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PRELIMINARY SUBSOIL STUDY
FOR FOUNDATION DESIGN
PROPOSED MIXED-USE BUILDING
301 BROADWAY STREET
EAGLE, COLORADO

PROJECT NO. 23-7-493

NOVEMBER 6, 2023

PREPARED FOR:

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PURPOSE AND SCOPE OF STUDY

This report presents the results of a preliminary subsoil study for a proposed mixed-use commercial and residential building to be located at 301 Broadway Street, Eagle, Colorado. The project site is shown on Figure 1. The purpose of the study was to develop recommendations for the foundation design. The study was conducted in accordance with our agreement for geotechnical engineering services to Alex Chay dated August 16, 2023.

A field exploration program consisting of an exploratory boring was conducted to obtain information on the general subsurface conditions. Samples of the subsoils obtained during the field exploration were tested in the laboratory to determine their classification, compressibility or swell, and other engineering characteristics. The results of the field exploration and laboratory testing were analyzed to develop recommendations for foundation types, depths and allowable pressures for the proposed building foundation. This report summarizes the data obtained during this study and presents our conclusions, design recommendations and other geotechnical engineering considerations based on the proposed construction and the subsurface conditions encountered.

PROPOSED CONSTRUCTION

Plans for the proposed structure were conceptual at the time of this study. The proposed building is assumed to be a two- or three-story structure, possibly with an underground parking garage. Ground floor could be slab-on-grade or structural over crawlspace. Any underground parking structure is assumed to have a slab-on-grade floor. Grading for the structure is assumed to be relatively minor with cut depths between about 7 feet without underground parking, to extensive with cut depths of 12 to 15 feet if underground parking is used. We assume moderate to moderately heavy foundation loadings, typical of the proposed type of construction.

When building location, grading and loading information have been developed, we should be notified to re-evaluate the recommendations presented in this report.

SITE CONDITIONS

The lot was occupied with a one-story commercial building with above ground parking. The terrain is relatively flat and nearly level. The site is bordered on the east by Broadway Street and on the north by West 3rd Street.

SUBSIDENCE POTENTIAL

Bedrock of the Pennsylvanian age Eagle Valley Evaporite underlies the town of Eagle. These rocks are a sequence of gypsiferous shale, fine-grained sandstone and siltstone with some

massive beds of gypsum and limestone. There is a possibility that massive gypsum deposits associated with the Eagle Valley Evaporite underlie portions of the lot. Dissolution of the gypsum under certain conditions can cause sinkholes to develop and can produce areas of localized subsidence. These sinkholes appear similar to others associated with the Eagle Valley Evaporite in the areas of the Eagle River Valley.

Sinkholes were not observed in the immediate area of the subject site. No evidence of cavities was encountered in the subsurface materials; however, the exploratory borings were relatively shallow, for foundation design only. Based on our present knowledge of the subsurface conditions at the site, it cannot be said for certain that sinkholes will not develop. The risk of future ground subsidence on the subject site throughout the service life of the proposed structure, in our opinion, is low; however, the owner should be made aware of the potential for sinkhole development. If further investigation of possible cavities in the bedrock below the site is desired, we should be contacted.

FIELD EXPLORATION

The field exploration for the project was conducted on September 26, 2023. One exploratory boring was drilled at the location shown on Figure 1 to evaluate the subsurface conditions. The boring was advanced with 4-inch diameter continuous flight augers powered by a truck-mounted CME-45B drill rig. The boring was logged by a representative of Kumar & Associates.

Samples of the subsoils were taken with 1⅜ inch and 2 inch I.D. spoon samplers. The samplers were driven into the subsoils at various depths with blows from a 140 pound hammer falling 30 inches. This test is similar to the standard penetration test described by ASTM Method D-1586. The penetration resistance values are an indication of the relative density or consistency of the subsoils. Depths at which the samples were taken and the penetration resistance values are shown on the Log of Exploratory Boring, Figure 2. The samples were returned to our laboratory for review by the project engineer and testing.

SUBSURFACE CONDITIONS

A graphic log of the subsurface conditions encountered at the site is shown on Figure 2. The subsoils encountered consist of about 1 foot of asphalt and subgrade material overlying medium stiff, sandy silty clay underlain at a depth of 7 feet by dense, silty sandy gravel and cobbles with small boulders that extended down to the depth drilled of 9½ feet. Drilling was difficult in the very dense gravel and cobble soil and practical drilling refusal was encountered in the deposit.

Laboratory testing performed on samples obtained from the borings included natural moisture content and density and gradation analyses. Results of swell-consolidation testing performed on a relatively undisturbed drive sample of the silty clay soils, presented on Figure 3, indicate low to

moderate compressibility under existing moisture conditions and light loading, a low expansion potential when wetted under a 1000 psf surcharge, and moderate compressibility when loaded after wetting. The laboratory testing is summarized in Table 1.

No free water was encountered in the boring at the time of drilling and the subsoils were moist to slightly moist

FOUNDATION BEARING CONDITIONS

The clay soils encountered in the boring possesses a low bearing capacity and are not suited to support the proposed type of construction. A lower risk of settlement would be to remove the clay soils and place a spread footing foundation on the natural undisturbed gravel and cobble soil. Provided below are recommendations for a spread footing foundation. If recommendations for a deep foundation system are desired, we should be contacted.

DESIGN RECOMMENDATIONS

FOUNDATIONS

Considering the subsurface conditions encountered in the exploratory borings and the nature of the proposed construction, we recommend the building be founded with spread footings bearing on the natural gravel and cobble soils with a slight risk of settlement.

The design and construction criteria presented below should be observed for a spread footing foundation system.

1) Footings placed on the undisturbed natural coarse granular soils (or on compacted structural fill) should be designed for an allowable bearing pressure of 4,000 psf. Based on experience, we expect settlement of footings designed and constructed as discussed in this section will be about 1 inch or less.
2) The footings should have a minimum width of 18 inches for continuous walls and 2 feet for isolated pads.
3) Exterior footings and footings beneath unheated areas should be provided with adequate soil cover above their bearing elevation for frost protection. Placement of foundations at least 48 inches below exterior grade is typically used in this area.
4) Continuous foundation walls should be reinforced top and bottom to span local anomalies and better withstand the effects of some differential settlement such as by assuming an unsupported length of at least 10 feet. Foundation walls acting as retaining structures should also be designed to resist a lateral earth pressure corresponding to an equivalent fluid unit weight of at least 55 pcf for the on-site soil as backfill.

5) All existing fill, topsoil and any loose or disturbed soils should be removed and the footing bearing level extended down to firm natural coarse granular soils. The exposed soils in footing area should then be compacted. Any structural fill below footing areas should be compacted to at least 98% standard Proctor density at a moisture content within about 2% of optimum. Structural fill should consist of suitable granular soils, such as the on-site coarse granular soils, or aggregate base course.

6) A representative of the geotechnical engineer should observe all footing excavations prior to concrete placement to evaluate bearing conditions.

FLOOR SLABS

The natural on-site soils, exclusive of topsoil, are suitable to support lightly loaded slab-on-grade construction. The clay soils are compressible when wetted which could result in some slab settlement and distress if they become wetted. To reduce the effects of some differential movement, floor slabs should be separated from all bearing walls and columns with expansion joints which allow unrestrained vertical movement. Floor slab control joints should be used to reduce damage due to shrinkage cracking. The requirements for joint spacing and slab reinforcement should be established by the designer based on experience and the intended slab use. A minimum 4-inch layer of free-draining gravel should be placed beneath basement level slabs to facilitate drainage. This material should consist of minus 2-inch aggregate with at least 50% retained on the No. 4 sieve and less than 2% passing the No. 200 sieve.

All fill materials for support of floor slabs should be compacted to at least 95% of maximum standard Proctor density at a moisture content near optimum. Required fill can consist of the on-site soils devoid of vegetation, topsoil and oversized rocks, or road base can be imported.

UNDERDRAIN SYSTEM

Although free water was not encountered during our exploration, it has been our experience in the area and where clayey soils are present that local perched groundwater can develop during times of heavy precipitation or seasonal runoff. Frozen ground during spring runoff can also create a perched condition. We recommend below-grade construction, such as retaining walls, crawlspace, and basement areas, be protected from wetting and hydrostatic pressure buildup by an underdrain system.

The drains should consist of 4-inch diameter rigid perforated PVC drainpipe placed in the bottom of the wall backfill surrounded above the invert level with free-draining granular material. The drain should be placed at each level of excavation and at least 1 foot below lowest adjacent finish grade and sloped at a minimum ½ % to a suitable dry well or to a sump where the water can be

collected and pumped. Free-draining granular material used in the underdrain system should contain less than 2% passing the No. 200 sieve, less than 50% passing the No. 4 sieve and have a maximum size of 2 inches. The drain gravel backfill should be at least 1½ feet deep and be covered by a filter fabric such as Mirafi 140N or 160N.

SURFACE DRAINAGE

Positive surface drainage is a very important aspect of the project to prevent wetting of bearing soils. The following drainage precautions should be observed during construction and maintained at all times after the residence has been completed:

1) Inundation of the foundation excavations and underslab areas should be avoided during construction.
2) Exterior backfill should be adjusted to near optimum moisture and compacted to at least 95% of the maximum standard Proctor density in pavement and slab areas and to at least 90% of the maximum standard Proctor density in landscape areas.
3) The ground surface surrounding the exterior of the building should be sloped to drain away from the foundation in all directions. We recommend a minimum slope of 6 inches in the first 10 feet in unpaved areas and a minimum slope of 2½ inches in the first 10 feet in paved areas.
4) Roof downspouts and drains should discharge well beyond the limits of all backfill.
5) Landscaping which requires regular heavy irrigation should be located at least 5 feet from foundation walls. Consideration should be given to use of xeriscape to reduce the potential for wetting of soils below the building caused by irrigation.

LIMITATIONS

This study has been conducted in accordance with generally accepted geotechnical engineering principles and practices in this area at this time. We make no warranty either express or implied. The conclusions and recommendations submitted in this report are based upon the data obtained from the exploratory boring drilled at the location indicated on Figure 1, the proposed type of construction and our experience in the area. Our services do not include determining the presence, prevention, or possibility of mold or other biological contaminants (MOBC) developing in the future. If the client is concerned about MOBC, then a professional in this special field of practice should be consulted. Our findings include extrapolation of the subsurface conditions identified at the exploratory boring and variations in the subsurface conditions may not become evident until excavation is performed. If conditions encountered during construction appear different from those described in this report, we should be notified so that re-evaluation of the recommendations may be made.

This report has been prepared for the exclusive use by our client for design purposes. We are not responsible for technical interpretations by others of our information. As the project evolves, we should provide continued consultation and field services during construction to review and monitor the implementation of our recommendations, and to verify that the recommendations have been appropriately interpreted. Significant design changes may require additional analysis or modifications to the recommendations presented herein. We recommend on-site observation of excavations and foundation bearing strata and testing of structural fill by a representative of the geotechnical engineer.

Respectfully Submitted,

Kumar & Associates, Inc.

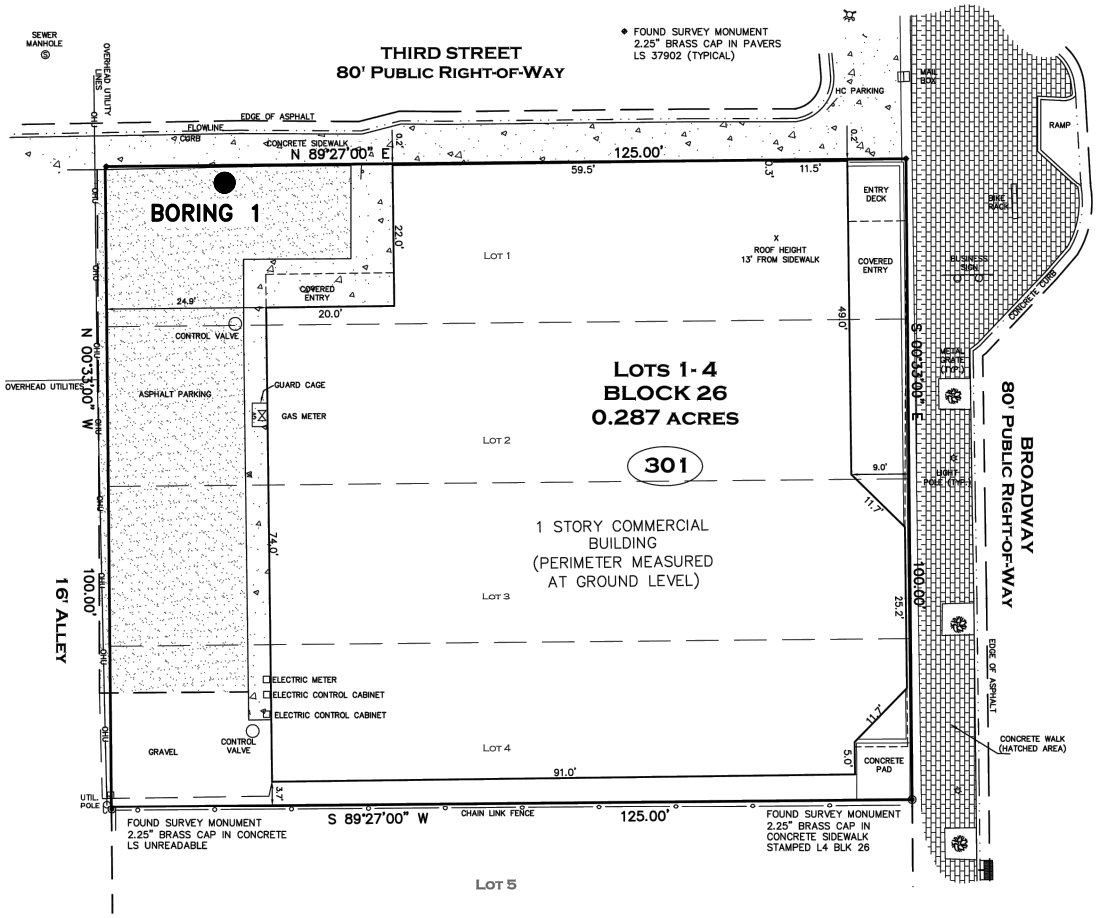
David. A. Noteboom, Staff Engineer

Reviewed by:

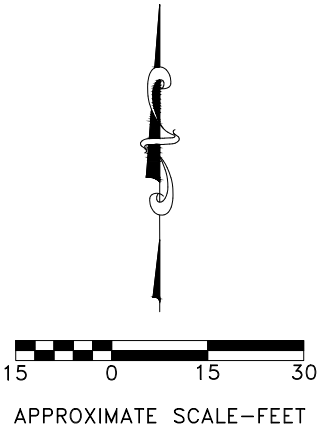
COLORADO REGISTERED DAVID A. YOUNG 32216 11-9-23 PROFESSIONAL ENGINEER

David A. Young, P.E.

DAY/kac



EXISTING CONDITIONS



APPROXIMATE SCALE–FEET

23–7–493	Kumar & Associates	LOCATION OF EXPLORATORY BORING	Fig. 1

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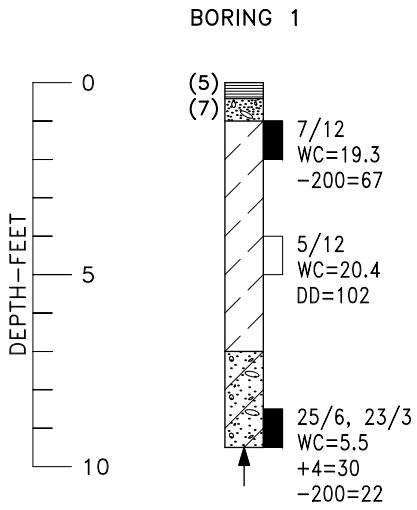


LEGEND

(5) ASPHALT; THICKNESS IN INCHES SHOWN IN PARENTHESES TO LEFT OF THE LOG.

(7) BASE COURSE; THICKNESS IN INCHES SHOWN IN PARENTHESES TO LEFT OF THE LOG.

CLAY (CL); SANDY, SILTY, MEDIUM STIFF, MOIST, MEDIUM BROWN.

GRAVEL AND COBBLES (GM); WITH BOULDERS, SANDY, SILTY, DENSE, SLIGHTLY MOIST, GRAY.

DRIVE SAMPLE, 2-INCH I.D. CALIFORNIA LINER SAMPLE.

DRIVE SAMPLE, 1 3/8-INCH I.D. SPLIT SPOON STANDARD PENETRATION TEST.

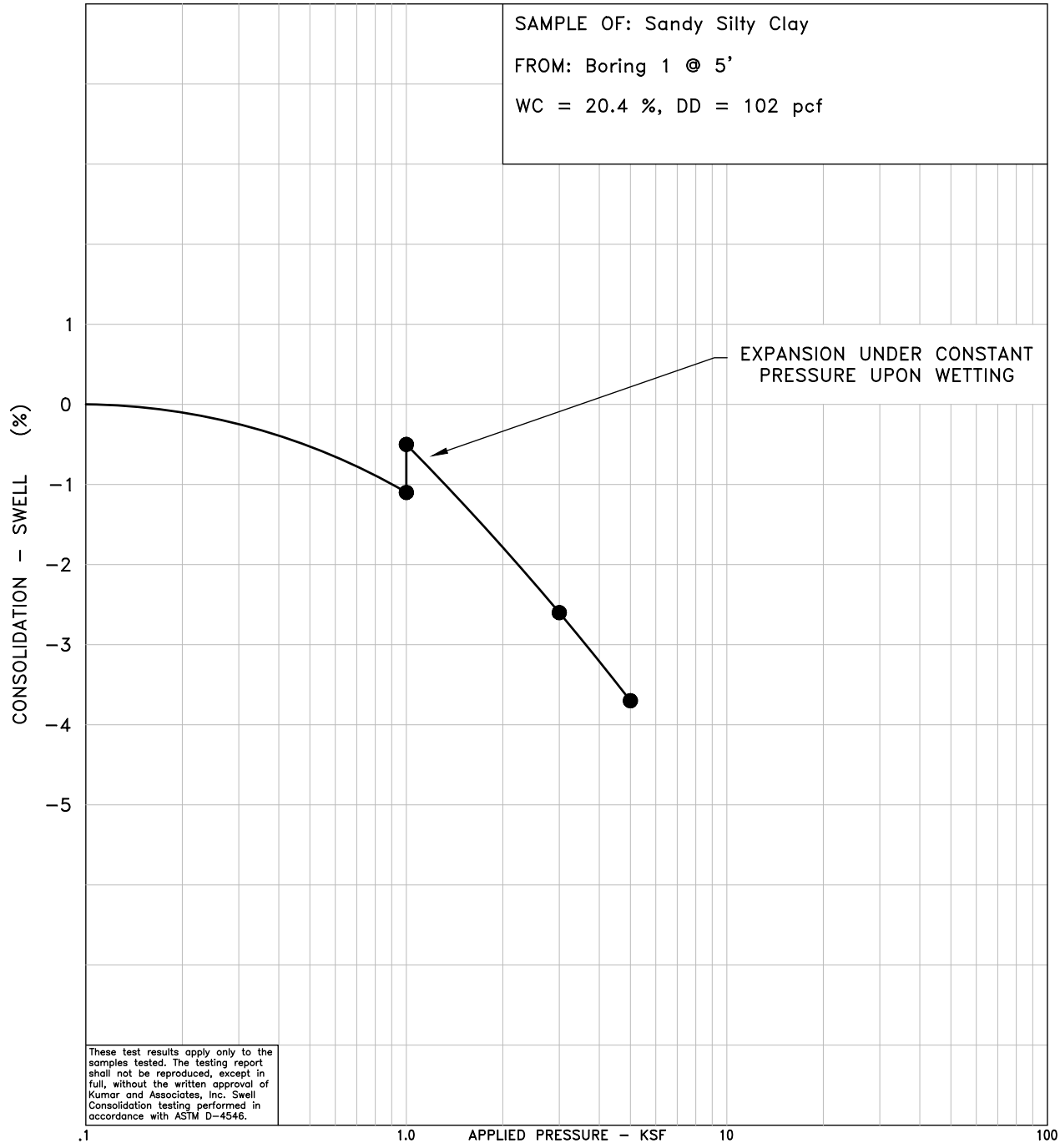
7/12 DRIVE SAMPLE BLOW COUNT. INDICATES THAT 7 BLOWS OF A 140-POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE THE SAMPLER 12 INCHES.

PRACTICAL AUGER DRILLING REFUSAL.

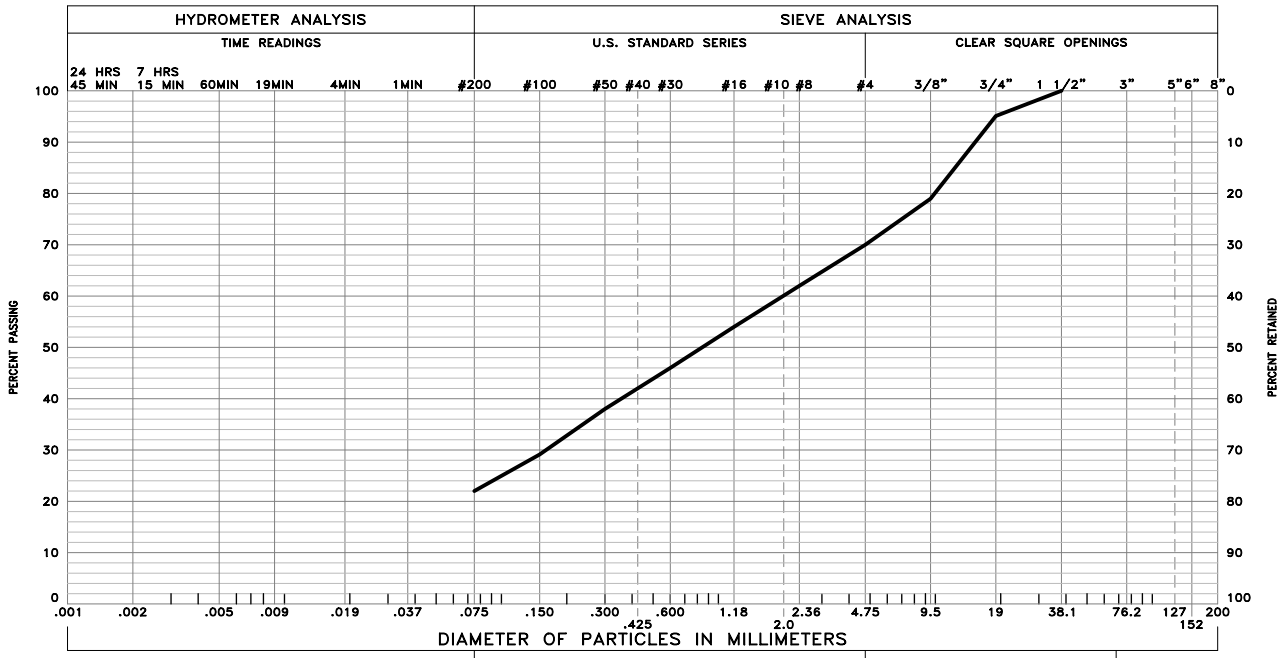
NOTES

1. THE EXPLORATORY BORING WAS DRILLED ON SEPTEMBER 26, 2023 WITH A 4-INCH DIAMETER CONTINUOUS FLIGHT POWER AUGER.
2. THE LOCATION OF THE EXPLORATORY BORING WAS MEASURED APPROXIMATELY BY PACING FROM FEATURES SHOWN ON THE SITE PLAN PROVIDED.
3. THE ELEVATION OF THE EXPLORATORY BORING WAS NOT MEASURED AND THE LOG OF THE EXPLORATORY BORING IS PLOTTED TO DEPTH.
4. THE EXPLORATORY BORING LOCATION SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.
5. THE LINES BETWEEN MATERIALS SHOWN ON THE EXPLORATORY BORING LOG REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES AND THE TRANSITIONS MAY BE GRADUAL.
6. GROUNDWATER WAS NOT ENCOUNTERED IN THE BORING AT THE TIME OF DRILLING.
7. LABORATORY TEST RESULTS:
   WC = WATER CONTENT (%) (ASTM D 2216);
   DD = DRY DENSITY (pcf) (ASTM D 2216);
   +4 = PERCENTAGE RETAINED ON NO. 4 SIEVE (ASTM D 6913);
   -200 = PERCENTAGE PASSING NO. 200 SIEVE (ASTM D 1140).

23-7-493	Kumar & Associates	LOG OF EXPLORATORY BORING	Fig. 2



23-7-493	Kumar & Associates	SWELL-CONSOLIDATION TEST RESULTS	Fig. 3



GRAVEL 30 % SAND 48 % SILT AND CLAY 22 %

LIQUID LIMIT – PLASTICITY INDEX –

SAMPLE OF: Silty Gravelly Sand FROM: Boring 1 @ 8.5'

These test results apply only to the samples which were tested. The testing report shall not be reproduced, except in full, without the written approval of Kumar & Associates, Inc. Sieve analysis testing is performed in accordance with ASTM D6913, ASTM D7928, ASTM C136 and/or ASTM D1140.

23-7-493	Kumar & Associates	GRADATION TEST RESULTS	Fig. 4

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TABLE 1
SUMMARY OF LABORATORY TEST RESULTS

Project No. 23-7-493

SAMPLE LOCATION		NATURAL MOISTURE CONTENT	NATURAL DRY DENSITY	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH		SOIL TYPE
BORING	DEPTH (ft)	(%)	(pcf)	GRAVEL (%)	SAND (%)		LIQUID LIMIT (%)	PLASTIC INDEX (%)	(psf)		
1	1	19.3				67					Sandy Silty Clay
	5	20.4	102								Sandy Silty Clay
	8½	5.5		30	48	22					Silty Gravelly Sand