)**	**Bottom of Boring (ft)**	**Water (ft)**	**Cave In (ft)**
Inside Diameter (in)	3.25	1.4	--	CME 45						
Hammer Weight (lb)	--	140		**Drill Mud**	03/05/19	12:20 PM	--	7.1	N/E	--
Hammer Fall (in)	--	30		--	03/05/19	12:40 PM	--	7.1	N/E	5.0
Hammer Type	--	Auto		--						

Depth (ft)	**Sample No. & Rec. (in)**	**Sample Depth (ft)**	**Sampler Blows per 6 inches**	**USCS Symbol**	**Visual Classification**	**Remarks**
0				A.P.	2" Asphaltic Pavement +/- 0.2'	
	S-1 10 in.	1- 3 ft	7 8 15 14	SP	Brown coarse to fine SAND, little Gravel, medium dense, dry	
	S-2 7 in.	3- 5 ft	24 18 15 17	SP	Brown coarse to fine SAND, some Gravel, trace Silt, dense, moist	
5	S-3 10 in.	5- 7 ft	41 20 27 30	SM	Brown coarse to fine SAND, some Gravel, little Silt, dense, moist	
	S-4 0 in.	7- 7.1 ft	50/1"	N.R.	No Recovery +/- 7.1' Soil Boring B-2 Terminated Approximately 7.1 feet Below Existing Ground Surface due to Auger and Split Spoon Sampler Refusals on Probable Bedrock	-Auger refusal at 6.5'
10						

Summary	Overburden (Linear ft) 7.1	Rock Cored (Linear ft)	--	No. of Samples 4

JZN Engineering, PC.	TEST BORING LOG	Boring No. B-3 Page 1 of 1

Project Name	Proposed Mixed-Use Development	**Project No.**	21850-000
Client	Gupta Development	**Representative**	T. Robinski
Project Location	147-151 Academy Street; Block 12309, Lot 3	**Contractor**	ETD, Inc.
	City of Jersey City, Hudson County, New Jersey	**Driller**	M. Ryan
Boring Location	Eastern corner of parking lot	**Date Started**	03/05/2019
Ground Surface Elev.	+/-0.5' above Academy St & Gray St Sidewalk **Datum** Not Surveyed	**Date Finished**	03/05/2019

Item	Casing	Sampler	Core Barrel	Rig Type	Water Level Data					
Type	H.S.A.	S.S.	--	Truck-Mounted	**Date**	**Time**	**Bottom of Casing (ft)**	**Bottom of Boring (ft)**	**Water (ft)**	**Cave In (ft)**
Inside Diameter (in)	3.25	1.4	--	CME 45						
Hammer Weight (lb)	--	140		**Drill Mud**	03/05/19	12:00 PM	--	6.0	N/E	--
Hammer Fall (in)	--	30		--						
Hammer Type	--	Safety		--						

Depth (ft)	Sample No. & Rec. (in)	Sample Depth (ft)	Sampler Blows per 6 inches	USCS Symbol	Visual Classification	Remarks
0						
	S-1 15 in.	0- 2 ft	6 6 8 15	A.P. Fill	3" Asphaltic Pavement +/- 0.3' Fill: Brown and black coarse to fine sand, little gracel, little debris, dry Debris: Brick +/- 2.0'	
	S-2 6 in.	2- 4 ft	25 22 20 24	SP	Brown coarse to fine SAND, some Gravel, little Silt, dense, dry	
5	S-3 6 in.	4- 5.8 ft	46 35 50/4"	SP	Brown coarse to fine SAND, some Gravel, very dense, dry +/- 6.0'	-S-3 bouncing when struck by hammer at 5.8'
					Soil Boring B-3 Terminated Approximately 6.0 feet Below Existing Ground Surface due to Auger and Split Spoon Sampler Refusals on Probable Bedrock	-Auger refusal at 6'
10						

Summary	Overburden (Linear ft)	6	Rock Cored (Linear ft)	--	No. of Samples	3

JZN Engineering, PC.	TEST BORING LOG	Boring No. B-4 Page 1 of 1

Project Name	Proposed Mixed-Use Development	**Project No.**	21850-000
Client	Gupta Development	**Representative**	T. Robinski
Project Location	147-151 Academy Street; Block 12309, Lot 3	**Contractor**	ETD, Inc.
	City of Jersey City, Hudson County, New Jersey	**Driller**	M. Ryan
Boring Location	Southern corner of parking lot	**Date Started**	03/05/2019
Ground Surface Elev.	+/-2' above Academy St & Gray St Sidewalk **Datum** Not Surveyed	**Date Finished**	03/05/2019

Item	Casing	Sampler	Core Barrel	Rig Type	Water Level Data					
					Date	Time	Bottom of Casing (ft.)	Bottom of Boring (ft.)	Water (ft.)	Cave In (ft.)
Type	H.S.A.	S.S.	--	Truck-Mounted						
Inside Diameter (in)	3.25	1.4	--	CME 45						
Hammer Weight (lb)	--	140		**Drill Mud**	03/05/19	11:30 AM	--	2.1	N/E	--
Hammer Fall (in)	--	30		--						
Hammer Type	--	Safety		--						

Depth (ft.)	Sample No. & Rec. (in)	Sample Depth (ft.)	Sampler Blows per 6 inches	USCS Symbol	Visual Classification	Remarks
0						
	S-1 15 in.	0- 2 ft.	5 5 4 6	A.P. SP	3" Asphaltic Pavement +/- 0.3' Brown coarse to fine SAND, trace Silt, medium dense, dry	-Offset boring 4' due north due to shallow refusal
	S-2 6 in.	2- 2.1 ft.	50/1"	N.R.	No Recovery +/- 2.1' Soil Boring B-4 Terminated Approximately 2.1 feet Below Existing Ground Surface due to Auger and Split Spoon Sampler Refusals on Probable Bedrock	-Auger refusal at 2'
5						
10						

Summary	Overburden (Linear ft.)	2.1	Rock Cored (Linear ft.)	--	No. of Samples	2

JZN Engineering, PC. — TEST BORING LOG

Boring No.	B-5	**Page**	1 of 1

Project Name	Proposed Mixed-Use Development	**Project No.**	21850-000
Client	Gupta Development	**Representative**	T. Robinski
Project Location	147-151 Academy Street; Block 12309, Lot 3	**Contractor**	ETD, Inc.
	City of Jersey City, Hudson County, New Jersey	**Driller**	M. Ryan
Boring Location	Center of parking lot	**Date Started**	03/05/2019
Ground Surface Elev.	+/-4' above Academy St & Gray St Sidewalk **Datum** Not Surveyed	**Date Finished**	03/05/2019

Item	Casing	Sampler	Core Barrel	Rig Type
Type	F.J.	S.S.	NQ	Truck-Mounted
Inside Diameter (in)	3.25	1.4	1.9	CME 45
Hammer Weight (lb)	--	140		**Drill Mud**
Hammer Fall (in)	--	30		--
Hammer Type	--	Auto		--

Water Level Data

Date	Time	Bottom of Casing (ft.)	Bottom of Boring (ft.)	Water (ft.)	Cave In (ft.)
03/05/19	1:10 PM	--	16.0	N/E	--

Depth (ft.)	Sample No. & Rec. (in)	Sample Depth (ft.)	Sampler Blows per 6 inches	USCS Symbol	Visual Classification	Remarks
0						
	S-1 6 in.	0- 2 ft.	24	A.P.	2" Asphaltic Pavement +/- 0.2'	
			7, 5, 4	SM	Tan brown fine SAND, some Silt, medium dense, dry	
	S-2 15 in.	2- 4 ft.	6, 10, 15, 18	SP	Brown coarse to fine SAND, trace Gravel, medium dense, dry	
5	S-3 14 in.	4- 6 ft.	13, 25, 26, 24	SM	Tan brown coarse to fine SAND, little Gravel, little Silt, very dense, moist	
	S-4 10 in.	6- 8 ft.	16, 17, 24, 40	SM	Tan brown medium to fine SAND, some Gravel, little Silt, medium dense, moist	
	S-5 6 in.	8- 9.3 ft.	21, 28, 50/3"	SM	Tan brown coarse to fine SAND, some Gravel, little Silt, very dense, moist	
10					+/-11.0'	
	C-1 Rec: 43.8 in. 73%	11- 15 ft.	25 min/15"	RQD: 37.8 in. 63%	Dark grey DIABASE; hard; slightly weathered; medium grained; moderately dipping fractures; closely jointed; very narrow, stained fractures	
					Soil Boring B-5 Terminated Approximately 12.2 ft. Below Existing Ground Surf	

Summary	Overburden (Linear ft.)	11	Rock Cored (Linear ft.)	5 ft.	No. of Samples	6