Estimating the Hypothetical Wind Power Potential on Public Lands in Vermont

Prepared for

The Vermont Department of Public Service

By

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Introduction

Interest in utility-scale wind power development in Vermont has increased substantially in recent years. Previous wind resource assessments by the Vermont Department of Public Service (DPS), private wind development firms, the National Renewable Energy Laboratory (NREL), and the newly released "New England Wind Resource Map" all document that the wind resources along the higher elevations of the Green Mountain ridges are substantial. Many of these windy ridges include publicly owned or controlled land. Policy questions have been raised regarding the use of this public land for commercial wind power development. Some of the issues frequently raised involve learning how much of this resource is on public land, and what is the hypothetical energy production potential of these resources, considering general land use restrictions. The Vermont Department of Public Service commissioned this study in 2003 in recognition of the need for baseline data on the wind energy potential on public lands[a] on which answers to these questions can be developed and future policies considered.

Purpose and Objectives

The purpose of this study is to develop estimates of the hypothetical wind power potential on public lands in Vermont. It seeks to estimate how much electrical energy, in a relative sense, could potentially be generated by wind power according to certain wind classes and land use categories. It is hoped that the results of this work will provide baseline data to individuals and organizations responsible for planning and managing public lands and the state's electrical energy supply and land use policies. Specifically the objectives of this study include:

- Assembling publicly available wind resource and public lands data, in collaboration with wind experts and state and federal land management personnel;
- Developing hypothetical estimates of the "Mean Annual Net Energy Production" potential on public lands;
- Categorizing tracts of public land according to its compatibility for wind power development; and
- Tabulating wind resource and land use data to determine the distribution of wind classes across broad categories of wind development compatibilities on public lands.

[a] "Public land" as used in this study includes municipal lands, lands in which the state holds title or has a legal interest, and federal lands as included in the VGIS databases, as are more fully described on page 9 of this report.

Methodology and Analyses

In this study, hypothetical wind energy production estimates for public lands were made considering the strength of the wind resource; the amount of available ridgeline along which wind turbines might be installed; the proximity to existing electric transmission infrastructure; and potential compatibility with using these ridgelines for wind power development. The methods and analyses used in performing this work are described in the following sections:

Section One: Mapping the Hypothetical Mean Annual Net Energy Production on Public Lands.

A. Assemble new wind resource maps for GIS processing.

A digital version of the "New England Wind Resource Map" prepared by TrueWind Solutions, LLC[b] in 2003, was obtained for this study. This wind power map was generated at a spatial resolution 200 meter square grid cells using publicly available 1:250,000 scale digital elevation models and a proprietary advanced numerical atmospheric computer model ("Mesomap") developed by TrueWind Solutions, LLC. The model outputs wind statistics for each grid cell calculated by integrating existing surface and upper-air meteorological data with a cell's elevation and other physiographic characteristics. The Vermont – New Hampshire portion of the New England Wind Resource Map is presented in Figure 1. The region's windier resource areas (orange-red colors) are shown to be off the Atlantic coast and along the highest ridges of the Appalachian Mountains.

The TrueWind Solutions' computer mapping program is capable of producing wind statistics for specified heights above "effective ground level"[c] (see www.truewind.com for details and assumptions used in the preparation of this map).

[b] The New England Wind Resource Map was produced in 2003 with joint funding from the Massachusetts Technology Collaborative Renewable Energy Trust, Connecticut Clean Energy Fund, and Northeast Utilities. It was validated by NREL and consulting meteorologists, including those familiar with Vermont's long-term wind resources. Visit Truewind's web site at www.truewind.com for further details about the map's accuracy and assumptions used in its preparation.

[c] "Selected heights chosen on the wind maps may not always be the actual height above ground level. Where the vegetation is dense, the "effective ground level" is not the base of the vegetation because the wind flow is displaced upward. The level of zero wind, called the displacement height, is typically about two-thirds the height of the top of the vegetation. In dense forests the height above ground at which the predicted wind speed actually occurs may be as much as 7-15 m (23-50 ft) higher than indicated on the maps. For example, in an area covered by forest with an average canopy height of approximately 18 m (60 ft), the Wind Map's wind speed prediction at the 50 m (164 ft) level would actually apply to a height of 62 m (204 ft) above ground [50 + 2/3(18)]".

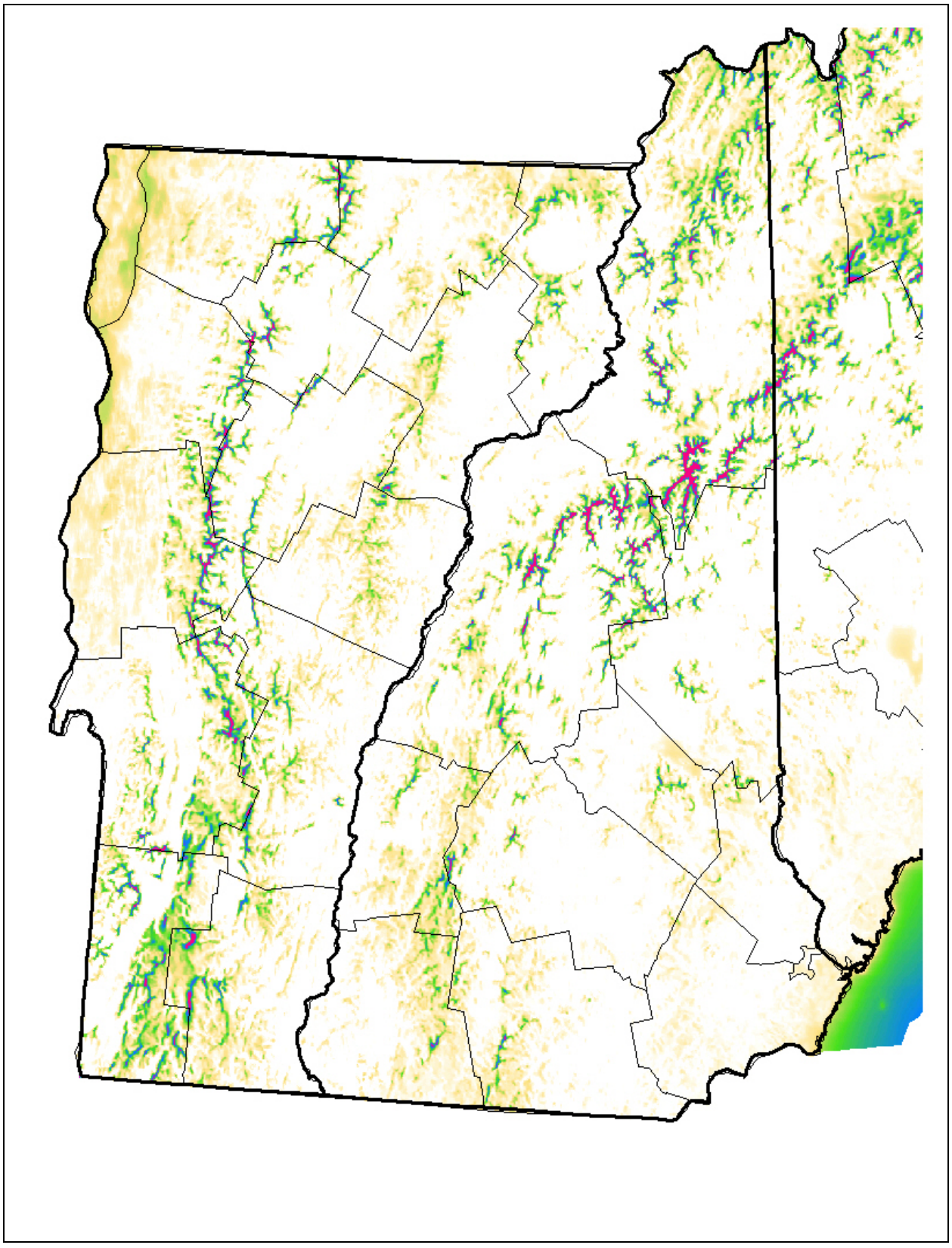

Figure 1: The Vermont and New Hampshire region of the New England Wind Map (50 meter wind speeds). Windier areas or commercial interest are green-blue to red shaded.

An electronic map of mean wind speeds at a height of 50 meters was selected for this study. The mean wind speed is a widely used statistic that is easily converted into energy production estimates for wind turbines and the 50-meter height is consistent with the hub-heights of commercially available turbines that are suitable for installation in New England's mountainous regions. The map also categorizes wind speed and wind power density values into seven wind classes that are routinely referenced in the wind industry and are used in this study as the basis for categorizing wind resources. The mean wind speed and power parameters associated with the seven wind classes at the height of 50 meters are presented in Table 1 along with the portion of Vermont's total land area; and the portions of federal, state, and municipal land area found in each wind class. It should be noted that most of the land area in Vermont, 56 percent (56%), falls below Wind Class 1, averaging less than 5.1 m/s (11.4 mph) mean annual wind speeds. Of the remaining 44 percent classified in Table 1, only the windiest portion of this is commercially attractive for wind power development. In this study, areas with wind

Wind Class	Wind Power Density, W/m^2	Speed, m/s (mph)	Land area (% of VT)	Federal (% of VT)	State (% of VT)	Municipal (% of VT)
<1		Insignificant	55.7	1.1	2.5	0.4
1	160	5.1 (11.4)	30.1	1.1	3.3	0.1
2	240	5.9 (13.2)	8.7	3.6	1.8	0.2
3	320	6.5 (14.6)	2.6	1.1	0.4	.03
4	400	7.0 (15.7)	1.2	0.2	0.4	0.0
5	480	7.4 (16.6)	1.2	0.2	0.1	.004
6	640	8.2 (18.3)	0.5	.04	.01	0.0
7	1600	11.0 (24.7)	.002	0.0	0.0	0.0
		Total:	100%	7.3%	8.5%	0.7%

Table 1: The left 4 columns show the Wind Classes (50-meter), associated power densities, mean wind speeds with the percent of Vermont's land area that lies within each wind class. In the three right columns is shown, as a percent of the total land area in Vermont, is the public land parcels in each Wind Class. Public land parcels in the lower right of the table are those that were further evaluated in this study.

resources of Class 4 or greater (mean annual wind speeds 7.0 meters per second (mps) (15.6 miles per hour) or greater) were considered to be commercially attractive. This

threshold corresponds to a wind resource where turbines would have typical minimum net annual capacity factors in the range of 25 - 30 percent[d].

The relative size of Vermont's windy land area to the state as a whole and to the public land area groups is displayed in Figures 2 and 3. The Wind Class 4 and greater areas represent about 3% of all of Vermont's land area (yellow square in Figure 2). The portion of public land that meets the Wind Class 4 or greater threshold is even smaller, less than one percent (1%) of the entire state (orange squares in Figure 2 and the sum of the lower right-hand corner values in Table 1). Within each public land ownership/control type, Wind Class 4 or greater wind resources amount to 0.44% federal land, .51% state land and less than .01% municipal land[e].

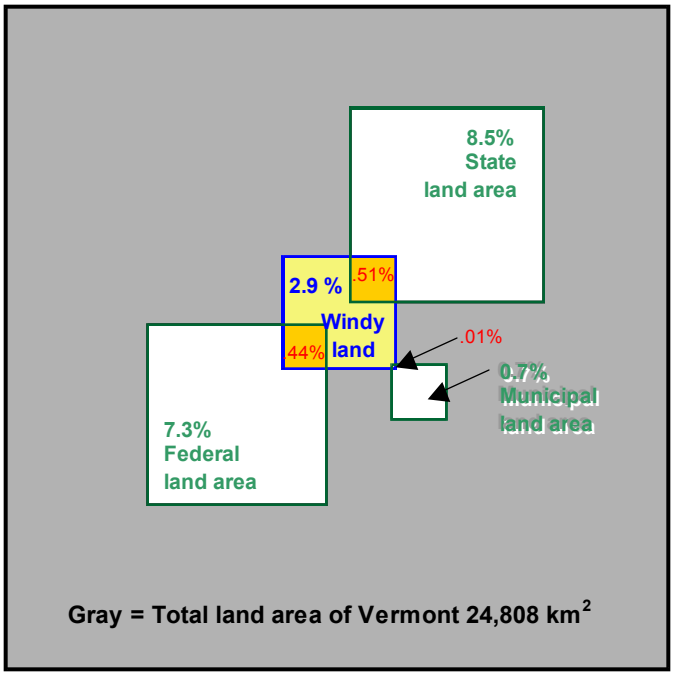

Figure 2: Diagram of the size of the types of public land considered in this study, relative to each other and the state as a whole. The yellow box illustrates the relative size of windy land and the over lap with the types of public land.

The seemingly small amount of windy land in Vermont is primarily the result of Vermont's narrow north-south oriented mountain ranges 'shielding' the broad, low-lying valley areas in the central and eastern parts of the state from the predominant westerly

[d] This threshold assumes that a wind power plant to sell power competitively in New England wholesale electric markets would need at least this level of performance. This threshold is not applicable to homeowner installations that can "net meter" or effectively value their output at retail electric rates.

[e] Stated another way, 6% of the federal land, 5.5% of the state land and less than 1% of the municipal land in Vermont has a Wind Class 4 or greater wind resource characteristic.

wind flow and rendering them unattractive for commercial development. On a larger scale the Adirondack Mountains in New York and Green Mountains in Vermont protect the Champlain Valley from the full influence of the upper-air westerly winds. The result

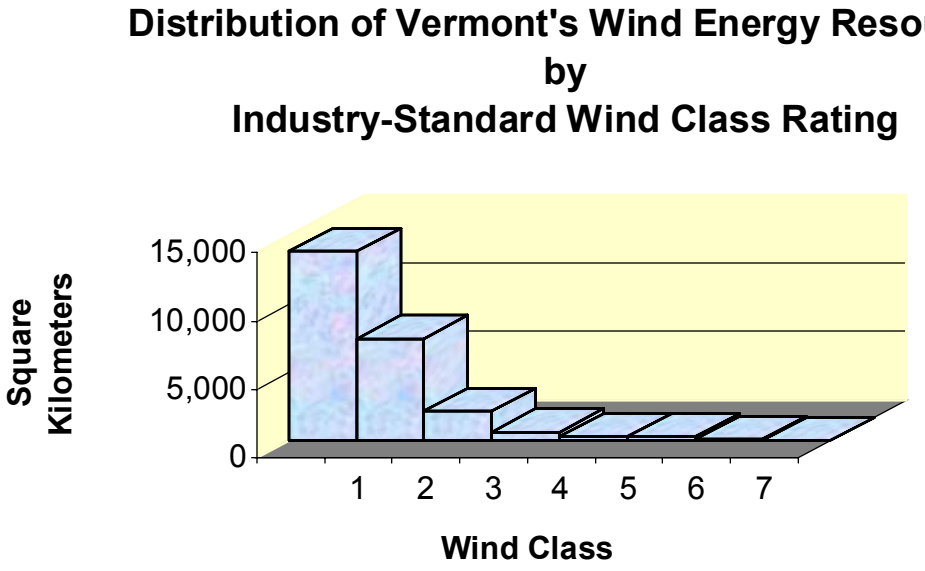

Figure 3: Areal distribution of Vermont's wind resource in standard Wind Classes at 50 meters above ground level. The left most column displays the land area (56% of Vermont) below a Class 1 wind resource (less than 5.1 m/s (11.4 mph) mean annual wind)

is that the wind power resource in the otherwise "open" Champlain Valley is less than what is usually required for commercial wind power development. This leaves a relatively small portion of Vermont's land area exposed to the undisturbed strong westerly wind flow, along the ridgelines of Vermont's mountain ranges, generally those higher than 760 meters (2,500 feet) AMSL.

B. Conversion from an area wind map to a linear map.

In practice wind turbines in Vermont's mountainous terrain and predominant westerly wind flow pattern will be installed in "turbine strings" or rows of wind turbines, that follow the higher portions of a ridgeline. To accommodate this phenomenon in this study, it was necessary to shift from an areal analysis based on the grid of 200-meter cells in the New England Wind Resource map, to a linear analysis using a map of turbine strings. Each turbine string represents a linear section of ridgeline (with Wind Class 4 or greater resource) where a hypothetical row of wind turbines could be installed. Knowing the length of the turbine strings made it possible to estimate how many turbines could be theoretically installed in each string, and thus a measure of potential energy production

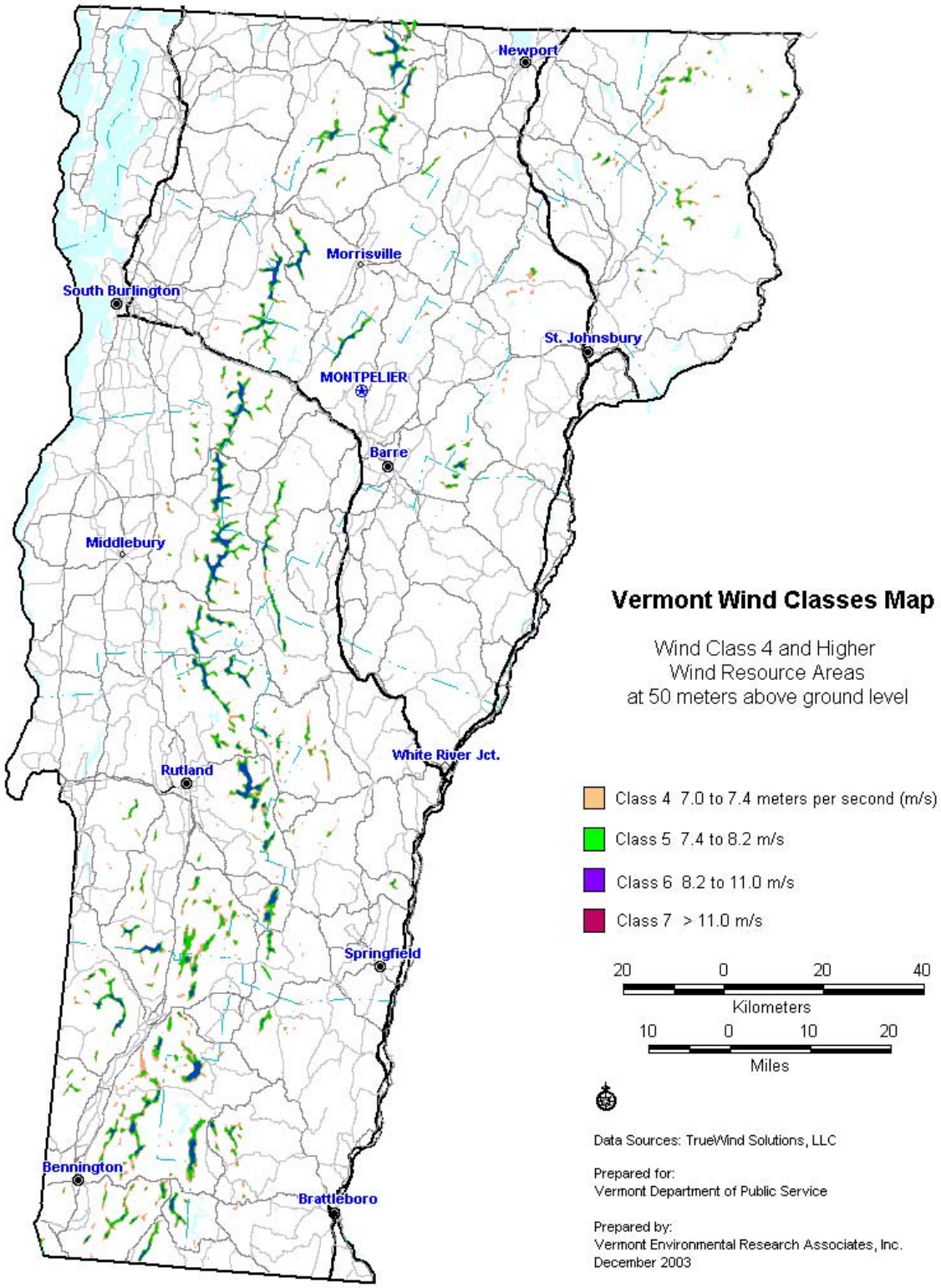

Figure 4: Wind Class 4 and higher wind resource areas in Vermont are shown as the color shaded areas. Approximately 3 % of the total land area in the state is in a Wind Class 4 or greater wind resource classification.

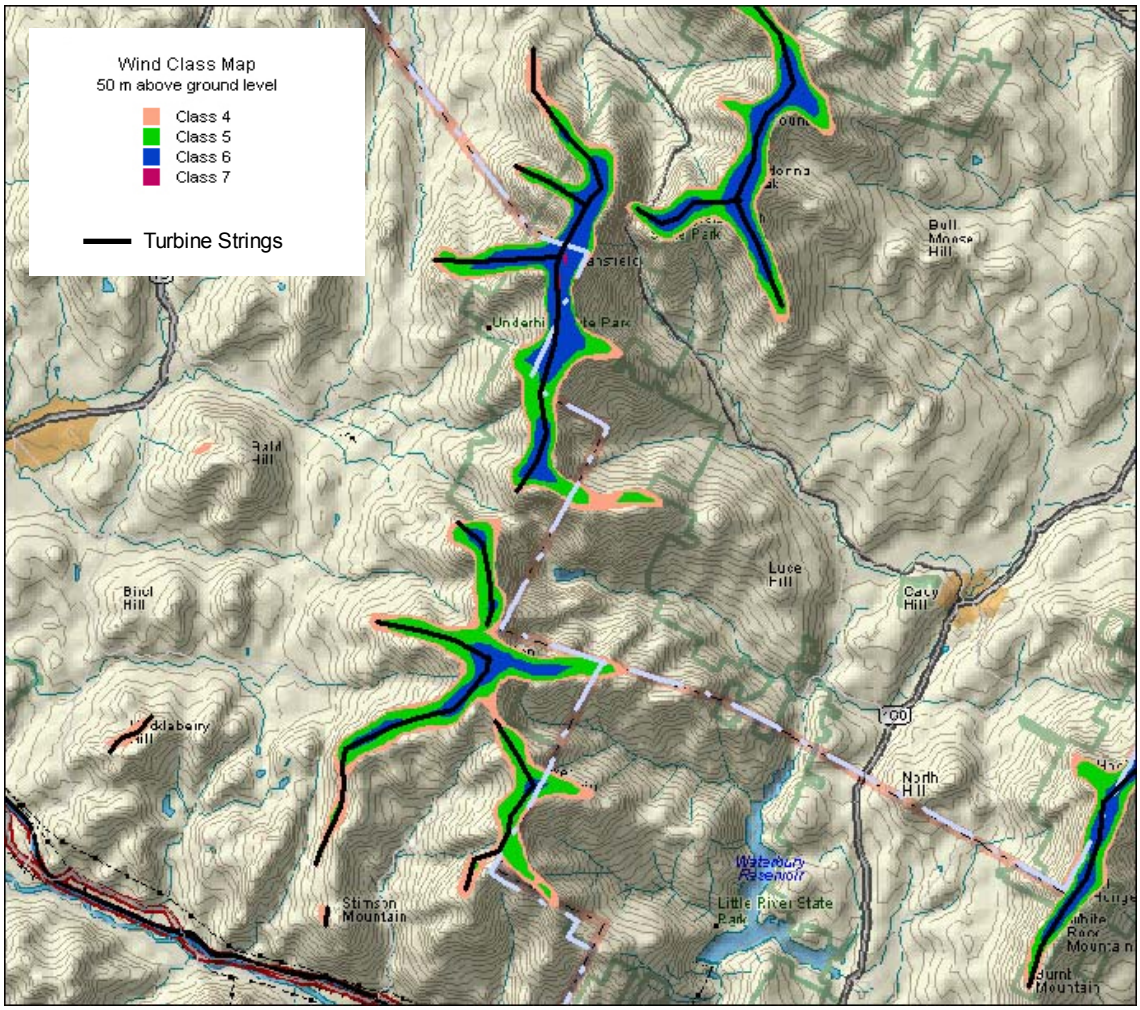

Figure 5: Topographic map section illustrating turbine strings drawn along the ridgelines with a Wind Class 4 or greater wind resource.

could be calculated for each turbine string. The turbine strings also have wind resource and other geographic parameters associated with them, based on underlying data layers in the GIS system of maps.

The end result of the process of manually creating possible turbine strings along the ridgeline is illustrated on a small section of a USGS topographic map in Figure 5. This end result of the process was done on a small-scale map where the ridgelines were distinctly visible and where the scale and accuracy were consistent with that of the 1:24,000 scale maps (USGS 7 ½ minute quads) used by the Vermont Center for Geographic Information (VGIS) and the University of Vermont Spatial Analysis Lab in digitizing the public lands boundaries. This level of accuracy was important in areas where public land boundaries follow the height-of-land and therefore are sometimes

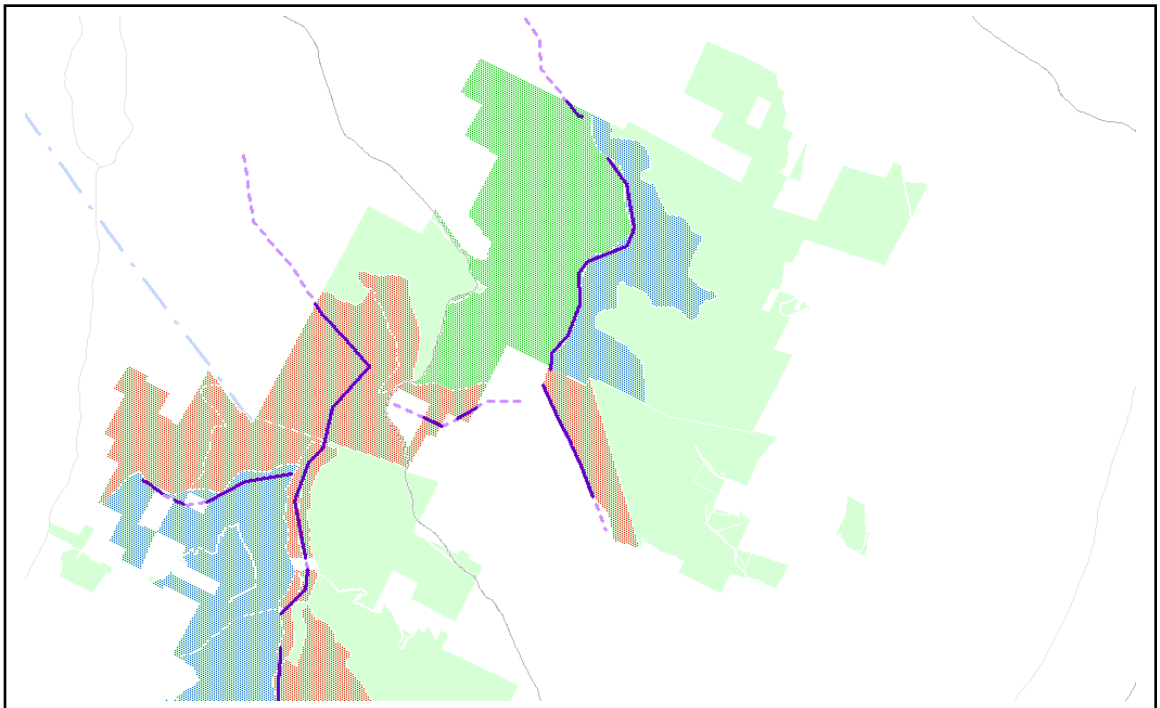

Figure 6: Public lands transected by turbine strings. The map illustrates the results of 'cutting' turbine strings, disregarding the portion that extends outside (the dashed line) of the public land parcel. The WDC categories segment the remaining sections of the turbine string (dark solid lines) and are identified by coloration of the Wind Development Compatibility ratings.

nearly coincident with turbine string locations[f]. Turbine strings were drawn through all the Wind Class 4 and higher wind resource areas as shown on the map in Figure 2.

Approximately 832 kilometers (517 miles) of turbine strings were drawn, corresponding roughly to enough ridgeline for 6000 MW of installed wind capacity (before any land use considerations are applied).

C. Identify hypothetical turbine strings on public lands.

GIS data layers containing public and private conserved parcel boundaries were obtained from the University of Vermont Spatial Analysis Lab, and the data layer of U.S. Forest Service Management Areas produced by the U.S. Forest Service. The polygon parcel data includes federal, state, and municipal public ownership. Additionally, lands technically not owned by the state, but on which it has "legal interests", such as through a conservation easement or other mechanism, were identified (see footnote on page 1). The GIS parcel data for state and municipal lands excludes parcels less than two acres in size, except those with "critical natural areas and state public access areas," and

[f] In the process of drawing turbine strings it was discovered that the locations of the ridgelines on the 1:24,000 scale maps did not line up well with the New England Wind Resource Map produced using 1:250,000 scale elevation data. Therefore a manual process was used to transfer the wind speed values assigned to each turbine string from the wind map to a second set of turbine strings drawn at the geographically accurate locations on the smaller scale maps.

public lands with "schools, garages or other non-natural resources oriented facilities."[g & h] Eleven municipal parcels were identified as possessing a Wind Class 4 or greater resource. All other municipal parcels fell under the Wind Class 4 threshold.

Once the public land parcels were queried from the database, turbine strings outside these parcel boundaries, (i.e., they were on private land) were eliminated from further review. The remaining turbine strings were 'cut' at every boundary intersection of differently designated parcels of public land to create a subset of turbine string segments of specific interest for this analysis. Figure 5 illustrates the process of cutting the turbine strings where they intersect with the boundaries of the parcels being evaluated. In the GIS database, the turbine string segments have land ownership/control data and other attributes associated with them to facilitate further evaluation for compatibility with wind energy development. The wind speed values for each turbine string segment were calculated based on the underlying wind map grid cell values of 50-meter wind speeds and the mean elevation above sea level were calculated based on a 1:250,000 scale digital elevation model (DEM) map.

D. Estimate the annual net energy production for each "turbine string" segment.

Since the hypothetical mean annual net energy production is the metric of interest in this study, it was necessary to convert the mean wind speed value into electric energy production estimates. To estimate the energy production for each string segment, the General Electric 1.5 megawatt (mW) turbine with a 70.5-meter rotor was modeled. Sea level power curve data was obtained for this turbine from the manufacturer and integrated with the wind speed frequency distribution associated with mean wind speeds for each turbine string segment. A Rayleigh frequency distribution of wind speeds was assumed[i] in these calculations. Losses due to the lower air density at higher elevations above sea level were calculated and applied to these annual energy production values. This linear adjustment ranged from .88 to .95 depending on the average elevation of the turbine string. Finally, an additional 10 percent was deducted to reflect typical

[g] The specific data layers used were *Conspri071902*, *EnvironMangareas_MAREA2003,* and *UtilityTransmit_VELCOTRANS,* all publicly available on the VCGI web site at www.vcgi.org, although *Conspri071902* may be distributed with UVM Spatial Analysis Laboratory written permission.

[h] Federal lands of interest in this study are entirely administered by the U. S. Forest Service, Green Mountain National Forest.

[i] Measured long-term hourly mean wind speeds at elevations up to 3,000 – 3,500 feet are generally consistent with this model of a wind speed frequency distribution. The Rayleigh frequency distribution can be specified with the mean wind speed.

turbulence, icing, wake and other losses to arrive at estimates for the annual net energy production for each 1.5 mW wind turbine.

The number of turbines that could 'fit' along each turbine string was then calculated. For north-south oriented ridgelines, the typical side-to-side distance between turbines would be between 2.5 and 3.0 rotor diameters to maintain reasonable rotor wake and turbulence losses. For a 70.5-meter rotor diameter turbine, this corresponds to spacing between turbines of 176 to 212 meters (578 to 695 feet). A representative value of 200 meters (656 feet) was used as the average spacing between turbines. The length of the turbine strings was divided by the spacing value to arrive at the number of 1.5 mW, 70.5-meter rotor turbines that could hypothetically be installed along the turbine string segments. The number of turbines, multiplied by the annual net energy production estimate for the line segment yielded the "total net annual energy projection estimate" assigned to each turbine string segment.

E. Screening for proximity to electric transmission lines.

Before being 'cut', each turbine string on public land was evaluated for its proximity to existing electric transmission lines. Digital maps of the Vermont electric transmission system provided by the Vermont Electric Company (VELCO) were used so that turbine strings that were too far away from existing transmission lines could be screened out. Turbine strings that were greater than 7 kilometers (4.35 miles) from existing transmission lines were queried and eliminated from further consideration on the basis that it would be cost prohibitive to build new transmission facilities for distances greater than seven kilometers. Transmission lines with an electrical capacity of greater than or equal to 34.5 kilovolts and smaller than 230 kilovolts were used in this screening procedure. The many smaller, local distribution lines were not included as they are insufficient in size to connect to a utility-scale wind development.

Section Two: Evaluating Wind Development Compatibility with Public Land Use Objectives.

In the second phase of this work, a categorization scheme for "wind development compatibility" (WDC) on public lands was developed in collaboration with the Vermont Agency of Natural Resources, Department of Forests, Parks, and Recreation (ANR), and U. S. Forest Service personnel. For state lands, where a state-wide land use categorization scheme did not exist, WDC categories were defined very broadly in terms

of their "potential compatibility" for wind energy development. These definitions were then circulated along with maps showing the windy areas and state parcels to the state Forest District Managers so they could evaluate and assign WDC categories to these specific parcels of state land. The results of this assignment were then manually input into the public lands data layer used in the GIS system. The full list of parcels reviewed by the district offices is included in Appendix 1.

The WDC categories were defined in a manner that would be consistent with existing U.S. Forest Service "Management Area" descriptions currently in use and applicable to lands contained in the Green Mountain National Forest. For the federal parcels being evaluated, the WDC categories were applied to the U.S. Forest Service Management Areas as defined in the current Forest Management Plan[j]. A table summarizing the relationship of WDC categories to corresponding Forest Service Management Areas is included in Appendix 2.

The WDC categories are defined for those parcels where wind power development may be:

1. Potentially Compatible: May have qualities potentially compatible with management objectives;

2. Restricted: Legal restrictions may apply but only to part of the area. Inconsistent with management plan, and/or may threaten sensitive natural resource features in at least part of the area;

3. Prohibited: Conflicts with legal restrictions (i.e. conservation easement, deed restriction, funding requirement, permit condition, statutory conditions, etc.) or designated use; or

4. Undetermined: No management plan currently exists, is outdated or is currently under development. Resource information may be lacking.

The results of categorizing the public land parcels into the Wind Development Compatibility (WDC) categories are tabulated in terms of land area in the table to follow. If both WDC categories 1 (Potentially Compatible) and 2 (Restricted) are considered to have some potential for wind development, parcels with these designations represent 17.5 percent (17.5%) (right column in Table 2) of the total windy (Wind Class 4 or greater) public land.

[j] Green Mountain National Forest Land and Resource Management Plan 1993 as amended, Chapter IV Forest Management Direction, F.4.92 Table 1 Management Prescriptions.

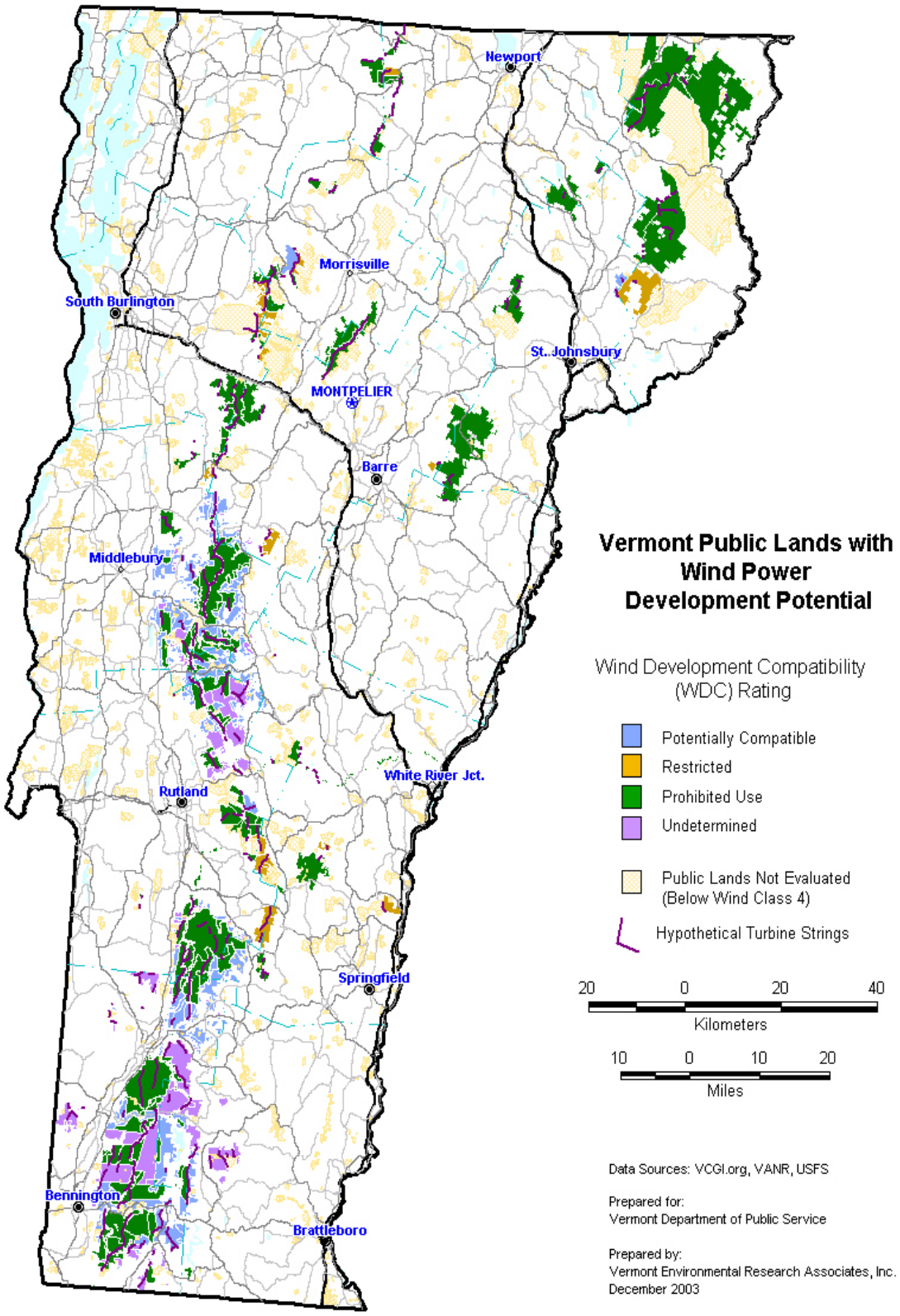

Figure 7: Public lands classified by Wind Development Compatibility ratings with turbine strings on those lands.

	Public Land Type			
Wind Development Compatibility	**Federal**	**State**	**Municipal**	**Total**
Potentially Compatible (1)	28.7%	1.3%	0.0%	**13.4%**
Restricted (2)	0.0%	7.0%	0.0%	**3.6%**
Prohibited (3)	40.0%	43.3%	0.0%	**40.1%**
Undetermined (4)	19.4%	0.0%	13.2%	**9.1%**
Not Categorized	11.9%	48.3%	86.8%	**33.8%**
Total	**100%**	**100%**	**100%**	**100%**

Table 2: Percentage of area of the parcels in each public land type by each Wind Development Compatibility (WDC) category. Categorized parcels have Class 4 or greater turbine strings on them.

The WDC-categorized land use parcels data was overlaid with the turbine string segments resulting from Phase One analyses. Areas where turbine strings and the public lands overlap were identified for further classification by state and federal personnel as to their wind development compatibility. The results of this categorization work are illustrated in the Figure 7 map, which shows all public lands, according to their WDC category along with the turbine strings that were analyzed.

Results and Conclusions

High-resolution computer-generated wind power maps were examined together with public lands and electric infrastructure maps and data to produce hypothetical estimates of the amount of wind energy that could be produced on public lands in Vermont.

In terms of Vermont's total land area, three percent (3%) is windy with Wind Class 4 or greater and less than one percent (1%) is windy and public. Virtually all of these windy areas are found along the higher elevations of the state's north-south oriented mountain ridges, generally those over 760 meters (2,500 feet) in elevation above mean sea level.

In interior New England, commercial-scale wind turbine development would occur in rows, or turbine strings, along the length of ridges, so a hypothetical estimate of the wind

energy potential in Vermont can be more appropriately based on length of linear ridgeline available, rather than by land area.

Turbine strings were drawn along all windy ridgelines for further processing using typical wind turbine spacing. Annual energy production (megawatt-hours) was then estimated for each turbine string that was within 7 kilometers (4.35 miles) of existing electric transmission lines. Further evaluation of the wind power potential on public lands involved assigning a Wind Development Compatibility (WDC) ranking to each turbine string or section of a string. Table 3 takes the WDC ranking in to account and summarizes the results in terms of the relative amounts of hypothetical wind energy production that could be produced from turbines in each of the public land and WDC categories. An important limitation of the amount of wind energy that could be produced off land in the results of the WDC categorization scheme shown in Table 3 where only 9 percent (9%) of the hypothetical wind energy generation on federal land and 2 percent (2%) of the state land is ranked at "Potentially Compatible".

	Public Land Type			
WDC Category	Federal	State	Municipal	**Total**
Potentially Compatible (1)	9.0%	2.2%	0.0%	**11.2%**
Restricted (2)	0.0%	8.6%	0.0%	**8.6%**
Prohibited (3)	35.9%	26.7%	0.0%	**62.6%**
Undetermined (4)	15.5%	0.0%	2.1%	**17.6%**
Totals	**60.4%**	**37.5%**	**2.1%**	**100%**

Table 3: Relative amounts of hypothetical mean annual net wind energy generation (Megawatt-hours) by Wind Development Compatibility.

This study developed estimates of the hypothetical wind energy potential on public lands in Vermont, expressed in terms of wind energy production. Other areas of investigation that could further refine and complement the estimates in this study include: using additional screening criteria (e.g., screening out those areas with important ecological

value such as deer yards or wetlands); and examining the relationship between regional potential wind energy production and regional needs.

Appendix 1

List of Windy State Parcels with Compatibility Rating

Compatibility between Existing State Land Use Objectives and Wind Energy Development		
1	Potentially Compatible	May have qualities potentially compatible with management objectives
2	Restrictive	Legal restrictions may apply but only to part of the area. Inconsistent with management plan, and/or may threaten sensitive natural resource features in at least part of the area.
3	Prohibited	Conflicts with legal restrictions (i.e. conservation easement, deed restriction, funding requirement, permit condition, statutory conditions, etc.)
4	Undetermined	No management plan currently exists, is outdated or is currently under development. Resource information may be lacking.

Compatibility Rating (ANR Input)	POLYID	Name
3	01095-005A	LEWIS CREEK WILDLIFE MANAGEMENT AREA
3	01095-005B	LEWIS CREEK WILDLIFE MANAGEMENT AREA
1	03030-002	HAPGOOD STATE FOREST
1	03045-014A	RUPERT STATE FOREST
3	03065-001A	STAMFORD MEADOWS WILDLIFE MANAGEMENT AREA
3	03065-001B	STAMFORD MEADOWS WILDLIFE MANAGEMENT AREA
1	05010-001C	DARLING STATE PARK
1	05010-001D	DARLING STATE PARK
3	05020-002A	GROTON STATE FOREST
3	05065-002A	STEAM MILL BROOK WILDLIFE MANAGEMENT AREA
3	05065-002B	STEAM MILL BROOK WILDLIFE MANAGEMENT AREA
3	05070-005A	WILLOUGHBY STATE FOREST
3	05075-003A	STEAM MILL BROOK WILDLIFE MANAGEMENT AREA
3	05075-003I	STEAM MILL BROOK WILDLIFE MANAGEMENT AREA
3	07005-001	ROBBINS MOUNTAIN WILDLIFE MANAGEMENT AREA
3	07005-002A	MOUNT MANSFIELD STATE FOREST
3	07005-002B	MOUNT MANSFIELD STATE FOREST
3	07005-003A	MOUNT MANSFIELD STATE FOREST
2	07010-001A	CAMELS HUMP STATE FOREST
2	07010-001D	CAMELS HUMP STATE FOREST
3	07040-003A	HUNTINGTON GAP WILDLIFE MANAGEMENT AREA
3	07040-003B	HUNTINGTON GAP WILDLIFE MANAGEMENT AREA
3	09005-004A	VERMONT LAND TRUST EASEMENT
3	09010-001A	VERMONT LAND TRUST EASEMENT
3	09040-001A	VERMONT LAND TRUST EASEMENT
3	09040-002	WEST MOUNTAIN MATRIX
3	09080-004A	THE KINGDOM STATE FOREST
2	09085-002A	VICTORY STATE FOREST
3	11055-002A	JAY STATE FOREST
3	11055-002B	JAY STATE FOREST
3	11055-002C	JAY STATE FOREST
3	11060-003	JAY STATE FOREST
3	15005-001D	LONG TRAIL STATE FOREST
3	15005-001E	LONG TRAIL STATE FOREST
3	15005-001I	LONG TRAIL STATE FOREST
3	15005-002A	LONG TRAIL STATE FOREST
3	15005-004A	LONG TRAIL STATE FOREST
3	15005-005A	LONG TRAIL STATE FOREST
3	15005-005B	LONG TRAIL STATE FOREST
3	15040-001AB	MOUNT MANSFIELD STATE FOREST
3	15040-001AC	MOUNT MANSFIELD STATE FOREST
3	15040-001AD	MOUNT MANSFIELD STATE FOREST
3	15040-001AG	MOUNT MANSFIELD STATE FOREST
2	15040-001AH	MOUNT MANSFIELD STATE FOREST
2	15040-001AI	MOUNT MANSFIELD STATE FOREST
2	15040-001AJ	MOUNT MANSFIELD STATE FOREST
2	15040-001AO	MOUNT MANSFIELD STATE FOREST
3	15040-001AQ	MOUNT MANSFIELD STATE FOREST
3	15040-001AR	MOUNT MANSFIELD STATE FOREST
1	15040-001B	MOUNT MANSFIELD STATE FOREST
2	15040-001G	MOUNT MANSFIELD STATE FOREST
3	15040-004A	MOUNT MANSFIELD NATURAL AREA
3	15040-004B	MOUNT MANSFIELD NATURAL AREA
3	15040-004C	MOUNT MANSFIELD NATURAL AREA

Appendix 1

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4	Undetermined	No management plan currently exists, is outdated or is currently under development. Resource information may be lacking.

Compatibility Rating (ANR Input)	POLYID	Name
3	15040-004E	MOUNT MANSFIELD NATURAL AREA
3	15040-004F	MOUNT MANSFIELD NATURAL AREA
3	15040-004H	MOUNT MANSFIELD NATURAL AREA
3	15040-004I	MOUNT MANSFIELD NATURAL AREA
3	15040-009A	MOUNT MANSFIELD STATE FOREST
3	19060-003A	JAY STATE FOREST
3	19060-004A	JAY STATE FOREST
3	19060-007A	JAY STATE FOREST
3	19060-008A	GREEN MOUNTAIN CLUB
3	19060-009A	JAY STATE FOREST
2	19060-010A	JAY STATE FOREST
3	19065-004B	GREEN MOUNTAIN CLUB
3	19065-006B	LONG TRAIL STATE FOREST
3	19090-003A	HAZENS NOTCH STATE PARK
3	19090-004A	LONG TRAIL STATE FOREST
3	19095-006	THE TRUST FOR PUBLIC LAND
3	21020-001	MOUNT CARMEL STATE FOREST
2	21060-001A	OKEMO STATE FOREST
3	21060-001B	OKEMO STATE FOREST
3	21060-001D	OKEMO STATE FOREST
3	21110-010B	PLYMSBURY WILDLIFE MANAGEMENT AREA
3	21120-003D	VERMONT LAND TRUST EASEMENT
3	21120-004A	VERMONT LAND TRUST EASEMENT
3	21120-004C	VERMONT LAND TRUST EASEMENT
3	21120-008A	VERMONT LAND TRUST EASEMENT
3	23030-002A	CAMELS HUMP STATE PARK
3	23030-002B	CAMELS HUMP STATE PARK
3	23030-002H	CAMELS HUMP STATE PARK
3	23030-002I	CAMELS HUMP STATE PARK
3	23030-002K	CAMELS HUMP STATE PARK
3	23030-002L	CAMELS HUMP STATE PARK
3	23030-002M	CAMELS HUMP STATE PARK
3	23030-002O	CAMELS HUMP STATE PARK
3	23030-002P	CAMELS HUMP STATE PARK
3	23030-003A	CAMELS HUMP STATE PARK
3	23040-006A	GREEN MOUNTAIN CLUB EASEMENT
2	23070-002A	LR JONES STATE FOREST
2	23075-001A	ROXBURY STATE FOREST
2	23075-001J	ROXBURY STATE FOREST
3	23075-001K	ROXBURY STATE FOREST
3	23100-004E	CC PUTNAM STATE FOREST
3	23100-004H	CC PUTNAM STATE FOREST
3	23100-004J	CC PUTNAM STATE FOREST
3	23100-004K	CC PUTNAM STATE FOREST
3	23100-004P	CC PUTNAM STATE FOREST
3	25100-002A	ATHERTON MEADOWS WILDLIFE MANAGEMENT AREA
3	27050-001A	TINY POND WILDLIFE MANAGEMENT AREA
3	27060-002A	COOLIDGE STATE FOREST
2	27060-002AD	COOLIDGE STATE FOREST
2	27060-002AF	COOLIDGE STATE FOREST
3	27060-002AH	COOLIDGE STATE FOREST
3	27060-002AI	COOLIDGE STATE FOREST
3	27060-002AJ	COOLIDGE STATE FOREST
2	27060-002AK	COOLIDGE STATE FOREST

Appendix 1

List of Windy State Parcels with Compatibility Rating

Compatibility between Existing State Land Use Objectives and Wind Energy Development		
1	Potentially Compatible	May have qualities potentially compatible with management objectives
2	Restrictive	Legal restrictions may apply but only to part of the area. Inconsistent with management plan, and/or may threaten sensitive natural resource features in at least part of the area.
3	Prohibited	Conflicts with legal restrictions (i.e. conservation easement, deed restriction, funding requirement, permit condition, statutory conditions, etc.)
4	Undetermined	No management plan currently exists, is outdated or is currently under development. Resource information may be lacking.

Compatibility Rating (ANR Input)	POLYID	Name
3	27060-002C	COOLIDGE STATE FOREST
1	27060-002D	COOLIDGE STATE FOREST
3	27060-002E	COOLIDGE STATE FOREST
2	27060-002R	COOLIDGE STATE FOREST
2	27060-002Z	COOLIDGE STATE FOREST
3	27070-007A	ARTHUR DAVIS WILDLIFE MANAGEMENT AREA
2	27075-004E	RILEY BOSTWICK WILDLIFE MANAGEMENT AREA
1	27075-005A	MOUNT CUSHMAN STATE FOREST
3	27095-002W	LES NEWELL WILDLIFE MANAGEMENT AREA
2	27115-001A	ASCUTNEY STATE PARK

Appendix 2

U.S. Forest Service Management Areas
and
Wind Development Compatibility Categories

Wind Development Categories	USFS Management Areas	Description
1	2.1A	Trees of many ages and sizes where roaded recreation is offered. Recreation, aesthetic and wildlife benefits will be emphasized. Uneven aged management of timber will be used.
1	2.1B	Similar to 2.1A except no commerical timber management will occur.
1	2.2A	Similar to 2.1A except semi-primitive recreation will be offered.
1	2.2B	Similar to 2.2A except no commercial timber management will occur.
1	3.1	Mosaic of vegetative conditions, wildlife, high quality sawtimber and roaded natural recreation.
1	4.1	Deer winter areas where roaded recreation opportunities exist. Predominantly softwoods providing stable deer habitat for deer.
1	4.2	Similar to 4.1 except semi-primitive recreation opportunities will exist.
3	5.1	Wildnerness. Managed according to the provisions of the Wilderness Act of 1964.
3	6.1	Primitive areas provide opportunities to experience solitude and remoteness in a primitive setting. The areas will appear entirely natural, will have no roads, no timber harvesting, and few visitors.
3.	6.2A	Semi-Primitive areas have few open roads, and appear almost entirely natural. Wildlife and timber management activities are selected, scheduled and located to ensure that backcountry recreation is protected.
3	6.2B	Similar to 6.2A except no commercial timber management will be performed.
1	7.1	Highly developed recreation areas, include downhill ski areas and high density campgrounds.
3	8.1	Special areas have uncommon or outstanding biological, geological, recreational, cultural or historic significance. Acreage does not include special trail corridors.
4	9.2	New acquired lands where future management options will be kept open until inventories can be done.
1	9.3	Potential ski area expansion will be kept open on the lands until specific proposal are received and studied.