Final Report
Assessment of Effects for the Proposed Expansion/Modification of the Beech Ridge Wind Energy Facility, Greenbrier and Nicholas Counties, West Virginia

WVDCH File #06-147-GB

GRAY & PAPE, INC.
ARCHAEOLOGY • HISTORY • HISTORIC PRESERVATION

March 21, 2012

Prepared for:
Invenergy LLC
51 Monroe Street, Suite 1604
Rockville, Maryland 20850

Prepared by:
Gray & Pape, Inc.
100 West Franklin Street
Suite 102
Richmond, Virginia 23220

Gray & Pape Project No. 10-62201

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ASSESSMENT OF EFFECTS FOR THE PROPOSED EXPANSION/MODIFICATION OF THE BEECH RIDGE WIND ENERGY FACILITY, GREENBRIER AND NICHOLAS COUNTIES, WEST VIRGINIA

WVDCH File #06-147-GB

Prepared for:
Erik Duncan
Invenergy LLC
51 Monroe Street, Suite 1604
Rockville, Maryland 20850
304-549-7696

Prepared by:
Lena L. Sweeten McDonald, M.A.

Gray & Pape, Inc.
100 West Franklin Street
Richmond, Virginia 23220
(804) 644-0656

Patrick W. O'Bannon, Ph.D.
Senior Manager

21 March 2012

ABSTRACT

Gray & Pape, Inc. has contracted with Invenergy LLC, to assess the potential effects of the proposed expansion/modification of the Beech Ridge Wind Energy Facility in Greenbrier and Nicholas counties, West Virginia, upon historic architectural resources that are listed in or eligible for listing in the National Register of Historic Places. This report documents the results of that assessment.

The proposed modification is subject to federal review under Section 106 of the National Historic Preservation Act and under the National Environmental Policy Act. As defined in 36 CFR Part 800, the proposed modification constitutes an undertaking, as it requires "a Federal permit, license, or approval." The U.S. Fish & Wildlife Service is serving as the lead Federal agency for the undertaking and is overseeing the review process. The Public Service Commission of West Virginia is serving as the lead review agency for compliance with state laws and regulations pertaining to the undertaking, including 150CSR30 governing siting certificates for exempt wholesale generators. As the State Historic Preservation Office, the West Virginia Division of Culture and History is fulfilling review responsibilities as required for both the state and Federal review processes. During consultation with the West Virginia Division of Culture and History, visual, noise, and cultural effects were identified as the three types of effects most likely to result from construction of the proposed undertaking.

The proposed expansion/modification of the Beech Ridge Wind Energy Facility will include the construction of up to 33 wind turbine generators in an area that is north and west of the existing facility. To allow flexibility in placement of the wind turbine generators, a total of 47 sites are being evaluated for construction. Commercial operation of the 33 turbines is expected to occur immediately upon completion of construction.

The cultural resources investigations for this undertaking are being conducted within the regulatory frameworks of the National Historic Preservation Act and the National Environmental Policy Act, as well as state review policies and regulations. A 5-mile Area of Potential Effects (approximately 103,450 acres or 162 square miles) was defined around the 47 locations being evaluated for wind turbine generators at the outset of cultural resources investigations. Portions of the Area of Potential Effects for the current undertaking overlap the Area of Potential Effects delineated for the first phase of the Beech Ridge Wind Energy Facility in 2006-2007.

Within the defined Area of Potential Effects that goes beyond the area delineated in 2006-2007, Gray & Pape's reconnaissance-level historical architectural survey identified a total of 206 historic-period resources (more than 50 years old) that are likely to have one or more wind turbine generators within their viewsheds if the undertaking is constructed. All newly identified resources with anticipated views of the undertaking were documented using West Virginia Historic Property Inventory forms. Of these newly identified resources, only the Mt. Urim Baptist Church (NI-0026-0192) and its associated cemetery (Field Number 175) were recommended eligible for inclusion in the National Register of Historic Places based on eligibility criteria specified in 36 CFR 60.4. The West Virginia Division of Culture and History concurred with this recommendation on 23 June 2011. Electronic viewshed analysis

indicates that the Mt. Urim Baptist Church and associated cemetery will not have views of the undertaking. Consequently, the project will not have an adverse visual effect on the historic property.

As noted above, portions of the Area of Potential Effects for the current undertaking overlap the Area of Potential Effects delineated for the 2006-2007 investigations. For historic-period resources identified during 2006–2007, only those that had experienced major changes and are anticipated to have views of the undertaking were documented with updated inventory forms. “Major changes” include, but are not limited to, alterations such as new additions, demolition in whole or in part, and/or replacement or removal of character-defining historic fabric such as original sash, siding, doors, and decorative elements. The previously identified National Register-eligible Duo Historic District is expected to have views of the undertaking. Construction of the proposed undertaking will add visual elements to the landscape that are not in keeping with the area’s historic patterns of settlement and development. Consequently, the proposed project will introduce visual elements that constitute an adverse effect for the Duo Historic District.

An acoustic analysis was conducted to ascertain if the undertaking will have audible effects on historic properties within the Area of Potential Effects. Four previously identified National Register-eligible resources are located within or close to the 1-mile buffer established for the acoustical study. They are the Duo Historic District, the Olive Baptist Church (GB-0038-0107B), a rural cemetery (Field Number 00046), and a dwelling (GB-0038-0099). Acoustical analysis indicates that noise levels associated with construction and day-to-day operation of the facility will be masked by existing ambient noise levels. The proposed undertaking will have no adverse effect upon historic properties caused by noise.

Construction of the proposed undertaking will result in the addition of up to 33 additional wind turbine generators at the Beech Ridge Wind Energy Facility. The proposed undertaking represents a permanent change to the rural landscape within the Area of Potential Effects. The immediate change will be primarily visual in nature and will affect the setting, feeling, and association of the rural landscape. As a result, in addition to adverse visual effects, the project will have adverse cultural effects within the Area of Potential Effects.

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1.0 INTRODUCTION

Gray & Pape, Inc. has contracted with Invenergy LLC, to assess the potential effects of the proposed expansion/modification of the Beech Ridge Wind Energy Facility in Greenbrier and Nicholas counties, West Virginia, upon historic architectural resources that are listed in or eligible for listing in the National Register of Historic Places. This report documents the results of that assessment.

The proposed modification is subject to federal review under Section 106 of the National Historic Preservation Act and under the National Environmental Policy Act. As defined in 36 CFR Part 800, the proposed modification constitutes an undertaking, as it requires "a Federal permit, license, or approval." The U.S. Fish & Wildlife Service is serving as the lead Federal agency for the undertaking and is overseeing the review process. The Public Service Commission of West Virginia is serving as the lead review agency for compliance with state laws and regulations pertaining to the undertaking, including 150CSR30 governing siting certificates for exempt wholesale generators. As the State Historic Preservation Office, the West Virginia Division of Culture and History is fulfilling review responsibilities as required for both the state and Federal review processes. During consultation with the West Virginia Division of Culture and History, visual, noise, and cultural effects were identified as the three types of effects most likely to result from construction of the proposed undertaking.

1.1 Description of the Undertaking

A proposed expansion of the Beech Ridge Wind Energy facility is being planned. As noted above, the proposed expansion qualifies as an undertaking because, as specified in 36 CFR Part 800, it "requires a Federal permit, license, or approval" (USGPO 2010a).

The proposed Undertaking is located within the Kentucky, Wilderness, and Richwood Magisterial Districts in Nicholas County and the Meadow Bluff and Williamsburg Magisterial Districts in Greenbrier County (Figure 1). The APE is located in the Allegheny Mountains and the terrain is characterized by low mountains, ridges, and narrow valleys. The 1 million-acre Monongahela National Forest is located to the east of the APE.

The Undertaking is planned to consist of up to 33 WTGs. To allow flexibility in placement of the WTGs, a total of 47 sites are being evaluated for construction of the 33 WTGs. The proposed WTGs will be General Electric (GE) 1.6xle models or similar and associated equipment, with each WTG to be mounted on individual 100-meter tall towers across about 8 square miles of ridgelines in Greenbrier County. The associated equipment includes a 2 MVA transformer at each WTG tower, and 34.5kV underground transmission lines for the electrical collection system that could connect into the existing 34.5/138kV substation or by a supplemental substation located along and directly adjacent to the existing project 138kv overhead transmission line. The service center for the existing facility, which is located in the northern portion of the proposed expansion area, also will serve the expanded facility.

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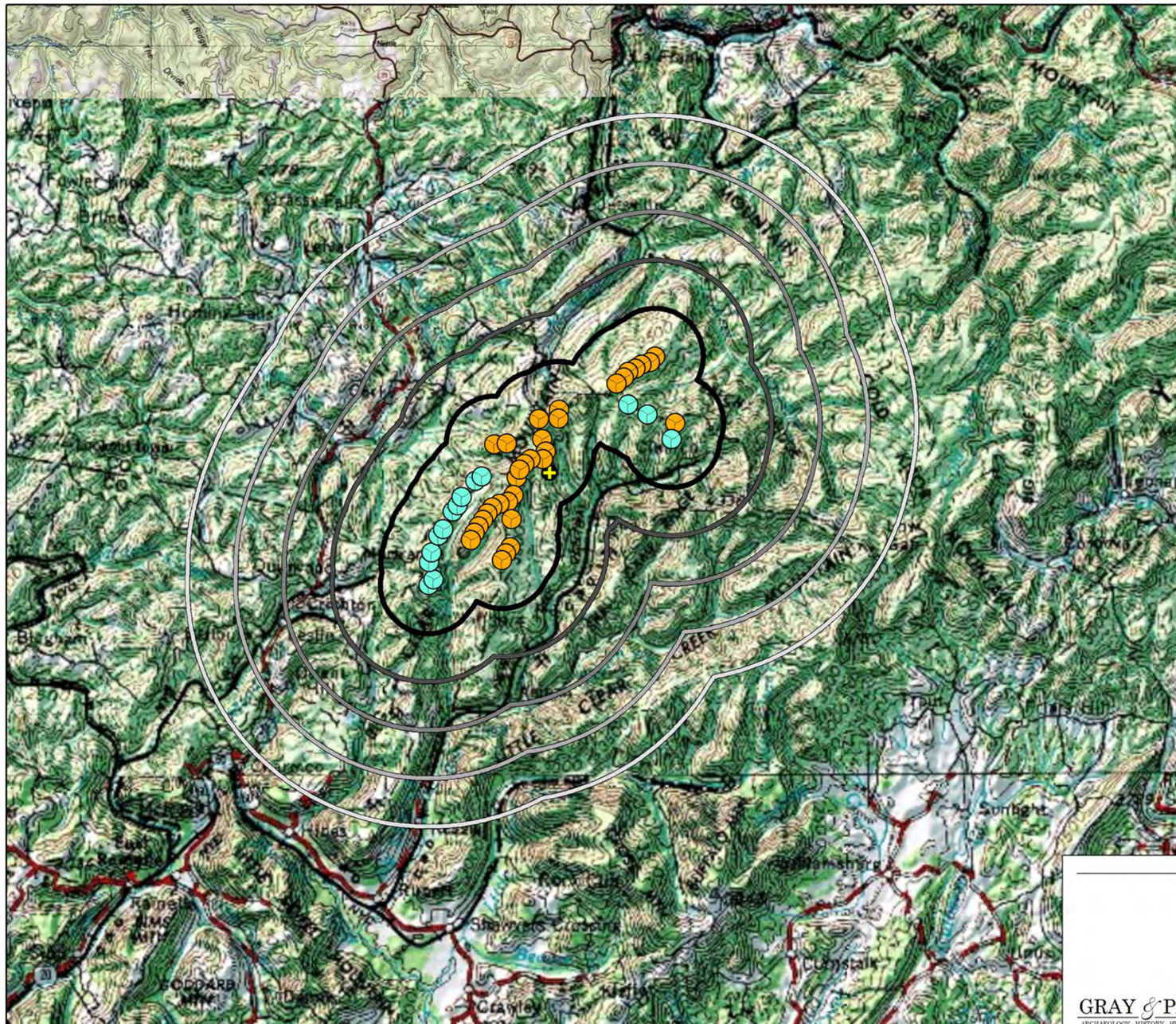

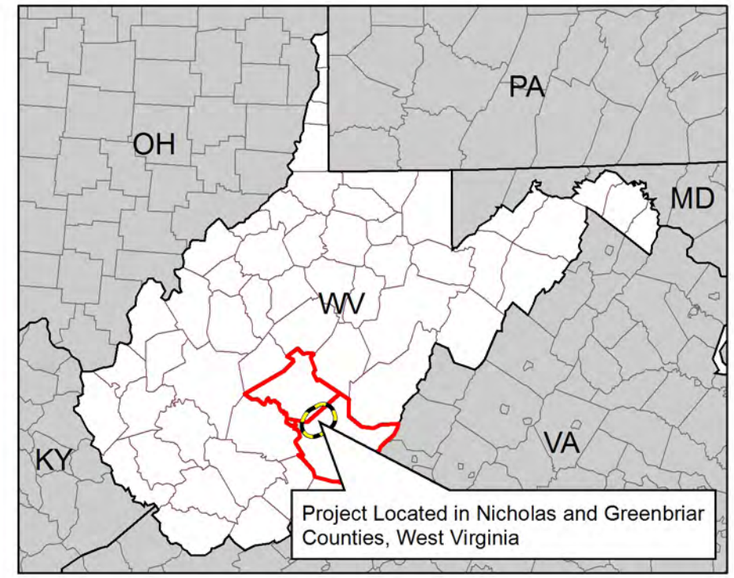

LEGEND

N W E S

5-Mile/8-Kilometer Project Area Buffer (1-Mile/1.6 Kilometer Increments)

Study Area Centroid

Proposed Turbine

Proposed Turbine (Alternate Site)

4 0 4 Kilometers

2.5 0 2.5 Miles

Location of Undertaking in Greenbrier and Nicholas Counties, West Virginia

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Figure 1

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Each WTG incorporates a horizontal-axis propeller that drives a gearbox and generator mounted to the top of a 100-m (328-ft) high tower. A nacelle for weather protection and noise control encloses the gearbox and generator. The 100-m (328-ft) diameter rotor has three blades, which attach to a hub that contains active blade pitch control; this system provides for peak aerodynamic efficiency over a range of wind conditions. The WTGs include the following noise control treatments in their design: impact noise insulation of the gearbox and generator, reduced-noise gearbox, reduced-noise nacelle; vibration isolation mounts, and quieted-design rotor blades. Commercial operation of the final 33 WTGs is expected to occur immediately upon completion of construction.

1.2 Area of Potential Effects

As defined by Federal regulations in *36 CFR Part 800*, an Area of Potential Effects (APE) "means the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The APE is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking" (USGPO 2010a). An effect "means alteration to the characteristics of a historic property qualifying it for inclusion in or eligibility for the NRHP" (USGPO 2010a).

The historical architectural investigation for the Undertaking is being conducted within the regulatory frameworks of NHPA and NEPA. Following the precedent established in 2006-2007, a 5-mile APE (encompassing approximately 103,450 acres or 162 square miles) for the Undertaking was defined around the locations of proposed WTGs at the outset of Gray & Pape's historical architectural survey. To establish the broadest possible APE, a 5-mile radius was drawn around the location of each of the 47 sites being evaluated. These radii were merged to create a single APE boundary that extends at least 5 miles around each site being evaluated.

The APE for the Undertaking overlaps with the APE from the 2006-2007 investigation; a total of approximately 72,654 acres (114 square miles) of the current APE was included in the 2006-2007 APE (Figure 2). A historical architectural survey already had been completed by Gray & Pape for the areas in which the overlap exists (O'Bannon and Sweeten 2007). A detailed historic context for Greenbrier and Nicholas counties was developed as part of that effort. Gray & Pape did not duplicate efforts from the previous investigations, but built upon those findings to complete the work described herein.

As stated in *36 CFR Part 800*, an adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeing, or association. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance, or be cumulative (USGPO 2010a).

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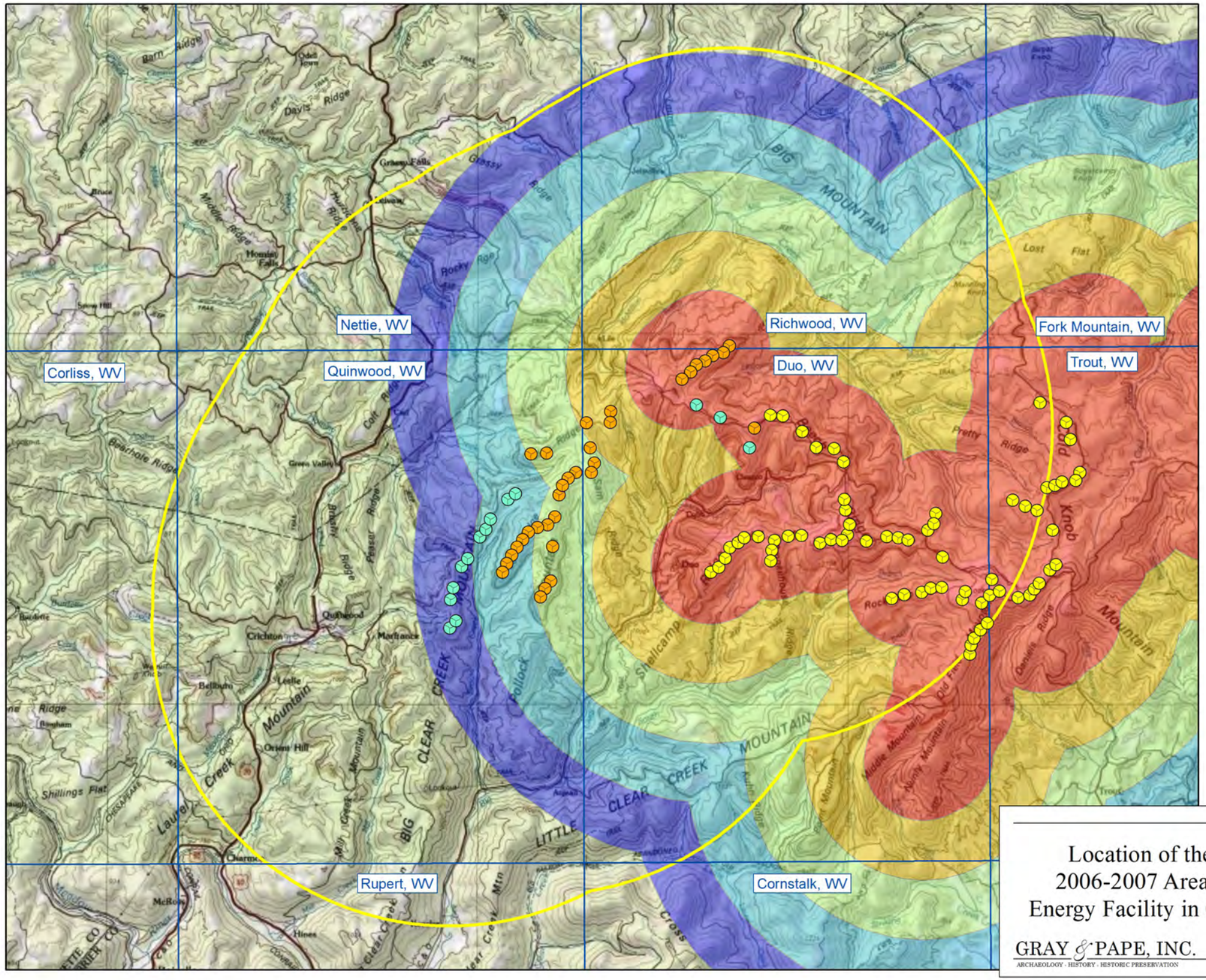

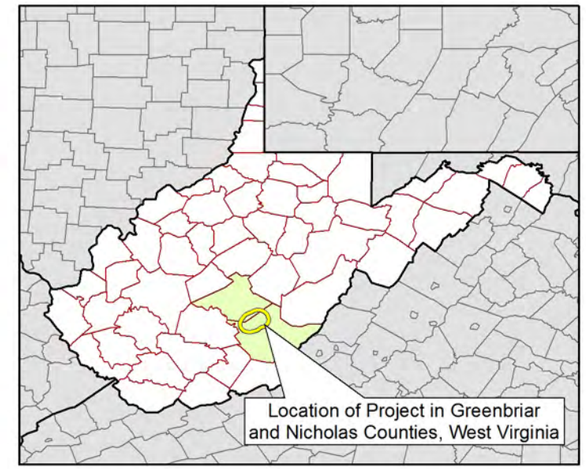

LEGEND

- Proposed Turbine
- Proposed Turbine (Alternate Site)
- Existing Turbine
- Proposed Study Area (5-Mile/8-Kilometer Radius)

Previous Viewshed Study Area

- 1-Mile/1.6-Kilometers
- 2-Miles/3.2-Kilometers
- 3-Miles/4.8-Kilometers
- 4-Miles/6.4-Kilometers
- 5-Miles/8-Kilometers

USGS 7.5' Quadrangle Boundary

3 0 3 Kilometers

2 0 2 Miles

N W E S

Location of the Undertaking's Area of Potential Effects and 2006-2007 Area of Potential Effects of the Beech Ridge Wind Energy Facility in Greenbrier and Nicholas Counties, West Virginia

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Figure 2

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As stated in *36 CFR Part 800*, examples of adverse effects on historic properties include, but are not limited to:

(1) Physical destruction of or damage to all or part of the property;
(2) Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation and provision of handicapped access, that is not consistent with the Secretary's Standards for the Treatment of Historic Properties (36 CFR Part 68) and applicable guidelines;
(3) Removal of the property from its historic location;
(4) Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance;
(5) Introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features;
(6) Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organizations; and
(7) Transfer, lease, or sale of property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance (USGPO 2010a).

1.3 Previous Investigations

In 2010, Gray & Pape contracted with Invenergy to undertake a historic architectural survey for the proposed expansion/modification of the Beech Ridge Wind Energy Facility. Invenergy requested that a reconnaissance-level historic architecture survey be conducted to inventory all above-ground cultural resources, including updating forms for previously inventoried properties within an APE. Fieldwork conducted during the course of this survey was designed to provide the client with definitive information on the current condition of each inventoried resource. The project also entailed identification of potentially significant cultural and historic landscapes and districts.

For the Beech Ridge Undertaking, Gray & Pape developed and refined a research design and methodology for the cultural resources investigations described herein. The research design and methods were established with reference to the *West Virginia National Register and Architecture/History Survey Manual* (WVDCH 2005) and the U.S. Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* (United States Department of the Interior [USDI] 1983). The preparation of the survey report and any recommendations concerning the National Register eligibility of historic architectural resources identified during the survey will be made with reference to 36 CFR Part 800*: Protection of Historic Properties* (USGPO 2010a); 36 CFR 60*: National Register of Historic Places* [USGPO 2010b]*;* the Secretary of the Interior's *Standards and Guidelines for Archaeology and Historic Preservation* (1983); National Register Bulletin 15, *How to Apply the National Register Criteria for Evaluation* (USDI 1995); and National Register Bulletin 16B, *How to Complete the National Register Registration Form* (1997). The Gray & Pape

Project Manager, Principal Investigator, and Project Architectural Historians completing this survey exceed the professional qualification standards of the USDI.

The findings of the architectural survey were presented in *Reconnaissance-Level Architectural Survey for the Proposed Expansion/Modification of the Beech Ridge Wind Energy Facility, Greenbrier and Nicholas Counties, West Virginia* (Sweeten McDonald et al. 2011). This report was submitted to, and approved by, the WVDCH and USFWS, and is on file in the WVDCH's permanent archives. The WVDCH has concurred with all NRHP eligibility recommendations presented in the report. Locations of all NRHP-eligible resources are illustrated in Appendix A.

During the course of investigations, the newly identified Mt. Urim Baptist Church (NI-0026-0192) and its associated cemetery (Field Number 175) were recommended eligible for inclusion in the NRHP based on eligibility criteria specified in 36 CFR 60.4. The WVDCH concurred with this recommendation on 23 June 2011. No other properties newly identified during the current investigation were recommended eligible for the NRHP.

1.4 Report Organization

This report is organized in 6 sections and 4 appendices. Section 1.0 provides the introductory materials regarding the project. The methods used to identify historic architectural resources are detailed in Section 2.0. Visual effects of the proposed wind energy facility are discussed in Section 3.0, while noise effects are in Section 4.0. In Section 5.0, the cultural effects of the proposed facility are described. The references cited are in section 6.0 of this report.

Appendix A presents the results of the viewshed analysis for the proposed wind turbine facility as well as photographs and photo simulations showing the anticipated visual effects of the Undertaking (Appendix A, Figures A7, A8 and A10-A22). The full text of the acoustical study of the proposed wind energy facility is reproduced in Appendix B.

1.5 Acknowledgements

Preparation of this report was a team effort undertaken by staff at Gray & Pape and Saratoga Associates Landscape Architects, Architects, Engineers, and Planners, P.C. (Saratoga Associates). Photo simulations and viewshed analyses were prepared by Saratoga Associates. Gordon Perkins of Saratoga Associates also participated in fieldwork, took digital photographs to be used for photo simulations, while John Guariglia supervised preparation of all photo simulations, viewshed analyses, and mapping viewshed analysis results. Acentech Incorporated prepared the acoustical study for the Undertaking.

Senior Principal Investigator Lena Sweeten McDonald of Gray & Pape participated in fieldwork and compiled project documentation, and, with Senior Manager Patrick O'Bannon of Gray & Pape, oversaw preparation of this report. Julisa Melendez served as the report editor, and graphics were completed by Carly Meyer. Bryan Cross coordinated with Saratoga Associates in the preparation of GIS data and field mapping used by Gray & Pape for the report. The authors would like to thank the above staff for their contributions to the project.

2.0 RESEARCH DESIGN AND METHODS

The built environment yields immediate evidence of the character of the historic architectural properties that are located in a given area, as well as their relative integrity and ubiquity. A visual record of previous activities and periods of growth or change, therefore, can be discerned through study of the architectural resources in a given area. However, historically significant patterns, trends, and events, as well as association with significant persons are not always immediately apparent through a visual survey alone. Historical research, including review of maps, local histories, and atlases also is necessary to develop a fuller understanding of the influences that shaped an area's development and change over time.

2.1 National Register of Historic Places Criteria for Evaluation of Eligibility

As part of the Section 106 review process, cultural resources investigations generally are conducted with the purpose of identifying resources that are listed in or eligible for inclusion in the NRHP. The NRHP, which is administered by the National Park Service (NPS) identifies districts, sites, buildings, structures, and objects (defined below at 2.5.2) that are significant in American history, architecture, archaeology, engineering, and culture. The quality of significance is present in resources that "possess integrity of location, design, setting, materials, workmanship, feeling, and association" and meet one or more of the following criteria:

> A. that are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> B. that are associated with the lives of persons significant in our past; or
>
> C. that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
>
> D. that have yielded, or may be likely to yield, information important in prehistory or history (USGPO 2010b).

2.2.1 Criteria Considerations

Ordinarily, cemeteries, birthplaces, graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years shall not be considered eligible for the NRHP. Such properties will qualify, however, if they are integral parts of historic districts that meet the criteria or if they fall within the following categories:

A. a religious property deriving primary significance from architectural or artistic distinction or historical importance; or

B. a building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event; or

C. a birthplace or grave of a historical figure of outstanding importance if there is no other appropriate site or building directly associated with his productive life; or

D. a cemetery that derives its primary significance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events; or

E. a reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived; or

F. a property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own historical significance; or

G. a property achieving significance within the past 50 years if it is of exceptional importance (USGPO 2010b).

2.2.2 Resource Types

The NPS recognizes five types, or categories, of properties that may be listed in or eligible for the NRHP. Each of these types is defined below.

- **Building**. A building is a structure created to shelter any form of human activity, such as a house, barn, church, hotel, or similar structure. The term "building" may refer to a historically and functionally related complex, such as a courthouse and jail or a house and barn.
- **Site**. A site is the location of a significant event, a prehistoric or historic occupation or activity, or a building or structure, whether standing, ruined, or vanished, where the location itself maintains historical or archaeological value regardless of the value of any existing structure.
- **Structure**. A structure is a work made up of interdependent and interrelated parts in a definite pattern of organization. Constructed by man, it is often an engineering project large in scale. The term is used to distinguish resources created with some purpose other than the shelter of human activity from buildings. Examples of structures include fortifications, roads, and bridges.
- **Object**. An object is a material thing of functional, aesthetic, cultural, historical, or scientific value that may be, by nature or design, movable yet related to a specific setting or environment. Examples of objects include railroad locomotive, ships, airplanes, and memorials.

- **District**. A district is a geographically definable area, urban or rural, possessing a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united by past events or aesthetically by plan or physical development (USDI 1995).

2.2.3 Cultural Landscapes

A cultural landscape is a geographic area (including both cultural and natural resources and the wildlife or domestic animals therein), associated with a historic event, activity, or person, or exhibiting other cultural or aesthetic values. There are four general types of cultural landscapes, not mutually exclusive: historic sites, historic designed landscapes, historic vernacular landscapes, and ethnographic landscapes. Following is a summary of landscape types, as defined by the NPS (NPS 2008).

- **Historic site**: a landscape significant for its association with a historic event, activity, or person. Examples include battlefields and presidential homes and properties.

- **Historic designed landscape**: a landscape that was consciously designed or laid out by a landscape architect, master gardener, architect, engineer, or horticulturist according to design principles, or an amateur gardener working in a recognized style or tradition. Examples include parks, campuses, and estates.

- **Historic vernacular landscape**: a landscape that evolved through use by the people whose activities or occupancy shaped it. The landscape reflects the physical, biological, and cultural character of everyday lives. Examples include rural historic districts and agricultural landscapes.

- **Ethnographic landscape**: a landscape containing a variety of natural and cultural resources that associated people define as heritage resources. Examples include contemporary settlements, sacred religious sites, and massive geological structures.

Cultural landscapes are listed, or determined eligible for inclusion, in the NRHP as sites or historic districts. They must meet the NRHP evaluation criteria, described above, in terms of both significance and integrity. The NPS has provided guidance for evaluating the significance of rural historic landscapes associated with agricultural land uses and practices (McClelland et al 1999).

> First, the [landscape] characteristics must have served or resulted from an important event, activity, or theme in agricultural development as recognized by the historic contexts for the area. Second, the property must have had a direct involvement in the significant events or activities by contributing to the area's economy, productivity, or identity as an agricultural community. Third, through historic landscape characteristics, the property must cogently reflect the period of time in which the important events took place (McClelland et al. 1999:13).

Significance of a cultural resource under NRHP eligibility Criterion A is derived from events that have made a significant contribution to the broad patterns of our history. Significance of

a cultural landscape under NRHP Criterion B is established through association of the resource with the lives of individuals who made important contributions on a local, state, or national level. Significance under Criterion B often is unrelated to historic uses, such as a farm that also was the home of a political leader, writer, poet, artist, or industrialist. Historic landscape characteristics are important in establishing the historic association and setting of these properties.

Significance under Criterion C applies to the physical qualities of a landscape. Significant physical qualities may be present in a number of ways. For example, the organization of space, visible in the arrangement of fields or siting of farmsteads, may illustrate a significant pattern of land use associated with traditional practices unique to a specific community. Similarly, an irrigation or transportation system may reflect an important innovation in engineering that fostered a community's prosperity.

Significance under Criterion D is associated with properties that have yielded or are likely to yield information important to prehistory or history. Abandoned roadways, reforested fields, remnant stone walls, and battlefield earthworks are examples of resources that can possess characteristics that meet the significance requirement of Criterion D.

2.2.4 Integrity

Historic integrity is a measure of a property's evolution and current condition. Change over time can contribute to a property's historic significance if those changes are related to the trends and patterns of development identified in the historic context.

Applying any of the NRHP eligibility criteria involves two tests. First, a property must satisfy one or more of the criteria and, second, the property must retain sufficient integrity to illustrate or convey its significance (USDI 1995:44–45). The seven aspects of integrity are defined as follows.

- **Location** is the place where the historic property was constructed or the place where the historic event occurred.

- **Design** is the combination of elements that create the form, plan, space, structure, and style of a property.

- **Setting** is the physical environment of a historic property.

- **Materials** are the physical elements that were combined or deposited during a particular period of time and in a particular pattern or configuration to form a historic property.

- **Workmanship** is the physical evidence of the crafts of a particular culture or people during any given period in history or prehistory.

- **Feeling** is a property's expression of the aesthetic or historic sense of a particular period of time.

- **Association** is the direct link between an important historic event or person and a historic property (USDI 1995:44–45).

For a historic architectural or archaeological property to be considered eligible for inclusion in the NRHP, it must retain one or more of these aspects of integrity. Cultural resources that have undergone extensive expansions over time may have lost the characteristics that convey integrity, thereby rendering the properties ineligible for listing in the NRHP.

2.3 Research Design and Methods

Working within the regulatory framework and guidelines described above, Gray & Pape developed a research design and methods appropriate for the Undertaking. The research design and methods are based on the firm's 2006-2007 historical architectural investigations for the Beech Ridge Wind Energy Facility (O'Bannon and Sweeten 2007).

2.3.1 Archival Research

A survey of historical architectural resources is designed to record the current condition of a historic-period resource by means of written description and digital photo-documentation and to place it within a general historic context. Building on the research conducted in 2006–2007, Gray & Pape tailored additional research to provide contextual information for the types of resources located within the Undertaking's defined APE. The research included consultation of county histories, historical maps, newspaper clipping files, pictorial histories, atlases, and other secondary sources. Gray & Pape also sought any cultural resource reports completed since 2006 that covered areas within the Undertaking's defined APE.

Gray & Pape conducted archival research in Charleston, West Virginia, at the West Virginia Archives and History Library and WVDCH in September 2010. Staff at the WVDCH provided CD-ROM copies of all official WVDCH HPI forms for previously identified resources within the APE. Forms for 108 resources in Greenbrier and Nicholas counties were provided.

Local repositories, including the Greenbrier County Public Library and the Greenbrier Historical Society were consulted during the course of the historical architectural investigation. Archival research at the repositories in the vicinity was completed concurrently with the architectural survey and was based on the findings of the survey. Gray & Pape also retrieved archival materials relevant to the current investigation from the Library of Virginia, located in Richmond.

Utilizing the findings of the background research as well as the results of fieldwork investigations, Gray & Pape developed a historic context for resource types and/or themes that were not discussed in the 2006–2007 report. This information aided in evaluating the type and character of newly identified historic-period architectural resources. The context considers the history of the area, as well as changes to the built environment over time, including settlement patterns, commerce, natural resources extraction, and other relevant historic trends. Consideration of the rural historical landscape also is presented in this context.

2.3.2 Field Methods

Gray & Pape's field survey team assembled in Lewisburg, West Virginia, on 24 October 2010 to review the historical architectural investigation's parameters, field maps and survey forms, photo-documentation requirements, landscape assessments, and all other aspects of the survey methods. The field survey commenced 25 October 2010 and concluded on 29 October 2010. The survey team was composed of staff with training in American architectural history, architectural field survey techniques, and digital photography. A Gray & Pape Principal Investigator was part of the team throughout the survey. The survey methods complied with the *Secretary of the Interior's Standards and Guidelines for Identification* (USDI 1983) as well as the survey guidelines promulgated by the WVDCH (specifically Part 2, which discusses Review and Compliance surveys) (WVDCH 2005).

Gray & Pape performed a field survey of all architectural resources 50 years or older located within the Undertaking's defined APE. As previously noted, the Undertaking's defined APE and the APE for the 2006-2007 historical architectural survey overlap to some extent. Approximately 50 resources identified during the 2006–2007 investigation were field-checked for any major changes. "Major changes" include, but are not limited to, alterations such as new additions, demolition in whole or in part, and/or replacement or removal of character-defining historic fabric such as original sash, siding, doors, and decorative elements. The survey team endeavored to remain within the publicly owned right-of-way during fieldwork unless invited onto the property by the property's owner. The team's field maps included the boundaries of the current APE, the area of overlap with the 2006–2007 historical architectural survey, and locations of all previously identified architectural resources. Due to the recent vintage of the previous architectural survey, no unrecorded resources were assumed to be present within the area of overlap between the 2006–2007 APE and the Undertaking's defined APE. Resources identified during the 2006–2007 investigations were photographed only if major changes had taken place at the property during the intervening years.

Within the western one-third of the current APE, which was not included in the 2006–2007 investigation, Gray & Pape digitally photo-documented each previously unrecorded historic-period resource with exterior views. Photographs included at least one three-quarter view of the primary building associated with each resource and of any secondary buildings. Resources were documented with 35-mm digital photography according to the guidelines set forth by the WVDCH for architectural survey (WVDCH 2005). All digital photography met the requirements of the National Park Service's March 2005 photo policy expansion. Field photo logs were used to match photographs with HPI forms. The location of each resource was recorded on field maps. Locational data was incorporated into a GIS dataset as part of the documentation record for the historical architectural survey. Furthermore, in the western one-third of the current APE, Gray & Pape's survey team examined the rural landscape as a whole using the same methods as in 2006-2007. Representative photographs of the landscape and built environment were taken, and field notes were annotated to record both typical and atypical characteristics.

Field observations and other information were collected and used to generate an architectural description of each historic-period resource. All information gathered was recorded on

WVDCH HPI forms, as well as data pertaining to historical use, construction date, and current condition. This information, along with the aforementioned archival research, was used to develop a statement of significance for each resource. For the previously recorded resources, Gray & Pape updated the HPI forms for properties that had major changes since their previous survey, including new digital photo documentation.

As field investigations proceeded, the survey team member traversed all passable publicly owned roads. Some county-maintained roads were unpaved and were not fully passable, but these tended to be in remote, generally undeveloped areas. Survey team members did not enter any privately owned driveways or roads. In all instances, historical architectural resources were observed and documented from the publicly owned right-of-way unless a property owner invited the team onto the site. Buildings that may be construed as public, such as churches, stores, and schools, also were approached more closely. Every effort was made to identify and record each resource over 50 years old within the Undertaking's defined APE. Given the remote character of the landscape, Gray & Pape acknowledges that access to all properties from publicly owned rights-of-way was not possible. For all properties, Gray & Pape sought to respect the wishes of owners concerning access.

Similar to the investigations carried out in 2006-2007, Gray & Pape's fieldwork investigations also considered each resource within the context of rural historic districts and/or landscapes. The Pickaway Rural Historic District study (Sibold and Ripley 1998), available at WVDCH, provided guidance for identifying similar property types within the Undertaking's defined APE. Locations of potential rural historic districts and/or landscapes were marked on field maps, as well as pertinent information concerning each potential district and/or landscape, such as the types of individual resources present, defining characteristics, and a preliminary determination of appropriate boundaries for each district and/or landscape. Photographs of potential districts and/or landscapes were keyed to field maps as well.

2.4 Historic Properties within the Area of Potential Effects

Below, Table 1 lists the NRHP-eligible resources located within the Undertaking's defined APE. The table includes information regarding the characteristics that qualify each property for the NRHP and a summary of the Undertaking's effects on the property.

Table 1. NRHP-Eligible Resources within the Area of Potential Effects							
Name	**Figure No.**	**Plate No.**	**Address/ Location**	**NRHP Criteria**	**NRHP Criteria Consideration**	**NRHP Qualifying Characteristics**	**Effect**
Mt. Urim Baptist Church (NI-0026-0192) and associated cemetery (Field Number 175)	A4 A7 A8	View point 1-4	County Route 17	A, C	Criteria Consideration A (Religious Properties)	Rectangular 1-room plan, clapboard siding, front-gabled roof, symmetrical fenestration; built by local carpenters and craftsmen. Integrity of location, design, setting, workmanship, materials, feeling, and association	No Effects
Duo Historic District	A4 A5 A10-A22	View Point 5-10	Duo Road	A		Association with historical patterns of development; association with coal mining. Organization, buildings, and patterns of land use as a company town. Integrity of location, design, setting, feeling, and association.	Visual Effects – 1-30 turbines visible from areas within the district depending on vantage point; Cultural Effects – changes to the setting, feeling, and association of the district's cultural landscape.

3.0 VISUAL EFFECTS

3.1 Viewshed Analysis

A computer generated viewshed analyses was conducted to determine the visibility of the Undertaking from all historic-period resources within the APE that were identified during field investigations in October 2010. Mapping of the results of the field investigations are presented in Appendix A (Figures A2, A3, A6 and A9). Two NRHP-eligible resources are within the Undertaking's defined APE (Figure A1).

The first portion of the electronic viewshed analysis for the Undertaking was prepared by Saratoga Associates; this firm also provided all viewshed analyses in 2006-2007. The analysis included all 47 WTG sites that were being evaluated and shows all areas of the entire current APE within which one or more WTGs will have the potential to be visible. From the total 47 WTG sites, up to 33 will be selected for construction during the proposed expansion/modification of the Beech Ridge Wind Energy Facility. Consequently, the viewshed analysis considers the maximum possible visual effect of the Undertaking, but with the differential of 14 sites, actual visual effects will be less than projected by the viewshed analysis.

To assess the likelihood for visual effects on NRHP-eligible resources, the first step in conducting a visibility analysis is to create viewshed maps (Figures A2 and A3) in order to determine whether or not the Undertaking would be visible from a given location. Also known as defining the zone of visual influence, viewshed mapping identifies the geographic area within which there is a relatively high probability that some portion of the Undertaking would be visible.

The overall accuracy of viewshed mapping is dependent on the number and location of control points (study points representing proposed WTGs) and the resolution of the data used in the viewshed calculation. To calculate the maximum range of potential WTG visibility, one control point was established at the WTG high point (i.e., apex of blade rotation or 497 feet) for each of the 47 WTG sites being evaluated. The resulting composite viewshed identifies the geographic area within the 5-mile study radius (APE) where some portion of the Undertaking (the apex of one or more WTG blades) is theoretically visible.

For the entirety of the Undertaking's defined APE, the first viewshed map was prepared by defining the area within which there would be no views of the Undertaking because of the screening effect caused by intervening topography (Figure A2). This treeless condition analysis is used to identify the maximum potential geographic area within which further investigation is appropriate. A second map was prepared by illustrating the probable screening effect of existing mature vegetation (Figure A3). This vegetative condition, although not considered definitive, acceptably identifies the geographic area within which

one could expect to be substantially screened from views of the Undertaking by intervening forest vegetation.[1]

Identified viewshed areas were further quantified to illustrate the number of WTGs that may be visible from any given area. This cumulative degree of visibility is summarized on each map using the following groupings:

- 1–5 WTGs visible;
- 6–10 WTGs visible;
- 11–20 WTGs visible;
- 21–30 WTGs visible;
- 31–40 WTGs visible; and,
- 41–47 WTGs visible.

By themselves, the viewshed maps do not show which specific WTG(s) one could theoretically see from a given vantage point or how much of each WTG is visible above intervening landforms or vegetation (e.g., 100 percent, 50 percent, 10 percent etc., of total WTG height). Instead these maps identify the geographic area within which there is a relatively high probability (theoretical visibility) that *some portion* of one or more WTGs would be visible. The primary purpose of these maps is to assist in determining the potential visibility of the Undertaking from the identified historic resources.

In this evaluation, ArcGIS 9.2 and ArcGIS Spatial Analyst software were used to generate a viewshed overlay map based on publicly available digital topographic and vegetation data sets. Viewshed maps were created by first importing a digital elevation model (DEM) of the study area. This DEM, obtained through the United State Geologic Survey (USGS) from its National Elevation Dataset, is based on the best publicly available digital elevation data. The DEM data was sampled at a 10-meter grid cell resolution and projected to the Universal Transverse Mercator (UTM) coordinate system. The computer then scanned from each control point to all cells within the DEM, distinguishing between grid cells that would be hidden from view and those that would be visible based solely on topography. Areas of the surrounding landscape where each control point would be visible were identified; areas interceded by topographic features would not be visible.

Vegetation data was extracted from the USGS National Land Cover Data Set 2001 (NLCD). The NLCD dataset, produced by the Multi-Resolution Land Characteristic Consortium, was developed from LandSat 7 Thematic Mapper (TM) imagery (2001 is the nominal year of image acquisition) and is sampled to a 30-meter grid resolution.[2] The screening effect of

[1] The vegetated viewshed map accounts for removal of vegetation where proposed access roads (20 feet) and turbine pads (100-foot radius) may require additional clearing.

[2] Thirty-meter (98.4 feet) resolution is the smallest vegetative grid cell increment commonly available for the project region. This resolution provides an appropriate degree of accuracy for development of 5-mile viewshed

vegetation was incorporated by adding 40 feet in height to DEM grid cells that are completely forested (according to NLCD dataset) and then repeating the calculation procedure to identify areas of no visibility due to interceding vegetation. Forested areas then were removed from the viewshed to account for areas located within a full forest canopy. Based on field observations, most trees in forested portions of the study area appear to be taller than 40 feet. This height thus represents a conservative estimate of the effect of vegetative screening.

It is important to note that the NLCD dataset is based on interpretation of forest areas that are clearly distinguishable from multispectral satellite imagery. As such, the potential screening value of site-specific vegetative cover, such as small hedgerows, individual trees, and other areas of non-forest tree cover, may not be represented in the viewshed analysis. Furthermore, the NLCD dataset does not include recently deforested areas or the screening value of existing structures (e.g. homes, farmsteads, commercial structures, etc). The latter is particularly important in populated areas. Given these conditions, the viewshed map may be considered to conservatively overestimate potential visibility of the Undertaking.

It is noteworthy that untrained reviewers often misinterpret treeless condition viewshed maps to represent wintertime, or leafless condition visibility. In fact, deciduous woodlands provide a substantial visual barrier in all seasons. Since the NLCD dataset generally identifies only larger stands of woodland vegetation that are clearly distinguishable from multispectral satellite imagery, viewshed maps that include the screening value of existing vegetation are equally representative of both leaf-on and leaf-off seasons. Treeless condition analysis is provided only to assist experienced visual analysis identify the maximum potential geographic area within which further investigation is appropriate. Such topography-only viewshed maps are not generally intended or appropriate for public interpretation or presentation.

Finally, the viewshed maps indicate locations in the surrounding landscape in which one or more WTG highpoints (i.e. apex of blade rotation) may be visible. These maps do not imply the magnitude of visibility (i.e., how much of each WTG is visible), the viewer's distance from each visible WTG, or the aesthetic character of what may be seen. Such interpretation is accomplished in subsequent analyses such as the completion of photo simulations. After NRHP eligibility of resources with visual effects has been established, photo simulations will be prepared to assess the effects on each resource and review agencies will determine if the effect is adverse.

After completing field investigations and identifying all historic-period resources within the 5-mile APE, Gray and Pape used Saratoga's electronic viewshed analysis to analyze if one or more proposed WTGs will be visible to a given NRHP-eligible resource (Figures A2, A3, A6 and A9). The location for each identified NRHP-eligible resource was created in ESRI ArcGIS 9.3 using field maps and notes, and then marked as an electronic point. It was taken into account that only a small portion of a feature may fall within the electronic viewshed. Furthermore, a resource was considered to have viewshed impacts from a proposed WTG if

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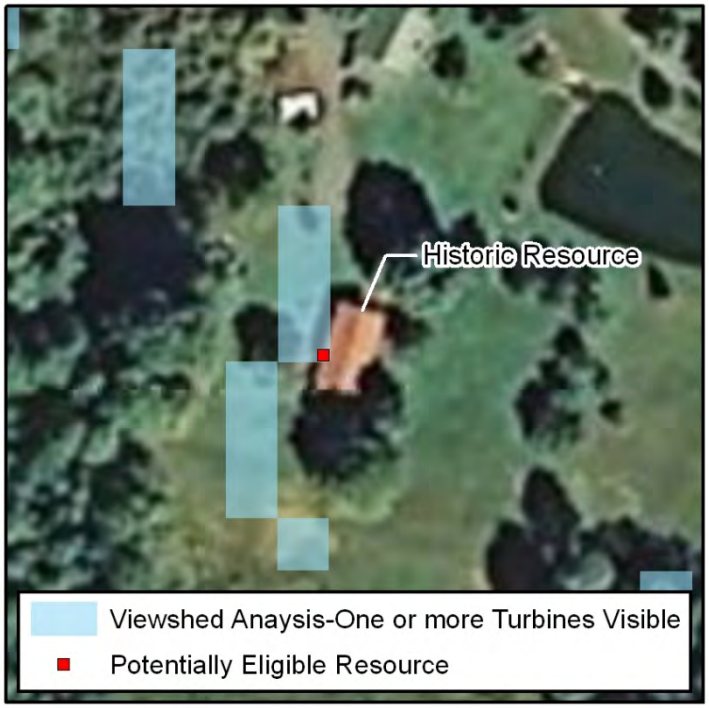
maps given the fairly broad patterns of existing land use in the area, as well as the accuracy of mapped topographic data (i.e., 1:24,000-scale USGS topographic maps with 10-foot contour intervals).

any portion of the resource intersects the electronic viewshed extent. Given the extent of the resources in the real world are polygons, each resource location was then visually compared with the electronic viewshed analysis. If appropriate, the resource point was repositioned to the intersections with the electronic viewshed extent. The extent of each resource was determined using 2009 aerial photography from the United States Department of Agriculture Farm Service Agency (USDA FSA) National Agricultural Imagery Program (NAIP), USGS 7.5' Series Topographic Quadrangles, and field maps and notes, as illustrated below.



Once the point locations were repositioned to the electronic viewshed extent, ArcGIS 9.3 and ArcGIS Spatial Analyst software was used to convert Saratoga's data from raster format to vector format. This allowed the viewshed data to be spatially queried with the resource data, identifying which resources intersect the electronic viewshed data. All historic-period resources identified as having visual impacts were documented with an HPI form and evaluated for NRHP eligibility, as described in the following chapters.

3.2 Photo Simulation Methods

A photo simulation of the proposed wind energy project was prepared from each appropriate NRHP-eligible resource. Photo simulations were developed by superimposing a rendering of a three-dimensional computer model of the proposed project into the base photograph taken from each corresponding resource. The three-dimensional computer model was developed with *Autodesk Architectural Desktop*, *Land Development Desktop* and *Autodesk Viz* (Viz) software.

Simulated perspectives (camera views) were then matched to the corresponding base photograph for each simulated view by replicating the precise UTM coordinates of the field

camera position (as recorded by GPS) and the focal length of the camera lens used (e.g. 50mm). Precisely matching these parameters assures scale accuracy between the base photograph and the subsequent simulated view. The camera's target position was set to match the bearing of the corresponding existing condition photograph as recorded in the field. With the existing conditions photograph displayed as a "viewport background," minor camera adjustments were made (horizontal and vertical positioning, and camera roll) to align the horizon in the background photograph with the corresponding features of the 3D model.

The proposed condition model was rendered using the base photograph as a "Viz background environment map." The 3D model was rendered using sunlight settings approximating the date and time of day the base photograph was taken. To the extent practicable, and to the extent necessary to reveal impacts, design details of the proposed WTGs were built into the 3D model and incorporated into the photo simulation. Consequently, the scale, alignment, elevations and location of the visible elements of the proposed facilities are true to the conceptual design. The rendered view was then opened using *Adobe Photoshop 7.0* software for post-production editing (i.e., airbrush out portions of WTGs that fall below foreground topography and vegetation). Limited tree clearing, anticipated during construction, was not illustrated in the simulations.

The photo simulations are taken from a single vantage point looking toward the proposed wind energy facility. The view shown is intended to be representative, rather than comprehensive. A photo simulation shows the number of WTGs visible from that specific point, not the total number of WTGs visible from throughout a property's boundaries. In actuality, the number of WTGs visible from a property, or from within a historic district, will vary depending on where an observer is located. Consequently, the photo simulations are illustrative, whereas the data used to generate the viewshed analysis results are quantifiable. As previously noted, the visual effects of the proposed project will not be uniform throughout the APE. Topographical variations often result in viewsheds of very different expanses from vantage points that are relatively close together. Additionally, the electronic viewshed analysis did not take into account the influence of screening by vegetation that is shorter than the 40-foot standard. As a result, it is not unusual for NRHP-eligible resources in close proximity to each other to have different levels of visual effects. The specific visual effects for each NRHP-eligible resource are discussed in greater detail in Section 3.3.

3.3 Visual Effects to NRHP-Eligible Resources

The setting in which the Undertaking will be located is generally quite rural, with a number of former coal mining company towns located in the hilltops and along transportation corridors. Widely dispersed farmsteads and residential development exist in unincorporated parts of both counties as well. Historically, comparatively isolated mining camps, logging camps, and mills also were located in the mountains, often alongside streams and rivers. In Nicholas County, the former mining and lumber boom town of Richwood stands approximately 1.3 miles (2 kilometers) north of the APE's northernmost boundary line. In Greenbrier County, the nearest city of substantial size is Lewisburg, which is situated approximately 16 miles (26 kilometers) southeast of the APE's southernmost boundary line. Historical development patterns in the APE have been profoundly influenced by the wealth of natural resources found throughout West Virginia, including fertile floodplains and

valleys, numerous rivers and streams, extensive coal and other mineral deposits, and dense forests.

The Undertaking is located in a rural area with steeply to gently rolling topography. The APE includes portions of Greenbrier and Nicholas counties. Since the area's settlement during the early nineteenth century, agriculture, coal mining, and lumbering have ranked among the most important economic endeavors. Coal mining continues to be pursued on a moderate scale in northwestern Greenbrier County and southern Nicholas County. Both counties also have vast tracts of land that include managed timber resources; much of these areas were clear cut one or more times over the course of the twentieth century and continue to be managed as such today.

The Undertaking will consist of construction of up to 33 WTGs that will be in addition to the WTGs already present at the Beech Ridge Wind Energy Facility. Taking into account the screening effects of the existing topography and vegetation, results of the viewshed analysis indicate that a total of approximately 1-5 WTGs could be visible from the NRHP-eligible Mt. Urim Baptist Church (NI-0026-0192) and associated cemetery (Field Number 175) (Appendix A, Figure A6). The viewshed analysis, presented in Figure A2, shows a series of 4 viewpoints taken from the south side of the church and cemetery grounds, looking toward the proposed WTGS. The viewshed model indicates that only Viewpoint 1 shows a possible visibility of WTGs, with a range of 1 to 5 WTG's visible from this vantage point. A field survey to verify the results of the viewshed analysis, however, revealed that dense foliage along the south side of CR 17/3, as well as topography to the south of the church and cemetery, significantly limits the field of vision from the south side of the church and cemetery grounds, effectively obscuring visibility of the proposed WTGs. A photo simulation of Viewpoint 1 shows that existing foliage obscures any visibility of WTGs from Mt. Urim Church and cemetery (Appendix A, Figures A7 and A8). Because no WTGs are potentially visible from Viewpoints 2 through 4, photo simulations for these vantage points are not included. From the perspective of the church and cemetery, none of the proposed WTGs will stand above the tree-line. As a result, the Undertaking will not have an adverse effect on the Mt. Urim Baptist Church and associated cemetery. It should be noted that removal of those trees that currently screen Mt. Urim Baptist Church from the proposed WTGs poses the potential to expose the church to views of said proposed WTGs. However, this scenario appears highly unlikely, as multiple property owners in this area, including the Mt. Urim Baptist Church congregation, would have to simultaneously agree to remove enough trees to expose the church to views of the proposed WTGs.

Taking into account the screening effects of the existing topography and vegetation, results of the viewshed analysis indicate that areas within the NRHP-eligible Duo Historic District may have views of 1-30 of the Undertaking's WTGs (Appendix A, Figures A9 through A22). The number of WTGs that will be visible will depend on the vantage point from within the district, with the majority of the district expected to have views of 1-10 WTGs. Some WTGs will stand above the existing tree-line while others will remain entirely obscured by the existing tree-line. Construction of the WTGs will add additional industrial elements to a greater extent of the rural landscape than currently exists. These industrial elements are, however, of a similar visual character to the coal mining activity that continues a short

distance south of Duo in the vicinity of Anjean. The visual elements introduced by WTGs are large-scale, permanent features on the landscape, much as coal-mining tipples, surface mines, and other aspects of modern mining have significant visual effects on rural landscapes. The scale of today's energy production activity, however, is often greater than those of historic practices. Consequently, the Undertaking will introduce visual elements that constitute an adverse effect for the Duo Historic District. Photo simulations illustrating likely visual effects were prepared for the historic district. The six vantage points from which photographs were taken are depicted on Figure A9 in Appendix A. The completed photo simulations are provided in Figures A10 through A22, also located in Appendix A.

4.0 NOISE EFFECTS

In February 2011, Acentech conducted an acoustical study to ascertain the likelihood of audible effects caused by the Undertaking. The full text of the acoustic analysis is provided in Appendix C of this report. The WVPSC Guidelines for Noise Studies for Siting Certificates include:

- Preconstruction – identify land uses and existing ambient sound levels (Ldn) in communities within one mile of the facility;
- Construction – predict construction noise associated with blasting, earthmoving, pile driving, erection, traffic, and equipment installation at the nearest property boundary and within one mile and five miles from the facility. Identify noise sensitive areas within one mile and five miles of the facility. The noise sensitive areas include hospitals, schools, residences, cemeteries, parks, and churches. Describe construction equipment, procedure, and potential noise mitigation options.
- Operation – predict operation noise and identify land uses and type of structures (residential, commercial, or industrial) within one mile of the facility. Describe equipment and procedures to mitigate potential noise (Acentech 2011:2).

To determine the existing ambient sound levels (Ldn) in the vicinity of the Undertaking, a series of sound monitoring locations were established. Most of the monitoring locations were placed near dwellings or small groups of dwellings, and the locations ranged from 5,000 feet to 10,600 feet from the nearest proposed new WTG location. In Duo, the monitoring location was 10,600 feet from the nearest proposed new WTG and also was 3,600 feet from the nearest existing operating WTG at the Beech Ridge facility.

The ambient sound survey characterized the existing land uses, sound sources, acoustic environment, and specifically, representative long-term Ldn values in the area. The field team also collected short-term measurements and observations during visits to each monitoring location. The observed sources typically included wind in trees, local and distant traffic, dogs, birds, aircraft, distant mining industry, and a flowing creek (Acentech 2011:3).

4.1 Construction Sound Levels

When construction of the Undertaking commences, initial activities will include improvements and new construction of facility access roads; then clearing, excavation, foundation, and backfill work at the WTGs and the substation. Concrete for construction will be made at temporary on-site batch plants using trucked-in materials. Subsequently, construction of the WTG towers will begin, followed by installation of the WTGs, as well as trenching and installation of the electrical collection system and installation of substation equipment. Finally, prior to commercial operation, the individual equipment items and the entire facility will be tested and commissioned (Acentech 2011:4).

A majority of the construction activities associated with the Undertaking will be conducted during daylight hours. At times over the planned construction schedule, the construction

activities will be audible to nearby residents. Any construction at the facility in the evening and nighttime is expected to be limited to relatively quiet activities and to be less noticeable than in the daytime. The following mitigation measures will be employed during the construction phase of the Undertaking:

- Effective exhaust mufflers in proper working condition will be installed on all engine-powered construction equipment at the site. Mufflers found to be defective will be replaced promptly.
- Contractors will be required to comply with federal limits on truck noise.
- Construction contractors will be required to ensure that their employee and delivery vehicles are driven responsibly.
- Nighttime construction work that occurs will generally be limited to relatively quiet activities, such as welding and installing equipment, cabling, and instrumentation.
- The community will be notified in advance of any blasting activity (Acentech 2011:4)

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Construction sound that may be heard off-site will vary from hour-to-hour and day-to-day in accordance with the equipment in use and the operations being performed at the site. The temporary noise associated with construction of the Undertaking will be similar to the noise produced during excavation, grading, and steel erection activities at many other mid-size building projects, and the current timber and mining activities in the region. Since the construction activity at the site will be temporary, will occur mostly in the daytime hours, and will produce sounds that are already familiar to the community, its overall noise impact on the community beyond 1,000 feet of the nearest WTG is not expected to be significant (Acentech 2011:4-6).

4.2 Operational Sound Levels

The range of sound levels that will propagate from the operating WTGs to various locations in the community around the site have been predicted by assuming maximum sound output of all 33 WTGs, which occurs under conditions of maximum rated wind speed. The Undertaking's construction sound levels were estimated on a time-weighted basis (Ldn) for outdoor locations; for indoor locations, these levels would be reduced by 12 dBA with the windows open and by 24 dBA or more with the windows closed. Measurements and estimates indicate, however, that the long-term Ldn sound levels of the facility will be significantly less than the existing ambient Ldn levels at that distance for both outdoor and indoor locations (Acentech 2011:5-6).

The Beech Ridge facility will be available to operate 24 hours per day and seven days per week. It is expected that routine operation will produce day-night sound levels in the community that are similar to or lower than the measured existing ambient day-night sound levels (Acentech 2011:6-7).

4.3 Noise Effects for NRHP-Eligible Resources

Four NRHP-eligible resources identified during the 2006-2007 investigations for the Beech Ridge Wind Energy Facility (O'Bannon and Sweeten 2007) are located within or close to the

1-mile buffer established for the acoustical study that has been carried out with regard to the proposed Undertaking. These four previously identified resources are the Duo Historic District, the Olive Baptist Church (GB-0038-0107B), a rural cemetery (Field Number 00046), and a dwelling (GB-0038-0099). Only the Duo Historic District is within the 1-mile buffer for the acoustical study that was conducted by Acentech (2011). The previously identified Olive Baptist Church (GB-0038-0107B) is located a short distance beyond the east edge of the 1-mile buffer. The previously identified cemetery (Field Number 00046) is located along Panther Creek Road a short distance beyond the east edge of the 1-mile buffer. All of the 47 WTG locations being evaluated for construction are located west of the WTGS constructed during the first phase of the Beech Ridge Wind Energy Facility, putting any new WTGs farther away from the four NRHP-eligible resources than existing WTGs are now. A previously identified dwelling (GB-0038-0099) is located along Upper Spring Creek Road a short distance beyond the east edge of this buffer. With the exception of the Duo Historic District, no major changes have taken place at the properties since that time. In Duo, since 2006–2007, some of the buildings in the historic district have been removed, altered, or abandoned. Overall, however, the district still was found to be eligible for the NRHP.

During construction of the Undertaking, all of these resources are expected to have temporary noise effects caused by typical construction activities. Over the long term, day-to-day operation of the Beech Ridge wind energy facility is not anticipated to exceed existing ambient sound levels and, thus, will not have an audible effect on any of the NRHP-eligible resources within or close to the 1-mile buffer (Acentech 2011:5-7). No adverse effect due to noise is anticipated as a result of the Undertaking.

5.0 CULTURAL EFFECTS

Previous patterns of settlement and economic development within the APE have revolved around three important activities: farming, mining, and lumbering. Each of these activities is based upon the extraction of natural resources for consumption. While farm commodities were largely consumed locally, coal and lumber were shipped to more distant locations for use. For example, coal mined from Nicholas County mines might be shipped to coal-fired power plants in Pittsburgh, while lumber from Greenbrier County forests was used to make chairs and broom handles that were nationally distributed through retail outlets.

Farming, mining, and lumbering remain important to the local economy. During the early 2000s, Greenbrier County, for example, had 1,063 active farms and was the largest producer of beef in West Virginia. More than 400,000 acres of local forests are managed for timber production by firms such as Meadwestvaco and Georgia Pacific (Greater Greenbrier Chamber of Commerce 2008). Mining activity has declined since the 1960s but, in 2008, Nicholas County produced more than 1.3 million tons of coal from subsurface mining, and more than 3 million tons of coal from surface mining (West Virginia Office of Miners' Health, Safety, and Training 2008). Since the 1990s, reforestation and land reclamation have been routinely undertaken on clear-cut and surface mined lands. As a result of the combined effects of farming, mining, and lumbering, the landscape within the APE undergoes change on a regular basis. Changes to the landscape, however, tend to be cyclical as, for example, farmers shift crops or allow fields to lay fallow, forests are cut and then permitted to revegetate, and surface-mined land is reclaimed.

Construction of the Undertaking will continue the pattern of extracting a natural resource – in this case, wind – from the local landscape. As a result, the proposed expansion/modification of the existing 67-WTG Beech Ridge Wind Energy Facility is not out of character with the area's historic patterns of settlement and development. The facility, however, will result in the construction of an additional 33 WTGs, which represent a permanent change to the rural landscape.

As noted in Section 3.0, the immediate change to the rural landscape will be primarily visual in nature. No noise effects are anticipated as a result of this project. The visual effects will be adverse as they will affect the setting, feeling, and association of the rural landscape. These three characteristics contribute to the integrity of each of the NRHP-eligible resources located within the APE. As defined in 36 CFR Part 800, criteria of adverse effect include "change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance," and "introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features" (USGPO 2010a).

Within the APE, the Duo Historic District will experience adverse visual effects. With the nearest proposed WTG planned to be approximately 10,600 feet from Duo, the visual effect is not expected to be extremely obtrusive (Appendix A, Figures A9 through A22). On the other hand, the Mt. Urim Baptist Church (NI-0026-0192) and associated cemetery (Field

Number 175) are not anticipated to have any views of the Undertaking (Appendix A, Figures A6 through A8). The area within which these two historic properties are located is primarily noted for its mining, forestry and, to a lesser extent, farming activity. Furthermore, managed forests occupy large tracts of the hills and ridges that characterize the local topography. The extant landscape has a rural character in keeping with historic patterns of development. The proposed Undertaking will introduce additional, industrial elements to the landscape in a manner that began with the construction of the Beech Ridge Wind Energy Facility. The cumulative effects of the two phases of the Beech Ridge project result in an erosion of the traditional landscape, which, in turn, affects the cultural heritage of local residents. Consequently, in addition to adverse visual effects, the project will have adverse cultural effects within the APE.

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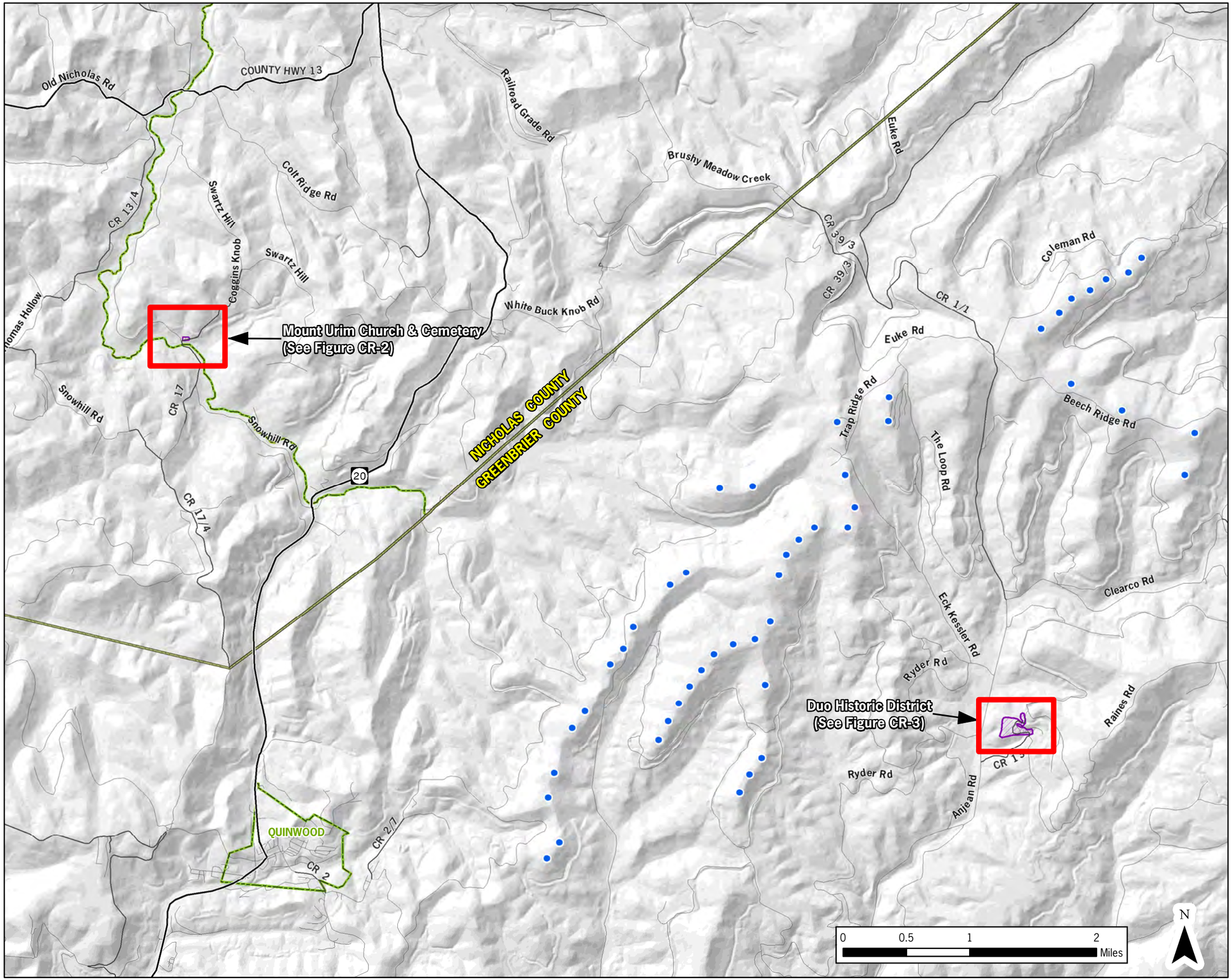
APPENDIX A

RESULTS OF VIEWSHED ANALYSIS



Beech Ridge Energy -- Phase II Expansion/Modification

Figure A1

NRHP - Eligible Resource Locations

December 2011

Key

- Proposed Wind Turbine (497' ht. to Blade Tip)
- Historic Property
- Federal Highways, State Routes
- County Routes
- Local Roads
- Municipal Boundaries
- County Boundaries

PROJECT # 2010-044.30M

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File Location:
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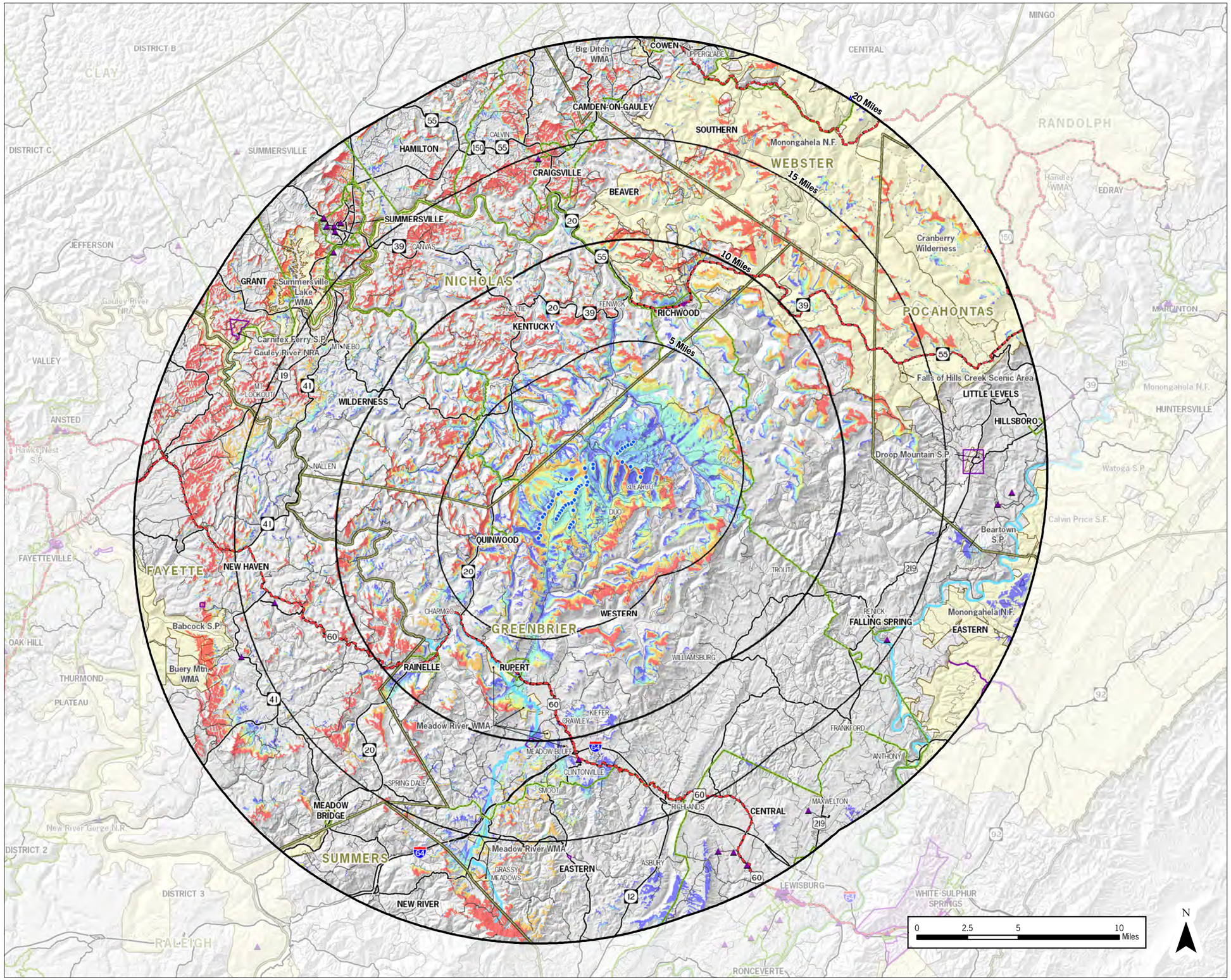

Beech Ridge Energy
Phase II Expansion/Modification

Figure A2

Topographic Viewshed for the APE

June 2011

Key

Number of Turbines Visible

- 1 - 5
- 6 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 47
- Proposed Wind Turbine (497' ht. to Blade Tip)
- National Register of Historic Places
- Historic Districts
- Scenic Byways
- Federal Highways, State Routes
- County Routes
- Local Roads
- Major Rivers
- Municipal Boundaries
- County Boundaries
- Scenic and Recreational Resources

PROJECT # 2010-044.10M

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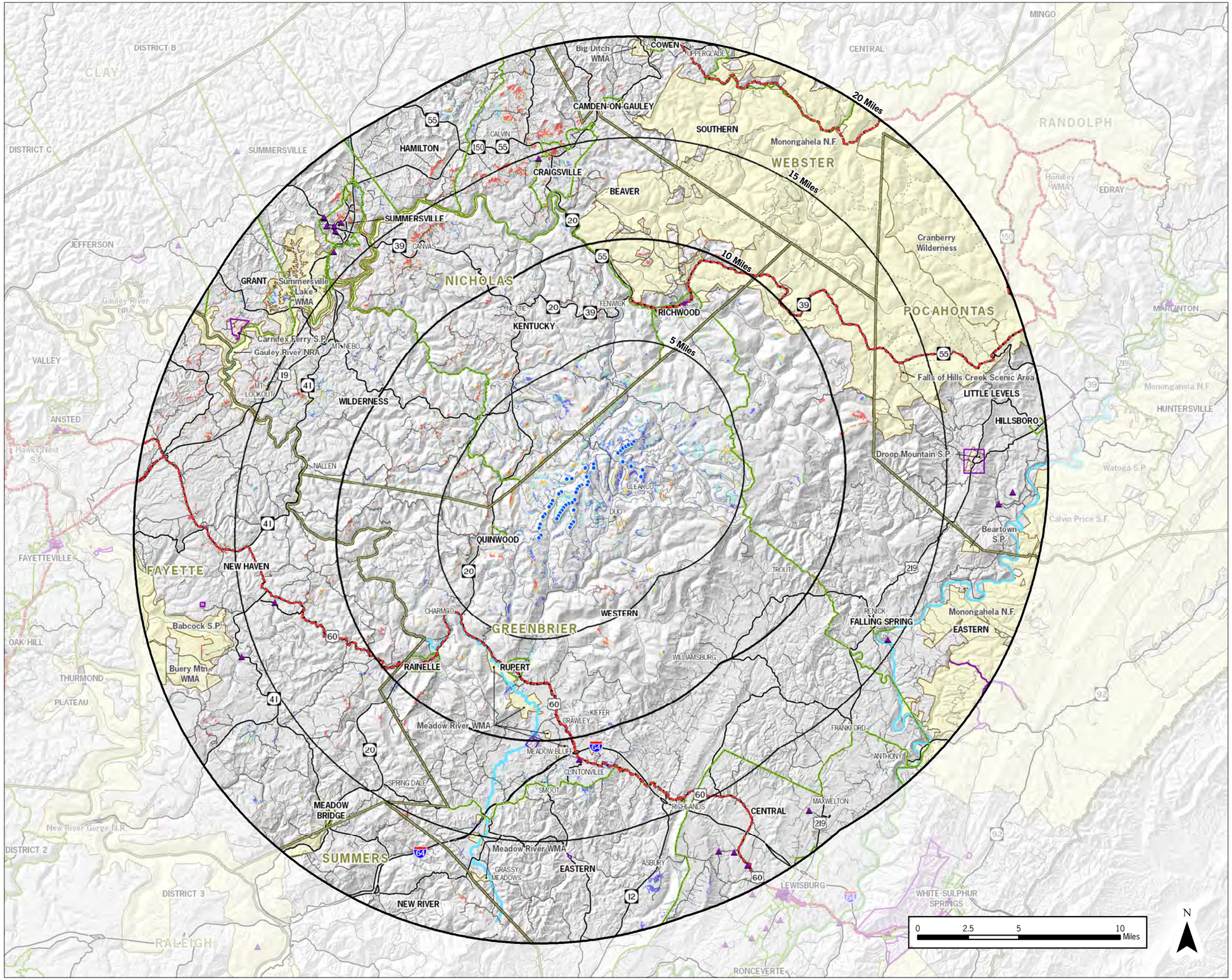

Beech Ridge Energy
Phase II Expansion/Modification

Figure A3

Vegetated Viewshed* for the APE

*- Assumes a uniform tree height of 40' (12.192m) in forested areas.

June 2011

Key

Number of Turbines Visible

- 1 - 5
- 6 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 47
- Proposed Wind Turbine (497' ht. to Blade Tip)
- National Register of Historic Places
- Historic Districts
- Scenic Byways
- Federal Highways, State Routes
- County Routes
- Local Roads
- Major Rivers
- Municipal Boundaries
- County Boundaries
- Scenic and Recreational Resources

PROJECT # 2010-044.10M

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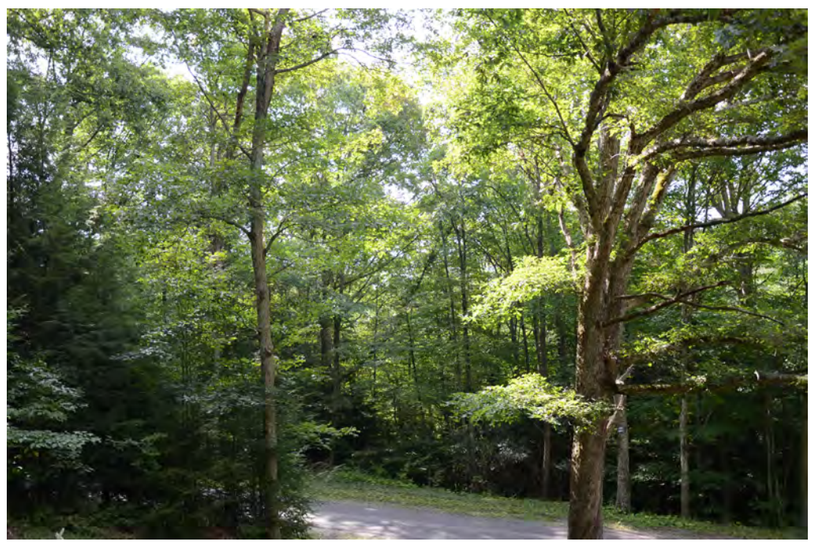
Beech Ridge Energy

Viewpoint 1

Viewpoint 2

Viewpoint 3



Viewpoint 4

Viewpoint 5

Viewpoint 6

FIGURE A4

Viewpoint Photo Log

Beech Ridge Energy

Viewpoint 7

Viewpoint 8

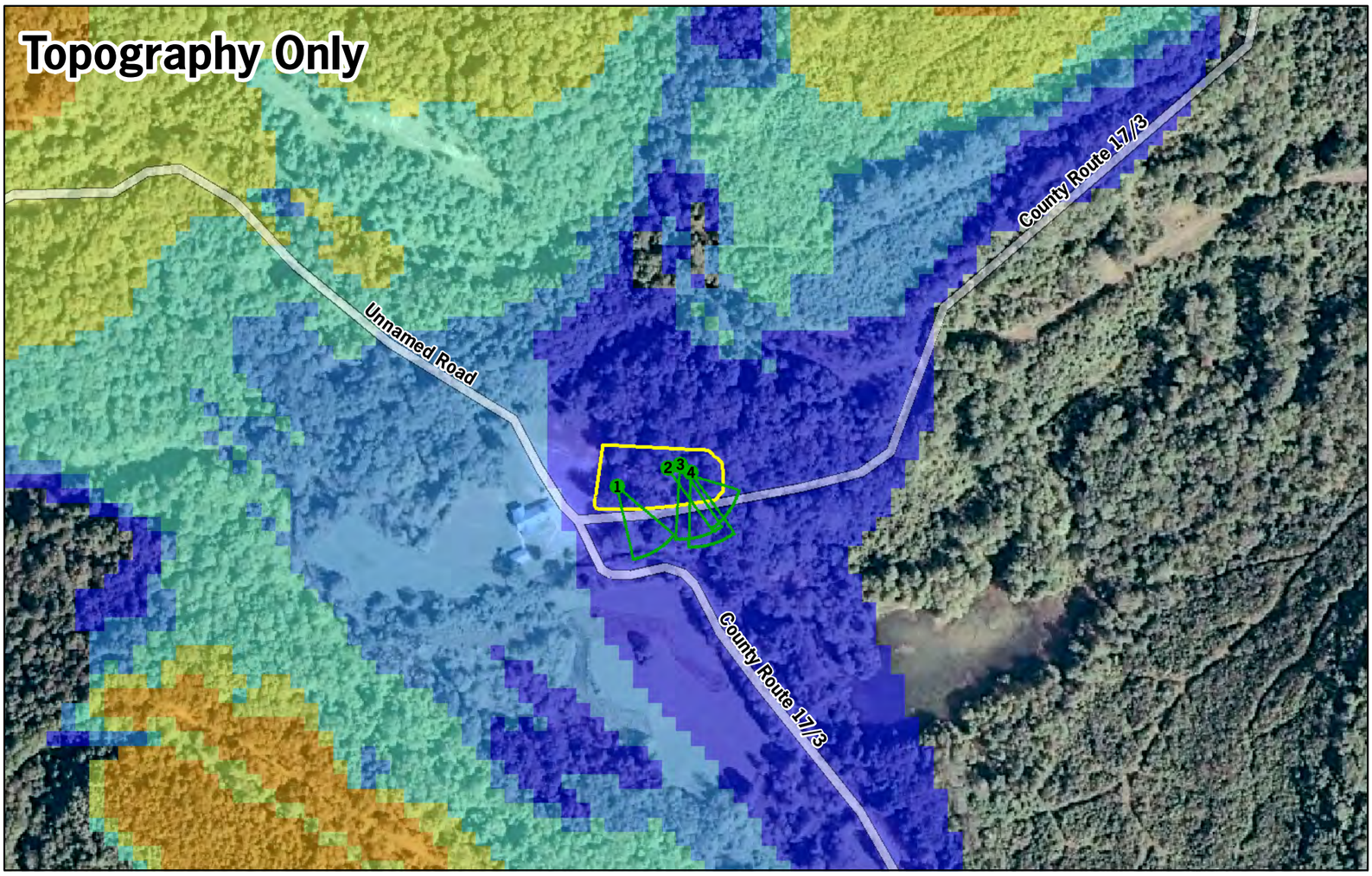
Viewpoint 9

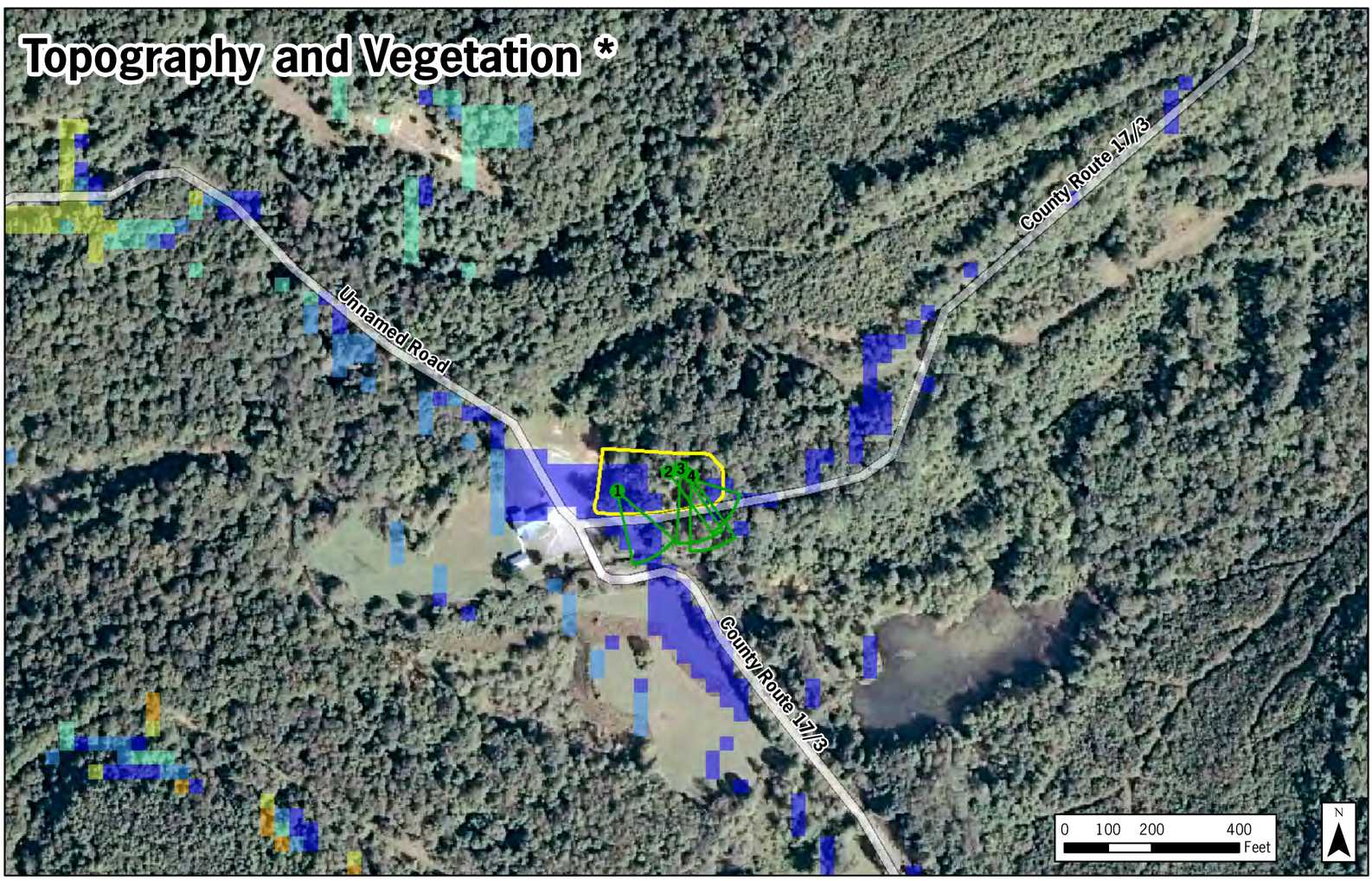
Viewpoint 10

FIGURE A5

Viewpoint Photo Log

Beech Ridge Energy





Beech Ridge Energy - Phase II Expansion/Modification

Figure A6

Viewshed Maps
Mount Urim Church & Cemetery Property

* Assumes uniform forest height of 40' (12.192 m) in forested areas.

December 2011

Key

Mount Urim Church and Cemetery

Photo Location and View Orientation

Number of Turbines Visible

1 - 5	21 - 30
6 - 10	31 - 40
11 - 20	41 - 47

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Beech Ridge Energy

Existing Condition

Beech Ridge Energy

FIGURE A7

Photo Simulation

Viewpoint 1 - Mount Urim Church & Cemetery, Leivasy

Approximately 2.1 Miles From Nearest Proposed Project Turbine in View

SARATOGA ASSOCIATES

Photo Simulations should be viewed in full color and 11"x17" format.

Proposed Condition

Beech Ridge Energy

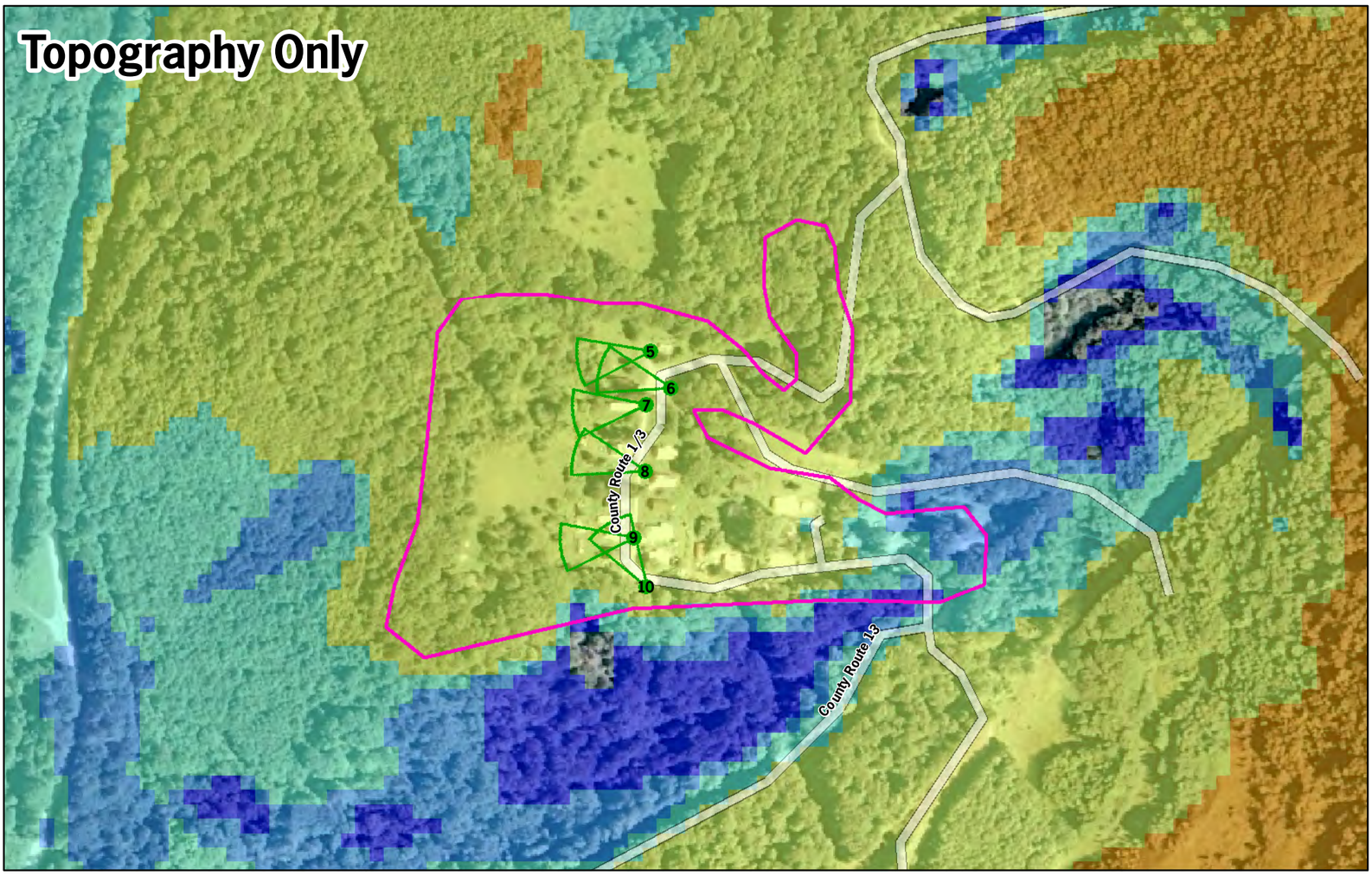
Note: As illustrated from this location, it appears that visibility will be limited due to intervening vegetation.

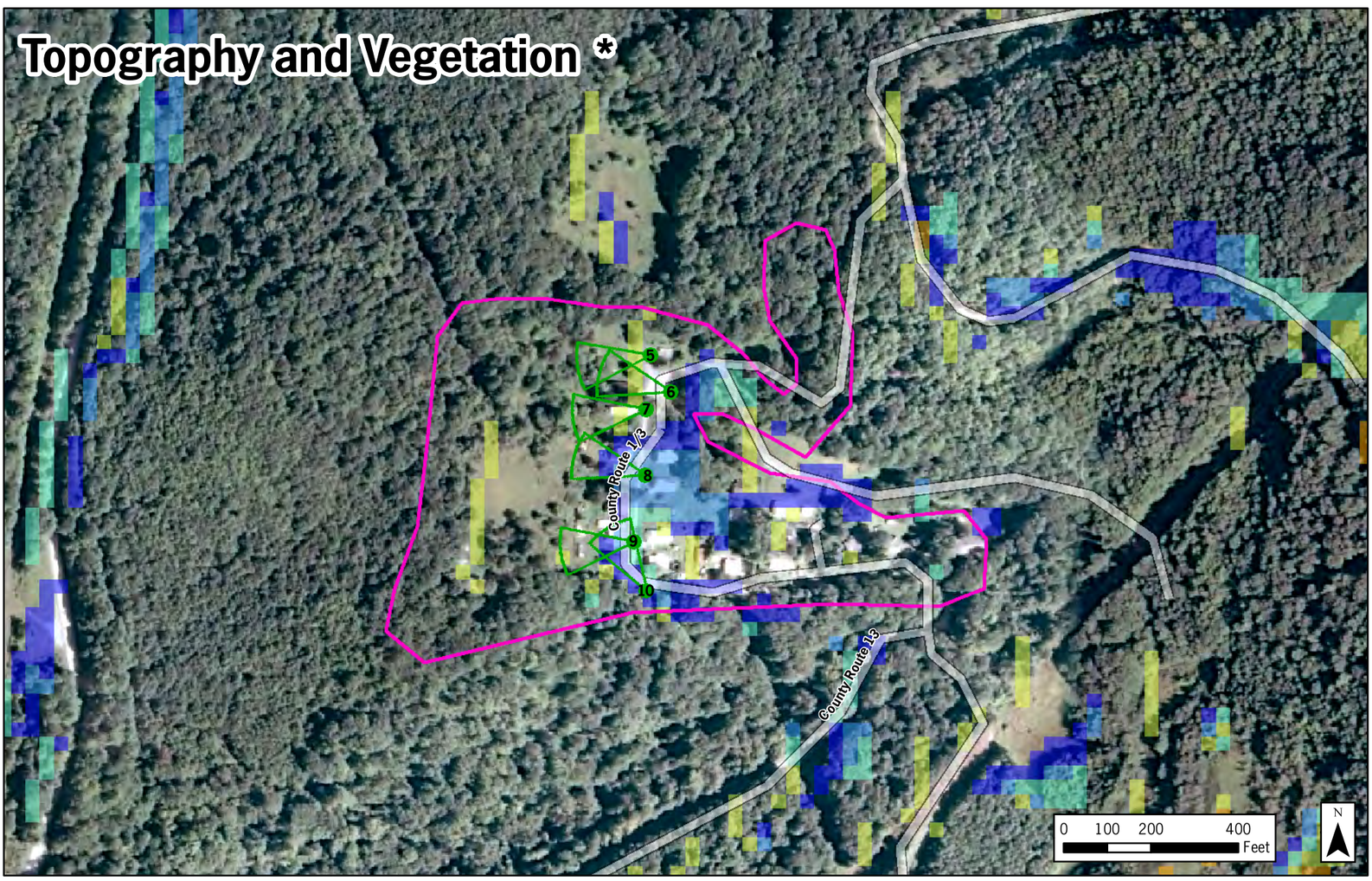
FIGURE A8

Photo Simulation

Viewpoint 1 - Mount Urim Church & Cemetery, Leivasy

Approximately 4.6 Miles From Nearest Proposed Project Turbine in View





Beech Ridge Energy - Phase II Expansion/Modification

Figure A9

Viewshed Maps
Duo Historic District

* Assumes uniform forest height of 40' (12.192 m) in forested areas.

December 2011

Key

Duo Historic District

Simulation Location and View Orientation

Number of Turbines Visible

1 - 5	21 - 30
6 - 10	31 - 40
11 - 20	41 - 47

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Beech Ridge Energy

Existing Condition

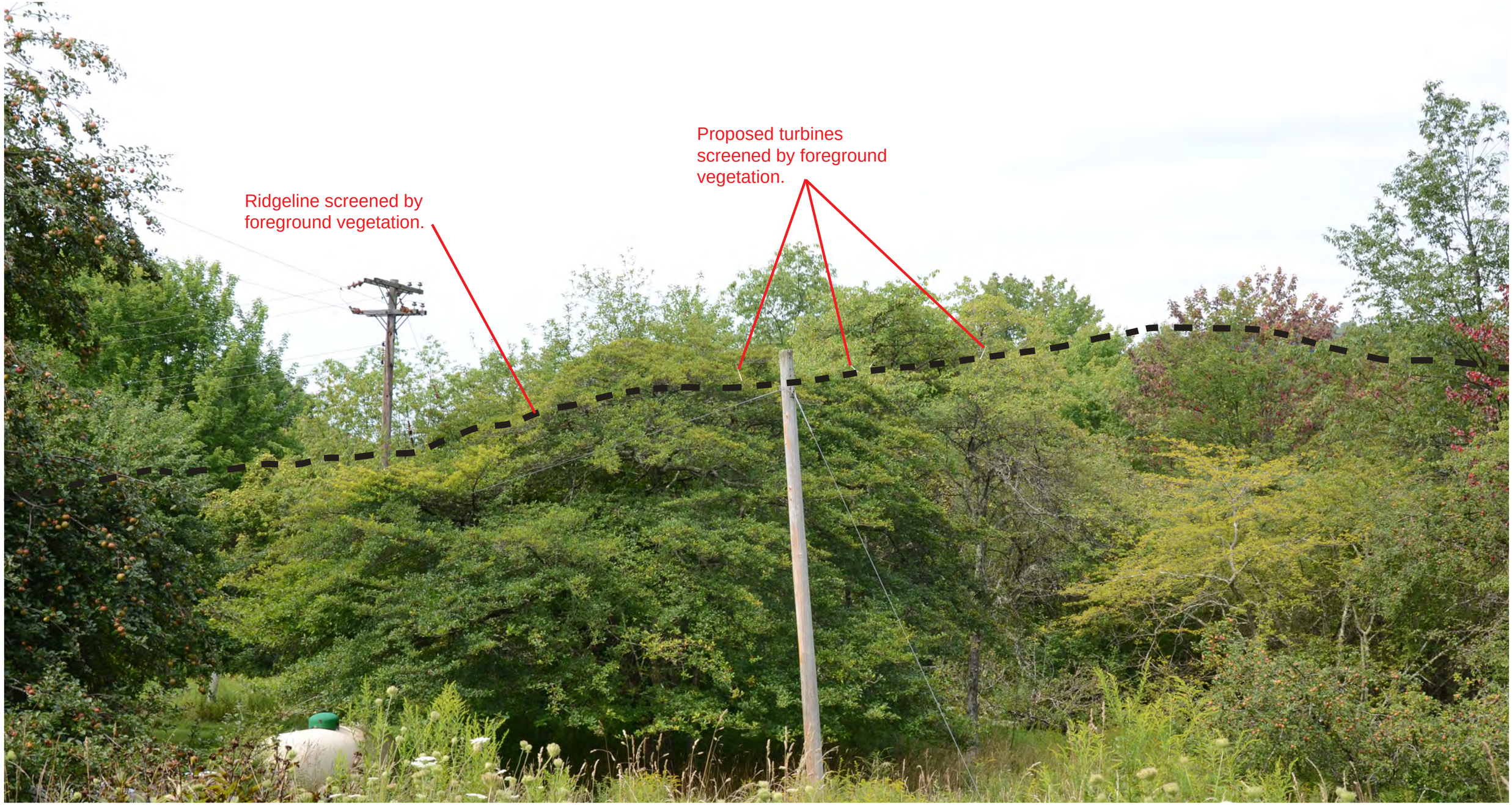
Beech Ridge Energy

FIGURE A10

Photo Simulation

Viewpoint 5 - County Route 13 , Duo

Approximately 2.0 Miles From Nearest Proposed Project Turbine in View



Proposed Condition

Beech Ridge Energy

Note: As illustrated from this location, it appears that visibility will be limited due to intervening vegetation.

FIGURE A11

Photo Simulation

Viewpoint 5 - County Route 13 , Duo

Approximately 2.0 Miles From Nearest Proposed Project Turbine in View

Existing Condition

Beech Ridge Energy

FIGURE A12

Photo Simulation

Viewpoint 6 - County Route 13 , Duo

Approximately 2.2 Miles From Nearest Proposed Project Turbine in View

Proposed Condition

Beech Ridge Energy

FIGURE A13

Photo Simulation

Viewpoint 6 - County Route 13 , Duo

Approximately 2.2 Miles From Nearest Proposed Project Turbine in View

Existing Condition

Beech Ridge Energy

FIGURE A14

Photo Simulation

Viewpoint 7 - County Route 13 , Duo

Approximately 2.2 Miles From Nearest Proposed Project Turbine in View

Proposed Condition

Beech Ridge Energy

FIGURE A15

Photo Simulation

Viewpoint 7 - County Route 13 , Duo

Approximately 2.2 Miles From Nearest Proposed Project Turbine in View

Proposed Condition - 2X Magnification

Beech Ridge Energy

FIGURE A16

Photo Simulation

Viewpoint 7 - County Route 13 , Duo

Approximately 2.2 Miles From Nearest Proposed Project Turbine in View

Existing Condition

Beech Ridge Energy

FIGURE A17

Photo Simulation

Viewpoint 8 - County Route 13 , Duo

Approximately 2.0 Miles From Nearest Proposed Project Turbine in View

Proposed Condition

Beech Ridge Energy

Note: As illustrated from this location, it appears that visibility will be limited due to intervening vegetation and structures.

FIGURE A18

Photo Simulation

Viewpoint 8 - County Route 13 , Duo

Approximately 2.0 Miles From Nearest Proposed Project Turbine in View

Existing Condition

Beech Ridge Energy

FIGURE A19

Photo Simulation

Viewpoint 9 - County Route 13 , Duo

Approximately 2.0 Miles From Nearest Proposed Project Turbine in View

Proposed Condition

Beech Ridge Energy

Note: As illustrated from this location, it appears that visibility will be limited due to intervening vegetation.

FIGURE A20

Photo Simulation

Viewpoint 9 - County Route 13 , Duo

Approximately 2.0 Miles From Nearest Proposed Project Turbine in View

Existing Condition

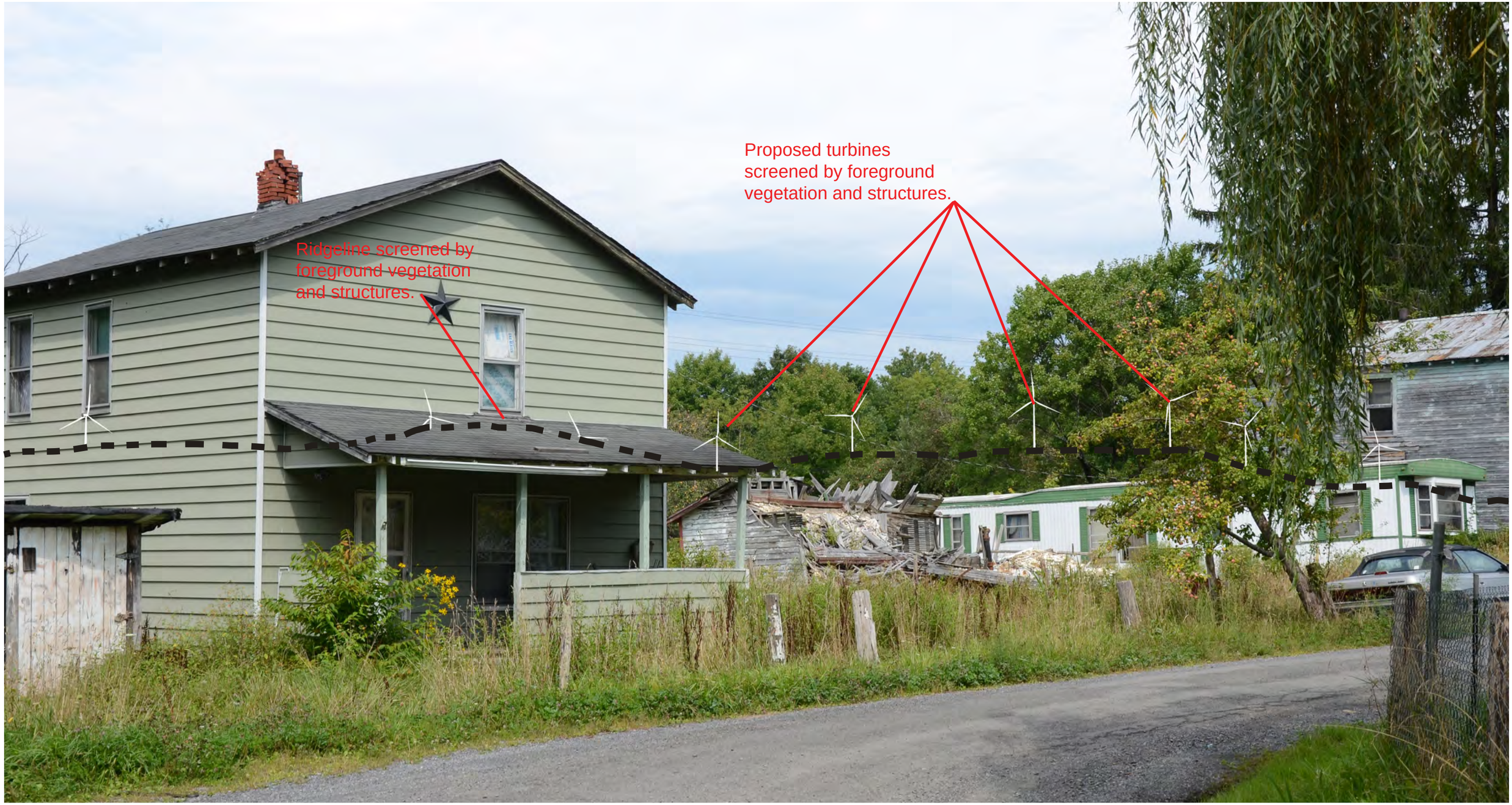
Beech Ridge Energy

FIGURE A21

Photo Simulation

Viewpoint 10 - County Route 13 , Duo

Approximately 2.1 Miles From Nearest Proposed Project Turbine in View



Proposed Condition

Beech Ridge Energy

Note: As illustrated from this location, it appears that visibility will be limited due to intervening vegetation and structures.

FIGURE A22

Photo Simulation

Viewpoint 10 - County Route 13 , Duo

Approximately 2.1 Miles From Nearest Proposed Project Turbine in View

APPENDIX B

ACOUSTIC STUDY OF PROPOSED EXPANSION/MODIFICATION OF BEECH RIDGE WIND FARM, GREENBRIER COUNTY, WV

Acentech Report No. 421 ---- REV DRAFT-3

Acoustical Study of Proposed Expansion/Modification of Beech Ridge Wind Farm Greenbrier County, WV

June 2011

James D. Barnes

Submitted by:

Acentech Incorporated
33 Moulton Street
Cambridge, MA 02138

Prepared for:

Beech Ridge Energy II LLC
c/o Invenergy LLC
51 Monroe Street, Suite 1604
Rockville, MD 20850

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3. Guidelines for Noise Studies 2
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7. Noise Impact Assessment 8

Appendix A – Sound in Lay Terms A-1

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Figure 6. View Looking NE from Location 4 (Town of Quinwood).

Figure 7. Leq A-Weighted and C-Weighted Existing Ambient Sound Levels Measured at Location 1 (Town of Duo) and Wind Speeds for 10-Minute Intervals during 4 – 15 February 2011.

Figure 8. Leq A-Weighted and C-Weighted Existing Ambient Sound Levels Measured at Location 2 (Beech Ridge Road) and Wind Speeds for 10-Minute Intervals during 4 – 15 February 2011.

Figure 9. Leq A-Weighted and C-Weighted Existing Ambient Sound Levels Measured at Location 3 (NW of Project Site) and Wind Speeds for 10-Minute Intervals during 4 – 15 February 2011.

Figure 10. Leq A-Weighted and C-Weighted Existing Ambient Sound Levels Measured at Location 4 (Town of Quinwood) and Wind Speeds for 10-Minute Intervals during 4 – 15 February 2011.

Figure 11. Area Map of Proposed Expansion of Beech Ridge Wind Farm with Estimated Construction A-Weighted Ldn Sound Level Contours Compared to Average Measured Existing Ambient A-Weighted Ldn Sound Levels (dBA) at Locations 1 to 4.

Figure 12. Estimated A-Weighted Ldn Sound Level for Operation (dBA) of Proposed Expansion of Beech Ridge Wind Farm at Residential Structures within One Mile of Project Boundary.

Figure 13. Area Map of Proposed Expansion of Beech Ridge Wind Farm with Estimated Operation A-Weighted Ldn Sound Level Contours Compared to Average Measured Existing Ambient A-Weighted Ldn Sound Levels (dBA) at Locations 1 to 4.

List of Figures and Tables Con't.

Figure 14. Area Map of Proposed Expansion of Beech Ridge Wind Farm Showing Land Use Classifications with Estimated Operation A-Weighted Ldn Sound Level Contours Compared to Average Measured Existing Ambient A-Weighted Ldn Sound Levels (dBA) at Locations 1 to 4.

Figure 15. Estimated C-Weighted Ldn Sound Level for Operation (dBC) of Proposed Expansion of Beech Ridge Wind Farm at Residential Structures within One Mile of Project Boundary.

Figure 16. Area Map of Proposed Expansion of Beech Ridge Wind Farm with Estimated Operation C-Weighted Ldn Sound Level Contours Compared to Average Measured Existing Ambient C-Weighted Ldn Sound Levels (dBC) at Locations 1 to 4.

****

Table 1. Description of Monitoring Locations for Preconstruction Ambient Sound Survey (4 - 15 February 2011).

Table 2. Type of Acoustic Instrumentation Used for Ambient Sound Survey (4 - 15 February 2011).

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Table 4. Estimated Equivalent Sound Levels (Leq*) of Representative Construction Equipment at Various Distances.

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Table 7. Estimated A-Weighted and C-Weighted Ldn Sound Levels (dBA and dBC) for WTG Facility at Each Residential Location within One Mile of Expansion Area.

Table 8. Estimated A-Weighted Ldn Sound Levels (dBA) for Existing and Proposed WTG Facility and Associated Increases (All Residential Structures in Town of Duo).

1. Introduction

Beech Ridge Energy LLC has successfully designed, certificated, and constructed a portion of a large-scale wind farm in Greenbrier County, West Virginia consisting of 67 turbines and 100 MW of turbine capacity at a mountainous rural site in the southeast portion of the state. Beech Ridge Energy LLC successfully operates these 67 turbines and now proposes to continue construction of the certificated facility to the west by installing up to 85.5 MW of turbine capacity. At the request of Beech Ridge Energy LLC, Acentech Incorporated has performed an acoustical study of the expansion area and provided information for review by the West Virginia Public Service Commission (WVPSC) for the site permitting process. Acentech has to date reviewed the facility and site drawings, equipment information, and the noise study guidelines of the WVPSC; toured the project area; conducted sound measurements and observations of the existing ambient conditions at representative community locations; and estimated construction and operation sound levels for the facility. This report presents the ambient sound measurements and results of our acoustical study.

2. Description of Proposed Facility and Site

The proposed expansion consists of up to 33 General Electric (GE) Model 1.6xle-100 wind turbine generators (WTGs) and associated equipment, with each WTG including its 100-meter diameter rotor to be mounted on individual 100-meter tall towers across about 8 square miles of ridgelines in Greenbrier County, WV. The associated equipment includes a 2 MVA transformer at each WTG tower, and 34.5kV underground transmission lines for the electrical collection system that will connect into the existing 34.5/138kV substation with a 200 MVA main transformer and 138kv overhead transmission line or supplemental substation/transmission line that would connect to the existing project related transmission line. The service center for the existing portion of the wind farm, which is located in the northern section of the proposed expansion area, will also serve the expanded facility. Figure 1 displays the proposed new wind turbines overlaid on a map of the region. The study evaluated 47 potential locations for the 33 turbines, and therefore, included 14 alternate locations.

Each GE Model 1.6xle-100 wind turbine incorporates a horizontal-axis propeller that drives a gearbox and generator mounted to the top of a 100-m (328-ft) high tower. A nacelle for weather protection and noise control encloses the gearbox and generator. The 100-m (328-ft) diameter rotor has three blades, which attach to a hub that contains active blade pitch control; this system provides for peak aerodynamic efficiency over a range of wind conditions. During routine operation, the rotational speed of the rotor will range from 9.75 to 16.18 revolutions per minute; and at wind speeds

below 3 m/s (6.7 mph) and at wind speeds above 25 to 30 m/s (56 to 67 mph), it will not operate. The rated capacity of this unit is 1.6 MW at a wind speed of 11 m/s (24 mph). The WTGs include the following noise control treatments into its design: impact noise insulation of the gearbox and generator, reduced-noise gearbox, reduced-noise nacelle; vibration isolation mounts, and quieted-design rotor blades.

The existing wind farm and proposed area are located on the mountain ridges to the north of US Rt. 60 and I-64 and south of the Monongahela National Forest, and to the west of Rt. 219, and to the east of WV Rt. 20. Lightly traveled paved and unpaved roads cross this rural area, which is dotted with scattered homes and seasonal hunting cabins, and with several small groups of homes in settlements such as Duo. The existing substation is located to the east of the proposed expansion area and in the center of the existing wind farm with the overhead transmission line running to the northwest from the substation out to the external power grid.

3. Guidelines for Noise Studies

The WVPSC Guidelines for Noise Studies for Siting Certificates include:

- Preconstruction – identify land uses and existing ambient sound levels (Ldn) in communities within one mile of the facility.

- Construction – predict construction noise associated with blasting, earthmoving, pile driving, erection, traffic, and equipment installation at the nearest property boundary and within one mile and five miles from the facility. Identify noise sensitive areas within one mile and five miles of the facility. The noise sensitive areas include hospitals, schools, residences, cemeteries, parks, and churches. Describe construction equipment, procedure, and potential noise mitigation options.

- Operation – predict operation noise and identify land uses and type of structures (residential, commercial, or industrial) within one mile of the facility. Describe equipment and procedures to mitigate potential noise.

Information on the preconstruction ambient, construction, and operation sounds for the facility are presented in the following sections. Please refer to “Appendix A - Sound in Lay Terms” for a useful overview of sound and its measurement.

4. Preconstruction Ambient Sound Measurements

Figure 2 is a map of the project area with an overlay of the proposed turbine sites, land use classifications, the community sound measurement locations, and the measured day-night sound levels (Ldn). Table 1 describes the four monitoring locations selected for the ambient survey that Acentech conducted over a nominal one-week period in the first half of February 2011. The acoustic environment and nearby land uses were observed at these locations, and they were judged representative of those at the noise sensitive receptors, such as residences and churches, in the community bordering the expansion site.

The weather during the survey was seasonal and ranged from clear to cloudy skies with very little snow, calm to windy conditions, and temperatures from about 0ºF to 15ºF during the first half of the survey, and warming to 30ºF to 40ºF near the end of the survey. As Table 1 notes, most of the monitoring locations are in close proximity to nearby homes/seasonal residences or small groups of homes, and the locations range from 1600 ft. to 10,600 from the nearest proposed new WTG location. The monitoring location in the Town of Duo that is 10,600 ft. from the nearest proposed new WTG is also 3600 ft. from the nearest existing operating wind turbine.

The purpose of the ambient survey was to characterize the existing land uses, sound sources, acoustic environment, and specifically, representative long-term Ldn values in the area. Figures 3 through 6 display photographs of the four locations where the A-weighted sound levels were monitored continuously during the survey. The field team also collected short-term measurements and observations during visits to each monitoring location. The observed sources typically included wind in trees, local and distant traffic, dogs, birds, aircraft, distant mining industry, and a flowing creek. The sound of the existing wind facility was observed at the Town of Duo location during one visit before the local wind speed picked up and the associated sound of wind in the trees masked the turbine sound; in general, the wind was from the southwest and the Duo location was typically crosswind/downwind of the nearest turbines at the time. The average sound levels at the Duo location ranged from 41 dBA to 43 dBA during the time when the wind facility sound was observed, and although the nearest turbines could be heard at times, the field team judged that turbine sound did not significantly influence the average sound levels. As the ambient data below indicate, the long-term Ldn sound level at the Duo location was similar to the Ldn levels measured at the three other community monitoring locations that are much farther from the existing wind facility. Table 2 lists the instruments that were employed for the ambient survey.

Figures 6 through 9 display the variations in sound levels that were measured at the four locations. To address the WVPSC Noise Guidelines for Noise Studies, the figures show the Leq sound level for

each 10-minute interval, and also, indicate the Ldn sound level for the nominal one-week period. The figures, in addition, present the wind speeds for each 10-minute interval that were measured at the two nearby meteorological towers operated by Beech Ridge Energy LLC . As mentioned above, Appendix A provides an overview on sound and its measurement, and in particular, discusses the Leq and Ldn descriptors. Please note that Leq sound levels include both the steady background sounds (steady wind in trees, rushing stream, or distant industry) and the short-term intrusive sounds (e.g., dog barks or local car passby). Table 3 lists the long-term Ldn values measured at each location. Of most significance, the data indicate that the long-term Ldn sound levels ranged from 47 dBA to 50 dBA, with an average value of 48 dBA and a standard deviation of 1 dBA across the four locations. The measured Ldn values, sound source types, and land uses are relatively uniform across the study area and the ambient sound level contours are judged to be generally flat within this area. Therefore, Fig. 2 displays the individual measured Ldn values, but no individual contours.

5. Construction Noise Estimates and Mitigation Measures

Initial construction activities (Construction Phase I) will include improvements and new construction of facility access roads; then clearing, excavation, foundation, and backfill work at the WTGs and the substation. Concrete for the project will be made at temporary on-site batch plants using trucked-in materials. Phase I activities will be followed by Phase II activities, which are comprised of erection of the WTG towers and installation of the WTGs; trenching and installation of the electrical collection system; and installation of substation equipment. Finally, prior to commercial operation, the individual equipment items and the entire facility will be tested and commissioned during Phase III.

A majority of the construction activities associated with the proposed project will be conducted during daylight hours. At times over the planned construction schedule, the construction activities will be audible to nearby residents. Any construction at the facility in the evening and nighttime is expected to be limited to relatively quiet activities and to be less noticeable than in the daytime.

The following mitigation measures will be employed during the construction phase of the project:

- Effective exhaust mufflers in proper working condition will be installed on all engine-powered construction equipment at the site. Mufflers found to be defective will be replaced promptly.

- Require contractors to comply with federal limits on truck noise.

- Construction contractors will be required to ensure that their employee and delivery vehicles are driven responsibly.

- Nighttime construction work that does occur will generally be limited to relatively quiet activities, such as welding and installing equipment, cabling, and instrumentation.

- If blasting is required, it will be conducted in accordance with standard industrial practices and include those requirements established by the WVPSC in its original approved siting certificate for the Beech Ridge Facility with the overall goal of reducing potential impacts to nearby residents.

Construction sound that may be heard off-site will vary from hour-to-hour and day-to-day in accordance with the equipment in use and the operations being performed at the site. Since the construction activity at the site will be temporary, will occur mostly in the daytime hours, and will produce sounds that are already familiar to the community, its overall noise impact on the community beyond 1000 ft. of the nearest turbine is not expected to be significant. Note that the community currently experiences sound from timber and mining operations.

Typical on-site equipment used to construct the wind farm project will include trucks, cranes, dozers, excavators, trenchers, graders, and batch plants. Representative equivalent sound levels associated with these construction items during the workday are listed in Table 4. For example, with 2 trucks, 1 dozer, and 1 excavator operating at a WTG, the calculated equivalent sound level during the workday is 44 dBA at 3300 ft, which is the closest distance of a residence (Residential Structure GB-0125 listed in Table 7) to a proposed new turbine. The reported sound levels are based on the results of extensive previous acoustical studies of engine-powered construction equipment. Figure 11 displays the contours of the estimated maximum Ldn sound levels over the entire study area for Construction Phase 1, with comparisons to the measured preconstruction ambient Ldn values. The sound estimates for the expansion study assume construction activity at all 47 potential turbine locations, although only 33 turbines will be constructed. These contours were developed with a commercial computer noise modeling program, Cadna/A. This program employs ray-tracing technology that accounts for various factors, including geometric spreading, atmospheric absorption, and ground conditions; for the purpose of our modeling, we have assumed that the community is always downwind from the project equipment.

6. Station Sound Estimates and Mitigation Measures

The range of sound levels that will propagate from the wind turbine generators to various locations in the community around the site has been predicted. The project is addressing the facility sound with the purchase of the General Electric 1.6xle-100 wind turbine generator, which incorporates the following noise control treatments into its design:

- Noise insulation of the gearbox and generator
- Reduced-noise gearbox
- Reduced-noise nacelle
- Vibration isolation mounts
- Quieted-design rotor blades

In addition, the project will specify and purchase high-efficiency, reduced-noise transformers. The estimated A-weighted Ldn operating sound levels for the four community monitoring locations are listed in Table 5; and for the five residences within one mile of the project (only two residences within one mile of a turbine), the estimates are shown in Table 7 and plotted versus distance to the nearest WTG on Fig. 12. Of added note, Figs. 13 and 14 (without and with land use classifications, respectively) display the A-weighted Ldn sound contours for operation of the proposed facility expansion. Similar to the estimated construction noise values, the estimated Ldn values and contours for the operating phase were developed with the computer noise modeling program, Cadna/A. Measurements and observations made by the field team in February 2011 along Cold Knob Road about one mile east of the existing A-line turbines during a time with favorable turbine operating, background sound, and sound propagation conditions, support the Cadna modeling procedure. The estimated values for the wind farm Ldn sound levels range at the community monitoring locations from 33 dBA to 47 dBA and at the five residences within one mile of the project from 38 dBA to 43 dBA, which compare to the measured range of preconstruction ambient Ldn values of 47 dBA to 50 dBA. The facility sound estimates assume maximum sound output of all wind turbine generators at 47 potential locations, which occurs under conditions of maximum rated wind speed [11 m/s (24 mph) to cutout]. As previously noted, the study evaluated all 47 potential locations for the turbines although only 33 turbines will be installed as part of the expansion phase. Under conditions of reduced wind speeds, the background sound associated with wind in trees would be less; however, the WTG sound emissions would also be less.

The project sound levels are estimated on a time-weighted basis (Ldn) for outdoor locations; for indoor locations, these levels would be reduced by 12 dBA with the windows open and by 24 dBA or more with the windows closed. We anticipate that the wind farm may be heard at times in the

community at distances of 3300 ft. from the project, however, ambient sounds will provide useful masking of the turbine sound and our measurements and estimates indicate that the long-term Ldn sound levels of the wind farm will be significantly less than the existing ambient Ldn levels at that distance for both outdoor and indoor locations.

To address the potential issue of low frequency sound for the expansion project, we employed the Cadna model to estimate the C-weighted Ldn sound levels for the proposed new turbines; these estimates, including comparisons with the measured ambient C-weighted Ldn values, are presented on Figs. 15 and 16 and listed in Tables 6 and 7. As described in Appendix A, the C-weighted sound level (dBC) slightly de-emphasizes the low and high frequencies relative to the mid frequency components of sound. The de-emphasis of low frequency sound with the C-weighting filter is less than with the A-weighting filter, which results in a measured C-weighted sound level being greater than its corresponding A-weighted sound level at a given community location. By comparing an A-weighted sound level (dBA) with a C-weighted sound level (dBC), one can determine the low frequency component of the sound. The estimated C-weighted Ldn sound levels for the wind farm range from 52 dBC to 62 dBC at the community monitoring locations and from 54 dBC to 59 dBC at the five residences within one mile of the project; these estimates compare to the measured preconstruction ambient C-weighted Ldn values of 55 dBC to 73 dBC across the monitoring locations.

The study also considered the potential additive effects of the existing and the proposed expansion on the sound levels in the community. The Town of Duo is located between the existing wind facility and the proposed expansion area. These residences are approximately two miles from the nearest turbine of the proposed expansion and about 3600 ft from the nearest existing turbines. Table 8 presents the estimates of the existing turbines, expansion turbines, total for both sets of turbines, and the increases due to the new turbines at the Duo residential locations. As the table indicates, the total Ldn sound levels for most of the locations range from 39 to 41 dBA with an increase of 1 dBA due to the proposed new turbines; and the total levels for the two locations that were lower, 35 and 37 dBA, included as would be anticipated greater respective contributions of 3 and 2 dBA for the new turbines. The sound model is conservative as it assumes that all turbines are operating at maximum sound power output and that the Duo locations are downwind of all turbines. The resulting estimates indicate that the total sound levels will remain quite modest with the proposed expansion turbines operating.

7. Noise Impact Assessment

As noted in Section 5, the majority of the construction activities associated with the project will be conducted during the daylight hours, and it will vary over time, depending on the equipment in use and the operations being performed at the site. The temporary noise associated with construction of the project will be similar to the noise produced during excavation, grading, and steel erection activities at many other mid-size building projects, and the current timber and mining activities in the region.

The project will be available to operate 24-hours per day and seven days per week. It is expected that routine operation will produce day-night sound levels in the community that are similar to or lower than the measured existing ambient day-night sound levels.

Similar to the community residents (e.g., Town of Duo) located at 3600 ft. from the existing wind facility, the community residents at 3300 ft. from the proposed expansion turbines may at times hear sounds associated with construction or operation of the project, but the overall impact is not expected to be significant at either outdoor or indoor locations.

Figure 1. Area Map with Proposed Beech Ridge Phase II Wind Farm Showing Turbine Locations and One Mile and Five-Mile Buffer Zones.

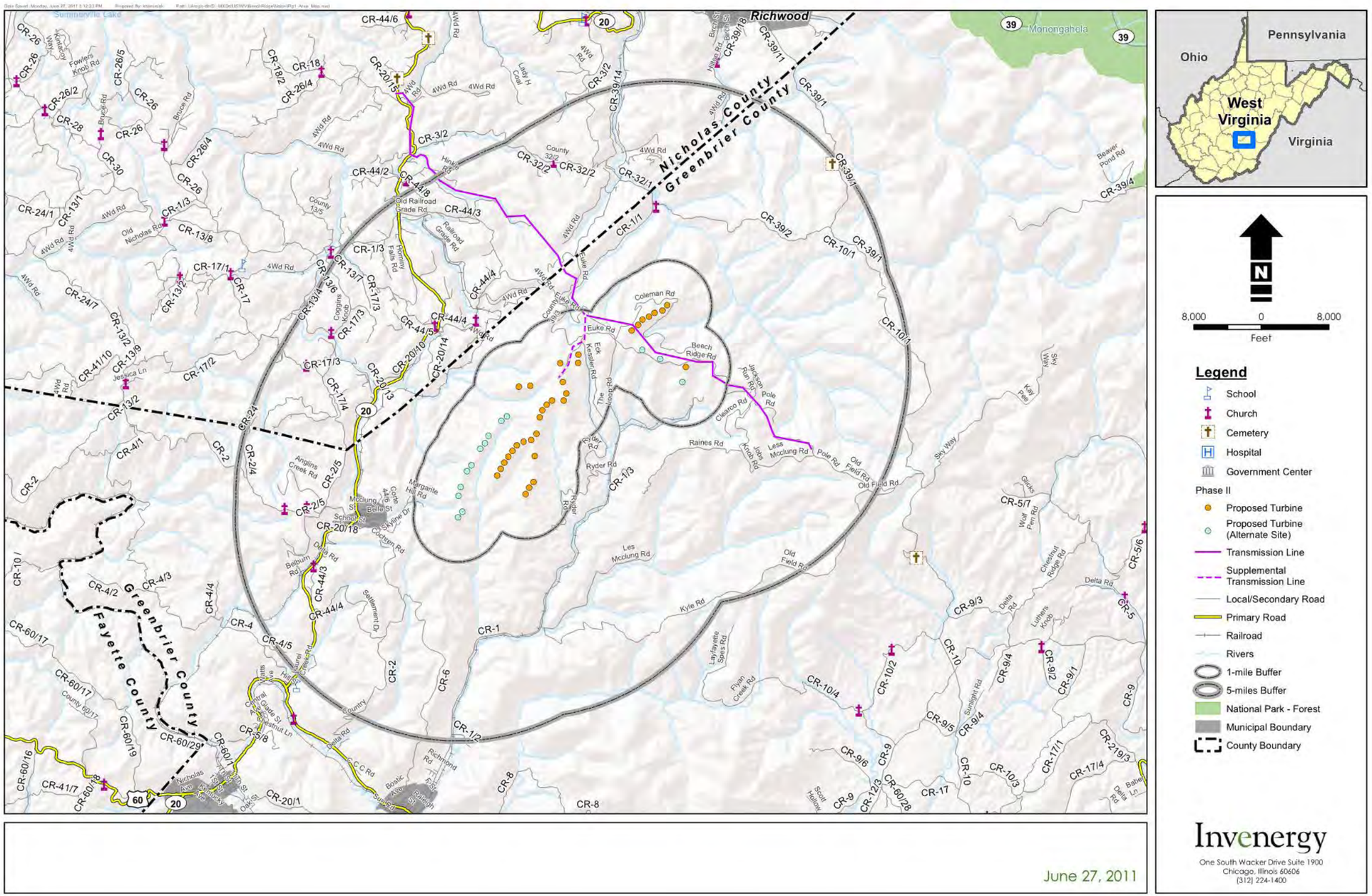
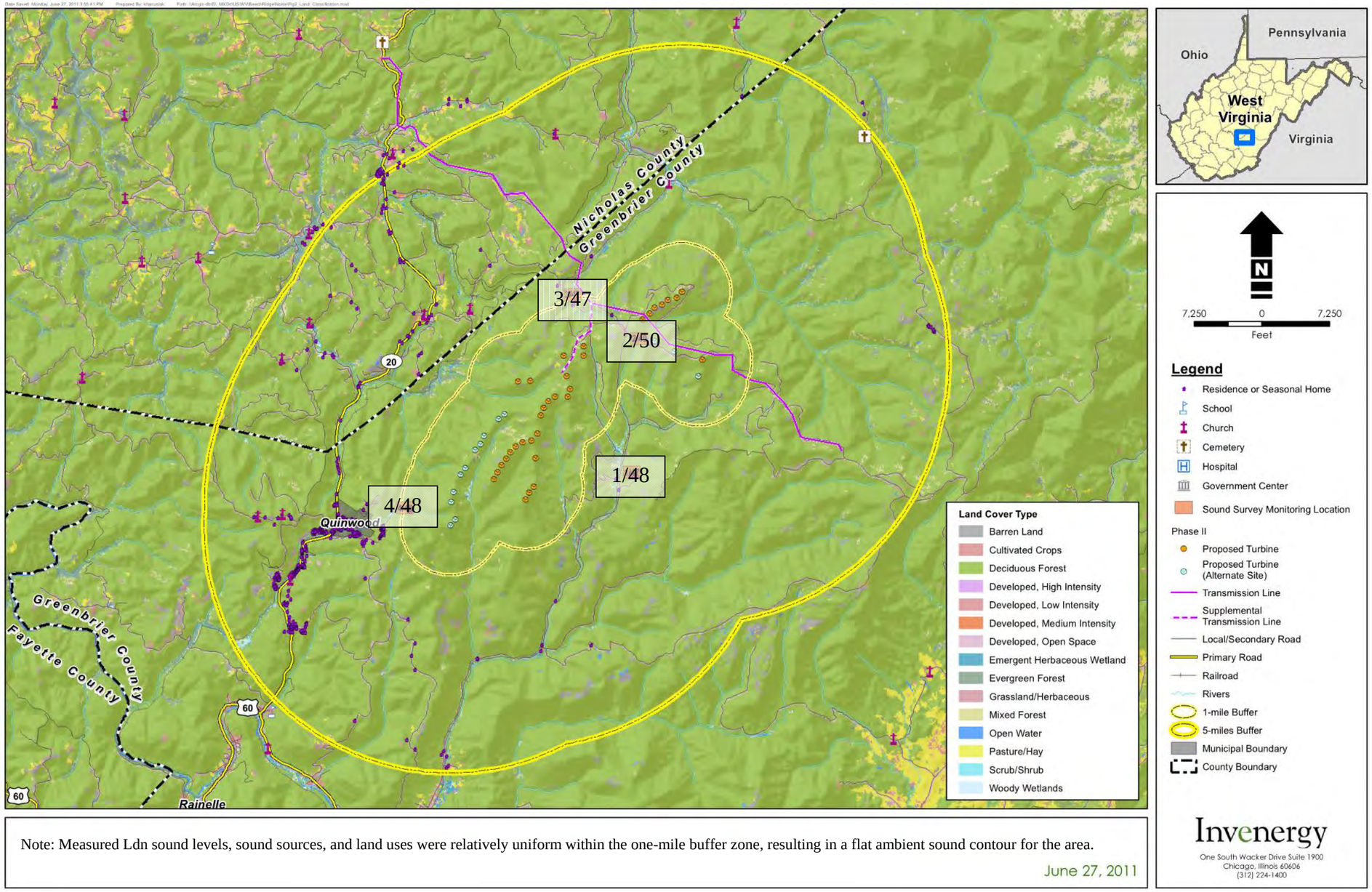


Figure 2. Area Map Showing Land Use Classifications with Community Sound Monitoring Locations 1 through 4 and Average Measured Existing Ambient A-Weighted Day-Night Sound Levels (Ldn, dBA) during 4 – 15 February 2011 Sound Survey.



Note: Measured Ldn sound levels, sound sources, and land uses were relatively uniform within the one-mile buffer zone, resulting in a flat ambient sound contour for the area.

Figure 3. View Looking SW from Location 1 (Town of Duo).

Figure 4. View Looking E from Location 2 (Beech Ridge Road).

Figure 5. View Looking SE from Location 3 (NW of Project Site).

Figure 6. View Looking NE from Location 4 (Town of Quinwood).

Figure 7. Leq A-Weighted and C-Weighted Existing Ambient Sound Levels Measured at Location 1 (Town of Duo) and Wind Speeds for 10-Minute Intervals during 4 – 15 February 2011.

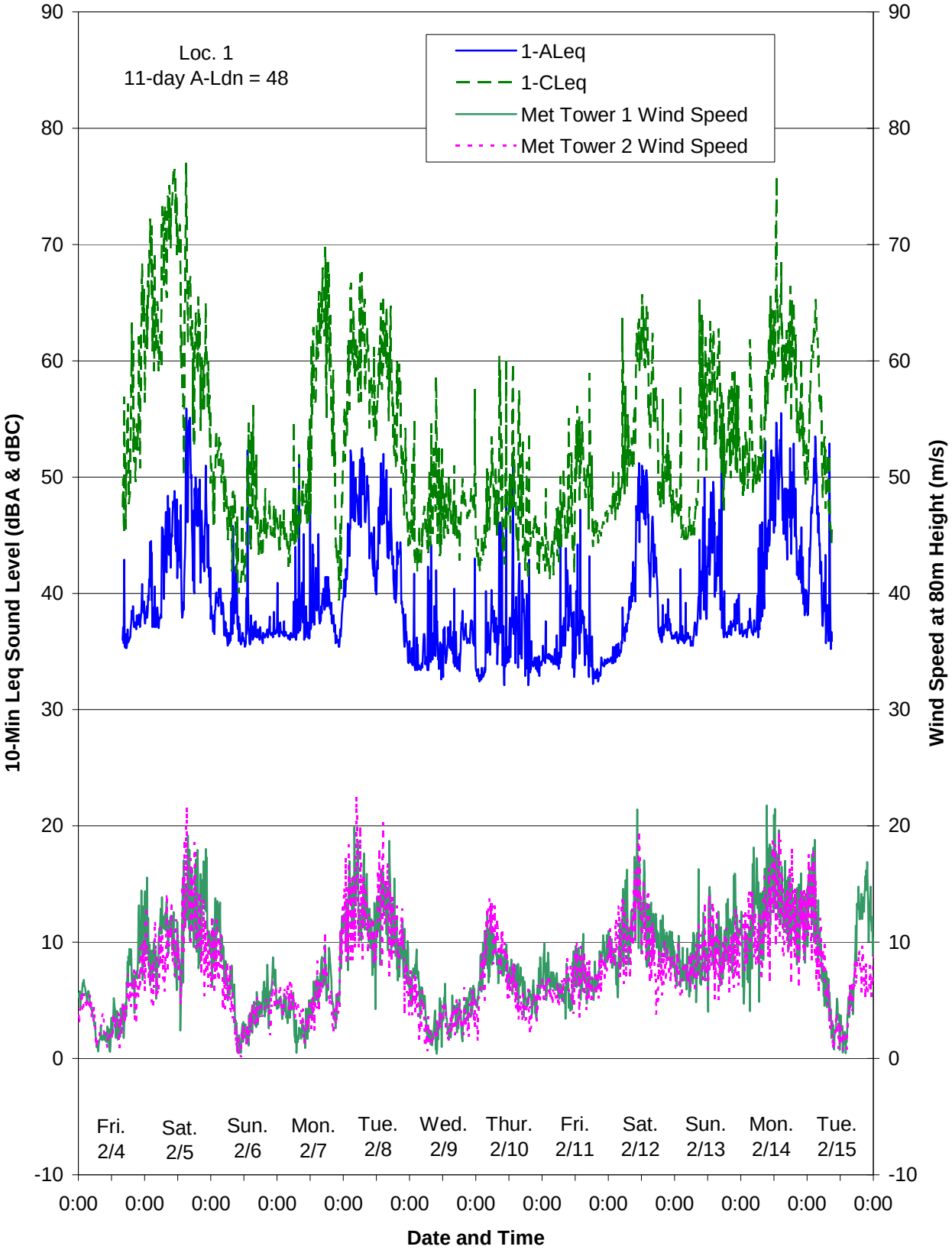


Figure 8. Leq A-Weighted and C-Weighted Existing Ambient Sound Levels Measured at Location 2 (Beech Ridge Road) and Wind Speeds for 10-Minute Intervals during 4 – 15 February 2011.

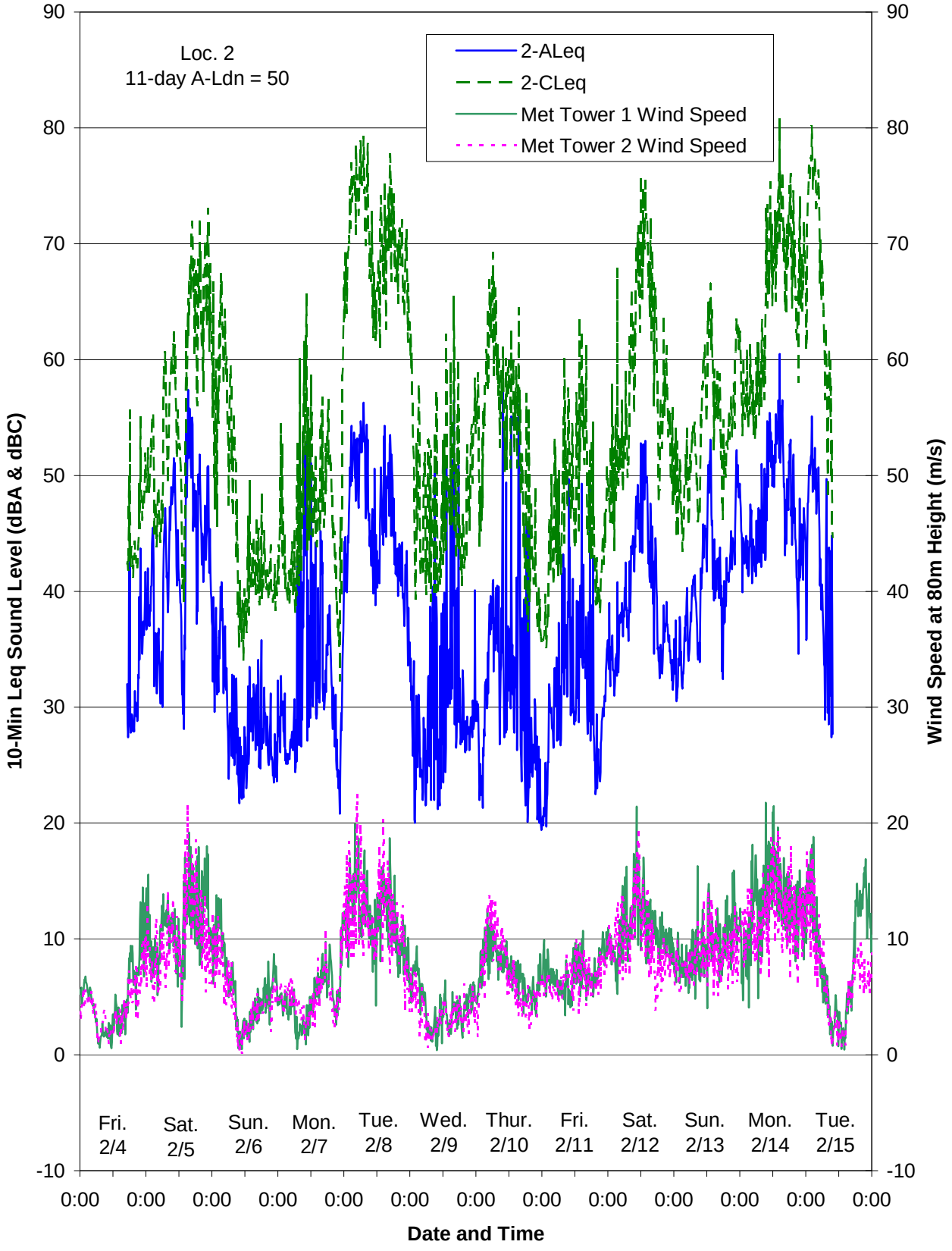


Figure 9. Leq A-Weighted and C-Weighted Existing Ambient Sound Levels Measured at Location 3 (NW of Project Site) and Wind Speeds for 10-Minute Intervals during 4 – 15 February 2011.

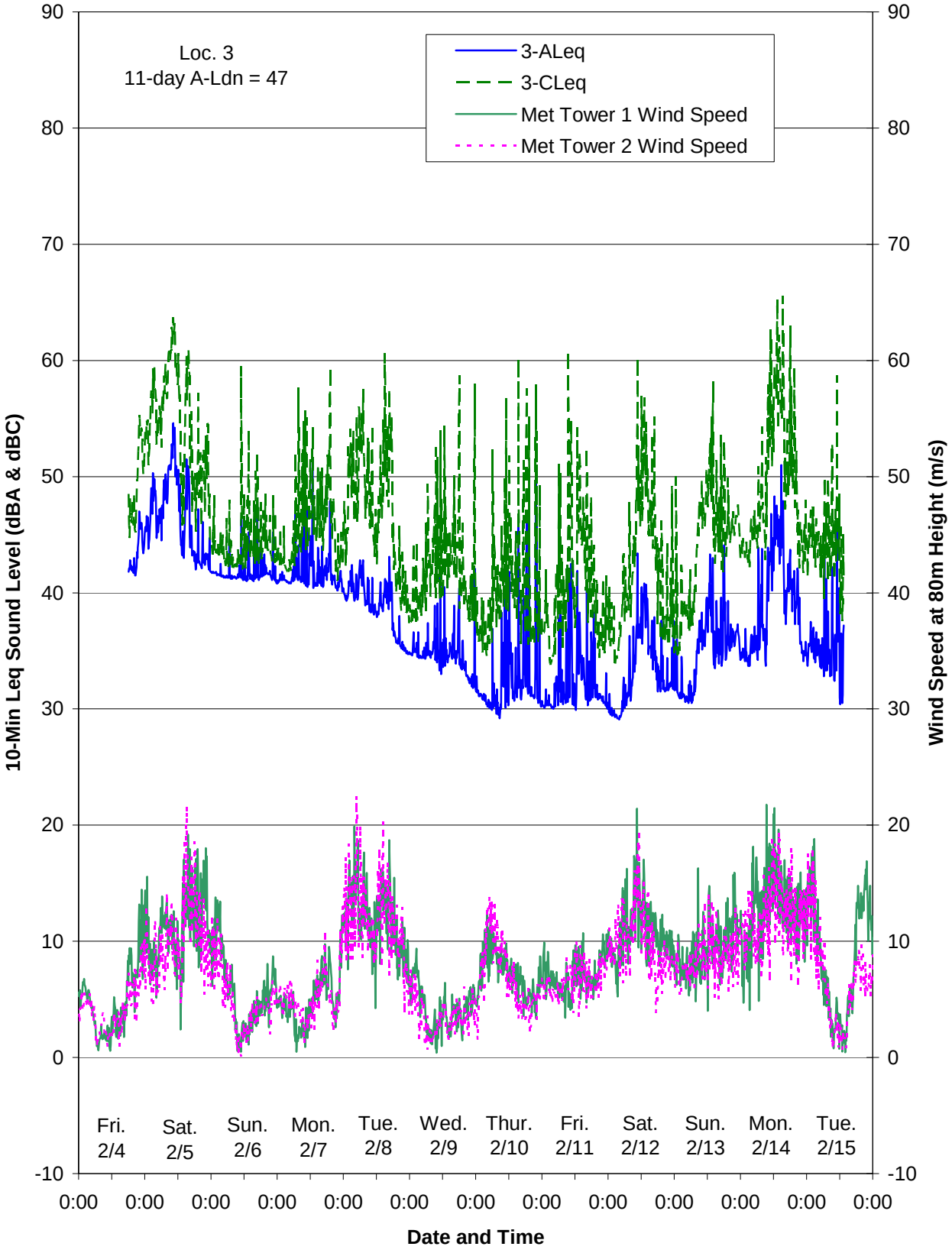


Figure 10. Leq A-Weighted and C-Weighted Existing Ambient Sound Levels Measured at Location 4 (Town of Quinwood) and Wind Speeds for 10-Minute Intervals during 4 – 15 February 2011.

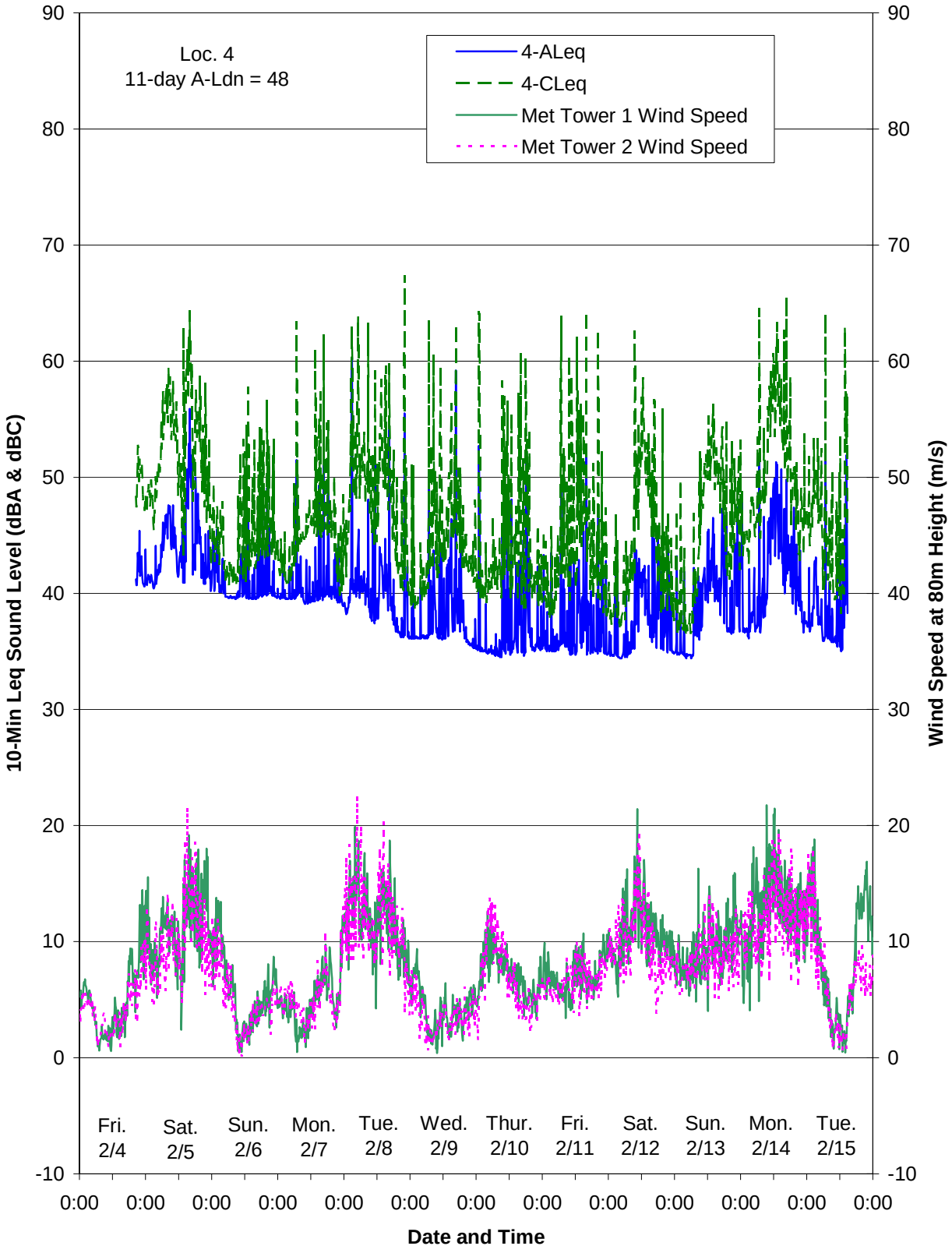
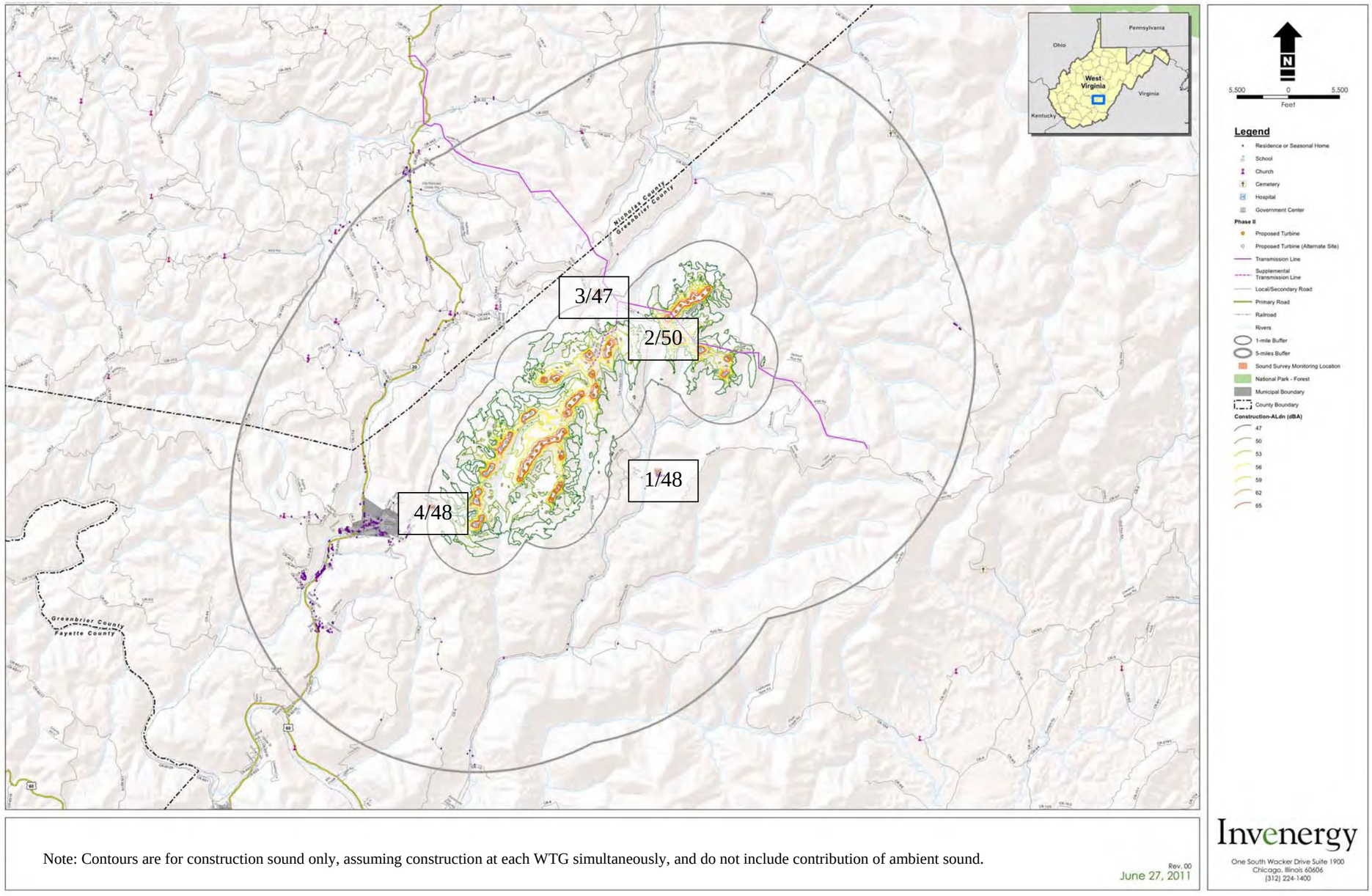


Figure 11. Area Map of Proposed Expansion of Beech Ridge Wind Farm with Estimated Construction A-Weighted Ldn Sound Level Contours Compared to Average Measured Existing Ambient A-Weighted Ldn Sound Levels (dBA) at Locations 1 to 4.



Note: Contours are for construction sound only, assuming construction at each WTG simultaneously, and do not include contribution of ambient sound.

Figure 12. Estimated A-Weighted Ldn Sound Level for Operation (dBA) of Proposed Expansion of Beech Ridge Wind Farm at Residential Structures within One Mile of Project Boundary.

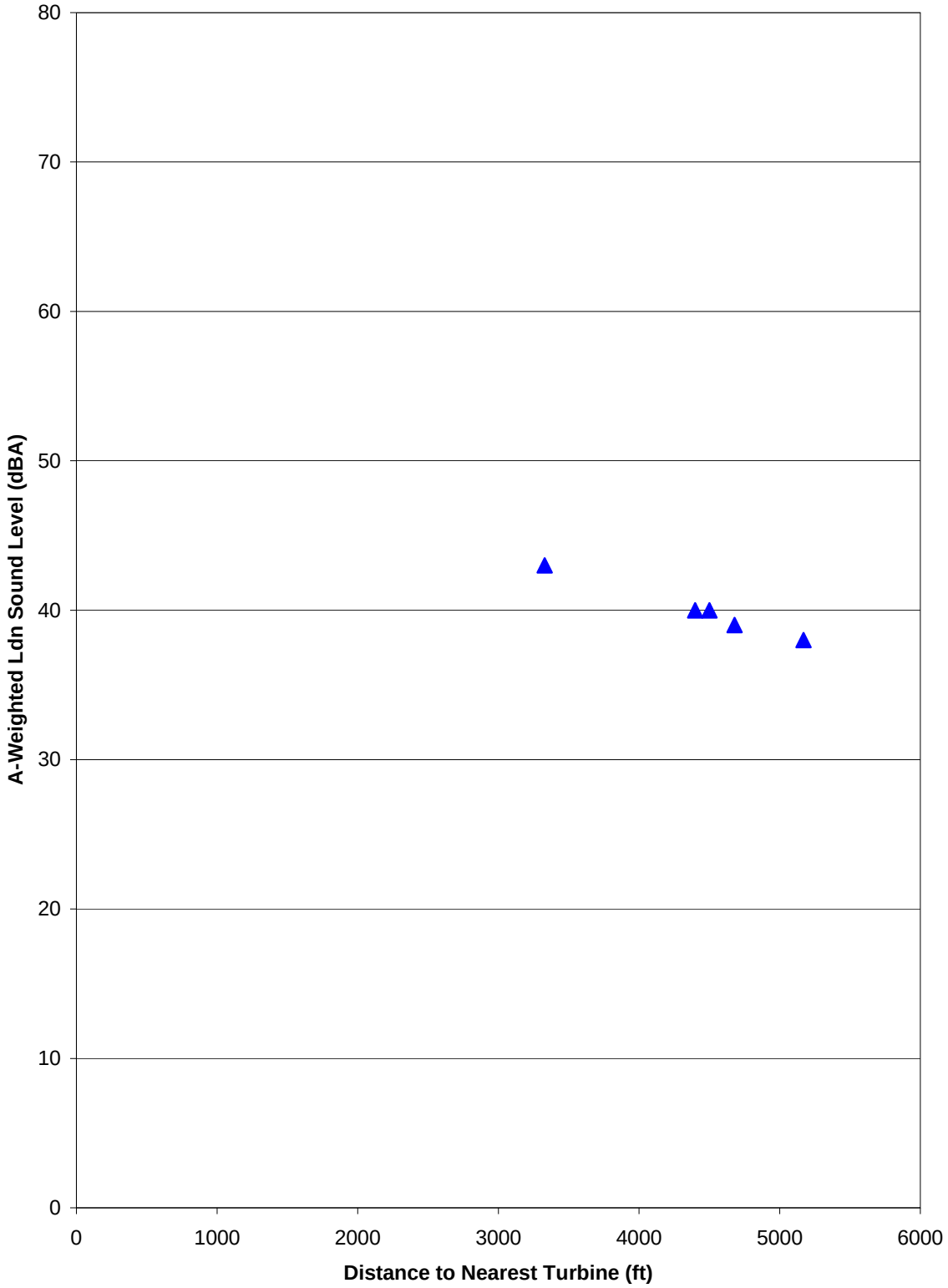


Figure 13. Area Map of Proposed Expansion of Beech Ridge Wind Farm with Estimated Operation A-Weighted Ldn Sound Level Contours Compared to Average Measured Existing Ambient A-Weighted Ldn Sound Levels (dBA) at Locations 1 to 4.

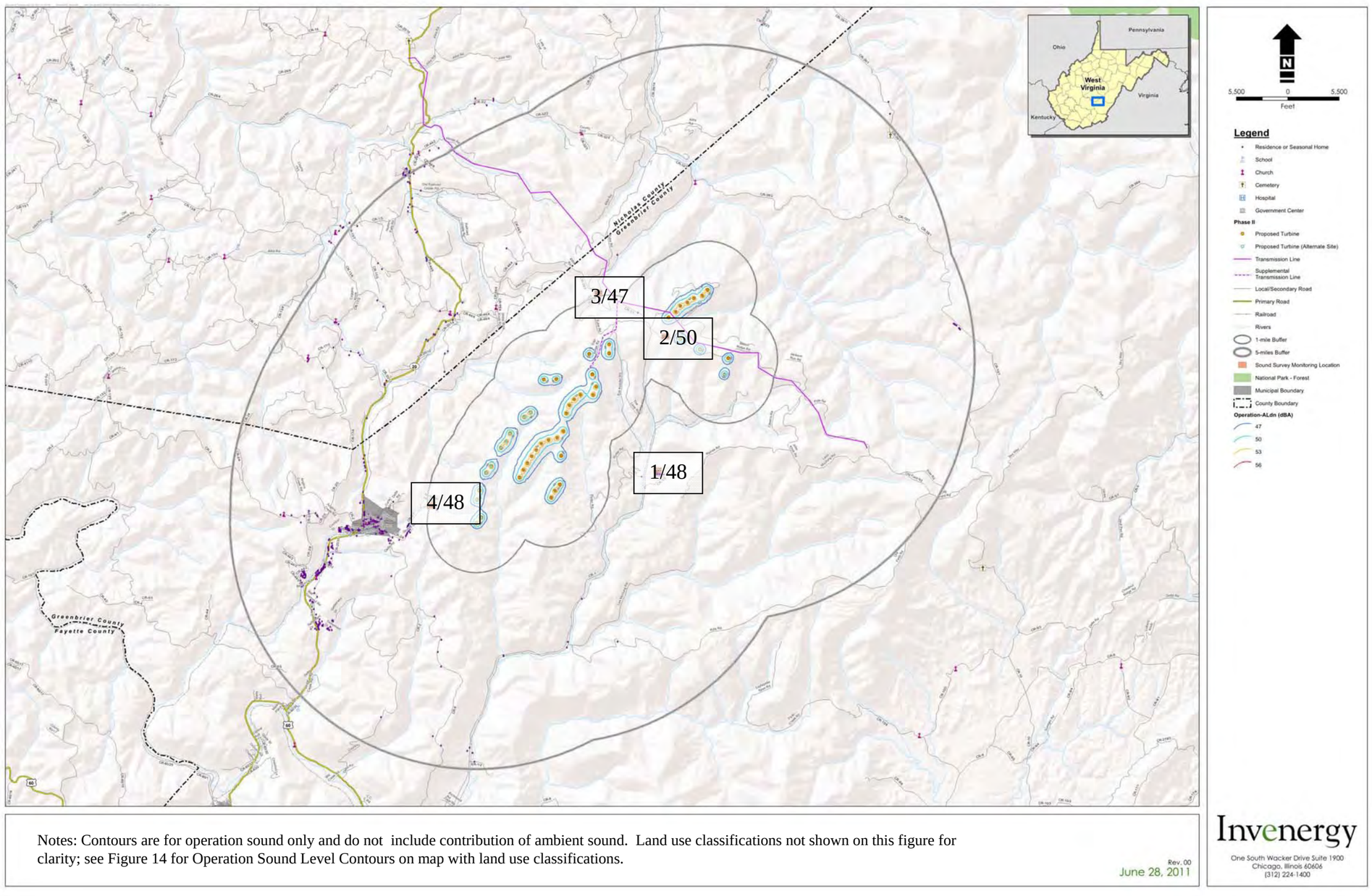
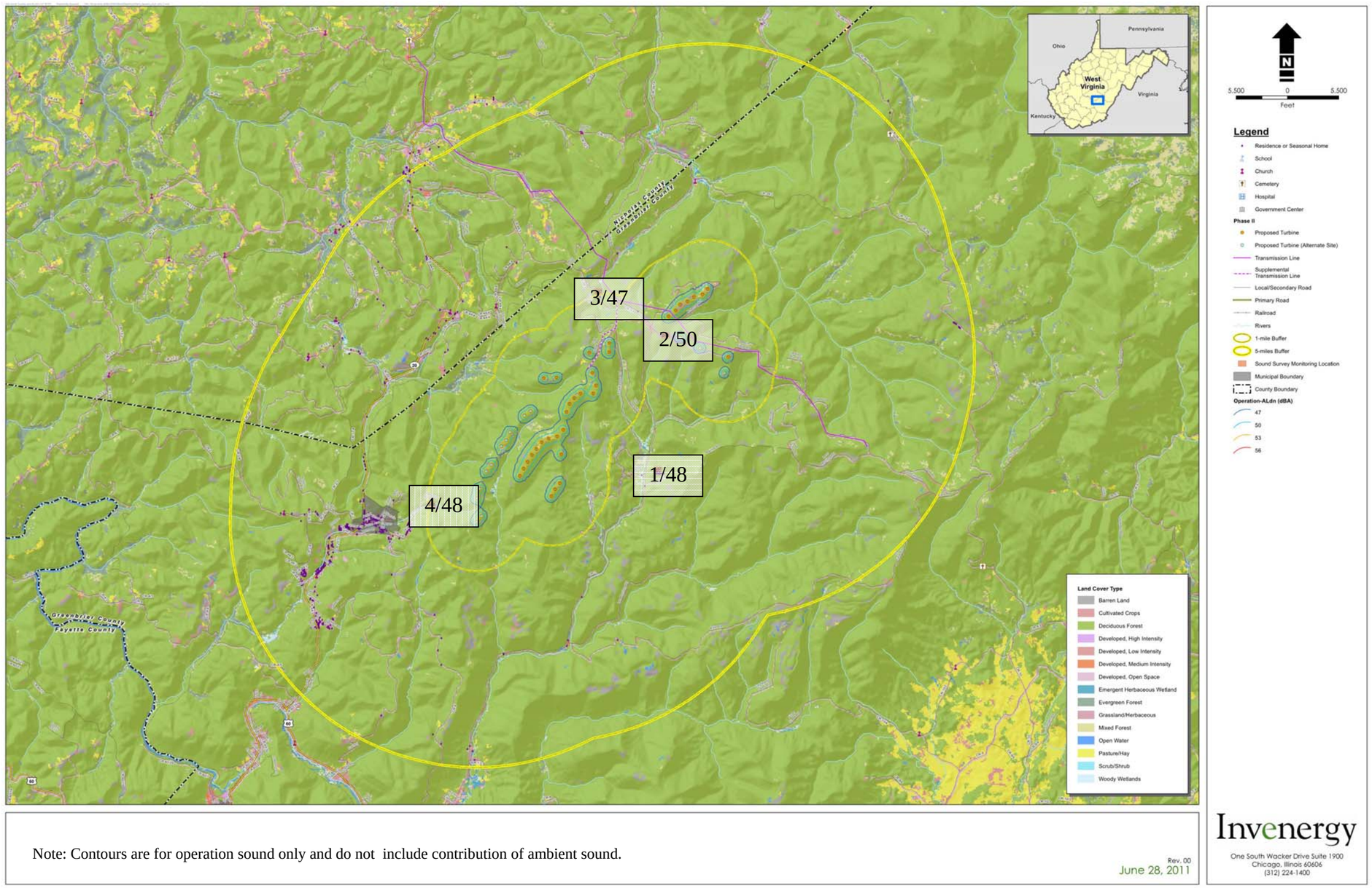


Figure 14. Area Map of Proposed Expansion of Beech Ridge Wind Farm Showing Land Use Classifications with Estimated Operation A-Weighted Ldn Sound Level Contours Compared to Average Measured Existing Ambient A-Weighted Ldn Sound Levels (dBA) at Locations 1 to 4.



Note: Contours are for operation sound only and do not include contribution of ambient sound.

Figure 15. Estimated C-Weighted Ldn Sound Level for Operation (dBC) of Proposed Expansion of Beech Ridge Wind Farm at Residential Structures within One Mile of Project Boundary.

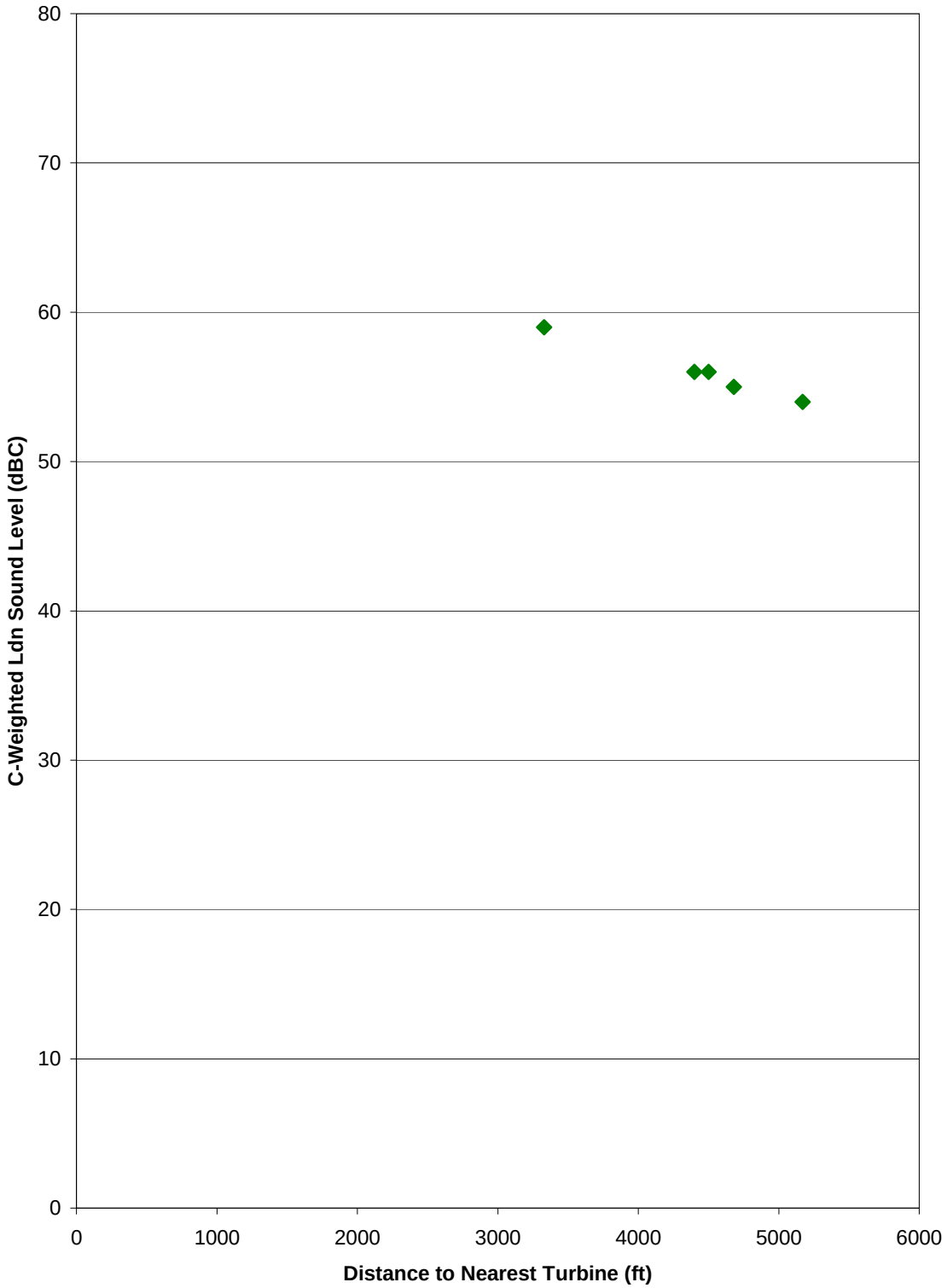


Figure 16. Area Map of Proposed Expansion of Beech Ridge Wind Farm with Estimated Operation C-Weighted Ldn Sound Level Contours Compared to Average Measured Existing Ambient C-Weighted Ldn Sound Levels (dBC) at Locations 1 to 4.

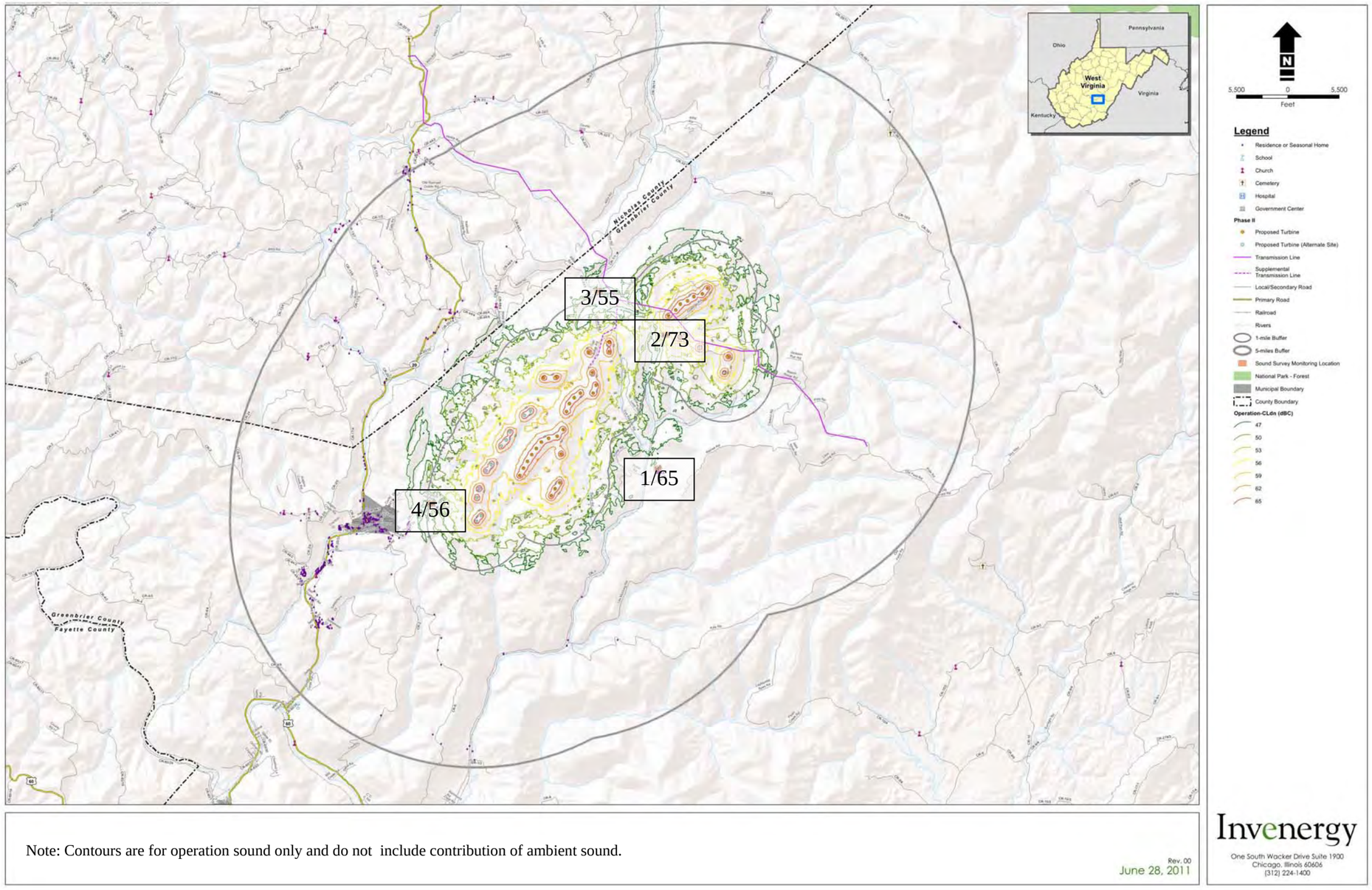


Table 1.
Description of Monitoring Locations for Preconstruction Ambient Sound Survey
(4 - 15 February 2011).

Location	Description	Approx. Dist. (ft.) to nearest WTG
1 – Town of Duo	hamlet with several homes and small church	10,500 (3600*)
2 – Beech Ridge Road	very few scattered rural homes	1600
3 – NW of Project Site	near hamlet with several homes	5800
4 – Town of Quinwood	near hamlet with several homes	5000

* nearest WTG is at existing operating wind facility.

Table 2.
Type of Acoustic Instrumentation Used for Ambient Sound Survey
(4 - 15 February 2011).

Instrument Type	Manufacturer	Model
Continuous Sound Level Monitors	Rion	NL-31 & NL-32
Preamplifiers	Rion	NH-21
1/2" Microphones	Rion	UC-53A
Calibrator	Bruel & Kjaer	4231
Precision Sound Level Meter and Octave Band Analyzer	Rion	NA-27
Preamplifier	Rion	NH-20
1/2" Microphone	Rion	UC-53A
Calibrator	Norsonic	1251

Table 3.
Summary of Monitoring Locations and Ldn Sound Levels (dBA) Measured during Ambient Sound Survey (4 - 15 February 2011).

Location	GPS Reading (UTM)			Dist. to Nearest WTG (ft.)	Ambient Ldn*
	Easting (m)	Northing (m)	Elev. (m)		
1 – Town of Duo	535224	4213961	1033	10,500	48
2 – Beech Ridge Road	535472	4218322	1206	1600	50
3 – NW of Project Site	533286	4219763	971	5800	47
4 – Town of Quinwood	527828	4212790	921	5000	48

* Ldn measured for over 255 hours at Locations 1 - 4.

Note that across the four locations, measured average Ldn of 48 dBA with a standard deviation of 1 dBA.

Table 4.
Estimated Equivalent Sound Levels (Leq*) of Representative Construction Equipment at Various Distances.

Equipment	Construction Sound Levels (dBA)		
	3300 ft. †	**1 mile**	**5 miles**
Phase I – Preparation & Foundation			
Blasting	50**	43**	14**
Pile Driving	49**	42**	13**
Dozer	39	32	3
Excavator	40	33	4
Trencher	40	33	4
Grader	38	31	2
Roller	35	28	<0
Trucks	34	27	<0
Batch Plant	31	24	<0
Phase II – Erection & Installation			
Trucks	34	27	<0
Crane	40	33	4
Phase III – Test & Commission			
Trucks	34	27	<0

* Estimated Leq sound levels over a 10-hour daytime shift. 24-hr Ldn would be 4 dBA less than each Leq.

† Estimated sound levels at nearest year-round community residence to WTG (Residence GB-0125 in Table 7).

** Estimated values for blasting and pile driving are maximum (Lmax) sound levels, not Leq.

Reference: ESEERCO Power Plant Construction Noise Guide, BBN Report No. 3321, May 1977.

Table 5.
Comparison of Average Measured A-Weighted Ldn Sound Levels during Ambient Sound Survey with Estimated A-Weighted Ldn Sound Levels for WTG Facility (dBA).

Location*	Dist. to Nearest WTG (ft.)	Average Measured Ambient A-Weighted Ldn	Estimated Facility Operation A-Weighted Ldn
1 – Town of Duo	10,500	48	34
2 – Beech Ridge Road	1600	50	47
3 – NW of Project Site	5800	47	37
4 – Town of Quinwood	5000	48	38

* Comparisons provided for the actual sound monitoring locations; in some areas, residences are located closer to wind turbines.

Table 6.
Comparison of Average Measured C-Weighted Ldn Sound Levels during Ambient Sound Survey with Estimated C-Weighted Ldn Sound Levels for WTG Facility (dBC).

Location*	Dist. to Nearest WTG (ft.)	Average Measured Ambient C-Weighted Ldn	Estimated Facility Operation C-Weighted Ldn
1 – Town of Duo	10,500	65	53
2 – Beech Ridge Road	1600	73	62
3 – NW of Project Site	5800	55	54
4 – Town of Quinwood	5000	56	52

* Comparisons provided for the actual sound monitoring locations; in some areas, residences are located closer to wind turbines.

Table 7.
Estimated A-Weighted and C-Weighted Ldn Sound Levels (dBA and dBC) for WTG Facility at Each Residential Location within One Mile of Expansion Area.

Residential Structures w/in 1 mile of Expansion	GPS Reading (UTM)			Dist. to Nearest WTG (ft.)	Estimated Facility Operation A-Weighted Ldn (dBA)	Estimated Facility Operation C-Weighted Ldn (dBC)
	Easting (m)	Northing (m)	Elev. (m)			
GB-0125	534579	4219112	1132	3300	43	59
235	528032	4212705	922	4400	40	56
234	528003	4212678	924	4500	40	56
GB-0126	533309	4219424	961	4680	39	55
GB-0128	533341	4219584	952	5200	38	54

Table 8.
Estimated A-Weighted Ldn Sound Levels (dBA) for Existing and Proposed WTG Facility and Associated Increases (All Residential Structures in Town of Duo).

Residential Structures	Estimated Ldn Sound Levels (dBA)			
	67 Existing Turbines	Proposed New Turbines (47)	67 Existing and Proposed New Turbines	Increase with Proposed New Turbines
GB-0001	35	33	37	2
GB-0132	33	32	35	3
GB-0133	40	34	41	1
GB-0134	39	32	40	1
GB-0135	40	32	40	1
GB-0136	39	32	40	1
GB-0137	40	32	40	1
GB-0138	39	31	40	1
GB-0139	40	32	40	1
GB-0140	39	31	40	1
GB-0141	39	32	40	1
GB-0142	39	31	40	1
GB-0143	38	31	39	1
GB-0144	39	34	40	1
GB-0145	39	34	40	1
GB-0146	39	34	40	1
GB-0147	40	34	41	1
GB-0148	40	34	41	1
GB-0149	39	34	40	1
GB-0150	39	33	40	1
GB-0151	39	31	40	1
GB-0152	40	31	40	1

Notes:
Values rounded-off to nearest integer for display.
Estimates for new turbines include all 47 potential locations; only 33 turbines to be installed.
Estimated increases at other residential locations in area near the existing turbines are less than 1 dBA.

Appendix A

Sound in Lay Terms

Sounds we hear come from small pressure oscillations, or sound waves, that travel through the air and actuate our hearing mechanism. These airborne pressure oscillations cause the eardrum and small bones of the middle ear to vibrate. These vibrations are transmitted to the fluid-filled cochlea of the inner ear's sensory organ. Sensory hair cells then transduce these vibrations into nerve impulses that are transmitted to the brain where they are perceived and interpreted.

Noise is often defined as unwanted sound and the degree of disturbance or annoyance of an intruding noise depends on various factors including the magnitude and nature of the intruding noise, the magnitude of the background or ambient sound present without the intruding noise, and the nature of the activity of people in the area where the noise is heard. For example, people relaxing at home generally prefer a quiet environment, while factory employees may be accustomed to relatively high noise levels when at work.

The magnitude, or loudness, of sound waves (pressure oscillations) is described quantitatively by the terms sound pressure level, sound level, or simply noise level. The magnitude of a sound is measured in decibels, abbreviated dB. Decibels are used to quantify sound pressure levels just as degrees are used to quantify temperature and inches are used to quantify distance. The faintest sound level that can be heard by a young healthy ear is about 0 dB, a moderate sound level is about 50 dB, and a loud sound level is about 100 dB. Various common outdoor sound levels are listed below.

130 dBA	Loud siren at 100 feet
95 dBA	Pile Driver at 100 feet
80 dBA	Truck at 100 feet
65 dBA	Lawn mower at 100 feet
60 dBA	Average speech
55 dBA	Automobile 30 mph at 100 feet
50 dBA	Quiet urban daytime
35 dBA	Quiet suburban nighttime
25 dBA	Quiet rural nighttime

Sound energy spreads as it travels away from its source causing the sound level to diminish. Other factors that reduce sound levels include absorption in the atmosphere, diffraction and refraction in the atmosphere, and terrain.

The frequency of a sound is analogous to its tonal quality or pitch. The unit for frequency is hertz, abbreviated Hz (formerly cycles per second or cps). Thus, if a sound wave oscillates 500 times per second, its frequency is 500 Hz. The fundamental frequency of Middle C on a piano keyboard, for example, is 262 Hz. However, most sounds include a composite of many frequencies and are characterized as broad band or random. The normal frequency range of human hearing extends from a low frequency of about 20 to 50 Hz (a rumbling sound) up to a high frequency of about 10,000 to 15,000 Hz (a hissing sound) or even higher for some people. People have different hearing sensitivity to different frequencies and generally hear best in the mid-frequency region that is common to human speech, about 500 to 4000 Hz.

Appendix A Con't.

Sound level meters are usually equipped with electronic filters or weighting circuits, such as specified in standards ANSI S1.4 or IEC 651, for the purpose of simulating the frequency response characteristics of the human ear. The A-weighting filter included with essentially all sound level meters is most commonly employed for this purpose because the measured sound level data correlate well with subjective response to sounds. Sound levels measured using the A-weighting network are designated by dBA.

The background or ambient acoustic environment in most communities varies from place to place and varies with time at any given location due to the composite of many nearby and distant sound sources. The ambient environment includes high sound level single-events such as the passby of an airplane or nearby car, the barking of a dog, thunder, or a siren. The ambient acoustic environment also includes relatively steady residual or background sounds caused by sources such as distant traffic and ventilation equipment. The quantity of the single-event sounds and the amplitude of the background sounds are usually least during the late night hours from about midnight to 5:00 am. Indeed, the ambient sound level at a location is related to the amount of human activity in its vicinity. The amplitude statistics of this rather complex acoustic environment are considered to be non-Gaussian (because of the presence of the lower-level residual background sounds) and non-stationary (because of diurnal and seasonal variations).

At any location, a complete physical description of the ambient acoustic environment might include its sound level at various frequencies, as a function of time. As a first step towards simplifying this multi-dimensional description, it has become common practice to eliminate the frequency variable by measuring the A-weighted sound level (dBA), as observed on a standard sound level meter. The A-weighting filter emphasizes the mid-frequency components of sounds to approximate the frequency response of the human ear. A-weighted sound levels correlate well with our perception of most sounds.

Another weighting network employed in most sound level meters is the C-weighting network. The C-weighted sound level (dBC) slightly de-emphasizes the low and high frequencies relative to the mid frequency components of sound. The de-emphasis of low frequency sound with the C-weighting filter is less than with the A-weighting filter. By comparing an A-weighted sound level (dBA) with a C-weighted sound level (dBC), we can determine the low frequency component of the sound.

An increase or decrease of the outdoor ambient sound level in a community by 1 or 2 dB is generally not noticeable. Whereas a change of the ambient sound level by 5 or 6 dB is generally noticeable and an increase or decrease of the ambient sound level by 10 dB is generally considered to represent a doubling or halving of the perceived sound.

To evaluate impacts and report time-varying ambient sound levels it is common practice, using the A-weighted scale, to measure the equivalent sound level and the day-night sound level. The equivalent sound level (Leq) is the level of a steady-state sound that has the same (equivalent) energy as the time-varying sound of interest, taken over a specified time period. Thus, the equivalent sound level is a single-valued level that expresses the time-averaged total energy of the entire ambient sound energy. It includes both the high-level single event sounds and the relatively steady background sounds. The day-night sound level (Ldn) is simply the average equivalent sound for 24-hours after 10 dBA has been added to the nighttime sound levels from 10pm to 7am. Adding 10 dBA to the nighttime sound levels accounts for people's expectations that nighttime be a quiet period. Both the equivalent sound level and the day-night

sound levels have been selected by the U.S. Environmental Protection Agency (USEPA) as the best descriptors to use for the purpose of identifying and evaluating levels of environmental noise. EPA has identified an Ldn level of 55 dBA as protective of the health and welfare of humans. In addition, the Federal Energy Regulatory Commission (FERC) employs an Ldn level of 55 dBA as its criterion during review of proposed projects.

As part of the application process, the West Virginia Public Service Commission (WVPSC) Guidelines for Noise Studies for Siting Certificates require a project to submit preconstruction ambient Ldn data and facility operation Ldn estimates for review in addition to information on construction noise