CONNECTICUT DEPARTMENT OF AGRICULTURE
450 Columbus Blvd, Suite 701 | Hartford, Connecticut 06103 | 860.713.2500
Office of the Commissioner
An Equal Opportunity Employer

July 16, 2025

Melanie A. Bachman
Executive Director
Connecticut Siting Council
10 Franklin Square
New Britain, CT 06051

Re: FirstLight – Shepaug Solar Southbury, Proposed 3.0-Megawatt AC Solar Generating Facility

Dear Executive Director Bachman:

Pursuant to 16-50k(a) of the Connecticut General Statutes, we have reviewed the above cited project with respect to agricultural impacts, specifically, to determine whether "…such project will not materially affect the status of such land as prime farmland…"

This project will be located at 2225 River Road in Southbury on a parcel owned by FirstLight's subsidiary, FirstLight CT Housatonic LLC. The entirety of the property at 2225 River Road is 553.67 acres of which 53.5 acres are classified as prime farmland soils. The Generation Footprint contains 10.86 acres of prime farmland soils.

In an email to the Department of Agriculture, dated May 20, 2025, the Petitioner (FirstLight) has agreed to:

1. Restore the existing Prime Farmland and establish an apiary and pollinator habitat of native, seasonal, and biodiverse wildflowers, grasses, and shrubs beneath and around the solar array.
    a. Plant species will be selected based on their compatibility with local soil conditions, shade tolerance, and value to pollinators throughout the growing season from early spring through late fall.
    b. Seed mixes will include plants known to thrive in partial shade and require minimal maintenance once established. FirstLight will consult with a third-party specialist to develop a site-specific seed mix.
    c. The seeding of native pollinator habitat will occur within the solar array area following the completion of racking and panel installation anticipated to take place in late April to early May, depending on construction timeframe, site conditions and weather.
    d. A compact tractor equipped with a no-till seed drill will be used to navigate between rows. Hand-broadcasted seeding will be done in hard to access places.
2. Partner with local beekeepers to install an apiary and manage beehives on-site.
    a. In years one through three, two to four hives will be established; each hive is expected to produce between 20-30 pounds of honey annually and maintain a population between 40,000-80,000 bees during peak season (spring/summer).

b. As the habitat matures, the apiary will expand to maximize the number of hives that can be supported via the meadows and local farms, anticipated at a maximum of 20 hives, each producing 50-100 pounds of honey annually.
c. These bees will contribute to local pollination services for nearby farms.

3. Produce agricultural products such as honey, beeswax, and propolis from the apiary.

Based on preliminary information provided to the Agency (enclosed), and the successful implementation of the co-uses described in the attached, the Department of Agriculture concludes this project will not materially affect the status of project land as prime farmland.

This letter is conditioned upon all dual use plans being fully implemented and operational for the duration of the solar installation. If the Petitioner sells the solar project to another entity, dual use programing and decommissioning responsibilities must carry over to the new owner.

Should any project changes raise concerns to the Agency, we reserve the right to modify our position on this project, including opposing it, as detailed plans are provided by the Petitioner. Nothing in this letter relieves the Petitioner of other obligations under applicable federal, state, and local law that may be necessary as part of the proposed project design and implementation.

If you have any questions, please feel free to contact Jaime Smith of my staff. Jaime can be reached at jaime.smith@ct.gov.

Sincerely,

Bryan P. Hurlburt
Commissioner

Enc. Shepaug Solar Agrivoltaics Farm Plan

Cc: Katie Dykes, Commissioner, Department of Energy and Environmental Protection
Sandra Brown, Director, Project Development, FirstLight

Agrivoltaics Farm Plan

for

Shepaug Solar

May 20, 2025

100 District Avenue, Suite 102
Burlington, MA 01803
P: 781-653-4240

Property Information

1. Provide a description of the Parcel, including but not limited to the following:

   A. Owner(s), farm name and location;

The Shepaug Solar Array (the "Project") is owned by Shepaug LLC and will be located at 2225 River Road in Southbury, CT at FirstLight's existing Shepaug Generation Station hydroelectric facility operated under FERC License No. 2576. The property at 225 River Road is owned by FirstLight's subsidiary, FirstLight CT Housatonic LLC.

   B. Identify past lessee name(s) and land use, if a tenant farmer was present in the last five years; and

No tenant farmer has been present at the site in the last 5 years. Prior to the construction of the Shepaug Dam in 1955, the property may have had agricultural activity occurring in the mid to late 1800s. Since then, it has returned via natural succession to forested former agricultural meadows, which are maintained and monitored under FirstLight's FERC License.

At present, under FERC's license, FirstLight has permitted three Non-Project Use Approvals (NPUAs). Currently, there are three active on the property, but not adjacent to the proposed Project.

- Middlesex Construction Laydown Area: A license has been issued to Middlesex Construction for the storage of steel materials.
- Shepaug Station Solar: A license has been issued to Shepaug Station LLC for the construction of a small ground-mount solar facility adjacent to the Shepaug Dam embankment. This property is not on Prime Farmland.
- Fischel Properties Marina (Unbuilt): A license was granted for a proposed marina, though it has not yet been developed.

   C. Total Parcel acreage, identification of prime farmland soils & acreage;

      a. Include appropriate maps and surveys to allow evaluation.

The 2225 River Road property is approximately 553.67 acres of which 53.5 acres is designated as Prime Farmland Soils as specified by the Southbury CT GIS system. Although a small portion of the parcel is classified as Prime Farmland, the land is currently wooded and has not been in agricultural production since the late 1800s. The Solar Generation Footprint is 10.86 acres and is shown in the blue outlined area in Figure 1 below, which also shows the location of Prime Farmland soils and acreage. The site's Environmental Resource Screening is provided as Attachment 1 below.

FirstLight

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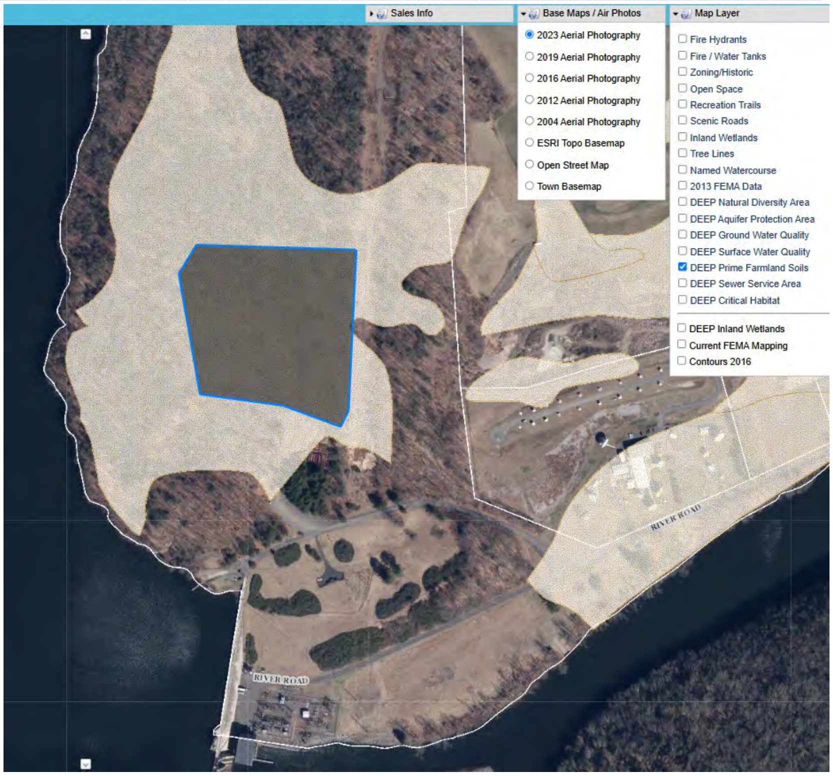

Figure 1: Solar Generation Footprint and Prime Farmland Soils;
Prepared by CT licensed Surveyor and Engineer Thomas E. Little, All Point Technology

2. Provide an overview of the energy project, including but not limited to the following:

   A. The size of the project in megawatts (MW);

The Project will have a solar generation capacity of 1,999kW AC or 3,002kW DC.

   B. The Project Site and Generation Footprint being proposed as it relates to prime farmland on the property;

The Project Site contains semi-mature forest, and the Generation Footprint includes approximately 10.86-acres classified as Connecticut Prime Farmland. There will be no impact on existing agricultural production, as the land has not been actively farmed for over 100 years.

As part of the Project's development, we are committed to preparing and returning portions of the wooded Prime Farmland into productive agricultural use. This will be achieved through the establishment of native pollinator habitat and the introduction of an on-site apiary to support biodiversity and promote long-term soil health in alignment with responsible land stewardship practices.

   C. Identify whether the project is participating in a state program (including SCEF, NRES, or any state procurement);

The Project is currently under consideration for participation in the Shared Clean Energy Facilities (SCEF) Program.

D. A description of infrastructure needed to support the project; and

FirstLight's geotechnical consultant, GEI Consultants Inc., recommended that the solar array be supported using driven or drilled piles. FirstLight is currently considering various racking options to establish the best design for the Project Site. The final racking design will be determined following final design engineering.

As part of the design provided in the concept plan in Attachment 2 dated September 10, 2024 formal stormwater management features will be engineered to collect and naturally filter stormwater onsite. These features will enable in situ infiltration, ensuring that no stormwater results in runoff.

The path to interconnect the Project includes a proposed three-phase extension from the Project Site to the Point of Interconnection along River Road, adjacent to the existing substation. The project has reserved electric capacity from Eversource CT, as part of our executed Interconnection Agreement, and has been approved to interconnect at this location. This extension will be constructed primarily on overhead poles, except for an underground segment crossing the existing Eversource transmission easement, which has been authorized by Eversource.

E. The proposed lifetime of the project, including any extensions.

The Project is designed for long-term operation and is anticipated to have a useful life of approximately 25 to 30 years. Following the completion of the SCEF Program, the operations for the site's pollinator habitat and on-site apiary are anticipated to continue throughout the Project's life and will be reassessed for effectiveness on an ongoing basis, including identifying opportunities for expanded agricultural activities.

3. Provide a description of past agricultural activities on the Parcel, including but not limited to the following:

   A. All production agriculture that has taken place both on the Parcel and within the proposed Generation Footprint during the past five years;

There has not been agricultural production on either the Property nor the Generation Footprint within the past 5 years.

   B. The approximate location of crops, livestock, farm buildings, etc. used to support the farming operation;

      b. Include appropriate maps and surveys to allow evaluation; and

There has been no agricultural production onsite within the past 5 years.

   C. Describe overall how the project will impact production agriculture currently being conducted on the farm.

There will be no impact on production agriculture, as there is no productive agriculture at the site at present.

Property Management

1. Describe project plans to displace soil on the property including panel installation methods, interconnections, grading, and soil stockpiling;

The Project's soil displacement plans are expected to be minimal and are outlined below:

Racking Installation Methods:

The Project will utilize a dual-post galvanized steel racking system designed to accommodate the site's wind and snow loads as required by State and Federal Building Codes. The racking foundations are anticipated to be ground or helical screws, which are compatible with the site's soil conditions and help minimize soil disturbance.

Interconnections:

Soil displacement will be limited to only the underground portion of the interconnection extension, which includes approximately 1,780 feet of new line of which 120 feet is anticipated to be underground. The conduit is 2 feet wide by 4 feet deep, resulting in approximately 960 cubic feet of soil displaced. Excavated soil from this limited activity will be reused as graded fill within the existing transmission line easement or redistributed on-site. No soil is expected to be transported off-site.

Grading:

Minimal grading is anticipated across the Project Site. Grading will only be performed in localized areas as necessary to direct water to our stormwater feature/basin, utilizing best management practices. Grading will follow the SCEF Program guidance, with a focus on preserving existing soil structure and minimizing compaction.

Soil Stockpiling:

Any soil temporarily displaced during construction will be stockpiled on-site in designated areas and will be reused within the Project parcel for backfill or site grading. No additional major soil excavations are anticipated.

2. Identify whether the farmland has been used in production agriculture in the past five years;

There has been no agricultural production onsite within the past 5 years.

3. Provide a detailed explanation of the agrivoltaics co-use proposed, including but not limited to the following:

    A. Describe farm plan for all agricultural activities on the entire parcel, including planned crops and/or livestock grazing;

The proposed Farm Plan for the Shepaug Solar Project is to restore and return the existing Prime Farmland into active agricultural use by establishing a pollinator habitat with apiary. This approach allows for the property to be returned to its earlier use, while allowing the soil to transition from semi-deciduous forest into pollinator meadow, preparing it for future use at an active agricultural property.

FirstLight will partner with local beekeepers to install an apiary and manage beehives on-site. The apiary will serve as a home for honeybee colonies, which will forage on the native pollinator plantings underneath and around the solar generation footprint. We intend to establish a partnership with a local beekeeping company upon evaluating the services offered by potential partners in the area.

During the initial vegetation management period (years 1-3, as outlined below), we anticipate installing 2-4 hives. Each hive is expected to produce between 20-30 pounds of honey annually and maintain a population between 40,000-80,000 bees during peak season (spring/summer). As the habitat matures, and under the guidance of our partner, we plan to expand the apiary to maximize the number of bee hives that can be supported via the meadows and local farms. We anticipate this will be a maximum of 20 hives, each producing 50-100 pounds of honey annually, during the long-term vegetation management period. These bees will contribute to local pollination services for nearby farms while supporting the health and resilience of Connecticut's ecosystems.

The apiary is expected to produce agricultural products such as honey, beeswax, and propolis. These products may be sold locally or used for educational and outreach purposes to enhance FirstLight's economic and social impact in collaboration with our apiary partner.

In addition to the apiary, the Project will establish a pollinator-friendly habitat across the generation footprint. Native wildflowers, grasses, and low-growing shrubs will be seeded beneath and around the solar array, as well as in an adjacent meadow near the Shepaug Hydrogeneration to create a biodiverse habitat that supports nearby farms and Connecticut's pollinator populations.

Plant species will be selected based on their compatibility with local soil conditions, shade tolerance, and value to pollinators throughout the growing season from early spring through late fall. Seed mixes will include plants known to thrive in partial shade and require minimal maintenance once established.

Vegetation management is expected to follow the approach below:

- Initial vegetation management period (Years 1-3): Managed through bimonthly mowing to ensure successful establishment of the habitat and control of invasive species.
- Long-term vegetation management period (Post Year 3): Transition to biannual mowing, with attention to avoiding peak flowering and foraging periods for pollinators.

B. Seed Mix Identification: Identify any planned row crops, cover crops and/or vegetation mix, as appropriate;

The Project aims to establish ecologically beneficial agricultural activity through the integration of native pollinator habitat and on-site beekeeping. While no row crops or livestock grazing are currently planned, FirstLight will plant a carefully selected mix of native, seasonal, and biodiverse wildflowers, grasses, and shrubs beneath and around the solar array. These plantings are intended to support pollinators and other beneficial insects, improve soil health, and promote biodiversity.

Although the final seed mix has not been determined, FirstLight will consult with a third-party specialist to develop a site-specific seed mix. The following criteria will guide seed selection based on compatibility with the Project Site's sandy loam soils:

- Mature height of 36" or less
- Tolerant of sun and shade
- Host plant for pollinators

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P: 781-653-4240

- Bloom periods staggered from spring to fall
- Compatible with dry to mesic soil conditions

A preliminary list of native plant species under consideration is provided as Attachment 3. The species listed in the attachment were drawn from the University of Massachusetts Amherst's "Recommended Plant Species List for Solar Arrays" (2022), which was developed in collaboration with ecological experts to support dual-use and pollinator-friendly solar development. Although the final seed mix has not yet been finalized, FirstLight will continue working with local seed experts to finalize a mix that is best suited for the site.

C. Describe how planting of vegetative cover or crops will be conducted for each of the follow areas including the sequence of planting (which areas will be planted and when), planned month of planting, planting method (drilled, broadcast, bareroot or plugs), and equipment to be used;

   a. Array Planting;

Initial Plantings:
The seeding of native pollinator habitat will occur within the solar array area following the completion of racking and panel installation to avoid disturbance to new vegetation. This is anticipated to take place in late April to early May, depending on construction timeframe, site conditions and weather.

Planting Method/Equipment:
A compact tractor equipped with a no-till seed drill will be used to navigate between rows. In narrow or hard to reach areas, seed will be hand-broadcasted.

Ongoing Maintenance:
Once established, the habitat will be maintained through bimonthly mowing for the first three years to support establishment. Mowing will occur outside peak flowering and foraging seasons. After year three, vegetation management will transition to a biannual mowing schedule.

   b. Border Area Planting;

Initial Plantings:
Border areas will be planted with native wildflowers and grasses selected for their compatibility with partial shade and local soil conditions. Species will be chosen to promote habitat diversity and minimize erosion along the project perimeter. Planting is scheduled for late April to early May.

Planting Method/Equipment:
A compact tractor equipped with a no-till seed drill will be used to navigate between rows. In narrow or hard to reach areas, seed will be hand-broadcasted.

Ongoing Maintenance:
Once established, the habitat will be maintained through bimonthly mowing for the first three years to support establishment. Mowing will occur outside peak flowering and foraging seasons. After year three, vegetation management will transition to a biannual mowing schedule.

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c. Stormwater Detention Area Planting;

Initial Plantings:
Stormwater basins will be planted with a wetland-adapted native seed mix that supports infiltration, sediment control, and pollinator activity. Planting will occur in mid-May, after the risk of frost and once soil temperatures are consistently above 50°F.

Planting Method/Equipment:
A compact tractor equipped with a no-till seed drill will be used to navigate between rows. In narrow or hard to reach areas, seeds will be hand-broadcasted.

Ongoing Maintenance:
Once established, the habitat will be maintained through bimonthly mowing for the first three years to support establishment. Mowing will occur outside peak flowering and foraging seasons. After year three, vegetation management will transition to a biannual mowing schedule.

D. If grazing animals are proposed, DOAG's Requirements for Solar Grazing must be followed; A Grazing Plan is required and should include the following information:

a. The type and number of animals to be used;

b. The time and duration of grazing, and the decision making process for ensuring that vegetation is not over-grazed;

c. Forage and vegetation mix establishment and maintenance;

d. Plans for fencing;

e. Plans for a water source;

f. Plans for soil testing; and

g. Contingency plan for unforeseen climate events;

This section is not applicable for the Project, as solar grazing is not anticipated to regularly occur.

Design Specifications

1. Provide a description of the proposed modules, including but not limited to the following:

FirstLight and its Development partner have developed a preliminary design with specifications for both modules and racking vendors; however, selection of vendors will be completed during final design engineering.

A. Panel height;

The design selected will stand at minimum 3 feet for the leading edge (the lowest edge of the solar module) to the ground, and 9 feet from the crown edge (the tallest edge) of the module, at its maximum height no panel will stand over 12 feet based on topography.

B. Panel dimensions;

Our modules will be approximately 85 inches x 40 inches. As of now, we are targeting bifacial modules with an estimated wattage of approximately 445-460 Watts per module, which will be determined based on final design and engineering.

C. Row width;

The row width will be approximately 13 feet.

D. Module inter-row spacing; and

The module interrow spacing will be approximately 14 feet.

E. How this configuration will support the Dual Use selected;

The fixed tilt solar design will support native pollinator species to be planted within and surrounding the arrays. The spacing between rows, and overall spacing of the array promotes tremendous sunshine to propagate our pollinator-friendly seeding plan and promote Apiary activities. Additionally, this form of fixed tilt design allows rainfall to irrigate naturally, between our solar rows, and creates ideal conditions for our seed mix to thrive long term and create Apiary habitat.

2. Identify whether panels will be fixed, tracking, bifacial, vertical, and/or semitransparent;

The panels will be fixed and bifacial.

3. If dual-use production agriculture is proposed, demonstrate how sunlight reduction from panels is based upon compatibility with the proposed agricultural activities;

   A. Documentation must be provided to establish the maximum sunlight reduction from panel shading on every square foot of land directly beneath, behind, and in the areas adjacent to and within the array's design. Project proposals shall demonstrate how this sunlight reduction is based upon compatibility with the proposed agricultural products and will sustain continued productivity;

      a. Growing Season/Time of Day Considerations: The typical growing season should be March/April through October/November, with sunlight reduction to be measured between 10AM and 5PM for March and October, and from 9AM to 6PM from April through September.

The Shepaug Solar Project will integrate a pollinator-friendly habitat beneath and around fixed-tilt solar arrays. Peer-reviewed studies provide insights on expected light reduction under similar agrivoltaic systems. Research indicates that fixed-tilt solar arrays can reduce photosynthetically active radiation (PAR) beneath the arrays by approximately 22-47%, depending on panel orientation and spacing (Ukwu, U.N., Muller, O., Meier-Grüll, M. *et al. Sci Rep* **15**, 1190 (2025)).

This level of shading is compatible with the proposed pollinator habitat, as the selected plants will be adaptable to shady site conditions. Many native wildflowers and grasses suitable for pollinator habitats are adapted to partial shade and can thrive under these light conditions. Additionally, shading can offer additional benefits, such as reduced soil moisture evaporation and regulated microclimates, which can enhance plant resilience and biodiversity.

FirstLight will collaborate with local seed specialists to select plant species that are both shade-tolerant and adapted to the site's sunlight conditions. The goal is to maintain a productive and sustainable pollinator habitat that supports our on-site apiary and Connecticut's ecosystems and agricultural activities.

Additional Requirements & Attachments

1. Provide contact information for the individual that will grant any person authorized by the State of Connecticut access to the Project Site for research and data collection purposes related to Agrivoltaics for the lifetime of the Project, with advance notice of site visits;

    FirstLight's Land Management Dept.
    Email: Land.management@firstlight.energy
    PO Box 5002
    New Milford, CT 06776

2. If the land is leased from a farmer or dual-use production agriculture in collaboration with a farmer is proposed, provide an attestation from the farmer confirming their input and involvement in the proposed project;

The property and project site are owned by FirstLight CT Housatonic LLC and is not currently in collaboration with a farmer at this time. If, in the future, FirstLight decides to partner with local farmers, FirstLight attests to contact DOAG with any critical changes to our agricultural cultivation plans.

3. Provide comprehensive maps, site plans and surveys that include the following information:

    A. Date prepared;

8/10/24

    B. Parcel topography;

Included in Attachment 1

    C. Soils classification;

Included a soils classification map in Attachment 4 and included our Geotech Report dated April 2024, which shows a number of select soil sampling profiles through the array footprint in Attachment 5.

    D. North arrow;

Included in all applicable Attachments

    E. Identification of Project Site and Generation Footprint; and

Included in all applicable Attachments

F. Identify and label location of agricultural activities, any proposed soil grading, stormwater basins, access roads, interconnections, and existing buildings and/or farm structures;

Pollinator plantings will be established beneath and around the solar panels, including throughout inter-row spacing and along the interior of the perimeter fencing.

4. Provide photos of the Project Site and Parcel; and

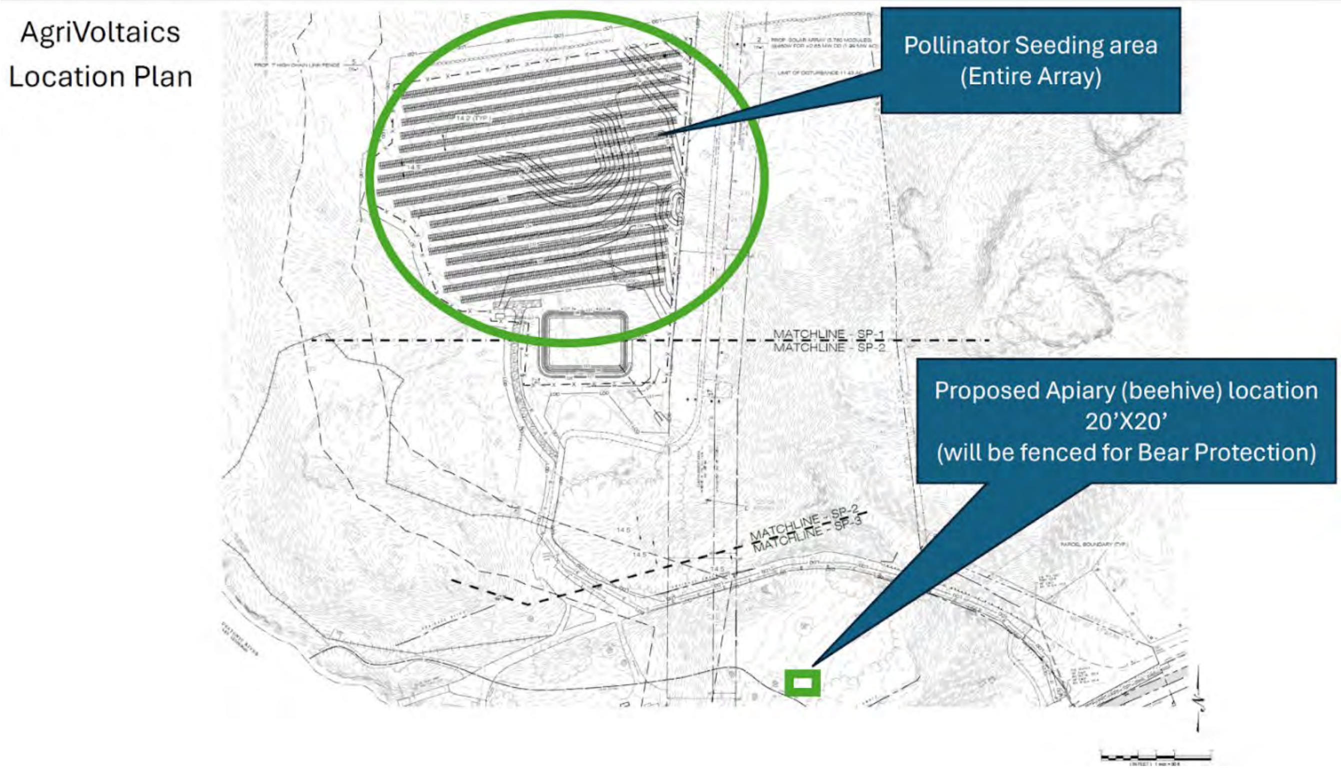

Figure 2: Solar Generation Footprint and Agrivoltaic Feature Location

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Figure 3: Existing Shepaug Substation and Point of Interconnection

Figure 4: Proposed Apiary Location (View to Southeast)

Figure 5: Proposed Entrance Area to Solar Generation Footprint (View to North)

Figure 6: Solar Generation Footprint Location to the Left, from the Existing Eversource Easement (View to Northwest)

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Figure 7: Site Access Path with Existing Storage Yard South of Proposed Solar Generation Footprint (View to North)

Figure 8: Existing Eversource Easement and Proposed Interconnection Underground Location (View to Southeast)

5. Attest that, if the Bidder sells the solar project to another entity, Farm Plan Requirements and decommissioning responsibilities will carry over to the new owner.

FirstLight and DHD attest that if the Bidder sells the solar project to another entity, Farm Plan Requirements and decommissioning responsibilities will carry over to the new owner.

Attachments

Attachment 1. Environmental Resource Screening

Attachment 2. Solar Concept Plan

Attachment 3. Array Planting Species List

Attachment 4. Project Site Soil Classification

Attachment 5. Geotechnical Report

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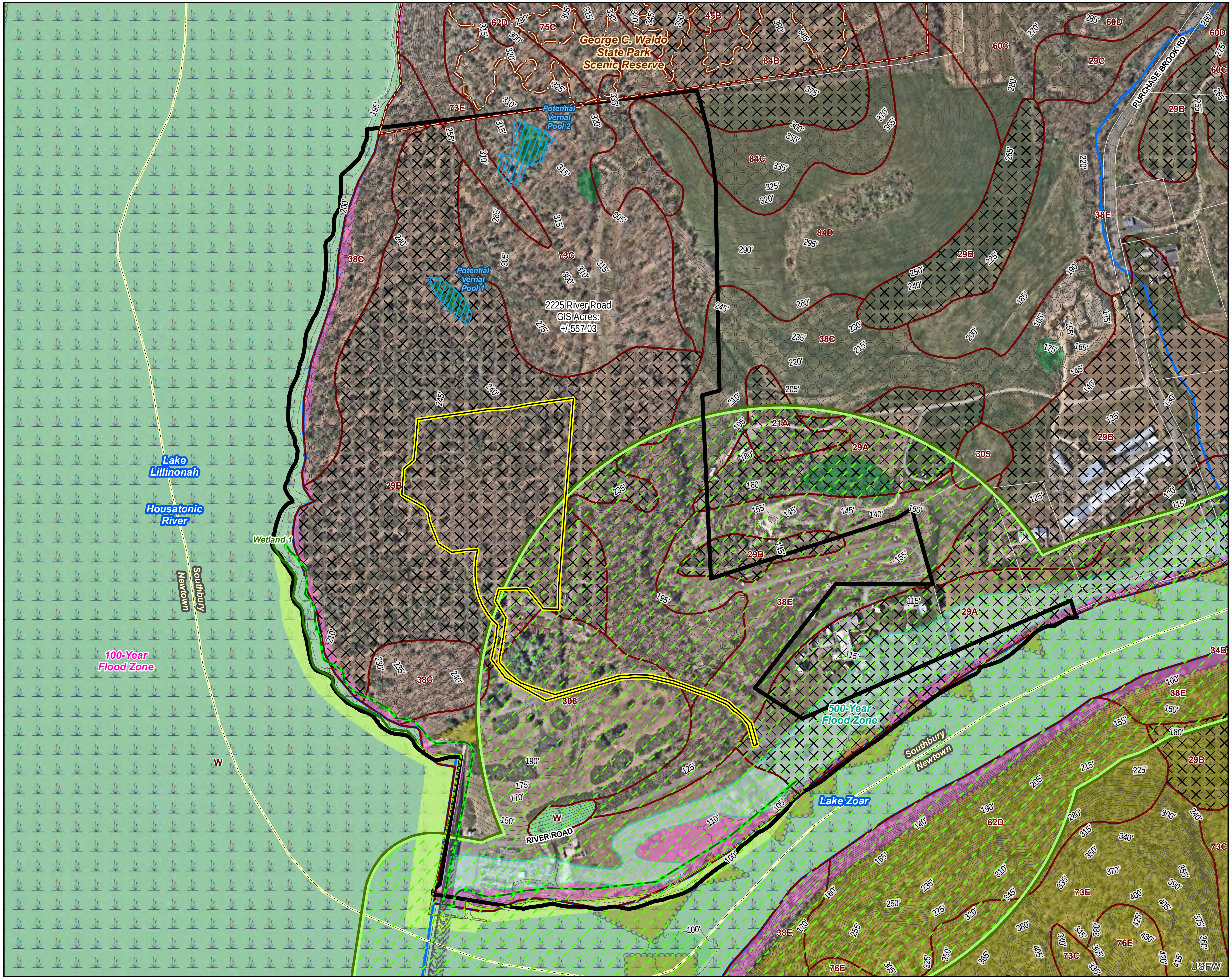
Attachment 1. Environmental Resource Screening



Environmental Resources
Proposed Solar Facility
FirstLight Shepaug
2225 River Road
Southbury, Connecticut

Legend

Site
Project Area
5-foot Contour Line
Approximate Wetland Boundary (APT)
50-Foot Upland Review Area (APT)
Delineated Wetland Boundary (APT)
Potential Vernal Pool (APT)
Approximate Wetland Area (APT)
Coastal Boundary*
Natural Diversity Database Area (June 2024)
Critical Habitat (Oct 2019)*
Cold Water Supporting Drainage Basin*
Cold Water Habitat Site*
Forestland Habitat Impact (CTDEEP)
Wetlands
Tidal Wetland*

Bioscience/CT NWI Wetland Functions 2010

Freshwater Forested/Shrub Wetland
Open Water
Watercourse
Public Water Supply Watershed*
Aquifer Protection Area (Jan 2022)*
100-Year Flood Zone
500-Year Flood Zone
Floodway*
Prime Farmland Soils
Statewide Important Farmland Soils

Soils
State CT DEEP Property
Hiking Trail CT Blue-Blazed*
Hiking Trail Other
Municipal Boundary

Historic Resources

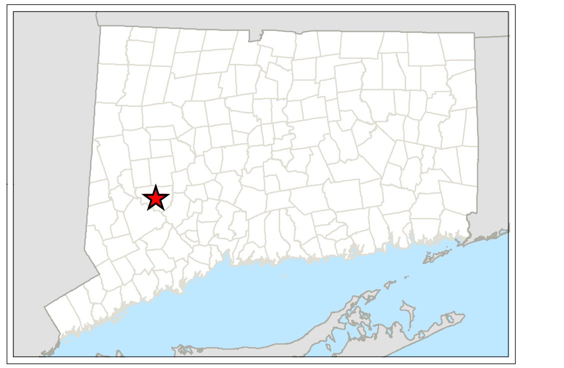
Inventoried*
Local*
National Historic Landmarks*
National Register*
National Register Non-Contributing*
State Register*
State Register Non-Contributing*
National Historic Landmark District*
National Register District (Potentially Abutting Site)
State Register District*
Local Historic District*

N W E S

400 200 0 400 Feet

1 inch = 400 feet

Information depicted on this map is based solely on publicly-available data, which has limitations and may not represent the true extents of resources. The data has not been field verified. It is intended to be used for general planning purposes only and cannot be relied upon for design, permitting or construction.



ALL-POINTS TECHNOLOGY CORPORATION

Map Sources:

*indicates no data in mapped extent

Ortho Base Map: Nearmap 2023

Elevation contours derived from 2016 LiDAR data maintained by CTECO

NWI+ wetland data provided by CTECO

Flood Zones obtained from FEMA National Flood Hazard Layer(NFHL) dataset.

Forestland Habitat Impact is a CTDEEP web service prepared by the Wildlife Division: https://ctdeep.maps.arcgis.com/apps/webappviewer/index.html?id=7b81844bab634281b544c20bf2d7bfb8

CTDEEP's data library (http://www.ct.gov/deep)
Data layers are maintained and updated by CTDEEP and represent the most recent publications.

Map Date: September 2024

C:\Users\mkope\APT GIS Dropbox\APT GIS Team Folder\Projects\Davis Hill Development\Shepaug_River_Road_Southbury_CT\mxd\EVResourcesScreen_Southbury_SCEF_Sept2024.mxd

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Attachment 2. Solar Concept Plan

Davis Hill Development
A Skyview Ventures Company
114 N. PEARL ST. #2C
PORT CHESTER, NY 10573

FirstLight
11 S. BEDFORD ST.
BURLINGTON, MA 01803

ALL-POINTS
TECHNOLOGY CORPORATION
567 VAUXHALL STREET EXTENSION - SUITE 311
WATERFORD, CT 06385 PHONE: (860)-663-1697
WWW.ALLPOINTSTECH.COM FAX: (860)-663-0935

SCEF SUBMITTAL DOCUMENTS

NO	DATE	REVISION
1		
2		
3		
4		
5		
6		
7		

DESIGN PROFESSIONALS OF RECORD

PROF: THOMAS E. LITTLE, P.E.
COMP: ALL-POINTS TECHNOLOGY CORPORATION, P.C.
ADD: 567 VAUXHALL STREET EXTENSION - SUITE 311 WATERFORD, CT 06385

OWNER: FIRSTLIGHT CT HOUSATONIC LLC
ADDRESS: 111 SOUTH BEDFORD ST BURLINGTON, MA 01830

SHEPAUG SOLAR

SITE ADDRESS:
2225 RIVER ROAD
SOUTHBURY, CT 06488

APT FILING NUMBER: CT653140

DRAWN BY: UKA

DATE: 09/10/24 CHECKED BY: TEL

SHEET TITLE:
OVERALL SITE GRADING & UTILITY PLAN

SHEET NUMBER:
SP-0

MATCHLINE - SEE SHEET SP-2

PROPOSED 10' X 20' CONCRETE EQUIPMENT PAD (5 / DN-1)

(1 / DN-2) (2 / DN-2) (5 / DN-2) (2 / SP-1)
PROP. PERMANENT GRASS LINED
STORMWATER MANAGEMENT BASIN (B-1) (TYP.)
BOTTOM: 222.00'
PRINCIPAL SPILLWAY: 225.00
EMERGENCY SPILLWAY: 226.00
TOP:227.30'

NOTES:
1. GRADE/SHAPE AREA TO MAINTAIN EXIST. DRAINAGE PATTERNS.
2. CONTRACTOR SHALL REMOVE ALL BAFFLES AND CONVERT SEDIMENT BASINS TO INFILTRATION BASINS.
3. CONTRACTOR SHALL REPLACE TEMPORARY SEDIMENT BASIN OUTLET WITH GRAVEL OVERFLOW WEIR UPON THE SITE OR DRAINAGE AREA BEING DEEMED STABILIZED PER THE SWPCP.
4. CONTRACTOR SHALL MODIFY/REPLACE THE TEMPORARY SEDIMENT BASIN RISER AS NEEDED UPON THE SITE OR DRAINAGE AREA BEING DEEMED STABILIZED PER THE SWPCP.

40 0 20 40 80
(IN FEET) 1 inch = 40 ft.

Davis Hill Development
A Skyview Ventures Company
114 N. PEARL ST. #2C
PORT CHESTER, NY 10573

FirstLight
11 S. BEDFORD ST.
BURLINGTON, MA 01803

ALL-POINTS TECHNOLOGY CORPORATION
567 VAUXHALL STREET EXTENSION - SUITE 311
WATERFORD, CT 06385 PHONE: (860)-663-1697
WWW.ALLPOINTSTECH.COM FAX: (860)-663-0935

SCEF SUBMITTAL DOCUMENTS

NO	DATE	REVISION
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DESIGN PROFESSIONALS OF RECORD

PROF: THOMAS E. LITTLE, P.E.
COMP: ALL-POINTS TECHNOLOGY CORPORATION, P.C.
ADD: 567 VAUXHALL STREET EXTENSION - SUITE 311 WATERFORD, CT 06385

OWNER: FIRSTLIGHT CT HOUSATONIC LLC
ADDRESS: 111 SOUTH BEDFORD ST BURLINGTON, MA 01830

SHEPAUG SOLAR

SITE ADDRESS:
2225 RIVER ROAD
SOUTHBURY, CT 06488

APT FILING NUMBER: CT653140

DRAWN BY: UKA

DATE: 09/10/24

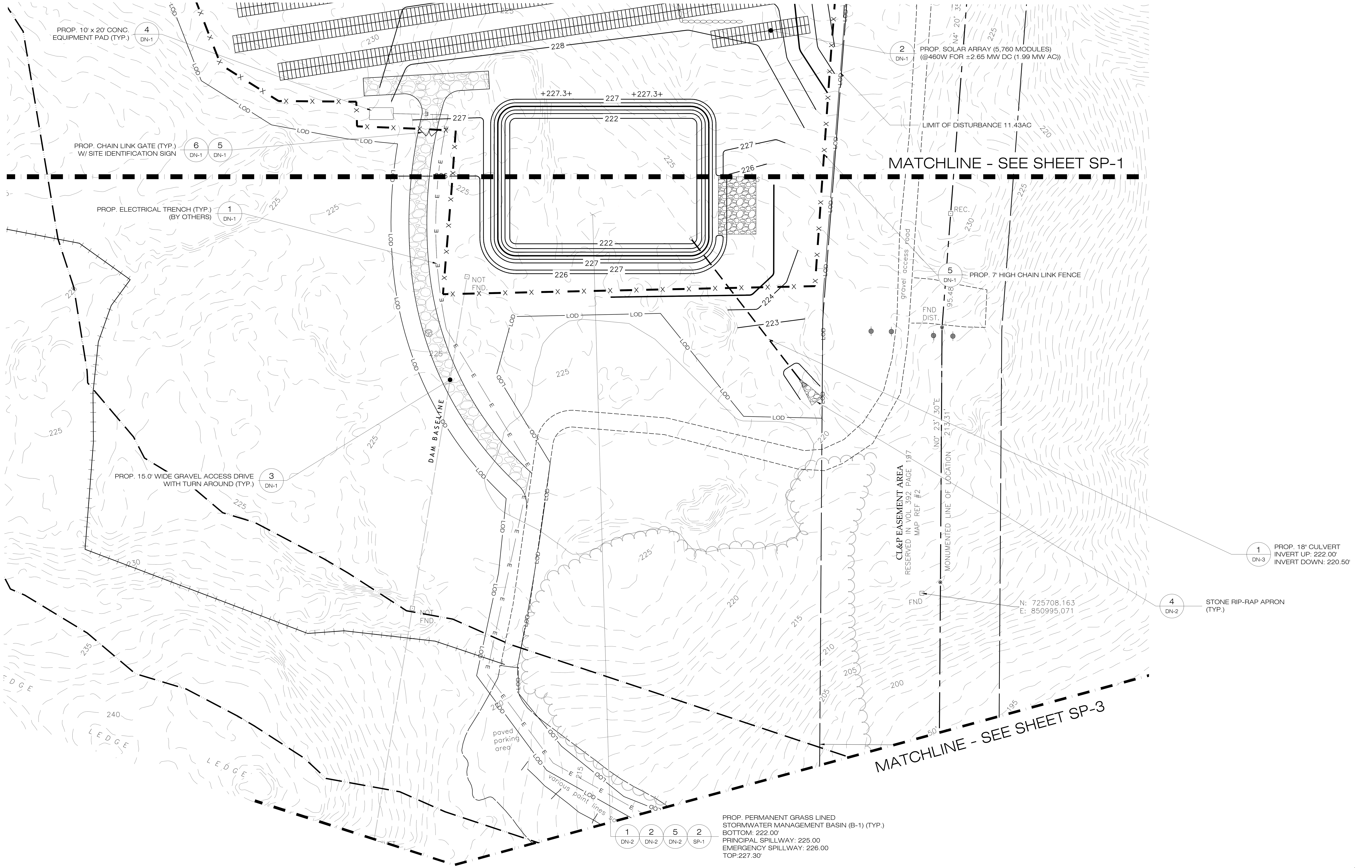
CHECKED BY: TEL

SHEET TITLE:

SITE GRADING & UTILITY PLAN

SHEET NUMBER:

SP-1



NOTES:
1. GRADE/SHAPE AREA TO MAINTAIN EXIST. DRAINAGE PATTERNS.
2. CONTRACTOR SHALL REMOVE ALL BAFFLES AND CONVERT SEDIMENT BASINS TO INFILTRATION BASINS.
3. CONTRACTOR SHALL REPLACE TEMPORARY SEDIMENT BASIN OUTLET WITH GRAVEL OVERFLOW WEIR UPON THE SITE OR DRAINAGE AREA BEING DEEMED STABILIZED PER THE SWPCP.
4. CONTRACTOR SHALL MODIFY/REPLACE THE TEMPORARY SEDIMENT BASIN RISER AS NEEDED UPON THE SITE OR DRAINAGE AREA BEING DEEMED STABILIZED PER THE SWPCP.
5. CONTRACTOR SHALL INSTALL INFILTRATION SWALE ALONG ACCESS ROAD.

Davis Hill Development
A Skyview Ventures Company
114 N. PEARL ST. #2C
PORT CHESTER, NY 10573

FirstLight
11 S. BEDFORD ST.
BURLINGTON, MA 01803

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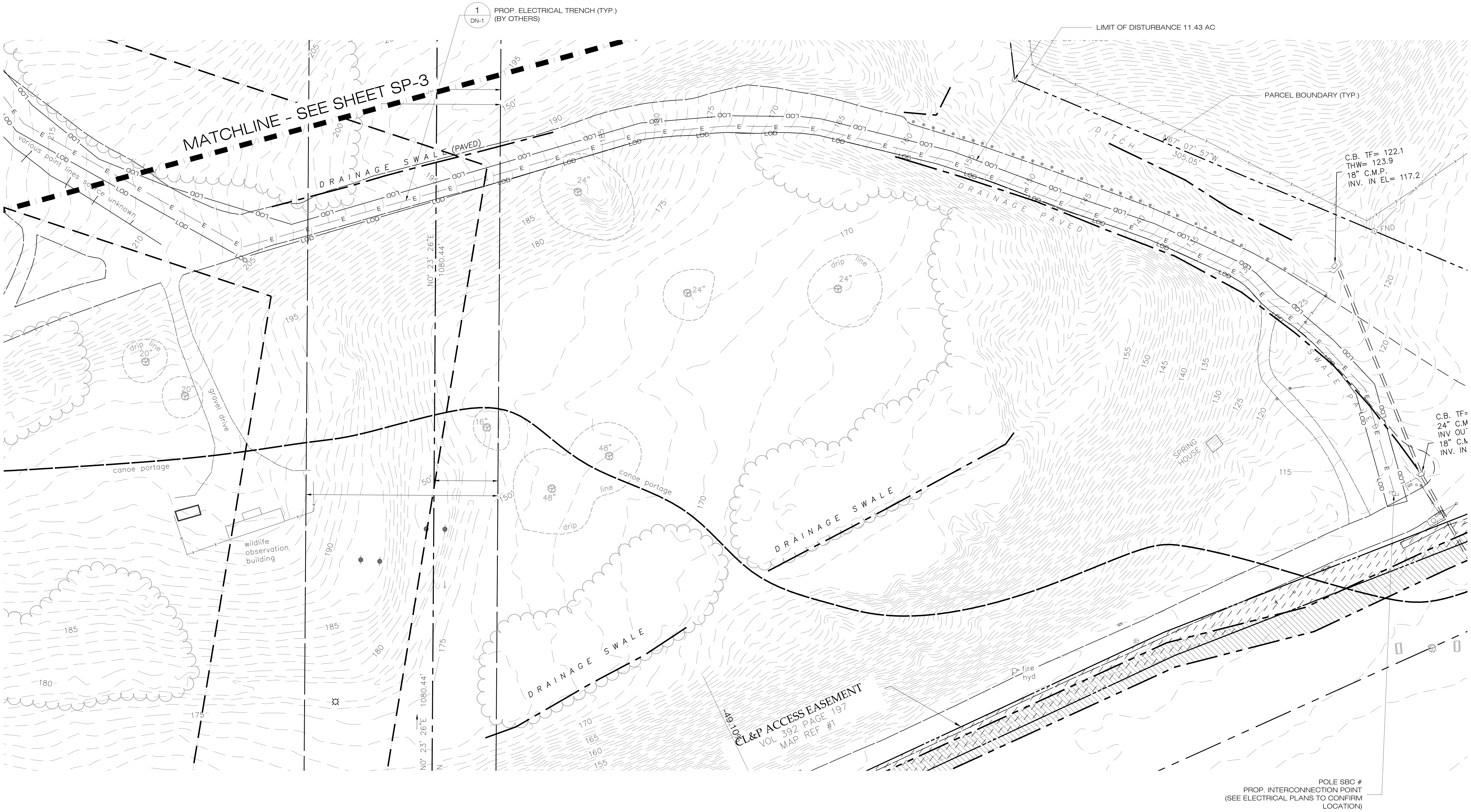
SHEET TITLE:
SITE GRADING & UTILITY PLAN

SHEET NUMBER:
SP-2



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5. CONTRACTOR SHALL INSTALL INFILTRATION SWALE ALONG ACCESS ROAD.

(IN FEET) 1 inch = 40 ft.

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PORT CHESTER, NY 10573

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BURLINGTON, MA 01803

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567 VAUXHALL STREET EXTENSION - SUITE 311
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ADDRESS: 111 SOUTH BEDFORD ST BURLINGTON, MA 01830

SHEPAUG SOLAR

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2225 RIVER ROAD
SOUTHBURY, CT 06488

APT FILING NUMBER: CT653140

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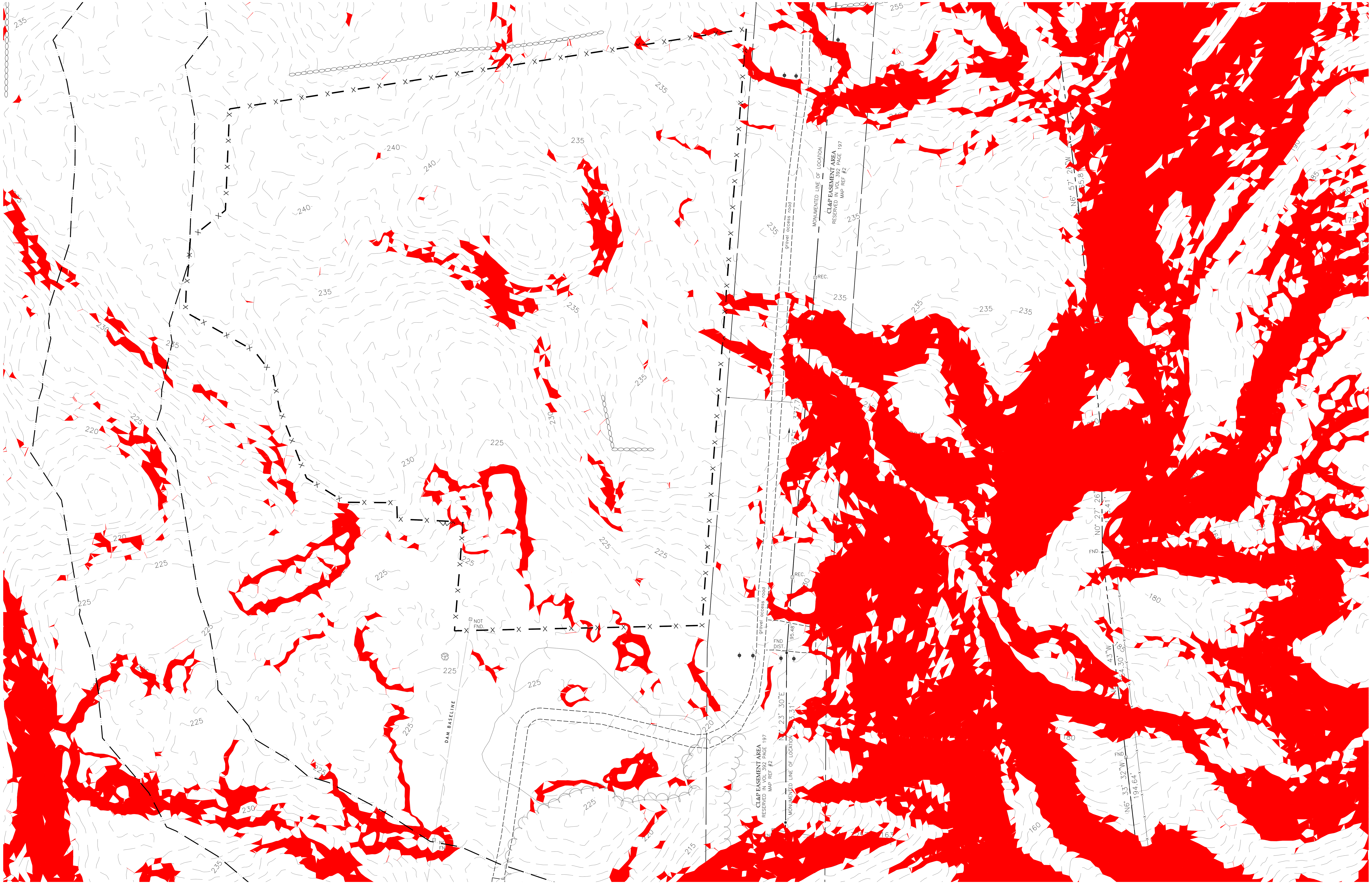
SHEET TITLE:
SITE PLAN

SHEET NUMBER:
SP-3



Slopes (Within Fenceline)			
Minimum Slope	Maximum Slope	Area (S.F.)	Color
15.00%	Vertical	15,940.97	

50 0 25 50 100
(IN FEET) 1 inch = 50 ft.

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PORT CHESTER, NY 10573

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BURLINGTON, MA 01803

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APT FILING NUMBER: CT653140

DRAWN BY: UKA

DATE: 09/10/24 CHECKED BY: TEL

SHEET TITLE:

SLOPE ANALYSIS

SHEET NUMBER:

SA-1

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Burlington, MA 01803
P: 781-653-4240

Attachment 3. Array Planting Species List

Shepaug Solar Project Potential Pollinator-Friendly Species List

Source: University of Massachusetts Amherst Recommended Plant Species List for Solar Arrays (2022)

Species Name	Common Name	Flower Color	Height	Bloom Period	Sun/Shade	Soil	Bee Species Names	Butterfly and Moth Species Names
Wildflowers								
Anemone virginiana	thimbleweed	white	12-24"	Apr-May	full sun to partial shade	mesic to dry		
Campanula rotundifolia	bluebell	blue	12-18"	June-Sept	full sun to partial shade	mesic		
Erythronium americanum	American trout lily	yellow	3-6"	April	partial shade to full shade	mesic	*Andrena erythronii*	
Eupatorium hyssopifolium	hyssop-leaved thoroughwort	white	12-36"	Aug-Nov	full sun to partial shade	mesic to dry		*Vanessa virginiensis*
Eurybia divaricata	white wood aster	white with yellow, red	12-30"	Aug-Sept	partial shade to full shade	mesic to dry		*Vanessa virginiensis*
Fragaria virginiana	wild strawberry	white	3-9"	Apr-May	full sun to partial shade	mesic		*Strymon melinus*
Penstemon digitalis	smooth penstemon	white	24"	Apr-June	full sun to partial shade	mesic to dry		
Pycnanthemum tenuifolium	narrowleaf mountain mint	white	24-36"	July-Sept	full sun to partial shade	mesic to dry		*Sphinx eremitus*
Pycnanthemum virginianum	Virginia mountain mint	white	12-36"	July-Aug	full sun to partial shade	mesic		*Sphinx eremitus*
Solidago rugosa	wrinkle-leaved goldenrod	yellow	to 36"	Sept-Oct	full sun to partial shade	mesic	*Andrena asteris, Andrena braccata, Andrena canadensis, Andrena hirticincta, Andrena nubecula, Andrena placata, Andrena simplex, Perdita octomaculata, Pseudopanurgas nebrascensis, Colletes simulans, Colletes solidaginis*	*Vanessa virginiensis*
Tradescantia ohiensis	Ohio spiderwort	purple	24-36"	July-Sept	full sun to partial shade	mesic to dry		
Grasses								
Andropogon virginicus	broomsedge bluestem		3'		full sun to partial shade	mesic to dry	*Hesperia metea*	
Eragrostis spectabilis	purple lovegrass		2'		full sun	mesic to dry	*Poanes zabulon*	
Schizachyrium scoparium	little bluestem		3'		full sun	mesic to dry	*Atrytonopsis hianna, Hesperia leonardus(?), Hesperia metea, Hesperia sassacus*	
Tridens flavus	purpletop tridens		2.5'		full sun to partial shade	mesic to dry	*Cercyonis pegala, Polites origenes, Pompeius verna*	
Shrubs								
Arctostaphylos uva-ursi	kinnikinnick, bearberry	purple-blue	2-12"	Apr-June	full sun to partial shade	mesic		*Callophrys polios*
Diervilla lonicera	bush honeysuckle	yellow	6-36"	June-July	full sun to full shade	moist to dry		
Epigaea repens	trailing arbutus	white to pink	1-3"	May-July	full sun to partial shade	moist		
Gaultheria procumbens	eastern teaberry	pink	4-8"	May-July	full sun to partial shade			
Vaccinium angustifolium	lowbush blueberry	white to pink	6"-2'	May	full sun to full shade	moist	*Andrena bradleyi, Andrena carolina, Habropoda laboriosa, Osmia virga, Melitta americana*	*Acharia stimulea, Callophrys augustus, Datana major, Paonias astylus, Satyrium liparops*

100 District Avenue, Suite 102
Burlington, MA 01803
P: 781-653-4240

Attachment 4. Project Site Soil Classification

CT DEEP Prime Farmland Soils

CT Soil Classifications

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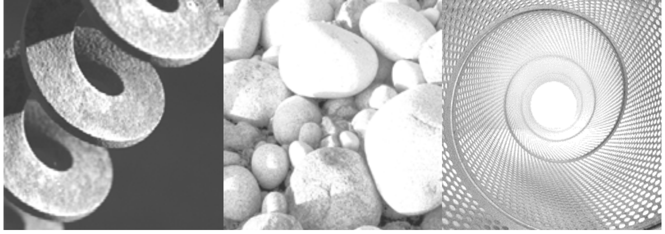
Burlington, MA 01803
P: 781-653-4240

Attachment 5. Geotechnical Report



GEI Consultants

Consulting
Engineers and
Scientists

Geotechnical Report

Shepaug Dam – Northern Solar Array

Southbury, Connecticut

Submitted to:
Davis Hill Development, A Skyview Ventures Company
105 Prospect Street
Greenwich, CT 06830

Submitted by:
GEI Consultants, Inc.
400 Unicorn Park Drive
Woburn, MA 01801
781-721-4000

April 2024
Project 2305289

Matthew Farren, P.E. (CT)
Project Manager

Andrew R. Sanna, P.E. (MA)
Sr. Geotechnical Engineer

Table of Contents

Executive Summary iii

1. Introduction 1
- 1.1 Scope of Services 1
- 1.2 Authorization 2
- 1.3 GEI Team 2
- 1.4 Elevation Datum and Horizontal Coordinate System 2
- 1.5 Project Description 2
- 1.6 Site Description 3

2. Subsurface Explorations and Conditions 4
- 2.1 Subsurface Explorations 4
  - 2.1.1 Test Pits 4
  - 2.1.2 Test Borings 4
- 2.2 Geologic Setting 5
- 2.3 Subsurface Conditions 6
- 2.4 Groundwater Conditions 7
- 2.5 Laboratory Testing 7
- 2.5.1 Index Testing 7
- 2.5.2 Corrosivity Indicators Testing 7
- 2.6 Field Testing 8
- 2.6.1 Electrical Resistivity Survey 8
- 2.6.2 Guelph Permeameter Testing 8
- 2.7 Sample Storage and Disposition 8

3. Geotechnical Recommendations 9
- 3.1 Design Load Recommendations 9
- 3.2 Foundation Recommendations 9
- 3.3 Allowable Soil Bearing Capacity 10
- 3.4 Pile-supported PV Array Recommendations 10
- 3.5 Ballast-Supported PV Array Recommendations 11
- 3.6 Frost Susceptibility 12
- 3.7 Adfreeze/Freezing Conditions 12
- 3.8 Soil Corrosivity 13
- 3.9 USDA Soil Texture and Infiltration Rate 14

4. Construction Considerations 15
- 4.1 Shallow Foundations 15
- 4.2 Access Road Cross Section 15
- 4.3 Freezing Conditions 15
- 4.4 Cuts and Fills 16

4.5 Dam Safety Precautions 17

5. Limitations 18

6. References 19

Recommended Material Specifications

- Structural Fill
- Ordinary Fill
- Geotextile

Tables

1. Estimated Saturated Hydraulic Conductivity
2. Exploration Data
3. Recommended Soil Properties
4. Corrosivity Laboratory Testing Results
5. Electrical Resistivity Results
6. USDA Soil Texture and Infiltration Rate

Figures

1. Site Location Map
2. Exploration Location Plan
3. USDA Soil Texture Triangle

Appendices

A. Exploration Logs
B. Laboratory Testing Results
C. Field Testing – Infiltration Testing
D. Calculations
E. NAVFAC DM 7.2 Pile Calculations

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Executive Summary

GEI Consultants, Inc. (GEI) prepared this report to present the results of a subsurface exploration program, and geotechnical design and construction recommendations for the proposed ground-mounted photovoltaic (PV) array north of Shepaug Dam in Southbury, Connecticut. Shepaug Dam is owned and operated by FirstLight Power Services, LLC. Davis Hill Development (DHD), a Skyview Ventures company, engaged GEI to provide geotechnical services for this project.

The geotechnical exploration program consisted of 4 borings at the proposed location of the solar array and 9 test pits at the proposed stormwater management basin. Borings B-1, B-2, and B-3 were performed within the footprint of the proposed solar array. Boring B-4 was drilled near the center of the proposed equipment pad.

We performed electrical resistivity soundings along two orthogonal transverses at the site on March 4, 2024. The soil resistivity measurements generally ranged from 139,228.9 to 279,606.8 Ohm-cm.

GEI performed 9 field infiltration tests (one in each test pit within the proposed stormwater management basin), using a Guelph permeameter. The estimated saturated hydraulic conductivity from the tests within the proposed stormwater management basin ranged from 0.45 in/hr to 54 in/hr.

The subsurface profile generally consisted of a thin layer of topsoil over loose to medium dense silty sand or silt and sand, over medium dense sand and gravel (encountered in only some explorations), over very dense till (encountered in most explorations). The bedrock was found to be slightly weathered gneiss. Shallow bedrock is assumed to exist throughout the site with refusal in the explorations ranging from 5 feet to 20 feet below ground surface. Groundwater was not encountered in any of the explorations.

We recommend that the solar array be supported on piles (driven or drilled), ballast systems, or shallow foundations. The shallow bedrock might prohibit the use of piles in some areas.

The piles should be designed by a Connecticut professional engineer. The piles should bear in the dense natural soils or bedrock. The very dense till along with possible cobbles and possible shallow bedrock may be encountered during installation of the piles. These conditions may result in difficulty reaching the required depth and maintaining proper pile location and alignment, for some piles and pile types. Predrilling may be required. We recommend discussing pile options with pile suppliers/designers who will have a better understanding of the capabilities and limitation of their specific foundation products.

If shallow foundations or ballast systems are chosen as the foundation for the solar arrays, we recommended the following values to use for bearing capacities:

Bearing Stratum	Maximum Allowable Bearing Pressure
Sand and Silt	1 tons/ft^2
Sand and Gravel	2 tons/ft^2
Glacial Till	2 tons/ft^2

The on-site soils may be susceptible to frost action and a foundation design should consider adfreeze and soil freezing. We recommend using a minimum design frost depth of 42 inches below final grade.

The site is classified as Site Class C for seismic design purposes. Based on the soil type, density indicated by SPT N-values, and groundwater elevation, we do not anticipate encountering any liquefiable soils.

1. Introduction

GEI Consultants, Inc. (GEI) prepared this report to present the results of a subsurface exploration program, and foundation and construction recommendations for the proposed ground-mounted photovoltaic (PV) array located to the north of Shepaug Dam in Southbury, Connecticut, which is owned and operated by FirstLight Power Services, LLC. Davis Hill Development (DHD), A Skyview Ventures Company engaged GEI to provide geotechnical engineering services for this project.

1.1 Scope of Services

GEI completed the following scope of services for this report. These services were performed to investigate the subsurface conditions at the Site:

- Marked out the proposed test pits and borings in preparation for calling DigSafe.
- Performed a subsurface exploration program consisting of nine test pits and four borings that was performed from March 25 to March 27, 2024.
- Performed nine Guelph permeameter tests within test pits at the proposed stormwater management basin at depths ranging between 2 and 7 feet below grade.
- Performed three grain size distribution tests (one test included hydrometer analyses) on samples collected from borings from the exploration program.
- Graphed the grain size distribution test results on the United States Department of Agriculture (USDA) Soil Texture Triangle, and estimate the infiltration rates based on published references.
- Performed soil resistivity, pH, sulfates, and chlorides testing on two composite soil samples collected from test pits TP-2 and TP-9.
- Provided soil corrosivity analysis.
- Performed an electrical resistivity sounding along two orthogonal traverses at the site using the Wenner 4-point method.
- Developed soil parameters that can be used in the design of a pile-supported or shallow foundations-supported PV array.
- Developed frost parameters that can be used in the design of a pile-supported or shallow foundations-supported PV array.
- Prepared this report presenting the results of the subsurface explorations and our recommendations.

We performed these services in general accordance with the 2022 Edition of the Connecticut Building Code which is comprised of the International Building Code 2021 (IBC) and a separate package with Connecticut amendments (Building Code).

1.2 Authorization

Our work was performed in general accordance with our proposal to DHD, A Skyview Ventures Company dated August 29, 2023, and our Standard Professional Services Agreement with Davis Hill Development, A Skyview Ventures Company signed on November 1, 2023.

1.3 GEI Team

The following GEI personnel performed the services for this report:

- Matthew Farren, P.E. (MA, CT) Project Manager / Geotechnical Engineer
- Andrew Sanna, P.E. (MA) In-House Reviewer
- Malinda Chea Geotechnical Project Professional
- Tom Rezzani Geotechnical Project Professional

1.4 Elevation Datum and Horizontal Coordinate System

Elevations stated in this report are in feet and refer to the North American Vertical Datum of 1988. To convert from NAVD88 to National Geodetic Vertical Datum (NGVD) 29, add 0.9 ft (i.e., El. 100.0 ft NAVD88 = El. 100.9 ft NGVD29).

The nearby Shepaug Dam uses the Connecticut Light & Power (CL&P) Datum as the elevation datum in their drawings and surveys. To convert from CL&P to National Geodetic Vertical Datum (NGVD) 29, subtract 1.7 ft (i.e., El. 207.0 ft CL&P = El. 205.3 ft NGVD).

Horizontal coordinates (northing and easting) are U.S. State Plane coordinates in U.S. survey feet and are referenced to the North American Datum of 1983 (NAD83), Connecticut Zone (0600).

1.5 Project Description

We understand DHD is proposing to install a 1.9 MW_{AC} ground-mounted PV array in a wooded area located north of Shepaug Dam (Figs. 1 and 2) in Southbury, Connecticut. The proposed northern solar array will be built on about 6.2 acres on land that begins about 850 feet to the north of the left abutment of Shepaug dam.

The proposed northern array is separate from the proposed array located within the security fence just downstream of the left non-overflow section of the dam. GEI submitted a geotechnical report titled "Shepaug Dam – Solar Array" which was dated July 2023 for the proposed array downstream of the left non-overflow section. To distinguish between the two solar arrays, we will refer to the subject of this report as the northern array.

We understand there will be one stormwater basin and one proposed equipment pad, both of which will be located to the south of the proposed northern array. The proposed equipment pad will be about 20 feet by 10 feet (Fig. 2).

Our understanding of the project is based on the drawing titled, "Concept Plan" prepared by All Points Technology Corporation P.C. and last dated December 7, 2023. The drawing indicates that the proposed northern solar array will be approximately 1.9 MW_{AC} and consist of 5,760 modules and will be built in the forested area north of the existing dam. There is a proposed gravel access road that will lead to the array from the south from the existing laydown area.

1.6 Site Description

Shepaug Dam is a hydroelectric concrete gravity dam (hydraulic height of 138 feet) located at the border of Newtown and Southbury, Connecticut that is owned by FirstLight Power and regulated by the Federal Energy Regulatory Commission (FERC).

The proposed northern array, proposed stormwater basin, and proposed equipment pad will be located north of the Shepaug Dam in an undeveloped wooded area, owned by FirstLight Power LLC, with several scattered logging roads. An existing laydown area is located to the south of the undeveloped wooded area. Overhead electrical lines with a gravel access road beneath the lines are located to the east of the proposed northern solar array.

The ground surface of the undeveloped wooded area gradually slopes upward to the north. The ground surface elevation of the proposed northern array ranges from approximately El. 225 to El. 240. The ground surface at the proposed stormwater basin is relatively level with ground surface elevation ranging between El. 223 to El. 227.

2. Subsurface Explorations and Conditions

2.1 Subsurface Explorations

GEI visited the site on February 19, 2024, to stake out the perimeter of the proposed explorations (test pits and borings) in preparation for calling the 811 CBYD (Call Before You Dig) utility mark out service.

On March 25, 2024, GEI field representative staked out the location of the explorations in the field using a handheld mobile device. A GEI field representative was on site from March 25 to March 27, 2024, to coordinate, log explorations, and obtain soil samples. Soil was visually classified in the field using GEI's visual-manual soil description guide, which is based on the Unified Soil Classification System (USCS) ASTM D2487. The test pit and boring logs along with GEI's visual-manual soil description guide are included in Appendix A.

Approximate exploration locations are shown in Fig. 2. A summary of the exploration data is provided in Table 2.

2.1.1 Test Pits

We engaged New England Boring Contractors (NEBC) of Glastonbury, Connecticut to excavate nine test pits, TP-1 through TP-9, from March 25 to March 26, 2024. The test pits were excavated using a JCB 85 Z-1 eco mini excavator within the proposed stormwater management basin as shown in Fig. 2.

The excavations were performed to evaluate the soil conditions for the proposed stormwater management basin. Guelph permeameter tests were performed in each test pit by a GEI field representative at depths ranging from 2 to 7 feet below grade to measure the soil's in-situ saturated hydraulic conductivity (as discussed further in Section 2.6.2). The test pits were excavated to depths ranging from 5 to 10 feet below ground surface. Soil samples were collected from the sidewalls or from the stockpile of excavated material at various depth intervals based on the observed soil strata.

Upon completion, the test pits were backfilled in lifts with the excavated soil and the lifts were tamped with the excavator bucket.

2.1.2 Test Borings

We engaged NEBC to drill four borings at the site on March 27, 2024. Borings were drilled with a Mobile Drill B53 track-mounted drilling rig using hollow-stem augers and/or mud rotary drilling at the proposed northern array and equipment pad location as shown in Fig. 2.

Boring B-1 was drilled near the southwestern corner of the proposed northern solar array and encountered auger refusal at 16 feet. The boring was offset 5 feet east and encountered split spoon sampler refusal at 20.3 feet.

Boring B-2 was drilled near the southeastern corner of the proposed northern solar array and encountered auger refusal at 5 feet. The boring was offset 5 feet west and again encountered auger refusal at 5 feet.

Boring B-3 was drilled near the center of the proposed northern solar array and encountered difficult drilling at 3 feet. The boring was offset 5 feet south and encountered auger refusal at 12.5 feet.

Boring B-4 was drilled near the center of the proposed equipment pad and encountered auger refusal at 8.5 feet. Drillers switched to drilling with 4-inch casing and drive and wash drilling techniques. A 5-foot rock core with an NX core barrel was obtained in boring B-4 from 10 to 15 feet.

We performed Standard Penetration Tests (SPTs) and obtained split-spoon samples in general accordance with ASTM D1586 using an automatic hammer. Split-spoon samples were generally collected at about 5 feet intervals to the boring termination depth.

The drilling contractor used an automatic hammer to perform the SPTs and measure N-values in the field (termed N_i), which resulted in a variation of efficiency of delivering the theoretical energy of a 140-pound weight freefalling 30 inches. To use the data set in design the N_i values were normalized to 60 percent of the theoretical energy delivered in the SPT (termed N_{60}) by conservatively assuming the automatic hammer is 80 percent efficient. Both the N_i and corrected N_{60} values are provided in the site class calculation in Appendix D. N_{60} values are referenced throughout this report.

All borings were tremie grouted upon completion.

2.2 Geologic Setting

The Supporting Technical Information Document (STID) for the dam indicates that the bedrock in the area consists of granitic gneiss, gneiss and schist of the Hartland Formation of the Wappinger and Stockbridge Groups, and dolomitic marble of the Stockbridge Marble Unit of the Wappinger and Stockbridge Groups. The boring program in 1984/1985 (which was not available for review, but was mentioned in the STID) indicates that the dam was founded on gneiss and schist.

The STID for the dam lists the soils as unconsolidated deposits overlying the bedrock that consist principally of Pleistocene glacial deposits. Glaciofluvial sand and gravel, deposited in temporary glacial lakes and meltwater flows, are also found along the banks of the Housatonic River. More recent alluvial deposits may overlay the sand and gravel in local areas.

2.3 Subsurface Conditions

The soil layers encountered in the test pits and borings are described below, beginning at the ground surface. The soil conditions are known only at the test pits and boring locations. Conditions at other locations may vary significantly from the description given below.

Topsoil – Topsoil was encountered at ground surface in each test pit and boring. The thickness of the topsoil ranged between 4-inches to 2 feet.

Silty Sand – A layer of silty sand was encountered below the topsoil in test pits TP-1 through TP-6, TP-8, and TP-9 within the proposed stormwater management basin footprint. The silty sand layer observed in the test pits was generally described as orangey brown, yellowish brown, or tan fine to medium sand with the estimated percentage of nonplastic fines ranging from 20 to 30 percent. The layer extended to depths ranging between 3 and 5 feet below grade. Roots were observed in the silty sand layer. No SPT tests were performed in this layer to estimate the density. The layer was not encountered in borings within the footprint of the proposed solar array.

Sand and Silt – A layer of sand and silt was encountered below the topsoil in test pit TP-7 and in borings B-1 and B-2, and below the silty sand layer in test pits TP-2 and TP-4. The sand and silt layer observed was generally between 2.5 and 9 feet thick. Test pits TP-2 terminated in this layer. The layer was generally described as narrowly graded sand with silt or widely graded sand with silt with varying amounts of gravel. The percentage of nonplastic fines ranged from about 7 percent to approximately 11.2 percent. The N_{60} values ranged between 4 and 27 blows per foot, indicating a loose to medium dense soil.

Sand and Gravel – A layer of sand and gravel was encountered below the topsoil in borings B-3 and B-4, below the silty sand in test pit TP-3, and below the sand and silt in test pit TP-7. The layer consisted of widely graded sand with gravel or narrowly graded sand with gravel and typically had less than 5 percent nonplastic fines. The estimated percentage of gravel encountered ranged from about 15 percent to about 30 percent. The N_{60} values ranged from 13 to 23 blows per foot indicating a medium dense soil. The layer was found to be between 4 and 5 feet thick in the explorations.

Cobbles up to 8 inches in diameter were observed in test pits TP-3 and TP-7 in the sand and gravel layer.

Till – A layer of till was encountered below the silty sand layer in test pits TP-1, TP-5, TP-6, TP-8, and TP-9, below the sand and silt layer in boring B-1, and below the sand and gravel layer in borings B-3 and B-4. The layer was generally described as silty sand or silty sand with gravel with about 15 to 30.4 percent nonplastic fines. Test pits TP-1, TP-5, TP6, TP-8, and TP-9 terminated in the till layer. The N_{60} value in this layer ranged between 55 and over 100 blows per foot indicating a very dense soil.

Cobbles up to 8 inches in diameter were encountered in the till in test pit TP-1.

Bedrock – Refusal on possible bedrock was encountered in test pits TP-3, TP-4, and TP-7 and borings B-1 through B-4. Depth of refusal was encountered between 5 and 20.3 feet below ground surface (El. 209 to El. 227). Shallow bedrock appears to be present throughout the site without a clear trend on bedrock depth or elevation. Weathered rock fragments were excavated in test pit TP-3 from 6.5 to 7 feet. Bedrock was cored in boring B-4 with a NX core barrel from 10 to 15 feet. The bedrock was classified as a dark gray, fine to medium grained, slightly weathered, and moderately fractured, Gneiss. The rock quality designation (RQD) was 20 percent.

Recommended values of soil properties and design parameters are presented in Table 3. The properties were estimated using data from the N_{60}-values, laboratory testing results, published empirical correlations, and our engineering judgement.

2.4 Groundwater Conditions

Groundwater was not encountered in any of the borings and test pits. The nearby Lake Lillinoah (upstream reservoir of Shepaug Dam) has a normal pool of about El. 100.4 NAVD88, which is over 100 feet below the proposed site location.

Groundwater levels are subject to seasonal and weather-related variations. Groundwater measurements made at different times and different locations may be significantly different than the measurements taken as part of this investigation.

2.5 Laboratory Testing

2.5.1 Index Testing

We performed three grain size distribution analyses (including hydrometer analysis on one sample) in general accordance with ASTM D6913/D7928 at GEI's laboratory in Woburn, Massachusetts. Grain size distribution analyses tests were performed on soil samples collected from borings B-1 (S2), B-2 (S1 Bottom 13"), and B-3 (S3) to confirm field classifications and to estimate engineering properties.

Results of the laboratory tests are attached as Appendix B and have been incorporated into the soil descriptions on the borings logs, B-1, B-2, and B-3, in Appendix A.

2.5.2 Corrosivity Indicators Testing

GeoTesting Express of Acton, Massachusetts, under subcontract to GEI, performed laboratory testing on one composite soil sample collected from test pit TP-2 from 3.5 to 6 feet, and one composite soil sample collected from test pit TP-9 from 1.3 to 5 feet. The soil samples were tested for pH (ASTM G51), sulfates (ASTM D516), chlorides (ASTM D512), and electrical resistivity (ASTM G57). Test results are presented in Table 4 and discussed in Section 3.8. GeoTesting Express laboratory test results are included in Appendix B.

2.6 Field Testing

2.6.1 Electrical Resistivity Survey

We performed an electrical resistivity sounding along two orthogonal transverses at the site on March 4, 2024 as shown on Fig. 2. The electrical resistivity was performed near the existing lay down area. Measurements were taken using an L & R Industries MiniRes Instrument.

The resistivity soundings were collected using the Wenner 4-point method. Array a-spacings of 2.5, 5, 10, 20, and 50 feet generally in the northeast to southwest orientation and a-spacings of 2.5, 5, 20, 20, and 50 feet generally in the southwest to northeast orientation is used.

The soil resistivity measurements generally ranged from 139,228.9 to 279,606.8 Ohm-cm. The measured resistance and calculated apparent resistivity for each a-spacing interval are presented in Table 5.

2.6.2 Guelph Permeameter Testing

GEI performed nine field infiltration tests (one in each test pit within the proposed stormwater management basin), using a Guelph permeameter. GEI performed the testing at depths provided by All-Points Technology. After the infiltration testing was completed, the test pits were advanced past the test depth to the depths listed in Table 2.

The Guelph permeameter testing was performed in general accordance with ASTM D5126 to estimate the infiltration rate of soils above the groundwater table. It should be noted that the Guelph permeameter testing has been performed in unsaturated soils and it provides an estimation of saturated permeability in these soils. The field infiltration test calculations are provided in Appendix C. Table 1 summarizes the saturated hydraulic conductivity results.

2.7 Sample Storage and Disposition

All soil samples collected during our explorations are being stored at our office in Woburn, Massachusetts. The soil samples will be held for 6 months after the issuance of this report. We will discard the samples after the 6 months has elapsed unless other arrangements are made by DHD.

3. Geotechnical Recommendations

3.1 Design Load Recommendations

We recommend that wind, snow, and seismic loading from the Building Code be considered when developing design loads for the foundations.

We recommend that the foundation be designed to resist the forces caused by the specific exposure categories for wind and snow at the site in the Municipality of Southbury

The design wind load should be determined in accordance with Chapter 26 to 30 of ASCE 7. Basic wind speed is provided in the Connecticut amendments to Chapter 16 of the IBC. For the Municipality of Southbury, the allowable stress design wind speed is 85 mph (basic design wind speed of 110 mph for Risk Category I).

The design snow load should be estimated in accordance with Chapter 7 of ASCE 7 with the exception of ground snow load, which is provided in the Connecticut amendments to Chapter 16 of the IBC. For the Municipality of Southbury, the ground snow load (Pg) is 35 lb/ft^2.

We recommend using Site Class C for seismic design, in accordance with Chapter 20 of ASCE 7 based on N-values from the SPT testing performed in the borings on site as shown in the calculation in Appendix D.

Corresponding design values, for Site Class C, for Southbury, Connecticut according to the 2021 IBC [International Building Code] with Connecticut Amendments are:

$S_S = 0.199$
$S_1 = 0.054$
$S_{DS} = 0.172$
$S_{D1} = 0.054$

Based on the soil type, density, and saturation levels indicated by the blow count data from the subsurface exploration, we do not anticipate encountering any liquefiable soils.

3.2 Foundation Recommendations

We recommend that the solar arrays be supported on piles (driven or drilled) if depth to bedrock allows. We also provided recommendations if the solar arrays are supported on ballast systems or shallow foundations.

Recommended geotechnical properties for foundation design are provided in Table 3. Recommended values for computing lateral earth pressure against below-grade structures, such as utility structures or retaining walls, are also provided in Table 3.

3.3 Allowable Soil Bearing Capacity

The maximum allowable bearing pressure that should be used for the design are given below (based on 2022 Connecticut State Building Code Table 1806.2 and engineering judgement):

Bearing Stratum	Maximum Allowable Bearing Pressure
Sand and Silt	1 tons/ft^2
Sand and Gravel	2 tons/ft^2
Glacial Till	2 tons/ft^2

The bearing capacities can be used for the design of the equipment pad or the design of the solar panel foundations (if a ballast system or shallow foundations are selected).

The natural soils may be susceptible to frost heave, see section 3.6 below. We recommend that the proposed equipment pad or other slabs or footings bear on Structural Fill that extend below the frost depth or natural soil below the frost depth. If some seasonal movement of the proposed equipment pad is acceptable, we recommend all organics, and the top foot of the existing frost susceptible material below the slab should be removed and replaced with compacted Structural Fill. At least 18 inches of Structural Fill should be placed below the slab in all areas.

For subgrade preparation loose, disturbed, soft, fill, or organic soil should be removed from the bottom of the excavation, and the subgrade should be compacted with a vibratory compactor weighing at least 200 pounds.

3.4 Pile-supported PV Array Recommendations

The piles should be designed by a Connecticut Professional Engineer. The piles should bear in the dense natural soils or bedrock. Drilled piles are possible at this site based on the soil conditions. Driven piles for solar arrays are typically small W-section-piles and should only be considered if the shallow bedrock areas can be mitigated. Drilled piles for solar arrays typically consist of ground screws and can include pilot holes to penetrate dense zones or rock. Recommended geotechnical parameters for pile design are provided in Table 3.

Very dense soils along with cobbles and boulders and possible shallow bedrock at the site could be encountered during installation of the piles. Borings B-1 through B-3 encountered auger refusal on possible bedrock at depths ranging between 5 and 20.3 feet below ground surface. Boring B-4, which was drilled at the proposed equipment pad, encountered rock at 8.5 feet. Therefore, shallow bedrock could exist in other areas besides the boring locations. Cobbles were encountered in the test pits. There was some rig chatter while drilling borings indicating possible cobbles.

These conditions may result in difficulty reaching the required depth and maintaining proper pile location and alignment, for some piles and pile types. Pre-drilling may be required. We recommend discussing pile options with pile suppliers/designers who will have a better understanding of the capabilities and limitation of their specific foundation products.

Potential pile-support systems include but are not limited to ground screw piles and driven piles. Ground screws are advertised as a cost-effective solution to rocky soil environments. We understand that pilot holes for the ground screws can be drilled through boulders or into bedrock. Driven piles should only be considered if the shallow bedrock areas can be mitigated.

Loading is unknown at the time, but there will be lateral load applied to the piles. When performing laterally loaded pile analyses, we recommend the soil properties as described in Table 3. Group effect p-multipliers should be used in the analyses if the spacing is less than 5B.

For axial loading, we recommend that piles be designed using an allowable skin friction and allowable end bearing based on the NAVFAC DM 7.02 analysis procedure provided in Appendix E. This methodology develops skin friction and end bearing based on the effective vertical stress, friction angle of the onsite soil, pile size, and the horizontal earth pressure coefficients (provided in Table 3).

Alternatively, the pile designer can opt to perform load tests to estimate the allowable loads.

The soil chemical and resistivity test results in Table 4 are provided so that the pile designer can perform a corrosivity analysis based on the materials of the pile. The onsite soils are generally non-corrosive as discussed in Section 3.8.

The pile designer should consider the forces caused by frost on the piles, compared to the pile tension capacity. Recommended adfreeze and frost depth consideration are discussed below in Section 3.6.

3.5 Ballast-Supported PV Array Recommendations

The ballast system should be designed by a Connecticut professional engineer. The ballast system typically uses concrete as a weight to maintain the solar arrays in place without any penetrations into the subsurface. Potential Ballast-Support systems include but are not limited to:

- Precast Concrete Ballast.
- Cast-in-Place Concrete Ballast.

If the PV array or a portion of the PV array is supported by a ballast ground-mount systems, the topsoil should be removed and the subgrade should be proof-rolled with a 5-ton vibratory roller before placing the ballast system.

Where fill is added, we recommend that Structural Fill be placed in 9-inch lifts and compacted to at least 95 percent of its maximum dry density determined in accordance with ASTM D1557 (Modified Proctor).

We recommend a maximum allowable soil bearing pressure as shown in the Allowable Soil Bearing Capacity table above (Section 3.3).

The details of the surface preparation for the ballast system depend on the system selected. Generally, the bearing surface for each ballast system element should be level.

The natural soils are susceptible to frost heave (as described in Section 3.6). Therefore, some movement of the ballast foundation should be expected because there are no foundations present that extend below the frost zone.

3.6 Frost Susceptibility

We recommend that a frost depth of 42 inches be used as provided in the Connecticut amendments to Chapter 16 of the IBC.

Soils at the site are variable consisting of sand, gravel, and silt. This variability is present within the frost zone soils. Three grain sizes tests performed from soil samples collected in the borings, one of which was from within the frost zone. The soils are classified as:

- B1 S2: Widely graded sand with silt having 7.0 percent passing the No 200 sieve.
- B2 S1 Bottom 13”: Narrowly graded sand with silt having 11.9 percent passing the No 200 sieve.
- B3 S3: Silty sand with gravel having 30.4 percent passing the No 200 sieve and about 1.5 percent smaller than 0.02 mm.

Typically, soils with more than 10 percent passing the No. 200 sieve are considered frost susceptible. Based on the criteria that soils with portions finer than 0.02 mm that make up more than 3 percent are frost susceptible, as presented in USACE (1983). B3 S3 has less than 3 percent portion finer than 0.02 mm, but with the variable soils present, it should be assumed some of the soil on site are susceptible to frost heave.

The topsoil is frost susceptible.

3.7 Adfreeze/Freezing Conditions

Soil in contact with foundations near the ground surface can freeze to the foundation and develop a substantial adfreeze bond. If the soil in contact with the foundation is frost susceptible, heave can transmit uplift forces to the foundation. Based on the borings, and laboratory tests as presented in Section 3.6, some of the soil above the frost line depth may be frost susceptible.

We recommend using the average value of adfreeze bond stress of 100 kPa (approximately 2,100 lb/ft^2) and 65 kPa (approximately 1,300 lb/ft^2) for fine grained soils frozen to steel and concrete, respectively, as reported in the Canadian Foundation Engineering Manual 4th Edition.

3.8 Soil Corrosivity

Electrical resistivity is a broad indicator of soil corrosivity because corrosion reactions are electrochemical in nature and proceed most rapidly when resistivity (i.e., resistance to the flow of ions and electrical current) is low. Specifically, resistivity is a measure of how strongly a given material opposes the flow of electrical current. The samples from TP-2 and TP-9 had electrical resistivity readings of 182,528 Ω-cm and 1,718,928 Ω-cm respectively, indicating a virtually non-corrosive environment (which agrees with the results of the field electrical resistivity testing).

Sulfates in soil and groundwater in concentrations greater than 1,000 mg/kg are generally considered to be corrosive to structural elements. The American Concrete Institute recommends that Type II cement be used if sulfate concentrations exceed 1,000 mg/kg. Sample test results from TP-2 and TP-9 indicate sulfate concentrations of <10 mg/kg in both cases.

Chloride concentrations above 500 mg/kg are generally considered to be corrosive to structural elements. Sample test results from TP-2 and TP-9 indicate chloride concentrations of <10 mg/kg in both cases.

We summarized our evaluation of the soil corrosivity to structural elements shown in the table below by comparing the laboratory test results to some available corrosivity references.

Test	Laboratory Results (TP-2 / TP-9)	Reference	Corrosivity to Structural Elements
pH	7.97 / 7.20	Caltrans - Corrosion Guidelines May 2021	Not corrosive
Electrical Resistivity	182,528 Ω-cm / 1,718,928 Ω-cm	EPRI - Environmental Factors Governing Corrosion Rates, Report 1021854 December 2011	Virtually non-corrosive
Chloride	<10 mg/kg	Caltrans - Corrosion Guidelines May 2021	Not corrosive
Sulfate	<10 mg/kg	Caltrans - Corrosion Guidelines May 2021	Not corrosive

We recommend that steel piles be galvanized, or a corrosion allowance of 1/16 inch should be considered in design for steel piles because of the low corrosion susceptibility.

3.9 USDA Soil Texture and Infiltration Rate

We evaluated USDA soil textures by plotting the grain size analysis results on the USDA Soil Texture Triangle (Fig. 3). The soil texture classes for two samples were "Sand," and for one sample was "Sandy Loam.".

We then obtained the minimum infiltration rates using Table 10-2 of the Connecticut Stormwater Quality Manual (2024). The default infiltration rate is based on the USDA soil textures. The default infiltration rate for "Sand" is 8.27 inches/hr, and for "Sandy Loam" is 1.02 inches/hr.

These grain size analyses were performed within borings performed at the northern array. The infiltration rates were similarly variable compared to the infiltration rates measured during the infiltration tests performed at the proposed stormwater management basin as described in Section 2.6.2 and in Table 1. As shown in Table 1, the estimated saturated hydraulic conductivity from the tests within the proposed stormwater management basin ranged from 0.45 in/hr to 54 in/hr.

4. Construction Considerations

4.1 Shallow Foundations

If any shallow foundations are required (equipment pad, solar arrays, or elsewhere), we recommend that the excavation to the final subgrade be performed in such a way that limits disturbing or loosening subgrade soils. The subgrade should be proof-rolled with a 5-ton vibratory roller; with the vibrator turned off in cohesive soils (if encountered).

Any soft zones, organic soils, or fill encountered should be overexcavated and replaced with Structural Fill. Structural Fill should be placed over the subgrade to bring the soil up to the appropriate elevation.

4.2 Access Road Cross Section

We understand that the access road at the site will be a gravel surface road.

We recommend that the gravel road section consist of 12 inches of Processed Aggregate Base (CTDOT M.05.01). The gravel should be placed and compacted in accordance with CTDOT Standard Specifications for Roads, Bridges, Facilities, and Incidental Construction. We recommend the gravel layer be compacted with at least four coverages of a vibratory roller imparting an impact load of at least 10 tons. Water should be added to materials during compaction.

Before placing the gravel, the subgrade should be compacted with at least four coverages using a vibratory roller imparting an impact load of at least 10 tons. Soft areas should be excavated and replaced with Ordinary Fill meeting the gradation and compaction criteria contained in the Recommended Materials Specifications Section.

We recommend that the road surface be graded with a minimum cross slope of ½ inch per foot of road width to allow water to drain. Drainage ditches should be provided along the edges of the road to direct surface water and runoff away from the road and subbase.

Periodic maintenance of ruts and fine surface grading should be expected for the access road section.

4.3 Freezing Conditions

The soils at the site may be frost susceptible. Therefore, if construction is performed during freezing weather, special precautions will be required to prevent the subgrade soils from freezing. Freezing of the soil beneath the foundation during construction may result in subsequent settlement of the structure.

All subgrades should be free of frost before placement of concrete. Frost-susceptible soils that have frozen should be removed and replaced with compacted Structural Fill. The footing and the soil adjacent to the footing should be insulated and heated as necessary until they are backfilled.

Soil placed as fill should be free of frost, as should the ground on which it is placed.

If footings are built and left exposed during the winter, precautions should be taken to prevent freezing of the underlying soil.

4.4 Cuts and Fills

Based on our understanding of the project, the solar array will generally follow the contour of the ground surface on the northern side of the solar array and will require some cut and fill on the southern side of the solar array. We recommend that final cut and fill slopes be no steeper than 3H:1V to allow for the planting and maintenance of grass cover.

We recommend removing sod, organics, roots, and any surface boulders from the site before placing fill. Where filling is required to achieve the desired grades, reused cut soils should be free of organic matter, surface coatings, frozen material, boulders, debris, and other deleterious materials. If filling is required below equipment pads or other on-site structures supported on shallow foundations (including solar arrays), Structural Fill should only be used. Ordinary fill or approved onsite fill may be used outside of the footprint of the foundations.

Onsite fill and Ordinary Fill should be compacted in 12-inch-thick loose lifts with a vibratory roller or plate compactor to at least 92 percent of the maximum dry density determined in accordance with ASTM D1557 (Modified AASHTO Compaction). Structural Fill should be placed and compacted in 9-inch-thick loose lifts to at least 95 percent of the maximum dry density determined in accordance with ASTM D1557 (Modified AASHTO Compaction).

Based on the grain size testing and soil descriptions observed in the borings, it appears that the onsite soils (Sand and Gravel layers) can be reused as Ordinary Fill, but not Structural Fill. The topsoil and the deeper soils like silt/clay/fine sand and till (unlikely to be encountered) cannot be reused as fill onsite.

Soils containing high percentages of fines will be very sensitive to moisture content during placement and compaction. Proper moisture control is important to achieve adequate compaction. In addition, the on-site soils, either in-situ or if reused as fill, may be easily disturbed if they become wet or saturated. Protection of exposed soil will be required.

4.5 Dam Safety Precautions

The proposed solar array will be located about 850 feet north of the dam and will likely not impact the operation of the dam.

Project specifications should require the contractor to maintain stable site conditions at all times. Specific measures to stabilize equipment traffic areas could include compacted aggregate placed over a geotextile, temporary drainage, or other appropriate measures.

If a pile foundation system is used for the solar array foundations, the driving of the piles and compaction for the gravel road should be far enough away to not affect the dam or powerhouse. However, we recommend monitoring vibrations at the dam and powerhouse. If excessive vibrations or movement are encountered at either location or movement is detected, the construction should stop until methodologies are changed to reduce vibrations or movement.

Because of the short anticipated length of the piles, pre-augering of the soil for piles to reduce the potential for ground heave is unnecessary. However, predrilling may be required to get through cobbles and into bedrock if encountered.

The bedrock at the site is anticipated to be gneiss and schist. Piles may be driven to the top of bedrock or drilled into the top of bedrock.

Before construction, the area should be reviewed to ensure no conflicts with existing utilities or structures.

We recommend an engineer be onsite during foundation installation.

5. Limitations

This report was prepared for exclusive use of Skyview Ventures, LLC and the design team. Our recommendations are based on the project information provided to us at the time of this report and may require modification if there are any changes in the nature, design, or location of the proposed PV array. We cannot accept responsibility for designs based on our recommendations unless we are engaged to review the final plans and specifications to determine whether any changes in the project affect the validity of our recommendations, and whether our recommendations have been properly implemented in the design.

The recommendations in this report are based in part on the data obtained from the subsurface explorations. The nature and extent of variations between explorations may not become evident until construction. If variations from the anticipated conditions are encountered, it may be necessary to revise the recommendations in this report. We recommend that GEI be engaged to make site visits during construction to check that the subsurface conditions exposed during construction are in general conformance with our design assumptions and ascertain that the work is being performed in compliance with the contract documents.

Our professional services for this project have been performed in accordance with generally accepted engineering practices. No warranty, expressed or implied, is made.

6. References

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EPRI (2011) Environmental Factors Governing Corrosion Rates, Report 1021854 December 2011

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Recommended Material Specifications

Structural Fill and Ordinary Fill shall consist of hard, durable sand and gravel, free of clay, organic matter, surface coatings, and other deleterious materials. Soil finer than the No. 200 sieve (the “fines”) should be nonplastic. On-site material can be re-used as Ordinary Fill, provided they can meet the appropriate gradation and compaction requirements indicated below and do not contain deleterious materials. Soils to be used as fill imported from off site should also meet the gradation requirements given below.

Structural Fill

Structural Fill shall meet the following gradation requirements:

Sieve Size	Percent Passing by Weight
3 inches	100
0.5 inch	50 to 100
No. 4	35 to 85
No. 16	20 to 65
No. 50	5 to 40
No. 200 (fines)	0 to 8

Structural Fill shall be compacted in maximum 9-inch-thick, loose lifts to at least 95 percent of the maximum dry density determined in accordance with ASTM D1557 (Modified AASHTO Compaction). The moisture content should be held to within ±3 percent of optimum moisture content (as determined by ASTM D1557).

Ordinary Fill

Ordinary Fill shall meet the following gradation requirements:

Sieve Size	Percent Passing by Weight
6 inches	100
3 inches	80 to 100
No. 4	20 to 100
No. 200 (fines)	0 to 20

Ordinary Fill shall be compacted in maximum 12-inch-thick, loose lifts to at least 92 percent of the maximum dry density determined in accordance with ASTM D1557

(Modified AASHTO Compaction). The moisture content should be held to within ±3 percent of optimum moisture content (as determined by ASTM D1557).

Geotextile

Geotextile should be a non-woven fabric, consisting of Mirafi 140N or an approved equal product.

Tables

Table 1. Estimated Soil Hydraulic Conductivity
Northern Solar Array
Shepaug Dam
Southbury, Connecticut

Test Pit Number	Test Pit Coordinates[1]		Field Test Depth	Soil Layer at Test Depth	Estimated Saturated Hydraulic Conductivity[2] (in/hr)
	Northing	Easting	(ft)		
TP1	726087	850684	6.0 - 6.5	Silty Sand	11.46
TP2	726089	850730	3.0 - 3.5	Silty Sand	1.80
TP3	726104	850777	4.0 - 4.5	Narrowly Graded Sand with Gravel	39.46
TP4	726056	850772	7.0 - 7.5	Narrowly Graded Sand with Silt and Gravel	3.59
TP5	726061	850722	2.0 - 2.5	Silty Sand	0.45
TP6	726039	850690	3.0 - 3.5	Silty Sand	0.62
TP7	726011	850656	5.0 - 5.5	Narrowly Graded Sand with Gravel	54.00
TP8	726023	850729	2.0 - 2.5	Silty Sand	1.06
TP9	726015	850769	2.0 - 2.5	Silty Sand	1.99

Notes:
1. State Plane (NAD83) Coordinates were obtained in the field using a GPS unit.
2. Infiltration field test performed using a Guelph Permeameter. See Appendix C for test results.

Table 2. Exploration Data
Northern Solar Array
Shepaug Dam
Southbury, Connecticut

Exploration Number	Exploration Coordinates[1]		Approx. Ground Surface Elevation[2]	Depth to Bottom of Exploration	Depth to Refusal	Estimated Elevation of Refusal
	Northing	Easting	(ft)	(ft)	(ft)	(ft)
TP1	726087	850684	227	10.0	--	--
TP2	726089	850730	224	6.0	--	--
TP3	726104	850777	225	7.0	7.0	218
TP4	726056	850772	227	8.0	8.0	219
TP5	726061	850722	223	5.0	--	--
TP6	726039	850690	223	6.0	--	--
TP7	726011	850656	223	8.0	8.0	215
TP8	726023	850729	223	5.0	--	--
TP9	726015	850769	223	5.0	--	--
B1	726130	850422	229	20.3	20.3	209
B2	726135	850877	232	5.0	5.0	227
B3	726413	850622	239	12.5	12.5	227
B4[3]	726105	850539	229	15.0	8.5	221

Notes:
1. State Plane (NAD83) Coordinates were obtained in the field using a GPS unit.
2. Elevations were estimated from the GPS unit and presented in the NAVD 88 datum.
3. Drillers cored 5 feet of bedrock in boring B4.

Table 3. Recommended Soil Properties
Northern Solar Array
Shepaug Dam
Southbury, Connecticut

Area Soils Encountered	Layer/Soil Type	Total Unit Weight, γ (pcf)	Friction Angle, ϕ (deg)	Lateral Earth Pressures[1]			Lateral Pile Analyses Properties	
				Coefficient of Active Earth Pressure, Ka	Coefficient of At Rest Earth Pressure, Ko	Coefficient of Passive Earth Pressure, Kp	Soil Model	k (pci)
B-1 and B-2	Silty Sand or Sand and Silt	125	32	0.27	0.47	6.5	Sand (Reese)	75
B-3 and B-4	Sand and Gravel	125	34	0.25	0.44	7.8	Sand (Reese)	125
B-1, B-3, and B-4	Till	125	40	0.20	0.36	13.5	Sand (Reese)	250
Proposed Fill	Ordinary Fill	120	30	0.30	0.50	5.5	Sand (Reese)	50
	Structural Fill	125	35	0.24	0.43	8.5	Sand (Reese)	140

Notes:
1. See Appendix D (Calculations) for lateral earth pressure calculations according to AASHTO (2020).

Table 4. Corrosivity Laboratory Testing Results
Shepaug Dam Northern Solar Array
Southbury, Connecticut

Sample ID	Chloride ASTM D512 (mg/kg)	Sulfate ASTM D516 (mg/kg)	Electrical Resistivity ASTM G57 (Ω-cm)	Electrical Conductivity ASTM G57 $(\Omega\text{-cm})^{-1}$	pH ASTM G51
TP-2 (3.5-6 feet)	<10	<10	182,528	5.48×10^{-6}	7.97
TP-9 (1.3-5 feet)	<10	<10	1,718,928	5.82×10^{-7}	7.20

Table 5. Electrical Resistivity Results
Northern Solar Array
Shepaug Dam
Southbury, Connecticut

Line	Spacing (feet)			Readings			Apparent Resistivity (Ohm-cm)	Notes
	"a"	Potential	Current	Potential (Volts)	Current (mAmp)	Resistivity (Ohms)		
Line 1: NE-SW	2.5	1.25	3.75	400	10	467.6	223,876.9	High range.
	5	2.5	7.5	400	10	177.1	169,583.4	High range.
	10	5	15	400	10	89.6	171,594.3	High range.
	20	10	30	400	10	38.8	148,612.9	High range.
	50	25	75	400	10	29.2	279,606.8	High range.
Line 2: SE-NW	2.5	1.25	3.75	400	10	481.6	230,579.8	High range.
	5	2.5	7.5	400	10	145.4	139,228.9	High range.
	10	5	15	400	10	93.6	179,254.8	High range.
	20	10	30	400	10	43.2	165,465.9	High range.
	50	25	75	400	10	20.4	195,341.7	High range.

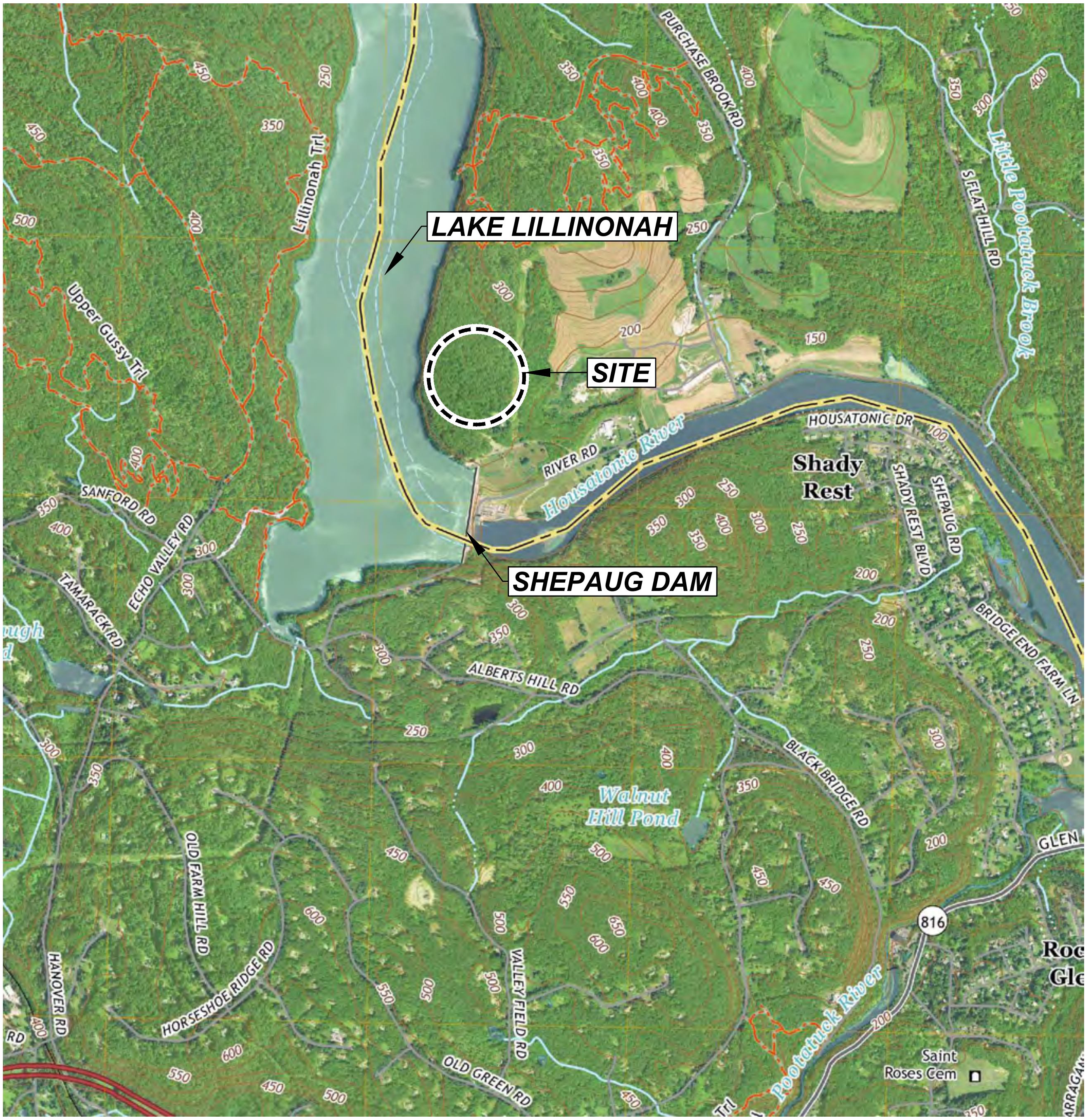
Notes:
1. Test was performed on March 4, 2024.
2. The weather was cloudy with temperatures in the 50's °F.
3. Test was performed in the existing lay down area which is covered in gravel and grass.
4. Measurements were taken using an L & R Industries MiniRes Instrument.

Table 6. USDA Soil Texture and Infiltration Rate
Northern Solar Array
Shepaug Dam
Southbury, Connecticut

Boring / Sample ID	Sample Depth (feet)	Percent Sand[1]	Percent Silt[1]	Percent Clay[1]	USDA Soil Texture[2]	Infiltration Rate (inches/hour)[3]
B-1 (S2)	5-7	90.6	9.4	0.0	Sand	8.27
B-2 (S1Bottom 13")	0-2	89.9	10.1	0.0	Sand	8.27
B-3 (S3)	10-12	63.5	36.1	0.5	Sandy Loam	1.02

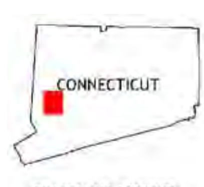
Notes:
1. USDA classification of soil particle sizes passing the #10 (2 mm) sieve (mm): Sand: 0.05 to 2, Silt: 0.002 to 0.05, Clay: <0.002.
2. USDA soil texture is based on the soil texture triangle shown in Fig. 3.
3. Infiltration Rate (referred to as Rawls rate) are based on recommendations in Rawls, Brakensiek and Saxton, 1982 and presented in Table 10-2 of the Connecticut Stormwater Quality Manual, 2024.

Figures



0 1000 2000 4000 6000

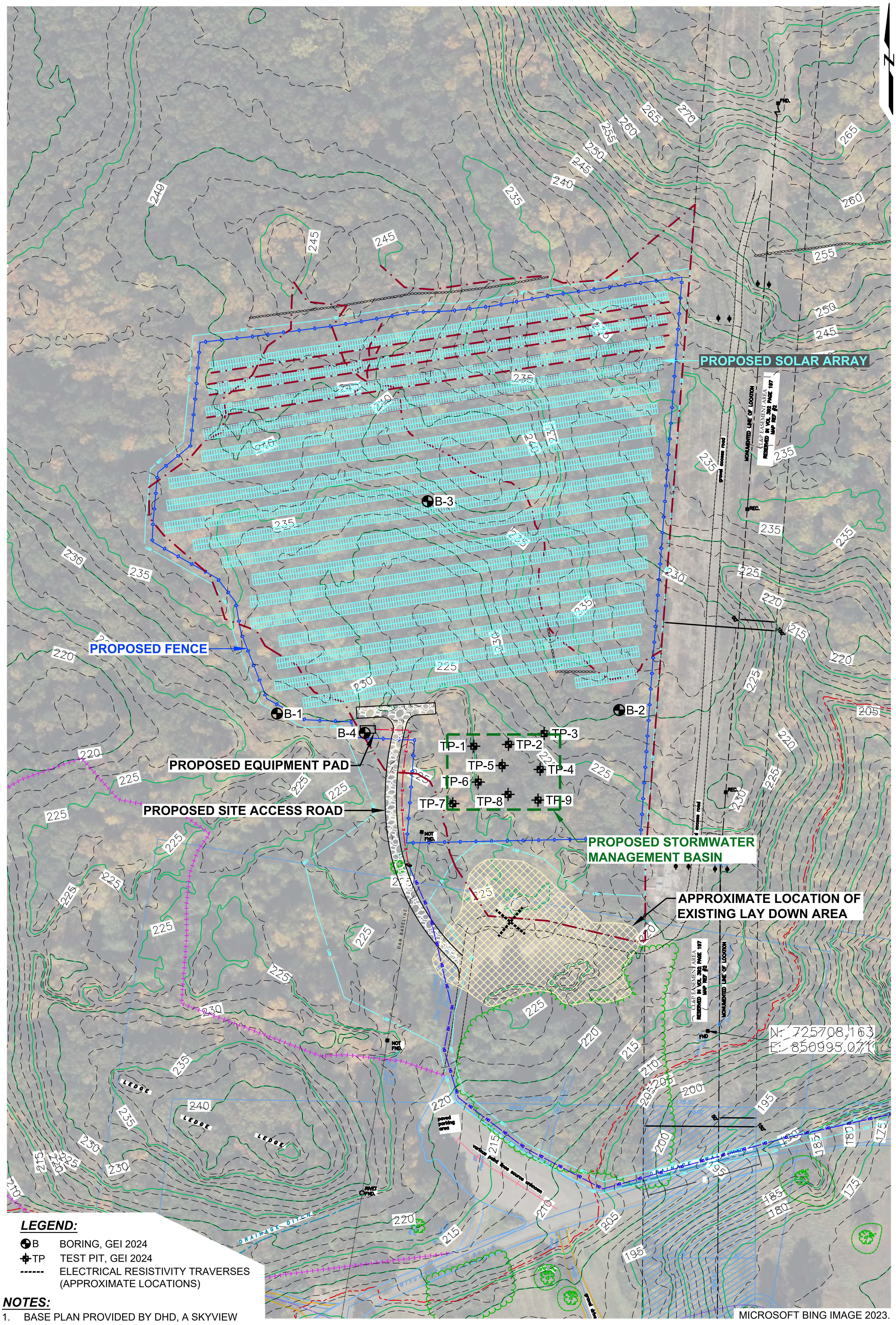
SCALE, FEET



This Image is from U.S.G.S. Topographic 7.5 Minute Series
Newtown, CT Quadrangle, 2021.
Datum is North American Vertical Datum of 1988 (NAVD88).
Contour Interval is 10 Feet.

Northern Solar Array Shepaug Dam Southbury and Newtown, Connecticut	GEI Consultants	SITE LOCATION MAP
DHD, A Skyview Ventures Company Greenwich, Connecticut	Project 2305289	April 2024 Fig. 1

\\geiconsultants.com\data\Data_Storage\Working\SKYVIEW VENTURES\2305289 Shepaug Dam Solar Array_Larger Array\00_CAD\Figures\Gt\2305289-01



MICROSOFT BING IMAGE 2023.

LEGEND:

- B — BORING, GEI 2024
- TP — TEST PIT, GEI 2024
- ------ ELECTRICAL RESISTIVITY TRAVERSES (APPROXIMATE LOCATIONS)

NOTES:

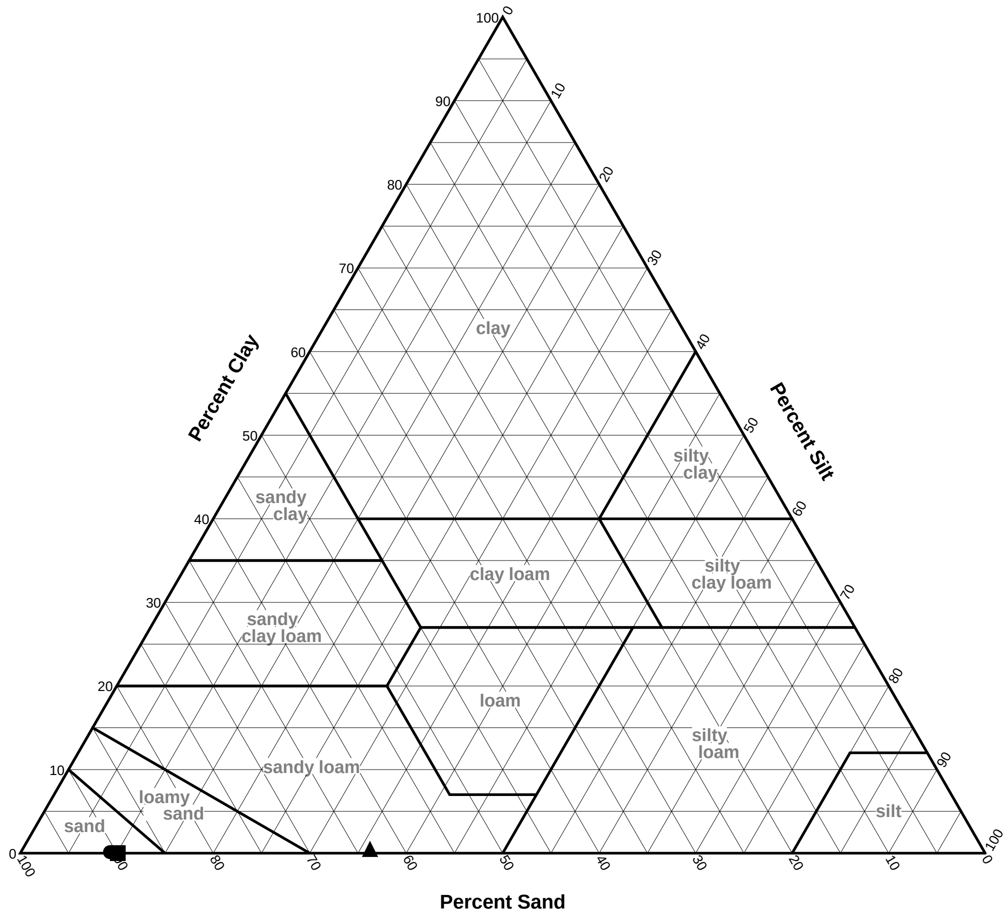
1. BASE PLAN PROVIDED BY DHD, A SKYVIEW VENTURES COMPANY ON JANUARY 31, 2024.
2. CONTOURS REPRESENT EXISTING TOPOGRAPHY USING NAVD88 DATUM.

0 120 240

SCALE, FEET

Northern Solar Array Shepaug Dam Southbury and Newtown, Connecticut	GEI Consultants	EXPLORATION LOCATION PLAN
DHD, A Skyview Ventures Company Greenwich, Connecticut	Project 2305289	April 2024 Fig. 2

USDA Soil Classification



SOIL DATA

	Source	Sample No.	Depth	Percentages From Material Passing a #10 Sieve			Classification
				Sand	Silt	Clay	
●	B1	S2	5-7 ft	90.6	9.4	0.0	Sand
■	B2	S1Bot13"	0-2 ft	89.9	10.1	0.0	Sand
▲	B3	S3	10-12 ft	63.5	36.1	0.5	Sandy loam

GEI Consultants, Inc.
400 Unicorn Park Drive
Woburn, MA 01801

Client: Skyview Ventures
Project: Shepaug Dam Solar Array

Project No.: 2305289

Figure 3

Checked By: W. Lukas

Appendix A

Borings and Test Pit Logs

GEI's Visual Manual Soil Description Guide

BORING INFORMATION

NORTHING (ft): 726,130 **EASTING (ft):** 850,422
GROUND SURFACE EL. (ft): 229 **DATE START/END:** 3/27/2024
VERT./HORIZ. DATUMS: NAVD 88/NAD 83 **DRILLING COMPANY:** New England Boring Contractors
TOTAL DEPTH (ft): 20.3 **DRILLER NAME:** D. Deangelis
LOGGED BY: M. Chea **RIG TYPE:** Mobile B-53 ATV

BORING B-1

DRILLING INFORMATION

HAMMER TYPE: Automatic **CASING I.D./O.D.:** NA/ NA **CORE BARREL TYPE:** NA
AUGER I.D./O.D.: 3.25 inch / 6.25 inch **DRILL ROD O.D.:** 2.625 inch **CORE BARREL I.D./O.D.:** NA / NA
DRILLING METHOD: Hollow Stem Auger
WATER LEVEL DEPTHS (ft): Not Encountered. Borehole was dry upon completion.

ABBREVIATIONS:
Pen. = Penetration Length
Rec. = Recovery Length
RQD = Rock Quality Designation = Length of Sound Cores>4 in / Pen.,%
WOR = Weight of Rods
WOH = Weight of Hammer
S = Split Spoon Sample
C = Core Sample
U = Undisturbed Sample
SC = Sonic Core
DP = Direct Push Sample
HSA = Hollow-Stem Auger
Qp = Pocket Penetrometer Strength
Sv = Pocket Torvane Shear Strength
LL = Liquid Limit
PI = Plasticity Index
PID = Photoionization Detector
I.D./O.D.= Inside Diameter/Outside Diameter
NA, NM = Not Applicable, Not Measured
Blows per 6 in.: 140-lb hammer falling 30 inches to drive a 2-inch-O.D. split spoon sampler.

Elev. (ft)	Depth (ft)	Sample No.	Sample Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD	Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		S1	0 to 2	24/8	1-3-2-1	Observed auger cuttings to consist of sand and gravel at 1 ft.		S1: TOPSOIL: Silty SAND (SM), ~70% fine sand, ~30% organic silt, trace of roots, trace of leaves, dark brown, moist.
	5	S2	5 to 7	24/12	7-11-9-10		SAND AND SILT	S2: WIDELY GRADED SAND WITH SILT (SW-SM), 78.8% fine to coarse sand, 14.2% fine gravel, 7% nonplastic fines, medium dense, light brown, moist.
220	10	S3	10 to 12	24/15	33-69-61-30	Rig chattered from 10 to 14 ft. Observed coarse gravel in the cuttings.	TILL	S3: SILTY SAND WITH GRAVEL (SM), ~60% fine to medium sand, ~20% fine to coarse subangular to angular gravel, ~15% nonplastic fines, very dense, light grayish brown, moist.
	15	S4	15 to 16.3	15/13	35-45-65/3"	Encountered auger refusal at 16.5 ft. Offset borehole 5 ft east and augered continously to 20 ft.	TILL	S4: SILTY SAND WITH GRAVEL(SM), ~55% fine to medium sand, ~30% fine to coarse subangular to angular gravel, ~15% nonplastic fines, very dense, light gray, moist.
210	20	S5	20 to 20.3	3/1	60/3"	Encountered spoon refusal at 20.3 ft. Spoon bouncing.		S5: Angular coarse gravel. Bottom of borehole at 20.3 ft. Tremie grouted hole upon completion.

NOTES: 1. Boring located near southwestern corner of proposed solar array.
2. Coordinates and ground surface elevation were obtained with a GPS unit.

PROJECT NAME: Shepaug Dam Solar Array
CITY/STATE: Newtown and Southbury, CT
GEI PROJECT NUMBER: 2305289

GEI Consultants

BORING INFORMATION

NORTHING (ft): 726,135
EASTING (ft): 850,877
GROUND SURFACE EL. (ft): 232
DATE START/END: 3/27/2024
VERT./HORIZ. DATUMS: NAVD 88/NAD 83
DRILLING COMPANY: New England Boring Contractors
TOTAL DEPTH (ft): 5.0
DRILLER NAME: D. Deangelis
LOGGED BY: M. Chea
RIG TYPE: Mobile B-53 ATV

BORING B-2

DRILLING INFORMATION

HAMMER TYPE: Automatic
CASING I.D./O.D.: NA/ NA
CORE BARREL TYPE: NA
AUGER I.D./O.D.: 3.25 inch / 6.25 inch
DRILL ROD O.D.: 2.625 inch
CORE BARREL I.D./O.D.: NA / NA
DRILLING METHOD: Hollow Stem Auger
WATER LEVEL DEPTHS (ft): Not Encountered. Borehole was dry upon completion.

ABBREVIATIONS:
Pen. = Penetration Length
Rec. = Recovery Length
RQD = Rock Quality Designation = Length of Sound Cores>4 in / Pen.,%
WOR = Weight of Rods
WOH = Weight of Hammer
S = Split Spoon Sample
C = Core Sample
U = Undisturbed Sample
SC = Sonic Core
DP = Direct Push Sample
HSA = Hollow-Stem Auger
Qp = Pocket Penetrometer Strength
Sv = Pocket Torvane Shear Strength
LL = Liquid Limit
PI = Plasticity Index
PID = Photoionization Detector
I.D./O.D.= Inside Diameter/Outside Diameter
NA, NM = Not Applicable, Not Measured
Blows per 6 in.: 140-lb hammer falling 30 inches to drive a 2-inch-O.D. split spoon sampler.

Elev. (ft)	Depth (ft)	Sample No.	Sample Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD	Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
232	0	S1	0 to 2	24/17	1-2-1-1			S1 (0-4"): TOPSOIL: Silty SAND (SM), ~70% fine sand, ~30% organic silt, trace of roots, trace of leaves, dark brown, moist.
							SAND AND SILT	S1 (4-17"): NARROWLY GRADED SAND WITH SILT (SP-SM), 79.3% fine to coarse sand, 11.9% nonplastic fines, 8.8% fine gravel, very loose, orangey brown to brown, moist.
230								
								Observed rock fragments at teeth of augers.
	5					Encountered auger refusal at 5 ft. Offset boring 5 ft west and again encountered refusal at 5 ft.		Bottom of borehole at 5 ft. Tremie grouted hole upon completion.
	10							
220								
	15							
	20							
210								

NOTES: 1. Boring located near southeastern corner of solar array.
2. Coordinates and ground surface elevation were obtained with a GPS unit.

PROJECT NAME: Shepaug Dam Solar Array
CITY/STATE: Newtown and Southbury, CT
GEI PROJECT NUMBER: 2305289

GEI Consultants

BORING INFORMATION			
NORTHING (ft):	726,413	EASTING (ft):	850,622
GROUND SURFACE EL. (ft):	239	DATE START/END:	3/27/2024
VERT./HORIZ. DATUMS:	NAVD 88/NAD 83	DRILLING COMPANY:	New England Boring Contractors
TOTAL DEPTH (ft):	12.5	DRILLER NAME:	D. Deangelis
LOGGED BY:	M. Chea	RIG TYPE:	Mobile B-53 ATV

BORING B-3

DRILLING INFORMATION

HAMMER TYPE: Automatic | **CASING I.D./O.D.:** NA/ NA | **CORE BARREL TYPE:** NA

AUGER I.D./O.D.: 3.25 inch / 6.25 inch | **DRILL ROD O.D.:** 2.625 inch | **CORE BARREL I.D./O.D.:** NA / NA

DRILLING METHOD: Hollow Stem Auger

WATER LEVEL DEPTHS (ft): Not Encountered. Borehole was dry upon completion.

ABBREVIATIONS:
Pen. = Penetration Length
Rec. = Recovery Length
RQD = Rock Quality Designation = Length of Sound Cores>4 in / Pen.,%
WOR = Weight of Rods
WOH = Weight of Hammer
S = Split Spoon Sample
C = Core Sample
U = Undisturbed Sample
SC = Sonic Core
DP = Direct Push Sample
HSA = Hollow-Stem Auger
Qp = Pocket Penetrometer Strength
Sv = Pocket Torvane Shear Strength
LL = Liquid Limit
PI = Plasticity Index
PID = Photoionization Detector
I.D./O.D.= Inside Diameter/Outside Diameter
NA, NM = Not Applicable, Not Measured
Blows per 6 in.: 140-lb hammer falling 30 inches to drive a 2-inch-O.D. split spoon sampler.

Elev. (ft)	Depth (ft)	Sample No.	Sample Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD	Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
	0	S1	0 to 2	24/15	1-3-7-8			S1 (0-8"): TOPSOIL: Silty SAND (SM), ~65% fine sand, ~35% organic silt, trace of roots, trace of leaves, dark brown, moist.
						Rig chattered at 3 ft. Offset borehole 5 ft south and augered continuously to 5 ft.	SAND AND GRAVEL	S1 (8-15"): NARROWLY GRADED SAND WITH GRAVEL (SP), ~70% fine to coarse sand, ~30% fine to coarse angular gravel, medium dense, light brown, moist.
	5	S2	5 to 7	24/20	28-35-41-51	Rig chattered slightly from 7 to 8 ft.	TILL	S2: SILTY SAND WITH GRAVEL (SM), ~55% fine to medium sand, ~30% fine to coarse angular gravel, ~15% nonplastic fines, very dense, light brown to light grayish brown, moist. Tip of spoon contained coarse, angular gravel.
230								
	10	S3	10 to 12	24/16	21-20-21-26			S3: SILTY SAND WITH GRAVEL (SM), 40% fine to coarse sand, 29.6% fine angular gravel, 30.4% nonplastic fines, dense, light gray, moist.
						Encountered auger refusal at 12.5 ft.		Bottom of borehole at 12.5 ft. Tremie grouted hole upon completion.
	15							
220								
	20							

NOTES: 1. Boring located near center of proposed solar array.
2. Coordinates and ground surface elevation were obtained with a GPS unit.

PROJECT NAME: Shepaug Dam Solar Array

CITY/STATE: Newtown and Southbury, CT

GEI PROJECT NUMBER: 2305289

GEI Consultants

BORING INFORMATION		BORING
NORTHING (ft): 726,105	EASTING (ft): 850,539	
GROUND SURFACE EL. (ft): 229	DATE START/END: 3/27/2024	**B-4**
VERT./HORIZ. DATUMS: NAVD 88/NAD 83	DRILLING COMPANY: New England Boring Contractors	
TOTAL DEPTH (ft): 15.0	DRILLER NAME: D. Deangelis	
LOGGED BY: M. Chea	RIG TYPE: Mobile B-53 ATV	PAGE 1 of 1

DRILLING INFORMATION

HAMMER TYPE: Automatic **CASING I.D./O.D.:** 4 inch/ 4.5 inch **CORE BARREL TYPE:** NX

AUGER I.D./O.D.: 3.25 inch / 6.25 inch **DRILL ROD O.D.:** 2.625 inch **CORE BARREL I.D./O.D.:** NA / NA

DRILLING METHOD: Hollow Stem Auger/Drive and Wash Casing

WATER LEVEL DEPTHS (ft): Not Encountered

ABBREVIATIONS:
Pen. = Penetration Length
Rec. = Recovery Length
RQD = Rock Quality Designation = Length of Sound Cores>4 in / Pen.,%
WOR = Weight of Rods
WOH = Weight of Hammer
S = Split Spoon Sample
C = Core Sample
U = Undisturbed Sample
SC = Sonic Core
DP = Direct Push Sample
HSA = Hollow-Stem Auger
Qp = Pocket Penetrometer Strength
Sv = Pocket Torvane Shear Strength
LL = Liquid Limit
PI = Plasticity Index
PID = Photoionization Detector
I.D./O.D.= Inside Diameter/Outside Diameter
NA, NM = Not Applicable, Not Measured
Blows per 6 in.: 140-lb hammer falling 30 inches to drive a 2-inch-O.D. split spoon sampler.

Elev. (ft)	Depth (ft)	Sample No.	Sample Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD	Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
	0	S1	0 to 2	24/13	4-8-9-6		SAND AND GRAVEL	S1 (0-4"): TOPSOIL: Silty SAND (SM), ~70% fine sand, ~30% organic silt, trace of roots, trace of leaves, dark brown, moist. S1 (4-13"): NARROWLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), ~75% fine to medium sand, ~15% fine angular gravel, ~10% nonplastic fines, medium dense, light brown, moist.
	5	S2	5 to 7	24/19	16-25-28-33		TILL	S2: SILTY SAND WITH GRAVEL (SM), ~60% fine to medium sand, ~20% fine to coarse gravel, ~20% nonplastic fines, very dense, light grayish brown, moist.
220	10	C1	10 to 15	60/35	20	Encountered auger refusal at 8.5 ft. Switched to drilling with 4-inch casing. Advanced roller bit from 8.5 to 10 ft. Started core run at 10 ft. Core Time (min/ft) = 2.5, 1.9, 1.8, 1.8, 11.5	BEDROCK	C1: Dark gray, GNEISS, fine to medium grained, slightly weathered, moderately fractured, vein of quartz, irregular joints.
	15							Bottom of borehole at 15 ft. Tremie grouted hole upon completion.
210	20							

NOTES: 1. Boring located near center of proposed equipment pad.
2. Coordinates and ground surface elevation were obtained with a GPS unit.

PROJECT NAME: Shepaug Dam Solar Array

CITY/STATE: Newtown and Southbury, CT

GEI PROJECT NUMBER: 2305289

GEI Consultants

Rock Core Photographs
Shepaug Dam Solar Array
Newtown and Southbury, Connecticut

Boring Details

Boring ID	B-4
Core ID	C1
Depth	10 – 15 ft

GEI Consultants

TEST PIT LOG

TP-1

Project	Shepaug Dam Solar Array	**PG.**	1 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726087; E: 850684
Client	DHD, A Skyview Ventures Company		NW corner of proposed basin
Contractor	New England Boring Contractors	**Ground El.**	227
Equipment/Reach	JCB 85 Z-1 eco mini excavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	40s/Cloudy	**Date**	3/26/2024

Depth	Sample No. and Type	Sample Depth (ft)	Soil Description
1 2			0-2 ft: TOPSOIL: Silty Sand (SM), ~80% fine sand, ~20% organic silt, trace of roots, dark brown, moist.
3 4	G1	2-4	2 - 4 ft: SILTY SAND (SM), ~70% fine sand, ~30% nonplastic fines, trace of roots, orangey brown, moist. Roots extend to 3 ft.
5 6 7 8 9 10	G2	4-10	4 -10 ft: TILL: SILTY SAND (SM), ~75% fine to medium sand, ~15% nonplastic fines, ~10% fine gravel, ~5% of total volume of cobbles up to 8 inches in diameter, light gray, moist.
			Bottom of test pit at 10 ft. Backfilled test pit with excavated material in lifts and tamped with excavator bucket.

Notes:

1. Observed on western and southern sides of excavation wall a layer of brown sand with silt and gravel layer below the topsoil.
2 Performed a Guelph permeameter test at 6 ft (see permeameter test form).
3. Test pit was dry at completion of excavation.

Pit Dimensions (ft)

length	13
width	10
depth	10

GEI Consultants

TEST PIT LOG

TP-1

Project	Shepaug Dam Solar Array	**PG.**	2 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726087; E: 850684
Client	DHD, A Skyview Ventures Company		NW corner of proposed basin
Contractor	New England Boring Contractors	**Ground El.**	227
Equipment/Reach	JCB 85 Z-1 eco mini excavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	40s/Cloudy	**Date**	3/26/2024

Photos

Photo 1: TP-1 bottom and side wall to 10 ft

Photo 2: TP-1 excavated soil

Notes:
1. Observed on western and southern sides of excavation wall a layer of brown sand with silt and gravel layer below the topsoil.
2 Performed a Guelph permeameter test at 6 ft (see permeameter test form).
3. Test pit was dry at completion of excavation.

Pit Dimensions (ft)

length	13
width	10
depth	10

GEI Consultants

TEST PIT LOG

TP-2

Project	Shepaug Dam Solar Array	**PG.**	1 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726089; E: 850730
Client	DHD, A Skyview Ventures Company		Northern edge of proposed basin
Contractor	New England Boring Contractors	**Ground El.**	224
Equipment/Reach	JCB 85 Z-1 eco mini excavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	40s/Cloudy	**Date**	3/26/2024

Depth	Sample No. and Type	Sample Depth (ft)	Soil Description
1			0-1 ft: TOPSOIL: Silty Sand (SM), ~80% fine sand, ~20% organic silt, trace of roots, dark brown, moist.
2, 3	G1	1-3.5	1 - 3.5 ft: SILTY SAND (SM), ~70% fine sand, ~30% nonplastic fines, orangey brown to yellowish brown, moist. Roots extends to 3 ft.
4, 5, 6	G2	3.5-6	3.5 -6 ft: NARROWLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), ~70% fine to medium sand, ~20% fine to coarse gravel, ~10% nonplastic fines, light gray, moist.
			Bottom of test pit at 6 ft. Backfilled test pit with excavated material in lifts and tamped with excavator bucket.

Notes:
1. Performed a Guelph permeameter test at 3 ft (see permeameter test form).
2. Test pit was dry at completion of excavation.
3. Obtained a 5 gallon bucket sample from 3.5 to 6 ft for corrosivity testing.

Pit Dimensions (ft)

length	10
width	7
depth	6

GEI Consultants

TEST PIT LOG

TP-2

Project	Shepaug Dam Solar Array	**PG.**	2 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726089; E: 850730
Client	DHD, A Skyview Ventures Company		Northern edge of proposed basin
Contractor	New England Boring Contractors	**Ground El.**	224
Equipment/Reach	JCB 85 Z-1 eco miniexcavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	40s/Cloudy	**Date**	3/26/2024

Photos

Photo 1: TP-2 bottom and side wall to 6 ft

Photo 2: TP-2 excavated soil

Notes:
1. Performed a Guelph permeameter test at 3 ft (see permeameter test form).
2. Test pit was dry at completion of excavation.
3. Obtained a 5 gallon bucket sample from 3.5 to 6 ft for corrosivity testing.

Pit Dimensions (ft)

length	10
width	7
depth	6

GEI Consultants

TEST PIT LOG

TP-3

Project	Shepaug Dam Solar Array	**PG.**	1 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726104: E: 850777
Client	DHD, A Skyview Ventures Company		NE corner of proposed basin
Contractor	New England Boring Contractors	**Ground El.**	225
Equipment/Reach	JCB 85 Z-1 eco mini excavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	40s/Cloudy	**Date**	3/25/2024

Depth	Sample No. and Type	Sample Depth (ft)	Soil Description
1			0 - 1 ft: TOPSOIL: Silty Sand (SM), ~80% fine sand, ~20% organic silt, trace of roots, dark brown, moist.
2 3	G1	1-3	1 - 3 ft: SILTY SAND (SM), ~70% fine sand, ~30% nonplastic fines, trace of roots, orangey brown, moist.
4 5 6 7	G2	3-7	3 - 7 ft: NARROWLY GRADED SAND WITH GRAVEL (SP), ~75% fine to coarse sand, ~20% fine to coarse gravel, ~5% nonplastic fines, trace of cobbles up to 8 inches in diameter, light grayish brown, moist. Excavator removed weathered rock pieces from 6.5 to 7 ft. Encountered refusal at 7 ft. (Likely bedrock)
			Bottom of test pit at 7 ft. Backfilled test pit with excavated material in lifts and tamped with excavator bucket.

Notes:
1. Performed a Guelph permeameter test at 4 ft (see permeameter test form).
2. Test pit was dry at completion of excavation.

Pit Dimensions (ft)

length	13
width	12
depth	7

GEI Consultants

TEST PIT LOG

TP-3

Project	Shepaug Dam Solar Array	**PG.**	2 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726104: E: 850777
Client	DHD, A Skyview Ventures Company		NE corner of proposed basin
Contractor	New England Boring Contractors	**Ground El.**	225
Equipment/Reach	JCB 85 Z-1 eco mini excavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	40s/Cloudy	**Date**	3/25/2024

Photos

Photo 1: TP-3 bottom and side wall to 7 ft

Photo 2: TP-3 excavated soil

Notes:
1. Performed a Guelph permeameter test at 4 ft (see permeameter test form).
2. Test pit was dry at completion of excavation.

Pit Dimensions (ft)

length	13
width	12
depth	7

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TEST PIT LOG

TP-4

Project	Shepaug Dam Solar Array	**PG.**	1 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726056; E: 850772
Client	DHD, A Skyview Ventures Company		Eastern edge of proposed basin
Contractor	New England Boring Contractors	**Ground El.**	227
Equipment/Reach	JCB 85 Z-1 eco mini excavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	40s/Clear	**Date**	3/25/2024

Depth	Sample No. and Type	Sample Depth (ft)	Soil Description
1			0 - 1 ft: TOPSOIL: Silty Sand (SM), ~80% fine sand, ~20% organic silt, trace of roots, dark brown, moist.
2, 3			1- 3 ft: SILTY SAND (SM), ~80% fine to medium sand, ~20% nonplastic fines, trace of roots, tan, moist.
4, 5, 6, 7, 8	G1	3-8 stockpile	3 - 8 ft: NARROWLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), ~65% fine to coarse sand, ~25% fine to coarse gravel, ~10% nonplastic fines, light gray, moist. Encountered refusal on hard surface at 8 ft (Likely bedrock).
			Bottom of test pit at 8 ft. Backfilled test pit with excavated material in lifts and tamped with excavator bucket.

Notes:
1. Performed a Guelph permeameter test at 7 ft (see permeameter test form).
2. Test pit was dry at completion of excavation.

Pit Dimensions (ft)

length	12
width	15
depth	8

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TEST PIT LOG

TP-4

Project	Shepaug Dam Solar Array	**PG.**	2 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726056; E: 850772
Client	DHD, A Skyview Ventures Company		Eastern edge of proposed basin
Contractor	New England Boring Contractors	**Ground El.**	227
Equipment/Reach	JCB 85 Z-1 eco mini excavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	40s/Clear	**Date**	3/25/2024

Photos

Photo 1: TP-4 bottom and side wall to 8 ft

Photo 2: TP-4 excavated soil

Notes:
1. Performed a Guelph permeameter test at 7 ft (see permeameter test form).
2. Test pit was dry at completion of excavation.

Pit Dimensions (ft)

length	12
width	15
depth	8

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TEST PIT LOG

TP-5

Project	Shepaug Dam Solar Array	**PG.**	1 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726061; E: 850722
Client	DHD, A Skyview Ventures Company		Center of proposed basin
Contractor	New England Boring Contractors	**Ground El.**	223
Equipment/Reach	JCB 85 Z-1 eco mini excavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	30s/Clear	**Date**	3/25/2024

Depth	Sample No. and Type	Sample Depth (ft)	Soil Description
1			0 - 1 ft: TOPSOIL: Silty Sand (SM), ~70% fine sand, ~30% organic silt, trace of roots, dark brown, moist.
2 3	G1	1-3	1- 3 ft: SILTY SAND (SM), ~75% fine to medium sand, ~25% nonplastic fines, trace of roots, tan to brown, moist.
4 5	G2	3-5	3 - 5 ft: TILL: SILTY SAND (SM), ~80% fine to medium sand, ~20% nonplastic fines, light gray, moist.
			Bottom of test pit at 5 ft. Backfilled test pit with excavated material in lifts and tamped with excavator bucket.

Notes:
1. Performed a Guelph permeameter test at 2 ft (see permeameter test form).
2. Test pit was dry at completion of excavation.

Pit Dimensions (ft)

length 11

width 7

depth 5

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TEST PIT LOG

TP-5

Project	Shepaug Dam Solar Array	**PG.**	2 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726061; E: 850722
Client	DHD, A Skyview Ventures Company		Center of proposed basin
Contractor	New England Boring Contractors	**Ground El.**	223
Equipment/Reach	JCB 85 Z-1 eco mini excavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	30s/Clear	**Date**	3/25/2024

Photos

Photo 1: TP-5 bottom and side wall to 5 ft

Photo 2: TP-5 excavated soil

Notes:
1. Performed a Guelph permeameter test at 2 ft (see permeameter test form).
2. Test pit was dry at completion of excavation.

Pit Dimensions (ft)

length	11
width	7
depth	5

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TEST PIT LOG

TP-6

Project	Shepaug Dam Solar Array	**PG.**	1 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726039; E: 850690
Client	DHD, A Skyview Ventures Company		Western edge of proposed basin
Contractor	New England Boring Contractors	**Ground El.**	223
Equipment/Reach	JCB 85 Z-1 eco mini excavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	30s/Clear	**Date**	3/25/2024

Depth	Sample No. and Type	Sample Depth (ft)	Soil Description
1 2			0 - 2 ft: TOPSOIL: Silty Sand (SM), ~65% fine sand, ~35% organic silt, trace of roots, dark brown, moist.
3 4 5	G1	2-5	2 - 5 ft: SILTY SAND (SM), ~70% fine to medium sand, ~30% nonplastic fines, trace of roots, orangey brown, moist.
6	G2	5-6	5 - 6ft: TILL: SILTY SAND (SM), ~80% fine to medium sand, ~20% nonplastic fines, light gray, moist.
			Bottom of test pit at 6 ft. Backfilled test pit with excavated material in lifts and tamped with excavator bucket.

Notes:
1. Performed a Guelph permeameter test at 3 ft (see permeameter test form).
2. Test pit was dry at completion of excavation.

Pit Dimensions (ft)

length	10
width	12
depth	6

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TEST PIT LOG

TP-6

Project	Shepaug Dam Solar Array	**PG.**	2 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726039; E: 850690
Client	DHD, A Skyview Ventures Company		Western edge of proposed basin
Contractor	New England Boring Contractors	**Ground El.**	223
Equipment/Reach	JCB 85 Z-1 eco mini excavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	30s/Clear	**Date**	3/25/2024

Photos

Photo 1: TP-6 bottom and side wall to 6 ft

Photo 2: TP-6 excavated soil

Notes:
1. Performed a Guelph permeameter test at 3 ft (see permeameter test form).
2. Test pit was dry at completion of excavation.

Pit Dimensions (ft)

length	10
width	12
depth	6

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TEST PIT LOG

TP-7

Project	Shepaug Dam Solar Array	**PG.**	1 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726011; E: 850656
Client	DHD, A Skyview Ventures Company		NW corner of proposed basin
Contractor	New England Boring Contractors	**Ground El.**	223
Equipment/Reach	JCB 85 Z-1 eco mini excavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	40s/Cloudy	**Date**	3/26/2024

Depth	Sample No. and Type	Sample Depth (ft)	Soil Description
1 2			0 - 2 ft: TOPSOIL: Silty Sand (SM), ~65% fine sand, ~35% organic silt, dark brown, moist. Roots extended to 2 ft.
3 4	G1	2-4	2 - 4 ft: POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), ~70% fine to coarse sand, ~20% fine to coarse gravel, ~10% nonplastic fines, orangey brown, moist.
5 6 7 8	G2	4-8	4 - 8ft: NARROWLY GRADED SAND WITH GRAVEL (SP), ~65% fine to coarse sand, ~30% fine to coarse gravel, ~5% nonplastic fines, ~5% of total volume of cobbles up to 8 inches in diameter, light brown, moist. Excavator indicated encountered refusal on hard surface at 8 ft (Likely bedrock).
			Bottom of test pit at 8 ft. Backfilled test pit with excavated material in lifts and tamped with excavator bucket.

Notes:
1. Performed a Guelph permeameter test at 5 ft (see permeameter test form).
2. Test pit was dry at completion of excavation.

Pit Dimensions (ft)

length 15

width 10

depth 8

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TEST PIT LOG

TP-7

Project	Shepaug Dam Solar Array	**PG.**	2 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726011; E: 850656
Client	DHD, A Skyview Ventures Company		NW corner of proposed basin
Contractor	New England Boring Contractors	**Ground El.**	223
Equipment/Reach	JCB 85 Z-1 eco mini excavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	40s/Cloudy	**Date**	3/26/2024

Photos

Photo 1: TP-7 bottom and side wall to 8 ft

Photo 2: TP-7 excavated soil

Notes:
1. Performed a Guelph permeameter test at 5 ft (see permeameter test form).
2. Test pit was dry at completion of excavation.

Pit Dimensions (ft)

length	15
width	10
depth	8

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TEST PIT LOG

TP-8

Project	Shepaug Dam Solar Array
City/Town	Newtown and Southbury, CT
Client	DHD, A Skyview Ventures Company
Contractor	New England Boring Contractors
Equipment/Reach	JCB 85 Z-1 eco mini excavator
Operator	D. Deangelis **GEI Rep** M. Chea
Weather	40s/Clear

PG.	1 **OF** 2
Location	N: 726023; E: 850729
	Southern edge of proposed pad
Ground El.	223
Datum	NAVD88
GEI Proj. No.	2305289
Date	3/25/2024

Depth	Sample No. and Type	Sample Depth (ft)	Soil Description
1			0 - 1.5 ft: TOPSOIL: Silty Sand (SM), ~70% fine sand, ~30% organic silt, trace of roots, dark brown, moist.
2 3 4	G1	1.5-4.5	1.5 - 4.5 ft: SILTY SAND (SM), ~70% fine to medium sand, ~20% nonplastic fines, 10% fine to coarse gravel, trace of roots up to 3 ft, orangey brown to brown, moist.
5			Observed on the sidewalls of the excavation a transition to a light gray silty sand at 4.5 ft.
			Bottom of test pit at 5 ft. Backfilled test pit with excavated material in lifts and tamped with excavator bucket.

Notes:
1. Performed a Guelph permeameter test at 2 ft (see permeameter test form).
2. Test pit was dry at completion of excavation.

Pit Dimensions (ft)

length	6
width	6
depth	5

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TEST PIT LOG

TP-8

Project	Shepaug Dam Solar Array	**PG.**	2 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726023; E: 850729
Client	DHD, A Skyview Ventures Company		Southern edge of proposed pad
Contractor	New England Boring Contractors	**Ground El.**	223
Equipment/Reach	JCB 85 Z-1 eco mini excavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	40s/Clear	**Date**	3/25/2024

Photos

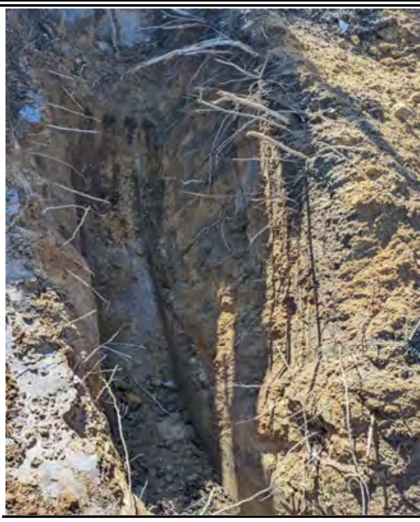

Photo 1: TP-8 bottom and side wall to 5 ft

Photo 2: TP-8 excavated soil

Notes:

1. Performed a Guelph permeameter test at 2 ft (see permeameter test form).
2. Test pit was dry at completion of excavation.

Pit Dimensions (ft)

length	6
width	6
depth	5

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TEST PIT LOG

TP-9

Project	Shepaug Dam Solar Array	**PG.**	1 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726015; E: 850769
Client	DHD, A Skyview Ventures Company		SE corner of proposed basin
Contractor	New England Boring Contractors	**Ground El.**	223
Equipment/Reach	JCB 85 Z-1 eco mini excavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	30s/Cloudy	**Date**	3/26/2024

Depth	Sample No. and Type	Sample Depth (ft)	Soil Description
1			0 - 1.3 ft: TOPSOIL: Silty Sand (SM), ~70% fine sand, ~30% organic silt, trace of roots, dark brown, moist.
2, 3	G1	1.3-4	1.3 - 4 ft: SILTY SAND (SM), ~70% fine sand, ~30% nonplastic fines, trace of roots up to 3 ft, tan, moist.
4, 5	G2	4-5	4 - 5 ft: TILL: SILTY SAND (SM), ~75% fine sand, ~25% nonplastic fines, light gray, moist.
			Bottom of test pit at 5 ft. Backfilled test pit with excavated material in lifts and tamped with excavator bucket.

Notes:
1. Performed a Guelph permeameter test at 2 ft (see permeameter test form).
2. Test pit was dry at completion of excavation.
3. Obtained a 5 gallon bucket sample from 1.3 to 5 ft for corrosivity testing.

Pit Dimensions (ft)

length 10

width 6

depth 5

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TEST PIT LOG

TP-9

Project	Shepaug Dam Solar Array	**PG.**	2 **OF** 2
City/Town	Newtown and Southbury, CT	**Location**	N: 726015; E: 850769
Client	DHD, A Skyview Ventures Company		SE corner of proposed basin
Contractor	New England Boring Contractors	**Ground El.**	223
Equipment/Reach	JCB 85 Z-1 eco mini excavator	**Datum**	NAVD88
Operator	D. Deangelis **GEI Rep** M. Chea	**GEI Proj. No.**	2305289
Weather	30s/Cloudy	**Date**	3/26/2024

Photos


Photo 1: TP-9 bottom and side wall to 5 ft


Photo 2: TP-9 excavated soil

Notes:
1. Performed a Guelph permeameter test at 2 ft (see permeameter test form).
2. Test pit was dry at completion of excavation.
3. Obtained a 5 gallon bucket sample from 1.3 to 5 ft for corrosivity testing.

Pit Dimensions (ft)

length	10
width	6
depth	5

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COARSE-GRAINED SOILS
VISUAL-MANUAL DESCRIPTIONS

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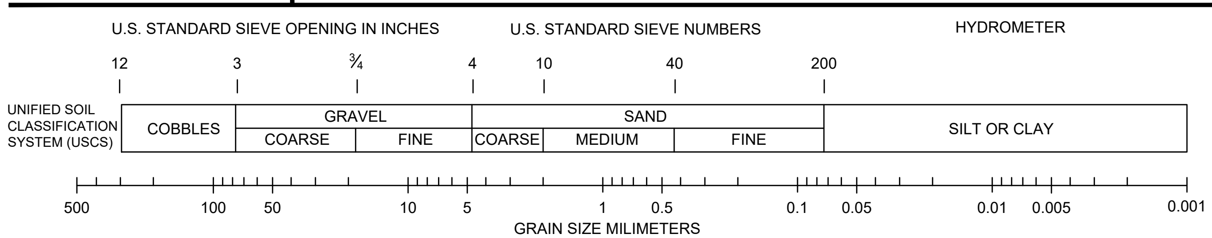
TYPICAL SOIL COLORS

- YELLOW
- OLIVE
- LIGHT BROWN
- BROWN
- REDDISH BROWN
- RED
- GRAY
- BLACK

SOILS WITH <50% FINES

				GROUP PATTERN & SYMBOL		GROUP NAME
GRAVEL % Gravel > % Sand	≤5% Fines	WIDELY GRADED		GW	<15% Sand	WIDELY GRADED GRAVEL
					≥15% Sand	WIDELY GRADED GRAVEL WITH SAND
		NARROWLY GRADED		GP	<15% Sand	NARROWLY GRADED GRAVEL
					≥15% Sand	NARROWLY GRADED GRAVEL WITH SAND
	~10% Fines	WIDELY GRADED	Fines = ML or MH	GW-GM	<15% Sand	WIDELY GRADED GRAVEL WITH SILT
					≥15% Sand	WIDELY GRADED GRAVEL WITH SILT AND SAND
			Fines = CL or CH	GW-GC	<15% Sand	WIDELY GRADED GRAVEL WITH CLAY
					≥15% Sand	WIDELY GRADED GRAVEL WITH CLAY AND SAND
		NARROWLY GRADED	Fines = ML or MH	GP-GM	<15% Sand	NARROWLY GRADED GRAVEL WITH SILT
					≥15% Sand	NARROWLY GRADED GRAVEL WITH SILT AND SAND
			Fines = CL or CH	GP-GC	<15% Sand	NARROWLY GRADED GRAVEL WITH CLAY
					≥15% Sand	NARROWLY GRADED GRAVEL WITH CLAY AND SAND
	≥15% Fines		Fines = ML or MH	GM	<15% Sand	SILTY GRAVEL
					≥15% Sand	SILTY GRAVEL WITH SAND
			Fines = CL or CH	GC	<15% Sand	CLAYEY GRAVEL
					≥15% Sand	CLAYEY GRAVEL WITH SAND
SAND % Sand ≥ % Gravel	≤5% Fines	WIDELY GRADED		SW	<15% Gravel	WIDELY GRADED SAND
					≥15% Gravel	WIDELY GRADED SAND WITH GRAVEL
		NARROWLY GRADED		SP	<15% Gravel	NARROWLY GRADED SAND
					≥15% Gravel	NARROWLY GRADED SAND WITH GRAVEL
	~10% Fines	WIDELY GRADED	Fines = ML or MH	SW-SM	<15% Gravel	WIDELY GRADED SAND WITH SILT
					≥15% Gravel	WIDELY GRADED SAND WITH SILT AND GRAVEL
			Fines = CL or CH	SW-SC	<15% Gravel	WIDELY GRADED SAND WITH CLAY
					≥15% Gravel	WIDELY GRADED SAND WITH CLAY AND GRAVEL
		NARROWLY GRADED	Fines = ML or MH	SP-SM	<15% Gravel	NARROWLY GRADED SAND WITH SILT
					≥15% Gravel	NARROWLY GRADED SAND WITH SILT AND GRAVEL
			Fines = CL or CH	SP-SC	<15% Gravel	NARROWLY GRADED SAND WITH CLAY
					≥15% Gravel	NARROWLY GRADED SAND WITH CLAY AND GRAVEL
	≥15% Fines		Fines = ML or MH	SM	<15% Gravel	SILTY SAND
					≥15% Gravel	SILTY SAND WITH GRAVEL
			Fines = CL or CH	SC	<15% Gravel	CLAYEY SAND
					≥15% Gravel	CLAYEY SAND WITH GRAVEL



ROUNDED SUBROUNDED SUBANGULAR ANGULAR

1. GROUP NAME and (SYMBOL)
2. Structure , if any. (stratified layer thicknesses, lenses, varves, gradational changes)
3. Describe sand, gravel and fines components, with percentages, in order of predominance. Include max gravel size. For test pits give percent cobbles and boulders, by volume, and include max size.
4. Color
5. Moisture: dry, moist, wet
6. Sheen, odor, roots, ash, brick, cementation, reaction with HCL, etc.
7. "Fill," local name or geologic name, if known

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FINE-GRAINED SOILS

VISUAL-MANUAL DESCRIPTIONS

GROUP PATTERN & SYMBOL — **GROUP NAME**

SOILS WITH ≥50% FINES

CL

- <30% plus No. 200
  - <15% plus No. 200 → LEAN CLAY
  - 15-25% plus No. 200
    - % Sand ≥% Gravel → LEAN CLAY WITH SAND
    - % Sand <% Gravel → LEAN CLAY WITH GRAVEL
- ≥30% plus No. 200
  - % Sand ≥% of Gravel
    - <15 % Gravel → SANDY LEAN CLAY
    - ≥15% Gravel → SANDY LEAN CLAY WITH GRAVEL
  - % Sand <% of Gravel
    - <15 % Sand → GRAVELLY LEAN CLAY
    - ≥15% Sand → GRAVELLY LEAN CLAY WITH SAND

ML

- <30% plus No. 200
  - <15% plus No. 200 → SILT
  - 15-25% plus No. 200
    - % Sand ≥% Gravel → SILT WITH SAND
    - % Sand <% Gravel → SILT WITH GRAVEL
- ≥30% plus No. 200
  - % Sand ≥% of Gravel
    - <15 % Gravel → SANDY SILT
    - ≥15% Gravel → SANDY SILT WITH GRAVEL
  - % Sand <% of Gravel
    - <15 % Sand → GRAVELLY SILT
    - ≥15% Sand → GRAVELLY SILT WITH SAND

CH

- <30% plus No. 200
  - <15% plus No. 200 → FAT CLAY
  - 15-25% plus No. 200
    - % Sand ≥% Gravel → FAT CLAY WITH SAND
    - % Sand <% Gravel → FAT CLAY WITH GRAVEL
- ≥30% plus No. 200
  - % Sand ≥% of Gravel
    - <15 % Gravel → SANDY FAT CLAY
    - ≥15% Gravel → SANDY FAT CLAY WITH GRAVEL
  - % Sand <% of Gravel
    - <15 % Sand → GRAVELLY FAT CLAY
    - ≥15% Sand → GRAVELLY FAT CLAY WITH SAND

MH

- <30% plus No. 200
  - <15% plus No. 200 → ELASTIC SILT
  - 15-25% plus No. 200
    - % Sand ≥% Gravel → ELASTIC SILT WITH SAND
    - % Sand <% Gravel → ELASTIC SILT WITH GRAVEL
- ≥30% plus No. 200
  - % Sand ≥% of Gravel
    - <15 % Gravel → SANDY ELASTIC SILT
    - ≥15% Gravel → SANDY ELASTIC CLAY WITH GRAVEL
  - % Sand <% of Gravel
    - <15 % Sand → GRAVELLY ELASTIC SILT
    - ≥15% Sand → GRAVELLY ELASTIC SILT WITH SAND

OL/OH

- <30% plus No. 200
  - <15% plus No. 200 → ORGANIC SOIL
  - 15-25% plus No. 200
    - % Sand ≥% Gravel → ORGANIC SOIL WITH SAND
    - % Sand <% Gravel → ORGANIC SOIL WITH GRAVEL
- ≥30% plus No. 200
  - % Sand ≥% of Gravel
    - <15 % Gravel → SANDY ORGANIC SOIL
    - ≥15% Gravel → SANDY ORGANIC SOIL WITH GRAVEL
  - % Sand <% of Gravel
    - <15 % Sand → GRAVELLY ORGANIC SOIL
    - ≥15% Sand → GRAVELLY ORGANIC SOIL WITH SAND

ID OF INORGANIC FINE SOILS FROM MANUAL TESTS

Symbol	Name	Dry Strength	Dilatancy	Toughness*
ML	Silt	None to low	Slow to rapid	Low or thread cannot be formed
CL	Lean Clay	Medium to high	None to slow	Medium
MH	Elastic Silt	Low to medium	None to slow	Low to medium
CH	Fat Clay	High to very high	None	High

1. GROUP NAME and (SYMBOL)
2. Describe fines, sand, and gravel components, in order of predominance. Include plasticity of fines. Include percentages of sand and gravel.
3. Color
4. Moisture: dry, moist, wet
5. Sheen, odor, roots, ash, brick, cementation, torvane and penetrometer results, etc.
6. "Fill," local name or geologic name, if known

PEAT

Peat refers to a sample composed primarily of vegetable matter in varying stages of decomposition. The description should begin: PEAT (PT) and need not include percentages of sand, gravel or fines.

CRITERIA FOR DESCRIBING PLASTICITY

Description	Criteria
Nonplastic ML	A 1/8-in. (3 -mm) thread cannot be rolled at any water content
Low Plasticity ML, MH	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit *
Medium Plasticity MH, CL	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High Plasticity CH	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

* Toughness refers to the strength of the thread near plastic limit. The lump refers to a lump of soil drier than the plastic, similar to dry strength.

Appendix B

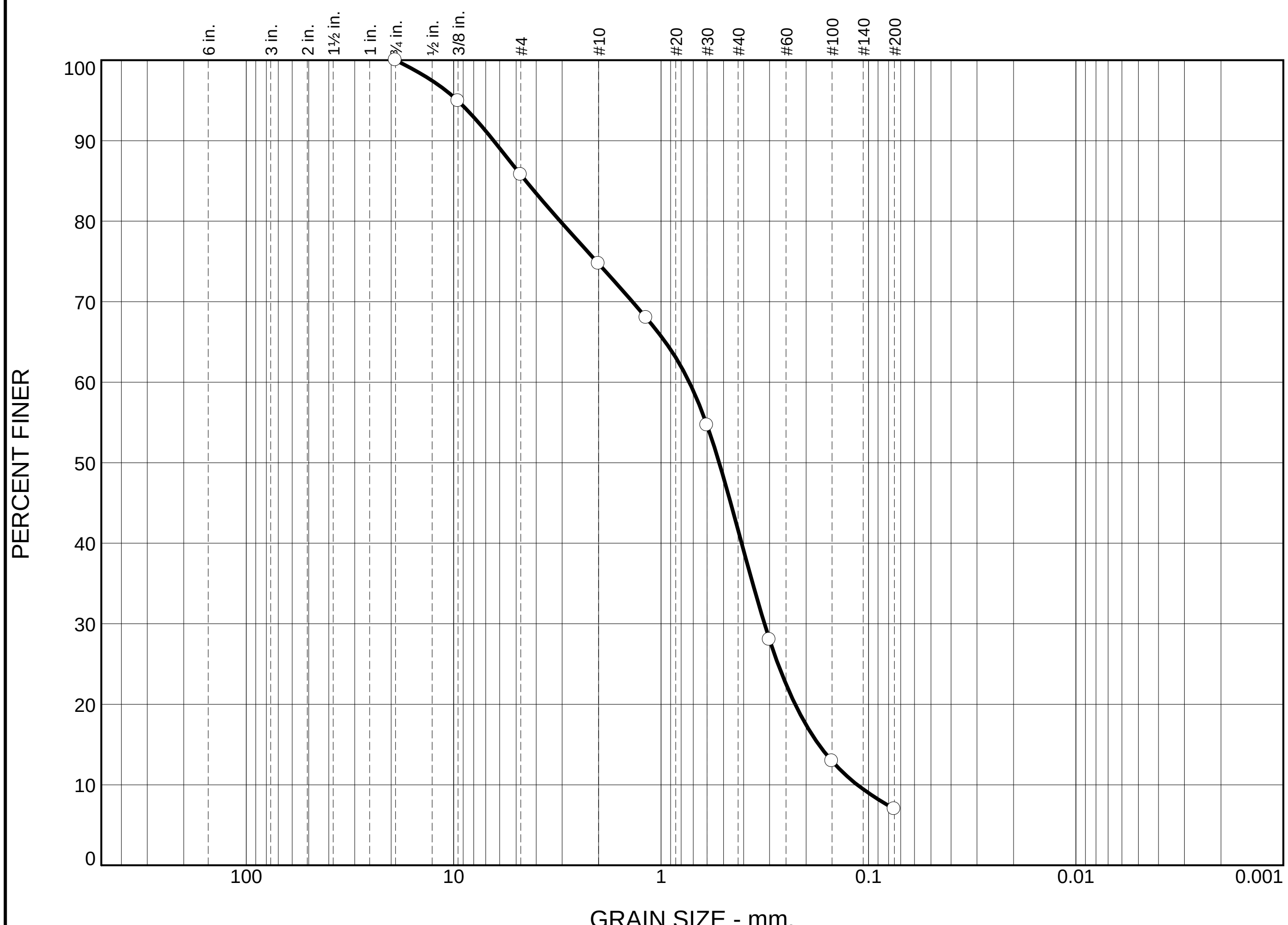
Laboratory Testing Results

- **B.1 GEI Laboratory Testing Results (Grain Size Testing with Hydrometers)**
- **B.2 GeoTesting Express Laboratory Testing Results (Corrosivity Testing)**

Appendix B.1

GEI Laboratory Testing Results (Grain Size Testing with Hydrometers)

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	14.2	11.1	33.1	34.6	7.0	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			4.4882	0.7310	0.5247	0.3174	0.1737	0.1132	1.22	6.46

Material Description	USCS	AASHTO
○ Widely Graded SAND with Silt	SW-SM	

Project No. 2305289 **Client:** Skyview Ventures
Project: Shepaug Dam Solar Array

○ **Source of Sample:** B1 **Depth:** 5-7 ft **Sample Number:** S2

Remarks:
○As received WC = 5.1%
Fines classified visually

GEI Consultants, Inc.
400 Unicorn Park Drive
Woburn, MA 01801

Figure

Tested By: S. Larson 4/4/24 **Checked By:** W. Lukas 4/4/24

GRAIN SIZE DISTRIBUTION TEST DATA

4/10/2024

Client: Skyview Ventures
Project: Shepaug Dam Solar Array
Project Number: 2305289
Location: B1
Depth: 5-7 ft **Sample Number:** S2
Material Description: Widely Graded SAND with Silt
USCS Classification: SW-SM
Testing Remarks: As received WC = 5.1%
Fines classified visually
Tested by: S. Larson 4/4/24 **Checked by:** W. Lukas 4/4/24

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
256.65	0.00	214.02	3/4	214.02	100.0
			3/8	227.02	94.9
			#4	250.52	85.8
			#10	278.91	74.7
			#16	296.14	68.0
			#30	330.40	54.7
			#50	398.77	28.0
			#100	437.43	13.0
			#200	452.76	7.0

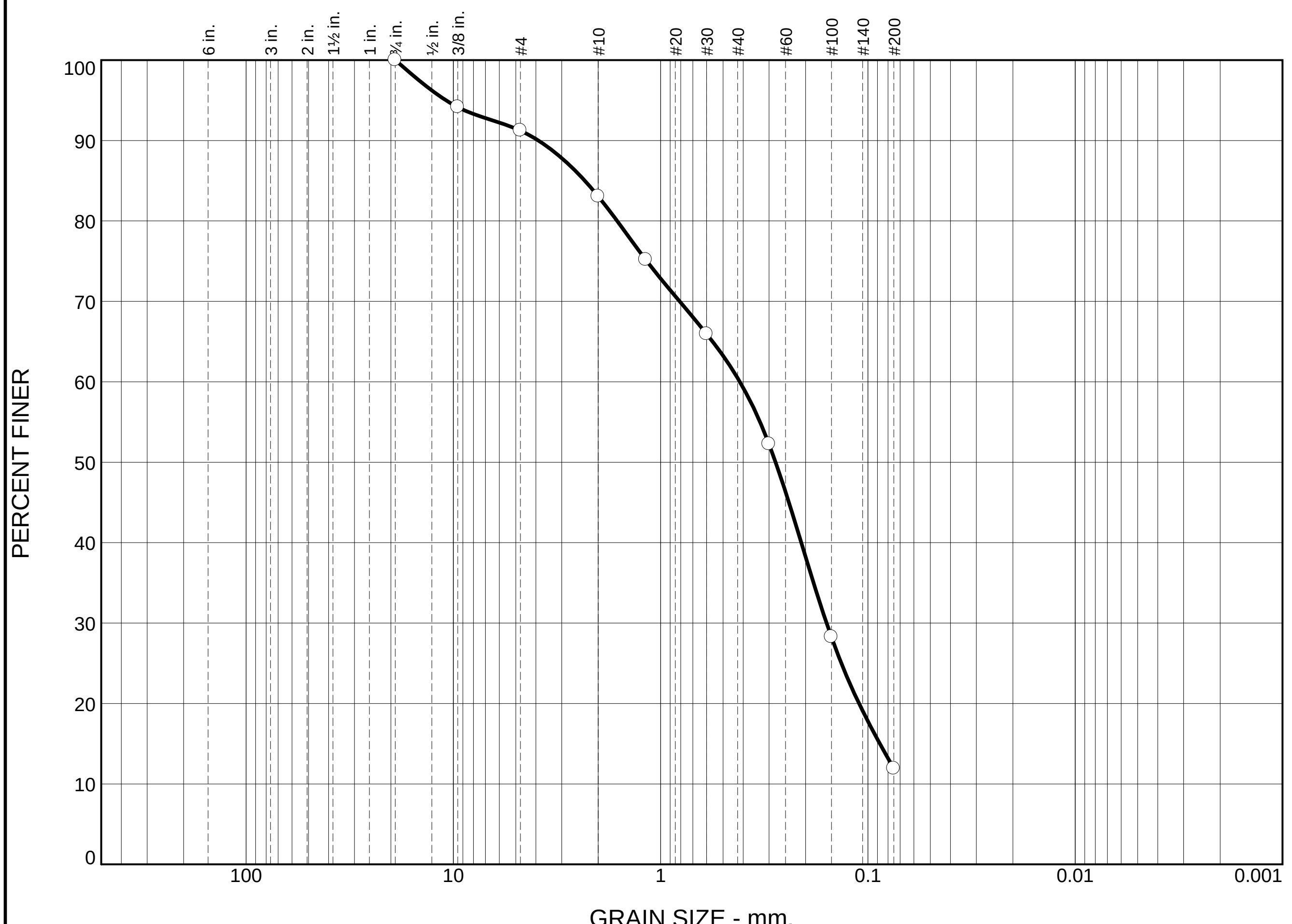
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	14.2	14.2	11.1	33.1	34.6	78.8			7.0

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.1132	0.1737	0.2259	0.3174	0.5247	0.7310	3.0603	4.4882	6.4160	9.5849

Fineness Modulus	C_u	C_c
2.79	6.46	1.22

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	8.8	8.1	22.6	48.6	11.9	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			2.3215	0.4149	0.2789	0.1583	0.0876			

Material Description	USCS	AASHTO
○ Narrowly Graded SAND with Silt	SP-SM	

Project No. 2305289 **Client:** Skyview Ventures

Project: Shepaug Dam Solar Array

○ **Source of Sample:** B2 **Depth:** 0-2 ft **Sample Number:** S1Bot13"

Remarks:

○As received WC = 7.8%

Fines classified visually

GEI Consultants, Inc.
400 Unicorn Park Drive
Woburn, MA 01801

Figure

Tested By: S. Larson 4/4/24 **Checked By:** W. Lukas 4/4/24

GRAIN SIZE DISTRIBUTION TEST DATA

4/10/2024

Client: Skyview Ventures
Project: Shepaug Dam Solar Array
Project Number: 2305289
Location: B2
Depth: 0-2 ft **Sample Number:** S1Bot13"
Material Description: Narrowly Graded SAND with Silt
USCS Classification: SP-SM
Testing Remarks: As received WC = 7.8%
Fines classified visually
Tested by: S. Larson 4/4/24 **Checked by:** W. Lukas 4/4/24

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
214.04	0.00	203.56	3/4	203.56	100.0
			3/8	216.07	94.2
			#4	222.33	91.2
			#10	239.82	83.1
			#16	256.69	75.2
			#30	276.47	65.9
			#50	305.77	52.2
			#100	357.11	28.3
			#200	392.08	11.9

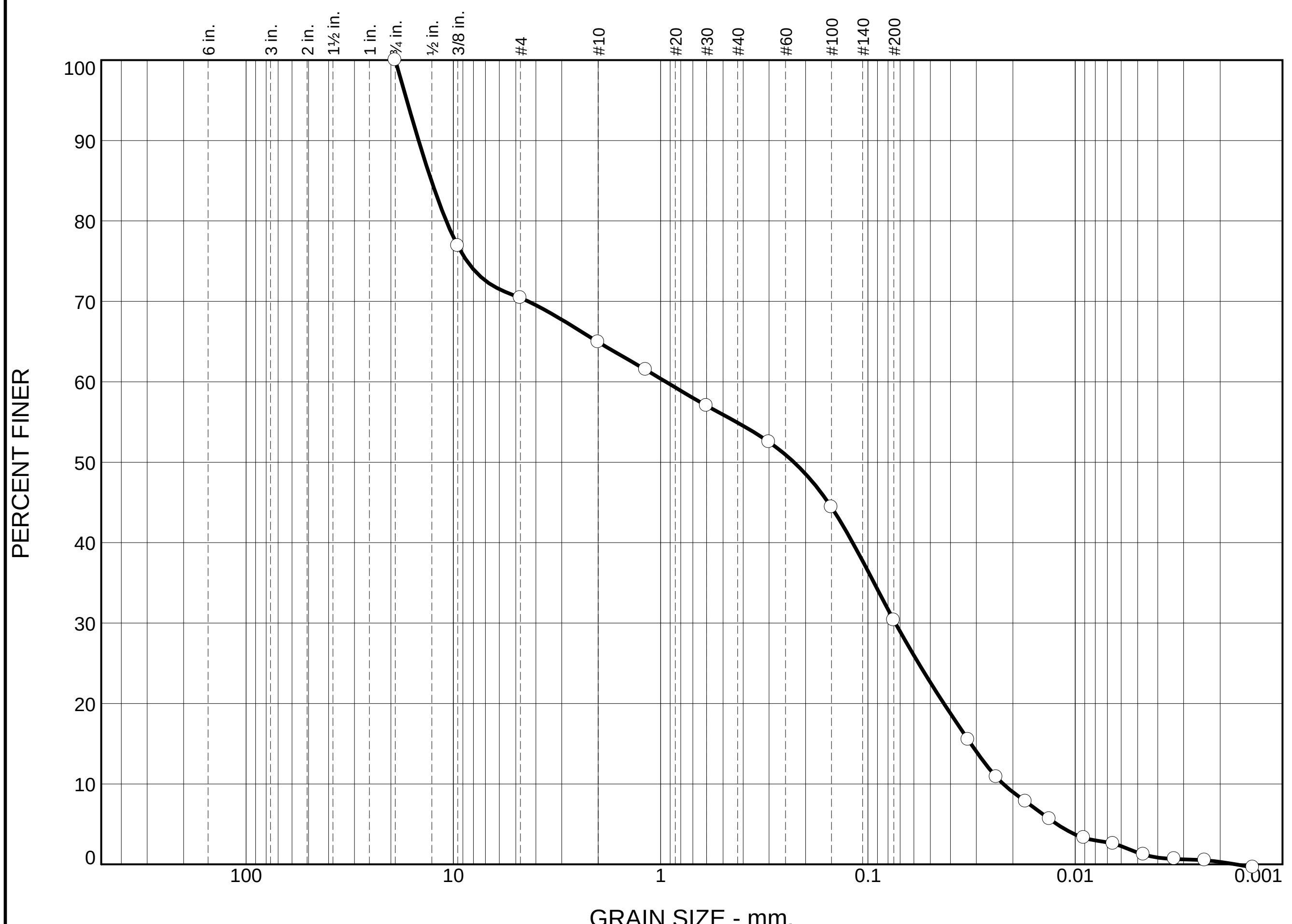
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	8.8	8.8	8.1	22.6	48.6	79.3			11.9

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
	0.0876	0.1104	0.1583	0.2789	0.4149	1.6216	2.3215	3.8874	10.8553

Fineness Modulus
2.08

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	29.6	5.5	10.0	24.5	28.9	1.5

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			12.7618	0.9435	0.2274	0.0737	0.0319	0.0222	0.26	42.42

Material Description	USCS	AASHTO
○ Silty SAND with Gravel	SM	

Project No. 2305289 **Client:** Skyview Ventures

Project: Shepaug Dam Solar Array

○ **Source of Sample:** B3 **Depth:** 10-12 ft **Sample Number:** S3

Remarks:

○As received WC = 2.4%

Fines classified visually

GEI Consultants, Inc.
400 Unicorn Park Drive
Woburn, MA 01801

Figure

Tested By: M. Alstede 4/10/24 **Checked By:** W. Lukas 4/10/24

GRAIN SIZE DISTRIBUTION TEST DATA

4/10/2024

Client: Skyview Ventures
Project: Shepaug Dam Solar Array
Project Number: 2305289
Location: B3
Depth: 10-12 ft **Sample Number:** S3
Material Description: Silty SAND with Gravel
USCS Classification: SM
Testing Remarks: As received WC = 2.4%
Fines classified visually
Tested by: M. Alstede 4/10/24 **Checked by:** W. Lukas 4/10/24

Sieve Test Data

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
293.50	0.00	198.46	3/4	198.46	100.0
			3/8	266.25	76.9
			#4	285.26	70.4
			#10	301.35	64.9
71.18	0.00	203.57	#16	207.35	61.5
			#30	212.25	57.0
			#50	217.20	52.5
			#100	226.07	44.4
			#200	241.48	30.4

Hydrometer Test Data

Hydrometer test uses material passing #10
Percent passing #10 based upon complete sample = 64.9
Weight of hydrometer sample =71.18
Automatic temperature correction
Composite correction (fluid density and meniscus height) at 20 deg. C = -4.207
Meniscus correction only = 0.7
Specific gravity of solids = 2.7
Hydrometer type = 151H
Hydrometer effective depth equation: L = 16.294964 **-** 0.2645 **x Rm**

Elapsed Time (min.)	Temp. (deg. C.)	Actual Reading	Corrected Reading	K	Rm	Eff. Depth	Diameter (mm.)	Percent Finer
2.00	20.9	1.0148	1.0107	0.0133	15.5	12.2	0.0328	15.5
4.00	20.9	1.0116	1.0075	0.0133	12.3	13.0	0.0240	10.8
8.00	20.9	1.0095	1.0054	0.0133	10.2	13.6	0.0173	7.8
14.00	20.9	1.0080	1.0039	0.0133	8.7	14.0	0.0133	5.6
31.00	20.8	1.0064	1.0023	0.0133	7.1	14.4	0.0091	3.3
60.00	20.8	1.0059	1.0018	0.0133	6.6	14.5	0.0066	2.6
120.00	20.6	1.0050	1.0008	0.0133	5.7	14.8	0.0047	1.2
240.00	20.7	1.0046	1.0005	0.0133	5.3	14.9	0.0033	0.7
473.00	20.6	1.0045	1.0003	0.0133	5.2	14.9	0.0024	0.5
1417.00	19.8	1.0040	0.9997	0.0135	4.7	15.1	0.0014	-0.4

Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	0.0	29.6	29.6	5.5	10.0	24.5	40.0	28.9	1.5	30.4

D_{10}	D_{15}	D_{20}	D_{30}	D_{50}	D_{60}	D_{80}	D_{85}	D_{90}	D_{95}
0.0222	0.0319	0.0430	0.0737	0.2274	0.9435	10.8273	12.7618	14.7069	16.7742

Fineness Modulus	C_u	C_c
2.71	42.42	0.26

Appendix B.2

GeoTesting Express Laboratory Testing Results (Corrosivity Testing)

Client:	GEI Consultants, Inc.		
Project Name:	Shepaug Dam Solar Array		
Project Location:	Southbury, CT		
GTX #:	318872		
Test Date:	04/03/24	Date Due:	4/10/24
Tested By:	BTM		
Checked By:	ank		

Laboratory pH of Soil by ASTM G51

Sample ID	Boring ID	Depth ft	Description	Soil Temperature °C	pH #1	pH #2	pH #3	Ave pH
5 Gallon Bucket Sample	TP-2	3.5-6'	Moist, yellowish brown silty sand	21.3	8.17	7.86	7.88	7.97
5 Gallon Bucket Sample	TP-9	1.3-5'	Moist, yellowish brown silty sand	21.3	7.31	7.14	7.15	7.20

Notes:

pH meter was standardized using pH 4, 7 and 10 buffers.
Test soil as soon as it arrives, but before 24 hours has passed from taking the sample. If the soil is frozen, let it thaw.
Press the pH probe into the as received soil and wait 1 minute to read value.
After one minute take a second and then a third reading. Readings shall be within 0.4 pH units of each other.
Record the 3 readings and report the average.

Client:	GEI Consultants, Inc.
Project:	Chepaug Dam Solar Array
Location:	Southbury, CT
GTX#:	318872
Test Date:	04/05/24
Due Date:	04/10/24
Tested By:	NMK
Checked By:	ank

Laboratory Measurement of Soil Resistivity Using the Wenner Four-Electrode Method by ASTM G57 (Laboratory Measurement)

Boring ID	Sample ID	Depth, ft.	Sample Description	Electrical Resistivity, ohm-cm	Electrical Conductivity, $(ohm\text{-}cm)^{-1}$
TP-2	5 Gallon Bucket Sample	3.5-6 '	Moist, yellowish brown silty sand	182,528	5.48E-06

Notes: Test Equipment: Nilsson Model 400 Soil Resistance Meter, MC Miller Soil Box
Water added to sample to create a thick slurry prior to testing (saturated condition).
Electrical Conductivity is calculated as inverse of Electrical Resistivity (per ASTM G57)
Test conducted in standard laboratory atmosphere: 68-73 F

Client:	GEI Consultants, Inc.
Project:	Chepaug Dam Solar Array
Location:	Southbury, CT
GTX#:	318872
Test Date:	04/05/24
Due Date:	04/10/24
Tested By:	NMK
Checked By:	ank

Laboratory Measurement of Soil Resistivity Using the Wenner Four-Electrode Method by ASTM G57 (Laboratory Measurement)

Boring ID	Sample ID	Depth, ft.	Sample Description	Electrical Resistivity, ohm-cm	Electrical Conductivity, $(\text{ohm-cm})^{-1}$
TP-9	5 Gallon Bucket Sample	1.3-5 '	Moist, yellowish brown silty sand	1,718,928	5.82E-07

Notes: Test Equipment: Nilsson Model 400 Soil Resistance Meter, MC Miller Soil Box
Water added to sample to create a thick slurry prior to testing (saturated condition).
Electrical Conductivity is calculated as inverse of Electrical Resistivity (per ASTM G57)
Test conducted in standard laboratory atmosphere: 68-73 F

PO Box 572455 / Salt Lake City UT 84157-2455 / USA
TEL +1 801 262 2448 · FAX +1 801 262 9870 · www.TEi-TS.com

GEOTESTING EXPRESS INCORPORATED
125 NAGOG PARK
ACTON MA 01720-3451
USA

Analysis No.	TS-A2411809
Report Date	09 April 2024
Date Sampled	03 April 2024
Date Received	05 April 2024
Where Sampled	Acton, MA USA
Sampled By	Client

This is to attest that we have examined: Soil: Project: Shepaug Dam Solar Array; Site Location: Southbury, CT; Job Number: GTX-318872

When examined to the applicable requirements of:

ASTM D 512-12*	"Standard Test Methods for Chloride Ion in Water" Method B
ASTM D 516-16	"Standard Test Method for Sulfate Ion in Water"

Results:

ASTM D 512 - Chloride Method B

Sample		Results		Minimum Detection Limit
		ppm (mg/kg)	%[1]	
5 Gallon Bucket Sample		< 10.	< 0.0010	10.
TP-2	3.5 – 6.0'			
5 Gallon Bucket Sample		< 10.	< 0.0010	
TP-9	1.3 – 5.0'			

NOTE: [1]Percent by weight after drying and prepared as per the Standard. *Withdrawn 2021 without Replacement

ASTM D 516 – Sulfates (Soluble)

Sample		Results		Minimum Detection Limit
		ppm (mg/kg)	%[1]	
5 Gallon Bucket Sample		< 10.	< 0.0010	10.
TP-2	3.5 – 6.0'			
5 Gallon Bucket Sample		< 10.	< 0.0010	
TP-9	1.3 – 5.0'			

NOTE: [1]Percent by weight after drying and prepared as per the Standard.

END OF ANALYSIS

USEPA Laboratory ID UT00930

Merrill Gee P.E. – Engineer in Charge

Appendix C

Field Testing – Infiltration Testing

GEI Consultants, Inc.
Shepaug Dam Solar Array - Project 2305289
Guelph Permeameter Testing - TP1

Calc. by: M. Chea **Date:** 4/3/2024
Check by: K. Gleichauf **Date:** 4/4/2024

Single Head Method - Test 1

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_1	-	5	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_1	-	8	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_1	-	0.803		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_1	-	4.6960	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	8.541E-03	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	7.118E-02	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Single Head Method - Test 2

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_2	-	10	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_2	-	12	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_2	-	1.288		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_2	-	7.044	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	7.632E-03	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	6.360E-02	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Test Averages

• Soil Saturated Hydraulic Conductivity	K_{fs}	-	**8.087E-03**	cm/sec	or	11.461 in/hour

GEI Consultants, Inc.
Shepaug Dam Solar Array - Project 2305289
Guelph Permeameter Testing - TP2

Calc. by: M. Chea **Date:** 4/3/2024
Check by: K. Gleichauf **Date:** 4/4/2024

Single Head Method - Test 1

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_1	-	5	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_1	-	1.3	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_1	-	0.803		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_1	-	0.7631	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	1.388E-03	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	1.157E-02	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Single Head Method - Test 2

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_2	-	10	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_2	-	1.8	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_2	-	1.288		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_2	-	1.0566	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	1.145E-03	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	9.540E-03	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Test Averages

• Soil Saturated Hydraulic Conductivity	K_{fs}	-	**1.266E-03**	cm/sec	or	1.795 in/hour

GEI Consultants, Inc.
Shepaug Dam Solar Array - Project 2305289
Guelph Permeameter Testing - TP3

Calc. by: M. Chea **Date:** 4/3/2024
Check by: K. Gleichauf **Date:** 4/4/2024

Single Head Method - Test 1

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_1	-	5	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	4		(Table 2)
• Steady State Rate of Water Level Change	R_1	-	14.5	cm/min	(Obtained during testing). This test did not achieve steady state. Ran out of water before reaching steady state. R2 is the average of the last 3 rate changes.

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.36	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_1	-	0.803		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_1	-	8.5115	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	2.560E-02	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	7.111E-02	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Single Head Method - Test 2

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_2	-	10	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	4		(Table 2)
• Steady State Rate of Water Level Change	R_2	-	33.4	cm/min	(Obtained during testing) This test did not achieve steady state. Ran out of water before reaching steady state. R2 is the average of the last 3 rate changes.

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.36	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_2	-	1.288		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_2	-	19.6058	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	3.008E-02	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	8.355E-02	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Test Averages

• Soil Saturated Hydraulic Conductivity	K_{fs}	-	**2.784E-02**	cm/sec	or	39.456 in/hour

GEI Consultants, Inc. | **Calc. by:** M. Chea | **Date:** 4/3/2024
Shepaug Dam Solar Array - Project 2305289 | **Check by:** K. Gleichauf | **Date:** 4/4/2024
Guelph Permeameter Testing - TP4

Single Head Method - Test 1

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_1	-	5	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_1	-	2.6	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_1	-	0.803		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_1	-	1.5262	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	2.776E-03	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	2.313E-02	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Single Head Method - Test 2

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_2	-	10	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_2	-	3.6	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_2	-	1.288		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_2	-	2.1132	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	2.290E-03	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	1.908E-02	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Test Averages

• Soil Saturated Hydraulic Conductivity	K_{fs}	-	**2.533E-03**	cm/sec	or	3.590 in/hour

GEI Consultants, Inc.	**Calc. by:** M. Chea	**Date:** 4/3/2024
Shepaug Dam Solar Array - Project 2305289	**Check by:** K. Gleichauf	**Date:** 4/4/2024
Guelph Permeameter Testing - TP5		

Single Head Method - Test 1

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_1	-	5	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_1	-	0.3	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_1	-	0.803		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_1	-	0.1761	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	3.203E-04	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	2.669E-03	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Single Head Method - Test 2

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_2	-	10	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_2	-	0.5	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_2	-	1.288		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_2	-	0.2935	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	3.180E-04	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	2.650E-03	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Test Averages

• Soil Saturated Hydraulic Conductivity	K_{fs}	-	**3.191E-04**	cm/sec	or	0.452 in/hour

GEI Consultants, Inc.
Shepaug Dam Solar Array - Project 2305289
Guelph Permeameter Testing - TP6

Calc. by: M. Chea **Date:** 4/3/2024
Check by: K. Gleichauf **Date:** 4/4/2024

Single Head Method - Test 1

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_1	-	5	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_1	-	0.4	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_1	-	0.803		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_1	-	0.2348	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	4.271E-04	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	3.559E-03	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Single Head Method - Test 2

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_2	-	10	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_2	-	0.7	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_2	-	1.288		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_2	-	0.4109	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	4.452E-04	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	3.710E-03	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Test Averages

• Soil Saturated Hydraulic Conductivity	K_{fs}	-	**4.361E-04**	cm/sec	or	0.618 in/hour

GEI Consultants, Inc. | **Calc. by:** M. Chea | **Date:** 4/3/2024
Shepaug Dam Solar Array - Project 2305289 | **Check by:** K. Gleichauf | **Date:** 4/4/2024
Guelph Permeameter Testing - TP7

Single Head Method - Test 1

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_1	-	5	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	4		(Table 2)
• Steady State Rate of Water Level Change	R_1	-	27.2	cm/min	(Obtained during testing). This test did not achieve steady state. Ran out of water before reaching steady state. R2 is the average of the last 3 rate changes.

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.36	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_1	-	0.803		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_1	-	15.9664	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	4.802E-02	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	1.334E-01	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Single Head Method - Test 2

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_2	-	10	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	4		(Table 2)
• Steady State Rate of Water Level Change	R_2	-	31.3	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.36	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_2	-	1.288		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_2	-	18.3731	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	2.819E-02	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	7.830E-02	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Test Averages

• Soil Saturated Hydraulic Conductivity	K_{fs}	-	**3.810E-02**	cm/sec	or	54.004 in/hour

GEI Consultants, Inc.
Shepaug Dam Solar Array - Project 2305289
Guelph Permeameter Testing - TP8

Calc. by: M. Chea **Date:** 4/3/2024
Check by: K. Gleichauf **Date:** 4/4/2024

Single Head Method - Test 1

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_1	-	5	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_1	-	0.8	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_1	-	0.803		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_1	-	0.4696	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	8.541E-04	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	7.118E-03	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Single Head Method - Test 2

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_2	-	10	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_2	-	1	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_2	-	1.288		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_2	-	0.587	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	6.360E-04	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	5.300E-03	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Test Averages

• Soil Saturated Hydraulic Conductivity	K_{fs}	-	**7.451E-04**	cm/sec	or	1.056 in/hour

GEI Consultants, Inc.	**Calc. by:**	M. Chea	**Date:**	4/3/2024
Shepaug Dam Solar Array - Project 2305289	**Check by:**	K. Gleichauf	**Date:**	4/4/2024
Guelph Permeameter Testing - TP9				

Single Head Method - Test 1

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_1	-	5	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_1	-	0.6	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_1	-	0.803		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_1	-	0.3522	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	6.406E-04	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	5.338E-03	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Single Head Method - Test 2

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_2	-	10	cm	
• Borehole Radius	a	-	3	cm	
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_2	-	3.4	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_2	-	1.288		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_2	-	1.9958	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	2.162E-03	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	1.802E-02	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Test Averages

• Soil Saturated Hydraulic Conductivity	K_{fs}	-	**1.402E-03**	cm/sec	or	1.986 in/hour

Table 2

	Soil Texture-Structure Category	α^*(cm^{-1})	Shape Factor
1	Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
2	Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
3	Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
4	Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Table 3

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi\left(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1)\right)}$ $G_2 = \frac{H_1 C_2}{\pi\left(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1)\right)}$ $K_{fs} = G_2 Q_2 - G_1 Q_1$ $G_3 = \frac{(2H_2^2 + a^2 C_2)C_1}{2\pi\left(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1)\right)}$ $G_4 = \frac{(2H_1^2 + a^2 C_1)C_2}{2\pi\left(2H_1 H_2(H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1)\right)}$ $\Phi_m = G_3 Q_1 - G_4 Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), a^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

Appendix D

Calculations

Purpose: Calculate lateral earth pressures for the Shepaug Dam Northern Solar Array

Reference: AASHTO (2020). "AASHTO LRFD Bridge Design Specifications," 9th Edition.

Calculations: **Lateral Earth Pressure Coefficients k_0, k_a, and k_p**

	Sand and Silt	**Sand and Gravel**	**Till**	**Ordinary Fill**	**Structural Fill**
Effective Friction Angle of Soil, ϕ'_f (deg)	32.0	34.0	40.0	30.0	35.0
Friction Angle Between Fill and Wall, δ	21.4	22.8	26.8	20.1	23.5
Angle of Fill to the Horizontal, β (deg)	0.0	0.0	0.0	0.0	0.0
Angle of Back Face of Wall to the Horizontal, θ (deg)	90.0	90.0	90.0	90.0	90.0
At-Rest Lateral Earth Pressure Coefficient, k_o (Eq. 3.11.5.2-1)	**0.47**	**0.44**	**0.36**	**0.50**	**0.43**
Γ (Eq. 3.11.5.3-2)	2.81	2.93	3.29	2.69	2.99
Active Lateral Earth Pressure Coefficient, k_a (Eq. 3.11.5.3-1)	**0.27**	**0.25**	**0.20**	**0.30**	**0.24**
$-\delta/\phi_f$	-0.67	-0.67	-0.67	-0.67	-0.67
β/ϕ_f	0.0	0.0	0.0	0.0	0.0
Coefficient of Passive Pressure for $\beta/\phi_f = 0$, k_p (Figure 3.11.5.4-2)	7.8	9.5	18.0	6.4	10.5
Reduction Factor of k_p, R (Figure 3.11.5.4-2)	0.837	0.818	0.749	0.856	0.808
Coefficient of Passive Pressure[(1)], k_p	**6.5**	**7.8**	**13.5**	**5.5**	**8.5**

Project: Shepaug Dam - Northern Solar Array
Newtown and Southbury, CT
GEI Project No.: 2305289

Site Class Evaluation - Shepaug Dam - Solar Array

Prepared By: M.Chea 4/8/2024
Checked By: K. Gleichauf 4/12/2024

Purpose: Evaluate seismic design criteria in accordance with 2015 International Building Code (IBC), ASCE 7-10, and the CT Amendments (2018).

Layer	Soil	B-1			
		N_i	N_{60i}	Layer (D_i)	D_i/N_{60i}
1	Sand & Silt	5	7	3.5	0.53
2		20	27	5	0.19
3	Till	100	133	5	0.04
4		100	133	5	0.04
5		100	133	1.5	0.01
6		100	133	80	0.60
7					
8					
9					
			Σ =	100	1.4
				$\overline{N}$	**71.31**

Layer	Soil	B-2			
		N_i	N_{60i}	Layer (D_i)	D_i/N_{60i}
1	Sand & Silt	3	4	5	1.25
2	Possible	100	133	95	0.71
3	Rock				
4					
5					
6					
7					
8					
9					
			Σ =	100	2.0
				$\overline{N}$	**50.83**

Layer	Soil	B-3			
		N_i	N_{60i}	Layer (D_i)	D_i/N_{60i}
1	Sand&Gravel	10	13	3.5	0.26
2		76	101	5	0.05
3	Till	41	55	4.0	0.07
4		41	55	88	1.60
5					
6					
7					
8					
9					
			Σ =	100	2.0
				$\overline{N}$	**50.24**

Layer	Soil	B-4			
		N_i	N_{60i}	Layer (D_i)	D_i/N_{60i}
1	Sand&Gravel	17	23	3.5	0.15
2	Till	53	70	6.5	0.09
3	Rock	100	133	90	0.68
4					
5					
6					
7					
8					
9					
			Σ =	100	0.9
				$\overline{N}$	**108.26**

Notes:
1. Conservatively assumed last layer encountered extended to 100 ft depth for B-1 and B-3.
2. Rock was encountered in B-4

Site Class Evaluation - Shepaug

$$N_{60} = N * C_E$$
$$where\ C_E = 1.33\ (Assumed\ automatic\ hammer\ had\ 80\%\ energy)$$

$$\overline{N} = \frac{\sum d_i}{\sum \frac{d_i}{N_{60i}}}$$

ASCE eq. 20.4-6

From ASCE Table 20.3-1 where $\overline{N}$ > 50, Site Class C

Project: Shepaug Dam - Northern Solar Array
Newtown and Southbury, CT
GEI Project No.: 2305289

Site Seismic Coefficients

Horizontal Response Spectral Acceleration (0.2 sec), Town of Southbury	S_s =	0.199	(from CTBC App. N)
Horizontal Response Spectral Acceleration (1 sec), Town of Southbury	S_1 =	0.054	(from CTBC App. N)

Use values from Town of Newtown because higher values

Site Seismic Coefficients (Site Class C):	F_a = 1.3		S_{MS} =	0.259	S_{DS} =	0.172
	F_V = 1.5		S_{M1} =	0.081	S_{D1} =	0.054

Design Response Spectra

Short Period Site Coefficient F_a	ASCE Table 11.4-1	
Long Period Site Coefficient F_v	ASCE Table 11.4-2	
Max. Considered Earthquake Spectral Acceleration (0.2 sec),	ASCE Eq. 11.4.1	$S_{MS} = F_a \ x \ S_s$
Max. Considered Earthquake Spectral Acceleration (1.0 sec),	ASCE Eq. 11.4.2	$S_{M1} = F_v \ x \ S_1$
Design Spectral Acceleration (0.2 sec),	ASCE Eq. 11.4.3	$S_{DS} = \frac{2}{3} S_{MS}$
Design Spectral Acceleration (1 sec),	ASCE Eq. 11.4.4	$S_{D1} = \frac{2}{3} S_{M1}$

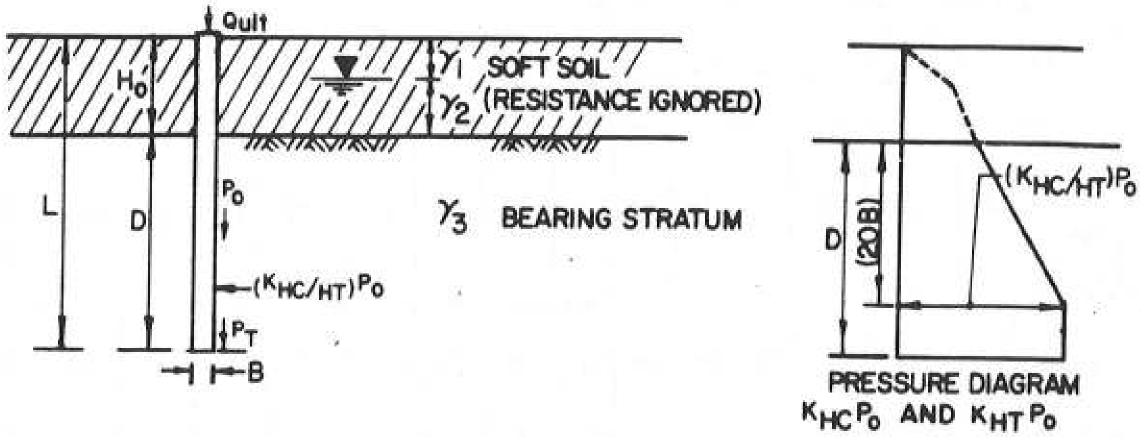
Appendix E

NAVFAC DM 7.2 excerpt (Pile Design)

Naval Facilities Engineering Command
200 Stovall Street
Alexandria, Virginia 22332-2300

Foundations &
Earth Structures

DESIGN MANUAL 7.02
REVALIDATED BY CHANGE 1 SEPTEMBER 1986



(A) ULTIMATE LOAD CAPACITY IN COMPRESSION

$$Q_{ult} = P_T N_q A_T + \sum_{H=H_O}^{H=H_O+D} (K_{HC})(P_O)(\tan\delta)(S)$$

WHERE Q_{ult} = ULTIMATE LOAD CAPACITY IN COMPRESSION

P_T = EFFECTIVE VERTICAL STRESS AT PILE TIP (SEE NOTE 1)

N_q = BEARING CAPACITY FACTOR (SEE TABLE, FIGURE 1 CONTINUED)

A_T = AREA OF PILE TIP

K_{HC} = RATIO OF HORIZONTAL TO VERTICAL EFFECTIVE STRESS ON SIDE OF ELEMENT WHEN ELEMENT IS IN COMPRESSION.

P_o = EFFECTIVE VERTICAL STRESS OVER LENGTH OF EMBEDMENT, D (SEE NOTE 1)

δ = FRICTION ANGLE BETWEEN PILE AND SOIL (SEE TABLE, FIGURE 1 CONTINUED)

S = SURFACE AREA OF PILE PER UNIT LENGTH

FOR CALCULATING Q_{all}, USE F_S OF 2 FOR TEMPORARY LOADS, 3 FOR PERMANENT LOADS. (SEE NOTE 2)

(B) ULTIMATE LOAD CAPACITY IN TENSION

$$T_{ult} = \sum_{H=H_O}^{H=H_O+D} (K_{HT})(P_O)(\tan\delta)(S)(H)$$

WHERE: T_{ult} = ULTIMATE LOAD CAPACITY IN TENSION, PULLOUT

K_{HT} = RATIO OF HORIZONTAL TO VERTICAL EFFECTIVE STRESS ON SIDE OF ELEMENT WHEN ELEMENT IS IN TENSION

FOR CALCULATING T_{all}, USE $F_S = 3$ ON T_{ult} PLUS THE WEIGHT OF THE PILE (W_P), THUS $T_{all} = \frac{T_{ult}}{3} + W_P$ (SEE NOTE 2)

NOTE-1: EXPERIMENTAL AND FIELD EVIDENCE INDICATE THAT BEARING PRESSURE AND SKIN FRICTION INCREASE WITH VERTICAL EFFECTIVE STRESS P_o UP TO A LIMITING DEPTH OF EMBEDMENT, DEPENDING ON THE RELATIVE DENSITY OF THE GRANULAR SOIL AND POSITION OF THE WATER TABLE. BEYOND THIS LIMITING DEPTH (10B± TO 40B±) THERE IS VERY LITTLE INCREASE IN END BEARING, AND INCREASE IN SIDE FRICTION IS DIRECTLY PROPORTIONAL TO THE SURFACE AREA OF THE PILE. THEREFORE, IF D IS GREATER THAN 20 B, LIMIT P_o AT THE PILE TIP TO THAT VALUE CORRESPONDING TO D = 20B.

NOTE-2: IF BUILDING LOADS AND SUBSURFACE CONDITION ARE WELL DOCUMENTED IN THE OPINION OF THE ENGINEER, A LESSER FACTOR OF SAFETY CAN BE USED BUT NOT LESS THAN 2.0 PROVIDED PILE CAPACITY IS VERIFIED BY LOAD TEST AND SETTLEMENTS ARE ACCEPTABLE.

FIGURE 1
Load Carrying Capacity of Single Pile in Granular Soils

BEARING CAPACITY FACTORS - N_q

ϕ* (DEGREES)	26	28	30	31	32	33	34	35	36	37	38	39	40
N_q (DRIVEN PILE DISPLACEMENT)	10	15	21	24	29	35	42	50	62	77	86	120	145
N_q ** (DRILLED PIERS)	5	8	10	12	14	17	21	25	30	38	43	60	72

EARTH PRESSURE COEFFICIENTS K_{HC} AND K_{HT}

PILE TYPE	K_{HC}	K_{HT}
DRIVEN SINGLE H-PILE	0.5 – 1.0	0.3 – 0.5
DRIVEN SINGLE DISPLACEMENT PILE	1.0 – 1.5	0.6 – 1.0
DRIVEN SINGLE DISPLACEMENT TAPERED PILE	1.5 – 2.0	1.0 – 1.3
DRIVEN JETTED PILE	0.4 – 0.9	0.3 – 0.6
DRILLED PILE (LESS THAN 24" DIAMETER)	0.7	0.4

FRICTION ANGLE - δ

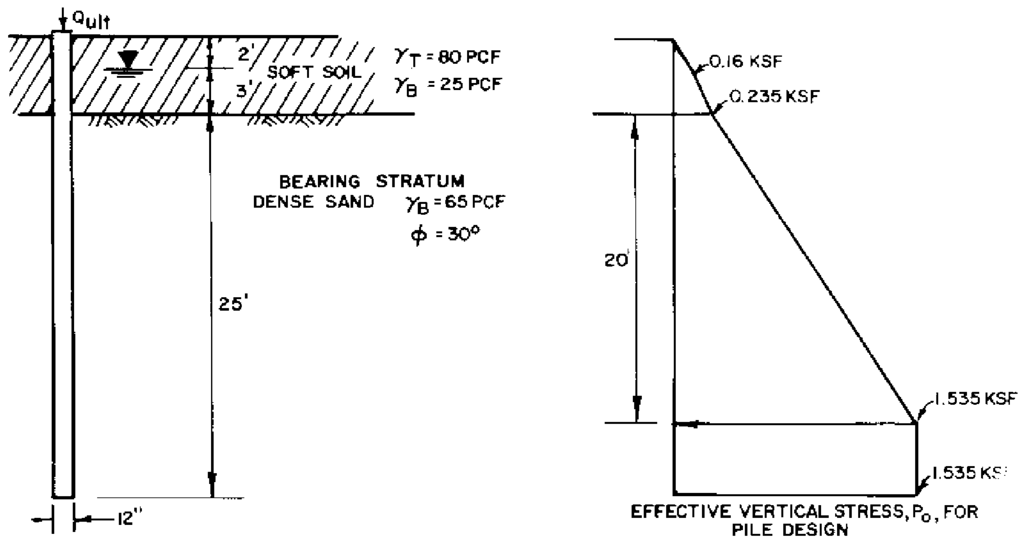
PILE TYPE	δ
STEEL	20°
CONCRETE	3/4 ϕ
TIMBER	3/4 ϕ

* LIMIT ϕ TO 28° IF JETTING IS USED

** (A) IN CASE A BAILER OR GRAB BUCKET IS USED BELOW GROUNDWATER TABLE, CALCULATE END BEARING BASED ON ϕ NOT EXCEEDING 28°.

(B) FOR PIERS GREATER THAN 24-INCH DIAMETER, SETTLEMENT RATHER THAN BEARING CAPACITY USUALLY CONTROLS THE DESIGN. FOR ESTIMATING SETTLEMENT, TAKE 50% OF THE SETTLEMENT FOR AN EQUIVALENT FOOTING RESTING ON THE SURFACE OF COMPARABLE GRANULAR SOILS. (CHAPTER 5, DM-7.1).

FIGURE 1 (continued)
Load Carrying Capacity of Single Pile in Granular Soils



FOR A 12" DIAMETER CLOSED END, DRIVEN PIPE PILE, CONCRETE FILLED, FIND Q_{all} AND T_{all} FOR A 30 FOOT LONG PILE.

P_o MAX OCCURS AT 20B, OR 20' INTO BEARING STRATUM.

$\phi = 30^\circ$, $N_q = 21$

$K_{HC} = 1.5$, $\delta = 20^\circ$

$K_{HT} = 1.0$

$A_T = \pi \times 0.5^2 = 0.78$ SF

CIRCUM. AREA / lf $= 1 \times \pi = 3.14$ SF / lf

$$Q_{ult} = 1.535 \times 21 \times 0.78 + \left[(1.5 \times (\frac{0.235 + 1.535}{2}) \times \text{TAN } 20 \times 20 \times 3.14) + (1.5 \times 1.535 \times \text{TAN } 20 \times 5 \times 3.14) \right]$$

$$= 25.14 + [30.34 + 13.16]$$

$$= 68.64 \text{ K}$$

FOR $F_S = 3$, $Q_{all} = \frac{68.64}{3} = 22.9$ K

$$T_{ult} = 1.0 \times (\frac{0.235 + 1.535}{2}) \times \text{TAN } 20 \times 20 \times 3.14 + 1.0 \times 1.535 \times \text{TAN } 20 \times 5 \times 3.14$$

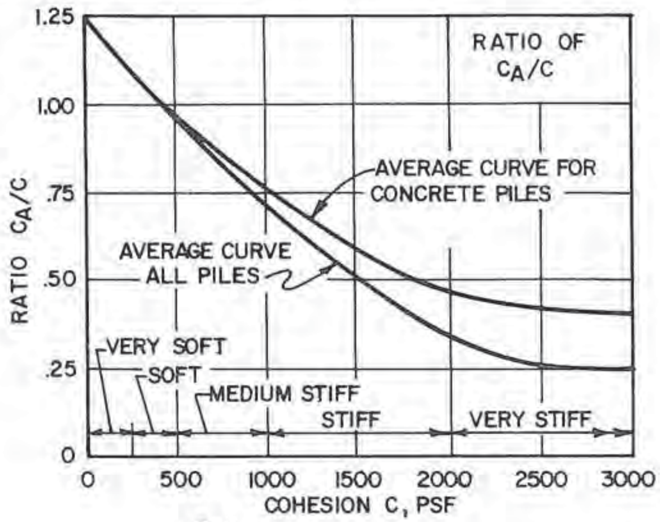
$$= 20.23 + 8.77$$

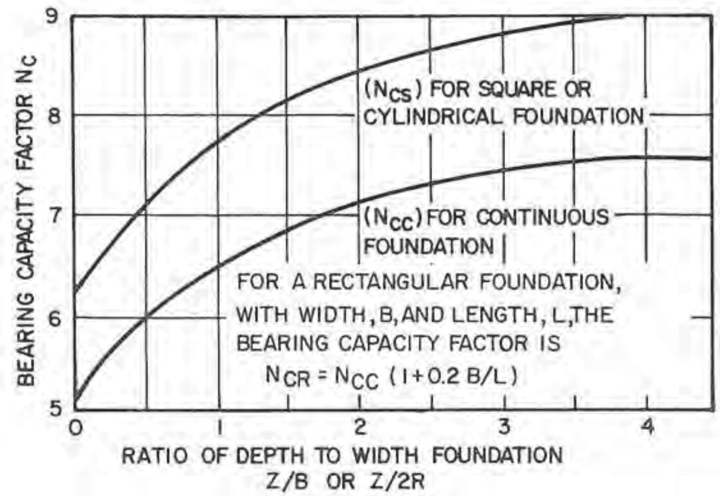
$$= 29.0 \text{ K}$$

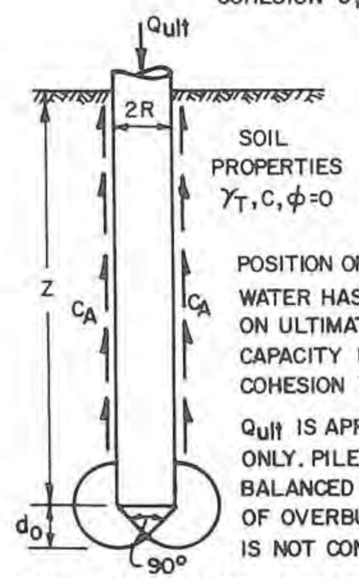
$W_P \approx .117$ K/lf $\times$ 30' $= 3.5$ K

$$T_{all} = \frac{29.0}{3} + 3.5 = 13.2 \text{K}$$

FIGURE 1 (continued)
Load Carrying Capacity of Single Pile in Granular Soils







SOIL PROPERTIES
$\gamma_T, C, \phi=0$

POSITION OF GROUND-WATER HAS NO EFFECT ON ULTIMATE LOAD CAPACITY UNLESS COHESION IS CHANGED.

Q_{ult} IS APPLIED LOAD ONLY. PILE WEIGHT IS BALANCED BY WEIGHT OF OVERBURDEN AND IS NOT CONSIDERED.

ULTIMATE LOAD CAPACITY IN COMPRESSION

$$Q_{ult} = C\,\underset{(N_{CC})}{(N_{CS})}\,\pi R^2 + C_A\, 2\pi RZ$$

RECOMMENDED VALUES OF ADHESION

PILE TYPE	CONSISTENCY OF SOIL	COHESION, C PSF	ADHESION, C_A PSF
TIMBER AND CONCRETE	VERY SOFT	0 - 250	0 - 250
	SOFT	250 - 500	250 - 480
	MED. STIFF	500 - 1000	480 - 750
	STIFF	1000 - 2000	750 - 950
	VERY STIFF	2000 - 4000	950 - 1300
STEEL	VERY SOFT	0 - 250	0 - 250
	SOFT	250 - 500	250 - 460
	MED. STIFF	500 - 1000	460 - 700
	STIFF	1000 - 2000	700 - 720
	VERY STIFF	2000 - 4000	720 - 750

ULTIMATE LOAD CAPACITY IN TENSION

$T_{ult} = C_A\, 2\pi RZ$

T_{ult} UNDER SUSTAINED LOAD MAY BE LIMITED BY OTHER FACTORS, SEE TEXT.

FIGURE 2
Ultimate Load Capacity of Single Pile or Pier in Cohesive Soils

(3) Drilled Piers. For drilled piers greater than 24 inches in diameter settlement rather than bearing capacity may control. A reduced end bearing resistance may result from entrapment of bentonite slurry if used to maintain an open excavation to the pier's tip. Bells, or enlarged bases, are usually not stable in granular soils.

(4) Piles and Drilled Piers in Cohesive Soils. See Figure 2 and Table 3. Experience demonstrates that pile driving permanently alters surface adhesion of clays having a shear strength greater than 500 psf (see Figure 2). In softer clays the remolded material consolidates with time, regaining adhesion approximately equal to original strength. Shear strength for point-bearing resistance is essentially unchanged by pile driving. For drilled piers, use Table 3 from Reference 4, Soils and Geology, Procedures for Foundation Design of Buildings and Other Structures, by the Departments of Army and Air Force, for determining side friction. Ultimate resistance to pullout cannot exceed the total resistance of reduced adhesion acting over the pile surface or the effective weight of the soil mass which is available to react against pullout. The allowable sustained pullout load usually is limited by the tendency for the pile to move upward gradually while mobilizing an adhesion less than the failure value.

Adhesion factors in Figure 2 may be very conservative for evaluating piles driven into stiff but normally consolidated clays. Available data suggests that for piles driven into normally to slightly overconsolidated clays, the side friction is about 0.25 to 0.4 times the effective overburden.

(5) Piles Penetrating Multi-layered Soil Profile. Where piles penetrate several different strata, a simple approach is to add supporting capacity of the individual layers, except where a soft layer may consolidate and relieve load or cause drag on the pile. For further guidance on bearing capacity when a pile penetrates layered soil and terminates in granular strata see Reference 5, Ultimate Bearing Capacity of Foundations on Layered Soils Under Inclined Loads, by Meyerhoff and Hanna, which considers the ultimate bearing capacity of a deep member in sand underlying a clay layer and for the case of a sand bearing stratum overlying a weak clay layer.

(6) Pile Buckling. For fully embedded piles, buckling usually is not a problem. For a fully embedded, free headed pile with length equal to or greater than 4T, the critical load for buckling is as follows (after Reference 6, Design of Pile Foundations, by Vesic):

$$P_{crit} = 0.78\ T^3 f \quad \text{for } L \geq 4T$$

where: P_{crit} = critical load for buckling

f = coefficient of variation of lateral subgrade reaction (see Figure 10)

T = relative stiffness factor (see Figure 10)

L = length of pile.

TABLE 3

Design Parameters for Side Friction for Drilled Piers in Cohesive Soils

Design Category	Side Resistance		Remarks
	C_A/C	Limit on side shear - tsf	
A. Straight-sided shafts in either homogeneous or layered soil with no soil of exceptional stiffness below the base			
1. Shafts installed dry or by the slurry displacement method	0.6	2.0	
2. Shafts installed with drilling mud along some portion of the hole with possible mud entrapment	0.3(a)	0.5(a)	(a) C_A/C may be increased to 0.6 and side shear increased to 2.0 tsf for segments drilled dry
B. Belled shafts in either homogeneous or layered clays with no soil of exceptional stiffness below the base			
1. Shafts installed dry or by the slurry displacement methods	0.3	0.5	
2. Shafts installed with drilling mud along some portion of the hole with possible mud entrapment	0.15(b)	0.3(b)	(b) C_A/C may be increased to 0.3 and side shear increased to 0.5 tsf for segments drilled dry