REPORT

19-0640 S

July 19, 2019

Explorations and Geotechnical Engineering Services

Proposed Concrete Water Storage Tank
Village District of Eidelweiss
Madison, New Hampshire

Prepared For:
Jones & Beach Engineers, Inc.
Attention: Mr. Christopher Albert
85 Portsmouth Avenue, Box 219
Stratham, NH 03885

Prepared By:
S. W. Cole Engineering, Inc.
10 Centre Road
Somersworth, NH 03878-2926
T: 603-692-0088

S.W.COLE ENGINEERING, INC.

- *Geotechnical Engineering*
- *Construction Materials Testing and Special Inspections*
- *GeoEnvironmental Services*
- *Test Boring Explorations*

www.swcole.com

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July 19, 2019

Jones & Beach Engineers, Inc.
Attention: Mr. Christopher Albert
85 Portsmouth Avenue, Box 219
Stratham, NH 03885

Subject: Explorations and Geotechnical Engineering Services
Proposed Concrete Water Storage Tank
Village District of Eidelweiss
Madison, New Hampshire

Dear Chris:

In accordance with our Agreement, dated June 21, 2019, we have performed subsurface explorations for the proposed Concrete Water Storage Tank in the Village District of Eidelweiss of Madison, New Hampshire. This report summarizes our findings and geotechnical recommendations, and its contents are subject to the limitations set forth in Appendix A.

1.0 INTRODUCTION

1.1 Scope and Purpose

The purpose of our services was to obtain subsurface information at the site in order to develop geotechnical recommendations relative to foundations and earthwork associated with proposed tank construction. Our scope of services included review of refusal/bedrock information from test pits excavated by others, the making of four test boring explorations, a geotechnical analysis of the subsurface findings and preparation of this report.

1.2 Site and Proposed Construction

The site is located in the Village District of Eidelweiss, east of the termination of Reinach Place in Madison, New Hampshire. The area currently contains two 30,000

gallon tanks in the immediate facility. Existing plans indicate that ground surface elevations in the proposed new tank area are at about elevations 934 to 935 feet.

We understand the new tank will constructed with a finish floor level at elevation 934.0 feet, requiring minor cuts to attain subgrade. The tank will have an inner diameter of 37 feet and a design water height of about 15 feet, therefore holding approximately 0.12 MG. We understand preference is to support the tank walls on a haunched floor slab with thickened perimeter wall foundations.

The proposed tank location is depicted on the “Draft Water Tower Plan” (Drawing CON1) prepared by Jones & Beach Engineers, Inc., revision dated June 21, 2019. This plan has been included in Appendix B.

2.0 EXPLORATION

Four test borings (B-1 through B-4) were made at the site on July 2, 2019 by S. W. Cole Explorations, LLC. The exploration locations were selected and located in the field by others prior to undertaking the test boring work. The approximate exploration locations have been included on Drawing CON1. Logs of the explorations and a key to the notes and symbols used on the logs are attached in Appendix C. The elevations shown on the logs were estimated based on topographic information shown on the plan in Appendix B.

The test borings were drilled using cased wash-boring techniques. In anticipation of shallow bedrock from existing test pit information, we did not sample shallow overburden soils, electing to seat the casing in bedrock and sampling 5 feet of rock core in each of the four borings.

3.0 SUBSURFACE CONDITIONS

Beneath surficial topsoil, overburden soils are silty sands with gravel, cobbles and borings. Bedrock depths are in the range of 3 to 4.5 feet below existing grade. Bedrock is described as granite with variable weathering and Rock Quality Designation values ranging from 0 to 49 percent, indicative of considerable fracturing.

Groundwater was not observed during the test boring program. For more information, please refer to the attached logs.

4.0 EVALUATION AND RECOMMENDATIONS

4.1 General Findings

Based on the subsurface findings, the site is suitable to support the proposed tank on a haunched floor slab with thickened perimeter wall foundations. The four test borings encountered bedrock in the range of elevations 530 to 532 feet, about 2 to 4 feet below tank floor level. We recommend that all overburden soils be removed beneath the tank to expose the bedrock surface. Materials used to refill to bottom of haunched slab level should consist of compacted Crushed Stone.

There is the potential for an undulating bedrock surface beneath the tank area, requiring sporadic bedrock removal.

4.2 Site and Subgrade Preparation

We recommend that site preparation begin with the construction of an erosion control system to protect adjacent drainage ways and areas outside the construction limits. As much vegetation as possible should remain outside the construction areas to lessen the potential for erosion and site disturbance.

All overburden soils should be removed beneath the tank area. The extent of removal should extend 1 foot laterally outward from outside edge of the haunched perimeter foundation wall for every 1-foot of excavation depth (1H:1V bearing splay). Bedrock subgrades should consist of sound, intact bedrock. Loose or weathered rock or fractured rock pieces should be removed prior to placement of Crushed Stone.

The over-excavated area and any fill required to attain subgrade should consist of compacted NHDOT Standard Specification 703-1 Standard Stone Size #467.

4.3 Excavation and Dewatering

Bedrock removal may be required in some areas to achieve subgrade. Bedrock removal could be undertaken by mechanical methods such as drilling and splitting and/or hydraulic hoe ram, or with controlled blasting.

If blasting is used to achieve proposed grades, we anticipate that some over-blasting will occur. We recommend blasting bedrock to a depth of no more than 1-foot below subgrade level. Over-blasted bedrock should be removed and replaced with compacted Crushed Stone. We recommend that an experienced drilling and blasting contractor be engaged to provide rock removal and that the contractor be required to submit qualifications and references prior to commencement of excavation. We recommend a detailed blasting plan be developed prior to blasting work. An owner coordinated pre-blast survey should be conducted on all structures and drinking water wells located within 500 feet of the blast area. The close proximity of existing structures and utilities should be considered during planning. Blasting activities should be undertaken in a manner to reduce vibrations as much as possible to reduce potential for damage to other structures. Vibrations due to blasting should be monitored by qualified personnel.

While groundwater levels appear to be below excavation levels, it is possible that ponded water may occur following periods of precipitation. Sumping and pumping dewatering techniques should be adequate to control groundwater and runoff water in excavations.

Excavations must be properly shored or sloped in accordance with OSHA Regulations to prevent sloughing and caving of the sidewalls during construction. Care must be taken to preclude undermining adjacent structures and utilities. The design and planning of excavations and dewatering is the responsibility of the contractor.

4.4 Foundations

We understand that the proposed water storage tank perimeter will be supported by a haunched slab. We recommend the haunched slab be cast over at least 6 inches of Crushed Stone bearing on intact bedrock subgrades. Given bedrock subgrades and Crushed Stone fill, frost protection is not a consideration. For foundations bearing on properly prepared subgrades, we recommend the following geotechnical parameters for design consideration:

Geotechnical Foundation Parameters	
Net Allowable Bearing Pressure	6.0 ksf
Base Friction Factor	0.50
Total Unit Weight of Backfill	125 pcf
At-Rest Lateral Earth Pressure Coefficient	0.5
Internal Friction Angle of Backfill	30°
Seismic Soil Site Class	B (IBC 2009)
USGS Spectral Response Acceleration Parameter S1	0.089
USGS Spectral Response Acceleration Parameter SS	0.288
Estimated Total Settlement	½-inch
Differential Settlement	½-inch across width of tank

4.6 Slab-On-Grade

The on-grade tank slab floor may be designed using a subgrade reaction modulus of 180 pci (pounds per cubic inch) provided the slab is underlain by at least 6 inches of compacted Crushed Stone placed over properly prepared subgrade. The structural engineer or concrete consultant must design steel reinforcing appropriate to slab thickness and function.

The on-grade slab should be appropriately cured using moisture retention methods after casting. Typical slab curing methods should be used for at least 7 days. Project specifications should incorporate curing methods consistent with current applicable American Concrete Institute (ACI) procedures.

4.7 Backfill and Compaction

We recommend the following fill and backfill materials.

Structural Fill: Backfill for foundations should be clean, non-frost susceptible sand and gravel meeting the gradation requirements for Structural Fill as given below:

Structural Fill	
Sieve Size	**Percent Finer by Weight**
4 inch	100
3 inch	90 to 100
¼ inch	25 to 90
#40	0 to 30
#200	0 to 6

In our opinion, NHDOT 209.2.1.2 Gravel Backfill meets the intention of the Structural Fill specification and is an adequate substitute.

Crushed Stone: The crushed stone used beneath the tank floor and perimeter / thickened portion of the haunched slab should be washed, hard, durable rock meeting the requirements of 2016 NHDOT Standard Specification 703-1 Standard Stone Size #467.

Reuse of Site Soils: The non-organic on-site soils are unsuitable for reuse in water storage tank areas, but may be suitable for reuse as Common Borrow in landscape areas, provided they are at a compactable moisture content at the time of reuse.

Recycled Products: Borrow products including recycled crushed materials such as asphalt, concrete, and brick can be submitted to S.W.COLE for review and consideration as Structural Fill. Recycled products must also be tested in accordance with state environmental regulations and approved by a qualified environmental consultant.

Placement and Compaction: Fill should be placed in horizontal lifts and compacted such that the desired density is achieved throughout the lift thickness with 3 to 5 passes of the compaction equipment. Loose lift thicknesses for grading, fill and backfill activities should not exceed 12 inches. We recommend that fill and backfill in water storage tank and mounded soils areas be compacted to at least 95 percent of its maximum dry density as determined by ASTM D-1557. Crushed Stone should be compacted in maximum 12-inch thick lifts with 3 to 5 passes of a vibratory plate compactor having a static weight of at least 500 pounds.

4.8 Weather Considerations

Construction activity should be limited during wet and freezing weather and the site soils may require drying or thawing before construction activities may continue. The contractor should anticipate the need for water to temper fills in order to facilitate compaction during dry weather. If construction takes place during cold weather, subgrades, foundations and floor slabs must be protected during freezing conditions. Concrete and fill must not be placed on frozen soil; and once placed, the concrete and soil beneath the structure must be protected from freezing.

4.9 Design Review and Construction Testing

S.W.COLE should be retained to review the construction documents prior to bidding to determine that our earthwork and foundation recommendations have been properly interpreted and implemented.

A soils and concrete testing program should be implemented during construction to observe compliance with the design concepts, plans, and specifications. S.W.COLE is available to observe earthwork activities, the preparation of foundation bearing surfaces and pavement subgrades, as well as to provide testing and IBC Special Inspection services for soils and concrete construction materials.

5.0 CLOSURE

It has been a pleasure to be of assistance to you with this phase of your project. We look forward to working with you during the construction phase of the project.

Sincerely,

S. W. Cole Engineering, Inc.

Anthony J. Hersh, P.E.
Senior Geotechnical Engineer

AJH:cbm

APPENDIX A

Limitations

This report has been prepared for the exclusive use of Jones & Beach Engineers, Inc. for specific application to the proposed Concrete Water Storage tank east of Reinach Place in the Village District of Eidelweiss of Madison, New Hampshire. S. W. Cole Engineering, Inc. (S.W.COLE) has endeavored to conduct our services in accordance with generally accepted soil and foundation engineering practices. No warranty, expressed or implied, is made.

The soil profiles described in the report are intended to convey general trends in subsurface conditions. The boundaries between strata are approximate and are based upon interpretation of exploration data and samples.

The analyses performed during this investigation and recommendations presented in this report are based in part upon the data obtained from subsurface explorations made at the site. Variations in subsurface conditions may occur between explorations and may not become evident until construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and to review the recommendations of this report.

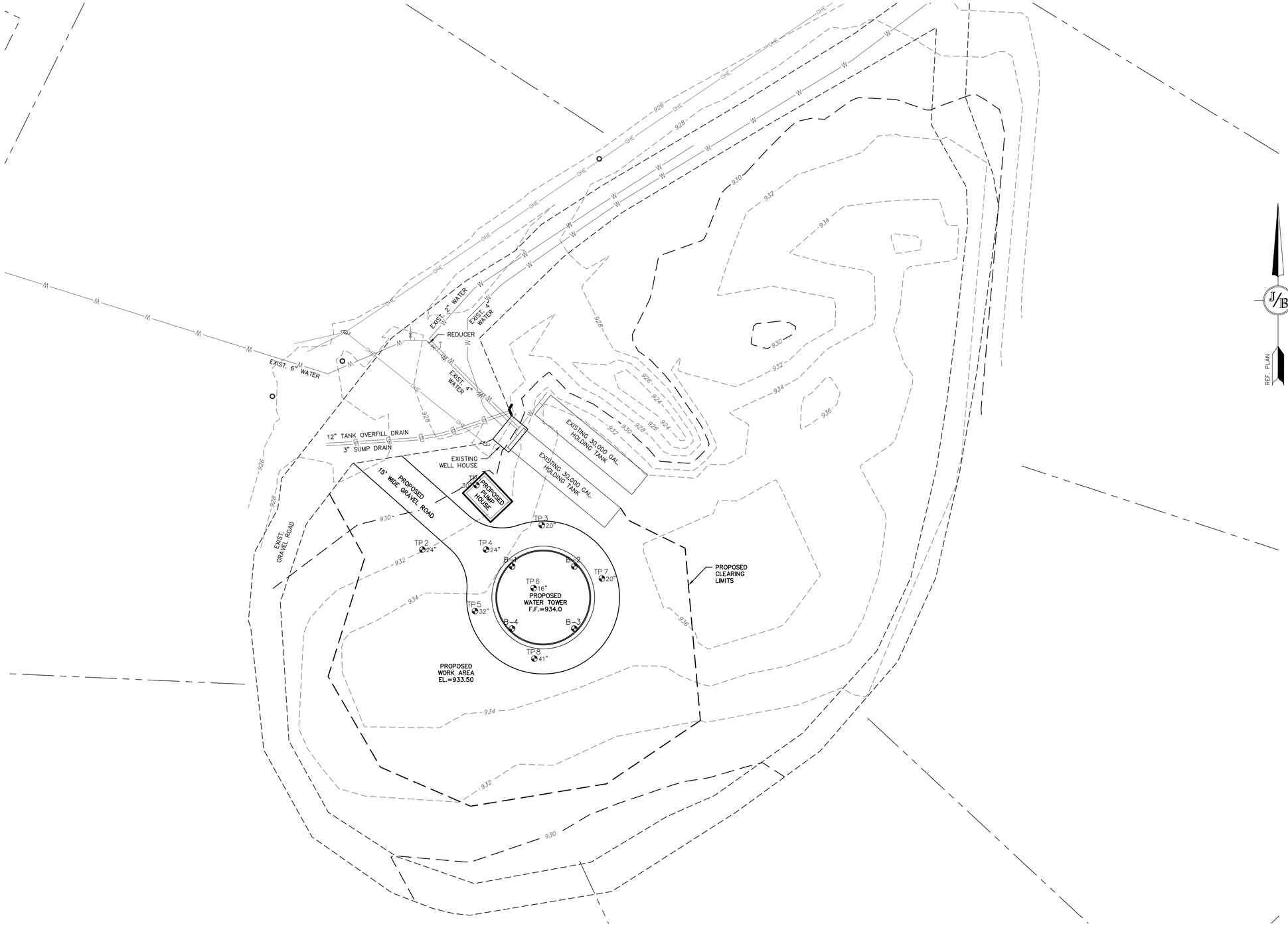
Observations have been made during exploration work to assess site groundwater levels. Fluctuations in water levels will occur due to variations in rainfall, temperature, and other factors.

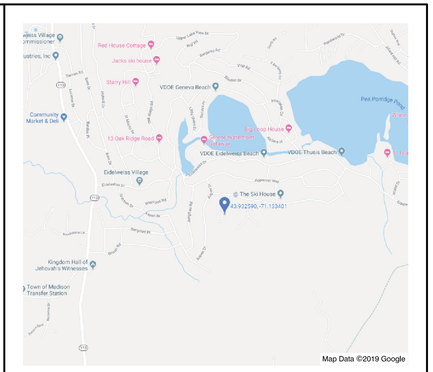
S.W.COLE's scope of services has not included the investigation, detection, or prevention of any Biological Pollutants at the project site or in any existing or proposed structure at the site. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria, and viruses, and the byproducts of any such biological organisms.

Recommendations contained in this report are based substantially upon information provided by others regarding the proposed project. In the event that any changes are made in the design, nature, or location of the proposed project, S.W.COLE should review such changes as they relate to analyses associated with this report. Recommendations contained in this report shall not be considered valid unless the changes are reviewed by S.W.COLE.

APPENDIX B

Figures





LOCUS SCALE: 1"=2000'

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)

1 inch = 20 ft.

Design: CSA	Draft: AMJ	Date: 06/20/2019
Checked: CSA	Scale: 1" = 20'	Project No.: 19078
Drawing Name: 19078-CONCEPT.dwg		

REV.	DATE	REVISION	BY
1	06/21/19	REVISED BORING LOCATIONS	AMJ
0	06/20/19	ISSUED FOR REVIEW	AMJ

Designed and Produced in NH

J/B Jones & Beach Engineers, Inc.

85 Portsmouth Ave.
PO Box 219
Stratham, NH 03885

Civil Engineering Services

603-772-4746
FAX: 603-772-0227
E-MAIL: JBE@JONESANDBEACH.COM

Plan Name:	DRAFT WATER TOWER PLAN
Project:	VILLAGE DISTRICT OF EIDELWEISS 1680 CONWAY ROAD, MADISON, NH
Owner of Record:	ADAM LEISER, COMMISSIONER 1680 CONWAY ROAD, PO BOX 1027, MADISON, NH 03849

DRAWING No.

CON1

SHEET 1 OF 1

JBE PROJECT NO. 19078

APPENDIX C

Exploration Logs and Key

S.W.COLE ENGINEERING, INC.

BORING LOG

CLIENT: Jones & Beach Engineers, Inc.
PROJECT: Proposed Concrete Water Storage Tank
LOCATION: Village District of Eidelweiss, Madison, NH

BORING NO.: B-1
SHEET: 1 of 1
PROJECT NO. 19-0640
DATE START: 7/2/2019
DATE FINISH: 7/2/2019

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 934' +/- **TOTAL DEPTH (FT):** 8.5 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Jeff Lee **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted CME 850 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:** NQ2 / 2
HAMMER EFFICIENCY FACTOR: **HAMMER DROP (inch):** 30 / 30
WATER LEVEL DEPTHS (ft): No free water observed
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level: ▽ At time of Drilling; ▼ At Completion of Drilling; ▼ After Drilling
D = Split Spoon Sample; U = Thin Walled Tube Sample; R = Rock Core Sample; V = Field Vane Shear
Pen. = Penetration Length; Rec. = Recovery Length; bpf = Blows per Foot; mpf = Minute per Foot
WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; PID = Photoionization Detector
S_v = Field Vane Shear Strength, kips/sq.ft.; q_u = Unconfined Compressive Strength, kips/sq.ft.; Ø = Friction Angle (Estimated); N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
										3 inches Topsoil anf Forest Duff		
										0.3 Brown, silty SAND some gravel with cobbles and boulders		
			1R		3.5-8.5	60/40	0			3.5 Hard, moderately weathered, extremely to moderately fractured, tan, coarse-grained, TWO-MICA GRANITE, with partings very close to close, horizontal to shallow.		
930												
	5											

Bottom of Exploration at 8.5 feet

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING LOG

CLIENT:	Jones & Beach Engineers, Inc.
PROJECT:	Proposed Concrete Water Storage Tank
LOCATION:	Village District of Eidelweiss, Madison, NH

BORING NO.:	**B-2**
SHEET:	1 of 1
PROJECT NO.	19-0640
DATE START:	7/2/2019
DATE FINISH:	7/2/2019

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 935' +/- **TOTAL DEPTH (FT):** 9.0 **LOGGED BY:** Antonio Santiago

DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Jeff Lee **DRILLING METHOD:** Cased Boring

RIG TYPE: Track Mounted CME 850 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon

HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:** NQ2 / 2

HAMMER EFFICIENCY FACTOR: **HAMMER DROP (inch):** 30 / 30

WATER LEVEL DEPTHS (ft): No free water observed

GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:

Water Level
- ▽ At time of Drilling
- ▼ At Completion of Drilling
- ▼ After Drilling

D = Split Spoon Sample
U = Thin Walled Tube Sample
R = Rock Core Sample
V = Field Vane Shear

Pen. = Penetration Length
Rec. = Recovery Length
bpf = Blows per Foot
mpf = Minute per Foot

WOR = Weight of Rods
WOH = Weight of Hammer
RQD = Rock Quality Designation
PID = Photoionization Detector

S_v = Field Vane Shear Strength, kips/sq.ft.
q_u = Unconfined Compressive Strength, kips/sq.ft.
Ø = Friction Angle (Estimated)
N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
										3 inches Topsoil anf Forest Duff		
										0.3 Brown, silty SAND some gravel with cobbles and boulders		
			1R		4-9	60/60	14			4.0 Hard, slightly weathered, extremely to slightly fractured, gray, medium-grained, TWO-MICA GRANITE, with partings very close to close, horizontal.		
930	5											

Bottom of Exploration at 9.0 feet

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

S.W.COLE ENGINEERING, INC.

BORING LOG

CLIENT: Jones & Beach Engineers, Inc.
PROJECT: Proposed Concrete Water Storage Tank
LOCATION: Village District of Eidelweiss, Madison, NH

BORING NO.: B-3
SHEET: 1 of 1
PROJECT NO. 19-0640
DATE START: 7/2/2019
DATE FINISH: 7/2/2019

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 935' +/- **TOTAL DEPTH (FT):** 9.5 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Jeff Lee **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted CME 850 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:** NQ2 / 2
HAMMER EFFICIENCY FACTOR: **HAMMER DROP (inch):** 30 / 30
WATER LEVEL DEPTHS (ft): No free water observed
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level: ▽ At time of Drilling; ▼ At Completion of Drilling; ▼ After Drilling
D = Split Spoon Sample; U = Thin Walled Tube Sample; R = Rock Core Sample; V = Field Vane Shear
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S_v = Field Vane Shear Strength, kips/sq.ft.; q_u = Unconfined Compressive Strength, kips/sq.ft.; Ø = Friction Angle (Estimated); N/A = Not Applicable

Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
										3 inches Topsoil anf Forest Duff		
										0.3 Brown, silty SAND some gravel with cobbles and boulders		
										3.0 Probable boulder or weathered rock		
930	5		1R		4.5-9.5	60/54	8			4.5 Hard, moderately weathered, extremely to moderately fractured, tan, coarse-grained, TWO-MICA GRANITE, with partings very close to close, horizontal to moderately dipping.		
										9.0		

Bottom of Exploration at 9.5 feet

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

S.W.COLE ENGINEERING, INC.

BORING LOG

CLIENT: Jones & Beach Engineers, Inc.
PROJECT: Proposed Concrete Water Storage Tank
LOCATION: Village District of Eidelweiss, Madison, NH

BORING NO.: B-4
SHEET: 1 of 1
PROJECT NO. 19-0640
DATE START: 7/2/2019
DATE FINISH: 7/2/2019

Drilling Information

LOCATION: See Exploration Location Plan **ELEVATION (FT):** 935' +/- **TOTAL DEPTH (FT):** 8.0 **LOGGED BY:** Antonio Santiago
DRILLING CO.: S. W. Cole Explorations, LLC **DRILLER:** Jeff Lee **DRILLING METHOD:** Cased Boring
RIG TYPE: Track Mounted CME 850 **AUGER ID/OD:** N/A / N/A **SAMPLER:** Standard Split-Spoon
HAMMER TYPE: Automatic / Automatic **HAMMER WEIGHT (lbs):** 140 / 140 **CASING ID/OD:** 4 in / 4 1/2 in **CORE BARREL:** NQ2 / 2
HAMMER EFFICIENCY FACTOR: **HAMMER DROP (inch):** 30 / 30
WATER LEVEL DEPTHS (ft): No free water observed
GENERAL NOTES:

KEY TO NOTES AND SYMBOLS:
Water Level: ▽ At time of Drilling; ▼ At Completion of Drilling; ▼ After Drilling
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Elev. (ft)	Depth (ft)	Casing Pen. (bpf)	SAMPLE INFORMATION: Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blow Count or RQD	Field / Lab Test Data	Graphic Log	Sample Description & Classification	H_20 Depth	Remarks
										3 inches Topsoil anf Forest Duff		
										0.3 Brown, silty SAND some gravel with cobbles and boulders		
			1R		3-8	60/51	49			3.0 Hard, slightly weathered, extremely fractured to sound, gray, medium-grained, TWO-MICA GRANITE, with joints very close to moderatly close, horizontal to shallow.		
930	5											
										Bottom of Exploration at 8.0 feet		

Stratification lines represent approximate boundary between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to other factors than those present at the time measurements were made.

BORING NO.: B-4

KEY TO NOTES & SYMBOLS
Test Boring and Test Pit Explorations

Stratification lines represent the approximate boundary between soil types and the transition may be gradual.

Key to Symbols Used:

w	-	water content, percent (dry weight basis)
q_u	-	unconfined compressive strength, kips/sq. ft. - laboratory test
S_v	-	field vane shear strength, kips/sq. ft.
L_v	-	lab vane shear strength, kips/sq. ft.
q_p	-	unconfined compressive strength, kips/sq. ft. – pocket penetrometer test
O	-	organic content, percent (dry weight basis)
W_L	-	liquid limit - Atterberg test
W_P	-	plastic limit - Atterberg test
WOH	-	advance by weight of hammer
WOM	-	advance by weight of man
WOR	-	advance by weight of rods
HYD	-	advance by force of hydraulic piston on drill
RQD	-	Rock Quality Designator - an index of the quality of a rock mass.
γ_T	-	total soil weight
γ_B	-	buoyant soil weight

Description of Proportions:

Trace:	0 to 5%
Some:	5 to 12%
"Y"	12 to 35%
And	35+%
With	Undifferentiated

Description of Stratified Soils

Parting:	0 to 1/16" thickness
Seam:	1/16" to 1/2" thickness
Layer:	½" to 12" thickness
Varved:	Alternating seams or layers
Occasional:	one or less per foot of thickness
Frequent:	more than one per foot of thickness

REFUSAL: **Test Boring Explorations** - Refusal depth indicates that depth at which, in the drill foreman's opinion, sufficient resistance to the advance of the casing, auger, probe rod or sampler was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

REFUSAL: **Test Pit Explorations** - Refusal depth indicates that depth at which sufficient resistance to the advance of the backhoe bucket was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

Although refusal may indicate the encountering of the bedrock surface, it may indicate the striking of large cobbles, boulders, very dense or cemented soil, or other buried natural or man-made objects or it may indicate the encountering of a harder zone after penetrating a considerable depth through a weathered or disintegrated zone of the bedrock.