PART 1 - GENERAL

1.1 GENERAL

A. The following report furnished by the Owner describes the results of the subsurface investigation made on the site. It and the tabulated results of the borings are included for the Contractor's information only. The Contractor shall determine soil conditions and shall accept conditions as they exist.

B. The data on indicated subsurface conditions are not intended as representations of warranties of the continuity of such conditions between soil borings. It is expressly understood that the Owner will not be responsible for interpretations or conclusions drawn there from by the Contractor. The data are made available for the convenience of the Contractor.

END OF SECTION 000860

BARRON & ASSOCIATES, P.C.
10440 Main Street
Clarence, New York 14031

Tel: (716) 759-7821 www.barronandassociatespc.com Fax: (716) 759-7823

March 5, 2010 Job No: 10-510

Kideney Architects, P.C.
200 John James Audubon Parkway, Suite 303
Buffalo, New York 14228

ATTN: Mr. Glenn A. Pawloski, AIA

RE: Geotechnical Engineering Report
Proposed VA Hospital
Multi-Story Parking Ramp Structure
3495 Bailey Avenue (US Route 62)
City of Buffalo, Erie County, New York
(KA Job No. 2009040.00))

Gentlemen:

This report presents the findings of the subsurface investigation program and geotechnical engineering recommendations for the above referenced project. The geographic orientation of the project site is illustrated on the U.S. Geologic Survey (USGS) site location map in Figure No. 1. The project site is illustrated in Figure No. 2, entitled "Test Boring Location Plan", which includes: the approximate location of six test borings that were drilled by Buffalo Drilling Company, Inc. (BDC); relative ground surface elevations; and additional site details. As noted in Figure No. 2, the test boring locations were provided by the client. Borings B-1, B-2, B-4, and B-6 were moved slightly, from their original locations, due to the presence of underground utilities.

EXPLORATION METHODS

Sampling Method: A truck-mounted Diedrich D-50 rotary drill rig was used to drill six test borings to depths of approximately 32 to 40 feet below the ground surface by using 2-1/4 inch inside diameter (ID), continuous flight hollow stem augers. Samples were recovered by driving a standard split-spoon sampler (2-foot long by 1-3/8 inch inside diameter) 24 inches with a 140-pound hammer falling 30 inches per blow per the American Society of Testing and Materials (ASTM) Standard D 1586. The number of blows from six to 18 inches of penetration is defined as the Standard Penetration Test (SPT) N-value. Auger refusal, which may infer the top of bedrock, was encountered at four of the borings.

Any encountered groundwater conditions are documented in the field on the BDC driller's logs for each test boring. If indicators of groundwater are observed on the sampling equipment, the depth to

groundwater is also checked and measured through the hollow stem augers at the completion of the sampling efforts.

Classification/Identification: The retrieved soil and fill samples were initially logged in the field by the BDC driller, and a portion of each sample was placed and sealed in a glass jar. The boring logs, which are included in Appendix A, were based upon the field logs and a second visual classification/identification of recovered samples in the laboratory by a geologist. Classification/ identification of samples, as noted on the boring logs, is based on the Unified Soil Classification System (USCS) in ASTM D2487/D2488. Refer to Appendix B entitled, "Geotechnical Reference Standards", for an explanation of the terminology that is used for the soil and rock descriptions.

SITE AND SUBSURFACE CONDITIONS

General: The proposed site for development on the southern side of the existing 11-story Veterans Administration (VA) Hospital that is addressed as 3495 Bailey Avenue (US Route 62) in the City of Buffalo, Erie County, New York. As shown in Figure No. 2, the project site is accessible by Bailey Avenue on the west and LeBrun Road on the east. The site is currently an asphalt paved parking area. The topography generally slopes downward (by approximately four to ten feet) from the north to the south of the proposed development area.

Subsurface Soil/Fill Conditions: In general, subsurface conditions were noted to consist of thin asphalt pavement and subbase gravel veneers on a variably thick stiff to very stiff cohesive fill on a thick very stiff to hard silty clay glacial till over an apparent weathered limestone bedrock surface. The fill and natural soil types have been differentiated to the extent possible in this investigation.

In Figure No. 1, Main Street (NYS Route 5) is to the north and northwest of the project site and roughly defines the top of the Onondaga Escarpment; which was a resisting front to the advancing glaciers. On the top of the escarpment in this area, the depth to bedrock is generally shallow (i.e., five to 15 feet), except B&A is aware of anomalously deep soil conditions to the east of the project site and just south of the intersection of Niagara Falls Boulevard at Main Street (near the west corner of the State University of New York at Buffalo campus) that is west of the project site. The soil deposits, as is the depth to the apparent bedrock surface, are also unusually deep at the project site. It is uncertain if these other anomalously deep soil conditions are continuous, separate or inter-connected geologic features (that is, gouges, mini-glacially eroded valleys, or glacial stream cuts) relative to the project site.

The asphalt pavement ranged from approximately four to six inches thick, while the subbase gravel layer was approximately two inches thick. The topsoil thickness was not investigated and is expected to vary across the boundaries of the project site. Surficial and buried woody vegetation and all organic laden materials (e.g., topsoil layer) are unsuitable for load bearing conditions.

Beneath the asphalt pavement and subbase gravel at boring B-2, an apparent pocket of a granular fill was encountered and extended to approximately two feet below the ground surface. The granular fill consisted of a non-plastic, gravelly fine-sized to coarse-sized sand with lesser amounts of silt. The relative density of this moist gravelly sand was in a low-level medium dense state. Approvable granular fills that are in a loose to medium dense state can be improved with proper sorting of deleterious materials and oversized fractions (if present), properly conditioned (i.e., drying and blending), and thoroughly compacted, but will be dependant upon the silt content of the fill. The density states of silty fine-sized sand soil, if encountered, are sensitive to the moisture content level and are difficult to improve with compaction.

Beneath the asphalt pavement and subbase gravel and the granular fill at boring B-2, a cohesive fill was encountered and extended to approximately two foot (at boring B-4) to ten foot (at borings B-2 and B-3) depth below ground surface. The fill thickness increased from the west (at borings B-1 and B-4) to the east (at borings B-3 and B-6) across the project site. This slightly to moderately plastic silty clay fill generally contained lesser amounts of gravel and fine-sized to coarse-sized sand. Trace amounts of brick, asphalt, slag, and roots were also noted to be present in this fill. Except for the upper two feet of granular fill at boring B-2, the cohesive fill is believed to have originated from the earthwork construction efforts at the hospital. The cohesive fill is the excavated natural silty clay glacial till. The stiffness of the cohesive fill varied with depth and ranged from the stiff (N-values of 8 to 15) to hard (greater than 30) states. In part, the fill likely retained some of its stiffness characteristics from the originally deposited silty clay glacial till, but like many fills are subsequently placed in uncontrolled and uncompacted states. The split spoon sample recoveries at the lowest identified cohesive fill samples were also generally poor. This data, coupled with the construction practices at that time, would suggest that some of the original topsoil layer may not have been stripped at the deeper fill locations.

Beneath the cohesive fill at boring B-1, an approximate two foot thick pocket of naturally deposited cohesive soil was encountered and extended to approximately six feet below the ground surface (relative elevation of 87.6 feet). This cohesive soil is described as a moderately plastic silty clay soil that contains lesser amounts of fine-sized sand. This stiff silty clay soil was in a moist state.

Beneath the cohesive fill and natural silty clay soil (at boring B-1), an approximate 29 to 33 foot thick layer of a naturally deposited cohesive glacial till was present and extended the full depth drilled at all of the boring locations. This slightly to moderately plastic silty clay glacial till contained varying amounts of gravel and lesser amounts of fine-sized to coarse-sized sand. The consistency/stiffness of this moist silty clay glacial till was generally in the very stiff to hard states. The bottom ten feet of the silty clay glacial till was noted to be in a predominately very stiff state. Apparent pockets of a stiff state were present at the four to six foot depth range of boring B-5 and in the lower part of boring B-3. The

stiffnesses/consistencies (N-values) of the lower half of the natural silty clay glacial till are less than the upper half of the unit and are more erratic. Glacially compacted till would have increased or very high stiffness (N-values of 50+ to 100+) throughout its depth, whereas the silty clay till at the project site suggests that the glacial till mass may have been deposited from the glacier and/or was only partially compacted by the glacier. Pockets of even lower relative stiffness may be present. These lower and erratic N-values in the lower silty clay glacial till are susceptible to large differential settlements for heavily loaded (such as, the proposed parking ramp structure) shallow footings.

Within the glacial till, spoon refusal (i.e., N-values of 50+ to 100+) conditions were encountered and may also reflect a boulder/cobble condition. The ability to auger, with the drill rig, to these levels would suggest that the upper cobbles-boulders or weathered bedrock can be removed with conventional excavating equipment (e.g., backhoes, excavators, caisson/drilled pier drill rigs).

Bedrock: Auger refusal, which are generally inferred to be top of the apparent bedrock, was encountered at four of the test borings. The two at 40 foot bores (that is, B-2 and B-3) were not advanced to auger refusal, but this condition would have been expected to be encountered within a nominal depth of advancement. The apparent bedrock surface is approximately 32 to 43 feet below the ground surface (relative elevations of 56.6 to 55.1 feet). The apparent bedrock surface is relatively level, but dips slightly downward from the northwest to the southeast. No confirmatory rock cores were taken.

Based upon the regional geology, the site is immediately southwest of the Onondaga Escarpment and the Onondaga Limestone is the uppermost bedrock unit. However, glacial erosion is likely to have removed the Onondaga Limestone and, possibly, the immediately underlying thin Akron Dolostone, thereby, possibly, leaving the Bertie Limestone formation as the uppermost unit beneath the project site. The upper ten feet of this bedrock type is expected to be of poor quality (i.e., Rock Quality Designation [RQD] assumed to be 40 percent with a range of 30 to 65 percent). This upper Bertie Limestone is estimated to have a uniaxial compressive strength of 15 kips per square inch (ksi) with a range of 10 to 25 ksi. If present, it is assumed that the Onondaga Limestone or, more likely, the Akron Dolostone will have physical properties that are similar to the Bertie Limestone, but should be confirmed.

Groundwater: No appreciable amounts of groundwater were encountered at the test borings during drilling operations. An artesian (i.e., pressurized) groundwater condition from the fractured bedrock is not expected. The static groundwater level is believed more than 45 feet or more below the ground surface and in the upper ten feet of the bedrock unit. The regional topography (see Figure No. 1) suggests that the groundwater flow direction is from the southeast to the northwest, towards the

Onondaga Escarpment. Note also that the surficial granular fills, if present, are conducive to the creation of localized apparent perched groundwater table conditions.

Note that the groundwater readings were taken at completion of drilling efforts and, therefore, an adequate amount of time for the groundwater level to recharge to static conditions was probably not allowed. Fluctuations in the groundwater level may occur due to other factors than those present during field operations.

EARTHQUAKE/SEISMIC CONSIDERATIONS

Site Class Definition: For the given site conditions, the most applicable site definition is Site Class C, as listed in Table 1615.1.1 and Table 1615.1.5 of the Building Code of New York State, © 2007.

Liquefaction Potential: For the project site, the Site Class C design spectral response acceleration parameters S_{DS}, at 0.2 seconds, and S_{D1}, at one second, are 0.23g and 0.067g (g = 32.2 feet/sec^2), respectively, for this part of Erie County, New York. These values have a two percent probability of being exceeded in 50 years. Based upon the above conditions and an approximate magnitude 6.0 earthquake on the Richter Scale, the potential for liquefaction or settlement of the Site Class C soils is considered extremely low.

FOUNDATION DESIGN AND CONSTRUCTION RECOMMENDATIONS

General: This section will present and discuss recommendations on foundation design and construction, retaining walls, placement of controlled fills, and subgrade and base layer requirements for concrete slabs, paved parking and roadway areas.

As shown in Figure No. 2, the proposed development is to consist of a multi-story, slab-on-grade and concrete framed parking ramp structure on/near the southern side of the existing Veterans Administration Hospital. This structure is approximately 96,000 square feet in first floor (footprint) area. The existing ground surface generally slopes slightly downward from the north to the south of the development area.

For the purposes of this report, the proposed top of the parking ramp structure's finish first floor relative elevation is taken as 100 feet ±; which is the same as the immediately measured finish floor elevation of the existing hospital. The below grade floor relative elevation is expected to be variable and may range from 85 to 90 feet. The preliminary maximum exterior and interior column loads are expected to be 575 kips and 950 kips, respectively; which would suggest support by a deep foundation system. At the at grade level, several small and lightly loaded structural elements (with maximum design bearing wall loads of two to three kips/foot and/or column loads of 20 to 30 kips) may be considered in the proposed design and do not need to be founded on a deep foundation system. The maximum live floor loads in

the proposed parking ramp are taken as 50 pounds per square foot (psf) and the maximum wheel load is taken as 3,000 pounds. Certain small and lightly loaded structural elements of the proposed structure may have maximum live floor loads of 100 psf.

Site Preparation and Earthwork: General site preparation will include the demolition and complete removal of any encountered foundations and floor slabs, and removing all unsuitable surficial material (i.e., asphalt pavement, concrete, brick, expansive slag, organic or topsoil layer, and construction and demolition-like fill) to a depth where firm, granular or cohesive fills or naturally occurring soils are encountered. It is recommended, particularly in the location of the proposed structure, that any slag and/or cinder/ash containing material, if encountered, should be tested to determine the expansion and corrosion characteristics (where applicable for direct or potential contact with foundation elements and buried utilities) of these materials prior to their use on-site. Any rubble-like and brick fill, boulders, or wood fill in particular, if encountered, will require undercutting. The proposed structure's area is to be proof rolled with a fully loaded ten-wheel dump truck. All encountered soft and disturbed zones should be undercut and stabilized with granular fill that is placed in compacted lifts prior to placement of additional fill materials above. Refer to Appendix D entitled "General Earthwork Specification" for definition of the fill types and gradations, recommended minimum compaction requirements for various site developments, and placement and compaction methods. The NYS Department of Transportation (NYSDOT) specification numbers for typical aggregate subbase/base course components are Item No. 304.12 (Metric) Subbase Course, Type 2 (< 2 inch maximum size), which is preferred, or Item No. 304.14 (Metric) Subbase Course, Type 4 (< 2 inch maximum size).

As shown in Figure No. 2, the proposed site for development is currently unoccupied by any buildings/structures. Since cavities (from the footings, foundation walls, basements, and tanks, as encountered) would not remain, backfilling in compacted lifts with several feet of controlled select granular fill, such as a number two crusher run stone or with suitable stripped and approved on-site fill material, would not be required.

It is unknown if any former residential/commercial/industrial structures existed on the project site. It is unknown if any former footings and foundation walls may be buried at the proposed site. Septic tank locations and the abandonment conditions or practices are normally unknown. If encountered during site development, it is recommended that any tanks should be properly removed under the applicable local and state regulations. The remaining cavities, from the aforementioned items, should be backfilled with select/approved granular fill that is placed in compacted lifts.

Parking Ramp Structure Foundations and Slab Types: It is assumed that the existing hospital to the immediate north of the project site is either on a deep foundation system (e.g., concrete filled drilled piers) or on a shallow foundation that bears on a thin layer of very high (N-values of 50+) silty clay

glacial till layer overlying shallow bedrock and/or is on shallow bedrock. Due to the presence of the variable thickness of the cohesive fill, varying stiffness/consistency of the naturally deposited silty clay glacial till, potential differential settlement concerns and large proposed column loads, a deep foundation system (i.e., drilled piers) that bears on the weathered limestone bedrock is recommended for the proposed parking ramp structure. For the deep foundation system that bears on this weathered bedrock, a Seismic Site Class C is recommended.

No new fill appears to be required to raise the site grade beneath the proposed structure. Some excavation may be required for the lowest proposed parking ramp level. The compressibility properties of the very stiff cohesive fill and/or natural silty clay glacial till are not design concerns for a rigid pavement/slab-on-grade. If a conventional rigid pavement or concrete slab-on-grade is directly constructed on these conditions for the lowest proposed parking ramp level, differential settlements are expected to be within acceptable limits. Structural slab construction for the lowest proposed parking ramp level is not recommended.

For small (in area) and lightly loaded (2 to 3 kips/foot or 20 to 30 kips) structural elements at grade level, shallow footings that bear on approved deep very stiff or better cohesive fills are an acceptable foundation type. All fill materials beneath footings would, otherwise, be considered for removal to an approvable very stiff or better natural silty clay glacial till. A variable thickness of thin lifts of thoroughly compacted select/approved granular fill that extends to approved very stiff to hard naturally deposited silty clay soil/fill may be required. The shallow footing bearing capacity would be limited to 1,500 psf for the approvable subgrades. Total and differential settlements of less than one inch and 3/4^{ths} of an inch, respectively, are expected.

<u>Drilled Piers - Allowable Load Carrying Capacity</u>: Straight shaft drilled piers that are cast-in-place concrete, with or without grade beams, are recommended for the deep foundation system for the proposed structure. As based upon the subsurface data, the drilled piers are to bear on the weathered limestone unit (approximate relative elevations of 55 to 57 feet). The top of the piers are to be at a four foot minimum depth below final grade for the perimeter piers and two and one-half foot minimum depth below finished floor for the interior piers in heated areas or as recommended by the design structural engineer. A four foot minimum depth (as required by local or New York State code) is required to provide adequate protection from frost. The drilled pier lengths are expected to vary from approximately 28 to 40 feet. Since the site grade will not be raised, there are no negative skin friction effects.

The following capacities are based upon an exterior grade of 89.5 feet (south central side of parking ramp), a top of pier relative elevation of 85.5 feet and a pier bearing relative elevation of 56 feet.

Pier Diameter (feet):	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
Allowable Axial Base/End Load (kips):	280	395	530	685	860	1,050	1,260	1,490
Allowable Soil Pullout Resistance (kips):	91	114	137	160	182	205	228	251
Total Pier Buoyant Dead Weight (kips):	12	19	27	37	48	61	76	92

Two foot diameter is the minimum recommended pier diameter. For drilled piers from six to seven feet in diameter, the equivalent net allowable bearing capacity is recommended not to exceed 60,000 pounds per square foot (psf) of base area for the drilled piers. The allowable pullout/uplift soil resistance/load does not include the buoyant pier weight. For each six-inch increase in pier diameter, the allowable pullout/uplift soil resistance/load can be increased by 23 kips.

For drilled piers at the same bearing elevation as the above, exterior grade of 95.5 feet (northwest side of proposed parking ramp) and a top of pier relative elevation of 91.5 feet, the additional load increases to the above values are listed below. These values are the expected contributions for approximately six feet of the upper very stiff cohesive fill and the associated six feet of drilled pier length.

Pier Diameter (feet):	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
Added Allowable Axial Load (kips):	15	18	22	25	29	32	36	39
Added Allowable Soil Pullout (kips):	11	13	16	19	21	24	27	29
Added Pier Buoyant Dead Weight (kips):	3	4.5	6	8.5	11.5	14.5	17.5	21

Total and differential settlements of less than one inch and 3/4^{ths} of an inch, respectively, are expected for the above drilled piers. Refer to the engineering computations, which are included as Appendix C, for additional foundation design and construction details.

The concrete mix for the pier foundations is recommended to have a minimum 28-day unconfined compressive strength of 3,500 pounds per square inch (psi). Due to the expected low dissolved sulfate concentrations within the bedrock groundwater in this regional area and without actual field data, type I/II Portland cement, at a minimum, is recommended for this below grade construction that is on or within the bedrock. It is recommended that the bedrock groundwater quality should be tested in order to ensure that type II or V Portland cement is not required.

For lateral analysis of drilled piers, the horizontal coefficient/modulus/stiffness parameters are a function of the analytical method employed (i.e., p-y curves, Broms, Terzaghi's, etc.). In order to correlate with the selection of the proper horizontal parameter, the average design values of 2,700 psf for the unconsolidated undrained shearing strength and a density/unit weight of 120 pcf for the very stiff silty clay glacial till are recommended for a top of pier at relative elevation of 85.5 feet. For the p-y curve and Broms methods, the cyclic parameter is usually taken as 0.4 of the initial static parameter,

but this does not produce a multiple for the load-deflection response. The 2007 Building Code of New York State presents the allowable lateral pressures by soil type class in Table No. 1804.2. For the very stiff or better silty clay glacial till/fill, the Class 4 static value of 150 psf/foot depth would be more appropriate, rather than the Class 5 value of 100 psf/foot depth that would apply to these soil/fill types in a upper level medium stiff to stiff states.

The subsurface data suggests that the drilled holes would be constructed in the dry. Past regional and local site experience has shown that some groundwater may not be expected to emanate from the upper fractured bedrock unit, if the cohesive soil/glacial till layers are breeched. Groundwater may be entrapped within the lower, more pervious sand/silt glacial till unit, if encountered. These soil and groundwater conditions would be at the base of the pier and would suggest the use of pumping the excavation to a near dry condition or use of a drilling mud/slurry prior to concrete placement. The concrete would be placed by an approved tremie method in either an open cased hole or through a drilling mud/slurry.

The allowable end bearing capacity and other design capacities of the drilled piers may be modified upon the implementation and evaluation of confirmatory subsurface investigation program, at a minimum. Prior to the construction of the drilled pier foundations, the drilling contractor will take the existing conditions at his own risk or will verify the type, quality, consistency/relative density, and elevation of the soil and/or bedrock and of the groundwater (quality and quantity) conditions.

Additional Foundation Considerations: In addition to the above, the following recommendations will provide additional assurances with regard to proper foundation construction.

a) All fill placed beneath, adjacent, or above foundations must comply with the "General Earthwork Specification", included as Appendix D.
b) Backfill of foundations with approved select granular fill must be completed prior to placement of substantial superstructure loads, except for basement walls or substructure areas that may additionally require superstructure loads and possibly internal bracing.
c) The upper silty materials may rut and "pump" if exposed to excessive surface water and repeated construction traffic. Proper site management and fill placement operations are needed to minimize costly undercuts and subgrade repairs prior to placement of concrete slabs and asphalt pavement. It is noted that construction during wet/rainy and/or Fall and Spring conditions may require added precautions and possibly a thicker base layer to maintain a stable subgrade condition.
d) Step footings, if utilized, should have a rise to run ratio of 1:2, with a two-foot maximum rise and a four-foot minimum run between steps or as recommended by the design structural engineer.

Stabilization of Excavations: The trench/excavation sidewall stability concerns can be addressed with the Occupational Safety and Health Act (OSHA) requirements as set forth in Subpart P of 29 CFR Part 1926, Sections 1926.650 to 1926.652. In lieu of a properly designed shoring system, side slopes of the

trench excavation should be one on one (vertical to horizontal distance) or flatter in cohesive soils or one on one and one-half or flatter in the granular materials, as required by OSHA.

Water must not be allowed to accumulate or pond on exposed foundation bearing grades. Surface water and groundwater from within the excavation must be either pumped, diverted or channelized by gravity flow to effectuate the construction of the proposed foundation.

Retaining Walls: The retaining walls and grade beams are recommended to be supported by the drilled piers. While not unique design concerns, these retaining wall structures or other substructures, if considered, must be adequately designed and constructed to support horizontal soil pressures and surface loads. Refer to Appendix C and the following recommendations which will provide additional assurances with regard to proper design and construction of retaining walls and fixed/restrained walls.

a) At the location of the proposed structure, design the wall foundation based on the previously recommended maximum net allowable bearing capacity and bearing conditions.

b) Cantilever (such as, retaining) walls and fixed/restrained walls must be adequately designed and constructed to support horizontal soil pressures and surface loads.

c) Uniformly distributed surface surcharge loads should be applied at 100 percent of the load times the appropriate lateral earth pressure coefficient to the retaining wall. The lateral design stress on the wall is the sum of the equivalent lateral fluid pressure and other applied surface stresses and subsurface stresses (i.e., footings).

d) The recommended at rest (rigid wall), active, and passive static earth pressure coefficients for unsaturated, select granular sandy gravel fill against an earth retaining structure/wall are 0.76, 0.24, and 2.8 (with an ultimate value of 4.2), respectively. The respective equivalent static lateral fluid pressures are recommended to be 90, 30 and 330 (with an ultimate value of 500) pounds per square foot (psf) per foot depth, which are based upon a moist, compacted unit backfill weight of 120 pounds per cubic foot (pcf). The at rest value would account for the average expected compaction induced stresses and/or the potential influences of hydrostatic pressure. If a moist, compacted granular sandy silt or silty sand fill is used, the recommended active and passive static earth pressure coefficients are 0.33 and 2.0 (with an ultimate value of 3.0) and the equivalent static lateral fluid pressures are 45 and 270 (with an ultimate value of 405) psf per foot depth, which is based upon a unit backfill weight of 135 pcf. The static lateral fluid pressures can be directly proportioned for other unit weights.

e) For a soil/fill that is at or near a saturated/liquefied state, the equivalent static lateral fluid pressure on a wall from earthquake/seismic induced loading is recommended to be at least equal to the unit weight of the backfill. For unsaturated backfill conditions under earthquake/seismic induced loading, it is recommended that an additional (to the static) lateral load per foot of wall length (in pounds/foot) to a non-yielding wall will be located at 0.6 times the earth height behind the wall, as taken from the base of the wall, and will be equal to 6.8 times (for S_{ds} = 0.25g) to 13.5 times (for S_{ds} = 0.50g) the earth height squared behind the wall, in feet (for a soil backfill unit weight of 120 pcf and for Site Class C to E soils). As applied to yielding walls, these multiplying factors may be reduced by 33 percent. The earthquake/seismic lateral pressures or loads can be directly proportioned for other unit weights and S_{ds} values. Use a 1.75 multiplier to the earthquake/seismic lateral pressures or loads for walls bearing on Site Class B/A rock. Since non-yielding/rigid walls may move into the backfill, the equivalent lateral static fluid pressure for the static passive condition would also be a structural engineering design concern.

f) Lateral stresses from surface loading (such as, trucks) would not generally be a design concern if the load is transient and the loading is at a horizontal distance from the subsurface wall that is greater than the depth of the subsurface cavity. The geotechnical engineer should be consulted once the type and magnitude of the surface loading are identified.

g) The ultimate values of the friction factor or coefficient of sliding friction for the concrete footing of a retaining wall or foundation wall are recommended to be 0.35 on a silty sand/non-plastic sandy silt interface, 0.45 on non-plastic sand and gravel mixtures with less than five percent silt or on NYSDOT Item No. 304.12, Type 2 and Item No. 304.14, Type 4 gravel interfaces, and 0.60 if cast against a clean, sound and rough bedrock interface (which has a Factor of Safety = 1.0). Use a value of 0.5 for a smooth surface of either bedrock or if a dental concrete leveling course, without bonding reinforcing bars, is to be placed on the bedrock surface prior to casting the footing/foundation wall. For foundations on very stiff to hard natural cohesive soils, the cohesion/adhesion for sliding resistance is limited to 1,000 psf. The minimum recommended factor of safety against sliding is 1.5.

h) The minimum recommended factors of safety against overturning of a retaining wall are 1.5 for a clean/silt-free compacted granular backfill or for foundations on approved rock and 2.0 for a compacted cohesive backfill.

i) Relieve any hydrostatic or water pressure that develops behind the walls from in-flowing groundwater as is normally provided in practice. The exterior and interior sides of walls are to have a properly designed and installed dewatering system or as determined by the design civil/structural engineer.

Subgrade Soils and Vapor Barrier: For the most part and based on test results for similar soils/fills, the surficial medium stiff to low-level stiff and slightly to moderately plastic natural silty clay soil/fill may be somewhat difficult to compact in a controlled manner considering the natural moisture contents that are estimated to be at to wet of optimum at the time of this investigation. The excavated and approvable soil/fill types are expected to be available in limited quantities. The organic-free soil/fill types may be suitable for re-use as general fill with the implementation of sorting and removal methods for over-sized and deleterious materials, by uniformly applying soil conditioning methods (i.e., drying and blending), and with compaction, if additional volume of soil for wall backfill or for raising site grades is needed.

Excavated and approvable granular (i.e., sand or gravel and non-plastic sandy silt) natural soil/fill are not expected to be available in any reasonable quantities, except for the subbase gravel beneath the existing pavement. The amount of this granular fill is a function of the final grading/excavation plan and proposed floor system that is implemented. For the most part, granular (i.e., sand or gravel) soil/fill is expected to be acceptable for on-site re-use, as general/ordinary fill without substantial reworking and/or modification, while silty fine-sized sand to non-plastic sandy silt may first require drying and blending.

These previously discussed soils or dissimilar excavated materials should not be commingled prior to their use on-site, unless designated for a green area. General fill material is recommended to be placed on prepared and approved subgrade and in accordance with previous recommendations.

At the discretion of the design architect, a vapor barrier may be considered for use in the proposed structure. The use of a thin gravel cushion, as a capillary break, or a thin sand cushion over a vapor barrier that is placed beneath the concrete slabs are at the discretion of the design architect/engineer or as required by local code. Gradations of gravels that are satisfactory capillary breaks include 1 ¼-inch or ¾-inch crushed stone or aggregate per the ASTM D2321 Types IA, IB and II with less than 5 % fines. A number two crusher run stone may also be applicable, but the gradation and material property specifications must qualify.

It is assumed that there will be little change in the existing grade other than some minor excavation. It is reasonably assumed that some stiff/very stiff or better cohesive fill and/or upper natural silty clay glacial till will remain in-place as the top of pavement subgrades. The cohesive fill and silty clay glacial till would generally be expected to be compacted to 92% minimum of ASTM D 1557 and pass a proof roll. Areas of unsuitable material will be undercut and replaced with an approved material that will be compacted and proof rolled. Fills and buried organic layers, if encountered, are not suitable for load bearing purposes.

Parking Ramp Facility Paved Areas: The characteristics of the natural silt and clay soils/fills and the known frost penetration in Western New York requires that specific attention is provided to the design and construction of paved roadway and parking areas. For new pavement sections, isolated pockets of surficial silty/cohesive/fine-grained soil/fill may be encountered and may be too soft and wet in the proposed parking ramp area. These types of soil/fill may be adequately conditioned (i.e., dried and blended) and compacted to support necessary construction equipment and normal pavement section. Otherwise, the removal/undercutting of the silty/cohesive/fine-grained soil/fill to a firm, approved subgrade and subsequent placement and compaction of select or approved granular fill will be required in order to accommodate the recommended paved sections.

It is recommended that the subgrade surface is adequately graded and/or underdrains are installed to prevent water accumulation. Above the approved subgrade surface (i.e., minimum 92 percent compaction of ASTM D1557), a minimum eight-inch thick select granular layer is recommended as the base course for lightly loaded (that is, non-automotive and office type) areas. A geotextile filter and strength fabric (such as, Mirafi 600X or equal) and minimum 12-inch thick base course are recommended for all heavily traveled and parking areas (heavy duty section). The NYS Department of Transportation (NYSDOT) specification numbers for typical aggregate subbase/base course components are Item No. 304.12 (Metric) Subbase Course, Type 2 (< 2 inch maximum size), which is preferred, or Item No. 304.14 (Metric) Subbase Course, Type 4 (< 2 inch maximum size). The granular base layer is to be compacted to at least 95 percent of the ASTM D1557maximum dry density.

Portland cement concrete slabs should have minimum thicknesses of four inches for the lightly loaded areas and six inches for the heavy duty section or as determined by the design structural engineer. For the proposed parking ramp with the approvable cohesive fill in-place (92% min. of ASTM D 1557), the maximum effective modulus of subgrade reaction value at the top of the 12 inch minimum thick compacted select granular base course layer (95% min. of ASTM D 1557) is recommended not to exceed 150 pounds per cubic inch (pci) for concrete slab-on-grade design purposes. Similarly, for a top of subgrade at a relative elevation of 85 feet or slightly lower and consisting of the upper level very stiff to hard natural silty clay glacial till, the maximum effective modulus of subgrade reaction is recommended not to exceed 375 pci. A Poission Ratio of 0.4 is recommended.

Limitations, Field Inspections and Monitoring: This report is based on the preliminary information that is provided by project representatives and the subsurface conditions that were encountered at the test boring locations. Due to the nature of the investigation method, test pit excavation will provide a greater level of delineation of the subsurface soil/fill conditions than can be defined by the test boring data alone. As detailed in Appendix E "Limitations", modification regarding proposed building/structure location and other site developments can result in changes to provided recommendations. It is recommended that the geotechnical engineer be provided the opportunity to generally review the final detailed design and contract specifications. Required earthwork and foundation construction should be done under the supervision of experienced construction personnel and in a manner consistent with proven methods. All site work should be carefully monitored and tested by experienced geotechnical personnel to assure compliance with earthwork and foundation construction specifications.

Thank you for the opportunity to assist on this project. If questions should arise, please call the undersigned at your earliest convenience.

Very truly yours,
BARRON & ASSOCIATES, INC.
and
BUFFALO DRILLING COMPANY, INC.

James S. Barron, P.E.
President/Geotechnical Engineer

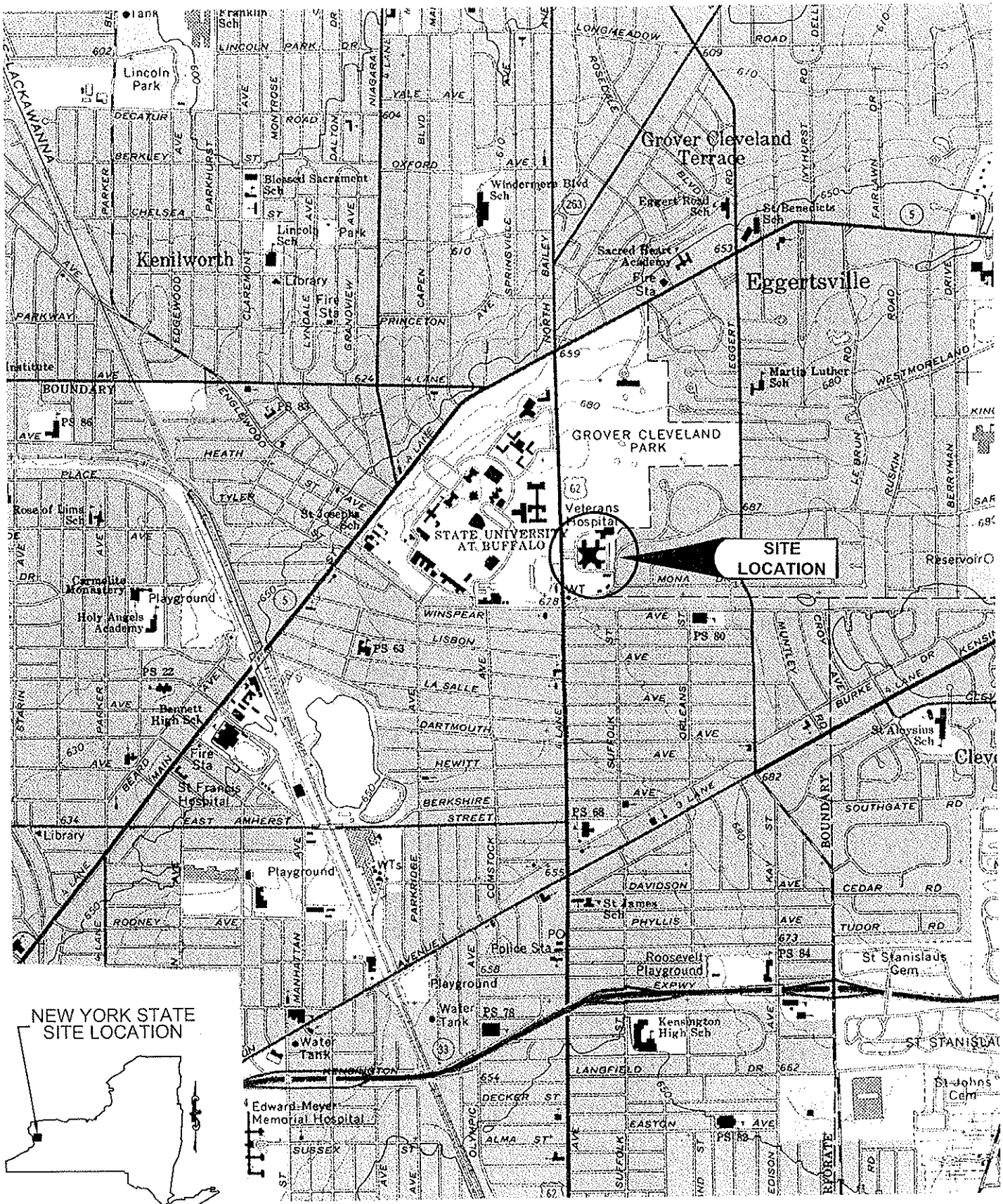
STATE OF NEW YORK
JAMES S. BARRON
58612
LICENSED PROFESSIONAL ENGINEER

3.9.10

Carmen M. Panuccio
Geotechnical Engineer

Z:\Reports\Geotech. & Sp. Insp. Reports\Wpp10\10-510.doc

www.barronandassociatespc.com



BARRON & ASSOCIATES, P.C. & BUFFALO DRILLING COMPANY
10440 MAIN ST.
CLARENCE, NY 14031
(716)759-7821
FAX (716)759-7823
INFO@BUFFALODRILLING.COM
INFO@BARRONANDASSOCIATESPC.COM

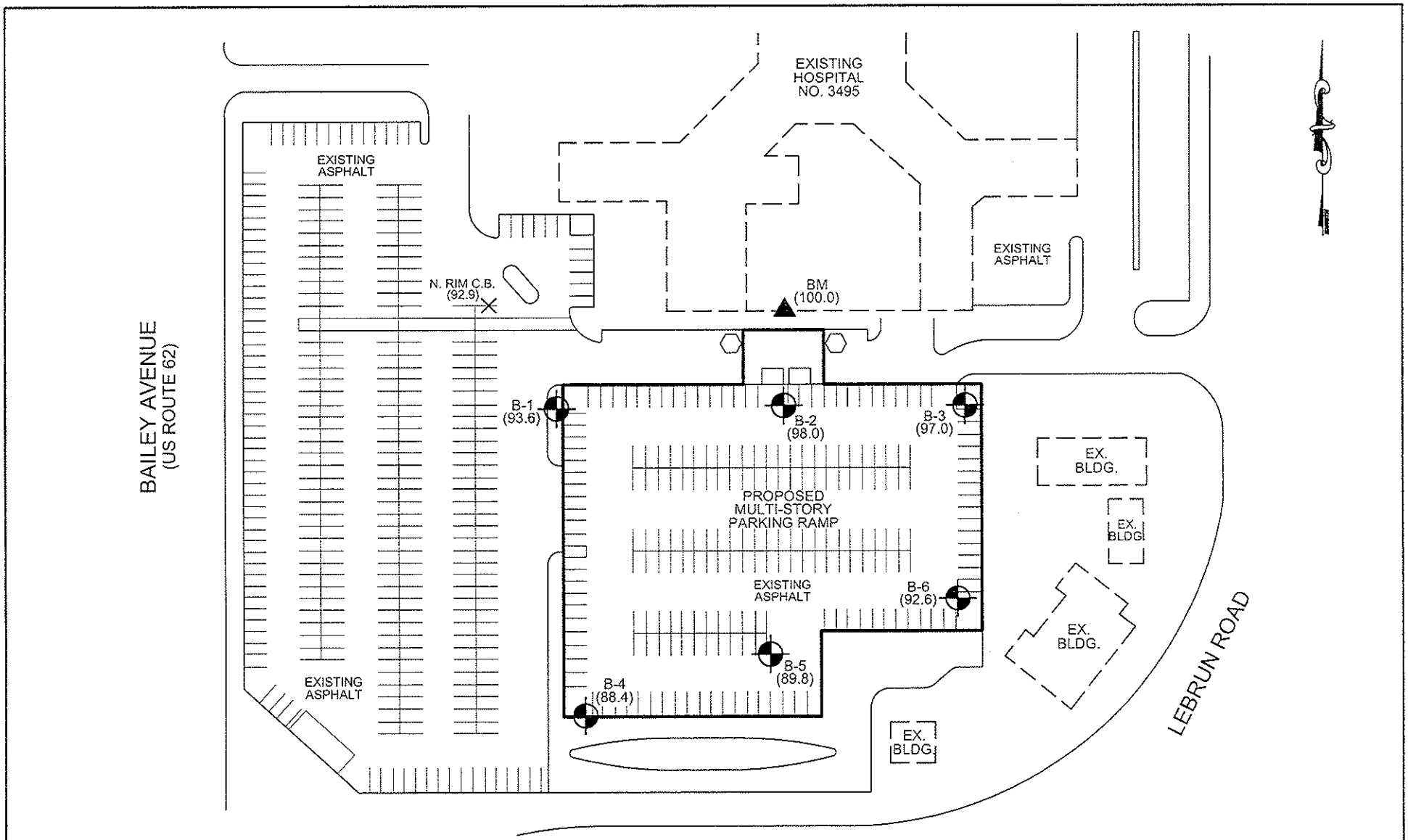
DRAWN: DAN KASPROWICZ

CLIENT: KIDENEY ARCHITECTS, P.C.
200 JOHN JAMES AUDUBON PARKWAY
BUFFALO, NEW YORK 14228

PROJECT: PROPOSED VA HOSPITAL
MULTI-STORY PARKING RAMP STRUCTURE
3495 BAILEY AVENUE (US ROUTE 62)
BUFFALO, ERIE CO., NEW YORK 14215

USGS SITE LOCATION PLAN
BUFFALO NE, N.Y. QUAD
1965

JOB NO.: 10-510	SCALE: 1" = 2000' ±
DATE: 3/1/2010	FIGURE NO. 1



LEGEND		
⌖	B-2	= TEST BORING & NO.
	(98.0)	= RELATIVE GROUND SURFACE ELEVATION (FT.)
×		= SPOT ELEVATION
▲	BM	= BENCH MARK (FINISH FLOOR OF EXISTING BUILDING)

NOTES:

1. BORINGS, BUILDINGS, SITE FEATURES, PROPERTY LINE LOCATIONS, AND SCALE OF DRAWING ARE APPROXIMATE.
2. BASE MAP REFERENCE AND BORING LOCATIONS PROVIDED BY KIDENEY ARCHITECTS, TITLED "TEST BORING PLAN - BUFFALO VA PARKING RAMP DESIGN", B-1, UNDATED.

BARRON & ASSOCIATES, P.C. & BUFFALO DRILLING COMPANY
10440 MAIN ST.
CLARENCE, NY 14031
(716)759-7821
FAX (716)759-7823
INFO@BUFFALODRILLING.COM
INFO@BARRONANDASSOCIATESPC.COM

DRAWN: DAN KASPROWICZ

CLIENT: KIDENEY ARCHITECTS, P.C.
200 JOHN JAMES AUDUBON PARKWAY
BUFFALO, NEW YORK 14228

PROJECT: PROPOSED VA HOSPITAL
MULTI-STORY PARKING RAMP STRUCTURE
3495 BAILEY AVENUE (US ROUTE 62)
BUFFALO, ERIE CO., NEW YORK 14215

TEST BORING LOCATION PLAN

0 60 120 240

JOB NO.: 10-510	SCALE: 1" = 120' ±
DATE: 3/1/2010	FIGURE NO. 2

BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY. INC.
10440 MAIN STREET
CLARENCE, N.Y. 14031
(716) 759-7821
FAX (716) 759-7823
e-mail: info@buffalodrilling.com
info@barronandassociatespc.com

APPENDIX A

TEST BORING LOGS

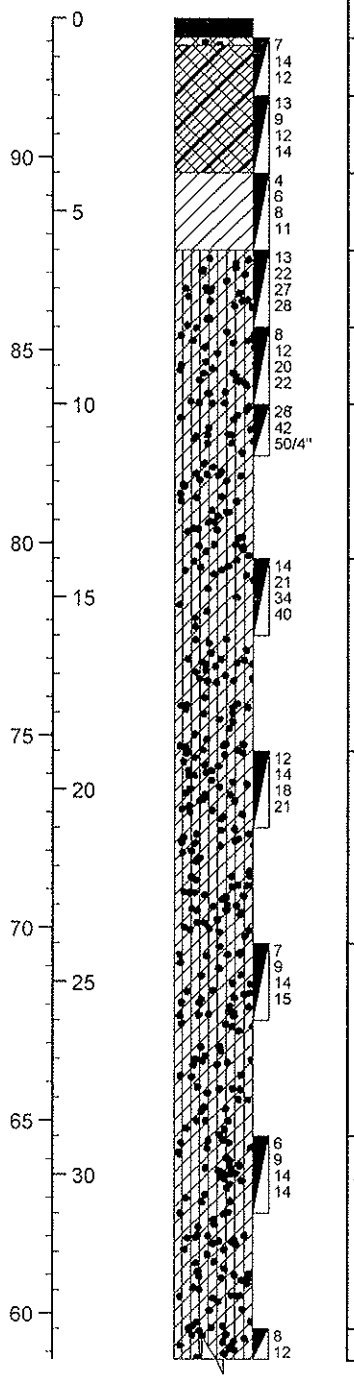
BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY, INC.
10440 MAIN STREET
CLARENCE, NEW YORK 14031
(716) 759-7821 FAX: (716) 759-7823

TEST BORING LOG

JOB No.: 10-510 **BORING No.:** B-1

PROJECT: Proposed VA Hospital Multi-Story Parking Ramp Structure
3495 Bailey Avenue, Buffalo, Erie Co., New York 14215

DRILLER:	C. Weaver	**TYPE OF DRILL RIG:**	Diedrich D-50 (Truck)
SAMPLING METHODS:	ASTM D1586	**SIZE AND TYPE OF BIT:**	2 1/4" I.D. H.S.A.
DATE STARTED:	2/15/10	**SURFACE ELEVATION (ft.):**	93.6
DATE COMPLETED:	2/15/10	**GROUNDWATER DEPTH (ft.):** (measured at completion unless indicated below)	None



Elevation/ Depth (feet)	Soil Symbols Sampler Symbols Field Test Data	Sample No. : Range	N-Value	% REC (RQD)	Soil and Rock Description / Remarks
					Asphalt (6")
					Base Stone (2")
		S-1 : 0.5'- 2.0'	26	15	Gray/brown, v. stiff Clay, some Silt, little Gravel, little f/c Sand, sl./ mod. plastic, moist (CL-Fill)
		S-2 : 2.0'- 4.0'	21	75	...grade: Dk. brown, tr. Asphalt, tr. Roots
		S-3 : 4.0'- 6.0'	14	75	Brown, stiff CLAY, some Silt, little f. Sand, mod. plastic, moist (CL)
		S-4 : 6.0'- 8.0'	49	90	Gray/brown, hard CLAY, some silt, little Gravel, little f/c Sand, sl./ mod. plastic, moist (CL-Till)
		S-5 : 8.0'- 10.0'	32	100	Same as S-4
		S-6 : 10.0'- 11.3'	92+	75	...grade: some Gravel
		S-7 : 14.0'- 16.0'	55	15	Same as S-6
		S-8 : 19.0'- 21.0'	32	50	...grade: little Gravel
		S-9 : 24.0'- 26.0'	23	100	...grade: v. stiff, tr. f/c Sand
		S-10 : 29.0'- 31.0'	23	90	Same as S-9
					Same as S-9

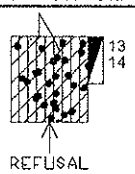
Logged by: B. Smith

BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY, INC.
10440 MAIN STREET
CLARENCE, NEW YORK 14031
(716) 759-7821 FAX: (716) 759-7823

TEST BORING LOG (CONTINUATION)

JOB No.: 10-510 **BORING No.:** B-1

PROJECT: Proposed VA Hospital Multi-Story Parking Ramp Structure
3495 Bailey Avenue, Buffalo, Erie Co., New York 14215

Elevation/ Depth (feet)	Soil Symbols Sampler Symbols Field Test Data	Sample No. : Range	N-Value	% REC (RQD)	Soil and Rock Description / Remarks
35		S-11 : 34.0'- 36.0'	25	100	
55, 40, 50, 45, 45, 50, 40, 55, 35, 60, 30, 65, 25, 70, 20, 75					Depth to Bottom of Hole: 37.0 feet

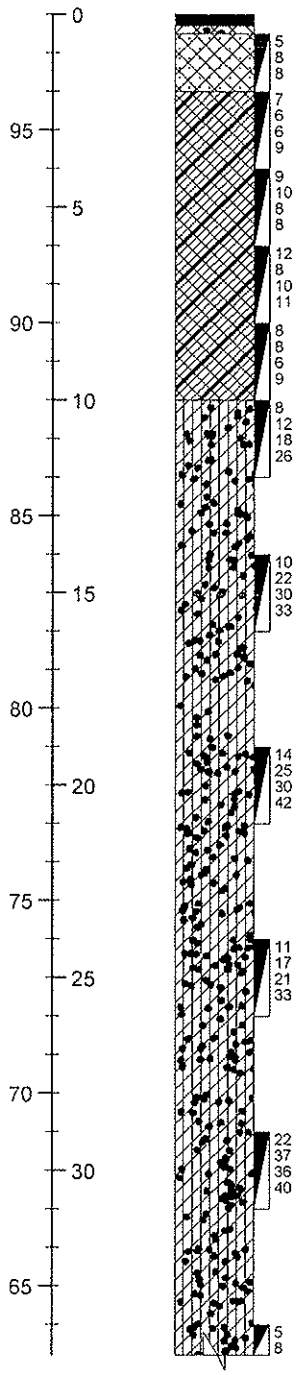
BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY, INC.
10440 MAIN STREET
CLARENCE, NEW YORK 14031
(716) 759-7821 FAX: (716) 759-7823

TEST BORING LOG

JOB No.: 10-510 **BORING No.:** B-2

PROJECT: Proposed VA Hospital Multi-Story Parking Ramp Structure
3495 Bailey Avenue, Buffalo, Erie Co., New York 14215

DRILLER:	C. Weaver	**TYPE OF DRILL RIG:**	Diedrich D-50 (Truck)
SAMPLING METHODS:	ASTM D1586	**SIZE AND TYPE OF BIT:**	2 1/4" I.D. H.S.A.
DATE STARTED:	2/15/10	**SURFACE ELEVATION (ft.):**	98.0
DATE COMPLETED:	2/15/10	**GROUNDWATER DEPTH (ft.):** (measured at completion unless indicated below)	None



Elevation/ Depth (feet)	Soil Symbols Sampler Symbols Field Test Data	Sample No. : Range	N-Value	% REC (RQD)	Soil and Rock Description / Remarks
					Asphalt (4")
					Base Stone (2")
		S-1 : 0.5'- 2.0'	16	5	Gray/brown, m. dense f/c Sand, some Gravel, little Silt, moist (SW-SM-Fill)
		S-2 : 2.0'- 4.0'	12	15	Gray/brown, stiff Clay, some Silt, little Gravel, little f/c Sand, sl./mod. plastic, moist (CL-Fill)
		S-3 : 4.0'- 6.0'	18	70	...grade: v. stiff
		S-4 : 6.0'- 8.0'	18	75	Same as S-3
		S-5 : 8.0'- 10.0'	14	80	...grade: stiff, little Brick
		S-6 : 10.0'- 12.0'	30	75	Gray/brown, v. stiff CLAY, some Silt, little Gravel, little f/c Sand, sl. / mod. plastic, moist (CL-Till)
		S-7 : 14.0'- 16.0'	52	100	...grade: hard, some Gravel
		S-8 : 19.0'- 21.0'	55	90	Same as S-7
		S-9 : 24.0'- 26.0'	38	80	Same as S-7
		S-10 : 29.0'- 31.0'	73	0	Same as S-7 (No Sample)
					...grade: v. stiff, tr. f/c Sand

Logged by: B. Smith

BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY, INC.
10440 MAIN STREET
CLARENCE, NEW YORK 14031
(716) 759-7821 FAX: (716) 759-7823

TEST BORING LOG (CONTINUATION)

JOB No.: 10-510 **BORING No.:** B-2

PROJECT: Proposed VA Hospital Multi-Story Parking Ramp Structure
3495 Bailey Avenue, Buffalo, Erie Co., New York 14215

Elevation/ Depth (feet)	Soil Symbols Sampler Symbols Field Test Data	Sample No. : Range	N-Value	% REC (RQD)	Soil and Rock Description / Remarks
35	14 16	S-11 : 34.0'- 36.0'	22	100	
60	9 12 12 14	S-12 : 38.0'- 40.0'	24	70	Same as S-11
40					Depth to Bottom of Hole: 40.0 feet
55					
45					
50					
50					
45					
55					
40					
60					
35					
65					
30					
70					
25					
75					

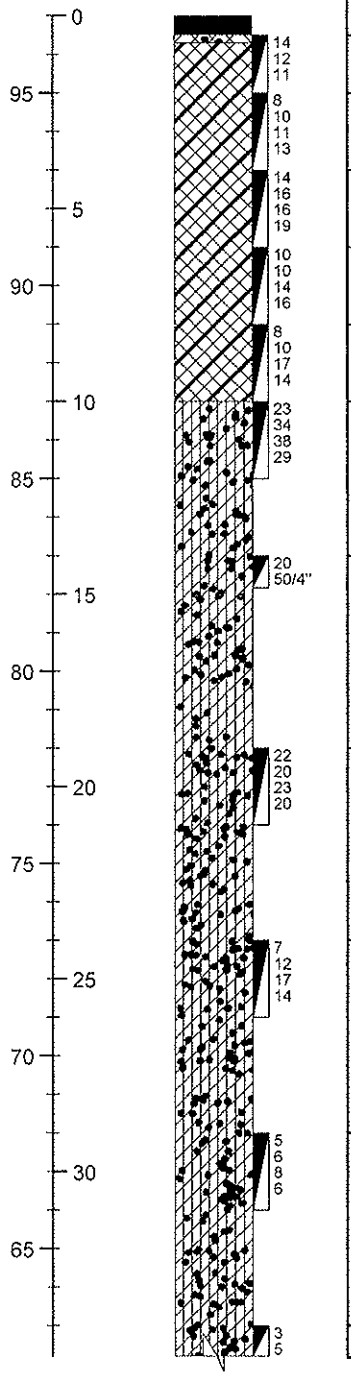
BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY, INC.
10440 MAIN STREET
CLARENCE, NEW YORK 14031
(716) 759-7821 FAX: (716) 759-7823

TEST BORING LOG

JOB No.: 10-510 **BORING No.:** B-3

PROJECT: Proposed VA Hospital Multi-Story Parking Ramp Structure
3495 Bailey Avenue, Buffalo, Erie Co., New York 14215

DRILLER:	C. Weaver	**TYPE OF DRILL RIG:**	Diedrich D-50 (Truck)
SAMPLING METHODS:	ASTM D1586	**SIZE AND TYPE OF BIT:**	2 1/4" I.D. H.S.A.
DATE STARTED:	2/15/10	**SURFACE ELEVATION (ft.):**	97.0
DATE COMPLETED:	2/15/10	**GROUNDWATER DEPTH (ft.):** (measured at completion unless indicated below)	None



Elevation/ Depth (feet)	Soil Symbols Sampler Symbols Field Test Data	Sample No. : Range	N-Value	% REC (RQD)	Soil and Rock Description / Remarks
					Asphalt (6")
					Base Stone (2")
		S-1 : 0.5'- 2.0'	23	40	Gray/brown, v. stiff Clay, some Silt, little Gravel, little f/c Sand, sl. / mod. plastic, moist (CL-Fill)
		S-2 : 2.0'- 4.0'	21	50	Same as S-1
		S-3 : 4.0'- 6.0'	32	60	...grade: hard
		S-4 : 6.0'- 8.0'	24	75	...grade: Dk. brown, v. stiff, tr. Gravel, tr. Roots
		S-5 : 8.0'- 10.0'	27	20	...grade: Gray/brown, tr. Slag
		S-6 : 10.0'- 12.0'	72	95	Gray/brown, hard CLAY, some Silt, little Gravel, little f/c Sand, sl./ mod. plastic, moist (CL-Till)
		S-7 : 14.0'- 14.8'	50+	0	Same as S-6 (No Sample)
		S-8 : 19.0'- 21.0'	43	90	Same as S-6
		S-9 : 24.0'- 26.0'	29	0	...grade: v. stiff (No Sample)
		S-10 : 29.0'- 31.0'	14	90	...grade: stiff, tr. f/c Sand
					Same as S-10

Logged by: B. Smith

BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY, INC.
10440 MAIN STREET
CLARENCE, NEW YORK 14031
(716) 759-7821 FAX: (716) 759-7823

TEST BORING LOG (CONTINUATION)

JOB No.: 10-510 **BORING No.:** B-3

PROJECT: Proposed VA Hospital Multi-Story Parking Ramp Structure
3495 Bailey Avenue, Buffalo, Erie Co., New York 14215

Elevation/ Depth (feet)	Soil Symbols Sampler Symbols Field Test Data	Sample No. : Range	N-Value	% REC (RQD)	Soil and Rock Description / Remarks
35	9 14	S-11 : 34.0'- 36.0'	14	60	
60					
	8 8 14 16	S-12 : 38.0'- 40.0'	22	65	...grade: v. stiff
40					
55					Depth to Bottom of Hole: 40.0 feet
45					
50					
50					
45					
55					
40					
60					
35					
65					
30					
70					
25					
75					
20					

BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY, INC.
10440 MAIN STREET
CLARENCE, NEW YORK 14031
(716) 759-7821 FAX: (716) 759-7823

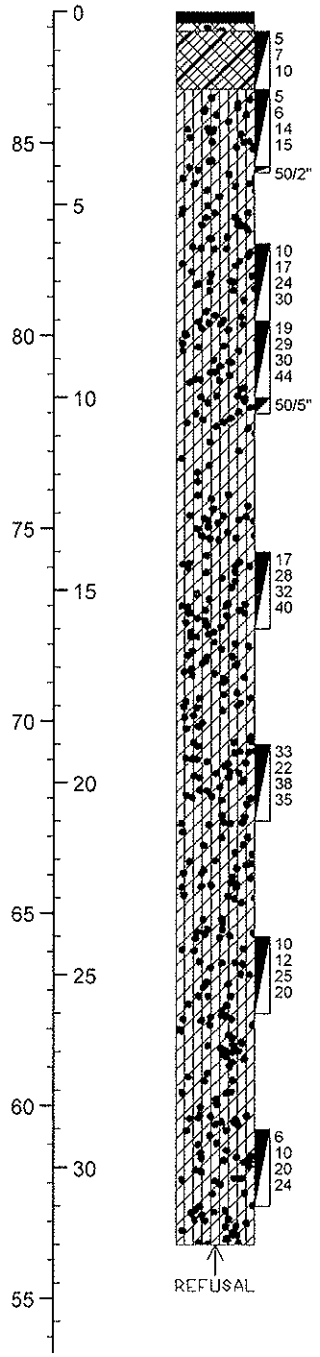
TEST BORING LOG

JOB No.: 10-510 **BORING No.:** B-4

PROJECT: Proposed VA Hospital Multi-Story Parking Ramp Structure
3495 Bailey Avenue, Buffalo, Erie Co., New York 14215

DRILLER:	C. Weaver	**TYPE OF DRILL RIG:**	Diedrich D-50 (Truck)
SAMPLING METHODS:	ASTM D1586	**SIZE AND TYPE OF BIT:**	2 1/4" I.D. H.S.A.
DATE STARTED:	2/18/10	**SURFACE ELEVATION (ft.):**	88.4
DATE COMPLETED:	2/18/10	**GROUNDWATER DEPTH (ft.):** (measured at completion unless indicated below)	None

Elevation/ Depth (feet) | Soil Symbols Sampler Symbols Field Test Data



Sample No. : Range	N-Value	% REC (RQD)	Soil and Rock Description / Remarks
			Asphalt (4")
			Base Stone (2")
S-1 : 0.5'- 2.0'	17	10	Dk. brown, v. stiff Clay, some Silt, little Gravel, little f/c Sand, tr. Asphalt, sl./mod. plastic, moist (CL-Fill)
S-2 : 2.0'- 4.0'	20	40	Brown, v. stiff CLAY, some Silt, little Gravel, little f/c Sand, sl./mod. plastic, moist (CL-Till)
S-3 : 4.0'- 4.2'	50+	0	...grade: hard (No Sample)
S-4 : 6.0'- 8.0'	41	100	Same as S-3
S-5 : 8.0'- 10.0'	59	100	Same as S-3
S-6 : 10.0'- 10.4'	50+	50	Same as S-3
S-7 : 14.0'- 16.0'	60	95	Same as S-3
S-8 : 19.0'- 21.0'	60	75	Same as S-3
S-9 : 24.0'- 26.0'	37	75	...grade: tr. f/c Sand
S-10 : 29.0'- 31.0'	30	100	...grade: v. stiff
			Depth to Bottom of Hole: 32.0 feet

Logged by: B. Smith

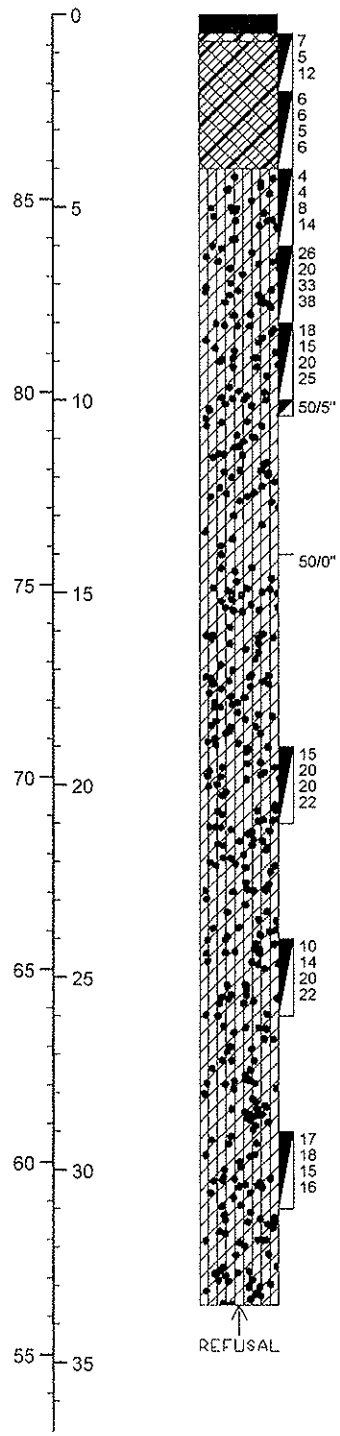
BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY, INC.
10440 MAIN STREET
CLARENCE, NEW YORK 14031
(716) 759-7821 FAX: (716) 759-7823

TEST BORING LOG

JOB No.: 10-510 **BORING No.:** B-5

PROJECT: Proposed VA Hospital Multi-Story Parking Ramp Structure
3495 Bailey Avenue, Buffalo, Erie Co., New York 14215

DRILLER:	C. Weaver	**TYPE OF DRILL RIG:**	Diedrich D-50 (Truck)
SAMPLING METHODS:	ASTM D1586	**SIZE AND TYPE OF BIT:**	2 1/4" I.D. H.S.A.
DATE STARTED:	2/18/10	**SURFACE ELEVATION (FT):**	89.8
DATE COMPLETED:	2/18/10	**GROUNDWATER DEPTH (FT):** (measured at completion unless indicated below)	None



Elevation/ Depth	Soil Symbols Sampler Symbols Field Test Data	Sample No. : Range	N-Value	% REC (RQD)	Soil and Rock Description / Remarks
					Asphalt (6")
					Base Stone (2")
		S-1 : 0.5' - 2.0'	17	20	Dk. brown, v. stiff Clay, some Silt, little Gravel, little f/c Sand, tr. Slag, tr. Brick, sl./mod. plastic, moist (CL-Fill)
		S-2 : 2.0' - 4.0'	11	70	...grade: stiff
		S-3 : 4.0' - 6.0'	12	70	Gray/brown, stiff CLAY, some Silt, little Gravel, little f/c Sand, sl./ mod. plastic, moist (CL-Till)
		S-4 : 6.0' - 8.0'	53	75	...grade: hard
		S-5 : 8.0' - 10.0'	35	5	Same as S-4
		S-6 : 10.0' - 10.4'	50+	0	Same as S-4 (No Sample)
		S-7 : 14.0' - 14.0'	50+	0	Same as S-4 (No Sample)
		S-8 : 19.0' - 21.0'	40	60	Same as S-4
		S-9 : 24.0' - 26.0'	34	70	...grade: tr. f/c Sand
		S-10 : 29.0' - 31.0'	33	45	Same as S-9
					Depth to Bottom of Hole: 33.5 feet

Logged by: B. Smith

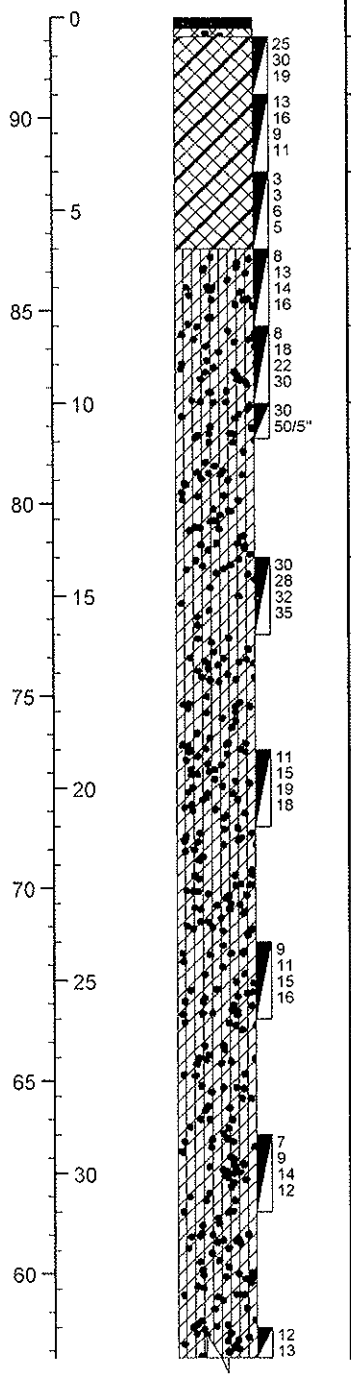
BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY, INC.
10440 MAIN STREET
CLARENCE, NEW YORK 14031
(716) 759-7821 FAX: (716) 759-7823

TEST BORING LOG

JOB No.: 10-510 **BORING No.:** B-6

PROJECT: Proposed VA Hospital Multi-Story Parking Ramp Structure
3495 Bailey Avenue, Buffalo, Erie Co., New York 14215

DRILLER:	C. Weaver	**TYPE OF DRILL RIG:**	Diedrich D-50 (Truck)
SAMPLING METHODS:	ASTM D1586	**SIZE AND TYPE OF BIT:**	2 1/4" I.D. H.S.A.
DATE STARTED:	2/16/10	**SURFACE ELEVATION (ft.):**	92.6
DATE COMPLETED:	2/16/10	**GROUNDWATER DEPTH (ft.):** (measured at completion unless indicated below)	None



Sample No. : Range	N-Value	% REC (RQD)	Soil and Rock Description / Remarks
			Asphalt (4")
			Base Stone (2")
S-1 : 0.5'- 2.0'	49	40	Brown, hard Clay, some Silt, little Gravel, little f/c Sand, sl./mod. plastic, moist (CL-Fill)
S-2 : 2.0'- 4.0'	25	60	...grade: v. stiff
S-3 : 4.0'- 6.0'	9	15	...grade: Dk. brown, stiff, tr. Plastic, tr. Roots
S-4 : 6.0'- 8.0'	27	80	Gay/brown, v. stiff CLAY, some Silt, little Gravel, little f/c Sand, sl./ mod. plastic, moist (CL-Till)
S-5 : 8.0'- 10.0'	40	95	...grade: hard
S-6 : 10.0'- 10.9'	50+	80	Same as S-5
S-7 : 14.0'- 16.0'	60	60	Same as S-5
S-8 : 19.0'- 21.0'	34	75	Same as S-5
S-9 : 24.0'- 26.0'	26	90	...grade: v. stiff, tr. f/c Sand
S-10 : 29.0'- 31.0'	23	50	Same as S-9
			...grade: hard (No Sample)

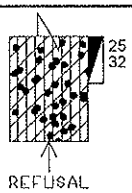
Logged by: B. Smith

BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY, INC.
10440 MAIN STREET
CLARENCE, NEW YORK 14031
(716) 759-7821 FAX: (716) 759-7823

TEST BORING LOG (CONTINUATION)

JOB No.: 10-510 **BORING No.:** B-6

PROJECT: Proposed VA Hospital Multi-Story Parking Ramp Structure
3495 Bailey Avenue, Buffalo, Erie Co., New York 14215

Elevation/ Depth (feet)	Soil Symbols Sampler Symbols Field Test Data	Sample No. : Range	N-Value	% REC (RQD)	Soil and Rock Description / Remarks
35		S-11 : 34.0'- 36.0'	38	0	
55					Depth to Bottom of Hole: 37.5 feet
40					
50					
45					
45					
50					
40					
55					
35					
60					
30					
65					
25					
70					
20					
75					

BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY. INC.
10440 MAIN STREET
CLARENCE, N.Y. 14031
(716) 759-7821
FAX (716) 759-7823
e-mail: info@buffalodrilling.com
info@barronandassociatespc.com

APPENDIX B

GEOTECHNICAL REFERENCE STANDARDS

GEOTECHNICAL REFERENCE STANDARDS
SUMMARY OF LOGGING TECHNIQUES

Depth (feet)	Blows per 0.5 foot	Sample No.	N	% REC (RQD)	SOIL AND ROCK DESCRIPTION	Remarks

DEPTH: This column provides the verticle scale of the boring log in feet below ground surface.

BLOWS: The number of blows obtained from each of the 0.5-foot intervals of sampler penetration.

Note:
WR = static weight of drill rods.
WH = static weight of rods and hammer.

SAMPLE IDENTIFICATION NUMBER:
An "S" preceding the sample number identifies a Disturbed Sample.
A "U" preceding the sample number identifies an Undisturbed Sample (Shelby tube).
A "C" preceding the sample number identifies a Rock Core Sample.

% RECOVERY: The length of sample recovered divided by the total length sampled. The result is a numerically-expressed percentage.

(RQD): "Rock Quality Designation" The total length of pieces > 4 inches divided by the total length of core run.

N-VALUE: The Standard Penetration Test N-Value, as specified by ASTM D1586 is defined as the number of blows required by a 140-pound hammer falling 30 inches per blow to drive a 2-inch outside diameter split spoon sampler 12 inches.

TERMINOLOGY USED FOR SOIL DESCRIPTION

Density Description of Granular Soil

Number of Blows per foot, N	Relative Density
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium
30 - 50	Dense
Over 50	Very Dense

Consistency Description of Cohesive Soil

Number of Blows per foot, N	Consistency
Below 2	Very soft
2 - 4	Soft
4 - 8	Medium
8 - 15	Stiff
15 - 30	Very Stiff
Over 30	Hard

Grain Size

Boulder	-	greater than 12-inch diameter
Cobble	-	passing 12-inch, retained on 3-inch.
Gravel	-	passing 3-inch, retained on No. 4 sieve
Sand	- Coarse	passing No. 4 sieve, retained on No. 10 sieve
	- Medium	passing No. 10 sieve, retained on No. 40 sieve
	- Fine	passing No. 40 sieve, retained on No. 200 sieve
Silt	-	0.074 mm to 0.005 mm
Clay	-	smaller than 0.005 mm

Description of Percentage or Proportions Used in Soil Sample Classification

Trace	0 - 10 %
Little	10 - 20 %
Some	20 - 35 %
And	35 - 50 %

Abbreviations Used In Soil Sample Classification

f	- fine	v	- very
m	- medium	gr	- gray
c	- coarse	bn	- brown
f/m	- fine to medium	yel	- yellow
f/c	- fine to coarse	sl	- slight
tr	- trace		

Plasticity

Non-plastic	- A 1/8-inch thread cannot be rolled at any water content.
Slight Plasticity	- The thread can barely be rolled.
Moderate Plasticity	- Thread is easy to roll and little time is required to reach plastic limit.
Plastic	- Considerable time is required to reach plastic limit. Thread can be re-rolled several times after reaching the plastic limit.

Moisture

Dry	- Absence of moisture, dusty, dry to the touch.
Moist	- Small quantity of moisture. Soil usually above groundwater level.
Wet	- Moisture noticeable to the touch. Soil may be below groundwater level.
Saturated	- Visible free water. Usually soil is below groundwater level.

TERMINOLOGY USED FOR ROCK DESCRIPTION

Bedding

Parting	Less than 0.02 ft.
Band	0.02 to 0.2 ft.
Thin Bed	0.2 to 0.5 ft.
Medium Bed	0.5 to 1.0 ft.
Thick Bed	1.0 to 2.0 ft.
Massive	Over 2.0 ft.

Hardness

Very Soft or Plastic	- Can be indented with thumb.
Soft	- Can be scratched with fingernail.
Moderately Hard	- Can be scratched easily with knife. Cannot be scratched with fingernail.
Hard	- Difficult to scratch with knife.
Very Hard	- Cannot be scratched with knife.

Crystallinity or Texture

Dense	- Crystals are so small they cannot be distinguished with the naked eye.
Very Fine Crystalline	- Crystals barely discernible with the naked eye.
Crystalline	- Crystals are medium size; up to 1/8-inch diameter.
Very Coarsely Crystalline	- Crystals larger than 1/8-inch diameter.

Voids

Pourous	- Smaller than a pinhead. Their presence is indicated by the degree of absorbancy.
Pitted	- Pinhead size to 1/4-inch. If only thin walls separate the individual pits, the core may be described as honeycombed.
Vug	- 1/4-inch to the diameter of the core. The upper limit will vary with core size.
Cavity	- Larger than the diameter of the core.

REMARKS: Denotes exact depth of recovery and general documentation of drilling efforts.

Notes: Description and classification are based on visual inspection of samples and boring operations.

The stratum lines shown on the boring logs are based upon interpretation and may not represent precise subsurface conditions.

Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. Fluctuations in the water level may occur due to other factors than those present at the time measurements are taken.

SOIL CLASSIFICATION CHART
(Unified Soil Classification System)

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOILS More than 50% of material larger than No. 200 sieve	GRAVELS More than 50% of coarse fraction larger than No. 4 sieve	Clean Gravels (little or no fines)		GW	Well-graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
		Gravels with appreciable amounts of fines		GM	Silty gravels, gravel-sand-silt mixtures
				GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS Less than 50% of coarse fraction larger than No. 4 sieve	Clean sands (little or no fines)		SW	Well-graded sands, gravelly sands, little or no fines
				SP	Poorly-graded sands, gravelly sands, little or no fines
		Sands with appreciable amounts of fines		SM	Silty sands, silt-sand mixture
				SC	Clayey sands, sand-clay mixture
FINE-GRAINED SOILS Less than 50% of material larger than No. 200 sieve	SILTS AND CLAYS Low plasticity Liquid Limit less than 50%			ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
				CL	Inorganic clays of low to medium plasticity, gravely clays, sandy clays, silty clays, lean clays
				OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS High plasticity Liquid Limit greater than 50%			MH	Inorganic silts, micaceous or diatomaceous fine sand or silt soils
				CH	Inorganic clays of high plasticity, fat clays
				OH	Organic clays of medium to high plasticity, organic silts
	Highly Organic Soils			Pt	Peat, humus, swamp soils with organic contents
	Miscellaneous Fill			FILL	Miscellaneous fill may belong in any division but is identified as FILL

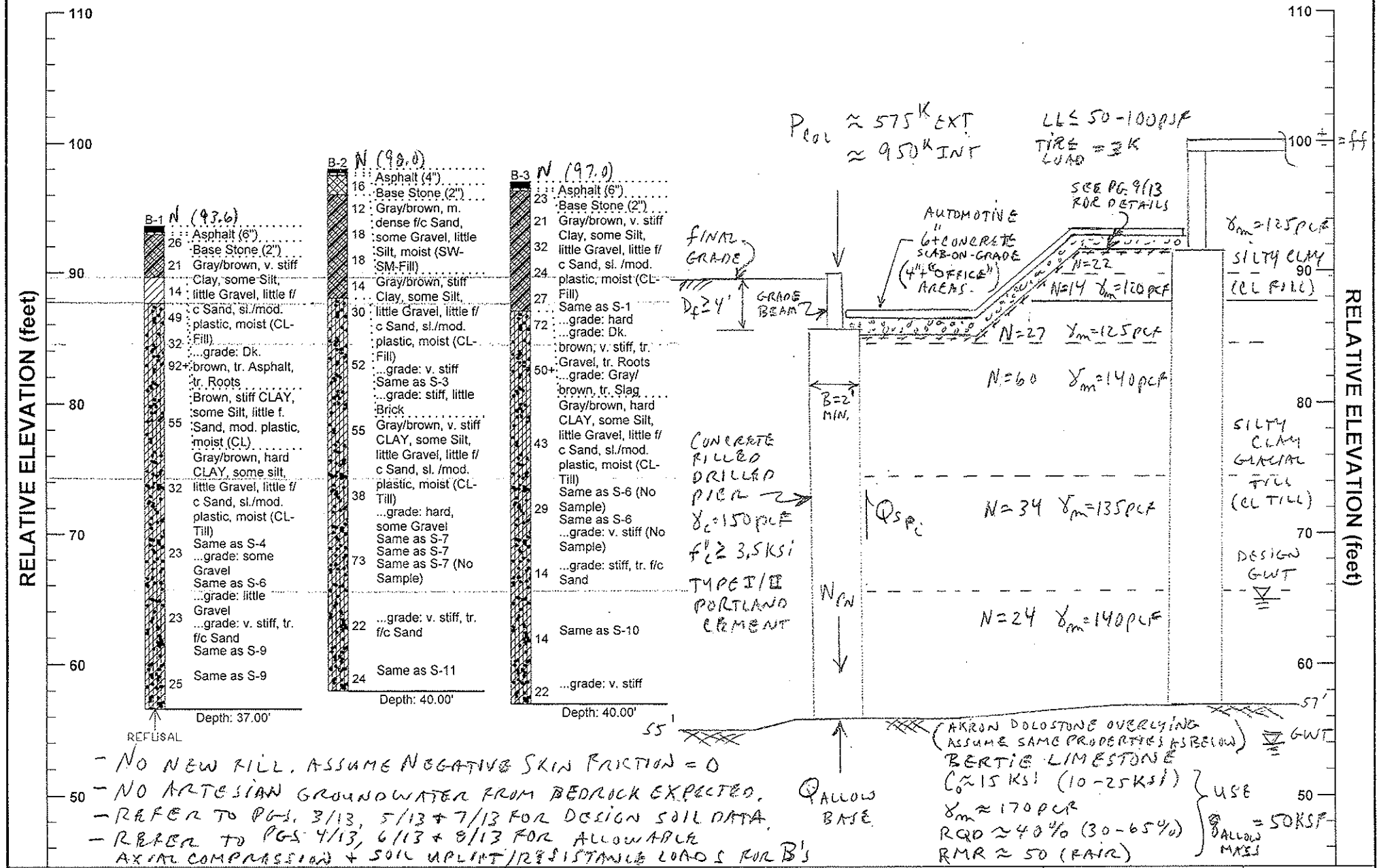
BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY. INC.
10440 MAIN STREET
CLARENCE, N.Y. 14031
(716) 759-7821
FAX (716) 759-7823
e-mail: info@buffalodrilling.com
info@barronandassociatespc.com

APPENDIX C

ENGINEERING COMPUTATIONS AND SCHEMATICS

"PROFILE OF BORINGS"

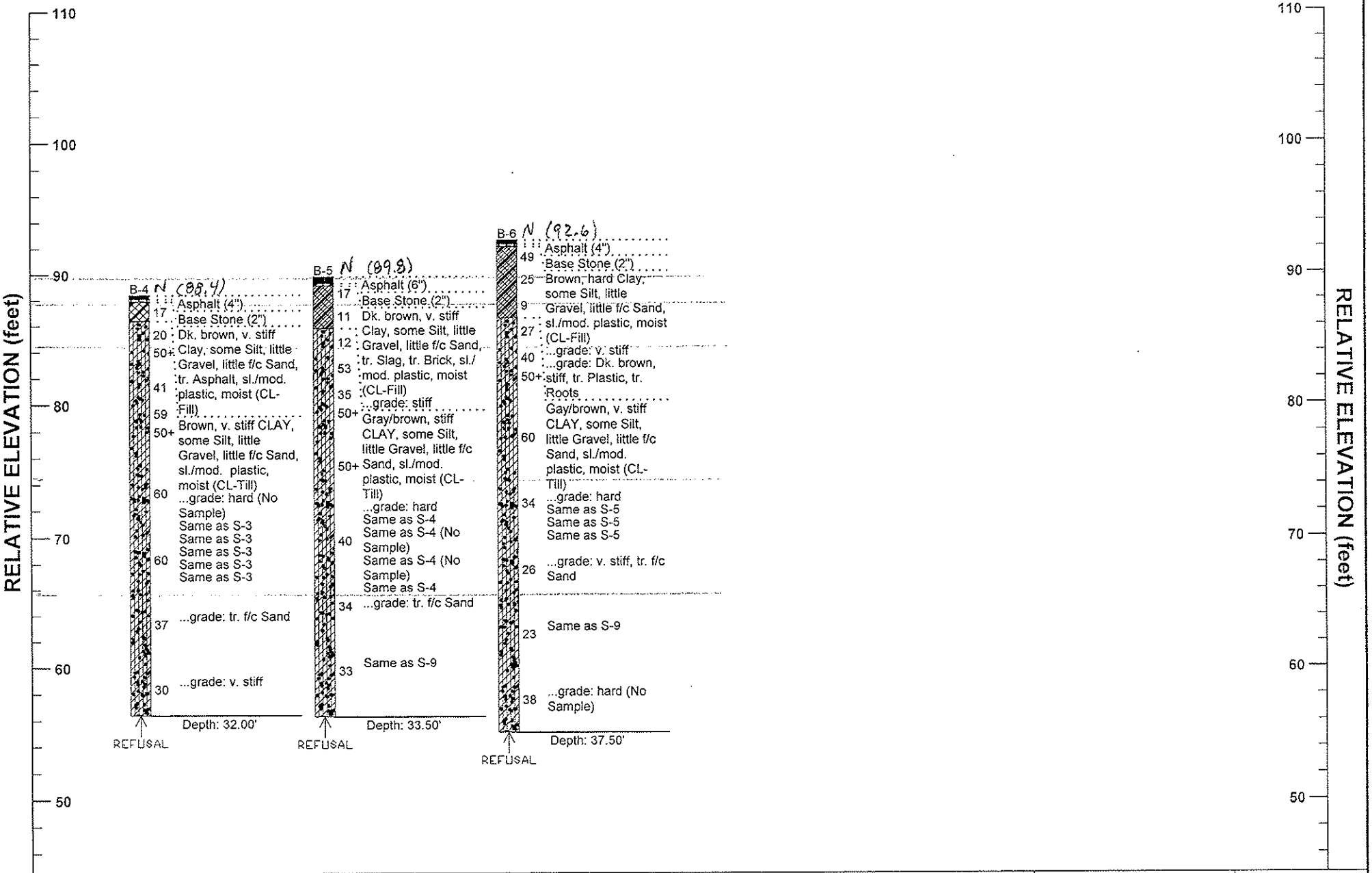
DESIGN PROFILE



- NO NEW FILL. ASSUME NEGATIVE SKIN FRICTION = 0
- NO ARTESIAN GROUNDWATER FROM BEDROCK EXPECTED.
- REFER TO PGS. 3/13, 5/13 + 7/13 FOR DESIGN SOIL DATA.
- REFER TO PGS 4/13, 6/13 + 8/13 FOR ALLOWABLE AXIAL COMPRESSION + SOIL UPLIFT/RESISTANCE LOADS FOR B's

BARRON & ASSOCIATES, P.C. & BUFFALO DRILLING COMPANY, INC. 10440 MAIN STREET, CLARENCE, NEW YORK 14031	PLOTTED: 2/25/2010 BY: A. Camping	JOB NO.: 10-510
PROJECT: Proposed VA Hospital Multi-Story Parking Ramp Structure 3495 Bailey Avenue, Buffalo, Erie Co., New York 14215	PAGE NO.: 1 OF 13	FIGURE NO.: P-1

"PROFILE OF BORINGS"



BARRON & ASSOCIATES, P.C. & BUFFALO DRILLING COMPANY, INC. **10440 MAIN STREET, CLARENCE, NEW YORK 14031**	PLOTTED: 3/5/2010 BY: A. Camping	JOB NO.: 10-510
PROJECT: Proposed VA Hospital Multi-Story Parking Ramp Structure 3495 Bailey Avenue, Buffalo, Erie Co., New York 14215	PAGE NO.: 2 of 13	FIGURE NO.: P-2

GEOTECHNICAL ENGINEERING CAPACITIES OF STRAIGHT DRILLED PIERS

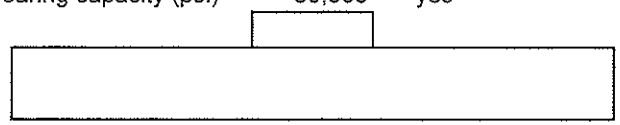
Total Settlement ≤ 1 inch (Reese and O'Neill method for l / B ≥ 3, B ≤ 8 ft., α_3 = 0.036)

RAMP: Cohesive Undrained L = 29.5 ft.

Elev. top of pier =	85.5	feet	Pier Length (l) =	29.5	feet
Elev. bottom of pier =	56.0	feet	Avg. Existing Grade =	89.5	feet
Density of concrete (δ_c) =	150	pcf	Ground Water Table =	65.5	feet
Compressive Strength (f'_c) =	3,500	psi	Elev. of Neutral Plane =	89.5	feet

(GWT and NP must be a listed bottom of layer elevation)

Layer (i)	Elev. Layer Bottom (feet)	Layer Thickness (t) (feet)	Mass Density of Soil (pcf)	Eff. Stress Mid-Depth of Layer (psf)	N-Value Design (-)	$(N_1)_{60}$ (-)	Friction Angle (phi) (degrees)	Cohesion (C_{uu}) (psf)	Adhesion (5,500 psf max. soil) (psf)	Available Adhesion Layer Thickness t_{ai} (feet)	Ultimate Adhesion Skin Friction $Q'_{csf\ ult\ i}$ (plf)	Absolute Ultimate Granular Skin Friction $q_{\Phi sf\ ult\ i}$ (psf)	4 ksf Max. Stress & Neutral Plane Adjusted: Ultimate Granular Skin Friction $q_{\Phi sf\ ult\ i}$ (psf)	4 ksf Max. Stress & Neutral Plane Adjusted: Ultimate Granular Skin Friction $Q'_{\Phi sf\ ult\ i}$ (plf)	Uncounted NSF Top 5': Ultimate Cohesive Skin Friction $Q'_{csf\ ult\ i}$ (plf)
0	89.5	0.0	0	0	0	0	0	0	0	0.0	0	0	0	0	0
1	88.5	1.0	120	60	14.0	28	0.0	1,347	741	0.0	0	0	0	0	0
2	87.5	1.0	120	180	14.0	25	0.0	1,363	750	0.0	0	0	0	0	0
3	84.5	3.0	125	428	27.0	41	0.0	2,648	1,457	0.0	0	0	0	0	0
4	74.5	10.0	140	1,315	60.0	69	0.0	5,923	3,258	10.0	32,579	0	0	0	0
5	65.5	9.0	135	2,623	34.0	31	0.0	3,425	1,884	9.0	16,955	0	0	0	0
6	56.0	9.5	140	3,599	24.0	19	0.0	2,415	1,328	9.5	12,618	0	0	0	0
7	56.0	0.0	140	3,967	24.0	19	0.0	2,414	1,328	0.0	0	0	0	0	0
8	56.0	0.0	140	3,967	24.0	19	0.0	2,414	1,328	0.0	0	0	0	0	0
9	56.0	0.0	140	3,967	24.0	19	0.0	2,414	1,328	0.0	0	0	0	0	0
10	56.0	0.0	140	3,967	24.0	19	0.0	2,414	1,328	0.0	0	0	0	0	0
11	56.0	0.0	140	3,967	24.0	19	0.0	2,414	1,328	0.0	0	0	0	0	0
12	56.0	0.0	140	3,967	24.0	19	0.0	2,414	1,328	0.0	0	0	0	0	0
base	56.0		apparent bedrock net allowable bearing capacity (psf) =					50,000	yes						



- *Layer 12 elevation also defines the soil drained/undrained soil bearing conditons for pier base/tip. The underlying soil strength is >/= the soil strength in layer 12.*
- In cohesive soil, any portion of pier less than 5 feet below ground surface has no positive, but can have negative, skin friction.
- Above neutral plane in layered soils, a loose granular layer is considered to contribute to NSF, if its thickness is less than the thickness of the overlying cohesive layer. Treat as a single layer and avoid spilting by groundwater table, if possible.
- Frictional/drained soils have cohesion = 0 psf. To not include either side resistance in a layer, make friction angle = 0 and/or adhesion = 0.

GEOTECHNICAL ENGINEERING CAPACITIES OF STRAIGHT DRILLED PIERS

Total Settlement ≤ 1 inch (Reese and O'Neill method for l / B ≥ 3, B ≤ 8 ft., α_3 = 0.036)

RAMP: Cohesive Undrained L = 29.5 ft.

Granular base adjustment factor for large B, α_3 = 0.036

FS compression skin soil/IGM = 3.0 FS compression base soil/IGM = 3.0 FS uplift/pullout soil/IGM = 3.0

Pier Diameter B (feet)	Total Buoyant Weight of Pier W_{pt} (kips)	Net Weight of Pier W_{pn} (kips)	Ultimate Axial Skin Compression: Negative Skin Friction $Q_{nsf\ ult}$ (kips)	Positive Skin Friction $Q_{psf\ ult}$ (kips)	B Above Base Adjusted Cohesive Positive Skin Friction $Q_{Bpsf\ ult}$ (kips)	On Soil/Intermediate Geomat'l.: Allowable Axial Compression Base on Granular $Q_{allow\ base}$ (kips)	Allowable Axial Compression Base on Cohesive $Q_{allow\ base}$ (kips)	Allowable Axial Compression Total $Q_{allow\ total}$ (kips)	On Bedrock: Allowable Axial Compression Base on Bedrock $Q_{allow\ base}$ (kips)	Allowable Axial Compression Total $Q_{allow\ total}$ (kips)	Allowable Axial Equivalent Base Pressure $q_{allow\ base}$ (ksf)	Soil Uplift/ Pullout (Non-NSF) Upper Granular Skin Friction $Q_{\Phi u/psf\ ult}$ (kips)	Soil Uplift/ Pullout Allowable (Pos+Neg +Non-NSF) Skin Friction $Q_{u/psf\ all}$ (kips)
2.0	12.1	1.3	0.0	390.5	-16.7	0.0	22.8	146.1	157.1	280.4	89.3	0.0	91.1
2.5	19.0	2.0	0.0	488.1	-26.1	0.0	35.6	187.6	245.4	397.4	81.0	0.0	113.9
3.0	27.3	2.9	0.0	585.8	-37.6	0.0	51.2	231.0	353.4	533.3	75.4	0.0	136.7
3.5	37.2	3.9	0.0	683.4	-51.1	0.0	69.7	276.5	481.1	687.9	71.5	0.0	159.5
4.0	48.5	5.1	0.0	781.0	-66.8	0.0	91.0	324.0	628.3	861.3	68.5	0.0	182.2
4.5	61.4	6.5	0.0	878.6	-84.5	0.0	115.2	373.4	795.2	1,053.4	66.2	0.0	205.0
5.0	75.9	8.0	0.0	976.3	-104.3	0.0	142.2	424.8	981.7	1,264.4	64.4	0.0	227.8
5.5	91.8	9.7	0.0	1,073.9	-126.2	0.0	172.1	478.3	1,187.9	1,494.1	62.9	0.0	250.6
6.0	109.2	11.6	0.0	1,171.5	-150.2	0.0	204.8	533.7	1,413.7	1,742.6	61.6	0.0	273.4
6.5	128.2	13.6	0.0	1,269.2	-176.3	0.0	342.2	692.9	1,659.2	2,009.9	60.6	0.0	296.1
7.0	148.7	15.8	0.0	1,366.8	-204.5	0.0	396.7	768.4	1,924.2	2,295.9	59.7	0.0	318.9
7.5	170.7	18.1	0.0	1,464.4	-234.7	0.0	455.2	847.0	2,208.9	2,600.7	58.9	0.0	341.7
8.0	194.2	20.6	0.0	1,562.0	-267.0	0.0	517.7	928.8	2,513.3	2,924.4	58.2	0.0	364.5
										USE ⇑	USE ⇑		USE ⇑

- In compression in cohesive soil, part of pier < 5 feet below ground surface has no positive skin friction, but can have NSF; and part of pier < B feet above the bottom of pier has no skin friction.
- In uplift in cohesive soil, part of pier < 5 feet below ground surface has no resisting skin friction (incl. NSF), but part of pier < B feet above the bottom of pier has resisting (positive & NSF) skin friction.

GEOTECHNICAL ENGINEERING CAPACITIES OF STRAIGHT DRILLED PIERS

Total Settlement ≤ 1 inch (Reese and O'Neill method for l / B ≥ 3, B ≤ 8 ft., α_3 = 0.036)

RAMP: Cohesive Drained L = 29.5 ft. phi' = 30 deg

C.M.Panuccio
page 5 of 13
Job No. 10-510

Elev. top of pier = 85.5 feet
Elev. bottom of pier = 56.0 feet
Density of concrete (δ_c) = 150 pcf
Compressive Strength (f'_c) = 3,500 psi

Pier Length (l) = 29.5 feet
Avg. Existing Grade = 89.5 feet
Ground Water Table = 65.5 feet
Elev. of Neutral Plane = 89.5 feet
(GWT and NP must be a listed bottom of layer elevation)

Layer (i)	Elev. Layer Bottom (feet)	Layer Thickness (t) (feet)	Mass Density of Soil (pcf)	Eff. Stress Mid-Depth of Layer (psf)	N-Value Design (-)	$(N_1)_{60}$ (-)	Friction Angle (phi) (degrees)	Cohesion (C_{uu}) (psf)	Adhesion (5,500 psf max. soil) (psf)	Available Adhesion Layer Thickness t_{ai} (feet)	Ultimate Adhesion Skin Friction $Q'_{csf\ ult\ i}$ (plf)	Absolute Ultimate Granular Skin Friction $q_{\Phi sf\ ult\ i}$ (psf)	4 ksf Max. Stress & Neutral Plane Adjusted: Ultimate Granular Skin Friction $q_{\Phi sf\ ult\ i}$ (psf)	4 ksf Max. Stress & Neutral Plane Adjusted: Ultimate Granular Skin Friction $Q'_{\Phi sf\ ult\ i}$ (plf)	Uncounted NSF Top 5': Ultimate Cohesive Skin Friction $Q'_{csf\ ult\ i}$ (plf)
0	89.5	0.0	0	0	0	0	0	0	0	0.0	0	0	0	0	0
1	88.5	1.0	120	60	10.0	10	30.1	0	0	0.0	0	0	0	0	0
2	87.5	1.0	120	180	10.0	10	30.1	0	0	0.0	0	0	0	0	0
3	84.5	3.0	125	428	10.0	10	30.1	0	0	0.0	0	513	513	1,539	0
4	74.5	10.0	140	1,315	10.0	10	30.1	0	0	0.0	0	1,411	1,411	14,111	0
5	65.5	9.0	135	2,623	10.0	10	30.1	0	0	0.0	0	2,370	2,370	21,333	0
6	56.0	9.5	140	3,599	10.0	10	30.1	0	0	0.0	0	2,793	2,793	26,534	0
7	56.0	0.0	140	3,967	10.0	10	30.1	0	0	0.0	0	2,851	2,851	0	0
8	56.0	0.0	140	3,967	10.0	10	30.1	0	0	0.0	0	2,851	2,851	0	0
9	56.0	0.0	140	3,967	10.0	10	30.1	0	0	0.0	0	2,851	2,851	0	0
10	56.0	0.0	140	3,967	10.0	10	30.1	0	0	0.0	0	2,851	2,851	0	0
11	56.0	0.0	140	3,967	10.0	10	30.1	0	0	0.0	0	2,851	2,851	0	0
12	56.0	0.0	140	3,967	10.0	10	30.1	0	0	0.0	0	2,851	2,851	0	0
base	56.0														

apparent bedrock net allowable bearing capacity (psf) = 50,000 yes

- *Layer 12 elevation also defines the soil drained/undrained soil bearing conditons for pier base/tip. The underlying soil strength is >/= the soil strength in layer 12.*
- In cohesive soil, any portion of pier less than 5 feet below ground surface has no positive, but can have negative, skin friction.
- Above neutral plane in layered soils, a loose granular layer is considered to contribute to NSF, if its thickness is less than the thickness of the overlying cohesive layer. Treat as a single layer and avoid spilting by groundwater table, if possible.
- Frictional/drained soils have cohesion = 0 psf. To not include either side resistance in a layer, make friction angle = 0 and/or adhesion = 0.

GEOTECHNICAL ENGINEERING CAPACITIES OF STRAIGHT DRILLED PIERS

Total Settlement ≤ 1 inch (Reese and O'Neill method for l / B ≥ 3, B ≤ 8 ft., α_3 = 0.036)

RAMP: Cohesive Drained L = 29.5 ft. phi' = 30 deg

C.M.Panuccio
page 6 of 12
Job No. 10-510

Granular base adjustment factor for large B, α_3 = 0.036

FS compression skin soil/IGM = 3.0 FS compression base soil/IGM = 3.0 FS uplift/pullout soil/IGM = 3.0

Pier Diameter B (feet)	Total Buoyant Weight of Pier W_{pt} (kips)	Net Weight of Pier W_{pn} (kips)	Ultimate Axial Skin Compression: Negative Skin Friction $Q_{nsf\ ult}$ (kips)	Positive Skin Friction $Q_{psf\ ult}$ (kips)	B Above Base Adjusted Cohesive Positive Skin Friction $Q_{Bpsf\ ult}$ (kips)	On Soil/Intermediate Geomat'l.: Allowable Axial Compression Base on Granular $Q_{allow\ base}$ (kips)	Allowable Axial Compression Base on Cohesive $Q_{allow\ base}$ (kips)	Allowable Axial Compression Total $Q_{allow\ total}$ (kips)	On Bedrock: Allowable Axial Compression Base on Bedrock $Q_{allow\ base}$ (kips)	Allowable Axial Compression Total $Q_{allow\ total}$ (kips)	Allowable Axial Equivalent Base Pressure $q_{allow\ base}$ (ksf)	Soil Uplift/ Pullout (Non-NSF) Upper Granular Skin Friction $Q_{\Phi u/psf\ ult}$ (kips)	Soil Uplift/ Pullout Allowable (Pos+Neg +Non-NSF) Skin Friction $Q_{u/psf\ all}$ (kips)
2.0	12.1	1.3	0.0	399.1	0.0	12.6	0.0	144.3	157.1	288.8	91.9	0.0	93.1
2.5	19.0	2.0	0.0	498.9	0.0	19.6	0.0	183.9	245.4	409.7	83.5	0.0	116.4
3.0	27.3	2.9	0.0	598.6	0.0	28.3	0.0	224.9	353.4	550.1	77.8	0.0	139.7
3.5	37.2	3.9	0.0	698.4	0.0	38.5	0.0	267.3	481.1	709.9	73.8	0.0	163.0
4.0	48.5	5.1	0.0	798.2	0.0	50.3	0.0	311.2	628.3	889.2	70.8	0.0	186.2
4.5	61.4	6.5	0.0	898.0	0.0	63.6	0.0	356.4	795.2	1,088.0	68.4	0.0	209.5
5.0	75.9	8.0	0.0	997.7	0.0	78.5	0.0	403.1	981.7	1,306.3	66.5	0.0	232.8
5.5	91.8	9.7	0.0	1,097.5	0.0	95.0	0.0	451.1	1,187.9	1,544.0	65.0	0.0	256.1
6.0	109.2	11.6	0.0	1,197.3	0.0	113.1	0.0	500.6	1,413.7	1,801.2	63.7	0.0	279.4
6.5	128.2	13.6	0.0	1,297.0	0.0	132.7	0.0	551.5	1,659.2	2,077.9	62.6	0.0	302.6
7.0	148.7	15.8	0.0	1,396.8	0.0	152.7	0.0	602.6	1,924.2	2,374.1	61.7	0.0	325.9
7.5	170.7	18.1	0.0	1,496.6	0.0	163.6	0.0	644.4	2,208.9	2,689.7	60.9	0.0	349.2
8.0	194.2	20.6	0.0	1,596.4	0.0	174.5	0.0	686.1	2,513.3	3,024.8	60.2	0.0	372.5
										USE ⇑	USE ⇑		USE ⇑

- In compression in cohesive soil, part of pier < 5 feet below ground surface has no positive skin friction, but can have NSF; and part of pier < B feet above the bottom of pier has no skin friction.
- In uplift in cohesive soil, part of pier < 5 feet below ground surface has no resisting skin friction (incl. NSF), but part of pier < B feet above the bottom of pier has resisting (positive & NSF) skin friction.

GEOTECHNICAL ENGINEERING CAPACITIES OF STRAIGHT DRILLED PIERS

Total Settlement ≤ 1 inch (Reese and O'Neill method for l / B ≥ 3, B ≤ 8 ft., α_3 = 0.036)

RAMP: Cohesive Undrained L = 35.5 ft.

Elev. top of pier = 91.5 feet
Elev. bottom of pier = 56.0 feet
Density of concrete (δ_c) = 150 pcf
Compressive Strength (f'_c) = 3,500 psi

Pier Length (l) = 35.5 feet
Avg. Existing Grade = 95.5 feet
Ground Water Table = 65.5 feet
Elev. of Neutral Plane = 95.5 feet
(GWT and NP must be a listed bottom of layer elevation)

Layer (i)	Elev. Layer Bottom (feet)	Layer Thickness (t) (feet)	Mass Density of Soil (pcf)	Eff. Stress Mid-Depth of Layer (psf)	N-Value Design (-)	$(N_1)_{60}$ (-)	Friction Angle (phi) (degrees)	Cohesion (C_{uu}) (psf)	Adhesion (5,500 psf max. soil) (psf)	Available Adhesion Layer Thickness t_{ai} (feet)	Ultimate Adhesion Skin Friction $Q'_{csf\ ult\ i}$ (plf)	Absolute Ultimate Granular Skin Friction $q_{\Phi sf\ ult\ i}$ (psf)	4 ksf Max. Stress & Neutral Plane Adjusted: Ultimate Granular Skin Friction $q_{\Phi sf\ ult\ i}$ (psf)	4 ksf Max. Stress & Neutral Plane Adjusted: Ultimate Granular Skin Friction $Q'_{\Phi sf\ ult\ i}$ (plf)	Uncounted NSF Top 5' Ultimate Cohesive Skin Friction $Q'_{csf\ ult\ i}$ (plf)
0	95.5	0.0	0	0	0	0	0	0	0	0.0	0	0	0	0	0
1	89.5	6.0	125	375	22.0	34	0.0	2,162	1,189	1.0	1,189	0	0	0	0
2	88.5	1.0	120	810	14.0	18	0.0	1,385	762	1.0	762	0	0	0	0
3	87.5	1.0	120	930	14.0	18	0.0	1,405	773	1.0	773	0	0	0	0
4	84.5	3.0	125	1,178	27.0	32	0.0	2,678	1,473	3.0	4,418	0	0	0	0
5	74.5	10.0	140	2,065	60.0	59	0.0	5,970	3,284	10.0	32,836	0	0	0	0
6	65.5	9.0	135	3,373	34.0	28	0.0	3,424	1,883	9.0	16,951	0	0	0	0
7	56.0	9.5	140	4,349	24.0	18	0.0	2,396	1,318	9.5	12,520	0	0	0	0
8	56.0	0.0	140	4,717	24.0	17	0.0	2,414	1,328	0.0	0	0	0	0	0
9	56.0	0.0	140	4,717	24.0	17	0.0	2,414	1,328	0.0	0	0	0	0	0
10	56.0	0.0	140	4,717	24.0	19	0.0	2,414	1,328	0.0	0	0	0	0	0
11	56.0	0.0	140	4,717	24.0	19	0.0	2,414	1,328	0.0	0	0	0	0	0
12	56.0	0.0	140	4,717	24.0	19	0.0	2,414	1,328	0.0	0	0	0	0	0
base	56.0														

apparent bedrock net allowable bearing capacity (psf) = 50,000 yes

- *Layer 12 elevation also defines the soil drained/undrained soil bearing conditons for pier base/tip. The underlying soil strength is >/= the soil strength in layer 12.*
- In cohesive soil, any portion of pier less than 5 feet below ground surface has no positive, but can have negative, skin friction.
- Above neutral plane in layered soils, a loose granular layer is considered to contribute to NSF, if its thickness is less than the thickness of the overlying cohesive layer. Treat as a single layer and avoid spilting by groundwater table, if possible.
- Frictional/drained soils have cohesion = 0 psf. To not include either side resistance in a layer, make friction angle = 0 and/or adhesion = 0.

GEOTECHNICAL ENGINEERING CAPACITIES OF STRAIGHT DRILLED PIERS

Total Settlement ≤ 1 inch (Reese and O'Neill method for l / B ≥ 3, B ≤ 8 ft., α_3 = 0.036)

RAMP: Cohesive Undrained L = 35.5 ft.

Granular base adjustment factor for large B, α_3 = 0.036

FS compression skin soil/IGM = 3.0 FS compression base soil/IGM = 3.0 FS uplift/pullout soil/IGM = 3.0

Pier Diameter B (feet)	Total Buoyant Weight of Pier W_{pt} (kips)	Net Weight of Pier W_{pn} (kips)	Ultimate Axial Skin Compression: Negative Skin Friction $Q_{nsf\ ult}$ (kips)	Positive Skin Friction $Q_{psf\ ult}$ (kips)	B Above Base Adjusted Cohesive Positive Skin Friction $Q_{Bpsf\ ult}$ (kips)	On Soil/Intermediate Geomat'l.: Allowable Axial Compression Base on Granular $Q_{allow\ base}$ (kips)	Allowable Axial Compression Base on Cohesive $Q_{allow\ base}$ (kips)	Allowable Axial Compression Total $Q_{allow\ total}$ (kips)	On Bedrock: Allowable Axial Compression Base on Bedrock $Q_{allow\ base}$ (kips)	Allowable Axial Compression Total $Q_{allow\ total}$ (kips)	Allowable Axial Equivalent Base Pressure $q_{allow\ base}$ (ksf)	Soil Uplift/ Pullout (Non-NSF) Upper Granular Skin Friction $Q_{\Phi u/psf\ ult}$ (kips)	Soil Uplift/ Pullout Allowable (Pos+Neg +Non-NSF) Skin Friction $Q_{u/psf\ all}$ (kips)
2.0	15.0	1.7	0.0	436.4	-16.6	0.0	22.8	160.9	157.1	295.3	94.0	0.0	101.8
2.5	23.4	2.7	0.0	545.4	-25.9	0.0	35.5	206.0	245.4	415.9	84.7	0.0	127.3
3.0	33.7	3.9	0.0	654.5	-37.3	0.0	51.2	253.0	353.4	555.3	78.6	0.0	152.7
3.5	45.8	5.3	0.0	763.6	-50.7	0.0	69.7	302.0	481.1	713.4	74.1	0.0	178.2
4.0	59.9	6.9	0.0	872.7	-66.2	0.0	91.0	352.9	628.3	890.2	70.8	0.0	203.6
4.5	75.8	8.8	0.0	981.8	-83.8	0.0	115.2	405.7	795.2	1,085.7	68.3	0.0	229.1
5.0	93.5	10.9	0.0	1,090.9	-103.5	0.0	142.2	460.5	981.7	1,300.0	66.2	0.0	254.5
5.5	113.2	13.1	0.0	1,200.0	-125.2	0.0	172.1	517.2	1,187.9	1,533.0	64.5	0.0	280.0
6.0	134.7	15.6	0.0	1,309.1	-149.0	0.0	204.8	575.8	1,413.7	1,784.8	63.1	0.0	305.4
6.5	158.1	18.3	0.0	1,418.1	-174.9	0.0	342.1	738.2	1,659.2	2,055.2	61.9	0.0	330.9
7.0	183.3	21.3	0.0	1,527.2	-202.9	0.0	396.6	816.8	1,924.2	2,344.4	60.9	0.0	356.4
7.5	210.4	24.4	0.0	1,636.3	-232.9	0.0	455.2	898.6	2,208.9	2,652.3	60.0	0.0	381.8
8.0	239.4	27.8	0.0	1,745.4	-265.0	0.0	517.7	983.4	2,513.3	2,979.0	59.3	0.0	407.3
										USE ⇑	USE ⇑		USE ⇑

- In compression in cohesive soil, part of pier < 5 feet below ground surface has no positive skin friction, but can have NSF; and part of pier < B feet above the bottom of pier has no skin friction.
- In uplift in cohesive soil, part of pier < 5 feet below ground surface has no resisting skin friction (incl. NSF), but part of pier < B feet above the bottom of pier has resisting (positive & NSF) skin friction.

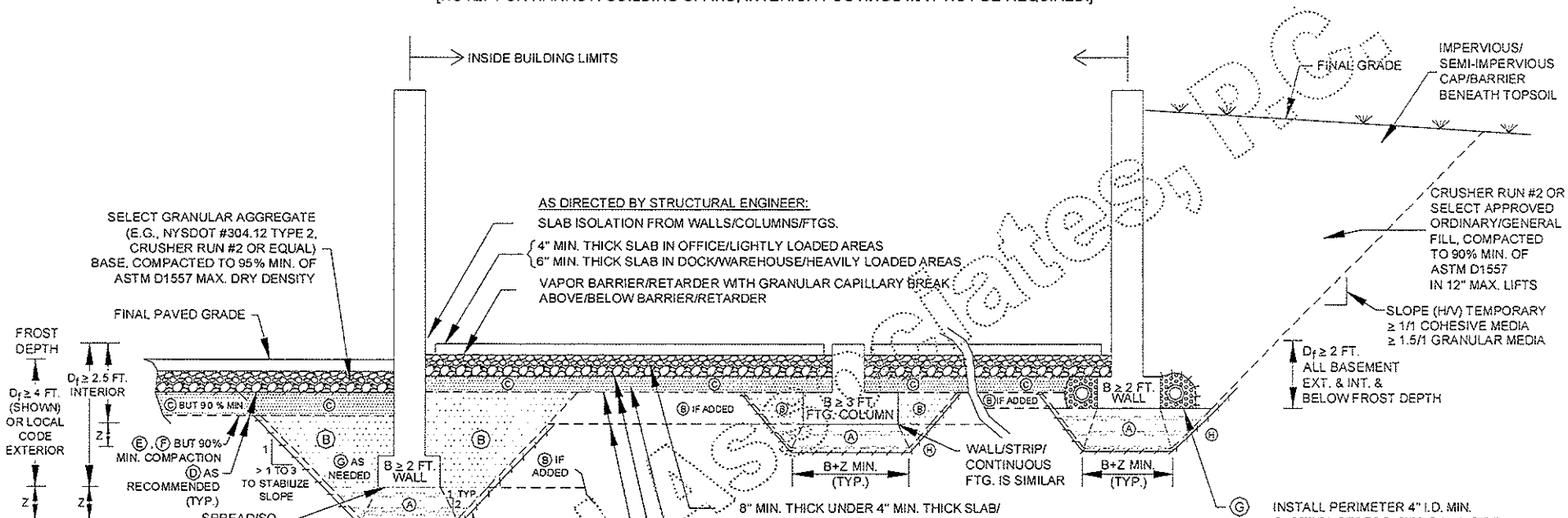
BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY, INC.
10440 MAIN ST.
CLARENCE, NY 14031
(716)759-7821
FAX (716)759-7823
e-mail: info@buffalodrilling.com
info@barronandassociatespc.com

B&A JOB NO.: 10-510

DATE: 02/17/10

TYPICAL SCHEMATICS OF RECOMMENDED SHALLOW WALL AND COLUMN FOOTINGS ON APPROVED FILL MEDIA AND SLAB SYSTEMS

[NOTE: FOR NARROW BUILDING SPANS, INTERIOR FOOTINGS MAY NOT BE REQUIRED.]



- MATCH FTG. DEPTH OF LATERAL ADDITION WHERE IT ABUTS EXISTING STRUCTURE FTG.
- FOR FTGS. ON BEDROCK, SEE GENERAL NOTES PAGE
- FTG. AT RECOMMENDED MIN. DEPTH BELOW EXISTING GRADE, UNLESS EXISTING SOIL/FILL WITHIN THIS DEPTH RANGE IS RECOMMENDED TO BE PROPERLY DRIED, BLENDED, COMPACTED TO 95% MIN. OF ASTM D1557 MAX. DRY DENSITY AND APPROVED
- Z IS MIN. DEPTH: AS RECOMMENDED IN THE REPORT, EXCAVATE/UNDERCUT TO APPROVED NATURAL SOIL/BEDROCK UNLESS APPROVABLE STATES ARE ENCOUNTERED, DOCUMENTED & CONFIRMED AT SHALLOWER DEPTHS; TO BACKFILL TO GRADE OF OPENINGS/CAVITIES/BASEMENT AREAS; TO RAISE GRADES; OR IN UNACCEPTABLE CONDITIONS UP TO THE GREATER DEPTH OF 4 FT. OR FOOTING WIDTH (B) BELOW FTG. TO AN APPROVABLE STATE

CONTACT SURFACES (TYP.): APPROVED UNDISTURBED NAT'L SOIL/BEDROCK SUBGRADE AT BEARING GRADE [NO OVER EXCAVATION; FOR MINOR DISTURBANCE OF CONTACT SURFACES UNDER FTG., COMPACT SOIL COMPACTED TO 92% MIN. OF ASTM D1557 MAX. DRY DENSITY/USE CONCRETE TO LEVEL BEDROCK, AS NEEDED]. APPROVABLE FILL CONDITIONS SHALL BE AS RECOMMENDED IN REPORT OR AS DIRECTED IN THE FIELD BY GEOTECHNICAL ENGINEER/ AUTHORIZED BY CLIENT

8" MIN. THICK UNDER 4" MIN. THICK SLAB/ 12" MIN. THICK UNDER 6" MIN. THICK SLAB SELECT GRANULAR AGGREGATE BASE (E.G., NYSDOT #304.12 TYPE 2, CRUSHER RUN #2 OR EQUAL) COMPACTED TO 95% MIN. OF ASTM D1557 MAX. DRY DENSITY

Ⓒ GRANULAR AGGREGATE SUBBASE, IF RECOMMENDED IN REPORT, COMPACTED TO 92% MIN. OF ASTM D1557 MAX. DRY DENSITY/ Ⓑ, IF ADDED

Ⓓ GEOTEXTILE STRENGTH & FILTER FABRIC (E.G., MIRAFI 600X OR EQUAL) UNDER LOWER OF GRANULAR BASE OR SUBBASE, IF USED, ON COHESIVE/SILTY SOIL SUBGRADES

Ⓔ STRIP TOPSOIL, ORGANICS & UNSUITABLE/UNAPPROVABLE NATURAL SOIL/FILL; GRADE TO LEVEL ELEV.; COMPACT, PROOFROLL & APPROVE

Ⓕ AS NEEDED, UNDERCUT & BACKFILL Ⓑ, EXCEPT COMPACT TO 95 % MIN. OF ASTM D1557 MAX. DRY DENSITY BELOW FTG. BEARING GRADE

Ⓑ	THIN LIFTS OF SELECT/APPROVED ORDINARY/GENERAL FILL COMPACTED TO 92 % MIN. OF ASTM D1557 MAX. DRY DENSITY IN 12" MAX. LIFTS ABOVE FTG. BEARING GRADE & FOUNDATION BACKFILL AREA/ZONE
Ⓐ	SELECT/APPROVED GRANULAR AGGREGATE (E.G., NYSDOT #304.12 TYPE 2, CRUSHER RUN # 2 OR EQUAL) COMPACTED TO 95% MIN. OF ASTM D1557 MAX. DRY DENSITY IN 12 IN. MAX LIFTS, OR ALTERNATIVELY, AS RECOMMENDED IN REPORT, CONTROLLED LOW STRENGTH MATERIAL (CLSM) WITH VERIFIED 200 PSI MIN. 28 DAY COMPRESSIVE STRENGTH THAT IS POURED IN MAX. 3 FT. SET LIFTS, OR LEAN CONCRETE WITH VERIFIED 28 DAY COMPRESSIVE STRENGTH OF 1,000 PSI MIN. ON SOIL OR EQUAL/BETTER THAN FOOTING CONCRETE STRENGTH ON BEDROCK

NOT TO SCALE

BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY, INC.
10440 MAIN ST.
CLARENCE, NY 14031
(716)759-7821
FAX (716)759-7823
e-mail: info@buffalodrilling.com
info@barronandassociatespc.com

GENERAL NOTES

a) Bottom of exterior foundations are to bear at a minimum depth below the final exterior grade that is greater than the frost depth as defined by local or State building codes.

b) Bottom of foundation trench excavation is to be inspected by experienced geotechnical personnel and, especially, prior to any placement and compaction of crusher run stone, select granular fill, approved general granular fill, or other approved fill.

c) All areas of the foundation trench bottom which are concluded to be unacceptable must be over excavated from the bottom of footing/foundation elevation or, if recommended, from the bottom of the minimum depth of the undercut for the compacted select granular fill layer, upon which the bottom of footing/foundation will bear, to the top of the approved fill or natural soil, for less than a four foot depth or the footing width (whichever is greater), and backfilled with approved compacted granular fill.

d) Over-excavated/undercut areas must extend laterally beyond each vertically projected edge of the foundation by a minimum distance that is equal to one-half the total depth of the undercut or equating to a slope of two vertical to one horizontal. Side slopes of the trench excavation should be one on one (vertical to horizontal distance) or flatter in cohesive soils or one on one and one-half or flatter in the granular materials, as required by OSHA.

e) Where recommended, a geotextile strength and filter fabric will line the bottom and side slopes, up to the foundation bearing elevation at a minimum, of the excavation/undercut. Overlap unsewn seams as per the manufacturer's recommendations.

f) All foundations shall bear on approved dense/very stiff natural soil/weathered rock, if supported by the calculations, or thoroughly compacted select/approved granular fill, with a minimum thickness as determined by the calculations [see c) also], unless very stiff-hard/dense-very dense natural soil/fill/rock conditions are encountered and approved at a shallower depth.

g) Water must not be allowed to accumulate or pond in foundation trench bottom. Adequate drainage is to be provided.

h) During winter construction, foundations are to be protected from freezing during the curing period and, thereafter, properly backfilled to the required compaction specifications, as specified by the architect/design engineer.

i) In the event that any shallow drilled piers, tanks, foundation walls, strip or spread footings, and/or concrete slabs-on-grade from any existing, former or previously unknown on-site structures are encountered during excavation, the following demolition conditions will apply, unless indicated otherwise in the schematics of the foundation system:
   - complete removal in and near the proposed building/structure foundation area (except if the foundations and slab-on-grade are to be tied into any existing buildings/structures which are to remain),
   - removal down to three feet below final grade in the parking lot & driveways, {unless the slab-on-grade is in structurally sound condition & is approved for use as a part of the pavement system}. (Note that complete removal is optional.) and
   - removal down to three feet below final grade in green/grassed areas. (Note: complete removal is optional.)

j) If tree, shrub, or other vegetative root systems or organic deposits are encountered, the removal conditions in h) above apply.

k) Any slag, cinder and/or ash fill shall be verified to have very low potential for expansion and/or corrosion characteristics, where applicable for direct or potential (via leachate) contact with foundation elements and buried utilities or as directed by the design engineer/architect.

l) In the event that boulders and/or bedrock are encountered during excavation, the following conditions will apply:
   - remove boulders that are one-quarter (1/3 in drumlins) or greater of the min. footing width, at the exposed footing subgrade.
   - remove boulders that are one foot or greater in size/max. dimension, at the exposed pad subgrade.
   - as/if indicated/directed by engineer in schematics of the foundation system:
     - apparent top of bedrock and/or boulders that are one-half or greater of the min. footing width will not be located within a depth equal to the footing width, at a min., from the bottom of the footing.
     - apparent top of bedrock and/or boulders that are two feet or greater in size/max. dimension will not be located within a depth of four feet, at a min., from the bottom of the building/tank/other structure pad.
     - subgrade is to be adequately probed/tested, at spaced intervals, along the footing line or building/tank/other structure pad in order to confirm the absence of boulders and/or bedrock within these depths.
     - remove any suspected subsurface boulder and/or bedrock obstructions, that meet the preceding depth criteria.

m) At the locations of the demolished structures in i), vegetative/organic deposits in j), slag, cinder and/or ash fil in k) or bedrock and/or boulders in l) above, place and compact the select/approved fill, if needed, to the elevation of the bottom of the pavement base/subbase stone layer or as required in c) above for the proposed building/structure foundation.

n) To the extent practical, the entire site is to be proof rolled and stabilized, as needed, prior to placement of base/subbase stone layer beneath the floor slab and asphalt/concrete paved areas.

o) Geotextile strength and filter fabric is recommended beneath the base/subbase layer and atop the subgrade under the building/structure floor slab and in the heavily traveled asphalt paved areas at a minimum, if cohesive/silty/non-plastic fine sandy soils/fills & during wet weather/seasons.

p) The top and/or walls/sides of shallow depth subsurface structures (such as, basement, tank, vault, basin, pool, pipe, culvert, conduit, etc.), which would contain voids at times, or a trench/excavation, or retaining structure, is considered to be subject to loads from a shallow foundation, if it is within a horizontal distance of two times the narrowest dimension/width of the foundation, and must be properly evaluated and designed.

q) Cohesive natural soils/fills will be pre-approved by geotechnical engineer prior to any on-site use in load bearing areas.

BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY, INC.
10440 MAIN ST.
CLARENCE, NY 14031
(716)759-7821
FAX (716)759-7823
e-mail: info@buffalodrilling.com
info@barronandassociatespc.com

GENERAL NOTES: FOOTINGS ON TOP OF APPROVED SLIGHTLY WEATHERED/SOUND/COMPETENT BEDROCK

a) The net allowable bearing capacity is generally = 10,000 psf, if used for all building foundations. However, differential settlement is a concern for footings of the same building that bear on media (i.e., soil and rock) with different strength/settlement properties. The net allowable bearing capacity of the weaker strata will generally need to be reduced to limit the allowable differential settlement.

b) In order to bear at the min. frost depth, some rock excavation may be required. Alternatively, for footings that bear atop an approved limestone, dolomite or hard shale rock that is less than the frost depth, hooked #4 or #5 rebars/dowels may be grouted to a 48 inch min. depth into approved rock at a four foot center to center spacing or within each massive block of fractured rock. The structural requirements for the rebars/dowels shall be as specified by the design engineer.

FOOTING SETTLEMENT

a) If a compacted select/approved granular fill layer is placed in an undercut area (under wall footings and/or interior footings), the settlement occurs immediately and is proportioned by the thickness of the layer (if < 2 x B for wall footings and if < B for square/rectangular footings) and the $q_{allow\ 1}$, of settlement. The magnitude of this settlement is generally less than 0.5 inch.

b) The approved granular (non-plastic silt, silty sand and sandy gravel) natural soils/fills that exist on-site and are beneath a recommended undercut depth, where applicable, below the footings should be properly compacted and inspected prior to placement and compaction of the select/approved granular fill and the footing construction. Most of the settlement will occur immediately and the magnitude of the settlement, which is evaluated in concert with the soil conditions in a) above, is estimated to be less than approximately 1.0 inch.

c) The approved cohesive natural soils/fills that exist on-site and are beneath the undercut depth, where applicable, below the footings should be properly compacted, as needed, and inspected prior to placement and compaction of the select/approved granular fill and footing construction. The magnitude of settlement is evaluated in concert with the conditions in d) below.

d) For the upper cohesive fills/natural soils and lower natural cohesive soil layers that exist, the N values of these layers indicate a slightly to highly overconsolidated state or effective preconsolidation pressure (p'_c). [Also refer to ASCE/USACE No. 9, Design Guide "Settlement Analysis," pg. 5 for p'_c estimation.]

The deeper hard glacial till and bedrock layers are assumed to be incompressible relative to applied loads. Unless stated or calculated otherwise, consolidation settlement of the underlying cohesive fill and natural soil layers are also not considered to be a concern for the foundation loads, due to the slightly to highly over-consolidated state of these fills/natural soils. Based upon the allowable load per footing width, total and differential settlements are expected to be within acceptable limits and are generally not likely to exceed 1.0 and 0.5 to 0.75 inches, respectively (per P,H&T, page 309), if all compacted granular fills and/or natural cohesive soils (per P,H&T, page 273).

e) For foundations on the potentially high bedrock condition, limit total settlement and differential settlement < 3/4 inch.

f) If bearing capacity differences exist for approved natural soils/fills at the building center/core and the wings, add control joints, at a min., between the building center/core and the start of each building wing.

Barron and Associates

BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY, INC.
10440 MAIN ST.
CLARENCE, NY 14031
(716)759-7821
FAX (716)759-7823
e-mail: info@buffalodrilling.com
info@barronandassociatespc.com

LATERAL EARTH PRESSURE ON GENERIC BLOCK FOUNDATIONS FOR SIGNS, FREE-STANDING RETAINING WALLS, OR BELOW GRADE/BASEMENT/TANK/POOL RETAINING WALLS (Less Than 20 Feet High)

a) Porous filter media, in contact with the basement/below grade foundation wall or retaining walls, protects and is in contact with a minimum 4 inch diameter perforated drainage pipes at the footing/base of the foundation/structural wall (exterior backfill side and interior basement side) and/or weep pipes through the wall, as needed and as applicable.

b) Where recommended, a geotextile filter fabric will protect the gravel filter media from the earth backfill. Overlap unsewn seams as per the manufacturer's recommendations.

c) Waterproof earth side of wall, as is customarily provided in practice.

d) Drainage pipes are connected to an appropriately designed collector pipe, conveyance, and/or sump pump system as is applicable for the intended purpose of the wall and as customarily provided/installed in practice.

e) For potential groundwater table conditions above the top of the basement slab-on-grade condition, install continuous waterstops (with no joints in stop) at wall and floor construction joints, as is customarily provided in practice. Interior intermediate drainage pipes beneath the slab, that are spaced on-center and in both directions, do appear to be needed.

f) Assume a uniformly graded, clean coarse sand or sandy gravel backfills:

* equivalent N-value in a dense state: $(N_1)_{60}$ = 40 blows/foot
* friction angle: ϕ' = 38 degrees {Teng, pg. 12}
* average in-place densities: moist - γ_m = 120 pcf
  saturated - γ_{sat} = 132 pcf submerged - $\gamma' = (\gamma_{sat} - \gamma_w)$ = 70 pcf

g) Assume at base of wall/footing, coefficient of friction against sliding (f_s) at base of wall (Refer to Teng, pg. 320-1):

$f_s = \tan(0.58 \times \phi') = 0.40$ (AREA silty soil to silty coarse-grained soil)

h) Use equivalent fluid pressure design approach {Hough, pg. 249 and NAVFAC pg. 7-10-9}:

* at rest pressure coefficient - $K_0 = 1 - \sin(\phi') = 0.38$
* effective lateral pressure of soil - $\gamma'_l = K_o \times \gamma' = 26.6$ pcf
* hydrostatic pressure - γ_w = 62.4 pcf
* equivalent fluid pressure with water level - at the top of the grade at the wall $\gamma_{eo} = \gamma'_l + \gamma_w = 89$ pcf (say 90 pcf)
* equivalent fluid pressure with compaction induced lateral stress increase (W&F, pg 409) $\gamma_{eo} = 2 \times K_o \times \gamma_m = 91$ pcf (say 90 pcf)
* active pressure case - $K_a = [1 - \sin(\phi')] / [1 + \sin(\phi')] = 0.24$
  $\gamma_{ea} = K_a \times \gamma_m = 29$ pcf (say 30 pcf)
* passive pressure case - $K_p = [1 + \sin(\phi')] / [1 - \sin(\phi')] = 4.2$
  $\gamma_{ep} = K_p \times \gamma_m = 504$ pcf (say 330 pcf with a F.S. = 1.5)

		Thoroughly Compacted ⇒⇒		Uniformly Graded & Clean Coarse Sand or Sandy Gravel Fill	Non-Plastic Silty Sand or Sandy Silt Fill	
USE:	Earth Pressure Coefficient	Static Active	=	0.24	0.33	
		Static At-Rest	=	0.76	1.00	
		Static Passive	=	2.80	2.00	(with F.S. = 1.5)
		Static Passive	=	4.20	3.00	(with F.S. = 1.0)
USE:	Equivalent Fluid Pressure	Static Active	=	30 pcf		
		Static At-Rest	=	90 pcf (for rigid walls)		
		Static Passive	=	330 pcf (with F.S. = 1.5)	[500 pcf with (with F.S. = 1.0)]	

[For earthquakes, structural engineer may elect to use the above Static Passive case instead of the below Earthquake Lateral Load for Non-Yielding Wall movement into the soil backfill.]

USE: Simplified Model for Earthquake Lateral Load/Ft. Wall Length @ 0.6 H_{bw} above base. Loads for Non-Yielding Wall.

H_{bw} = Earth Height Behind Wall (feet)

Reduce load by 33% for Yielding Wall (active case) = (6.8 psf / foot) x H_{bw}^2 (NYS, S_{ds} = 0.25 g)

(γ_m = 120 pcf for S_{ds} value. Add to Static At Rest/ Active Pressure/Load for unsaturated backfill case) = (13.5 psf / foot) x H_{bw}^2 (NYS, S_{ds} = 0.50 g)

= (17.5 psf / foot) x H_{bw}^2 (NEern NYS, $S_{ds} \leq 0.65$ g)

[Above for Site Class C to E soils. Interpolate for other S_{ds} values.

Use 1.75 x values for walls on Class B/A rock or on rigid foundation base. (FEMA NEHRP Guidelines)]

Saturated/Liquified Soil During Earthquake = 132 pcf

(Equivalent Fluid Pressure. Add to inertial hydrodynamic pressure, not presented here.)

(For looser/denser backfills, adjust above pressures by the ratio = new density / 120 pcf or / 132 pcf (for saturated case))

USE:	Coefficient of Friction Against Sliding (f_s)	=	0.45	(on compacted NYSDOT Item #304.12 or #304.14 gravels)
	(use lowest f_s with no underlying weaker layers)	=	0.35	(on compacted granular soil & non-plastic silt)
		=	0.20	(slab-on-grade on polyethylene on granular fill)
	[with a F.S. = 1.0]	=	0.60/0.50	(on clean, rough, & sound bedrock/smooth bedrock)
	Min. Factor of Safety Against Sliding	=	1.5	

[Rev.9-30-09]

BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY, INC.
10440 MAIN ST.
CLARENCE, NY 14031
(716)759-7821
FAX (716)759-7823
e-mail: info@buffalodrilling.com
info@barronandassociatespc.com

DATA INPUT BY: Carmen M. Panuccio
B&A JOB NO.: 10-510
CLIENT: Kideney Architects, PC
PROJECT: Proposed VA Hospital
Multi-Story Parking Ramp Structure
3495 Bailey Avenue (US Route 62)
City of Buffalo, Erie County, New York

BUILDING CODE OF NEW YORK STATE © - 2007: USGS 2002 ACCELERATIONS at 2% IN 50 YEARS CALCULATED BY LATITUDE AND LONGITUDE

Site Latitude (o) = +42.9506

Site Longitude (o) = -78.8122

Seismic Site Class = C

Building/Structure with Deep Foundation

S_s = 0.2 sec acceleration value for Class B (in g's)

Acceleration Values Below are S_s * 100

LAT. =	LONG. = -78.8500	-78.8122	-78.8000
42.9500	28.210		28.351
+42.9506	28.216	28.322	28.357
43.0000	28.717		28.839

S_1 = 1.0 sec acceleration value for Class B (in g's)

Acceleration Values Below are S_1 * 100

LAT. =	LONG. = -78.8500	-78.8122	-78.8000
42.9500	5.8449		5.8694
+42.9506	5.8454	5.864	5.8699
43.0000	5.8863		5.9101

SEISMIC SITE CLASS	Site Coefficient and Design Spectral Response Acceleration Values			
	0.2 Second		1.0 Second	
	F_a	$S_{ds} = 0.6667 * F_a * S_s$	F_v	$S_{d1} = 0.6667 * F_v * S_1$
A	0.8000	0.1511 g	0.8000	0.0313 g
B	1.0000	0.1888 g	1.0000	0.0391 g
C	1.2000	0.2266 g	1.7000	0.0665 g
D	1.5734	0.2971 g	2.4000	0.0938 g
E	2.3937	0.4520 g	3.5000	0.1368 g
F	2.3937	0.4520 g	3.5000	0.1368 g

<<------- USE THESE VALUES FOR DEEP FOUNDATIONS

Only residential buildings in Town of Amherst, Erie Co., N.Y.

Sds = 0.227 g Seismic Design Category = B

NOTE: F_a and F_v values are linearly interpolated, for the above S_s and S_s values, respectively, within the appropriate range of the mapped spectral response accelerations. (Gridded data at 0.05 degree increments from: http://earthquake.usgs.gov/research/hazmaps/products_data/2002/data/)

BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY. INC.
10440 MAIN STREET
CLARENCE, N.Y. 14031
(716) 759-7821
FAX (716) 759-7823
e-mail: info@buffalodrilling.com
info@barronandassociatespc.com

APPENDIX D

GENERAL EARTHWORK SPECIFICATION

Barron & Associates, P.C.
GENERAL EARTHWORK SPECIFICATION

PART I GENERAL

1.1 SITE AND SUBSURFACE CONDITIONS

1.1.1 Overview

This specification is included as a courtesy to the clients of Barron & Associates, P.C, and addresses earthwork site preparation. Additions and modifications are necessary to create a job-specific specification. This specification may serve as a basis for the development for a technical specification under Division 2, *Site Work*.

1.1.2 Site Conditions

The site-specific conditions are described under separate cover or may be available from the OWNER.

1.1.3 Subsurface Conditions

The site-specific subsurface conditions are described under separate cover or may be available from the OWNER.

1.2 REFERENCES

American Standard for Testing and Measurement (ASTM):

ASTM C136	Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C2922	Density for Soil and Soil-Aggregate in Place by Nuclear Methods
ASTM D422	Test Method for Particle-Size Analysis of Soils
ASTM D1140	Amount of Material in Soils Finer Than the No. 200 Sieve
ASTM D1557	Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft^3)
ASTM D2216	Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D2487	1990 Classification of Soils for Engineering Purposes
ASTM D4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.3 DEFINITIONS

1.3.1 Unacceptable Material

Soil material containing debris, wood, scrap material, vegetation, refuse, soft unsound particles, and other organic, frozen, deleterious, or objectionable materials. Contaminated soils shall be properly documented and removed or remediated on site. If necessary, remediation procedure will be defined by the OWNER.

1.3.2 Unsuitable Material

Brown, organic topsoil and underlying soft pockets of organic silt or wet, reworked silty clay.

1.3.3 Ordinary Fill

Friable soil containing no stone greater than two-thirds loose lift thickness and no unacceptable or unsuitable materials. In general, existing random fill is expected to be acceptable for reuse as ordinary fill given proper sorting, blending, drying, and controlled placement methods.

1.3.4 Granular Fill

Ordinary fill meeting the designation of ASTM D2487 classification of GW with a maximum of 10 percent by weight passing ASTM D1140, No. 200 sieve.

1.3.5 Select Granular Fill

Clean, uncoated soil which contains no unacceptable materials and conforms to the gradation requirements defined in Table A: Select Granular Fill.

Table A: Select Granular Fill	
Sieve Size	Percent Finer by Weight
2/3 of the loose lift thickness	100
No. 10	30 - 95
No. 40	10 - 70
No. 200	0 - 15

1.3.6 Sand and Gravel

Clean, hard, durable, uncoated particle of sand and gravel, free from lumps of clay, containing no unacceptable matter, and conforming to gradation requirements of *Table B : Sand and Gravel*

Table B: Sand and Gravel	
Sieve	Percent Finer by Weight
*	100
No. 4	50 - 85
No. 10	--
No. 40	10 - 35
No. 100	--
No. 200	0 - 8

* Job-Specific. To be determined by the ENGINEER

1.3.7 Crushed Stone

Clean, durable, sharp-angled fragments of rock or crushed gravel stone of uniform quality, containing no unacceptable matter, free from coatings, and conforming to gradation requirements of *Table C: Crushed Stone*

Table C: Crushed Stone		
	Percent Passing	
Sieve Size	¾-inch Stone	1 ¼-inch Stone
1 ½-inch	—	100
1 ¼-inch	—	85-100
1- inch	100	—
¾-inch	90-100	10-40
5/8-inch	—	—
½-inch	10-50	0-8
3/8-inch	0-20	—
#4	0-5	—

1.3.8 Flowable Fill

Also known as Controlled Low Strength Material – Controlled Density Fill (CLSM-CDF), this material is available under a variety of producer names (e.g., K-Krete©, M-Crete, Flash Fill©, Flowable Mortar, Unshrinkable Fill, etc.). This non-settling backfill mixture is most commonly used for its flowable characteristics, its support strength under traffic loads, and its removability at a later date. The material may be produced on-site or off-site. In either case, the producer of such materials and the product must meet certain certification criteria. Such information is beyond the scope of this specification and will be considered on a site-specific basis.

Flowable fill may be acceptable for use as a backfill for utility trenches of other low-lying areas which require a compacted granular fill. Its use and warranty of performance is left to the CONTRACTOR in such applications.

The use of flowable fill under load-bearing structural components in place of properly placed and compacted granular fill is NOT common and is questionable. The localized use of such material may have profound affects on the performance of a foundation system. Site-specific conditions and the extent of anticipated use of flowable fill must be examined by geotechnical engineer. Cost of such consultation shall be borne by the CONTRACTOR unless specifically directed by the OWNER to seek such consultation. Without such consultation, warranty of performance for such use is left to the CONTRACTOR.

1.4 SUBMITTALS

The following submittals shall be provided in accordance with approved submittals procedures.

1. Fill Source: Provide name and source locations of fill material.

2. Field Test Reports: Field tests will be performed by OWNER's Representative as needed. CONTRACTOR may be required to perform such tests on proposed off-site fill materials.
   a. Fill material grain size analyses per ASTM C136, D422, D1140, D2487
   b. Moisture/Density test results per ASTM D2216
   c. Liquid limit, plastic limit, and plasticity index per ASTM D4318
   d. Compaction/Density test results per ASTM C2922 and D1557

3. Sample: Geotextile fabric

PART 2 PRODUCTS

Geotextile Fabric: Mirafi 600X or equal. (Also referred to as synthetic fabric).

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 General

Manner of excavation shall minimize disturbance of underlying natural ground. If deemed necessary by the Engineer, alter construction procedures to reduce subgrade disturbance. Excavate areas which have been excessively disturbed to firm ground and backfill with properly compacted granular fill.

3.1.2 Roads and Walks

Keep roads and walks free of dirt and debris at all times.

3.1.3 Trees, Shrubs, and Existing Facilities

Protect from any damage all vegetation and facilities identified to remain.

3.1.4 Utility Lines

Locate all utilities within the area of disturbance prior to the start of work. Show locations on initial plans. Protect utility lines from damage. Notify the ENGINEER immediately of damage to or an encounter with an unknown utility. Damage to utility lines are to be repaired by the CONTRACTOR at no additional cost. The CONTRACTOR shall have underground utility owners stake out utility locations prior to the start of clearing and excavation operations.

3.2 VERIFICATION OF CONDITIONS/PROOF-ROLLING

Prior to placement of the initial layer of fill over the natural ground, proof-roll the exposed natural ground above the groundwater table elevation by making two passes with a fully-loaded ten-wheel truck. Excavate unstable areas detected by this process and replace with compacted granular fill.

3.3 PREPARATION

3.3.1 Surface Preparation

Within the site limits indicated on the drawings, excavate all unsuitable material to firm natural ground in the manner specified herein. Follow a construction procedure which permits visual identification of firm natural ground. In the even that groundwater is encountered, the ENGINEER may require that the size of the open excavation be limited to that which can be handled by open pumping to allow visual inspection of the excavation bottom and the performance of backfill operations to be conducted in a dry state.

Excavation of unsuitable material shall be limited to the greater of the following:

- A distance of 5 feet beyond building lines or
- The area defined by a one-horizontal to one-vertical line sloping down from the outside bottom edge of exterior footings to firm natural ground.

3.4 PLACEMENT AND COMPACTION

3.4.1 General

Place fill in accordance with *Table D: Compaction Alternatives.* These alternatives are provided as minimum compaction
standards only and in no way relieve the CONTRACTOR of his obligation to achieve any specified degree of compaction by whatever means may be necessary.

Grade to provide positive drainage and a smooth surface which will readily shed water. To the extent practicable, compact each layer to the specified density on the same day placed. Place fill in horizontal layers. Where horizontal layers meet a natural slope, key layer into slope by cutting a bench.

Fill that is too wet for proper compaction: Disc, harrow, or otherwise dry to proper moisture content for compaction to the required density.

Fill that is too dry for proper compaction: Uniformly apply water over the surface of the loose layer in sufficient quantity to allow compaction to the required density.

Table D: Compaction Alternatives					
Compaction Method	Max. Stone Size	Maximum Loose Lift Thickness (inches)		Maximum Number of Passes	
		Below Structure and Pavements	Less Critical Areas	Below Structure and Pavements	Less Critical Areas
Hand operated vibratory plate of light roller in confined areas	3	4	4	4	4
Hand operated vibratory drum rollers weighing at least 1,000 pounds in confined areas	4	6	8	4	4
Loaded 10-wheel truck or D-8 crawler	6	10	12	4	2
Light vibratory drum roller; Min. weight at drum 8,000lbs; Min. dynamic force 10,000lbs.	8	12	12	6	2
Minimum vibratory drum; Min. weight at drum 10,000lbs; Min. dynamic force 20,000lbs.	8	18	18	6	4

3.4.2 Dewatering

Provide adequate pumping and drainage facilities to keep excavated areas sufficiently dry of groundwater and surface run-off. Dewatering shall avoid adversely affection construction procedures or causing excessive disturbance of underlying natural ground. Drain all pumped water in such a manner as to avoid damage to adjacent property.

If requested by the ENGINEER, place a 6-inch to 12-inch layer of sand and gravel or crushed stone over the natural underlying soil to stabilize area which have been disturbed due to groundwater seepage pressures and to expedite dewatering operations. Particular attention shall be given areas under proposed foundations.

3.5 FIELD QUALITY CONTROL

3.5.1 Compaction Requirements

Allow the ENGINEER sufficient time to make necessary observations and tests. Base the degree of compaction on maximum dry density as determined by ASTM D1557. The minimum degree of compaction for placed fill shall be as indicated *in Table E: Compaction Requirements.*

Table E: Compaction Requirements	
Area	Minimum Degree of Compaction (%)
Below foundation	95
Pavement and building subbase and base courses	95
Below building slab base course and above bottom of foundation	92
Below pavement subbase and base courses	90
Trench backfill outside of building	90
Trench backfill inside of building	Refer to one of the above-listed categories
Ordinary fill within 5 feet of grade	90
Vegetated areas below 5 feet of grade	85

3.5.2 Testing

Site work should be monitored and tested by geotechnical ENGINEER or his representative and in accordance with requirements of the design team to assure compliance with earthwork and foundation construction specifications.

The owner will retain a geotechnical ENGINEER or his representative to perform on-site observations and testing during this phase of construction operations. The geotechnical ENGINEER or his representative will:

- Observe excavation and dewatering of building and controlled fill areas;
- Observe backfill and compaction within building and controlled fill areas;
- Laboratory test and analyze fill material; and
- Observe construction – and performing water content, gradation, and compaction tests.

On a timely basis, the CONTRACTOR will receive copies of test results submitted to the OWNER. In addition, during construction the geotechnical ENGINEER will advise the OWNER and CONTRACTOR in writing of conditions which fail to conform to the Contract Documents. The CONTRACTOR shall take immediate action to remedy indicated deficiencies.

The geotechnical ENGINEER or his representative will not supervise or direct the actual work of the CONTRACTOR or employees and representatives of the CONTRACTOR. The presence of, observations by, and testing performed by the geotechnical ENGINEER or his representatives shall not excuse the CONTRACTOR from defects discovered in the work.

BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY. INC.
10440 MAIN STREET
CLARENCE, N.Y. 14031
(716) 759-7821
FAX (716) 759-7823
e-mail: info@buffalodrilling.com
info@barronandassociatespc.com

APPENDIX E

LIMITATIONS

BARRON & ASSOCIATES, P.C. &
BUFFALO DRILLING COMPANY. INC.
10440 MAIN STREET
CLARENCE, N.Y. 14031
(716) 759-7821
FAX (716) 759-7823
e-mail: info@buffalodrilling.com
info@barronandassociatespc.com

LIMITATIONS

1. This report is based on the data that was obtained from the subsurface explorations and on the design of the proposed structure as submitted to the geotechnical engineer. A geotechnical engineer, who is experienced in foundation construction and earthwork, should be engaged to review the final design and specifications in order to determine whether any change in concept may have any effect on the validity of the conclusions presented herein, and whether these conclusions have, in fact, been implemented in the design and specifications.

2. The subsurface conditions, including thicknesses, between the exploration locations are approximate and simplified representations of the strata and transitions. There is the possibility that variations in soil and rock conditions and boundaries will be encountered during construction. In order to permit correlation between the exploratory soil data and the actual soil conditions encountered during construction and so as to assess conformance with the plans and specifications as originally contemplated, it is recommended that a geotechnical engineer, who is experienced in foundation construction and earthwork monitoring, should be retained to perform continuous construction review during the site preparation and foundation construction operations.

3. The subsurface exploration logs and subsurface conditions may aid in estimating material quality and quantities, such as topsoil/organic matter, fills, natural soils, and rock, but are not to be relied upon as the exclusive means for bid preparation purposes. It is the responsibility of the contractor to perform any additional site examinations and explorations and to prepare an accurate bid.

4. Disclaimers:

   a. In the event that any changes in the nature, design or location of the proposed structure is planned, the conclusions that are contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are modified or verified in writing.

   b. The geotechnical engineering report has been prepared for this project by Barron & Associates, P.C. This report is for assistance in design only and is not a sufficient basis on which to prepare an accurate bid.

   c. This report has been prepared for the exclusive use of Kideney Architects, P.C. of Buffalo, New York, their client, and their designated design representatives for specific application to the development of the proposed multi-story, slab-on-grade and concrete framed parking ramp structure, with approximately 96,000 square feet in total footprint area on/near the southern side of the existing Veterans Administration (VA) Hospital that is addressed as 3495 Bailey Avenue (US Route 62) in the City of Buffalo, Erie County, New York and in accordance with generally accepted geotechnical engineering practice. No other warranty, expressed or implied, is made.