Roxbury Wind Project

Soil Survey Report

February 21, 2018

Prepared for:

Palmer Management Corporation
13 Elm Street, Suite 200
Cohasset, MA 02025

Prepared by:

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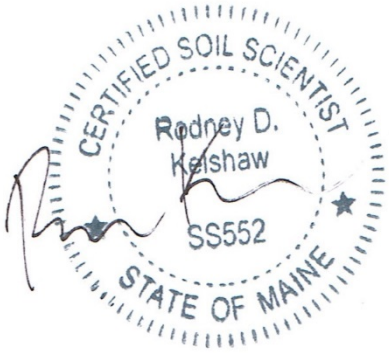
30 Park Drive
Topsham, ME 04086

Sign-off Sheet

The accompanying soil profile descriptions and soil survey maps, and this soil narrative report entitled “Roxbury Wind Project Soil Survey Report”, dated February 21, 2018, were completed in accordance with the standards adopted by the Maine Association of Professional Soil Scientists, February 1995, as amended, and prepared by Rodney D. Kelshaw CSS #552.



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1.0 INTRODUCTION

At the request of Palmer Management Corporation, Stantec Consulting Services Inc. (Stantec) completed a soil survey for the proposed Roxbury Wind Project (Project) in Roxbury, Maine. The purpose of this report is to describe the soil types identified within the survey area of the proposed wind farm site and how these soils may affect development of the site for this project. The project consists of four proposed turbine locations and associated infrastructure, including access roads and an electrical collector line that will extend from the turbines to an existing substation.

This soil survey is a compilation of on-site soil investigation data supported by publicly available information from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) soil surveys for Oxford County. Two classes of soil survey were performed, and this report was developed to meet the typical requirements of the Maine Department of Environmental Protection (MDEP) Site Location of Development Act (Site Law) and the Maine Land Use Planning Commission (LUPC) for wind power projects. It includes information on the ability or limitation of the soil to support the activities inherent to the construction and operation of the proposed project.

2.0 SITE DESCRIPTION

The soil survey study area (site) is located on the southern side of State Route 120 and east of Horseshoe Valley Road in Roxbury, Maine (Figure 1). The site is approximately 89 acres; situated on the North Twin Mountain ridgeline. It also includes proposed access along an existing aggregate road extending from Horseshoe Valley Road to the ridgeline and a proposed electrical collector line that extends along the southern side of an existing transmission line corridor from the ridgeline, easterly to an existing substation located on the eastern side of Route 120. At the time of the on-site survey the existing/proposed access road had not been recently maintained and several severe washouts were present.

The site is currently undeveloped, with the primary use being forestland. The history of timber harvesting on the site has resulted in a mixed-growth forest composed of multiple-aged stands. Dominant tree species are spruce (*Picea* sp.), balsam fir, (*Abies balsamea*), maple (*Acer* sp.), and birch (*Betula* sp.). There is an existing network of timber trails throughout the site, most dominant in the northern section. Due to the high rate of timber harvesting the site contains many areas that are disturbed from use of large scale timber harvesting equipment. These roads and ruts intercept surface and subsurface runoff which is then concentrated in small, discrete areas that hold water for extended periods and function similar to wetlands, although do not meet the parameters to be mapped as such. There is also a meteorological tower located at the site; however, it recently blew down and was in disrepair at the time of the on-site survey.

3.0 PURPOSE

The purpose of the soil survey is to provide project engineers with site-specific soil information which will be used to design project components and for project permitting. The soil investigation is performed to obtain information that will make possible a taxonomic classification for the various soils that exist on-site; particularly in areas of proposed development, including the proposed access road corridor, within the proposed turbine pad sites, and along the proposed electrical collector line corridor.

This report identifies soil limitations including soil drainage, physical properties, depth to bedrock, and other limiting factors. Knowing the depth to bedrock will affect project design for roads, anchoring of turbines, blasting requirements, and identify sources for road building materials. Hydrological Soil Group (HSG) ratings, which are based on site specific soil data, are part of the calculations for stormwater runoff curve values used for stormwater control design and culvert location and sizing. Information from this report may be used to plan temporary erosion and sediment control to be implemented during project construction, as well as permanent stormwater management during operation of the project.

A soil survey is tailored to the specific project, and as such, the report may not be suitable for other uses because the soil limitations and properties that are suitable for one type of project may not be suitable for a different project. Potential limitations for development identified in this report are intended for this specific project and should not be used for any other purpose. The accompanying soil survey maps depict the location and extent of soils found on the site (Figures 2-1 through 2-9 and Figure 3).

4.0 METHODS

This report and map were completed in accordance with the standards adopted by the Maine Association of Professional Soil Scientists (MAPSS) in the "*Guidelines for Maine Certified Soil Scientists for Soils Identification and Mapping*" (revised 2009)[1] and follows the standards detailed in the USDA NRCS "*Soil Survey Manual*"[2]. Two classes of soil survey were completed for this survey. A Class L (linear) soil survey was conducted for the proposed turbine array; which includes the turbine pads, access roads and crane paths, and collector line within the turbine array area. A Class D (medium intensity) survey was conducted for the proposed electrical collector line corridor from the ridgeline to the existing substation on State Route 120.

The soil survey site boundary was determined based on the proposed turbine layout from November 2017, and consisted of a 100-foot wide survey area primarily along the existing access road from Horseshoe Valley Road to the ridgeline, a polygon of variable width extending from 300 feet north of the northernmost turbine to 300 feet south of the southernmost turbine, and an approximately 100-foot wide corridor extending along the southern side of the existing cleared distribution line from the ridgeline, easterly to the substation at State Route 120. The locations of the

[1] Maine Association of Professional Soil Scientists. 2009. *Guidelines for Maine Certified Soil Scientists for Soils Identification and Mapping*.
[2] Soil Science Division Staff. 2017. *Soil Survey Manual, ed*. C. Ditzler, K.Scheffe, and H.C. Monger USDA Handbook 18. Government Printing Office, Washington, D.C.

turbines currently depicted on the soil survey maps are a revised proposed turbine layout, from February 2018, and therefore does not match all turbine locations that were being proposed at the time of the soil survey fieldwork.

Kleinschmidt Associates (KA) performed a wetland delineation and stream mapping of the site and Stantec was provided the shapefile data which was used to help determine hydric soil boundaries and surface water flow for stormwater planning. Stantec observed the KA wetland feature boundaries on-site, and dug test pits in several wetlands mapped by KA to obtain detailed soil information. The soil boundaries depicted within the Class D soil survey area is the NRCS county soil survey shapefile data that was supplemented with on-site KA wetland and stream data. Stantec also field verified sections of this mapping and obtained on-site soil data with auger borings and test pits in limited areas.

Soils are described using the standard soil terminology developed by the USDA NRCS and the MAPSS Key to Soil Drainage Classes, as well as a list of regional indicators for identification of hydric soils *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Regional Supplement.*[3] Soil types identified are depicted on the proposed project site plans at a scale of 1 inch equals 100 feet for the Class L survey area (Figures 2-1 to 2-9) and at a scale of 1 inch equals 500 feet for the Class D survey area (Figure 3).

A State of Maine Certified Soil Scientist (CSS) conducted the on-site soil survey on November 14 and 15, 2017. Temperatures were approximately 40 degrees Fahrenheit on both days, there was a light snow cover on the soil surface which did not impede data collection and there was no frost in the ground. Recent climatic conditions were typical for this time of year. For site orientation, an iPad equipped with a mapping grade Global Positioning System (GPS) and base layers including an aerial photograph, topography, NRCS soil boundaries, project site boundaries, proposed turbine locations, and KA identified wetlands and streams was used.

Fieldwork consisted of documenting soil morphology and characteristics with hand dug test pits, borings, and existing ditch cuts and borrow areas to a depth of bedrock, refusal, or limit of the soil auger. Other factors used to determine soil characteristics were changes in vegetation, slope, aspect, and observations of exposed bedrock and surface stones. Test pits, boring locations, some exposed bedrock, map unit boundaries, and other pertinent site features were recorded in the field using a mapping grade GPS. Test pit locations were chosen where representative soil descriptions could be collected to determine the soil series or phase. To aid in development of the accompanying soil survey maps the auger borings and changes in topography were used to determine the soil series and map unit boundaries.

5.0 SOIL MAP AND MAP UNIT DESCRIPTION

5.1 SOIL MAP REQUIREMENTS

The Class L (for Linear Projects) standards were developed by MAPSS to provide minimum soil information necessary to allow for the design and construction of long but narrow projects with little or no adjacent development. Class D (Medium Intensity) surveys are designed to be utilized for projects that will require minor to moderate soil

[3] U.S. Army Corps of Engineers. 2012. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region (Version 2.0)*, ed. J. S. Wakeley, R. W. Lichvar, and C. V. Noble. ERDC/EL TR-12-1. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

disturbance or design that will require site specific soil information. These standards were the basis of this soil survey and are detailed in Appendix D: MAPSS Standards for Soil Surveys. The accompanying soil figures/maps meets the requirements of Class L and D soil surveys, as outlined by the MAPSS Guidelines. The soil survey map units are designed according to the standards of the National Cooperative Soil Survey, and the soils are classified at the series level according to the current Keys to Soil Taxonomy. Soil map units are phases of soil series.

Soil map unit boundaries are observed throughout their length and their placement corresponds to changes in soil and/or landforms. Map unit boundary placement is based on observed soil characteristics, using observations of vegetation, landforms, and other site features as indications of changes in soil condition.

5.2 SOIL MAP UNITS

Soil map unit boundaries are depicted on the attached soil survey maps (Figures 2-1 through 2-9 and Figure 3). These figures depict the size and location of the soil map units relative to each other and existing site features. Every map unit is composed of the named soil and smaller areas of other soil series or phases (inclusions). On this site, the inclusions are typically located along the map unit boundary. These inclusions are listed in each soil map unit description (Appendix E). Most inclusions have properties or patterns that are similar to those of the dominant soil in the map unit and generally do not affect use and management.

A soil survey map unit consists of a portion of the landscape composed of the identified soil components and associated landscape properties, such as similar topography, aspect, configuration, stoniness, vegetation, depth to seasonal groundwater table, depth to bedrock, depth to impermeable layer, kinds of soil (soil horizons) and miscellaneous land area. The soils within an area enclosed by a map unit boundary have a minimum of 75 percent of the soil(s) that provide the name of that map unit or similar (soils that differ so little from the named soil(s) in the map unit that there are no important differences in interpretations). No one similar soil is greater than the named soil(s). The total amount of dissimilar soils (soils that differ sufficiently from the named soil(s) to affect major interpretations) do not exceed 25 percent of the map unit.

6.0 SOIL CHARACTERISTICS AND FINDINGS

On-site soils identified were formed in supraglacial loamy soil over bedrock and loamy mantle overlying glacial till. Soils formed in glacial till are Becket, Westbury, Monadnock, and Wambeck. Soils that formed in supraglacial loamy deposits are Lyman and Tunbridge. Appendix A is the Site Law Form E Soil Condition Summary Table, Appendix B is Site Law Form F Soil Profile/Classification Information, the table in Appendix C lists the mapped soil series and some important properties of each, Appendix D is the MAPSS Standards for Soil Surveys, Appendix E are the Map Unit Descriptions for the Class L survey area, and Appendix F is a glossary of terms.

6.1 BECKET-WESTBURY COMPLEX (BW)

This map unit was mapped within the proposed electrical collector corridor that extends from the ridgeline to the substation; on the foot slope of the ridge near State Route 120. Becket and Westbury soils are loamy mantle overlying dense glacial till. They are very deep and located on drumlins and glaciated uplands. Becket soil is well

drained whereas Westbury soil is somewhat poorly drained. This map unit contains poorly drained phases of the soil that are inclusions mapped as wetlands.

6.2 HUMAN-TRANSPORTED MATERIAL (HT)

Human transported material is soil patent material that was moved horizontally onto a pedon from a source area outside of that pedon by purposeful human activity. This is the existing aggregate base road and associated staging areas/log landings. These were primarily created by excavation of adjacent soil from what are now ditches or borrow areas and placed for the road construction.

6.3 LYMAN-TUNBRIDGE-ROCK OUTCROP COMPLEX (LR)

Lyman and Tunbridge sandy loam soil formed in loamy supraglacial till on glaciated uplands. Lyman soil is shallow to bedrock and somewhat excessively drained whereas Tunbridge soil is moderately deep and well drained. The dominant soil depth is between 10 and 20 inches, however, there are inclusions of deep soil with dense till, and exposed bedrock outcrops. These soils were mapped on pinnacles along the ridgeline.

6.4 LYMAN-TUNBRIDGE-BECKET, COMPLEX (LU)

This map unit was the dominant soil mapped within the proposed electrical collector line corridor along most of the side slope and near the base of the slope along Route 120. Lyman and Tunbridge sandy loam soil formed in loamy supraglacial till on glaciated uplands. Lyman soil is shallow to bedrock and somewhat excessively drained whereas Tunbridge soil is moderately deep and well drained. Becket soils are loamy mantle overlying dense glacial till, very deep and located on drumlins and glaciated uplands. Becket soil is typically well drained however, inclusions in this map unit include drainage classes from poorly to well drained and the poorly drained phases are inclusions mapped as wetlands. This map unit is dominantly between 10 and 20 inches to bedrock with large areas of soil that reaches greater than 60 inches to bedrock. These deeper soils also contain areas that are extremely cobbly. This complex also contains less numerous, dissimilar inclusions of very shallow soil and exposed bedrock.

6.5 MANUFACTURED LAYER (ML)

A manufactured layer is an artificial, root-limiting layer below the soil surface. Horseshoe Valley Road and State Route 120 are paved and short sections of these roads cross through the western and eastern ends of the site.

6.6 MONADNOCK FINE SANDY LOAM (MO)

Monadnock soil is very deep, well-drained soil that formed in loamy over sandy melt-out glacial till on hills and mountains on glaciated uplands. Monadnock was mapped in a large bench on the south-central portion of the ridgeline. Phases of this soil with poorer drainage are inclusions located along wetland boundaries.

6.7 MONADNOCK, POORLY DRAINED (MP)

The Mondanock, poorly drained map unit is a large pocket of very deep, sandy melt out on the ridgeline near the southern end of the site. It is a poorly and very poorly drained/hydric phase of this soil series and is mapped as a wetland. Monadnock was mapped in a large bench on the south-central portion of the ridgeline.

6.8 TUNBRIDGE, POORLY DRAINED (TP)

This map unit is a phase of Tunbridge that is poorly drained/hydric soil and mapped as wetland. It is mapped in depressions/pockets within the larger area mapped as Tunbridge.

6.9 TUNBRIDGE-LYMAN-ROCK OUTCROP COMPLEX (TR)

This map unit is similar to Lr, however the dominant soil depth is between 20 and 40 inches. This is the most dominant map unit across the Class L soil survey site and encompasses most of the ridgeline area and the higher elevations along the existing road.

6.10 WAUMBEK FINE SANDY LOAM (WA)

Waumbek soils are very deep, moderately well drained soils formed in stony, sandy till on glaciated uplands. This map unit contains phases of this series that are very stony, very gravelly, and/or well drained. This soil is mapped primarily along the lower elevations of the existing road on the western side of the site.

6.11 WAUMBEK FINE SANDY LOAM, POORLY DRAINED (WP)

Waumbek soils are very deep soils formed in stony, sandy till on glaciated uplands. This map unit is a poorly drained phase of Waumbek; which is also mapped as wetland. This map unit contains phases of this series that are very stony, or very gravelly. This soil is mapped primarily along the lower elevations of the existing road on the western side of the site.

7.0 CONCLUSIONS AND SURVEY LIMITATIONS

Results of this soil survey conclude that this site will require major engineering techniques to overcome the limiting factors for a proposed wind power generating facility. However, with proper planning, engineering, and construction techniques, the soils are appropriate for the proposed project and are not significantly dissimilar than limitations at other wind power projects constructed in Maine. The difference at this site is the scale and proportion of the limitations. The three most significant limitations are steep slopes, bedrock, and stormwater control.

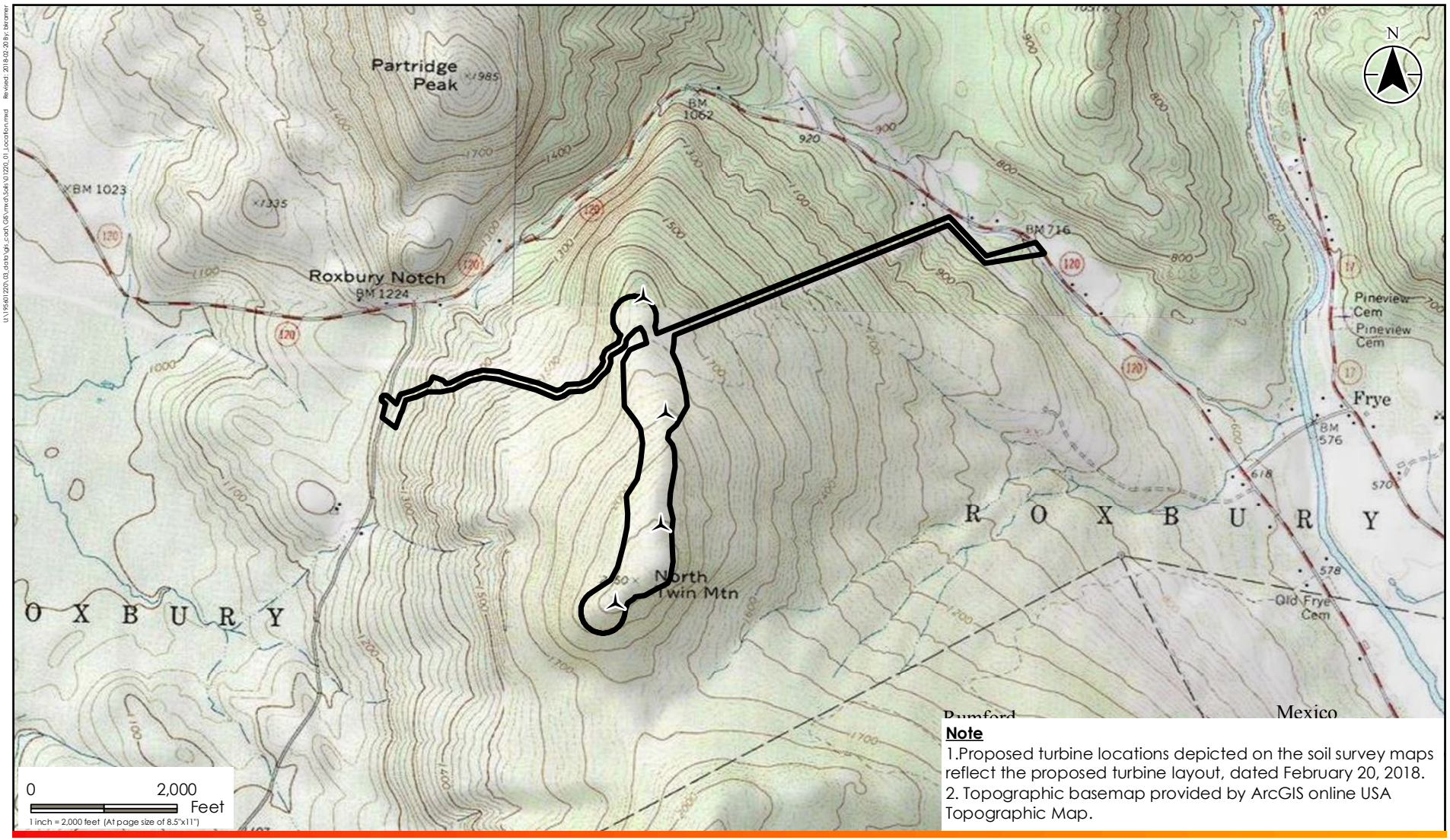
Development in or disturbance of the wetlands should be avoided and minimized, if possible, because it typically requires additional local, state, and federal oversight and permitting. The soil drainage in poorly and somewhat poorly drained soil can also be a concern for construction and long-term project use, such as rutting, freeze/thaw cycles, and other issues associated with a high-water table. The steep slopes increase the likelihood for soil erosion in areas of soil disturbance. Increasing the ridgeline impervious area can also increase stormwater surface flow quantity and

velocity. Engineering techniques to control stormwater flow and runoff during construction will be extremely important to minimize the potential for impacts to downslope resources. Long term engineering controls that can be utilized include vegetated buffers and structures that do not constrict surface and subsurface flow.

The scope of this investigation was conducted in accordance with the Class L and D soil survey standards and guidelines established by MAPSS. The conclusions and recommendations presented in this soil report are based on data obtained from on-site investigation and supplemental USDA/NRCS soil maps and information. This soil report and associated soil figures were prepared for exclusive use by Palmer Management Corporation for specific application to their proposed construction of the Roxbury Wind Project.

FIGURES

Figure 1. Site Location Map



Note

1.Proposed turbine locations depicted on the soil survey maps reflect the proposed turbine layout, dated February 20, 2018.
2. Topographic basemap provided by ArcGIS online USA Topographic Map.

195601220

Stantec

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Prepared by EMK on 2018-01-16
Review by RK on 2018-01-17

01220_01_Location.mxd

Legend

- Proposed Turbine Location
- Site Boundary

Client/Project

Palmer Management Corporation
Roxbury Wind Project
Roxbury, Maine

Figure No.

1

Title

Site Location Map

2/21/2018

Figure(s) 2-1 through 2-9. Class L Soil Survey Maps

Stantec

Legend

- Proposed Turbine Location
- Test Pit
- Auger Boring
- Rock Outcrop
- Survey Area
- Stream
- Wetland
- 2' Contour
- 10' Contour
- Stormwater Feature

Soil Map Units

- BwC - Becket-Westbury complex, 8-15% slopes (HSG C/D)
- BwD - Becket-Westbury complex, 15-35% slopes (HSG C/D)
- Ht - Human Transported Material (HSG N/A)
- LrD - Lyman-Tunbridge-Rock Outcrop complex, 15-35% slopes (HSG D)
- LrE - Lyman-Tunbridge-Rock Outcrop complex, >35% slopes (HSG D)
- LuD - Lyman-Tunbridge-Becket complex, 15-35% slopes (HSG D/C)
- Ml - Manufactured Layer (HSG N/A)
- MoC - Monadnock fine sandy loam, 8-15% slopes (HSG C)
- MpB - Monadnock, poorly drained, 3-8% slopes (HSG D)
- TpC - Tunbridge, poorly drained, 8-15% slopes (HSG D)
- TpD - Tunbridge, poorly drained, 15-35% slopes (HSG D)
- TrC - Tunbridge-Lyman-Rock Outcrop complex, 8-15% slopes (HSG D)
- TrD - Tunbridge-Lyman-Rock Outcrop complex, 15-35% slopes (HSG D)
- TrE - Tunbridge-Lyman-Rock Outcrop complex, >35% slopes (HSG D)
- WaC - Wambeck fine sandy loam, 8-15% slopes (HSG B)
- WaD - Waumbek fine sandy loam, 15-35% slopes (HSG B)
- WaE - Wambeck fine sandy loam, >35% slopes (HSG B)
- WpC - Waumbek fine sandy loam, poorly drained, 8-15% slopes (HSG D)
- WpE - Waumbek fine sandy loam, poorly drained, >35% slopes (HSG D)

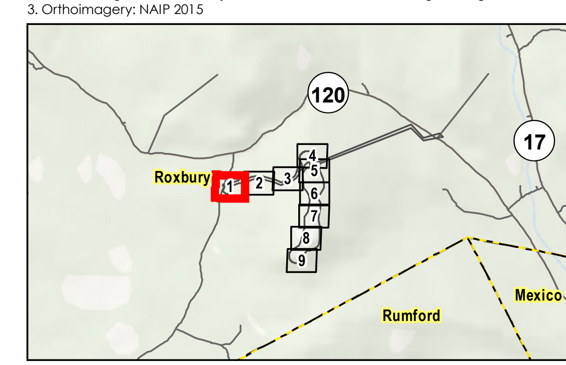
CERTIFIED SOIL SCIENTIST
Rodney D. Kelshaw
SS552
STATE OF MAINE

0 100 200 Feet

1 inch = 100 feet (At original document size of 11x17)

Notes

1. Proposed turbine locations depicted on the soil survey maps reflect the proposed turbine layout, dated February 20, 2018.
2. 2' contours shown on this plan were originally created and compiled for the former First Wind Longfellow Wind Project and obtained from SGC Engineering, LLC.
3. Orthoimagery: NAIP 2015



Project Location
Roxbury, Maine

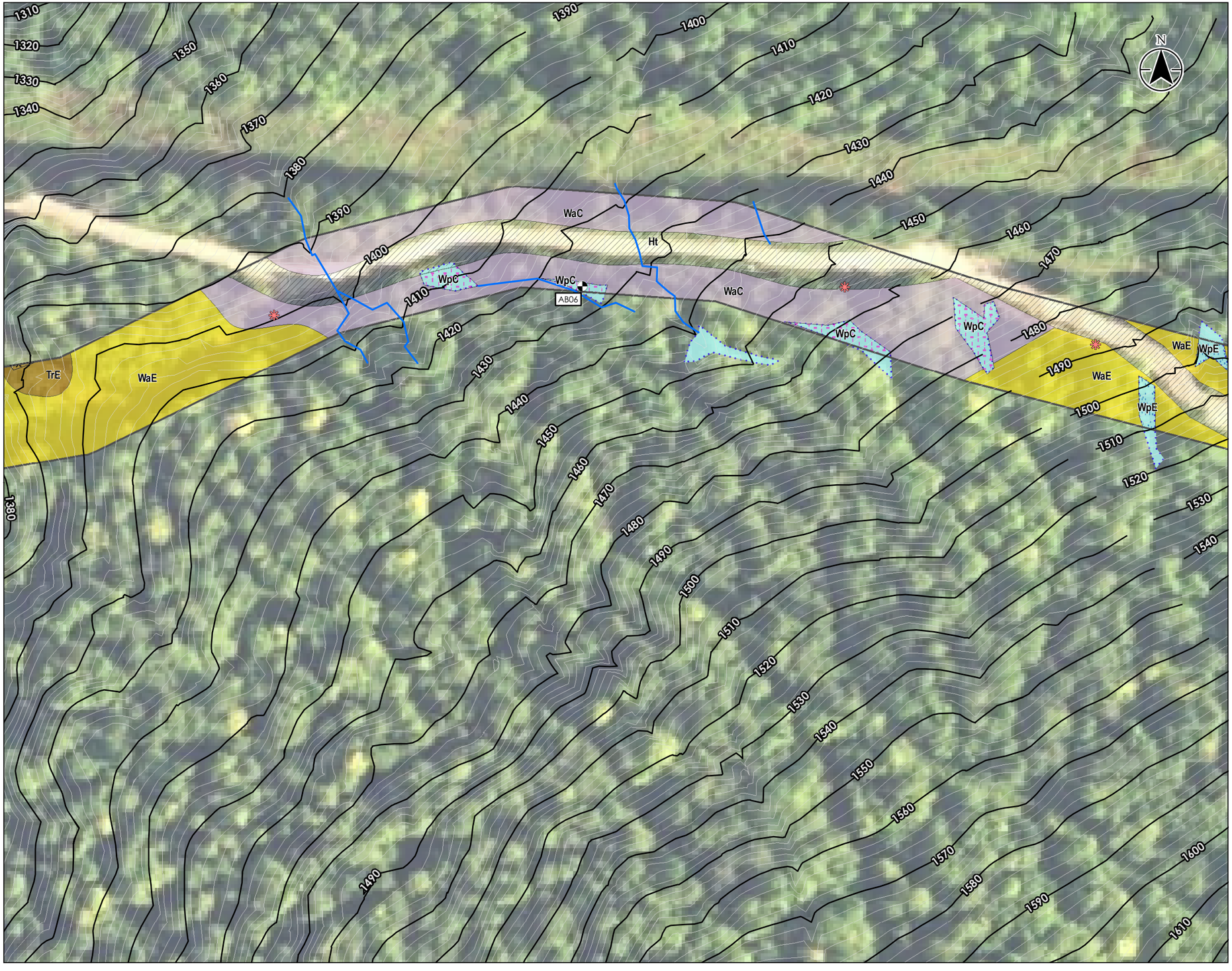
195601220
Prepared by EMK on 2018-01-16
Review by RK on 2018-01-17

Client/Project
Palmer Management Corporation
Roxbury Wind Project
Roxbury, Maine

Figure No.
2-1

Title
Class L Soil Survey Map

2/21/2018



Stantec

Legend

- Proposed Turbine Location
- Test Pit
- Auger Boring
- Rock Outcrop
- Survey Area
- Stream
- Wetland
- 2' Contour
- 10' Contour
- Stormwater Feature

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- MI - Manufactured Layer (HSG N/A)
- MoC - Monadnock fine sandy loam, 8-15% slopes (HSG C)
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CERTIFIED SOIL SCIENTIST Rodney D. Kershaw SS552 STATE OF MAINE

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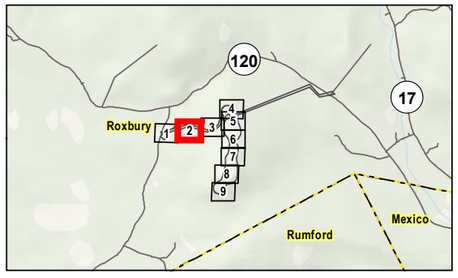
1. Proposed turbine locations depicted on the soil survey maps reflect the proposed turbine layout, dated February 20, 2018.
2. 2' contours shown on this plan were originally created and compiled for the former First Wind Longfellow Wind Project and obtained from SGC Engineering, LLC.
3. Orthoimagery: NAIP 2015



Project Location
Roxbury, Maine

195601220
Prepared by EMK on 2018-01-16
Review by RK on 2018-01-17

Client/Project
Palmer Management Corporation
Roxbury Wind Project
Roxbury, Maine

Figure No.
2-2

Title
Class L Soil Survey Map

2/21/2018

Stantec

Legend

- Proposed Turbine Location
- Test Pit
- Auger Boring
- Rock Outcrop
- Survey Area
- Stream
- Wetland
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- 10' Contour
- Stormwater Feature

CERTIFIED SOIL SCIENTIST
Rodney D. Kershaw
SS552
STATE OF MAINE

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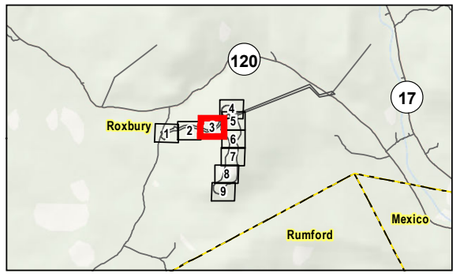

Project Location
Roxbury, Maine

195601220
Prepared by EMK on 2018-01-16
Review by RK on 2018-01-17

Client/Project
Palmer Management Corporation
Roxbury Wind Project
Roxbury, Maine

Figure No.
2-3

Title
Class L Soil Survey Map

2/21/2018

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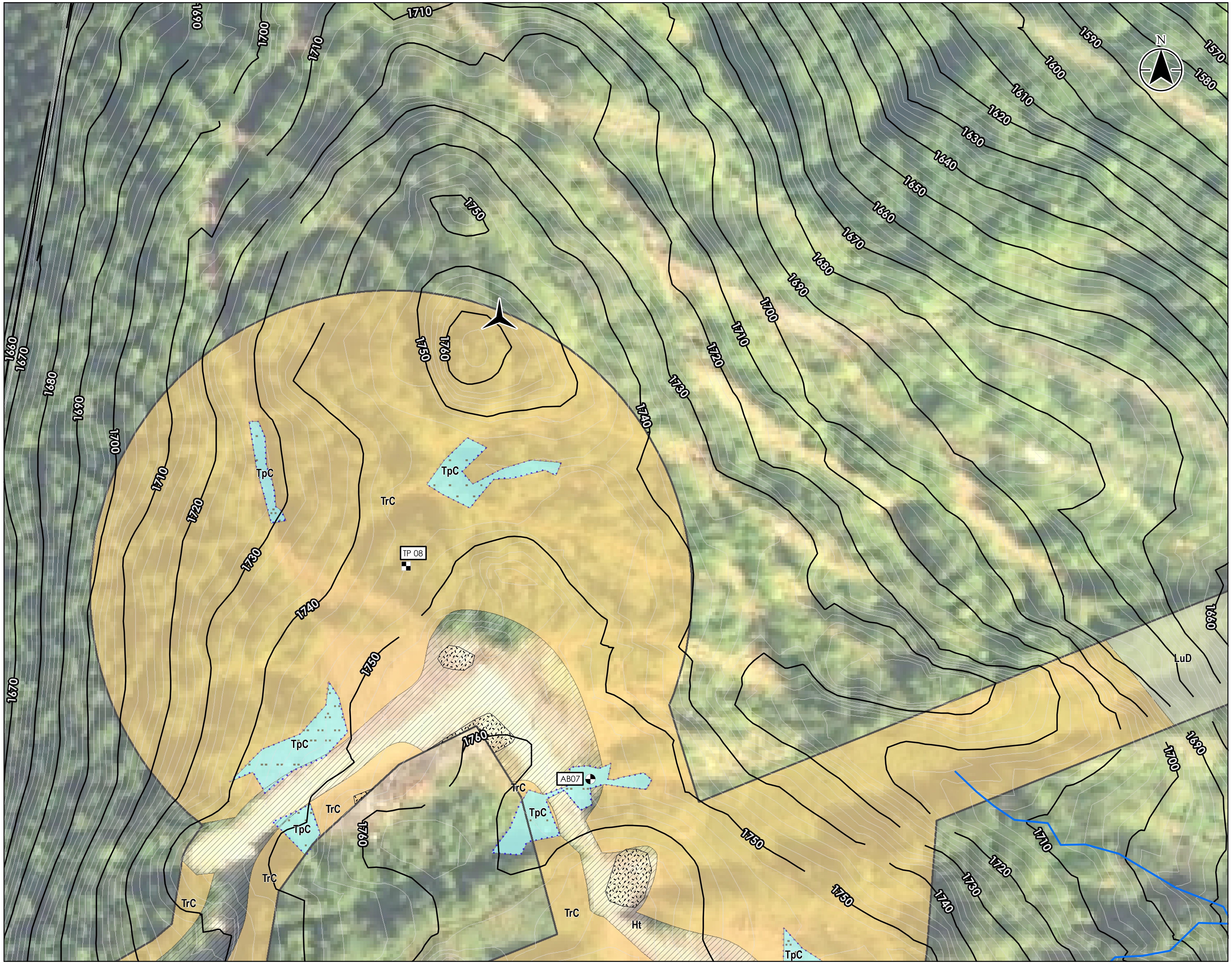

Stantec

Legend

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- Ml - Manufactured Layer (HSG N/A)
- MoC - Monadnock fine sandy loam, 8-15% slopes (HSG C)
- MpB - Monadnock, poorly drained, 3-8% slopes (HSG D)
- TpC - Tunbridge, poorly drained, 8-15% slopes (HSG D)
- TpD - Tunbridge, poorly drained, 15-35% (HSG D)
- TrC - Tunbridge-Lyman-Rock Outcrop complex, 8-15% slopes (HSG D)
- TrD - Tunbridge-Lyman-Rock Outcrop complex, 15-35% slopes (HSG D)
- TrE - Tunbridge-Lyman-Rock Outcrop complex, >35% slopes (HSG D)
- WaC - Wambeck fine sandy loam, 8-15% slopes (HSG B)
- WaD - Waumbek fine sandy loam, 15-35% slopes (HSG B)
- WaE - Wambeck fine sandy loam, >35% slopes (HSG B)
- WpC - Waumbek fine sandy loam, poorly drained, 8-15% slopes (HSG D)
- WpE - Waumbek fine sandy loam, poorly drained, >35% slopes (HSG D)

CERTIFIED SOIL SCIENTIST Rodney D. Kelshaw SS552 STATE OF MAINE

0 100 200 Feet

1 inch = 100 feet (At original document size of 11x17)

Notes

1. Proposed turbine locations depicted on the soil survey maps reflect the proposed turbine layout, dated February 20, 2018.
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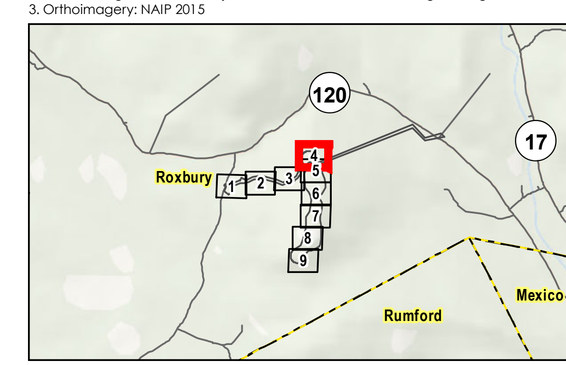
3. Orthoimagery: NAIP 2015



Project Location
Roxbury, Maine

195601220
Prepared by EMK on 2018-01-16
Review by RK on 2018-01-17

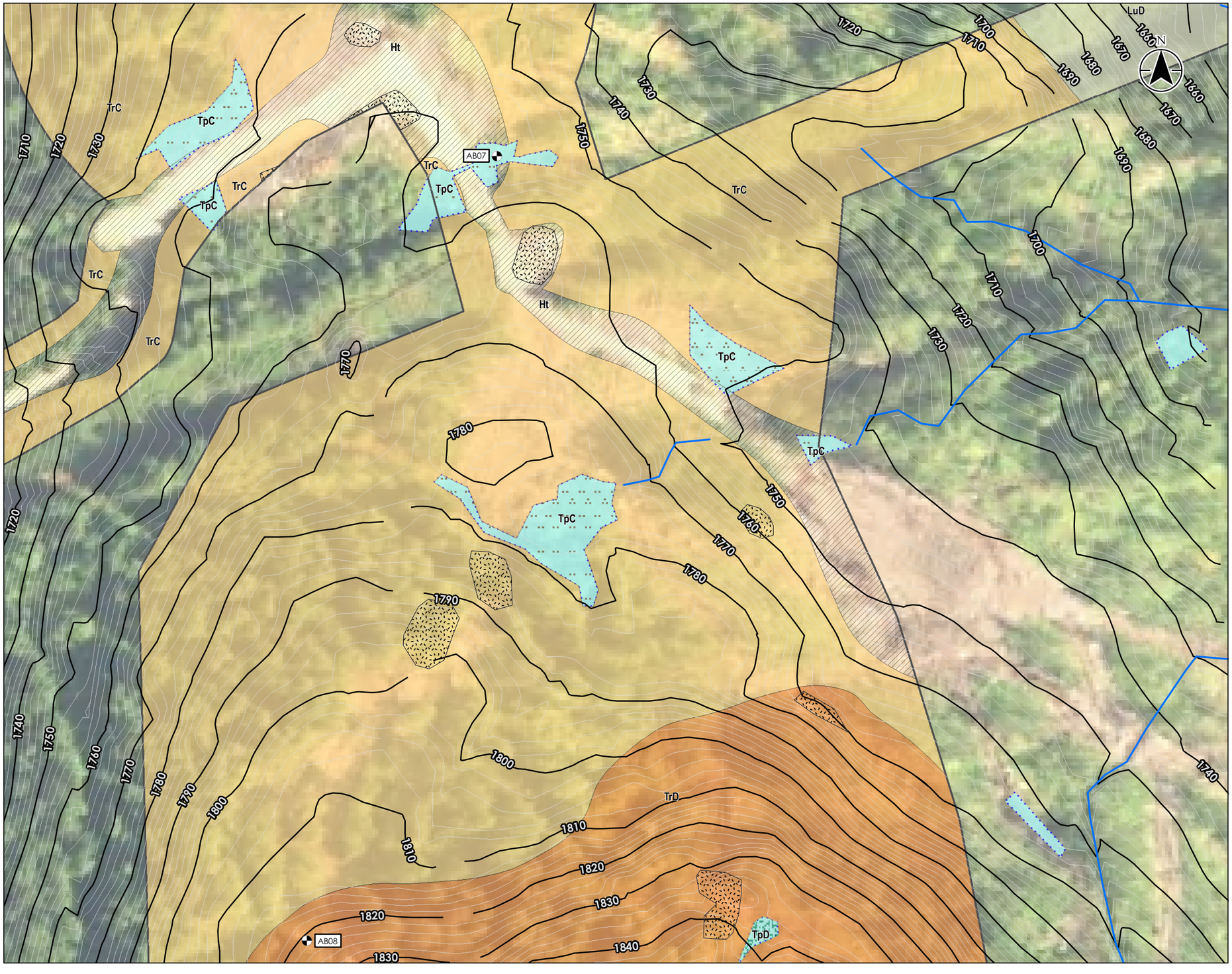
Client/Project
Palmer Management Corporation
Roxbury Wind Project
Roxbury, Maine

Figure No.
2-4

Title
Class L Soil Survey Map

2/21/2018

U:\195601220\03_data\gis_cad\GIS\mxd\Soils\01220_02_SoilSurvey_LClass.mxd Revised: 2018-02-20 By: bkramer



Stantec

Legend

- Proposed Turbine Location
- Test Pit
- Auger Boring
- Rock Outcrop
- Survey Area
- Stream
- Wetland
- 2' Contour
- 10' Contour
- Stormwater Feature

Soil Map Units

- BwC - Becket-Westbury complex, 8-15% slopes (HSG C/D)
- BwD - Becket-Westbury complex, 15-35% slopes (HSG C/D)
- Ht - Human Transported Material (HSG N/A)
- LrD - Lyman-Tunbridge-Rock Outcrop complex, 15-35% slopes (HSG D)
- LrE - Lyman-Tunbridge-Rock Outcrop complex, >35% slopes (HSG D)
- LuD - Lyman-Tunbridge-Becket complex, 15-35% slopes (HSG D/C)
- MI - Manufactured Layer (HSG N/A)
- MoC - Monadnock fine sandy loam, 8-15% slopes (HSG C)
- MpB - Monadnock, poorly drained, 3-8% slopes (HSG D)
- TpC - Tunbridge, poorly drained, 8-15% slopes (HSG D)
- TpD - Tunbridge, poorly drained, 15-35% (HSG D)
- TrC - Tunbridge-Lyman-Rock Outcrop complex, 8-15% slopes (HSG D)
- TrD - Tunbridge-Lyman-Rock Outcrop complex, 15-35% slopes (HSG D)
- TrE - Tunbridge-Lyman-Rock Outcrop complex, >35% slopes (HSG D)
- WaC - Wambeck fine sandy loam, 8-15% slopes (HSG B)
- WaD - Waumbek fine sandy loam, 15-35% slopes (HSG B)
- WaE - Wambeck fine sandy loam, >35% slopes (HSG B)
- WpC - Waumbek fine sandy loam, poorly drained, 8-15% slopes (HSG D)
- WpE - Waumbek fine sandy loam, poorly drained, >35% slopes (HSG D)

0 100 200 Feet

1 inch = 100 feet (At original document size of 11x17)

CERTIFIED SOIL SCIENTIST Rodney D. Keshaw SS552 STATE OF MAINE

Notes

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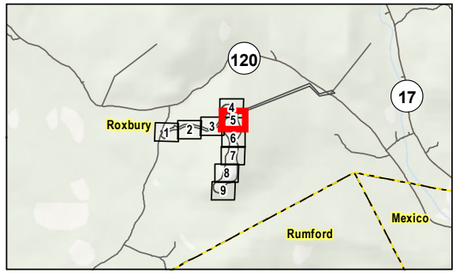
3. Orthoimagery: NAIP 2015



Project Location
Roxbury, Maine

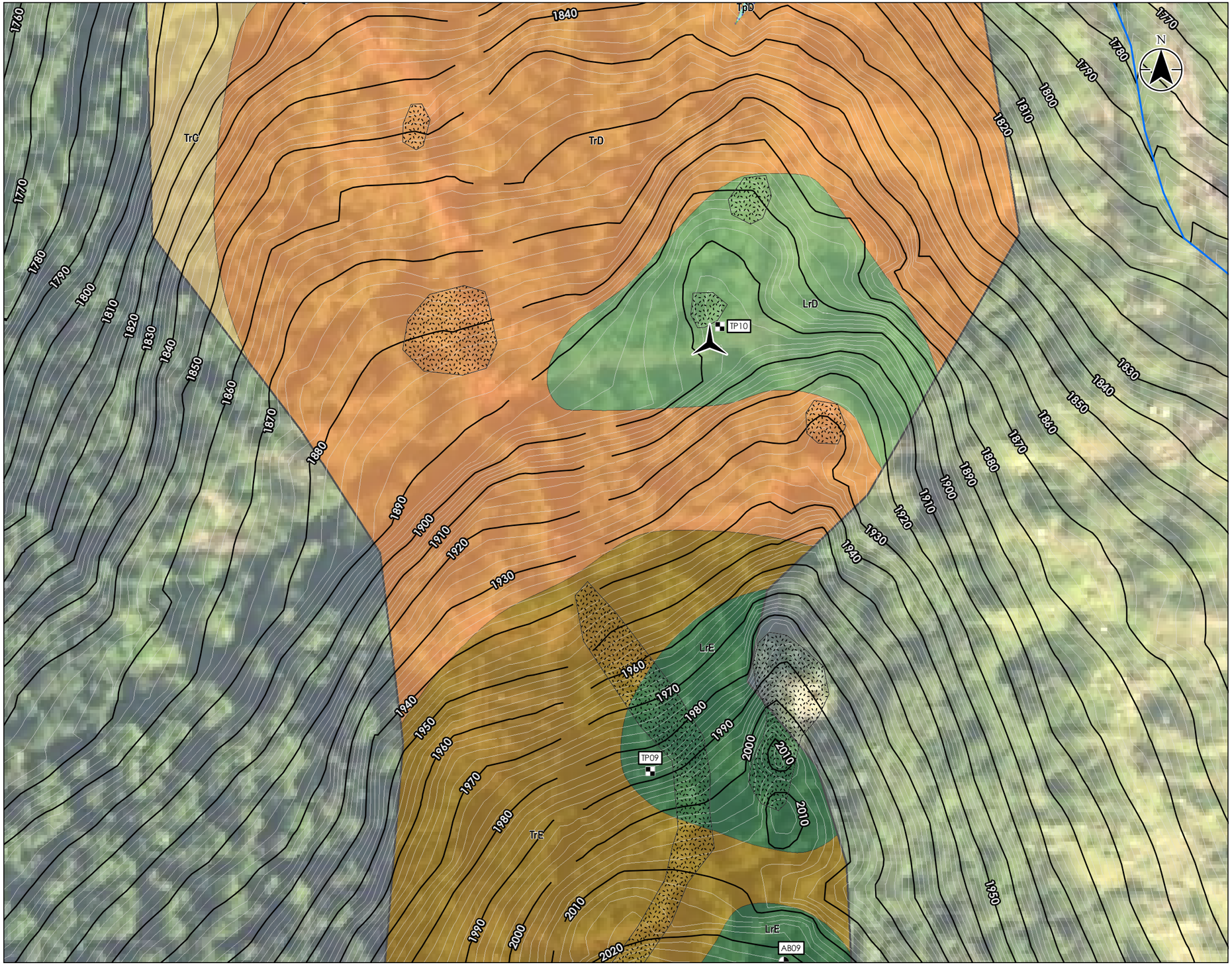
195601220
Prepared by EMK on 2018-01-16
Review by RK on 2018-01-17

Client/Project
Palmer Management Corporation
Roxbury Wind Project
Roxbury, Maine

Figure No.
2-5

Title
Class L Soil Survey Map

2/21/2018



Stantec

Legend

- Proposed Turbine Location
- Test Pit
- Auger Boring
- Rock Outcrop
- Survey Area
- Stream
- Wetland
- 2' Contour
- 10' Contour
- Stormwater Feature

Soil Map Units

- BwC - Becket-Westbury complex, 8-15% slopes (HSG C/D)
- BwD - Becket-Westbury complex, 15-35% slopes (HSG C/D)
- Ht - Human Transported Material (HSG N/A)
- LrD - Lyman-Tunbridge-Rock Outcrop complex, 15-35% slopes (HSG D)
- LrE - Lyman-Tunbridge-Rock Outcrop complex, >35% slopes (HSG D)
- LuD - Lyman-Tunbridge-Becket complex, 15-35% slopes (HSG D/C)
- MI - Manufactured Layer (HSG N/A)
- MoC - Monadnock fine sandy loam, 8-15% slopes (HSG C)
- MpB - Monadnock, poorly drained, 3-8% slopes (HSG D)
- TpC - Tunbridge, poorly drained, 8-15% slopes (HSG D)
- TpD - Tunbridge, poorly drained, 15-35% (HSG D)
- TrC - Tunbridge-Lyman-Rock Outcrop complex, 8-15% slopes (HSG D)
- TrD - Tunbridge-Lyman-Rock Outcrop complex, 15-35% slopes (HSG D)
- TrE - Tunbridge-Lyman-Rock Outcrop complex, >35% slopes (HSG D)
- WaC - Wambeck fine sandy loam, 8-15% slopes (HSG B)
- WaD - Waumbek fine sandy loam, 15-35% slopes (HSG B)
- WaE - Wambeck fine sandy loam, >35% slopes (HSG B)
- WpC - Waumbek fine sandy loam, poorly drained, 8-15% slopes (HSG D)
- WpE - Waumbek fine sandy loam, poorly drained, >35% slopes (HSG D)

CERTIFIED SOIL SCIENTIST
Rodney D. Kershaw
SS552
STATE OF MAINE

0 100 200 Feet

1 inch = 100 feet (At original document size of 11x17)

Notes

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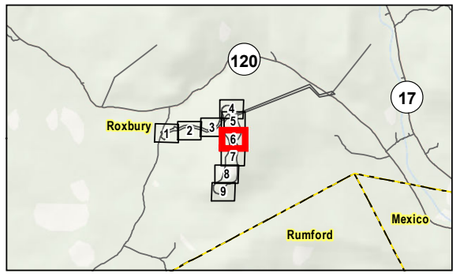


Project Location
Roxbury, Maine

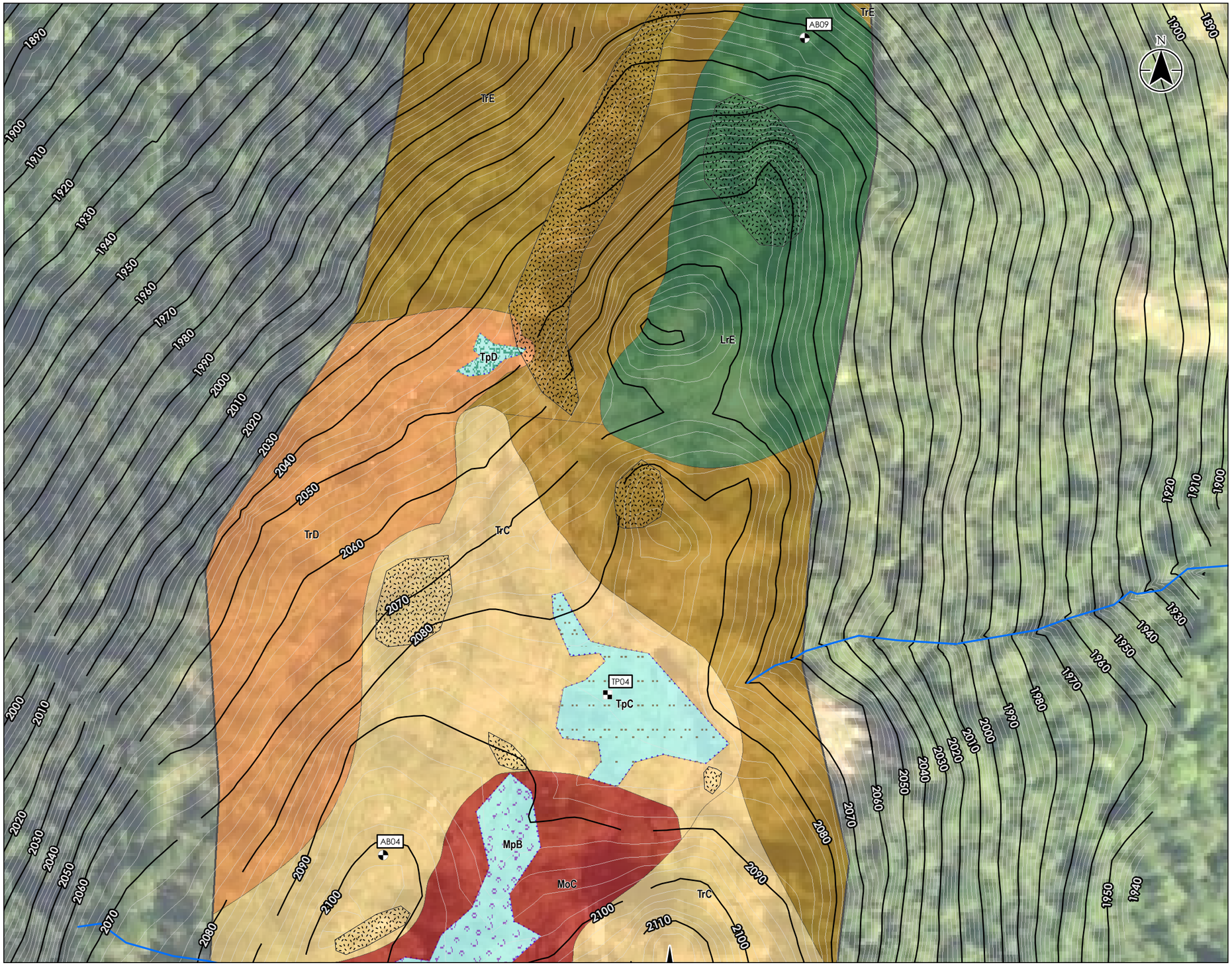
195601220
Prepared by EMK on 2018-01-16
Review by RK on 2018-01-17

Client/Project
Palmer Management Corporation
Roxbury Wind Project
Roxbury, Maine

Figure No.
2-6

Title
Class L Soil Survey Map

2/21/2018



Stantec

Legend

- Proposed Turbine Location
- Test Pit
- Auger Boring
- Rock Outcrop
- Survey Area
- Stream
- Wetland
- 2' Contour
- 10' Contour
- Stormwater Feature

Soil Map Units

- BwC - Becket-Westbury complex, 8-15% slopes (HSG C/D)
- BwD - Becket-Westbury complex, 15-35% slopes (HSG C/D)
- Ht - Human Transported Material (HSG N/A)
- LrD - Lyman-Tunbridge-Rock Outcrop complex, 15-35% slopes (HSG D)
- LrE - Lyman-Tunbridge-Rock Outcrop complex, >35% slopes (HSG D)
- LuD - Lyman-Tunbridge-Becket complex, 15-35% slopes (HSG D/C)
- Ml - Manufactured Layer (HSG N/A)
- MoC - Monadnock fine sandy loam, 8-15% slopes (HSG C)
- MpB - Monadnock, poorly drained, 3-8% slopes (HSG D)
- TpC - Tunbridge, poorly drained, 8-15% slopes (HSG D)
- TpD - Tunbridge, poorly drained, 15-35% (HSG D)
- TrC - Tunbridge-Lyman-Rock Outcrop complex, 8-15% slopes (HSG D)
- TrD - Tunbridge-Lyman-Rock Outcrop complex, 15-35% slopes (HSG D)
- TrE - Tunbridge-Lyman-Rock Outcrop complex, >35% slopes (HSG D)
- WaC - Wambeck fine sandy loam, 8-15% slopes (HSG B)
- WaD - Waumbek fine sandy loam, 15-35% slopes (HSG B)
- WaE - Wambeck fine sandy loam, >35% slopes (HSG B)
- WpC - Waumbek fine sandy loam, poorly drained, 8-15% slopes (HSG D)
- WpE - Waumbek fine sandy loam, poorly drained, >35% slopes (HSG D)

CERTIFIED SOIL SCIENTIST
Rodney D. Keshaw
SS552
STATE OF MAINE

0 100 200 Feet

1 inch = 100 feet (At original document size of 11x17)

Notes

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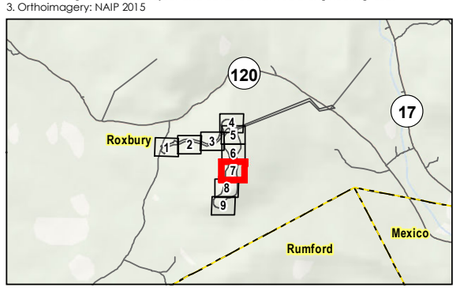


Project Location
Roxbury, Maine

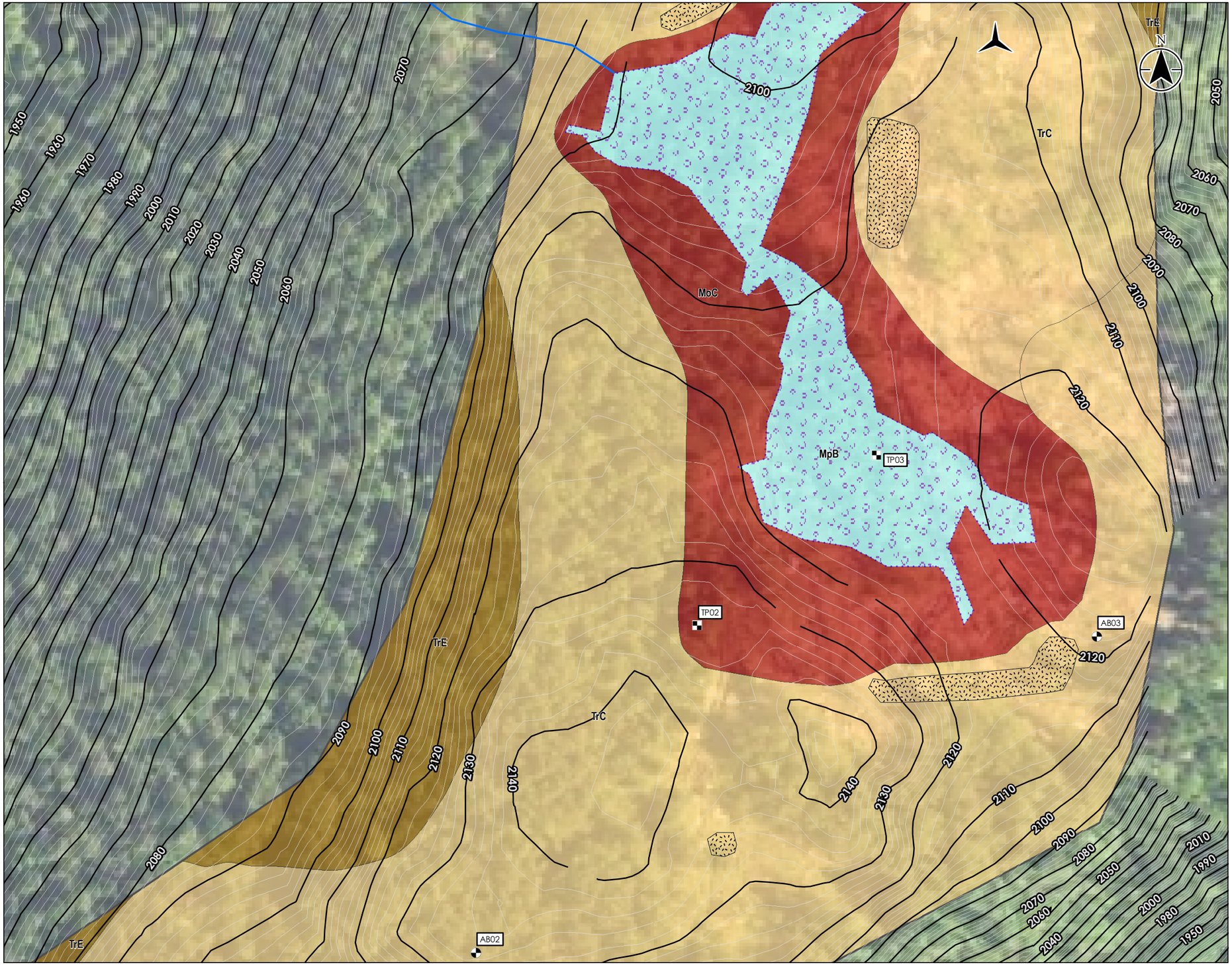
195601220
Prepared by EMK on 2018-01-16
Review by RK on 2018-01-17

Client/Project
Palmer Management Corporation
Roxbury Wind Project
Roxbury, Maine

Figure No.
2-7

Title
Class L Soil Survey Map

2/21/2018



Stantec

Legend

- Proposed Turbine Location
- Test Pit
- Auger Boring
- Rock Outcrop
- Survey Area
- Stream
- Wetland
- 2' Contour
- 10' Contour
- Stormwater Feature

Soil Map Units

- BwC - Becket-Westbury complex, 8-15% slopes (HSG C/D)
- BwD - Becket-Westbury complex, 15-35% slopes (HSG C/D)
- Ht - Human Transported Material (HSG N/A)
- LrD - Lyman-Tunbridge-Rock Outcrop complex, 15-35% slopes (HSG D)
- LrE - Lyman-Tunbridge-Rock Outcrop complex, >35% slopes (HSG D)
- LuD - Lyman-Tunbridge-Becket complex, 15-35% slopes (HSG D/C)
- MI - Manufactured Layer (HSG N/A)
- MoC - Monadnock fine sandy loam, 8-15% slopes (HSG C)
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- TpD - Tunbridge, poorly drained, 15-35% (HSG D)
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- TrD - Tunbridge-Lyman-Rock Outcrop complex, 15-35% slopes (HSG D)
- TrE - Tunbridge-Lyman-Rock Outcrop complex, >35% slopes (HSG D)
- WaC - Wambeck fine sandy loam, 8-15% slopes (HSG B)
- WaD - Waumbek fine sandy loam, 15-35% slopes (HSG B)
- WaE - Wambeck fine sandy loam, >35% slopes (HSG B)
- WpC - Waumbek fine sandy loam, poorly drained, 8-15% slopes (HSG D)
- WpE - Waumbek fine sandy loam, poorly drained, >35% slopes (HSG D)

0 100 200 Feet

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CERTIFIED SOIL SCIENTIST Rodney D. Kershaw SS552 STATE OF MAINE

Notes

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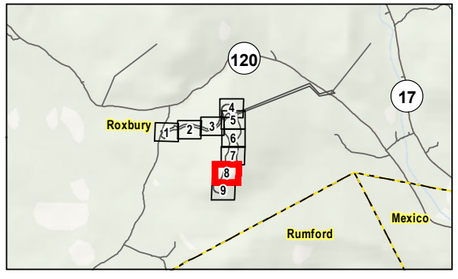


Project Location
Roxbury, Maine

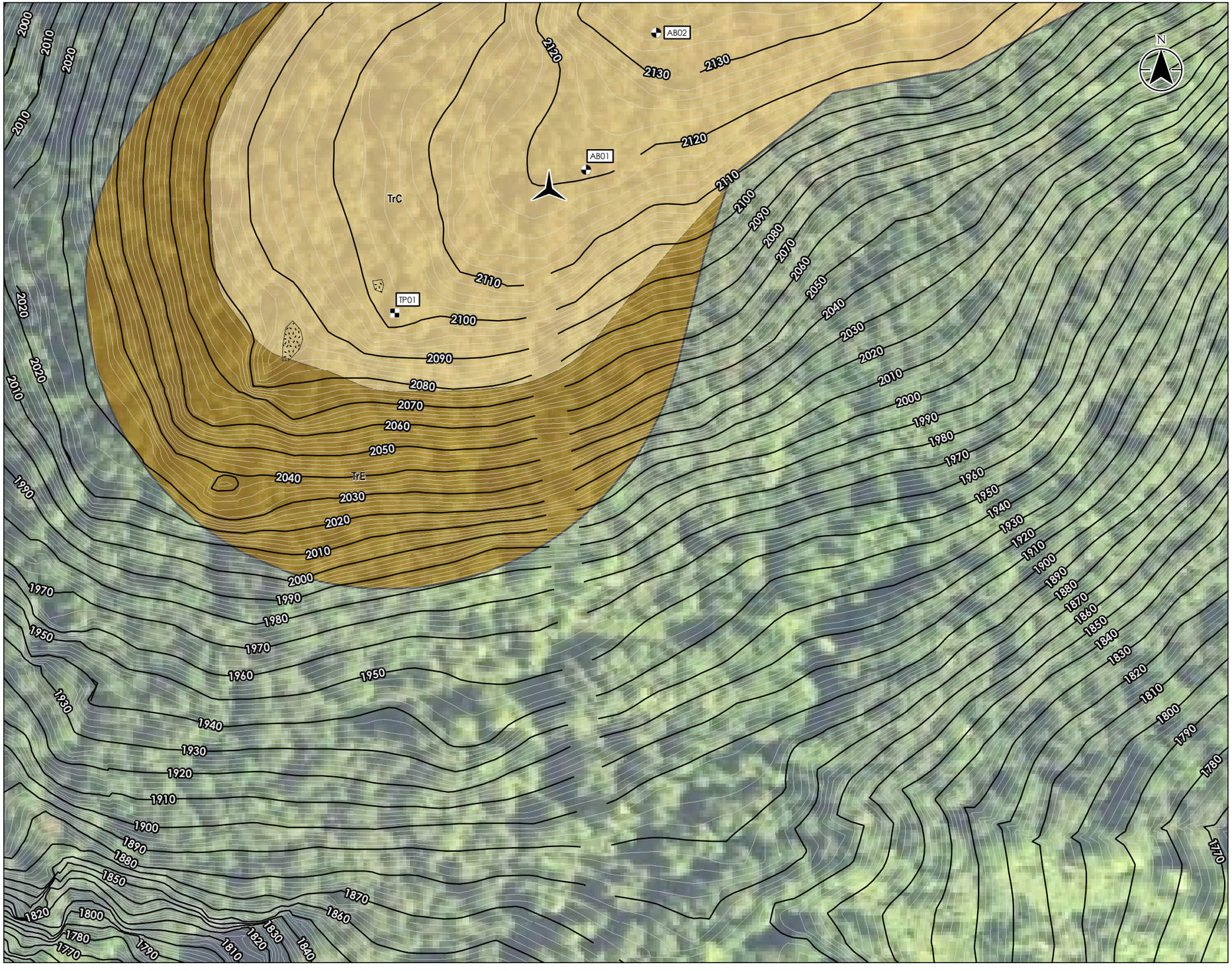
195601220
Prepared by EMK on 2018-01-16
Review by RK on 2018-01-17

Client/Project
Palmer Management Corporation
Roxbury Wind Project
Roxbury, Maine

Figure No.
2-8

Title
Class L Soil Survey Map

2/21/2018



Stantec

Legend

- Proposed Turbine Location
- Test Pit
- Auger Boring
- Rock Outcrop
- Survey Area
- Stream
- Wetland
- 2' Contour
- 10' Contour
- Stormwater Feature

Soil Map Units

- BwC - Becket-Westbury complex, 8-15% slopes (HSG C/D)
- BwD - Becket-Westbury complex, 15-35% slopes (HSG C/D)
- Ht - Human Transported Material (HSG N/A)
- LrD - Lyman-Tunbridge-Rock Outcrop complex, 15-35% slopes (HSG D)
- LrE - Lyman-Tunbridge-Rock Outcrop complex, >35% slopes (HSG D)
- LuD - Lyman-Tunbridge-Becket complex, 15-35% slopes (HSG D/C)
- MI - Manufactured Layer (HSG N/A)
- MoC - Monadnock fine sandy loam, 8-15% slopes (HSG C)
- MpB - Monadnock, poorly drained, 3-8% slopes (HSG D)
- TpC - Tunbridge, poorly drained, 8-15% slopes (HSG D)
- TpD - Tunbridge, poorly drained, 15-35% (HSG D)
- TrC - Tunbridge-Lyman-Rock Outcrop complex, 8-15% slopes (HSG D)
- TrD - Tunbridge-Lyman-Rock Outcrop complex, 15-35% slopes (HSG D)
- TrE - Tunbridge-Lyman-Rock Outcrop complex, >35% slopes (HSG D)
- WaC - Wambeck fine sandy loam, 8-15% slopes (HSG B)
- WaD - Waumbek fine sandy loam, 15-35% slopes (HSG B)
- WaE - Wambeck fine sandy loam, >35% slopes (HSG B)
- WpC - Waumbek fine sandy loam, poorly drained, 8-15% slopes (HSG D)
- WpE - Waumbek fine sandy loam, poorly drained, >35% slopes (HSG D)

0 100 200 Feet

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CERTIFIED SOIL SCIENTIST
Rodney D. Keshaw
SS552
STATE OF MAINE

Notes

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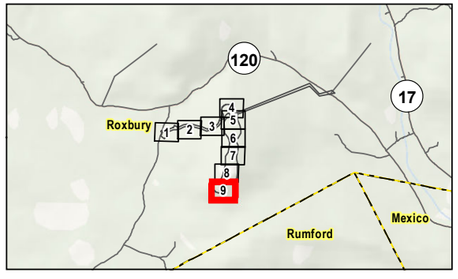
3. Orthoimagery: NAIP 2015



Project Location
Roxbury, Maine

195601220
Prepared by EMK on 2018-01-16
Review by RK on 2018-01-17

Client/Project
Palmer Management Corporation
Roxbury Wind Project
Roxbury, Maine

Figure No.
2-9

Title
Class L Soil Survey Map

2/21/2018

Figure 3. Class D Soil Survey Map

Stantec

Legend

- Proposed Turbine Location
- Test Pit
- Auger Boring
- Rock Outcrop
- Survey Area
- Stream
- Wetland
- USGS 20' Contour

Soil Map Units

- BwC - Becket-Westbury complex, 8-15% slopes (HSG C/D)
- BwD - Becket-Westbury complex, 15-35% slopes (HSG C/D)
- Ht - Human Transported Material (HSG N/A)
- LrD - Lyman-Tunbridge-Rock Outcrop complex, 15-35% slopes (HSG D)
- LrE - Lyman-Tunbridge-Rock Outcrop complex, >35% slopes (HSG D)
- LuD - Lyman-Tunbridge-Becket complex, 15-35% slopes (HSG D/C)
- TpC - Tunbridge, poorly drained, 8-15% slopes (HSG D)
- TpD - Tunbridge, poorly drained, 15-35% (HSG D)
- TrC - Tunbridge-Lyman-Rock Outcrop complex, 8-15% slopes (HSG D)
- TrD - Tunbridge-Lyman-Rock Outcrop complex, 15-35% slopes (HSG D)
- TrE - Tunbridge-Lyman-Rock Outcrop complex, >35% slopes (HSG D)

CERTIFIED SOIL SCIENTIST
Rodney D. Kelshaw
SS552
STATE OF MAINE

0 500 1,000 Feet

1 inch = 500 feet (At original document size of 11x17)

Notes

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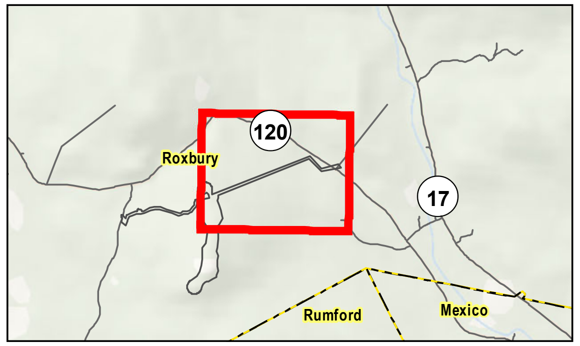
2. Coordinate System: NAD 1983 StatePlane Maine West FIPS 1802 Feet
3. Orthoimagery: NAIP 2015



Project Location
Roxbury, Maine

195601220
Prepared by EMK on 2018-01-16
Review by RK on 2018-01-17

Client/Project
Palmer Management Corporation
Roxbury Wind Project
Roxbury, Maine

Figure No.
3

Title
Class D Soil Survey Map

2/21/2018

Appendix A FORM E: SOIL CONDITIONS SUMMARY TABLE

FORM E 2/02

SOIL CONDITIONS SUMMARY TABLE

SUMMARY LOG OF SUBSURFACE EXPLORATIONS AT PROJECT SITES

Project Name:	Applicant Name:	Project Location (municipality):
Roxbury Wind Project	Palmer Management Corporation	Roxbury

Lot No.	Exploration Symbol (TP 1, B 2, etc.)	🖩 or 🖮 if at SSWD Field	Description of subsurface materials by: ● Soil profile/condition (if by S.E.), ● Soil series name (if by C.S.S.), or by ● Geologic unit (if by C.G.)	Depths to (check one): ☑ inches ☐ cm — Mottling (seasonal watertable)	Bedrock	Firm or Restrictive Layer	Limit of Exploration	Ground Surface Slope (%)
	TP 1	☐	Tunbridge stfsl, mwdr	25	29	N.O.	29	3-8
	TP 2	☐	Monadnok sl, pdr	0	N.O.	24	48	3-8
	TP 3	☐	Bucksport muck	0	N.O.	N.O.	48	3-8
	TP 4	☐	Tunbridge, pdr	0	39	N.O.	39	3-8
	TP 5	☐	Waumbek fsl	23	N.O.	34	70	8-15
	TP 6	☐	Waumbek fsl	23	N.O.	34	60	15-35
	TP 7	☐	Waumbek ls	23	N.O.	29	60	15-35
	TP 8	☐	Tunbridge sl, swpdr	10	22	N.O.	22	8-15
	TP 9	☐	Abram fsl	N.O.	5	N.O.	5	15-35
	TP 10	☐	Tunbridge fsl	N.O.	29	N.O.	29	8-15
	TP 11	☐	Becket excobfsl, pdr	0	N.O.	20	26	8-15
		☐						
	AB 1	☐	Tunbridge fsl	N.O.	21	N.O.	21	3-8
	AB 2	☐	Tunbridge fsl	N.O.	24	N.O.	24	3-8
	AB 3	☐	Tunbridge fsl	N.O.	29	N.O.	29	8-15
	AB 4	☐	Abram fsl	N.O.	4	N.O.	4	8-15
	AB 5	☐	Waumbek vstsl	10	N.O.	18	18	15-35
	AB 6	☐	Waumbek ls, pdr	7	24	N.O.	24	8-15
	AB 7	☐	Tunbridge ls, pdr	0	24	N.O.	24	8-15
	AB 8	☐	Lyman fsl	N.O.	17	N.O.	17	15-35
	AB 9	☐	Abram fsl	N.O.	5	N.O.	5	15-35
		☐						
		☐						
		☐						
		☐						
		☐						
		☐						
		☐						
		☐	N.O. = Not Observed					
		☐						
		☐						

INVESTIGATOR INFORMATION AND SIGNATURE

Signature:	Date: 2018-02-08
Name Printed/typed: Rodney Kelshaw	Cert/Lic/Reg. # 552

Title: ☑ Licensed Site Evaluator ☑ Certified Soil Scientist ☐ Certified Geologist ☐ Other:

CERTIFIED SOIL SCIENTIST Rodney D. Kelshaw SS552 STATE OF MAINE affix professional seal

DEP Form E Rev. 9/01

Appendix B FORM F: TEST PIT/AUGER BORING LOGS

FORM F 2/02

SOIL PROFILE / CLASSIFICATION INFORMATION

DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT PROJECT SITES

Project Name:	Applicant Name:	Project Location (municipality):
Roxbury Wind Project	Palmer Management Corporation	Roxbury

Exploration Symbol: TP01 ☒ Test Pit ☐ Boring

1 " Organic horizon thickness Ground surface elev. 2100

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–6	fsl		black / reddish gray	
6–12	cobfsl	VERY FRIABLE	very dusky red	NOT OBSERVED
12–18	fsl		dark reddish brown	
18–24	sl			
24–30			brown	C,2,F
30–36	BEDROCK			
36–42				
42–48				

soil data by S.E.	Soil Profile	Classification Condition	Slope Percent	Limiting Factor Depth	☐ Groundwater ☐ Restrictive Layer ☐ Bedrock
soil data by S.S.	Soil series/phase name: Tunbridge	☐ Hydric ☒ Non-hydric			Hydrologic Soil Group: D

Exploration Symbol: TP02 ☒ Test Pit ☐ Boring

3 " Organic horizon thickness Ground surface elev. 2140

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–6	cobfsl	VERY FRIABLE	brown	ORGANIC STAINING
6–12				
12–18	sl		light olive brown	C,2,P
18–24	cobsl		olive	
24–30				
30–36				
36–42				
42–48				

soil data by S.E.	Soil Profile	Classification Condition	Slope Percent	Limiting Factor Depth	☐ Groundwater ☐ Restrictive Layer ☐ Bedrock
soil data by S.S.	Soil series/phase name: Monadnock, poorly drained	☒ Hydric ☐ Non-hydric			Hydrologic Soil Group: D

Exploration Symbol: TP04 ☒ Test Pit ☐ Boring

12 " Organic horizon thickness Ground surface elev. 2100

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–6	vcobsl	FRIABLE	light olive gray	C,2,d
6–12				
12–18	fsl		light brownish gray	
18–24				
24–30				
30–36	BEDROCK			
36–42				
42–48				

soil data by S.E.	Soil Profile	Classification Condition	Slope Percent	Limiting Factor Depth	☐ Groundwater ☐ Restrictive Layer ☐ Bedrock
soil data by S.S.	Soil series/phase name: Tunbridge, poorly drained	☒ Hydric ☐ Non-hydric			Hydrologic Soil Group: D

Exploration Symbol: TP09 ☒ Test Pit ☐ Boring

6 " Organic horizon thickness Ground surface elev. 1960

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–6	fsl	VERY FRIABLE	reddish gray / dark rd. brown	NOT OBSERVED
6–12				
12–18	BEDROCK			
18–24				
24–30				
30–36				
36–42				
42–48				

soil data by S.E.	Soil Profile	Classification Condition	Slope Percent	Limiting Factor Depth	☐ Groundwater ☐ Restrictive Layer ☐ Bedrock
soil data by S.S.	Soil series/phase name: Abram	☐ Hydric ☒ Non-hydric			Hydrologic Soil Group: D

INVESTIGATOR INFORMATION AND SIGNATURE

Signature:	Date: 2018-02-08
Name Printed/typed: Rodney D Kelshaw	Cert/Lic/Reg. # CSS 552

Title: ☒ Licensed Site Evaluator ☒ Certified Soil Scientist ☐ Certified Geologist ☐ Other:

Rodney D. Kelshaw SS552 STATE OF MAINE CERTIFIED SOIL SCIENTIST affix professional seal

FORM F 2/02

SOIL PROFILE / CLASSIFICATION INFORMATION

DETAILED DESCRIPTION OF SUBSURFACE CONDITIONS AT PROJECT SITES

Project Name:	Applicant Name:	Project Location (municipality):
ROXBURY WIND PROJECT	PALMER MANAGMENT CORPORATION	Roxbury

Exploration Symbol: TP 10 ☒ Test Pit ☐ Boring

3 " Organic horizon thickness Ground surface elev. 1930

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–3	fsl	VERY FRIABLE	weak red	NOT OBSERVED
3–6			grayish brown	
6–13			dark reddish brown	
13–22			dark brown	
22–30			dark yellowish brown	
30–48	BEDROCK			

soil data by S.E.	Soil Classification: ___ Profile ___ Condition	Slope: ___ Percent	Limiting Factor: ___ " Depth	☐ Groundwater ☐ Restrictive Layer ☐ Bedrock
soil data by S.S.	Soil series/phase name: TUNBRIDGE	☐ Hydric ☒ Non-hydric	Hydrologic Soil Group: D	

Exploration Symbol: TP05 ☒ Test Pit ☐ Boring

1 " Organic horizon thickness Ground surface elev. 1260

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–3	fsl	VERY FRIABLE	brown	NOT OBSERVED
3–15			yellowish red	
15–18	Cob fsl	FRIABLE	yellowish brown	
18–24	Cob fsl		light olive brown	
24–36	fsl		olive gray	c, 2, f
36–48	vcobls			

70+"

soil data by S.E.	Soil Classification: ___ Profile ___ Condition	Slope: ___ Percent	Limiting Factor: ___ " Depth	☐ Groundwater ☐ Restrictive Layer ☐ Bedrock
soil data by S.S.	Soil series/phase name: WAUMBEK	☐ Hydric ☒ Non-hydric	Hydrologic Soil Group: B	

Exploration Symbol: AB06 ☐ Test Pit ☒ Boring

0 " Organic horizon thickness Ground surface elev. 1430

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–2	ls		brown	NOT OBSERVED
2–9			black	
9–12	sl	VERY FRIABLE	brown	c, 2, d
12–25	ls		olive	m, 2, d
25–48		LOI	24"	

soil data by S.E.	Soil Classification: ___ Profile ___ Condition	Slope: ___ Percent	Limiting Factor: ___ " Depth	☐ Groundwater ☐ Restrictive Layer ☐ Bedrock
soil data by S.S.	Soil series/phase name: WAUMBEK, poorly drained	☒ Hydric ☐ Non-hydric	Hydrologic Soil Group: D	

Exploration Symbol: ______ ☐ Test Pit ☐ Boring

____ " Organic horizon thickness Ground surface elev. ______

Depth below mineral soil surface (inches)	Texture	Consistency	Color	Mottling
0–48				

soil data by S.E.	Soil Classification: ___ Profile ___ Condition	Slope: ___ Percent	Limiting Factor: ___ " Depth	☐ Groundwater ☐ Restrictive Layer ☐ Bedrock
soil data by S.S.	Soil series/phase name:	☐ Hydric ☐ Non-hydric	Hydrologic Soil Group:	

INVESTIGATOR INFORMATION AND SIGNATURE

Signature: [illegible]	Date: 2018-02-08
Name Printed/typed: RODNEY D. KELSHAW	Cert/Lic/Reg. # CSS 552
Title: ☒ Licensed Site Evaluator ☐ Certified Geologist	☒ Certified Soil Scientist ☐ Other:

CERTIFIED SOIL SCIENTIST
Rodney D. Kelshaw
SS552
STATE OF MAINE

affix professional seal

Appendix C SOIL SURVEY TABLE

Map Unit Symbol	Map Unit Name	Hydrologic Soil Group
BwC	Becket-Westbury complex, 8-15% slopes	C/D
BwD	Becket-Westbury complex, 15-35% slopes	C/D
Ht	Human Transported Material	N/A
LrD	Lyman-Tunbridge-Rock Outcrop complex, 15-35% slopes	D
LrE	Lyman-Tunbridge-Rock Outcrop complex, >35% slopes	D
LuD	Lyman-Tunbridge-Becket complex, 15-35% slopes	D/C
Ml	Manufactured Layer	N/A
MoC	Monadnock fine sandy loam, 8-15% slopes	C
MpB	Monadnock, poorly drained, 3-8% slopes	D
TpC	Tunbridge, poorly drained, 8-15% slopes	D
TpD	Tunbridge, poorly drained, 15-35% slopes	D
TrC	Tunbridge-Lyman-Rock Outcrop complex, 8-15% slopes	D
TrD	Tunbridge-Lyman-Rock Outcrop complex, 15-35% slopes	D
TrE	Tunbridge-Lyman-Rock Outcrop complex, >35% slopes	D
WaC	Waumbek fine sandy loam, 8-15% slopes	B
WaD	Waumbek fine sandy loam, 15-35% slopes	B
WaE	Waumbek fine sandy loam, >35% slopes	B
WpC	Waumbek fine sandy loam, poorly drained, 8-15% slopes	D
WpE	Waumbek fine sandy loam, poorly drained, >35% slopes	D

Appendix D MAPSS STANDARDS FOR SOIL SURVEYS

A Class L Soil Survey (for Linear Projects)

This standard is designed to provide the minimum soil information necessary to allow for the design and construction of long but narrow projects with little or no adjacent development. Class L map units shall be made on the basis of parent material, slope, soil texture, soil depth to dense till or bedrock and soil drainage at the Class A High Intensity map unit size.

1. Map units will not contain dissimilar, limiting, individual inclusions larger than 1/8 acre. Dissimilar, limiting inclusions may total more than 1/8 acre per map unit delineation, in the aggregate, if not contiguous.
2. Scale of 1 inch equals 100 feet or larger (e.g. 1" = 50')
3. Ground control – base line and test pits for which detailed data are recorded are located to sub-meter accuracy under the direction of a qualified professional.
4. Base map – with two-foot contour lines.

A Class D (Medium Intensity) Soil Survey

1. Map units may contain dissimilar, limiting, individual inclusions larger than five-acres provided that each dissimilar, limiting inclusion is smaller than the minimum map unit size utilized. Dissimilar, limiting inclusions may total more than 1/8 acre per map unit delineation, in the aggregate, if not contiguous.
2. Scale of 1 inch equals 2,000 feet or larger (e.g. 1" = 1,320')
3. Ground control – as determined by the mapper.
4. Base map – as determined by the mapper.

Appendix E CLASS L SOIL MAP UNIT DESCRIPTIONS

SOIL SURVEY REPORT

February 21, 2018

Map Unit: **Lyman-Tunbridge-Rock outcrop complex**
Classification: Lyman: Loamy, isotic, frigid Lithic Haplorthods
Tunbridge: Coarse-loamy, isotic, frigid Typic Haplorthods
Map Unit Symbol: LrD, LrE

SETTING
Parent Material: Loamy supraglacial till
Landform: Glaciated uplands
Position in Landscape: Ridge summits and shoulders
Slope Gradient Range: (D) 15-35%, (E) >35%

COMPOSITION AND SOIL CHARACTERISTICS
Drainage Class: Lyman: Somewhat excessively drained
Tunbridge: Well drained
Depth to Water Table: Lyman: < 20" to bedrock with no water table
Tunbridge: 20 to <40" to bedrock with no water table

Typical Profile Description:
Lyman:
0 – 2" Hemic
2 – 4" Very dusky red, fine sandy loam, sbk, VFR
4 – 7" Grayish brown, fine sandy loam, sbk, VFR
7 – 13" Dark reddish brown, fine sandy loam, sbk, VFR
13 – 17" Dark brown, fine sandy loam, sbk, VFR
17" Bedrock

Tunbridge:
0 – 3" Hemic
3 – 5" Very dusky red, fine sandy loam, sbk, VFR
5 – 7" Grayish brown, fine sandy loam, sbk, VFR
7 – 13" Dark reddish brown, fine sandy loam, sbk, VFR
13 – 23" Dark brown, fine sandy loam, sbk, VFR
23 – 32" Dark yellowish brown, fine sandy loam, sbk, VFR
32" Bedrock

Hydrologic Group: D
Soil Erosion K Factor: 0.37
Potential for Frost Action: Moderate
Saturated Hydraulic Conductivity: Moderately High
Depth to Bedrock: 0 to <40"
Hazard to Flooding: None

INCLUSIONS (within mapping unit)
Similar: Abram
Dissimilar: None Observed

USE AND MANAGEMENT

On this site these soils are located on ridge summits and shoulders with some of the steepest slopes. The transition from exposed bedrock outcrops to moderately deep soil is rapid and the pattern complex; with the dominant depth to bedrock being shallow. This map unit occupies only a small portion of the site and the locations of the map units are avoidable for project components such as roads and turbine pads. If construction is proposed in these areas then blasting will likely be required; however, the blast rock remnants typically create high value road building materials since it is resistant to erosion and alteration from large vehicle traffic. These soils are susceptible to erosion so disturbance should be minimized by the use of erosion control devices and sediment controls should be installed downslope of these areas prior to work to avoid off-site sedimentation.

SOIL SURVEY REPORT

February 21, 2018

Map Unit: **Monadnock, fine sandy loam**
Classification: Coarse-loamy over sandy or sandy-skeletal, isotic over mixed, frigid Typic Haplorthods
Map Unit Symbol: MoC

SETTING
Parent Material: Loamy over sandy melt-out till
Landform: Glaciated uplands
Position in Landscape: Pockets on ridge summits
Slope Gradient Range: (C) 8-15%

COMPOSITION AND SOIL CHARACTERISTICS
Drainage Class: Well drained
Depth to Water Table: >40”

Typical Profile Description:
0 – 10” Very dark red, sandy loam, sbk, VFR
10 – 20” Dark reddish brown, sandy loam, sbk, VFR
20 – 48+” Brown, Coarse loamy sand, sbk, FR

Hydrologic Group: C
Soil Erosion K Factor: 0.32
Potential for Frost Action: Moderate
Saturated Hydraulic Conductivity: High
Depth to Bedrock: >40”
Hazard to Flooding: None

INCLUSIONS (within mapping unit)
Similar: Monadnock moderately well and somewhat poorly drained
Dissimilar: Monadnock poorly drained, Lyman, Tunbridge

USE AND MANAGEMENT

This map unit is located in a large bench on the main ridgeline. It is composed of deeper soil within the shallower Tunbridge-Lyman-Rock outcrop complex. The depth of this soil reduces the potential for blasting for typical road construction. Slopes are less steep in this map unit so the potential for erosion is reduced, however the map unit encompasses some wetland areas so construction activities should use erosion control devices and sediment controls should be installed prior to work to avoid erosion and sedimentation of wetlands and other adjacent resources. Due to the high rate of timber harvesting in the area the site contains many areas that are disturbed from use of large scale timber harvesting equipment. These roads and ruts intercept surface and subsurface runoff which is then concentrated in small, discrete areas that hold water for extended periods and function similar to wetlands, although do meet the parameters to be mapped as such. These small inclusions could pose issues for construction activities due to the high water table.

SOIL SURVEY REPORT

February 21, 2018

Map Unit: **Monadnock, poorly drained**
Classification: Coarse-loamy over sandy or sandy-skeletal, isotic over mixed, frigid Typic Endoaquods
Map Unit Symbol: MpB

SETTING
Parent Material: Loamy over sandy melt-out till
Landform: Glaciated uplands
Position in Landscape: Pockets on ridge summits
Slope Gradient Range: (B) 3-8%

COMPOSITION AND SOIL CHARACTERISTICS
Drainage Class: Poorly drained
Depth to Water Table: 0”

Typical Profile Description:
0 – 3” Very dusky red, sapric
3 – 13” Brown, cobbly fine sandy loam, sbk, VFR; organic stripping, oxidized root channels
13 – 23” Light olive brown, sandy loam, sbk, VFR; hcr 20%, d
23 – 51+” Olive, coarse sandy loam, sbk, VFR

Hydrologic Group: D
Soil Erosion K Factor: 0.17
Potential for Frost Action: Moderate
Saturated Hydraulic Conductivity: High
Depth to Bedrock: >60”
Hazard to Flooding: None

INCLUSIONS (within mapping unit)
Similar: Monadnock somewhat poorly drained
Dissimilar: Tunbridge, Lyman, Monadnock

USE AND MANAGEMENT

This map unit encompass a discrete area within the larger Monadnock map unit. It formed in a concave depression in the landscape that retains groundwater for a duration long enough to form hydric soil. It is mapped as wetland and alteration of this area should be avoided or minimized. This area possesses a high water table and may pose limitations for construction, such as rutting or compaction and higher susceptibility to frost action.

These soils are susceptible to erosion so disturbance should be minimized by the use of erosion control devices and sediment controls should be installed prior to work to avoid disturbance of the adjacent resource.

SOIL SURVEY REPORT

February 21, 2018

Map Unit: **Tunbridge, poorly drained**
Classification: Coarse-loamy, isotic, frigid Typic Endoaquods
Map Unit Symbol: TpC, TpD

SETTING
Parent Material: Loamy supraglacial till
Landform: Glaciated uplands
Position in Landscape: Pockets on ridge summits
Slope Gradient Range: (C) 8-15%, (D) 15-35%

COMPOSITION AND SOIL CHARACTERISTICS
Drainage Class: Poorly drained
Depth to Water Table: 0”

Typical Profile Description:
0 – 10” Dark reddish brown, mucky sandy loam, m, VFR
10 – 14” Dark grayish brown, loamy sand, sbk, VFR ; hcr 15%, P
14 – 22” Light olive brown, loamy sand, pl, FR; free water
22 – 24” Light olive brown, loamy sand, pl, FI
24” Bedrock

Hydrologic Group: D
Soil Erosion K Factor: 0.17
Potential for Frost Action: Moderate
Saturated Hydraulic Conductivity: High
Depth to Bedrock: 20 to <40”
Hazard to Flooding: None

INCLUSIONS (within mapping unit)
Similar: Lyman poorly drained, Tunbridge somewhat poorly drained
Dissimilar: Tunbridge, Lyman, Monadnock

USE AND MANAGEMENT

These map units encompass small, discrete areas within the larger Tunbridge-Lyman-Rock outcrop complexes. They formed in concave depressions in the landscape that retain groundwater for a duration long enough to form hydric soil. They are mapped as wetland and alteration of these areas should be avoided or minimized. These areas possess a high-water table and may pose limitations for construction, such as rutting or compaction and higher susceptibility to frost action.

If construction is proposed in these areas then blasting will likely be required; however, the blast rock remnants typically creates high value road building materials since it is resistant to erosion and alteration from large vehicle traffic. These soils are susceptible to erosion so disturbance should be minimized by the use of erosion control devices and sediment controls should be installed downslope of these areas prior to work to avoid off-site sedimentation and impact to adjacent wetland.

SOIL SURVEY REPORT

February 21, 2018

Map Unit: **Tunbridge-Lyman-Rock outcrop complex**
Classification: Tunbridge: Coarse-loamy, isotic, frigid Typic Haplorthods
Lyman: Loamy, isotic, frigid Lithic Haplorthods
Map Unit Symbol: TrC, TrD, TrE

SETTING
Parent Material: Loamy supraglacial till
Landform: Glaciated uplands
Position in Landscape: Ridge summits, shoulders and backslopes
Slope Gradient Range: (C) 8-15%, (D) 15-35%, (E) >35%

COMPOSITION AND SOIL CHARACTERISTICS
Drainage Class: Tunbridge: Well drained
Lyman: Somewhat excessively drained
Depth to Water Table: Tunbridge: 20 to <40" to bedrock with no water table
Lyman: < 20" to bedrock with no water table

Typical Profile Description:
Tunbridge:
0 – 3" Hemic
3 – 5" Very dusky red, fine sandy loam, sbk, VFR
5 – 7" Grayish brown, fine sandy loam, sbk, VFR
7 – 13" Dark reddish brown, fine sandy loam, sbk, VFR
13 – 23" Dark brown, fine sandy loam, sbk, VFR
23 – 32" Dark yellowish brown, fine sandy loam, sbk, VFR
32" Bedrock

Lyman:
0 – 2" Hemic
2 – 4" Very dusky red, fine sandy loam, sbk, VFR
4 – 7" Grayish brown, fine sandy loam, sbk, VFR
7 – 13" Dark reddish brown, fine sandy loam, sbk, VFR
13 – 17" Dark brown, fine sandy loam, sbk, VFR
17" Bedrock

Hydrologic Group: D
Soil Erosion K Factor: 0.37
Potential for Frost Action: Moderate
Saturated Hydraulic Conductivity: Moderately High
Depth to Bedrock: 0 to <40"
Hazard to Flooding: None

INCLUSIONS (within mapping unit)
Similar: Abram, Tunbridge somewhat poorly to moderately well drained phases
Dissimilar: Tunbridge poorly drained, Becket, Monadnock

USE AND MANAGEMENT

These map units encompass the largest portion of the site and are located on ridge summits, shoulders and backslopes. They encompass areas with some of the steepest slopes. The transition from exposed bedrock outcrops to moderately deep soil is rapid and the distribution of series within the map unit is complex and undulating. This undulating topography creates pockets where phases of poorly drained to moderately well drained drainage classes developed. The poorly drained areas are hydric soil, are mapped as wetland and alteration of these areas should be avoided or minimized. The areas with high water tables may pose limitations for construction, such as rutting or compaction and higher susceptibility to frost action and erosion. The deeper Becket and Monadnock soils are located in pockets in the bedrock along the map unit boundaries with other deeper soils.

If construction is proposed in these areas then blasting will likely be required; however, the blast rock remnants typically create high value road building materials since it is resistant to erosion and alteration from large vehicle traffic. These soils are susceptible to erosion so disturbance should be minimized by the use of erosion control devices and sediment controls should be installed downslope of these areas prior to work to avoid off-site sedimentation.

SOIL SURVEY REPORT

February 21, 2018

Map Unit: **Waumbek, fine sandy loam, poorly drained**
Classification: Sandy-skeletal, isotic, frigid Typic Haploaquads
Map Unit Symbol: WpC, WpE

SETTING
Parent Material: Stony, sandy till
Landform: Glaciated uplands
Position in Landscape: Back and Toeslopes
Slope Gradient Range: (C) 8-15%, (E) >35%

COMPOSITION AND SOIL CHARACTERISTICS
Drainage Class: Poorly drained
Depth to Water Table: 0”

Typical Profile Description:
0 – 1” Brown, loamy sand sediment, free water
1 – 7” Black, loamy sand, ma, VFR, free water
7 – 10” Brown, sandy loam, ma, VFR, hcr 8%, d
10 – 24” Olive, loamy sand, ma, F, hcr 20%, d

Hydrologic Group: D
Soil Erosion K Factor: 0.17
Potential for Frost Action: Moderate
Saturated Hydraulic Conductivity: High
Depth to Bedrock: <60”
Hazard to Flooding: None

INCLUSIONS (within mapping unit)
Similar: Naskeag somewhat poorly drained, Waumbeck well drained
Dissimilar: Lyman, Tunbridge

USE AND MANAGEMENT

This map unit is located on the back and toeslopes within the project area where the access road is currently proposed; along the edge of the existing aggregate base road that extends to the ridgeline. They formed in concave depressions in the landscape that retain groundwater for a duration long enough to form hydric soil. They are mapped as wetland and alteration of these areas should be avoided or minimized. These areas possess a high-water table and may pose limitations for construction, such as rutting or compaction and higher susceptibility to frost action. The loamy/coarse textured soil of this map unit are also highly susceptible to erosion; particularly in the more steeply sloping areas. Erosion and sediment controls should be installed prior to commencement of construction activities to avoid erosion and sedimentation of adjacent wetlands and streams.

SOIL SURVEY REPORT

February 21, 2018

Map Unit: **Waumbek, fine sandy loam**
Classification: Sandy-skeletal, isotic, frigid Aquic Haplorthods
Map Unit Symbol: WaC, WaD, WaE

SETTING
Parent Material: Stony, sandy till
Landform: Glaciated uplands
Position in Landscape: Backslopes and footslopes
Slope Gradient Range: (C) 8-15%, (D) 15-35%, (E) >35%

COMPOSITION AND SOIL CHARACTERISTICS
Drainage Class: Moderately well drained
Depth to Water Table: 40 - <60”

Typical Profile Description:
0 – 1” Black, fibric
1 – 4” Brown, fine sandy loam, sbk, VFR
4 – 13” Yellowish red, fine sandy loam, sbk, FR
13 – 15” Yellowish brown, fine sandy loam, sbk, VFR
15 – 17” Brown, cobbly fine sandy loam, sbk, FR
17 – 24” Light olive brown, cobbly fine sandy loam, sbk, FR
24 – 35” Olive gray, fine sandy loam, m, FR; hcr 15%, d
35 – 70+” Olive gray, very cobbly loamy sand, m, FR; hcr 30%, d

Hydrologic Group: B
Soil Erosion K Factor: 0.17
Potential for Frost Action: Moderate
Saturated Hydraulic Conductivity: High
Depth to Bedrock: <60”
Hazard to Flooding: None

INCLUSIONS (within mapping unit)
Similar: Naskeag somewhat poorly drained, Waumbeck well drained
Dissimilar: Lyman, Tunbridge

USE AND MANAGEMENT

This map unit is located on the back and toeslopes within the project area where the access road is currently proposed; along the edge of the existing aggregate base road that extends to the ridgeline. There are streams and other surface drains that extend downslope that carry significant amounts of surface water across the site which are currently eroding the adjacent road. The loamy/coarse textured soil of this map unit are also highly susceptible to erosion; particularly in the more steeply sloping areas. These surface water features are depicted on the soil survey map as “Stormwater Features” and project engineers should plan for additional stormwater management in these areas. Erosion and sediment controls should be installed prior to commencement of construction activities to avoid erosion and sedimentation of wetlands and other adjacent resources. The coarser textured soils may also be suitable sources of aggregate for road and other site construction.

Appendix F GLOSSARY

Complex: Two or more dissimilar major components that occur in a regularly repeating pattern or in an unpredictable pattern.

Limiting Dissimilar Soil: Generally, map unit delineations contain soils other than those identified in the map unit name. These minor soil components reduce the purity of the soil map unit. Minor components that most detract from purity because they are the most dissimilar to the mapped name and are the most limiting for use.

Soil Drainage Class:

- Excessively Drained: Soil depth is less than 25 cm (10 inches) to bedrock; or has a sandy or sandy-skeletal particle-size class with a loamy cap less than 25 cm (10 inches) thick.
- Somewhat Excessively Drained: Soil depth is 25 to 50 cm (10 to 20 inches) to bedrock with a loamy or loamy-skeletal particle-size class; or soil depth is 50 cm (20 inches) or greater to bedrock with a sandy or sandy-skeletal particle-size class with a loamy cap 25 cm (10 inches) thick or greater.
- Well Drained: Soil depth is at least 50 cm (20 inches) to bedrock and has a texture of loamy very fine sand or finer and redoximorphic features, if present, are 100 cm (40 inches) or more below the mineral soil surface.
- Moderately Well Drained: Has redoximorphic features at a depth of 40 cm (16 inches) to less than 100 cm (40 inches) below the mineral soil surface.
- Somewhat Poorly Drained: Is not VERY POORLY or POORLY DRAINED and has redoximorphic features at a depth of less than 40 cm (16 inches) below the mineral soil surface.
- Poorly Drained: Has dominant textures in the upper 50 cm (20 inches) (below the A-horizon if present) of loamy fine sand or coarser and has redoximorphic features within 18 cm (7 inches) of the mineral soil surface; or has dominant textures in the upper 50 cm (20 inches) (below the A-horizon if present) of loamy fine sand or coarser and has a Bh- or Bhs-horizon with value/chroma of 3/3 or less that begins within 18 cm (7 inches) of the mineral soil surface and is direclty underlain by a horizon that has redoximorphic features; or has an A-horizon that is 18 cm (7 inches) thick or greater with value/chroma of 3/2 or less and a textures in all sub-horizonswithin 50 cm (20 inches) of the mineral soil surface of loamy fine sand or coarser and has redoximorphic features directly below the A-horizon; or has a depleted or gleyed matrix within 50 cm (20 inches) of the mineral soil surface and redox depletions with value of 4 or more and chroma of 2 or less in ped interiors that are less than 18 cm (7 inches) below the mineral soil surface; or has an A-horizon that is 18 cm (7 inches) thick or greater with value/chroma of 3/2 or less and has a depleted or gleyed matrix within 50 cm (20 inches) of the mineral soils surface and has redox depletions with value of 4 or more and chroma of 2 or less in ped interiors or a depleted or gleyed matrix directly beneath the A-horizon.

SOIL SURVEY REPORT

February 21, 2018

Soil Depth:

- Very Shallow: < 10 inches of mineral soil above bedrock
- Shallow: 10 to < 20 inches of mineral soil above bedrock
- Moderately Deep: 20 to <40 inches of mineral soil above bedrock
- Deep: 40 to <60 inches of mineral soil above bedrock
- Very Deep: >60 inches of mineral soil above bedrock

Soil Map Unit: Designed to efficiently deliver soil information to meet user needs for management and land use decisions. They can appear on maps as individual areas (i.e. polygon), points, or lines. They are a collection of areas defined and named the same in terms of their major soil components, miscellaneous areas, or both.

Soil Phase: These terms are added to a map unit component name to covey important information about a map unit and differentiate it from other map units on the map unit legend.

Soil Series: Represents a three-dimensional soil body having a unique combination of properties that distinguish it from neighboring series.