

REPORT OF GEOTECHNICAL INVESTIGATION

PROPOSED SITE IMPROVEMENTS

769 Northfield Avenue
Block 166.15, Lot 9
Township of West Orange, Essex County, New Jersey

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Township of West Orange, Essex County, New Jersey

TABLE OF CONTENTS

1.0	EXECUTIVE SUMMARY	1
2.0	PROJECT DETAILS	1
3.0	SCOPE OF SERVICES.....	2
3.1	Field Investigation	2
3.2	Laboratory Testing	3
4.0	SUMMARY OF SUBSURFACE CONDITIONS.....	4
4.1	Site Geology.....	4
4.2	Subsurface Soil Profile	4
4.3	Groundwater.....	4
5.0	CONCLUSIONS AND RECOMMENDATIONS.....	5
5.1	General.....	5
5.2	Foundation Design Recommendations	5
5.3	Pavement Recommendations	7
5.4	Groundwater Considerations	8
5.5	Site Preparation and Earthwork.....	8
5.6	Preliminary Retaining Walls and Lateral Earth Pressure Recommendations.....	11
5.7	Seismic and Liquefaction Considerations.....	13
5.8	Temporary Excavations	13
5.9	Supplemental Post Investigation Services.....	13
6.0	GENERAL COMMENTS AND LIMITATIONS	14

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TABLE OF CONTENTS
(continued)

APPENDICES

Boring Location Plan
Records of Subsurface Exploration
Geotechnical Terms and Symbols
USCS Standard Classification System

1.0 EXECUTIVE SUMMARY

Dynamic Earth, LLC (Dynamic Earth) has completed a geotechnical investigation at the subject site. Based on the subsurface conditions encountered, proposed foundations are expected to bear directly on underlying rock and/or within approved compacted structural fill. **If encountered below proposed foundations, existing fill material is not suitable for direct support of proposed foundations and will need to be overexcavated and replaced with structural fill material.** Following overexcavation and replacement (if required), the proposed structures may be supported on a conventional shallow foundation system bearing within approved subgrade materials.

Relatively shallow refusal was encountered during this investigation on bedrock. **As such, the contractor should anticipate the use of excavation equipment with rock ripping tools and/or pneumatic hammers where rock and/or obstructions are encountered near proposed subgrade elevations. In particular, rock should be anticipated where site grades will be cut, such as within the proposed pavement areas southwest of the proposed retaining walls.**

The on-site soils are preliminarily expected to be suitable for support of proposed pavements provided that those materials are prepared and evaluated as detailed herein. Due to the potential variability of existing fill material, at least partial overexcavation and replacement and/or subgrade stabilization should be anticipated within the proposed pavement areas.

2.0 PROJECT DETAILS

Our initial scope included performing a preliminary investigation. Subsequent to our proposal, site and grading plans were finalized, therefore, we conducted a full geotechnical investigation, analysis, and report. The subject site is located at 769 Northfield Avenue, Township of West Orange, New Jersey and is further identified as Block 166.15, Lot 9. The site is bound to the north by a wooded area and a residential neighborhood beyond; to the east by an existing property (The Life Christian Church); to the south by Northfield Avenue; and to the west by an existing commercial property (Stratford Manor Rehabilitation & Care Center).

At the time of Dynamic Earth's field investigation, the subject site was developed with an existing three-story office building (occupying a footprint area of approximately 23,391 square feet) with associated pavements, utilities, and landscaped areas. The proposed site improvements will include the construction of a canopy to the north of the existing structure that will occupy a footprint area of approximately 1,120 square feet. The proposed site improvements also include construction of pavements, utilities, and retaining walls. The proposed site improvement details were provided on an August, 6 2021 *Grading Plan* prepared by Dynamic Engineering Consultants,

PC (Dynamic). Architectural details were provided on an August 5, 2021 (last revised) *Drawing A2 - Building Elevations* prepared by Rotwein & Blake.

Based on the grading plan, two retaining wall structures are proposed within the central and northern portion of the site that will be approximately 60 feet long and 120 feet long. The proposed walls will have maximum exposed heights of approximately seven feet and nine feet, respectively. The proposed site grading will include earth cuts on the order of approximately five feet on the low side of the walls, and earth fills on the order of approximately three feet on the high side of the walls.

Topographic information was provided on a June 25, 2020 *Boundary Location & Topographic Survey* prepared by Dynamic Survey, LLC. Existing site grades generally slope downward from north to south and range between approximately 510.0 feet within the northern portion of the site and 427.0 feet within the southern portion of the site. The elevations included herein reference the North American Vertical Datum of 1988 (NAVD 1988), unless otherwise noted.

The final structural loads have not been developed at this time. Based on our experience with similar facilities, we assume that the maximum loads will be less than the following:

- Canopy Axial Column Loads – 100 kips
- Pavement Loads – 60,000 (18) kip equivalent single axle load (ESAL)

3.0 SCOPE OF SERVICES

3.1 Field Investigation

Field exploration of the project site was conducted by means of three soil borings (identified as borings B-1 through B-3). The borings were drilled with a truck-mounted drill rig using mud rotary drilling techniques and were backfilled to the surface at completion of the testing. The test locations are shown on the accompanying *Boring Location Plan*.

Test Location Summary Table		
Number	Proposed Location	Final Depth (feet)
B-1	Canopy	1.3 ¹
B-2	Pavement	3.8 ¹
B-3	Retaining Wall	12.0 ²

¹ Refusal on apparent bedrock

² Rock coring was performed

The soil borings were completed in the presence of a Dynamic Earth engineer who performed field tests, recorded visual classifications, and collected samples of the various strata encountered. The

test locations were located in the field using normal taping procedures and estimated right angles. These locations are presumed to be accurate within several feet.

Soil borings and standard penetration tests (SPTs) were conducted in general accordance with ASTM D5783 (*Standard Guide for Use of Direct Rotary Drilling with water based drilling fluid for Geoenvironmental Exploration and the installation of subsurface water quality monitoring devices*) and ASTM D1586 (*Standard Test Method for Standard Penetration Test and Split Barrel Sampling of Soils*), respectively. The N-value for various soil types can be correlated with the engineering behavior of earthworks and foundations.

Rock cores were obtained using a diamond bit core barrel in accordance with ASTM designation D 2113 (*Standard Practice for Rock Core Drilling and Sampling of Rock for Site Exploration*). Rock Quality Designations (RQD's) were determined in accordance with ASTM D 6032 (*Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Core*) and are provided on the boring logs within the appendix of this report. RQD 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.

Groundwater level observations were recorded during and at the completion of field operations prior to backfilling the borings. Seasonal variations, temperature effects, man-made effects, and recent rainfall conditions may influence the levels of the groundwater, and the observed levels will depend on the permeability of the soils. While groundwater elevations derived from sources other than seasonally observed groundwater monitoring wells may not be representative of true groundwater levels.

3.2 Laboratory Testing

Physical/Textural Analysis: Each sample was subjected to supplemental identification and classifications in general accordance with ASTM D2488 (visual-manual procedure). The engineering classifications are utilized in conjunction with the site data to estimate properties of the soil types encountered and to assess the soil response under construction and service loads

4.0 SUMMARY OF SUBSURFACE CONDITIONS

4.1 Site Geology

The subject property is situated in the Newark Basin Geomorphic Province of New Jersey. Specifically, the site is situated in the Lower Jurassic aged Preakness Basalt. The Preakness Basalt is comprised of dark greenish-gray to black, very fine grained, dense, hard basalt composed mostly of intergrown calcic plagioclase and clinopyroxene. Overburden materials include man-made fill material.

4.2 Subsurface Soil Profile

Details of the subsurface materials encountered are presented on the *Records of Subsurface Exploration* presented in the Appendix of this report. The subsurface soil conditions encountered in the soil borings consisted of the following generalized strata in order of increasing depth.

Surface Cover Material: Borings were performed within existing pavement areas and encountered approximately six inches of asphaltic concrete at the surface with no apparent subbase material.

Existing Fill Material: Beneath the surficial cover, existing fill material was encountered that generally consisted of sand, gravel, and clay with variable amounts of debris (asphalt millings). The existing fill material was encountered to depths ranging between approximately 1.3 feet and 3.8 feet below the ground surface; corresponding to elevations ranging between 465.1 feet and 457.7 feet. Except where refusal of the split spoon sampler was encountered, Standard Penetration Test (SPT) N-values within this stratum ranged between approximately 11 blows per foot (bpf) and 31 bpf.

Rock: Beneath the existing fill material, bedrock was encountered that generally consisted of very hard, very slightly weathered basalt rock. Rock core recovery values ranged from 53 and 60 inches and the rock quality designation (RQD) encountered ranged between approximately 88 and 100 percent; corresponding to a relatively good to excellent rock mass quality.

4.3 Groundwater

Groundwater was not encountered during our subsurface exploration. Groundwater levels are expected to fluctuate seasonally and following period of significant precipitation.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 General

Based on the subsurface conditions encountered, proposed foundations are expected to bear directly on underlying rock and/or within approved compacted structural fill (following overexcavation and replacement of existing fill). **If encountered below proposed foundations, existing fill material is not suitable for direct support of proposed foundations without the risk of excessive settlement and will need to be overexcavated and replaced with structural fill material.** Following overexcavation and replacement (if required), the proposed structures may be supported on a conventional shallow foundation system bearing within approved subgrade materials.

Relatively shallow refusal was encountered during this investigation was encountered on bedrock. **As such, the contractor should anticipate the use of excavation equipment with rock ripping tools and/or pneumatic hammers where rock and/or obstructions are encountered near proposed subgrade elevations. In particular, rock should be anticipated where site grades will be cut, such as within the proposed pavement areas southwest of the proposed retaining walls.** Furthermore, special handling to segregate oversized debris/rock fragments from proposed structural fill and/or processing these materials to smaller particle sizes may be required.

The recommendations presented herein are sufficient to support the initial design and planning phase. These recommendations are contingent on the assumption that Dynamic Earth will remain involved in the final design process and that Dynamic Earth will be engaged to conduct the necessary construction phase geotechnical testing and inspection to ensure these recommendations are properly implemented.

5.2 Foundation Design Recommendations

Anticipated Bearing Strata: Based on the aforementioned grading plan, the majority of proposed foundations are preliminarily expected to extend deeper than the existing fill material (within the underlying rock stratum). As detailed throughout this report, the existing fill material is not suitable for direct foundation support and will need to be overexcavated and replaced if encountered at proposed subgrade elevations.

Shallow Foundation Design Criteria: Following overexcavation and replacement of existing fill material (if encountered below foundation subgrade elevations), the proposed structures may be supported on conventional shallow foundations bearing within the rock stratum and/or newly placed compacted structural fill material. A maximum allowable net bearing capacity of 8,000 pounds per square foot (psf) may be achieved for foundations bearing entirely within the underlying rock stratum. A maximum allowable net bearing capacity of 3,000 psf may be achieved for

foundations bearing within newly placed structural fill material. Regardless of loading conditions, proposed foundations should be sized no less than minimum dimensions of 24 inches for continuous wall footings and 36 inches for isolated column footings.

Footings subject to tension loads should be designed so that the maximum toe pressure due to the combined effect of vertical loads and overturning moment does not exceed the recommended maximum allowable net bearing pressure recommended above. In addition, positive contact pressure should be maintained throughout the base of the footings such that no uplift or tension exists between the base of the footings and the supporting soil. Uplift loads should be resisted by the weight of the concrete, side friction (vertical along the footer) should be neglected.

Lateral resistance should be provided by friction on the base of the footing with a recommended coefficient of friction against sliding:

- Formed concrete on gravel subbase material – 0.40; and
- Mass concrete on gravel subbase material – 0.50.

Inspection/Overexcavation Criteria: The suitability of the subgrade materials along and below the footing bottoms must be verified by Dynamic Earth’s geotechnical engineer prior to placing concrete, especially to confirm that unsuitable soils are removed and new fills are adequately placed and compacted. Any overexcavation to be restored with structural fill (on-site or imported) will need to extend at least one foot laterally beyond footing edges for each vertical foot of overexcavation. Alternatively, proposed foundations may be designed to bear deeper (below the existing fill material). The bottom of overexcavations should be compacted with smooth drum rollers, walk-behind compactors, vibrating plates or plate tampers (“jumping jacks”) to compact locally disturbed materials and densify underlying natural soil zones.

Partial Rock Support: Footings should not bear partially on rock and partially on soil due to the risk of brittle fracture at hinging points. Any foundation subgrades that would result in partially supported rock conditions should be overexcavated an additional six inches and replaced with well graded, compacted structural fill, per Section 5.5, to provide a cushion against brittle fracture. Alternatively, isolated spread footings may be extended to bear entirely on rock.

Frost Coverage Embedment Depth: Footings subject to frost action should be placed at least 36 inches below adjacent exterior grades or as required by the local building code to provide protection from frost penetration. Interior footings not subject to frost action (including during the period of construction) may be placed at a minimum depth of 18 inches below the slab subgrade.

Settlement: Dynamic Earth estimates post construction settlements of proposed foundations on to be less than one inch if the recommendations outlined in this report are properly implemented. Differential settlements of building foundations should be less than one-half inch.

5.3 Pavement Recommendations

The on-site soils are expected to be suitable for support of proposed pavement areas. **Due to the potential variability of the existing fill material, at least partial overexcavation and replacement and/or stabilization should be anticipated. In addition, rock should be anticipated where site grades will be cut within the proposed pavement areas southwest of the proposed retaining walls.** Depending on construction phase evaluation, overexcavation may be limited with the use of geogrid reinforcement or subgrade stabilization, as directed by the geotechnical engineer of record. Depending on the overall subgrade conditions and weather conditions, more extensive mitigation efforts may be required.

Preliminary Design Criteria: A design California Bearing Ratio (CBR) value of seven has been assigned to the anticipated properly prepared subgrade soils for pavement design purposes. This value was correlated with pertinent soil support values and assumed traffic loads to prepare flexible and rigid pavement designs per the AASHTO *Guide for the Design of Pavement Structures*.

Pavement Sections: The recommended flexible pavement section is presented below in tabular format:

RECOMMENDED FLEXIBLE PAVEMENT SECTION		
Layer	Material ¹	Thickness (Inches)
Surface	HMA 9.5 PG 64 (L or M) (Section 902.02.01) ²	1.5
Base	HMA 19.0 PG 64 (L or M) (Section 902.02.01) ²	2.5
Subbase	DGA (Section 901.10) ²	6.0

¹ Per New Jersey Department of Transportation *Standard Specification for Road and Bridge Construction* 2019

² Per the designation compaction level shall be “L” or Low for Standard Duty Pavement and “M” or Medium for Heavy Duty Pavement.

A rigid concrete pavement should be used to provide suitable support at areas of high traffic or severe turns (such as dumpster area pads and driveway aprons). The recommended rigid pavement is presented below in tabular format:

RECOMMENDED RIGID PAVEMENT SECTION		
Layer	Material	Thickness (Inches)
Surface	4,000 psi air-entrained concrete	5.0
Base	NJDOT DGA	6.0

Additional Design Considerations: The pavement section thickness designs presented in this report are based on the design parameters detailed herein and are contingent on proper construction, inspection and maintenance. The designs are contingent on achieving the minimum soil support value in the field. To accomplish this requirement, all subgrade soil and supporting fill or backfill must be placed, prepared and evaluated as detailed in Sections 5.2 and 5.3 of this report. Proper drainage must be provided for the pavement structure including appropriate grading and surface water control, as well as measures to drain water from the subgrade such as bleeder drains at inlets.

The performance of the pavement also will depend on the quality of materials and workmanship. Dynamic Earth recommends that New Jersey Department of Transportation (NJDOT) standards for materials, workmanship and maintenance be applied to this site. Project specifications should include verifying that the installed asphaltic concrete material composition is within tolerance for the specified materials and that the percentage of air voids of the installed pavement is within specified ranges for the respective materials. All rigid concrete pavements should be suitably air-entrained, jointed and reinforced.

5.4 Groundwater Considerations

Groundwater levels are expected to be deeper than proposed excavations and the need for extensive dewatering or permanent groundwater control is not anticipated for this project. However, the contractor should anticipate the need for at least construction phase groundwater control of perched or infiltrating water.

While the means of groundwater control will need to be determined by the contractor, the use of gravity fed sump pumps are typically suitable for dewatering of surface runoff, perched and infiltrating water. Surface water runoff must be controlled and diverted away from construction areas by grading and limiting the exposure of excavations to rainfall.

5.5 Site Preparation and Earthwork

Surface Preparation/Proofrolling: Prior to placing any fill or subbase materials to raise or restore grades to the desired subgrade elevations, the existing exposed soils should be compacted to a firm and unyielding surface with several passes in two perpendicular directions with a vibratory, smooth drum roller during favorable moisture conditions. The drum roller should be operated in the static mode or a kneading “sheepsfoot” roller should be used if fine-grained soils are encountered at the subgrade elevation. The surface then should be proofrolled with a loaded tandem axle truck in the presence of Dynamic Earth to help identify soft or loose pockets which may require removal and replacement or further investigation. Dynamic Earth anticipates at least partial overexcavation if the subgrade is wetted or subjected to repeated construction traffic. Any fill or backfill should be

placed and compacted in accordance with the recommendations included herein.

Subgrade Protection and Inspection: Every effort should be made to minimize disturbance of the on-site soils by construction traffic and surface runoff. Portions of the on-site soils are moisture sensitive and every effort should be made to minimize disturbance of the on-site soils by construction traffic and surface runoff. The on-site soils will likely become unsuitable if exposed to moisture and/or construction traffic. If these materials become overly wetted, the on-site soils will likely require increased handling such as discing and drying during extended periods of favorable weather and/or partial overexcavation and geogrid stabilization. Therefore, the subgrades should be sealed daily and construction traffic be minimized to designated non-structural areas and following periods of precipitation as an attempt to minimize deterioration of otherwise suitable subgrade soils. Geogrid reinforcement may be considered for excessively soft or pumping, conditions as directed by the geotechnical engineer. Dynamic Earth should be retained as the Geotechnical Engineer of Record to inspect soil conditions during construction and verify the suitability of prepared foundation, floor slab and pavement subgrades for support of design loads.

Import/On-site Structural Fill Material: Soils placed as structural fill material should consist of well graded sand or gravel with a maximum particle size of three inches in diameter and less than 15 percent of material passing the number 200 sieve. These materials should be free of objectionable debris (clay clumps, organic and/or deleterious material, etc.) and within moisture contents suitable for compaction. Alternative soil types with higher percentages of silt and clay may be considered, provided that the contractor is able to achieve proper compaction and maintain suitable subgrade once the material is placed. Fine-grained soils and/or granular soils with higher percentages of silt and clay are extremely moisture sensitive and will only be suitable for reuse as structural fill material under ideal weather conditions. Materials wetted beyond the optimum moisture content; that contain oversized rock or debris; or with increased amounts of objectionable debris will not be suitable for reuse as structural fill material without special handling. As such, the contractor should be responsible for importing structural fill material and/or processing on-site soils as required so that these materials are suitable for structural fill placement.

Cobble/boulder sized fragments and/or oversized debris greater than three inches in diameter will need to be separated from material to be placed as structural fill. Approved material between three to 12 inches in diameter may be crushed or individually placed in fill layers deeper than two feet below proposed 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. The larger material should not be placed near areas of the proposed utility or planned excavation. Boulders larger than approximately 12 inches are not expected to be adequate for use as fill or backfill and should be removed from the site or crushed to an adequate size.

The on-site soils include existing fill material and underlying bedrock. Portions of the existing fill material are anticipated to be suitable for reuse as structural fill material, provided moisture contents are suitable to achieve compaction and objectionable/oversized materials (if encountered) are separated. Due to the potential variability of the existing fill material, special handling should be anticipated to segregate debris from existing fill material to be used as structural fill. Portions of the existing fill material contained increased amounts of fine-grained materials; therefore, moisture conditioning during a period of favorable weather should be anticipated and/or these materials will likely become unsuitable for use as structural fill material. If required, excavated rock may be reused as structural fill material provided that these materials are processed as detailed above.

Compaction and Placement Requirements: Structural fill and backfill should be placed in maximum 12 inch loose lifts and compacted to 95 percent of the maximum dry density within a targeted two percent of the optimum moisture content as determined by ASTM D 1557 (Modified Proctor). Variations in moisture content may be acceptable subject to Dynamic Earth's on-site geotechnical engineer's approval if the contractor is able to achieve the necessary compaction. Dynamic Earth recommends using a minimum 20-ton smooth drum roller to compact subgrade soils beneath pavements and hand operated vibratory jumping jacks and plate compactors within confined excavations for foundations or utilities. The drum roller should be operated in the static mode or a kneading "sheepsfoot" roller should be used to compact fine-grained soils. Fill material compacted with hand operated equipment, static drum roller and/or sheepsfoot roller, may need to be placed in thinner, loose lifts and an increased number of passes may be required to achieve proper compaction.

Structural Fill Testing: Before filling operations begin, representative samples of each proposed fill material (on-site and imported) should be collected. The samples should be tested to determine the maximum dry density, optimum moisture content, natural moisture content, gradation, and plasticity of the soil. These tests are needed for quality control during compaction and also to determine if the fill material is acceptable. The placement of all fill and backfill will need to be monitored by Dynamic Earth to ensure that the specified material and lift thicknesses are properly installed. A sufficient number of in-place density tests should be performed during fill placement to ensure that the specified compaction is achieved throughout the height of the fill or backfill.

Difficult Excavation: Split spoon sampler refusal was encountered at depths as shallow as 1.3 feet below the ground surface. As such, difficult excavation to remove cobble/boulder sized fragments and rock should be anticipated during construction. **Rock should be anticipated within excavations for proposed foundations and where site grades will be cut, such as within the proposed pavement areas southwest of the proposed retaining walls.**

While small boulder and cobble sized rock fragments may typically be removed with conventional excavation equipment, heavy excavation equipment with rock ripping tools may be required for larger boulder sized fragments. 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. Planned excavation depths beyond refusal depths will likely require pneumatic hammers to remove the rock.

Asphalt Milling Reuse: We anticipate that at least a portion of existing asphaltic concrete may be reused within the subbase layer of the proposed pavement section, provided that environmental concerns do not preclude reuse. The millings should be processed to a maximum particle size of 1.5 inches and blended (less than 50 percent) with approved dense graded aggregate (DGA) in accordance with the NJDOT DGA Gradation requirements. The approved DGA material shall not contain with asphaltic millings prior to blending.

5.6 Preliminary Retaining Walls and Lateral Earth Pressure Recommendations

General: Based on the August 6, 2021 *Grading Plan* prepared by Dynamic Engineering Consultants, PC (Dynamic), two retaining wall structures are proposed within the central portion of the site that will be approximately 60 feet long and 120 feet long, respectively. The specific type and design of the retaining walls have not been determined at this time; however, the proposed walls will have maximum exposed heights of approximately seven feet and nine feet, respectively. Earth cuts on the order of approximately five feet are anticipated on the low side of the walls, and earth fills of approximately three feet are anticipated on the high side of the walls.

Soil Parameters and Design Considerations: Proposed retaining walls that are free to rotate generally can be designed to resist active earth pressures. Restrained walls and retaining wall corners need to be designed to resist at-rest earth pressures. Backfill soils adjacent to these structures should consist of freely draining materials composed primarily of sand and gravel. The soil parameters provided below apply to properly compacted granular fill and backfill placed in a well-drained, level condition and may be used for preliminary design of retaining structures.

SUMMARY OF LATERAL EARTH PRESSURE PARAMETERS						
Stratum	Moist Density, γ_{moist} , (pcf)	Internal Friction Angle, Φ (degrees)	Coefficient of Active Earth Pressure (K_a)	Coefficient of Passive Earth Pressure (K_p)	Coefficient of At Rest Earth Pressure (K_o)	Cohesion (psf)
Existing Fill Material	120	27	0.38	2.63	0.45	0
Import/ Granular Soil	130	30	0.33	3.0	0.50	0
Rock	150	36	0.26	3.85	0.41	0

The effect of any surcharge loads including construction equipment, traffic, proposed structures and temporary and permanent stockpiles also will need to be included in earth pressure calculations. Dynamic Earth would be pleased to assist with the calculation of lateral earth pressures based on the soil parameters presented herein during the structural design phase.

Retaining walls should be designed so that the combined effect of vertical and horizontal resultant loads and overturning moment does not exceed the maximum allowable soil bearing capacity recommended in this report.

Adequate drainage of water which may collect on the backfill side of the retaining walls should be incorporated into the design and/or hydrostatic pressures should be added to the pressure calculations. A system of perforated drain pipes should be used at the base of the backfill side of the wall structure to collect and remove the water and relieve hydrostatic pressure.

Dynamic Earth recommends that granular soils be used to backfill the proposed subgrade and retaining walls. Clays and silts or soils with a fine fraction with a liquid limit exceeding 40 or a plastic index exceeding 20 should not be used as backfill. Acceptable backfill should be placed in maximum nine-inch loose lifts and compacted to 95 percent of the maximum dry density, within two percent of the optimum moisture content, as determined by ASTM D1557 (Modified Proctor). A maximum density of 135 pounds per cubic foot should not be exceeded in order to avoid creating excessive lateral pressure on the walls during compaction operations.

Dynamic Earth recommends that backfill directly behind the walls be compacted with light, hand-held compactors. Heavy compactors and grading equipment should not be allowed to operate within a zone measured at a 45-degree angle from the base of the walls during backfilling to avoid developing excessive temporary or long-term lateral soil pressures.

Resistance to sliding should be provided by friction resistance at the base of the retaining structure foundation. Passive earth pressures at the toe of the retaining structure should be neglected in the design.

5.7 Seismic and Liquefaction Considerations

Based on our preliminary investigation, the soils encountered are most consistent with Site Class C defined by the *International Building Code*. Based on the seismic zone and soil profile, liquefaction considerations are not expected to have a substantial impact on design.

5.8 Temporary Excavations

The natural soils encountered during the investigation are consistent with Type C Soil Conditions as defined by 29 CFR Part 1926 (OSHA) which require a maximum unbraced excavation angle of 1.5:1 (horizontal: vertical). 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.

5.9 Supplemental Post Investigation Services

Construction Monitoring and Testing: The recommendations presented herein are contingent on the owner retaining Dynamic Earth to perform inspection, testing, and consultation during construction as described in previous sections of this report. **Construction phase evaluation by Dynamic Earth should be performed to further evaluate the lateral extent of existing fill material and to confirm suitability for structural support.** Limited overexcavation and replacement of fill material within pavement areas and/or special handling should be expected. **Construction phase evaluation with subgrade inspections and/or Dynamic Cone Penetrometer (DCP) testing should be performed to confirm design bearing capacities for the proposed foundation.** Monitoring and testing should also be performed to verify that suitable materials are used for controlled fill, and that they are properly placed and compacted over suitable subgrade soils. Testing of fill placement will also be critical to limiting differential settlement.

6.0 GENERAL COMMENTS AND LIMITATIONS

Supplemental recommendations will be required upon finalization of conceptual site plans or if significant changes are made in the characteristics or location of the proposed structures. Dynamic Earth should be included as a consultant to the design team and should be provided final plans for review to confirm these criteria apply or to modify recommendations as necessary.

The recommendations presented herein should be utilized by a qualified engineer in preparing preliminary design concepts and site grading. The engineer should consider these recommendations as minimum physical standards that may be superseded by local and regional building codes and structural considerations. These recommendations are prepared for the use of the client for the specific project detailed and should not be used by any third party. These recommendations are relevant to the preliminary design phase and should not be substituted for construction specifications.

The possibility exists that conditions between test locations may differ from those at specific test pit locations, and conditions may not be as anticipated by the designers or contractors. In addition, the construction process may itself alter soil conditions. Therefore, Dynamic Earth Geotechnical Engineers or their representatives should observe and document the final construction procedures used and the conditions encountered, as well as conduct testing and inspection to ensure the design criteria are met or recommendations to address deviations are implemented.

Dynamic Earth assumes that a qualified contractor will be employed to perform the construction work, and that the contractor will be required to exercise care to ensure all excavations are performed in accordance with applicable regulations and good practice. Particular attention should be paid to avoiding damaging or undermining adjacent properties and maintaining slope stability.

The exploration and analysis of the foundation conditions reported herein are presented to form a reasonable basis for preliminary site evaluation. The recommendations submitted for the proposed construction are based on the available soil information and the preliminary design details furnished or assumed. Deviations from the noted subsurface conditions encountered during construction should be brought to the attention of the geotechnical engineer.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been promulgated after being prepared in accordance with generally accepted professional engineering practice in the fields of foundation engineering, soil mechanics, and engineering geology. No other warranties are implied or expressed.

Boring Location Plan

Records of Subsurface Exploration

Project: Proposed Site Improvements							Proj. No.: 2530-99-006E									
Location: 769 Northfield Ave, West Orange, Essex County, New Jersey							Client: Altera 769, LLC c/o Altera Development									
Surface Elevation:		459.0 feet			Date Started:		08-25-2021		Groundwater Data		Depth	EI.	Additional Groundwater Data	Depth	EI.	
Termination Depth:		1.3 feet			Date Completed:		08-25-2021				(ft)	(ft)		(ft)	(ft)	
Proposed Location:		Proposed Canopy			Logged by:		J. Alvarez		While Drilling:		NE	-				
Drill/Test Method:		HSA/SPT			Contractor:		Boring Brothers		At Completion:		NE	-				
Hammer Type:		Auto			Rig Type:		CME 75									
Sample Information							Depth (ft)	Strata	DESCRIPTION OF MATERIALS (Classification)				Remarks			
Depth (Feet)	Number	Type	Rec (in)	RQD %	Blows per 6" or drill time (mm:ss)										N	
0.5-1.3	S-1	SS	6	--	-- 14		64/10		Surface Cover		6" Asphalt with no apparent subbase material					
					50/4 --				FILL		Dark gray and black sand and gravel, asphalt millings (FILL)					
											Boring B-1 encountered refusal on apparent bedrock at approximately 1.3 feet below the ground surface.					

Project: Proposed Site Improvements										Proj. No.: 2530-99-006E									
Location: 769 Northfield Ave, West Orange, Essex County, New Jersey										Client: Altera 769, LLC c/o Altera Development									
Surface Elevation: 467.0 feet					Date Started: 08-25-2021					Groundwater Data		Depth	El.	Additional Groundwater Data		Depth	El.		
Termination Depth: 3.8 feet					Date Completed: 08-25-2021							(ft)	(ft)			(ft)	(ft)		
Proposed Location: Proposed Retaining Wall					Logged by: J. Alvarez					While Drilling: ▽		NE	-						
Drill/Test Method: HSA/SPT					Contractor: Boring Brothers					At Completion: ▼		NE	-						
Hammer Type: Auto					Rig Type: CME 75														
Sample Information							Depth (ft)	Strata	DESCRIPTION OF MATERIALS (Classification)						Remarks				
Depth (Feet)	Number	Type	Rec (in)	RQD %	Blows per 6" or drill time (mm:ss)												N		
0.5-2.0	S-1	SS	12	--	--	5	8	Surface Cover		6" Asphalt with no apparent subbase material									
					3	8													
2.0-4.0	S-2	SS	12	--	12	11	31	FILL		Dark brown and yellowish brown clay, some coarse to fine sand, moist (FILL)									
					20	50/4													
										As above (FILL)									
										Boring B-2 encountered refusal on apparent bedrock at approximately 3.8 feet below the ground surface.									



BOREHOLE LOG

Boring No : B-3

Page 1 of 1

Project: Proposed Site Improvements										Proj. No.: 2530-99-006E											
Location: 769 Northfield Ave, West Orange, Essex County, New Jersey										Client: Altera 769, LLC c/o Altera Development											
Surface Elevation: 467.0 feet					Date Started: 08-25-2021					Groundwater Data		Depth		El.		Additional Groundwater Data		Depth		El.	
Termination Depth: 12.0 feet					Date Completed: 08-25-2021							(ft)		(ft)				(ft)		(ft)	
Proposed Location: Proposed Building Addition					Logged by: J. Alvarez					While Drilling: ▽		NE		-							
Drill/Test Method: HSA/SPT					Contractor: Boring Brothers					At Completion: ▼		NE		-							
Hammer Type: Auto					Rig Type: CME 75																
Sample Information										Depth (ft)	Strata	DESCRIPTION OF MATERIALS (Classification)	Remarks								
Depth (Feet)	Number	Type	Rec (in)	RQD %	Blows per 6" or drill time (mm:ss)		N														
					--	8				Surface Cover	6" Asphalt with no apparent subbase material										
0.5-1.9	S-1	SS	6	--	6	50/5	56/11			FILL	Dark gray and light brown coarse to fine sand and gravel, asphalt millings, moist (FILL)										
2.0-7.0	C-1	RC	60	100	05:00		--			Rock	Gray very hard, very slightly weathered, basalt rock										
					05:00																
					03:00																
					05:00																
					03:00																
7.0-12.0	C-2	RC	53	88	05:00		--				As above										
					05:00																
					03:00																
					02:00																
					04:00																
											Boring B-3 was terminated at approximately 12 feet below the ground surface.										

Geotechnical Terms and Symbols



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GEOTECHNICAL TERMS AND SYMBOLS

SAMPLE IDENTIFICATION

The Unified Soil Classification System is used to identify the soil unless otherwise noted.

SOIL PROPERTY SYMBOLS

N: Standard Penetration Value: Blows per ft. or a 140 lb. hammer falling 30" on a 2" O.D. split-spoon.
Qu: Unconfined compressive strength, TSF.
Qp: Penetrometer value, unconfined compressive strength, TSF.
Mc: Moisture content, %
LL: Liquid limit, %
PI: Plasticity index, %
 δd : Natural dry density, PCF.
▼: Apparent groundwater level at time noted after completion of boring.
=

DRILLING AND SAMPLING SYMBOLS

NE: Not Encountered (Groundwater was not encountered)
SS: Split-Spoon – 1½" I.D., 2" O.D., except where noted
ST: Shelby Tube – 3" O.D., except where noted
AU: Auger Sample
OB: Diamond Bit
CB: Carbide Bit
WS: Washed Sample

RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

<u>Term (Non-Cohesive Soils)</u>	<u>Standard Penetration Resistance</u>
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

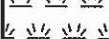
<u>Term (Cohesive Soils)</u>	<u>Qu (TSF)</u>
Very Soft	0-0.25
Soft	0.25-0.50
Firm (Medium)	0.50-1.00
Stiff	1.00-2.00
Very Stiff	2.00-4.00
Hard	4.00 +

PARTICLE SIZE

Boulders	8 in. +	Coarse Sand	5mm-0.6mm	Silt	0.074mm-0.005mm
Cobbles	8 in. – 3 in.	Medium Sand	0.6mm-0.2mm	Clay	- 0.005mm
Gravel	3 in. – 5mm	Fine Sand	0.2mm – 0.074mm		

USCS Standard Classification System

UNIFIED SOIL CLASSIFICATION SYSTEM - ASTM D2488

MAJOR DIVISION			GROUP SYMBOL	LETTER SYMBOL	GROUP NAME
COARSE GRAINED SOILS CONTAINS MORE THAN 50% FINES	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVEL WITH <u>* 5% FINES</u>		GW	Well-graded GRAVEL
				GP	Poorly graded GRAVEL
		GRAVEL WITH BETWEEN 5% AND 15% FINES		GW-GM	Well-graded GRAVEL with silt
				GW-GC	Well-graded GRAVEL with clay
				GP-GM	Poorly graded GRAVEL with silt
				GP-GC	Poorly graded GRAVEL with clay
		GRAVEL WITH ≥ 15% FINES		GM	Silty GRAVEL
				GC	Clayey GRAVEL
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SAND WITH <u>* 5% FINES</u>		SW	Well-graded SAND
				SP	Poorly graded SAND
		SAND WITH BETWEEN 5% AND 15% FINES		SW-SM	Well-graded SAND with silt
				SW-SC	Well-graded SAND with clay
				SP-SM	Poorly graded SAND with silt
				SP-SC	Poorly graded SAND with clay
		SAND WITH ≥ 15% FINES		SM	Silty SAND
				SC	Clayey SAND
FINE GRAINED SOILS CONTAINS MORE THAN 50% FINES	SILT AND CLAY	LIQUID LIMIT <u>LESS THAN 50</u>		ML	Inorganic SILT with low plasticity
				CL	Lean inorganic CLAY with low plasticity
				OL	Organic SILT with low plasticity
		LIQUID LIMIT <u>GREATER THAN 50</u>		MH	Elastic inorganic SILT with moderate to high plasticity
				CH	Fat inorganic CLAY with moderate to high plasticity
				OH	Organic SILT or CLAY with moderate to high plasticity
			HIGHLY ORGANIC SOILS		

NOTES:

- 1) Sample descriptions are based on visual field and laboratory observations using classification methods of ASTM D2488. Where laboratory data are available, classifications are in accordance with ASTM D2487.
- 2) Solid lines between soil descriptions indicate change in interpreted geologic unit. Dashed lines indicate stratigraphic change within the unit.
- 3) Fines are material passing the U.S. Std. #200 Sieve.