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July 29, 2021 ***via email:*** ***jwendling@wilderbalter.com***

James R. Wendling
WB 30 Water Street, LLC
480 Bedford Road
Chappaqua, NY 10514

RE: Geotechnical Summary Letter
Proposed Residential Development
30 Water Street
Ossining, NY
SESI Project No. 11498

Dear Mr. Wendling:

We have completed our geotechnical investigation for the proposed 18,664 SF residential building (South Building) and 14,010 SF garage structure (North Building) that may be constructed at 30 Water Street in the Village of Ossining, NY, (Ossining). The subject Site is referenced herein as “the Property” or “the Site.” The Property has also been known as the Ossining Works Site, or the Ossining Department of Public Works (DPW). The approximately 3.117-acre site is bounded by Central Avenue to the north, Water Street to the west, Main Street to the south and a forested area to the east. The property is divided into a north and south section by the Sing Sing Kill, that generally runs from east to west across the long axis of the Property.

The following sections provide a brief summary of the proposed foundation support options.

EVALUATION AND RECOMMENDATIONS

<u>General</u>

The recommended site preparation procedures discussed in this letter are based on geotechnical engineering considerations. Our geotechnical design considerations may require modifications to address on-going environmental investigations.

Based on the proposed basement floor elevation of +4 in the approximate western two-thirds of the residential structure, (south building) and the observed groundwater table elevations of between +4 and +13.5, it is anticipated that the basement will be below the groundwater table. Typically, when structures extend below the groundwater table, construction requires support of the excavation sidewalls, a dewatering system to lower the groundwater table and the excavation and stockpiling or removal of the excavated materials from the site. In addition, a temporary or permanent dewatering system would require treatment prior to discharge.

Given the fact that the south building is planned to extend below the water table, we recommend it be supported by a mat foundation following the In-Situ Stabilization/Soil Mixing program and selective use of additional ground improvement measures. The mat and foundation walls would need to be designed to withstand hydrostatic pressures.

Based on the subsurface conditions and the absence of a below grade level, the garage structure, (north building) may be constructed using conventional spread foundations and floor slab supported on soils following a ground improvement measures.

SITE PREPARATION AND PROCEDURES

<u>Demolition</u>

Site preparation should begin by removing the existing structures, stockpile(s) and all existing surface and subsurface improvements, if present, from within and at least ten feet beyond the limits of proposed buildings, as possible. All subsurface utilities that will be abandoned should be completely removed from within the limits of the proposed building areas. All excavated materials will need to be screened for contamination by the environmental engineers prior to removal from the site. Any excavations created by the removal of foundations, utilities, or for environmental purposes, etc should be backfilled with controlled compacted fill. The controlled compacted fill should be placed in accordance with the recommendations of this report under the observation of a geotechnical engineer.

<u>Building Area Procedures</u>

After completion of the building demolition and subsurface element removal, the work area should then be leveled and proofrolled using a minimum 10-ton roller. Any soft areas may be undercut if required and backfilled with a ¾-inch clean crushed stone layer compacted or healed with the bucket of the machine.

This would be followed by the construction of a working pad and performance of the In-Situ Stabilization / Soil Mixing and if required, an additional Ground Improvement Plan (GIP), installation of a support of excavation (SOE) system, and installation of a dewatering system, where required. Depending upon the SOE bracing required, excavating the fill and natural soils from within the site limits to the required foundation subgrade depth would be performed in stages. As the soils are removed, the building area should be compacted with a walk behind or remote controlled, double drum vibratory roller, or healed using the back of the excavator or loader bucket. We recommend a minimum 12-inch thick layer of ¾-inch clean crushed stone or a concrete mud mat be placed after the excavation has reached the subgrade to protect the bearing surface.

<u>Foundation Procedures</u>

Residential Structure:
Considering the need for a water-tight bathtub foundation, the residential structure should be supported by a mat foundation founded on recommended ISS/Soil Mixing and if required, additional GIP.

The preliminary mat foundation design can utilize a maximum design bearing capacity of 2.5 tons per square foot (tsf), 5,000 psf; however, this will depend on the GIP chosen. Greater bearing capacity may be available from the chosen GIP. A mat foundation bearing on the improved soils may be designed using a modulus of subgrade reaction of 50 pci. The mat foundation and foundation walls would need to be designed to withstand hydrostatic pressures. A water-stop should be installed between the walls and mat and a waterproofing membrane should be installed on the exterior of the foundation. The construction of the residential structure basement will also require a support of excavation (SOE) system to be installed along the perimeter of the residential buildings site to support the surrounding roadways and structures. As discussed above, it may be possible to create the perimeter walls for the water-tight bathtub foundation using the MMC's extended up to the finished grade.

Garage Structure

The garage structure would be supported on spread footings following a GIP consisting of Densified Stone Columns or Rigid Inclusions described below. After the GIP has been successfully completed for the garage structure, the proposed footings and slab may be placed on the improved ground. Depending upon the GIP selected, an initial maximum design bearing capacity of 2.5 tsf (5,000 psf) may be used for preliminary design. Regardless of the loads, the minimum plan dimension of isolated footings should be 36 inches and the minimum width of continuous footings should be 24 inches.

In-Situ Stabilization/Soil Mixing

Based on a review of the Arcadis Report, remedial technologies capable of achieving the remedial action objective for the site should reduce the mobility and/or the potential for exposure to the impacted material without removal or treatment. We understand that the possible solution for the southern building includes the performance of in-situ solidification (ISS). In order to provide uniform support for the building, it may be necessary to complete this throughout the entire building footprint.

Arcadis recommended the excavation of the upper five (5) feet of material, where necessary, to clear obstructions (i.e., former building foundations and utilities) and then the performance of ISS to address the soils that contain significant quantities of non-aqueous phase liquid (NAPL) contaminants which were observed to depths of up to 34 feet below grade. The ISS process, also known as soil mixing, involves mixing Portland cement (and other pozzolanic materials) with impacted soil to reduce the leachability and mobility of contaminants present in the soils.

Soil Mixing has also been implemented as a ground improvement technique that improves soft or loose soils, by mechanically mixing them with either wet grout or a dry cementitious binder. In addition to the encapsulation of contamination, soil mixing can increase bearing capacity, decrease settlement and increase global stability.

Soil mixing used to encapsulate contaminants is generally performed as mass soil mixing (MSM). The MSM process is typically constructed in pre-defined "cells" on the order of 12 to 14 feet square in plan area. Commonly the cells are mixed adjacent to others to form a mass stabilization zone, all with a designed strength and stiffness.

Soil mixing can also be installed as mixed modulus columns (MMC). MMC's are typically used to create a column of mixed soil and cement to support discrete columns or foundation elements, similar to rigid inclusions. After the preparation of a working platform, the rig is moved into place and the elements installed. Generally, a displacement auger is used to penetrate down to the designed depth. Concrete is pumped as the tool is pulled upwards. Once the MMC is installed up to the design level, a column of gravel or crushed stone, horizontally displaced, is installed on top. The MMC technique can be performed to greater depths and approximate the results of MSM by using a large diameter column placed in a smaller grid spacing to create an overlap; for example, an 8-foot diameter column placed on a 7-foot triangular pattern. The actual dimensions would be determined by the ground improvement contractor.

In the case of a water-tight, bathtub mat foundation, it may be possible to extend the MMC's to the ground surface to provide support of the excavation sidewalls and create a water resistant ring around the proposed building foundation, similar to a secant wall. Such a ring would help to limit the amount of ground water pumping, treatment and disposal required to achieve the proposed excavation depths.

Soils vary widely in their ability to be mixed, depending upon the soil type, strength, water content, plasticity, stratigraphy, and texture. Laboratory testing is typically recommended as part of the design. Pre-production laboratory testing is used to determine the mix methodology, energy, and binder content. The design depth and mix design as well as the process would be determined by the ground improvement contractor after review of the site and soil conditions as well as the foundation requirements.

Additional Ground Improvement Programs (GIP)

Based on the area of known DNAPL contamination, the ISS/Soil Mixing process would be primarily performed in the residential building and may potentially be applicable to the garage structure. As an alternative, other GIP's, such as Densified Stone Columns (DSC) or Rigid Inclusions (RI) may be applicable in non-contaminated areas of the residential building. These techniques may also be applicable to the entire proposed garage structure area, based on the environmental study results, site requirements and foundation design and loads.

Densified Stone Columns Option:

The densified stone column (DSC) GIP requires the drilling of an open hole and the placement of aggregate in the hole to be rammed in lifts to the bearing level of the foundation. Based on the presence of loose soils and the presence of the water table at depths of four (4) to 8.5 feet below the ground surface, the "open hole" technique may be problematic due to the possibility of sloughing or cave-in of the hole before completion of the DSC.

Considering the subsurface conditions at the site, an Impact® Pier Foundation (IPF) system may be more effective. The IPF DSC system uses a mandrel which is inserted into the ground to maintain an open hole. The initial displacement of the soils caused by the insertion of the mandrel, followed by construction of a rammed aggregate pier, reinforces the soil through the lateral displacement of the materials. The construction of an aggregate pier through the opening created by the mandrel is used to transfer the foundation and slab loads to the underlying soils. SESI assumes the DSCs would be installed to depths of up to 35 feet beneath foundations and to shallower depths beneath the floor slabs.

After installation of the DSCs, the site is raised by the installation of a load transfer platform constructed using structural fill or dense graded aggregate. A conventional slab can then be constructed on top of the load transfer platform. In addition, the DSC GIP is generally a non-intrusive solution avoiding contact with potentially contaminated soils and does not produce significant ground vibrations which may affect adjacent structures such as the existing open culvert or existing utilities in the roadway. The Rammed Aggregate Pier DSC and the IPF system are proprietary ground improvement methods performed on a design-build basis by GeoStructures, Inc. Menard USA and Hayward Baker also have similar GIP's.

Due to the need to insert a mandrel into the ground, the buried obstructions (i.e. foundations walls and floor slabs, etc.) would need to be removed.

Rigid Inclusions Option:

The installation of rigid inclusions, such as Controlled Modulus Columns (CMCs) or GeoConcrete Columns (GCCs) within the upper soil strata improves the soil layers and allows the use of conventional spread foundations and conventional floor slabs constructed on-grade. CMCs and GCCs are proprietary ground improvement methods performed on a design-build basis by Menard Group USA and GeoStructures, Inc. In general, CMCs and GCCs are very similar ground improvement methods. Both consist of grouted or concrete rigid elements which are constructed under low pressure in auger holes. The result is a composite system, where the soil and the rigid elements share any new fill and building loads. A load transfer pad (LTP) may be required for rigid inclusions. The thickness of the LTP, which is used to transfer the building loads to the rigid inclusions, can vary depending on the site soils and design of the rigid inclusion system. The LTP will typically vary between 6 inches and 3 feet thick beneath the footings and floor slab. The LTP materials generally need to meet very strict gradation requirements and compaction criteria. The LTP materials typically consist of recycled concrete aggregates or dense-graded aggregate placed in controlled compacted lifts.

Due to the need to drill a hole into the ground to construct the columns, buried obstructions (i.e. foundations walls and floor slabs, etc.) would need to be removed. In addition, the rigid inclusion GIP is generally a non-intrusive solution avoiding contact with potentially contaminated soils and does not produce significant ground vibrations which may affect adjacent structures such as the existing open culvert or existing utilities in the roadway.

Sincerely,

SESI CONSULTING ENGINEERS

Michael St. Pierre, P.E.
President

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