APPENDIX M – WETLAND REPORT

WETLANDS REPORT

PROPOSED WALLINGFORD RENEWABLE ENERGY

WALLINGFORD, CONNECTICUT

January 2018

REMA

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WALLINGFORD RENEWABLE ENERGY

WALLINGFORD, CT

1.0 INTRODUCTION

This *Wetlands Report* represents documentation of the effort by Rema Ecological Services, LLC ("REMA") to conduct in-field delineation and characterization of regulatory wetlands and watercourses (including a focus on potential vernal pools) on the subject site ("the Site," "the Study Area"). REMA utilized information developed previously on the Site including prior delineation work by others, as well as data collected at the Site by REMA in October through December 2017.

Three REMA staff (specifically George Logan – Senior Ecologist/Wetland Scientist; Tony Ianello – Natural Resources Specialist; and James McManus – Professional Soil Scientist) with expertise in soils, ecology, wetlands, and wildlife, visited the Site, starting on October 5th, 2017. The last Site visit supporting this report was conducted on December 12th, 2017. In all, REMA staff visited the Site on 9 different days since early October 2017, logging nearly 64 hours in the field.

While this *Wetlands Report* is meant to describe the regulated or "jurisdictional" resources at the Site (i.e., wetlands and watercourses), the report describes the context of the overall ecological resources observed. An *On-Site Soil Investigation & Wetland Delineation Report* is included as Attachment A of this *Wetlands Report*, and provides detailed information on the Site's upland and wetland soil types. Attachment B provides several figures, including archived and recent aerial photographs, to aid in the identification of the described regulated resources. Attachment C provides representative annotated photographs of each of the regulated resource areas. In Attachment D, details supporting the wetland functions and values assessment are presented. Attachment E provides maps illustrating potential vernal pool ("PVP") calculation radius information.

2.0 STUDY AREA SETTING

The Study Area encompasses roughly 116 acres in Wallingford, Connecticut (see Figure 1 in Attachment B). The parcels that comprise the Study Area are owned by two separate entities: (1) the Town of Wallingford ("Town Property"); and (2) Materials Innovation and Materials Authority ("MIRA") ("MIRA Property").

The Site is located within the southern section of Wallingford, approximately 1.2 miles west of Interstate 91. The Quinnipiac River roughly defines the Site's western boundary, with the Quinnipiac River State Park located immediately west of the river and Wilbur Cross Parkway located adjacent to the west of the park. State Route 5 generally bounds the Study Area to the east, roughly 1,200 feet away. The Study Area extends a little over half a mile (0.54 miles) from north of Ball Street south, to the MIRA parcel's southern boundary. Two intersecting electric transmission right-of-ways ("ROWs") traverse the Town Property; a natural gas transmission line ROW and oil pipeline ROW run parallel to the Quinnipiac River on the MIRA Property portion of the Site.

3.0 PAST LAND USES

The Study Area has undergone many significant land use changes since the beginning of the 20th century, with the Town Property and MIRA Property having distinctly different histories. The overall Site was predominantly in agricultural use in the 1800s through the 1950s, based on archived aerial photography;[1] however, certain portions of the Quinnipiac River floodplain, and the wetter portions of the interior wetlands, appear to have been periodically logged during this timeframe. Beginning in the late 1940s, and even through the early part of the 21st century, archival aerial photography indicates that the landscape of the Study Area changed rapidly through time.

In the following sections, we summarize the major landscape-level changes that have occurred from 1934 through 2004. Past land uses have affected the wetland resources within the Study Area, including their ecological integrity and the functions and values they provide. The REMA-delineated and verified wetlands shown in Figure A (Attachment B) will be used as a frame of reference in the discussion below.

1934 Aerial

The Study Area was in agricultural use in 1934 (Figure A1). The Town Property included several prominent fields with row crops and fruit trees, but a large section of the Town Property was pasture. In addition to the wetlands associated with the Quinnipiac River floodplain, several interior wetlands, interconnected with intermittent watercourses, are

[1] Archived aerials were viewed from online sources for flight years: 1934, 1951, 1965, 1970, 1986, 1995, and 2004. Additionally we viewed the 1995 aerial photographs (stereo pairs), available from our library, using a 3x mirror stereoscope.

evident. Many upland scrub-shrub areas are also scattered throughout the Town Property. Mature trees are few and found mostly along the river banks, as was typical in much of southern New England at the time.

The MIRA Property also included several farm fields and pasture, as well as immature woods, which covered about half of the MIRA Property. A farm house and associated buildings were located to the west of Wetland B2, and an access road through this wetland to the larger central field and to a barn structure is clearly visible (see Figure A2). A ditch draining Wetland B2 to Wetland B1 existed at that time, which is still present today.

Also within the MIRA Property, a small area of wetlands (located between Wetlands B3, B4 and B5) has been filled (see Figure A2 and Figure 2). As is evident in the 1965 aerial, a future trailer park will partially lie within this filled area within the MIRA Property. A road through a wooded area appears to have extended west from this fill area to the edge of the Quinnipiac River, where a small structure is visible.

1951 Aerial

Most of the agricultural field areas remained within the Town Property, but were reverting to young woods in 1951. In the far northern section of the Town Property, a sand and gravel extraction operation is evident. Two of the agricultural fields remained active on the MIRA Property, while others had been abandoned and are scrub-shrub areas. Within the MIRA Property, a small orchard is visible in the area that will become a trailer park in the years to come (as seen on the 1965 aerial).

1965 Aerial

By this flight year, many changes had taken place in the northern area of the Town Property. While the interior wetlands remained, most of the trees and shrub thickets in the upland areas had been cleared. Sand and gravel extraction continued, and landfill activities are evident, particularly in the northern area of the Town Property (Figure B1). The MIRA Property was reverting to woodland, while the trailer park appears to be well established within the prior orchard. At the top of the sandy escarpment to the east of the trailer park, a cluster of new homes is apparent (Figure B2). The natural gas line transmission corridor was developed on the MIRA Property prior to the 1965 imagery.

1970 Aerial

By this flight year, significant changes to the Town Property associated with the landfill have occurred; it appears that encroachment on some of its interior wetlands has also occurred. The woodlands within the MIRA Property continued to mature during the five year interval.

1986 Aerial

In the Town Property, the future landfill shape is beginning to be apparent in 1986. Additional wetlands and their connecting intermittent watercourses appear to have been filled to accommodate the expanding landfill operation (Figure C1).

Some major changes have also taken place within the MIRA Property. The trailer park remained more or less as shown previously, but the great majority of the upland woods were cleared or intensely logged, including areas between the interior forested wetlands, and areas to the west of the gas line ROW, almost to the river's edge (Figure C2). Also cleared and/or logged were some of the interior wetlands near and in what is now Wetland B1, as shown on Figure A. However, the greatest change was associated with the easternmost section of the MIRA Property in the vicinity of today's Wetland B3 and the uplands to the immediate east. The aerial photograph appears to indicate that upwards of 6.5 acres of wetland and upland has been excavated, and now appears as an extensive open sandy area (see Figure C2). A dirt roadway can also be seen crossing Wetland B2, providing access to the central upland portion of the MIRA Property. The hydrology of Wetland B2 appears to have been manipulated, severing its historic connection with Wetland B3 and filling nearly an acre of wetlands; what is now Wetland B3 appears to hold a greater depth and volume of water under 1986 conditions.

1995 Aerial

The configuration and extent of the landfill cells are evident within the Town Property; activities on the northern, larger landfill cell appear almost complete, while the southern smaller landfill cell is still active (Figure D1). On the MIRA Property, the previously cleared and logged uplands and wetlands have reverted to young woodland, while the disturbed Wetland B3 appears to be a mosaic of wet meadow, with scattered woody

vegetation (Figure D2). Wetland B2 appears to have been hydrologically altered, resulting in the dying off of most of its woody vegetation. The trailer park appears to still be active.
2004 Aerial

Landfill activities ceased on the Town Property, but the transfer station is in place. A second electric transmission line ROW has been developed through the southern portion of the Town Property, connecting to the older electric transmission line which extends to the north (Figure E1).

On the MIRA Property, the trailer park and the cluster of homes were removed between successive aerial photo flights. Wetland B3 is seen as a mosaic of emergent and scrub shrub cover types, while Wetland B2 is now indicated as almost devoid of woody vegetation and appears as an emergent wetland mostly dominated by common reed (*Phragmites australis*) (Figure E1). The cleared and logged upland areas evident in the 1980s imagery were apparently left to succeed and mature.

4.0 SURFACE WATER RESOURCES & WETLANDS

4.1 Introduction

The Study Area's wetlands and surface waters (shown in Figure 2) were characterized by examining Federal and State wetlands maps and previous delineation surveys, as well as by conducting detailed field investigations of vegetation, soils, and hydrology to demarcate jurisdictional wetland boundaries. This section briefly describes the overall wetland and surface water resources (i.e., streams and open water habitats) associated with the Study Area. Additional detail regarding potential vernal pool habitats is provided in Section 6.0. All of the wetlands and surface waters within the Study Area were field-delineated or field-verified in accordance with both State and Federal statutes and criteria by professional wetland/soil scientists.[2] REMA soil scientists verified and adjusted wetland delineations performed by other qualified professionals in 2001 and in April through June of 2017, and continued with wetland delineations within the Study Area.

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).

[2] i.e., George T. Logan, MS, PWS, CSE, and James M. McManus, MS, CPSS.

It should be noted that the Study Area contains soils that are considered "alluvial" and are regulated by State Statute as wetlands. Those alluvial soil types, which are moderately well or well drained, are not considered "hydric" and, therefore, are not jurisdictional wetlands per the Federal criteria. The differences between these two wetland boundaries are not shown on the attached figures (see Attachment B). In all cases, the more restrictive State-regulated wetlands were delineated in the field. This was particularly the case for those wetlands, such as Wetlands B1 and B5, which are in part or in whole within the active floodplain of the Quinnipiac River. The only exception is Wetland A2h, which is a State wetland but does not qualify for Federal jurisdiction (see Figure A, Attachment B).

4.2 Wetland Flow Patterns & Surficial Geology

Wetland flow patterns within the Study Area are mostly influenced and defined by topography, surficial geology, and past anthropogenic disturbances.[3] Only one bedrock type underlies the Site reddish poorly sorted arkose (New Haven Arkose; TRnh), of Triassic age, formed 205 to 240 million years ago. However, this bedrock lies up to 250 feet below the surface of the land. The surficial deposits (and anthropogenic activities) have influenced the formation of the Site's wetlands, and their flow patterns.

As can be seen in Figure 2 (Attachment B), the major deposits associated with the Study Area are:

- *alluvium* (al) (i.e., gravel, sand, silt, and clay occurring as thin covers on the river valley floor);
- *terrace alluvium* (ta) (i.e., thin deposits of gravel and sand capping river terraces in the river valley);
- *outwash* (ow) (i.e., gravel, sand, and silt); and
- *swamp deposits* (s) (i.e., muck composed of organic matter mixed with sand, silt, and clay).[4]

Within existing active floodplain of the Quinnipiac River, deposits of recent alluvium can also be found.

[3] For an overview of past land uses within the study area refer to Section 3.0.
[4] Porter, S.C. 1960. The Surficial Geology of the Wallingford Quadrangle. State Geological and Natural History Survey of Connecticut. Quadrangle Report No. 10.

The organic deposits within the Study Area are predominantly associated with the central wetlands that occur on the MIRA Property (i.e., Wetlands B2, B3, B4, and B5,). These deposits have accumulated in abandoned channels and cut-off meanders of the river, where muck overlies alluvium or glacial-contact stratified drift (i.e., outwash).

Flow patterns (and ultimately wetland hydrology) under existing conditions are influenced not only by topography and surficial geology, but perhaps more so by land uses of the past 60 to 70 years. The "A-system" wetlands, associated with the Quinnipiac River (see Figure A) have been influenced more by activities within the river's large watershed than by past activities within the Study Area. The "B-system" wetlands, as well as some of the small isolated wetlands (e.g., Wetlands C, D, E, and F), have been greatly influenced by past land uses. These wetlands are independent of the river, except during major flood events, and their hydrology is dominated by interaction with the local or subregional groundwater regime. At one time, in the early 20th century, the "B-system" wetlands were interconnected hydrologically, until the activities described here and in Section 3.0 took place over the intervening decades.

For instance, Wetland B2 was once connected to Wetlands B3, B4, and an off-site wetland to the south, where a natural stream formed, flowing southwest, connecting to the Quinnipiac River. Both past farming activities, which cut a channel westerly to Wetland B1, and the stripping and grading of Wetland B3, cut off easterly flow. Under existing conditions, the only outflow for Wetland B2 is westerly through a restrictive channel and a culvert at the natural gas line ROW. As mentioned elsewhere, this has drastically altered the wetland's hydrology and has led to its invasion by common reed.

Likewise, Wetland B3 flows traveling south to Wetland B4 are restricted to a culvert under the roadway that once served the trailer park. Flows from Wetland B4 are restricted southwesterly to the off-site wetland to the south, by a ditched outlet watercourse and a culvert under a dirt service road which provides access to a pump station owned by the adjacent landowner to the south.

Wetland B5 once flowed south to the off-site wetland to the south and its outlet stream, but under existing conditions southerly flows are laminar and only during high intensity rainfall events, or when Quinnipiac River floodwaters reach this wetland over the old service road. Primary flow is westerly via a shallow ditch through the gas line ROW to Wetland B1.

Finally, Wetland B1 once only flowed south towards the off-site wetland and its outlet stream, but that connection was severed many years ago when an outlet ditch was dug westerly to the Quinnipiac River.

It should be mentioned that Wetlands B1 and B5, are all within the influence of the Quinnipiac River during even moderate flood events, so floodwaters may back up into these wetland areas.

4.3 Wetland Characterization Units

The "A-system" wetlands (i.e., Wetlands A2, A3, and A4) are associated with the Quinnipiac River riparian corridor, while the "B-system" interior wetlands flow to the Quinnipiac River and, for the most part, are only influenced by river water during substantial flood events. The portions of the "A-series" wetlands located on the eastern side of the Quinnipiac River encompass approximately 14.1 acres within the Study Area. Other regulated wetlands are smaller isolated pockets (i.e., Wetlands A1, and C through F) (see Figure A, Attachment B).

We have separated the "B-system" wetlands to its various distinct components based on hydrologic "breaks" and overall differences in vegetative cover types and physiography, as well as upon their disturbance history. In all, the "B-system" wetlands encompass approximately 19.2 acres within the MIRA Property of the Study Area.

"A-System" Wetlands

4.3.1 Man-Made Pond/Marsh (Wetland A1; WA1)

Located in the far northeastern section of the Town Property, this partially delineated wetland was created through excavation in the early 1990s (see Figure 2A, and Photo 1A). It can be characterized as an open water retention pond with an associated emergent marsh. Wetland A1 is classified as a "palustrine aquatic bed, floating vascular (PAB4Hh)," and as "palustrine emergent, *Phragmites australis* (PEM5Eh)," per the National Wetlands Inventory ("NWI") classification system (United States Fish and Wildlife Service ("USFWS")).[5] The wetland's dominant hydrologic regimes are *permanently flooded*, *seasonally flooded*, and *saturated*. Pond depth is estimated at 4 feet or more. The

[5] Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe, 1979. Classification of Wetlands and Deepwater Habitats of the United States. U.S. Fish and Wildlife Service. Washington, D.C. FWS/OBS-79/31.

hydrogeomorphic ("HGM") classification of this wetland is *groundwater depression* (Brinson 1993).[6]

Since this is a recent, man-made wetland/watercourse, its soils are mapped as *Aquents* (308w). This wetland has abrupt, steep slopes to the surrounding uplands.

The typical invasive plants and native volunteer species surround the pond and marsh margin, including multiflora rose (*Rosa multiflora*), fox grape (*Vitis labrusca*), and speckled alder (*Alnus incana*). The marsh is dominated almost exclusively by the invasive common reed, and in the late summer and early fall, the water surface is covered by common duckweed (*Lemna minor*).

4.3.2 Riparian Wetlands (Wetland A2, WA2)

This is an extensive wetland and watercourse system directly associated with the Quinnipiac River and its forested floodplain, located at the western extent of the Study Area, spanning both the Town Property and MIRA Property (see Figure A, and Photos 2 through 13). Only the areas to the east of the river were inventoried and characterized.

The Quinnipiac River is considered a medium to large, low-gradient perennial watercourse. The "A-system" wetlands located here are typical for this size river. Its characteristic vegetative communities are arranged along a topographical gradient from bank and exposed bar, from poorly drained *low floodplain* (which is regularly flooded) to moderately well drained and well drained *high floodplain* (which is occasionally to rarely flooded).

Within the Study Area, Wetland A2 (located on the Town Property) is the least characteristic, from a vegetative composition perspective, of the typical river floodplain. "A-system wetlands" on the MIRA Property contain the more typical composition that is dominated by silver maple (*Acer saccharinum*), particularly in the poorly drained low floodplain areas.

The Town Property section of Wetland A2 has a higher abundance of invasive species, especially in the moderately well drained somewhat higher floodplain. These include multiflora rose, Morrow's honeysuckle (*Lonicera morrowii*), Japanese knotweed (*Fallopia japonica*), Asiatic bittersweet (*Celastrus orbiculatus*), and garlic mustard (*Alliaria petiolata*). The MIRA Property has a considerably lesser abundance of such invasives.

[6] Brinson, M.M. 1993. A hydrogeomorphic classification for wetlands, Technical Report WRP–DE–4, U.S. Army Corps of Engineers Engineer Waterways Experiment Station, Vicksburg, MS.

Typical tree species within the poorly drained to moderately well drained floodplain forest include – in addition to silver maple – red maple (*Acer rubrum*), green ash (*Fraxinus pensylvanica*), cottonwood (*Populus deltoides*), American elm (*Ulmus americana*), sycamore (*Platanus occidentalis*), box elder (*Acer negundo*), pin oak (*Quercus palustris*), catalpa (*Catalpa speciosa*), and basswood (*Tilia americana*).

The woody understory of the poorly drained low floodplain forest is relatively sparse, with such species as spicebush (*Lindera benzoin*) and sweet pepperbush (*Clethra alnifolia*). Higher up in the floodplain, in the moderately well drained areas, shrub density and diversity increases, with highbush blueberry (*Vaccinium corymbosum*), gray dogwood (*Swida racemosa*), winterberry (*Ilex verticillata*), and northern arrowwood (*Viburnum dentatum*).

The herb layer of the lower floodplain, which is flooded more often, especially early in the growing season, is dominated more by species such as smartweeds, including Pennsylvania smartweed (*Polygonum pensylvanicum*) and ricecut grass (*Leersia oryzoides*). Somewhat higher up in the floodplain, diversity increases, especially diversity of perennial species, including false nettle (*Boehmeria cylindrica*), sensitive fern (*Onoclea sensibilis*), Canadian woodnettle (*Laportea canadensis*), jack-in-the-pulpit (*Arisaema triphyllum*), skunk cabbage (*Symplocarpus foetidus*), white avens (*Geum canadense*), goldenrods (*Solidago* spp.), wood aster (*Eurybia divaricata*), jewelweed (*Impatiens capensis*), whitegrass (*Leersia virginica*), and Canada clearweed (*Pilea pumila*).

Per the NWI classification system, the Quinnipiac River is a "riverine lower perennial unconsolidated bottom permanently flooded diked/impounded (R2UBHh)," while the associated floodplain forest is a "palustrine forested broad leaved deciduous temporarily/seasonally flooded/saturated (PFO1A/E)." This system does not classify the moderately well drained or well drained alluvial forest. We have identified the latter separately as Wetland A2h (discussed below).

The dominant hydrologic regimes of Wetland A2 are seasonally flooded, temporarily flooded, seasonally saturated, and permanently flooded. The HGM classification of this wetland includes both *surface-water slope*, and *groundwater slope* (Brinson 1993).

This stretch of the Quinnipiac River has a relatively high load of fine sediment, and experiences some significant flows during larger storm events, as evident by the moderate to severe erosion of some of its banks. On the days of the REMA Site inspections, the

depth of river water varied from a foot to four feet. The substrate is generally sandy, with a few sections with coarser materials (i.e., gravel, cobble), but also areas with mucky silt.

The USDA-NRCS Web Soil Survey (see Attachment A), identified soil types associated with Wetland A2 including the poorly drained Rippowam (103) fine sandy loam, the somewhat poorly drained Bash (104) silt loam, and the moderately well drained Pootatuck (102) fine sandy loam. These soil series were confirmed during our field investigations.

4.3.3 High Floodplain Wetland (Wetland A2h; WA2h)

Located just east of the low-floodplain riparian wetlands (WA2), "High Floodplain" occupies a forested section of the MIRA Property, and is crossed by the natural gas line ROW (see Figure 2J). This wetland subunit occupies approximately 1.3 acres within the Study Area. This is not a jurisdictional wetland per Federal criteria, having "non-hydric" soils of alluvial origin, but is regulated per State Statutes. Wetland A2h is a nearly level distinct terrace that is approximately four to five feet higher than the poorly drained low floodplain (see Photos 49B and 50B). The dominant soil type within this State-regulated wetland is the well-drained Occum (101) fine sandy loam. This soil series is not mapped by the USDA-NRCS in this area, but was confirmed by the soil scientist in the field.

The tree canopy does not have the more typical floodplain tree species, such as silver maple. Rather, it is dominated by mixed hardwoods including bitternut hickory (*Carya codiformis*), red maple, American beech (*Fagus grandifolia*), black birch (*Betula lenta*), tulip poplar (*Liriodendron tulipifera*), and red oak (*Quercus rubra*). The understory is of low-moderate density and includes such species as ironwood (*Carpinus caroliniana*), maple-leaved viburnum (*Viburnum acerifolium*), and Morrow's honeysuckle. The herb layer is likely much more diverse during the early part of the growing season than during our late season inspection, however, Pennsylvania sedge (*Carex pensylvanica*) and grasses (*Poa* spp.) are dominant. Lianas include green briar (*Smilax rotundifolia*), with some river grape (*Vitis riparia*).

4.3.4 Disturbed Floodplain Wetland (Wetland A3; WA3)

Located in the southwestern section of the Town Property, this wetland is characterized by soil disturbance due to its location at the edge of the existing capped landfill and within the electric ROW (see Figure A). A small portion of the wetland is wooded (see Photo 13A), but the remaining area is dominated by common reed, as well as a patch of Japanese knotweed. Its easternmost extent is periodically mowed, providing access to a nearby

monitoring well. In addition to the *Phragmites*, other herb species include mugwort (*Artemisia vulgaris*) and garlic mustard. The forested portion is dominated by pole-sized red maple and green ash, with multiflora rose and Morrow's honeysuckle.

Wetland A3 is classified as a "palustrine emergent, *Phragmites australis* (PEM5E)," per the NWI classification system (USFWS), with a "palustrine forested broad leaved deciduous (PFO1A/E)" component. The wetland's dominant hydrologic regimes are *permanently flooded*, *seasonally flooded*, and *seasonally saturated*. The HGM classification of this wetland is part *surface-water depression*, and part *surface-water slope* (Brinson 1993). Since this is a disturbed wetland, its soils are mapped as *Aquents* (308w).

"B-System" Wetlands

4.3.6 Interior Forested Wetland (Wetland B1; WB1)

Wetland B1, which is approximately 4.5 acres in size, is one of the interior wetlands delineated within the MIRA Property. While it is relatively close to the Quinnipiac River and its floodplain wetlands, it is not hydrologically dependent on river flows. River water only backs up into this wetland during extreme and rare flood events. Rather, it is an expression of local groundwater hydrology, surface flows, and overflows from both Wetland B2 and Wetland B5. As mentioned above, at one time this wetland discharged into an off-site wetland and its prominent watercourse to the south, but a short, deep, channel was cut west to the river sometime in the early 20th century, likely to drain the wetland to allow for pasturage. Figure 2C (Attachment B) shows this wetland and the flow regimes.

Within this wetland unit there are five embedded PVP habitats (i.e., PVP#1, through PVP#5; Figure 2C). These are shallow, seasonally flooded areas, which may be breeding habitat for vernal pool obligate amphibians, specifically, wood frogs (*Lithobates sylvatica*). A more extensive description and discussion of these and other PVP habitats identified at the Site is provided in Section 5.0.

Per the NWI classification system (USFWS), Wetland B1 is a "palustrine, forested, broad-leaved deciduous" (PFO1A/E) wetland. However, a roughly 50-foot gas pipeline ROW cuts through this wetland and supports a wet meadow cover type, dominated by common reed (see Photo 5B). This wetland's dominant hydrologic regimes are *seasonally flooded*, and *seasonally saturated*. The HGM classification of this wetland is part *surface-water*

slope and part *surface-water depression* (Brinson 1993). The soils are mapped as the poorly drained Rippowam (103) fine sandy loam per Web Soil Survey (see Attachment A).

The wetland's trees are relatively young (+/- 35 to 40 years) due to the clearcutting and logging that took place here in the 1980s (see Photos 1B through 5B). Typical canopy trees include red maple, American elm, American beech, green ash, black gum (*Nyssa sylvatica*), red oak, beech, and tulip poplar. The woody understory is moderately dense and supports such species as spicebush, winterberry, multiflora rose, highbush blueberry, sweet pepperbush, ironwood, witch-hazel (*Hamamelis virginiana*), buttonbush (*Cephalanthus occidentalis*), and meadow sweet (*Spirea latifolia*). The herbaceous layer is dense in the seasonally saturated sections of the wetland, but sparse in the seasonally flooded sections. Dominant species observed include royal, sensitive, New York, and cinnamon ferns (*Osmunda regalis*, *Onoclea sensibilis*, *Thelypteris noveboracensis*, *Osmundastrum cinnamomeum*), marginal woodfern (*Dryopteris marginalis*), Virginia jumpseed (*Polygonum virginianum*), poison ivy, grasses (*Poa* spp.), whitegrass, smartweeds (*Polygonum* spp.), stout wood reedgrass (*Cinna arundinacea*), swamp dewberry (*Rubus hispidus*), sedges (*C. stricta, C. lurida, C. intumescens, C. crinita,* etc.), deer tongue (*Dichanthelium clandestinum),* blue flag (*Iris discolor*), rough-stem goldenrod (*Solidago rugosa*), and Pennsylvania sedge. Lianas are limited and include green briar, fox grape, and Asiatic bittersweet.

4.3.7 Interior Emergent Wetland (Wetland B2; WB2)

Wetland B2 is north-centrally located on the MIRA Property, and is roughly 2.2 acres in size (see Figure 2). It is an old cut-off meander of the Quinnipiac River. As organics accumulated over several thousand years, the present wetland was formed in organic "swamp" deposits (see Figure 3). At one time, several decades ago, this wetland was contiguous with Wetland B3, which also contained organic deposits. However, this connection was severed in the 1980s when a portion of the wetland was filled and the balance (i.e., Wetland B3) was "mucked out" and regraded (see also Section 3.0). As can be seen in Figure 2D (Attachment B), the only outlet for this wetland is a 12-inch culvert and ditch through the gas pipeline ROW, allowing overflow to Wetland B1. The ditch was in place in the 1934 aerial, likely excavated decades prior for farming purposes.

It is also possible, based on the archival aerial photos, that Wetland B2 was hydrologically manipulated as part of farming practices, including the harvesting of peat. Both the surficial geology map (Figure 3) and the USDA-NRCS Web Soil Survey indicate that this

wetland has moderately deep organics. However, field observations revealed only a few inches of muck over a tight, glayed, very fine sand.

The historic disturbances and hydrologic manipulation led to the establishment and proliferation of the invasive common reed sometime after the work that was done in Wetland B2. The *Phragmites* took advantage of altered, wetter hydrology, which produced die-back of trees and shrubs. While *Phragmites* is the dominant species within the bulk of this wetland, there is a forested wetland fringe, particularly at the western end and southern section of its perimeter (see Photos 7B and 8B). Trees in this location include black gum, red maple, pin oak, swamp white oak (*Quercus bicolor*); dominant shrubs are sweet pepperbush, winterberry, alder, and spicebush.

Per the NWI classification system (USFWS), Wetland B2 is classified as a "palustrine emergent, *Phragmites australis* (PEM5E)" wetland. This wetland's dominant hydrologic regimes are *seasonally flooded*, and *saturated*. The HGM classification of this wetland is *groundwater depression* (Brinson 1993). The soils are mapped as the very poorly drained Timakwa and Natchaug mucks (17) soil series complex per Web Soil Survey (see Attachment A). However, as stated above, this wetland would more properly be mapped as Aquents (308w) due to the past soil and hydrology disturbances.

4.3.8 Interior Scrub-Shrub/Emergent/Forested Wetland (Wetland B3; WB3)

Wetland B3 is located within the eastern section of the MIRA Property, and encompasses roughly 5.4 acres (see Figures A, 2E-1 and 2E-2) (Photos 9B through 17B). Originally characterized by "swamp deposits" (see Figure 2), this is a disturbed wetland that (per aerial photographic evidence) was "mucked-out" and regraded in the early to mid-1980s. The semi-perennial[7] watercourse that once originated at this wetland and flowed all the way to the Quinnipiac River was also removed.

The bulk of this regulated resource is a mosaic of emergent and scrub-shrub wetland cover types, with a forested component remaining within its western and southern extent. Two PVP habitats (PVP#7 and PVP#7A) were identified at the southern end, where flows from

[7] We give this prior watercourse, as well as the one that still remains within Wetlands B4, and the contiguous off-site wetland to the south of the Study Area, a semi-perennial designation based on the USGS topographic survey that shows a "dashed" blue line. A solid blue line would indicate a perennial watercourse. A semi-perennial watercourse may flow continually during wetter years, but will at a minimum retain moisture/saturation throughout a normal percipitation year. See also discussion of watercourse for Wetland B6.

the wetland are culverted under an old roadway that provided access to a residential trailer park once existing in this vicinity.

Due to the relatively recent disturbance, common reed has taken hold and is the dominant species in the emergent cover type (i.e., wet meadow/marsh) (see Figure 2E-2). *Phragmites* can be found throughout the portion of the wetland that was disturbed, and has formed some dense patches. In other areas it is sparse to moderate in density, less abundant in areas where woody species have taken hold and are keeping *Phragmites* in check through shading. We also observed, in the more open areas, several patches of the invasive mile-a-minute vine ("MAM") (*Persicaria perfoliata*) (see Photos 13B and 14B). These two invasive species are effective colonizers of disturbed soil. Infestations of MAM have been observed in other locations along the Quinnipiac River riparian corridor, beginning in about 2010. Since that time, proliferation of MAM have been substantially reduced and kept somewhat in check by the release of a biological control agent (a leaf-eating beetle).[8]

In the less disturbed wooded portions of the wetland, red maple, black gum, American elm, and green ash dominate the overstory, with the woody understory supporting such species as sweet pepperbush, highbush blueberry, winterberry, and multiflora rose. Herbs within these areas include the typical suite of skunk cabbage, cinnamon and sensitive ferns, swamp dewberry, and a variety of sedges.

In the mosaic of emergent and scrub shrub cover types (including patches of trees), which dominate Wetland B3, red maple and gray birch (*Betula populifolia*) is dominant. The shrub layer includes many of the same species seen elsewhere within this wetland, but, as mentioned above, *Phragmites* dominates the herb layer. Other species include goldenrods, asters, Joe-pye-weeds (*Eutrochium* spp.), and soft rush. *Sphagnum* mosses carpet a few areas of the previously disturbed wetland, being able to grow in a low-nutrient, mostly saturated environment.

In the southernmost portion of the wetland, just north of the abandoned access roadway to the once present trailer park, there is a fairly diverse wet meadow, with a few marsh inclusions, that are devoid of *Phragmites*. In this location, sedge, grass, rush, and forb diversity is higher, and includes such species as blue flag iris, burreed (*Sparganium americanum*), and wool grass (*Scirpus cyperinus*).

[8] A small weevil, *Rhinoncomimus latipes*, was found to be host-specific to MAM weed, and field release was approved by USDA-APHIS in 2004. Weevil adults feed on MAM foliage, and larvae feed within nodes and can suppress growth and reduce seed production. The weevils are active from early spring through the fall, completing multiple generations.

Per the NWI classification system (USFWS) (see Figure 4), Wetland B3 is classified as a "palustrine, scrub-shrub, broad-leaved deciduous (PSS1E)." However, as noted above, this wetland contains several cover types in complex, and retains a small western portion of PF01E ("palustrine, forested, broad-leaved cover type"). This wetland's dominant hydrologic regimes are *seasonally flooded*, *seasonally saturated*, and *saturated*. The HGM classification of this wetland is *groundwater slope* and *groundwater depression* (Brinson 1993). The soils are mapped as the very poorly drained Timakwa and Natchaug mucks (17) soil series complex per Web Soil Survey (see Attachment A). However, although a few remnant areas with these soils remain, as stated above, this wetland would be more properly mapped as Aquents (308w) due to the removal of organics in the 1980s. Moreover, only a portion of this wetland has a very poorly drained drainage class; the bulk of the wetland is now poorly drained, even though seasonal groundwater discharge is expected here.

It should be noted that overflows of Wetland B3 directly through its southernmost emergent wetland – over the abandoned roadway and into Wetland B4 – take place on a regular basis. This might be due, in part, to the diminished capacity of the culvert under the roadway.

4.3.9 Interior Scrub-Shrub/Emergent/Forested Wetland (Wetland B4; WB4)

Wetland B4 is located predominantly within the southeastern section of the MIRA Property, and encompasses roughly 1.7 acres (see Figures A and 2F). This wetland has also seen significant disturbance over the past few decades through filling, ditching, excavation, hydrologic alteration, and clearing (see also Section 3.0).

A portion of this wetland adjacent to the former trailer park (which existed for several decades to the immediate west) has been cleared and/or impacted by shallow fill. Aerial photographs indicate that it was used to park vehicles. Once the trailer park was taken out, this area reverted to wetlands. Two small ponds that had been excavated and/or bermed in the past, are now filled in and grown over. Its southern section, up against a steep slope, was once cleared to provide passage for utilities (electric service) and its watercourse was ditched to facilitate flows.

The cover types within Wetland B4 include emergent (some of which is dominated by *Phragmites*), scrub shrub, and forested (see Figure 2F). Despite the past disturbance, the northeastern forested portion of the wetland – and least disturbed – retains a healthy suite of native plants (see Photos 19B through 25B). The emergent component that is not dominated by *Phragmites* includes monkey flower (*Mimulus ringens*), rushes, sedges

(including tussock and lurid), joe-pye-weed, purple willowherb (*Epilobium* spp.), boneset (*Eupatorium perfoliatum*), roughstem goldenrod, wool grass, and purple loosestrife (*Lythrum salicaria*) (see Photo 22B). The scrub shrub cover type includes silky dogwood, glossy buckthorn (*Rhamnus frangula*), multiflora rose, and speckled alder. The forested component is dominated by red maple, and also includes yellow birch, American elm, black gum, spicebush, sweet pepperbush, highbush blueberry, skunk cabbage, cinnamon and sensitive ferns, and swamp dewberry.

Per the NWI classification system (USFWS) (see Figure 3), Wetland B4 is classified as a "palustrine, scrub-shrub, broad-leaved deciduous (PSS1E)." However, only about one third of the wetland retains this cover type, as described above. This wetland's dominant hydrologic regimes are *seasonally flooded*, *seasonally saturated*, and *saturated*. The HGM classification of this wetland is *groundwater slope* and *groundwater depression* (Brinson 1993). The soils are mapped as the poorly drained Rippowam (103), which is a soil type derived from alluvial deposits. However, the regular or even periodic (e.g., once in 25 to 30 years) influence of the Quinnipiac River does not reach this wetland. Moreover, this wetland was characterized by "swamp deposits" per the surficial geology mapping (see Figure 3). Some Timakwa and Natchaug mucks (17) soil series complex may remain within this wetland, but due to past disturbances this wetland would be more properly mapped as Aquents (308w).

We note that Wetland B4's outlet stream once flowed unimpeded to off-site wetlands to the south, and eventually to the river. However, not only has the watercourse been diverted and ditched (see Photo 23B), but also it is now culverted under an access driveway to a pump house further west that is owned by the property owner to the south.

4.3.10 Interior Scrub-Shrub/Emergent/Forested Wetland (Wetland B5; WB5)

Wetland B5 is located within the south-central portion of the MIRA Property, and is roughly 5.4 acres in size (see Figures 2, and 2G, Photos 27B to 36B). This wetland is the least disturbed of the interior B-system wetlands, although it reflects two historic alterations: (1) the wetland formerly drained both south and west, but the south flow path has been, for the most part, severed;[9] and (2) some filling and encroachment took place

[9] An east-west trending roadway was cleared through the wetland over a period of many decades, and runs along the southern property boundary of the MIRA Property, and includes the placement of sandy fill. A section of this roadway has retained wetland characteristics (i.e. soils, hydrology, and vegetation) supportive of state-jurisdictional wetland. This roadway is proposed for a wetland crossing to allow access to a solar array to the west (see further discussion in Section 7.1).

when the trailer park was active immediately to the east. Household debris and fill piles can be seen along the eastern wetland edge, both within and outside of the wetland boundary (see also Section 3.0).

Wetland B5 contains two PVP habitats. One, PVP#8, is a contiguous seasonally flooded area at the southwestern corner of the wetland, while a second, PVP#6, is a loosely connected seasonally flooded area, embedded within the forested portion of the wetland (see Section 5.0 for further descriptions of the Site's PVP habitats).

Based on surficial geology mapping (see Figure 2), Wetland B5 is also an old "cut-off" meander of the Quinnipiac River, which over a long period of time was filled with organic deposits. At most areas of wetland's northern edge there is an abrupt demarcation between wetlands and uplands at the toe of a short but steep slope (Photo 30B). Immediately, even at the edge, the organic deposits are two to three feet deep, indicating that this edge of the wetland was an old riverbank. Along the southern edge, slopes are much more gradual, because this area was away from the old river meander's thalweg, which was up against the northern edge (Photo 27B). This was also verified by the presence of deeper organics on the north side of the wetland.

One major cover type, forested swamp, occurs within this wetland, with one variant: thin canopy forested swamp with a dense shrub/sapling layer, occupying about an acre within its northern portion. Here organics are deep, and woody vegetation only grows on elevated hummocks.[10] Tree canopy cover in this area is no more than 30%, but some shrub species are over 20 feet in height. The west-central portion of the wetland is less wet, with shallower organics, or only mineral/mucky soils, and includes several prominent upland islands and inclusions that were not separately delineated. This is an important factor when discussing PVP habitat in Section 5.0.

Trees associated with this wetland are fairly mature, with a few being over 24 inches diameter at breast height ("dbh"), particularly along its northern edge. Red maple is dominant, but American elm, black gum, yellow birch, pin oak, and swamp white oak are occasionally present. In the wetter, hummocky, northern portion of the wetland, with an more open canopy, a variety of native shrubs are at their maximum growth, including highbush blueberry, sweet pepperbush, winterberry, northern arrowwood, buttonbush,[11]

[10] Microtopography throughout at least 2/3rds of the wetland area is quite pronounced.
[11] One buttonbush was more than 20 feet in height. This the largest specimen ever encountered in CT by the field investigators.

maleberry (*Lyonia ligustrina*), red chokeberry (*Aronia arbutifolia*), swamp azalea (*Rhododendron viscosum*), and swamp rose (*Rosa palustris*) (see Photo 33B).

Herb layer diversity within the northern more open portion of the swamp is likely to be relatively high. However, due to the season (Fall), and difficulty in passage through this portion of the swamp, only a few species were readily observed. These include: many sedges (e.g., tussock, lurid, fringed, bladder, etc.); rushes; grasses; cinnamon, sensitive, New York, marsh, and royal ferns; blue flag iris; devil's beggartick (e.g., *Bidens frondosa*); skunk cabbage; jack-in-the-pulpit; swamp dewberry; and arrow-leaved tearthumb (*Persicaria sagittata*).

Within the balance of the swamp, tree canopy approaches 90% and is dominated by red maple in the overstory, and sweet pepperbush and spicebush in the woody understory. The herbaceous layer supports many of the same herbaceous species but at lower densities, with skunk cabbage, tussock sedge, and ferns dominant.

Per the NWI classification system (USFWS) (see Figure 4), Wetland B5 is classified as a "palustrine, scrub-shrub, broad-leaved deciduous (PSS1E)," but with the recognition that a forested component is present. However, technically, the entire swamp is forested, as mentioned above (i.e., PFO1E). This wetland's dominant hydrologic regimes are *seasonally flooded*, *seasonally saturated*, and *saturated*, with the latter being dominant through most of the delineated wetland. The HGM classification of this wetland is *groundwater slope* and *groundwater depression* (Brinson 1993), with the latter being dominant. The soils are mapped as the poorly drained Rippowam (103), which is a soil type derived from alluvial deposits. While the influence of the Quinnipiac River does reach this wetland,[12] it is likely infrequent. Moreover, this wetland was characterized by "swamp deposits" per the surficial geology mapping (see Figure 3). Therefore, the Timakwa and Natchaug mucks (17) soil series complex are likely the dominant soils in the wetter very poorly drained sections of the wetland, while the poorly drained Rippowam (103), and the very poorly drained Saco (108) soil series, both derived from alluvial deposits, would be dominant in the balance of the wetland.

[12] It is also mapped to be within the 100-year floodplain.

"Isolated" Wetlands

There are four isolated wetlands within the Study Area, ranging from 0.01 to 0.06 acres in size (see Figure A). They occur as depressional areas in an upland landscape. Only one of these is natural or has not been influenced by man-made activities.

4.3.13 Disturbed Forested Wetland (Wetland C; WC)

Wetland C is located within the western portion of the Town Property, and is roughly 0.03 acres in size (see Figure A). It is a *seasonally flooded* forested wetland pocket that was likely created during landfill operations. It is dominated by red maple in the overstory and has no woody understory, except for some stunted multiflora rose. Due to the disturbed nature of this wetland and its surroundings, the soils are mapped as Aquents (308w) and are poorly drained.

4.3.14 Wetland Pocket (Wetland D; WD)

Wetland D is located within the western portion of the MIRA Property, and is roughly 0.01 acres in size (see Figures A and 2C). It is a *seasonally flooded* forested wetland pocket in a natural depression. It is dominated by red maple, American beech, and tulip poplar (*Liriodendron tulipifera*), with witch-hazel in the overstory. The herbaceous layer includes royal and sensitive ferns, sedges, poison ivy, and Virginia jumpseed (see Photo 1D). Soils are somewhat poorly drained ("hydric") to poorly drained. The dominant soil series is the Raypol (12) silt loam.

4.3.15 Disturbed Wetland Pocket (Wetland E; WE)

Wetland E is located within the southwestern portion of the MIRA Property, and is roughly 0.03 acres in size (see Figures A and 2C). It is a *seasonally flooded* to *seasonally saturated* forested wetland pocket in a somewhat natural depression. It is dominated by red maple, American beech, shagbark hickory (*Carya ovata*), and tulip poplar (*Liriodendron tulipifera*) in the overstory and has a sparse understory dominated by sweet pepperbush. The herbaceous layer includes cinnamon fern, woodfern (*Dryopteris* sp.), and sedges (see Photo 1E). Soils are somewhat poorly drained ("hydric") to poorly drained. The dominant soil series is the Raypol (12) silt loam.

4.3.16 Disturbed Emergent Wetland (Wetland F; WF)

Wetland F is located within the southeastern portion of the MIRA Property, and is roughly 0.04 acres in size (see Figures A and 2F). It is a *seasonally flooded* to *temporarily flooded* emergent wetland that was created by the ponding of water within a compacted fill area adjacent to an abandoned driveway that served the former trailer park (see Photo 1G). Its hydrology is influenced by overflows from Wetland B3, which cannot pass through an undersized and somewhat clogged culvert. Along its western edge, this wetland's herb layer is dense and diverse, and includes soft rush, grass-leaved goldenrods *(Euthamia graminifolia*), rough-stemmed goldenrod, boneset, joe-pye-weed, narrow-leaved cattail (*Typha angustifolia*), tussock, lurid, and fringed sedges, deer-tongue (*Dichanthelium clandestinum*), wool grass, late goldenrod (*Solidago gigantea*), red top grass (*Agrostis gigantea*), path rush (*Juncus tenuis*), New York aster (*Symphyotrichum novi-belgii*), bushy aster (*Symphyotrichum dumosum*), purple loosestrife, purple willowherbs, and arrow-leaved tearthumb. Due to the disturbed nature of this wetland and its surroundings, the soils are mapped as Aquents (308w) and are poorly drained.

Man-made Wetland Swales

There are two man-made drainage ditches or swales associated with the Study Area, which exhibit wetland hydrology and are dominated by hydrophytes (i.e., wetland plants) (see Figure 2). Swale #1 and #2 are found within the Study Area's Town Property. Swale #1 is a short drainage that feeds Wetland A1. Swale #2 is associated with surface drainage off landfill areas. Typical vegetation within these swales include common reed (the most prevalent species), reed canary grass, soft rush, and sedges.

5.0 WETLAND FUNCTIONS & VALUES

Functions and values were assessed for the Site's two major, and distinct, wetland systems, the "A-System," which is comprised of the wetlands directly associated with the Quinnipiac River and its active floodplain, and the "B-System," comprised of the "interior" interconnected wetlands, most of which are found on the MIRA Property. The methodology used is the United States Army Corps of Engineers ("USACE") Highway Methodology or the *Descriptive Approach*. This methodology was published in 1995 and amended in 1998. It has much in common with other assessment methodologies in use in the northeastern United States.

To summarize, after a thorough and detailed wetland inventory and characterization has been completed, each wetland's properties are compared with lists of numbered rationales for each of 14 functions and values. The rationale lists are attached (Attachment D), and the columns to the left indicated whether they are applicable [yes (Y) or no (N)], and explanatory notes are added as needed. Table 1 summarizes the wetland functions and values assessment, as to whether the function/value is a *principal* function/value (P), *present* to some degree (Y), or *absent* (N).

Table 1: Summary of Wetland Function-Value Assessment for the Wetland Resources Associated with Wallingford Renewable Energy

Function	"A-System" Wetlands	"B-System" Wetlands
1. Groundwater Recharge/Discharge	Y	**P**
2. Floodflow Alteration	**P**	**P**
3. Fish and Shellfish Habitat	**P**	N
4. Sediment/Toxicant/Pathogen Retention	**P**	P
5. Nutrient Removal	**P**	P
6. Production Export	**P**	Y
7. Sediment/Shoreline Stabilization	**P**	N
8. Wildlife Habitat	**P**	**P**
9. Recreation	Y	N
10. Educational/Scientific Value	Y	Y
11. Uniqueness/Heritage Value	**P**	Y
12. Visual Quality Aesthetics	Y	Y
13. Endangered Species Habitat	**P**	N
14. Fish & Shellfish Habitat (marine)	N/A	N/A

Notes: *P = Primary function; Y = function present; N = function not appreciably present*
Based on the USACE "Descriptive Approach" wetland functions and values methodology

6.0 POTENTIAL VERNAL POOL HABITATS

6.1 Introduction

During our fieldwork, nine seasonally flooded areas of wetlands were identified as PVP habitats (i.e., PVP#1 through PVP #8; see Figure V, Attachment B). While REMA staff surveys were not conducted during the time of the year when amphibian breeding can be directly observed, observations by others were considered, and extensive cover searching was undertaken and hydrologic indicators were examined.

Information regarding likely maximum water depth and relative duration of inundation in a depression was identified based on observations of the depth and quality of organic deposits (i.e., muck) and underlying soil parent materials within a PVP, as well as water stains on tree trunks, vegetation, and hummocks. When we began our investigations on October 5th, 2017, all of the PVP habitats that we identified were, at most, saturated to the surface, without any standing water, with the exception of PVP#7. During our October 12th, 2017 field visit, after approximately 0.88 inches of precipitation[13] none of the PVPs, with the exception of the single aforementioned area, were holding water. After roughly 3.83 inches of precipitation during two consecutive days, many of the seasonally flooded areas we were investigating as PVPs were holding water on October 26th, 2017. After 3.27 inches of additional precipitation, we returned to the Site on November 1st, 2017 to find that the same PVPs were still holding water. Finally, on December 12th, 2017, all of the PVPs were holding water. For some, depth of inundation had likely reached a near maximum.

The cover searching was highly informative and allowed REMA to pinpoint the areas of the Site that had the highest likelihood of having productive vernal pools (i.e., Tier I[14]).

6.2 Amphibian Survey Results

Cover searches were conducted throughout those areas (i.e., uplands and wetland) that were within several hundred feet of PVP habitats. This included the majority of the MIRA Property. The cover search areas also included the floodplain wetlands of the Quinnipiac River.

[13] Precipitation based on the Meriden Airport published data online (Weather Underground).
[14] Tier I vernal pools are those pools that are considered to be exemplary habitats and productive for vernal pool amphibian obligate species per the Calhoun and Klemens (2002) Best Development Practices.

The most numerous amphibian encountered was the red-backed salamander (*Plethodon cinereus*), found both in uplands and wetlands. Other species observed, but at lesser numbers, were spring peeper (*Pseudacris crucifer*), green frog (*Lithobates clamitans*), eastern American toad (*Anaxyrus americanus*), and pickerel frog (*Lithobates palustris*). Due to the season (early fall), many of these amphibians were torpid and were not moving around to any great degree.

Wood frogs (*Lithobates sylvaticus*), which are one of the vernal pool indicator species, were encountered throughout the interior wetlands and adjacent uplands. The total count of both adults and juveniles was 47, although some double counting may have occurred. The greatest concentration of wood frog (close to half) was within the southwestern portion of Wetland B5, including the adjacent upland, and also within roughly 200 feet of PVPs #4 and #5. Most of the young of the year were encountered in the first habitat cluster. This would indicate that PVP#6 (embedded) and PVP #8 had the highest productivity for wood frogs, at least during the 2017 breeding season.

We note that we did not encounter any ambystomatid salamanders, such as spotted salamander (*Ambystoma maculatum*), during our intense cover searches in suitable habitats. While they may still occur within the Site, it is unlikely that there an abundant population, as appears to be the case with wood frogs.

6.3 Potential Vernal Pool Descriptions

As a result of our surveys and cover searches, we determined that the pools with highest likelihood of being productive for wood frog breeding and reproduction were PVP#4, PVP#5, PVP#6, and PVP#8. We also expect that these same habitats are productive for facultative vernal pool amphibians, such as the spring peeper. Following are brief descriptions and discussion of each of the PVPs.

6.3.1 PVP#1

This PVP is found embedded with the wooded northern portion of Wetland B1, within the MIRA Property (see Figures V and V1). This small pool is roughly 432 square feet in size; based on indirect hydrologic indicators it would likely hold up to 18 inches of water during the early spring. It is underlain by about 16 inches of topsoil that is high in organic matter, over glayed medium sand. The pool was saturated to the surface on October 5th and had 10 inches of water on November 1st, 2017. The pool proper is strewn with branches (see Photos V1 and V2).

Associated vegetation observed within the pool or its immediate perimeter include, green ash, red maple, spicebush, winterberry, multiflora rose, highbush blueberry, royal, cinnamon and sensitive ferns, Virginia jumpseed, smartweeds, poison ivy, grasses, marginal woodfern, stout wood reedgrass, and swamp dewberry.

6.3.2 PVP#2

This PVP is found on the MIRA Property, embedded within Wetland B1 (see Figures V and V2). It is the deeper portion of a seasonally flooded forested wetland. This inundation is made possible, in part, by a partially clogged and restrictive culvert the carries flows under the gas pipeline access roadway (see Photos 3, 4, and 5).

The PVP habitat is approximately 1,120 square feet in size and will pond a maximum of about 12 inches of water. It is underlain by 14 inches of topsoil high in organic matter, with the top 4 inches almost free of a mineral fraction. The pool was saturated to the surface on October 5th and had 8-10 inches of water on November 1st, 2017.

Vegetation observed within the pool or its perimeter included red maple, red oak, American beech, black gum, meadowsweet (*Spirea latifolia*), sweet pepperbush, highbush blueberry, witch-hazel, cinnamon and sensitive ferns, sedges (including tussock), blue flag iris, grasses, and deer tongue.

6.3.3 PVP#3

This PVP is found on the MIRA Property embedded within Wetland B1 (see Figures V and V3), approximately 50 feet to the southwest of PVP#2 and also adjacent to the gas pipeline ROW (see Figures V and V3). The PVP habitat is approximately 807 square feet in size and will pond a maximum of about 14 inches of water. It is underlain by 9 inches of topsoil that is not high in organic matter (i.e., loamy find sand). The pool was saturated to within 2 inches of ground surface on October 5th and had 3-4 inches of water on November 1st, 2017, occupying only about 30% of the pool depression (see Photos 6 and 7).

Vegetation observed within the pool or its perimeter included red maple, black gum, tulip poplar, sweet pepperbush, witch-hazel, multiflora rose, royal, cinnamon, and sensitive ferns, sedges (including tussock), roughstem goldenrod, and Asiatic bittersweet.

6.3.4 PVP#4

This PVP is found on the MIRA Property, embedded within Wetland B1 (see Figures V and V4). It is the deeper portion of a seasonally flooded forested wetland, which is also in the pathway of the overflow from Wetland B5 (see Photo 8). However, flow velocities are not very high, so amphibian breeding can be sustained without dislodgement.

The PVP habitat is approximately 3,117 square feet in size and will pond a maximum of about 14 inches of water. It is underlain by 12 inches of topsoil that is high in organic matter, and has very poorly drained soils. The pool was saturated to within 12 inches surface on October 5th and had 12-13 inches of water on November 1st, 2017.

Vegetation observed within the pool or its perimeter included red maple, red oak, American beech, black gum, black birch, sweet pepperbush, highbush blueberry, witch-hazel, winterberry, swamp azalea, buttonbush (*Cephalanthus occidentalis*), cinnamon, royal, and sensitive ferns, evergreen woodfern, sedges (including tussock and bladder), stout wood reedgrass, and roughstem goldenrods. Some *Sphagnum* mosses were observed on hummocks associated with the PVP.

6.3.5 PVP#5

This PVP is found on the MIRA Property roughly 90 feet southwest of PVP#4 (see Figures V and V5). This wetland/pool has seen significant disturbance in the past, as evidenced by steep sided banks, debris (i.e., metal, tires, etc.) and the soils (see Photos 9 and 10).

The PVP habitat is approximately 2,751 square feet in size and will pond a maximum of about 26 inches of water within its eastern section, averaging 12 to 14 inches overall. It is underlain by 12 inches of topsoil that is high in organic matter, over 22 inches of tight silt loam with organics lenses, over loamy medium sand. It is the silt loam that allows for a perched water table in this pool, with very poorly drained soils. The pool was saturated to the surface on October 5th and had about 12 inches of water on November 1st, 2017.

Vegetation observed within the pool or its perimeter included red maple, swamp white oak, American beech, black gum, tulip poplar, sweet pepperbush, buttonbush, cinnamon and royal ferns, woodferns, sedges, and green briar.

6.3.6 PVP#6

This PVP habitat is embedded within the central section of Wetland B5 (see Figures V and V6). As can be seen in Photo 11 (Attachment B), this portion of the forested swamp has pronounced hummocks and interconnected flooded areas which hold up to 10 inches of water. It should be noted that this embedded habitat is adjacent to two upland islands that were not delineated (see Figure 2G), as no Project activities are proposed within Wetland B6. These upland islands, the seasonally saturated portion of the wetland to the west, and the moist and transitional adjacent upland offer some of the most optimal habitat for the wood frogs, confirmed by a relatively high abundance of adults and juveniles observed in this location during cover searching.

The PVP habitat encompasses an area of roughly 6,131 square feet, with a flooded coverage of about 60 percent. It is underlain by at least 24 inches of muck. The habitat was saturated to the surface on October 5th and had an average of 7 to 8 inches of water on November 1st, 2017.

Vegetation observed within the pool or its perimeter included red maple, black gum, sweet pepperbush, swamp azalea, winterberry, highbush blueberry, cinnamon, New York, sensitive, and royal ferns, sedges (including bladder and tussock), jewelweed, and swamp dewberry. *Sphagnum* mosses were common on some hummocks or areas of shallow inundation.

6.3.7 PVP#7

This PVP habitat is located at the far southern end of Wetland B3 (see Figures V and V7). This is a man-made pool, with hydrology that is in great measure dependent on a partially clogged culvert that passes water from Wetland B3 to Wetland B4, located under the access roadway to the former trailer park (nearby to the southwest).

The PVP habitat is roughly 1,531 square feet in size, and is underlain by a few inches of organics over firm, very fine sand. On October 5th, water averaged 10 inches; by November 1st, 2017, water levels had risen to roughly 14 inches. This was the only potential vernal pool habitat that maintained water throughout the survey period. This is due to the aforementioned culvert, as well as the fact that there is significant groundwater discharge within Wetland B3 that flows through this area.

The pool area could be classified as an emergent marsh and wet meadow, with a woody perimeter. It is an open habitat with limited shade from trees and shrubs. Vegetation

observed within this PVP or its perimeter included red maple, swamp white oak, black gum, winterberry, highbush blueberry, sweet pepperbush, sensitive and cinnamon ferns, sedges (including tussock), watercress (*Nasturtium officinale*), water parsnip (*Sium suave*), cattail, and common reed. The latter two species appear to be expanding southerly into the pool area.

This pool habitat is more likely to be used for breeding by spring peeper, American toad, green frog, and pickerel frog, than by wood frog. Having at least a semi-permanent inundated hydrologic regime and a more open canopy, it is more likely to attract amphibians such as green frogs, which were observed here. However, breeding by wood frogs is also possible.

6.3.8 PVP#7A

This PVP habitat is located at the southern end of Wetland B3 (see Figure V). This is a seasonally flooded section of Wetland B3, which is maintained by the abandoned paved access to the former trailer park. It is roughly 75 feet northwesterly of PVP#7.

The PVP habitat is roughly 3,120 square feet in size, and is underlain by roughly two feet of organics (i.e., muck)[15]. On October 5th no inundation was observed; by December 12th, 2017, water levels averaged 9 to 10 inches across this area, with a maximum depth of 12 inches.

The pool area is classified as a wooded swamp (see Photos 17 and 18). Woody vegetation observed within this PVP or its perimeter included red maple, black gum, winterberry, highbush blueberry, sweet pepperbush, swamp azalea, and black chokeberry (*Aronia melanocarpa*). Unlike all of the other inventoried PVPs, PVP#7A is characterized by a moderately dense and diverse herbaceous stratum, which included sedges, soft rush, grasses, ricecut grass, sticktights, marsh, sensitive and cinnamon ferns, mad dog skullcap (*Scutellaria lateriflora*), and American water-horehound (*Lycopus americanus*). This pool habitat could be used for breeding by wood frog, particularly during wetter years. However, the presence of a developed herb stratum could indicate that this pool is marginal for amphibian breeding.

[15] This pool is located in the westernmost portion of Wetland B3 that was not "mucked-out" and disturbed (see discussion in Section 3.0).

6.3.9 PVP#8

This PVP is found on the MIRA Property at the southwesterly corner of Wetland B5 (see Figures V and V8). This wetland/pool was, in part, created when the hydrologic connection between Wetland B5 and Wetland B6 was severed to the south by a woods road (see Photos 14, 15, and 16). It is a seasonally flooded portion of the wetland, with numerous prominent hummocks with trees and shrubs growing on them. Cover searches resulted in a relatively higher abundance of adult and juvenile wood frogs to the west, within the transitional/moist upland forest.

The PVP habitat is approximately 2,242 square feet in size and will pond a maximum of about 14 inches of water. It is underlain by at least 14 inches of muck, over firm very find sand. The pool was saturated to the surface on October 5th and had about 12 inches of water on November 1st, 2017.

Vegetation observed within the pool or its perimeter included red maple, black gum, American elm, sweet pepperbush, highbush blueberry, cinnamon and royal ferns, woodferns, sedges (including tussock), swamp dewberry, and jewelweed.

6.4 Discussion

The overall Site has seen significant changes over the past decades as a result of development, agricultural activities, clearcutting, hydrologic manipulation, filling, and grading, as described in Section 3.0. Even so, wood frogs have been able to colonize and reproduce at the Site after each disturbance event, while spotted salamanders (*Ambystoma maculatum*), which is the other common obligate species of vernal pools, were not observed in association with the Site and its PVPs, but cannot be excluded.

While it is not possible to accurately estimate the wood frog population, our cover searching, combined with hydrologic evaluations, has given us an understanding of which pools are most likely to be productive, while the remaining areas may be only productive during wetter spring seasons. Additional field confirmation will occur during the appropriate season in the spring.

In our experience, having studied and inventoried numerous vernal pools and their associated terrestrial habitats over the past couple of decades in Southern New England, only a few of the PVPs may be moderately productive for wood frogs, while none are likely

productive for spotted salamanders.[16] This is based on the estimated hydroperiods for the investigated pools. Only a few of these pools, specifically, PVP#4, PVP#5, PVP#6, and PVP#8, would likely stay inundated long enough, during normal precipitation years, for the successful emerging of metamorphs. For PVP#5, this is based on its large, deep inundation, with restrictive organics/soil layers; the rest have been identified as higher productivity habitats because they are associated with a large wetland with a stable supply of water (i.e., Wetland B5).

According to Paton and Crouch (2002), for wood frog metamorphs to emerge, breeding pools must remain inundated until mid-July, or for about 21 weeks from the time of breeding and egg deposition. Vernal pools with hydroperiods of 28 to 36 weeks were found to be have the most obligate species and be the most productive (i.e., most egg masses), according to a recent Rhode Island study (Mitchell et al. 2009).

Wood frogs are known to travel greater distances then spotted salamanders (Newcomb Homan et al. 2004; Berven and Grudzien 1990), and also can utilize habitats such as seasonally flooded forested swamps for breeding, with a relatively short hydroperiod (Klemens 1993).

Several studies targeting wood frogs have been completed that shed light on the movement and habitat selection of post-breeding wood frogs, including for overwintering (e.g., Berven, 2009; Patrick et al. 2008; Rittenhouse and Semlitsch 2007; Baldwin et al. 2006; Regosin et al. 2005; Regosin et al. 2003). These studies show that wood frogs tend to use moist lowland forest, including forested swamps, during the summer period, and occupy upland forested habitat during late fall and winter months for overwintering (i.e., hibernation). These studies also showed that wood frogs do not emerge from the breeding pool in a random fashion, but are non-random and highly directional in their movements, often following habitat features linking the preferred habitats (i.e., breeding pool with lowland forests and drainageways, wetland corridors). Therefore, maintaining connectivity between these preferred habitats and the breeding areas is a top priority.

To evaluate the potential impacts to the PVP habitat and the surrounding terrestrial habitats, the resources were assessed using the methodology developed by Calhoun and Klemens (2002) and the USACE. These methodologies assess ecological significance based on: 1) biological value, and 2) conditions of the critical terrestrial habitat. The biological rating

[16] Very productive vernal pools in CT would typically have well over 80-100 wood frog egg masses, and over 40-50 spotted salamander egg masses.

is based on the presence of federal or state-listed species and the abundance and diversity of "obligate" vernal pool amphibians. For the purposes of this assessment, it is conservatively assumed that the highest biological value is support at the nine PVPs; their presence and value will be confirmed through additional surveys in the spring of 2018. The terrestrial habitat is assessed based on the integrity of the vernal pool envelope [which is the area located within 100 feet of each PVP's edge; a.k.a. Vernal Pool Envelope ("VPE")], and the critical terrestrial habitat ("CTH") (extending from 100 feet to 750 feet of each PVP's edge).

A priority rating of "Tier I" is assigned to vernal pool habitats considered to have relatively high breeding activity and relatively intact terrestrial habitat (Tier II and Tier III pools represent lower amphibian productivity and fragmented terrestrial habitat). Pools with 25 percent of less developed areas in the CTH are identified as having high priority for maintaining 25 percent or less development within this terrestrial habitat, including site clearing, grading and construction.

Construction and operation of the Project would not result in direct physical impact to the site's PVPs. However, while vernal pool-dependent species require vernal pool habitat for breeding and egg and juvenile development, the vernal pool amphibians depend on the surrounding terrestrial habitat for most of their adult lives. The Calhoun and Klemens (2002) "Best Development Practices" ("BDP") recommend protecting up to 750 feet from the vernal pool edge for obligate pool-breeding amphibians.

We have analyzed the proposed layout and configuration of the solar arrays for the Project, with respect to their placement in relation to the nine identified PVP habitats. Attachment E provides maps illustrating each PVP with its respective VPE and CTH radius, with discussion provided below.

All but two of the PVPs (i.e., PVP #1 and #8) of the 100-foot VPEs, which are intact under existing conditions, will be completely avoided by the arrays. Two of the VPEs, for PVPs #7 and #7A, currently have functional roadways traversing them. These roadways will be utilized for access to solar arrays without any expansion. For PVP #8, the existing functional roadway within its VPE will be utilized for access, but without further expansion. An additional small area of its VPE will be utilized for a safe turnaround.

As seen in Table 2, for PVP #1, installation of the fence and tree clearing will result in a change to approximately 4% of its VPE, although access will not be restricted by these activities. PVPs #7, #7A, and #8 have existing woods roads, access roads, or cleared areas

within their VPEs (see Figure V); the Project will utilize the existing road for access that extends within these areas. This reflects approximately 6% and 3% of the VPE for PVPs #7 and #7A, respectively. For PVP #8, the existing access road must be slightly adjusted (to stay within the property boundary) and extended westerly to allow for safe vehicle turning. With the additional proposed activities approximately 12% of the VPE will be utilized for access purposes, fence installation and tree clearing. All of the remaining PVPs will have no Project activities within the respective VPEs.

Table 2: Proposed Activities within VPEs Associated with Wallingford Renewable Energy

PVP#	PVP Area (acres)	VPE Area (acres)	Existing VPE Disturbed?	Project Disturbance?	Percent of VPE Affected by Project Activities[17]
1	0.001	0.90	No	Yes – fence and minor clearing	4
2	0.026	1.03	Yes – Utility ROWs	No	-
3	0.019	0.97	Yes – Utility ROWs	No	-
4	0.072	1.32	Yes – Utility ROW	No	-
5	0.063	1.37	Yes – past disturbance, current trash	No	-
6	0.141	1.49	No	No	-
7	0.035	1.09	Yes – existing access road	Yes – use of existing access road	6
7A	0.072	1.27	Yes – existing access road	Yes – use of existing access road	3
8	0.052	1.21	Yes – existing access roads	Yes – use of existing access road; enhanced turnaround; fence and minor clearing	12

The 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 from 100 feet to 750 feet from the edge of each.

[17] Includes clearing as well as other existing and proposed activities.

As shown in Table 3, six of the nine PVPs achieve the recommended "25% or less" disturbance within the CTH. For PVP #6, the recommendation is nearly achieved at 28%. For PVPs #7 and #7A intrusions within the CTH are 29% and 38%, respectively. As has been discussed above, these two PVPs may not be particularly productive for obligate amphibians. PVP #7 was found to support "non-vernal pool obligate" amphibians, such as green frog, while PVP #7A may have marginal hydrology.

Table 3: Proposed Activities within CTHs Associated with Wallingford Renewable Energy

PVP#	PVP Area (acres)	CTH Area (acres)	CTH Area Disturbance (acres)	Percent of CTH Affected by Project Activities[18]
1	0.001	41.0	5.08	12
2	0.026	41.9	8.98	21
3	0.019	41.5	8.14	20
4	0.072	43.8	8.29	19
5	0.063	44.0	5.31	12
6	0.141	45.0	12.69	28
7	0.035	42.3	12.38	29
7A	0.072	43.5	16.50	38
8	0.052	43.0	10.21	24

Based upon the proposed encroachment upon the PVPs CTHs, it is expected that there will be impacts to the overall wood frog population, and perhaps to any spotted salamanders that may be present at the Site. However, in our professional opinion, sufficient upland wooded habitat, as well as suitable hibernation habitat, embedded within the delineated wetlands,[19] will remain intact and well-connected, both on-site and off-site, to provide for all of the life cycle requirements of a modest population of wood frogs. Furthermore, the diminution of the wood frog population would not be to a level that would alter the "physical" characteristics of the Site's wetland resources, such as through a significant diminution of nutrient cycling by wood frog tadpoles.

Based on our surveys at the Site, our study of the past habitat disturbances, and our understanding of the ecology of vernal pools and their obligate amphibians, it is our opinion

[18] Includes both existing and proposed disturbances to CTHs

[19] We note that many of the delineated wetland areas included moderately drained to well drained areas, that are alluvial/floodplain "CT-statutory" wetlands. Also several upland islands within

that the wood frog population at the Site and the nine potential breeding habitats will be conserved post-development.

In the post-development phase, the solar array areas, which would be maintained to a dense grass and forb cover, will allow for the movement and migration of wood frogs between breeding pools and preferred terrestrial habitats. However, any spotted salamanders that occur at the Site would only likely cross at the narrow clearings to access wooded areas.

7.0 OVERVIEW OF POTENTIAL WETLAND & WATERCOURSE IMPACTS

7.1 Direct Wetland Impacts

According to the plans developed for the Project, *direct* wetland impacts are limited to 800 square feet (0.018 acres), which represents a very small fraction of the wetlands within the Study Area's roughly 116 acres. This delineated wetland area to be impacted is State-regulated, based on soils, and does not qualify as a federal jurisdictional wetland.

This minor wetland impact will provide access to a developable portion of the Site on the southern portion of the MIRA Property, and avoid the need for a new wetland crossing through an undisturbed portion of a forested wetland, such as at the western section of Wetland B5 (see Figure 2G, Attachment B).

The area that would be impacted is part of Wetland B5, specifically a previously disturbed area which is currently an abandoned woods road. The roadbed is somewhat elevated, about two feet above the wetlands to the south, and about one foot above the wetlands to the north. Wetland B5 overflows southerly over the roadbed to off-site wetlands. As can be seen in Photos A through C (Attachment C), the wetlands on both sides of this woods road are degraded through filling and excavation. To the south there is an emergent wetland cover type dominated by common reed. To the north is a forested portion of Wetland B5, with invasives such as multiflora rose up against the roadway.

The cleared portion of this roadway averages 11 to 12 feet in width, which would be wide enough to accommodate construction-related vehicles, with some tree limb trimming. It

Wetland B5, were not excluded in the wetland delineations. Both of these sets of areas are suitable habitat for wood frog hibernation.

may also be necessary to cover the road surface with several inches of stone, in preparation for construction vehicle access.

7.2 Indirect Wetland 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 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, 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 sensitivity, and their ecological and physical characteristics. These potential impacts are discussed below.

7.2.1 Erosion and Sedimentation

If not properly controlled, the potential for soil erosion and subsequent deposition in wetlands or watercourses exists at construction sites that involve soil disturbance. At this Site, the risk, or the potential for adverse impacts, from erosion and sedimentation is considered low to very low. The primary reasons for this assessment are: (1) a detailed erosion and sedimentation control plan has been prepared and submitted, which complies with the Connecticut Department of Energy and Environmental Protection's ("CTDEEP's") 2002 *Connecticut Guidelines for Erosion and Sediment Control*; (2) the dominant upland soils (i.e., Deerfield and Penwood soil series) in the areas where soils would be disturbed have *low* erodibility (i.e., K-Factor 0.17; whole soil)[20]; and (3) with a few exceptions, slopes in the areas of the "pier-driven" solar arrays slopes are either nearly flat or gentle.

[20] Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation ("RUSLE") to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity ("Ksat"). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

7.2.2 Removal of Native Vegetation and Habitat Loss

Habitat loss associated with land clearing, if not properly mitigated, has the potential of impacting wetlands and watercourses. At the Site, the majority of the habitat to be cleared and converted to grassy fields that will support the solar arrays is nearly flat to gently sloping. Moreover, most of the woodland to be cleared was cleared in the past, most recently in the mid-1980s.

Because the proposed land use is considered to be of low intensity, post-construction, the ecological services that would have been offered by undisturbed wetland buffers in protecting and maintaining wetland functions and values, such as in the case of a more intense land use proposal, are not as necessary for the Project. The plans show a minimum undisturbed wetland buffer of 25 feet, except in the area of the proposed wetland crossing (see above discussion). These undisturbed wetland buffers are of sufficient width to protect and maintain wetland functions and values at the Site.

7.2.3 Potential Impacts to Wetland Hydrology and Stream Flow

The hydrologic and flow regimes of the Site's wetlands, and particularly those of Wetlands B3 and B4, are dependent to a great extent on contributions by groundwater discharge originating in the land to be developed for the Project. However, since all of the areas to be developed will maintain their present capacity to infiltrate rainwater and runoff, impacts to the hydrologic and flow regimes of the Site's wetlands are not expected.

7.2.4 Potential Water Quality Impacts

Stormwater runoff from impervious surfaces of industrial sites, if not properly managed, has the potential of degrading the water quality (i.e., surface and groundwater) of regulated resources. However, the Project does not generate runoff that contains the typical runoff constituents, such as heavy metals, nutrients, and sediment. In essence, rainwater washes off the solar arrays and infiltrates into the ground below. Once the developed areas are stabilized with vegetation, runoff will be negligible. Therefore, water quality impacts to regulated wetlands and watercourses are not expected.

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ATTACHMENT A:
On-Site Soil Investigation & Wetland Delineation Report

REMA ECOLOGICAL SERVICES, LLC
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860.649.REMA (7362)

REPORT DATE: December 14, 2017

ON-SITE SOIL INVESTIGATION & WETLAND DELINEATION REPORT

PROJECT NAME & SITE LOCATION:

+/- 114 (3 parcels)
Oliver Creek Road & Pent Road
Wallingford, CT

REMA Job No.: 17-2017-WAL29

Field Investigation Date(s): 10/5 to 10/13/2017

Field Investigation Method(s):

- ☒ Spade and Auger
- ☐ Backhoe Test Pits
- ☐ Other:

REPORT PREPARED FOR:

Tetra Tech
2 Lan Drive, Suite 210
Westford, MA 01886
Attn.: Lynn Gresock, VP

Field Conditions:

Weather: Sunny to Overcast, 40s to 60s
Soil Moisture: Moderate-High
Snow Depth: none
Frost Depth: none

Purpose of Investigation:

- ☒ Wetland Delineation/Flagging in Field
- ☐ Wetland Mapping on Sketch Plan or Topographic Plan
- ☐ High Intensity Soil Mapping by Soil Scientist
- ☒ Medium Intensity Soil Mapping from *'The Soil Survey of Connecticut'* Maps (USDA-NRCS)
- ☐ Other:

Base Map Source(s): CT Soil Survey (USDA-NRCS) (attached)

Wetland Boundary Marker Series: RES-A-1 to A-5, RES-C-1 to C-10, RES-E-1 to E-9, W3-100 to 103, W17-100 to 103, and W18-100 to 128 (closed); RES-CT-1 to CT-81, RES-B-1 to B-59, RES-CT-300 to CT-319, RES-CT-500 to CT-506, RES-U-1 to U-15, W1-100 to 110, W2-100 to 141, W4-100 to 121, W13-132 to 140, W13-173 to 214, W16-100 to 121, and W14-103 to 107 (open)

General Site Description/Comments: The "study area" or "site" encompasses +/-114 acres of land (3 parcels; two ownerships) that can be accessed off of Pent Road within the southern section of Wallingford. In its present state the northern parcel, owned by the Town of Wallingford (Town Property), is comprised of capped landfills with a grassy cover, wooded floodplain wetlands associated with the Quinnipiac River, and scrub-shrub and vine tangles. The soils within the Town Property are mostly disturbed with the exception of areas associated with the river floodplain. The southern parcels owned by Materials Innovation and Materials Authority (MIRA) (the MIRA Property), are mostly wooded, but also characterized with areas of past disturbance vegetated by invasives in a mosaic of open, scrub-shrub, and wooded habitats. The MIRA Property includes significant areas of past soil disturbance, mostly within its eastern and north-central sections, as well as undisturbed soils. The undisturbed soils are derived from glaciofluvial (i.e. stratified sand & gravel), alluvial (i.e., stratified sand & silt), and organic (i.e., peat and muck) deposits, while the disturbed soils are derived from fill or from exposed sandy parent material. The undisturbed upland soils are the excessively drained Penwood (35), and the moderately well drained Deerfield (24) soil series. The disturbed upland soils are mapped as Udorthents (308) and as Dumps (302). The undisturbed wetland soils are the poorly drained Walpole (13), the very poorly drained Scarboro (15), the poorly drained Rippowam (103), the moderately well drained Pootatuck (102), and the well-drained Occum (101) soil series, and the very poorly drained Timakwa and Natchaug (17) soil series complex. The disturbed wetland soils are mapped as Aquents (308W). The majority of the delineated wetland areas within the site are wooded swamps, but also include inclusions of emergent (i.e., marsh, wet meadow) and scrub shrub swamp.

ON-SITE SOIL INVESTIGATION & WETLAND DELINEATION REPORT *(CONTINUED)*

PROJECT NAME & SITE LOCATION: +/- 114-acres (3 parcels)
Pent Road and Oliver Creek Road, Wallingford, CT

SOIL MAP UNITS

Upland Soils

Udorthents (308). This soil mapping unit consists of well drained to moderately well drained soils that have been altered by excavation (i.e. sand and gravel borrow pits). 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.

Penwood loamy sand (35). This series consists of very deep, excessively drained soils formed in sandy outwash. They are nearly level to strongly sloping soils on glaciofluvial landforms. Slope ranges from 0 to 15 percent. Permeability of the Penwood soils is rapid or very rapid throughout. Thickness of the solum ranges from 20 to 36 inches. Rock fragments, dominantly fine gravel, range from 0 to 10 percent in the solum and from 0 to 15 percent in the substratum. Unless limed, the soil is very strongly acid to moderately acid throughout. Typically, these soils have a dark brown loamy sand surface layer 8 inches thick. The subsoil from 8 to 18 inches is yellowish red loamy sand, loose structure, with no mottles. The substratum from 18 to 60 inches is reddish brown sand (single grain) with no mottles.

Deerfield loamy fine sand (24). This series consists of very deep, moderately well drained soils formed in sandy water deposited glacial outwash materials. They are nearly level to strongly sloping soils on glaciofluvial terraces, deltas and outwash plains, typically in slight depressions and broad drainage ways. The soils formed in thick deposits of sand derived mainly from granite, gneiss and quartzite, but in places containing materials from schist and sandstone. The sand is poorly graded; medium sand is generally dominant and typically contains little or no gravel. Typically, these soils have a very dark grayish brown loamy fine sand surface layer 8 inches thick. The subsoil from 8 to 28 inches is dark yellowish brown loamy sand with mottles below 16 inches. The substratum from 28 to 60 inches is dark brown and brown, mottled fine sand.

Wetland Soils

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.

Scarboro muck (15). This series consists of very deep, very poorly drained soils formed in sandy water deposited glacial outwash materials. They are nearly level soils on glaciofluvial landforms, typically in low depressions and drainage ways of outwash plains and terraces. The soils formed in a loamy sand, lying over stratified sandy and gravelly outwash derived from a variety of acid rocks. Typically these soils have a 9 inch black mucky peat or very dark brown mucky sandy loamy surface layer. The subsurface layer from 9 to 16 inches is gray loamy sand. The substratum from 16 to 60 inches is olive gray, grayish brown and light yellowish brown loamy sand, loamy fine sand and coarse sand. The substratum may be stratified.

Walpole sandy loam (13). This series consists of deep, poorly drained soils formed in sandy water deposited glacial outwash materials. They are nearly level to gently sloping soils on glaciofluvial landforms, typically in shallow drainage ways and low-lying positions on stream terraces and outwash plains. The soils formed in loamy over stratified sandy and gravelly outwash derived from a variety of acid rocks. Typically, these soils have a very dark brown sandy loam surface layer 6 inches thick. The subsoil from 6 to 23 inches is mottled, grayish brown sandy loam. The substratum from 23 to 60 inches is mottled, light brownish gray, gravelly loamy sand and gravelly sand.

ON-SITE SOIL INVESTIGATION & WETLAND DELINEATION REPORT *(CONTINUED)*

PROJECT NAME & SITE LOCATION: +/- 114-acres (3 parcels)
Pent Road and Oliver Creek Road, Wallingford, CT

SOIL MAP UNITS

Wetland Soils

Timakwa and Natchaug mucks (17). The Timakwa series consists of very deep, very poorly drained soils formed in formed in woody and herbaceous organic materials 16-50 inches thick overlying sand deposits over sandy deposits in depressions on lake plains, outwash plains, till plains, moraines, pond basins, and flood plains. Adrian soils are in extinct lake and pond basins, primarily within outwash plains. Basins range from nearly an acre to several hundred acres in size. Saturated hydraulic conductivity is moderately low to high in the organic layers and high or very high in the sandy material. Slope ranges from 0 to 2 percent. Mean annual temperature is about 48 degrees F and the mean annual precipitation is about 47 inches. Adjacent upland soils are generally sandy. Typically these soils have a black muck layer that is 33 inches thick. The substratum to a depth of 60 inches is gray, loose sand.

The Natchaug series consists of very deep, very poorly drained soils formed in well-decomposed organic materials 16-50 inches thick overlying loamy mineral deposits, deposits in depressions on lake plains, outwash plains, till plains, moraines, and flood plains. These soils have moderate to very rapid permeability in the organic material and moderately slow to moderately rapid permeability in the loamy material. Slope ranges from 0 to 2 percent. Mean annual temperature is about 48 degrees F. and mean annual precipitation is about 47 inches. Typically these soils have a black muck layer that is 33 inches thick. The substratum to a depth of 60 inches is dark gray, friable, gravelly silt loam.

Occum sandy loam (101). This series consists of deep, well drained soils formed in loamy, alluvial sediments. They are nearly level soils on floodplains of rivers and major streams. Occum soils formed in recent alluvium derived mainly from schist, gneiss or granite. Typically, these soils have a very dark grayish brown fine sandy loam surface layer 8 inches thick. The subsoil from 8 to 35 inches is dark brown sandy loam. From 35 to 60 inches the substratum is dark grayish brown gravelly sand. This soil was formerly mapped in Connecticut as Ondawa.

Rippowam fine sandy loam (103). The Rippowam series consists of deep, poorly drained soils formed in loamy, alluvial sediments. They are nearly level soils on floodplains. The soils formed in recent alluvium derived mainly from schist, gneiss or granite. Typically, these soils have a very dark grayish brown fine sandy loam surface layer 5 inches thick. The subsoil from 5 to 27 inches is dark grayish brown, mottled fine sandy loam and sandy loam. From 27 to 60 inches the substratum is dark gray and grayish brown, loose stratified, loamy sand and very gravelly sand. This soil was formerly mapped in Connecticut as Rumney.

Pootatuck fine sandy loam (102). This series consists of deep, moderately well drained soils formed in coarse-loamy, alluvial sediments. They are nearly level soils on floodplains of rivers and major streams. The soils formed in recent alluvium derived mainly from schist, gneiss or granite. Typically, these soils have a very dark grayish brown fine sandy loam surface layer 5 inches thick. The subsoil from 5 to 30 inches is dark yellowish brown fine sandy loam in the upper subsoil and dark brown, mottled sandy loam in the lower subsoil. From 30 to 60 inches the substratum is dark brown and grayish brown, mottled gravelly sand.

ON-SITE SOIL INVESTIGATION & WETLAND DELINEATION REPORT *(CONTINUED)*

PROJECT NAME & SITE LOCATION: +/- 114-acres (3 parcels)
Pent Road and Oliver Creek Road, Wallingford, CT

SOIL MAP UNITS

See previous pages.

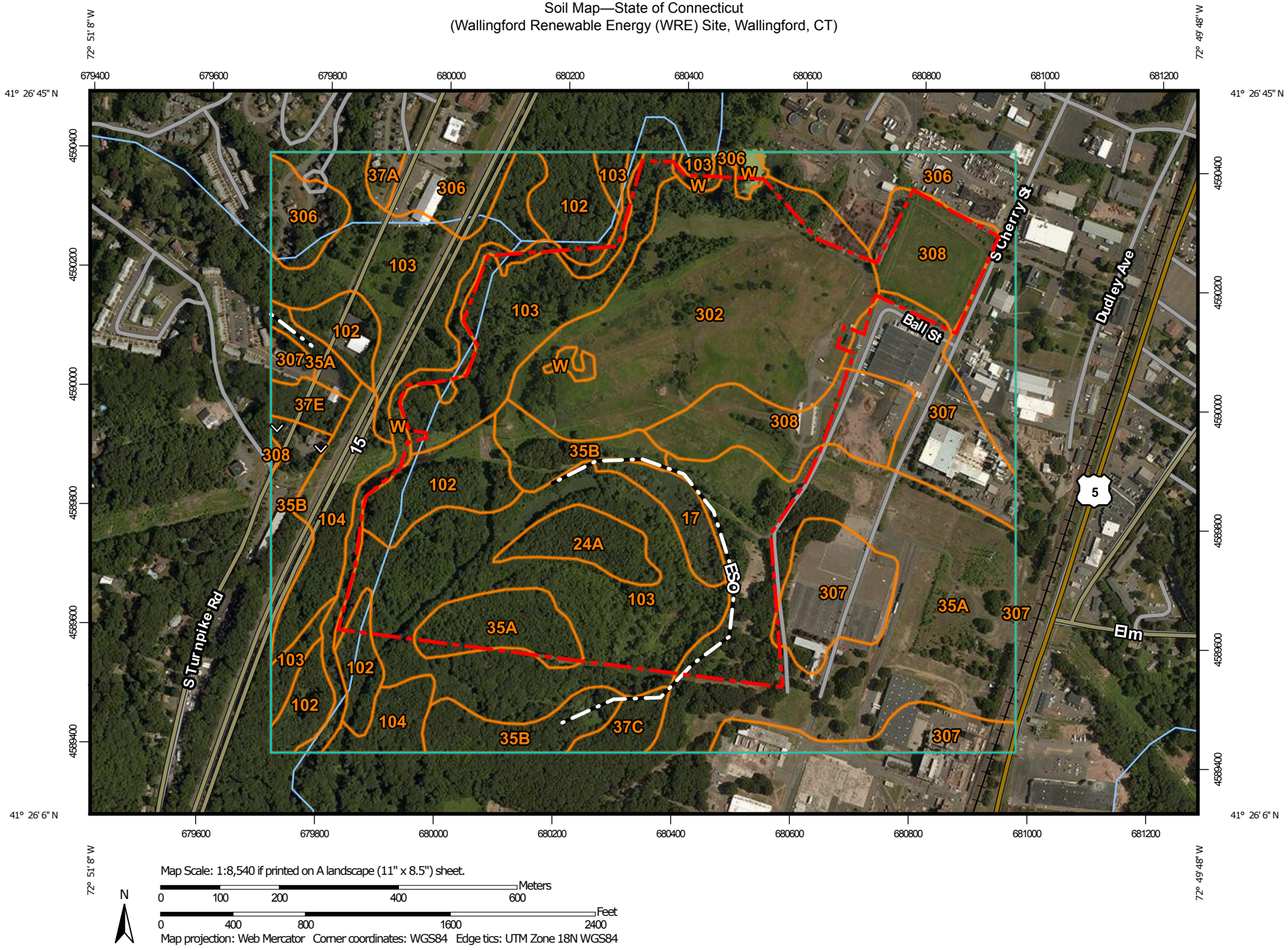
Any accompanying soil logs and soil maps, and the on-site soil investigation narrative are in accordance with the taxonomic classification of the National Cooperative Soil Survey of the USDA Natural Resource Conservation Service, and with the Connecticut Soil Legend (DEP Bulletin No.5, 1983), as amended by USDA-NRCS. Jurisdictional wetland boundaries were delineated pursuant to the Connecticut General Statutes (CGS Sections 22a-36 to 22a-45), as amended. The site investigation was conducted and/or reviewed by the undersigned Registered Soil Scientist(s) [registered with the Society of Soil Scientists of Southern New England (SSSSNE) in accordance with the standards of the Federal Office of Personnel Management].

Respectfully submitted,

REMA ECOLOGICAL SERVICES, LLC

George T. Logan, MS, PWS, CSE
Registered Soil Scientist, Professional Wetland Scientist
Field Investigator/Senior Reviewer

Soil Map—State of Connecticut
(Wallingford Renewable Energy (WRE) Site, Wallingford, CT)



Map Scale: 1:8,540 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 400 800 1600 2400

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: State of Connecticut
Survey Area Data: Version 16, Sep 15, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 27, 2014—Jul 22, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
17	Timakwa and Natchaug soils, 0 to 2 percent slopes	3.5	1.1%
24A	Deerfield loamy fine sand, 0 to 3 percent slopes	4.8	1.5%
35A	Penwood loamy sand, 0 to 3 percent slopes	55.7	17.8%
35B	Penwood loamy sand, 3 to 8 percent slopes	14.8	4.7%
37A	Manchester gravelly sandy loam, 0 to 3 percent slopes	1.1	0.3%
37C	Manchester gravelly sandy loam, 3 to 15 percent slopes	2.5	0.8%
37E	Manchester gravelly sandy loam, 15 to 45 percent slopes	2.1	0.7%
102	Pootatuck fine sandy loam	20.8	6.6%
103	Rippowam fine sandy loam	71.4	22.8%
104	Bash silt loam	11.5	3.7%
302	Dumps	41.4	13.2%
306	Udorthents-Urban land complex	26.3	8.4%
307	Urban land	29.0	9.3%
308	Udorthents, smoothed	19.2	6.1%
W	Water	9.4	3.0%
Totals for Area of Interest		**313.7**	**100.0%**

State of Connecticut

35A—Penwood loamy sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9ln0
Elevation: 0 to 1,200 feet
Mean annual precipitation: 43 to 54 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 140 to 185 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Penwood and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Penwood

Setting

Landform: Terraces, outwash plains
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy glaciofluvial deposits derived from sandstone and shale

Typical profile

Ap - 0 to 8 inches: loamy sand
Bw1 - 8 to 18 inches: loamy sand
Bw2 - 18 to 30 inches: sand
C - 30 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 99.62 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Manchester

Percent of map unit: 5 percent
Landform: Eskers, kames, outwash plains, terraces
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Hartford

Percent of map unit: 5 percent
Landform: Terraces, outwash plains
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Branford

Percent of map unit: 5 percent
Landform: Outwash plains, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Ellington

Percent of map unit: 3 percent
Landform: Outwash plains, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Unnamed, gravelly substratum

Percent of map unit: 2 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: State of Connecticut
Survey Area Data: Version 16, Sep 15, 2017

State of Connecticut

24A—Deerfield loamy fine sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 9ll2
Elevation: 0 to 1,200 feet
Mean annual precipitation: 43 to 54 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 140 to 185 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Deerfield and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Deerfield

Setting

Landform: Outwash plains, terraces
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Sandy glaciofluvial deposits derived from granite and/or schist and/or gneiss

Typical profile

Ap - 0 to 8 inches: loamy fine sand
Bw1 - 8 to 16 inches: loamy sand
Bw2 - 16 to 28 inches: loamy sand
C1 - 28 to 34 inches: fine sand
C2 - 34 to 60 inches: fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Windsor
Percent of map unit: 5 percent
Landform: Terraces, kames, outwash plains
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Penwood
Percent of map unit: 5 percent
Landform: Outwash plains, terraces
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Hinckley
Percent of map unit: 3 percent
Landform: Terraces, eskers, kames, outwash plains
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Ninigret
Percent of map unit: 3 percent
Landform: Outwash plains, terraces
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Walpole
Percent of map unit: 2 percent
Landform: Depressions on terraces, drainageways on terraces
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

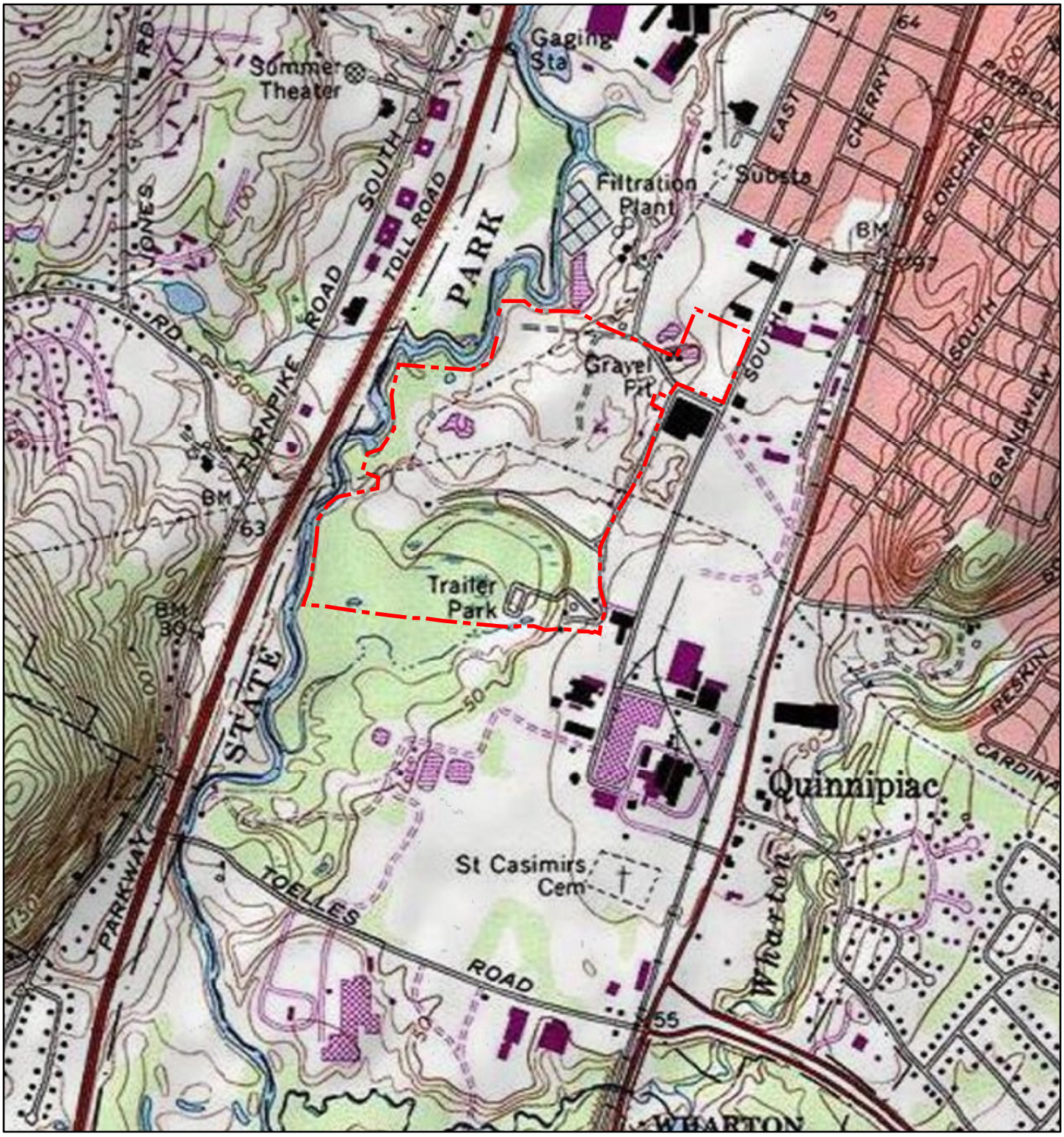
Scarboro
Percent of map unit: 2 percent
Landform: Depressions, terraces, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: State of Connecticut
Survey Area Data: Version 16, Sep 15, 2017

ATTACHMENT B:
Figures

Figure 1: Study Area Locus



November 11, 2017

1:18,056

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0 0.175 0.35 0.7 km

N

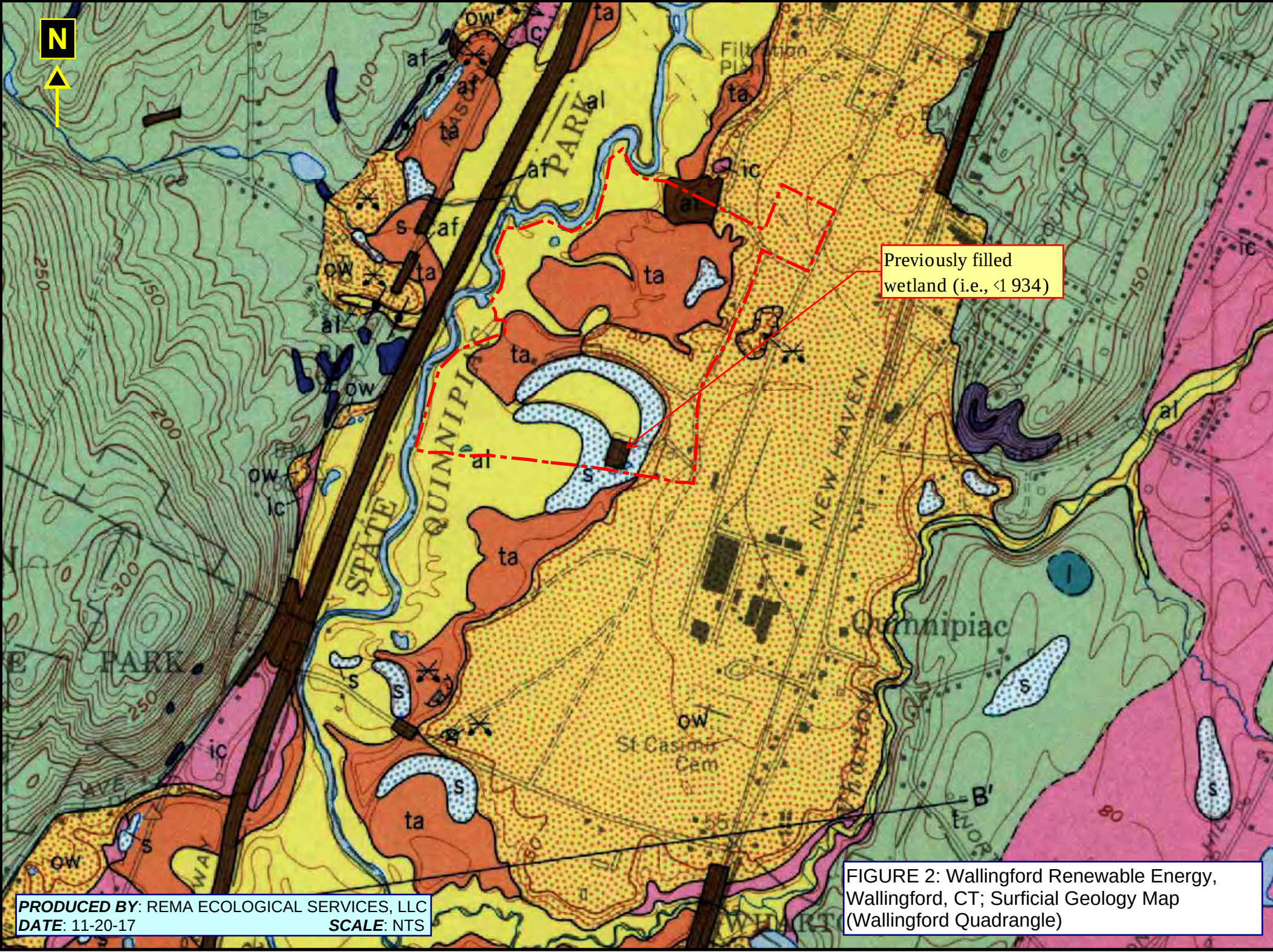

FIGURE 2: Wallingford Renewable Energy, Wallingford, CT; Surficial Geology Map (Wallingford Quadrangle)

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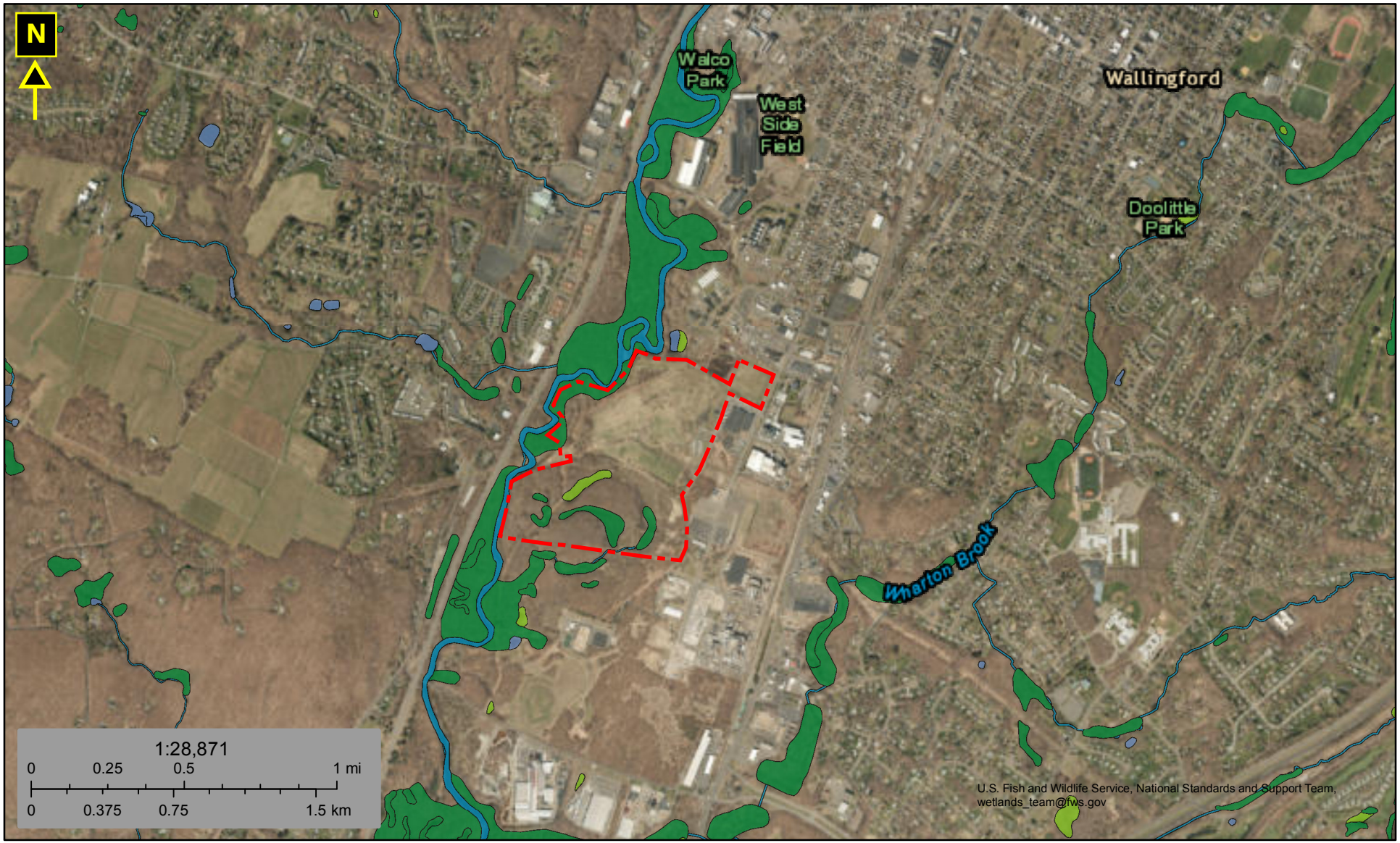
DATE: 11-20-17 ***SCALE***: NTS

U.S. Fish and Wildlife Service

National Wetlands Inventory

FIGURE 3: Wallingford Renewable Energy, Wallingford, CT; Jurisdictional Wetland Areas Classification per NWI, on a 2016 Aerial Photo (CT GIS)



November 19, 2017

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

FIGURE A1: Wallingford Renewable Energy, Wallingford, CT; Town Property, as seen on a 1934 aerial photograph (CT State Library Online)

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DATE: 11-14-17 ***SCALE***: NTS


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FIGURE A2: Wallingford Renewable Energy, Wallingford, CT; MIRA Property, as seen on a 1934 aerial photograph (CT State Library Online)
Approximate Center of Property
Quinnipiac River
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DATE: 11-14-17
SCALE: NTS

FIGURE B1: Wallingford Renewable Energy, Wallingford, CT; Town Property, as seen on a 1965 aerial photograph (CT State Library Online)

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