WETLANDS & HABITATS REPORT

SOLAR GENERATION FACILITY

North Stonington, Connecticut

February 19, 2021

REMA

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1.0 INTRODUCTION

This *Wetlands and Habitats Report* describes inventory of natural habitats and the in-field delineations and characterization of regulatory wetlands and watercourses by Rema Ecological Services, LLC (REMA) on the proposed 9.9 MW (AC) Solar Photovoltaic Power Generation Facility site (the site, the study area) during 2017 through 2020. Figure 2 (Attachment A) shows the delineated wetland units, and Figure 3 (Attachment A) shows the distribution of upland cover types.

Specifically, four REMA staff with expertise in soils, ecology, botany, and wildlife visited the subject site starting on February 6th, 2017. The most recent site inspection was conducted on December 30th, 2020. As there are multiple seasonally flooded pools in the south-central portion of the site, spring vernal pools inventories took place in all four years. In all, REMA staff visited the site on 24 different days since February 2017, logging nearly 175 hours in the field.

2.0 LANDSCAPE SETTING AND BEDROCK GEOLOGY

The study area encompasses roughly 157 acres of land in North Stonington, Connecticut. Of this acreage, 43 acres would be developed to accommodate the solar power generation facility. The site consists of several adjoining parcels on the north side of Interstate 95, both south and north of New London Turnpike (Route 184), west of Boombridge Road, and east of the easterly terminus of Cranberry Bog Road. The northern 31.13-acre parcel abuts the north side of Route 184. The overall site drains southerly, passing under the highway (I-95) as an unnamed perennial tributary (Basin No. 100-1). This stream flows about 0.4 miles into Lewis Pond, which discharges into the Pawcatuck River.

The entire site is underlain by the Potter Hill Granitic Gneiss formation. This is a light to medium gray, well-foliated, fine to medium-grained granitic gneiss, that weathers into acidic coarse-loamy soil, of low to moderate fertility. Several examples of this bedrock type can be seen exposed in the larger central quarry, in the far northwestern corner of the site, and just west of the "Wetland E" stream corridor, a few hundred feet north of the northern limit of past quarrying.

3.0 NORTHERN & NORTH CENTRAL PART OF SITE

3.1 Topography, Soils, and Erosion Risks

This central section of the site, south or Route 184, is traversed by two headwaters stream corridors and one less well defined drainageway, all to be avoided by the proposed project (see Figure 2, Attachment A).

The forested northern and central portions of the site, where the solar arrays will be located, have coarse-loamy soils derived from glacial till. Throughout this area, the acidic, coarse-loamy upland soils have developed into soils in the Charlton/ Canton/Leicester catena. The wetland soils in the northern portion of the site, underlain by glacial till, are mostly the poorly drained Leicester and very poorly drained Whitman series. Moderately well drained Sutton series is important north of Route 184. The "A" soil horizons (i.e., topsoil) are thickened in this portion of the site, since most areas were farmed in the past. In the central forested portion of the site, south of Route 184 and west of Boombridge Road, the "A" horizons are very thin, just an inch or two, indicating that these areas have not been intensely farmed in the past.

The upper soil horizons throughout most of the forested sections of the site are *not* underlain by fine-textured compact till (a.k.a. hardpan) which originates from the prior Illinoian glaciation. Paxton soil, derived from compact till has highly erosible subsoil, with an erosion "K" coefficient of 0.48, only encompass a small section of the site, in the eastern section of the northern parcel, north of Route 184. By comparison, the "B" horizon (i.e., subsoil) of Charlton fine sandy loam, the dominant well drained soil type throughout the balance of the site, is 0.24. In general, slopes are also gentle to moderate, and the few steeper slopes are not extensive.

However, shallow-to-bedrock Chatfield soils are also present, boulders under two feet in diameter are common, and there are occasional sizable glacial erratics. Bedrock outcrops were observed in the forested northwestern corner of the site, and also on the upland forested hillside, east of the Wetland E stream corridor (see Figure 2, Attachment A).

3.3 Vegetation Overview

The vegetation in the northern and north-central areas is mostly immature forest or maturing forest, with one central tract of mature mixed oak-pine forest. There are also dense sapling thickets on the forest perimeter, as shown on the Vegetative Cover Types map, Figure 3, in Attachment A.

Immature mixed deciduous-evergreen forest occupies the east-central formerly farmed areas. White pine is the dominant evergreen species in the northern forest. A roughly four-acres dense grove of Eastern hemlock abuts the easternmost stream corridor. Evergreen sapling thickets occur adjacent to the larger, central quarry area, white pine saplings thickets are concentrated on the north side, and red cedar saplings elsewhere, but a mix of evergreen, oak, and gray birch saplings is most common within and adjacent to the central former quarry and also next to the dirt roads. The mosaic of immature evergreen/hardwood copses and open sand barren will be left untouched (see also Section 7.0).

The most mature forest occupies approximately eight acres at the center of the site, including an old cemetery, as shown on Figure 3, Attachment A. This tract is the only example of this cover type, mapped as Zone U10 and in part U9. Oaks and white pines are the dominant species. We estimate that over 10% of the trees are > 18" in diameter, though a formal assessment of tree size distribution was not conducted. One of the rare species, the red bat, is most likely to roost in this portion of the site, since it prefers mature forest. As elsewhere in Connecticut, oaks are the dominant hardwoods in well-drained, acidic coarse-loamy soil, and red maples are overwhelmingly dominant in till-derived, wetland soils. Black birch is also present and may form a monoculture in formerly farmed soils (cropland).

Understory species composition is as expected for these forested communities, with wildflowers like spotted wintergreen and shinleaf, not depauperate, but also not with a high likelihood of rare species, since these are widespread forest types. This is in contrast to the forests growing on landforms underlain by mafic basalt, gabbro, or limestone, where the bedrock weathers into sub-acidic to circum-neutral soils. Plant diversity, and accompanying insect diversity is significantly higher in forests underlain by those bedrock types than it is at this site, and the likelihood of rare forest species is higher as well.

Soils & Vegetation on Sandy/Gravelly Glacial Outwash

In the southern portion of the site, the Surficial Geology Map of Connecticut (Stone et al. 1991) shows a large, contiguous deposit of sand and gravel (glacial outwash). This material was quarried (mined) for sand and gravel in the second half of the 20th century. Figure 3 (Attachment A) shows the approximate limits of this mining operation, an area encompassing nearly 58 acres. Vegetation in the formerly excavated portion is low in species diversity, dominated by a few species of early successional plants, though variable in density and species make-up, depending on the soil moisture regimes, depth to bedrock, proximity of seasonally and temporarily flooded pools, and the amount of time elapsed since cessation of earth-mining at a particular location. Most of the well-drained soil supports dense thickets of invasive autumn olive and multiflora rose and thickets of saplings of gray birch, white pine, and red cedar, and is designated Zone 16.

Roughly ten percent of the former quarry is still partly open, with sparse grasses, patches of drought-tolerant woody species such as gray birch or red cedar, and bedrock knobs, designated as Zone 17 (i.e., U17) on Figure 3, the cover type map (Attachment A). Scattered seasonal wetlands have developed in depressions including, several productive vernal pools. A network of dirt roadways crisscrosses the excavated area. Well-drained roadsides also belong in Zone 17, too small and too narrow for them to be mapped on Figure 3.

The southernmost section of the quarried area is occupied by continuous wetlands, all part of Wetland 2E (see Figure 2, Attachment A). Seasonally wet, disturbed soils with irregular topography support dense shrub and sapling thickets and tangles with multiple seasonal pools, ditches, and drainageways, some hydrologically interconnected, others isolated. Large, deep permanent, excavated ponds in the southwestern section of the site, near the highway, are fed mostly by drainage from the north. Strips of grassy meadow occur along sunny roadsides, pond perimeters, and pool edges. Native wetland plant species, other than the common colonizers, are present in low numbers, more so near the perimeter of the large quarried area, which is delimited on Figure 3 (Attachment A) by a thick yellow dashed line.

However, water quality is good, and the wetlands support vernal pool amphibians and associated predatory reptile fauna, as well as songbirds. Figure 3 also shows the sighting

locations of three Connecticut Special Concern herptiles: ribbon snake, spotted turtle, and Eastern box turtle (also see Section 7.0). Goat willow and multiflora rose are the two dominant shrubs in the wetlands. Though not native plants, they do support foliage insects (e.g., caterpillars), as they are closely related to native roses and willows.

North of I-95, the site's immediate landscape setting includes a dog kennel on an adjoining property, farmland to the northwest, and single-family homes to the northeast, west, and east. The site's ecological integrity is reduced by its location between a major highway (I-95) and another major secondary road (Rt. 184). These fragment the landscape, limiting dispersal and genetic exchange, for both plants and fauna, and have hampered natural recolonization of areas disturbed by farming and by the sand and gravel excavation.

4.0 PAST LAND USES

A series of historic-archival aerial photographs, now available on-line, were reviewed, to understand the chronology of the past land uses that have influenced wetland and vegetation development over the past century. These include photos taken in 1934, 1951, 1965, 1970, 1986, 1990, 1995, and 2004[1] (see Figures A and B, Attachment A). The 1951 aerial photo showed open fields in multiple currently forested areas, and also three large fields within the area to be quarried. The stone walls delimit former farm fields in the site's northeastern, east-central, and southwestern forested areas. Dense invasive thickets occupy the former fields to the east of the Wetland B/1B corridor. Along the central forested wetland corridor, Wetland E, abundant Japanese barberry indicates that grazing was a former land use, since livestock avoids barberry. Level, even ground, low diversity herbs, and overwhelming dominance of black birch trees is an indicator of former crop fields.

The excavation was underway by the mid 1970's. The 1986 photo showed the maximum extent of unvegetated bare soil. The final stage, excavation of the southern ponds, to depths of four to eight feet, took place between 1986 and 1990. However, some sand and gravel extraction was still taking place at the far eastern portion of the mining area

[1] Also, more recent aerial photographs, that is 2005 and forward were viewed on various online platforms, including Google Earth.

until sometime around 2004, based on aerial photography, at which point these areas were abandoned.

The network of looping haul roads through the quarry are still passable but only the largest are still visible on the 2018 aerial photo, the base map for Figures 2 and 3 (Attachment A). During the twenty-five to thirty years since cessation of excavation work, dense, lush, thicket vegetation has become established on moist and wet soils. Some upland areas support dense sapling thickets of gray birch, white pine, or red cedar. However, dry areas, with shallow sand over bedrock are still less than 50% unvegetated.

At the far north end of the site, north of Route 184, two stone walls about twenty feet apart also delimit the sides of the former route of the Providence-New London Turnpike. The unpaved roadway was eroded and depressed over a foot, by centuries of traffic along this important thoroughfare. Portions are now often filled with water, where the old roadbed crosses the central drainageway (Wetland A-2). The review of the archival photographs also revealed that a ditch was dug to drain the shallow ponded area embedded at the south end of this drainageway, which is a functional vernal pool (see Section 6.0).

No quarry activity, and very little motorized traffic of any sort has taken place on the site over the past 15 to 20 years. This has limited the spread of mugwort, a serious invasive weed of open disturbed soils, that has "taken off" elsewhere in Connecticut, over the past fifteen years or so, especially at construction sites. This invasive is present along the first several hundred feet of the entry road, but has spread very little though the road network and within the two quarries.

5.0 SURFACE WATER RESOURCES & WETLANDS

5.1 Introduction

The study area's many wetlands and surface waters are shown in Figure 2 in Attachment A. After reviewing federal and state wetlands and soils maps, REMA staff conducted detailed site investigations of vegetation, soils, and hydrology to demarcate regulated (i.e., State), and jurisdictional (i.e., Federal) wetland boundaries. Attachment B provides representative annotated photographs of each of these regulated resource areas. This section briefly describes the overall wetland and surface water resources associated with the study area (i.e., streams, open water habitats, and seasonally flooded areas). Eleven

of the seasonally flooded pools had documented amphibian breeding, such that they were classified as vernal pools.

All of the wetlands and surface waters within the study area were field-delineated in accordance with both state and federal statutes and criteria by a professional wetland/soil scientist.[2] State regulated wetlands were delineated in accordance with the Inland Wetlands and Watercourses Act (Connecticut General Statutes §22a-38). Federal jurisdictional wetlands were delineated pursuant to the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual (1987): Northcentral and Northeast Region, Version 2.0 (2012).*

The initial wetland delineations took place in April 2017. As additional land was added to the study area, including the parcel to the north of Route 184, wetland delineations were conducted in November 2018 and May and July 2019.

5.2 Drainage Patterns and Hydrology

Wetlands and stream flow patterns are influenced by the underlying bedrock and topography. Beginning north of Route 184, the land slopes in a generally southerly direction towards I-95 and the Pawcatuck River, with hilly terrain on the north end of the site.

This site falls within local Basin No. 100-1, which drains southerly into the Pawcatuck River, and has an area of 1,050 acres (0.6 sq. miles). The northern limit of this basin is only about 1,000 feet north of Rt. 184.

The headwaters streams in the northeastern forested section of the site ("E" and "B") have intermittent flow along broad, forested wetland corridors. Because their watersheds are 35 acres or less, they support limited benthic macroinvertebrates, but, as shown in Figure 2, the Wetland E stream corridor has a productive "in line" vernal pool.

The two northwestern streams both flow into the west end of the large, seasonally to semi-permanently flooded shrub swamp (Wetland 2E), dominated by goat willow and multiflora rose. They converge, forming a single, defined channel, which flows southerly about 225 feet long before discharging into the westernmost excavated deep

[2] i.e., George T. Logan, MS, PWS, CSE.

pond. At the confluence of the two streams the upgradient watershed area is roughly 128 acres, according to USGS StreamStats. This is borderline for perennial flow. However, the rocky, ditched outlet stream from the ponds is fully perennial. Riffle beetles (Elmidae) and caddisflies (Trichoptera) were observed in this ditched watercourse that conveys outflow from the southern excavated ponds to the culvert under the highway.

The excavated ponds are permanent and support fish and spotted turtles, although they experience summer drawdowns, because they intercept the regional water table. Algal blooms were not observed. The maximum depth measured was more than eight feet; a depth of four feet was more typical.

Drainage and groundwater discharge from the northwestern portion of this Local Basin 100-1 also reaches the ponds, but flow patterns are disorganized through the disturbed former sand excavation in the west-central portion of the site. This area includes documented vernal pools ("H", "O", "E", "I", and "N"). The higher elevation upland portion has multiple isolated or interconnected wetlands with a wide range of hydrologic regimes, and a mix of emergent and scrub shrub vegetation. Wetlands include shallow, temporary sheet flow in roadbeds and broad shallow pools with abundant eastern toad breeding. Excavated pools (some over four feet) of various sizes may be flooded long enough (until late August) for salamander metamorphosis, or they may be flooded only until mid-summer, sufficient for wood frog breeding. A ribbon snake and an eastern box turtle were found in this cover type. Amphibian tadpoles are important food for both species.

At the base of the hill, an extensive shrub swamp is fed primarily by groundwater. It has numerous semi-permanently flooded pools and channels. Though facultative amphibians like green frogs and tree frogs were evident, and a few widely scattered spotted salamander egg masses were found, vernal pools are lacking. Low diversity vegetation is dominated by goat willow and multiflora rose, but other native shrubs and herbs like highbush blueberry, black willow, speckled alder, silky dogwood, and grape vines are present as well. Herbaceous vegetation included assorted grasses, sedges, jewelweed, and several *Dryopteris* species (wood fern and crested fern).

5.3 Soils

Throughout the quarried area wetland soils are mapped as Aquents (308w). Fluvaquents (109) may also be present where the stream passes through disturbed soils, and picks up and redeposits sediments. A-horizons are forming in most areas, and in a few deep vernal pool significant organic matter is building. In the north central and northern portion of the site, soils in the central stream corridors, Wetland E and Wetland B/1B, belong to USDA Mapping Unit 3, which include the Ridgebury, Leicester, and Whitman soil series and are very stony with slopes of 0 to 8%.

Following are brief descriptions of the identified wetland soil types:

Ridgebury fine sandy loam (3). This soil series consists of deep, poorly and somewhat poorly drained soils formed in a coarse-loamy mantle underlain by firm, compact glacial till on uplands. They are nearly level to moderately steep soils on till plains, low ridges and drumloidal landforms. The soils formed in acid glacial till derived mainly from schist, gneiss or granite. Typically, these soils have a black sandy loam surface layer 6 inches thick. The mottled subsoil from 6 to 16 inches is olive gray sandy loam. The mottled substratum from 16 to 60 inches is a light olive brown and olive, very firm and brittle gravelly sandy loam.

Leicester fine sandy loam (3). This series, which is some Connecticut counties is found only in complex with the Ridgebury and Whitman series, consists of deep, poorly drained loamy soils formed in friable glacial till on uplands. They are nearly level to gently sloping soils in drainage ways and low lying positions on till covered uplands. The soils formed in acid glacial till derived mainly from schist, gneiss or granite. Typically, these soils have a surface layer of black fine sandy loam 6 inches thick. The subsoil from 6 to 23 inches is grayish brown, mottled fine sandy loam. The substratum from 26 to 60 inches or more is dark yellowish brown, mottled, friable, gravelly fine sandy loam.

Whitman fine sandy loam (3). This series, which is some Connecticut counties is only mapped in complex with the Ridgebury and Leicester series, consists of deep, very poorly drained soils formed in a coarse-loamy mantle underlain by firm, compact glacial till on uplands. They are nearly level and gently sloping soils on till plains, low ridges and drumloidal landforms. The soils formed in acid glacial till derived mainly from schist, gneiss or granite. Typically, these soils have a black fine sandy loam surface layer 8 inches thick. The mottled subsoil from 8 to 15 inches is gray sandy loam. The mottled substratum from 15 to 60 inches is firm, olive gray to gray dense glacial till.

Fluvaquents (109). This soil map unit consists of relatively recently formed, moderately well drained and well drained, floodplain soils. Fluvaquents are typically found in disturbed landscapes on floodplains where two or more feet of the original soil surface has been filled over or excavated. Most areas of Fluvaquents flood each year for short periods, mainly in the spring. The Fluvaquents soil mapping unit is a miscellaneous unit which includes a large variety of soil materials. Common locations of Fluvaquents include disturbed areas for community development and sand and gravel operations situated in the floodplains of rivers and major streams.

Aquents (308w). This soil map unit consists of poorly drained and very poorly drained, disturbed land areas. They are most often found on landscapes which have been subject to prior filling and/or excavation activities. In general, this soil map unit occurs where two or more feet of the original soil surface has been filled over, graded or excavated. The *Aquents* are characterized by a seasonal to prolonged high ground water table and either support or are capable of supporting wetland vegetation. *Aquents* are recently formed soils which have an aquic moisture regime. An aquic moisture regime is associated with a reducing soil environment that is virtually free of dissolved oxygen because the soil is saturated by groundwater or by water of the capillary fringe. The key feature is the presence of a ground water table at or very near to the soil surface for a period of fourteen days or longer during the growing season.

The upland type soils were identified through a high-intensity soil survey (i.e., HISS) conducted by REMA associate Bill Jackson, Registered Soil Scientist. This survey was concentrated within the areas of the proposed solar arrays. Additional soil types outside the footprint of the proposed solar arrays were checked to verify if they matched the published soil survey maps of Connecticut (see Attachment C). In general, we found that there were more moderately well drained Sutton soils within the areas of survey than indicated on the CT Soil Survey maps. Several representative soil profiles were described within the HISS areas and included with a memorandum in Attachment C[3].

Following are brief descriptions of the identified upland soil types:

Charlton very stony fine sandy loam (73). This series consists of very deep, well drained coarse-loamy soils formed in friable, glacial till on uplands. They are nearly level to very steep soils on till plains and hills. The soils formed in acid glacial till derived mainly from schist, gneiss or granite. In tilled areas, these soils have a surface layer of dark brown fine sandy loam 8 inches thick. The subsoil from 8 to 26 inches is

[3] The approximate locations of the representative soil profiles can be provided upon request.

yellowish brown fine sandy loam and sandy loam. The substratum from 26 to 60 inches or more is grayish brown gravelly fine sandy loam.

Chatfield loam (73). This series consists of moderately deep, well drained, and somewhat excessively drained soils formed in till. They are nearly level to very steep soils on glaciated plains, hills, and ridges. Slope ranges from 0 to 70 percent. Crystalline bedrock is at depths of 20 to 40 inches. Permeability is moderate or moderately rapid. In tilled areas, these soils have a surface layer that is very dark to dark grayish brown loam up to 8 inches thick. The subsoil from 8 to 26 inches is brown, flaggy silt loam.

Canton stony fine sandy loam (62). This series consists of deep, well drained soils formed in a coarse-loamy mantle underlain by sandy glacial till on uplands. They are nearly level to very steep soils on till plains and hills. The soils formed in acid glacial till derived mainly from schist, gneiss or granite. Typically, these soils have a surface layer of very dark grayish brown fine sandy loam 2 inches thick. The subsoil from 2 to 23 inches is yellowish brown fine sandy loam, gravelly fine sandy loam and gravelly sandy loam. The substratum from 23 to 60 inches is pale brown gravelly loamy sand.

Sutton fine sandy loam (51). This series consists of deep, moderately well drained loamy soils formed in friable, glacial till on uplands. They are nearly level to steeply sloping very stony soils on till plains, low ridges and hills, being typically located on lower slopes and in slight depressions. The soils formed in acid glacial till derived mainly from schist, gneiss or granite. Typically, these soils have a surface layer of dark brown fine sandy loam 8 inches thick. The subsoil from 8 to 28 inches is yellowish brown, mottled fine sandy loam and sandy loam. The substratum from 28 to 60 inches or more is light olive brown fine sandy loam.

Udorthents (308). This soil mapping unit consists of well drained to moderately well drained soils that have been altered by cutting, filling, or grading. The areas either have had two feet or more of the upper part of the original soil removed or have more than two feet of fill material on top of the original soil. *Udorthents* or Made Land soils can be found on any soil parent material but are typically fluvial on glacial till plains and outwash plains and stream terraces.

6.0 ECOLOGICAL COMMUNITIES

6.1 Regional Context

The site is located at the northern edge of the *Coastal Hardwood Zone* of the *Eastern Coastal Ecoregion Uplands Ecoregion* (Dowhan and Craig 1976).[4] An ecoregion is:

> *"An area characterized by a distinctive pattern of landscapes and regional climate as expressed by the vegetation composition and pattern and the presence or absence of certain indicator species and species groups."*

The climate of this coastal ecoregion has coastal influence. Bedrock is primarily metamorphic, complexly folded into north-trending belts. Terrain is hilly. Oak, black cherry, red maple, black birch and white pine (*Pinus strobus*) are important forest constituents, and forests also include many oaks (*Quercus* sp.) and hickories (*Carya* sp.). Dense thickets of vines and shrubs are common.

6.2 Vegetative Cover Types

Plant communities can be classified into *cover types* at any particular site, by considering plant species composition and site characteristics on a scale large enough to integrate minor differences. Whitlock et al. (1994) define a *cover type* as follows:

> *"A portion of a wetland or upland system that contains a uniform plant community composition and structure or that is influenced by one hydrologic regime. A distinct change in either hydrologic or vegetation characteristics indicates a change in cover types."* (Emphasis added.)

The cover type approach of ecosystem classification is well-suited to use as a rapid method of *habitat* survey. This method assumes that *vegetation structure* is a key factor influencing the type of fauna that a vegetation community is able to support. The vegetative *cover types* associated with the study area are described below.

Both upland and wetland cover types were encountered within the study area. REMA scientists have sampled and documented the soil types within the various cover types, as

[4] Dowhan, J.J. and R.J. Craig. 1976. Rare and endangered species of Connecticut and their habitats. Natural Resources Center, Dept. of Environmental Protection, 137 pp.

described in a previous section of the report (i.e., Section 4.0). Figure 2 (Attachment A) shows the locations of all the wetland units on the site; Figure 3 (Attachment A) shows locations of the major upland cover types, using codes defined in the Key in Table 1. Representative photographs of the study area and its vegetative cover types may be found in Attachment B.

While wildlife utilization was recorded during each of the 16 site visits, an exhaustive inventory was not undertaken, with the exception of breeding amphibian inventories conducted in March and April from 2017 and to 2020. A letter from Dawn McKay of the CT Wildlife Division, dated May 16, 2017 (see Attachment F) provided a list of "listed" species that have been recorded in the site vicinity. The habitat requirements of each rare species are described in Section 7.0.

A thorough understanding of the distribution of all the different cover types on the site, allows one to determine where each species would be most likely to occur. None of the species on the NDDB list were observed, but in the course of amphibian inventories, other CT Special Concern reptiles were observed: spotted turtle (*Clemmys guttata*), Eastern box turtle (*Terrapene c. carolina*), and ribbon snake (*Thamnophis s. suaritus*).

Natural resource observations were recorded for each cover type, throughout REMA fieldwork. A targeted survey for the two "listed" plants, *Plantago virginica* and *Crocanthemum propinquum* took place on November 29th, 2018, in the open, sandy portions of the quarry, which are the only suitable habitats for them. This is further discussed in Section 7.0 of this report. The cover type descriptions below note each area that was carefully searched because habitat was suitable for the target species, due to dry or sandy soil, full sun to partial shade, and, for the plantain, a history of disturbance.

It should be noted that detailed vegetative inventories of the herb stratum were not undertaken, nor were the thicket habitats comprehensively surveyed. However, the woody species and dominant herbs in plant communities in thickets, sand barrens, and forests were characterized while walking all over the site, surveying the seasonally flooded pools, and wetland areas. Brief descriptions of the thicket communities will also be given below.

6.2.1 Cover Type Descriptions

Upland vegetation cover types in the 17 mapped zones are defined in Table 1. Figure 3 (Attachment A) shows the locations of the mapped cover type units, on an April 2018 aerial photo base map. Some mapping units are termed "zones" because they encompass several cover types, as mosaics. Cover type numbering proceeds generally from north to south (top to bottom of Figure 3). The main criterion used to separate the cover type mapping units, is the same as that used in the National Wetland Inventory (NWI) wetland classification system: whether vegetation is deciduous or evergreen, or a mix of the two, and also the vegetation structure and height, the soil moisture or drainage class (e.g., moderately well drained, well drained), and the rockiness and depth of the soil. The northern portion of the site has examples of a typical range of forest cover types, for a post-agricultural Connecticut landscape.

It should be noted that some of the cover type "zones" described below include both wetland and upland cover types. Each wetland has also been given a unique identification number (e.g., Wetland B/1B), which is based on the wetland boundary marker (or survey flag) series by which they were delineated in the field. These regulated resources can be seen on the attached annotated 2018 aerial photograph (see Figure 2, Attachment A).

Table 1: Key to Upland Cover Types

ID/Zone[5]	Description
	Forest
U1	Deciduous forest with shallow soils and bedrock outcrops
U2	Forest, mixed evergreen-deciduous
U3	Deciduous forest, mature
U4	Post-agricultural forest with eastern red cedars
U5	Forest, deciduous with white pine understory
U6	Forest, moderately well-drained, white pine understory
U7	Forest, dense evergreens, white pine dominant
U8	Forest, mixed evergreen-deciduous
U9	Forest, deciduous
U10	Forest, mature, mixed evergreen-deciduous

[5] See Figure 3, Attachment A

U11	*Abandoned Quarry Area* Planted white pine and larch groves
U12	Thicket, young evergreens, eastern red cedar & white pine
U13	Forest, mature with eastern hemlocks
U14	Shrub thicket with dead ash stand
U15	Immature forest, deciduous, post-clearing (quarry)
U16	Thicket, autumn olive-dominated, post-quarrying
U17	Mosaic of sand barren, exposed bedrock & low woody copses

Zone U1, is located north of Route 184, and at the northwestern corner of the parcel, west and northwest of the central wetland (i.e., Wetland A-2) (see Photos U1a to U1c, Attachment B). This zone has a deciduous forest mostly of moderate age with bedrock outcrops and shallow Chatfield soils. Oaks are the dominant trees, but sugar maple, and black birch are also common. The understory is open and includes occasional lowbush blueberry, mountain laurel, white pine saplings, and maple leaf viburnum, few invasives (i.e., Japanese barberry), and many small surface boulders 8 to 15 inches in size. Common herbs include hayscented fern, dewberry, and Pennsylvania sedge. Both glaucous-leaved greenbrier and common greenbrier were observed here.

Zone U2, north of Route 184, is a deciduous forest gently sloping southerly down to the central wetland corridor (i.e., Wetland A-2) at north end of parcel (see Photos U2a through U2d, Attachment B). Soils are moderately well drained, and trees are relatively young, with some notable exception of trees with more than 20-ich dbh (diameter-at-breast-height). Near the wetland, ferns, such as New York fern, form a groundcover, and the dominant trees are red maples, black birch, and red oak. A few eastern red cedars are still holding on, but are in decline due to shade. An occasional hickory, American beech, American elm, and white pine were also noted. Tree stand is thin with large open areas. One American holly was noted. Oaks are dominant on the upper slope near the property boundary. The understory is replete with invasive Japanese barberry, pointing to this area's past use as a pasture, and firebush, multiflora rose, winterberry, and witch-hazel are occasional. Common herbs also include partridgeberry, laxiflora sedges, and hayscented fern.

Zone U3, north of Route 184, east of central wetland corridor, is mature deciduous forest (see Photos U3a through U3c, Attachment B). This vegetative zone is split to an upper (eastern) and lower (western) section by a relatively high, north-south oriented stone

wall. Moderate-size oaks (i.e., red, black, white) are dominant trees, and some red maple, sugar maple, and black birch are present as well. American beech sprouts and tree seedlings, including white pine, are dominant in the low-density understory. Lowbush blueberry and huckleberry are present but sparse. Other shrub and small statute tree species, especially at the interface with the forested wetland (i.e., Wetland A-2) include spicebush, Japanese barberry (low-density), ironwood, witch-hazel, and winterberry. Large patches of ferns include lady fern, hayscented fern, and New York fern. Common herbs include partridgeberry, spotted wintergreen, Pennsylvania and laxiflora sedges, a variety of grasses, and American wintergreen.

Embedded at the northeastern corner of this upland zone is Wetland B-2 (see Figure 2, Attachment A). This wetland, which originates off-site to the north, is a seasonally flooded to seasonally saturated forested wetland (see Photos WB2a and WB2b, Attachment B). Dominant and common trees include red maple, red oak, hickory, yellow birch, and green ash (dead). The understory supports spicebush, winterberry, ironwood, highbush blueberry, and mountain laurel. Common herbaceous species include skunk cabbage, jack-in-the-pulpit, cinnamon and New York ferns, and swamp dewberry. Draining from this wetland in a southwesterly direction is an intermittent stream with a narrow and shallow channel. This stream reaches the main wetland corridor on this parcel (i.e., Wetland A-2).

Zone U4, north of Route 184, east of central wetland corridor, is a dense post-agricultural forest with red cedars, most of them dead (see Photos U4a and U4b, Attachment B). This was the last section of the northern portion of the site that was abandoned as an agricultural field. Common trees include oaks, maples, black birch, and occasional white pine. The shrub stratum is dense and replete with multiflora rose, and Japanese barberry. Fox grape, and invasive Asiatic bittersweet form nearly impassible tangles.

Zone U5, just north of Route 184, and south, west, and east of Wetland A-2 is deciduous forested with a white pine understory zone (see Photos U5a through U5c, Attachment B). As in Zone U4, portions have a dense shrub stratum dominated by woody invasives. Elsewhere, white pine seedlings and saplings are present where there are no mature white pine trees. Soils are both well drained (east of Wetland A-2, north of Route 184) and moderately well drained. Dominant and common trees include oaks, black birch, sugar maple, American beech, black cherry, and slippery elm. Understory species include witch-hazel, sassafras (in the more sunlight areas), winterberry, firebush, highbush

blueberry (near wetland edge), ironwood, Japanese barberry, multiflora rose, and spicebush. Herbs noted include ferns (Christmas, evergreen woodfern, hayscented, New York), wintergreens (spotted, American), poison ivy, Pennsylvania and laxiflora sedges, and white grass. Both clubmoss and ground cedar form groundcover patches, particularly to the west of Wetland A-2. Lianas include greenbrier, and Japanese honeysuckle, and Asiatic bittersweet, the latter two species closer to Route 184.

Zone U6, just north of Rt 184, and east of wetland corridor A-2, is a moist, moderately well-drained, white pine understory, deciduous forest. It is dominated by many of the same overstory tree species as in zone U5, but with young age white pines in the mid-story and understory, and has much dead woody debris on the forest floor (see Photo U6a, Attachment B).

This cover type zone is contiguous with Wetland A-2, which dominates the central portion of the site, north of Route 184 (see Figure 2, Attachment A). Wetland A-2 is a seasonally flooded and seasonally saturated forested wetland with a locally dense woody understory (see Photos WA2a to WA2i, Attachment B). This wetland and its intermittent watercourse have their headwaters to the north of the property. The northern portion of this wetland within the property, mostly to the north of the abandoned roadbed of the old Providence-New London Turnpike[6], which is defined by two prominent parallel stone walls, is characterized by significant seasonal groundwater discharge and a fairly boulder strewn terrain. The southern portion is gently sloping to nearly level, includes an embedded vernal pool habitat (i.e., Vernal Pool 1; see Section 6.0), and is also characterized with open canopy clearings dominated by emergents (i.e., herbaceous wetland plants). A narrow and shallow man-made ditch drains this lower portion of the wetland, carrying the intermittent stream flows off-site to the west.

Dominant or common trees in Wetland A-2 include red maple, American elm, swamp white oak, tupelo, white pine, and red oak. The woody understory in the northern sloping section includes a much higher proportion of the invasive Japanese barberry, but other common shrub species throughout include, spicebush, winterberry, maleberry, firebush, privet, mountain laurel (at the wetland edge), buttonbush, silky and gray dogwoods, and sweet pepperbush. The herbaceous layer is quite dense and moderately diverse, especially in the more open, sunlight areas, and include skunk cabbage, jack-in-the

[6] Based on archival aerial photographs the turnpike was re-routed to its present configuration sometime between 1934 and 1951.

pulpit, a variety of sedges (tussock, bladder, lurid, fox, fringed, etc.), ferns (sensitive, marsh, cinnamon, New York, royal, spinulose wood, evergreen wood, Christmas), rough bedstraw, bugleweed, maddog skullcap, violets, purple willowherbs, swamp goldenrod, asters, jewelweed, stout wood reedgrass, blue-joint grass, bittercress, soft rush, white avens, golden saxifrage, poison ivy, and tall meadow rue, to name a few. Mosses, especially in the northern sloping section include several species of Sphagnum and Thuidium.

Zone U7, just south of Route 184, and just west of the off-site dog kennel, is an evergreen forest dominated by large white pines.

Zone U8, south of Route 184, occupies a large portion (i.e., +/- 11 acres) of the western section of the site (see Photo U8a, Attachment B). This is a mixed deciduous-evergreen forest, with deep well drained soils, in the Charlton and Canton series complex, and gently rolling topography. It is dominated by white pine, hickories, oaks, and sugar maple. Woody understory and herbaceous species are very similar to those described below in Zone U9.

Zone U9 is deciduous forest. It is dominated by black birch in the post-agricultural east central unit, between the two stream corridors (i.e., Wetland E and Wetland B/1B) (see Photos U9a to U9i, Attachment B). East of Wetland E and in the northern portion, east and south of the dog kennel, it is a mature, oak-dominated forest, with 20-inch dbh red and white oaks. Hop hornbeam, hickories, red maple, and sugar maple, and black cherry were observed on the lower slope. The low-density to locally moderate-density shrub stratum includes ericaceous shrubs (lowbush blueberries), maple-leaf viburnum, and occasional white pine (saplings). Herbs include running pine, princess pine, ground cedar, patches of Pennsylvania sedge, starflower, white grass, partridgeberry, wintergreens, (spotted, American), shinleaf, hayscented fern, partridgeberry, and polypody fern. Occasional greenbrier patches were noted. This deciduous forested cover type is also found on the far eastern edge of the site, just east of the Wetland B/1B corridor (see Figure 2, Attachment A). It is also associated with the site's small cemetery, just west of Zone U10.

It should be noted that Zone U9, including the upper undisturbed portion of Wetland E, which it surrounds, encompasses roughly 23 acres of the site. It is characterized by both gently rolling and moderately steep topography, the latter to the east of Wetland E, and

both well drained and moderately well drained soils. Wetland E, which begins off-site at a man-made pond and its outlet intermittent watercourse, traverses through the wooded U9 zone, before entering the once active sand and gravel mining area to the south. In northern undisturbed portion, Wetland E is a seasonally flooded, seasonally saturated, and saturated (in part), mature, forested wetland (see Photos WEa to WEg, Attachment B). It contains an embedded, or "cryptic" vernal pool habitat (i.e., Vernal Pool E; see Section 6.0). The southern portion, within the limits of the abandoned mining operation, was once completely cleared of woody vegetation, but not excavated. It is slowly returning to a red maple swamp cover type, and is characterized by pole-sized trees and a dense understory, which includes the native shrub complement of the undisturbed section, as well as gray birch and goat willow.

Wetland E is characterized by seasonal groundwater discharge, especially within its central section. While diversity of vegetation is moderately high, much of its central and upper section have moderate to locally high density of invasive Japanese barberry. The overstory is dominated by red maple and yellow birch. Other tree species include white pine, swamp white oak, ironwood, green ash, and tupelo. Common woody understory species include ironwood (at wetland edge), spicebush, sweet pepperbush, highbush blueberry, wintergreen, multiflora rose, and nannyberry. The herb stratum is fairly dense, where the shrub layer is more open, and is dominated by such species as skunk cabbage, hellebore, violets, jewelweed, cinnamon fern, stout wood reedgrass, crested fern, asters, a variety of sedges (tussock, bladder, fringed, etc.), tall meadow rue, and others. The intermittent stream associated with Wetland E is defined as it enters the property from the west, flowing through a boulder strewn terrain, then becomes more diffuse through the central and gently sloping portion of the wetland, especially as it enters the embedded vernal pool, and become more defined to the south, especially within the prior sand and gravel mining area.

Zone U10, just north of the central open quarry area, is mature mixed evergreen-deciduous forest (see Photos U10a and U10b, Attachment B). Large white pines, red oaks, and black oaks are intermixed with a wide range of smaller size classes. The terrain is undulating and sloping southerly. A low-density understory includes many white pine seedlings, occasional highbush blueberry, and some small patches of huckleberry and lowbush blueberry. Rock outcrops are occasional. Groundcover of rhizomatous Pennsylvania sedge is an indicator that this area has not been disturbed for many decades.

Four-foot tall stone walls encompass this zone to the north, east, and west. Old woods roads traverse this area.

Zone U11, in the northwestern portion of the abandoned quarry, consists of planted white pine and larch groves. It is situated on the excavated east-facing, west-facing, and north-facing steep slopes created by the quarry operation. Its eastern section is a planted grove of white pine, just east and above Wetland F (see Figure 2, Attachment A), while its northern and western sections also include planted larch groves on the steep hillsides. Several native shrub species were noted along the southern edge of the groves, including bayberry, maleberry, and highbush blueberry, as well as multiflora rose. Autumn olive is quite dense at the lower edge of this zone as it transitions to Zone U16. Pine needles cover the ground, but otherwise the understory is sparse.

Zone U12, at the northernmost extent of the quarry**,** consists of multiple stands of evergreen saplings, both white pines and red cedars, on the quarry perimeters. They have sprouted on disturbed soils after quarrying ceased. Additional strips of this cover type, mostly along old haul roads, were too small to map. The dark signature shows up clearly on the aerial photograph (i.e., Figure 3, Attachment A). Closely spaced stands of gray birch, and some trembling aspen, are usually associated with these evergreen thickets. At the edge of the northwestern unit of this cover type, just north of Vernal Pool H, other woody species include pole-size black birch, witch-hazel, cottonwood, and highbush blueberry. This cover type provides excellent winter cover for songbirds and the small tree seeds are also an important avian food source.

Zone U13, on the east side of the site, just west of the Wetland B/1B stream corridor, is a mature hemlock grove, roughly four acres in size (see Photos U13a and U13b). It is in good condition, not noticeably affected by wooly hemlock adelgid. A wide, old haul/woods road passes through it. It is mostly a single-species stand, with a thick needle layer, but a minimal shrub and herb strata. American beech sprouts grow along the eastern edge, and some mature red oaks, were noted on the west side. Moss grows on fallen rotting hemlock logs. Herbaceous abundance and diversity is low and includes partridgeberry, a few grasses, and Canada mayflower.

Zone U14, west of the Wetland B/1B corridor and south of the hemlock grove (i.e., U13), this is a dense thicket of woody invasives just outside the limits of the former quarry. This used to be a stand of red pines, which in all likelihood succumbed to a fungal disease

that has decimated most of the red pines in Connecticut. In addition to autumn olive and multiflora rose, Asiatic bittersweet is well established, and is stressing pole size native trees like oaks and red maples. Seed sources of a variety of invasives were likely present on the residential and farm properties just to the east. A group of dead ashes is also noteworthy in this cover type.

Zone U15, just south and west of Zone U14, also northwest of the Wetland B/1B stream corridor, this is an immature deciduous forest (see Photos U15a and U15b, Attachment B). Only its southernmost section adjacent to Wetland C (see Figure 2, Attachment A) was cleared as part of the quarry operation, but with the exception of some minor grading there, the balance of this zone was not touched, although its southern one third appears as an open field in a 1965 archival aerial photograph. This is an immature forest with few invasives, a low density woody understory, and native fern ground cover. The dominant tree is black birch, but also red and black oak, hickories, and white ash are in the overstory. Some American beech and white pine are found in the understory, as well as sparse lowbush blueberry and multiflora rose. Herbaceous species include grasses, Pennsylvania sedge, grasses, wintergreen, and New York and hayscented fern. Fox grape and common greenbrier were also observed.

Zone U16, south of the open portion of the old quarry (i.e., U17), as well as in the far northwestern portion of the study area, is the widespread deciduous thicket cover type on formerly disturbed, sandy upland soils (see Photos U16a and U16b, Attachment B). Several wetlands, including and vernal pool habitats, are embedded within this cover type. It is dominated by autumn olive and multiflora rose, and gray birch is also common. Where the soil is moderately well-drained, or adjacent to a delineated wetland, non-native goat willow and other willows are found along with low numbers of several native facultative wetland shrub species: steeplebush, meadowsweet, highbush blueberry, and maleberry. The irregular ground within the thickets in Zone U16 supports only a few herb species, such as wood fern (*Dryopteris carthusiana*) and avens (*Geum* spp). Strips and patches of grasses and some sedges are found all along the network of haul roads and in occasional small clearings. Additional forbs are also present along sunlit roadsides, such as grass-leaf goldenrod and lance-leaf aster. Prairie warbler, Northern Towhee, blue-winged warbler, and American goldfinch were among the bird species observed here. An Eastern box turtle was also found in this cover type (see Section 7.0). Invasive mugwort is established along the first four or five hundred feet of the haul road

proceeding southeasterly from the terminus of Cranberry Bog Road, but has not spread though most of the site, along the dirt roads passing through in this cover type.

Zone U17, in the south-central portion of the site is a mosaic of sand barren, exposed bedrock and low woody copses, that is, sparsely vegetated open ground (sand barren) and clusters of young evergreens and gray birches (see Photos U17a to U17l, Attachment B). Bedrock is near the surface or exposed as outcrops. Clumps (copses) of young red cedars, white pines, and birches are very similar to the evergreen thickets in Zone U12, but smaller. Two native warm season grasses, broom sedge and little blue stem are well established throughout this zone, as are *Polytrichum* moss, Canada cinquefoil, and prickly dewberry. Different grass species and a variety of lichens were noticed on a sparsely vegetated sandy bank just south of the mature forest stand (U10). One dense mugwort clone, about 20 feet in diameter was noted, but it does not seem to have spread between 2017 and 2020. Overall, plant and presumably insect diversity are low, but other sand barren plant, moss, and lichen species will likely take hold in the future. Self-sustaining sand barren habitats are increasingly uncommon in Connecticut, with an elevated likelihood of supporting rare uncommon species, which is a major reason this cover type will be preserved in its entirely.

7.0 VERNAL POOL SURVEYS

7.1 Vernal Pool Definitions

In Connecticut, vernal pools or vernal pool habitats are generally defined as bodies of standing water observed in the spring that typically result from various combinations of snowmelt, precipitation, and high groundwater tables associated with the spring season. These typically small depressions can be natural or man-made, and in most years dry up by the summer, losing water through infiltration, evapotranspiration, and the lowering of the groundwater table. Vernal pool habitats vary in many aspects including appearance, water depth, water source, hydroperiod, water quality, and surrounding habitats. Field investigations must coincide with the amphibian breeding and/or larval development time periods to determine if an area is functioning as a vernal pool habitat.

Although exceptions do exist, all or most of the following criteria are typically met in defining a vernal pool habitat:

- Contains water for approximately two months during the growing season;
- Occurs in a confined depression or basin that lacks a permanent outlet stream;
- Lacks fish populations;
- Dries out most years, usually by late summer[7]; and
- Provides for the breeding and reproduction of amphibians considered obligate to vernal pools.

The species that rely upon vernal pool habitats for their reproductive success are referred to as *obligate* vernal pool species. In Connecticut these are the following:

- Wood frog (*Lithobates sylvatica*)
- Eastern spadefoot toad (*Scaphiopus holbrookii*)
- Spotted salamander (*Ambystoma maculatum*)
- Jefferson salamander (*Ambystoma jeffersonianum*)
- Marbled salamander (*Ambystoma opacum*)
- Fairy shrimp (*Branchiopoda anostraca*)

The Eastern spadefoot toad and Jefferson salamander are listed in Connecticut as "endangered" and "special concern," respectively. The former species is known to occur off-site and to the southeast of the study area, while the latter is not known to occur to the east of the Connecticut River. During the vernal pool investigations, the spadefoot toad was not encountered, and as will be further presented in a following section, rearing of larva collected at several locations, over the course of two years, did not yield spadefoot toad. Nevertheless, the petitioner has hired an Eastern spadefoot specialist who will conduct on-site investigations starting in May of 2020.

7.2 Overview

This section presents and discusses the effort by Rema Ecological Services, LLC (REMA) to conduct in-field, breeding season surveys, of *eleven* semi-permanently to seasonally flooded wetland areas (see Figure 2, Attachment A). These were first

[7] Both permanently flooded and semi-permanently flooded waterbodies can support obligate vernal pool amphibian breeding and reproduction. However, these bodies of water most often also support amphibians that predate the larva of vernal pool obligates. These include, green and bull frogs, and red-spotted newts.

identified as vernal pool habitats in April 2017, with subsequent additions in April of 2018 and 2019, as additional properties were added to the study area.

One vernal pool, identified as Vernal Pool E (i.e., E-series) appears to be a natural "cryptic" vernal pool[8], embedded within a forested wetland corridor (see Figure 2, Attachment A). *Nine* of the identified vernal pools are the result of sand and gravel mining operations that took place in the southern portion of the study area starting in the 1960s and ending by 2004, based on archival aerial photography. *One* vernal pool, identified as Vernal Pool 1 (i.e., A-2-series) is located in the northern section of the study area, adjacent and to the north of Route 184. This pool is also embedded within a larger wetland system, but appears to have been influenced by agricultural activities, likely a watering hole for livestock (see Figure 2, Attachment A).

7.3 Vernal Pool Habitat Descriptions

Vernal Pool 1 (i.e., VP-1, A-2 series), contains up to two feet of water in depth, averaging 12 to 15 inches, and has a relatively open habit (see Photos 11, 12, 45 and 46, Attachment D). It is characterized by both scrub-shrub and emergent wetland cover types, with a forested wetland/upland fringe. The deeper southern portion of this seasonally flooded habitat, where most of the amphibian egg mases were observed, is replete with woody debris (i.e., branches) offering good cover and attachment sites for spotted salamander egg masses. The edge of the open water is shaded by red maple, white pine, and gray birch. Other common vegetation observed within or at the edge of the pool include sweet pepperbush, highbush blueberry, multiflora rose, buttonbush, sedges, including bladder, fox, and tussock, rushes, soft rush, smartweeds, cursed buttercup, false nettle, jewelweed, marsh, New York, sensitive, and cinnamon ferns, purple willowherbs, stout wood reedgrass, water horehound, and fox grape. Organic deposits over mineral substrate are up to 10 inches in depth. By late August or early September this pool no longer holds water (see Photo 11, Attachment D).

Vernal Pool E (i.e., VP-E, Wetland E), is inundated with up to 2 feet in depth, averaging 15 to 18 inches (see Photos 19 to 21, Attachment D), and contains more than one foot of organics over mineral substrate. In addition to a seasonal high groundwater table, this pool, which is embedded within a forested wetland, is fed by an intermittent stream,

[8] Cryptic vernal pools, as their name suggests, are typically embedded within larger wetlands, and can be overlooked.

which originates off-site to the northeast. Flows pass diffusely through the pool, and the watercourse continues flowing southerly in a defined channel. The pool is well shaded with trees such as red maple, yellow birch, swamp white oak, and red oak, the latter growing in the adjacent upland slope to the west. Common shrubs include winterberry, spicebush, multiflora rose, sweet pepperbush, and Japanese barberry (dominant). Observed herbaceous plants within or at the edge of the pool include skunk cabbage, hellebore, Christmas, sensitive, and cinnamon ferns, sedges, purple willowherbs, bittercress, pondweeds (*Potamogeton* sp.), and false nettle. This area does retain some water into the summer, supplied from the intermittent stream, especially during rain events, with a watershed of approximately 31 acres at the pool (USGS StreamStats).

Vernal Pool L (i.e., VP-L; Wetland L), is more than 4 feet in depth at its center, averaging 24-36 inches and (see Photos 31 and 32, Attachment D), and contains just 4 to 5 inches of organics over mineral substrate. This is an isolated wetland depression just north of the old haul road, off Cranberry Bog Road to the west, used during the mining operation within the southern portion of the study area. In all likelihood this depression is permanently flooded, at least in part, since it appears to contain water in summer aerial photography (i.e., Google Earth). The pool is mostly shaded with young trees such as red maple and gray birch, as well as with goat willow and autumn olive. Other observed vegetation includes black willow, meadowsweet, multiflora rose, grasses, and a few sedges.

Vernal Pool I (i.e., VP-I; Wetland I), is more than 2 feet in depth, averaging 15 to 16 inches and is (see Photos 6, 29, and 30, Attachment D), and contains just 2 to 4 inches of organics over thin mineral substrate, and bedrock. This is an isolated depression in the northern portion of an elongated wetland, just east of a north-south oriented old haul road used during the mining operation, at the far northeast edge of the mining area. This pool drains through a narrow constriction behind a very large glacial erratic (i.e., very large boulder). Its hydrologic regime is seasonally flooded. The pool is mostly shaded with young trees such as red maple and gray birch, as well as silky dogwood.

Vernal Pool G (i.e., VP-G; Wetland C), is the most recently "constructed" vernal pool within the study area, in the far southeastern corner of the past sand and gravel mining operation. It consists of a series of interconnected wide "ruts" left behind by excavation equipment, which created several shallow depressions, many of which were observed as open unvegetated ground (see Photos 4, 5, 22 through 28, and 47, Attachment D). Most

of these depressions had water depths of 6 to 8 inches during the four annual inventories, with a few areas with depths up to 16 inches. Apart from precipitation the source of water for these habitats is surface runoff from the north. We observed water flowing through shallow unvegetated swales or along the hard surfaces of abandoned haul roads to this general area, with an overflow westerly to Wetland 2E (see Figure 2, Attachment A). Because of its relatively large watershed these pools have extended hydroperiods despite their relatively shallow water depths.

The former channel of the easternmost seasonal watercourse (B/1B) was disrupted by the quarry operation, and has a disorganized flow path that includes the interconnected pools and temporary drainageways of Wetland G; the stream also flows subsurface. They overflow via a man-made wetland channel to Wetland 2E, located to the west. In the vegetated areas, common overstory woody vegetation included mostly young red maple, gray birch, speckled alder, and white pine. Common shrubs included Morrow's honeysuckle, willows (including goat willow), meadowsweet, and maleberry. Herbs included sedges, grasses, monkey flower, soft rush, sensitive fern, and goldenrods.

Vernal Pool 3E (i.e., VP-3E; Wetland 3E), is in part 18 to 24 inches in depth (maximum: 36 inches), but also contains a section that is 8 to 10 inches in depth, which also provided breeding habitat for vernal pool amphibians (see Photos 3, and 17, Attachment D). This pool is embedded within a larger scrub shrub wetland, created through excavation. Within the pool section organics were 2 to 3 inches deep over mineral substrate. The pool is mostly shaded with young trees such as red maple, gray birch, and black willow, as well as with goat willow and autumn olive. Other observed vegetation includes meadowsweet, silky and gray dogwood, multiflora rose, sedges, common reed, jewelweed, soft rush, grasses, and others.

Vernal Pool O (i.e., VP-O; Wetland O), is and isolated semi-permanently flooded pool/wetland created through excavation, and is located in the southeastern section of the study area (see Photos 9, 10, and 35 through 38, Attachment D). Maximum water depths during inventories were nearly 3 feet, with average depths of 18 to 24 inches. Within this pool organics were 6 to 8 inches thick over coarse mineral substrate. The pool is mostly shaded along its perimeter with young trees such as red maple, gray birch, and black willow, as well as with goat willow and autumn olive. Other observed vegetation includes meadowsweet, silky dogwood, multiflora rose, sedges, sensitive fern, woodferns, and grasses. In three of the four years of amphibian breeding surveys

the inundated areas were mostly covered with thick filamentous algae, making observations of amphibian egg masses challenging. This is due to the fact that much of the pool is open to sunlight, since woody vegetation only grows in its perimeter.

Vernal Pool C (i.e., VP-C; Wetland C), is a small (i.e., 16' x 9') pool embedded within Wetland C, at the far southeastern edge of the past sand and gravel mining operation, in a depression within a drainageway (see Photo 18, Attachment D). It receives both seasonal groundwater discharge and flows from the upper portion of the overall wetland located to the northeast. Water depths average 6 to 8 inches, with minimal organics accumulation over mineral substrate. The pool is mostly shaded with willows, Morrow's honeysuckle, firebush, and multiflora rose. Other observed vegetation includes meadowsweet, jewelweed, and grasses.

Vernal Pools H and 1H (i.e., VP-H, VP-1H; Wetlands H and 1H), are two interconnected seasonally flooded areas at the northeastern edge of the past sand and gravel extraction operation (see Photos 1, 2, and 13 through 16, Attachment D). Vernal Pool H is located to the north of Vernal Pool 1H, discharges down a steep slope to it, and is traversed by an east-west oriented haul/woods road. Seasonal inundation is 12 to 14 inches, averaging 8 inches. The pool is mostly shaded with red maple, gray birch, and white pine. Other observed vegetation includes grasses, a few sedges, and swamp dewberry.

Vernal Pool 1H, located downgradient and to the south of Vernal Pool H, is 8 to 10 inches in depth, with 2 to 3 inches of organics accumulation over mineral substrate. The pool is shaded predominately by red maple and white pine. Other observed vegetation includes steeplebush, maleberry, sedges, goldenrods, and grasses. This pool discharges to the southwest to Wetland 2H.

Vernal Pool N (i.e., VP-N; Wetland N), is an isolated seasonally flooded wetland created through excavation and located in the north-central portion of the past sand and gravel pit (see Photos 7, 8, 33, and 34, Attachment D). Water depths average 18 to 24 inches (maximum: 3 feet), with 4 to 8 inches of organics accumulation over mineral substrate. The pool is partially shaded with red maple, gray and white pine. Other observed vegetation includes willows, highbush blueberry, multiflora rose, sedges, goldenrods, and asters. The pool is replete with large woody debris (i.e., logs, branches).

7.4 Methods

Each of the vernal pool habitats described in the previous section were inventoried during at least two breeding seasons (i.e., 2019, 2020), and most of them were surveyed during four consecutive breeding seasons (i.e., 2017 to 2020). During each of the field survey events[9], the vernal pools were systematically reviewed, for component species (i.e., vertebrates and invertebrates), as well as abiotic characteristics (e.g., pH, temperature, depth, dimensions, etc.).

Each vernal pool was surveyed using chest waders/hip boots, dipnets, and a field pH meter. Detailed notes were taken in the field to allow accurate attribution of specific observations to particular pool locations, and a photographic log was compiled (see Attachment D).

Egg masses of indicator species amphibians [spotted salamander, *Ambystoma maculatum*; wood frog *Lithobates sylvaticus*] were enumerated during systematic walking transects of the basins, typically by two observers in parallel. Polarized glasses were used occasionally, but turbidity and pollen film were both low during all of the field dates, facilitating comprehensive reviews, with the exception of one vernal pool (i.e., VP-O) where observations were somewhat hampered with excessive green alga within the water column during three of the four years of surveys.

During the initial field visit on April 13th, 2017, and also during each subsequent visit, wood frog egg masses were observed to be well developed, and at a few of the pools with higher exposure to sunlight (e.g., Vernal Pool G) larva were observed emerging. This indicated that breeding by wood frogs, except during the 2018 breeding season[10], was largely complete and that egg mass counts were representative of the full breeding effort by that species for the season. Spotted salamander egg masses were variably developed, partly attributable to depth of deposition and time since deposition. Overall, it is estimated that the seasonal observations captured at least 90% of the breeding effort by the obligate amphibians during the 2017 to 2020 surveys.

[9] Vernal pool habitats were surveyed on: 4/13, 4/19, 4/22, and 4/29/2017, 4/13/2018, 4/10 and 4/17/2019, and 4/19/2020.
[10] It is possible that in 2018 a second pulse of egg mass laying was missed, based on observations elsewhere in the region.

During each survey date, and after a careful count of egg masses first from pool perimeter prior to entering the pool, one or two researchers methodically conducted dipnet sweeps, working towards each other from opposite sides of the vernal pool habitat. At each pool an attempt was made to dipnet the entire pool, but efforts were concentrated in representative micro-habitat areas, such as the shallow perimeter, areas with greater sun exposure, and areas with woody debris. Benthic litter materials were also investigated, such as deposits of fine particulate organic matter (FPOM), and samples were carefully sorted through in search of invertebrates, bivalves, and other aquatic organisms. Perimeter shallows were typically examined prior to entering the pool to increase the probability of capturing marbled salamander larvae, if present. Similarly, emergent, or erect herbaceous vegetation patches were sampled to reveal the invertebrate species often found occupying the three-dimensional structure of a lentic wetland system.

In addition to direct examination of the eleven vernal pools, other areas of ponding not previously identified as "potential vernal pools" (PVPs), such as the larger, open pond/marsh/scrub shrub wetland system that occupies the southernmost section of the study area (i.e., 2E-series wetland; see Figure 2, Attachment A), but also other potential areas, were surveyed. As will be further discussed below some obligate vernal pool amphibian breeding was observed, but it was spotty in space and time. This is not surprising because the ponds and Interstate 95 to the south limit nearby upland wooded habitat available for metamorphosed wood frogs and spotted salamanders.

However, additional amphibian activity was noted, based on calls and direct observation, such as spring peeper (*Pseudacris crucifer*), green frog (*Lithobates clamitans*), pickerel frog (*Lithobates palustris*), eastern toad (*Anaxyrus americanus*), gray tree frog (*Hyla versicolor*), and Fowler's toad (*Anaxyrus fowleri*). All of these species are potential *facultative* amphibians and not *obligate*, such as wood frog and spotted salamander.

7.5 Survey Results

The eleven confirmed vernal pools were surveyed for the presence or absence of obligate vernal pool indicators (i.e., wood frog, spotted salamanders, fairy shrimp), during four consecutive amphibian breeding seasons (i.e., 2017 through 2020). Table A, in Attachment D, provides a detailed summary of data collected for each of the pools.

Representative annotated photos of each of the surveyed areas are also included in Attachment D (i.e., Photos 1 to 47).

Five of the eleven vernal pool habitats were at least moderately productive for the two dominant vernal pool obligates (i.e., VP-3E, VP-G, VP-O, VP-E, and VP-1). One pool, that is, VP-I was only moderately productive for spotted salamander. Two pools, that is, Vernal Pool G and Vernal Pool 1 exhibited the highest productivity, with the former most productive for spotted salamander, while the latter for wood frog. Two pools (i.e., VP-H, and VP-E) were also breeding habitats for marbled salamander (*Ambystoma opacum*).

The more open sunlight habit of Vernal Pool 1, located in the northern section of the study area north of Route 184, combined with areas of shallow water attracted wood frogs, which laid egg masses in large rafts, allowing for relatively quick metamorphosis. The open shallow waters with emergent vegetation also allowed for abundant foraging opportunities for wood frogs, as algal production was high, as well as refugia from predators. In Vernal Pool G the many small depressional areas with interspersed vegetation promoted spotted salamander breeding and reproduction.

7.6 Discussion

The 2017 to 2020 amphibian breeding season field surveys indicate that six of the eleven confirmed vernal pool habitats (i.e., VP-3E, VP-G, VP-I, VP-O, VP-E, and VP-1) can be considered as Tier I vernal pool habitats, per the *Best Development Practices*[11] (BDP) (Calhoun and Klemens, 2002). Tier I pools are those that include at least 25 egg masses of any of the obligate vernal pool amphibians and, therefore, are worthy of conservation. Table 2 provides information regarding the presence of Project features relative to the 100-foot Vernal Pool Envelopes (VPEs). The VPE is considered critical for vernal pool conservation as it is considered to be most protective against direct "physical" impacts of vernal pools, and are also the preferred habitat area for emerging metamorphs.

[11] Calhoun, A. J. K. and M. W. Klemens. 2002. Best development practices: Conserving pool-breeding amphibians in residential and commercial developments in the northeastern United States. MCA Technical Paper No. 5, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, New York.

Table 2: Proposed Activities within VPEs Associated with Proposed Solar Facility

VP#	VP Area (acres) *(approximate)*	VPE Area (acres)	Existing VPE Disturbed?	Project Disturbance?	Percent of VPE Affected by Project Activities in CSC Petition
1	0.21	1.59	Yes – Route 184	0.15	9.4
C	0.006	0.96	none	0.00	-
E	0.11	1.47	none	0.16	10.9
G	0.17	2.27	Yes – ATV use	0.00	-
H	0.01	1.03	none	0.00	-
I	0.01	0.93	none	0.00	-
L	0.02	1.03	none	0.00	-
N	0.03	1.13	none	0.00	-
O	0.04	1.24	none	0.00	-
1H	0.02	1.14	none	0.00	-
3E	0.02	1.01	None	0.00	-

As seen in Table 2, of the eleven confirmed vernal pools, the VPEs for nine will remain intact (see Figures 4 to 26, Attachment D). In regard to the VPEs for Vernal Pool 1 and Vernal Pool E, which would be marginally within the proposed limit of disturbance (LOD), the encroachment is for the outer slopes of the proposed stormwater management basins (i.e., detention basins), which will be appropriately vegetated with native vegetation, including shrubs, so as to function as effective VPEs post-construction. Therefore, under proposed conditions the function of all of the VPEs to the eleven vernal pools will in essence remain and function the same as under existing conditions.

The "critical terrestrial habitat" (CTH) was also considered to determine the potential for Project impact. Calculations were completed to evaluate the area of proposed Project activities located within the zone outward of 750 feet from the edge of each vernal pool. In calculating the CTH we excluded the acreage of preferred habitat that was cut off by Route 184 and Interstate 95. Existing disturbances within the CTH, other than those of

the aforementioned transportation corridors, were calculated, including any residential structures and manicured lawns. While lawns can be traversed by obligate vernal pool amphibians, they are not the preferred wooded habitat where these species will hibernate, forage, and spent the majority of their life cycle during the non-breeding period. Lawns do not protect these species from desiccation as would the leaf litter and the duff layers found in woodland habitats.

We should note, however, that in the post-construction phase, amphibians will still traverse the solar array fields, which will be seeded with appropriate grasses and forbs, thus preserving connectivity and meta-population dynamics. Table 3, provides the metrics of pre- and post-construction CTHs for all of the study area's eleven vernal pool habitats.

Table 3: Proposed Activities within CTHs Associated with the Proposed Solar Facility

VP#	VP Area (acres) *(approximate)*	CTH Area (acres)	CTH Area Disturbance (Existing) (acres)	% of CTH Disturbance (Existing)	CTH Area Proposed (acres)	% of CTH Affected including by Project Activities in CSC Petition
1	0.21	28.02	1.47	5.24	15.87	43.3
C	0.006	36.31	2.2	6.05	32.02	**11.8**
E	0.11	45.45	2.38	5.23	29.24	35.6
G	0.17	44.89	1.32	2.94	40.32	**10.1**
H	0.01	42.73	2.76	6.45	38.24	**10.5**
I	0.01	42.10	0.0	0.0	31.27	**25.7**
L	0.02	42.74	0.11	2.57	42.27	**1.1**
N	0.03	43.38	0.0	0.0	36.75	**15.2**
O	0.04	44.14	1.49	3.37	43.76	**0.8**
1H	0.02	43.42	0.79	1.81	39.22	**9.6**
3E	0.02	42.61	1.86	4.36	42.61	**0.0**

Based on the BDP model (Calhoun and Klemens 2002), exceeding disturbance above the 25% threshold would result in an impact to a vernal pool. However, in this case some site specific factors would mitigate these impacts.

First, of the 11 confirmed vernal pools 9 are *conserved*, representing 85% of the observed productivity for spotted salamanders, based on egg mass counts spanning the four spring breeding seasons (i.e., 2017 – 2020). For wood frogs the observed productivity in the conserved pools falls to 45%, primarily because Vernal Pool 1, with 43.3% of its CTH affected by the proposal, also had the highest wood frog productivity of all the pools, almost three times that of next most productive pool (i.e., Vernal Pool G).

Second, as perhaps more importantly, both Vernal Pool 1 and Vernal Pool E are predominately wood frog breeding pools. Based on egg mass counts the wood frog to spotted salamander ratios are 4.3 to 1, and 2.5 to 1, for Vernal Pool 1 and Vernal Pool E, respectively, in favor of wood frogs. One of the factors that skews productivity towards wood frogs at these two pools is their landscape position within forested wetlands. Both these pools are embedded within larger wetland systems. This position favors wood frogs which are known to spend the majority of the growing season within forested wetlands. Since they are not semi-fossorial like spotted salamanders, they stay hydrated in wet to moist forested habitats, and only utilize upland forests in the fall in search for hibernacula. Wood frogs also utilize forested wetland corridors to disperse over the landscape and to reach other potential natal pools. It is widely understood, that unless there is major additional fragmentation of optimal non-breeding habitat by busy roadways and a significant increase of impervious surfaces, "wood frog vernal pools" can be conserved with a wooded CTH that is 50% or greater of the total acreage, if connectivity with suitable habitats is maintained. Therefore, we consider that both Vernal Pool 1 and Vernal Pool E, are considered "conserved" under the proposed conditions, in regard to wood frog breeding and reproduction.

It should also be noted that the petitioner heeded the recommendation of REMA in purchasing additional land in order to avoid adverse impacts to the overall obligate vernal pool amphibian population within the study area. It became quite apparent following the 2017 breeding season surveys that the southern portion of the overall site had a very diverse and productive herptile population, which apart from nine vernal pool habitats, contained three Connecticut Species of special concern, that is, ribbon snake (*Thamnophis sauritus*), eastern box turtle (*Terrapene c. Carolina*), and spotted turtle (*Clemys guttata*), all observed within or at the edge of wetland habitats.

Per the REMA recommendation, the petitioner purchased two additional parcels of land, one contiguous and to the north of the original study area and south of Route 184 (i.e.,

Providence-New London Turnpike), and one to the north of Route 184. These two additional land holdings total roughly 59 acres, and allow the solar array fields to be located away and to the north of most of the vernal pools discovered in the southern portion of the study area.

In our professional opinion, the project design and layout has succeeded in minimizing impacts to vernal pool habitats and their obligate amphibians, while maintaining connectivity between the pools, thus promoting robust metapopulations. In the post-construction phase diversity and productivity of amphibians, and in particular, of the obligate vernal pool species, will be maintained at the study area.

8.0 LISTED SPECIES SURVEYS

8.1 Overview

Prior to the commencement of fieldwork at the subject site in the Spring of 2017, REMA sent a query to the CT DEEP's Natural Diversity Data Base (NDDB), regarding the potential presence of CT-listed species [i.e., endangered (E), threatened (T), special concern (SC)] were known to be associated with the site. A response dated May 16th, 2017, was received from Ms. Dawn McKay, indicating that several listed species were known from the vicinity of the site (see Attachment F). These were:

➢ *Crocanthemum propinquum*	Low frostweed	SC
➢ *Plantago virginica*	Hoary plantain	SC
➢ *Calopteryx dimidiate*	Sparkling jewelwing	T
➢ *Lasiurus borealis*	Red Bat	SC
➢ *Scaphiopus holbrookii*	Eastern spadefoot	E
➢ *Margaritifera margaritefera*	Eastern pearlshell	SC

A review of the on-line information at the time of the 2017 query revealed several "estimated habitats" for listed species near the site but not overlapping the site. These were based on a December 2016 revision of the NDDB area maps. The most recent mapping, with a revision date of June 2020, still does not show any habitat areas overlapping the site, even with the addition of roughly 60 acres to the site to the north and south of the Providence-New London Turnpike (Route 184).

In the following narrative we discuss most of the species listed above, with two exceptions. The eastern pearlshell (Margaritifera margaritefera) would not be found within the study area, since the site does not contain any suitable habitat, that is, perennial streams.

While we cover searched for the eastern spadefoot (*Scaphiopus holbrookii*) each spring season while conducting vernal pool surveys, we did not specifically undertake robust surveys in the late spring or summer, during rainy nights, which is part of the standard protocol for spadefoot surveys. Our reasoning for not conducting these surveys was centered on the fact that the portions of the site with potential habitat was disturbed, relatively new (since the mid-1990s when the majority of mining had ceased), and based on our recommendations the proposed project was not going to be utilizing the southern portion of the study area. This was due to the plethora of vernal pool habitats as well as the presence of other CT-listed species. Nevertheless, we collected tadpoles in April and May of 2017 and 2018, for several locations and reared them. All of these metamorphosed as either wood frogs or gray tree frogs.

In discussions with Ms. Dawn McKay of the CT DEEP NDDB at the beginning of 2021, it was decided that a spadefoot specialist, Mr. Dennis McQuin, would be retained to conduct more robust surveys for spadefoot. These will begin in May of 2021.

Finally, searches for the listed Special Concern bat species (i.e., red bat) were not conducted, as special seasonal restrictions for the cutting of maternity roosting trees are being considered in the development plans.

In the course of our site investigations and natural resource inventories, REMA came across several additional CT-listed species of Special Concern. These were three herptile species: the ribbon snake (*Thamnophis s. sauritus*), the eastern box turtle (Terrapene c. Carolina), and the spotted turtle (Clemmys guttata). Annotated pictures for the two first species are included in Attachment E. The spotted turtle was observed but quickly escaped capture.

8.2 Herptiles

Ribbon Snake (*Thamnophis s. sauritus*)
CT Special Concern

The distribution of this species is spotty throughout Connecticut, and may have been extirpated in portions of its prior range as some of its favorite more open habitats have diminished and wetland habitats have been impacted, through pollution. The ribbon snake may be an indicator of high quality wetland habitat, even though it known from disturbed landscapes such as sand and gravel pits. This species seldom ventures too far from its preferred habitats, such as open grassy (moist or wet) meadows, shrub thickets bordering water, the edges of ponds and streams, and even some more open canopied seasonally flooded wooded swamps. Since it is semi-aquatic and mainly forages on ectothermic animals, such as toads, frogs, salamanders, an occasional fish and invertebrates, it mostly found near shallow open water.

Over the years, REMA scientists have observed ribbon snake numerous times, and always in water, above water, or near water, flowing or still. These snakes are semi-arboreal and are frequently found basking on branches of trees, bushes, or grasses overhanging water. In Connecticut the ribbon snake activity period is April to October, and at the subject site one specimen was observed in Wetland 3A, in branches above seasonally flooding (see Figure 2, Attachment A) (see Photos F4 through F7, Attachment E).

It is likely, that additional individuals are located throughout the southern portion of the subject site, mostly associated with Wetland 2E, and the various confirmed vernal pools, with abundant foraging opportunities, including larva of toads, frogs and salamanders. Potential hibernacula exist throughout the southern portion of the study area in the porous, sandy/gravelly soils, that occur along the edges of the past sand gravel mining site. Also, since the majority of the proposed activities associated with the solar array fields are hundreds of feet removed from the preferred habitat, and since all of the vernal pool habitats are considered "conserved," impacts to this CT-listed species are highly unlikely.

Eastern Box Turtle (*Terrapene c. carolina*)
Special Concern

Eastern box turtles use a variety of different habitats; they forage for invertebrates and plant matter in meadow and forested habitat; mushrooms, arthopods, and earthworms are found on the forest floor in closed canopy forests. Red maple swamps, in particular, are

a preferred habitat, 48 of a total of 85 Eastern box turtles were in red maple swamps, according to MS Thesis research in Illinois by Jeanne Marie Baker. Like any reptile, they bask in sunny spots in cool weather. They are often observed along forest edges and utility corridors, but the greater ease of observation does not mean that sunny edges are their primary habitat. During extended hot spells, they cool themselves off by burrowing under leaf litter, in moist, soft soil (aestivation), or by soaking in a stream or puddle.

Shrub or vine cover is a key habitat component, providing a safe, concealed, shaded location during resting periods. They are sensitive to overheating and dehydration, and often spend the heat of the day in the shade of a bush. Invasive woody species do provide cover, and even if few herbivorous insects feed on the foliage of an invasive plant, its fallen leaves and twigs, will still be eaten by detrivore invertebrates, a preferred food of Eastern box turtles. If sufficient tree leaf litter also falls to the ground, a wooded area with a high proportion of invasive woody species can still provide adequate Eastern box turtle habitat.

Movements are limited to a small home range, usually under an acre, except during the spring breeding season, when females travel to egg-laying sites, and males set off to find females. Breeding takes place in the last ten days of May or in June, per data compiled by Dr. Klemens (1993), typically following a heavy rain. This minimizes dehydration risks, and also softens the soil, facilitating nest-digging. Most observations and road mortality take place during spring movements for breeding purposes.

In southern New England Eastern box turtles appear to use several different types of habitat for hibernation: a deep pile of leaves/compost in a depression or under a boulder; deep, moist soil at the edge of a wetland; and deep, well-aerated, sandy soil. The latter is present at the site. Sandy soil also needs to be moist enough to prevent dehydration of eggs, and temperatures not too high, per research cited by Ernst and Lovich (2009)[12].

Like many plant and animal species, eastern box turtles are vulnerable to habitat fragmentation and to inbreeding. Despite the small home range, those studying box turtles in Connecticut have found that in small, isolated habitat fragments (e.g., less than twenty acres), Eastern box turtles may persist for ten or twenty years, but not over the long term.

[12] Turtles of the United States and Canada

At this site, one female, roughly 14-year old, eastern box turtle was observed at the edge of Wetland 2E (see Figure 3, Attachment A) (see Photos F1 to F3, Attachment E). It is likely, based on the types of habitats within the study area, that additional box turtles are present at the overall site, especially in wooded areas along the wetland corridors. Therefore, the standard search and exclusion protocol recommended by the CT DEEP would have to be employed prior to any land disturbance.

Spotted Turtle (*Clemmys guttata*)
Special Concern

Habitat on this site is suitable for spotted turtles (*Clemmys guttata*) and one was found within a semi-permanently flooded area, part of the complex of wetland habitats identified as Wetland 2E (see Figures 2 and 3, Attachment A).

This small, black turtle has a smooth, keelless carapace, no larger than 12.5 cm. across, with yellow spots. The head, neck, and legs also have yellow spots. This species feeds on aquatic fauna, both tadpoles and invertebrates, in a variety of flooded wetlands, vernal pools, slow-moving, muddy-bottomed streams, ditches, red maple swamps, and floodplain sloughs. Spotted turtles move among a group of wetlands, with different food sources available at different times.

The matrix of contiguous natural habitat around the suitable wetland habitats on this site is unfragmented by barriers such as busy roads (except occasional ATV use). Nesting occurs on top of hummocks and tussocks within swamps, and also on well-drained embankments and open grassy areas. The southern marsh-meadow-shrub swamp complex (i.e., Wetland 2E), with adjacent sandy suitable nesting habitat on the side slopes of the old quarry. Moreover, abundant foraging opportunities in the conserved vernal pools and within other aquatic habitats in the southern portion of the overall study area will remain intact.

Water quality affects habitat quality by influencing wetland productivity – the biomass of aquatic fauna available for foraging by spotted turtle. The site is large enough and isolated, such the wetlands are fed by groundwater & rainfall, well-filtered by soil, and not degraded by surface runoff from surrounding developed land uses. Abundant toad and wood frog tadpoles were observed in all the seasonal pools.

The status of Wood Frog (*Lithobates sylvaticus*) on the site is closely linked to that of spotted turtle. Wood frog tadpoles are an important prey for the state-listed spotted turtle and an obligate vernal pool species, such that conservation of this species goes hand in hand with spotted turtle conservation. To support the spotted turtle population, is important not only that wood frogs persist on the property, but that they persist in high enough numbers, such that the quantity of available food will remain high. As discussed in a previous section, all of the vernal pools in the vicinity of the preferred habitat for spotted turtle will be preserved.

8.3 Invertebrates

Sparkling Jewelwing (*Calopteryx diminiata*)
Threatened

The sparkling jewelwing is reported to be found along forest streams and rivers with moderate to swift currents, but this species prefers stream segments that are mostly open with little canopy of trees. It is typically associated with acidic waters, and specifically tannin-rich waters. The stream habitat usually has a sandy substrate and plentiful aquatic vegetation, such as wild celery (*Vallisneria americana*), to which the female sparkling jewelwing attaches eggs by submerging under the water's surface for up to fifteen minutes. This behavior gives this species an advantage in areas where oviposition could be disturbed by other jewelwings. The hatched larvae are fully aquatic, and the adults tend to stay near the stream habitats from which they emerged. Reportedly this species is often found in small colonies. Flight times in Connecticut centers around May and June.

REMA did not specifically survey for this species, although the more common ebony jewelwing (*Calopteryx maculata*) was observed in September 2019, along the southern section of the stream associated with Wetland E, south of the crossing within the abandoned quarry area. Since oviposition takes place in flowing waters that tend to be perennial, intermittent streams, such as those that characterize the site would not be preferred by this species, if it was present.

Nevertheless, should this species be present and associated with the flowing streams of Wetland E and the southernmost section of Wetland B/1B, the proposed activities at the site would not affect these habitats, and this species would be secure.

8.4 Plants

Low frostweed (*Crocanthemum propinquum*)
Special Concern

This species is one of four *Crocanthemum* species (rock roses or frostweeds) that occur in southern New England (Connecticut, Massachusetts, and Rhode Island). It is the only one that is rhizomatous, spreading by underground runners, and forming patches. It is a member of a small family, the Cistaceae or rock rose family, that also includes pinweeds (*Lechea* spp.) and a low, bushy dry-site plant called *Hudsonia tomentosa,* also found in sandy habitats. It has the lowest genetic diversity of the four species, based on a recent genetic study by Samuel Oboe, Brian Conolly, and Mark Brandt (2013).

Two of the other species, *Crocanthemum bicknelli*, and *C. canadense* are more secure from a conservation standpoint, and are not listed as rare plants. The fourth, *C. dumosum* is also listed as a Species of Special Concern, but the above referenced genetic study strongly indicated that it is in fact just a variety of *C. canadense*.

C*rocanthemum propinquum* plants are often arranged in a line, along a rhizome, and by carefully probing in the soil between two plants, one can find the slender connecting rhizome. The small, linear, blunt-tipped leaves are untoothed and alternately arranged on stems with few branches. Fertile flowers are produced in June at the tip of the plant. Cleistogamous (self-fertilizing) flowers in leaf axils produce rounded seeds. Early summer flowers, with showy yellow petals, produce a few rounded seed capsules at the top of the plant. There are only a few capsules, not a large cluster, as in *C. canadense*. While a REMA botanist conducted a moderate-intensity survey for this listed plant, and only any areas with the highest probability of occurrence, that is, the open sand-barren type habitats within Upland Cover Type 17 (see Figure 3, Attachment A), the likelihood of this plant being present is relatively low. Nevertheless, the preferred habitats will be left intact and will not be influenced in any way by the proposed solar facility.

Hoary plantain (*Plantago virginica*)

Special Concern

This CT Special Concern plant is an annual or biennial, with a rosette of wide, entire, parallel-veined basal leaves that look very much like those of *Plantago major*, another species in this genus. It bears a tightly packed hairy spike of seeds of high nutritional value for songbirds and for small rodents. Its flowers are green to brown, with 3 or 4 petals and sepals, also hairy. It is closely related to several genera in Scrophulariaceae or snapdragon family, but its taxonomy has been revised, and it now has its own family Plantaginaceae.

This species is reported to grow in open sunny sites with previously disturbed soil, and to grow well on sandy, dry soil. A REMA botanist searched for this species each time they visited the site in the remaining open portions of the site. Searching took place along the many dirt roads, and in the residual sandy/gravelly quarry area, after over 15 - 20 years of natural recovery, post-quarrying. *Plantago virgininca* was not found, but because the open quarry areas will all be preserved, the proposed project will not adversely affect it, if it is present on the site.

8.5 Mammals - *Chiroptera*

Eastern Red bat (*Lasiurus borealis*)
Special Concern

Red bat is widely distributed in forested regions of the United States. In Connecticut they tend to choose rural habitats, away from human habitation, in mature woods near clearings or forest-field ecotones. They are migratory species, arriving in Connecticut in April and leaving by late October, after breeding. During their time in Connecticut, they roost in dense foliage oaks, one of their preferred roosting trees. They give birth and rear their pups through July. Because red bat is a tree-roosting species, it has not been adversely affected by white-nose syndrome (WNS). However, its distribution and abundance in Connecticut has declined due to impacts to preferred habitats, which includes mature forests, and good quality edge habitat.

Northern Long-Eared bat (*Myotis septentrionalis*)
Endangered (Connecticut); Threatened (Federal)

The Northern Long-Eared Bat (NLEB), which also federally listed as "threatened," was not listed in the original May 29, 2017 letter for the DEEP's NDDB regarding potential listed species at the subject site (see Attachment F). Also, since more than one year had gone by since the original query, a new query was submitted to Dawn McKay of NDDB on December 31st, 2020. In a brief email communication, Ms. McKay informed us that the original 2017 list of "listed species" would still be considered valid. As noted, the 2017 list did not include NLEB.

This is one bat species that has been severely impacted by white-nose syndrome (WNS), and is in danger of extinction. This bat species hibernates in caves and mines in the winter where is most susceptible to WNS. In Connecticut this species hibernacula have been surveyed, and a map has been produced showing the towns in which these are found (see Attachment G). The closest hibernacula to the site are roughly 47 miles to the west in the Town of North Branford. There are no recorded hibernacula in North Stonington.

In the summer, this species will roost singly or in small colonies underneath the exfoliating bark of mature trees, or in crevices of tree snags. They will occasionally roost in structures such as barns.

Discussion – Mitigation

It is likely that the red bat utilizes the site during the roosting season, and the possibility exists that NLEB could also utilize the site. The presence of mature forest, forested edges, wetlands, and on-site or nearby open water sources, contribute to this assessment.

As a precautionary mitigative measure, tree clearing for the proposed solar facility will be restricted according with 4(d) rule requirements of the Endangered Species Act (ESA), associated with the conservation of NLEB. Tree clearing will not occur in the months of June or July, in order to avoid the pup rearing season for not only NLEB but also for the other listed bat (i.e., red bat). In the post-construction phase of the project, significant wooded areas will remain on the site or in the vicinity, and expansion of edge habitat will take place, providing additional foraging lanes for bats. Therefore, the site will continue to provide suitable habitats for the Connecticut and federally-listed bats during the spring and summer activity period.

8.6 Conclusion

Based on the listed species surveys conducted by REMA during several growing seasons, and as discussed above, it is unlikely that any of the species found in the May 2017 letter from DEEP's NDDB, occur or breed on the subject site, with the possible exception of eastern spadefoot, for which additional surveys will be conducted in 2021. The two listed plants, if they would be present, would only occur in the disturbed, sand barren-type habitats within southern portion of the study area, all of which will be left intact, and beyond the influence of the proposed solar array fields.

The three additional Special Concern herptile species that were observed, that is, the ribbon snake, eastern box turtle, and spotted turtle, will all be secure following development, as long as the search and exclusion protocols for eastern box turtles, per the CT DEEP standards, are employed prior to land clearing.

9.0 PROPOSED & POTENTIAL WETLAND/WATERCOURSE IMPACTS

9.1 Direct Wetland/Watercourse Impacts

Direct wetland and watercourse impacts are proposed at four locations (i.e., Impact Areas 1 through 4; IA-1 through 1A-4, see Figure 2, Attachment A), to provide access to proposed solar array fields, totaling 3,749 square feet (i.e., 0.086 Acres) of wetland alteration, and 20 linear feet of watercourse impact. In the northern section of the project area, access is provided from Providence-New London Turnpike (Route 184), while to the southern portion of the project area, access is provided from the east, from Boombridge Road. Also, an internal access roadway is proposed in the northeastern section of the project area, providing connectivity between proposed array fields.

The access roadway from Route 184 (i.e., Impact Area 1; IA-1), would disturb approximately 1,136 square feet (0.026 acres) of a forested wetland (i.e., Wetland A2, see Figure 2, Attachment A) (see Photos IA-1a Attachment H). This necessary access roadway traverses a narrow section of forested wetland, as well as the ditched outlet intermittent watercourse to the wetland. This ditching shows up on the 1934 archival aerial photograph and it was likely an attempt to dry out the wetland, which at the time was open wet meadow and used as pasture. A 9-foot wide box culvert is proposed at this

location (i.e., Culvert C-1), which will span the existing watercourse channel, allowing for unfettered movement of flows and aquatic organisms, and adhering to the CT DEEP Stream Crossing Guidelines and USACE Openness Ratio Calculations. Thus, the direct impact to this wetland has been minimized and the intensity of this crossing upon wetland functions and values shall be *minimal*.
Also, in the northern portion of the project area, an internal roadway connecting two solar array fields crosses an intermittent watercourse, which drains Wetland B-2 (see Photos IA-2a, Attachment H). The impact at this watercourse is 20 linear feet, but the narrow (i.e., +/- 3-foot) stream channel will be spanned using a 6-foot wide bottomless arch culvert (i.e., Culvert C-2). Impact to this regulated resource is considered *negligible*.

In the southern portion of the project area, access will be provided from Boombridge Road, along an existing unimproved roadway, which has been used for many decades to access to the property. This woods road also crosses a wetland corridor and watercourse at grade, approximately 700 feet westerly of Boombridge Road. Starting from the east, the first wetland/watercourse crossing will require an existing culvert to be retrofitted and improved (see Photos IA-4a and IA-4b, Attachment H). This will entail a wetland impact of 279 square feet (0.006 acres) (i.e., Impact Area 4; IA-4; see Figure 2, Attachment A). At this location a 10-foot wide bottomless arch culvert will be installed (i.e., Culvert C-4), improving on the existing culvert by upgrading it to comply with the CT DEEP Stream Crossing Guidelines and USACE Openness Ratio Calculations. Thus, the direct impact to this wetland and watercourse has been minimized and the intensity of this crossing upon wetland functions and values shall be *minimal*. In fact, the installation of the bottomless arch culvert is considered as a net benefit to the wetland and its intermittent watercourse.

Further west, along the same woods road, a wetland crossing will impact 2,334 square feet (0.053 acres) of wetland and 20 linear feet of intermittent watercourse (see Impact Area 3; IA-3, see Figure 2, Attachment A) (see Photos IA-3a and IA-3b, Attachment H). At this location a 9-foot wide bottomless arch culvert will be installed (i.e., Culvert C-3), which will comply with the CT DEEP Stream Crossing Guidelines and USACE Openness Ratio Calculations. The selected location for a crossing takes advantage of the historic wetland/watercourse disturbances, thus minimizing impacts to wetland/watercourse functions and values. Thus, the direct impacts to the wetland and watercourse have been minimized and its intensity is considered to be *low*.

9.2 Indirect Wetland/Watercourse Impacts

Indirect or secondary impacts to a wetland or watercourse can occur as a result of activities *outside* of wetlands or watercourses. Such impacts can be *short-term* or *long-term*, and are typically associated with erosion and sedimentation, mostly during the construction period, the removal or disturbance of vegetation in upland areas but adjacent or in close proximity to wetlands or watercourses, the alteration of wetland hydrology or the flow regime of a watercourse, and the discharge of degraded surface water or groundwater, in the post-construction phase, which may adversely impact the water quality of the regulated resources.

The potential for any of these indirect impacts to occur at the site as a result of the proposal depends on the regulated resources themselves, their environmental sensitivity, and their ecological and physical characteristics. These potential impacts, as they relate to the specific development proposal, are discussed below.

9.2.1 Erosion and Sedimentation

The potential for soil erosion and subsequent deposition in wetlands or watercourses exists at every construction site that involves soil disturbance. At this site the risk or the potential for adverse impacts from erosion and sedimentation is considered to be *moderate.* The primary reasons for this assessment are as follows: (1) appropriate erosion and sedimentation controls have been proposed, in accordance with the 2002 *Connecticut Guidelines for Soil Erosion & Sediment Control*, (2) the dominant soils in the areas to be exposed or excavated during the construction phase have *moderate* erodibility[13]; and (3) slopes subject to soil disturbance are generally *gentle* to *moderate* throughout most of the site (i.e., B- and C-slopes).

The site plans show sizeable detention basins, which will act as sedimentation basins during construction, that are proposed in the lower portions of the areas to be graded for the solar panel installations and include diversion swales to trap and convey surface

[13] The two dominant upland soil types to be disturbed at the site are the well-drained Paxton and Montauk soil series complex, and the well-drained Charlton and Canton soil series complex. The K-factor for these soils, which indicates the susceptibility of a soil to sheet and rill erosion is moderate, based on K-Factor (whole soil) ratings of 0.24 to 0.28, respectively. However, slope increases the erodibility of these soils, which necessitates the use of robust erosion and sedimentation controls.

flows to them. All constructed slopes, including those of all detention basins, will be kept at a 3:1 slope or less, and many other controls are proposed, as seen in the submitted documents by the petitioner. Nevertheless, diligent monitoring and maintenance of erosion and sedimentation controls is necessary to ensure that the regulated resources are protected during the construction phase.

9.2.2 Removal of Native Vegetation and Habitat Loss

Habitat loss associated with land clearing is an unavoidable consequence of land development, which has the potential of impacting wetlands and watercourses. At the subject site, a minimum permanent wetland buffer of 25 feet is maintained throughout, except at the proposed wetland/watercourse crossings. The security fence that surrounds the solar array fields are typically further away from delineated wetlands, and the solar panels are yet further away.

In the northern section of the project area (i.e., north of Route 184), the 25-foot minimum wetland and watercourse buffer are maintained. In the southern portion of the project area (i.e., south of Route 184 and west of Boombridge Road), wetland buffers are much wider, often in excess of 100 feet or more, with the exception of the proposed detention basins and their outlets. The project design in this portion of the site recognizes that the wetlands and watercourses in this section of the study area conferred higher functions and values, provided higher plant and animal diversity and abundance, and were more sensitive to nearby activities. Therefore, greater separation distances from this resources were provided.

Overall, the wetland and watercourse buffers that are proposed are of sufficient width and quality to continue to protect the regulated resources and to provide complimentary habitat that will maintain wetland functions and values.

9.2.3 Potential Impacts to Wetland Hydrology and Stream Flow

The hydrologic and flow regimes to the site's wetland areas, including isolated wetlands, are dependent predominately on direct precipitation and surface flows from their respective watersheds. However, seasonally for most wetlands, a groundwater component is also contributing the wetland hydrology, as infiltrated rain water rides on the underlying till or bedrock that is characteristic of most of the site's soils, and

discharges into wetland areas. Throughout the site, surface and shallow groundwater flows will be maintained. There will be no significant diversions of flows from the proposal which would deny water to any wetland. Therefore, the proposed activities will not result in any appreciable hydrologic changes (i.e., overall or localized) to the regulated wetlands, and no impacts to wetland hydrology are anticipated.

9.2.4 Potential Water Quality Impacts

Stormwater runoff from impervious surfaces of development (e.g., commercial, residential) sites has the potential of degrading the water quality (i.e., surface and groundwater) of regulated resources. Generation of potential pollutants on impervious surfaces typically results from vehicular traffic over them. The more the "axle-miles" or the movements of vehicles over impervious surfaces, the higher is the potential loading of runoff constituents, including sediment, nutrients, heavy metals, and the like.

However, at this site, runoff constituents associated with vehicular traffic and "active" interconnect impervious surfaces will not be generated. All stormwater runoff generated from the "inactive" and functionally disconnected impervious surfaces (i.e., solar panels) will be treated on site through properly sited, configured, and sized, above-ground, primary treatment systems, in accordance with the guidelines set forth in CT DEEP's Stormwater Quality Manual (2004). It should be noted, however, that the primary water *quality* control measure at the site is the maintained grass and forb cover associated with the solar array fields. The proposed stormwater basins' primary function is water *quantity* control. Therefore, with the proposed best management practices in place, the water quality of the receiving waters, including off-site wetlands and watercourses will maintained.

10.0 REFERENCES

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Attachment A

Figures (1 to 3, A and B)

FIGURE 1:

SITE LOCUS MAP
North Stonington Solar Facility

2000 1000 0 2000
GRAPHIC SCALE IN FEET

N

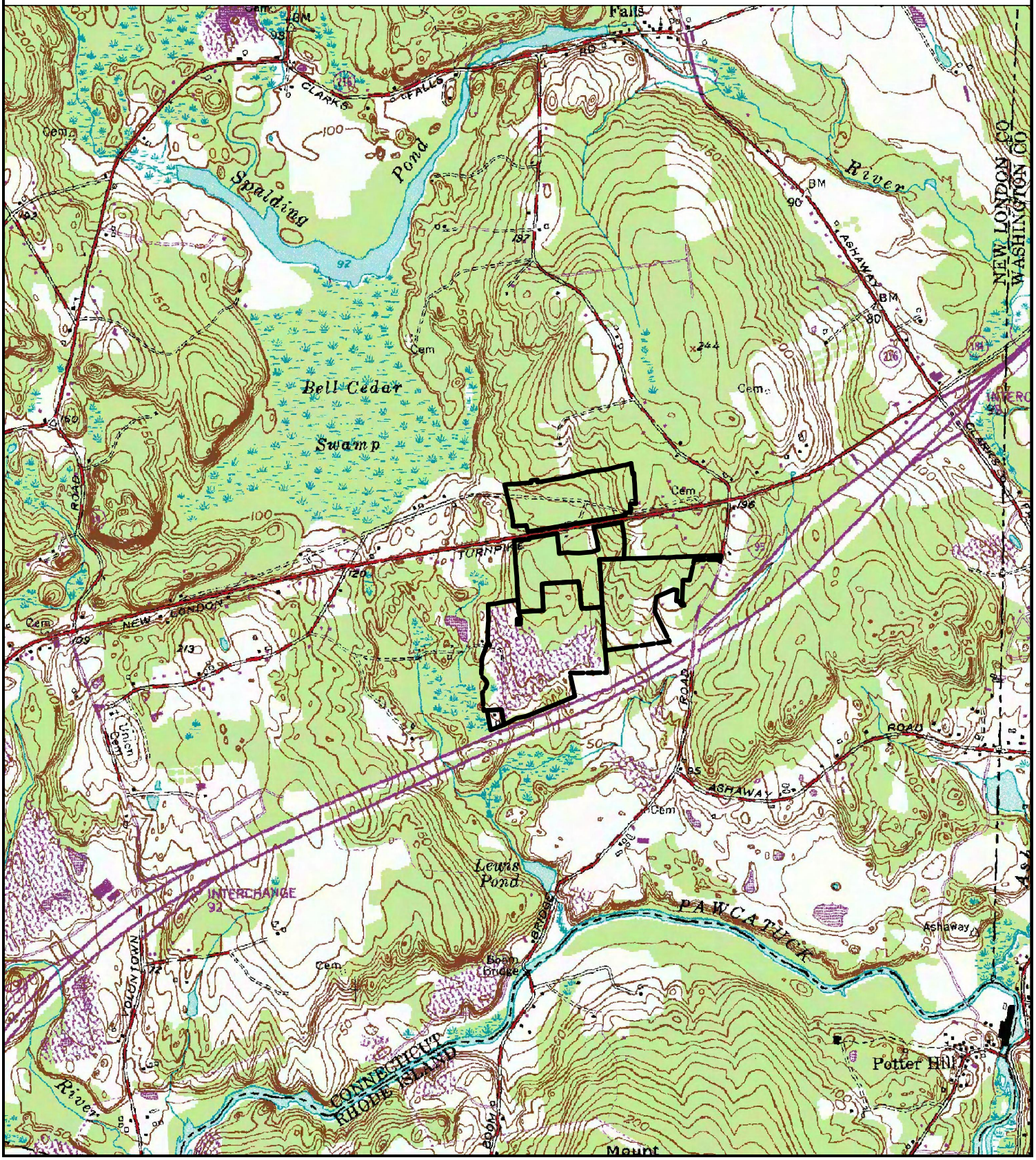

FIGURE 2:

WETLANDS & WATERCOURSES
North Stonington Solar Facility
(as seen on a 2018 aerial photo)

Legend

- Delineated Wetlands
- Mapped Wetlands
- STUDY SITE

N — WETLAND ID *(per wetland survey flag series)*

VERNAL POOL

Observed breeding by vernal pool obligate amphibians

IA-1 — *Direct Wetland Impact Areas for access to site and internal connectivity*

Miner-Meeting House Rd
Cranberry Bog Rd
Jewish War Veterans Memorial Hwy
Boom Bridge Rd
Provider
184
95

B-2
IA-2
A-2
VP-1
IA-1
C-2
E
VP-E
A/1A
IA-3
IA-4
B/1B
H-1
I
1C
G
C
F
H
1H
2H
K
O
N
J
M
3E
X
L
2E

Watercourse Outlet

Google Earth

N

1000 ft

FIGURE 3:

VEGETATIVE COVER TYPES (ZONES)
North Stonington Solar Facility
(as seen on a 2018 aerial photo)

Legend

- Delineated Wetlands
- Mapped Wetlands
- STUDY SITE

U9 COVER TYPE (ZONE)

Edge of Past Mining Operation

- Ribbon Snake (***Thamnophis sauritus***)
- Eastern Box Turtle (***Terrapene carolina carolina***)
- Spotted turtle (***Clemmys guttata***)

NOTE: for wetland cover type IDs see Figure 2

Cemetery

Providence-New London Turnpike (184)

Cranberry Bog Rd

Boom Bridge Rd

95

Google Earth

N

1000 ft

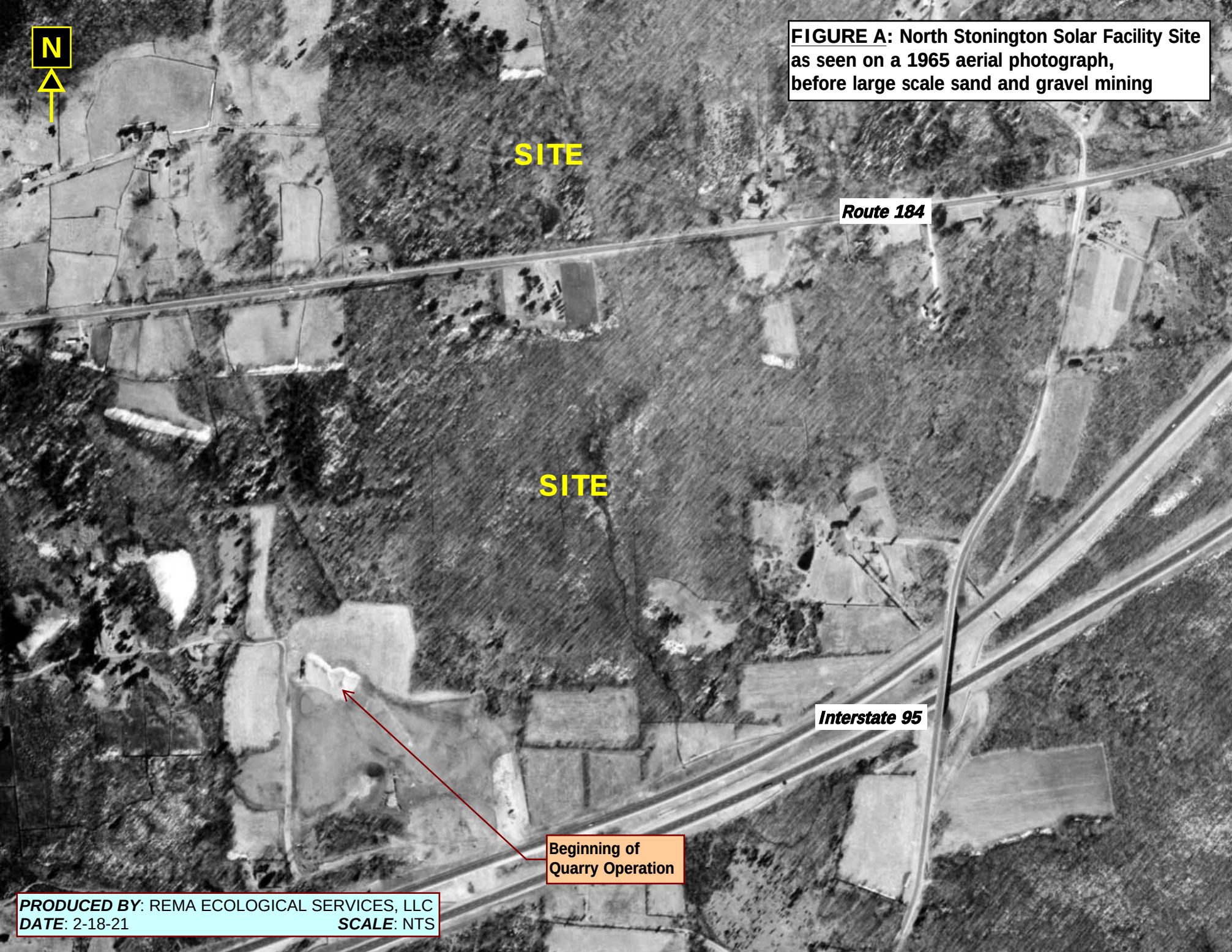

FIGURE A: North Stonington Solar Facility Site as seen on a 1965 aerial photograph, before large scale sand and gravel mining

PRODUCED BY: REMA ECOLOGICAL SERVICES, LLC
DATE: 2-18-21 ***SCALE***: NTS


PRODUCED BY: REMA ECOLOGICAL SERVICES, LLC
DATE: 2-18-21
SCALE: NTS
FIGURE B: North Stonington Solar Facility Site as seen on a 2004 aerial photograph, showing the limits of final quarry operation
SITE
Route 184
SITE
Interstate 95
Final Extent of Quarry Operation
N

Attachment B

Annotated Photographs of Vegetative Cover Types/Zones
(Uplands & Wetlands)

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo U1a: Upland Cover Type U1; northwesterly section of study area; shallow soils and bedrock outcrops; facing easterly.

Photo U1b: Upland Cover Type U1; facing southerly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo U1c: Upland Cover Type U1; northwesterly section of study area; shallow soils and bedrock outcrops; facing northeasterly.

Photo U2a: Upland Cover Type U2; westerly of Wetland A-2; facing northwesterly

Photo U2b: Upland Cover Type U2; near old turnpike route; a few red cedars remain; facing southeasterly.

Photo U2c: Upland Cover Type U2; westerly of Wetland A-2; moderately well drained soils; note American Holly; facing easterly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo U2d: Upland Cover Type U2; facing southeasterly.

Photo U3a: Upland Cover Type U3; mature deciduous forest; below tall, north-south oriented stone wall; moderately well drained soils; facing southeasterly

Photo U3b: Upland Cover Type U3; facing southerly.

Photo U3c: Upland Cover Type U3; mature deciduous forest; above tall, north-south oriented stone wall; well drained soils; facing northwesterly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo U4a: Upland Cover Type U4; post-agricultural forest with eastern red cedar; facing southeasterly.

Photo U4b: Upland Cover Type U4; post-agricultural forest; dense understory with invasive multiflora rose and Japanese barberry; facing northeasterly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo U5a: Upland Cover Type U5; deciduous forest with white pine understory; Route 184 in background; facing southeasterly.

Photo U5b: Upland Cover Type U5; southwestern section of northern portion of project area; facing northwesterly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo U5c: Upland Cover Type U5; deciduous forest with white pine understory; west of Wetland A-2; facing southeasterly.

Photo U6a: Upland Cover Type U6; moderately well drained forest, east of Vernal Pool 1; facing northwesterly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo U8a: Upland Cover Type U8; mixed evergreen/deciduous forest; facing southwesterly.

Photo U9a: Upland Cover Type U9; deciduous forest; black birch grove on slope above (east) of Wetland E; facing northeasterly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo U9b: Upland Cover Type U9; deciduous forest; Wetland E in background; facing southerly.

Photo U9c: Upland Cover Type U9; deciduous forest; Upland Cover Type 13 in background; December 2020; facing southeasterly

Photo U9d: Upland Cover Type U9; deciduous forest; east of Wetland E; facing easterly.

Photo U9e: Upland Cover Type U9; deciduous forest; small unit at western section of study area with embedded small cemetery; November 2018; facing southeasterly

Photo U9f: Upland Cover Type U9; deciduous forest; west of Wetland E; December 2020; facing southwesterly.

Photo U9g: Upland Cover Type U9; deciduous forest; November 2018; west of Wetland E; facing northerly

Photo U9h: Upland Cover Type U9; deciduous forest; east of Wetland E; December 2020; one of 18 test holes developed in describing the site's soils; facing southeasterly

Photo U9i: Upland Cover Type U9; deciduous forest; west of Wetland E; November 2018; Upland Unit 10 in background; facing southwesterly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo U10a: Upland Cover Type U10; mature, mixed evergreen/deciduous forest; facing northerly

Photo U10b: Upland Cover Type U10; deciduous forest; west of Wetland E; April 2017; facing westerly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo U11a: Upland Cover Type U11; planted white pine grove; April 2017; facing southwesterly

Photo U11b: Upland Cover Type U11; planted white pine grove; April 2017; Upland Cover Type 16 at toe of slope, and Wetland F; facing westerly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo U13a: Upland Cover Type U13; mature hemlock forest; December 2020; along old woods road that starts at Boom Bridge Road; facing easterly

Photo U13b: Upland Cover Type U13; mature hemlock forest; April 2020; pileated woodpecker hole; facing easterly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo U15a: Upland Cover Type U15; post-clearing immature deciduous forest; December 2020; once within the footprint of the quarry; facing northeasterly

Photo U15b: Upland Cover Type U15; post-clearing immature deciduous forest; December 2020; Wetland C in far background; facing southerly

Photo U16a: Upland Cover Type U16; thicket, autumn olive dominated; December 2020; one of many trails in southern portion of site; facing westerly

Photo U16b: Upland Cover Type U16; thicket, autumn olive dominated; trail from end of Cranberry Bog Road; April 2017; facing easterly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo U17a: Upland Cover Type U17; mosaic of sand barren, exposed bedrock, low woody copses; sparse meadow with broom sedge, with red cedar, white pine, gray birch in background; facing easterly

Photo U17b: Upland Cover Type U17; open meadow and sparsely vegetated bare ground, showing a boulderpile in a concentration of red cedar and gray birch. Dominant grass is little blue stem; facing northerly

Photo U17c: Upland Cover Type U17; mosaic of sand barren, exposed bedrock, low woody copses; note exposed bedrock; facing northeasterly

Photo U17d: Upland Cover Type U17; droughty open meadow on thin substrate over bedrock; facing northwesterly

Photo U17e: Upland Cover Type U17; mosaic of sand barren, exposed bedrock, low woody copses; April 2017; white pine dominates at the northern edge of the old quarry; facing easterly

Photo U17f: Upland Cover Type U17; old wood road at far northeastern edge of abandoned quarry; just easterly of Wetland H-1; facing southerly

Photo U17g: Upland Cover Type U17; mosaic of sand barren, exposed bedrock, low woody copses; November 2018; facing northerly

Photo U17h: Upland Cover Type U17; exposed unvegetated ground; northwesterly of Wetland G (Vernal Pool G); facing northeasterly

Photo U17i: Upland Cover Type U17; mosaic of sand barren, exposed bedrock, low woody copses; Prickly dewberry (*Rubus flagellaris*) is a widespread, dominant native groundcover

Photo U17j: Upland Cover Type U17; Haircap moss (*Polytrichum* spp,) is a dominant groundcover, as is Canada cinquefoil (*Potentilla canadensis*). Note the rocky ground.

Photo U17k: Upland Cover Type U17; mosaic of sand barren, exposed bedrock, low woody copses; Hawkweed (*Hieraceum* spp), occasional. Hawkweed cannot readily be identified to species during the winter season (December 2020).

Photo U17l: Upland Cover Type U17; *Cladonia* spp. This lichen genus is characteristic of open sandplain habitats. Occasional at this site.

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo W1Ca: Wetland 1C, isolated; north of Vernal Pool G and Wetland C; facing easterly

Photo W2Ea: Wetland 2E; wetland complex in southern section of study area; northwesterly pond; facing notherly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo W2Eb: off-site forested wetland, immediately west of the southwestern corner of the old quarry operation and Wetland 2E; facing westerly

Photo W2EC: Wetland 2E; seepage wetland at southwesterly corner of old quarry, receives groundwater from off-site wetland (see previous photo); facing easterly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo W3Ea: Wetland 3E; (also see photos for Vernal Pool 3E); facing easterly

Photo WA/1Aa: Wetland A/1A; wetland and watercourse south (downstream) of Impact Area 4; facing southerly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo W2Ed: Wetland 2E; outlet stream through embankment at southern edge of study area; flows to large culvert under Interstate 95 at far end; facing southeasterly

Photo W2Ee: Wetland 2E; outlet stream; aquatic organisms at riffle indicate good water quality; facing northerly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo W2Ef: Wetland 2E; southern edge of wetland complex with shallow water and marsh habitats; facing westerly

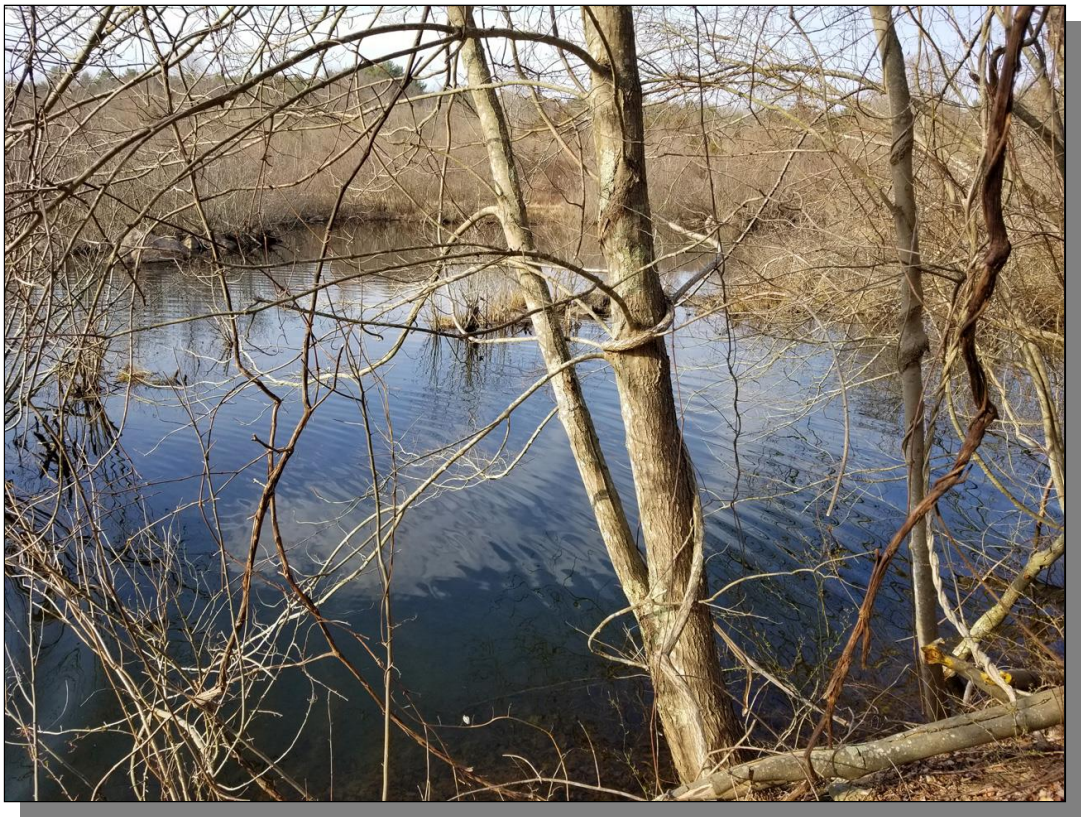

Photo W2Eg: Wetland 2E; deep water habitat (over 9 feet); contained finfish; facing northerly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo W2Eh: Wetland 2E; seasonal flow in ditch running parallel to old quarry access road, south of Wetland 3E; facing southwesterly

Photo W2Ei: Wetland 2E; scrub shrub and wet meadow cover types; far eastern section of wetland complex; facing northwesterly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo W2Ej: Wetland 2E; example of marsh habitat; western portion; facing southwesterly

Photo W2Ek: Wetland 2E; scrub shrub (sapling) cover type; old access road for quarry operation; facing northerly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo W2El: Wetland 2E; example of shallow open water and marsh and scrub shrub fringe; western portion; facing southwesterly

Photo W2Em: Wetland 2E; viewed from elevated berm at southern property boundary; facing northeasterly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo W2Eq: Wetland 2E; large stand of boneset seeding heavily. Monoculture of autumn olive on upland bank on far side of pond.

Photo W2Er: Wetland 2E; marsh habitat with floating burreed

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo W2Eo: Wetland 2E; shows the mature goat willows and other intermixed shrubs, dense shrub thicket on pond edge, with some alder and blueberry present. Dense herb stratum with both forbs & graminoids. Open water ditch at left.

Photo W2Ep: Wetland 2E; seasonally flooded shrub swamp with willows in background (shrub swamp cover type); some open water, and some emergent wet meadow with sedge clumps & grasses.

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo W2Ha: Wetland 2H; via outlet from Vernal Pool 1H; facing southwesterly

Photo W2Hb: Wetland 2H; lower portion; scrub shrub wetland; abuts Upland Cover Type 16, which is dominated by autumn olive; facing westerly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo WA-1Ab: Wetland A/1A; wetland and watercourse north (upstream) of Impact Area 4; facing northerly

Photo WA2a: Wetland A-2; central portion; infested with Japanese barberry pointing to its past use as pasture; facing northerly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo WA2b: Wetland A-2; outlet ditch; facing westerly

Photo WA2c: Wetland A-2; outlet man-made ditch pointing to its past use as pasture; facing westerly

Photo WA2d: Wetland A-2; within old roadbed for Providence-New London Turnpike facing northwesterly

Photo WA2e: Wetland A-2; southern section; embedded wet meadow; facing southeasterly

Photo WA2f: Wetland A-2; northern portion, eastern edge; facing northwesterly

Photo WA2g: Wetland A-2; central section; eastern edge; facing southeasterly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo WA2h: Wetland A-2; northern portion, intermittent watercourse; facing southerly

Photo WA2i: Wetland A-2; upper section; seepage area; facing northerly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo WB-1Ba: Wetland B/1B; below proposed wetland crossing; central section; facing southerly

Photo WB-1Bb: Wetland B/1B; central section (close up); facing southerly

North Stonington Solar, North Stonington, CT
Photos taken April 2017 through December 2020, by REMA Ecological Services, LLC

Photo WB-1Bc: Wetland B/1B; above proposed wetland crossing; upper section at property boundary; facing northerly

Photo WB-1Bd: Wetland B/1B; central section (April 2020); facing southerly