Exhibit CS-BW-56

Docket 8302
Exhibit CS-ECOS-8
Geotechnical Report

Geotechnical Engineering Report

Proposed Chelsea Solar Farm

Bennington, Vermont

August 6, 2014

Terracon Project No. J2145148

Prepared for:

Ecos Energy

Minneapolis, Minnesota

Prepared by:

Terracon Consultants, Inc.

Rocky Hill, Connecticut

August 6, 2014

Ecos Energy
222 S 9th Street, Suite 1600
Minneapolis, MN 55402

Attn: Mr. Steve Broyer
P: (612) 326 1500
E: steve.broyer@ecosrenewable.com

Re: Geotechnical Engineering Report
Proposed Chelsea Solar Farm
Bennington, Vermont
Terracon Project No. J2145148

Dear Mr. Broyer:

Terracon Consultants, Inc. (Terracon) is submitting, herewith, the results of our geotechnical evaluation for the above-referenced project. The purpose of this evaluation was to obtain information on subsurface conditions at the project site and, based on this information, to provide recommendations regarding the design and construction of foundations and site development for the proposed photovoltaic panel installations. An environmental assessment was not part of the Terracon assignment.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Christian B. Rice
Digitally signed by Christian B. Rice
DN: cn=Christian B. Rice, c=US, ou=Terracon, email=cbrice@terracon.com
Date: 2014.08.07 17:38:48 -04'00'

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Michael W. Laney, P.E.
Energy Sector Specialist

STATE OF VERMONT
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No. 50958
CIVIL
LICENSED
PROFESSIONAL ENGINEER

/cbr/J2145148
Attachment

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EXECUTIVE SUMMARY

A geotechnical engineering report has been completed for the proposed ground-mounted fixed tilt photovoltaic panel array in Bennington, Vermont. Six (6) borings and two (2) test pits were advanced to depths ranging from 4.5 to 17 feet below existing ground surface (bgs) to provide geotechnical information.

Site subsurface conditions generally consist of about 4 to more than 17 feet of stiff to hard sandy lean clay (glacial till) over bedrock. The following geotechnical considerations for project design and construction were identified and are discussed in the report:

- The proposed solar arrays may be supported on drilled shafts or driven steel posts embedded in the native glacial till or weathered bedrock. As an alternative, the photovoltaic panels may be founded on ballasted foundations at the ground surface.

- Shallow bedrock within portions of the site and boulders in the glacial till will impact the installation of driven steel posts. Some parts of the site will not be suitable for driven steel posts.

- Slabs may derive support from the native glacial till.

- The site is judged to be International Building Code (IBC) seismic Site Class “C”.

- Groundwater was encountered at depths ranging from about 3 to 16 feet bgs.

Close monitoring of the construction operations discussed herein will be critical in achieving foundation support. We therefore recommend that Terracon be retained to monitor this portion of the work.

This summary should be used in conjunction with the entire report for design purposes. Details are not included or fully developed in this summary; the report must be read in its entirety for a comprehensive understanding of the information contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
PROPOSED CHELSEA SOLAR FARM
BENNINGTON, VERMONT

Terracon Project No. J2145148
August 6, 2014

1.0 INTRODUCTION

The geotechnical engineering evaluation for the proposed photovoltaic (PV) panel installations in Bennington, Vermont, as shown on the Site Location Map (Exhibit A-1) in Appendix A, has been completed. Six (6) borings (B-1 through B-6) and two (2) test pits (TP-1 and TP-2) were advanced throughout the site to depths up to approximately 17 feet below existing ground surface (bgs). An Exploration Location Diagram (Exhibit A-2) and individual exploration logs are included in Appendix A.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- earthwork
- foundation design and construction
- seismic considerations
- slab design and construction

2.0 PROJECT INFORMATION

The project site is located approximately 600 feet northeast of Willow Road in the town of Bennington, Vermont. The site borders U.S. Route 7 to the west and an agricultural field and dense forest to the east. The site is dense forest. The site slopes moderately downward towards the southwest.

2.1 Project Description

Our knowledge of the project is based on our recent discussions and review of the preliminary plan, titled *"Clearing Plan"*, Sheet No. 5 of 8, revised June 13, 2014, by Ecos Energy of Minneapolis, Minnesota.

The overall project will consist of the construction of ground-mounted photovoltaic arrays, transformers, inverters, and other electrical appurtenances. Access to the site will be provided from Apple Hill Road. A summary description of the project is presented below:

Item	Description
Site layout	Appendix A, Exhibit A-2, Exploration Location Diagram
Structures	Ground-mounted photovoltaic panel arrays with various electrical appurtenances, including transformers and inverters.
Assumed array construction	Steel-framed
Estimated maximum loads	2 to 3 kips (axial) 1 to 2 kips (lateral)
Grading	Cuts and fill up to 10 feet, or so, anticipated to achieve finished grade within proposed solar field.
Permanent soil slopes	Finished slopes to develop site will be stable at 3 Horizontal to 1 Vertical (3H:1V) maximum.

2.2 Site Location and Description

Item	Description
Location	15-acre forest, approximately 600 feet northeast of Willow Road in the Town of Bennington, Vermont
Existing improvements	Heavily forested area
Current ground cover	Topsoil/forest mat
Existing topography	Sloping downward moderately to the southwest

3.0 SUBSURFACE EXPLORATIONS AND CONDITIONS

3.1 Typical Profile

Based on the results of the explorations and observations at the time of fieldwork, subsurface conditions on the project site can be generalized as follows:

Description	Approximate Depth to Bottom of Stratum (feet bgs)	Material Encountered [1]	Consistency / Relative Density
Glacial Till	4 to >17	Brown, sandy clay, trace gravel, occasional to frequent cobbles and boulders	Stiff to hard

Description	Approximate Depth to Bottom of Stratum (feet bgs)	Material Encountered [1]	Consistency / Relative Density
Weathered Bedrock	10 to >17	Dolostone, moderately to highly weathered, tan to light brown	N/A
Bedrock	>17	Dolostone, white, gray, and tan	N/A

1. Topsoil/forest mat (about 4 to 8 inches thick) and subsoil (about 8 to 24 inches thick) were encountered at the surface in all explorations.

The *Surficial Geologic Map of Vermont (1970)* identifies the soils in the vicinity of the site as glacial till. The *Bedrock Geologic Map of Vermont (2011)* identifies the bedrock in the vicinity of the site as dolostone with quartz.

Conditions encountered at each exploration location are indicated on the individual exploration logs in Appendix A of this report. Stratification boundaries on the exploration logs represent the approximate location of changes in soil and rock types; *in situ*, the transition between materials may be gradual. Further details of the explorations can be found on the exploration logs.

3.3 Laboratory Testing

Laboratory testing, consisting of two corrosivity tests [pH (Standard Methods for the Examination of Water and Wastewater, 1992, APHA, 18th edition, 4500-H^+ B), sulfate concentrations (Methods for Chemical Analysis of Water and Wastes, March 1983, 375.2), chloride concentrations (Standard Methods for the Examination of Water and Wastewater, 1992, APHA, 18th edition, 4500-CL E), and soil resistivity (Standard Methods for the Examination of Water and Wastewater, 1992, APHA, 18th edition, 2510B)], was performed on representative soil samples of the glacial till recovered from the test borings. The results of the laboratory testing are tabulated below.

	pH	Sulfate [1,2] (mg/kg)	Chloride [1,3] (mg/kg)	Resistivity [1,4] (ohms/cm)
B-2 (7 to 9 feet)	7.1	443	22	6,410
B-6 (5 to 7 feet)	7.0	296	15	28,600

1. Matrix Type – soil/solid
2. Report Limit (RL) – 50 mg/kg
3. RL – 10 mg/kg
4. RL – 100 ohms/cm

3.4 *In-situ* Resistivity

On June 13, 2014, a Terracon field engineer completed in-situ soil resistivity testing in general accordance with ASTM G57 by the Wenner Four Probe Method. The testing was completed using a Megger DET5/4R Digital Earth Tester. Two resistivity lines were completed with electrodes spaced at approximately 2.5, 5, 10, and 20 feet. One test line was conducted in the southeastern portion of the site and the other test line was conducted in the western portion of the site. The location and orientation of resistivity lines are shown on Exhibit A-2. The resistivity test results are tabulated below:

	Resistivity (ohm-cm)	
Electrode Spacing (ft)	**Line 1**	**Line 2**
2.5	193,895	84,785
5	190,160	46,535
10	118,920	28,915
20	110,685	24,820

Based on the results of the *in-situ* resistivity tests, the site soils are essentially non-corrosive. However, one the laboratory resistivity test results indicated moderate corrosivity. The pH of the soils was measured at 7.1 and 7.0, i.e., neutral. These test results are provided to assist in determining the type and degree of corrosion protection that may be required. We recommend that a certified corrosion engineer be employed to determine the need for corrosion protection and to design appropriate protective measures, if required.

3.5 Groundwater

Groundwater was encountered in four of the explorations at depths ranging from approximately 3 to 15 feet below existing ground surface at the time of the explorations. However, fluctuations in groundwater level may occur because of seasonal variations in the amount of rainfall, runoff, and other factors. Additionally, grade adjustments on and around the site, as well as surrounding drainage improvements, may affect the water table. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project. Groundwater levels are tabulated below:

Boring	Depth to Groundwater While Sampling (feet bgs)
B-2	3
B-3	8
B-5	15.5
TP-1	3

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Site subsurface conditions generally consist of about 4 to 17 feet of stiff to hard sandy lean clay (glacial till) over bedrock. Based on these encountered subsurface conditions, we recommend that the proposed photovoltaic panels be supported on either drilled shafts or driven steel posts, provided that sufficient embedment depths to resist overturning or uplift forces can be achieved. However, competent bedrock was encountered at 4 feet in B-4 and possible competent bedrock was encountered at 5.5 feet in B-1. Similar shallow bedrock may exist elsewhere on the site, preventing driven steel posts from reaching adequate embedment. Boulders were also encountered in the glacial till (B-5 and B-6). Such boulders will likely be encountered elsewhere on the site, again preventing driven steel posts from reaching their design embedment. As an alternative, the photovoltaic panels can be founded on ballasted foundations at the ground surface. We recommend that lightly-loaded equipment cabinets and other ancillary structures be founded on slabs deriving support from the glacial till. Design recommendations are presented below.

We recommend that the exposed subgrades be thoroughly evaluated after excavation to proposed grade. We recommend that the geotechnical engineer be retained to evaluate the bearing material for the foundation subgrade.

4.2 Earthwork

4.2.1 Site Preparation

The site is currently heavily forested and vegetation removal will be required to develop the site. Stumps, topsoil, organic subsoil (subsoil with visible roots), and any otherwise unsuitable materials should be removed prior to placing any required fill. The exposed subgrade should be compacted with at least six passes of a vibratory roller or heavy plate compactor. Unstable subgrades should be removed and replaced with compacted structural fill or minus ¾-inch crushed stone, as necessary.

4.2.2 Material Types

Fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
Structural Fill [2,3]	GW, GW-GM, SW, SW-SM, SP, GP	All locations and elevations. Although not soil of a preferred classification, excavated glacial till may be selectively re-used as structural fill, provided it is can be adequately compacted. Cobbles and boulders should be culled prior to re-use. A sheepsfoot roller may be required to facilitate compaction. The high fines content will make the material difficult to work with in damp or wet conditions. Imported structural fill should meet the gradation requirements in Note 2 (below).
Slab Base	GW, GW-GM, SW, SW-SM, SP, GP	Select fill beneath slabs meeting the gradation requirements of M2.01.7 (Dense-Graded Crushed Stone for Subbase).
Common Fill [4]	Varies	Common fill may be used for general site grading. Common fill should not be used under settlement or frost-sensitive structures. The glacial till may be re-used as common fill, provided it can be adequately compacted. Cobbles and boulders should be culled prior to re-use. A sheepsfoot roller may be required to facilitate compaction. The high fines content will make the material difficult to work with in damp or wet conditions.
Crushed Stone	GP	For use on wet subgrades and as drainage fill. Should be uniform ¾-inch angular crushed stone.
Lean Concrete	Not applicable	Can be used to level subgrades between foundations and native soils. Lean concrete should be flowable, self-compacting concrete with a compressive strength between 300 and 2,000 psi.

1. Compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used. Fill should not be placed on a frozen subgrade.
2. Imported structural fill should meet the following gradation:

	Percent Passing by Weight
Sieve Size	**Structural Fill**
6″	100
3″	70 – 100
2″	(100)*
¾″	45 – 95
No. 4	30 – 90
No. 10	25 – 80
No. 40	10 – 50

Fill Type [1]	USCS Classification	Acceptable Location for Placement
	No. 200	0 – 12

* Maximum 2-inch particle size within 12 inches of concrete elements.

3. Recommendation for re-use of site soils as structural fill applies only to re-use on this site and only if Terracon is monitoring construction.
4. Common fill should have a maximum particle size of 6 inches and no more than 25 percent by weight passing the US No. 200 sieve.

4.2.3 Compaction Requirements

Item	Description
Fill Lift Thickness	8 inches or less in loose thickness
Compaction Requirements [1]	95 percent maximum modified Proctor dry density (ASTM D1557, Method C)
Moisture Content – Granular Material	Workable moisture levels

1. We recommend that fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested, as required, until the specified moisture and compaction requirements are achieved.

4.2.4 Utility Trench Backfill

All trench excavations should be made with sufficient working space to permit construction including backfill placement and compaction. As utility trenches can provide a conduit for groundwater flow, trenches should be backfilled with material that approximately matches the permeability characteristics of the surrounding soil. Should higher permeability fill be used in trenches, consideration should be given to installing seepage collars and/or check dams to reduce the likelihood of migration of water through the trenches.

4.2.5 Grading and Drainage

The site currently slopes moderately downward to the southwest with an elevation change of about 100 feet. Based on grading plans provided at the time of this report, cuts and fills up to about 10 feet, or so, are anticipated to achieve finished grade within proposed solar fields.

Adequate drainage should be provided at the site to reduce the likelihood of an increase in moisture content of the foundation soils. Surface drainage would likely consist of limited swales to control erosion and flow of runoff towards the equipment.

Permanent slopes will be required to reach finished grade. Design of permanent soil slopes should be based on a grade no steeper than 3 Horizontal to 1 Vertical (3H:1V), which would be suitable for cut slopes in existing soil and for fill slopes of common fill. Soil placed to create cut or fill slopes should be compacted to at least 92 percent of the maximum dry density, as determined by ASTM D1557, Method C. Bedrock slopes could be steeper, perhaps around

1H:6V in competent bedrock. However, if bedrock is encountered during excavation, a geotechnical engineer should review the exposed bedrock and provide slope recommendations appropriate to the bedrock type and condition. Slopes in weathered bedrock should be flatter than in competent bedrock.

4.2.6 Earthwork Construction Considerations

Although the exposed soil subgrade is anticipated to be relatively stable upon initial exposure, unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. Should unstable subgrade conditions develop, stabilization measures will need to be employed.

Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, wet, or disturbed, the affected material should be removed, or should be scarified, moisture conditioned, and recompacted.

As a minimum, temporary excavations should be sloped or braced, as required by Occupational Health and Safety Administration (OSHA) regulations, to provide stability and safe working conditions. The contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations, as required, to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, State, and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; proofrolling; placement and compaction of controlled compacted fills; backfilling of excavations in the completed subgrade; and for construction of foundations.

4.3 Foundation Recommendations

4.3.1 Foundations

We recommend the photovoltaic panels be supported on drilled shafts, or on driven steel post provided adequate embedment can be achieved. Alternatively, the photovoltaic panels may be founded on ballasted foundations at the ground surface. The following table summarizes which foundation type(s) would be appropriate based on the encountered subsurface conditions in the explorations:

Boring	Subsurface Condition	Preferred Foundation Type [1]
B-1	Possible shallow bedrock	Drilled shaft
B-2	Adequate depth of glacial till	Drilled shaft or driven post
B-3	Adequate depth of glacial till	Drilled shaft or driven post
B-4	Shallow competent bedrock	Drilled Shaft
B-5	Boulders in glacial till	Drilled shaft or driven post, but may meet obstructions
B-6	Boulders in glacial till	Drilled shaft or driven post, but may meet obstructions
1. Ballasted foundations appropriate at all locations.		

The above table should be used only as a guide to project planning. Shallow bedrock and/or boulders in the glacial till may exist elsewhere on the site. Additional geotechnical studies or a geophysical survey would be useful in further delineating which areas of the site would be suitable for a particular foundation type.

Design recommendations and construction considerations for the recommended foundation systems are presented below:

4.3.1.1 Drilled Shaft Foundation Design Recommendations

Description	Value
Net Allowable Bearing Capacity [1]	
Glacial Till and Bedrock (5 to >17 feet)	8 ksf
Ultimate Side Friction [2]	
Glacial Till and Bedrock (4 to >17 feet)	2.0 ksf
Coefficient Lateral Subgrade Reaction [3]	
Glacial Till and Bedrock (0 to >17 feet)	60 (z/D) kcf
Angle of Internal Friction	
Glacial Till	34 degrees
Weathered Bedrock	40 degrees
Competent Bedrock	45 degrees
Estimated *In-situ* Soil/Bedrock Unit Weight	
Glacial Till	125 pcf
Weathered Bedrock	140 pcf
Competent Bedrock	160 pcf
Approximate Groundwater Depth (6/12/14 & 6/13/14)	3 to 15.5 feet
Concrete minimum 28-day unconfined compressive strength [4]	4,000 psi
Minimum drilled shaft diameter	18 inches
Allowable deflection at top of shaft	0.5 inch
1. The allowable end bearing capacity is based on the shaft being terminated at least 1 foot below frost depth, i.e. minimum embedment of 5 feet. The allowable end bearing capacity assumes that loose soil at the base	

Description	Value
of the shaft has been removed and that the base has not been disturbed or made unstable by an unbalanced hydrostatic pressure.	
2. Contribution to shaft capacity from soils within the frost depth of 4 feet should be ignored. The uplift capacity of the shaft will be based on side friction and the dead weight of the shaft.	
3. z is depth below the ground surface and D is diameter of shaft, both in feet.	
4. Air entraining admixtures should be used for concrete exposed to freezing.	

The drilled shaft will be designed to resist tension loads and therefore should have reinforcing steel installed throughout the entire length of the shaft. Technical specifications should be prepared that require material and installation detail submittals, proof of experience in drilled shaft installation, concrete placement methods, and the use and removal of temporary steel casing.

4.3.1.2 Drilled Shaft Foundation Construction Considerations

Drilled shafts should be aligned vertically. The drilling method or combination of methods selected by the contractor should be submitted for review by the geotechnical engineer, prior to mobilization of drilling equipment. Temporary casing may be required to reduce the likelihood of caving of the shaft. The shafts may extend below the groundwater table; therefore, drilling mud could be required to stabilize the hole. Concrete should be placed by directing the concrete down the center of the shaft in dry holes and by tremie methods if there is water in the shaft.

4.3.1.3 Driven Post Design Recommendations

Subsurface conditions (shallow competent bedrock and boulders in the glacial till) over parts of the site, as discussed above, may not be conducive to installation of driven posts. The following recommendations apply to areas where the driven posts can reach their design embedment.

The panels may be supported on driven steel posts, which should be structurally designed to resist vertical loading and uplift, and also bending forces. We recommend that the posts be driven below the frost depth of 4 feet, at a minimum. Based on our experience, we anticipate post driven lengths could be around 6 to 8 feet below the ground surface in order to achieve the required resistances to uplift and bending forces. Driving resistance should be correlated to vertical load capacity, based on the equipment used to install the posts. A minimum factor of safety of 2 should be applied to the vertical load capacity. Full-scale pull-out testing should be performed on selected posts to determine uplift capacity. A minimum factor of safety of 1.5 should be applied to the uplift capacity. Full-scale lateral load testing should also be performed. The required lateral capacity should be mobilized with less than ½ inch of movement at ground level. Corrosion protection should be applied to the steel posts, if warranted by the results of the testing presented in this report.

4.3.1.4 Driven Post Construction Considerations

The steel posts should be driven vertically. Driving should be monitored, such that if obstructions are encountered, the effect on the posts can be determined. Damaged posts should be replaced. Frequent obstructions may require the pre-augering of the post holes to facilitate driving. Competent bedrock was encountered as close as 4 feet bgs during our explorations; therefore, driven posts may not reach required depths to resist vertical loading and uplift in certain areas of the site. Should shallow refusal be encountered, uplift load testing on the post should be performed.

4.3.1.5 Ballasted Foundation Design Recommendations

As an alternative to drilled shafts or driven posts, photovoltaic panels may be supported with precast ballasted foundations deriving support from the glacial till or on a leveling course of crushed stone. The glacial till is capable of supporting the imposed loads.

4.3.1.6 Ballasted Foundation Construction Considerations

We recommend the area underlying the ballast foundations be rough graded and then thoroughly proofrolled with a vibratory roller or heavy plate compactor prior to final grading and placement of the leveling course of crushed stone, if needed. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas previously filled or backfilled. Areas where unsuitable or unstable conditions are located should be repaired by removing and replacing the affected material with properly compacted structural fill, as necessary.

4.3.2 Ancillary Equipment Foundations

Lightly-loaded ancillary equipment may be supported on slabs underlain by at least a 12-inch thickness of compacted structural fill or minus ¾-inch crushed stone placed on the glacial till, the surface of which should be thoroughly compacted. Design recommendations and construction considerations for the recommended equipment cabinet foundations are presented in the following paragraphs and tables.

4.3.2.1 Slab Design Recommendations

Description	Value
Slab support	12-inch thick layer compacted structural fill or minus ¾-inch crushed stone bearing on the glacial till
Net allowable bearing pressure	3,000 psf
Modulus of subgrade reaction	200 pounds per square inch per in (psi/in) for point loading
Minimum embedment below finished grade for frost protection [1,2]	48 inches
Approximate total settlement [3]	1 inch
Estimated differential settlement [3]	½ inch
Coefficient of sliding friction [4]	0.5 (ultimate)
Portland Cement Concrete [5]	Type II Reinforced Portland Cement Concrete

1. Consideration should be given to using dense insulation boards (Dow Styrofoam Highload, or similar) under and adjacent to lightly loaded slabs, to provide the equivalent of 48 inches of earth cover, thus reducing frost penetration
2. Air entraining admixtures should be used for concrete exposed to freezing.
3. Settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the thickness of compacted fill, and the quality of the earthwork operations.
4. If rigid insulation is used beneath the slab for frost protection, the coefficient of sliding friction between the concrete and the insulation should be based on the manufacturer's recommendation.
5. Minimum 28-day compressive strength of 4,000 psi with fiber mesh.

We recommend the 12-inch thick layer of compacted structural fill or crushed stone beneath the slabs to provide both a uniform bearing surface and a capillary break between the glacial till and the concrete and to allow the slab to adjust to any variation in the support characteristics of the native soils. Should this layer be omitted, there is the possibility of distress in the slab due to differential movement and of moisture in the concrete of the slab. However, provided the soil support characteristics are uniform over the area of the slab and the capillary break is not required, the slab could be placed directly on the glacial till. In this case, the modulus of subgrade reaction should be reduced to 150 psi/in and the net allowable bearing pressure reduced to 1,500 psf.

4.3.2.2 Slab Construction Considerations

On most sites, the site grading is generally accomplished early in the construction phase. However as construction proceeds, the subgrade may be disturbed by foundation excavations, construction traffic, rainfall, etc. As a result, the subgrade may not be suitable for placement of structural fill or minus ¾-inch crushed stone, and corrective action will be required.

We recommend the area underlying the slabs be rough graded and then thoroughly proofrolled with a vibratory roller or heavy plate compactor prior to final grading and placement of structural fill. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas previously filled or backfilled. Areas where unsuitable or unstable conditions are located should be repaired by removing and replacing the affected material with properly compacted structural fill, as necessary.

4.4 Seismic Considerations

Description	Value
Code Used	International Building Code, 2009 (IBC)
Site Class [1]	C
Maximum considered earthquake ground motions (5 percent damping) [2]	0.072g 1.0 second MCE spectral acceleration (S_1)
	0.185g 0.2 second MCE spectral acceleration (S_s)
Liquefaction potential in event of an earthquake	Not susceptible

1. The IBC uses a site soil profile determination extending a depth of 100 feet for seismic site classification. The current scope of work requested does not include a 100-foot soil profile determination; the explorations performed for this evaluation extended to a maximum depth of 17 feet. However this seismic site class definition considers that bedrock, encountered in our explorations, underlies the remaining soil profile below the maximum depth of the explorations.
2. USGS Seismic Design Maps which references IBC.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications, so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction, and other earth-related construction phases of the project.

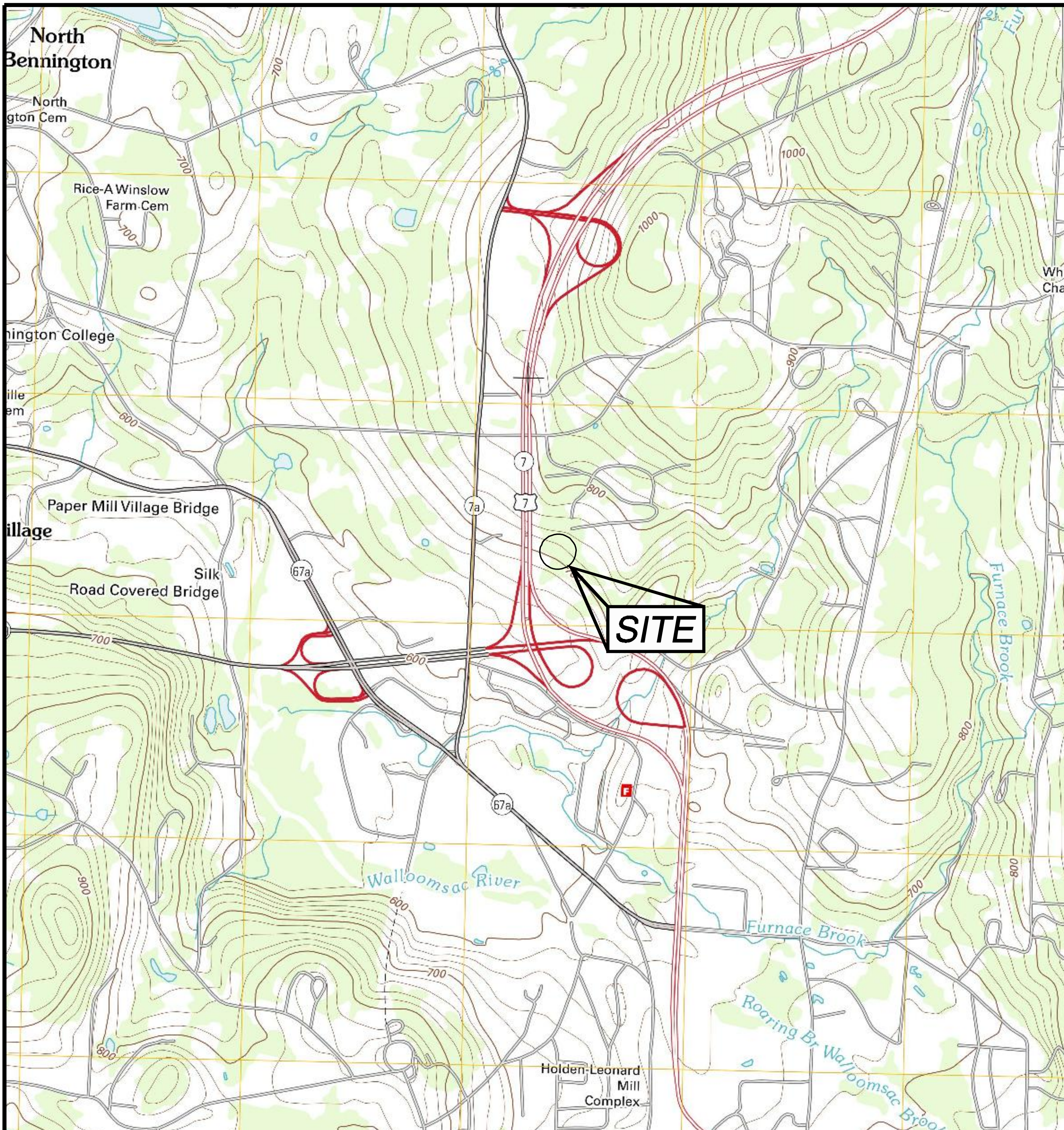
The analysis and recommendations presented in this report are based upon the data obtained from the explorations performed by others at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between explorations, across the site, or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

Variations in soil composition may influence *in-situ* resistivity results. Resistivity values should be evaluated based on the measured data in conjunction with published values for the material.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials, or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION



SCALE: 1:24 000

1 | 1/2 | 0 | 1 MILE

1000 | 0 | 1000 | 2000 | 3000 | 4000 | 5000 | 6000 | 7000 FEET

1 | .5 | 0 | 1 KILOMETER

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

QUADRANGLE LOCATION

Project Mngr: BDO	Project No. J2145148	Terracon Consulting Engineers and Scientists	SITE LOCATION MAP	EXHIBIT
Drawn By: CBR	Quadrangle: BENNINGTON, VT - 2012		PROPOSED CHELSEA SOLAR FARM	A-1
Checked By: BDO	File No. J2145148.dwg		140 RUSSETT DRIVE	
Approved By: RWM	Date: AUGUST 2014	201 Hammer Mill Road Rocky Hill, CT 06067 PH. (860)721 1900 FAX.(860)721 1939	BENNINGTON, VERMONT	

200 0 100 200

APPROXIMATE SCALE IN FEET

LEGEND

B-1 TEST BORING LOCATION (TYP)

TP-1 TEST PIT LOCATION (TYP)

LINE 1 RESISTIVITY TEST LOCATION (TYP)

NOTES:

1. THIS DIAGRAM WAS PREPARED BASED ON A PLAN BY ECOS ENERGY OF MINNEAPOLIS, MINNESOTA, SHEET No. 5 OF 8, TITLED "*CLEARING PLAN*", REVISED: FEBRUARY 3, 2014.
2. THE TEST BORINGS B-1 THROUGH B-6 AND TEST PITS TP-1 AND TP-2 WERE ADVANCED ON JUNE 12 AND 13, 2014 UNDER THE DIRECTION OF TERRACON WITH EQUIPMENT OWNED AND OPERATED BY NEW ENGLAND BORING CONTRACTORS, INC. OF DERRY, NEW HAMPSHIRE.
3. RESISTIVITY TESTING WAS PERFORMED ON JUNE 13, 2014 BY A TERRACON FIELD ENGINEER.
4. THE APPROXIMATE LOCATIONS OF THE EXPLORATIONS WERE LOCATED WITH A HANDHELD GPS UNIT. THE LOCATIONS SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.
5. USE OF THIS DIAGRAM IS LIMITED TO THE ILLUSTRATION OF THE APPROXIMATE LOCATIONS OF THE EXPLORATIONS, RESISTIVITY TESTING, AND OTHER PERTINENT SITE FEATURES. ANY OTHER USE OF THIS DIAGRAM WITHOUT PERMISSION FROM TERRACON IS PROHIBITED.

Project Mngr: BDO	Project No. J2145148	Terracon Consulting Engineers and Scientists	EXPLORATION LOCATION DIAGRAM	EXHIBIT
Drawn By: CBR	Scale: 1" = 200'		PROPOSED CHELSEA SOLAR FARM 140 RUSSETT DRIVE BENNINGTON, VERMONT	A-2
Checked By: BDO	File No. J2145148.dwg	201 Hammer Mill Road Rocky Hill, CT 06067 PH. (860)721 1900 FAX.(860)721 1939		
Approved By: RWM	Date: AUGUST 2014			

Field Exploration Description

The approximate test boring locations, which are shown Exhibit A-2, were located using a handheld GPS unit. The locations of the test borings should be considered accurate only to the degree implied by the method used to define them. The ground elevations at the test boring locations were estimated by interpolating between contours of existing grade shown on the *"Clearing Plan"*, Sheet No. 5 of 8, Revised June 13, 2014, by Ecos Energy LLC of Minneapolis, Minnesota. Ground surface elevations rounded to the nearest foot are shown on the individual boring logs in Appendix A.

Terracon observed the advancement of six test borings (B-1 through B-6) and two test pits (TP-1 and TP-2) on June 12 and 13, 2014. The borings were advanced using an all terrain vehicle (ATV) mounted Diedrich D50 rotary drill rig, owned and operated by New England Boring Contractors, Inc. of Derry, New Hampshire. The borings were advanced using 2¼ -inch inside diameter hollow-stem augers with the exception of B-4 which advanced using 4-inch inside diameter steel flush wall casing and roller bit. B-1 encountered auger refusal on a boulder or bedrock at a depth of about 5.5 feet bgs. B-2 and B-5 terminated without refusal in weathered bedrock at a depth of about 17 feet. B-3 encountered auger refusal on competent bedrock at a depth of about 10 feet. B-4 encountered competent bedrock and was cored with a NQ-2 core barrel from 4 to 9 feet. B-6 terminated without refusal in the glacial till at a depth of about 17 feet. The test pits were excavated by New England Boring Contractors, Inc. using a Komatsu PC27MR backhoe with a 15-inch wide toothed bucket. TP-1 and TP-2 were terminated in the glacial till at 5 and 4.5 feet, respectively.

In the split-barrel sampling procedure, which was used to take soil samples in the test borings, the number of blows required to advance a standard 2-inch O.D. split-barrel sampler typically the middle 12 inches of the total 24-inch penetration by means of a 140-pound safety hammer with a free fall of 30 inches is the Standard Penetration Test (SPT) resistance value "N". This "N" value is used to estimate the *in-situ* relative density of cohesionless soils and consistency of cohesive soils.

The samples were placed in labeled glass jars and transported to our Rocky Hill (Hartford) laboratory for further review by a Terracon geotechnical engineer, laboratory testing, and classification. Bulk samples were collected at B-3 and B-5 and sent to the Neil O. Anderson & Associates, Inc. Lodi, California laboratory for testing. Information provided on the boring logs attached to this report includes soil descriptions, relative density and/or consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled with cuttings prior to the drill crew leaving the site. The excavator backfilled the test pits after our observations.

Field logs of the explorations were prepared by a Terracon field engineer. These logs included visual classifications of the materials encountered during drilling as well as interpretation by our field engineer of the subsurface conditions between samples. Final exploration logs included with this report represent further interpretation by the geotechnical engineer of the field logs and incorporate, where appropriate, modifications based on laboratory classification and testing of the samples.

BORING LOG NO. B-1

PROJECT: Proposed Chelsea Solar Farm

CLIENT: Ecos Energy
Minneapolis, MN

SITE: 140 Russett Drive
Bennington, Vermont

LOCATION See Exhibit A-2

Latitude: 42.9098° Longitude: -73.20748°

Approximate Surface Elev: 732 (Ft.) +/-

GRAPHIC LOG	DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
	0.5	**FOREST MAT**	731.5+/-								
	1.0	**SILTY SAND (SM)**, with roots, brown, medium dense, **(SUBSOIL)**	731+/-			X	7	2-5-7-17 N=12			
		SANDY LEAN CLAY (CL), trace gravel, brown, stiff to very stiff, **(GLACIAL TILL)**				X	13	13-12-14-16 N=26			28-20-8
	5.5		726.5+/-	5							

Auger Refusal on Boulder or Bedrock at 5.5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples taken with a 2" O.D. split spoon sampler driven with a hammer operated by winch and cable

Advancement Method:
2 1/4" inside diameter hollow-stem augers

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
201 Hammer Mill Road
Rocky Hill, Connecticut

Boring Started: 6/12/2014	Boring Completed: 6/12/2014
Drill Rig: Diedrich D-50	Driller: R. Burne
Project No.: J2145148	Exhibit: A-4

BORING LOG NO. B-2

PROJECT: Proposed Chelsea Solar Farm

CLIENT: Ecos Energy
Minneapolis, MN

SITE: 140 Russett Drive
Bennington, Vermont

LOCATION See Exhibit A-2

Latitude: 42.91011° Longitude: -73.20583°

Approximate Surface Elev: 740 (Ft.) +/-

DEPTH	Material Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
0.5	**FOREST MAT**	739.5+/-								
1.0	**SILTY SAND (SM)**, with roots, light brown, medium dense, **(SUBSOIL)**	739+/-			X	14	3-8-21-27 N=29			
	SANDY LEAN CLAY (CL), trace gravel, brown, stiff to very stiff, **(GLACIAL TILL)**			▽	X	11	7-9-7-8 N=16			
			5		X	20	3-5-5-7 N=10	14	118	
					X	20	3-7-12-12 N=19			
10.5		729.5+/-	10		X	18	9-11-27-30 N=38			
	DOLOMITE, moderately weathered, tan to light brown, **(WEATHERED BEDROCK)**									
17.0		723+/-	15		X	18	20-29-38-36 N=67			
	Boring Terminated at 17 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples taken with a 2" O.D. split spoon sampler driven with a hammer operated by winch and cable

Advancement Method:
2 1/4" inside diameter hollow-stem augers

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *3.0' While Drilling*

Terracon
201 Hammer Mill Road
Rocky Hill, Connecticut

Boring Started: 6/12/2014	Boring Completed: 6/12/2014
Drill Rig: Diedrich D-50	Driller: R. Burne
Project No.: J2145148	Exhibit: A-5

BORING LOG NO. B-3

PROJECT: Proposed Chelsea Solar Farm

CLIENT: Ecos Energy
Minneapolis, MN

SITE: 140 Russett Drive
Bennington, Vermont

LOCATION See Exhibit A-2

Latitude: 42.90928° Longitude: -73.2073°

Approximate Surface Elev: 706 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
0.7	**FOREST MAT**	705.5+/-								
1.5	**SILTY SAND (SM)**, with roots, brown, medium dense, **(SUBSOIL)**	704.5+/-				11	3-4-8-18 N=12			
	SANDY LEAN CLAY (CL), with gravel, occasional cobbles, brown, stiff to very stiff, **(GLACIAL TILL)**					20	5-7-7-7 N=14			
			5			6	14-12-11-10 N=23			
				▽		9	10-7-7-100/4" N=14	14		
10.0		696+/-	10							
10.1	**DOLOMITE**, moderately weathered, tan to light brown, **(WEATHERED BEDROCK)**	696+/-				1	100/1"			
	Auger Refusal on Competent Bedrock at 10.1 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples taken with a 2" O.D. split spoon sampler driven with a hammer operated by winch and cable

Advancement Method:
2 1/4" inside diameter hollow-stem augers

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *8.0' While Drilling*

Terracon
201 Hammer Mill Road
Rocky Hill, Connecticut

Boring Started: 6/12/2014	Boring Completed: 6/12/2014
Drill Rig: Diedrich D-50	Driller: R. Burne
Project No.: J2145148	Exhibit: A-6

BORING LOG NO. B-4

PROJECT: Proposed Chelsea Solar Farm

CLIENT: Ecos Energy
Minneapolis, MN

SITE: 140 Russett Drive
Bennington, Vermont

LOCATION See Exhibit A-2

Latitude: 42.90883° Longitude: -73.20602°

Approximate Surface Elev: 710 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
0.3 **FOREST MAT**	709.5+/-								
SILTY SAND (SM), with roots, brown, medium dense, **(SUBSOIL)**					6	3-3-7-12 N=10			
2.0	708+/-								
SANDY LEAN CLAY (CL), trace gravel, brown, very stiff, **(GLACIAL TILL)**					14	10-12-26-50 N=38			
4.0	706+/-								
DOLOMITE, white and gray and tan, **(BEDROCK)**		5			46	Core Rate (min/foot) 4-3-3.5-2-2.5 RQD=45%			
9.0	701+/-								

Boring Terminated at 9 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples taken with a 2" O.D. split spoon sampler driven with a hammer operated by winch and cable

Advancement Method:
4" inside diameter steel flush well casing with roller bit from 0' to 4', NQ-2 Bedrock Core Barrel from 4' to 9'

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
No free water observed

Terracon
201 Hammer Mill Road
Rocky Hill, Connecticut

Boring Started: 6/12/2014	Boring Completed: 6/13/2014
Drill Rig: Diedrich D-50	Driller: R. Burne
Project No.: J2145148	Exhibit: A-7

BORING LOG NO. B-5

PROJECT: Proposed Chelsea Solar Farm

CLIENT: Ecos Energy
Minneapolis, MN

SITE: 140 Russett Drive
Bennington, Vermont

LOCATION See Exhibit A-2

Latitude: 42.90806° Longitude: -73.20712°

Approximate Surface Elev: 690 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
0.5	**FOREST MAT**	689.5+/-								
1.0	**SILTY SAND (SM)**, with roots, brown, medium dense, **(SUBSOIL)**	689+/-			X	9	1-6-12-18 N=18			
	SANDY LEAN CLAY (CL), with gravel, frequent cobbles and boulders, brown, stiff to hard, **(GLACIAL TILL)**				X	5	14-10-12-12 N=22			
			5		X	12	30-28-34-52 N=62			
					X	15	46-42-32-37 N=74			
			10		X	6	53-60-100/3"			
15.0		675+/-	15							
	DOLOMITE, highly weathered, light brown, **(WEATHERED BEDROCK)**			▽	X	15	9-8-12-13 N=20			
17.0		673+/-								
	Boring Terminated at 17 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples taken with a 2" O.D. split spoon sampler driven with a hammer operated by winch and cable

Advancement Method:
2 1/4" inside diameter hollow-stem augers

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *16.0' While Drilling*

Terracon
201 Hammer Mill Road
Rocky Hill, Connecticut

Boring Started: 6/13/2014	Boring Completed: 6/13/2014
Drill Rig: Diedrich D-50	Driller: R. Burne
Project No.: J2145148	Exhibit: A-8

BORING LOG NO. B-6

PROJECT: Proposed Chelsea Solar Farm

CLIENT: Ecos Energy
Minneapolis, MN

SITE: 140 Russett Drive
Bennington, Vermont

LOCATION See Exhibit A-2

Latitude: 42.9077° Longitude: -73.2054°

Approximate Surface Elev: 700 (Ft.) +/-

DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
0.3	**FOREST MAT**	699.5+/-								
0.7	**SILTY SAND (SM)**, with roots, brown, **(SUBSOIL)**	699.5+/-				13	2-6-10-13 N=16			
	SANDY LEAN CLAY (CL), trace gravel, frequent cobbles and boulders, tan to brown, stiff to hard, **(GLACIAL TILL)**					7	11-38-24-15 N=62			
			5			12	6-6-12-14 N=18			
						8	28-57-77-65			
			10			7	15-25-100/1"			
			15	▽		16	46-61-60-60			
17.0		683+/-								

Boring Terminated at 17 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.
Samples taken with a 2" O.D. split spoon sampler driven with a hammer operated by winch and cable

Advancement Method:
2 1/4" inside diameter hollow-stem augers

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
▽ *15.5' While Drilling*

Terracon
201 Hammer Mill Road
Rocky Hill, Connecticut

Boring Started: 6/13/2014	Boring Completed: 6/13/2014
Drill Rig: Diedrich D-50	Driller: R. Burne
Project No.: J2145148	Exhibit: A-9

TEST PIT LOG NO. TP-1

PROJECT: Proposed Chelsea Solar Farm

CLIENT: Ecos Energy
Minneapolis, MN

SITE: 140 Russett Drive
Bennington, Vermont

LOCATION See Exhibit A-2

Latitude: 42.91011° Longitude: -73.20583°

Approximate Surface Elev: 740 (Ft.) +/-

GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
	0.5	**FOREST MAT**	739.5+/-								
	1.0	**SILTY SAND (SM)**, with roots, brown, **(SUBSOIL)**	739+/-								
	4.5	**SANDY LEAN CLAY (CL)**, trace gravel, light brown to brown, **(GLACIAL TILL)**	735.5+/-		▽						
		Test Pit Terminated at 4.5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Komatsu PC27MR Backhoe with 15-inch wide bucket

Abandonment Method:
Test pit backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:
Test Pit Dimensions: 15" Width X 8' Length X 4.5' Depth

WATER LEVEL OBSERVATIONS

▽ *3.0' While Excavating*

Terracon
201 Hammer Mill Road
Rocky Hill, Connecticut

Test Pit Started: 6/12/2014	Test Pit Completed: 6/12/2014
Excavator: Komatsu PC27MR	Operator: B. Thompson
Project No.: J2145148	Exhibit: A-10

TEST PIT LOG NO. TP-2

PROJECT: Proposed Chelsea Solar Farm

CLIENT: Ecos Energy
Minneapolis, MN

SITE: 140 Russett Drive
Bennington, Vermont

LOCATION See Exhibit A-2

Latitude: 42.90806° Longitude: -73.20712°

Approximate Surface Elev: 690 (Ft.) +/-

GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI
	0.5	**FOREST MAT**	689.5+/-								
	1.0	**SILTY SAND (SM)**, with roots, brown, **(SUBSOIL)**	689+/-								
	5.0	**SANDY LEAN CLAY (CL)**, with gravel, frequent cobbles and boulders, brown, **(GLACIAL TILL)**	685+/-	5							
		Test Pit Terminated at 5 Feet									

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Komatsu PC27MR Backhoe with 15-inch wide bucket

Abandonment Method:
Test pit backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:
Test Pit Dimensions: 15" Width X 8' Length X 5' Depth

WATER LEVEL OBSERVATIONS
No free water observed

Terracon
201 Hammer Mill Road
Rocky Hill, Connecticut

Test Pit Started: 6/12/2014	Test Pit Completed: 6/12/2014
Excavator: Komatsu PC27MR	Operator: B. Thompson
Project No.: J2145148	Exhibit: A-11

APPENDIX B
LABORATORY TESTING

Laboratory Testing Summary

Descriptive classifications of the soils indicated on the boring logs are in accordance with the enclosed General Notes and the Unified Soil Classification System (USCS). USCS symbols are also shown. A brief description of the USCS is attached to this report. Classification was generally by visual/manual procedures.

Descriptive classifications of the soils indicated on the boring logs are in accordance with the enclosed General Notes and the Unified Soil Classification System (USCS). USCS symbols are also shown. A brief description of the USCS is attached to this report. Classification was generally by visual/manual procedures aided by the results of grain size distribution testing.

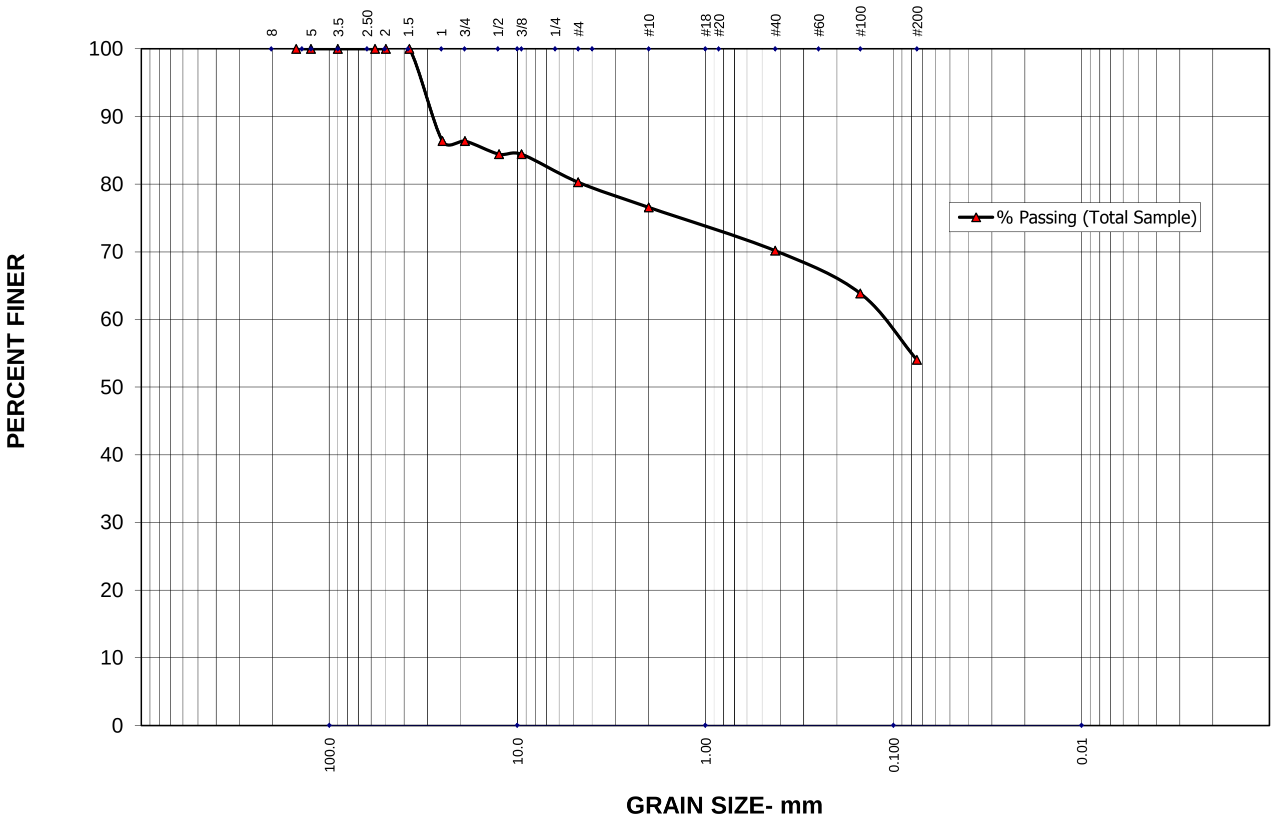
Laboratory testing, consisting of two (2) corrosivity tests [pH (Standard Methods for the Examination of Water and Wastewater, 1992, APHA, 18th edition, 4500-H^+ B), sulfate concentrations (EPA-600/4-79-020, Methods for Chemical Analysis of Water and Wastes, March 1983, 375.2), chloride concentrations (Standard Methods for the Examination of Water and Wastewater, 1992, APHA, 18th edition, 4500-CL E), and soil resistivity (Standard Methods for the Examination of Water and Wastewater, 1992, APHA, 18th edition, 2510B)], was performed on representative soil samples of the glaciofluvial deposit recovered from the test borings. The results of the above-listed laboratory testing are tabulated in Section 3.3.

Laboratory testing, consisting of water content determinations (ASTM D2216), grain size distribution testing (ASTM D422), soil density (ASTM D7263), and determination of Atterberg Limits (ASTM D4318), was performed on representative soil samples recovered from the borings. The water contents, soil density, and Atterberg limits are presented on the boring logs. The results of the Atterberg limits and grain size distribution testing are included as Exhibits B-2 and B-3, respectively.

Laboratory testing, consisting of theoretical maximum density (ASTM D1557) and thermal conductivity of soils (ASTM D5334), was performed by Neil O. Anderson & Associates, Inc. on representative bulk samples taken from B-3 and B-5. The results of the testing are included as Exhibits B-3 through B-6.

GRAIN SIZE DISTRIBUTION TEST REPORT

ASTM TEST METHOD D422



% Cobbles	% Gravel	Coarse	Medium	Fine	% Fines	
		14.2	24.4	61.5	Silt (>0.002mm)	Clay (<0.002mm)
0.0	20	% Sand		26	54.0	

USCS Classification: SANDY LEAN CLAY, Brown (CL)

Sieve Size (mm)	U.S. Sieve Size (in.)	Cumulative Wt. Retained	% Passing (Total Sample)	% Passing (Sand Portion)	Specification Minimum	Maximum
150.0	6"	0.00	100			
125.0	5"	0.00	100			
90.0	3.5"	0.00	100			
57.0	2.25"	0.00	100			
50.0	2"	0.00	100			
37.5	1.5"	0.00	100			
25.0	1"	29.10	86			
19.0	3/4"	29.10	86			
12.5	1/2"	33.25	84			
9.5	3/8"	33.25	84			
6.3	1/4"					
4.75	#4	42.08	80			
2.00	#10	50.01	77			
0.425	#40	63.68	70			
0.300	#50					
0.150	#100	77.16	64			
0.075	#200	98.12	54			

Total Dry Wt. 213.42 g
Moisture Conten 14.3 %

Project: **PROPOSED CHELSEA SOLAR FARM**	Project No.: **J2145148**		Date: **7/16/2014**
City: Bennington, Vermont	Specification: N/A		Report No: Exhibit B-2
Source: B-3	Sampled from: B-3 7' to 8'10"		

Terracon

201 Hammer Mill Road
Rocky Hill, CT 06067
860-721-1900 (p) 860-721-1939 (f)
http://www.terracon.com/

Remarks:

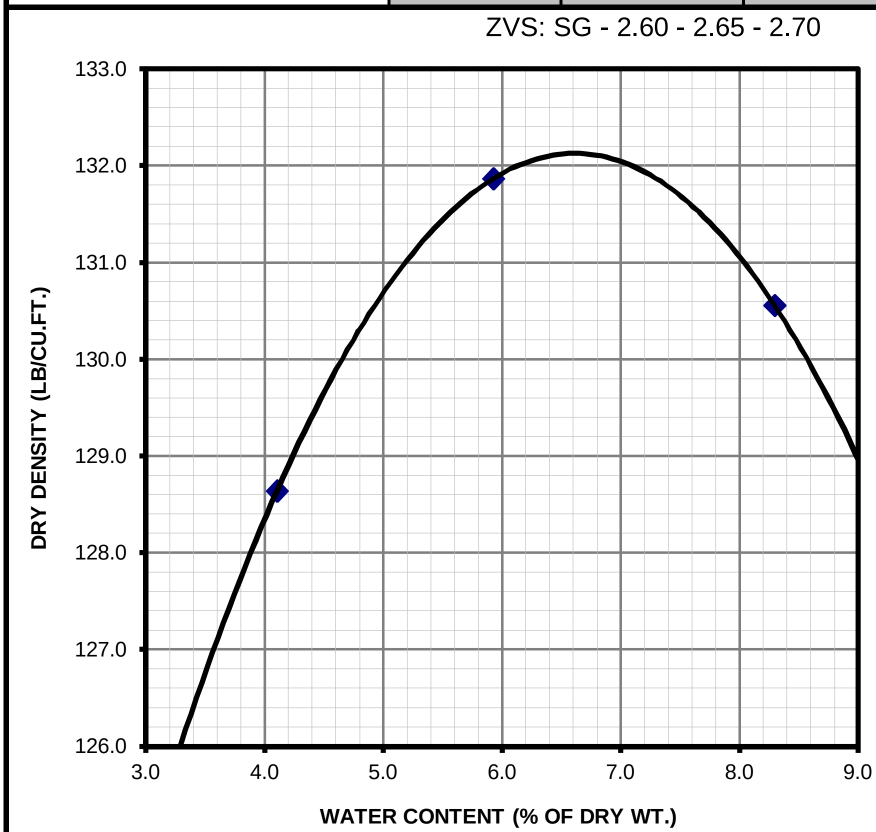
Tested By:	C. Klopfer	Date:	7/16/2014
Reviewed By:	C. Rice	Date:	8/6/2014

Proctor Data Sheet

NEIL O. ANDERSON AND ASSOCIATES
A Terracon COMPANY

JOB NAME:	Bennington Solar Project		Sample Tag No: 16706			DATE:	7/15/2014
JOB NUMBER:	SGE140028					MATERIAL SOURCI	BORING #3
SAMPLE ID:	3215					TEST METHOD:	D1557c
DIA. OF MOLD, IN.:	6	NUMBER OF LAYERS:	5	NUMBER OF BLOWS/LAYER:	56	WEIGHT OF RAMMER:	10
HEIGHT OF DROP, IN.:	18	MAX. PARTICLE SIZE:	0.75	HEIGHT OF SAMPLE, IN.:	4.5	HAND/MECH. RAMMER:	MECH

A. WATER ADDED, %	0%	3%	6%			
B. MOLD NUMBER	6	6	6			
C. WT. OF WET SOIL & MOLD	7342	7538	7596			
D. WT. OF MOLD	2786	2786	2786			
E. WT. OF WET SOIL **(C - D)**	4556	4752	4810			
F. VOL. OF SOIL SAMPLE, CU. FT.	0.075	0.075	0.075			
G. WET DENSITY, LB/CU.FT. **(E / F)**	**133.9**	**139.7**	**141.4**			
H. CONTAINER NO.	236	222	226			
I. WT. OF WET SOIL & TARE	968	823	850			
J. WT. OF DRY SOIL & TARE	935	784	795			
K. WT. OF WATER **(I - J)**	33	39	55			
L. WT. OF TARE	131	126	132			
M. WT. OF DRY SOIL **(J - L)**	804	658	663			
N. WATER CONTENT, % **(K / M) * 100**	**4.1**	**5.9**	**8.3**			
O. DRY UNIT WT., LB/CU.FT. **G / (1 + N)**	**128.6**	**131.9**	**130.6**			



TEST RESULTS

OPTIMUM WATER CONTENT, %	**6.6**
MAXIMUM DRY DENSITY, LB/CU.FT.	**132.1**

CLASSIFICATION OF SAMPLE:

CL-ML

INFORMATION ON SAMPLE:

Brown silty clay, some gravel

LIQUID AND PLASTIC LIMITS:

LL: __________ PL: __________ PI: __________

SYMBOL FROM PLASTIC CHART:

TESTED BY:	Joe Allen
CHECKED BY:	
SUBMITTED BY:	Terracon

NEIL O. ANDERSON AND ASSOCIATES
A Terracon COMPANY

THERMAL RESISTIVITY

ASTM D5334

JOB NUMBER	SGE140028	**REPORT DATE**	7/24/2014
JOB NAME	Bennington Solar Farms	**TECHNICIAN**	CT
SAMPLE ID	B3	**PROJ. MANAGER**	Ryan King
AGENCY/CONTRACT			
SAMPLE INFO			

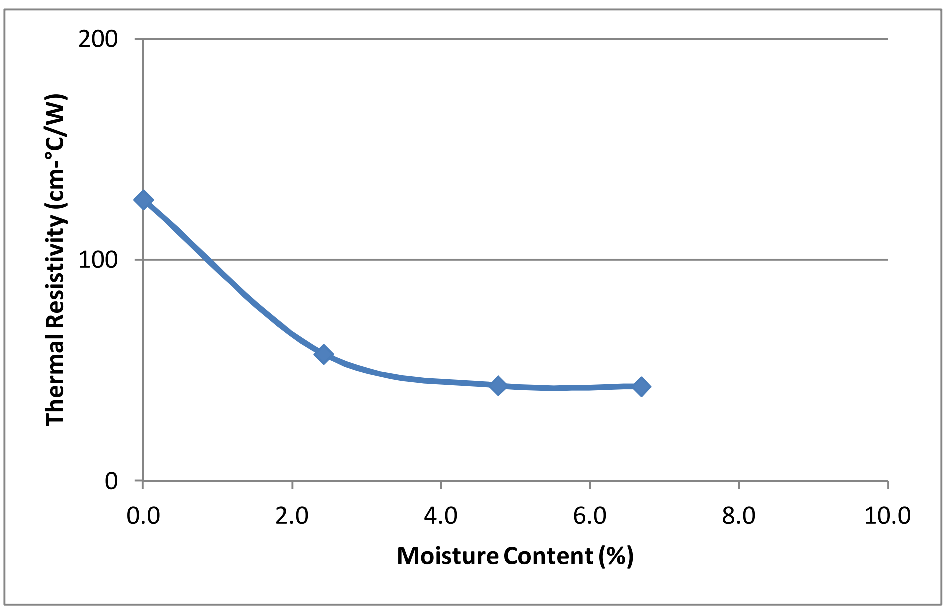
Summary

Below are the results of the thermal resistivity testing for the subject sample. The soil was tested in accordance with ASTM D5334 - Thermal Conductivity of Soils by Thermal Needle Probe Procedure.

The test included measurement of moisture content, density, and thermal conductivity relative to moisture content. Bulk samples were remolded to 90% of the ASTM D1557 Maximum Dry Density. A series of measurements were taken from various moisture contents ranging from optimum moisture content to a totally dry condition.

Dry Density, pcf[1]	Moisture Content (%)	Temperature (°C)	Conductivity (W/m-°C)	Resistivity (cm-°C/W)
118.9	6.7	26.84	2.339	43
	4.8	23.96	2.317	43
	2.4	16.78	1.742	57
	0.0	19.02	0.786	127

1. Dry Density is 90% of ASTM D1557 Max Density



NOTES:

PLATE 0

Test ran on material passing the 3/8" Sieve.
Approximately 15% of material retained on sieve

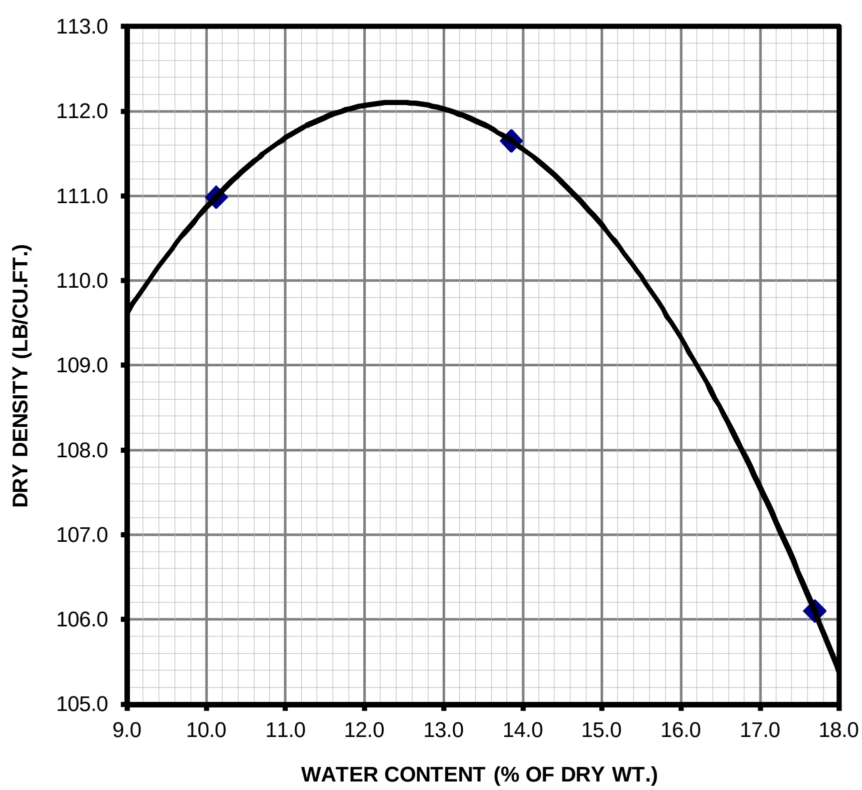
Proctor Data Sheet

NEIL O. ANDERSON AND ASSOCIATES
A Terracon COMPANY

JOB NAME:	Bennington Solar Project		Sample Tag No:	16706		DATE:	7/15/2014
JOB NUMBER:	SGE140028					MATERIAL SOURCE:	Boring #5
SAMPLE ID:	3214					TEST METHOD:	D1557B
DIA. OF MOLD, IN.:	4	NUMBER OF LAYERS:	5	NUMBER OF BLOWS/LAYER:	25	WEIGHT OF RAMMER:	10
HEIGHT OF DROP, IN.:	18	MAX. PARTICLE SIZE:	4	HEIGHT OF SAMPLE, IN.:	4.5	HAND/MECH. RAMMER:	Mech

A. WATER ADDED, %	-6%	-3%	0%			
B. MOLD NUMBER	4	4	4			
C. WT. OF WET SOIL & MOLD	3832	3906	3872			
D. WT. OF MOLD	1984	1984	1984			
E. WT. OF WET SOIL **(C - D)**	1848	1922	1888			
F. VOL. OF SOIL SAMPLE, CU. FT.	0.033	0.033	0.033			
G. WET DENSITY, LB/CU.FT. **(E / F)**	**122.2**	**127.1**	**124.9**			
H. CONTAINER NO.	Z1	212	2020			
I. WT. OF WET SOIL & TARE	735	556	730			
J. WT. OF DRY SOIL & TARE	685	506	649			
K. WT. OF WATER **(I - J)**	50	50	81			
L. WT. OF TARE	191	145	191			
M. WT. OF DRY SOIL **(J - L)**	494	361	458			
N. WATER CONTENT, % **(K / M) * 100**	**10.1**	**13.9**	**17.7**			
O. DRY UNIT WT., LB/CU.FT. **G / (1 + N)**	**111.0**	**111.7**	**106.1**			

ZVS: SG - 2.60 - 2.65 - 2.70



TEST RESULTS

OPTIMUM WATER CONTENT, %	**12.4**
MAXIMUM DRY DENSITY, LB/CU.FT.	**112.1**

CLASSIFICATION OF SAMPLE:

CL-ML

INFORMATION ON SAMPLE:

Light brown silty clay

LIQUID AND PLASTIC LIMITS:

LL: __________ PL: __________ PI: __________

SYMBOL FROM PLASTIC CHART:

TESTED BY:	Jared Edwards
CHECKED BY:	
SUBMITTED BY:	Terracon

NEIL O. ANDERSON AND ASSOCIATES

THERMAL RESISTIVITY

ASTM D5334

JOB NUMBER	SGE140028	**REPORT DATE**	7/24/2014
JOB NAME	Bennington Solar Farms	**TECHNICIAN**	CT
SAMPLE ID	B5	**PROJ. MANAGER**	Ryan King
AGENCY/CONTRACT			
SAMPLE INFO			

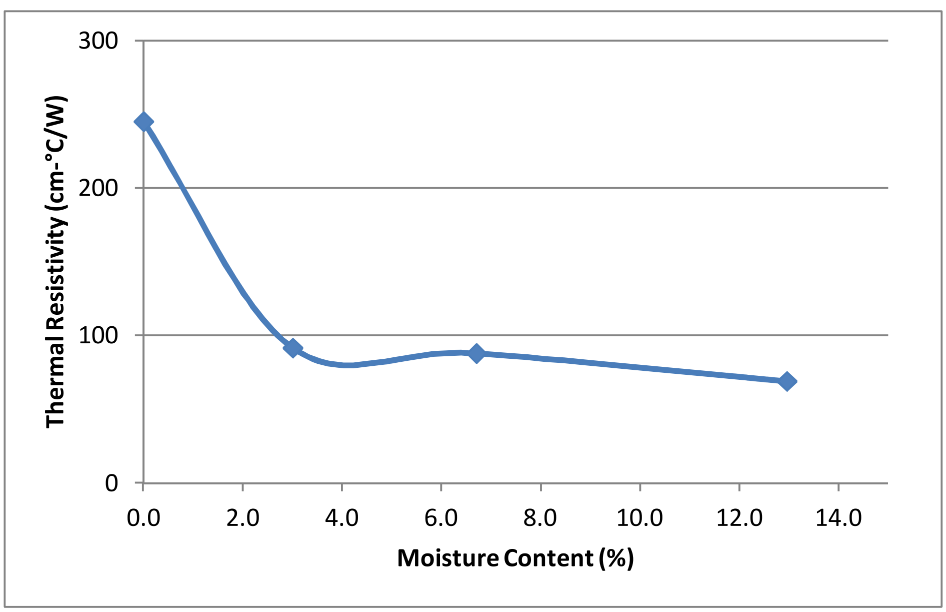
Summary

Below are the results of the thermal resistivity testing for the subject sample. The soil was tested in accordance with ASTM D5334 - Thermal Conductivity of Soils by Thermal Needle Probe Procedure.

The test included measurement of moisture content, density, and thermal conductivity relative to moisture content. Bulk samples were remolded to 90% of the ASTM D1557 Maximum Dry Density. A series of measurements were taken from various moisture contents ranging from optimum moisture content to a totally dry condition.

Dry Density, pcf[1]	Moisture Content (%)	Temperature (°C)	Conductivity (W/m-°C)	Resistivity (cm-°C/W)
100.9	13.0	26.46	1.446	69
	6.7	19.82	1.137	88
	3.0	25.99	1.090	92
	0.0	21.07	0.408	245

1. Dry Density is 90% of ASTM D1557 Max Density



NOTES:

PLATE 0

Test ran on material passing the 3/8" Sieve
Approximately 5% material retained on sieve

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger	Split Spoon
Shelby Tube	Macro Core
Ring Sampler	Rock Core
Grab Sample	No Recovery

WATER LEVEL

- Water Initially Encountered
- Water Level After a Specified Period of Time
- Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			**CONSISTENCY OF FINE-GRAINED SOILS** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	$\geq$ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification: Group Symbol	Soil Classification: Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]	GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]	SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G,H,I]
			Fines classify as CL or CH	SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]	CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [K,L,M,N]
					Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K,L,M]
			PI plots below "A" line	MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [K,L,M,P]
					Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.

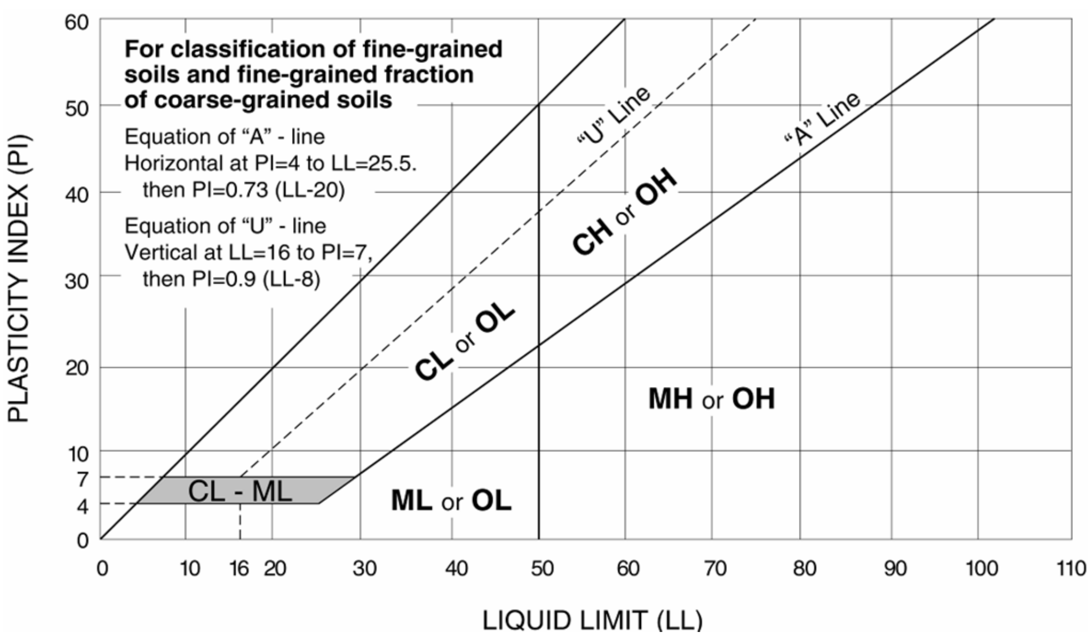


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Exhibit C-2

DESCRIPTION OF ROCK PROPERTIES

WEATHERING	
Term	**Description**
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, PSI (MPa)**
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (<19 mm)	**Laminated**	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	**Very thin**	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	**Thin**	2 in – 1 ft (50 – 300 mm)
Moderate	8 in – 2 ft (200 – 600 mm)	**Medium**	1 ft – 3 ft (300 – 900 mm)
Wide	2 ft – 6 ft (600 mm – 2.0 m)	**Thick**	3 ft – 10 ft (900 mm – 3 m)
Very Wide	6 ft – 20 ft (2.0 – 6 m)	**Massive**	> 10 ft (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0 degree angle.

ROCK QUALITY DESIGNATION (RQD*)	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

*The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009 Technical Manual for Design and Construction of Road Tunnels – Civil Elements

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