

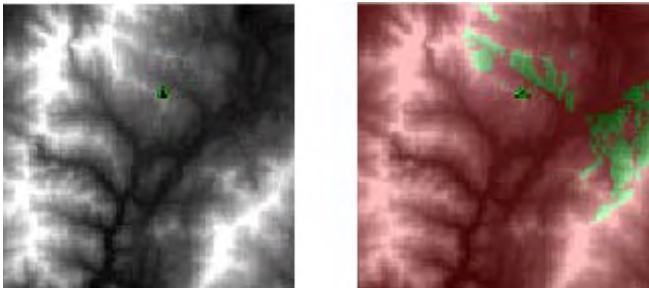
Appendix A: Methodology for Performing a viewshed analysis

Viewshed identifies the cells in an input raster that can be seen from one or more observation points or lines. Each cell in the output raster receives a value that indicates how many observer points can be seen from each location. If you have only one observer point, each cell that can see that observer point is given a value of 1. All cells that cannot see the observer point are given a value of 0. The observer points feature class can contain points or lines. The nodes and vertices of lines will be used as observation points.

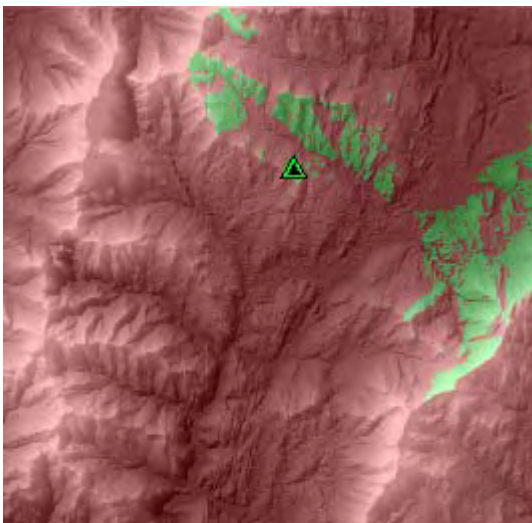
Why calculate viewshed?

Viewshed is useful when you want to know how visible objects might be—for example, from which locations on the landscape will the water towers be visible if they are placed in this location? or What will the view be like from this road?

In the example below, the viewshed from an observation tower is identified. The elevation raster displays the height of the land (darker locations represent lower elevations), and the observation tower is marked as a green triangle. The height of the observation tower can be specified in the analysis. Cells in green are visible from the observation tower, and cells in red are not visible.



Displaying a hillshade underneath your elevation and the output from the Viewshed function is a useful technique for visualizing the relationship between visibility and terrain.

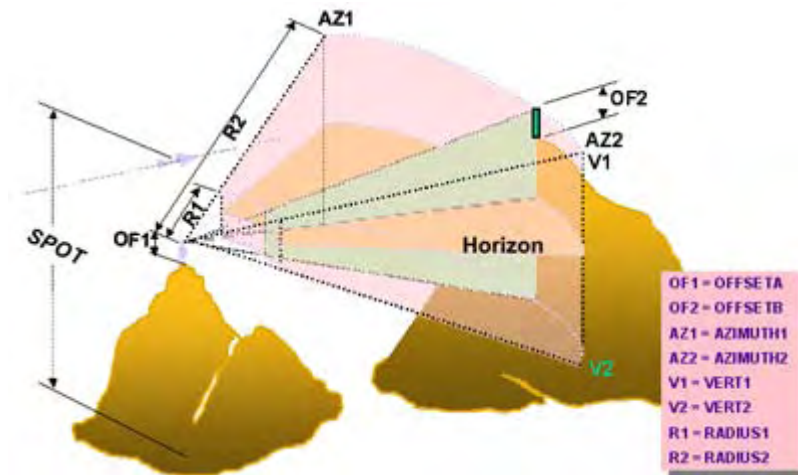


Not only can you determine which cells can be seen from the observation tower, if

you have several observation points, you can also determine which observers can see each observed location. Knowing which observer can see which locations can affect decision making. For example, in a visual quality study for siting a landfill, if it is determined that the proposed landfill can only be seen from dirt roads and not from the primary and secondary roads, it may be deemed a favorable location.

Controlling the viewshed

The image below graphically depicts how a viewshed is performed. The observation point is on the mountain top to the left (at OF1 in the image). The direction of the viewshed is within the cone looking to the right. You can control how much to offset the observation point (for example, the height of the tower), the direction to look, and how high and low to look from the horizon.

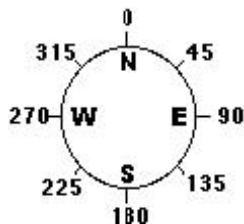


There are nine characteristics of the viewshed that you can control:

1. The surface elevations for the observation points (Spot)
2. The vertical distance in surface units to be added to the z-value of the observation points (OffsetA)
3. The vertical distance in surface units to add to the z-value of each cell as it is considered for visibility (OffsetB)

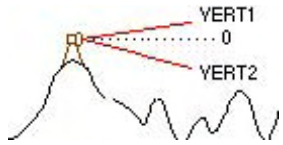


4. The start of the horizontal angle to limit the scan (Azimuth1)
5. The end of the horizontal angle to limit the scan (Azimuth2)

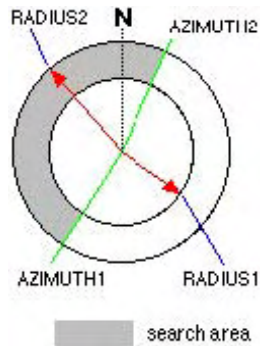


6. The top of the vertical angle to limit the scan (Vert1)

7. The bottom of the vertical angle to limit the scan (Vert2)



8. The inner radius that limits the search distance when identifying areas visible from each observation point (Radius1)
9. The outer radius that limits the search distance when identifying areas visible from each observation point (Radius2)



Source: ESRI, ArcGIS Help Files, “Performing a viewshed analysis, General concepts of spatial analyst tools”, Version 9.1, 2005

APPENDIX B

TABLE OF VIEWS

APPENDIX B

Table of Views

KIBBY WIND PROJECT

Table of Views

The following table provides a summary of viewpoints of the proposed Kibby Wind Project. Photographs illustrating most locations are found in Appendix C. Viewpoints from which simulation photomontages were created are noted (see Appendix D) and calculated to the closest and the farthest turbine. Viewpoints are generally organized from closest to farthest away. Duration of view indicates an approximate distance of possible views along segments identified. The number of turbines indicates all potential turbines that can be seen along a segment of travel. Not all will necessarily be seen from individual points.

Viewpoint/ Photo #	Location	Distance To Nearest/Farthest Visible Turbine (miles)	Approximate Duration of View (miles)	Number of Turbines in View	Notes
1	Spenser Bale Road	.2/4	.5	15	Spenser Bale Road is a private logging road and would provide access to the proposed project. It runs along the southern end of the Series A ridge. Logging activities open up views to both the Kibby Range and to turbines along Kibby ridge (series A)
2 Simulation	Kibby Mountain Fire Tower	.6/7.1	Point	44	Seen as part of a 360° panorama within relatively narrow arc to south and southwest; project viewed below the observer and seen with backdrop of distant mountains; portions of roads and project site clearing will be visible.
3a-f	Gold Brook Road	.8/3.3	.5 Intermittently	27	This is one of the more heavily used private logging roads in the area. Project ridges are glimpsed intermittently and in some cases portions would be seen directly ahead in views.
4a/b	Wahl Road	1.1/4.7	.5 Intermittently	26	Turbines as well as the substation, collector lines and transmission line will be visible along Wahl Road. Currently there is extensive logging activity along this road.
5 Simulation	Route 27	1./6	.5 Intermittently	22	Visible from the vicinity of Vine Road and around Sarampus Falls Picnic Area; most views along Route 27 are of other area mountains. Possibility of views from Stratton village but intervening buildings and trees combined with the distance (10 miles) will make them extremely difficult to see.

6 Simulation	Sarampus Falls Picnic Area	1.4/1.9	Point	6	The turbines will be difficult to see from the picnic area but the tops of turbines will be visible from the grassy area near the River and Falls.
7	Chain of Ponds	1.9/3.8	1 mile Intermittently	15	Only three turbine blades will be visible from Natanis Pond, but more will be visible along the eastern sides at the lower end of the Chain of Ponds, especially from Lower Pond.
8	Spectacle Pond	3.6/6.1	2/3 of pond	12	Viewshed analysis indicates potential views of up to 12 turbines from the eastern side of the pond.
9 Simulation	Jim Pond	4/7.5	Most of Pond	24	The project would not be visible from the boat launch areas or campsites, but a portion of the Kibby Range (Series B) would be visible from camps around the pond and from the pond itself.
10	King and Bartlett Lake	7.5/9.7	Half of Pond	16	The project will be visible from the southeastern portions of the pond. It would not be visible from the camp area.
11a-b Simulation	Eustis Ridge Porter Nideau Road	9/15	.2	42	Project would be glimpsed from the road in two locations by open meadows but more visible to homes in the area.
12	Flagstaff Road/Dead River Causeway	9.9/15.1	.1	37	The causeway crosses the Dead River with lovely views looking south to the Bigelow Range; the Kibby Range (Series B) is visible to the northwest.
13a/b	Flagstaff Lake	10-20	Half the Pond	44	Larger trees along the shoreline block many views around the lake, but the project would be visible from some open water areas and from a few campsites such as Safford Brook,. Views around the lake tend to be focused on the dramatic Bigelow Range
14	Tim Pond	11/18	¼ of Pond	24	Project may be visible from the southern portions of Tim Pond
15	Flagstaff Mountain Road	11.3/15	.1	44	At the height of land on the flanks of Flagstaff Mountain there is a viewpoint overlooking Flagstaff Lake. The Kibby ranges are visible at the edge of the view.
16	Cranberry Peak	15/20	Point	44	A popular and relatively easy hike in the Bigelows with a broad panorama including the Kibby ranges.

17 Simulation	Bigelow Range/Appalachian Trail ¹	15.7/20	.5	44	The project ridges are seen in the background with a backdrop of more distant mountains so that the turbines would be difficult to see. Part of large panorama of views. Clearing for the transmission line as it crosses the Bigelow preserve may be visible from some vantage points on the Bigelow range.
18	Crocker Mountain	21/27	Point		Only a portion of the project ridges are seen from this viewpoint. The Bigelow Range is prominent in the foreground while the Kibby ranges are seen in the background along with other mountains.
19	Jackman Rest Area	21/27	Point		A relatively small portion of the Kibby range is visible from this point. Numerous intervening ridges and great distance would make the project difficult to see.

¹ The Appalachian Trail and the Jackman Rest Area are outside the 15-mile study area but are included here as significant viewpoints just beyond 20 miles of the nearest turbine. Data for numbers of turbines in the view is not available outside the 20-mile radius study area.

APPENDIX C

PHOTOGRAPHS

- **Views of Project Site**
- **Views of Project Site from Surrounding Areas**
- **Views of Transmission Line Crossing Locations**

APPENDIX C

Photographs of the Site and Surrounding Areas

VIEWS OF THE PROJECT SITE



Photo 1a. A Series (Kibby Mountain)
View to met tower from Spencer Bale Road



Photo 1b. View to B2 Meteorological Tower from Logging Road on Site

VIEWS OF THE KIBBY PROJECT RIDGES FROM SURROUNDING AREAS

The following photographs illustrate views from roads and recreation areas surrounding the projects site. Photo numbers are keyed to the Viewshed Maps (Appendix A). Photographs are unavailable for a few points for which visibility was determined from the viewshed map only. For several of the viewpoints simulation photographs illustrating how the project would appear can be found in Appendix D. All photographs were taken at a 50mm equivalent focal length unless otherwise noted. Distances to the nearest proposed turbine are indicated in parentheses. In a few instances, photographs illustrate views seen from the viewpoint in directions other than toward the project site (e.g photos 2c-h from Kibby Mountain Fire Tower and views toward the Bigelow and Sugarloaf-Saddleback Ranges).

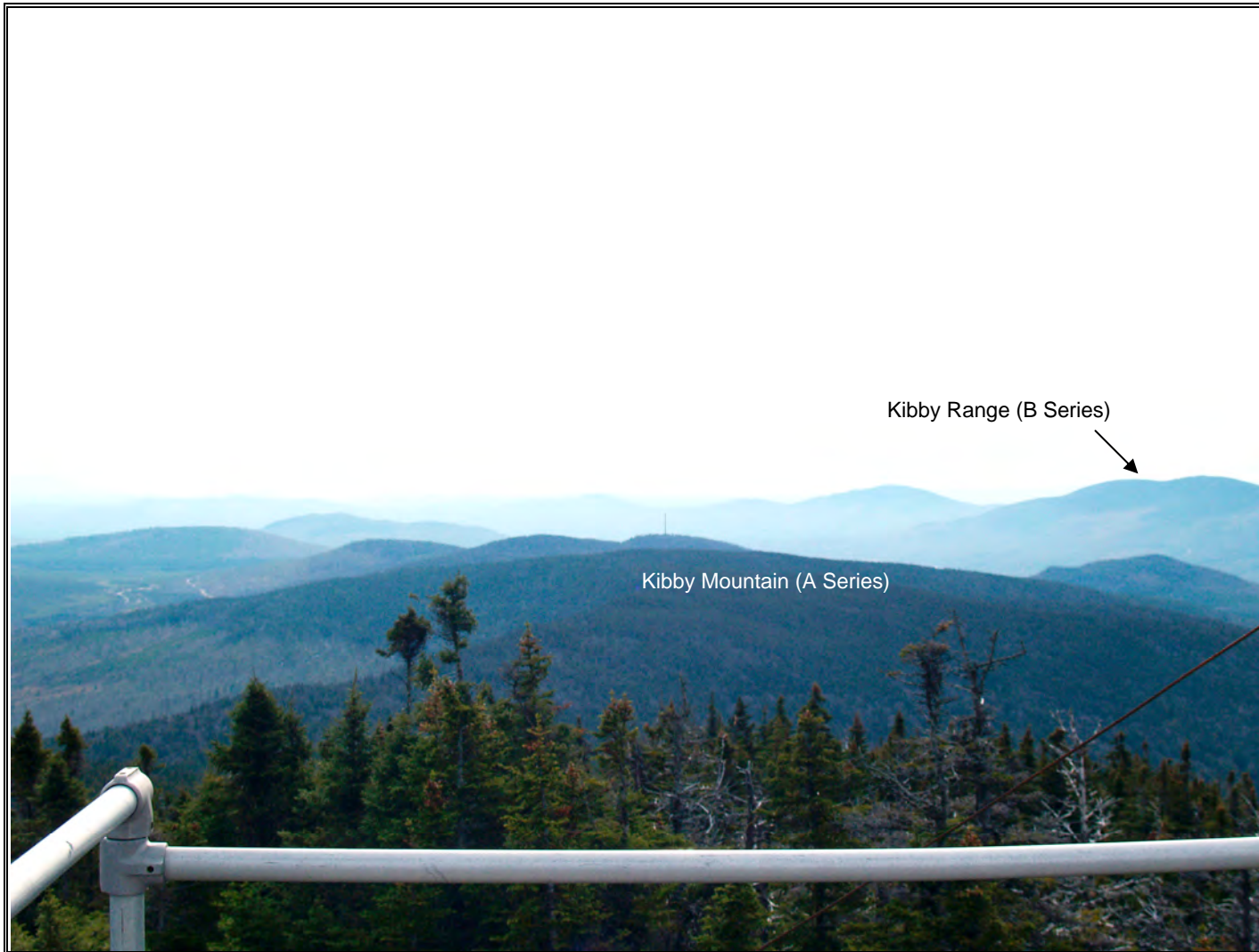


Photo 2a. Kibby Mountain Fire Tower (.7)
A Series ridge is directly ahead with the met tower visible.

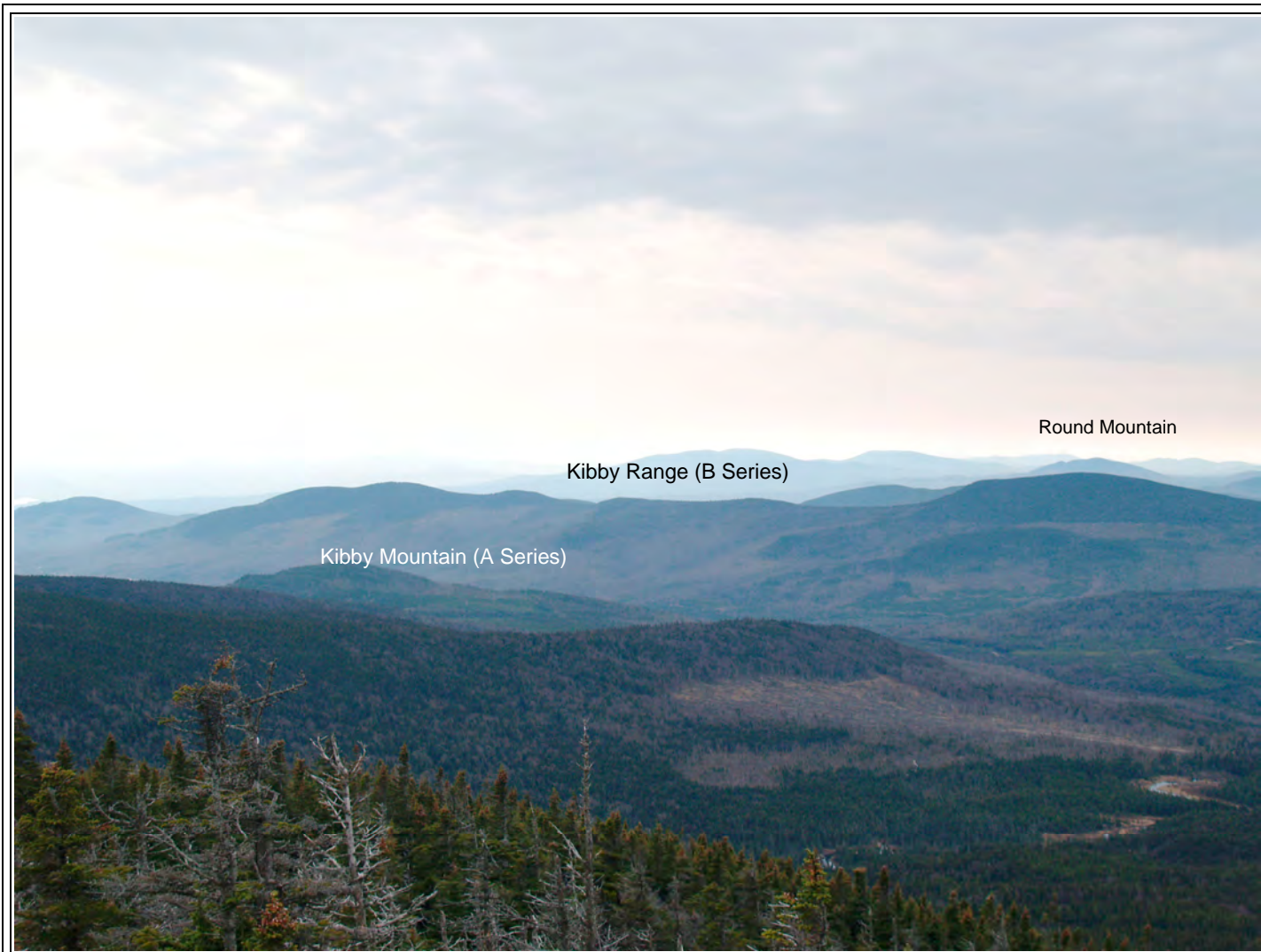


Photo 2b. Kibby Mountain Fire Tower (.7)
Looking southwest over foreground ridge (A Series) to Kibby Range beyond (B Series)

Views Around Kibby Mountain Outside the Project Area¹

The following six photographs illustrate the panorama of views from the Kibby Mountain Fire Tower in which the project would not be seen.



Photo 2c. Southeast of project site to King and Bartlett Lake
Spenser Bale Mountain at left



Photo 2d. Southwest of project site to Gold Brook Road in Valley,
and unnamed mountains to right.

¹ Views toward Flagstaff Lake and the Bigelow and Longfellow Ranges are not illustrated due to extensive haze at that distance on the day of the visit.

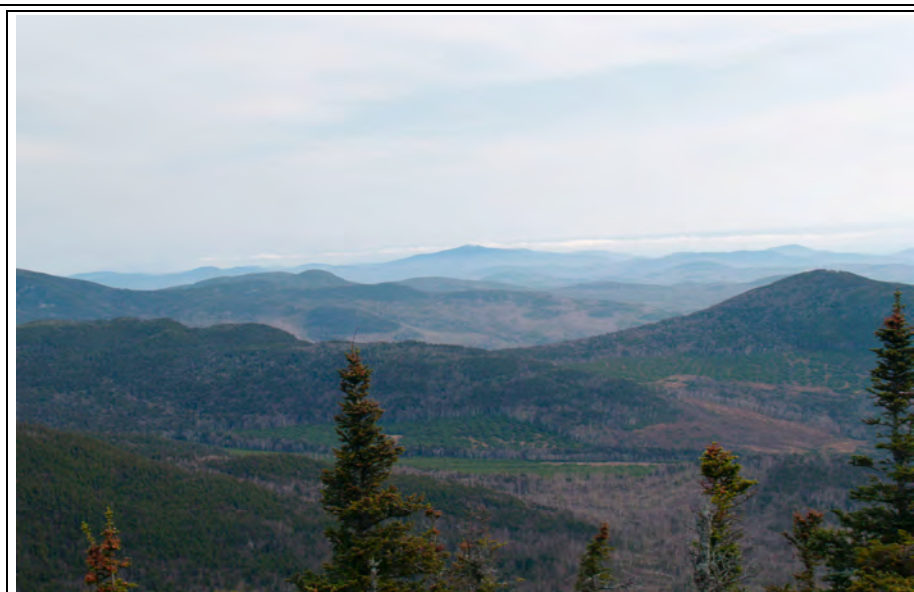


Photo 2e. NE to SpencerBale Mountain (right); Kibby Mountain (left); Tumbledown beyond.

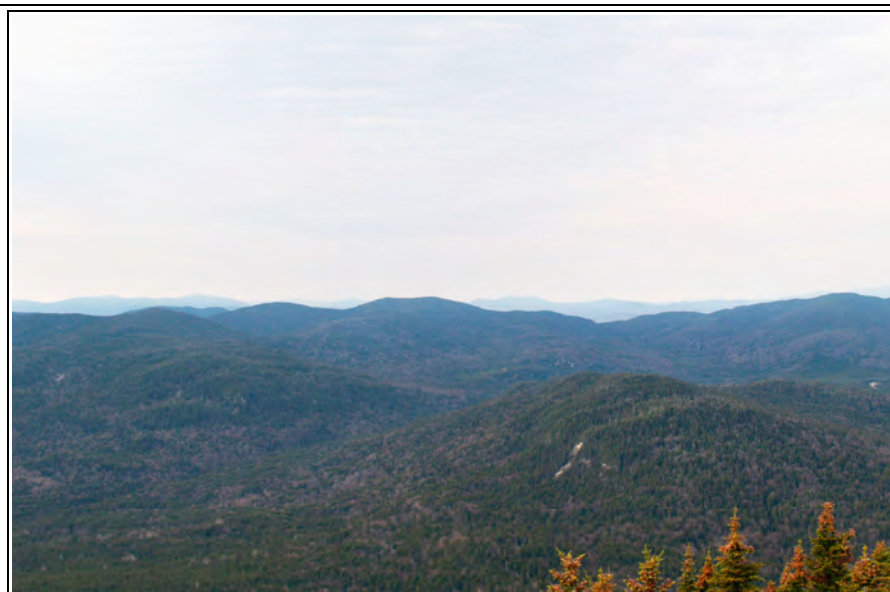


Photo 2f. View West to Unnamed Mountains



Photo 2g. Northeast to Kibby Mountain (foreground ridges); Tumbledown Mountain beyond.

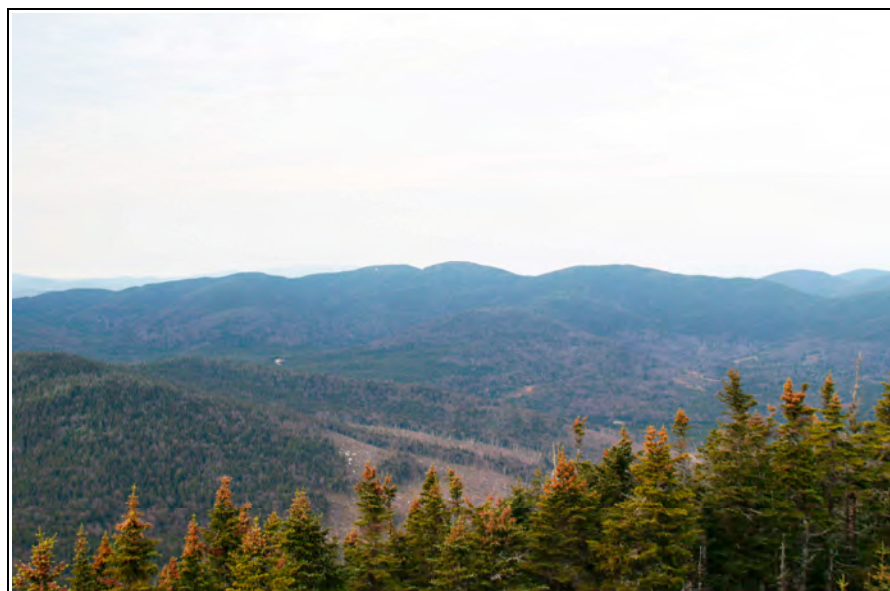


Photo 2h. Northwest to Caribou Mountain



Photo 3a. Gold Brook Road to A Series (Kibby Mountain) (1 mile)



Photo 3b. Gold Brook Road to B Series, Mile 7 (1 mile)



Photo 3c. Gold Brook Road to B Series, Mile 9.5 (1 mile)



Photo 4a. Wahl Road
View of substation site on Kibby Range



Photo 4b. SpencerBale Road (1 mile)
View of Kibby Range (B Series)



Photo 5. Route 27 Near Vine Road (3 miles)
View to a portion of B Series (Kibby Range)



Photo 6. Route 27 Sarampus Falls Rest Area (1.5 miles)
Kibby Range is behind trees.

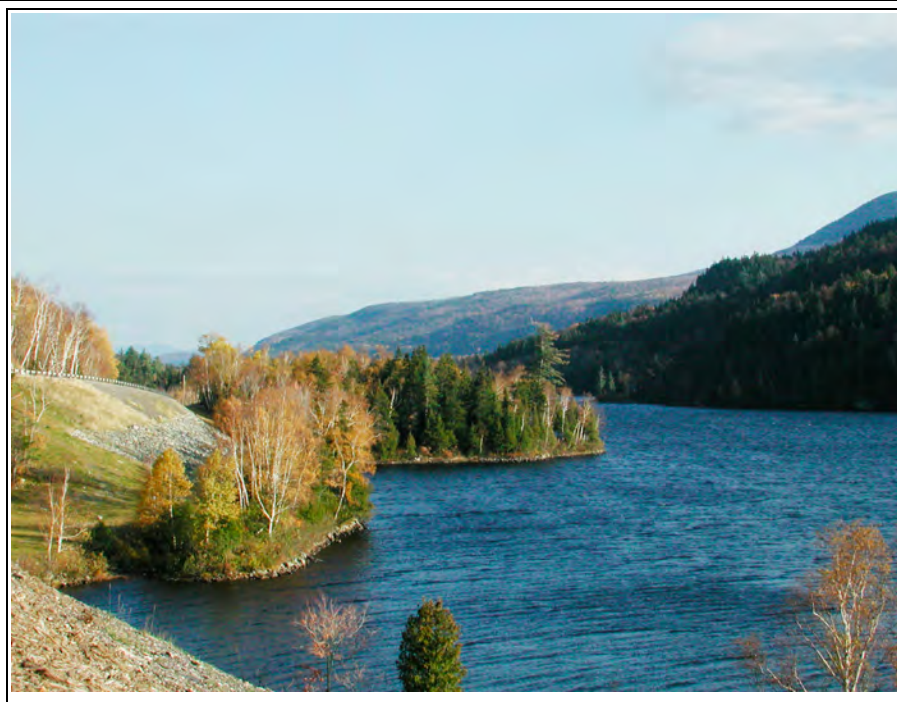


Photo 7a. View of Natanis Pond from Route 27 Overlook
The Proposed Project would not be visible from this point.



Photo 7b. Natanis Pond from Campground Beach (6 miles)
The blades tips of three turbines would be visible over the hill on the left (flanks of Sisk Mountain). The Bigelow Range is seen in the distance at the end of the lake.



Kibby Range (B Series)

Photo 9a Jim Pond (4.8 miles)

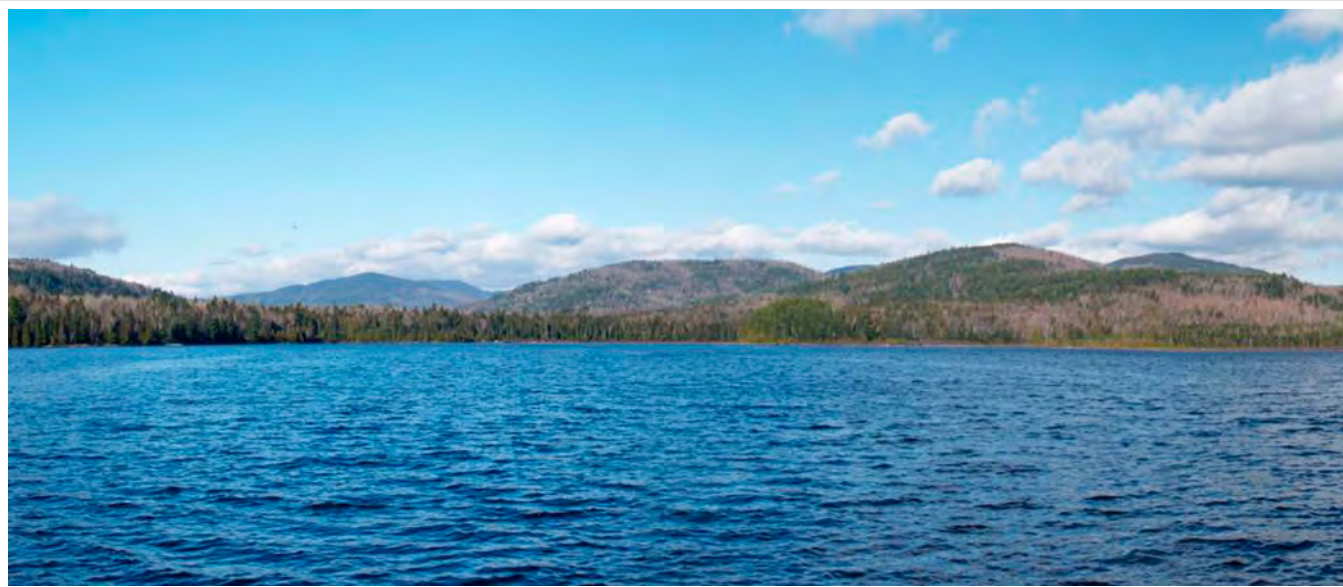


Photo 9b Jim Pond Panorama Looking North



Photo 9c. Jim Pond Panorama Looking West
Bag and Round Mountains are seen in the distance.



Photo 10. View from King and Bartlett Camps
The project would not be visible from Camp but would be from eastern portions of the lake. (7.5 miles)



Photo 11a Porter Nideau Road on Eustis Ridge (8 miles)



Photo 11b. View from Porter Nideau Road, Eustis Ridge (8 miles)
Same view as above in leaf-off conditions.



Photo 11c. Porter Nideau Road on Eustis Ridge (8 miles)
A second viewpoint further east.



Photo 12a. Flagstaff Road Causeway (10 miles)
Looking north to Kibby Range (center) with Antler Hill in Front.

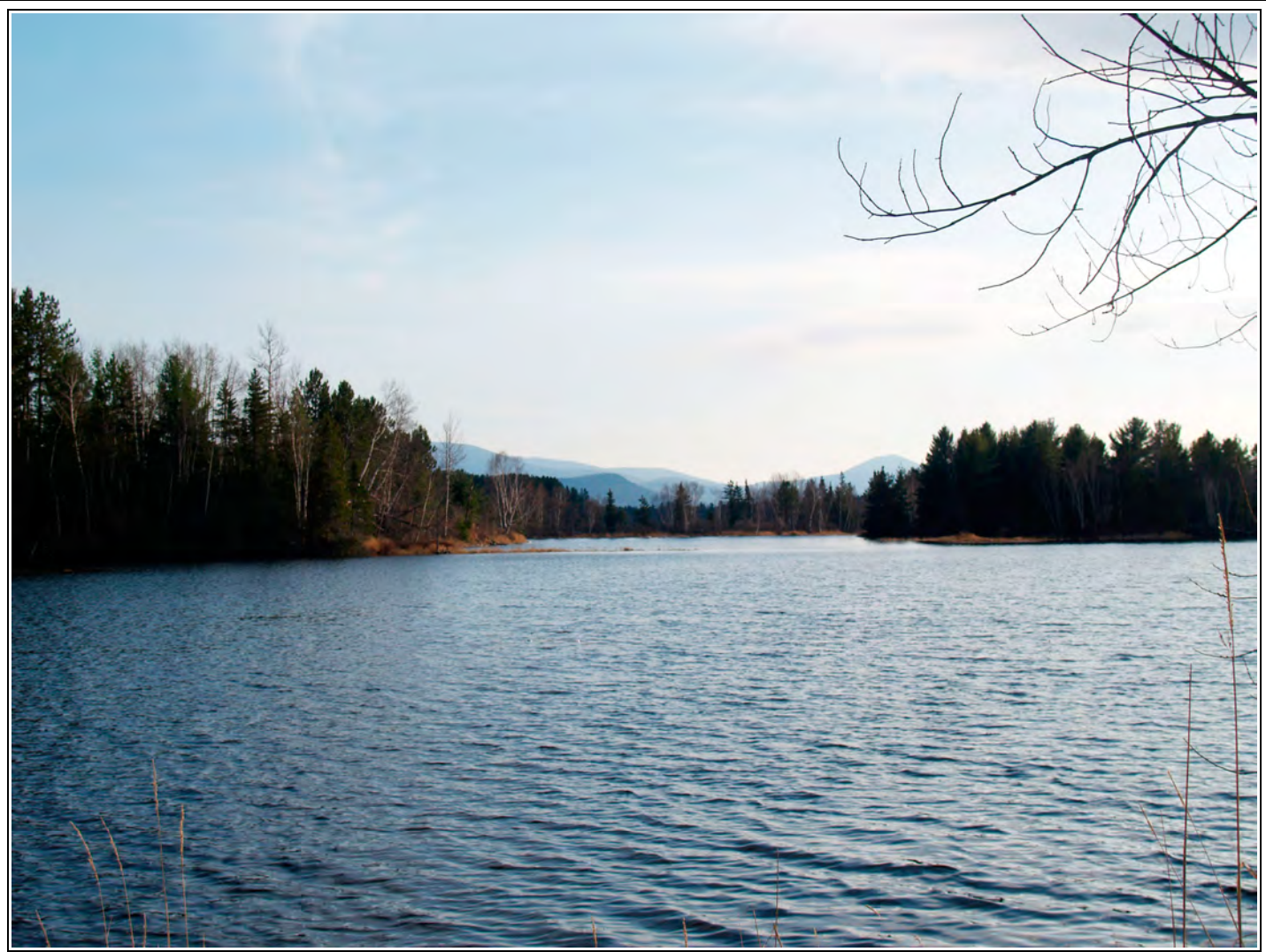


Photo 12b. View from Flagstaff Road Causeway looking south to Bigelow Range



Photo 13a. Flagstaff Lake South Shore (12.5 miles)
From campsite in Bigelow Preserve. Kibby Range is behind trees.

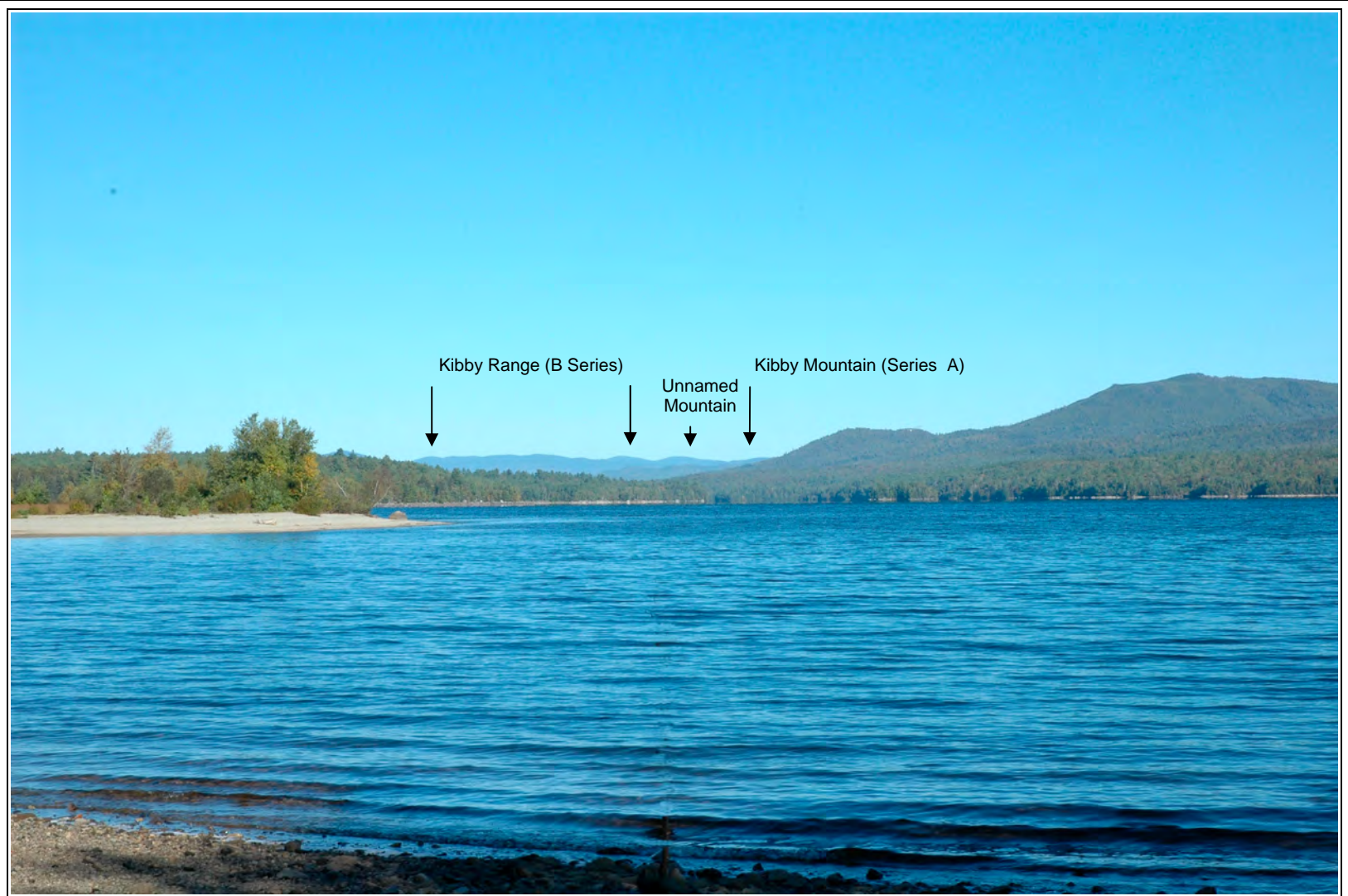


Photo 13b. Flagstaff Lake Safford Brook Campsite (18 miles)

Flagstaff Mountain is in the foreground right; Camera Ridge is in the middleground with Kibby Range beyond left, and the southern end of the Kibby Mountain ridge visible at right beyond Flagstaff Mountain. An unnamed peak is between the two ridges in the background.



Photo 13c. Flagstaff Lake to Bigelow Range
From Campsite along the Southern Shore in Bigelow Preserve



Photo 13d. Flagstaff Lake Cathedral Pines Area to Bigelow Range
Views of the Bigelow Range are dominant around the Lake



Photo 15a. View to Kibby Range from Flagstaff Mountain Road (12 miles)
Kibby Range is seen behind Antler Hill; the highest point on the left is in the clouds.



Photo 15b. Flagstaff Mountain Road panorama.



Photo 17a. View from West Peak, Appalachian, Trail Bigelow Range (17 Miles)
The ridges appear lower than background ridges from this vantage point.



Photo 17b. View from Avery Peak, Appalachian, Trail Bigelow Range



Photo 18. View from Crocker Mountain, Appalachian, Trail Bigelow Range (21.5 miles)
Kibby Mountain is beyond Cranberry Peak (left). The proposed project would be to the south (left) of Kibby Mountain.

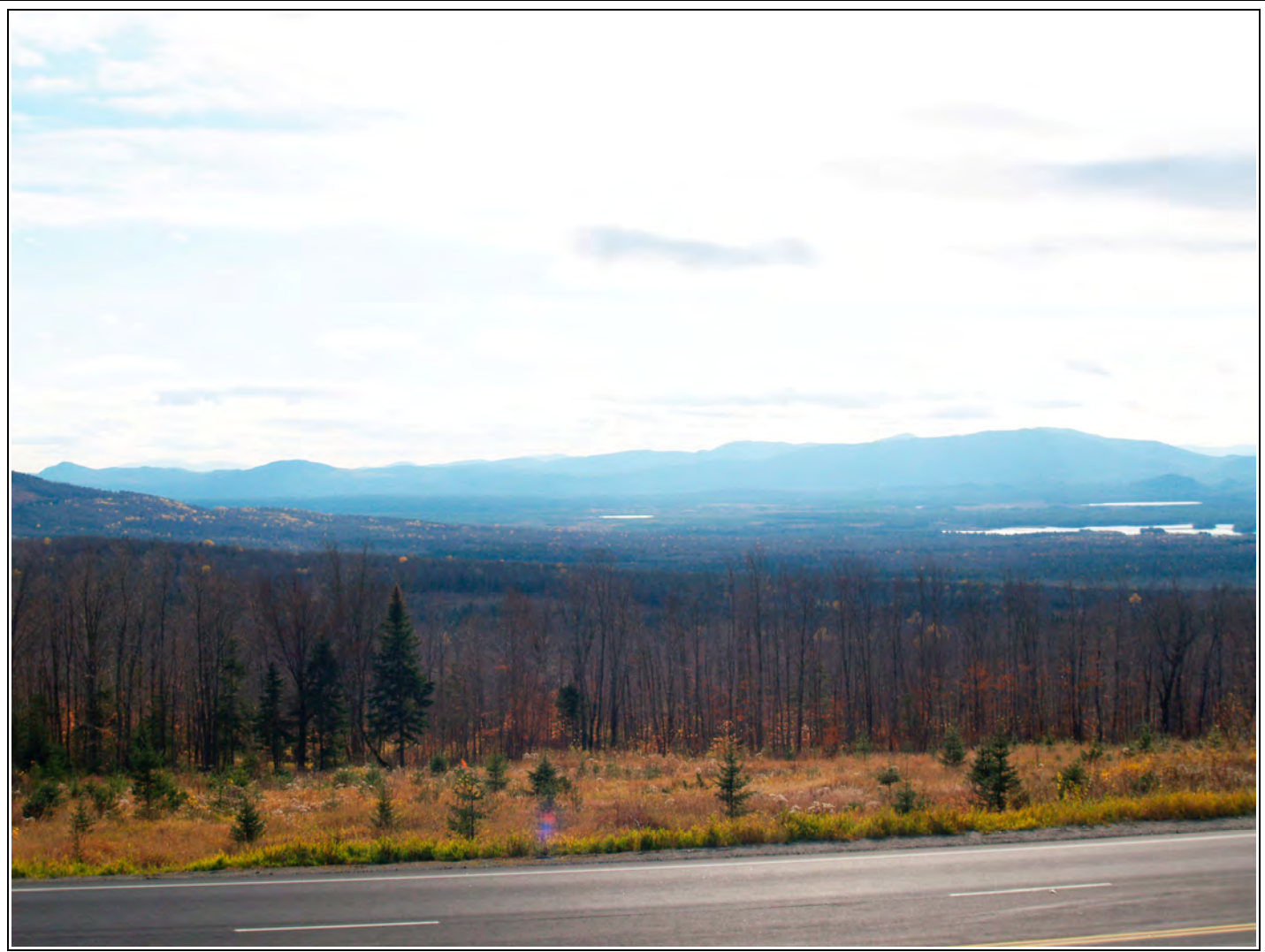


Photo 19a. View from Jackman Rest Area Route 201 (21 miles)
The proposed project is largely behind foreground ridges and would be difficult to see.



Kibby Range (B Series)



Three-Slide Mountain

Tumbledown Mountain

No. 5 Mountain

Photo 19b. Telephoto View from Jackman Rest Area, Route 201 (21 miles)
Only a small portion of the Kibby Range (B Series) can be seen behind other foreground mountains.

VIEWS OF TRANSMISSION LINE CROSSING LOCATIONS

The following photographs illustrate locations where the proposed 115kV transmission line would cross state roads and the Appalachian Trail. At both the Appalachian Trail and the Route 16/27 crossings (below), the line would parallel the existing Boralex line which can be seen in both photographs, and the visual impacts would be very similar. The lower photographs illustrate the Route 16 crossing and Route 27 (north of Stratton) crossing locations. Trucks or people are shown at the crossing locations.



Photo 20a. Existing Boralex 115kv Transmission Line At AT Crossing
Most plantings are very dense and the line is difficult to see. The proposed line would be similarly screened



Photo 20b. Route 16/27 115kv Crossing Looking North
Only the wires are visible at the crossing of the existing Boralex line; poles would be similarly set back from the road with the proposed line.



Photo 20c. Route 16 Transmission Crossing Looking North.

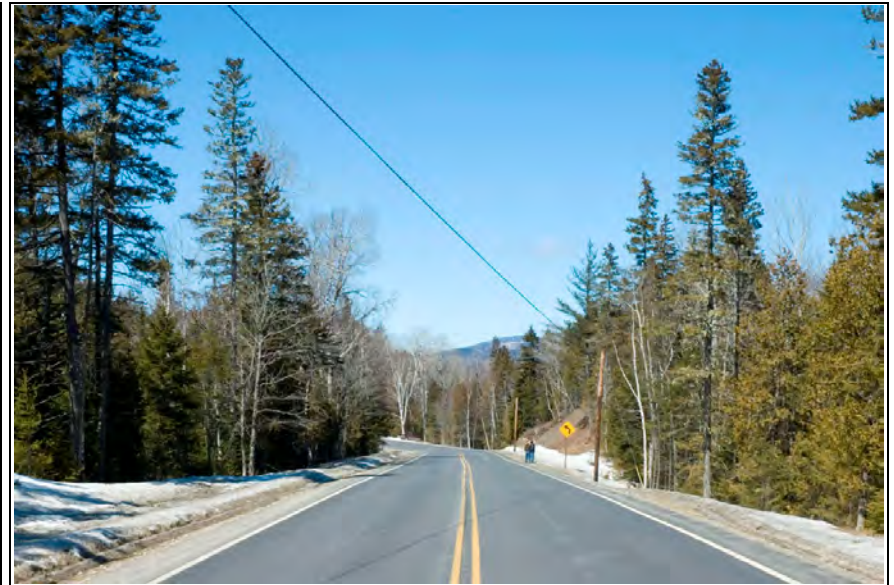


Photo 20d. Route 27 Crossing Looking North

APPENDIX D

SIMULATIONS

- **Kibby Mountain Fire Tower Southeast**
- **Kibby Mountain Fire Tower South**
- **Kibby Mountain Fire Tower Composite**
 - **Route 27 Near Vine Road**
- **Sarampus Falls Picnic Area (Route 27)**
 - **Jim Pond**
- **Porter Nideau Road, Eustis Ridge**
 - **Avery Peak**
 - **Simulation Methodology**



Note:

This panorama was created from the montages shown for Viewpoint 1a and Viewpoint 1b. For technical information on the montages, please refer to the figures for those viewpoints.

Prepared for:



Jean E. Vissering Landscape Architecture

Prepared by:

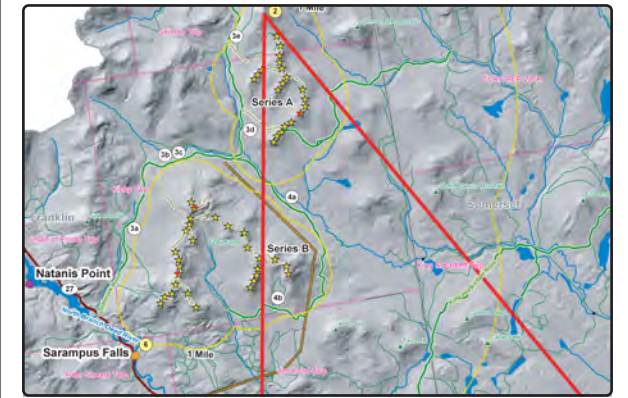


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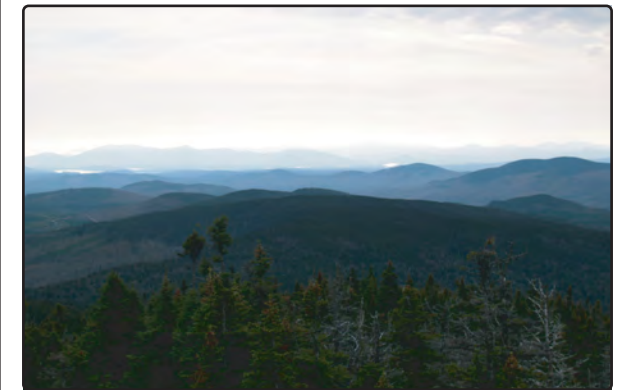
Xtra-Spatial Productions, LLC.



Viewpoint Location Map






Original Image



Technical Information

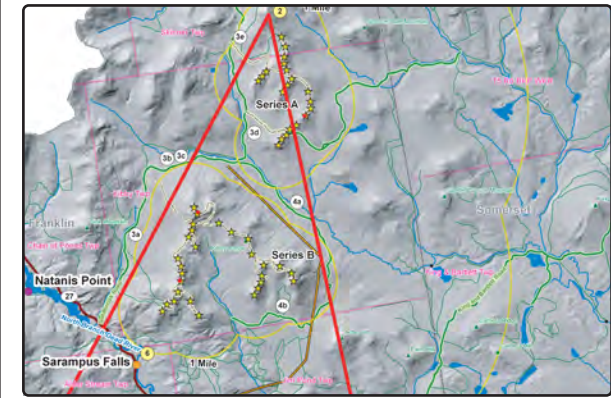
Turbine Information	
Turbine Model	V90-3.0 MW
Hub Height	80 meters
Rotor Diameter	90 meters
Turbine Layout Date	November 7th, 2006
Viewpoint Information	
Waypoint #	057
View Coordinates (easting, northing)	379184.87 m, 5030711.81 m
Viewpoint Location	Kibby Mountain Firetower
Viewer Elevation	1109.2 m / 3639.06 ft.
Angle of View / H.F.O.V.	159.25° / 40.0°
Distance to Closest Turbine	.587 Mi (TURA01)
Distance to Farthest Turbine	7.090 Mi (TR B-16)
Camera Model	Olympus E500
Lens Setting	50mm
f-Stop	6.3
Date and Time	2006/11/11-11:30:26
Proper Viewing Distance	16.19 inches

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 Prepared by:  Jean E. Vissering Landscape Architecture
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 Xtra-Spatial Productions, LLC.

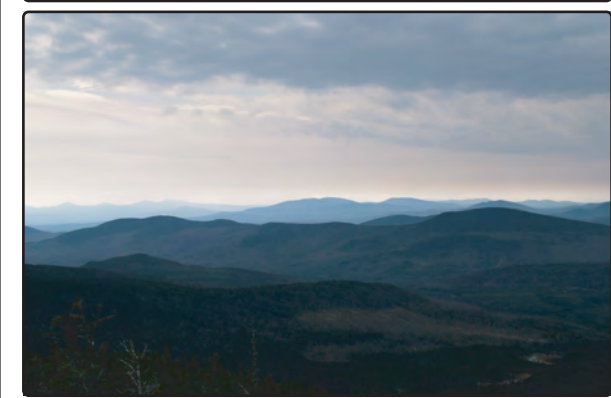
Viewpoint #2a: Kibby Mountain Fire Tower Southeast



Viewpoint Location Map




Original Image



Technical Information

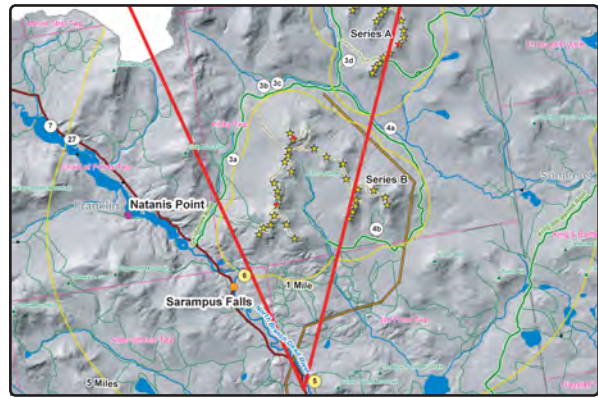
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<i>Rotor Diameter</i>	90 meters
<i>Turbine Layout Date</i>	November 7th, 2006
Viewpoint Information	
<i>Waypoint #</i>	057
<i>View Coordinates (easting, northing)</i>	379184.87 m, 5030711.81 m
<i>Viewpoint Location</i>	Kibby Mountain Firetower
<i>Viewer Elevation</i>	1109.2 m / 3639.06 ft.
<i>Angle of View / H.F.O.V.</i>	186.75° / 40.0°
<i>Distance to Closest Turbine</i>	.587 Mi (TURA01)
<i>Distance to Farthest Turbine</i>	7.090 Mi (TR B-16)
<i>Camera Model</i>	Olympus E500
<i>Lens Setting</i>	50mm
<i>f-Stop</i>	7.1
<i>Date and Time</i>	2006/11/11-11:30:40
<i>Proper Viewing Distance</i>	16.19 inches

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 Xtra-Spatial Productions, LLC.

Viewpoint #2b: Kibby Mountain Fire Tower South



Viewpoint Location Map



Original Image



Technical Information

Turbine Information	
<i>Turbine Model</i>	V90-3.0 MW
<i>Hub Height</i>	80 meters
<i>Rotor Diameter</i>	90 meters
<i>Turbine Layout Date</i>	November 7th, 2006
Viewpoint Information	
<i>Waypoint #</i>	064
<i>View Coordinates (easting, northing)</i>	376818.76 m, 5013878.65 m
<i>Viewpoint Location</i>	Rte. 27 - near Vine Road
<i>Viewer Elevation</i>	376.458 m / 1235.08 ft.
<i>Angle of View / H.F.O.V.</i>	353.75° / 38.58°
<i>Distance to Closest Turbine</i>	13.644 Mi (TR B-25)
<i>Distance to Farthest Turbine</i>	19.162 Mi (TURA01)
<i>Camera Model</i>	Olympus E500
<i>Lens Setting</i>	50mm
<i>f-Stop</i>	5.0
<i>Date and Time</i>	2006/11/11-14:31:15
<i>Proper Viewing Distance</i>	16.90 inches

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 STONE ENVIRONMENTAL INC
 Xtra-Spatial Productions, LLC.

Viewpoint #5: Route 27 Near Vine Road



Viewpoint Location Map



Original Image



Technical Information

Turbine Information	
<i>Turbine Model</i>	V90-3.0 MW
<i>Hub Height</i>	80 meters
<i>Rotor Diameter</i>	90 meters
<i>Turbine Layout Date</i>	November 7th, 2006
Viewpoint Information	
<i>Waypoint #</i>	014
<i>View Coordinates (easting, northing)</i>	374182.24 m, 5017664.42 m
<i>Viewpoint Location</i>	Rte. 27 - Sarampus Falls
<i>Viewer Elevation</i>	375.212 m / 1231.00 ft.
<i>Angle of View / H.F.O.V.</i>	20.15° / 28.07°
<i>Distance to Closest Turbine</i>	1.392 Mi (TR B-14)
<i>Distance to Farthest Turbine</i>	1.949 Mi (TR B-11)
<i>Camera Model</i>	Olympus E500
<i>Lens Setting</i>	50mm
<i>f-Stop</i>	5.0
<i>Date and Time</i>	2006/10/10-09:52:00
<i>Proper Viewing Distance</i>	23.6 inches

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 Prepared by:  Jean E. Vissering Landscape Architecture
 STONE ENVIRONMENTAL INC
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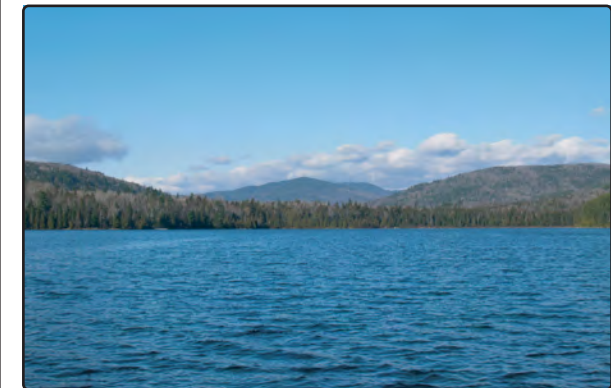
Viewpoint #6: Sarampus Falls Picnic Area



Viewpoint Location Map



Original Image



Technical Information

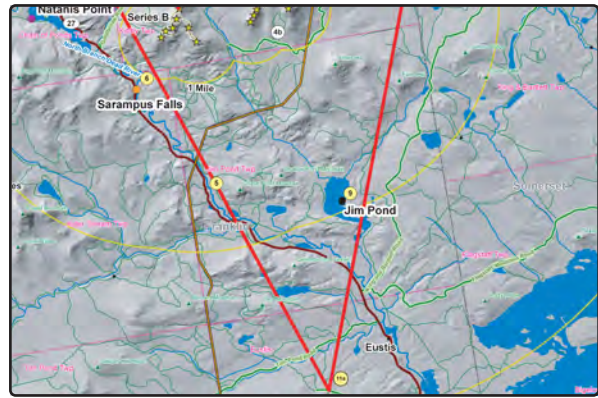
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<i>Rotor Diameter</i>	90 meters
<i>Turbine Layout Date</i>	November 7th, 2006
Viewpoint Information	
<i>Waypoint #</i>	043
<i>View Coordinates (easting, northing)</i>	382047.49 m, 5013318.40 m
<i>Viewpoint Location</i>	Jim Pond
<i>Viewer Elevation</i>	374.76 m / 1229.51 ft.
<i>Angle of View / H.F.O.V.</i>	318.7° / 38.58°
<i>Distance to Closest Turbine</i>	5.064 Mi (TR B-25)
<i>Distance to Farthest Turbine</i>	7.479 Mi (TR B-01)
<i>Camera Model</i>	Olympus E500
<i>Lens Setting</i>	50mm
<i>f-Stop</i>	7.1
<i>Date and Time</i>	2006/11/01-11:45:21
<i>Proper Viewing Distance</i>	16.90 inches

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 Prepared by:  Jean E. Vissering Landscape Architecture
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Viewpoint #9: Jim Pond



Viewpoint Location Map



Original Image



Technical Information

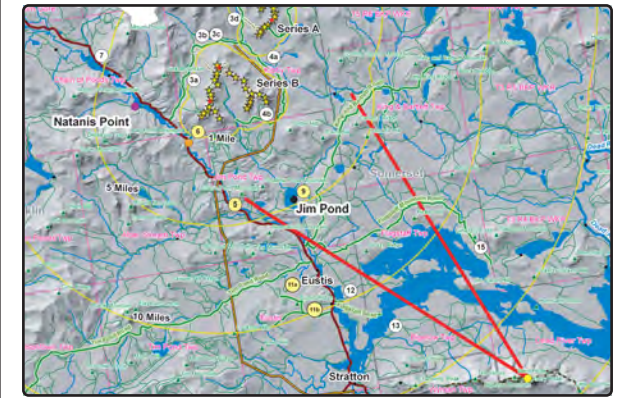
Turbine Information	
<i>Turbine Model</i>	V90-3.0 MW
<i>Hub Height</i>	80 meters
<i>Rotor Diameter</i>	90 meters
<i>Turbine Layout Date</i>	November 7th, 2006
Viewpoint Information	
<i>Waypoint #</i>	067
<i>View Coordinates (easting, northing)</i>	381550.98 m, 5006171.91 m
<i>Viewpoint Location</i>	Eustis Ridge
<i>Viewer Elevation</i>	468.003 m / 1535.42 ft.
<i>Angle of View / H.F.O.V.</i>	349.875° / 39.5°
<i>Distance to Closest Turbine</i>	9.343 Mi (TR B-25)
<i>Distance to Farthest Turbine</i>	15.032 Mi (TURA01)
<i>Camera Model</i>	Olympus E500
<i>Lens Setting</i>	50mm
<i>f-Stop</i>	5.6
<i>Date and Time</i>	2006/11/11-15:23:04
<i>Proper Viewing Distance</i>	16.43 inches

Prepared for:  **Jean E. Vissering Landscape Architecture**
 Prepared by:  **STONE ENVIRONMENTAL INC**
Xtra-Spatial Productions, LLC.

Viewpoint #11a: Porter Nideau Road, Eustis Ridge



Viewpoint Location Map






Original Image



Technical Information

Turbine Information	
<i>Turbine Model</i>	V90-3.0 MW
<i>Hub Height</i>	80 meters
<i>Rotor Diameter</i>	90 meters
<i>Turbine Layout Date</i>	November 7th, 2006
Viewpoint Information	
<i>Waypoint #</i>	None
<i>View Coordinates (easting, northing)</i>	399752.46 m, 5000037.09 m
<i>Viewpoint Location</i>	Avery Peak
<i>Viewer Elevation</i>	1242.66 m / 4076.92 ft.
<i>Angle of View / H.F.O.V.</i>	314.2° / 25.8°
<i>Distance to Closest Turbine</i>	15.698 Mi (TR B-28)
<i>Distance to Farthest Turbine</i>	20.746 Mi (TURA01)
<i>Camera Model</i>	Olympus E500
<i>Lens Setting</i>	50mm
<i>f-Stop</i>	22.0
<i>Date and Time</i>	2006/09/12-12:28:38
<i>Proper Viewing Distance</i>	25.77 inches

Prepared for:  TransCanada In business to deliver
 Prepared by:  Jean E. Vissering Landscape Architecture
 STONE ENVIRONMENTAL INC
 Xtra-Spatial Productions, LLC.

Viewpoint #17: Avery Peak, Appalachian Trail

Appendix D

Methodology Used in Preparing Photomontages for the Proposed Windfarm on Kibby Mountain, Maine

Prepared by James A. Zack, President
Xtra-Spatial Productions, LLC.

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12 December 2006

1. Introduction

A digital photomontage is the end result of a computer graphics operation in which portions of two (or more) digital images are combined or composited into a single digital image. The technique of photomontaging has been used to present photosimulations of proposed construction projects that may alter visual resources such as scenic vistas, skylines, and nighttime scenes. The digital photomontage is a specific type of photosimulation where a portion or portions of a computer-generated scene are “pasted” onto an actual, real-world image captured with a camera in the field. This contrasts with the more prevalent form of photosimulation where the entire image is computer-generated.

The advantage of a digital photomontage over the computer-generated photosimulation lies in the higher degree of verisimilitude—a work with a high degree of verisimilitude means that the work is very realistic and believable; works of this nature are often said to be “true to life”—conveyed by the photomontage since most of the image is derived from an actual image of the subject matter. Moreover, by alternatively displaying the unaltered image and the photomontage, changes can be seen in their natural context.

This document describes the methodology used by Xtra-Spatial Productions, LLC in the creation of a set of photomontages of a proposed forty-seven turbine Windfarm on Kibby Mountain and the Kibby Range near the town of Stratton, Maine.

The requisite inputs and the process of creating a digital photomontage are described below.

2. Required Data

This section describes the requisite data inputs to create a successful digital photomontage.

2.1 Imagery Depicting Baseline Conditions

One of the two imagery streams feeding into the photomontage process is the *in situ* digital image of the scene. A necessary component of this imagery is the data about the image, or the image *metadata*.

For this project, seven digital images were selected to demonstrate the visual impact of the project from six locations in the viewshed of the proposed Windfarm project.

2.1.1 Digital Imagery

This data is the actual digital image captured in the field with one of two digital cameras.

A Nikon D100 six-megapixel digital camera with a fixed-focal-length lens was used to acquire one image (Avery Peak). An Olympus EVOLT E-500 eight-megapixel digital camera with a Zuiko Digital 14-45mm focal length zoom lens was used to acquire digital image from six other locations deemed to be representative of areas where visual resources may be compromised by the construction of the Kibby Mountain Windfarm.

The Nikon D100 captured image was saved as an uncompressed RAW files that was converted to minimally compressed JPEG image with pixel dimensions of 3008 wide by 2000 high. No filter was used on the lens.

The Olympus E-500 captured images as uncompressed Olympus Raw Format (ORF) files with pixel dimensions of 3264 wide by 2448 high. A UV Skylight filter used when capturing the image to reduce haze and the backscattering of light in backlit images.

2.1.2 Metadata for Digital Imagery

Data about the data (metadata) were required to expedite the process of camera matching described in §3.1.2 below. Many of these data are recorded to the JPEG and ORF images and accessible through the Image Editing software Photoshop (Adobe, Inc.).

2.1.2.1 Digital Camera Specifications

The dimensions of the Nikon D100's imaging sensor were needed to assist in determining the horizontal and vertical fields of view of the camera for a specific focal length. From Digital Photography Review (http://www.dpreview.com/reviews/specs/Nikon/nikon_d100.asp), the sensor size is 23.7mm x 15.5 mm.

The dimensions of the Olympus EVOLT E-500's imaging sensor were needed to assist in determining the horizontal and vertical fields of view of the camera for a specific focal length. From the manufacturer's web site (http://www.olympusamerica.com/cpg_section/product.asp?product=1192&fl=4), the sensor size is 17.3mm x 13.0mm.

2.1.2.2 Time of Day

Time of day is captured both on camera's memory card file system and in the file's metadata tags. The owner of the Nikon D100 camera failed to properly set the AM/PM

setting and to advance the time setting to adjust for Daylight Saving Time. The error in the timestamp for the Avery Peak image was corrected by adding 13 hours to it.

The owner of the Olympus EVOLT E-500 camera failed to properly reset the time from Daylight Saving Time for the Eustis Ridge, Jim Pond, and Kibby Mountain images, so the recorded times were actually one hour advanced from actual time. A simple adjustment was made to correct this error.

The time of day is critical for replicating the position of the Sun when simulating illumination of the turbines, meteorological towers, tower pad clearings, roads, and powerline swaths to in the Computer Model.

The times of day for the seven images are presented in Appendix A. Metadata for *In Situ* Digital Images.

2.1.2.3 Day of the Year

The day of the year is captured both on camera's memory card file system and in the file's metadata tags.

The day of the year is critical for replicating the position of the Sun when simulating illumination the turbines, meteorological towers, tower pad clearings, roads, and powerline swaths to in the Computer Model.

The days of the year for the seven images are presented in Appendix A. Metadata for *In Situ* Digital Images.

2.1.2.4 Location of Camera

A GPS unit was used to capture the 2D (latitude and longitude, but not elevation) of the location of each camera station. These locations were used to create an ESRI Shapefile in the WGS 83 Geographic (latitude and longitude) coordinate system. The names of the locations are referred to in the text and Appendix as:

- Sarampus Falls
- Avery Peak
- Eustis Ridge
- Route 27 near Vine Road
- Jim Pond
- Kibby Mountain (two images were recorded here, one towards Series A turbines, the other towards Series B turbines)

The locations of the camera stations were examined in ArcMap (ESRI, Inc.) using USGS Digital Raster Graphics (described in §2.2.1.4) and a digital representation of the road network as a backdrop to ascertain the validity of the coordinates.

The location of the cameras is crucial in replicating the camera positions in the Computer Model.

2.1.2.5 Orientation of Camera

The parameters defining the exterior orientation of the camera are crucial for the camera matching operation described in §3.1.2 below. These parameters include:

- *Bearing* of the camera's optical axis in compass degrees using true North (as opposed to magnetic North) as zero degrees; this measure is also known as the *azimuth* of the camera or the camera's *heading*; the bearing was measured in the field using an orienteering compass aligned to the camera lens; the values were bearings from magnetic North; these were converted to bearings from true North by subtracting 13.78 degrees (as determined by the GeoMag software version 2.3.0.0). For unknown reasons, the field measurements were not accurate enough to achieve acceptable camera matching on their own; instead they served only as an initial estimate of bearing for the empirical method of camera matching described in §3.1.2 below.
- *Inclination* or *pitch* of the camera's optical axis, where a perfectly horizontal camera has a pitch of zero degrees, and a camera pointing straight up has a pitch of -90 degrees. This information was not captured in the field, but rather estimated by the camera matching method described in §3.1.2 below.
- *Bank* (or *tilt* or *roll*) of the vertical axis of the camera's sensor; ideally, there should be no bank in the camera, but unless a bubble level is incorporated into the camera body, this is a difficult proposition. Bank was not recorded in the field, but estimated using the camera matching method described in §3.1.2 below.
- *Horizontal Field of View (HFOV)* of the lens which has a trigonometric relation to the focal length of the lens and the image sensor (defined in §2.1.2.1 above); the HFOV can be calculated as

$$(1) \quad \text{HFOV} = 2 * \tan^{-1}((\text{image sensor width} / 2) / \text{focal length})$$

All Olympus E-500 images were taken with a (nominal) 25mm focal length setting on the zoom lens. While not verified by the author, the 25mm focal length reported in the images' metadata is presumed to be an estimate with precision no better than 1mm. Assuming a 25mm focal length, the HFOV for this image is calculated as

$$(2) \quad \begin{aligned} \text{HFOV} &= 2 * \tan^{-1}((17.3\text{mm} / 2) / 25.0\text{mm}) \\ &= 2 * \tan^{-1}(0.346) \\ &= 38.17^\circ \end{aligned}$$

The Nikon D100 image was taken with a fixed focal length lens of 50mm. The HFOV for this image is calculated as

$$(3) \quad \begin{aligned} \text{HFOV} &= 2 * \tan^{-1}((23.7\text{mm} / 2) / 50.0\text{mm}) \\ &= 2 * \tan^{-1}(0.237) \\ &= 26.66^\circ \end{aligned}$$

2.1.2.6 Atmospheric Conditions

In order to match the atmospheric conditions of the Computer Model with that of the imagery, a qualitative assessment of the amount of haze and direct light is needed. The images were acquired on four separate days, September 12th, October 10th, November 1st and November 11th. The September 12th Avery Peak, October 10th Sarampus Falls, and November 1st Jim Pond images all appeared to be illuminated a full Sun (*i.e.*, there was no partial obscuration by clouds) with only a light haze present. A linear haze model with a 90km 100% haze (all colors blend to a light blue hue beyond this distance) was used in the Computer Model for rendering these images. Furthermore, to simulate bright sunlight and light haze, a small amount of ambient light was included in the atmosphere component of the Computer Model. This provides more contrast between directly illuminated portions of the render and those portions illuminated by only ambient light.

The November 11th images from Route 27 near Vine Road, Eustis Ridge, and Kibby Mountain all show a sky with heavy overcast conditions and much more haze. For these images a Sun with 25% of its rays absorbed or reflected (*i.e.*, only 75% intensity) was used for rendering. An exponential haze model with a 100km 100% haze (all colors blend to a medium blue-gray hue beyond this distance) was used in the Computer Model for rendering these images. Since a more diffuse light was simulated on this day, more ambient light was included in the atmospheric component of the Computer Model.

2.2 Computer Model of Altered Landscape

The second input stream to the Photomontage is generated by creating a Computer Model of the study area depicting the additional 3D Objects (wind turbines and meteorological towers), turbine/tower pad clearings, and new access roads. This Computer Model should be as close to reality as possible. The methodology used in the generation of the Computer Model is beyond the scope of this document, but the required data are briefly described below.

2.2.1 GIS Data

All data used in the creation of the Computer Model is in the form of Geographic Information System (*GIS*) datasets. There are two basic types of GIS datasets: vector-based (discrete points, lines, and polygons), and raster-based (arrays of values representing either continuous variables, such as elevation, or nominal values, such as land cover).

2.2.1.1 Camera Stations

The GPS data describing the camera station location (see §2.1.2.4) were used to create an ESRI Shapefile containing a point for each place of acquisition of the seven field images. These points corresponded to the camera station and contained additional attributes such as image sequence number, nominal bearing, and location name.

2.2.1.2 Terrain Model

A set of raster Digital Elevation Models (*DEMs*) was obtained from the USGS Seamless Database for the 46km (East-West) by 38km (North-South) study area encompassing the proposed Windfarm and camera locations. The nominal resolution for this dataset is 1/3 of an arc-second. When projected to the Universal Transverse Mercator (UTM) projection, the resolution was approximately 10 meters in both the North-South and the East-West directions.

2.2.1.3 Land Cover Data

A raster dataset characterizing the land cover for the study area was obtained from the U.S. Fish & Wildlife Service. The Gulf of Maine Landcover (GOMLC) dataset (http://www.maine.gov/dep/gis/training/melcd/gulf_of_maine_landcover_2000_fgdc_metadata.txt) is “an amalgamation of basically all the available landcover data for the Gulf of Maine basin as of 1997, including NLCD [National Land Cover Dataset], Gap [Gap Analysis Program], CCAP [Coastal Change Assessment Program], and wetlands data” (http://www.maine.gov/dep/gis/training/melcd/review_of_legacy_data.shtml). To be compatible with existing ecosystem models at Xtra-Spatial Productions, LLC, the GOMLC dataset were “cross-walked” or remapped to the Anderson Level 2 Land Cover classification as defined by the NLCD the USGS Seamless Database website. This data was used for purposes of both camera matching and vegetative screening of the altered conditions (roads, turbines, towers, pads, powerline swaths).

2.2.2 3D Object Data

The wind turbines and meteorological towers (“met towers”) represent major differences between the *status quo* and the proposed alteration of the visual resource of the study area. Therefore, the turbines and met towers had to be modeled as entities and then placed in the correct locations in order to depict them in their proper scale, appearance and locations in the digital photomontage.

2.2.2.1 Geometry of 3D Objects

Xtra-Spatial Productions, LLC already had a three-blade, horizontal axis wind turbine model that was used for another project (Gamesa G87 2MW). The dimensioning, however, did not conform to the dimensions proposed for the Kibby Mountain Windfarm (Vestas V90 3.0MW). Using 3D Studio MAX (Kinetix, Inc.), a new model was created to conform to the specified dimensions:

- 80m height to rotor axis and
- 127m maximum height to blade tip at top-dead-center

Additionally, all dimensioning as described in Horizon Wind’s document titled *Appendix 4: Vestas V82 and V90 Wind Turbine Specifications, and the Vestas V100 Wind Turbine Product Brochure*

(http://www.horizonwind.com/images_projects/Arrowsmith/permit/ARR_App_4_Turbine_Specs.pdf) were used to build a highly realistic model of the G87 turbine. The turbine 3D model is depicted below both with the rotor still and with the rotor in rotation.



Turbine with rotor still



Turbine with rotor spinning

From this “master 3D model,” six derivative models were built representing the blades in various positions along their rotation:

- Blade #1 at top-dead-center (0°)
- Blade #1 at 20°
- Blade #1 at 40°
- Blade #1 at 60°
- Blade # 1 at 80°
- Blade # 1 at 100°

This was done to simulate the random nature of the spinning blades at 20° increments. Note that due to the trifold radial symmetry of the blade configurations, no further

variations were needed to simulate a full revolution of the turbine rotor. In other words, a 120° rotation of Blade #1 would look the same as a 0° rotation of Blade #1.

The met towers were modeled as simple tubes, 84 meters tall and with a base diameter of 1.5 meters tapering to 1.0 meter at the top of the tower.

2.2.2.2 Materials of 3D Objects

A single material was assigned to the entire turbine (save the aircraft warning beacons). The material was a semi-glossy white paint that maximizes visibility to aircraft. The base of the tower was assigned a concrete material.

The met towers use a single material simulating flat light-gray galvanized metal. Guy wires were modeled but for the photomontages, the wires were not rendered.

2.2.2.3 Locations and orientation of 3D Objects

A CAD drawing of turbine locations, pad dimensioning, and access roads was provided by Stone Environmental Inc. The elevations of the base of the tower were assumed to be the terrain elevation from the 10-meter DEM (§2.2.1.2) at the turbines' locations.

The turbines were oriented to face due northwest or 315° (the direction of the prevailing winds) with a +/- 10° random variation.

The met tower locations were provided in a text file containing crude latitude/longitude coordinates. When mapped along with the turbines and pads, it was apparent that the met towers' locations were not precise enough. The towers were moved to the nearest pad and placed therein to preclude interference between the supporting guy wires, and turbine rotor blades.

3. Processing

This section describes the steps necessary to convert the data into a digital photomontage.

3.1 Creation of the Computer Model

The Computer Model was created using Visual Nature Studio (VNS) version 2.75 (3D Nature, LLC). The entire process of creating the model is beyond the scope of this document, but the highlights are presented below.

3.1.1 Integration of GIS Data and 3D Object Data

VNS models are created by applying textures, billboarded images, and 3D models to a terrain surface. The terrain surface was imported from the DEMs described in §2.2.1.2 above.

Shapefiles of access roads and turbine pad boundaries were imported into the VNS project. A cross-section was created for the access roads with a 20-foot (~6.1m) width of gravel and a 24-foot-wide shoulder of disturbed earth on each side of the road. The

cross-section for ridgetop roads between turbines was modeled as a 34-foot (~10.5m) width of gravel and a 24-foot-wide shoulder of disturbed earth on each side of the road.

Turbine pads were assigned a disturbed earth ecosystem to represent the necessary clearing to construct and erect the turbines.

Shapefiles for the camera location and the turbine locations were added to the VNS project. The six 3D Models of the turbine (see §2.2.2.1) were imported into the project and assigned at random to all forty-seven turbine locations. Similarly, the met tower 3D Model was assigned to points representing their locations.

For each field image, a light simulating the Sun's position and intensity was created to match the time of day and the atmospheric conditions corresponding to *in situ* conditions when the digital photo was acquired.

3.1.2 Camera matching

The process of creating a model camera that matches the orientation of the actual digital camera is the most time-consuming aspect of the project. Fortunately, the position and HFOV of the camera was specified with a high degree of confidence. The estimated bearing was useful to set up a crude orientation of the camera, but an iterative approach to tweaking this, and other parameters (*i.e.*, pitch and bank) was necessary. This iterative approach was achieved using a down-sampled version of the original digital image and a preview render of the terrain model of the same pixel dimensions. The field image was superimposed on the rendered image with some transparency. Furthermore, a Post-Process that simulates cartoon inking was used to darken portions of the rendering where the distances between adjacent pixels in the rendered image exceed a certain threshold. This technique, in effect, produces local horizon lines that were instrumental in confirming the veracity of the camera matching operation. In cases of mismatch, the preview render was moved horizontally and vertically, as well as rotated, until the skylines and foreground ridgelines were coincident. The amount of displacement and rotation of the preview was noted, and the heading, pitch and bank parameters of the VNS camera were adjusted. A new preview render was generated and the process repeated until the camera match was optimal.

Once the camera's orientation was matched, the parameter values were keyframed to prevent accidental changes to the parameter values.

3.2 Rendering of Computer Model to Match Digital Images

The terrain and the turbines were rendered at the same resolution as the digital images (*e.g.*, 3008 by 2000 pixels for Nikon D100; 3264 by 2448 for Olympus EVOLT E-500).

For each of the seven photomontages, a set of two computer renderings was produced. The first rendering was a photosimulation of the Computer Model from the simulated camera using all components: lights, atmospheres, 3D Objects, new roads, pads, powerline swaths, as well as the ecosystems defined by the remapped GOMLC database

described in §2.2.1.3 above. To match the overall hue and saturation of the field image, post-processes to partially desaturate and apply a bluish tint were applied as needed.

A second rendering was made to serve as a binary mask delineating those parts of the altered landscape that would be visible in from the camera location thereby excluding portions of the altered landscape that would be obscured by ridgelines or screened by vegetation. For this operation all elements of the altered landscape (turbines, met towers, access roads, pads) were assigned a 100% luminous (glowing) white material. Sunlight, ambient light, haze were all turned off for this rendering and a black sky was used. This produced a rendering where those portions of the altered landscaped elements that are unobscured and unobscured are white and the rest of the image is black. Edges of the unobscured/unscreened altered landscape elements are anti-aliased as shades of gray in the rendering process. This prevents the occurrence of stairstepping of pixels and facilitates the smooth compositing of rendered elements and the field image. This image will hereafter be referred to as “the mask.”

3.3 Compositing of Computer Model Output and Digital Images

The process of compositing two images involves the preservation of parts of each image and the discarding of the complimentary parts of the image. The only parts of the photosimulation image that were retained were the portions that were not black in the mask image.

To initiate the compositing operation, the field digital image was loaded into Photoshop. Next, the mask was opened, copied, and pasted as a new layer over the digital image. Finally, the photosimulation output of the Computer Model was opened, copied, and pasted as yet another new layer over the digital image.

3.3.1 Render Image Masking

The portions of the mask that are pure black were selected using the Magic Wand tool of Photoshop (using a tolerance of “0,” anti-aliasing enabled, and contiguous pixels disabled). This selection was then inverted to create a selection of pixels that correspond to the unobscured/unscreened portions of the altered landscape elements in the photosimulation.

3.3.2 Foreground Object Masking

Since no attempt was made to photosimulate foreground elements in the field image, in some photomontages it was necessary to deselect some selected pixels from §3.3.1 that would be obscured by foreground objects in the base image. Trees in the foreground presented the majority of the foreground objects requiring this deselection operation. The marquee and polygonal lasso tools were used to deselect pixels from the selected set by temporarily disabling visibility of the mask layer and the photosimulation layer.

3.3.3 Assignment of Layer Mask for Photosimulation

Once the selected set of pixels has been limited as described in §3.3.1 and §3.3.2 above, the selected set of pixels was saved as a Layer Mask for the photosimulation layer and visibility of that layer was re-enabled. This operation created transparent pixels in all portions of the photosimulation layer not in the selected set of pixels, creating the photomontage.

3.3.4 Application of Gaussian Blur to Computer Model Output

Since the rendering of the computer model is done without optics, the image is often “too sharp” and doesn’t look like it was captured optically as was the digital image.

Therefore, in cases where such sharpness creates a distracting or less convincing photomontage, a Gaussian Blur filter with a radius value of 0.8 pixels was applied to “soften” the visible portions of the photosimulation layer. Thus the turbines appeared to be similar in sharpness as the digital image.

4. Results

Photometrically correct photomontages produced using accurate Sun position failed to produce significant contrast of the turbines and met towers in several simulations. Such conditions were found when the turbines were illuminated when the Sun was either nearly directly behind the camera or nearly directly behind the turbine (backlit). At the behest of the contractor, a new photosimulation was produced wherein the turbines were not lit by the actual Sun at its computed position based on the field image, but rather by an artificial light more perpendicular to the camera’s optical axis. Additionally, this light was used to cast some shadowing on the turbines (self-shadowing). Using VNS it is possible to have each light in the Computer Model illuminate certain objects and not illuminate others. The results of this operation produced photomontages that better showed the turbines and other elements of the altered landscape.

5. Caveats

There are several caveats to consider when presenting photomontages to an audience that may be unfamiliar with this form of analysis. Lack of awareness of these caveats can create mistrust and even deception among the audience and the presenter.

5.1 Digital Imaging versus Human Visual Perception

Human visual perception represents millions of years of evolutionary progress and is indeed a marvel of Nature. Photography has been around for 150 years or so, and digital imaging is a product of the late Twentieth Century. There are some important differences in the way the eye/brain system perceives visual stimulus and the way digital images present themselves to this system.

Most notable is that human visual perception is not constant across the entire field of view. While the distribution of the sensing rods and cones are more or less constant from the fovea of the eye to the peripheral areas of the retina, the distribution of the optical ganglia is not. At the fovea, there is a one-to-one ratio of sensors (rods and cones) to

ganglia; each sensor has its own ganglion. As one moves away from the fovea (*i.e.*, increases eccentricity), more sensors feed into a single ganglion, which “averages” their photoreceptive impulses. Thus the eye is a variable resolution imaging system. The digital camera is a constant resolution imaging system. We have no way to create digital raster images that mimic this characteristic of the eye/brain system. The resolving power at the fovea of the eye is incredibly greater than any digital imaging device. So even if a turbine appears to be an insignificant smudge on our digital photomontage, the eye may see an actual turbine in detail if a turbine actually was to be there.

5.2 Proper Viewing Distances

In order to preserve the scale of objects in a photograph of digital image, the viewer must be placed at the correct distance from the photograph or image. All images should be viewed at the distance that preserves the HFOV as shown in Appendix A, column “Photomontage Viewing Instructions.” So, for example, if the Eustis Ridge image is projected onto a screen such that it is 10 feet wide, the viewer should stand such that she is approximately 14 feet away from the screen. Likewise, if the image were printed on an 8” x 10” sheet, the viewer should hold the sheet at a distance of approximately 14 inches.

5.3 Tradeoffs between Full Resolution and Full Field of View

Since the human eye has much greater resolving power than any extant digital imaging system, a tradeoff must be made between resolution and field of view. The binocular eye/brain system has a HFOV of 180 degrees if one includes low resolution portions of peripheral vision and about 40 degrees if one limits it to the highest resolution portions of the retina. If one were to produce a fisheye (~160° HFOV) image of a vista, it is most unlikely that anything on the horizon would be discernable since there are only a finite number of pixels that can be used to cover such a wide field of view. Likewise, if one were to replicate the resolving power of the foveal region of the retina, she would need to restrict the HFOV to only a couple of degrees! This would not give the viewer the context of the scene that is so often crucial to the decision-making process. This tradeoff should be considered when presenting a photomontage to the public.

Appendix A. Metadata for *In Situ* Digital Images

Location Name	Date of Image Acquisition	Time of Image Acquisition	Bearing	Pitch	Roll	Horizontal FOV	Equivalent Focal Length	Viewing Instructions
Sarampus Falls	October 10th, 2006	9:52am EDT	20.15°	9.9° up	1.0° CW	28.07°	70.00mm	Distance = 2.00 x image width
Avery Peak	September 13th, 2006	1:28pm EDT	314.2°	0.15° down	1.1° CW	25.8°	76.41mm	Distance = 2.18 x image width
Route 27 near Vine Road	November 11th, 2006	1:31pm EST	353.75°	2.75° up	0°	38.58°	51.44mm	Distance = 1.43 x image width
Jim Pond	November 1st, 2006	10:45pm EST	318.7°	1.95° up	0°	38.58°	51.44mm	Distance = 1.43 x image width
Eustis Ridge	November 11th, 2006	2:23pm EST	349.875°	1.50° up	1.88° CW	39.5°	50.13mm	Distance = 1.39 x image width
Kibby Mountain to Series A	November 11th, 2006	10:30am EST	159.25°	2.38° down	0.75° CW	40.0°	49.45mm	Distance = 1.37 x image width
Kibby Mountain to Series B	November 11th, 2006	10:30am EST	186.75°	1.00° down	0.50° CW	40.0°	49.45mm	Distance = 1.37 x image width

APPENDIX E

RESUMES

- **Jean E. Vissering Landscape Architect**
 - **David Healy, Stone Environmental**
 - **James Zack, Xtraspatial Productions**

Jean E. Vissering Landscape Architecture

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RESUME

EDUCATION

Master of Landscape Architecture - 1975, North Carolina State University, Raleigh, NC, American Society of Landscape Architects Book Award.

Bachelor of Science in Landscape Architecture - 1972, University of Massachusetts, Amherst, MA. Cum Laude. Honors Thesis on Pedestrian Environments.

PROFESSIONAL EXPERIENCE

Professional Consulting: Recent Design and Planning Projects

- Currently preparing a visual assessment of the Deerfield Wind Project on behalf of Vermont Environmental Research Associates (VERA) and PPM. The project would include up to 22 turbines in the vicinity of the existing Searsburg Wind Facility.
- Currently working with the Center for Victims of Violent Crimes to design a ceremonial garden to honor those who have lost their lives to violent crimes. The garden will be located on State property near the State House in Montpelier.
- Appointed as member of the National Academy of Science Wind Energy Committee. The Committee's report will be finalized in 2007.
- Currently assisting the Vermont District #2 Environmental Commission to review a proposed subdivision adjacent to Interstate 91 in Windsor.
- Worked with the Addison County Regional Planning Commission in aesthetic review under §248 of the Vermont Electric Coop (VELCO) Northwest Reliability Project. The project includes additional 345kV, 115kV transmission lines and new and expanded substations. I have worked with the Towns of Leicester, Salisbury, Middlebury and New Haven, and with affected property owners.
- Reviewed proposed wind energy proposals in the vicinity of Jordanville and Cherry Valley, NY for Otsego 2000.
- Assisted the Bennington Regional Commission and the Town of Manchester in a public information and review process by providing information regarding the aesthetic effects of the proposed Little Equinox Wind Energy Project.
- Scenic evaluation methodology and protection strategies for the Town of Huntington's

- Conservation Commission to be used as a tool for prioritizing conservation efforts.
- Elm Court Park: a small pocket park developed by the Trust for Public Land and the City of Montpelier. The park demonstrates ecological approaches to design and contains a butterfly garden.
 - Prepared a visual assessment for the proposed Glebe Mountain wind project on behalf of the Town of Londonderry. My review also examined impacts to surrounding towns. (I am now working with the Glebe Mountain Group on this project.)
 - Presented an overview of the visual issues involved in wind energy development to Scenic America's Board of Directors and Affiliates at their annual meeting in Washington, D.C. Scenic America will use the information to develop a policy on wind energy issues and a strategy for involvement.
 - Prepared the report, *Wind Energy and Vermont's Scenic Landscape*, for the Vermont Public Service Department summarizing discussions among stakeholders concerning the visual impacts of wind energy. The guidelines are intended for use by the PSB, prospective developers, and by local and regional planning organizations.
 - Sabin's Pasture, Montpelier: a site plan for a 147-unit mixed-use neighborhood-scaled project. The project was designed to provide a model for development using "smart growth" principles including compact and traditional patterns of growth and the preservation of open space. The design was part of a community process and was funded by the Central Vermont Community Land Trust, a housing advocacy organization.
 - Brochure for the Public Service Board, *Siting a Wind Turbine on Your Property*, designed to encourage the sensitive siting of small wind turbines to protect scenic views.
 - City of Montpelier's *Open Space Plan Views and Vistas Study*: I worked with the Conservation Commission to develop priorities for protection. Arrowwood Environmental conducted ecological studies. This study included a professional visual assessment, public survey, and public meetings.
 - Turntable Park, Stonecutters Way, Montpelier: design for restoration of an historic turntable, along with accommodation of recreational and theatrical use of a small park. (Designed in collaboration with the Office of Robert White).
 - Review of numerous projects for aesthetic impacts under Vermont's Land Use Law, Act 250. Examples include Old Stone House Subdivision in South Burlington, a proposed RV park in Sharon, a wind turbine in Middlebury, Pittsford Post Office, a proposed gas station in Hartland, the Sheffield Quarry, and a Bell Atlantic Communications Tower in Sharon.
 - Design and construction supervision for numerous residential and institutional projects.
 - Randolph Family Housing and Templeton Court, landscape design for low-income housing projects in Randolph and White River Junction, VT.
 - Plainfield Common, a public riverside park and small formalized parking area in the village center of Plainfield; this project involved extensive public involvement
 - Streetscape Master Plan for Chelsea village: village plantings and hardscape improvements for the village center's greens and streets, as well as for several parks and public areas.
 - Street tree inventory and plan for the City of Montpelier.
 - Conservation and development plans for landholdings in various towns. Plans provide for the protection of important resources including scenic values, agricultural lands, wetlands, and valuable forestland while identifying appropriate areas for development.

- "Scenic Resource Evaluation Process": a team project to develop guidelines for Vermont Agency of Natural Resources' review of Act 250 projects.

Teaching Experience

- **2000-present:** Landscape Design courses at Studio Place Arts in Barre.
- **1982 -1997: Lecturer (University of Vermont, School of Natural Resources and Department of Plant and Soil Science)**
I taught a variety of courses depending on the semester and year. Courses included *Park and Recreation Design* (Recreation Management); *Landscape Design Studio*, and *Colloquium in Ecological Landscape Design* (Plant and Soil Science), and *Visual Resource Planning and Management* (Natural Resources graduate level), and *Environmental Aesthetics and Planning* (Natural Resources). I also organized a seminar and lecture series for Shelburne Farms and for Plant and Soil Science focusing on topics in Sustainable and Ecological Landscape Design. I assisted graduate students in Natural Resources Planning and served on several graduate committees.
- **1996: Faculty (Vermont Design Institute)**
Served as a faculty facilitator for a summer workshop on finding patterns in the landscape as a planning tool.
- **1995: Lecturer (Norwich University, Department of Architecture)**
Taught a course in Landscape Architecture, the first to be taught in the school. Early Design and Planning Experience

Additional Experience

- **1981 - 1982: State Lands Planner (Agency of Natural Resources, Department of Forests, Parks and Recreation)**
Preparation and Coordination of all land management plans for the Department of Forests, Parks, and Recreation; review of plans under Act 250 and Act 248 for aesthetic impacts; provided design services and related expertise to other Agency departments and to municipalities.
- **1978 - 1981: Park Planner (VT. Dept. of Forests, Parks and Recreation)**
Designed state park facilities including site analysis and working drawings, grading plans, construction details, planting plans, etc. Also prepared permit applications, organized public meetings and supervised construction of projects. Reviewed plans under Act 250 for aesthetic impacts. Instrumental in organizing a new state lands management unit.

PUBLICATIONS AND ILLUSTRATIONS

Sabin's Pasture: A Vision for Development and Conservation, Central Vermont Community Land Trust, March 2003.

Siting a Wind Turbine on Your Property: Putting Two Good Things Together, Small Wind Technology & Vermont's Scenic Landscape, Public Service Board, December 2002

Wind Energy and Vermont's Scenic Landscape: A Discussion Based on the Woodbury Stakeholder Workshops, Vermont Public Service Department, August 2002.

Scenic Resource Evaluation Process, Vermont Agency of Natural Resources, July 1, 1990. Guidelines to be used by the Agency of Natural Resources in reviewing visual impacts of development projects under Act 250 in areas of regional and statewide scenic significance.

"Impact Assessment of Timber Harvesting Activity in Vermont: Final Report-March 1990": a research project conducted by the University of Vermont on behalf of the Vermont Department of Forests, Parks, and Recreation. My focus was the visual impacts of timber harvesting.

"Landscapes, Scenic Corridors and Visual Resources": a chapter of the 1989 Vermont Recreation Plan which outlines a five year plan for protecting and enhancing scenic resources in Vermont.

"Healing Springs Nature Trail Guide": a nature trail at Shaftsbury State Park, text, illustrations, and design of trail and bridges.

"The View from the Sidewalk": a walking tour emphasizing the interconnections of environment and culture that shaped the cityscape of Raleigh, North Carolina, text and illustrations. Published by the Raleigh Chamber of Commerce.

Illustrations for other books, guides and newsletters.



DAVID J. HEALY

EDUCATION

University of California, Los Angeles
M.A., Urban Planning, 1972

University of Massachusetts, Lowell
B.S., Meteorology, 1969

WORK EXPERIENCE

Stone Environmental, Inc.
Montpelier, Vermont, USA, *Vice-President*, 1995 - Present

Develop and grow GIS and database application services business unit. Guides the design, development and manages all geographic information system project applications. Responsible for planning, public policy, education, information analysis, data product development and training for the company. Principle-in-charge of wastewater and water resource planning and modeling projects.

visualDATA, inc.
Co-Founder & President, 1992 - 1995

Conducted GIS planning, studies, surveys, training, education, information analysis and data product development, nationally and internationally.

Office of Geographic Information Services, State of Vermont
Montpelier, Vermont, USA
GIS Operations Administrator, 1989 - 1992

Developed and executed all aspects of intergovernmental GIS-plans, database development & management, standards, policies and training programs; prepared project technical specifications, RFPs and managed all size contracts; oversaw

software and hardware acquisition; developed application priorities and oversaw their execution. (*Interim Director* - July, 1989 to March, 1990)

Governor's Office of Policy Research, State of Vermont
Montpelier, Vermont, USA
Policy Analyst, 1982 - 1989

Developed plan for the Vermont Geographic Information System (VGIS); managed acquisition, installation, staff training of GIS hardware & software; drafted Vermont's GIS legislation and guided it through legislature; prepared GIS Executive Order, policies, guidelines and standards. Prepared growth trend analyses for the *Commission on Vermont's Future*. Conducted numerous demographic, economic and environmental policy analyses. Developed and managed interagency implementation of measures to streamline statewide permit/license systems. Managed the Vermont State Data Center and served as official contact with the U.S. Bureau of the Census.

Planning and Budget Affairs Office, Commonwealth of the Northern Mariana Islands
Saipan, Northern Mariana Islands
Program Planning Coordinator, 1980 - 1981

Assisted in supervising operations of environmental and energy planning

programs and 14 person office; developed procedures for capital improvement projects; prepared energy, environmental and physical development plans, policies, draft legislation and grant applications; reviewed impacts of major development projects in coastal zone; and established citizen advisory committee for review of policies and plans.

Consultant
San Francisco, California, USA
1978 - 1980

Conducted studies for various public and private clients on: EPA policies on secondary air quality impacts associated with wastewater treatment facilities; transportation control strategies in South Coast Air Quality Management Plan; and history of California air quality implementation plans.

U.S. Environmental Protection Agency, Region IX
San Francisco, California, USA
Community Planner, 1972 - 1978

Developed programs for achieving air quality standards in the Los Angeles air basin; initiated regional policies for the mitigation of secondary air quality impacts of wastewater treatment facilities; initiated recommendations for national and regional air quality policies and regulations; initiated innovative governmental approaches for integrated

environmental management; managed grants to South Coast Air Quality Management District; negotiated and managed numerous contracts with public agencies and consulting firms; developed transportation control strategies and regulations in air implementation plans; reviewed Federal EIS'; and provided guidance to and review of California water basin and waste treatment facility plans.

UCLA/Friends of Mammoth Environmental Study Project
Mammoth Lakes, California, USA
Field Team Coordinator, 1972

Developed alternative land use and institutional arrangement proposals for a small community impacted by a major ski area expansion.

PUBLICATIONS AND PRESENTATIONS

Healy, D.J., and Stancioff, A
Poverty/Vulnerability Mapping in Niger, Developing Multiple-factor Poverty Mapping Indicators for Poverty Reduction Programs, Africa GIS 03, Dakar, Senegal

Healy, D.J., *Using GIS to Help Understand Poverty/Vulnerability In Africa*, ESRI 2003 International User Conference, San Diego, CA

Healy, D.J., *Developing a Poverty Information System, Niger Experience, The Impact Of Poverty Maps: Past Experiences And New Directions Workshop, Brussels, Belgium*

Stancioff, A and Healy, D.J., *Conflict Forecasting Using GIS*

Winchell, M, Healy, D.J. and B. Douglas, "A New Paradigm for Town-wide Decentralized Wastewater Needs Analysis." NOWRA 2002 Conference & Education Program, Kansas City MO

Healy, D.J. and B. Douglas, 1999, "Use of GIS Tools for Conducting Community On-site Septic Management Planning." USEPA Conference on Environmental Problem Solving With Geographic Information Systems, Cincinnati OH

Estes, T. L., M.H. Pottinger, D.J. Healy, C.T. Stone, and A. Hiscock, 1998. "Chemical-Specific Method for Determining Geographic Distribution of Leaching Potential." American Chemical Society Annual Meeting, Boston, MA.

Healy, D.J., 1996. "Atlas of Crop Acreage by County for the United States." Stone Environmental.

Healy, D.J., 1996. "Areas of the United States With a High Potential Susceptibility to Groundwater Contamination." Stone Environmental.

Healy, D.J., 1992. "Vermont's GIS, Four Years Later, Lessons Learned, Proceedings 1992 Annual ESRI User Conference.

Healy, D.J., 1991. "VGIS Handbook of Policies, Standards, Guidelines, and Procedures." Vermont Office of Geographic Information Services.

Healy, D.J., 1990. "Vermont's GIS." 1990 Northeast URISA Conference.

Healy, D.J., 1990. "Vermont's GIS - Planning to Implementation." *Proceedings 1990 URISA Conference.*

Healy, D.J., 1988. "Demographic and Economic Analysis, Technical Appendix, *Final Report of the Commission on the Future of Vermont.*"

Healy, D.J., M. Wilson, T. Douse, 1986. "County Profile Series, Vermont County Demographic & Economic Reports." OPRC & DET.

Healy, D.J., S. McReynolds, F. Schmidt, 1984. "Close Up/Vermont" *American Demographic.*

Healy, D.J., P. Gillies, 1984. "The Regulation of Vermont." Office of the Secretary of State.

Healy, D.J., 1982-1984. "Vermont Vital Trends." Study Paper Series, State Planning Office.

Healy, D.J., 1975. "Attempting Regional Environmental Management." Regional Environmental Management, Coate and Bonner, Editors, John Wiley and Sons, New York.

Healy, D.J., 1972. "Land Use Alternatives and Implementation." Facing the Future: Five Alternatives for Mammoth Lakes, SAUP/UCLA, Friends of Mammoth, Mammoth Lakes, CA.

ADDITIONAL EDUCATION

- Certified Public Manager, State of Vermont
- Courses in ARC/INFO® and Public Finance
- Authorized ArcView® Instructor

HONORS AND AWARDS

- EPA Bronze Medal
- U.S. Public Health Service Traineeship in Environmental Planning and Management

PROFESSIONAL AND COMMUNITY ACTIVITIES

Vermont Center for Geographic Information

Member, Board of Directors

James A. Zack

President, Xtra-Spatial Productions, LLC

Experience Summary

Mr. Zack has over twenty years of experience in the field of geodata processing. During the past fifteen years, he has concentrated on the application of Geographic Information Systems, Internet/Web, and Landscape Visualization technologies to a wide range of natural/cultural resource and environmental projects. Mr. Zack formed Xtra-Spatial Productions, LLC in July of 2000 and serves as its president and owner. He has worked on GIS Software Development efforts, and has designed and delivered software trainings. Mr. Zack has designed and implemented geodatabases and developed custom applications using GIS technology. He has served as a GIS consultant to various governmental and private enterprises. He has also taught introductory courses in GIS and Remote Sensing at the Boulder campus of the University of Colorado. Mr. Zack is a 3D Nature Certified instructor for World Construction Set. He is also an accomplished digital photographer specializing in panoramas and re-occupation of sites of archived photographs.

Credentials

M.S., Geography -- University of California-Riverside (1989)

B.Sc. Geology -- University of Florida (1979)

Professional Affiliations

Member of the American Planning Association

Member of the Capital District Planning Association

Member of Urban and Regional Information Systems Association

Member of the American Society for Photogrammetry and Remote Sensing

Other Affiliations

Member of the Residents Committee to Protect the Adirondacks

Organizer of Sustainable Saratoga Springs

Honors

American Society for Photogrammetry and Remote Sensing "Best Scientific Paper in GIS" Award 1992

Phi Beta Kappa, 1979

Employment History

2000-present: President, Xtra-Spatial Productions, LLC, Boulder, CO and Saratoga Springs, NY

2000-2003: Research Associate, Natural Resources Ecology Laboratory, Colorado State University, Ft. Collins, CO

1997-2000: Senior GIS Analyst, Geomega, Inc., Boulder, CO

1995-1997: Research Associate, Natural Resources Ecology Laboratory, Colorado State University, Ft. Collins, CO

1990-1994: Research and Teaching Assistant, Department of Geography, University of Colorado, Boulder, CO

1990: Data Modeler/Consultant, Platte River Associates, Denver, CO

1985-1990: GIS Applications Programmer, Environmental Systems Research Institute, Redlands, CA

1980-1984: Geophysicist, Cities Service Oil and Gas Co., Tulsa, OK

1979-1980: Seismic Analyst, Chevron Geosciences Co., Houston, TX

Computer Skills

Mr. Zack is proficient with Wintel-based, Macintosh and Linux/Unix workstations. He has programming experience in C, Java, and Visual Basic. Mr. Zack has extensive experience with ESRI GIS software (ArcGIS, ArcView with Spatial Analyst and 3D Analyst Extensions, ArcInfo, Internet Map Server) and the fourth-generation languages specific to that product line (VBA, Avenue, Arc Macro Language, and Map Objects). He has Internet/Web skills for HTML and JavaScript coding, XML document design, XSL Transformation language, Virtual Reality Modeling Language (VRML), Keyhole Markup Language (KML) and uses Adobe GoLive and LiveMotion software to design pages and sites. Mr. Zack is also proficient in the Adobe line of multimedia products including Premiere, Photoshop, and Encore DVD. He is also proficient in audio editing using Cakewalk Pro Audio. Over the past nine years, Mr. Zack has gained experienced in three-dimensional modeling using AutoDesk's 3D Studio MAX. Also during this time, he has become a master of 3D Nature's World Construction Set and Visual Nature Studio software for 3D landscape visualization, as well as realtime scene generation using Scene Express. Mr. Zack has used a wide range of hardware and OS variants and has performed many system administrative tasks.

Key Projects

Landscape Visualization (most of the more recent projects can be viewed at Xtra-Spatial Productions, LLC website: <http://www.spatialexperts.com/projects>)

Trained and assisted the staff of Nicklaus Design, LLC in efforts to visualize proposed golf course design plans.

Created and produced a set of animations showing wetlands rehabilitation and recreation facility improvements for riparian corridor in Springfield, Oregon.

Produced a set of animated flyovers for six eighteen-hole golf courses along the Carolina coast (in collaboration with VR Marketing, Inc., N. Myrtle Beach, SC).

Designed, created, and produced a scientific animation showing the proposed renovation of a golf course green complex (in collaboration with TerraVea, Boulder, CO)

Trained and assisted staff of Envision Utah in efforts to visualize various scenarios related to Transfer of Development Rights for Layton, Utah, and to visualize small community development in Mantua, Utah.

Created photosimulations of a proposed mountaintop Digital TV tower site as part of a qualitative analysis of visual resources on the western edge of the Metropolitan Denver Area.

Created photorealistic "time-lapse" animations of the proposed mining operations expansion/reclamation efforts for a major gold producer in Colorado.

Created photorealistic images of Rocky Mountain National Park under present day conditions and under several scenarios of global climate change to be used in visual quality analysis.

Created photorealistic fly-through animation of a large open pit copper mining operation in Indonesia as part of a promotional campaign.

Created a Web-based interactive experience for visualizing a golf course using linked photorealistic panoramas, fly-overs, and other HTML-based assets.

Created texture maps used in the background of a best-selling snowboarding video game.

Provided technical assistance and guidance for external landscape and urban scene visualizations.

Multimedia, GIS, and Internet Mapping

Conducted Wildlife Impact Assessment Temporal Analysis of the Town of Bolton, NY 1966-2004 for the Residents Committee to Protect the Adirondacks.

Conducting Analysis of Buildout and the spatial distribution of development pressures for the Adirondack State Park, NY for the Residents Committee to Protect the Adirondacks.

Produced high-quality large-format maps for assisting in Open Space acquisitions in the Adirondack State Park, NY for the Residents Committee to Protect the Adirondacks.

Produced instructional 3D, animated video for public education at a Superfund site in Georgia.

Co-designed, developed, and implemented SCoP, a Web-based Mapping System for presenting multiscale biological resource data for the state of Colorado (<http://ndis.nrel.colostate.edu/>).

Designed and conducted spatially discrete analysis of perceived Digital TV tower sizes to census blocks along the western edge of the Metropolitan Denver Area.

Developed and implemented methodology for predicting probabilities of finding archaeological sites based on environmental variable for an Air Force base in Montana.

Mapped multiple soil characteristics across a 5000-acre site to examine correlations with vegetation abundance.

Provided spatial modeling support for regression-based analysis of revegetation potential for a Nevada Copper mine.

Publications/Presentations/Achievements

Interpretive Poster of "The Great Carry," a perspective view of the Old Military Road between Fort Edward and Fort William Henry used by the British Army during the French and Indian War. In progress with anticipated release to commemorate the 250th anniversary of the 1755 Battle of Lake George.

(www.spatialexperts.com/Interpretive_frame.html)

Winner of the 2001 Poster Contest ESRI-Denver Regional Office for "A Quantitative Comparison of the Visual Intrusion of Proposed Digital TV Towers at Two Sites." September 2001.

Theobald, D., and **J. Zack**, Presentation of "Disseminating Natural Diversity Information Using ArcView IMS: Design Issues and Technical Considerations," Eighteenth Annual ESRI User Conference, San Diego, CA, July 1998.

Product/Project Engineering of "ClimateData and HydroData ArcData products (alpha and beta versions)," with Hydrosphere Data Products, Inc., April, 1993.

Cartographic production for "Natural Hazards in Puerto Rico: Attitudes, Experience, and Behavior of Homeowners" by Dr. Risa Palm and Dr. Michael E. Hodgson, 1993.

Presentation of "Summary of GIS Database Operations to Support the RSS/MODM Project," Twelfth Annual ESRI User Conference, Palm Springs, CA, June 1992.

Participant in City and County of Boulder Wildland Fire Symposium, Boulder, CO, May 1992.

Zack, J., "Hurricane Hazard Mitigation in Puerto Rico: A Quantitative Approach," paper presented for Quantitative Methods in Geography, Dr. Andrei Rogers, University of Colorado at Boulder, 1992. **Zack, J.**, and R. Minnich, "Integration of a Geographic Information Systems with a Diagnostic Wind Field Model in Complex Terrain for Fire Management," *Forest Science*, June 1991.

Palm, R., J. Molinelli, D. Lyons, D. Blanchard, and **J. Zack**, "Multi-hazard Risk Perception in Puerto Rico after Hurricane Hugo," presentation at First Conference on Natural Hazards, Boulder, Colorado, June 1991.

Marozas, B., and **J. Zack**, "GIS and archaeological site location," in *Interpreting Space*, Allen, Green and Zubrow, eds., Taylor and Francis: London. 1990.

Zack, J., "Assessing the Effects of Terrain on a Multispectral Classification of Fuel Models as Part of a Wildfire Management Decision Support System," paper presented for Remote Sensing of the Environment, Dr. Alexander F.H. Goetz, University of Colorado at Boulder, 1990.

Presentation of "Integration of a Geographic Information Systems with a Diagnostic Wind Field Model in Complex Terrain for Fire Management," Annual Meeting of the Great Plains and Rocky Mountain Division of the American Association of Geographers, Kearney, Nebraska, October, 1990.

Presentation of "Calculation and Cartographic Display of Spatial Statistics in the ARC/INFO Environment," Tenth Annual International ARC/INFO Users' Conference, Palm Springs, CA, May 1990.

Presentation of "TIN Tricks and Shortcuts," in *Proceedings Ninth Annual International ARC/INFO Users' Conference, Technical Sessions*, Palm Springs, CA, May 1989.

Primary designer of two-day "Applications Programming" course presented by Environmental Systems Research Institute to corporate/governmental clients, 1988-9.

Zack, J., "Integration of a Geographic Information Systems with a Diagnostic Wind Field Model in Complex Terrain for Fire Management," Master's Thesis, UC-Riverside, 1989.

Marozas, B., and **J. Zack**, "The Use of Geographic Information to Measure Independent Variables for Archaeological Site Location Studies," Paper presented at the 53rd Annual Meeting for American Archaeology, Phoenix, Arizona, 1988.