5 ENVIRONMENTAL CONSEQUENCES

The CEQ and DOI regulations for implementing NEPA require that the Service discuss:

- the environmental impacts of the alternatives, including the proposed action, any adverse environmental effects which cannot be avoided should the proposal be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented....40 CFR § 1502.16. 32

This chapter describes the environmental effects of the 4 alternatives identified in Chapter 3. We categorize the significance of impacts in terms of their context and intensity. 33 The following sections provide the criteria used to evaluate significance of impacts for each of the aspects of the human environment analyzed. Additionally, the terms minor, moderate, and major are used to describe the degree of impact in determining whether an impact is significant.

Before presenting the detailed effects analysis, each of the 4 alternatives is briefly summarized below.

Alternative 1 is the No-Action/No ITP/No Take alternative. This alternative will be used to analyze the environmental consequences of continued operations of the 67 turbines under the Court stipulation and the eventual decommissioning of these 67 turbines. With full seasonal operating restrictions in place, there is no take of listed bats, and therefore this alternative does not include an ITP, HCP, or implementation of any minimization or mitigation measures for bats. The existing turbine cut-in-speed of 3.5 m/s would not change under this alternative. No additional turbines would be constructed under this alternative. BRE would continue to operate its facility consistent with its state siting certificate, which requires 3 years of post-construction wildlife mortality surveys to assess the Project’s impacts on bats and birds. If the Project causes significant levels of bat or bird mortality and adaptive management techniques are proven effective and economically feasible in reducing such mortality, BRE would make a good faith effort to implement facility-wide adaptive management strategies to reduce mortality levels, consistent with its APP. Alternative 1 (67 turbines with 100.5 MW nameplate capacity) has the potential to generate a maximum of 639,000 MWh of electricity per year with operating restrictions.

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32 Section 1502.16 further defines the content of the “consequences” assessment to include:
“it shall include discussions of:
(a) Direct effects and their significance
(b) Indirect effects and their significance
(c) Possible conflicts between the proposed action and the objectives of federal, regional, state, and local (and in the case of a reservation, Indian tribe) land use plans, policies and controls for the area concerned.
(d) The environmental effects of alternatives including the proposed action.
(e) Energy requirements and conservation potential of various alternatives and mitigation measures.
(f) Natural or depletable resource requirements and conservation potential of various alternatives and mitigation measures.
(g) Urban quality, historic and cultural resources, and the design of the built environment, including the reuse and conservation potential of various alternatives and mitigation measures.
(h) Means to mitigate adverse environmental impacts (if not fully already fully covered in alternatives.)

33 See CEQ regulations at 40 CFR § 1508.27 for a definition of the term “significantly,” further explaining the relevance of context and intensity.
Alternative 2 is the Proposed Action Alternative: issuance of an ITP for the Indiana bat and Virginia big-eared bat and implementation of an HCP as submitted by the Applicant. The analysis for this alternative evaluates the impacts of construction of an additional 33 turbines (Phase II) and associated infrastructure along with operation and eventual decommissioning of the entire 100-turbine wind Project. Under this alternative, the current seasonal operating restrictions imposed by the court order/settlement agreement and modified stipulation will be lifted and more energy will be generated. Take of listed bats will occur because the turbines will be operating at night and during the season when bats are active. The HCP includes:

1. measures to reduce take of listed bats (turbine feathering at low wind speeds and raised cut-in speeds of 4.8 m/s for 12 weeks of the year during fall);
2. off-site conservation measures for the listed bats; and
3. an RMAMP to test and measure the effectiveness of turbine operations in reducing listed bat mortality.

Under Alternative 2 BRE also will implement an APP. Alternative 2 (100 turbines with 186 MW nameplate capacity) has the potential to generate a maximum of 1,542,000 MWh of electricity per year with operating restrictions.

Alternative 3 is the Additional Covered Species Alternative. Similar to the Proposed Action Alternative, the analysis of Alternative 3 evaluates the impacts of an ITP and HCP for construction of 33 additional turbines, operation of all 100 turbines, and eventual decommissioning of 100 turbines, but additionally evaluates the impacts of including 3 additional bats species in the HCP and the impacts of additional minimization and mitigation measures for these 3 species. Measures to be added to the HCP would include higher turbine cut-in speeds of 6.5 m/s for longer seasons and on-site mitigation habitat protection and enhancement (or off-site if on-site is not practicable). Like the Proposed Action Alternative, under Alternative 3 BRE would implement an RMAMP and an APP. Alternative 3 (100 turbines with 186 MW nameplate capacity) has the potential to generate a maximum of 1,184,000 MWh of electricity per year with operating restrictions.

Finally, Alternative 4 is the Phase I Only Alternative. Alternative 4 is used to evaluate the impacts of an ITP for the Indiana bat and Virginia big-eared bat and implementation of an HCP for operation and eventual decommissioning of the 67-turbine wind Project. The curtailment measures would be the same as Alternative 2; however, the minimum number of listed bats protected at offsite mitigation sites would be less than alternative 2, commensurate with reduced mortality of listed bats under Alternative 4. Like the Proposed Action and Alternative 3, under Alternative 4 BRE would implement an RMAMP and an APP. Alternative 4 (67 turbines with 100.5 MW nameplate capacity) has the potential to generate a maximum of 832,000 MWh per year with operating restrictions.

Chapter 5 is organized by resource as in Chapter 4. Within each resource section, environmental effects associated with the No-Action Alternative are presented first (to facilitate comparison with other alternatives), followed sequentially by Alternatives 2, 3, and 4. Table 5-1 provides for comparison of the main features of each alternative. The same table appears in chapter 3 but is repeated here for the convenience of the reader. The direct and indirect effects of each alternative are disclosed in each resource section. These sections are then followed by the cumulative effects analysis of each alternative by resource.

34 As indicated in Chapter 1 of this DEIS, the 100-turbine Beech Ridge Wind Energy Project consists of 2 phases. Phase I (67 turbines) were constructed prior to establishment of a federal nexus with the Service. These turbines are currently operating under the restrictions of a modified stipulation such that take of listed bats is not likely. The environmental effects of constructing the 67 existing turbines are analyzed as a past action in the cumulative effects section of this DEIS (which analyzes the impacts of past, present, and reasonably foreseeable future actions). The effects of the current restricted turbine operating regime also are analyzed as part of cumulative effects (a past and ongoing action).
Table 5-1. Alternatives considered for detailed analysis for the Beech Ridge Wind Energy Project Habitat Conservation Plan. For the Proposed Action and each action alternative, the turbine blades would be feathered (pitched) to rotate at <2 revolutions/minute when wind speeds are below the cut-in speed, thus minimizing bat and bird mortality.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Construction Type</th>
<th>Energy Capacity with Curtailment</th>
<th>Operations</th>
<th>Permit Term (years)</th>
<th>Implement HCP</th>
<th>Implement RMAMP</th>
<th>Implement APP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 1: No-Action</td>
<td>No new construction</td>
<td>100.5 MW nameplate capacity; up to ~639,000 MWh/year</td>
<td>67 turbines would operate unrestricted 73% of time (6,364 hours per year) at normal cut-in speed of 3.5 m/s. Turbines will be turned off from 30 minutes before sunset to 15 minutes after sunrise from April 1 through November 15.</td>
<td>None</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Alternative 2: Proposed Action</td>
<td>33 turbines and associated infrastructure</td>
<td>186 MW nameplate capacity; up to ~1,540,000 MWh/year</td>
<td>100 turbines will operate 95% of time (8,295 hours per year). Turbines will be restricted so that blades move less than 2 rpms when wind speeds are below the raised cut-in speed set at 4.8 m/s from 30 minutes before sunset for 5 hours from July 15 through October 15.</td>
<td>25</td>
<td>Yes, with offsite mitigation</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Alternative 3: Additional Covered Species</td>
<td>33 turbines and associated infrastructure</td>
<td>186 MW nameplate capacity; up to ~1,183,000 MWh/year</td>
<td>100 turbines would operate 73% of time (6,364 hours per year) at normal cut-in speed of 3.5 m/s. Turbines will be restricted so that blades move less than 2 rpms when wind speeds are below the raised cut-in speed set at 6.5 m/s from 30 minutes before sunset to 15 minutes after sunrise from April 1 through October 15.</td>
<td>25</td>
<td>Yes, with on-site (or off-site) mitigation.</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Alternative 4: Phase I Only</td>
<td>No new construction</td>
<td>100.5 MW nameplate capacity; up to ~832,000 MWh/year</td>
<td>67 turbines would operate 95% of time (8,295 hours per year): Turbine will be restricted so that blades move less than 2 rpm when wind speeds are below the raised cut-in speed set at 4.8 m/s from 30 minutes before sunset for 5 hours from July 15 to October 15.</td>
<td>25</td>
<td>Yes; lower take estimates would warrant reduced offsite mitigation measures.</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>
5.1 Geology and Soils

5.1.1 Impact Criteria

There are no specific federal or state regulations pertaining to geology and soils that are relevant to the analysis for this Project. As per NEPA and CEQ guidelines, the human environment includes geologic resources, and impacts to these resources can result in secondary effects to other resources. Additionally, potential geologic hazards must be considered with respect to project siting that could pose a risk to people, structures, and other aspects of the human environment.

Impacts to soils and geology would be considered significant if:
- The project results in substantial soil erosion;
- The project is located on an unstable geologic unit or on soil that has a high likelihood of resulting in a major landslide; or
- The project is located on a known earthquake fault, exposing people, structures, and plants and animals to high risk of loss, injury, or death.

5.1.2 Direct and Indirect Effects Presented by Alternative

5.1.2.1 Alternative 1: No-Action

Under the No-Action Alternative, effects to soil and geologic resources would occur only in association with operation, maintenance, and decommissioning of Phase I, the 67-turbine Project, and associated infrastructure. There would be no new construction.

Phase I Operation
Project infrastructure (buildings, concrete pads, etc.) would prohibit 50 acres of soil from contributing to forest productivity for the life of the Project (approximately 25 years). There would be no new ground disturbance; 336 acres of reclaimed areas from Phase I construction would continue to recover and eventually become forested.

Phase I Decommissioning
BRE would implement BMPs during decommissioning to minimize soil erosion. Practices would include containing excavated material, protecting exposed soil and stabilizing restored material, and re-vegetating areas to be reclaimed. Ground disturbance would be limited to that which is necessary for safe and efficient removal of Project components. All temporarily disturbed areas would be restored to the approximate original contour and reclaimed in accordance with easement agreements.

No decommissioning activities would be conducted where soil is too wet to adequately support construction equipment (i.e., if such equipment created ruts in excess of 4 inches deep). Certified weed-free straw mulches, certified weed-free hay bale barriers, silt fences, and water bars would be used to control soil erosion. Soil erosion control measures would be monitored, especially after storms, and would be repaired or replaced as necessary. Decommissioning activities would be intermittent, short-term, and localized. BRE may begin decommissioning the Phase I turbines as early as 2035.

No-Action Alternative Summary
The No-Action Alternative would not result in substantial amounts of soil erosion. The Phase I Project is not located on an unstable geologic unit or on soil that has a high likelihood of resulting in a major landslide. The Phase I Project is not located on a known earthquake fault, exposing people, structures, and plants and animals to high risk of loss, injury, or death. The No-Action Alternative would not cause significant effects to geologic features or soils.
5.1.2.2 Alternative 2: Proposed Action

Under the Proposed Action Alternative 2, effects to soil and geologic resources would occur in association with construction of 33 Phase II turbines and associated infrastructure, and with operation, maintenance, and decommissioning of the entire 100-turbine Project and associated infrastructure.

Phase II Construction

The effects of the Proposed Action during the construction of Phase II of the Project will be largely limited to surface soil disturbance. Phase II of the Project will not impact karst formations or caves. Phase II of the Project also is not located on a known fault line. The Project is located in a low-level earthquake risk zone. It is approximately 180 miles west of the epicenter of a recent low level earthquake (see Section 4.1.2). Similar to the No-Action alternative, the risk of an earthquake at the Project site causing a landslide or exposing humans, plants, and wildlife to loss or injury is low.

Phase II construction of 33 turbines and associated infrastructure will affect 145 acres of soils covered with native vegetation; 124 acres of these soils will be temporarily disturbed during construction and reseeded to prevent soil erosion, and 21 acres will be covered with impervious surfaces and removed from forest productivity for the 25-year operational life of the Project (Table 3-2). In addition to these 145 acres, Phase II will affect an unknown amount of previously disturbed soils. Previously disturbed areas include agricultural lands, abandoned strip mines, and the site used for the Phase I batch plant and laydown area. The batch plant site is located in an old field and will be used for the same purposes during Phase II construction.

Ground will be excavated to install turbine tower pads. Rock blasting will be necessary at those turbine locations where rock prohibits excavation. The Project has been sited to use previously disturbed areas to the fullest extent practicable.

Phase I and Phase II 100-Turbine Project Operation

During the 25-year operating life of the Project, no soil disturbance is anticipated for maintenance and operation of the 100-turbines, transmission-line, or facility buildings. A small amount of soil disturbance may occasionally occur to access or repair underground cable or communication lines.

Mitigation for Phase II Construction and Project Operations

During construction of the 33 Phase II turbines and operation of the 100-turbine Project, BRE will implement BMPs to minimize soil erosion. Practices will include containing excavated material, protecting exposed soil and stabilizing restored material, and re-vegetating areas to be reclaimed. Ground disturbance will be limited to that which is necessary for safe and efficient construction. All temporarily disturbed areas will be restored to the approximate original contour and reclaimed in accordance with easement agreements.

No construction activities will be conducted where soil is too wet to adequately support construction equipment (i.e., if such equipment created ruts in excess of 4 in deep). Certified weed-free straw mulches, certified weed-free hay bale barriers, silt fences, and water bars will be used to control soil erosion. Soil erosion control measures will be monitored, especially after storms, and will be repaired or replaced as necessary. BRE will use existing roads within the Project area to avoid creating new access roads and use previously disturbed areas for some turbine foundation sites.

100-Turbine Decommissioning

If it is determined that the wind turbines are not to be replaced or repowered after 25 years, BRE will begin decommissioning Phase I turbines as early as 2035, and Phase II turbines as early as 2037. The decommissioning process will take several years. Impacts to soils and geology associated with decommissioning activities will be short-term and localized within the original Project footprint. Soil will be disturbed as the turbines, buildings, transmission line, and substations for Phases I and II are removed and the disturbed areas recontoured and seeded to herbaceous vegetation. Some access roads will be left in place at the request of the landowner. The extent of soil disturbance associated with
decommissioning will be comparable to that which occurred during Phase I and II construction combined (approximately 531 acres or 7.7% of the BRE leased lands (6,860 acres) and 0.8% of the surrounding commercial timber tract (63,000 acres).

Proposed Action Summary
In summary, under the Proposed Action Alternative, there will be periodic short-term and localized effects to soil and geologic resources associated with construction of Phase II turbines and decommissioning of the 100-turbine Project and associated infrastructure. This alternative is not expected to result in major soil erosion during construction, facility maintenance, or decommissioning provided that BMPs are effectively implemented. The Project has been sited and designed to avoid areas at high risk of major earthquakes and landslides. Thus, impacts to soil and geology are expected to be minor. The Proposed Action will not result in significant effects to geologic features or soils.

5.1.2.3 Alternative 3: ITP and HCP with Additional Covered Species
Similar to Alternative 2, under Alternative 3, effects to soil and geologic resources would occur in association with construction of 33 Phase II turbines and associated infrastructure, and with operation, maintenance, and decommissioning of the entire 100 turbine Project and associated infrastructure.

Construction, Operation, and Decommissioning
Under Alternative 3, geology and soil disturbances and associated mitigation would be the same as those described for the Proposed Action (construction of 33 turbines, operation of 100 turbines and infrastructure, and decommissioning of the entire facility). Impacts to soil and geology are expected to be periodic, short-term, and localized. This alternative would not be expected to result in substantial soil erosion. Nor would this alternative increase risks to the public associated with earthquakes and landslides. Thus impacts to soils and geology would be expected to be minor.

Alternative 3 Summary
Implementation of Alternative 3 will result in periodic short-term and localized effects to soil and geologic resources associated with construction of Phase II turbines and decommissioning of the 100-turbine Project and associated infrastructure. Alternative 3 is not expected to result in major soil erosion during construction, facility maintenance, or decommissioning provided that BMPs are effectively implemented. Phases I and II have been sited and designed to avoid areas at high risk of major earthquakes and landslides. Thus, impacts to soil and geology are expected to be minor. Alternative 3 will not result in significant effects to geologic features or soils.

5.1.2.4 Alternative 4: ITP and HCP for Phase I Only
Similar to Alternative 1, under Alternative 4, effects to soil and geologic resources would occur only in association with operation, maintenance, and decommissioning of Phase I, the 67-turbine Project. There would be no new construction.

Phase I Operation, and Decommissioning
Under Alternative 4, geology and soil disturbances and associated mitigation would be the same as those described for the No-Action Alternative. No new construction would occur. There would be periodic, short-term, and localized effects to soil and geologic resources associated with the decommissioning of the 67 turbines and associated infrastructure. This alternative would not be expected to result in substantial soil erosion or pose a high risk of damage from earthquakes and landslides. Thus, impacts to soil and geology are expected to be minor.

Alternative 4 Summary
Implementation of Alternative 4 would not result in substantial amounts of soil erosion. The Phase I Project is not located on an unstable geologic unit or on soil that has a high likelihood of resulting in a major landslide. The Phase I Project is not located on a known earthquake fault, exposing people, structures, and plants and animals to high risk of loss, injury, or death. Alternative 4 would not cause significant effects to geologic features or soils.
5.2 Noise

5.2.1 Impact Criteria

Pursuant to the PSC Rules Governing Siting Certificates for Exempt Wholesale Generators (Siting Rules; 150 CSR Series 30), the Applicant must prepare a predictive noise study that addresses pre-construction, construction, and operations noise levels. The Siting Rules do not specify noise "increase" criteria, that is, noise level increases that correspond to a relative impact. In the absence of any specific or absolute regulatory noise level limits, this EIS evaluates the potential effects of noise from the Project in terms of its likely audibility or perceptibility at residences (where people spend most of their time and are likely to be sensitive to noise) relative to the background sound level. This approach is commonly used in siting analyses for various types of new infrastructure projects.

The A-weighting curve is most often used for environmental noise measurement. Changes in background (ambient) sound levels around 5 dBA or 6 dBA generally are considered to be noticeable by most people. Changes in ambient sound levels by 10 dBA generally are considered to be doubling (if increased) or halving (if decreased) perceived sound. In other words, a new noise source without any distinctive character normally must have a sound level that is about 5 dBA higher than the background before it begins to be perceptible to most people.

For wind turbines, the threshold of perception is slightly lower due to modulating amplitude. Depending on the speed of turbine rotation, the sound level rises and falls slightly in about 1-second intervals. The down-turning blade briefly generates aerodynamic noise as it passes the tower, followed by a short pause then the sound of the next down-turning blade. This blade "swish" gives turbine noise a periodic sound that makes it more readily perceptible than a steady, bland sound of the same magnitude.

This assessment set the nominal noise impact threshold at 5 dBA above the prevailing background level. A project’s sound level must not be so loud that it legitimately creates disturbance at a large number of homes. Setting a nominal threshold of 5 dBA above the ambient sound level is consistent with facility siting guidelines in other states (NYSDEC 2001, MDLEG 2007) and represents a reasonable value for addressing concerns among all interested parties. Thus, an impact will be considered significant if it is predicted to result in noise 5 dBA above the prevailing background level.

5.2.2 Direct and Indirect Effects Presented by Alternative

This section addresses potential direct and indirect effects of noise by alternative. Methodologies for measuring and predicting noise are explained in detail in the acoustical assessments by Acentech (2006, 2011) of the construction and operation of the Project (provided in Appendix 4.B). Acentech (2006, 2011) estimated operational noise in Project Phases rather than the 100-turbine Project as a whole. Phase I post-construction noise was not measured, except for the town of Duo. Therefore, with exception of Duo, noise estimates are based on the pre-construction predictive models and analyses for the 2 Phases.

5.2.2.1 Alternative 1: No-Action

Under the No-Action Alternative, there would be no noise associated with new construction as no additional turbines would be built.

Phase I Operation

Consistent with the court order and settlement agreement, for the life of the Project (25 years), the existing 67 turbines would continue to operate and generate turbine noise year-round during daytime hours; however, turbines would continue to be turned off and not generate operational noise at night for 7.5 months of the year (April 1 through November 15). Noise would also be generated during the decommissioning phase when the Project is dismantled.

The existing 67 turbines are GE 1.5sle wind turbine generators. This model incorporates the following noise control treatments into its design:
BEECH RIDGE ENERGY WIND PROJECT
Habitat Conservation Plan
DRAFT ENVIRONMENTAL IMPACT STATEMENT

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

In addition, the Project installed high-efficiency, reduced-noise transformers.

Acentech (2006) modeled predicted noise levels at 6 monitoring sites resulting from operation of the then proposed 124-turbine Project (Appendix 4.B). Thus, modeled noise levels overestimate noise effects for the No-Action alternative (67 turbines) and reflect a worst case scenario. The Project would not necessarily be less noisy, but the area affected by turbine noise would be significantly smaller for the constructed Project as compared to the original 124-turbine layout.

When in operation, wind turbines emit noises that come from the gearbox and movement of the blades through air. The predicted turbine noise levels (Ldn) range between 28 dBA and 52 dBA, or 21 dB lower to 1 dB higher than existing ambient levels at these sites (Table 5-2). Additionally, Acentech (2006) modeled the turbine noise levels at locations within 0.2 to 1.1 mi of the nearest turbines, as well as at 3 communities (Trout, Friars Hill, and Williamsburg) located more than 2 mi from the nearest turbine. Predicted Ldn turbine-generated noise levels at these locations are between 17 dBA to 41 dBA, which are lower than the ambient average noise levels (49 dBA to 52 dBA) (Table 5-2).

Table 5-2. Ambient noise survey results and estimated turbine noise (dBA) from 6 locations identified in relationship to the 124-turbine Project.1

<table>
<thead>
<tr>
<th>Location</th>
<th>Description</th>
<th>Approximate distance to nearest turbine</th>
<th>Average measured ambient Ldn</th>
<th>Estimated facility operation Ldn</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Town of Duo</td>
<td>Hamlet with several homes &amp; small church</td>
<td>3,600 ft (0.7 mi)</td>
<td>49 dBA</td>
<td>39 dBA</td>
</tr>
<tr>
<td>2. Little Beech Knob</td>
<td>Few rural homes</td>
<td>3,200 ft (0.6 mi)</td>
<td>51 dBA</td>
<td>41 dBA</td>
</tr>
<tr>
<td>3. Hunting Cabins</td>
<td>Group of seasonal hunting cabins</td>
<td>900 ft (0.2 mi)</td>
<td>51 dBA</td>
<td>52 dBA</td>
</tr>
<tr>
<td>4. Home South of B Turbine Line</td>
<td>Rural home</td>
<td>4,100 ft (0.8 mi)</td>
<td>52 dBA</td>
<td>35 dBA</td>
</tr>
<tr>
<td>5. Flynn’s Creek</td>
<td>Scattered rural homes, farms, &amp; church</td>
<td>7,800 ft (1.5 mi)</td>
<td>49 dBA</td>
<td>28 dBA</td>
</tr>
<tr>
<td>6. Leonard /Cordova</td>
<td>Road between 2 small settlements</td>
<td>6,000 ft (1.1 mi)</td>
<td>49 dBA</td>
<td>34 dBA</td>
</tr>
<tr>
<td>Trout</td>
<td>Community</td>
<td>15,000 ft (2.8 mi)</td>
<td>Not measured</td>
<td>30 dBA</td>
</tr>
<tr>
<td>Friars Hill</td>
<td>Community</td>
<td>22,000 ft (4.2 mi)</td>
<td>Not measured</td>
<td>25 dBA</td>
</tr>
<tr>
<td>Williamsburg</td>
<td>Community</td>
<td>21,000 ft (3.9 mi)</td>
<td>Not measured</td>
<td>17 dBA</td>
</tr>
</tbody>
</table>

1 Comparisons are provided for the actual sound monitoring locations, in some areas, residences are located closer to wind turbines. See discussion that follows.
2 Homeowners in this area to participate in project, otherwise distance to nearest turbine will be 1 mi. Project participation is considered when landowners have agreed to have turbines sited closer than 3,500 ft to their residence.

Acentech (2006) estimated Project operation sound levels on a time-weighted basis (Ldn)35 for outdoor locations. Estimated sound levels for indoors of residences were reduced by 12 dBA and 24 dBA with

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35 Ldn is a time-weighted energy average noise level based on the A-weighted decibel. It is a measure of the overall noise experienced during an entire day. The time-weighting refers to the fact that noise occurring during certain sensitive time periods is
windows open and closed, respectively (Acentech 2006). Based on the existing ambient noise estimates and the predicted Project noise, Acentech (2006) predicted that the wind farm may be heard at locations within 4,000 ft of the nearest turbine. Turbine noise may be audible to less than 40 residences, based on the number of residences indicated within 1 mi of the original 124-turbine Project layout (Acentech 2006 see Appendix C, Report C-1, Figure 19).

Acentech (2011) monitored ambient noise in the Town of Duo in 2010 when the existing 67 turbines were operating to estimate potential noise associated with the Phase II 33-turbine Project (described in Section 4.2.2.2). Ambient Ldn for the Town of Duo was measured at 48 dBA. This is comparable to the ambient noise level estimated for the Town of Duo prior to construction of the 67 turbines (Acentech 2006).

Phase I Decommissioning
The impacts of noise from Phase I decommissioning would occur episodically over a period of several years as infrastructure is removed in phases. Acentech did not model the noise effects of decommissioning. However, one can assume that noise levels would be comparable in magnitude to those generated during construction of the 67 turbines. Phase I construction included noise associated with rock blasting, excavating, hauling, grading, concrete mixing, tower erection, and vehicle traffic noise. Noise levels associated with ground excavating and grading by heavy machinery, and truck hauling and other vehicle traffic noise during decommissioning would be similar to that during construction. Noise associated with MET and turbine tower deconstruction would also be comparable to that during tower construction. A crane is used to carry out the reverse sequence of steps that occurred during construction. Noise associated with destruction of tower pads (concrete jack hammering) would be different than any noises associated with construction. Jackhammer noise would be more protracted in nature and possibly more intrusive than rock-blasting, which is explosive but brief and infrequent. A jackhammer emits 89 dBA at 50 ft (FHWA 2006a, 2006b).

Representative Leq values associated with the equipment used to perform rock blasting, excavating, hauling, grading, concrete mixing, tower erection, and vehicle traffic noise are provided in Table 5-3. One can assume that certain decommissioning activities would be audible at residences within 1 mi of the Project. For a typical construction workday, Acentech (2006) estimated sound levels to be 54 dBA at 1,550 ft (the nearest permanent residence) and 41 dBA at 4,000 ft. Figure 19 in Acentech (2006; Appendix C, Report C-1) illustrates estimated maximum Ldn sound levels during construction over the entire original 124-turbine Project area.

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penalized for occurring at these times. In the Ldn scale, noise occurring between the hours of 10 p.m. to 7 a.m. is penalized by 10 dB. This penalty was selected to attempt to account for the higher sensitivity to noise in the nighttime and the expected further decrease in background noise levels that typically occur in the nighttime.
Table 5-3. Estimates\(^1\) of equivalent sound levels (Leq)\(^2\) of representative construction equipment used to construct a typical wind energy facility.

<table>
<thead>
<tr>
<th>Equipment type</th>
<th>Sound levels at varying distances (dBA)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>900 ft(^3)</td>
</tr>
<tr>
<td>Rock blasting(\textsuperscript{b})</td>
<td>66</td>
</tr>
<tr>
<td>Pile driving(\textsuperscript{b})</td>
<td>65</td>
</tr>
<tr>
<td>Bulldozer</td>
<td>55</td>
</tr>
<tr>
<td>Excavator</td>
<td>56</td>
</tr>
<tr>
<td>Trenching</td>
<td>56</td>
</tr>
<tr>
<td>Grader</td>
<td>54</td>
</tr>
<tr>
<td>Steamroller</td>
<td>51</td>
</tr>
<tr>
<td>Heavy truck</td>
<td>50</td>
</tr>
<tr>
<td>Batch plant</td>
<td>47</td>
</tr>
<tr>
<td>Crane</td>
<td>56</td>
</tr>
</tbody>
</table>

\(\textsuperscript{1}\) Sound level estimates based on ESEERCO (1977) as cited by Acentech (2006).

\(\textsuperscript{2}\) Estimated Leq sound levels over a 10-hour daytime shift; 24-hr Ldn would be 4 dBA less than each Leq.

\(\textsuperscript{3}\) Distance to seasonal hunting cabins (temporary residences).

\(\textsuperscript{4}\) Distance to nearest property boundary and year-round community residence (closest residence at Little Beech Knob to turbine). Homeowners in this area participate in Project. Otherwise, approximate distance to nearest turbine would be 1 mi.

\(\textsuperscript{5}\) Estimated values for blasting and pile driving are maximum sound levels (Lmax) as opposed to Leq.

Certain decommissioning activities, such as a jackhammer, within 1,550 ft of any sensitive receptor would create moderately disturbing noise. A value of 60 dBA exceeds the threshold 5 dBA above the measured ambient noise levels in nearby communities of 49 dBA to 52 dBA (Table 5-2). Other decommissioning noise would be temporary in nature and produce sounds already familiar to communities within hearing distance.

No-Action Alternative Summary
Vehicle and turbine noise associated with Phase I operation is not estimated to exceed the threshold of 5 dBA above measured ambient noise (Acentech 2006). Phase I operation is expected to have minor noise impacts. Certain Phase I decommissioning activities are expected to exceed the threshold of 5 dBA above measured ambient noise. This effect is significant but it will be temporary and will be confined to daytime hours. Decommissioning activities would cause moderately annoying sounds in the daytime causing some disruption to the solitude of the rural landscape.

5.2.2.2 Alternative 2: Proposed Action

Under the Proposed Action, BRE will construct the 33 Phase II turbines. The 100-turbine Project will operate as described in the HCP. For the term of the ITP, BRE will adjust the cut-in speed for all 100 turbines from 3.5 m/s (7.7 mph) to 4.8 m/s (10.6 mph) for the time of night from 30 minutes before sunset for 5 hours during the 12-week period from July 15 through October 15 (i.e., the Curtailment Plan). All 100 turbines will be feathered up to the point in time that the cut-in speed is reached; thus, there will only be minimal rotation of turbine blades (<2 rpm) during periods when winds are below the cut-in speed.

The Proposed Action will generate noise during construction of the Phase-II 33 turbines, and during operation, maintenance and decommissioning of the 100-turbine facility and associated infrastructure.

Phase II Construction
Acentech (2011) documents the acoustical assessment of a 47-turbine phase-II layout (33 proposed turbine locations and 14 alternate locations), although only 33 turbines will be constructed (provided in Appendix 4.C). Thus the study presents a worst case scenario for noise. As described in Section 4.2.2.2, ambient noise was assessed from 4 monitoring locations focused on nearby residences.
Facility construction will consist of the following activities:

- Access road construction and improvements,
- Timber clearing,
- Site preparation and foundation installation at 33 turbine sites,
- Concrete manufacturing,
- Material and subassembly delivery,
- Erection of 33 turbines, and
- Electrical interconnect line trenching.

Construction noise associated with these activities will include:

- Rock blasting,
- Pile-driving,
- Concrete drilling,
- Heavy equipment operation, and
- Vehicle traffic noise.

Construction activities will occur largely within normal daytime hours (7 a.m. to 7 p.m.). Noise will be similar in character to that associated with the timber and mining activities that already occur in the Project area and surrounding commercial timber property.

The individual pieces of equipment likely to be used for each construction phase and typical noise levels are summarized in Table 5-3. During the day when construction activities will occur, a sound level of 35 dBA is generally considered a negligible sound level even in the case of reduced background noise (USEPA 1978).

BRE has estimated that Phase II construction activities will occur over a period less than 2 years. The sound estimates for Phase II assumed construction activity at all 47 potential turbine locations (Acentech 2011). Noise from construction activities will constitute a temporary unavoidable impact at some of the homes in the Project area. Acentech (2011) estimated that typical construction activity will be 53 dBA at 1,640 ft (distance to residence closest to Phase II layout) and 44 dBA at 3,330 ft. Such levels generally would not be considered acceptable on a permanent basis. As an atypical daytime occurrence, construction noise of this magnitude will not go unnoticed by many in the vicinity of the Project. Nearby communities currently experience sounds from timber harvesting, and noise associated with log trucks, felling equipment, and other logging machinery are commonplace.

Phase II turbine sites are located more than 1,500 ft from permanent residences. However, there may be some cases where road construction or trenching operations occur closer to homes; this could result in higher sound levels if this work occurs very close to residences. For example, a short-term sound level of 80 dBA is theoretically possible where the distance to nearby work is about 200 ft. In such cases, every effort will be made to give affected residents advanced notice as to when this kind of work will occur and its duration.

100-Turbine Operation

At roughly 1,000 ft, modern wind turbine noise is normally 35 dBA to 45 dBA (BWEA 2000), which is comparable to background sound inside a typical suburban home (EPA 1978). This level of noise is not sufficient to cause hearing damage. Wind turbine noise created by aerodynamic modulation (blade swish) may be perceived by some as more annoying than steady sound or ‘white noise’ (Morehouse et al. 2007).

Acentech (2011) predicted noise levels that will propagate from 47 wind turbines operating at maximum output. Table 5-4 shows the estimated Ldn operating sound levels for the 4 monitoring sites. The predicted turbine noise levels (Ldn) range between 34 dBA and 47 dBA, none greater than average measured ambient levels (47 dBA to 50 dBA) at the 4 monitoring sites (Table 5-4). At 21 residences at varying distances less than 1 mi, estimated Ldn sound levels ranged from 38 dBA to 50 dBA (Acentech
In reduced wind speeds, background sounds would be less and so would turbine sound emissions.

Table 5-4. Ambient noise survey results and estimated turbine noise from 4 locations identified in relationship to 33 proposed and 14 alternate turbines for Phase II.¹

<table>
<thead>
<tr>
<th>Location</th>
<th>Approximate distance to nearest turbine</th>
<th>Average measured ambient A-weighted Ldn</th>
<th>Estimated facility operation A-weighted Ldn</th>
<th>Average measured ambient C-weighted Ldn</th>
<th>Estimated facility operation C-weighted Ldn</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Town of Duo</td>
<td>10,500 ft (2.0 mi)</td>
<td>48 dBA</td>
<td>34 dBA</td>
<td>65 dBC</td>
<td>53 dBC</td>
</tr>
<tr>
<td>2. Beech Ridge Road</td>
<td>1,600 ft (0.3 mi)</td>
<td>50 dBA</td>
<td>47 dBA</td>
<td>73 dBC</td>
<td>62 dBC</td>
</tr>
<tr>
<td>3. NW of Project</td>
<td>5,800 ft (1.1 mi)</td>
<td>47 dBA</td>
<td>37 dBA</td>
<td>55 dBC</td>
<td>54 dBC</td>
</tr>
<tr>
<td>4. Town of Quinwood</td>
<td>5,000 ft (0.9 mi)</td>
<td>48 dBA</td>
<td>38 dBA</td>
<td>56 dBC</td>
<td>52 dBC</td>
</tr>
</tbody>
</table>

¹ Comparisons are provided for the actual sound monitoring locations. In some areas, residences are located either closer or farther than the approximate distance to wind turbine.

Source: Acentech (2011).

Acentech (2011) estimated Project operation sound levels on a time-weighted basis (Ldn) for outdoor locations. Estimated sound levels for indoors of residences were reduced by 12 dBA and 24 dBA with windows open and closed, respectively (Acentech 2011). Based on the existing ambient noise estimates and the predicted Project noise, Acentech (2006) predicted that the Phase II turbines may be heard at locations within 1,600 ft. Long-term Ldn sound levels of the turbines will be similar to or less than the existing ambient Ldn levels at 1,600 ft for both indoor and outdoor locations.

The Project will be inaudible at night during the curtailment period (July 15 through October 15) when winds are below 4.8 m/s (10.6 mph) for the time of night from 30 minutes before sunset for 5 hours. Curtailment will reduce the amount of overall noise generated by operations as compared to a project with no curtailment.

Low Frequency Noise. Concerns for wind turbine noise include exposure to low-frequency sounds and infrasound, which are defined as that below 200 Hz and below 20 Hz, respectively. Low-frequency noises and infrasound and their effects on humans are not well understood, and there are opposing views on the subject (NRC 2007), ranging from non-existent or imagined effects to serious medical conditions.

Acentech (2011) estimated the C-weighted Ldn sound levels for the Phase II turbines to address the issue of low frequency sound. As stated in Section 4.2.1.1, the C-weighted scale includes more of the low-frequency range of sounds than the A-weighted scale. This results in a measured C-weighted sound level being greater than its corresponding A-weighted sound level at a given 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 C-weighted Ldn sound levels for the Phase II turbines and the measured ambient C-weighted Ldn values are provided in Table 5-4 (Acentech 2011; see Appendix C, Report C-2, Figures 15 and 16 and Tables 6 and 7). The estimated C-weighted Ldn sound levels for the Phase II turbines range from 52 dBC to 62 dBC at the monitoring locations (Table 5-4). At 21 residences at varying distances less than 1 mi, estimated Ldn sound levels ranged from 54 dBC to 62 dBC (Acentech 2011). These turbine noise estimates compare to the similar range of measured ambient C-weighted Ldn values of 55 dBC to 73 dBC at the monitoring locations (Table 5-4).

Madsen and Pedersen (2010) studied 33 old and 14 new turbines and found an average increase of low frequency noise per installed power of around 1 dB for new turbines compared to older turbines. Low-frequency noise is relatively higher for turbines in the 2.3-MW to 3.6-MW range as compared to turbines that are less than 2.0 MW (Moller and Pedersen 2011), and these larger turbines may contribute more...
significantly to annoying environmental noise. The installed Phase I turbines and the proposed Phase II turbines are and will not be in this larger range of turbine size.

Schust (2004) reviewed experimental studies on the effects of low frequency sounds and indicated negative physiological effects occurring when humans were exposed to low frequency sounds above 80 dBA. Low frequency and infrasonic sound from modern turbines has been measured to be around 50 dBA to 70 dBA (Leventhal 2006). Low-frequency noise associated with the 100-turbine Project will have minor contributions to annoying environmental noise. There is not enough evidence to suggest that this minor contribution will result in impacts to human health.

The main source of complaint about wind turbine noise has been determined to be the sound of the down-turning blade as it passes the tower (Leventhal 2006), which is not low-frequency noise. Blade swish noise coming from the Project will have minor contributions to annoying environmental noise at locations within 1,600 ft.

Other Potential Operational Noise Sources. The proposed Project will not involve any other new noise sources. Once the 33 turbines are built and operational, the proposed Project will contribute a small amount of traffic to local roads (see Section 5.14 Transportation). Impacts from traffic noise are not anticipated to be significant.

100-Turbine Decommissioning
Noise created during decommissioning activities will be similar to that described for the No-Action Alternative and similar to the noise created during construction of Phases I and II. BRE predicts that decommissioning the 100-turbine Project will take up to 3 years to complete. Noise will occur in association with the following activities:

- Dismantling and removing turbines, transmission line, and substation;
- Removing pad-mounted transformers;
- Removing all turbine and substation foundations to a depth of 4 ft;
- Grading disturbed areas and access roads to as near as practicable to the original contour at the request of the landowner.

Phase I and Phase II construction included noise associated with rock blasting, excavating, hauling, grading, concrete mixing, tower erection, and vehicle traffic noise. Noise levels associated with ground excavating and grading by heavy machinery, and truck hauling and other vehicle traffic noise during decommissioning would be similar to that during construction. Noise associated with MET and turbine tower deconstruction would also be comparable to that during tower construction. A crane is used to carry out the reverse sequence of steps that occurred during construction. Noise associated with destruction of tower pads (concrete jack hammering) would be different than any noises associated with construction. Jackhammer noise would be more protracted in nature and possibly more intrusive than rock-blasting, which is explosive but brief and infrequent. A jackhammer emits 89 dBA at 50 ft (FHWA 2006a, 2006b).

Representative Leq values associated with the equipment used to perform rock-blasting, excavating, hauling, grading, concrete mixing, tower erection, and vehicle traffic noise are provided in Table 5-3. One can assume that certain decommissioning activities would be audible at residences within 1 mi of the Project. For a typical construction workday, Acentech (2006) estimated sound levels to be 54 dBA at 1,550 ft (the nearest permanent residence) and 41 dBA at 4,000 ft. Figure 19 in Acentech (2006, Appendix C, Report C-1) illustrates estimated maximum Ldn sound levels during construction over the entire original 124-turbine Project area.

Certain decommissioning activities, such as a jackhammer, within 1,550 ft of any sensitive receptor would cause moderately disturbing noise. A value of 60 dBA exceeds the threshold 5 dBA above the measured ambient noise levels in nearby communities of 49 dBA to 52 dBA (Table 5-2). Other decommissioning noise would be temporary in nature and produce sounds already familiar to communities within hearing distance.
Avoidance, Minimization, and Mitigation

BRE already has in effect a reasonable complaint resolution procedure to ensure that any complaints regarding construction or operational sound are adequately investigated and resolved.

Construction activities will implement the following measures to reduce noise impacts:

- Construction activities will take place mostly during daylights hours.
- Effective exhaust mufflers will be installed and properly maintained on all construction equipment; contractors will comply with federal limits on truck noise.
- The Project will implement pile driving equipment identified as having the least noise impact and restrict this activity to weekdays between 7 a.m. to 7 p.m.
- BRE and its contractors will adhere to a Project-wide speed limit of 25 mph or lower depending on the requirements of the specific equipment utilizing the roads.
- Night-time construction work will be minimized and confined to relatively quiet activities.
- Construction during normal church-attending hours will be limited.
- The affected community will be notified in advance of any blasting activity, and blasting will be limited to daylight hours and will follow all state and federal regulations.

The Project layout was designed to minimize operational noise impacts. In their original 124-turbine layout, BRE eliminated those turbines identified as the most likely to create noise problems. Eliminating those turbines diminished the potential negative impact of noise from the Project as it removed most turbines within 1 mi of identified sensitive receptors.

Proposed Action Summary

Based on the results of the studies conducted for the Project (Acentech 2006, 2011) and what is currently understood about the effects of wind turbine noise on humans, sounds generated from Proposed Action operations are not expected to exceed the 5-dB threshold for significance. Noise impacts associated with certain construction and decommissioning activities will exceed the 5-dB threshold for significance. These activities are expected to be short-term and confined to daytime hours. Noise impacts to the surrounding communities would be moderate during rock-blasting and jack hammering activities. The Proposed Action Alternative would be noisier than the No-Action Alternative because of Phase II construction. The addition of 33 turbines will not make Project operations louder, but will increase the spatial area affected by turbine noise.

5.2.2.3 Alternative 3: ITP and HCP with Additional Covered Species

Under Alternative 3, BRE will construct the 33 Phase II turbines. Under this alternative, BRE’s Curtailment Plan and RMAMP would be modified to implement a 6.5 m/s cut-in speed as opposed to 4.8 m/s as the initial rate for curtailment. All 100 turbines would operate at 6.5 m/s from 30 minutes before sunset through 15 minutes after sunrise during the period from April 1 through October 15.

Phase II Construction, 100-Turbine Operation, and Decommissioning

Under Alternative 3, noise impacts associated with construction of 33 turbines and decommissioning of 100 turbines and associated infrastructure would be as described for the Proposed Action. Operations would include a longer curtailment season (April 1 through October 15), longer night-time restriction (30 minutes before sunset through 15 minutes after sunrise), and higher cut-in speed (6.5 m/s). This would result in a Project that would create less overall turbine noise at night as compared to the Proposed Action or a project with no curtailment.

Alternative 3 Summary

Based on the results of the studies conducted for the Project (Acentech 2006, 2011) and what is currently understood about the effects of wind turbine noise on humans, sounds generated from Alternative 3 operations are not expected to exceed the 5 dB threshold for significance. Noise impacts associated with certain construction and decommissioning activities will exceed the 5 dB threshold for significance. These
activities are expected to be short-term and confined to daytime hours. Noise impacts to the surrounding communities would be moderate during rock-blasting and jack hammering activities. Alternative 3 would be noisier than the No-Action Alternative because of Phase II construction and the extended period to remove 100 turbines as opposed to 67. The addition of 33 turbines will not make Project operations louder, but will increase the spatial area affected by turbine noise.

5.2.2.4 Alternative 4: ITP and HCP for Phase I Only

Under Alternative 4, an ITP pursuant to Section 10 (a)(1)(B) of the ESA would be issued for only the existing 67-turbine Project. Under this alternative, the Phase II 33-turbines would not be constructed. The Phase I Only Alternative would include the full implementation of the HCP as described for the Proposed Action. These actions would occur for the Project as it is currently constructed.

For the term of the ITP, BRE would adjust the cut-in speed for all 67 turbines from 3.5 m/s (7.7 mph) to 4.8 m/s (10.6 mph) for the time of night from 30 minutes before sunset for 5 hours during the 12-week period from July 15 through October 15 (BRE’s Curtailment Plan).

Phase I Construction and Decommissioning

Under Alternative 4, there would be no noise associated with construction as no new turbines would be built. Under Alternative 4, the 67 turbines, transmission line, and substation would be removed when the Project has reached the end of its functional life. Noise associated with decommissioning would be the same as described for the No-Action Alternative. Avoidance and minimization measures also would be as described for the No-Action Alternative.

Phase I Operation

Under Alternative 4, BRE would adjust the cut-in speed for all 67 turbines from 3.5 m/s (7.7 mph) to 4.8 m/s (10.6 mph) for the time of night from 30 minutes before sunset for 5 hours during the 12-week period from mid-July to mid-October (BRE’s Curtailment Plan). Operational noise associated with Alternative 4 would be greater than that associated with the No-Action Alternative because turbines would begin to operate at night from April 1 through November 15. Turbines would not generate noise only during the curtailment season (July 15 through October 15), during the restricted hours (for 5 hours from 30 minutes before sunset), and on those nights when wind speeds are less than 4.8 m/s (10.6 mph).

Under Alternative 4, operational noise would be the same as that described for the Proposed Action but would have a smaller area affected by turbine noise due to the fewer number of turbines. Conversely, Alternative 4 would create less overall noise as compared to a 100-turbine Project with no curtailment due to Alternative 4 having fewer turbines and a season with operational restrictions.

Alternative 4 Summary

Vehicle and turbine noise associated with Phase I operation is not estimated to exceed the threshold of 5 dBA above measured ambient noise (Acentech 2006). Phase I operation is expected to have minor noise impacts for longer periods of time than the No-Action Alternative because turbines would operate at night year-round albeit with restriction from July 15 to October 15. Certain Phase I decommissioning activities are expected to exceed the threshold of 5 dBA above measured ambient noise. This effect would be moderate but temporary and confined to daytime hours. Decommissioning activities would cause moderately annoying sounds in the daytime causing some disruption to the solitude of the rural landscape.

5.3 Air Quality and Climate

5.3.1 Impact Criteria

In February 2010, the CEQ provided for public comment a draft guidance memorandum on the ways in which Federal agencies can improve their consideration of the effects of greenhouse gas emissions and climate change impacts throughout the NEPA process and address these issues in their agency NEPA procedures.
If a Proposed Action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of carbon dioxide-equivalent greenhouse gas emissions on an annual basis, agencies should recognize this as an indication to conduct quantitative and qualitative assessments on those emissions. For long-term actions that have annual direct emissions less than 25,000 metric tons of carbon dioxide-equivalent, the CEQ encourages Federal agencies to consider whether the Proposed Action’s emissions in the long-term should be assessed. During the NEPA process, the CEQ also encourages agencies to determine which climate change impacts warrant consideration in relationship to a Proposed Action. Climate change impacts that warrant consideration in this DEIS are addressed under those Resource Sections that are relevant.

In accordance with Section 111 of the CAA of 1970, the USEPA established New Source Performance Standards (NSPS) to regulate emissions of air pollutants from new stationary sources. The WV Code of State Rules contains NSPS regulations beyond those promulgated at the federal level. These standards apply to a variety of facilities, including landfills, boilers, cement plants, and electric generating units fired by fossil fuels. All new sources of air emissions in West Virginia are required to obtain a permit from WVDEP’s Division of Air Quality.

Administered by the EPA, the Acid Rain Program was established by the CAA Amendments of 1990 to reduce emission of sulfur dioxide (SO$_2$) and nitrogen oxides (NO$_x$) through regulatory and market based approaches. No phases of the Project will emit SO$_2$ or NO$_x$.

Prevention of Significant Deterioration applies to new major sources of pollutants or major modifications at existing sources for pollutants where the area the source is located is in attainment or unclassifiable with the NAAQS. No phase of the Project will emit new major sources of pollutants. The Project is not and will not be associated with an existing source of air pollutants.

5.3.2 Direct and Indirect Effects Presented by Alternative

5.3.2.1 Alternative 1: No-Action

Under the No-Action Alternative, the proposed 33 turbines and HCP would not occur. Additionally, an ITP pursuant to Section 10 (a)(1)(B) of the ESA would not be issued for the BRE Project.

There would be no new construction or air emissions associated with construction.

Phase I Operation and Maintenance

Turbines will continue to operate year-round during daytime hours and will only operate at night during the winter months. The turbines themselves would not generate atmospheric emissions. Phase I maintenance requires a small amount of vehicular traffic resulting in the emission of carbon dioxide emissions and particulates, and fugitive dust from unpaved access roads. These emissions are not estimated to be significant contributions.

Phase I Decommissioning

The 67 turbines, transmission line, Project interconnect, and substation will be removed when the Project has reached the end of its functional life. During decommissioning, the operation of construction equipment and vehicles would affect air quality temporarily. Engine exhaust, fugitive dust generation during earth-moving, and travel on unpaved roads would create air emissions. Dust causes annoyance and deposits on surfaces at certain locations or residences. These impacts would be short-term and localized.

Phase I Avoidance and Minimization

During operation, maintenance, and decommissioning of Phase I, BRE would implement best management practices to minimize the amount of dust and exhaust generated by vehicle travel and equipment operation. All vehicles used for operation, maintenance, and decommissioning would be
maintained in good working condition to minimize emissions from Project-related activities. Roads would be watered to suppress dust on unpaved roads (public roads, as well as private access roads).

No-Action Alternative Summary
Air emissions permits are not required for the No-Action Alternative. Implementation of the No-Action Alternative would not have any new effects on the existing air quality in the Project area, with exception of a small amount of emissions and dust generated from Project vehicles. Phase I Project operation has the potential to produce approximately 638,728 MWh of electricity annually (assuming a 100.5-MW nameplate capacity and operating 72.6% of the time) with zero emissions. Power delivered to the grid from the Project would not add to the emissions produced at existing conventional power plants. Therefore, the No-Action Alternative is expected to have no effect on air quality.

5.3.2.2 Alternative 2: Proposed Action
Under the Proposed Action, BRE will construct the proposed 33 turbines and associated infrastructure and operate the 100-turbine Project according to the Project HCP. The Service will issue an ITP pursuant to Section 10 (a)(1)(B) of the ESA for the Project, and avoidance, minimization, and conservation efforts will be implemented as described in the HCP and specified in the ITP.

Phase II Construction
During the site preparation and construction phases, temporary impacts to air quality likely will result from the operation of construction equipment and vehicles. Impacts will occur as a result of emissions from engine exhaust, fugitive dust generation during earth-moving and vegetation removal, and travel on unpaved roads. Dust could cause annoyance and deposit on surfaces at certain locations or residences. These impacts are expected to be short-term and localized.

BRE will be required to obtain a permit from the WVDEP’s Division of Air Quality to operate a concrete batch plant for constructing the 33 turbine foundations. Particulate matter and aggregate and sand dust emissions are the primary pollutants of concern during the manufacture of concrete. For the most part, emissions will be fugitive in nature. The only point source emission will be from the transfer of cement and pozzolan material (added to concrete to increase certain material properties and reduce material costs) to silos, and these will be vented through a fabric filter. Fugitive dust will be generated during the transport of sand and aggregate, truck and mixer loading, vehicle traffic at the plant and on unpaved roads, and wind erosion from sand and aggregate storage piles.

Project construction is not anticipated to emit 25,000 metric tons or more of carbon dioxide-equivalent of greenhouse gases. The concrete batch plant will be a temporary source of air pollutants.

100-Turbine Project Operation
The operation of the 100-turbine Project will not generate major air emissions. Project maintenance will require a small amount of vehicular traffic resulting in the emission of carbon dioxide emissions and particulates. These emissions are not estimated to have a significant effect on local or regional air quality or contribute greatly to the amount of greenhouse gases. Project operation will not generate any new sources of air pollutants.

Project operation is expected to produce up to 1,542,006 MWh of electricity annually (assuming a 186-MW nameplate capacity and operating 94.5% of the time) with zero emissions. Power delivered to the grid from the Project will not add to the emissions produced at existing conventional power plants.

The Project will not cause direct emissions of 25,000 metric tons or more of carbon dioxide-equivalent greenhouse gas emissions on an annual basis. The Project is not expected to result in greenhouse gas emissions that will contribute to problems associated with climate change.

Available information on how wind projects affect local weather is limited. Several investigations have indicated that wind turbines effectively mix atmospheric layers and may affect changes in local
temperatures (Roy and Pacala 2004, Roy and Traiteur 2010, Zhou et al. 2012). Wind turbine blades stir up a layer of cooler air that usually settles on the ground at night, and mixes in warmer air on top. This layering effect is usually reversed during the daytime, with warm air on the surface and cooler air higher up. These changes, if spatially large enough, may have noticeable effects on local to regional weather and climate. For the period from 2003-2011, Zhou et al. (2012) showed a warming trend of up to 1.3° F (0.72° C) per decade, particularly at night-time, over wind farms relative to non-wind-farm regions.

100-Turbine Decommissioning
The 100 turbines, transmission line, Project interconnect, and substation will be removed when the Project has reached the end of its functional life. During decommissioning, the operation of construction equipment and vehicles will affect air quality temporarily. Engine exhaust, fugitive dust generation during earth-moving, and travel on unpaved roads will create minor air emissions. Dust causes annoyance and deposits on surfaces at certain locations or residences. These impacts will be short-term and localized.

Avoidance and Minimization
Best management practices will be implemented to minimize the amount of dust generated by construction activities. All construction vehicles will be maintained in good working condition to minimize emissions from construction-related activities. In addition, the extent of exposed/disturbed areas on the site at any one time will be minimized and restored/stabilized as soon as possible. Roads will be watered as needed throughout the duration of construction activities to suppress dust on unpaved roads (public roads as well as private access roads). Any unanticipated construction related dust problems will be identified and immediately reported to the construction manager and contractor.

Proposed Action Summary
An air emissions permit is required for the Proposed Action during construction. Operation of the 100-turbine Project would not have any new effects on the existing air quality in the Project area, with exception of a small amount of emissions and dust generated from Project vehicles. The Proposed Action will have minor effects on air quality associated with fugitive dust during construction and for the lifetime of the Project through decommissioning. The Proposed Action will add relatively minor amounts of greenhouse gases associated with vehicle and equipment emissions.

5.3.2.3 Alternative 3: ITP and HCP with Additional Covered Species
Under the Additional Covered Species Alternative, BRE would construct the proposed 33 turbines and associated infrastructure, operate the 100-turbine Project, and implement the HCP with modified avoidance and minimization measures to reduce bat mortality. The Service would issue an ITP pursuant to Section 10 (a)(1)(B) of the ESA for the Project to take the 2 listed bats and 3 additional bat species should they be listed during the permit term. The Project HCP would be modified to include avoidance, minimization, and conservation measures for 3 species, in addition to those measures for the 2 listed bats specified in the Project HCP. The Curtailment Plan would implement a 6.5 m/s cut-in speed initially, and results of the RMAMP would be used accordingly to adjust Project operations in subsequent years.

Phase II Construction
Under Alternative 3, construction impacts to air quality and climate would be as described for the Proposed Action. These impacts would be short-term and localized. BRE would be required to obtain a permit from the WVDEP’s Division of Air Quality to operate a concrete batch plant for constructing the 33 turbine foundations. The concrete batch plant would be a temporary source of air pollutants.

100 Turbine Operations
Under Alternative 3, operational impacts to air quality and climate would be as described for the Proposed Action. The operation of the 100-turbine Project would not generate major air emissions. Low levels of emissions and fugitive road dust associated with a small amount of vehicular traffic are not estimated to have a significant effect on local or regional air quality or contribute greatly to the amount of greenhouse gases. The Project is not expected to result in greenhouse gas emissions that will contribute to problems associated with climate change.
100-Turbine Decommissioning
The 100 turbines, transmission line, Project interconnect, and substation would be removed when the Project has reached the end of its functional life. During decommissioning, the operation of construction equipment and vehicles would affect air quality temporarily. Engine exhaust, fugitive dust generation during earth-moving, and travel on unpaved roads would create minor air emissions. Dust causes annoyance and deposits on surfaces at certain locations or residences. These impacts would be short-term and localized.

Avoidance and Minimization
BRE would avoid and minimize impacts to air quality and climate using measures as described for the Proposed Action.

Alternative 3 Summary
An air emissions permit is required for Alternative 3 during construction. Operation of the 100-turbine Project would not have any new effects on the existing air quality in the Project area, with exception of a small amount of emissions and dust generated from Project vehicles. Phase I Project operation would produce up to 1,184,030 MWh of electricity annually (assuming a 186-MW nameplate capacity and operating 72.6% of the time) with zero emissions. Power delivered to the grid from the Project would not add to the emissions produced at existing conventional power plants. The Alternative 3 will have minor effects on air quality.

5.3.2.4 Alternative 4: ITP and HCP for Phase I Only
Under the Phase I Only Alternative, the proposed 33 turbines would not be built. An ITP pursuant to Section 10 (a)(1)(B) of the ESA would be issued only for BRE’s Phase I Project, and the HCP would address measures for the operation of only 67 turbines. Off-site conservation measures would be reduced to address the unavoidable take of Indiana bats and Virginia big-eared bats. Take estimates for these 2 listed bats would be less than that estimated for the 100-turbine Project. There would be no new construction or air emissions associated with construction under Alternative 4.

Phase I Operation and Maintenance
The operation of the 67-turbine Project would not generate major air emissions. Project maintenance would require a small amount of vehicular traffic resulting in the emission of carbon dioxide emissions and particulates. These emissions are not estimated to have a significant effect on local or regional air quality or contribute greatly to the amount of greenhouse gases. Project operation would not generate any new sources of air pollutants.

Phase I Decommissioning
The 67 turbines, transmission line, Project interconnect, and substation would be removed when the Project has reached the end of its functional life. During decommissioning, the operation of construction equipment and vehicles would affect air quality temporarily. Engine exhaust, fugitive dust generation during earth-moving, and travel on unpaved roads would create air emissions. Dust causes annoyance and deposits on surfaces at certain locations or residences. These impacts would be short-term and localized.

Avoidance and Minimization
During operation, maintenance, and decommissioning of Phase I, BRE would implement BMPs to minimize the amount of dust and exhaust generated by vehicle travel and equipment operation. All vehicles used for operation, maintenance, and decommissioning would be maintained in good working condition to minimize emissions from Project-related activities. Roads would be watered to suppress dust on unpaved roads (public roads as well as private access roads).

Alternative 4 Summary
Air emissions permits are not required for the Phase I Only Alternative. Implementation of Alternative 4 would not have any new effects on the existing air quality in the Project area, with exception of a small amount of emissions and dust generated from Project vehicles. Phase I Project operation has the potential to produce approximately 831,839 MWh of electricity annually (assuming a 100.5-MW nameplate capacity and operating 94.5% of the time) with zero emissions. Power delivered to the grid from the Project would not add to the emissions produced at existing conventional power plants. We therefore conclude that Alternative 4 will have minor effects on air quality.

5.4 Water Resources

This section of the DEIS contains a discussion on the Project’s potential effects on water resources and the measures to protect water resources.

Effects to water resources are regulated at the federal level by the Federal WPCA (CWA) of 1972, Executive Order 11988: Floodplain Management (1977), Wild and Scenic Rivers Acts of 1968, and Safe Drinking Water Act of 1974. Dangers associated with development in floodplains are also addressed under Executive Order 11988 and the West Virginia State Building Code, which limit development in these areas.

Permits required to install and operate water pollution control equipment and treatment processes include the following:

- West Virginia National NPDES construction storm water general permit;
- An individual or nationwide permit under Sections 404 and 401 of the CWA; and
- Permit to install onsite sewage treatment for the O&M facility under West Virginia’s Department of Human Health and Resources regulations (64 CSR 9).

5.4.1 Impact Criteria

The alternatives will have the potential to affect water resources. The Service considers impacts to water resources to be significant should any of the following result:

- Lost functions and values at a unique hydrological feature;
- Significant alteration of the quantity or quality of a water supply for existing users;
- Compromised safety and security of any water supply;
- Natural functions of a floodplain or wetland that provides flood storage are affected, thus creating a potentially unsafe condition; or
- Water withdrawals that would result in substantially degraded aquatic resources.

Otherwise minor impacts on water resources could result in significant effects to other resources. For example, specialized flora or fauna that are highly dependent on certain hydrologic conditions may become vulnerable should these conditions become altered. In this case, impacts on water resources could be considered significant.

5.4.2 Direct and Indirect Effects Presented by Alternative

5.4.2.1 Alternative 1: No-Action

Under the No-Action Alternative, the proposed 33-turbines would not be constructed and the HCP would not be implemented. Additionally, an ITP pursuant to Section 10 (a)(1)(B) of the ESA would not be issued for the BRE Project, and the 67 turbines would operate as directed under the Settlement Agreement. There would be no new construction under the No-Action Alternative.

Phase I Operation

Under the No-Action Alternative, BRE would continue to implement erosion control BMPs to protect water quality in association with the Phase I Project; however BRE would be under no obligation to implement
SWPPP permit conditions. BRE has been released from its SWPPP permit that required 1) weekly inspections and inspections after each precipitation event of 0.5 inches or greater rainfall, and 2) prompt reporting and repair of any problems with silt fences or other erosion control measures.

Groundwater. Groundwater use would be confined to activities at the O&M where 15 to 20 employees, at most, would use the facilities during the day. Water is supplied locally through the use of wells, and the building generates sewage and wastewater comparable to that of a small business office. These wastes are managed through the on-site septic system. Thus, groundwater use in association with the No-Action Alternative is not expected to deplete any local groundwater water supply. The No-Action Alternative operations would have minor effects to groundwater resources.

Surface Water. Operation of the Phase I Project would have minor impacts to streams in association with stormwater runoff on unpaved roads, causing some sedimentation. These effects would be localized should they occur. Project operations would not involve the discharge of water or waste into streams, ponds, or wetlands.

Minor oil spills from leaking transformers or gear boxes are possible. Should these spills enter surface waters, they may cause localized impacts on water quality and, in turn, have the potential to impact vegetation and wildlife. These impacts would be unlikely due to the small volume of oil that would actually spill. Any potential oil spills are addressed in BRE’s SPCC Plan.

No water would be used during operations for dust suppression on roads. Considering the potential for minor sedimentation and spills, the No-Action Alternative operations would have minor effects to surface water resources.

Phase I Decommissioning
Under the No-Action Alternative, the 67 turbines, transmission line, and substation would be removed when the Project has reached the end of its functional life. As for construction, a GPP and SWPPPs would be implemented and kept on site during all decommissioning activities. Fuel and lubricants would be stored onsite during decommissioning. No other potential pollutants would be stored on the Project area. The GPP details procedures that would be used to protect groundwater resources such as using double-walled tanks or providing secondary containment. There may be minor, localized impacts to surface waters during decommissioning associated with sedimentation and erosion. Properly implemented sediment and erosion control measures would avoid and minimize surface water impacts.

BRE would implement BMPs outlined in a new SWPPP to protect water quality in association with the Phase I Project decommissioning. Decommissioning would involve water withdrawals from local streams and ponds for dust suppression on gravel roads during dry conditions. Dust suppression would require estimated water withdrawal of approximately 150,000 gallons per year over a 1 to 2 year period (Table 5-5). Small increments of this total amount (no more than 2,500 gallons/day or 30,000 gallons/month) would be withdrawn on those days when maintenance crews are driving during unusually dusty conditions (approximately 3 days per week for 20 weeks).
Table 5-5. Estimated water use per year associated with the four alternatives. During project operations, no water will be used for dust control.

<table>
<thead>
<tr>
<th>Construction:</th>
<th>Yards of concrete per element</th>
<th>Gallons per yard of concrete</th>
<th>Gallons per element</th>
<th>No. of elements</th>
<th>Total gallons per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well water for turbine pads (Alts. 2 and 3)</td>
<td>299</td>
<td>29</td>
<td>8,671</td>
<td>33</td>
<td>286,143</td>
</tr>
<tr>
<td>Stream and pond water for road dust suppression (Alts. 2 and 3)</td>
<td>15,000 gal/day, 20 days/month for 6 to 9 months</td>
<td>1,800,000-2,700,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decommissioning:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stream and pond water for dust suppression on roads during removal of Phase I and II components (Alts. 2 and 3)</td>
<td>2,500 gallons per day, 3 days/week, for 30 weeks per year for 2 to 3 years</td>
<td>225,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stream and pond water for dust suppression on roads during removal of Phase I components only (Alts. 1 and 4)</td>
<td>2,500 gallons per day, 3 days per week, for 20 weeks, for 1 to 2 years</td>
<td>150,000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: e-mail from K. Coppinger, Invenergy, May 17, 2012.

Impacts to surface water resources due to water withdrawals would vary based on the source. Volumes of water in headwater streams higher in the watershed are significantly less than perennial streams lower in the watershed, especially during dry periods when dust suppression is likely to be required. To minimize impacts to intermittent and ephemeral headwater streams, BRE would take water only from local perennial streams and ponds. Water withdrawals would have fewer effects to surface water resources if water was taken primarily from man-made ponds.

Although the WVDEP does not regulate water withdrawals of less than 750,000 gallons/day, it has developed water withdrawal guidance and a tool to help individuals know when it is environmentally safe to withdraw water from a stream (WVDEP 2012). The guidance is based on percentages of mean annual flow, based on a 10-year period that affords an appropriate flow to protect aquatic habitat.

Because the tool has not yet been validated as adequately protective of aquatic species under all weather and precipitation conditions, water users should use common sense when making water withdrawals so as not to dewater streams. The tool should be checked daily before withdrawing significant quantities of water from any watershed. Users should exercise caution particularly during drought or extended dry conditions or in cases where multiple users may be withdrawing water from the same source. If a trout stream is low and withdrawing additional water could expose portions of the stream bottom or banks that are normally submerged, including riffle areas downstream from pools from which water is typically withdrawn, users should find a different location or water source. Water users should not block, dam, or divert flows, or excavate pools in streams or their direct tributaries.

BRE has agreed to use this tool and to use common sense as described above when making water withdrawals (K. Coppinger, Invenergy, personal communication, May 23, 2012).

No-Action Alternative Summary
The No-Action Alternative has the potential to affect water resources. Water withdrawals from multiple perennial streams and ponds in small daily increments during summer months for 1 to 2 years would have a low likelihood of resulting in major alteration of the quantity or quality of water and habitat conditions, provided that readily available tools and common sense are used so as not to exceed stream...
flow volumes. Should water withdrawals modify hydrologic conditions in local streams, impacts on local water resources would be considered major.

Implementation of the No-Action Alternative is not expected to compromise the quantity, safety, and security of any water supply, nor affect flood storage capability of any floodplain or wetland. Implementation of the No-Action Alternative includes BRE’s compliance with the Project’s GPP and SWPPPs for protecting water resources in the Project area.

5.4.2.2 Alternative 2: Proposed Action

Regulatory Compliance Background

For Phase II siting and construction, BRE intends to avoid impacts to jurisdictional waters to the fullest extent practicable. Once the layout for the 33 turbines has been finalized, results of the field surveys and a summary of impacts will be submitted to the USACE, and the required authorizations and permits, if any, will be obtained.

Phase II Construction

Groundwater. Approximately 290,000 gallons of groundwater will be withdrawn from an existing well to prepare the concrete foundations for the 33 turbines (Table 5-5). Groundwater withdrawal can have impacts on nearby surface water sources. Water withdrawal impacts on groundwater resources are most often related to the rate of withdrawal (gallons per minute) and the rate of groundwater recharge. Water withdrawal for the batch plant could have effects on groundwater, and in turn nearby surface waters, if withdrawal rates exceed recharge rates. These effects are uncertain because withdrawal and recharge rates have not been measured or predicted.

There will be no impacts to groundwater from sewage disposal during the construction phase. Portable toilets would be used on site.

Surface Water Quality. Construction of the Phase II Project may contribute pollutants and sediments to streams in association with accidental spills and stormwater runoff on unpaved roads. These effects will be localized should they occur. Construction activities will be performed using standard construction BMPs so as to minimize the potential for accidental spills of solid material, contaminants, debris, and other pollutants. Excavated material or other construction materials will not be stockpiled or deposited within 100 ft of streams.

In addition, BRE will prepare and implement SWPPP(s) for the 33-turbine phase, as required by the WVDEP. The SWPPPs will ensure that erosion is minimized during storm events. In order to minimize damage to the land surface and property, they will limit the movement of crews and equipment to the Project site, including access routes, to that which is necessary for safe and efficient construction. When weather and ground conditions permit, deep ruts caused by construction will be levelled, filled and graded, or otherwise eliminated. Ruts, scars, and compacted soils will be loosened and levelled using a ripper or disc or other landowner-approved method. Damage to ditches, roads, and other features of the land will be repaired. Water bars or small terraces will be constructed along access road ditches on hillsides to minimize water erosion and to facilitate natural revegetation.

The SWPPPs also will include standard sediment control devices (e.g., silt fences, straw bales, netting, soil stabilizers, check dams) to minimize soil erosion during and after construction. Areas disturbed during construction will be stabilized and reclaimed using appropriate erosion control measures, including site-specific contouring, reseeding, or other measures agreed to by the landowner and designed and implemented in compliance with the Project’s approved SWPPPs.

Roads, portions of roads, crane paths, and staging areas not required for operation and maintenance will be restored to the original contour and made impassable to vehicular traffic. Areas to be reclaimed will be
contoured, graded, and seeded as needed to promote successful revegetation, provide for proper drainage, and prevent erosion.

**Surface Water Quantity.** Road dust suppression during Phase II construction will affect water levels in local streams and ponds. Effects will vary by the water source. To minimize impacts to intermittent and ephemeral headwater streams, water utilized for dust suppression will be taken from local perennial creeks and man-made ponds within the Project area. Approximately 15,000 gallons of water would be used each day that roads would need watering during the 6 to 9 months required for construction of Phase II. Depending on the source, water withdrawal could have adverse effects on aquatic communities and hydrologic conditions necessary to maintain flows in a stream. Withdrawal of 15,000 gallons for 20 days in 1 month is 300,000 gallons. In the dry season, when dust suppression is likely to be required, this could have a moderate impact on that particular stream source. Water withdrawals would have fewer effects to surface water resources if water was taken primarily from man-made ponds.

Pursuant to West Virginia Code §22-26, BRE is not required to register with the WVDEP and provide all requested survey information regarding withdrawals of state waters. Only large quantity users are required to register, which means “any person who withdraws over [750,000] gallons of water in a calendar month from the state’s waters.” However, the WVDEP tool and guidance on water withdrawal is based on percentages of mean annual flow over a 10-year period. This is to ensure that water sources maintain an appropriate flow to protect the aquatic habitat.

BRE has agreed to use this tool to help judge when it is safe to withdraw water from local streams and to apply common sense so as not to dewater streams. (See the more detailed description of these measures under the No-Action Alternative). These measures reduce the likelihood that substantial degradation of aquatic resources would occur.

**100-Turbine Project Operations**

*Groundwater.* A typical spread footer foundation for a 1.5-MW turbine is approximately 16 ft to 18 ft in diameter at the surface but may spread out below grade to as much as 49 ft in diameter and 12 ft deep. Similar to the Phase I Project, Phase II turbine foundations are not expected to affect the flow of groundwater, provided that foundation depths do not reach the water table in the Project area. Effects are uncertain because no information is available on the depth of the water table.

*Surface Water.* Project operations may have minor impacts to streams in association with stormwater runoff on unpaved roads causing some sedimentation. These effects would be localized should they occur. Project operations will not involve the discharge of water or waste into streams, ponds, or wetlands. The O&M building generates sewage and wastewater comparable to that of a small business office; these wastes are managed through the on-site septic system. O&M activities would not require water withdrawals for dust suppression.

Minor oil spills from leaking transformers or gear boxes are possible. Should these spills enter surface waters they may cause localized impacts on water quality and, in turn, have the potential to impact vegetation and wildlife. These impacts will be unlikely due to the small volume of oil that would actually spill. Any potential oil spills are addressed in BRE’s SPCCP.

**100-Turbine Project Decommissioning**

Project decommissioning will have similar effects on water resources as those described for Phase II construction but will extend to include the Phase I area as well. Potential effects on water resources include runoff and sedimentation from ground disturbance. These effects will be temporary and localized. Sediment and erosion control measures will be implemented during decommissioning to prevent runoff into water resources. Properly implemented sediment and erosion control measures would avoid and minimize surface water impacts. BRE does not anticipate implementing temporary stream crossings to remove the transmission line as they were not needed to construct the transmission line.
Water withdrawals will be necessary for dust abatement if road surfaces become dry during decommissioning. Water withdrawals would have minor effects to water resources if water is taken from streams with adequate flows, such as large perennial streams lower on the slopes of the ridge.

To remove the full build-out of the Project (100 turbines and associated infrastructure), BRE estimates that dust suppression will require 220,000 gallons of water per year for 2 to 3 years. Water will be withdrawn in small increments (no more than 2,500 gallons per day, 3 days per week for 30 weeks, or no more than 37,500 gallons per month) during dry months (Table 5-5).

Impacts to surface water resources due to water withdrawals will vary based on the source. Water withdrawals will have the greatest impacts to habitat conditions in streams higher in the watershed at higher elevations especially during dry periods when dust suppression is likely to be required. Volumes of water in headwater streams are significantly less than streams lower in the watershed. Water withdrawals will have fewer effects to surface water resources if water was taken from some of the man-made ponds. To reduce impacts to intermittent headwater streams, BRE has committed to taking water only from perennial water sources and ponds. In addition, BRE will use the WVDEP water withdrawal tool and common sense to reduce the likelihood that perennial streams are not dewatered.

As for construction, BRE’s GPP and SWPPPs would be implemented and kept on-site during all decommissioning activities. Fuel and lubricants would be stored on-site during decommissioning No other potential pollutants would be stored on the Project area. BRE will implement BMPs outlined in the existing SWPPP to protect water quality in association with the Phase I Project decommissioning. Conditions contained in the permits require 1) weekly inspections and inspections after 0.5 inch or greater rainfall, and 2) prompt reporting and repair of any problems with silt fences or other erosion control measures.

**Proposed Action Summary**

The Proposed Action has the potential to affect water resources. Minor, localized impacts to streams may occur in association with stormwater runoff on unpaved roads causing some sedimentation. Implementation of the Proposed Action includes BRE’s compliance with the Project’s GPP and SWPPPs for protecting water resources in the Project area. Implementation of the Proposed Action will not compromise the quantity, safety, and security of any water supply. Implementation of the Proposed Action also is not expected to affect flood storage capability of any floodplain or wetland.

Depleting wells or withdrawing too much water from perennial streams could result in alteration of the quantity or quality of water and habitat conditions if withdrawals exceed stream flow volumes. Withdrawing water from multiple perennial streams and ponds in small daily increments would have a low likelihood of resulting in major alteration of the quantity or quality of water and habitat conditions, provided that readily available tools and common sense are used so as not to exceed stream flow and well volumes. Should water withdrawals modify hydrologic conditions in local streams, impacts on local water resources would be considered major.

**5.4.2.3 Alternative 3: ITP and HCP with Additional Covered Species**

Under Alternative 3, effects to water resources associated with construction, operation, and decommissioning would be as described for the Proposed Action. Groundwater (286,143 gallons) would be drawn to make concrete for the turbine foundations. Surface water withdrawals would occur for dust suppression during construction, operation, and decommissioning (see Table 5-5). Minor, localized impacts to streams may occur in association with stormwater runoff on unpaved roads causing some sedimentation. Avoidance and minimization measures will be as described for the Proposed Action.

**Alternative 3 Summary**

Alternative 3 has the potential to affect water resources similar to Alternative 2. Depleting wells or withdrawing too much water from perennial streams may result in alteration of the quantity or quality of water and habitat conditions if withdrawals exceed stream flow volumes. Water withdrawals from multiple perennial streams and ponds in small daily increments would have a low likelihood of resulting in major...
alteration of the quantity or quality of water and habitat conditions, provided that readily available tools and common sense are used so as not to exceed stream flow and well volumes. Should water withdrawals modify hydrologic conditions in local streams, impacts on local water resources would be considered major.

Implementation of Alternative 3 would not compromise the quantity, safety, and security of any water supply, and is not expected to affect flood storage capability of any floodplain or wetland. Implementation of Alternative 3 includes BRE’s compliance with the Project’s GPP and SWPPPs for protecting water resources in the Project area.

5.4.2.4 Alternative 4: HCP and ITP for Phase I Only

Under Alternative 4, effects to water resources in associated with Project operation and decommissioning would be as described for the No-Action Alternative. There would be no new construction. Surface water withdrawals would occur for dust suppression during decommissioning (see Table 5-5). Minor, localized impacts to streams may occur in association with stormwater runoff on unpaved roads causing some sedimentation. Avoidance and minimization measures will be as described for the Phase I Project.

Alternative 4 Summary
Alternative 4 has the potential to affect water resources similar to Alternative 1. Water withdrawals from multiple perennial streams and ponds in small daily increments during summer months for 1 to 2 years would have a low likelihood of resulting in major alteration of the quantity or quality of water and habitat conditions, provided that readily available tools and common sense are used so as not to exceed stream flow volumes. Should water withdrawals modify hydrologic conditions in local streams, impacts on local water resources would be considered major.

Implementation of Alternative 4 would not compromise the quantity, safety, and security of any water supply, nor would it be expected to affect flood storage capability of any floodplain or wetland. Implementation of Alternative 4 includes BRE’s compliance with the Project’s GPP and SWPPPs for protecting water resources in the Project area.

5.5 Vegetation

This Section of the DEIS contains a discussion of the potential effects on vegetation and measures to protect vegetation resources in the Project area.

5.5.1 Impact Criteria

Federally-listed plants are afforded protection under the ESA and the State of West Virginia. Executive Order 13112 addresses federal coordination and response to the problems associated with invasive species. There are no specific federal or state regulations pertaining to non-listed plants that are relevant to the analysis for this Project. As per NEPA and CEQ guidelines, the human environment includes vegetation resources, and impacts to these resources can result in secondary effects to other resources.

Vegetation can be impacted at the individual, population, or community level. The Service considers impacts to vegetation resources to be significant should implementation of an alternative result in any of the following:

- Naturally occurring population reduced in numbers below levels for maintaining viability at local or regional level;
- Substantial loss or degradation of soil stabilization services;
- Substantial loss or degradation of habitat for a rare, threatened, or endangered animal species; and
- Introduction of invasive species that results in substantial replacement of native species.
5.5.2 Direct and Indirect Effects Presented by Alternative

5.5.2.1 Alternative 1: No-Action

Under the No-Action Alternative, effects to vegetation resources would be confined to those in association with operation and decommissioning activities. There would be no new construction.

Phase I Operation

Project infrastructure (buildings, concrete pads, etc.) would prevent 50 acres of soil from supporting vegetation for the life of the Project (25 years). There would be no new ground disturbance; 336 acres of reclaimed areas from Phase I construction would continue to recover and eventually become forested.

All maintenance activities would occur within areas previously disturbed by construction. No new vegetation disturbance would occur during Project operations. Turbine maintenance is not likely to need the assistance of heavy equipment. In the unlikely event that a large crane would be needed for turbine maintenance, vegetation would be cleared within the area previously disturbed during construction to provide for safe and efficient operation of the crane, but no large tree removal or soil disturbance would be necessary. Ground-disturbing activities may include the occasional need to access underground cable or communications lines.

Under the No-Action Alternative, turbines would be monitored for animal fatalities as required in the WVPSC's Siting Certificate. Herbaceous vegetation would be maintained around the O&M building and within 130 ft of each turbine to facilitate search efforts during post-construction mortality monitoring. Maintenance activities would occasionally need to remove unsafe trees from the facility. However, overall operation of the facility would not require any additional clearings. As such, additional effects to native vegetation from operations are not expected.

The transmission line route and other Project areas would be inspected for hazard trees that may pose safety threats or potential damage to Project facilities. Hazard trees will be trimmed or cut as needed. Inspections and tree cutting needed for these purposes will occur between November 15 and March 31 to ensure no potential for direct impacts to Indiana bats or Virginia big-eared bats, except in an emergency where there is a risk to public safety.

Noxious Weed Management. BRE would monitor the substation and areas around the turbines (the turbine laydown area) for invasive plants and use mechanical measures to control noxious weeds in these areas. No herbicides would be used to control vegetation.

Certain invasive plants have been detected along the roads, and they were present prior to the BRE Project. BRE’s weed control effort would not include the road system in the Project area. It is possible that invasive plants along the roads may encourage infestations elsewhere in the Project area.

Phase I Decommissioning

During the decommissioning of Phase I, impacts to vegetation would be limited to small amounts of clearing should forest regeneration impede crane access for dismantling the turbines. Tree harvesting would be confined to winter months and limited to that which is necessary to facilitate equipment access for removing Project components. Disturbed areas and access roads would be graded to as near as practicable the original contour if the landowner requests that BRE decommission these areas. If requested by the landowner, access roads would be left in place.

BRE’s plan for decommissioning includes land reclamation, monitoring of revegetation, and reseeding if needed to ensure revegetation success. Ground cover (vegetation) must cover at least 70% of the given disturbed area based on specific state reclamation requirements.
BEECH RIDGE ENERGY WIND PROJECT
Habitat Conservation Plan
DRAFT ENVIRONMENTAL IMPACT STATEMENT

It is assumed that BMPs implemented during construction of Phase I would be implemented during decommissioning activities to protect soil and vegetation resources but will be based on the current SWPPP requirements approved for the decommissioning effort. BMPs include the following.

- Excavated material would be contained, stabilized, and protected.
- Surface disturbance would be limited to that which is necessary for safe and efficient removal of Project components.
- All surface-disturbed areas would be restored to the approximate original contour and reclaimed in accordance with easement agreements.

No decommissioning activities would be conducted where soil is too wet to adequately support construction equipment (i.e., if such equipment created ruts in excess of 4 inches deep). Certified weed-free straw mulches, certified weed-free hay bale barriers, silt fences, and water bars would be used to control soil erosion. Soil erosion control measures would be monitored, especially after storms, and would be repaired or replaced if necessary.

Areas to be reclaimed after decommissioning would be contoured, graded, and seeded as needed to promote successful revegetation, to provide for proper drainage, and to prevent erosion. The seed mixtures used for reclamation after Phase I construction would be implemented for decommissioning (Table 5-6). Tree planting is not included in the reclamation plan.

Table 5-6. Beech Ridge Wind Energy Project seed mixtures used during reclamation of Phase I disturbed areas.

<table>
<thead>
<tr>
<th>Mix #1 Contractor’s Gold Mix</th>
<th>Mix #2 Erosion Gold Mix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species / Percent of Application</td>
<td>Species / Percent of Application</td>
</tr>
<tr>
<td>Annual Rye / 49.0%</td>
<td>Annual Ryegrass / 47.7%</td>
</tr>
<tr>
<td>Red Fescue / 29.4%</td>
<td>Fawn Tall Fescue / 14.4%</td>
</tr>
<tr>
<td>Perennial Rye / 19.6%</td>
<td>AllSport II Perennial Ryegrass / 19.1%</td>
</tr>
<tr>
<td>Trefoil / 7.6%</td>
<td>Med Red Clover / 9.5%</td>
</tr>
<tr>
<td>Other Crop Seed / 1.1%</td>
<td>Inert Matter / 1.2%</td>
</tr>
</tbody>
</table>

No-Action Alternative Summary
Implementation of the No-Action Alternative is not expected to cause reductions in numbers of any naturally-occurring plant population to such an extent as to affect population viability at the local or regional level. Implementation of the No-Action Alternative will result in minor effects to soil stabilization services during decommissioning when soils are exposed and unvegetated for a short period of time. It is possible that the No-Action Alternative may result in the introduction of invasive plants when soils are exposed during decommissioning. Implementation of Project BMPs would attempt to avoid and control noxious plant invasions in areas disturbed by the project, with exception of roadways. Implementation of the No-Action Alternative is not expected to result in substantial losses or degradation of habitat for a rare animal species or in substantial replacement of native species.

5.5.2.2 Alternative 2: Proposed Action

Phase II Construction
BRE estimates that Phase II construction will affect approximately 145 acres, most of which will be managed forest land. Table 5-7 shows the estimated impact to the various habitat types found on-site. Activities associated with creating work areas, laydown areas, turn-arounds, and road expansions will disturb the greatest amount of habitat. Of the 6,860-acre leased land, 2% will be disturbed to construct the Phase II Project.
Table 5-7. Beech Ridge Wind Energy Project estimated Phase II construction habitat disturbance.

<table>
<thead>
<tr>
<th>Habitat Type</th>
<th>Acres Impacted</th>
<th>Percent of Overall Disturbance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deciduous forest</td>
<td>114.6</td>
<td>79.0%</td>
</tr>
<tr>
<td>Open space</td>
<td>13.1</td>
<td>9.1%</td>
</tr>
<tr>
<td>Barren land</td>
<td>10.0</td>
<td>6.9%</td>
</tr>
<tr>
<td>Low intensity developed</td>
<td>3.2</td>
<td>2.2%</td>
</tr>
<tr>
<td>Mixed forest</td>
<td>1.6</td>
<td>1.1%</td>
</tr>
<tr>
<td>Evergreen forest</td>
<td>0.7</td>
<td>0.5%</td>
</tr>
<tr>
<td>Medium intensity developed</td>
<td>0.7</td>
<td>0.5%</td>
</tr>
<tr>
<td>Cultivated crops</td>
<td>0.6</td>
<td>0.4%</td>
</tr>
<tr>
<td>Pasture/hay</td>
<td>0.4</td>
<td>0.3%</td>
</tr>
<tr>
<td></td>
<td>144.9</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Effects to vegetation during construction will include death of individual plants through removal, crushing, soil compaction, or hazardous substance release. Plant individuals or groups may become stressed from loss of physical parts (e.g., leaves, branches, flowers), being covered in dust or other material, being exposed to altered light conditions or hydrology, or from other types of disturbances.

BRE will implement the following BMPs during construction to protect soil and vegetation resources.

- Excavated material will be contained, stabilized, and protected.
- Surface disturbance will be limited to that which is necessary for safe and efficient construction.
- All surface-disturbed areas will be restored to the approximate original contour and reclaimed in accordance with easement agreements.
- Removal or disturbance of vegetation will be minimized through site management (e.g., by utilizing previously disturbed areas, designating limited equipment/materials storage yards and staging areas, scalping) and reclaiming all disturbed areas not required for operations.

No construction or routine maintenance activities will be conducted when soil is too wet to adequately support construction equipment (i.e., if such equipment will create ruts in excess of 4 inches deep). Certified weed-free straw mulches, certified weed-free hay bale barriers, silt fences, and water bars will be used to control soil erosion. Soil erosion control measures will be monitored, especially after storms, and repaired or replaced as necessary. Construction activities will be avoided in areas of moderate to steep slopes (15-20%) as much as possible.

*Noxious Weed Management.* BRE would monitor the substation and areas around the turbines (the turbine laydown area) for invasive plants and use mechanical measures to control noxious weeds in these areas. No herbicides would be used to control vegetation.

Certain invasive plants have been detected along the roads, and they were present prior to the BRE Project. BRE’s weed control effort would not include the road system in the Project area. It is possible that weeds along the roads may encourage infestations elsewhere in the Project area.

*Restoration and Reclamation.* Roads, portions of roads, crane paths, and staging areas not required for operation and maintenance will be restored to the original contour and made impassable to vehicular traffic. Areas to be reclaimed will be contoured, graded, and seeded as needed to promote successful revegetation, to provide for proper drainage, and to prevent erosion. The seed mixtures used for reclamation after Phase I construction would be implemented for decommissioning (Table 5-6). Tree planting is not included in the reclamation plan. BRE intends to maintain areas needed for O&M clear of trees.

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Riparian Areas. Equipment will not cross riparian areas. BRE will conduct construction activities up to riparian areas from either side as they did for Phase I construction.

100-Turbine Project Operation
Phase II Project operations will remove 21 acres of soil from forest productivity for the life of the Project. Once construction activities are completed, 124 acres of disturbance will be reclaimed as described above. Altogether, the Project will remove 71 acres of soil from forest productivity for the life of the Project. Of the 6,860-acre leased area, 1% will be directly affected by the Project footprint.

Reclaimed areas will be comprised of regenerating forest and maintained herbaceous cover propagated from the applied seed mixes. Succession will be allowed to occur naturally in those areas of forest regeneration. Based on the management history of the Project area, one can assume that the cleared forest is second-growth beech-maple-cherry. In years 1-5, recovering habitat will consist of herds, bramble, and seedling trees. This early-successional stage often has the greatest species diversity, especially along edges. Years 5-10 will be characterized by shrubs and sapling trees. In years 10-25, stands will be composed of sapling and pole-sized trees. As forests regenerate, species assemblages will change until climax stage is reached and mature forest conditions predominate. After 25 years, stands will only then begin to resemble those mature stands that were cleared for the Project.

A 130-ft radius area around turbines is to be monitored for animal fatalities. The monitoring area will be regularly mowed to improve searcher efficiency for finding bird and bat carcasses. These areas and areas around the O&M building will be maintained in an herbaceous state. Maintenance activities will occasionally need to remove unsafe trees from the facility. However, overall operation of the facility will not require any additional clearings above what has already been described. As such, additional effects to native vegetation from operation are not expected.

Maintained herbaceous cover at the forest/Project interface will create abrupt edges. Edge effects include changes in environmental conditions, such as light, temperature, wind, and humidity. Edges have changes in vegetation structure and altered microclimate (increased temperature and decreased humidity). Maintained herbaceous openings will be relatively small as compared to an agricultural field, but these are unnatural spaces that will be low in botanical diversity.

Indirect effects to vegetation resources include the introduction or spread of invasive species in the Project area. Invasive species in the United States cause major environmental damages and losses adding up to almost $120 billion per year. There are approximately 50,000 foreign species and the number is increasing. About 42% of the species on the threatened or endangered species lists are at risk primarily because of alien-invasive species (Pimental et. al. 2004). Several studies have demonstrated that invasive plant species reduce native plant diversity and regularly invade areas through fragmented habitats caused by linear corridor developments (NISC 2008, Stubbs et. al. 2007, USEPA 1994, CEQ 1993).

In the high elevations of the Appalachians in West Virginia, there is a potential for spread of garlic mustard, autumn olive, bush honeysuckle, and Japanese stilt grass. Invasive plant management can only be successful through early intervention, frequent monitoring, and maintenance.

100-Turbine Decommissioning
During the decommissioning of Phases I and II, impacts to vegetation would be limited to small amounts of clearing should forest regeneration impede crane access for dismantling the turbines. Tree harvesting would be confined to winter months and limited to that which is necessary to facilitate equipment access for removing Project components. Disturbed areas and access roads will be graded to as near as practicable the original contour if the landowner requests that BRE decommission these areas. If requested by the landowner, access roads will be left in place.
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BRE’s plan for decommissioning includes land reclamation, monitoring of revegetation, and reseeding if needed to ensure revegetation success. Ground cover (vegetation) must cover at least 70% of the given disturbed area based on specific state reclamation requirements.

BMPs implemented during construction of Phase II will be implemented during decommissioning activities to protect soil and vegetation resources. BMPs include the following.

- Excavated material will be contained, stabilized, and protected.
- Surface disturbance will be limited to that which is necessary for safe and efficient removal of Project components.
- All surface-disturbed areas will be restored to the approximate original contour and reclaimed in accordance with easement agreements.

No decommissioning activities will be conducted where soil is too wet to adequately support construction equipment (i.e., if such equipment created ruts in excess of 4 inches deep). Certified weed-free straw mulches, certified weed-free hay bale barriers, silt fences, and water bars will be used to control soil erosion. Soil erosion control measures will be monitored, especially after storms, and would be repaired or replaced if necessary.

Areas to be reclaimed after decommissioning will be contoured, graded, and seeded as needed to promote successful revegetation, to provide for proper drainage and to prevent erosion. The seed mixtures used for reclamation after Phase I and Phase II construction will be implemented for decommissioning (Table 5-6). Tree planting is not included in the reclamation plan.

Proposed Action Summary
Implementation of the Proposed Action is not expected to cause reductions in numbers of any naturally occurring plant population as to affect population viability at the local or regional level. Implementation of the Proposed Action will result in minor effects to soil stabilization services during construction and decommissioning when soils are exposed and unvegetated for a short period of time. It is possible that the Proposed Action may result in the introduction of invasive plants when soils are exposed during construction and decommissioning. Implementation of Project BMPs will attempt to avoid and control noxious plant invasions in areas disturbed by the project, with exception of roadways which may become seed sources for the project area. Vigilance, early intervention, frequent monitoring, and maintenance of invasive plants on the project area may be needed. Implementation of the Proposed Action is not expected to result in substantial losses or degradation of habitat for any rare animal species, or in substantial replacement of native species. The Proposed Action will have moderate short-term impacts and minor long-term impacts to vegetation resources. Affected habitat types are in abundant supply in the landscape. The amount of impact to managed forest habitats is not likely to have wide-ranging effects on plants and animals that depend on them.

5.5.2.3 Alternative 3: ITP and HCP with Additional Covered Species
Under Alternative 3, effects to vegetation resources associated with construction, operation, and decommissioning would be as described for the Proposed Action. Regenerating forest in the Phase I and Phase II Project areas would continue to recover in the reclaimed areas, and herbaceous vegetation would be maintained around the O&M building and in the 130-ft radius search areas around turbines. Tree-growth would be managed to maintain an open corridor for the transmission line. Avoidance and minimization measures would be as described for the Proposed Action.

Alternative 3 Summary
As described for the Proposed Action, implementation of Alternative 3 is not expected to cause reductions in numbers of any naturally occurring plant population as to affect population viability at the local or regional level. Implementation of Alternative 3 would result in minor effects to soil stabilization services during construction and decommissioning when soils are exposed and unvegetated for a short period of time. It is possible that Alternative 3 may result in the introduction of invasive plants when soils are
exposed during construction and decommissioning. Implementation of Project BMPs would attempt to avoid and control noxious plant invasions within the project footprint, excluding roadways. Implementation of Alternative 3 is not expected to result in substantial losses or degradation of habitat for any rare animal species. Alternative 3 would have moderate short-term impacts and minor long-term impacts to vegetation resources. Affected habitat types are in abundant supply in the landscape. The amount of impact to managed forest habitats is not likely to have wide-ranging effects on common plants and animals that depend on them.

5.5.2.4 Alternative 4: ITP and HCP for Phase I Only

Under Alternative 4, effects to vegetation resources associated with operation and decommissioning would be as described for the No-Action Alternative. There would be no new construction, and no significant additional clearing would take place. Regenerating forest in the Phase I Project area would continue to recover in the reclaimed areas, and herbaceous vegetation would be maintained around the O&M building. Because post-construction monitoring would be conducted under Alternative 4, herbaceous vegetation would be maintained in the 130-ft radius search areas around turbines. Tree-growth would be managed to maintain the transmission line. Decommissioning activities may require some clearing of regeneration forest should certain sites impede crane access for turbine removal. Avoidance and minimization measures would be as described for the No-Action Alternative.

Alternative 4 Summary

Implementation of Alternative 4 is not expected to cause reductions in numbers of any naturally occurring plants as to affect population viability at the local or regional level. Implementation of Alternative 4 would result in minor effects to soil stabilization services during decommissioning when soils are exposed and unvegetated for a short period of time. It is possible that Alternative 4 may result in the introduction of invasive plants when soils are exposed during decommissioning. Implementation of Project BMPs would attempt to avoid and control noxious plant invasions in the project footprint, with exception of roadways. Implementation of Alternative 4 is not expected to result in substantial losses or degradation of habitat for any rare animal species, or in substantial replacement of native species.

5.6 Wildlife and Fisheries

This section of the DEIS addresses the potential effects on and measures to protect wildlife and fisheries resources in the Project area. Birds and bats are addressed separately in Sections 5.7 and 5.8, respectively.

5.6.1 Impact Criteria

Impacts to wildlife and fisheries resources are considered significant if an action would substantially affect a species’ population, or substantially diminish the quality or quantity of its habitat. Potential direct effects to species include, but are not limited to, disturbance, injury, mortality, and habitat alteration or loss during Project construction or maintenance activities. Potential indirect and secondary effects to species or habitats include habitat alteration or loss that occurs later in time or in another place due to groundwater or surface water withdrawal, creation of habitat edges or openings that may eventually attract different suites of species, and animal avoidance or displacement due to increased traffic or other human-related activities. This effects analysis considers the potential for the proposed Project to affect species distribution and life history strategies in the context of an effect's intensity, duration, and frequency. The evaluation of potential effects considers any implemented BMPs and mitigation measures designed to reduce impacts.

5.6.2 Direct and Indirect Effects Presented by Alternative

5.6.2.1 Alternative 1: No-Action

Under the No-Action Alternative, the proposed Project and HCP would not be implemented. Additionally, an ITP pursuant to Section 10 (a)(1)(B) of the ESA would not be issued for Phase I operation or Phase II
construction and operation. Impacts to wildlife and fisheries associated with construction of Phase I of the project, which are part of the baseline, are also further discussed in Section 5.15 – Cumulative Effects.

**Phase I Operation**

Impacts associated with operation of the Project under Alternative 1 would be similar to that described for the 100-turbine Project (Alternatives 2 and 3) but over a smaller area. All maintenance activities would occur within areas previously disturbed by construction (e.g., occasional redisturbance of vegetation in previously disturbed areas such as removal of hazard trees that could pose a safety threat or potentially damage Project facilities, removal of trees within the transmission line ROW as they become tall enough to interfere with power transmission, vegetation clearing around turbine pads to allow crane access for turbine maintenance). Ground-disturbing activities may include the occasional need to access underground cable or communications lines. Such activities generally would be commensurate or less intrusive than other activities in the region (e.g. timber harvesting, natural gas exploration). Infrequent disturbances of early-successional habitats would not be expected to result in population declines of abundant edge-adapted wildlife species. Less tolerant wildlife may be displaced by habitat loss and human presence in the project area.

Displacement impacts are potentially complex, involving changes in species abundance, shifts in habitat use, and disruption of life strategies. There are limited data available addressing impacts to mammals associated with habitat loss due to wind farm developments in the U.S.; the majority of studies have focused on bird and bat collision mortality. The effects of wind turbines on those animal species found in forested landscapes are assumed to occur but they are not fully understood. Wind facilities in forested landscapes create a noticeable disruption of habitat associated with turbine pad clearings, new roads, and transmission lines as compared to facilities constructed in open landscapes (e.g., agriculture or grassland).

The 67-turbine Project likely caused localized reductions in wildlife species dependent on forested habitats, such as deer mice, squirrels, and hares. New roads, the transmission line corridor, and other Project components may degrade habitat conditions for those species known to respond negatively to human intrusion such as black bear.

Conversely, some species have a greater tolerance than others for human activity and habitat modification in the vicinity of breeding and feeding areas. While habituation may not be immediate, species such as white-tailed deer, striped skunk, and raccoon generally adapt quickly to the presence of man-made features in their habitat, as evidenced by the abundance of these species in suburban settings. Deer have been observed at recently constructed wind power projects (Stantec 2010a, 2010b). Significant displacement of white-tailed deer, skunks, and raccoons from a wind power site has not been reported.

Under Alternative 1, general wildlife would experience minor effects associated with displacement. Black bears would be likely to avoid the Project area due to the increase in human intrusion. Snowshoe hare would be likely to avoid maintained areas surrounding the turbines, and cottontail rabbits would be likely to frequent them. Rodents that frequent woodlands would be replaced by those that use grassy forest openings. The magnitude of these impacts will be minimal as the Project will result in a small amount of habitat loss and disruption relative to the character of the surrounding landscape, which is predominately industrial forest. These impacts are expected to consist primarily of shifts in distribution of species within the Project area that could also occur in association with other types of impacts, such as logging and gas and mineral development.

Operation of the Phase I Project would have minor impacts to fish and other aquatic life in streams in association with stormwater runoff on unpaved roads causing some sedimentation. These effects would be localized should they occur. Project operations would not involve the discharge of water or waste into streams, ponds, or wetlands.
Minor oil spills from leaking transformers or gear boxes are possible. Should these spills enter surface waters they may cause localized impacts on water quality and, in turn, potentially impact fish and other aquatic life. These impacts would be unlikely due to the small volume of oil that would actually spill. Any potential oil spills are addressed in BRE’s SPCCP.

Phase I Decommissioning
Small areas of regenerated forest in the original construction disturbance may be cleared again to remove Project components. Direct impacts to wildlife and fisheries resources will be similar to construction impacts, but at a much lower level.

Disturbed areas and access roads will be graded to the original contour as near as practicable if the landowner requests that BRE decommission these areas. If requested by the landowner, access roads will be left in place.

BRE’s plan for decommissioning includes land reclamation, monitoring of revegetation, and reseeding if needed to ensure revegetation success. Ground cover (vegetation) must be established in at least 70% of the disturbed area based on specific state reclamation requirements. Small areas of regenerated forest in the original construction disturbance may be cleared again to allow crane access for remove turbines. Forest clearing of the regenerating forest will restart the regeneration process of the forest. Suitable wildlife habitat for some species generally occurs in forests more than 50 years in age. This will mean that areas that were originally cleared and then recycled for decommissioning will not provide suitable mature forest habitat for more than 70 to 75 years (assuming a 25-year project life). There are very few areas in the region that exhibit this mature forest structure.

Decommissioning activities would require water withdrawals from local perennial streams and ponds for dust suppression on gravel roads during dry conditions. There are fewer roads associated with the Phase I Project, and dust suppression would require water withdrawal of up to 150,000 gallons per year for 1 to 2 years. Fractions within this amount (up to 2,500 gallons/day) would be withdrawn on those days when maintenance crews are driving during unusually dusty conditions. Water for dust suppression could potentially be taken from any local pond or stream within the Phase I or II planning area. Because there are a number of designated trout streams in the area (Table 4-2), there is potential for minor to moderate impacts to fisheries and aquatic habitats as a result of water withdrawals if fish are entrained or water withdrawals exceed flows or recharge rates. To minimize the likelihood that significant effects would occur, BRE has committed to using state tools and common sense for water withdrawals to ensure adequate stream flows (see Water Resources effects in section 5.4).

No-Action Alternative Summary
Under the No-Action Alternative, the Project will not result in substantial changes in wildlife habitat or populations. Under Alternative 1, general wildlife would experience minor effects associated with displacement. There is potential fish entrainment and dewatering of state-designated trout streams if water withdrawals exceed flows or recharge rates. To minimize the likelihood that significant effects would occur, BRE has committed to using state tools and common sense for water withdrawals to ensure adequate stream flows.

5.6.2.2 Alternative 2: Proposed Action
Phase II Construction
BRE estimates that a total of 145 acres will be disturbed during construction of Phase II. An estimated 21 acres of this disturbance will be the result of newly constructed roads. As discussed in Section 5.5, the majority of this habitat (79%) was and will be deciduous forest and will not be replaced during the 25-year permit term.

Wildlife habitat removal will have unavoidable impacts such as mortality and habitat loss. Noise and human intrusion associated with construction will cause some animals to avoid the Project area forcing them to seek quieter sites.
In the Phase I and Phase II Project areas, 15 streams are designated trout waters, and 4 streams are probably trout waters but have not been documented (Section 4.4.2, Table 4-2: WVDEP Water Quality Standards Program, personal communication). Water withdrawals and sedimentation during project construction has the potential to adversely affect fisheries by stranding fish in isolated pools, smothering eggs, and polluting water. There are a number of warm and cold water streams in the proposed Project area, including the 19 streams that have been documented or are suspected as being trout fisheries (see Section 4.4.2, Table 4-2) that are within or proximal to the Project area. Properly installed sediment and erosion controls can prevent impacts to streams that may be at risk for receiving sediment from disturbed soils and minimize or eliminate impacts to these fisheries during project construction.

A large amount of water (over 2 million gallons in one year) is needed for construction (Table 5-5). Water withdrawals from wells for cement mixing should be monitored so as not to exceed the recharge rate of the well. Excessive water withdrawals from wells for cement mixing, or from local streams for dust suppression can potentially degrade aquatic habitat conditions in these 19 streams if water is withdrawn at a time when it would impact water quality or quantity.

To minimize effects when making water withdrawals, BRE has committed to taking water from local perennial streams and ponds, as well as using the state water withdrawal guidance, on-line tool, and common sense so as not to dewater streams (K. Coppinger, Invenergy, personal communication, May 23, 2012). The WVDEP has developed guidance and a tool to help individuals know when it is environmentally safe to withdraw water from a stream (WVDEP 2012). The guidance is based on percentages of mean annual flow, based on a 10-year period that affords an appropriate flow to protect aquatic habitat.

Because the tool has not yet been validated as adequately protective of aquatic species under all weather and precipitation conditions, water users should use common sense when making water withdrawals so as not to dewater streams. The tool should be checked daily before withdrawing significant quantities of water from any watershed known to contain trout. Users should exercise caution particularly during drought or extended dry conditions or in cases where multiple users may be withdrawing water from the same source. If a trout stream is low and withdrawing additional water could expose portions of the stream bottom or banks that are normally submerged, including riffle areas downstream from pools from which water is typically withdrawn, users should find a different location or water source that does not contain trout. Water users should not block, dam, or divert flows, or excavate pools in state designated trout streams or in their direct tributaries.

Construction of the Phase II Project will have minor to moderate effects to general wildlife associated with the conversion of 21 acres of habitat to development and the removal of 124 acres of mixed-age forest, predominately greater than 26 years old. Immediately following construction, BRE will reseed 124 acres and allow forests to regenerate. The reclaimed areas will benefit few species until woody regeneration initiates. Eventually, species that use early-successional forest habitat will use the regenerating forest patches. This includes snowshoe hare, white-tailed deer, and several small mammals. Conversely, animals that depend on mature forest (e.g., salamanders, squirrels, and black bears) will avoid using the Project area and newly created forest openings. It is important to note that although BRE is leasing 6,860 acres, a commercial timber company retains the timber harvesting rights on the leased lands, and logging is likely to continue in forests surrounding the Project.

100-Turbine Operation
The Proposed Action includes turbine operational adjustments. During the period from July 15 through October 15, turbine cut-in speed will be set at 4.8 m/s from 30 minutes before sunset for 5 hours. Curtailment is not expected to affect general wildlife species and is implemented to reduce bat mortality.

A 130-ft radius area around turbines will be monitored for animal fatalities. The monitoring area will be regularly mowed to improve searcher efficiency for finding bird and bat carcasses. These areas and around the O&M building will be maintained in an herbaceous state. Maintenance activities will
occasionally need to remove unsafe trees from the facility and transmission line. However, overall operation of the facility will not require any additional clearings above what has already been described.

Project operations will have impacts to general wildlife in the form of displacement or avoidance. Sensitive species such as black bear may avoid the Project area due to human intrusion. Humans are expected to frequent the sight to maintain turbines and monitor collision mortality. Some individual bears may acclimate eventually to the presence of the turbines and human activities. Increases in vehicle traffic may result in road-kill wildlife. BRE has set a 25 mph speed limit on all maintained Project roads to minimize the potential for animal/vehicle collisions. The newly created roads may also lead to increased accessibility of the tract by hunters, fisherman, and poachers.

Project operations will include occasional removal of small amounts of vegetation from previously disturbed areas such as removal of hazard trees and trees within the transmission line ROW, and clearing around turbine pads to allow crane access for turbine maintenance. Ground-disturbing activities may include the occasional need to access underground cable or communications lines. Such activities generally would be commensurate or less intrusive than other activities in the region (e.g. timber harvesting, natural gas exploration). Infrequent disturbances of early-successional habitats would not be expected to result in population declines of abundant edge-adapted wildlife species. Less tolerant wildlife may be displaced by edge effects and human presence in the project area.

Forest Fragmentation and Edge Effects. The effects of habitat fragmentation on animals have become an increasingly important concern. Habitat fragmentation is the process of subdividing habitat, which results in decreased continuity (isolation), reduced patch size, and general habitat loss (Andrén 1994). At the junction of two vegetation communities, such as forest and clearing, there is a tendency for species (plants and animals) diversity and density to increase. This is generally referred to as the edge effect. Forest edges have their own microclimate and species assemblages.

The extent of fragmentation in a landscape has been related to the magnitude of edge effect (Robinson et al. 1995, Donovan et al. 1997, Hartley and Hunter 1998). Adverse effects to wildlife associated with edges and fragmentation largely have been associated with landscapes dominated by agriculture or urbanization, and they have been researched primarily in bird communities. Studies that have looked at fragmentation and edge effects on animals other than birds and compared landscape contexts are limited. [Potential effects to birds from habitat edges, loss, and fragmentation are addressed in Section 5.7.2.2.] However, it is generally accepted that fragmenting contiguous forest decreases the amount of forest interior habitat and diminishes the overall forest habitat quality. The quantity of interior forest is reduced as the remaining forested patches become smaller and more isolated. The forest habitat quality is degraded as the smaller patches are affected by edge microclimate conditions and species assemblages.

The 100-turbine Project will affect 531 acres of forest, 71 acres of which will be converted to industrial development for the life of the Project. As with vegetation, the most evident effect to wildlife from habitat disturbance will be the creation of hard edge, potential introduction of invasive species, and the removal of mature forest habitat to construct the components of the facility. The mountain region of West Virginia is characterized by extensive blocks of second and third growth forest that is subject to fragmentation into smaller blocks as a result of past and ongoing commercial timber harvesting and energy exploration. The regional landscape is a vast shifting mosaic of patches and linear corridors due to these activities. The Project would create a significantly different kind of fragmentation, albeit over a relatively small area. Given the character of the landscape in which the Project resides, it would be difficult to isolate the Project’s contribution to edge and fragmentation effects from those associated with logging and mining. It is not known to what extent core mature forest habitat has been affected by logging and mining in the industrial landscape and how forest interior species have responded.

Noise Effects to Wildlife. Any existing noise standards for wind turbines focus primarily on effects to humans. The effect of wind turbine noise on wildlife is the subject of recent investigations. Research on
the effects of other types of noise on wildlife is not new, but wildlife responses to noise are difficult to translate and the impacts cannot always be quantified or related exclusively to noise disturbance.

Turbine blades at normal operating speeds can generate levels of sound beyond ambient background levels. Maintenance activities also can contribute to sound levels affecting wildlife communication distance, an animal’s ability to detect calls or danger, or to forage. Loud noises can mask other biologically relevant sound. Some wildlife are able to shift their vocalizations to reduce the masking effects of noise. However, when shifts do not occur or are significant, masking may prove detrimental to the health and survival of wildlife (Barber et al. 2009). Data suggest noise increases of 3 dB to 10 dB correspond to 30% to 90% reductions in alerting distances for wildlife, respectively (Barber et al. 2010). The noise impact models used to gauge effects to human health for this project (as discussed in Section 5.2 and in Acentech 2006, 2011) are not directly relevant to gauging effects to wildlife because these models factor in large buffer distances from human residences. We would expect noise disturbances to wildlife to be most pronounced within close proximity of the turbines, and to quickly attenuate with distance.

To date, the Service is aware of only one published study that addresses specifically the potential effect of wind turbine noise on wildlife. Rabin et al. (2006) used anti-predator behaviour in California ground squirrels to measure ecological disturbance cause by wind turbine noise. California ground squirrels use vocalizations to communicate predator danger. Squirrels exhibited a higher level of alertness and were more vigilant at the turbine sites than at the control sites.

Transportation and oil and gas infrastructure noise and wildlife responses have received more attention. In a natural gas field in New Mexico, Barber et al. (2009) reported bird nesting success was higher and predation levels lower in loud sites. In this case, the predator, the western scrub jay, was more likely to occupy quiet sites.

The extent that turbine noise affects wildlife choices and lifetime strategies has not been established. However, it cannot be discounted that wildlife may modify their behaviour to cope with wind turbine noise. This shift, or ecological disturbance, could force animals to avoid the Project area and experience stress when doing so.

Further research is needed to determine: how wind facilities affect background noise levels; whether sound masking and disturbance of wildlife occur; and how turbine operation and maintenance sound levels can vary by topographic area.

Effects to Aquatic Habitats. Operation of the 100-turbine Project will have minor impacts to fish and other aquatic life in streams in association with stormwater runoff on unpaved roads causing some sedimentation. These effects will be localized should they occur. Project operations will not involve water withdrawals from streams or the discharge of water or waste into streams, ponds, or wetlands.

Minor oil spills from leaking transformers or gear boxes are possible. Should these spills enter surface waters, they may cause localized impacts on water quality and, in turn, potentially impact aquatic wildlife. These impacts will be unlikely due to the small volume of oil that would actually spill. Any potential oil spills are addressed in BRE’s SPCCP.

100-Turbine Decommissioning
Small areas of regenerated forest in the original construction disturbance area may be cleared again to remove Project components. Direct impacts to wildlife and fisheries resources will be similar in character to construction impacts.

Disturbed areas and access roads will be graded to the original contour as near as practicable if the landowner requests that BRE decommission these areas. If requested by the landowner, access roads will be left in place.
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BRE’s plan for decommissioning includes land reclamation, monitoring of revegetation, and reseeding if needed to ensure revegetation success. Ground cover (vegetation) must cover at least 70% of the given disturbed area based on specific state reclamation requirements. Small areas of regenereated forest in the original construction disturbance may be cleared again to allow crane access for remove turbines. Forest clearing of the regenerating forest will restart the regeneration process of the forest. Suitable wildlife habitat for some species generally occurs in forests more than 50 years in age. This will mean that areas that were originally cleared and then recleared for decommissioning will not provide suitable mature forest habitat for more than 70 to 75 years (assuming a 25-year project life). There are very few areas in the region that exhibit this mature forest structure.

Decommissioning activities would require water withdrawals for dust suppression on gravel roads during dry conditions. BRE has estimated that dust suppression would require up to 225,000 gallons of water per year for 2 to 3 years (Table 5-5); fractions within this amount would be withdrawn on those days when maintenance crews are driving during unusually dusty conditions.

Mitigation for Phase II Construction, Operations, and Decommissioning
BRE has put into place measures to minimize direct effects to wildlife from vehicle collision, hunting, fishing, poaching, and sedimentation. Implementation of these measures would keep the direct take of individual animals low as both access to and use of Project area roadways will significantly decrease upon completion of construction.

Effectively implemented BMPs will minimize erosion and sedimentation to avoid impacts to streams and aquatic habitats. To address potential effects to wildlife and fisheries, BRE prohibits hunting, fishing, dogs, or possession of firearms by its employees and its designated contractors in the Project area during construction. These prohibitions are carried forward to include Project operation and maintenance. BRE has advised Project personnel regarding speed limits on roads (25 mph) to minimize wildlife mortality due to vehicle collisions. Potential increases in will be minimized through employee and contractor education regarding wildlife laws. If violations are discovered, the offense will be reported to the WVDNR, and the offending employee or contractor will be disciplined and may be dismissed by BRE and/or prosecuted by the WVDNR. Travel is restricted to designated roads; no off-road travel will be allowed except in emergencies.

For constructing the 33 turbines, BRE will limit tree-clearing to the period between November 15 and March 31, except that up to 15 acres may be cleared between April 1 and May 15 or between October 15 and November 14. Tree clearing will occur in the expansion area shown on Figure 1-4. The additional 30 to 45 days are needed to provide BRE flexibility should weather, deep snow, or ice prevent clearing or create safety issues for construction workers.

Turbine layout minimizes further fragmentation of wildlife habitat through the use, where practical, of previously disturbed lands. BRE will avoid constructing new roads by using existing roadways and address the protection of aquatic resources through the use of an SWPPP.

The Proposed Action includes off-site conservation measures to mitigate the effects of unavoidable incidental take of listed bats. BRE is proposing to establish a habitat conservation fund used to support conservation efforts for listed bats. The goal of these efforts will be to contribute to the conservation of Indiana bats and Virginia big-eared bats by protecting priority habitat, either winter hibernacula or summer maternity colonies or roosts. These conservation efforts are expected to have minor beneficial effects to general wildlife that may use these protected forested habitats.

As previously discussed, to reduce impacts to fisheries and other aquatic resources, BRE has committed to taking water only from perennial water sources and ponds. In addition, BRE will use the WVDEP water withdrawal tool, guidance, and common sense so that perennial streams are not dewatered and groundwater recharge rates are not exceeded.

Alternative 2 Summary
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Under Alternative 2, the Phase II Project will add 33 turbines to the existing 67 turbines on the leased lands. This will change the character of the habitat within the leased lands from that of industrial forest to energy development for the life of the Project (25 years). After decommissioning, the Project footprint will begin forest regeneration but with a slower initiation rate as soils overlain by development will need to first recover.

Core mature forest is currently fragmented due to ongoing commercial timber harvest and coal mining related activities. Linear breaks and large patches in wildlife habitat are abundant in the overall forested matrix in the Project area and the region. Implementation of Alternative 2 will add to this regional fragmentation. Local populations of forest interior wildlife species will be affected. Given the current moderately fragmented landscape, it is not likely that the 100-turbine Project will have major effects to forest interior wildlife populations resulting from habitat fragmentation. Even so, it would be difficult to isolate the Project’s fragmentation effects from those of other industrial activities.

Because there are a number of designated trout streams in the area (Table 4-2), there is potential for moderate to major impacts to fisheries and aquatic habitats as a result of water withdrawals if fish are entrained or water withdrawals exceed flows or recharge rates. To minimize the likelihood that significant effects to the quantity or quality of aquatic habitat would occur, BRE has committed to using state tools and common sense for water withdrawals to ensure adequate stream flows.

**5.6.2.3 Alternative 3: ITP and HCP with Additional Covered Species**

Under Alternative 3, impacts to wildlife and fisheries resources would be as described for Alternative 2 construction, O&M, and decommissioning. Overall, implementation of Alternative 3 is expected to have minor to moderate effects on wildlife and fisheries. Impacts to fisheries and aquatic resources will be major if large quantities of water are withdrawn that dewater streams or exceed recharge rates of streams or groundwater. This could affect local populations of aquatic organisms and fish or substantially affect the quantity or quality of aquatic habitat. The likelihood of significant aquatic effects will be minimized by following state guidance and tools for water withdrawals and using common sense.

Under this alternative, BRE’s Curtailment Plan and RMAMP would be modified to implement a 6.5 m/s cut-in speed as opposed to 4.8 m/s, the initial rate for curtailment. Furthermore, all 100 turbines would operate at 6.5 m/s from 30 minutes before sunset through 15 minutes after sunrise during the period April 1 through October 15. Curtailment is not expected to affect general wildlife species and is implemented to reduce bat mortality.

Habitat conservation measures would be implemented for Indiana bat and Virginia big-eared bat as described for the Proposed Action. Additional habitat protection measures would be implemented for the three additional covered species using the information derived from the field surveys described in Section 3.2.3.1 of this DEIS. The HCP would be modified to include measures to protect suitable roost/maternity habitat for the additional covered species on or near the Project site (if feasible).

If on-site or near-site protection is not feasible due to unwilling landowners or it creates an undesirable hazard to the species, then the HCP would include measures to protect suitable roost/maternity habitat or known hibernacula for the additional covered species off-site. In addition, BRE would enhance habitat by creating potential roost trees proximal to the nearest bat hibernacula. This habitat enhancement may provide an alternate site for roosting away from the Project. These conservation efforts are expected to have minor beneficial effects to general wildlife that may use these protected forested habitats.

**5.6.2.4 Alternative 4: ITP and HCP for Phase I Only**

Under Alternative 4, impacts to wildlife and fisheries resources would be as described for Alternative 1 construction, O&M, and decommissioning. Overall, implementation of Alternative 4 is expected to have minor impacts on wildlife and fisheries, with implementation of state tools and common sense to ensure that water withdrawals do not dewater streams.
5.7 Avian Resources

The Project’s potential effects to birds were indicated as issues in 67% of the comments received during the 60-day public scoping period. Commenters are concerned the Project may have impacts to Neotropical migrant and resident bird species that use the Project site for breeding or migration. They also are concerned that results from other wind projects show high mortality rates associated with turbine collisions and expressed a desire for the Applicant to operate the Project in a manner that includes measures to avoid, minimize, and mitigate for turbine associated bird mortality. Commenters are concerned that not enough is known about bird populations, distributions, and migratory habits, and bird/wind turbine interactions and expressed a desire that the Applicant should conduct research to supplement current understanding and knowledge of these bird-related issues.

5.7.1 Impact Criteria

 Federally-listed birds are afforded protection under the ESA. The BGEPA protects bald and golden eagles. The MBTA implements protection of native migratory birds. As per NEPA and CEQ guidelines, the human environment includes avian resources. Under Executive Order 13186, federal agencies are expected to carry out, among other things, the following.

1. Ensure that environmental analyses of Federal actions required by the NEPA or other established environmental review processes evaluate the effects of actions and agency plans on migratory birds, with emphasis on species of concern; and,
2. Identify where unintentional take reasonably attributable to agency actions is having, or is likely to have, a measurable negative effect on migratory bird populations, focusing first on species of concern, priority habitats, and key risk factors.

Birds can be affected at the individual and population level. Impacts to avian resources would be considered significant should implementation of an alternative result in any of the following:

- Naturally occurring population reduced in numbers below levels for maintaining viability at local or regional level;
- Substantial loss or degradation of habitat for a rare, threatened or endangered bird species; and
- Substantial change in habitat conditions producing indirect effects that cause naturally occurring populations to be reduced in numbers below levels for maintaining viability at local or regional levels.

5.7.2 Direct and Indirect Effects Presented by Alternative

Predicted effects to avian resources are discussed for each alternative considered in this DEIS. The discussion of the Project’s potential effects to birds relative to what is understood about wind projects in general is addressed largely under the Section discussing the Proposed Action (Section 5.7.2.2). Discussions for Alternatives 1, 3, and 4 will often refer to the more comprehensive effects analysis provided for the Proposed Action.

5.7.2.1 Alternative 1: No-Action

Under the No-Action Alternative, the proposed 33-turbines would not be constructed and the Project HCP would not be implemented. Additionally, an ITP pursuant to Section 10 (a)(1)(B) of the ESA would not be issued for the BRE Project, and the 67 turbines would operate as directed under the Settlement Agreement. There would be no new construction under the No-Action Alternative.

Phase I Operations

Under the No-Action Alternative, Project operations would be limited to the already constructed 67 turbines. Effects to birds would be as described for the Proposed Action (Section 5.6.2.2), only less in magnitude. Some species of birds would be displaced by the Project in the Phase I area. Birds that use mature and young forest at the BRE Project may avoid the clearings and adjacent woods within the Project footprint. Edge-dependent species may begin to use the habitat interfaces as shrubs regenerate,
and early-successional forest species will begin to occupy the reclaimed clearings. As shrubland habitat progresses, early-successional species would begin to occupy these sites. Many mature forest species would begin to use mid-successional habitats in less than 20 years. The temporary conversion of 336 acres (0.5%) of mixed-age forest in a forested landscape is not considered a major loss of this habitat type given the Project is located on more than 63,000 acres of managed forest habitat.

Under the No-Action Alternative, Project operations would be restricted at night from April 1 to November 15, which includes most of the spring and fall migration periods. It is possible that the No-Action Alternative will kill fewer birds at night than other alternatives simply because the blades are not spinning at all during the night-time when many passerines migrate. However, post-construction studies have not been conducted for a wind project that operates under this restricted scenario, and researchers are only just beginning to investigate whether curtailment strategies designed for bats also reduce bird mortality. Because birds collide with tall stationary or moving objects during the day and night, the Project is expected to kill birds under this restricted night time protocol, as well as while operating unrestricted during daylight hours. Therefore, this analysis assumes that operations under the No-Action Alternative would kill birds at the same rate as described for the Proposed Action, anywhere from 0 to 15.7 birds per turbine per year with an average around 5.32 birds per turbine per year (see similarly situated projects in the mid-Atlantic region summarized in Table 5-12 and Table 5-13).\(^{36}\) While the lower and higher ends of annual mortality rates are possible in any given year, over time we would expect bird mortality to be closer to the regional average. Because there would be fewer turbines than the Proposed Action, the magnitude of mortality would be less. Hence, turbine operation under the No-Action Alternative is predicted to kill roughly 350 birds per year (with a possible range of 0 to 1,050) and roughly 8,900 birds in 25 years of operation (with a possible range of 0 to 26,300) (Table 5-14).

The Phase I Project has 2 MET towers (Figure 1-2) 262 ft in height, lighted (single flashing light), and supported by guy wires. Bird mortality studies conducted at tower structures suggest birds are colliding mostly with the tower guy wires (Kruse 1996 as cited in Gehring et al. 2011, Gehring et al. 2011). Gehring et al. (2011) found that shorter towers (<480 ft) without guy wire supports were involved in significantly fewer avian collisions than taller towers supported by guy wires. Steady burning lights on towers also pose a much greater risk than unlit towers or towers with strobe or flashing lights (Gehring et al. 2009). The specifications of BRE’s MET towers are consistent with the Service’s recommendations for communications towers (<479 ft tall, equipped with flashing lights). Nonetheless, the Service recognizes that collision risk to birds associated with the MET towers cannot be ignored. Any MET tower mortality would be in addition to the 350 birds per year killed by the turbines.

There is no standard method for calculating mortality rates for MET towers at wind projects. Few projects report such data on an annual basis and results have been highly variable, ranging from little to no mortality at unguyed MET towers (Erickson et al. 2003b, Stantec 2008) to 3 to 5 times greater mortality at guyed MET towers than wind turbines (Young et al. 2003, Nicholson et al. 2005). For purposes of this analysis, we assumed that the two existing guyed BRE Project MET towers (262 feet tall) with flashing lights pose a 4 times greater risk to birds (21.3 birds per tower per year) than turbines (5.32 birds per tower per year); and that the two proposed unguyed MET towers for the expansion area would have little to no bird mortality. Applying the 21.3 birds per tower figure to the 2 Phase I guyed towers amounts to 43 birds annually or roughly 1,065 bird strikes for the 25-year Project operating life (Table 5-14).

Thus under the No-Action Alternative, we predict total mortality from birds colliding with turbines and MET towers is roughly 400 birds per year or 10,000 birds for the life of the Project (Table 5-14). (Note: numbers have been rounded up to the nearest 100 birds as our estimates are not as precise as the calculations might lead one to believe). Table 5-14 also shows a worst case scenario of 26,281 birds for the life of the project based upon the high end of the confidence interval. Although annual turbine mortality may occasionally be high in some years (exceeding the average of 5.32 birds per turbine), we

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36 The series of tables that follow show estimates of mortality. Estimates within each Project scenario will not always match exactly. The relatively small discrepancies are an artifact of calculations done in a spreadsheet application (Microsoft Excel®) where numbers were rounded.
do not believe it likely that such high levels would occur repeatedly given the adaptive management measures in the RMAMP and APP.

Table 5-9 shows the potential effect of Alternative 1 bird mortality as a percentage of current estimated breeding population sizes in West Virginia and in the Appalachian Mountains (Bird Conservation Region 28) for 10 birds of conservation concern. We applied the overall bird mortality rates from Table 5-14 for turbines and MET towers, but bracketed our predictions by using average fatality rate in the mid-Atlantic region of 5.32 birds per turbine per year, as well as the high end of the confidence interval (15.69 birds per turbine per year) as a worst case analysis, given that there are uncertainties associated with data on bird population sizes, survival, and reproduction.

Based on this worst-case analysis, the 67-turbine Project and 2 guyed MET towers potentially would kill 1 to 12 individuals of these species annually, roughly ≤ 0.05% of the most current estimated Appalachian Mountain population of any of these 10 species in a year. While this is a small percentage, we recognize that many of these bird species of conservation concern show likely or suspected declines in the long-term and/or short term (Table 5-9 and Table 5-16, and Appendix M), and some of these species have small breeding populations. These birds are suspected to be declining due to wide variety of sources of mortality across their breeding, migration, and wintering ranges. Thus bird mortality from the Project would be expected to contribute slightly to ongoing declines originating from many sources of bird mortality.

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37 See Alternative 2, Direct Effects to Avian Resources, for a more detailed description of the methods used to conduct this analysis.
Table 5-8. Coarse estimates of breeding population sizes and trends for 10 bird species of conservation concern at 4 geographic scales.

<table>
<thead>
<tr>
<th>Species</th>
<th>1995 Estimated Population Size</th>
<th>Abundance Index Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Survey-wide (U.S and Canada)</td>
<td>BCRs 28, 13, and 14</td>
</tr>
<tr>
<td>Blue-winged warbler</td>
<td>408,000</td>
<td>229,000</td>
</tr>
<tr>
<td>Bay breasted warbler</td>
<td>5,580,000</td>
<td>356,000</td>
</tr>
<tr>
<td>Red crossbill</td>
<td>6,000,000</td>
<td>29,000</td>
</tr>
<tr>
<td>Kentucky warbler</td>
<td>1,165,000</td>
<td>250,000</td>
</tr>
<tr>
<td>Prairie warbler</td>
<td>1,185,000</td>
<td>268,000</td>
</tr>
<tr>
<td>Wood thrush</td>
<td>10,990,000</td>
<td>6,250,000</td>
</tr>
<tr>
<td>Golden-winged warbler</td>
<td>210,000</td>
<td>30,300</td>
</tr>
<tr>
<td>Cerulean warbler</td>
<td>560,000</td>
<td>475,000</td>
</tr>
<tr>
<td>Canada warbler</td>
<td>1,205,000</td>
<td>217,000</td>
</tr>
<tr>
<td>Black-billed cuckoo</td>
<td>865,000</td>
<td>177,000</td>
</tr>
</tbody>
</table>

1 Population estimates from Partners in Flight Landbird Data Base, based on North American Breeding Bird Surveys from 1990-1999, using the Partners in Flight approach to estimating population sizes (Blancher et al. 2007). Estimates of breeding populations typically are portrayed as representing 1995, the mid-point of the survey timeframe (PIF and RMBO 2004).

2 BCR = Bird Conservation Region.


4 -- = not applicable; species not reported to breed in the region.
Studies show that most bird mortality occurs at wind power projects during fall migration. While the exact origin of migrating birds is unknown, we would predict most mortality to occur to migrating birds in the fall originating from many source populations including BCR 28 (Appalachian Mountains Region surrounding the Project area) and BCRs 13 and 14 (2 regions immediately north of BCR 28). A small but unknown proportion of the fatalities would be expected to occur to local breeding populations in West Virginia. Table 5-8 provides estimates of the 67-turbine Project’s potential effect on 8 birds of conservation concern that breed in West Virginia. (Note: The bay-breasted warbler and red cross-bill are not included in this analysis because they are only known to migrate through the state). Based on this analysis, the 67-turbine Project and 2 guyed MET towers potentially would kill on the order of < 0.4% of the estimated West Virginia population of any of these 8 species in a year. This analysis likely overestimates the effect because it does not account for annual recruitment and assumes all mortality would occur to birds originating from local populations.

The Project’s APP includes monitoring of bird mortality for the life of the project and an adaptive management framework. Should significant mortality of any migratory bird species occur, the APP includes measures to reduce and/or mitigate these losses through changes in turbine operations, off-site habitat protection, and possibly research.
Table 5-9. Potential effect of Alternative 1 and Alternative 4 (67-turbines and 2 MET towers) on 10 birds of conservation concern compared to breeding bird survey trends and estimated population sizes in West Virginia and Bird Conservation Region 28, Appalachian Mountains region.

<table>
<thead>
<tr>
<th>Species</th>
<th>Appalachian Mountains region (BCR 28) population, 1995¹</th>
<th>West Virginia breeding population 1995¹</th>
<th>Project annual mortality²</th>
<th>Maximum # killed in 25 years ³</th>
<th>Maximum % of Appalachian Mountain population affected annually</th>
<th>Maximum % of West Virginia population affected annually</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue-winged warbler</td>
<td>190,000</td>
<td>50,000</td>
<td>2 – 6</td>
<td>159</td>
<td>0.003</td>
<td>0.01</td>
</tr>
<tr>
<td>Cerulean warbler</td>
<td>450,000</td>
<td>200,000</td>
<td>1 - 2</td>
<td>50</td>
<td>0.0004</td>
<td>0.001</td>
</tr>
<tr>
<td>Black-billed cuckoo</td>
<td>79,000</td>
<td>13,000</td>
<td>4 - 10</td>
<td>250</td>
<td>0.01</td>
<td>0.08</td>
</tr>
<tr>
<td>Kentucky warbler</td>
<td>250,000</td>
<td>70,000</td>
<td>5 - 12</td>
<td>300</td>
<td>0.005</td>
<td>0.02</td>
</tr>
<tr>
<td>Canada warbler</td>
<td>28,000</td>
<td>3,000</td>
<td>5 - 12</td>
<td>300</td>
<td>0.04</td>
<td>0.4</td>
</tr>
<tr>
<td>Prairie warbler</td>
<td>260,000</td>
<td>40,000</td>
<td>1 - 2</td>
<td>50</td>
<td>0.0008</td>
<td>0.005</td>
</tr>
<tr>
<td>Bay-breasted warbler</td>
<td>NA</td>
<td>NA</td>
<td>5 - 12</td>
<td>300</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Red crossbill</td>
<td>3,000</td>
<td>NA</td>
<td>1 - 2</td>
<td>50</td>
<td>0.07</td>
<td>NA</td>
</tr>
<tr>
<td>Wood thrush</td>
<td>4,500,000</td>
<td>1,000,000</td>
<td>5 - 12</td>
<td>300</td>
<td>0.0003</td>
<td>0.001</td>
</tr>
<tr>
<td>Golden-winged warbler</td>
<td>20,000</td>
<td>8,000</td>
<td>0 – 1⁴</td>
<td>25⁴</td>
<td>0.005</td>
<td>0.01</td>
</tr>
</tbody>
</table>

¹ Based on North American Breeding Bird Surveys from 1990-1999 using the Partners in Flight approach to estimating population sizes (Blancher et al. 2007). Estimates of breeding populations typically are portrayed as representing 1995, the mid-point of the survey timeframe. Should updated population estimates become available prior to the FEIS, the numbers will be revised then.

² Fatalities based on multiplying species proportions (from column 4 in Table 5-16) x total predicted bird mortality from 67 turbines and 2 MET towers for 1 year (from Table 5-14), bracketing the mean (399 birds annually) with the high end (1,094 birds).

³ Fatalities based on multiplying species maximum number of birds from column 4 times 25 years.

⁴ Because golden-winged warblers have not been detected during post-construction monitoring surveys at wind power projects, a small number were assumed to be taken (1 per year) to facilitate the analysis.

Under the No-Action Alternative, BRE would implement the APP (Appendix B) and RMAMP (see Appendix C of Project HCP). Based on post-construction monitoring results, BRE would test whether its predictions about bird mortality are true. If significant bird mortality occurred, BRE would conduct additional studies and test ways to reduce these effects and/or mitigate for them. BRE’s adaptive management plan, presented in detail in the RMAMP, includes evaluating baseline migratory bird mortality rates and effects of various turbine operational protocols on migratory bird fatality rates, as well as for bats. The RMAMP includes multiple years of testing various turbine operational protocols and effects on estimated fatality rates. Monitoring would be conducted daily to evaluate relationships between bird fatality rates and weather. Monitoring would include investigations into probable causes of fatality events that could trigger the need for adaptive management, including weather events, turbine conditions, and other considerations.
BRE has consulted with the Service regarding the Project’s likelihood to kill eagles. Based on preliminary results of running the Service’s Risk Assessment Model, as described in the Draft Eagle Conservation Plan Guidance (USFWS 2011e), the Service believes Alternative 1 poses a low risk to bald eagles (predicted mean of 0.19 fatalities per year with a 80% confidence interval between 0 and 0.29 bald eagles per year) and a moderate risk to golden eagles (0.67 fatalities per year with a 80% confidence interval between 0 and 1.0 golden eagles per year). It should be noted that there is uncertainty in the predictions because modelling results have not been validated, and the model was developed primarily using data on bald eagles in the east. Therefore the model will be improved over time by collecting additional site-specific information on bald and golden eagle activity in the east. We have recommended and BRE has agreed to conduct additional eagle surveys to better characterize the peak eagle migration season and how eagles use the area during times of highest risk (i.e. whether they pass through the area quickly, the height eagles fly at, whether eagles stop over within the project area to rest or feed, etc.) Such information can be used to test turbine operational changes to reduce risk when eagles are in the project air space. While the degree to which these measures would be effective is currently unknown, the adaptive management framework of the APP is intended to reduce this uncertainty.

BRE believes the risk of taking an eagle is low and thus has decided to not seek an eagle permit at the current time. BRE’s APP addresses post-construction monitoring and adaptive management in the event of an eagle collision. BRE will work with the Service to evaluate the event and identify and implement avoidance or mitigation measures to reduce the risk of future mortalities. If a bald or golden eagle fatality occurs at the project, BRE will conduct follow-up post-construction monitoring in the season in which the fatality occurred during the subsequent year of operations to assess whether avoidance or mitigation measures are effective at reducing impacts on eagles. If new information becomes available that suggests that take of bald and/or golden eagles by the Project is likely, BRE will investigate and implement measures to minimize this risk.

Should take of an eagle or other significant bird mortality occur, BRE would consider and implement the following avoidance and minimization actions:

a. Removing/modifying the source(s) of bird attraction;
b. Implementing turbine operational protocols designed to reduce bird fatalities at turbines that data show are likely to take bald and/or golden eagles, or have shown higher than average bird fatality rates;
c. Implementing technological solutions; and
d. Negotiating with transmission line owners to retrofit power poles to adhere to APLIC guidelines (APLIC 1994, 2006).

Phase I Decommissioning

BRE’s plan for decommissioning includes land reclamation, monitoring of revegetation, and reseeding if needed to ensure revegetation success. Ground cover (vegetation) must cover at least 70% of the given disturbed area based on specific state reclamation requirements. Small amounts of regenerated forest in the original construction disturbance areas may be cleared again to allow crane access for removing Project components. This will set back the forest regeneration process in these newly cleared areas, but these affected areas are expected to be very small.

Direct impacts to avian resources associated with decommissioning would be similar to that associated with Project construction impacts, but habitat conversion will be significantly less in magnitude. Disturbance associated with decommissioning will likely be shorter in duration as compared to construction. It is not likely to take as much time to dismantle the Project as for construction, especially as Phase I construction experienced interruptions in construction during the court case and Settlement Agreement activities.

Disturbed areas and access roads will be graded to the original contour as near as practicable if the landowner requests that BRE decommission these areas. If requested by the landowner, access roads will be left in place.
Phase I Avoidance and Minimization Measures
The Project’s APP (Appendix B) details how BRE has incorporated and responded to recommendations found in guidance developed to avoid, minimize, and mitigate for avian impacts. Measures focus primarily on avoidance and minimization of impacts to birds. These measures include, but are not limited to, controlling carrion on the Project site so as not to attract avian scavengers and monitoring bird mortality to determine its significance and the effectiveness of the bat curtailment strategy in also reducing bird mortality.

Should the Project result in significant bird mortality (e.g. take of an eagle or other significant bird mortality), BRE would implement additional avoidance and minimization measures, and possibly mitigation.

No-Action Alternative Summary
The No-Action Alternative is not expected to cause naturally occurring populations of common birds to be reduced to numbers below levels for maintaining viability at regional or local levels, but is expected to contribute slightly to ongoing declines of species of concern already declining due to many sources of bird mortality. Because the effectiveness of measures to reduce bird mortality is uncertain, the APP and adaptive management strategy is designed to test the effectiveness of curtailment and to respond to significant bird mortality should it occur by reducing the mortality, and/or mitigating for it, if needed.

The No-Action Alternative would not result in substantial losses or degradation of habitat for a rare, threatened, or endangered animal species. The Proposed Action is not expected to result in substantial changes in habitat conditions producing indirect effects that cause naturally occurring populations to be reduced in numbers below levels for maintaining viability at local or regional levels. The conversion of 386 acres of managed forest habitat to forest openings and developed land is not considered a major loss of this habitat type given the Project is located on more than 63,000 acres of managed forest habitat.

5.7.2.2 Alternative 2: Proposed Action
Phase II Construction
Under the Proposed Action, Phase II construction will convert 145 acres of predominately forested habitat to 124 acres of grass/shrubland habitat and 21 acres of grass and developed habitat. Together with Phase I, the 100-turbine Project will convert 531 acres of predominately forested habitat to 460 acres of grass/shrubland habitat and 71 acres of grass and developed habitat. The converted habitat does not occur as large, expansive openings but as strings of roughly circular forest openings that are approximately 2 acres, similar to the openings that already occur in the landscape. The temporary conversion of 460 acres of mature forest is a minor effect considered in the context of its occurrence in an extensively forested landscape that is often exposed to habitat conversion associated with logging and mining disturbances.

Forest interior nesting birds will be displaced from areas converted to open habitat. Alteration of habitat would be expected to result in small decreases in abundance of some forest interior nesting birds such as Swainson’s thrush, ovenbird, black-throated blue warbler, and Canada warbler. Creating openings in forested areas that result in narrow roads and edge habitats is widely believed to increase rates of nest predation and parasitism. Species such as brown-headed cowbirds (which parasitize forest birds’ nests), blue jays, and American crows may increase in abundance as a result of increased edge habitat.

At the same time, the Proposed Action would produce a beneficial direct impact for bird species that nest or forage in the shrubby and early-successional habitat created by clearing forest for roads and pads. Species such as American woodcock, ruffed grouse, and several species of flycatchers, warblers, and sparrows would benefit from creation of early-successional habitat. These benefits would last for only a few years.
Habitat regeneration in contiguously forested landscapes goes through tree-growth stages accompanied by bird community changes. During the immediate years following clearing, the converted habitats will attract few bird species. Because mature forests are dominant in the regional landscape, impact to forest interior birds from habitat loss, displacement, or increased predators and nest parasites likely would be minor.

Increased noise and human activity associated with construction also will result in some short-term displacement of birds. However, due to the existing disturbance resulting from timber harvesting, most birds in the Phase II Project area likely are accustomed to a certain amount of disturbance. Pre-construction surveys showed many bird species that use edge habitats and forest near edges. Noise and disturbance impacts to birds related to Phase II construction will be temporary and minor.

100-Turbine Project Operations

Under the Proposed Action, the 100-turbine Project will operate as described in the HCP. For the term of the ITP, BRE will adjust the cut-in speed for all 100 turbines from 3.5 m/s (7.7 mph) to 4.8 m/s (10.6 mph) for the time of night from 30 minutes before sunset for 5 hours during the 12-week period from July 15 through October 15 (i.e., the Curtailment Plan). All 100 turbines will be feathered up to the point in time that the cut-in speed is reached; thus, there will only be minimal rotation of turbine blades (<2 rpm) during periods when winds are below the cut-in speed. The principle objective of the Curtailment Plan is to avoid operating turbines during low wind speeds at the time of the day when bats are most active and during the time of the year when bats are most active, thus reducing potential take of Covered Species and all other bat species. If research and monitoring results show that this proposed Curtailment Plan is not meeting the HCP’s goals and objectives, BRE will modify the Curtailment Plan to employ more restrictive operations (e.g., raising the cut-in speed, extending the hours or dates of curtailment). However, BRE’s Curtailment Plan will be modified only with the written agreement of the Service.

The purpose of this curtailment is to reduce mortality of bat species. Available reports from curtailment studies to date have not attempted to relate turbine operations to reductions in bird mortality. Hence, there is insufficient evidence to suggest that curtailment will result in reduced rates of bird mortality. Therefore, this analysis does not assume that BRE’s Curtailment Plan is a measure to avoid and minimize bird collisions with wind turbines. Rather, this analysis assumes that bird mortality will be related to the number of turbines and does not attempt to factor in changes in mortality due to curtailment.

Displacement and Project Avoidance. There are limited data that address impacts to birds associated with direct habitat loss due to wind farm developments in the U.S. The typical wind facility has a relatively small footprint, and the 100-turbine Project directly will occupy 1% of the leased lands. However, wind facilities in contiguously forested landscapes create conspicuous disruptions in habitat associated with turbine pad clearings, roads, and transmission lines as compared to facilities constructed in largely open landscapes, such as agriculture, rangeland, grassland, and barrens. The effects of these forest openings likely extend beyond the actual disruption in the form of displacement. Displacement results from avoidance of otherwise suitable habitat due to the presence of wind turbines and other facility appurtenances.

Unfortunately, there is limited research addressing the displacement effects of wind development on birds in the U.S., and to our knowledge, none of these studies were conducted in eastern forests. Studies conducted at wind facilities in open landscapes in the West and Midwest showed small-scale (<100 m [330 ft]) impacts on birds (Leddy et al. 1999, Johnson et al. 2000a, 200b, Erickson et al. 2004). Osborn et al. (1998) found significantly fewer birds and lower species diversity in the vicinity of turbines as compared to control sites and noted that birds avoided flying in areas with turbines. Grassland birds appeared to exhibit the most pronounced levels of avoidance behaviour. At the Buffalo Ridge Wind Resource Area, Leddy et al. (1999) observed that male songbird densities within species were 4 times greater in reference Conservation Reserve Program (CRP) grasslands as compared to CRP grasslands located within 180 m (~600 ft) of turbines.
BEECH RIDGE ENERGY WIND PROJECT  
Habitat Conservation Plan  
DRAFT ENVIRONMENTAL IMPACT STATEMENT

At the Buffalo Ridge project, Usgaard et al (1997 as cited in Strickland et al. 2011) documented 5.94 raptor nests per 39 mi² (24,711 acres) on land surrounding the facility, yet no nests were documented within the 12-mi² (7,907 acres) facility lands despite similar habitat conditions.

Other bird groups may not be as visibly affected by displacement/disturbances from wind turbines. At the Buffalo Ridge project, Johnson et al. (2000) did not observe turbine avoidance in 65% of bird groups, including waterfowl, shorebirds, doves, flycatchers, corvids, blackbirds, chickadees/nuthatches, tanagers/orioles, and thrushes.

Studies have not quantified disturbance displacement of forest birds from wind turbines. At a wind facility in Vermont, fewer interior forest birds were heard singing in the immediate vicinity of the turbines, although noise from the turbines may have been a confounding factor (Kerlinger 2002).

Forest interior nesting birds at the BRE Project may avoid the clearings and adjacent woods within the Project footprint. Edge species may begin to use the habitat interfaces as shrubs regenerate, and early-successional forest species will begin to occupy the reclaimed clearings. Common edge and early-successional forest species in the Project area include gray catbird, chestnut-sided warbler, chipping sparrow, field sparrow, and indigo bunting (Canterbury 2006). As shrubland habitat progresses, early-successional species such as eastern towhee, song sparrow, brown thrasher, and yellow-breasted chat will begin to occupy these sites. Many mature forest species such as red-eyed vireo, black-and-white warbler, and American redstart will begin to use mid-successional habitats in less than 20 years. Thus, the temporary conversion of 124 acres of mixed-age forest is not considered a major impact given the context of the surrounding forested landscape.

The majority of bird species recorded during surveys conducted in the Project area are associated with eastern hardwood forests in stands of various ages (Canterbury 2006, Young et al. 2012c). Studies by Shaffer and Johnson (2009) and Kerlinger (2002) concluded that, in general, bird species that are adapted to human disturbances or edge habitat are less likely to exhibit avoidance behaviour near turbines. Within the Project area, species often associated with disturbances in forested landscapes include chestnut-sided warbler, indigo bunting, hooded warbler, and black-and-white-warbler. However, O&M activities around avian nesting areas may decrease the reproductive success of some species within the Project area. The completed facility may result in a reduced number of certain forest interior birds that do not tolerate maintained forest openings that contain wind turbines. Common forest birds in the Project area that could be displaced include ovenbird, red-eyed vireo, and veery. In the absence of any reliable information on the effects of displacement on birds, one can only suggest that significant displacement could lead to population reductions for those species that are already compromised by limited habitat. However, forested habitat is not limited in the region of the Project. Overall, the surrounding landscape provides extensive medium quality forest, comprised of a mosaic of some intact large blocks of forest, and many smaller blocks of various ages exhibiting some recent disturbance activity or recovering from past disturbances. Clearing of 124 acres associated with the Phase II expansion area will further fragment this forest to a minor degree.


In 2011, 2 wind projects in West Virginia reported large-scale bird mortality events. Young and Courage (2011) reported 59 bird casualties on the morning of September 25 at the Mount Storm Energy Facility. Of these casualties, 31 were discovered near a single turbine. This unusual concentration of dead birds was related to foggy conditions and nacelle lights inadvertently left on. On October 3, staff at the Laurel Mountain Wind Project discovered 484 bird carcasses at the nearby substation and battery yard. Peterson (2011) concluded the event was likely related to inclement weather and bright lamps that were lit from dusk-to-dawn at the substation and battery storage system.
Artificial lighting has been thought to influence rates of bird collision at guyed communication towers, buildings, and other tall structures (Avery et al. 1976, Trapp 1998, Kerlinger 2000, Shire et al. 2000). A recent large collision event documented at a school on Backbone Mountain, near the Mountaineer wind facility in West Virginia, further suggested the potential for bright lighting combined with foggy conditions to result in high collision mortality of nocturnal migrants. On the morning of September 29, 2008, 494 songbirds, many of them warblers, collided with windows of the school during a relatively short period of time before and after sunrise (Christy Johnson-Hughes, USFWS, personal communication). This unprecedented mortality event was thought to be related to recent installation of bright lighting surrounding the school, which presumably attracted large numbers of birds, many of which collided with the building. The documentation of isolated, large scale mortality events such as this suggest that nocturnal migrants are susceptible to collision on an episodic basis rather than a continuous, predictable level, with factors such as lighting, weather conditions, and seasonal timing playing important roles in determining when collision events occur.

The blinking FAA lights typically installed on wind turbines do not appear to influence rates of collision (NRC 2007, Kerlinger et al. 2010). Jain et al. (2009a) found no significant correlation between mortality rates of nocturnally migrating birds at lit versus unlit turbines at Maple Ridge, New York, and this lack of correlation has been documented at other operational wind facilities (NRC 2007). Kerns and Kerlinger (2004) documented no differences in rates of collision between lit and unlit turbines at the Mountaineer facility in West Virginia. The largest single mortality event documented in their study (33 passerines in one night) was thought to be due to a combination of foggy conditions and bright sodium vapor lighting at a substation within the facility, and not related to the FAA-required lighting on the turbines themselves (Kerns and Kerlinger 2004). BRE has committed to minimizing as much as possible the use of bright, continuously burning lights at the Project to minimize the likelihood of large mortality events of birds caused by lighting (see Project APP, Appendix B).

Rates of avian collision mortality at existing wind facilities in the east and upper Midwest range from 0 to approximately 10 birds per turbine per year (Appendix J, Table J-1). Rates are highest for passerines (Table 5-10). Although avian collision mortality can occur during both the breeding and migration seasons, patterns in avian collision mortality at tall towers, buildings, wind turbines and other structures suggest that the majority of fatalities occur during the spring and fall migration periods (NRC 2007).

**Passerines.** In the Midwestern and Eastern U.S., passerines have accounted for the majority of fatalities at wind projects (Table 5-10). In general, the documented levels of fatalities are small relative to other potential sources of avian mortality (Erikson et al. 2001). The overall number of avian fatalities, the species involved, and the fatality rates are consistently low. When data are corrected for scavenging and observer efficiency biases, mortality studies indicate wind turbines typically account for 1 to 9 avian fatalities per turbine per year (Erickson et al. 2001, Jain et al. 2007). Fatalities occur in all months surveyed, and both resident and migrant birds are affected. Inclement weather could be a contributing factor at wind projects (Johnson et al. 2002), and some researchers believe this to be the case for other obstacles (Erickson et al. 2001).
Table 5-10. Documented avian fatalities by bird group at wind farms between 1994 and 2009 in the Eastern and Midwestern U.S. based on results of systematic searches conducted during limited study periods and not year-round. (Note: Numbers do not include incidentally discovered fatalities. Vultures are included in the raptor category.)

<table>
<thead>
<tr>
<th>Bird group</th>
<th># individuals</th>
<th>% of total fatalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passerine</td>
<td>688</td>
<td>73.6%</td>
</tr>
<tr>
<td>Unknown species</td>
<td>108</td>
<td>11.6%</td>
</tr>
<tr>
<td>Raptor</td>
<td>52</td>
<td>5.6%</td>
</tr>
<tr>
<td>Gamebird</td>
<td>42</td>
<td>4.5%</td>
</tr>
<tr>
<td>Waterfowl</td>
<td>21</td>
<td>2.2%</td>
</tr>
<tr>
<td>Shorebird</td>
<td>14</td>
<td>1.5%</td>
</tr>
<tr>
<td>Seabird</td>
<td>6</td>
<td>0.6%</td>
</tr>
<tr>
<td>Owl</td>
<td>4</td>
<td>0.4%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>935</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>


It is generally accepted that nocturnally migrating passerines fly in broad fronts (Lowry and Newman 1966, Bellrose 1971). This means as passerines migrate, they fan out across the flyway, feeding at stopover sites that are widely dispersed in the landscape. Also, it is generally accepted that nocturnally migrating passerines fly mostly at altitudes well above the rotor-swept area of wind turbines (Kerlinger 1995, Mabee and Cooper 2002, Mabee et al. 2004). However, migrant passerines may fly at lower altitudes in inclement weather and increase their risk of collisions with wind turbines along ridge lines. Even in favorable conditions, landing and taking off at night or dusk puts migrants at risk of collision, particularly when wind projects are proximal to stopover sites.

Although nocturnally migrating passerines are expected to pass above the Project area during spring and fall migration periods, most of these individuals are flying at consistently high altitudes above the height of the proposed turbines, as has been documented in the vast majority of recent radar surveys conducted at proposed wind facilities in the northeast (Appendix J, Table J-2). Literature review also suggested that, while impacts to nocturnally migrating passerines occur at most wind energy facilities, very small numbers of birds have collided with turbines relative to the large numbers of nocturnally migrating passerines (Erickson et al. 2002).

**Raptors.** Wind project fatalities include many species of birds, but raptor mortality has received the most attention. Wind projects may have an impact on raptor populations due to their long life-span and low reproductive potential.

The high rates of mortality specific to raptors found in California, particularly at Altamont Pass, have been attributed to a combination of characteristics (Orloff and Flannery 1992, Anderson et al. 2004, 2005, Smallwood and Thelander 2004, 2005). High mortality rates at this site have been linked to the relatively high density of raptors. The high density of raptors at Altamont Pass is probably related to the high density of prey resources. Thus the high density of raptors, along with the high density of turbines, increases the likelihood of bird-turbine collision at this site. In addition, the older turbines at Altamont Pass are supported on lattice towers that provide perches and operate with fast-spinning blades that may be difficult for raptors to avoid while foraging.

Significantly fewer raptors have been documented colliding with newer wind turbines than at the older California facilities. In general, projects constructed outside of California and within the last 5 to 15 years have much lower raptor density and probably lower prey densities (Erickson et al. 2002). Additionally,
newer developments have widely spaced turbines placed on tall tubular towers and blades that spin slow enough to remain visible even at high wind speeds. Studies have documented raptors exhibiting turbine-avoidance behaviours at modern wind facilities (Whitfield and Madders 2006, Chamberlain et al. 2006). The mechanism for this turbine avoidance is unknown; however, most raptors are diurnal and have good eyesight, suggesting they may be able to detect turbines visually as well as acoustically.

Raptors tend to migrate or travel locally along prominent landscape features, and wind turbines are typically built on prominent landscape features. However, evidence suggests that the risk of raptor collision with turbines is relatively low (see Table 5-10 and Table 5-11). Of 935 avian fatalities, raptors represented 5.6% of all fatalities. It has been difficult to determine if raptors involved in collisions were actively migrating or were local birds due to the timing overlap in occurrences of both at study sites. Collisions may have involved both migrant and local birds. Table 5-11 lists raptor mortalities by species based on the results of 31 post-construction studies.

Table 5-11. Species composition of documented raptor fatalities at wind farms in the Eastern and Midwestern U.S.

<table>
<thead>
<tr>
<th>Species</th>
<th>Number of individuals (% of total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turkey vulture</td>
<td>21 (40 %)</td>
</tr>
<tr>
<td>Red-tailed hawk</td>
<td>16 (31 %)</td>
</tr>
<tr>
<td>Sharp-shinned hawk</td>
<td>6 (11 %)</td>
</tr>
<tr>
<td>American kestrel</td>
<td>4 (8 %)</td>
</tr>
<tr>
<td>Broad-winged hawk</td>
<td>2 (4 %)</td>
</tr>
<tr>
<td>Osprey</td>
<td>2 (4 %)</td>
</tr>
<tr>
<td>Cooper’s hawk</td>
<td>1 (2 %)</td>
</tr>
<tr>
<td>Total</td>
<td>52</td>
</tr>
</tbody>
</table>


For the BRE Project, raptors were surveyed during spring and fall migration. In Phase I, results from spring surveys of pre- and post-construction conditions cannot be compared as methods differed between the 2 studies (Canterbury 2006, Young et al. 2012a). Young et al. (2012a, 2012c) found overall raptor use within the Project area to be slightly lower than that observed at other Hawk Watch sites in the region; however, project raptor surveys missed the peak period of several species of raptors and thus may have underestimated abundance.

Relationships have not been established between pre-construction and post-construction survey results with regard to raptor mortality. Based on post-construction monitoring studies at other operating wind energy facilities, raptors most likely to be impacted are resident birds that forage in open country, such as red-tailed hawks, as opposed to migrating raptors that pass through the area.

The 100-turbine Project has the potential to kill raptors. Based on what has been observed at existing wind projects in the eastern US, the rate of raptor mortality (excluding eagles) is not expected exceed more than 1-3 raptors and 6 vultures a year. Based on raptor surveys from 2005, the existing Phase I turbines located on Cold Knob and Beech Knob may pose a slightly higher risk to raptors than other portions of the study area (Canterbury 2006).

Following the Draft Eagle Conservation Plan Guidelines (Service 2011e), we used existing project eagle survey information to model the risk of take of bald and golden eagles from the proposed 100-turbine project. Preliminary results from the model predicted a moderate risk of take of 0.28 bald eagles per year on average (with an 80% confidence interval between 0 and 0.43 eagle per year), and a high risk of take of 1.0 golden eagle per year on average (with an 80% confidence interval between 0 and 1.6 eagles per year). BRE is collecting additional data on eagle use in the area to help refine this estimate and identify ways to determine ways to avoid, minimize, and if necessary, mitigate impacts during peak periods of eagle use. Additional surveys during peak migration will better assess how eagles use the area during the periods of highest use (e.g., whether they pass through the area quickly, what heights eagles fly at, whether eagles stop over within the project area to rest or feed).

The WVPSC siting certificate issued for the Project required a post-construction eagle and osprey study be conducted. Based on an agreement with the TAC, BRE will contribute to an ongoing eagle study conducted by West Virginia University to meet this requirement for eagles.

To date, there are 4 documented bald eagle fatalities (Brown and Hamilton 2006, Riddell in litt. 2010) and 1 documented injury (IDNR 2011) at modern industrial-scale wind energy facilities in North America. There also has been one bald eagle fatality at a small 60-foot-tall wind turbine in the Chesapeake Bay area of eastern Maryland (S. Nystrum, USFWS, pers. commun. 2012). There have been no documented bald eagle or golden eagle fatalities at industrial wind projects on ridgelines in the Appalachian Mountains. However rare, if the Project were to kill either a bald eagle or golden eagle, this would be considered a significant effect due to their protected status under BGEPA.

If a bald or golden eagle fatality occurs at the Project, BRE will conduct follow-up post-construction monitoring in the season in which the fatality occurred and during the subsequent year of operations to assess whether avoidance or mitigation measures are effective at reducing impacts on eagles. Avoidance and minimization actions under adaptive management could include: removing/modifying the source(s) of bird attraction; implementing turbine operational protocols designed to reduce bird fatalities at turbines that data show are likely to take bald and/or golden eagles, or have shown higher than average fatality rates; implementing technological solutions; and negotiating with transmission line owners to retrofit power poles to adhere to APLIC guidelines (APLIC 1994, 2006).

**Waterbirds.** Because there are small ponds and wetlands in the Project area and its vicinity, some waterbirds (waterfowl, wading birds, shorebirds, rails) may be present and could be at risk of colliding with turbines. However, research shows that waterfowl and other waterbirds rarely collide with wind turbines (see Table 5-10 and studies referenced). Waterbirds represent small percentages of the avian fatalities documented. Risk of collision to migrant waterfowl is likely to be minimal due to their tendency to migrate at high altitudes (Kerlinger and Moore 1989, Bellrose 1976). The potential for collision risk to resident and migrant waterbirds in the Project area is not likely to be significant.

**Estimated Bird Mortality from Project Turbine Operations**

There currently is no predictive model available to quantify expected avian collision mortality as a result of wind power turbine operation. Therefore, risk assessments must be based on pre-construction indices and indicators of risk (e.g., breeding bird and raptor migration surveys), along with empirical data from operating facilities (e.g., avian mortality surveys). When related to post-construction data, information from pre-construction surveys perceived as indicators of elevated risk (e.g., unusually high numbers, unusually low flight altitude, habitat that will act as an attractant, abundance of rare species) has not been reliably linked to mortality. Mortality rates can vary from year to year at the same site and seem to be...
influenced by weather events such as fog during peak migration that force birds to fly lower than normal and seek a landing. This is particularly apparent for night-migrating songbirds that tend to migrate in broad fronts rather than narrowly defined migration corridors. Therefore, based on existing data, we assume that mortality in the Project area is likely to be consistent with post-construction fatality rates at other wind sites on forested ridgelines and escarpments in the mid-Atlantic region (Table 5-12 and Table 5-13).

To arrive at an average fatality rate, we used comparable studies from wind power projects located on forested ridgelines or escarpments in the mid-Atlantic region. To reduce bias, we selected studies with comparable study periods, search frequencies, and contemporary fatality formulas:

- Searches conducted from early-April to mid-October or mid-November (corresponding to peak bird activity seasons from spring, summer and fall);
- Searches conducted daily (to minimize bias associated with predators removing carcasses before searchers have an opportunity to look for carcasses);
- Mortality rates adjusted, based on results of searcher efficiency and scavenger removal trials, and search conditions; and
- Mortality rates adjusted using contemporary equations rather than older equations that tend to be biased low; e.g., the contemporary modified Shoenfeld estimator (Erickson et al. 2004) or Huso estimator (Huso 2010).

Our approach assumes that all sites are equal with their potential to kill birds. Realistically, different sites and different turbines vary in the amount that they would contribute to regional bird mortality. Despite these limitations, this effort represents a reasonable approach to using the best scientific information available from which to make inferences about potential Project bird mortality, including relative comparisons among Alternatives.

Our analysis showed that estimates of average bird mortality from wind turbines on forested ridgelines and escarpments in the mid-Atlantic region are similar using either of two contemporary fatality estimators: 4.61 birds per turbine per year (using the modified Shoenfeld estimator) versus 4.91 birds per turbine per year (using the Huso estimator) (Table 5-12 and Table 5-13). Therefore, to calculate the overall average bird fatality rate for the mid-Atlantic region and the Project, we used the higher Huso estimator when studies used more than one estimator. Using the higher estimator err on the side of the species by predicting a slightly worse impact than if one only used one estimator.

Thus, we are using an average mortality rate of 5.32 birds per turbine per year, based on 14 post-construction studies at 8 wind projects located on forested ridgelines or escarpments in the mid-Atlantic region. Table 5-14 provides a summary of the bird mortality estimates for the 67- and 100-turbine Projects based on the rate of 5.32 birds per turbine per year.

In the Project APP (Appendix B), BRE found 5.85 birds per turbine per year to be the regional average mortality rate for birds on forested ridgelines in the eastern U.S. This is slightly higher than our estimated rate of 5.32 birds per turbine per year for forested ridgelines and escarpments in the Mid-Atlantic region. The 2 rates are not significantly different and are likely the result of only minor differences in geographic scope, studies used, and data analyses. The rate provided in the APP is within the range of mortality observed at wind projects in the Mid-Atlantic region (0-15.69 birds per turbine per year) and within the range we would expect for average mortality in the region (roughly 5-6 birds per turbine per year) in most years.

Using the rate of 5.32 birds per turbine per year, we estimate that the Proposed Action (Alternative 2) will result in 532 bird deaths per year as a result of operating 100 turbines. Based on this annual mortality estimate, the Project is expected to kill 13,300 birds over a 25-year period. Confidence intervals from the 14 studies provide a range of mortality estimates from a low of 0 birds per turbine per year to a high of 15.69 birds per turbine per year (Table 15.12). Applying these values, the 100-turbine project possibly could result in annual mortalities of up to 1,569 birds per year in some years (a worst case scenario), or
as low as zero birds per year in some years (in a best case scenario). Realistically, however, in most years we would predict values closer to the average value than the extreme ends of variation.
Table 5-12. Estimates of bird mortality at 8 existing wind farms on forested ridgelines and escarpments in the mid-Atlantic region. Operational cut-in speeds ranged from 3.0 m/s to 4.0 m/s, and searches were conducted on a daily basis. Mortality rates presented were derived using the modified Shoenfeld estimator (Erickson et al. 2004).

<table>
<thead>
<tr>
<th>Site and state</th>
<th>No. turbines</th>
<th>Dates surveyed</th>
<th>Estimated mortality rate (mean)</th>
<th>Annual project mortality based on mean</th>
<th>CI for mortality rate</th>
<th>Annual project mortality range based on CI</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mount Storm, West Virginia</td>
<td>132</td>
<td>Mar 23 – Oct 8, 2009</td>
<td>8.74 (^4)</td>
<td>1,154</td>
<td>5.12-12.77 (^4)</td>
<td>676-1,686</td>
<td>Young et al. (2009b, 2010a)</td>
</tr>
<tr>
<td>Mount Storm, West Virginia</td>
<td>132</td>
<td>Apr 16 - Oct 15, 2010</td>
<td>6.74 (^4)</td>
<td>890</td>
<td>3.92-10.03 (^4)</td>
<td>517-1,324</td>
<td>Young et al. (2010b, 2011c)</td>
</tr>
<tr>
<td>Mount Storm, West Virginia</td>
<td>132</td>
<td>Apr 12 – Oct 15, 2011</td>
<td>8.49 (^4)</td>
<td>1,121</td>
<td>6.59-12.36 (^4)</td>
<td>870-16,35</td>
<td>Young et al. (2011d, 2012d)</td>
</tr>
<tr>
<td>Casselman, Pennsylvania</td>
<td>23</td>
<td>Apr 19 - Nov 15, 2008</td>
<td>2.27</td>
<td>52</td>
<td>0.88-3.92</td>
<td>20-90</td>
<td>Arnett et al. (2009a), Librandi-Mumma and Capouillez (2011)</td>
</tr>
<tr>
<td>Locust Ridge II, Pennsylvania</td>
<td>51</td>
<td>Apr 1 – Nov 15, 2010</td>
<td>1.51</td>
<td>77</td>
<td>0.64-2.61</td>
<td>33-133</td>
<td>Arnett et al. (2011)</td>
</tr>
<tr>
<td>Site 6-3, Pennsylvania</td>
<td>nr</td>
<td>Apr 1 – Nov 15, 2007</td>
<td>1.80</td>
<td>--</td>
<td>nr</td>
<td>--</td>
<td>Librandi-Mumma and Capouillez (2011)</td>
</tr>
<tr>
<td>Site 2-14, Pennsylvania</td>
<td>nr</td>
<td>Apr 1 – Nov 15, 2009</td>
<td>5.00</td>
<td>--</td>
<td>0.00-6.90</td>
<td>--</td>
<td>Librandi-Mumma and Capouillez (2011)</td>
</tr>
<tr>
<td>Site 2-10, Pennsylvania</td>
<td>nr</td>
<td>Apr 1 – Nov 15, 2009</td>
<td>1.30</td>
<td>--</td>
<td>0.00-3.20</td>
<td>--</td>
<td>Librandi-Mumma and Capouillez (2011)</td>
</tr>
</tbody>
</table>

Mean rate (n=14) 4.61 Range (n=14) 0.00-12.77

1 Mortality rate is expressed in birds per turbine per year. 2 Turbine number x estimated mortality rate. 3 Ranges based on 90% or 95% confidence intervals. 4 Results from 2 post-construction studies in each year were summed to derive the rate.
Table 5-13. Estimates of bird mortality at 2 existing wind farms on forested ridgelines in the mid-Atlantic region. Operational cut-in speeds ranged from 3.0 m/s to 4.0 m/s, and searches were conducted on a daily basis. Mortality rates presented were derived using the Huso (2010) estimator.

<table>
<thead>
<tr>
<th>Site and state</th>
<th>No. turbines</th>
<th>Dates surveyed</th>
<th>Estimated mortality rate (mean)(^1)</th>
<th>Annual project mortality based on mean(^2)</th>
<th>CI for mortality rate(^{1,3})</th>
<th>Annual project mortality range based on CI(^3)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pennsylvania</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Locust Ridge II,</td>
<td>51</td>
<td>Apr 1 – Nov 15, 2010</td>
<td>2.20</td>
<td>112</td>
<td>0.82-4.52</td>
<td>42-231</td>
<td>Arnett et al. 2011</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mean rate (n=4) 4.91 Range (n=4) 0.82-15.69

\(^1\) Mortality rate is expressed in birds per turbine per year.  
\(^2\) Turbine number x estimated mortality rate.  
\(^3\) Ranges based on 90% or 95% confidence intervals.
Table 5-14. Predicted bird mortality for the Beech Ridge Energy Wind Project based on either a 67- or 100-turbine Project and 2 or 4 MET towers. Turbine mortality rates were derived using a combination of the modified Shoenfeld estimator (Erickson et al. 2004) and Huso (2010) estimator for 14 post-construction studies. MET tower mortality was derived as described in the text under the No-Action Alternative section 5.7.2.1.

<table>
<thead>
<tr>
<th>Mortality rate 1</th>
<th>Alternatives 1 and 4: 67-turbine Project + 2 MET Towers</th>
<th>Alternatives 2 and 3: 100-turbine Project + 4 MET Towers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Annual mortality</td>
<td>Life of Project mortality 2</td>
</tr>
<tr>
<td>Turbines:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>5.32</td>
<td>356</td>
</tr>
<tr>
<td>Low end of range</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td>High end of range</td>
<td>15.69</td>
<td>1,051</td>
</tr>
<tr>
<td>MET Towers:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guyed</td>
<td>21.3</td>
<td>43</td>
</tr>
<tr>
<td>Unguyed</td>
<td>0</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL (mean)</td>
<td>399</td>
<td>9,976</td>
</tr>
</tbody>
</table>

1 Mortality is expressed in birds per turbine per year or birds per tower per year.
2 Based on 25-year operational life across all turbines and towers in the Project.

Bird Mortality from Project Meteorological Towers
As previously discussed for the No-Action alternative, the Phase I Project has 2 lattice MET towers (Figure 1-2) 262 ft in height, lighted (single flashing light), and supported by guy wires. Phase II includes the addition of up to 2 self-supporting (unguyed) lattice MET towers 262 ft in height and lighted (single flashing light). This analysis assumes that the 4 Project MET towers under Alternative 2 (Proposed Action) will pose collision risk to birds.

As explained for the No-Action Alternative, we assumed that the 2 existing guyed MET towers in Phase I would kill 43 birds per year or 1,065 birds for the life of the Project (Table 5-14). We assumed the 2 future unguayed MET towers for Phase II would kill few to no birds for the life of the Project (Table 5-14). Thus, under the Proposed Action, we predict total mortality from birds colliding with turbines and MET towers is roughly 600 birds per year or 14,400 birds for the life of the Project (Table 5-14).

Bird Group Differences. Using the percentages shown in Table 5.10, we estimated the bird group composition of the Project mortality. Mortality by bird group from implementation of a 67- and 100-turbine project is presented in Table 5-15.
Table 5-15. Predicted composition of bird mortalities based on extrapolation of mortality composition from 31 post-construction studies conducted in the eastern and Midwestern U.S. The total predicted bird mortality from turbines and MET towers shown in Table 5-14 is spread across bird groups. This analysis does not assume that curtailment affects bird mortality.

<table>
<thead>
<tr>
<th>Bird group</th>
<th>Relative mortality</th>
<th>Alts. 1 and 4: 67-turbine Project + 2 MET Towers</th>
<th>Alts. 2 and 3 :100-turbine Project + 4 MET Towers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Annual mortality</td>
<td>Life-of-Project mortality</td>
</tr>
<tr>
<td>Passerine</td>
<td>0.736</td>
<td>295</td>
<td>7,343</td>
</tr>
<tr>
<td>Unidentified bird</td>
<td>0.116</td>
<td>47</td>
<td>1,157</td>
</tr>
<tr>
<td>Raptor</td>
<td>0.056</td>
<td>22</td>
<td>559</td>
</tr>
<tr>
<td>Gamebird</td>
<td>0.045</td>
<td>16</td>
<td>449</td>
</tr>
<tr>
<td>Waterfowl</td>
<td>0.022</td>
<td>9</td>
<td>219</td>
</tr>
<tr>
<td>Shorebird</td>
<td>0.015</td>
<td>6</td>
<td>149</td>
</tr>
<tr>
<td>Seabirds</td>
<td>0.006</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>Owl</td>
<td>0.004</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>0.736</td>
<td>295</td>
<td>7,343</td>
</tr>
</tbody>
</table>


The Service has identified bird species of conservation concern, i.e., those “migratory and non-migratory bird species (beyond those already designated as federally threatened or endangered) that represent [the Service’s] highest conservation priorities” (USFWS 2008a). Without additional action, these species are likely to become candidates for listing under the ESA. Birds of conservation concern were identified based on assessment of population trends, threats, distribution, abundance, and relative density. Within the Appalachian Mountains region (BCR 28), 25 bird species of concern have been identified. We analyzed a subset of 10 of these birds based upon known presence in the Project area during breeding and/or migration; presence of the species' habitat type on-site; and, with exception of the golden-winged warbler, documented mortality of these species at wind power projects in the eastern U.S.

Table 5-16 provides estimates of annual and life-of-Project turbine mortality for these 10 bird species of conservation concern compared to estimated population sizes in the Appalachian Mountains region (BCR 28) and West Virginia. We applied the overall bird mortality rates from Table 5-14 for turbines and MET towers, but bracketed our predictions by using average fatality rate in the mid-Atlantic region of 5.32 birds per turbine per year, as well as the high end of the confidence interval (15.69 birds per turbine per year) as a worst-case analysis, given that there are uncertainties associated with data on bird population sizes, survival, and reproduction.

Coarse population trends and estimates were obtained from published and on-line sources of Breeding Bird Survey (BBS) data (Table 5-8). The population estimates were taken from publicly available Partners in Flight (PIF) databases, which are based upon an average of BBS data from the years 1990 to 1999 (PIF and RMBO 2004). These PIF estimates typically are considered to represent the population size in 1995, the mid-point of the range over which the BBS data were averaged to arrive at the estimates.

There is considerable uncertainty about the total population sizes associated with these species, and the potential kill that might be expected. The population estimates are from approximately 1995, however,
updated estimates of population sizes are not yet available. Thogmartin et al. (2006) noted problems with trying to convert BBS indices of abundance to population estimates. The population estimates are derived from indices of relative abundance which are adjusted by several factors: presumed area of species breeding ranges; by pair (assuming each male bird recorded has a mate); by detection area; and by time of day. There is much variation associated with the data and variance estimates are not available. The roadside breeding bird surveys also under sample certain habitat types, such as mountaintops and interior forest. In addition, because surveyors count birds for only 3-minute intervals, they likely miss many birds. While the number and proportion of undetected birds present on BBS counts is unknown (Blancher et al, 2007), it could easily exceed 50% (R Dettmers, USFWS, personal communication, June 20, 2012). Thus population estimates derived from these surveys may underestimate species abundance. In addition, the mortality rate of these species is also likely to change as more information is collected from post-construction studies. Thus we consider the 1995 population numbers as our best estimate at this time. We consider these values to be “ball park” figures and do not regard them as precise. Future assessments are likely to use more updated information as we learn more. These data are best used to discern overall population trends (stable, increasing, or decreasing) and to make relative comparisons of effects across alternatives. While highly variable and imprecise, these population estimates are the best available scientific information upon which to provide context for environmental assessment and cumulative effects analysis of various sources of mortality.

We supplemented the PIF data analysis by also looking at BBS population trend analysis conducted by USGS and available on-line (Sauer et al. 2011). The USGS trend data allow for comparison at various scales and time frames, include confidence intervals, and assign a reliability measure to the trend (Appendix M). Numbers in Appendix M represent percent mean annual change in abundance across the time frames indicated. Variation around the mean (95% confidence intervals) is shown in parentheses. Numbers in red font could be interpreted as a declining trend, black font as a stable trend, and blue font as an increasing trend. Background shading in each block indicates a regional credibility measure assigned by USGS. Aqua background shading in the table indicates the greatest reliability and red shading the worst. (See Appendix M for more details.)

Looking at a regional and local scale, the blue-winged warbler appears relatively stable in the Appalachian Mountains region and West Virginia. The black-billed cuckoo appears to show a declining trend in the Appalachian Mountains and a relatively stable trend in West Virginia but there are some problems with the credibility of the data related to small sample sizes and precision. The Canada warbler appears to be stable in the Appalachians and increasing in West Virginia, but there are problems with small sample sizes and precision. The Kentucky warbler, prairie warbler, golden-winged warbler, Cerulean warbler, and wood thrush show declines in the long-term and short-term in the Appalachian Mountains and West Virginia. The golden-winged warbler shows the greatest decline of all species (approximately 8 to 9 % annually). The golden-winged warbler, Kentucky warbler, and prairie warbler show greater declines in the Appalachian Mountains and West Virginia than survey-wide or in the Eastern BBS region.

Based on the rough population estimates, each species contribution to total fatalities, and the Project’s annual turbine bird mortality based on the worst-case high-end estimate, the 100-turbine Project (the Proposed Action) potentially would kill a small fraction between 0.0004% and 0.06% of the estimated BCR 28 (Appalachian Mountains) population of any of these 10 species in any given year. While these percentages are small, we recognize that many of these birds show long-term trends of likely or suspected declines over a 45-year period (Table 5-8 and Table 5-16). Thus bird mortality from the Project would be expected to contribute slightly to ongoing declines originating from many sources of bird mortality.

38 PIF is in the process of calculating updated population estimates based on BBS data from 2000 to 2009, but the numbers have not yet been released. Should they become available prior to our final EIS, we will incorporate the updated numbers at that time.

39 While one could attempt to update the PIF 1995 population estimates to 2010 by applying the USGS trend data (mean annual % change), we have not done so, as this simple calculation would likely be inaccurate and compound many sources of error and variation in the data. The PIF population estimates are derived using complex formulas that make several adjustments to the data: pair adjustment, detection-area adjustment, and time of day adjustment. (Thogmartin et al. 2006).
Studies show that most bird mortality occurs at wind power projects during fall migration. While the exact origin of migrating birds is unknown, we would predict most mortality to occur to migrating birds in the fall originating from many source populations. A small but unknown proportion of the fatalities would be expected to occur to local breeding birds. Table 5-16 provides estimates of the project’s potential effect on breeding birds of conservation concern in West Virginia. Based on this analysis, the 100-turbine Project and 2 guyed MET towers potentially would kill a small proportion (<0.6%) of the estimated West Virginia population of any of these 8 species in a year. This analysis likely overestimates the effect because it assumes all mortality would be to birds originating from local populations and does not account for annual recruitment.

In the event that significant bird mortality does occur, the APP includes adaptive management provisions to test different strategies to reduce mortality and/or to mitigate for it. This includes testing turbine curtailment, and adjustments related to the highest risk turbines, times of year, and weather events. The approximately 300-acre offsite high-quality forest conservation area targeted in the HCP for Indiana bat would provide incidental benefits to birds in perpetuity. This high-quality older forest is surrounded by an extensive intact forest network. Protection of an intact block of forest would remove threats of logging and development in perpetuity, which would provide secure nesting sites for birds. BRE has initiated discussions with the landowner about purchasing the tract. In the event that the deal falls through, the HCP includes criteria for selecting alternate conservation sites or projects for bats. These alternate projects (e.g. cave gating) may not benefit birds. Thus the APP includes provisions for off-site habitat protection and/or research for birds, if needed.
Table 5-16. Potential effect of Alternative 2 and Alternative 3 (100 turbines and 4 MET towers) on 10 birds of conservation concern and relationships to breeding bird survey trends and estimated breeding population sizes in West Virginia and the Appalachian Mountains region.

<table>
<thead>
<tr>
<th>Species</th>
<th>BCR 28 population, 1995</th>
<th>West Virginia population, 1995</th>
<th>Proportion of total fatalities</th>
<th>Annual mortality</th>
<th>Maximum number killed in 25-years</th>
<th>Maximum % of BCR 28 population affected annually</th>
<th>Maximum % of West Virginia population affected annually</th>
<th>% of North American population affected in 25 years</th>
<th>% of Atlantic flyway population affected in 25 years</th>
<th>% change over 45 years (average % change annually)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue-winged warbler</td>
<td>190,000</td>
<td>50,000</td>
<td>0.00562</td>
<td>3-9</td>
<td>226</td>
<td>0.005</td>
<td>0.02</td>
<td>0.02-0.55</td>
<td>0.03-0.09</td>
<td>-0.3 (0.007) s</td>
</tr>
<tr>
<td>Cerulean warbler</td>
<td>450,000</td>
<td>200,000</td>
<td>0.00152</td>
<td>1-2</td>
<td>61</td>
<td>0.0004</td>
<td>0.001</td>
<td>0.006-0.02</td>
<td>0.009-0.02</td>
<td>-3.0 (0.07) s</td>
</tr>
<tr>
<td>Black-billed cuckoo</td>
<td>79,000</td>
<td>13,000</td>
<td>0.00910</td>
<td>5-15</td>
<td>367</td>
<td>0.003</td>
<td>0.1</td>
<td>0.01-0.04</td>
<td>0.04-0.12</td>
<td>-2.9 (0.06) s</td>
</tr>
<tr>
<td>Kentucky warbler</td>
<td>250,000</td>
<td>70,000</td>
<td>0.01124</td>
<td>6-18</td>
<td>453</td>
<td>0.007</td>
<td>0.03</td>
<td>0.01-0.04</td>
<td>0.14-0.35</td>
<td>-0.7 (0.02) s</td>
</tr>
<tr>
<td>Canada warbler</td>
<td>28,000</td>
<td>3,000</td>
<td>0.01124</td>
<td>6-18</td>
<td>453</td>
<td>0.06</td>
<td>0.6</td>
<td>0.01-0.04</td>
<td>0.03-0.08</td>
<td>-2.2 (0.05) s</td>
</tr>
<tr>
<td>Prairie warbler</td>
<td>260,000</td>
<td>40,000</td>
<td>0.00152</td>
<td>1-2</td>
<td>61</td>
<td>0.0008</td>
<td>0.005</td>
<td>0.002-0.005</td>
<td>0.01-0.04</td>
<td>-2.3 (0.05) s</td>
</tr>
<tr>
<td>Bay-breasted warbler</td>
<td>NA</td>
<td>NA</td>
<td>0.01124</td>
<td>6-18</td>
<td>453</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>0.003-0.008</td>
<td>0.3 (0.007) ns</td>
</tr>
<tr>
<td>Red crossbill</td>
<td>3,000</td>
<td>NA</td>
<td>0.00152</td>
<td>1-2</td>
<td>61</td>
<td>0.07</td>
<td>NA</td>
<td>0.0004-0.001</td>
<td>0.01-0.04</td>
<td>-0.8 (0.02) ns</td>
</tr>
<tr>
<td>Wood thrush</td>
<td>4,500,000</td>
<td>1,000,000</td>
<td>0.01124</td>
<td>6-18</td>
<td>453</td>
<td>0.0004</td>
<td>0.002</td>
<td>0.001-0.004</td>
<td>0.003-0.009</td>
<td>-1.8 (0.04) s</td>
</tr>
<tr>
<td>Golden-winged warbler</td>
<td>20,000</td>
<td>8,000</td>
<td>Not documented</td>
<td>1-2</td>
<td>50</td>
<td>0.01</td>
<td>0.03</td>
<td>0.01-0.03</td>
<td>0.14-0.28</td>
<td>-2.6 (0.06) s</td>
</tr>
</tbody>
</table>

1 Estimates of breeding populations based on Breeding Bird Survey data using the Partners in Flight approach to estimating population size (Blancher et al. 2007). Estimates of breeding populations typically are portrayed as representing 1995, the mid-point of the survey timeframe (PIF and RMBO 2004). Numbers will be revised should updated population estimates become available prior to the FEIS.

2 Proportion of birds killed by species based on totals from post-construction surveys at Mount Storm Wind Energy Facility, Grant County, West Virginia (Young et al. 2009, 2010, 2011c). If species not documented at Mount Storm, proportion was based on totals from publicly available data from mortality surveys conducted in the Eastern US (as compiled by Stantec Consulting Services Inc.).

3 Fatalities based on multiplying species proportions (from column 4 in this table) x total predicted bird mortality from 100 turbines and 2 MET towers for 1 year (from Table 5-14), bracketing the mean (575 birds annually) with the high end (1,612 birds).

4 Fatalities based on multiplying number of birds in column 5 times 25 years.

5 Based on USGS Breeding Bird Survey trend analysis for North America, 1966-2010 (Sauer et al. 2011).

6 Because golden-winged warblers have not been detected during post-construction monitoring surveys, the value of 2 is provided to illustrate a potential life-of-Project effect on the Atlantic flyway population; s = significant, ns = not significant.
Of particular note is the Project’s potential impact to golden-winged warblers. This species has experienced roughly a 9-10% annual decline in West Virginia between 1966 and 2010. Based upon pre-construction surveys, we assume a small breeding population of golden-winged warblers is present on and near the project site. The Project will impact an unknown amount of habitat suitable for golden-winged warblers. Habitat clearing will create temporary openings that quickly change to early successional, young forest edge habitat with brushy (briery) components favored by this species. This habitat benefit will typically last for 10 to 15 years until the habitat becomes overgrown with trees.

Because the project area has existing habitat and likely will create habitat, it may attract golden-winged warblers to the turbine risk zone and has the potential to kill both breeding and migrant warblers. While this species has not been observed in mortality studies at wind power projects built within its range, we are aware of no studies specifically designed to monitor habitat changes or to detect impacts to breeding or migrating golden-winged warblers. \(^4\) Post-construction studies typically monitor roughly 20 to 25% of all turbines and thus could easily miss a rare bird species killed at a turbine or MET tower that is not monitored. The species is known to collide with structures and has been identified as a “super collider” with communication towers (i.e., killed in higher numbers than would be expected by chance) (Arnold and Zink 2011). For purposes of this analysis, we estimated conservatively that the turbines were likely to kill no more than a small number of golden-winged warblers (1 to 2) annually. While it is not possible to estimate precisely the significance of these effects on a species that is near the southern limit of its range and regionally rare, the Service concludes that even small takes of this on-site small breeding population could be significant at the local scale, should it occur, given the local and regional population trend.

Should significant mortality of any migratory bird species occur, the APP includes measures to reduce and/or mitigate for it through an adaptive management framework designed to test the effectiveness of mortality reduction measures.

In summary, average and median bird fatality rates generally fall between 5 and 6 birds per turbine for the period from April 1 to November 15. These estimates vary across and within sites and generally range from 1 to 10 birds per turbine on average. When one considers confidence intervals as a measure of variation in mortality estimates, it is possible that during some years mortality rates could be as low as zero birds per turbine for some projects and as high as 15 birds per turbine for other projects. However, one would expect few projects to consistently be at these extreme ends of variation.

We predict that the 100-turbine Project and MET towers will cause bird mortality somewhere in the neighborhood of 500 to 600 birds per year; most of those (~75%) will be passerines and a few may be raptors (~6%, this includes vultures). Predictions will be validated through post-construction monitoring for the life of the project (described in more detail below). Should the Service determine that significant bird mortality has occurred (defined as take of an eagle, take of all migratory birds substantially exceeding the regional average of 5.32 birds per turbine per year, or take of an individual bird species likely to adversely affect the long-term status of that population), then BRE will work with the Service to reduce this mortality or mitigate for it as described in its APP.

**Summary of Collision Effects of Proposed Action to Avian Resources**

Available literature on avian collision at wind farms has been increasing due to the growing number of projects available for study. The majority of avian fatalities at existing wind farms appear to be of nocturnally migrating songbirds. The factors that influence increased risk of collision appear to be a combination of overall abundance, weather, and species-specific flight behaviours.

Certain predictions can be made about patterns of collision mortality of nocturnally migrating passerines at the BRE Wind Project. Mortality associated with collisions with modern wind turbine models in the U.S.

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\(^4\) For example, the Mount Storm Wind Power project in West Virginia occurs within the breeding range of the species. Migrant golden-winged warblers were seen near the project site during spring and summer 2003 pre-construction surveys but no breeding territories were found (Young et al. 2003). Surveyors concluded that vegetation in the project area at the time was atypical of golden-winged warbler habitat (i.e. it was too open and lacked dense shrubs). Post-construction studies have not been specifically designed to monitor this rare species and it is unknown whether or not more typical habitat has developed over time. Monitoring of approximately 20% of the 132 turbines annually for 3 years has not detected a dead golden-winged warbler to date (Young et al. 2009a, 2009b; 2010, 2011c).
has not been known to result in a significant population level impact to any one species, mainly because
the species with relatively high rates of collision mortality are regionally abundant. Collision mortality at
the Project is expected to be within the range of mortality observed at existing facilities in montane forest
landscapes in the Eastern U.S.

The anticipated mortality of passerines, raptors, and other birds at the BRE Project is expected to be
similar to that observed at 8 other modern facilities in the mid-Atlantic region. Excluding vultures and
eagles, overall raptor fatalities are expected to be 1 to 3 per year. The 100-turbine Project is expected kill
1-6 vultures per year, and these are most likely to be turkey vultures. A moderate risk of take of bald
eagles (0.28 birds per year estimated by the Service model) and golden eagles (1.0 bird per year
estimated by the Service model) will be reduced through an adaptive management framework which
includes monitoring of eagle flight paths and heights to determine ways to avoid, minimize, and if
necessary, mitigate impacts during peak periods of eagle use.

100-Turbine Decommissioning
BRE’s plan for decommissioning includes land reclamation, monitoring of revegetation, and reseeding if
needed to ensure revegetation success. Ground cover (vegetation) must cover at least 70% of the given
disturbed area based on specific state reclamation requirements. Small amounts of regenerated forest in
the original construction disturbance areas may be cleared again to allow crane access for removing
Project components. This will set back the forest regeneration process in these newly cleared areas, but
these affected areas are expected to be very small.

Direct impacts to avian resources associated with decommissioning would be similar to that associated
with Project construction impacts, but habitat conversion will be significantly less in magnitude.
Disturbance associated with decommissioning will likely be shorter in duration as compared to
construction. It is not likely to take as much time to dismantle the Project as for construction, especially as
Phase I construction experienced interruptions in construction during the court case and Settlement
Agreement activities.

Disturbed areas and access roads will be graded to the original contour as near as practicable if the
landowner requests that BRE decommission these areas. If requested by the landowner, access roads
will be left in place.

Avoidance and Minimization Measures for Avian Resources
Under the Proposed Action, BRE will implement the following measures to avoid and minimize impacts to
birds.

Phase II Construction
- Fragmentation of wildlife habitat has been and will continue to be minimized through the use,
where practical, of lands already disturbed, including using existing roadways.
  To minimize the potential for the destruction of nests, eggs, and young, clearing of trees would be
  conducted outside the nesting season, with the exception of 15 acres of trees that may be
  cleared during the nesting season. If clearing is required during the nesting season, habitats will
  be surveyed for nests by a trained biologist prior to clearing. If an active nest is found, an
  appropriate buffer will be established around the nest until the young have fledged.
- During Project construction, riparian areas will be avoided, where feasible. If avoidance is not
  feasible, activities within riparian areas will be conducted in conformance with SWPPP
  requirements.
- Removal or disturbance of vegetation will be minimized through site management (e.g., by
  utilizing previously disturbed areas, designating limited equipment/materials storage yards and
  staging areas, scalping) and reclaiming all disturbed areas not required for operations.
- To avoid attracting eagles and other raptors, the availability of carrion will be reduced by
  removing carcasses discovered in the entire Project area during regular maintenance and
  monitoring activities.
• Potential increases in poaching will be minimized through employee and contractor education regarding wildlife laws. If violations are discovered, the offense will be reported to the WVDNR, and the offending employee or contractor will be disciplined and may be dismissed by BRE and/or prosecuted by the WVDNR.
• Travel will be restricted to designated roads; no off-road travel will be allowed except in emergencies.
• Phase II construction will not occur during the avian breeding season with the exception of 15 acres of clearing that may occur between April 1 and May 15 or between October 15 and November 14. If this clearing occurs between April 1 and May 15, BRE will survey trees to be cut for nests by a trained biologist prior to construction. If an active nest is found, an appropriate buffer will be established around the nest until the young have fledged.
• Storm water management practices will not result in creating water sources that may be attractive birds, such as storm water detention ponds.
• Existing roads and previously disturbed lands were used where feasible to reduce vegetation impacts within the Project area. Surface disturbance was limited to that which is necessary for safe and efficient construction.
• Upon completion of construction, gates will be installed on private roads to restrict public access to turbine locations. The substation and O&M building will be fenced as required for public safety, but no other fencing is proposed at this time. The public will continue to have access to portions of the Project area via public roads and private roads that are regularly open to the public.

100-Turbine Project Operations
• The Project was sited in a previously disturbed landscape and avoids habitats for sensitive species. The avian risk assessment and pre-construction surveys did not find unusual habitats or avian assemblages in the Project area.
• Project facilities will not be located in habitats essential to listed birds and areas known to be used by high concentrations of birds.
• Turbines and Project appurtenances will be located on uplands, which are not limited in the landscape, and avoided surface water features and designated floodplains, which are more unusual and may provide habitat that is more limited in the landscape.
• Upon issuance of the ITP, BRE will operate the Project in accordance with approved turbine operational protocols that include feathering the blades so they hardly move at low wind speeds and raising the cut-in speed of all turbines at night. The purpose of this curtailment is primarily to reduce mortality of bat species. It is uncertain if such measures will reduce fatality risks to birds.
• BRE and its contractors will adhere to a Project-wide speed limit of 25 mph or lower depending on the requirements of the specific equipment utilizing the roads.
• Hunting, fishing, dogs, or possession of firearms by BRE’s employees and designated contractor(s) in the Project area are and will continue to be prohibited in the Project area.
• Mechanical measures will be used to control noxious weeds in all surface-disturbed areas. Herbicides will not be used to control noxious weeds.
• Unguyed, tubular towers and slow-rotating, upwind rotors will be used for all 100 turbines.
• Practices suggested by the APLIC (2006) were used to ensure that the transmission line was designed and constructed in a manner to minimize bird collision and electrocution risk.
• Collection and communication lines will be buried as they were for Phase I.
• Turbine lighting will be minimized to that which is required by the FAA. Low-voltage, shielded lights on a motion sensor will be used at the entrance door of each turbine to eliminate attracting nighttime migrating birds to the Project area.
• To minimize attracting night-migrating birds, security lighting at the O&M facility is kept to the minimum required; the lights have motion sensors so they operate only when needed, and the lights are down-shielded to minimize light emission into the sky.

Post-Construction Monitoring and Adaptive Management. As part of the Project’s APP, BRE will implement a post-construction monitoring, adaptive management, and reporting program to estimate and
BEECH RIDGE ENERGY WIND PROJECT
Habitat Conservation Plan
DRAFT ENVIRONMENTAL IMPACT STATEMENT

evaluate avian mortality resulting from the Project. The program will follow the protocol presented in the Project’s RMAMP (see Appendix C of the Project HCP).

BRE will analyze bird mortality monitoring data to address the following information needs.

1. Determine bird fatality rates for the Project.
2. Determine fatality rates for bird species of concern.
3. Compare estimated bird fatality rates to predicted fatality rates.
4. Evaluate bird fatalities within the project site in relation to site characteristics.
5. Compare bird fatality rates to those from existing projects in similar landscapes with similar species composition and use.
6. Determine the composition of fatalities in relation to migrating and resident birds at the site.
7. Assess whether bird fatality data suggest the need for measures to reduce impacts.

In addition, BRE’s O&M personnel will conduct weekly searches, year-round, for the presence of eagle carcasses and large-scale mortality events. During the HCP mortality monitoring period (April through November), O&M personnel will drive to all non-search turbines to check for readily-observable carcasses. Outside of the HCP monitoring period (i.e., December through March), O&M personnel will inspect areas around Project turbines for readily-observable carcasses.

BRE’s adaptive management plan, presented in detail in the RMAMP (Appendix C of the Project HCP), includes evaluating baseline migratory bird mortality rates and effects of various turbine operational protocols on migratory bird fatality rates, as well as for bats. The RMAMP includes multiple years of testing various turbine operational protocols and effects on estimated fatality rates. Monitoring will be conducted daily to evaluate relationships between bird fatality rates and weather. Monitoring will include investigations into probable causes of large-scale fatality events that could trigger the need for adaptive management, including weather events, turbine conditions, lighting, and other considerations.

The APP includes the following adaptive management thresholds and responses to significant events.

1. If documented fatalities are lower or not different than predicted and are not significant, no mitigation will be conducted.\(^4\)
2. If fatalities are greater than predicted and are likely to be significant, BRE will meet and confer with the Service and the applicable actions presented below will be carried out. If a particular cause can be identified, BRE will develop specific mitigation measures in consultation with the Service to address the occurrence.

If a bald or golden eagle fatality occurs at the project, the following actions will be taken.

1. BRE will, working with a trained and permitted wildlife biologist, promptly identify and secure the carcass at the place of its discovery. BRE will obtain a global positioning system location and take at least three pictures of the carcass, including identifying characteristics, and placement of the carcass in relation to any project infrastructure. BRE will notify the Service prior to the removal and storage of the carcass unless USFWS personnel cannot be reached and the carcass will be compromised. The carcass will be properly stored after its discovery until it can be transferred to state or federal authorities.
2. BRE will notify the Service within one business day after the discovery of the eagle fatality.
3. BRE will meet and confer with the Service to investigate, using available data, the circumstances under which the fatality occurred.
4. BRE will work with the Service to evaluate available data concerning the event and, as appropriate, identify and implement avoidance or mitigation measures to reduce the risk of future mortalities.

\(^4\) While the LWEG indicate that no further monitoring is needed under this scenario, BRE has committed to life-of-project monitoring in Appendix C in the HCP and will continue to monitor and report on bird mortalities.
5. BRE will conduct follow-up post-construction monitoring in the season in which the fatality occurred during the subsequent year of operations to assess whether avoidance or mitigation measures are effective at reducing impacts on eagles.

In addition, should an eagle fatality or significant mortality of any bird species of concern occur, avoidance and minimization actions that may be taken under adaptive management include the following:

1. Removing/modify the source(s) of bird attraction.
2. Implementing turbine operational protocols designed to reduce bird fatalities at turbines that data show are likely to take bald and/or golden eagles, or have shown higher than average bird fatality rates.
3. Implementing technological solutions.
4. Negotiating with transmission line owners to retrofit power poles to adhere to APLIC guidelines (APLIC 1994, 2006).

The APP is based on BRE’s assumption that impacts to migratory birds can be effectively avoided and reduced through cost-effective operational adjustments. However, research on reducing bird mortality at wind power projects is just beginning, and it is currently unknown whether these measures would be effective. If during monitoring, operational restrictions are not effective at avoiding and minimizing impacts and significant impacts to eagles or other migratory birds occur, then BRE will consider the potential for off-site mitigation to offset documented impacts, including possible off-site habitat preservation and/or restoration. The approximately 300-acre high quality forest off-site mitigation project currently targeted to mitigate impacts to Indiana bats (see Section 5.0 in the Project HCP) will also benefit migratory birds and thus may offset a portion of any adverse effect from the project. Should the deal on the targeted site fall through, is unknown to what degree alternative off-site mitigation areas would compensate for bird mortality by increasing survival or reproduction. Alternatively, if off-site mitigation is infeasible or ineffective and specific research needs addressing migratory bird mortality are identified, BRE would consider facilitating such research.

Proposed Action Summary
The Proposed Action is not expected to cause naturally occurring populations of common birds to be reduced to numbers below levels for maintaining viability at regional or local levels. While most mortality is expected to occur to migrating birds from many source populations, the Project would contribute slightly to ongoing declines of species of concern. Implementation of the RMAMP and APP will ensure that post-construction mortality results will be reviewed to assess collision impacts. Should significant impacts occur to avian resources at the regional or local population level, they will be addressed through additional avoidance and minimization measures and possibly mitigation measures. The research, monitoring, and adaptive management framework of the APP is intended to reduce uncertainty associated with the effectiveness of these measures.

The Proposed Action will not result in substantial losses or degradation of habitat for a rare, threatened, or endangered bird species. The Project is sited in suitable habitat for golden-winged warblers, a bird species of conservation concern, which depend on openings with pronounced herbaceous layers. The Project will not cause substantial reductions in golden-winged warbler habitat. However, the Service concludes that small takes of this golden-winged warbler breeding population could potentially be significant at the local scale, should they occur.

The Project poses a moderate to high risk of taking either a bald eagle or golden eagle. This risk will be reduced through additional eagle surveys and behaviour observations, removal of food source attractants, post-construction monitoring, and adaptive management, including changes in turbine operations and mitigation should an eagle collision occur. The research, monitoring, and adaptive management framework of the APP is intended to reduce uncertainty associated with the effectiveness of these measures.
The Proposed Action is not expected to result in substantial changes in habitat conditions producing indirect effects that cause naturally occurring populations to be reduced in numbers below levels for maintaining viability at local or regional levels. The conversion of 521 acres of managed forest habitat to regenerating forest and developed land is not considered a major loss of this habitat type given the Project is located on more than 63,000 acres of managed forest habitat.

5.7.2.3 Alternative 3: HCP and ITP for Additional Covered Species

Under Alternative 3, an ITP pursuant to Section 10 (a)(1)(B) of the ESA would be issued for development of the BRE Project. The Phase II 33 turbines would be constructed as described for the Proposed Action. Under this alternative BRE’s Curtailment Plan and RMAMP would be modified to implement a 6.5 m/s cut-in speed as opposed to 4.8 m/s as the rate for curtailment. Furthermore, all 100 turbines would operate at 6.5 m/s from 30 minutes before sunset through 15 minutes after sunrise during the period April 1 through October 15.

Phase II Construction

Phase II construction would convert 145 acres of predominately forested habitat to 124 acres of grass/shrubland habitat and 21 acres of grass and developed habitat. Together with Phase I, the 100-turbine Project would convert 531 acres of predominately forested habitat to 460 acres of grass/shrubland habitat and 71 acres of grass and developed habitat. Under Alternative 3, effects to avian resources associated with construction would be as described for the Proposed Action. Tree-clearing would not occur during the avian nesting season, with the possible exception of 15 acres. Construction activities would cause short-term disturbances to birds in the Project area.

100-Turbine Project Operation and MET Towers

Under Alternative 3, effects to avian resources associated with Project operations would be as described for the Proposed Action. Some species of birds would be displaced by the Project in the Phase I and II areas. Mature forest and early-successional forest birds at the BRE Project may avoid the new clearings and adjacent woods within the Project footprint. Edge species may begin to use the habitat interfaces as shrubs regenerate, and early-successional forest species will begin to occupy the reclaimed clearings. As shrubland habitat progresses, early-successional species would begin to occupy these sites. Many mature forest species would begin to use mid-successional habitats in less than 20 years. The temporary conversion of 460 acres of mature forest in a forested landscape is not a significant impact.

Under Alternative 3, upon the listing of 3 additional bat species, BRE’s Curtailment Plan and RMAMP would be modified to implement a 6.5 m/s cut-in speed as opposed to 4.8 m/s at night during the period April 1 through October 15. However, there is no evidence that curtailment reduces bird mortality. It is widely known that birds collide with tall stationary structures. This analysis assumes that the 100-turbine Project under Alternative 3 would have the same mortality rate as described for the Proposed Action, that is, approximately 5 to 6 birds per turbine per year, plus mortality from 4 MET towers. Under Alternative 3, the Project is estimated to kill roughly 600 birds per year and 14,400 birds during the 25-year permit term (Table 5-14).

Under Alternative 3, measures to avoid and minimize impacts to birds would be as described for the Proposed Action. The APP would be implemented to address avian mortality should the realized mortality be viewed as significant. Implementation of the APP ensures that should significant impacts to avian resources occur they will be addressed through additional avoidance and minimization measures whose effectiveness would be tested through an adaptive management framework, and through mitigation measures if needed.

100-Turbine Project Decommissioning

Under Alternative 3, effects to birds associated with Project decommissioning would be as described for the Proposed Action. The 100 turbines, transmission line, and substation would be removed when the Project had reached the end of its functional life.
Alternative 3 Summary
Alternative 3 is not expected to cause naturally occurring populations of common birds to be reduced to numbers below levels for maintaining viability at regional or local levels. Alternative 3 is expected to contribute slightly to ongoing declines of species of concern already declining due to many sources of bird mortality.

Implementation of the RMAMP and APP would ensure that post-construction mortality results will be reviewed to assess collision impacts. Implementation of the APP would ensure that should significant impacts to avian resources occur at the regional or local level, they would be addressed through additional avoidance and minimization measures and possibly mitigation measures. The research, monitoring, and adaptive management framework of the APP is intended to reduce uncertainty associated with the effectiveness of these measures.

Alternative 3 will not result in substantial losses or degradation of habitat for a rare, threatened, or endangered bird species. The Project is sited in suitable habitat for golden-winged warblers, a bird species of conservation concern, which depend on openings with pronounced herbaceous layers. The Project will not cause substantial reductions in golden-winged warbler habitat. However, the Service concludes that small takes of this golden-winged warbler breeding population could potentially be significant at the local scale.

The 100-turbine Project has a moderate to high likelihood of taking either a bald eagle or golden eagle, which can be reduced and mitigated. For all alternatives, the APP addresses post-construction monitoring and adaptive management, including mitigation, in the event of an eagle collision.

Alternative 3 is not expected to result in substantial changes in habitat conditions producing indirect effects that cause naturally occurring populations to be reduced in numbers below levels for maintaining viability at local or regional levels. The conversion of 521 acres of managed forest habitat to regenerating forest and developed land is not considered a major loss of this habitat type given the Project is located on more than 63,000 acres of managed forest habitat.

5.7.2.4 Alternative 4: HCP and ITP for Phase I Only
Under Alternative 4, an ITP pursuant to Section 10 (a)(1)(B) of the ESA would be issued for BRE’s existing 67-turbine Project. The Phase II 33 turbines would not be constructed as described for the Proposed Action and Alternative 3. Under this alternative, BRE’s Curtailment Plan and RMAMP would be implemented as the Applicant has described in the Project HCP, but would be applied only to the Phase I Project.

67-Turbine Project Operation and MET Towers
Under Alternative 4, effects to avian resources associated with Project operations would be as described for the No-Action Alternative. Some species of birds would be displaced by the Phase I Project. Mature forest birds and early-successional forest birds in the BRE Project area may avoid the new clearings and adjacent woods within the Project footprint. Edge species may begin to use the habitat interfaces 5 years after construction as shrubs regenerate, and early-successional forest species will begin to occupy the reclaimed clearings. Ten to 15 years after construction, as sapling stands progress, early-successional species continue to occupy these sites until stands become too dense. Many mature forest species would begin to use mid-successional habitats in less than 20 years. The temporary conversion of 460 acres of mature forest in a forested landscape would not be a significant impact.

Under Alternative 4, BRE’s Curtailment Plan would be implemented, but this analysis assumes that this avoidance and minimization measure would not reduce avian mortality. Because birds collide with tall stationary objects, this analysis assumes that operations under the No-Action Alternative would kill birds at the same rate as described for the Proposed Action, anywhere from 1 to 16 birds per turbine per year with an average around 5 to 6 birds per turbine year (see Table 5-14 and Table 5-15), plus MET tower mortality. Because there would be fewer turbines and MET towers than the Proposed Action, the
magnitude of mortality would be less. Hence, Alternative 4 is estimated to kill approximately 400 birds per year and 10,000 birds during the 25-year permit term.

The APP would be implemented to address avian mortality should the realized mortality be viewed as significant. Implementation of the APP ensures that should significant impacts to avian resources occur they will be addressed through additional avoidance and minimization measures whose effectiveness would be tested through an adaptive management framework, and through mitigation measures if needed.

Under Alternative 4, measures to avoid and minimize impacts to birds would be as described for the No-Action Alternative.

67-Turbine Project Decommissioning
Under Alternative 4, effects to birds associated with Project decommissioning would be as described for the No-Action. The 67 turbines, transmission line, and substation would be removed when the Project had reached the end of its functional life.

Alternative 4 Summary
Alternative 4 is not expected to cause naturally occurring populations of common birds to be reduced to numbers below levels for maintaining viability at local or regional levels. It would contribute slightly to ongoing declines of species of concern already declining due to many sources of bird mortality. Alternative 4 would not result in substantial losses or degradation of habitat for a rare, threatened, or endangered animal species. Alternative 4 is not expected to result in substantial changes in habitat conditions producing indirect effects that cause naturally occurring populations to be reduced in numbers below levels for maintaining viability at local or regional levels. The conversion of 386 acres of managed forest habitat to forest openings and developed land is considered a major loss of this habitat type given the Project is located on more than 63,000 acres of managed forest habitat.

The Proposed Action will not result in substantial losses or degradation of habitat for a rare, threatened, or endangered bird species. The Project is sited in suitable habitat for golden-winged warblers, a bird species of conservation concern, which depend on openings with pronounced herbaceous layers. The Project will not cause substantial reductions in golden-winged warbler habitat. However, the Service concludes that small takes of this golden-winged warbler breeding population could potentially be significant at the local scale.

The Project has a low to moderate likelihood of taking either a bald eagle or golden eagle. However, the Project APP addresses post-construction monitoring and adaptive management, including mitigation, in the event of an eagle collision.

5.7.3 Alternatives Comparison
Table 5-17 provides a comparison of bird mortality under implementation of each of the 4 alternatives and unrestricted operation of the Project. Because bird mortality is strongly related to the number of turbines, we expect that the 100-turbine Project under both the Proposed Action and Alternative 3 will result in more fatalities than that associated with the 67-turbine Project scenarios. It is possible that the No-Action Alternative will kill the fewest birds just because blades are not spinning at all during the nighttime when many passerines are migrating. However birds also collide with tall immobile objects. Researchers are only beginning to investigate the possibility that curtailed turbines reduce bird mortality. We are unaware of current evidence to date that would suggest that curtailment designed for bats (turning turbines off at night, feathering blades so that they hardly move below cut-in-speed, raising cut-in-speeds) also benefits birds. Thus we assume that unrestricted operation of the project would result in the same level of bird mortality as other alternatives with the same number and configuration of turbines and MET towers.
Table 5-17. Life-of-Project turbine and MET tower bird mortality predicted under each of the 4 alternatives and unrestricted operation of the Project.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Passerine</td>
<td>0.736</td>
<td>7,343</td>
<td>7,343</td>
<td>10,574</td>
<td>10,574</td>
<td>10,574</td>
<td></td>
</tr>
<tr>
<td>Unidentified bird</td>
<td>0.116</td>
<td>1,157</td>
<td>1,157</td>
<td>1,157</td>
<td>1,157</td>
<td>1,157</td>
<td></td>
</tr>
<tr>
<td>Raptor</td>
<td>0.056</td>
<td>559</td>
<td>559</td>
<td>804</td>
<td>804</td>
<td>804</td>
<td></td>
</tr>
<tr>
<td>Gamebird</td>
<td>0.045</td>
<td>499</td>
<td>499</td>
<td>646</td>
<td>646</td>
<td>646</td>
<td></td>
</tr>
<tr>
<td>Waterfowl</td>
<td>0.022</td>
<td>219</td>
<td>219</td>
<td>316</td>
<td>316</td>
<td>316</td>
<td></td>
</tr>
<tr>
<td>Shorebird</td>
<td>0.015</td>
<td>149</td>
<td>149</td>
<td>215</td>
<td>215</td>
<td>215</td>
<td></td>
</tr>
<tr>
<td>Seabird</td>
<td>0.006</td>
<td>60</td>
<td>60</td>
<td>86</td>
<td>86</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Owl</td>
<td>0.004</td>
<td>40</td>
<td>40</td>
<td>57</td>
<td>57</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>All birds</td>
<td>1.00</td>
<td>9,976</td>
<td>9,976</td>
<td>14,365</td>
<td>14,365</td>
<td>14,365</td>
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5.8 Bats

Primary issues identified during scoping for bats included occurrence in and use of the Project area, direct mortality from turbines, and loss of habitat.

5.8.1 Impact Criteria

This section discusses potential effects to all bat species in the Project area.

We first discuss the assessment of effects on listed bats, Indiana bat and Virginia big-eared bat, based on 3 criteria:

1. The magnitude of the impact on the animal’s habitat relative to the prevalence of that habitat;  
2. The magnitude of the impact on the animal relative to its abundance on a local, regional, and range-wide population scale; and  
3. Duration of impact.

It is possible to apply these criteria to the 2 listed bats because there is a reasonable amount of information on their suitable habitat and populations. Effects to listed bats are measurable quantitatively and would be considered significant if Project elements result in substantial reductions in population size or distribution.

Conversely, these same criteria cannot be used readily to determine the biological significance of effects to other bats for which there is little information about habitat requirements and populations. Population estimates for most bat species in North America are largely absent. While some regional and localized estimates of species exist, these anecdotal population estimates are not appropriate for quantitative evaluation of population effects. In addition, there are few studies that document bat mortality from other anthropogenic sources that could be used to rate the significance of bat mortality associated with the Project.
As discussed further in the cumulative effects analysis (Section 5.16.4.8), many species of bats are subject to numerous human activity related effects, as well as natural sources of mortality such as disease. Many cave dwelling bat populations have been dramatically reduced as a result of WNS. Additional cumulative effects to bat populations from wind power projects, habitat modification, disturbance, and other anthropogenic impacts have not been quantified but would be considered additive to all sources of bat mortality.

Given this uncertainty for unlisted bats and the fact that bats are long-lived species with low, reproductive growth rates (i.e., they recover slowly from perturbations), any moderate to large-scale mortality or large landscape level habitat modification lasting for long periods of time would be expected to have a high likelihood of having a significant additive impact on unlisted bat population levels at the local or regional scale. A negligible or minor cumulative effect would cause a minor or discountable impact that would not be expected to contribute to population declines of unlisted bats at the local or regional level.

5.8.2 Direct and Indirect Effects Presented by Alternative

5.8.2.1 Alternative 1: No-Action

Under the No-Action Alternative, the proposed Project and HCP would not be implemented. Additionally, an ITP pursuant to Section 10(a)(1)(B) of the ESA would not be issued for Phase I operation or Phase II construction and operation. BRE would continue to operate Phase I under the restrictions indicated in the Settlement Agreement to avoid bat mortality. The 67-turbine Project will operate in such a manner that no take of listed species would occur, thus precluding the need for an ITP. From November 16 through March 31 (winter months), the 67 turbines would be operated 24 hours per day. From April 1 to November 15 (non-winter months), the turbines would be operated from one-quarter hour after sunrise to one-half hour before sunset (daylight hours). The existing forest management land uses would be maintained at the proposed Phase II turbine locations.

Phase I Operation
Under the No-Action Alternative, no new turbines would be constructed. Direct and indirect impacts to bats would be limited to those associated with the on-going Phase I operation and maintenance. Bat mortality from collision and barotrauma would be avoided as turbine operation will not coincide with bat activity within the Project area. A small amount of tree-bat mortality could occur by occasional cutting of trees in the transmission-line ROW or hazard trees on the project site.

Phase I Decommissioning
Small areas of regenerated forest in the original construction disturbance area may be cleared again to allow crane access for removing turbines. Forest clearing of the regenerating forest will restart the regeneration process of the forest. Suitable maternity roosts generally occur in trees more than 50 years in age. This will mean that areas that were originally cleared and then recleared for decommissioning will not provide suitable maternity roosting habitat for bats for more than 70 to 75 years (assuming a 25-year Project operational life). Night-time roosting habitat may occur in much younger trees. However, reclearing of access roads, staging areas, and laydown areas for decommissioning will limit roosting opportunities until trees mature.

Bat displacement and effects of edge creation will be similar for that described for Project construction. There will be minor effects to forested patches that were not able to mature consistent with the surrounding areas due to clearing and re-clearing for decommissioning. These effects are expected to be minor and possibly less of an impact when compared to those associated with logging, mining, and natural gas operations in the region. Forestry practices in West Virginia often involve clear-cut, group- or single-tree selection cuts, or thinning on a 50-year cycle or less. Mining and gas development can often result in clear cuts for the duration of the operation, which can vary by project and is often based on how long it takes to exhaust the resource. This is typically less than 50 years.
Disturbed areas and access roads will be graded to the original contour as near as practicable if the landowner requests that BRE decommission these areas. If requested by the landowner, access roads will be left in place.

**No-Action Alternative Summary**

Under the No-Action Alternative, impacts to bats would not be significant. As it currently operates, the Phase I Project is not likely to kill bats or significantly modify suitable habitat. The Phase I Project would have much lower impacts as compared to other similar activities in the region. The impacts to both non-listed and listed bats would be the same since it is expected that there would be little to no mortality of bats.

**5.8.2.2 Alternative 2: Proposed Action**

Effects on bats associated with Phase I construction of the Project are considered a past effect that occurred prior to the Service’s ITP nexus and are described in Section 5.15–Cumulative Effects.

**Phase II Construction**

BRE estimates that 145 acres will be disturbed during construction of Phase II. Of this total land clearing, there will be 115 acres of deciduous forest and 2 acres of mixed deciduous and evergreen forest that have potential to serve as habitat for bats during the bat-active season (April 1 through November 15). Most habitat disturbance will consist of setting back forest succession and converting forest to herbaceous cover propagated by the reclamation seed mixes. Succession would be allowed to occur naturally on 124 acres that do not support Project facilities. Currently, 79% of the forest in the Phase II area is characterized as timber greater than 26 years old. As such, regenerating forest would not be replaced within the 25-year permit period and will serve as limited roosting habitat for bats during this term.

Habitat fragmentation increases the amount and proportion of edge habitat, increasing the ecological effects associated with edges. Creating forest gaps, edge habitat, and dense second-growth forest (during regeneration over the permit term) will have mixed effects on bats in the Project expansion area. The potential increase in foraging habitat through the creation of open areas is not likely to benefit bats substantially simply due to the current abundance of this type of habitat locally. Kunz et al. (2007a) suggests that it is possible that these cleared corridors may attract bats to forage near the turbines, increasing their risk for collision.

Unlisted bat mortality associated with Project construction will likely be minimal. Of the 145 acres to be cleared as part of Phase II, all but 15 acres will be cleared when bats are generally in hibernation (November 16 and March 31). The factors associated with changes in habitat quality and availability are more likely a greater influence on bats than is direct mortality associated with tree clearing activities. No studies to date have measured the rate at which bats disperse ahead of forest cutting operations. Trees that are cleared in the winter avoided mortality of bats. The lack of documentation is likely the result of the infrequency of the direct impact on bats, the cryptic nature of the site specific events, and the inability to replicate any rigorous scientific study (Lacki et al. 2007).

**100-Turbine Operation**

Impacts to bats from wind facilities are well documented in the continental U.S. (Johnson et al. 2003a, 2003b, Kunz et al. 2007a, Arnett et al. 2008, and Horn et al. 2008). Bat fatalities at wind facilities were documented in relatively small numbers in conjunction with avian fatality monitoring beginning in the late 1990s. However, several high profile bat mortality events at wind facilities in forested ridges of the Appalachian Mountains in 2003 and 2004 raised concerns about the impacts to bats from wind facilities (Arnett et al. 2008). Post-construction monitoring at wind facilities in the latter part of the decade continued to report higher than expected levels of bat mortality at wind energy sites, though mortality rates varied by region (Arnett et al. 2008, Johnson 2005).
Geographic Variation. In a review of 21 studies from 19 different wind energy facilities in 5 regions in the U.S. (Eastern, Rocky Mountains, Pacific Northwest, Midwestern, and South-central) and 1 province in Canada, Arnett et al. (2008) found that estimates of bat fatalities were highest at wind energy facilities located on forested ridges in the eastern U.S. and lowest in the Rocky Mountain and Pacific Northwest regions. Nationwide, mean estimated bat fatalities range from 0.1 bats per turbine per year to 69.6 bats per turbine per year. Bat fatalities were higher and yet somewhat variable among sites in the eastern U.S., with estimates ranging from 20.8 bats per turbine per year to 69.6 bats per turbine per year. (The 19 facilities surveyed included 18 facilities in forested landscapes and 1 in an agricultural landscape with a deciduous forest component and are combined from 21 separate studies.)

Species Distribution. Of the 45 species of bats with some seasonal distribution in the U.S. and Canada, post-construction surveys at wind energy facilities have documented 11 species (Arnett et al. 2008, USFWS 2010). Several consistent patterns have emerged with regard to the species distribution of bat fatalities at wind facilities. In terms of both overall numbers and geographic distribution, 3 species of tree-roosting migratory bats have consistently been the most impacted: hoary bat (foliage-roosting), eastern red bat (foliage roosting), and silver-haired bat (tree- and cavity-roosting) (Kunz et al. 2007b, Arnett et al. 2008). Collectively, these 3 species comprise about 75% of documented fatalities to date, and hoary bats make up about half of all fatalities (Arnett et al. 2008).

Conversely, fatalities of summer cave-dwelling species, including little brown, northern long-eared, and big brown bats, have typically been low (0 to 13.5%), except at a site in Alberta (Castle River) and 1 in Iowa (Top of Iowa) where little brown bats made up nearly 25% of the fatalities (Arnett et al. 2008). The range of Myotis fatalities found at all sites reported by Arnett et al (2008) was between 0 and 24%. Over a 3-year survey at the Maple Ridge wind facility, the percentage of Myotis fatalities varied between 10.1 and 18.6 of total fatalities found (Jain et al. 2007, 2009a, 2009b). Myotis fatalities in the mid-Atlantic region range from 3.0 to 5.9 bats/turbine/year (Arnett et al. 2008; Jain et al. 2007, 2009a, 2009b).

Behavioural Risk Factors. Although not well understood, there are several hypotheses that address why migratory tree-roosting bats appear to be most at risk from wind turbines. It has been suggested that certain migratory and/or mating behaviours unique to these species make them more susceptible to collision with wind turbines, especially during the fall migration period (August to November; Cryan and Brown 2007). Hoary bats do not hibernate in caves but instead perform cross-continental migration movements to winter in warm climates (Cryan 2003, Cryan et al. 2004, Cryan and Brown 2007). Silver-haired bats have also shown movement at the continental scale, although migration patterns may differ between western and eastern groups (Cryan 2003). These long distance movements may result in greater exposure to wind facilities over a larger area. Additionally, Cryan and Brown (2007) postulated that migrating hoary bats, and perhaps other species of tree dwelling bats, orient toward and congregate around the tallest, most highly-visible landscape structures during the fall to locate potential mates. This theory has been used to explain the disproportionately higher levels of mortality in the fall migration period, compared with the spring. It may also help to explain why disproportionately higher numbers of tree-roosting migratory bats than resident bats are being killed at wind facilities.

Another theory posits that bats may be attracted to wind turbine rotors while foraging. Horn et al. (2008) found a significant correlation between insect and bat activity and suggested that the open space created by wind turbines may create favorable foraging grounds for insectivorous bats. Horn et al. (2008) also found that bats are attracted to the wind turbine blades themselves, whether or not they are rotating. The bats may be investigating the turbines as roosting, foraging or, as posited above, mating sites (Horn et al. 2008). Color may also play a role in attracting additional prey for bats at wind turbines. Significantly more insects were found at pure white and light grey turbines than other turbine colors tested (Long et al. 2010). This increase in insect activity may lead to increased bat activity in the vicinity of turbine clearings and therefore mortality. Although there are many theories, the specific behavioural mechanisms

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42 Myotis are small brown bats with long, pointed projections in their ears. Myotis species include little brown bat, northern long-eared bat, eastern small-footed bat, Indiana bat, and gray bat.
explaining why bats are killed or injured by wind turbines remains largely unknown (Kunz et al. 2007a, 2007b, Kuvlesky et al. 2007).

Furthermore, bats are killed by barotrauma caused by rapid air-pressure reduction near moving turbine blades. Barotrauma damages to air-containing structures in the lungs are caused by rapid or excessive pressure change; pulmonary barotrauma is lung damage due to expansion of air in the lungs that is not accommodated by exhalation (Baerwald and Barclay 2007). The risk of collision or decompression sickness could disproportionately affect bats that may be flocking to turbines in association with mating behavior (Cryan and Brown 2007, Horn et al. 2008) or for foraging or roosting purposes (Horn et al. 2008). These studies suggest that migratory tree dwelling bats may be at an elevated risk from wind turbine blade collision or rotating blade vortices.

Seasonal Timing and Weather. Bats are known to suppress their activity during periods of rain, low temperatures, and strong winds (Erkert 1982, Adam et al. 1994, Erickson et al. 2002, Russo and Jones 2003). Accordingly, weather variables such as wind speed, temperature, and barometric pressure have been found to influence bat activity and mortality rates at some wind facilities. Of the 21 post-construction monitoring studies reviewed by Arnett et al. (2008), all studies that addressed relationships between bat fatalities and weather patterns found that most bats were killed on nights with low wind speed (<6 m/s) and that fatalities increased immediately before and after passage of storm fronts. For example, at studies conducted at the Mountaineer, West Virginia and Meyersdale, Pennsylvania wind facilities in 2004, the proportion of the night when wind speed was < 4 m/s was positively related to bat fatalities, whereas the reverse was true for proportion of the night when winds were > 6 m/s (Kerns et al. 2005). At Mountaineer and Meyersdale, during 81% of nights when no dead bats were found the next day, median nightly wind speed was on average > 6 m/s. Conversely, on nights before days when the highest numbers of dead bats were found, median nightly wind speed was 4.1 m/s at Mountaineer and 4.2 m/s at Meyersdale, and only 6.5 to 18.2% of these nights had wind speeds > 6 m/sec, respectively. The association of bat activity with wind speed is expected given that bat flight ability is limited by wind strength, as is the ability of their airborne, insect prey (Fiedler 2004).

This pattern has also been supported by pre- and post-construction acoustic monitoring of bat activity, which has documented a negative relationship with average nightly wind speed (Fiedler 2004, Reynolds 2006). Reynolds (2006) found activity of bats to be highest on nights with wind speeds of < 5.4 m/s wind speed during the spring migratory period at the Maple Ridge, New York wind facility. Bat activity levels at Buffalo Mountain, Tennessee also showed a negative association with average nightly wind speeds (Fiedler 2004).

Similar to low wind speeds, bat activity and temperature are common correlations conveyed in bat literature, both on a nightly basis (Lacki 1984, Negraeff and Brigham 1995, Hayes 1997, Vaughan et al. 1997, Gaisler et al. 1998) and annual basis (O’Farrell and Bradley 1970, Avery 1985). Pre- and post-construction acoustic surveys at wind facilities have documented bat activity to be negatively correlated with low nightly mean temperatures (Fiedler 2004, Reynolds 2006). Reynolds (2006) found that no detectable spring migratory activity occurred on nights when the daily mean temperature was below 10.5°C (50.9°F). Bat activity at Buffalo Mountain, Tennessee from 2000 to 2003 was most closely correlated with average nightly temperature (Fiedler 2004).

This is consistent with the observations of J. Kiser (personal communication(574,682),(796,699)) over 19 years during summer mist-netting surveys in the eastern U.S. According to Kiser, bat activity declined dramatically once night time temperatures dropped below approximately 12°C (54.5°F). Associations between temperature and bat fatalities in post-construction monitoring studies have been less consistent than for wind speed, but still have been documented. Although a correlation between temperature and bat fatality was not documented at Mountaineer, West Virginia, there was a positive association between temperature and fatality at Meyersdale, Pennsylvania (Kerns et al. 2005).

High barometric pressure at both Mountaineer and Meyersdale and low relative humidity at Meyersdale, conditions associated with the passage of storm fronts, were also associated with higher bat fatality rates.
(Kerns et al. 2005). However, because relative humidity is confounded by temperature (Thornthwaite 1940), it is not a reliable predictor of ecological variables, including mortality (A. Kurta, personal communication). Another index to the presence of storm fronts was associated with bat mortality at both Mountaineer and Meyersdale: few bat fatalities were discovered during storms at Mountaineer and Meyersdale, contrasted by the days with the highest number of fatalities which occurred in the few days after the storm, especially on low wind nights (Kerns et al. 2005).

These relationships are reinforced by operational curtailment experiments that have documented reductions in bat mortality by feathering blades so they hardly move at low wind speeds (when bats are active) and increasing the cut-in-speed (to higher wind speeds when bats are less active). The cut-in-speed is the wind speed at which turbines begin to produce electricity. Under normal unrestricted operations, many turbine designs permit blades to freewheel when they are below the cut-in-speed, the condition when turbine blades are rotating at 9 to 18 rpm but not producing power. Even at 9 to 18 rpm, the blade tips are moving at over 100 miles per hour and pose risk to bats in the rotor-swept area. At Beech Ridge, turbine rotation will be limited by feathering the turbine blades so there is only minimal rotation (<2 rpm) at winds below cut-in-speeds.

During an experimental study in 2008 during the peak fall fatality period at the Casselman wind facility in Pennsylvania, total bat fatalities at fully operational turbines were estimated to be 5.4 times greater on average than at turbines curtailed and feathered at wind speeds below of 5.0 and 6.5 m/s (there was no difference between the numbers of fatalities at the 2 different cut-in-speeds). In other words, overall bat mortality at feathered and curtailed turbines was reduced by 73% compared to fully operational control turbines (95% confidence interval = 53% to 87%) (Arnett et al. 2009). A similar study was conducted at Casselman in 2009, and preliminary results indicate that similarly high reductions in fatality were achieved, again with no significant difference in the 5.0 m/s and 6.5 m/s cut-in-speeds (Arnett et al. 2010).

At a similar study in southwestern Alberta, Canada, Baerwald et al. (2009) examined the difference in fatality rates under 2 experimental treatments: 1) turbines were curtailed below wind speeds of 5.5 m/s, and 2) a low-speed idle strategy was used where by operations of turbines were manipulated to change the pitch angle of the blades and lower the generator speed required to start energy production, which caused turbines to be motionless in low wind speeds. Fatalities were significantly reduced by 60.0% and 57.5%, respectively, under the 2 different treatments. Similar reductions in mortality were reported in a curtailment study by Behr in Germany (O. Behr, University of Erlangen, personal communication as cited by Arnett et al. 2009).

Good et al (2011) describes a curtailment study at the Fowler Ridge Wind Farm in Indiana, a project that has documented Indiana bat collisions with turbines on 2 occasions. The Fowler Ridge study conducted in 2010 demonstrated that bat casualty rates were significantly different between control and treatment turbines, and bat casualty rates were significantly different between experimental cut-in speeds. Overall bat fatality was reduced by 50% at 5-m/s cut-in speed and by 79% at 6.5 m/s cut-in speed compared to the control 3.5 m/s cut-in speed. The Indiana bat fatality recorded in 2010 was discovered at a turbine with a cut-in-speed raised to 5 m/s.

Young et al. (2011c) describes a feathering experiment conducted at Mount Storm Wind Energy Facility (Mount Storm) in northern West Virginia. Conducted in the summer and fall of 2010, the study looked at differences in mortality associated with feathering turbines such that they hardly rotate at wind speeds below the 4 m/s cut-in-speed. Compared to the control (fully operational turbines), overall bat mortality during summer was reduced by 47% when turbines were feathered for the first half of the night and by 20% when feathered for the second half of the night. Inconclusive results for feathering below wind speeds of 4 m/s all night were obtained during the summer and fall of 2011 (Young et al. 2012d).

Unlike avian turbine collision, some studies indicate that conditions caused by inclement weather (e.g., low fog or cloud ceilings or stormy conditions) do not appear to be strongly correlated with bat mortalities at wind farms. At sites in Minnesota, Wyoming, and Tennessee, bat collisions with wind turbines were observed to occur during clear weather during approximately one-third to one-half of the time (Johnson et
al. 2000a, Young et al. 2003, Nicholson 2001 and 2003 as cited by Johnson and Strickland 2003, Fiedler et al. 2007). At sites in West Virginia and Pennsylvania, Kerns et al. (2005) found that bat fatalities were most common before and after the passage of frontal systems at the Mountaineer and Meyersdale wind power projects.

Other Factors Potentially Related to Bat Fatalities

*Turbine Height and Rotor Diameter.* In their review of post-construction mortality studies conducted at 6 wind facilities in 7 states, Barclay et al. (2007) suggested that turbine height may influence the number of bat fatalities. While avian mortality remained constant with turbine height, the number of bat fatalities increased with increasing turbine height; turbines with > 65 m [213 ft] nacelle height had the highest fatality rates among bats. The authors suggest that the discrepancy between avian and bat mortality relative to turbine height could be related to their differing migratory flights height (Barclay et al. 2007). Barclay et al. (2007) did not find any relationship in rotor-swept area to bat mortality.

At Buffalo Mountain, Tennessee, mortality rates were almost 2 times as numerous at larger turbines (78 m [256 ft] nacelle height; 69.6 bats/turbine/year) than at smaller turbines (65 m [213 ft] nacelle height; 35.2 bats/turbine/year) (Fiedler et al. 2007). Similarly, at Buffalo Ridge, Minnesota, taller turbines with greater rotor-swept areas killed more bats per turbine and per MW compared with shorter turbines with smaller rotor diameters (Johnson et al. 2003a, 2004).

Good et al. (2011) observed higher bat mortality at turbines of same nacelle height but with longer blades, but did not test for significance. In the case where rotor rpm is the same, it is possible that longer blades create a greater risk simply because blade-tip speed is faster.

This NEPA analysis recognizes that taller turbines may kill more bats. However, this analysis does not attempt to make distinctions between the 2 Project Phases with regard to bat mortality. The Project HCP estimates potential Indiana bat mortality based on a per turbine mortality estimate derived from a range of regional studies with different types of turbines, including varying turbine heights and rotor sizes. The existing 67-turbines heights and rotor sizes fall within the range for which the Project HCP analyzed. BRE has stated that the 33-turbine expansion will likely include turbines with heights and rotors sizes that exceed the range included in the available existing studies from this region. As for the Project HCP, this DEIS analysis assumes that regional estimates of mortality are more representative of potential mortality and a better predictor of potential impacts at any given site than turbine height and rotor diameter, and further assumes that no one turbine or part of the 100-turbine Project will result in higher rates of bat mortality.

*Turbin Lighting.* Although bats are known to aggregate near lights (e.g., street lights) to forage on insect concentrations (Furlonger et al. 1987, Fenton 1997), data thus far do not indicate increased collision risk for turbines lit with FAA-regulation red strobe lights on nacelles. While some birds were found to be attracted to certain types of lit structures at Mountaineer (i.e., sodium vapor lighting) (Kerns and Kerlinger 2004), data from post-construction mortality studies at Mountaineer and Meyersdale did not indicate a significant difference in the number of bat fatalities found at lit and unlit turbines (Arnett et al. 2005). This is further supported by other post-construction mortality studies (Erickson et al. 2003a, 2003b, Johnson et al. 2003a, Fiedler et al. 2007, Kerlinger et al. 2010), as well as the thermal imaging camera investigation conducted by Horn et al. (2008) that documented no significant difference between the levels of bat activity at lighted versus non-lighted turbines at Mountaineer.

*Turbines as Simply Tall Structures.* Although bats collide with other tall anthropogenic structures, the frequency and magnitude of fatalities is much lower than those observed at wind turbines (Arnett 2005, Cryan and Veilleux 2007). Bat mortality from collision with other tall anthropogenic structures, including buildings, television and communication towers, lighthouse, fences, power lines, has been reported from around North America since 1930 (Saunders 1930, Ganier 1962, Gollop 1965, Terres 1956, Avery and Clement 1972, Zinn and Baker 1979, Dedon et al. 1989 as cited by Johnson and Strickland 2003, Crawford and Baker 1981, Timm 1989). Bat collisions with aircraft have been reported since 1967 (Peurach et al. 2009). Similar to mortality patterns at wind facilities and for bat-aircraft strikes (with the
exception of Brazilian free-tailed and Seminole bats), the majority of recorded bat collisions with other structures involved red, hoary, and silver-haired bats.

The frequency and magnitude of fatalities as a result of collision with tall anthropogenic structures has been lower than those observed at wind turbines (Arnett 2005, Cryan and Veilleux 2007) and have been much lower than that reported for birds (Saunders 1930, Overing 1936, Terres 1956, Anonymous 1961, Ganié 1962, Elder and Hansen 1967, Avery and Clement 1972, Zinn and Baker 1979 as cited by Johnson and Strickland 2003, Crawford and Baker 1981, Timm 1989). This is supported by several lines of evidence suggesting that bats are more at risk from rotating turbines than stationary structures. For example, of the 64 turbines studied at the Mountaineer and Meyersdale facilities in 2004, the only turbine at which no fatalities were observed was nonoperational throughout the study period (Kerns et al. 2005). MET towers searched at wind turbine sites in Wyoming, Tennessee, Minnesota, and Oregon resulted in no bat collision mortalities (Anderson et al. 2003a as cited by Johnson and Strickland 2003, Johnson et al. 2003a, 2003b, Nicholson 2003 as cited by Johnson and Strickland 2003). Conversely, avian mortality at MET towers was found to be 3 to 5 times higher than at wind turbines at a site in Wyoming (Young et al. 2003).

Proposed Action Bat Mortality

There are currently no predictive models available to quantify expected bat collision mortality as a result of wind energy facility operation. Risk assessments must be based on pre-construction indices and indicators of risk (e.g., acoustic surveys), along with empirical mortality data from operating facilities. However, predicting bat mortality rates at wind projects using only pre-construction bat detection rates is considered unreliable.

Wind energy facilities located along forested ridgelines in the eastern U.S. have the highest documented bat mortality rates (Arnett et al. 2007). Collision risk to bats in the Project area is likely to be consistent with other wind energy projects along forested ridgelines in the mid-Atlantic highlands. Two mortality estimators were used to derive mortality estimates for the mid-Atlantic Highland projects, the modified Shoenfeld estimator (Erickson et al. 2004) and Huso estimator (Huso 2010).

We first looked at mortality rates assuming no curtailment of Project operations. Using the modified Shoenfeld mortality estimator, the mean bat mortality at 14 available studies completed at 8 wind facilities is 24.77 bats per turbine per year, with rates ranging from 6.80 bats per turbine per year to 47.50 bats per turbine per year (Table 5-18). Based on the resulting confidence intervals from these studies, during some years mortality rates could be as low as 2.3 bats per turbine per year or as high as 91.60 bats per turbine per year (Table 5-18); however, we would expect mortality to be closer to the regional average over long periods of time.

We next looked at mortality rates using the Huso estimator (Huso 2010). The mean bat mortality at 4 available studies completed at 2 wind facilities is 26.92 bats per turbine per year, with means ranging from 17.40 bats per turbine per year to 25.15 bats per turbine per year (Table 5-19). Based on the resulting confidence intervals from these studies, during some years mortality rates could be as low as 11.80 bats per turbine per year or as high as 58.20 bats per turbine per year (Table 5-19). The rates for studies using the Huso estimator are slightly higher than those using the Shoenfeld estimator, but not significantly different as the confidence intervals overlap. To err on the side of the species and assume a worst case scenario, we therefore calculated the overall average fatality rates for the mid-Atlantic region and the project by using the higher Huso rate for a study when it also reported a rate derived using the Shoenfeld estimator.

Based on the results of 14 post-construction studies and the use of the modified Shoenfeld estimator (described in Erickson et al. 2004) and the Huso estimator (Huso 2010), the average bat mortality rate is 26.11 bats per turbine per year for 8 wind projects located on forested ridgelines in the mid-Atlantic.\footnote{The series of tables that follow show estimates of mortality. Estimates within each Project scenario will not always match exactly. The relatively small discrepancies are an artifact of calculations done in a spreadsheet application (Microsoft Excel®) where numbers were rounded.}
Highlands. Table 5-20 provides a summary of the bat mortality estimates for the 100-turbine Project based on the rate of 26.11 bats per turbine per year. Based on this rate and with no curtailment, we estimate the 100-turbine facility will kill roughly 2,600 bats per year. Based on this annual mortality estimate, the 100-turbine Project would kill roughly 65,000 bats over a 25-year period. Confidence intervals from the studies provided a range of mortality estimates from a low of 2.30 bats per turbine per year to a high of 91.60 bats per turbine per year. Applying these values and with no curtailment, the 100-turbine project could result in annual bat mortalities ranging in some years from 230 to 9,160 bats; however, realistically, over the long term, we would expect mortality to be closer to the regional average of 2,600 bats per year.

We then estimated bat mortality applying the operational curtailment proposed in the Project HCP. BRE estimates that operational curtailment at a cut-in speed of 4.8 m/s will result in a 50% reduction in bat mortality. The 50% reduction in mortality is based on curtailment studies that showed a 5 m/s cut-in speed reduced bat mortality from 50% to 87%. The 4.8 m/s cut-in speed is slightly outside the range tested and 50% represents the lower end of the mortality reduction found in the studies. Collectively these studies suggest that a minimum 50% reduction in bat fatalities is a reasonable assumption for the BRE Project where turbines will be feathered at wind speeds below 4.8 m/s from mid-July to mid-October.

Based on a rate of 26.11 bats per turbine per year and with the proposed curtailment, we estimate the Proposed Action will kill roughly 1,300 bats per year. Based on this annual mortality estimate, the Proposed Action is expected to kill roughly 32,600 bats over a 25-year period. Applying curtailment to the confidence interval values (2.30 to 91.60 bats per turbine per year), the Proposed Action possibly could result in annual bat mortalities that in some years range from 115 to 4,580 bats; however, over the long term, we would expect mortality closer to the regional average of 1,300 bats per year.
Table 5-18. Estimates of bat mortality at 8 existing wind farms on forested ridgelines and escarpments in the mid-Atlantic region. Operational cut-in speeds ranged from 3.0 m/s to 4.0 m/s, and searches were conducted on a daily basis. Mortality rates presented were derived using the modified Shoenfeld estimator (Erickson et al. 2004).

<table>
<thead>
<tr>
<th>Site and state</th>
<th>No. turbines</th>
<th>Dates surveyed</th>
<th>Estimated mortality rate (mean)</th>
<th>Annual project mortality based on mean</th>
<th>CI for mortality rate</th>
<th>Annual project mortality range based on CI</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mount Storm, West Virginia</td>
<td>132</td>
<td>Mar 23 – Oct 8, 2009</td>
<td>28.60</td>
<td>3,775</td>
<td>18.70-40.50</td>
<td>2,468-5,346</td>
<td>Young et al. (2009b, 2010a)</td>
</tr>
<tr>
<td>Locust Ridge II, Pennsylvania</td>
<td>51</td>
<td>Apr 1 – Nov 15, 2010</td>
<td>28.75</td>
<td>1,466</td>
<td>25.02-32.31</td>
<td>1,276-1,648</td>
<td>Arnett et al. (2011)</td>
</tr>
<tr>
<td>Site 6-3, Pennsylvania</td>
<td>nr</td>
<td>Apr 1 – Nov 15, 2007</td>
<td>42.70</td>
<td>--</td>
<td>nr</td>
<td>--</td>
<td>Librandi-Mumma and Capouillez (2011)</td>
</tr>
<tr>
<td>Site 6-3, Pennsylvania</td>
<td>nr</td>
<td>Apr 1 – Nov 15, 2008</td>
<td>34.30</td>
<td>--</td>
<td>nr</td>
<td>--</td>
<td>Librandi-Mumma and Capouillez (2011)</td>
</tr>
</tbody>
</table>

Mean rate (n=14) 24.77 Range (n=14) 2.30-91.60

1 Mortality rate is expressed in bats per turbine per year. 2 Turbine number x estimated mortality rate.
3 Ranges based on 90% or 95% confidence intervals. 4 Results from 2 post-construction studies in each year were summed to derive the rate.
5 Arnett et al. (2009a, 2010) and Young et al. (2001d, 2012d) describe the effects of curtailed and normal operations; values in table are based on non-curtailed turbines in study.
Estimates of bat mortality at 2 existing wind farms on forested ridgelines in the mid-Atlantic region. Operational cut-in speeds ranged from 3.0 m/s to 4.0 m/s, and searches were conducted on a daily basis. Mortality rates presented were derived using the Huso estimator (Huso 2010).

<table>
<thead>
<tr>
<th>Site and state</th>
<th>No. turbines</th>
<th>Dates surveyed</th>
<th>Estimated mortality rate (mean)</th>
<th>Annual project mortality based on mean</th>
<th>CI for mortality rate</th>
<th>Annual project mortality range based on CI</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casselman, Pennsylvania</td>
<td>23</td>
<td>Apr 1 – Nov 15, 2009</td>
<td>17.4 (^4)</td>
<td>400</td>
<td>11.80-27.80   (^4)</td>
<td>271-639</td>
<td>Arnett et al. 2010</td>
</tr>
<tr>
<td>Locust Ridge II, Pennsylvania</td>
<td>51</td>
<td>Apr 1 – Nov 15, 2009</td>
<td>30.91</td>
<td>1,576</td>
<td>27.42-34.81</td>
<td>1,398-1,775</td>
<td>Arnett et al. 2011</td>
</tr>
<tr>
<td>Locust Ridge II, Pennsylvania</td>
<td>51</td>
<td>Apr 1 – Nov 15, 2010</td>
<td>35.15</td>
<td>1,793</td>
<td>27.69-37.04</td>
<td>1,412-1,889</td>
<td>Arnett et al. 2011</td>
</tr>
<tr>
<td></td>
<td>Mean rate (n=4)</td>
<td></td>
<td>26.92</td>
<td>Range (n=4)</td>
<td>11.80-58.20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^1\) Mortality rate is expressed in bats per turbine per year. \(^2\) Turbine number x estimated mortality rate. \(^3\) Ranges based on 90\% or 95\% confidence intervals. \(^4\) Arnett et a. (2009a, 2010) describe the effects of curtailed and normal operations; values in table are based on non-curtailed turbines in study.
Table 5-20. Projected bat mortality for the Beech Ridge Energy Wind Project based on the 100-turbine Project with and without implementation of the Curtailment Plan. Mortality rates were derived using the modified Shoenfeld estimator (Erickson et al. 2004) or Huso estimator (Huso 2010) for 14 post-construction studies.

<table>
<thead>
<tr>
<th>Alternative 2</th>
<th>100-turbine Project w/o curtailment (3.5 m/s cut-in speed)</th>
<th>100-turbine Project w/ curtailment (4.8 m/s cut-in speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality rate 1</td>
<td>Annual mortality</td>
<td>Life of Project mortality 2</td>
</tr>
<tr>
<td>Mean</td>
<td>26.11</td>
<td>2661</td>
</tr>
<tr>
<td>Low end of range</td>
<td>2.30</td>
<td>230</td>
</tr>
<tr>
<td>High end of range</td>
<td>91.60</td>
<td>9160</td>
</tr>
</tbody>
</table>

1 Mortality rate is expressed in bats per turbine per year.
2 Based on 25-year operational life across all turbines in Project.

Bat Species Differences. The individual species that comprise the potential mortality of bats can be understood by analyzing the fatalities found at other wind facilities in the mid-Atlantic highlands. Studies completed at the Mountaineer, Meyersdale, Casselman, Mount Storm, and an undisclosed site in Pennsylvania document mortality of hoary bat, red bat, tri-colored bat, silver-haired bat, little brown bat, big brown bat, northern long-eared bat, and unidentified bats (Capouillez and Librandi-Mumma 2008; Kerns and Kerlinger 2004, Arnett et al. 2005, 2009a, 2009b, 2010, Young et al. 2009a, 2009b, 2010a, 2010b, 2011). Table 5-21 provides bat mortality by species under 2 scenarios for the 100-turbine Project, with and without modified operations, using the calculated average from the 14 studies. We predict the Proposed Project Alternative will result in mortality of roughly 22,800 migratory tree bats and 9,400 cave bats over the 25-year operating life of the project. Total bat mortality for the life of the project with project curtailment at the 4.8 m/s cut-in speed (32,600 bats) is approximately 45% less than that predicted under normal unrestricted operations at the 3.5 m/s cut-in speed (65,300 bats).

Table 5-22 provides bat mortality by species under 4 scenarios for the 100-turbine Project based on the low-end (2.30 bats per turbine per year) and high-end (91.60 bats per turbine per year) rates from the studies' confidence intervals. Under these scenarios, total bat mortality could possibly range from 2,900 to 114,400 bats for the life of the project. Realistically, we would not expect to see these extremes of variation. Rather we predict that bat mortality will fall somewhere between the low-end high-end rates and likely closer to the average of 26.11 bats per turbine per year and 32,600 bats over 25 years (Table 5-21).
Table 5-21. Predicted composition of bat mortalities based on extrapolation of mortality composition from other studies conducted in the Mid-Atlantic Highlands. The mean mortality rate (26.11 bats per turbine per year) is based on estimated rates from 14 post-construction studies that used the Shoenfeld or Huso estimators. Species composition of mortality is illustrated for the 100-turbine Project with and without operational curtailment. Implementation of the Curtailment Plan is estimated to reduce bat mortality by 50%.

<table>
<thead>
<tr>
<th>Alternative 2</th>
<th>100-turbine Project w/o curtailment (3.5 m/s cut-in speed)</th>
<th>100-turbine Project w/ curtailment (4.8 m/s cut-in speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Relative mortality (%)</td>
<td>Annual mortality</td>
</tr>
<tr>
<td><strong>Migratory Tree Bats:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hoary bat</td>
<td>31.9</td>
<td>833</td>
</tr>
<tr>
<td>Red bat</td>
<td>27.8</td>
<td>726</td>
</tr>
<tr>
<td>Silver-haired bat</td>
<td>10.3</td>
<td>269</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>1,828</td>
</tr>
<tr>
<td><strong>Cave Bats:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tri-colored bat</td>
<td>16.4</td>
<td>428</td>
</tr>
<tr>
<td>Little brown bat</td>
<td>8.7</td>
<td>227</td>
</tr>
<tr>
<td>Big brown bat</td>
<td>3.2</td>
<td>84</td>
</tr>
<tr>
<td>Northern long-eared bat</td>
<td>0.4</td>
<td>10</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>749</td>
</tr>
<tr>
<td>Unidentified bats</td>
<td>1.2</td>
<td>301</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>2,611</td>
</tr>
</tbody>
</table>

Table 5-22. Predicted composition of bat mortalities based on extrapolation of mortality composition from other studies conducted in the Mid-Atlantic Highlands. Mortality rates are based on the low-end and high-end confidence intervals from 14 post-construction studies that used the Shoefeld and Huso estimators. Species composition of mortality is illustrated for the 100-turbine Project with and without operational curtailment. Implementation of the Curtailment Plan is estimated to reduce bat mortality by 50%.

<table>
<thead>
<tr>
<th>Alternative 2</th>
<th>Low Rate: 2.30 bats per turbine per year</th>
<th>High Rate: 91.60 bats per turbine per year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100-turbine Project w/o curtailment (3.5 m/s cut-in speed)</td>
<td>100-turbine Project w/ curtailment (4.8 m/s cut-in speed)</td>
</tr>
<tr>
<td></td>
<td>100-turbine Project w/o curtailment (3.5 m/s cut-in speed)</td>
<td>100-turbine Project w/ curtailment (4.8 m/s cut-in speed)</td>
</tr>
<tr>
<td>Species</td>
<td>Relative mortality</td>
<td>Annual mortality</td>
</tr>
<tr>
<td>Migratory Tree Bats:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hoary bat</td>
<td>0.319</td>
<td>73</td>
</tr>
<tr>
<td>Red bat</td>
<td>0.278</td>
<td>64</td>
</tr>
<tr>
<td>Silver-haired bat</td>
<td>0.103</td>
<td>24</td>
</tr>
<tr>
<td>Cave Bats:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tri-colored bat</td>
<td>0.164</td>
<td>38</td>
</tr>
<tr>
<td>Little brown bat</td>
<td>0.087</td>
<td>20</td>
</tr>
<tr>
<td>Big brown bat</td>
<td>0.032</td>
<td>7</td>
</tr>
<tr>
<td>Northern long-eared bat</td>
<td>0.004</td>
<td>1</td>
</tr>
<tr>
<td>Unidentified bats</td>
<td>0.012</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>230</td>
<td>5,750</td>
</tr>
</tbody>
</table>
Mortality of Indiana bats or Virginia big-eared bats cannot be calculated in the same manner as non-listed bats because they are not as readily killed at wind projects. Little information is available regarding the circumstances under which Indiana bats may be at risk of collision or barotrauma with wind turbines. Three Indiana bat fatalities have been recorded at wind projects, which were studied through post-construction monitoring (Johnson et al. 2010; Good et al. 2011, Service 2011e). All 3 fatalities occurred during September. The estimated number of Indiana bats affected at these sites likely is higher than 3 due to biases associated with searcher efficiency and scavenger removal, but the actual number is unknown.

In its HCP, BRE has calculated that between approximately 2.5 and 5.0 Indiana bat fatalities would occur in the 100-turbine Project area annually, in the absence of avoidance, minimization, and mitigation measures to reduce fatality impacts. This was calculated using a little brown bat surrogate model for Indiana bat mortality since few Indiana bats have been found under wind turbines. Little brown bat is used a surrogate for Indiana bat because it is known to occur in the project area, commonly found under wind turbines, and has similar morphology, behaviour, and habitat use as Indiana bat. Using ratios of little brown to Indiana bats, the model estimates take of Indiana bat by simple proportions:

Bat fatalities per turbine per year x Proportion of little brown bat fatalities x Ratio of Indiana bats to little brown bats x Number of turbines = Number of Indiana bat fatalities per year for the project.

Chapter 4 of the HCP provides more details on assumptions, biases, and data sets considered and used in the calculations. Throughout HCP development, the Service worked with BRE to develop this model and feels comfortable that the method represents a reasonable approach to estimate take using best available science.

During years 1-3 of the ITP while BRE is testing the Curtailment Plan, BRE estimates that the take of up to 5 Indiana bats per year could occur at a 100-turbine project, for a total estimated take of up to 15 individuals during the first 3 years of the ITP. During this period, BRE will develop baseline bat mortality estimates, i.e., mortality estimates from fully operational turbines that will be used to judge success in meeting the biological goal of significantly reducing covered species and overall bat mortality in a cost effective manner consistent with the best available science. During Years 4-25 of the ITP, after Project-wide implementation of operational protocols developed during the first 3 years of the ITP, BRE concludes that the estimated amount of Indiana bat take can be reduced to 2.5 bats per year (50% of the take estimate), for a total estimated take of up to 70.0 Indiana bats over the entire 25-year term of the ITP (5.0 x 3 years + 2.5 x 22 years = 70.0) (Table 5-23).

The 50% reduction in mortality is based on curtailment studies that showed a 5 m/s cut-in speed reduced bat mortality from 50% to 87%. The 4.8 m/s cut-in speed is slightly outside the range tested, and 50% represents the lower end of the mortality reduction found in the studies. Collectively, these studies suggest that a minimum 50% reduction in bat fatalities is a reasonable assumption for the BRE Project where turbines will be feathered at wind speeds below 4.8 m/s from mid-July to mid-October.

Take of up to 70 Indiana bats represents less than 0.5% of the current population rangewide, in the Appalachian Recovery Unit, and in West Virginia (Table 5-23). In a best case scenario, all or most of this mortality will occur to individuals originating from many source populations during migration. The Service would consider this effect to be minor as long as it occurs in small increments over 25 years originating from multiple source populations. However, a small population of Indiana bats that hibernate in Snedegar’s Cave (the closest known occupied cave) may be at higher risk of turbine mortality than bats from other caves as 14 of the existing turbines are located at the outer edge of the 10-mi swarming radius (i.e., between 9 mi and 10 mi away). Should all or a substantial portion of the predicted Indiana bat mortality originate from Snedegar’s Cave, effects would be considered major at the local level and could raise concerns about population viability in this cave.

The USGS is assisting the Service in developing a model to further evaluate the effect of wind power mortality on Indiana bat populations. The model will allow comparisons at different scales (e.g. recovery
units, each individual hibernaculum, and clusters of hibernacula). Unfortunately, the model is not yet available. Should it become available by the time the Service prepares its final EIS, we will incorporate the results at that time.

During Years 1-3 of the ITP, BRE estimates that the take of up to 1 Virginia big-eared bat per year could occur at a 100-turbine project, for a total estimated take of up to 3 individuals during the first 3 years of the ITP. During this period, BRE will develop baseline bat mortality estimates that will be used to measure and achieve a reduction in covered species and all bat mortality. During Years 4-25 of the ITP, after Project-wide implementation of operational protocols developed during the first 3 years of the ITP, BRE concludes that estimated amount of Virginia big-eared bat take can be reduced to 0.5 bats per year, for a total estimated take of up to 14 Virginia big-eared bats over the entire 25-year term of the ITP (1.0 x 3 years + 0.5 x 22 years = 14.0) (Table 5-23). While the Service believes that take of 14 Virginia big-eared bats over the life of the project is highly unlikely given that the Project is located between two genetically isolated populations and outside the normal commuting distance of this species, we have used this take estimate in our DEIS as a worst case scenario. Take of up to 14 Virginia big-eared bats represents roughly 0.1% of the current population rangewide and in West Virginia (Table 5-23). This effect would be considered minor.

Alternative 2 would also impact several bat species whose status is under review. Under section 4(b)(3)(A) of the ESA, the Service is conducting a status review of the little brown bat and has determined that a 90-day petition for listing of northern long-eared bats and eastern small footed bats presents substantial scientific or commercial information indicating that listing the eastern small-footed bat and the northern long-eared bat throughout their entire ranges may be warranted (76 Federal Register 38095). Information in the petition and in Service files indicates that the continued existence of these two species may be threatened by destruction, modification, or curtailment of habitat from logging (northern long-eared bat); oil, gas, and mineral development (eastern small-footed and northern long-eared bats); and wind energy development (eastern small-footed and northern long-eared bats).

Little brown bats have been severely impacted by WNS and are frequently killed at wind power projects during migration. Under Alternative 2, we predict over 2,800 little brown bats would be killed over the life of the project. Pre-construction surveys also found reproductively active little brown bats on the Beech Ridge project site, indicating maternity areas are nearby. Turbines nearest these maternity areas likely pose the highest risk to breeding individuals and young. Thus, the Project has the potential affect local breeding populations of the declining little brown bat.

Although mortality of northern long-eared bats has been reported from wind power projects, they generally constitute a small fraction of total mortality (Kerns and Kerlinger 2004; Johnson 2005). Low numbers of the northern long-eared bat are consistent with its relative representation in regional bat communities and should not be taken as an indication that this species is not susceptible to wind energy-related mortality (76 Federal Register 38095). There are no reports of eastern small-footed bat fatalities at wind energy facilities to date; however, mist-net surveys conducted in Pennsylvania revealed that this species was present within wind facility Project areas (Capouillez and Librandi-Mumma 2008). Pre-construction bat surveys also found reproductively active eastern small footed and northern long-eared bats on the Beech Ridge project site, indicating maternity areas are nearby. Turbines nearest these maternity areas may pose high risk to breeding individuals and young. Thus, the Project has the potential to affect local breeding populations of these 2 species.
Table 5-23. Listed bat mortality for the 100-turbine Project with and without operational curtailment. Implementation of the Curtailment Plan is estimated to reduce bat mortality by 50%.

<table>
<thead>
<tr>
<th>Alternative 2</th>
<th>100-turbine Project w/o curtailment (3.5 m/s cut-in speed)</th>
<th>100-turbine Project w/ curtailment (4.8 m/s cut-in speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td>Annual mortality</td>
<td>Life-of-Project mortality</td>
</tr>
<tr>
<td>Indiana bat</td>
<td>2.5-5.0</td>
<td>62-125</td>
</tr>
<tr>
<td>Virginia big-eared bat</td>
<td>1.0</td>
<td>25</td>
</tr>
</tbody>
</table>

**Indiana bat current population:**

| Rangewide | 424,708 | 0.01-0.03 | 0.008-0.02 |
| Appalachian Mountain Recovery Unit | 32,358 | 0.2-0.4 | 0.1-0.2 |
| West Virginia | 20,358 | 0.3-0.6 | 0.2-0.3 |
| Snedegar’s Cave | 304 | 20-41 | 11-23 |

**Virginia big-eared bat current population:**

| Rangewide | 13,000 | 0.2 | 0.1 |
| West Virginia | 11,092 | 0.2 | 0.1 |

Other Effects to Bats Associated with Construction and Operation of the 100-Turbine Project

The magnitude of impact on local bat communities will vary based on the quality and quantity of habitat removed and the availability of alternate habitat of comparable quality and character. The 100-turbine Project is expected to result in the loss of approximately 567 acres of forest habitat for the life of the Project. Succession will be allowed to occur naturally in some areas (acreage undetermined). However, at present, 79% of the existing forest is characterized as timber greater than 26 years old. The existing forest habitat provides suitable roosting habitat and will result in a loss of roosting habitat over the life of the permit.

In some cases, conversion from forested to non-forest habitat could result in short- or long-term benefits to local bat communities, depending upon the configuration of the surrounding forested landscape and the individual species present. For example, forest gaps and clearings create additional foraging opportunities, as documented by higher levels of bat activity in fields, edges, and clearings (Hayes and Loeb 2007). These types of gaps are created from the linear nature of the access roads and turbine pads created for the wind facility. This apparent enhancement of foraging habitat is possibly a function of reduction in clutter, rather than enhancement of insect (prey) habitat. However, some species of bats in the region are interior forest feeders, while others prefer feeding in gaps and along forested edges and riparian corridors. Clutter-adapted foraging and vegetation gleaning species such as northern long-eared bat and Indiana bat are likely more abundant where forest canopy cover increases and forest canopy gap size decreases, whereas the opposite is true for open-adapted foraging species such as big brown bat and hoary bat (Ford et al. 2005)

Creation of forest gaps and clearings has been recommended as a management technique for some species (Krushes et al. 1996), but not all bat species in the eastern U.S. would benefit from such practices (Owen et al. 2003). Prey density in patch cuts has found to be similar to that of uncut areas, suggesting that clutter is more likely to influence bat use of a habitat depending on a bat’s morphological characteristics (Lacki et al. 2007). Larger species such as big brown bats, hoary bat, red bat, silver-haired bats have been shown to be more active along skidder trails, forest roads, and hiking trails whereas smaller species (e.g., tricolored bats) tend to be more active in forest interiors. This is thought to primarily driven by the amount of clutter (Lacki et al. 2007)
The potential increase in foraging habitat through the creation of open areas is not likely to substantially benefit bats in the Project area due to the current abundance of this type of habitat. Kunz et al. (2007a) suggests the possibility that those species that migrate, commute, or forage along these linear corridors may be at increased risk for collision. Displacement of bats could occur as a result of animals avoiding spinning turbine blades or increased human presence associated with maintenance activities. It is unknown whether or not bats roosting or migrating in close proximity to operating wind turbines become habituated to their presence or whether they become displaced by them. Displacement of bats could occur as a result of animals avoiding spinning turbine blades.

**100-Turbine Decommissioning**
Small areas of regenerated forest in the original construction disturbance area may be cleared again to remove Project components. Should invasive species have established a foot-hold by this time, the additional clearing could prove to be beneficial to their regeneraion. Disturbed areas and access roads will be graded to the original contour as near as practicable if the landowner requests that BRE decommission these areas. If requested by the landowner, access roads will be left in place.

The forest regeneration process will restart following clearing activities. Suitable maternity roosts generally occur in trees more than 50 years in age. This will mean that areas that were originally cleared and then recleared for decommissioning will not provide suitable maternity roosting habitat for bats for more than 70 to 75 years (assuming a 25-year project life). Night-time roosting habitat may occur in much younger trees; however, reclearing the area for decommissioning will limit roosting opportunities until trees mature.

Bat displacement and effects of edge creation will be similar for that described for Project construction. However, there will be minor effects to forests that will not be able to mature consistently with the surrounding areas due to clearing and re-clearing for decommissioning. These effects are expected to have less of an impact when compared to logging, mining, and natural gas operations in the region that remove entire stands on a 50-year cycle.

**Proposed Action Summary**
We predict the Proposed Action will kill approximately 22,000 tree-roosting migratory bats (e.g. silver-haired bat, eastern red bat, and hoary bat) over the 25-year permit term. The Proposed Action may also kill approximately 10,000 cave-dwelling bats during the term of the permit. The total number of bats that could potentially be killed over the 25-year permit term is roughly 32,000. There may also be up to 70 Indiana bats and 14 Virginia big-eared bats killed during the 25-year permit term. Effects to habitat as part of the implementation of Phase II construction and Project decommissioning are expected to be minor when taken into context with the type of land modification (e.g., commercial forestry operations and natural gas exploration) likely to occur on the property absent Phase II construction and operation. The overall estimated bat mortality is roughly double that of Alternative 3 and 1.5 times that of Alternative 4. However, the estimated mortality is expected be half that of a 100-turbine project that would operate unrestricted.

Effects to regional Indiana bat and Virginia big-eared bat populations would be considered minor if all or most of the mortality originates from many source populations during migration. Because most mortality at wind power projects occurs during migration, we assume that this scenario is most likely. However, some effect to local breeding populations (Snedegar’s Cave) is reasonably anticipated. It is currently unknown to what degree this small cave population affected by WNS can withstand even small levels of additive annual mortality from wind power.

Off-site mitigation in perpetuity would reduce these effects. BRE currently is negotiating with landowners to purchase an Indiana bat cave and install gates on mine portals occupied by Virginia big-eared bats. In the event these deals fall through, alternative forms of mitigation would be pursued that meet the criteria in the HCP for conservation projects such as protection of other caves, cave gating, and protection of maternity areas. By protecting a cave currently unaffected by WNS that supports Indiana and other bats,
and by removing real threats that affect bat survivorship (threats of human disturbance, logging, and development), the long-term survival of bat populations in the cave is increased. Preservation and gating of such caves in perpetuity would thus increase the likelihood that bats in the cave survive over time. Likewise, protection of a maternity area would remove threats to reproduction.

The biological significance of killing more than 22,000 tree-roosting migratory bats over the 25-year permit term is uncertain. Little information is available about the population estimates of non-listed bats to determine the significance of these impacts. These bats would be expected to have poor potential to recover from moderate to large-scale additive mortality from wind power, given their low reproductive potential. BRE has not currently proposed compensatory mitigation to benefit unlisted tree-roosting bats. If the impact to this group of bats could be mitigated to some degree, it would lessen the significance of this impact.

Likewise, the biological significance of killing 10,000 cave-roosting bats of unknown population sizes over 25 years is uncertain. The project likely will kill several cave bat species known to breed on or near the project site. Mitigation developed to compensate for take of Indiana bats and Virginia big-eared bats may incidentally benefit these species as well. Indiana bats, little brown bats, northern long-eared bats, and eastern small footed bats hibernate in the cave system that has been targeted for off-site mitigation under Alternative 2. Should the deal for purchasing this site fall through, alternate mitigation projects (cave gating or protection of an Indiana bat maternity area) may or may not benefit these species.

Other species of cave-dwelling bats may benefit from mitigation efforts that compensate for take to Indiana bat and Virginia big-eared bat. In addition to the aforementioned species, the cave system targeted for mitigation also supports red bat, and tri-colored bat. With the exception of tri-colored bat, cave-dwelling bats comprise a much smaller proportion of the mortality that results from wind facilities. The tree-roosting migratory bats, particularly hoary bats and red bats, have high numbers of estimated mortality relative to that of other bats.

5.8.2.3 Alternative 3: ITP and HCP with Additional Covered Species

Under the Alternative 3, an ITP pursuant to Section 10 (a)(1)(B) of the ESA would be issued for development of the BRE Project. The Project would be constructed as described for the Proposed Action. Under Alternative 3, the BRE HCP would include 3 other bat species (little brown bat, northern long-eared bat, and eastern small-footed bat) should they become listed under the ESA. These 3 species would be included as Covered Species in addition to the Indiana bat and Virginia big-eared bat. Habitat protection would include areas to benefit the 3 additional Covered Species, as well as the Indiana bat and Virginia big-eared bat. Additionally, the Curtailment Plan would be modified to implement expanded avoidance and minimization measures to protect roosting and brooding sites within and proximal to the Project area should they be identified.

Reproductive individuals of the 3 currently unlisted bat species were captured in mist-nets in summer. Therefore, it is assumed the Project area provides maternity areas for these bats. To reduce impacts to breeding individuals, BRE's Curtailment Plan and RMAMP would be modified to implement a 6.5 m/s cut-in speed (as opposed to 4.8 m/s in Alternative 2) as the initial rate for curtailment. Furthermore, all 100 turbines would operate at 6.5 m/s from 30 minutes before sunset through 15 minutes after sunrise during the period April 1 through October 15, which is the presumed period for which the 3 additional species, as well as Indiana bats and Virginia big-eared bats, are active.

If the Project’s research and monitoring results show that this modified Curtailment Plan reduces bat mortality by at least 76%, BRE could either implement their original Curtailment Plan (as described for the Proposed Action) or modify it as further described below (under analysis assumptions) to employ less restrictive operations that achieve the same or greater reduction in bat mortality. Less restrictive operations could include lowering the cut-in speed, contracting the seasonal curtailment period, contracting the night-time hourly period, applying curtailment to fewer turbines (those closest to bat maternity areas), or a combination of these 3 measures.
The measures described below would be implemented upon ITP issuance as if the species were currently listed under the ESA. Should these species be listed during the permit term, take authorization for them would become effective, and no additional conservation measures or permit modifications would be needed, provided that these measures have been fully implemented.

Habitat Assessment in the Project Area
Implementation of Alternative 3 would include mist-netting to locate maternity areas for each of the 3 unlisted bats. Delineated habitats would be used to evaluate specific areas of the Project that may pose the greatest risks to covered species.

Modified Operations Protocol
Under this alternative, BRE’s Curtailment Plan and RMAMP would be modified to implement a 6.5 m/s cut-in speed as opposed to 4.8 m/s as the rate for curtailment. Furthermore, all 100 turbines would operate at 6.5 m/s from 30 minutes before sunset through 15 minutes after sunrise during the period April 1 through October 15, which is the presumed period for which most bats are active. This change in Project operation would reduce further potential take of covered species and all bat species. Curtailment studies in North America showed that turbines with raised cut-in speeds between 5.0 m/s and 6.5 m/s killed fewer bats than normally operating turbines between 57.5% and 78.0% over the course of one fall migration season (Baerwald et al. 2009, Arnett et al. 2010, Good et al. 2011).

The Project’s research and monitoring goals would be adjusted to achieve reductions in overall bat mortality by at least 76%. One could question whether the 6.5 m/s cut-in speed would significantly affect bat mortality rates. A cursory analysis of the potential effects of altering turbine cut-in speeds can be made by applying the average fatality reductions from bat mortality studies (Table 5-24). This is a simplistic approach, but it appears that the implementation of increased turbine cut-in speeds may be more meaningful at some facilities than others. Additional work is necessary to better understand the relationships between low wind speed turbine operations and bat mortality. For purposes of analyzing effects of Alternative 3, we assumed a 76% mortality reduction can be achieved with a 6.5 m/s cut-in speed. This could be a significant avoidance measure, especially if reproductive females are among those avoided.
We first looked at mortality rates assuming no curtailment of Project operations using the estimates from the studies that used both the Shoenfeld and Huso estimators, just as for the Proposed Action. We then applied the 76% mortality reduction predicted for the modified curtailment strategy described for Alternative 3. Based on the average rate of 26.11 bats per turbine per year without curtailment, implementation of Alternative 3 would result in 627 bat deaths per year (Table 5-25). Assuming that population levels of bats and mortality rates remain within this range over the term of the permit, and based on the mean mortality rate (26.11 bats per turbine per year) and 76% reduction due to curtailment, we predict the Project will kill roughly 15,666 bats during the 25-year permit term. Based upon the ranges of variation in mortality estimates in Table 5-25, we would not expect mortality levels to be as low or as high as the best and worst case scenarios, respectively.

**Table 5-24.** Low wind-speed turbine operation and bat fatality reductions.

<table>
<thead>
<tr>
<th>Study</th>
<th>Start-up speed (m/s)</th>
<th>Bats per turbine per study period</th>
<th>Fatality reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good et al. (2011)</td>
<td>3.5 (control)</td>
<td>14.00</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>5.0</td>
<td>7.00</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>6.5</td>
<td>3.00</td>
<td>79%</td>
</tr>
<tr>
<td>Arnett et al. (2011; 2008 data)</td>
<td>3.5 (control)</td>
<td>2.04</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>5.0</td>
<td>0.27</td>
<td>87%</td>
</tr>
<tr>
<td></td>
<td>6.5</td>
<td>0.53</td>
<td>74%</td>
</tr>
<tr>
<td>Arnett et al. (2011; 2009 data)</td>
<td>3.5 (control)</td>
<td>2.29</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>5.0</td>
<td>0.73</td>
<td>68%</td>
</tr>
<tr>
<td></td>
<td>6.5</td>
<td>0.55</td>
<td>76%</td>
</tr>
<tr>
<td>Baerwald et al. (2008)</td>
<td>4.0 (control)</td>
<td>19.00</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>5.5</td>
<td>7.60</td>
<td>60%</td>
</tr>
<tr>
<td></td>
<td>5.5</td>
<td>8.10</td>
<td>57%</td>
</tr>
<tr>
<td>Mean Fatality Reductions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.0 and 5.5 m/s treatments</td>
<td>26.22 bats per turbine per year</td>
<td>64%</td>
</tr>
<tr>
<td></td>
<td>6.5 m/s treatments</td>
<td></td>
<td>76%</td>
</tr>
</tbody>
</table>

Table 5-25. Projected bat mortality for the Beech Ridge Energy Wind Project based on the 100-turbine Project with and without implementation of a 6.5 m/s cut-in speed. Mortality rates were derived using the modified Shoenfeld estimator (Erickson et al. 2004) or Huso estimator (Huso 2010) for 14 post-construction studies.

<table>
<thead>
<tr>
<th>Alternative 3</th>
<th>100-turbine Project w/o curtailment (3.5 m/s cut-in speed)</th>
<th>100-turbine Project w/ curtailment (6.5 m/s cut-in speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality rate ¹</td>
<td>Annual mortality</td>
<td>Life of Project mortality ²</td>
</tr>
<tr>
<td>Mean</td>
<td>26.11</td>
<td>2,611</td>
</tr>
<tr>
<td>Low end of range</td>
<td>2.30</td>
<td>230</td>
</tr>
<tr>
<td>High end of range</td>
<td>91.60</td>
<td>9,160</td>
</tr>
</tbody>
</table>

¹ Mortality rate is expressed in bats per turbine per year.

² Based on 25-year operational life across all turbines in Project.

**Bat Species Differences.** As for the Proposed Action, Table 5-26 shows the species composition of bat mortality estimated for Alternative 3 based upon an average overall mortality rate of 26.22 bats per turbine. We predict Alternative 3 will result in mortality of roughly 11,000 migratory tree bats and 4,500 cave bats over the 25-year operating life of the project. This includes roughly 1,400 little brown bats, 60 northern long-eared bats, and an unknown number of small-footed bats over the life of the project. Total bat mortality for the life of the project with project curtailment at the 6.5 m/s cut-in speed (15,700 bats) is...
approximately 75% less than that predicted under normal unrestricted operations at the 3.5 m/s cut-in speed (65,300 bats).

Table 5-27 provides bat mortality by species under 2 scenarios for the 100-turbine Project based on the low-end (2.30 bats per turbine per year) and high-end (91.60 bats per turbine per year) rates from the studies’ confidence intervals. Under these scenarios, total bat mortality could possibly range from 1,400 to 55,000 bats for the life of the project. Realistically, we would not expect to see these extremes of variation. Rather, we predict that bat mortality will fall somewhere between the low-end high-end rates and likely closer to the average of 26.11 bats per turbine per year and 15,700 bats over 25 years (Table 5-26).

Table 5-26. Predicted composition of bat mortalities based on extrapolation of mortality composition from 5 other studies conducted in the Mid-Atlantic Highlands. The mean mortality rate (26.11 bats per turbine per year) is based on estimated rates from 14 post-construction studies that used the Shoenfeld or Huso estimators. Species composition is illustrated for the 100-turbine Project with and without operational curtailment as described for Alternative 3. Implementation of Alternative 3 is estimated to reduce bat mortality by 76%.

<table>
<thead>
<tr>
<th>Alternative 3</th>
<th>100-turbine Project w/o curtailment (3.5 m/s cut-in speed)</th>
<th>100-turbine Project w/ curtailment (6.5 m/s cut-in speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Relative mortality (%)</td>
<td>Annual mortality</td>
</tr>
<tr>
<td>Migratory Tree Bats:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hoary bat</td>
<td>32.0</td>
<td>835</td>
</tr>
<tr>
<td>Red bat</td>
<td>27.8</td>
<td>726</td>
</tr>
<tr>
<td>Silver-haired bat</td>
<td>10.3</td>
<td>269</td>
</tr>
<tr>
<td>Total</td>
<td>1,830</td>
<td>45,758</td>
</tr>
<tr>
<td>Cave Bats:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tri-colored bat</td>
<td>16.4</td>
<td>428</td>
</tr>
<tr>
<td>Little brown bat</td>
<td>8.7</td>
<td>227</td>
</tr>
<tr>
<td>Big brown bat</td>
<td>3.2</td>
<td>84</td>
</tr>
<tr>
<td>Northern long-eared bat</td>
<td>0.4</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>749</td>
<td>18,734</td>
</tr>
<tr>
<td>Unidentified bats</td>
<td>1.2</td>
<td>31</td>
</tr>
<tr>
<td>Total</td>
<td>2,610</td>
<td>65,275</td>
</tr>
</tbody>
</table>

Table 5-27. Predicted composition of bat mortalities based on extrapolation of mortality composition from other studies conducted in the Mid-Atlantic Highlands. Mortality rates are based on the low-end and high-end confidence intervals from 14 post-construction studies that used the Shoenfeld and Huso estimators. Species composition of mortality is illustrated for the 100-turbine Project with and without operational curtailment. Implementation of the modified Curtailment Plan under Alternative 3 is estimated to reduce bat mortality by 76%.

<table>
<thead>
<tr>
<th>Alternative 3</th>
<th>Low Rate: 2.30 bats per turbine per year</th>
<th>High Rate: 91.60 bats per turbine per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-turbine Project w/o curtailment (3.5 m/s cut-in speed)</td>
<td>100-turbine Project w/ curtailment (6.5 m/s cut-in speed)</td>
<td>100-turbine Project w/o curtailment (3.5 m/s cut-in speed)</td>
</tr>
<tr>
<td><strong>Species</strong></td>
<td><strong>Relative mortality</strong></td>
<td><strong>Annual mortality</strong></td>
</tr>
<tr>
<td>Migratory Tree Bats:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hoary bat</td>
<td>0.319</td>
<td>73</td>
</tr>
<tr>
<td>Red bat</td>
<td>0.278</td>
<td>64</td>
</tr>
<tr>
<td>Silver-haired bat</td>
<td>0.103</td>
<td>24</td>
</tr>
<tr>
<td>Cave Bats:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tri-colored bat</td>
<td>0.164</td>
<td>38</td>
</tr>
<tr>
<td>Little brown bat</td>
<td>0.087</td>
<td>20</td>
</tr>
<tr>
<td>Big brown bat</td>
<td>0.032</td>
<td>7</td>
</tr>
<tr>
<td>Northern long-eared bat</td>
<td>0.004</td>
<td>1</td>
</tr>
<tr>
<td>Unidentified bats</td>
<td>0.012</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>230</td>
<td>5,750</td>
</tr>
</tbody>
</table>
Additionally, the Curtailment Plan would be modified to implement expanded avoidance and minimization measures to protect roosting and brooding sites within and proximal to the Project area should they be identified. Should sensitive habitats for any of these 3 additional species, the curtailment would be further modified to include a plan for modifying operations of specific turbines that pose the greatest risk to these sites.

**Listed Bats**

For the Proposed Action, the HCP estimates 2.5 Indiana bat deaths per year, for a total estimated take of up to 70.0 Indiana bats over the 25-year term of the ITP. Implementation of Alternative 3 could potentially reduce take of Indiana bats an additional 26% or more. During implementation of the ITP under Alternative 3, the take of up to 5.0 Indiana bats per year would be reduced by 76% to 1.2 Indiana bats annually for the 100-turbine Project (Table 5-28). The total estimated amount of Indiana bat take under implementation of Alternative 3 is estimated to be up to 30.0 Indiana bats over the entire 25-year term of the ITP (1.2 bats/year x 25 years = 30).

Take of up to 30 Indiana bats represents less than 0.5% of the current population rangewide, in the Appalachian Recovery Unit, and in West Virginia (Table 5-28). Because most bat mortality at wind projects occurs during fall migration, we assume that all or most of this mortality will occur in small annual increments to individuals originating from many source populations during migration. However, Indiana bats that hibernate in Snedegar’s Cave may be at higher risk of turbine mortality since 14 of the existing turbines are located at the outer edge of their 10-mi swarming radius. This cave supports a small, unstable population of Indiana bats affected by WNS. We would anticipate some mortality of these individuals over the life of the project.

For the Proposed Action, the HCP estimates 0.5 Virginia big-eared bat death per year, for a total estimated take of up to 14.0 individuals. Implementation of Alternative 3 could potentially reduce take of Virginia big-eared bats an additional 26% or more, i.e., 0.24 bats per year (Table 5-28). Project-wide implementation of a 6.5 m/s cut in speed would result in a total estimated take of up to 6 Virginia big-eared bats over the entire 25-year term of the ITP (0.24 bats/year x 25 years = 6). While the Service believes that take of 6 Virginia big-eared bats over the life of the project is unlikely given that the Project is located between two genetically isolated populations and outside the normal commuting distance of this species, we have used this take estimate in our DEIS as a worst case scenario. Take of up to 6 Virginia big-eared bats represents roughly 0.05% of the current population rangewide and in West Virginia (Table 5-28).

---

44We assumed the 76% reduction in mortality would begin from year 1, given that several studies have tested a 6.5 m/s cut-in speed and achieved this average level of reduction (Table 5.23). Thus there is greater certainty of the effectiveness of this cut-in speed (versus the as yet untested 4.8 m/s cut-in speed proposed by BRE under Alternative 2). Under Alternative 2, a 50% reduction in mortality from a 4.8 m/s cut-in speed was not assumed effective until year 4, allowing for testing and refinement to demonstrate effectiveness.
Table 5-28. Listed bat mortality for the 100-turbine Project with and without operational curtailment. Implementation of the Curtailment Plan is estimated to reduce bat mortality by 76%.

<table>
<thead>
<tr>
<th>Alternative 3</th>
<th>100-turbine Project w/o curtailment (3.5 m/s cut-in speed)</th>
<th>100-turbine Project w/ curtailment (6.5 m/s cut-in speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Annual mortality</td>
<td>Life-of-Project mortality</td>
</tr>
<tr>
<td>Indiana bat</td>
<td>2.5-5.0</td>
<td>62-125</td>
</tr>
<tr>
<td>Virginia big-eared bat</td>
<td>1.0</td>
<td>25</td>
</tr>
<tr>
<td><strong>Indiana bat current population:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rangewide</td>
<td>424,708</td>
<td>0.01-0.03</td>
</tr>
<tr>
<td>Appalachian Mountain Recovery Unit</td>
<td>32,358</td>
<td>0.2-0.4</td>
</tr>
<tr>
<td>West Virginia</td>
<td>20,358</td>
<td>0.3-0.6</td>
</tr>
<tr>
<td>Snedegar’s Cave</td>
<td>304</td>
<td>20-41</td>
</tr>
<tr>
<td><strong>Virginia big-eared bat current population:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rangewide</td>
<td>13,000</td>
<td>0.2</td>
</tr>
<tr>
<td>West Virginia</td>
<td>11,092</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Habitat Protection

In addition to protective measures described for the Indiana bat and Virginia big-eared bat, the HCP would include measures to protect suitable roost/maternity habitat for little brown bat, northern long-eared bat, and eastern small-footed bat on or near the Project site. Habitat protection measures implemented on or near the Project area may increase the incidence of bat use and, in turn, increase risks to bats. Conversely, measures to protect suitable roost/maternity habitat or known hibernacula for the additional covered species off-site may provide alternate sites for roosting away from the Project. Alternative 3 would benefit additional covered species and potentially increase species viability locally and regionally.

Other Effects to Bats Associated with Alternative 3

The magnitude of impact associated with habitat degradation and displacement on local bats would be the same as described for the Proposed Action.

Alternative 3 Summary

Based on average fatality rates and implementation of a 6.5 m/s cut-in speed demonstrated to reduce bat mortality by 76%, implementation of Alternative 3 is estimated to kill approximately 11,000 migratory tree-dwelling bats (e.g. silver-haired bat, eastern red bat, and hoary bat) and 4,500 unlisted cave-dwelling bats (tri-colored, little brown, big brown, and northern long-eared bats) over the 25-year permit term over the 25-year permit term, resulting in roughly 15,500 bat fatalities (Table 5-26). There would also be up to 30 Indiana bats and 6 Virginia big-eared bats killed during the 25-year permit term. We would expect most bat mortality to occur during migration. Some mortality of Indiana bats from a small, unstable local cave population is likely.

Effects to habitat as part of the implementation of Phase II construction and Project decommissioning are expected to be minor when taken into context with the type of land modification (e.g. commercial forestry operations and natural gas exploration) likely to occur on the property absent Phase II construction and operation.
Alternative 3 includes compensation for the unavoidable Project impacts to all 5 covered species; compensation would be achieved through suitable mitigation that would satisfy the goals and objectives for on-site and off-site conservation (cave or maternity area protection and gating in perpetuity). With mitigation, effects to cave-dwelling bats would be greatly reduced. The predicted mortality of 11,000 migratory tree-roosting bats over the 25-year permit term is considered an additive impact on tree bat populations at the local scale, given these bats low reproductive potential. If the impact to this group of bats could be mitigated to some degree, it would lessen the significance of this impact.

Overall, Alternative 3 is likely to result in lower bat mortality as compared to the Proposed Action and Alternative 4. Because the No-Action is not expected to kill bats, Alternative 3 will have greater bat mortality as compared to the No-Action. Alternative 3 will include measures to protect 3 additional species and expand the number of sites that are afforded protection as bat habitat.

5.8.2.4 Alternative 4: ITP with Full Implementation of Habitat Conservation Plan for Phase I Only

Under Alternative 4, an ITP pursuant to Section 10 (a)(1)(B) of the ESA would be issued for only the existing 67-turbine Project. The Phase I Only Alternative would include the full implementation of the HCP as described for the Proposed Action. These actions would occur for the Project as it is currently constructed. Under this alternative, the Phase II 33 turbines would not be constructed.

For the term of the ITP, BRE would adjust the cut-in speed for all 67 turbines from 3.5 m/s (7.7 mph) to 4.8 m/s (10.6 mph) for the time of night from 30 minutes before sunset for 5 hours during the 12-week period from mid-July to mid-October (BRE’s Curtailment Plan). Changing turbine cut-in speeds during this period of the year would help avoid key periods of bat activity around the Project, thus reducing potential take of covered species and all bat species. If research and monitoring results show that this proposed Curtailment Plan is not meeting the HCP’s goals and objectives, BRE would modify the Curtailment Plan to employ more restrictive operations. However, BRE’s Curtailment Plan would be modified only with the written agreement of Service.

This alternative would reduce the number of turbines BRE is proposing for the Project. Reducing the number of turbines would not necessarily eliminate the likelihood that Indiana bats or Virginia big-eared bats would be taken. A project of this size still poses a level of risk to bats. However, the estimated number of bat fatalities would be lower for 67 turbines than that for 100 turbines, as described for the Proposed Action.

67-Turbine Operation
Under Alternative 4, effects to bats would be as described for the Proposed Action, but mortality would be less due to the fewer number of turbines. Estimates of bat mortality were developed using the same metrics used for the Proposed Action. We first looked at mortality rates assuming no curtailment of Project operations using the estimates from the studies that used the Shoenfeld or Huso estimators, just as for the Proposed Action. We then applied the 50% mortality reduction predicted for the Curtailment Plan. Using the 26.11 bats per turbine per year as the mortality rate, implementation of Alternative 4 for the existing 67-turbine BRE Project with operational curtailment of 4.8 m/s would result in roughly 900 bat deaths per year per year (Table 5-29), assuming a minimum 50% reduction in mortality is reached (26.11 bats/turbine/year x 67 turbines x 0.5 reduction). Assuming that population levels of bats and mortality rates remain consistent over the term of the permit, the Project would kill approximately 22,000 bats during the 25 year permit term (26.11 bats/turbine/year x 67 turbines x 0.5 reduction x 25 years).
Table 5-29. Projected bat mortality for the Beech Ridge Energy Wind Project based on the 67-turbine Project with and without implementation of the Curtailment Plan. Mortality rates were derived using the modified Shoenfeld estimator (Erickson et al. 2004) or Huso estimator (Huso 2010) for 14 post-construction studies.

<table>
<thead>
<tr>
<th>Alternative 4</th>
<th>67-turbine Project w/o curtailment (3.5 m/s cut-in speed)</th>
<th>67-turbine Project w/ curtailment (4.8 m/s cut-in speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality rate ¹</td>
<td>Annual mortality</td>
<td>Life of Project mortality ²</td>
</tr>
<tr>
<td>Mean</td>
<td>26.11</td>
<td>1,749</td>
</tr>
<tr>
<td>Low end of range</td>
<td>2.30</td>
<td>154</td>
</tr>
<tr>
<td>High end of range</td>
<td>91.60</td>
<td>6,137</td>
</tr>
</tbody>
</table>

¹ Mortality rate is expressed in bats per turbine per year.
² Based on 25-year operational life across all turbines in Project.

Species composition and mortality rates from studies completed at 5 wind projects in the Mid-Atlantic Highlands were used to predict bat mortality by species under implementation of Alternative 4 assuming an average overall bat mortality rate of 26.11 bats per turbine (Table 5-30). We predict Alternative 4 will result in mortality of roughly 15,300 migratory tree bats and 6,300 cave bats over the 25-year operating life of the project. This includes roughly 1,900 little brown bats, 90 northern long-eared bats, and an unknown number of small-footed bats over the life of the project. Total bat mortality for the life of the project with project curtailment at the 4.8 m/s cut-in speed (22,000 bats) is approximately 50% less than that predicted under normal unrestricted operations at the 3.5 m/s cut-in speed (43,700 bats).

Table 5-31 provides bat mortality by species under 4 scenarios for the 100-turbine Project based on the low-end (2.30 bats per turbine per year) and high-end (91.60 bats per turbine per year) rates from the studies’ confidence intervals and the 2 cut-in speeds (3.5 m/s and 4.8 m/s). Under these scenarios, total bat mortality could possibly range from 1,900 to 76,700 bats for the life of the project. Realistically, we would not expect to see these extremes of variation. Rather we predict that bat mortality will fall somewhere between the low-end high-end rates and likely closer to the average of 26.11 bats per turbine per year and 22,000 bats over 25 years (Table 5-30).
Table 5-30. Predicted composition of bat mortalities based on extrapolation of mortality composition from 5 other studies conducted in the Mid-Atlantic Highlands. The mean mortality rate (26.11 bats per turbine per year) is based on estimated rates from 13 post-construction studies that used the Shoenfeld or Huso estimators. Species composition is illustrated for the 67-turbine Project with and without operational curtailment. Implementation of the modified curtailment is estimated to reduce bat mortality by 50%.

<table>
<thead>
<tr>
<th>Alternative 4</th>
<th>67-turbine Project w/o curtailment (3.5 m/s cut-in speed)</th>
<th>67-turbine Project w/ curtailment (4.8 m/s cut-in speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Species</td>
<td>Relative mortality (%) (^1)</td>
<td>Annual mortality</td>
</tr>
<tr>
<td>Migratory Tree Bats:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hoary bat</td>
<td>32.0</td>
<td>560</td>
</tr>
<tr>
<td>Red bat</td>
<td>27.8</td>
<td>486</td>
</tr>
<tr>
<td>Silver-haired bat</td>
<td>10.3</td>
<td>180</td>
</tr>
<tr>
<td>Subtotal</td>
<td>1,226</td>
<td>30,658</td>
</tr>
<tr>
<td>Cave Bats:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tri-colored bat</td>
<td>16.4</td>
<td>287</td>
</tr>
<tr>
<td>Little brown bat</td>
<td>8.7</td>
<td>152</td>
</tr>
<tr>
<td>Big brown bat</td>
<td>3.2</td>
<td>56</td>
</tr>
<tr>
<td>Northern long-eared bat</td>
<td>0.4</td>
<td>7</td>
</tr>
<tr>
<td>Subtotal</td>
<td>502</td>
<td>12,551</td>
</tr>
<tr>
<td>Unidentified bats</td>
<td>1.2</td>
<td>21</td>
</tr>
<tr>
<td>Total</td>
<td>1,749</td>
<td>43,734</td>
</tr>
</tbody>
</table>

Table 5-31. Predicted composition of bat mortalities based on extrapolation of mortality composition from other studies conducted in the Mid-Atlantic Highlands. Mortality rates are based on the low-end and high-end confidence intervals from 14 post-construction studies that used the Shoenfeld and Huso estimators. Species composition of mortality is illustrated for the 67-turbine Project with and without operational curtailment. Implementation of BRE’s Curtailment Plan is estimated to reduce bat mortality by 50%.

<table>
<thead>
<tr>
<th>Alternative 4</th>
<th>Low Rate: 2.30 bats per turbine per year</th>
<th>High Rate: 91.60 bats per turbine per year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>67-turbine Project w/o curtailment (3.5 m/s cut-in speed)</td>
<td>67-turbine Project w/ curtailment (4.8 m/s cut-in speed)</td>
</tr>
<tr>
<td>Species</td>
<td>Relative mortality %</td>
<td>Annual mortality</td>
</tr>
<tr>
<td>Migratory Tree Bats:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hoary bat</td>
<td>31.9</td>
<td>49</td>
</tr>
<tr>
<td>Red bat</td>
<td>27.8</td>
<td>43</td>
</tr>
<tr>
<td>Silver-haired bat</td>
<td>10.3</td>
<td>16</td>
</tr>
<tr>
<td>Cave Bats:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tri-colored bat</td>
<td>16.4</td>
<td>25</td>
</tr>
<tr>
<td>Little brown bat</td>
<td>8.7</td>
<td>13</td>
</tr>
<tr>
<td>Big brown bat</td>
<td>3.2</td>
<td>5</td>
</tr>
<tr>
<td>Northern long-eared bat</td>
<td>0.4</td>
<td>1</td>
</tr>
<tr>
<td>Unidentified bats</td>
<td>1.2</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>154</td>
<td>3,853</td>
</tr>
</tbody>
</table>
BRE estimates the 67-turbine Project could potentially take 1.6 to 3.1 Indiana bats annually, in the absence of avoidance, minimization, and mitigation measures to reduce fatality impacts. This was calculated using a surrogate model for Indiana bat mortality. During operation of the existing 67 turbines and implementation of the ITP under Alternative 4, it is estimated that that the take of up to 3.1 Indiana bats per year would be reduced to 1.6 Indiana bats at the 67-turbine Project assuming that implementation of a 4.8 m/s cut-in speed reduces mortality by 50%. The total estimated take under implementation of Alternative 4 is up to 39 Indiana bats over the entire 25-year term of the ITP (Table 5-32).

Take of up to 39 Indiana bats represents less than 0.2% of the current population rangewide, in the Appalachian Recovery Unit, and in West Virginia (Table 5-32). We would expect all or most of this mortality to occur in small annual increments to individuals originating from many source populations during migration. However, Indiana bats that hibernate in Snedegar’s Cave may be at higher risk of turbine mortality since 14 of the existing turbines are located at the edge of their 10-mi swarming radius. This cave supports a small, unstable population of Indiana bats affected by WNS. We would anticipate some mortality of these individuals over the life of the project.

**Table 5-32.** Listed bat mortality for the 67-turbine Project with and without operational curtailment. Implementation of the Curtailment Plan is estimated to reduce bat mortality by 50%.

<table>
<thead>
<tr>
<th>Alternative 4</th>
<th>67-turbine Project w/o curtailment (3.5 m/s cut-in speed)</th>
<th>67-turbine Project w/ curtailment (4.8 m/s cut-in speed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Annual mortality</td>
<td>Life-of-Project mortality</td>
</tr>
<tr>
<td>Indiana bat</td>
<td>1.6-3.1</td>
<td>40-78</td>
</tr>
<tr>
<td>Virginia big-eared bat</td>
<td>0.67</td>
<td>17</td>
</tr>
<tr>
<td><strong>Indiana bat current population:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rangewide</td>
<td>424,708</td>
<td>0.02-0.09</td>
</tr>
<tr>
<td>Appalachian Mountain Recovery Unit</td>
<td>32,358</td>
<td>0.12-0.24</td>
</tr>
<tr>
<td>West Virginia</td>
<td>20,358</td>
<td>0.20-0.38</td>
</tr>
<tr>
<td>Snedegar’s Cave</td>
<td>304</td>
<td>13.1-25.6</td>
</tr>
<tr>
<td><strong>Virginia big-eared bat current population:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rangewide</td>
<td>13,000</td>
<td>0.1</td>
</tr>
<tr>
<td>West Virginia</td>
<td>11,092</td>
<td>0.1</td>
</tr>
</tbody>
</table>

BRE estimates the 100-turbine Project will take of up to 1 Virginia big-eared bat per year with no operational curtailment in place. Operation of the existing 67-turbine Project is expected to reduce mortality to 0.67 bats per year because of the fewer turbines. Implementation of a 4.8 m/s cut-in speed is expected to reduce mortality by an additional 50% to 0.34 bats per year. Thus, implementation of the HCP under Alternative 4 would result in a total estimated take of up to 8 Virginia big-eared bats over the entire 25-year term of the ITP (Table 5-32). Take of up to 8 Virginia big-eared bats represents roughly 0.06% of the current population rangewide and in West Virginia (Table 5-32).

**Phase I Decommissioning**

Small areas of regenerated forest in the original construction disturbance may be cleared again to allow crane access for remove turbines. Forest clearing of the regenerating forest will restart the regeneration process of the forest. Suitable maternity roosts generally occur in trees more than 50 years in age. This will mean that areas that were originally cleared and then recleared for decommissioning will not provide suitable maternity roosting habitat for bats for more than 70 to 75 years (assuming a 25-year project life).
Night time roosting habitat may occur in much younger trees. However, reclearing of access roads, staging areas, and laydown areas for decommissioning will limit roosting opportunities until trees mature.

Bat displacement and effects of edge creation will be similar for that described for Project construction. There will be minor effects to forests that were not able to mature consistently with the surrounding areas due to clearing and re-clearing for decommissioning. These effects are expected to be minor and possibly less of an impact when compared to logging, mining, and natural gas operations in the region that periodically disturb or remove entire forests on a 50 year or less cycle.

Disturbed areas and access roads will be graded to the original contour as near as practicable if the landowner requests that BRE decommission these areas. If requested by the landowner, access roads will be left in place.

**Alternative 4 Summary**
Based on average fatality rates, implementation of Alternative 4 is estimated to kill approximately 15,300 migratory tree dwelling bats (e.g. silver-haired bat, eastern red bat, and hoary bat) and 6,300 cave-dwelling bats (e.g. little brown bat, big brown bat, northern long-eared bat), resulting in roughly 22,000 bat fatalities over the 25-year permit term (Table 5.30). There would be up to 39 Indiana bats and 8 Virginia big-eared bats killed during the 25-year permit term (Table 5-32). Effects to habitat are expected to be minor given that there would be no new construction under this alternative.

Alternative 4 includes compensation for the unavoidable Project impacts to the Indiana and Virginia big-eared bat (off-site hibernacula protection, cave gating, or maternity area protection in perpetuity). This mitigation would remove real threats that affect survivorship or reproduction (such as human disturbance, logging, and development) and thus increase the chance of long-term survival over time. Other species of cave-dwelling bats may benefit incidentally from mitigation efforts that compensate for take to Indiana bat and Virginia big-eared bat.

The biological significance of mortality of more than 15,000 tree-roosting migratory bats and over 6,000 cave-dwelling bats over the 25 year permit term is uncertain given the lack of population data. If the impact to tree-roosting bats could be mitigated to some degree, it would lessen the significance of this impact.

Because of fewer turbines, Alternative 4 will result in 31% fewer fatalities than Alternative 2; roughly 22,000 bats for Alternative 4 versus 32,000 bats for Alternative 2. However, Alternative 4 will result in 38% more fatalities than Alternative 3, even though Alternative 3 would include 33 more turbines (22,000 bats for Alternative 4 versus nearly 16,000 bats for Alternative 3). This difference is related to the greater effectiveness in reducing bat mortality associated with the higher cut-in-speed of Alternative 3. Because the No-Action Alternative is not expected to kill bats, Alternative 4 will have greater impacts to bats than No-Action.

**5.8.3 Alternatives Comparison**
Table 5-33 provides a comparison of bat mortality under implementation of each of the 4 alternatives and unrestricted operations of the 67- and 100-turbine Projects. Among all alternatives, the No-Action alternative will result in the lowest bat mortality. Among the three action alternatives, we predict implementation of Alternative 3 will result in the fewest bat fatalities annually and for the life of the Project.
Table 5-33. Life-of-Project bat morality for each of the 4 alternatives and unrestricted operation of the 67- and 100-turbine Projects. Estimates are based on 26.11 bats per turbine per year for the mortality rate derived from estimates from 14 post-construction studies conducted in the Mid-Atlantic Highland Region.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Life-of-Project mortality by bat group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All bats</td>
</tr>
<tr>
<td>Alternative 1: No-Action – No ITP/HCP [67 turbines; no night-time operation Apr-Nov]</td>
<td>0</td>
</tr>
<tr>
<td>Alternative 2: Proposed Action – ITP with Full Implementation of HCP [100 turbines; 4.8 m/s cut-in speed; 50% mortality reduction]</td>
<td>32,638</td>
</tr>
<tr>
<td>Alternative 3: Additional Covered Species with ITP and HCP with Additional Measures [100 turbines; 6.5 m/s cut-in speed; 78% mortality reduction]</td>
<td>15,666</td>
</tr>
<tr>
<td>Alternative 4: Phase I Only with ITP and HCP with Reduced Measures [67-turbines, 4.8 m/s cut-in speed; 50% mortality reduction]</td>
<td>21,862</td>
</tr>
<tr>
<td>Unrestricted Phase I Operation [67 turbines; 3.5 m/s cut-in speed]</td>
<td>43,734</td>
</tr>
<tr>
<td>Unrestricted Phase I and II Operation [100 turbines; 3.5 m/s cut-in speed]</td>
<td>65,275</td>
</tr>
</tbody>
</table>

¹ Includes hoary bat, red bat, and silver-haired bat.
² Includes tri-colored bat, little brown bat, big brown bat, and northern long-eared bat.

5.9 Socioeconomics

The NEPA analysis must consider the effects of the Proposed Action and alternatives on socioeconomic conditions. The WVPSC also requires that an Applicant consider the socioeconomic conditions relative to selecting the site of proposed development (CSR$150-30-3.1.a.2). In addition, per the requirements of Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations), socioeconomic impacts must be assessed for minority and low-income communities. Concerns also were raised during the scoping process about potential impacts of the Project on local property values.

5.9.1 Impact Criteria

Effects would be considered significant if any of the following results were to occur either directly or indirectly as a result of the Proposed Action or alternatives:

- Induce growth or concentrations of population that are in conflict with Greenbrier County’s Comprehensive or Land Use Plans;
- Conflict with housing projections and policies set forth in the Greenbrier County Comprehensive Plan;
- Displace existing housing, especially affordable housing;
- Disrupt or divide the physical arrangement of an established community;
- Cause a decrease in local or regional employment; or
Cause a decrease in local property values.

Adverse environmental justice effects would result if minority or low-income populations were disproportionately affected by the Project.

Any minority or low-income community suffers a disproportionate share of adverse environmental impacts resulting from actions that are not offset by Project benefits.

5.9.2 Direct and Indirect Effects Presented by Alternative

As discussed in Chapter 4.9.2.3, the demographics of minority and low-income populations within the affected project area indicate that there will not be any disproportionate adverse environmental impacts to those populations requiring additional consideration under environmental justice requirements. While there are almost certainly residents, employees, and local businesses who belong to the minority and low-income groups of concern, those individuals will not be impacted at a rate that appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group. While the available census and demographic information does not reach the scale that identifies whether each individual impacted by the project may fall into the minority or low-income status, readily available demographic information indicates that it would be unreasonable to conclude that there is a disproportionate risk to those populations.

Therefore, further consideration of the environmental justice policy under NEPA is not required because even if environmental impacts occur to some minority or low-income individuals and rise to the level of “significance” under NEPA, it is highly improbable that there will be a disproportionate impact, i.e., impact at a rate that appreciably exceed or is likely to appreciably exceed the risk or rate to the general population demographics at the state level. So the impacts, both positive and negative, that will occur in these counties will neither be disproportionately gained nor borne by minority or low-income populations under the proposed action or any of the alternatives.

5.9.2.1 Alternative 1: No-Action Alternative

Under the No-Action Alternative, the proposed 33 turbines and HCP would not occur. Additionally, an ITP pursuant to Section 10 (a)(1)(B) of the ESA would not be issued for the existing BRE Project.

There would be no new construction, and no added temporary construction jobs or increases in local business revenues (i.e., food, lodging, supplies). Negative effects would include lost opportunities for construction-related economic benefits to the local and county residents and governments.

Phase I Operation and Maintenance
Currently, the Project employs 7 full-time employees. With no new construction, there would be no changes to the existing socioeconomic resources as they relate to the current operation and maintenance activities at the 67-turbine facility. Some negative effects would result from loss of local opportunities for the approximately 200 temporary construction jobs and 3 long-term jobs associated with construction and O&M of a 100-turbine facility. Additionally, there may be lost opportunity for related increases in local business revenues associated with these businesses providing goods and services to the Project facility.

The 67-turbine Project would result in $400,000 yearly in tax revenue to Greenbrier County for 25 years and $200,000 yearly in tax revenue to the state.

Phase I Decommissioning
With no new construction, only the 67-turbine Phase I Project would be decommissioned. With only 67 turbines as opposed to 100 turbines, there would some lost opportunities for temporary employment of local workers involved in the decommissioning process, resulting in lost local wages and revenues.

Avoidance and Minimization
There would be no significant or measurable effects on socioeconomic resources associated with avoidance and minimization activities.

No-Action Alternative Summary
The No-Action Alternative would have some effects on socioeconomic resources in the form of lost opportunities for temporary construction jobs, long-term operation and maintenance jobs, and temporary decommissioning jobs. Based on the socioeconomic effect criteria above, the No-Action Alternative would not be expected to have significant effects on population growth/decline, housing, property values, and local employment, and would not be in conflict with the local land use plans.

5.9.2.2 Alternative 2: Proposed Action Alternative
Under the Proposed Action, BRE will construct the proposed 33 turbines and associated infrastructure and operate the 100-turbine Project according to the Project HCP. The Service will issue an ITP pursuant to Section 10 (a)(1)(B) of the ESA for the Project, and avoidance, minimization, and conservation efforts will be implemented as described in the HCP and specified in the ITP.

Phase II Construction
Because local/state/local construction trades will be used for portions of the Proposed Action construction, total wages and salaries paid to contractors and workers will increase temporarily, and will contribute to the total personal income of the region. It is estimated that approximately 200 temporary construction jobs will be created during Phase II construction. During the construction period, local businesses (food, lodging, supply vendors) will also experience increased sales and revenues.

100-Turbine Operation, Maintenance, and Decommissioning
Impacts on socioeconomic resources will vary by resource type. Project operation and maintenance will not cause additional impacts on leading industries within the Project area. Additional personal income will be generated for residents in the local area and the state by circulation and recirculation of dollars paid out by BRE as business expenditures and state and local taxes. Expenditures made for equipment, energy, fuel, operating supplies, and other products and services will benefit businesses in Greenbrier and Nicholas counties and the State of West Virginia. Long-term beneficial impacts on Greenbrier County's tax base as a result of the construction and operation of the wind farm will contribute to improving the local economy in this rural part of West Virginia.

The towns nearest to the Project are Trout, Williamsburg, and Rupert. The Project would have very limited demand for public services other than those related to public safety. The Project will not be fenced, so police and fire access will be available in case of an emergency.

The 100-turbine Project will result in more than $400,000 yearly in tax revenue to Greenbrier County for 25 years and $200,000 yearly in tax revenue to the state.

The Building and Trades Council concluded (through the use of IMPLAM described below) that the construction of the original 124-turbine Project would result in a substantial positive impact on the local economy and local employment (WVPSC 2006). There would be a positive change to the socioeconomic conditions related to the construction and operation of the Project. BRE anticipated that the 124-turbine Project would create 15-20 permanent jobs with a $35,000 average annual salary. Further, the Project would result in more than $400,000 yearly in tax revenue to Greenbrier County for 25 years and approximately $200,000 yearly in tax revenue to the state. For a 100-turbine project, it is estimated that approximately 10 permanent jobs would be created.

The IMPLAN software was used to analyze the potential impacts of this Project on the economy. Based on the low and high scenarios, the Project is likely to generate the following impacts to the economy of the State of West Virginia. These projections include construction activity related to the Project.

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45 IMPLAN software allows for predictive economical modeling and impacts analysis of proposed development projects.
BEECH RIDGE ENERGY WIND PROJECT
Habitat Conservation Plan
DRAFT ENVIRONMENTAL IMPACT STATEMENT

- 265 to 1,089 jobs, in low- and high-impact scenarios.
- $25.3 to $104 million of additional private sector output.
- $11.3 to $46.4 of value added, including $7.3 to $30 million of additional construction and employee compensation.
- $528,000 to $2.2 million of additional indirect business taxes.
- $1.9 to $7.9 million in federal tax revenue.
- $817,000 to $3.4 million in state tax revenues, half of which would be state personal income tax.

BRE is an equal opportunity employer and does not discriminate based on factors such as race or gender.

The indirect effects of operations may influence property values; however, studies suggest property values are not impacted by wind facilities. Goldman and Associates, Inc. (2006) provided testimony (Beech Ridge Energy LLC, No. 05-1590-E-CS, 2006 W.Va. PUC LEXIS 2624) on the impact of windmills on property values in Greenbrier County, WV. Goldman and Associates, Inc. assessed property values and interviewed local reality specialists and community members to determine impacts of development and operation of the Backbone Mountain wind farm on property values in neighboring Tucker County. Study results suggest that no evidence of property value diminution could be attributed to the wind facility and in general there was a positive to neutral response to the wind facility. There was insufficient data to conduct statistical analyses on the wind facility impacts.

Other site-specific studies include a 2006 study conducted in New York. Hoen (2006) found no measureable effects on property values within 5 mi from a wind facility. Another New York study (Heintzelman and Tuttle 2011), based on a large dataset of over 9 years, determined wind facilities did reduce property values by up to approximately 15%. In Illinois, Hinman's (2010) study improved methodologies regarding the analysis of wind facility impacts on property valuation. An initial "wind farm anticipation stigma" may have caused property values to diminish during the wind facility proposal and planning stage. However, after development of the wind facility, property values rebounded and even increased around the Illinois facility.

Two national-level studies provided statistical evidence to show that wind energy facilities did not influence property values. The National Renewable Energy Policy Project (Sterzinger et al. 2003) found no changes in average property values that were within a distance of 5 mi from wind facilities. Similarly, Hoen et al. (2009) collected data on approximately 7,500 homes situated within 10 mi of wind facilities. No conclusive evidence of the existence of any widespread property value impacts that might be present in communities surrounding wind facilities. Specifically, neither the view of the wind facilities nor the distance of the home to those facilities is found to have any consistent, measurable, and statistically significant effect on home sales prices. It is important to note that several year-round and seasonal homes exist within the 5-mi buffer of the Project site.

The Proposed Action does not appear to be in conflict with the Greenbrier County Comprehensive Plan (www.greenbriercounty.net), which encourages sustainable approaches to economic development and the use of green, low-impact development methods, energy efficient construction, and on-site energy sources. The comprehensive plan supports development of energy and mineral-related assets in conjunction with strict environmental standards, as well as stable, long-term economic developments and value-added markets that benefit workers and entrepreneurs.

Proposed Action Summary
Based on the type of development and use associated with the Project expansion, the rural demographics of the surrounding area, and the overall policies and planning recommendations contained in the Greenbrier County Comprehensive Plan, the effects of the Proposed Action on the socioeconomic resource will be largely positive in nature. Temporary and permanent employment opportunities will be provided to support the local residents, businesses, and economy. Additional tax revenues will be generated to benefit local and state government programs. Existing industry (logging, mining) will be allowed to continue largely unimpeded by the Project. The Project will not displace any existing housing,
or conflict with Greenbrier County’s Comprehensive or Land Use Plans. No specific studies were conducted to assess the Project’s effects on property values, but based on some general studies in other regions and countries, it is assumed the Project could have either no significant effect, or there could be a decrease in values of local, nearby properties. There are also no studies addressing the Project’s expected effects on future construction of new housing (e.g., second homes) in the area. Overall, socioeconomic effects are predicted to be positive, and could be viewed as significant in regard to the creation of some relatively well-paying temporary and permanent jobs within this rural area of West Virginia (particularly Nicolas County) that currently experiences median incomes below the state-wide average.

5.9.2.3 Alternative 3: ITP and HCP with Additional Covered Species

Under the Additional Covered Species Alternative, BRE would construct the proposed 33 turbines and associated infrastructure and operate the 100-turbine Project and implement the HCP’s avoidance and minimization measures to reduce bat mortality. The Service would issue an ITP pursuant to Section 10 (a)(1)(B) of the ESA for the Project to take the 2 listed bats. However, the Project HCP would be modified to include avoidance, minimization, and conservation measures for 3 species in addition to those measures for the 2 listed bats specified in the Project HCP.

Alternative 3 Summary
Under Alternative 3, Phase II would be constructed, operated, maintained, decommissioned, and mitigated in the same manner as Alternative 2: Proposed Action. Therefore, the effects on socioeconomic resources from Alternative 3 would be the same as those described above for Alternative 2.

5.9.2.4 Alternative 4: ITP and HCP for Phase I Only

Under the Phase I Only Alternative, the proposed 33 turbines would not be built. An ITP pursuant to Section 10 (a)(1)(B) of the ESA would be issued only for BRE’s Phase I Project, and the HCP would address measures for the operation of only 67 turbines. Conservation measures would be reduced to address the unavoidable take of Indiana bats and Virginia big-eared bats. Take estimates for these 2 listed bats would be less than that estimated for the 100-turbine Project.

Alternative 4 Summary
Under Alternative 4, the Phase II Project would not be constructed, and therefore the effects on socioeconomic resources would be the same as those described above for Alternative 1: No-Action. The Project would continue to provide full-time employment for 7 workers. There would some increase in tax revenue based on the increased energy produced from night-time operations in spring, summer, and fall.

5.10 Land Use and Recreation

The NEPA analysis must consider the effects of a Proposed Action and alternatives on the human environment, which includes land use and recreation. The following section addresses the key issues related to land use and recreation associated with the Project including: compatibility with local land use, zoning, and comprehensive planning; compatibility with planned development; loss of use to landowners; and effects to recreational resources.

5.10.1 Impact Criteria

The WVPSC requires that an Applicant estimate impacts of the Project on land uses within 5 mi and describe concurrent and secondary land uses of the Project area (CSR 150 § 30-3.1.n.). Effects of the Proposed Action or alternatives would be considered significant if the outcome eliminated current land uses within and proximal to the Project area. The WVPSC requires that an Applicant estimate impacts of the Project on recreation areas within 5 mi. Project activities were analyzed to consider whether existing recreational areas would be positively or negatively affected.

Impacts to land use and recreational resources would be considered significant should implementation of an alternative would result in any of the following:
5.10.2 Direct and Indirect Effects Presented by Alternative

5.10.2.1 Alternative 1: No-Action

Under the No-Action Alternative, the proposed 33 turbines would not be constructed and the HCP would not be implemented. Additionally, an ITP pursuant to Section 10 (a)(1)(B) of the ESA would not be issued for the existing Phase I Project.

Phase I Operation
Under the No-Action Alternative, the Phase I Project would remove 50 acres of industrial forest from productivity for the life of the Project. Approximately 336 acres of deciduous forest was cleared, reclaimed, and allow to regenerate. These cleared acres would continue to recover and eventually become merchantable timber (in 50-80 years depending on the landowner's forest regeneration practices). Landowners whose property is directly impacted by the Project are compensated through lease agreements for the life of the Project. Aside from cleared areas that are maintained for Project facilities, lands would still be available for forestry and mining.

No-Action would result in no new effects, positive or negative, on tourism and recreation. Under the No-Action Alternative, no new turbines would be constructed, and there would be no added direct or indirect effects on these resources. Since no additional Project construction would take place under the No-Action Alternative, direct and indirect effects to tourism and recreation would be limited to those associated with Phase I operations, maintenance, and decommissioning.

Where visible, it is estimated that under the No-Action Alternative, the Phase I Project will continue to have both positive and negative effects on tourism and recreation depending on the user’s perspective with regard to wind projects. Studies suggest that both negative and positive impacts to tourism may actually balance out, or that the overall impact may be minimal unless the industry becomes saturated and demand for certain recreational activities decline (Priskin 2007, Tourism Research Center 2008). The viewseshed and field-review visual resource analyses by Saratoga (2005) indicated that the Phase I Project generally would not be visible from the scenic and recreational resources within the 20-mile Visual Resource APE, with the exception of Droup Mountain Battlefield State Park where less than 7% of the turbines were expected to be visible from one of the overlook trails (Saratoga 2005; see Appendix G, Report G-1, Figure 3, Sheets 9 and 10). As noted in the Visual Resources section, even though the electronic viewseshed analyses by Saratoga (2005) did not identify specific trails and other publicly-accessible locations where the Phase I Project would be visible, it is likely that the Phase I Project is indeed visible from recreational trails and other remote locations in the VRA APE.

Phase I Decommissioning
Decommissioning activities would be similar in character to those associated with construction. However, the duration for decommissioning is likely to be significantly shorter as compared to that of the Phase I construction. Project decommissioning would have moderate effects to recreational activities on surrounding lands where these uses are designated. Impacts would include disturbances associated with equipment noise and fugitive dust. These disturbances would be short-term and largely affect those areas, mostly rural, relatively close to the Phase I Project area.

Avoidance and Minimization
There are few avoidance and minimization measures that address effects to land use and tourism with regard to Phase I operations and decommissioning. Disturbed areas and access roads will be graded to the original contour as near as practicable if the landowner requests that BRE decommission these areas. If requested by the landowner, access roads will be left in place.
No-Action Alternative Summary
The No-Action Alternative does not include actions that are incompatible with local land use, zoning, or any future planned development. The No-Action Alternative will result in minor losses of land that historically have been used for industrial forestry and mineral extraction. No-Action would result in no new effects, positive or negative, on tourism and recreation because no new turbines would be constructed, and there would be no added direct or indirect effects on these resources. Under the No-Action Alternative, direct and indirect effects to tourism and recreation would be limited to those associated with Phase I O&M and decommissioning. It is estimated that the No-Action Alternative will continue to have moderate impacts on tourism and recreational activities in the form of negative and positive effects on user viewshed. Similarly, under the No-Action Alternative, impacts to recreational resources would be considered moderate. Impacts to land use would be considered insignificant because the changes would be minimal in the context of the overall landscape.

5.10.2.2 Alternative 2: Proposed Action
Under the Proposed Action, BRE will construct the proposed 33 turbines and associated infrastructure and operate the 100-turbine Project according to the Project HCP. The Service will issue an ITP pursuant to Section 10(a)(1)(B) of the ESA for the Project, and avoidance, minimization, and conservation efforts will be implemented as described in the HCP and specified in the ITP.

Phase II Construction
Under the Proposed Action, the 33 turbines will be constructed on land that is currently used for industrial forestry and mineral extraction. Project construction would not be incompatible with the current land uses. Project construction will have moderate effects on recreational activities on surrounding lands where these uses are currently designated. Impacts will include disturbances associated with construction noise and fugitive dust. These disturbances will be short-term and will largely affect those areas, mostly rural, that are relatively close to the Phase II Project area.

100-Turbine Project Operations
Landowners whose property is directly impacted by the Project will be compensated through lease agreements over the life of the Project. Aside from cleared and maintained areas, land surrounding each turbine can still be forested and/or mined.

No local studies have been conducted to examine existing or future impacts from the BRE facility on local tourism. Although data on the impacts of wind energy facilities on tourism are currently limited, initial survey-based studies have indicated that facilities have little impact on tourism and may in some areas even attract visitors. The majority of tourists and residents surveyed in European studies held neutral or positive views towards wind turbines (78% in France, 70-80% in Scotland). A survey in southwest England indicated that 92% of visitors would not change their travel patterns to an area if a wind energy facility were established there. In Holland and Quebec, certain wind energy facilities serve as tourist attractions, although preliminary studies have indicated that most facilities are unlikely to attract visitors on their own (Priskin 2007). A report prepared by the British Wind Energy Association concluded that wind energy facility effects on tourism were “negligible at worst.” Tourist boards involved in the study did not raise wind energy as an issue affecting the industry or maintain any strong opinion concerning wind energy facilities. The report further concluded that “the judgment of acceptability based landscape protection will provide ample protection for the protection of tourism” from impacts associated with wind energy facilities (BWEA 2006). Both visitor and resident respondents to a survey distributed on Prince Edward Island held overwhelmingly positive opinions of wind turbines on the island and supported further wind energy development in the area; 71% of respondents either agreed or strongly agreed that the wind turbines were an attraction for visitors (Tourism Research Center 2008). However, in the CEIWEP (2007) literature review (including a WV study), they noted that wind energy facilities could be attractive to tourists (AusWEA 2004 as cited by CEIWEP 2007), but many see wind facilities as damaging to tourism in areas of high scenic beauty such as National Forests (Grady 2004, Schleede 2003). In general, it is thought that a proliferation of wind facilities in an area would likely not been seen as a tourist attraction.
These studies imply that both negative and positive impacts to tourism may actually balance out, or that overall impact may be minimal unless the industry becomes saturated and demand for such recreational activities decline.

In their visual resource assessment of the Phase II Project, Saratoga (2011) noted that several views from within the Phase II APE will likely contain existing (Phase I) wind turbines, but it is possible that previously unaltered views may have visibility of Phase II turbines. For recreational users (e.g., hikers, sight-seers), the perceived level of impact will likely vary depending on the viewers’ sensitivity to landscape changes. Where the Project is visible from longer distances (e.g., 15-20 mi), Saratoga (2011) estimates that it is likely to diminish the quality of the view and may even go un-noticed. These types of effects would be expected for hikers in the various public trails in the 20-mi area surrounding the Project.

Saratoga (2011) identified and evaluated 68 visual resources within the 20-mi Phase II VRA APE considered to be of cultural or aesthetic importance, including historic districts and properties, state and national highways, and state and national forests, parks, and recreational trails. Their viewshed analyses suggested that only 32 of these resources could theoretically have views of the Phase II Project. Subsequent limited field verification by Saratoga led them to suggest that the number of visible resources would likely be significantly less than 32 due to likely vegetative screening, and they concluded that the overall visibility would be limited to small areas distributed throughout the Phase II VRA APE.

100-Turbine Decommissioning
Decommissioning of the Project would not immediately affect the land use and recreational resources of the area. However, over time as the vegetation recovers, these resources are likely to return to pre-construction conditions.

Avoidance and Minimization
The elimination of 24 turbines from the original Project layout was to avoid and minimize impacts to bat hibernacula and visual resources. Upon decommissioning of the Project, BRE will restore disturbed areas the original contour as near as practicable if the landowner requests that BRE decommission these areas. If requested by the landowner, access roads will be left in place. Once the Project is decommissioned, lands occupied by the Project will be available once again for industrial forestry and mineral extraction.

Proposed Action Summary
The Proposed Action does not include actions that are incompatible with local land use, zoning, or any future planned development. The Proposed Action will result in minor losses of land that have historically been used for industrial forestry and mineral extraction, and as such, impacts to land use will be insignificant. Based on the potential that Phase II Project will be in the viewshed of scenic highways and recreation areas, the Proposed Action is likely to have moderate impacts on tourism and recreational activities, assuming there will be both negative and positive effects on receptors.

5.10.2.3 Alternative 3: ITP and HCP with Additional Covered Species
Under Alternative 3, impacts to land use and recreational resources would be as described for the Proposed Action construction, operations, and decommissioning.

Alternative 3 Summary
Alternative 3 does not include actions that are incompatible with local land use, zoning, or any future planned development. Alternative 3 would result in minor losses of land that have historically been used for industrial forestry and mineral extraction, and as such, impacts to land use will be insignificant. Based on the potential that Phase II will occur within the viewshed of scenic highways and recreation areas, it is estimated that Alternative 3 would have moderate impacts on tourism and recreational activities, assuming both negative and positive effects on receptors.
5.10.2.4 Alternative 4: ITP and HCP for Phase I Only

Under Alternative 4, impacts to land use and recreational resources would be as described for the No-Action Alternative operations and decommissioning.

Alternative 4 Summary

Alternative 4 does not include actions that are incompatible with local land use, zoning, or any future planned development. Alternative 4 would result in minor losses of land that have historically been used for industrial forestry and mineral extraction. Alternative 4 would result in no new effects, positive or negative, on tourism and recreation because no new turbines would be constructed, and there would be no added direct or indirect effects on these resources. Under Alternative 4, direct and indirect effects to tourism and recreation would be limited to those associated with Phase I O&M and decommissioning. It is estimated that Alternative 4 would continue to have moderate impacts on tourism and recreational activities in the form of negative and positive effects on user viewshed. Similarly, under Alternative 4, impacts to recreational resources would be considered moderate. Impacts to land use would be considered insignificant because the changes would be minimal in the context of the overall landscape.

5.11 Visual Resources

Visual resources associated with the Phase I and Phase II Projects were evaluated in 2 separate efforts, and it is important to note the distinctions between the 2 regarding the different focuses, methodologies, and study results. Please refer to Chapter 4 for more details related to these two efforts.

The primary assessments of visual resources, conducted by Saratoga Associates (Saratoga 2005, Saratoga 2011), described the visual character of the overall Project area, identified potential visual and aesthetic effects, and provided photo-simulations to allow agency decision-makers the ability to render a supportable determination of the visual significance of the Phase I and Phase II Projects. Saratoga’s assessments were conducted within a 20-mile viewshed APE in the Phase I and Phase II areas, and included inventories of cultural, highway, and recreational resources generally considered by society to be of cultural and/or aesthetic importance. Included in the cultural resources, among others, were structures and properties on the NRHP, as well as public highways and recreational resources. Concurrent efforts to evaluate effects on visual resources were also conducted in association with Cultural Resource assessments (O’Bannon and Sweeten 2007, Gray & Pape 2011, 2012). These efforts concentrated on the potential visual effects of the Phase I and Phase II Projects on historical architectural resources that are listed in, or eligible for listing in, the NRHP, and were undertaken within 5-mile APEs surrounding the Phase I and Phase II Project areas.

Effects on visual resources within the more generalized 20-mile APEs are discussed in this section. Visual effects related more specifically to cultural/architectural resources within the 5-mile APEs are presented in Section 5.11 below, and those related to recreational resources are presented in section 5.9.

It is important to note that the VRAs estimated the visual effects of the proposed wind turbine generators associated with the Phase I (Saratoga 2005) and Phase II (Saratoga 2011) projects. However, in the case of the Phase I Project, only 67 of the 124 turbines were actually built, so the estimated effects that were reported by Saratoga (2005) are likely overstated. Similarly, Saratoga (2011) estimated the effects of the Phase II Project based on a total of 44 turbines (33 proposed and 11 alternates), whereby the reported effects are likely overstated because only 33 would actually be constructed under the proposed action.

5.11.1 Impact Criteria

The analyses of visual resource impacts were primarily quantitative in nature and generally focused on identifying locations and geographic areas where turbines would be visible or where there would be a high probability that some portion of the Projects would be visible. For the Phase I and Phase II Projects, Saratoga (2005 and 2011) evaluated viewsheds and prepared exhibits to illustrate their potential visual effects from distances of up to 20 mi (Figure 4-13). This approach was coupled with the preparation of theoretical viewshed maps, photo-simulations, viewshed coverage summary tables, and general
strategies for mitigating impacts. Saratoga (2011) noted that it was not practical to evaluate every conceivable location where the BRE Projects might be visible, and that it is accepted practice to limit detailed evaluation of aesthetic impacts to locations generally considered by society to be of cultural and/or aesthetic importance. In the evaluation of effects on visual resources, Saratoga assumed that a view of one or more turbines would be considered an impact or effect, though Saratoga’s reports generally lacked the subjective ranking of impacts or in-depth discussions of the degrees of visual impacts.

The evaluation of visual effects can be subjective due to the wide variation in opinions regarding aesthetics and the perceived character of the landscape. For example, some people may find the visual presence of a wind turbine generator appealing, while others may find the same structure visually obtrusive. For the purpose of this DEIS, views of one or more wind turbines from the following resource types or sites would be considered significant effects, either negative or positive, depending on the viewer:

- National Parks and National Forests;
- Designated scenic highways and byways;
- State bikeways;
- State and County recreation areas and trails;
- State wildlife management areas; and
- Other recognized areas of scenic value.

The exceptions are for visual impacts to historic resources on or eligible for the NRHP, in which case any visibility of one or more wind turbines from those sites would be considered a significant adverse effect. Visual effects to NRHP resources are presented in more detail in Section 5.11 – Cultural Resources.

5.11.2 Direct and Indirect Effects Presented by Alternative

5.11.2.1 Alternative 1: No-Action

Phase I Operation

The viewshed maps from the Phase I VRA report (Saratoga 2005; see Appendix G, Report G-1, Figure 2, Sheets 1, 2, 3, and 4), prepared prior to Phase I construction, illustrated the geographic areas within which there would be a high probability that one or more of the 124 proposed turbines would be visible. Subsequent field reconnaissance by Saratoga in 2005 evaluated the accuracy of the viewshed maps and revealed that there were few locations in the viewshed where a significant number of turbines would be clearly visible. These field evaluations included traveling highways and visiting readily accessible topographic highpoints to identify representative open views of the Phase I Project area. Further evaluations included photographs taken from 13 publically-accessible locations to illustrate visibility with the naked eye, followed by photo simulations at 5 of these sites. The photo simulations superimposed renderings of the (then-proposed) 124 wind turbine generators, factoring in the effects of topography, vegetation, time-of-day, sunlight, and haze. Locations photographed during the field evaluation for visual impacts are listed below. Asterisks indicate locations selected for photo simulations.

- County Route 17 – East of Williamsburg* (4 mi from Project)
- Trout Road – Williamsburg Medical Center
- Intersection of County Routes 9 and 10* (3.3 mi from Project)
- Cold Knob
- County Route 4/5 – Lewisburg
- Ann Avenue

46 Note that only 67 of those turbines have been constructed, so the actual visual effects of the Phase I Project are different than those estimated by Saratoga (2005). Though a VRA has not been completed for the 67 built turbines, it is reasonable to assume that the actual extent of visual impacts from the built project exist but would be less than Saratoga reported for the proposed 124-turbine Project they evaluated.
With the effects of vegetative and topographic screening factored in, the report concluded that the overall visibility of the Phase I Project would be minor, and that there would be little visibility of the Project within the 5-mi viewshed, with a slight increase in visibility between 7 and 18 mi. Within the 5-mi viewshed, most visibility would occur in the Trout and Williamsburg areas. The report predicted there would be a few small pockets of potential visibility, primarily towards the south and southeast of the Project along portions of roadways (e.g., US 219) and adjacent open fields. The report stressed that the viewshed assessments did not distinguish between visibility of entire turbines verses the top 6 in of the blade, so the viewshed maps likely exaggerated the extent of true visibility.

Saratoga’s field reviews (2005) confirmed that views of the 124 turbines originally proposed would be limited and largely confined to the eastern half of the VRA APE. Potential views from the western half of the APE would likely be extremely limited and fleeting in nature due to screening, distance, and the effects of typical atmospheric conditions (i.e., haze, fog, rain). The 2005 viewed field review analyses indicated that the Project generally would not be visible from the scenic and recreational resources within the APE, with the exception of Droop Mountain Battlefield State Park where less than 7% of the turbines were expected to be visible from one of the overlook trails (Saratoga 2005; see Appendix G, Report G-1, Figure 3, Sheets 9 and 10). One of the photo simulations shows the view from a point near County Route 223, approximately 3.5 mi from the Project (Saratoga 2005, see Appendix G, Report G-1, Figure 3, Sheets 7 and 8). From that location, approximately 70% of the Project would be visible, but the report noted that this location is not accessible by vehicle (it must be walked to from County Route 223) and is not identified as publicly accessible. From the photo simulations, Saratoga (2005) further concluded:

1. With few exceptions only a small portion (less than 15%) of the proposed Project would be seen from most views, even those that are most open;
2. The vertical form of the turbines are similar to existing landscape elements (e.g. silos, utility poles, fence posts, building edges);
3. From most locations, vegetation and topography screen a significant portion of the proposed Project;
4. Turbine form, color, and layout reduce the potential visual impact;
5. The optical effect of distance reduces the visibility and dominance of the proposed turbines; and
6. The effects of past, current, and future logging operations detract from the aesthetic value of existing views.

In the Phase II VRA, Saratoga (2011) included photo simulations from several viewpoints within the Phase I APE where the existing 67 turbines are visible. The existing conditions photos for these simulations illustrate the actual visual effects of the Phase I turbines, as constructed. The following figures from the Saratoga (2011) report offer representative photographic views of the Phase I turbines from various distances on clear days (Table 5-34).

<table>
<thead>
<tr>
<th>Approximate distance from Phase I turbines (mi)</th>
<th>Figure references in Saratoga (2011) 1</th>
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</thead>
<tbody>
<tr>
<td>0.5 - 1</td>
<td>A2-A, A5-A</td>
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<tr>
<td>6</td>
<td>A7-A</td>
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<td>6</td>
<td>A4-A</td>
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<td>9</td>
<td>A9-A</td>
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<td>14</td>
<td>A8-A</td>
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Phase I Decommissioning
Decommissioning activities would be similar in character to those associated with construction. However, the duration for decommissioning is likely to be significantly shorter as compared to that of the Phase I construction. Project decommissioning would have significant effects on visual resources, both positive and negative, depending on the receptor, as the Phase I Project is dismantled and removed from view.

Phase I Avoidance, Minimization, and Mitigation
The Phase I Built Project incorporated the following mitigation measures into its design and operation:

- BRE developed the wind farm layout so that turbines were located at least 1 mi from existing residences;
- In part to limit the aesthetic effect of the wind farm, the turbines were not illuminated, except as required by FAA regulations and except for low voltage lights on a motion sensor at the entrance door to each turbine;
- Turbines were coated/painted a non-reflective and non-obtrusive off-white color;
- Turbines were similar in design and size, including tower height, and all turbines comprising Phase I were consistent in color and blade rotation direction (clockwise);
- Existing roads were used for construction and maintenance where possible, minimizing viewshed effects created by new road construction;
- Access roads created for the Project were located along ridge tops when possible to minimize visible cuts and fills; and
- Temporarily disturbed areas in wooded areas will be allowed to re-vegetate naturally to the maximum extent possible while still allowing for access and maintenance of the Project.

No-Action Alternative Summary
No-Action would result in no new effects, positive or negative, on visual resources. Under the No-Action Alternative, no new turbines would be constructed, and there would be no added direct or indirect effects on visual resources associated with wind turbines. Since no additional Project construction would take place under the No-Action Alternative, direct and indirect effects to visual resources would be limited to those associated with Phase I O&M and decommissioning. Mitigation would be limited to that previously implemented for Phase I. The visual assessments of the Phase I Project before (Saratoga 2005) and after (Saratoga 2011) Phase I construction indicate that wind turbines are visible from numerous locations in the 20-mi APE, including visually-sensitive resources such as the Droop Mountain Battlefield State Park and others. Based on the results and conclusions of Saratoga’s viewshed, photo simulation, and field verification efforts, it is therefore assumed that there are existing visual effects from the operation of the Phase I Project, and that some of these effects are significant because the Project is visible from visually sensitive resources. Under the No-Action Alternative, these significant effects would continue to occur until Phase I decommissioning.

5.11.2.2 Alternative 2: Proposed Action
Phase II Construction
Under the Proposed Action, Phase II construction would add new wind turbines at 33 of the 47 sites that have been evaluated for effects to visual resources. Construction will involve the use of large mobile cranes, which will work briefly at each turbine location but not result in prolonged adverse visual impacts. Turbine components will be transported through the APE via large trucks, but this would not be considered a significant visual impact due to the temporary nature of the work.

This effects analysis recognizes that Project construction will have impacts on visual resources. However, the larger concern rests with the impacts the Project will have once fully constructed. Hence, effects to visual resources are largely confined to that associated with Project operations. In summary, construction-related visual impacts will be temporary and relatively brief.
Phase II 33-Turbine Project Operations

The VRA for the Phase II Project (Saratoga 2011) considered a total of 47 new turbine locations, including the 33 primary and 14 alternate locations. The Phase II VRA was designed to address the WVPSC legislative rules related to the construction and operation of electric generating facilities. It followed standard accepted methodologies of visual assessment and included both quantitative (i.e., visual impact - how much will be seen from what locations) and qualitative (i.e., aesthetic impact - how the Project will be perceived) aspects. The Phase II VRA also considered the effects of the 67-turbine Phase I Built Project added to those of the proposed Phase II Project. Results of the Phase II VRA related to the Proposed Action are summarized below.

- Viewshed analyses for the 47 proposed turbine sites indicated that screening by vegetation and topography will restrict views of any Phase II turbines from 96.9% of the Phase II 20-mi APE. Similarly, vegetative and topographic screening will restrict views of the cumulative (i.e., combined) Phase I/Phase II Project from 94.3% of the Phase II APE, meaning the cumulative visibility of both Projects is 5.7% of the APE. The Phase II Project would result in a 1.4% increase in overall visibility of wind turbines when compared with existing conditions.

- Turbine visibility is more common in the immediate vicinity and within 5 mi of the proposed Phase II turbines. Filtered or framed views are possible through foreground vegetation and buildings in some community centers such as Quinwood and Craigsville. Visibility from lowlands to the southeast of the Project is very limited.

- Photo simulations indicate the existing Phase I Project turbines are currently visible from many of the locations where the proposed Phase II turbines will be visible. There are a number of opportunities in foreground distance (0.0 to 0.5 mi) and middle ground distance (0.5 to 3.0 mi) at higher elevations where all or most of the proposed turbines will be viewable. At background distances (3.0 mi to horizon), turbines will appear small and occupy less of the overall view. Distances to the proposed turbine locations from the viewpoints range from less than 1 mi to over 13 mi (Saratoga 2011; see Appendix G, Report G-2, Figures A2 through A9) for illustrations of how distance can affect the visibility of the turbines.

- A total of 68 visually sensitive resources were identified within the Phase II APE as part of a detailed assessment of aesthetic impacts. Factoring in viewshed screening and field confirmation efforts, potential visibility of at least some portions of the Phase II Project was indicated for up to 32 of these, including 2 Cultural Resources, 10 Highways, 3 National Recreational Resources, and 17 State and County Recreational Resources. Field confirmation by Saratoga, however, suggests visibility from several of these resources will be localized, short duration, or non-existent.

- Regarding the character of view, the existing Phase I turbines currently present a noticeable vertical element to the landscape from several areas within 10 mi of the Phase II Project, but become much less noticeable beyond 10 mi. The addition of the Phase II turbines would expand the areas from which a distinct perpendicular element is visible. Where existing turbines are not currently visible, the proposed turbines would be the tallest visible elements on the regional landscape as seen from some locations.

- The existing and proposed turbines will be viewed by local residents and visitors to the area. The area is rural with a small resident population, but can receive large numbers of tourists each year to enjoy the recreational and scenic resources. The sensitivity of individuals to visual quality is typically variable, and therefore the perception of visual impact is subjective. The presence of turbines may diminish the aesthetic experience of the viewer, or conversely the viewer may find the wind power project visually interesting.

- The red flashing aviation obstruction lights on existing Phase I turbines are visible nighttime elements within the APE, though generally only a few of the FAA-mandated lights can be seen
BEECH RIDGE ENERGY WIND PROJECT
Habitat Conservation Plan
DRAFT ENVIRONMENTAL IMPACT STATEMENT

from a given location. The turbines are distributed over large geographic areas and every third turbine will need to be lit, but the VRA report assumes that the Phase II Project will not add significantly to the existing visual intrusion caused by the FAA lighting.

- The proposed access roads for the Phase II Project are relatively minor components of the Project, and it is anticipated that they will not be highly visible or seen as out-of-place by residents or passers-by.

Note that the Phase I VRA (Saratoga 2005) was completed before the Phase I Project was constructed, and included the potential visual effects of the then-proposed 124 turbines. However, only 67 turbines were actually constructed in Phase I, so Saratoga’s pre-construction Phase I VRA overstates the visual impacts because roughly half of the proposed turbines were not installed. The Phase II VRA (Saratoga 2011) addresses the effects of the 67 built turbines, and more accurately reflects the Phase I visual impacts.

100-Turbine Project Operation
The level of visual impact will be dependent on the viewers’ sensitivity to visual change and to the location of the viewpoint in relation to the proposed turbines. Though existing Phase I turbines can currently be viewed from several locations, it is possible that previously-unaltered views may have visibility of the Phase II Project. In conclusion, because up to 97% of the APE will be screened from view, it is anticipated that the operation of the Phase II Project will, overall, have a minor visual impact on the surrounding landscape when viewed as a whole. However, portions of the Phase II Project will be theoretically visible from up to 32 of 68 visually sensitive resources (47%), including 2 Cultural Resources, a Scenic Highway, 3 National Recreational Resources, and 17 State and County Recreational Resources.

It will be necessary to light 11 additional turbines with FAA lighting, increasing the number of lit turbines from 22 to 33. Turbine lighting will have a low to moderate impact on night-time visual effects.

Mitigation for Phase II Construction and Project Operation
The effects of the Phase II Project construction on visual resources in the 20-mile APE will be mitigated by minimizing potential visual impacts (Saratoga 2011). Strategies will include the following.

- To minimize visual complexity, all turbines will be similar in color and overall appearance to the existing Phase I turbines, and will have the same number of blades that rotate in the same direction. However, BRE plans to use a turbine model that is more than 25% taller and have a rotor-diameter that is nearly 30% bigger. The Phase II VRA did not account for this.
- Turbines will not be used for commercial advertising or include conspicuous lettering or logos identifying the Project owner or equipment manufacturer.
- Subsurface routing of electrical interconnects between turbines will be maximized to the extent possible.
- The existing Phase I O&M building and 138-kV transmission line will be utilized.
- Where possible, existing roadways will be utilized for access to proposed turbine locations. Clearing along existing and new roadways will be kept to a minimum (but not to the extent that it impedes transportation of materials).
- Vegetation clearing around the base of the turbines will be kept to a minimum (but not to the extent that it impedes operations).
- The color of the blades, nacelle, and tower will be a neutral off-white. Where specifications permit, non-specular paint will be used on all outside surfaces to minimize reflected glare.

Proposed Action Summary
As indicated by the Phase II VRA, the Proposed Action will affect up to 32 visually-sensitive resources. These impacts are considered major effects based on the impact criteria used in this analysis. Views of the Phase II Project from cultural resources listed in the NRHP would be considered significant adverse effects. Views of the Phase II Project from non-NRHP resources would also be considered significant.
effects, but they could be adverse or positive effects, depending on the viewer’s opinions. Though the Proposed Action would add to the number of FAA-mandated red flashing aviation obstruction lights in the APE, the VRA suggests this would not add significantly to the existing visual intrusion caused by the FAA lighting. However, because the Phase II Project will add 50% more FAA lighting, this will have a low to moderate effect on night-time visual resources. Although, overall effects on visual resources will be avoided and minimized to the fullest extent practicable, unavoidable visual impacts to cultural resources listed in the NRHP will likely need mitigation.

5.11.2.3 Alternative 3: ITP and HCP with Additional Covered Species

Phase I Construction
Under Alternative 3, effects to visual resource from the construction of the Phase II Project would be the same as those described for Alternative 2, the Proposed Action.

100-Turbine Project Operation
Under Alternative 3, the effects to visual resource from the operation of the 100-turbine Project would be the same as those described for Alternative 2, the Proposed Action.

Mitigation for Phase II Construction and Project Operation
Under Alternative 3, the visual resource mitigation measures for the Phase II construction and the 100-turbine Project operation would be the same as those described for Alternative 2, the Proposed Action.

Alternative 3 Summary
Within the Phase II VRA, the Proposed Action will affect up to 32 visually-sensitive resources. These impacts are considered major effects based on the impact criteria used in this analysis. Views of the Phase II Project from cultural resources listed in the NRHP would be considered significant adverse effects. Views of the Phase II Project from non-NRHP resources would also be considered significant effects, but they could be adverse or positive effects, depending on the viewer’s opinions. Though the Proposed Action would add to the number of FAA-mandated red flashing aviation obstruction lights in the APE, the VRA suggests this would not add significantly to the existing visual intrusion caused by the FAA lighting. However, because the Phase II Project will add 50% more FAA lighting, this will have a low to moderate effect on night-time visual resources. Although overall effects on visual resources will be avoided and minimized to the fullest extent practicable, unavoidable visual impacts to cultural resources will likely need mitigation.

5.11.2.4 Alternative 4: ITP and HCP for Phase I Only

Phase I Project Operation
Under Alternative 4, impacts to visual resources associated with Phase I Operations would be as described for the No-Action Alternative.

Phase I Decommissioning
Decommissioning activities would be similar to those described for the No-Action Alternative. Project decommissioning would have significant effects on visual resources, both positive and negative, depending on the receptor, as the Phase I Project is dismantled and removed from view.

Phase I Avoidance, Minimization, and Mitigation
Under Alternative 4, there would be no specific additional mitigation related to visual resources affected by the Phase I Project. However, by not constructing the 33 turbines of the Phase II Project, overall effects of the wind energy Project on visual resource would be mitigated through avoidance and minimization.
Alternative 4 Summary
Alternative 4 would result in no new effects, positive or negative, on visual resources. No new turbines would be constructed, so there would be no added direct or indirect effect on visual resources. Direct and indirect effects on visual resources would be limited to those associated with Phase I O&M and decommissioning. Mitigation would include that previously implemented for Phase I, as well as the avoidance and minimization of impacts associated with not constructing additional wind turbines. The visual assessments of the Phase I Project before (Saratoga 2005) and after (Saratoga 2011) its construction indicates that wind turbines are visible from numerous locations in the 20-mi APE, including visually-sensitive resources such as the Droop Mountain Battlefield State Park and others. Based on the results and conclusions of Saratoga’s viewshed, photo simulation, and field verification efforts, it is therefore assumed that there are existing visual effects from the operation of the Phase I Project, and that some of these effects are significant because the Project is visible from visually sensitive resources. Under the Alternative 4, these significant effects would continue to occur until Phase I is decommissioned.

5.12 Cultural Resources
This section evaluates the potential effects that implementing the Proposed Action and alternatives would have on cultural resources during construction, O&M, and decommissioning of the Project. Historic structure cultural resources associated with the Phase I and Phase II Projects were evaluated primarily by O’Bannon and Sweeten (2007) and Gray & Pape (2008, 2011a, 2011b, 2012). Archaeological cultural resources were evaluated by Cultural Resource Analysts, Inc. (CRA 2009, 2010, 2011; see reports in Appendix K).

5.12.1 Impact Criteria
The NHPA affords protection to all historic properties defined as: “…any Pre-European contact or historic district, site, building, structure, or object included in, or eligible for listing on the National Register, including artifacts, records, and material remains related to such a property or resource (46 CFR 800, as amended 2006, Title III, Section 301, #5).” Once a cultural resource is identified, the historic significance of the property must be evaluated in terms of its ability to meet the NRHP criteria (36 CFR 800.4 (c)(1)). A cultural resource that meets the criteria is considered an historic property entitled to the consideration afforded by Section 106 of the NHPA, as outlined in the ACHP’s implementing regulations (36 CFR 800).

Impacts to cultural resources (i.e., historic structures, archaeological sites, and traditional cultural properties) that are eligible for listing on the NRHP would be considered significant if they result in adverse effects. As noted in Gray & Pape (2011b), under 36 CFR Part 800 an “adverse effect” is found when an undertaking may alter, directly or indirectly, any characteristic of a historic property that would 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, feeling, 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. Conversely, significant beneficial effects may result from the removal of an adverse effect (as in decommissioning).

As noted in Chapter 4, there are no known NRHP-eligible cultural resources within the Phase II Project area of direct impact (i.e., where ground is disturbed by construction), and as such none of the identified cultural resources would be directly affected by the Phase II Project. For the purpose of this DEIS, therefore, impacts to cultural resources located in the 5-mile Cultural Resource APE would be limited to visual effects, noise effects, and cultural effects (e.g., setting, feeling, and association of the rural landscape). Any such effect to cultural resources identified as eligible for or listed in the NRHP, and located within the APE, would be considered a significant adverse effect.
5.12.2 Direct and Indirect Effects Presented By Alternative

5.12.2.1 Alternative 1: No-Action

Phase I Operation

Historic Structures Cultural Resources. Eligible historic properties within the Phase I APE are described in Section 4.11.2. BHE (2008) documents the assessment of visual, noise, and cultural effects in the Phase I Project area, and for the purpose of the report, any visibility of a turbine from a NRHP-listed or eligible resource was considered an adverse effect. Note that BHE’s assessment of effects, as summarized below, was based on the original Phase I proposal that included 124 wind turbines, and that effects would be less than originally reported because the actual Phase I construction included only 67 turbines.

The assessment of effects resulted in the identification of 26 locations where the construction of the Phase I Project could result in adverse visual effects to NRHP-eligible historic properties. These included three historic districts, the Duo Historic District, the Williamsburg/Trout Historic District, and the Friars Hill Historic District, as well as churches, cemeteries, schools, and individual properties both within and beyond the boundaries of these historic districts.

BHE (2008) concluded that none of the NRHP-eligible historic properties were located in the direct Project area, and therefore none would be directly impacted by the Phase I Project. Only one eligible historic property, the Duo Historic District, was found to be located within 1 mi of the closest Phase I turbine. Acoustical analysis indicated that the noise levels associated with operation of this turbine would be masked by existing ambient noise levels, and therefore it was concluded that the turbine would have no adverse noise effect on this historic district. On April 10, 2008, the WVSHPO concurred with the BHE report’s findings.

The cultural resources effects assessment report (BHE 2008) concluded that development and operation of the 124-turbine wind energy facility would add visual elements to the landscape that may not be in keeping with the area’s historic patterns of settlement. Based on the locations of known architectural resources in the historic structures APE, BHE indicated that the Phase I Project could thereby constitute an adverse effect for 26 out of the 51 eligible resources identified in that APE. Development of the Phase I Project would result in a semi-permanent change to the rural landscape, including immediate visual changes. The visual changes would affect the setting, feeling, and association of the rural landscape, resulting in adverse visual and cultural effects within some portions of the Phase I Cultural Resource APE.

Along with their assessment of effects report, BHE submitted a draft MOA to WVSHPO on February 15, 2008, to address the adverse effects on 20 NRHP-eligible historic buildings and structures within the historic structures APE. As compensation for these potential adverse effects, the MOA (1) provided 6 copies of the Architectural Investigations report for the Beech Ridge Energy facility (dated March 6, 2007) in hard-copy and electronic format, for deposit in local public libraries and historical societies; (2) provided for a 1-time monetary payment of $10,000 for future assistance in historic preservation-related activities conducted by the Greenbrier Historical Society or the Williamsburg Historical Foundation; and (3) contained detailed information regarding archaeological surveys that would be conducted once design had sufficiently advanced to the point where ground disturbing activity was known. The WVSHPO signed the MOA on July 31, 2008; Beech Ridge Energy, LLC signed on August 4, 2008. A copy of the MOA is contained in Appendix K of this DEIS.

Archaeological Cultural Resources. On behalf of BRE, Cultural Resource Analysts, Inc., (CRA) conducted a “Phase I” archaeological survey for the Phase I Project. The survey was completed during the summer and early fall of 2008 within the direct archaeological APE, which was defined as the footprint of the ground disturbing activities associated with the wind turbines, construction layout areas, access roads, substation, operations facility, and transmission line. A report (CRA 2009) and 3 subsequent addendums (i.e., to address changes and additions to the ground disturbance footprint of the Phase I Project) were submitted by CRA between January 2009 and April 2010 (CRA 2009, 2010). Based on the results of the
Phase I archaeological surveys, CRA recommended that there were 3 new archaeological sites within the direct APE that were NRHP-eligible and warranted protection, to include avoidance by all Project activities by no less than 100 ft. The WVSHPO concurred with the report findings and indicated that if the resources were avoided by the construction activities, it was the opinion of WVDHC that the Phase I Project would have no effects on the resources.

**Phase I Decommissioning**

Decommissioning activities would be similar in character to those associated with construction. However, the duration for decommissioning is likely to be significantly shorter as compared to that of the Phase I construction. In accordance with the impact criteria above, Project decommissioning would have significant beneficial effects on those NRHP-eligible historic structure cultural resources with views of the 67 turbines as the Phase I Project is dismantled and removed from view.

**Phase I Mitigation**

The Phase I Built Project incorporated the following mitigation measures into its design and operation, some of which help mitigate the visual effects to cultural historic structures and direct disturbance-type effects to archaeological resources:

- BRE developed the wind farm layout so that turbines were located at least a mi from existing residences;
- In part to limit the aesthetic effect of the wind farm, the turbines were not illuminated, except as required by FAA regulations, and except for a low voltage lights on a motion sensor at the entrance door to each turbine;
- Turbines were coated/painted a non-reflective and non-obtrusive off-white color;
- Turbines were similar in design and size, including tower height, and all turbines comprising Phase I were consistent in color and blade rotation direction (clockwise);
- Existing roads were used for construction and maintenance where possible, minimizing new road construction;
- Access roads created for the Project were located along ridge tops when possible to minimize visible cuts and fills;
- Temporarily disturbed areas in wooded areas will be allowed to re-vegetate naturally to the maximum extent possible while still allowing for access and maintenance of the Project; and
- As the Phase I Project was constructed, NRHP-eligible archaeological resources were avoided by ground disturbance activities. As a result, adverse effects to archaeological resources by the Phase I Project were entirely mitigated through avoidance.

**No-Action Alternative Summary**

Under Alternative 1, no new turbines would be constructed, so there would be no new impacts, direct or indirect, positive or negative, to cultural resources. Since no additional Project construction would take place, direct and indirect effects on cultural resources would be limited to those associated with Phase I O&M and decommissioning. Mitigation would therefore be limited to that previously implemented for Phase I. Ongoing impacts to up to 26 identified NRHP-eligible historic structure cultural resources would continue to occur from the operation of Phase I until decommissioning. Decommissioning of the existing 67 turbines would not directly impact any area previously undisturbed during construction, and therefore effects on archaeological resources would be avoided. By not constructing the 33 turbines of the Phase II Project, overall effects of the Project on cultural resources would be mitigated through avoidance and minimization under the No-Action Alternative.
5.12.2.2 Alternative 2: Proposed Action

Phase II Construction
Under the Proposed Action Alternative, Phase II construction will add new wind turbines at 33 of the 47 sites that have been surveyed and evaluated for architectural and archaeological resources. Construction will include new and upgraded access roads, collector cables, temporary staging areas, and other supporting infrastructure. Temporary ground impacts for each turbine are estimated at approximately 4.0 acres. Construction vehicles, including those transporting the new turbines, will travel through portions of the Phase II historic structures APE on their way to and from the turbine locations. Construction activities will temporarily generate noise from trucks, cranes, dozers, excavators, graders, and batch plants, and some of these noises will be heard from nearby residences, communities, properties, and public roadways. Construction-related noises will vary, and will be lessened or eliminated by increasing distance from the construction sites.

Effects of construction on historic structures within the Phase II APE are expected to be temporary and primarily limited to construction noise and temporary views of construction cranes. A study to assess noise associated with the construction and operation of the Phase II Project (Acentech 2011) reported that the majority of construction activities will be conducted during daylight hours, and that some of the activities will be audible to nearby residences. The town of Duo, which is one of the NRHP-eligible historic districts in the Phase II APE, is located between the existing Phase I facility and the proposed Phase II expansion area. Most of Duo’s residences are approximately two mi from the nearest Phase II turbine locations. Based on the acoustical study, it is expected that the temporary noise generated by Phase II Project construction will be similar to noise generated by typical mid-sized building projects and the current timber and mining activities in the region.

Though no NRHP-eligible archaeological resources were identified within the expected ground-disturbance footprint of the Phase II Project, CRA (2011) recommends further survey of specific landforms and soil types in the Project area prior to construction to confirm that these types of cultural resources do not exist and will therefore not be affected by Project construction. BRE will conduct additional archaeological surveys prior to beginning construction of the phase II turbines. The Service and BRE are in discussions with WVSHPMO and the Catawba Nation to develop another MOA (as described for Phase I) to avoid and mitigate for any effects of Phase II construction on archaeological resources.

100-Turbine Project Operation
The 100-turbine Project has not been specifically evaluated as to the effects on cultural resources. In the absence of a comprehensive assessment on the 100-turbine Project, it is reasonable to assume that the Phase I and Phase II cultural resource assessments can be used to estimate the combined effects. It is important to note that the actual effects of the 100-turbine Project will be less than those reported by both the Phase I and Phase II cultural resource assessments, as only 67 of the 124 Phase I turbines were built, and only 33 of the 44 turbine locations that were evaluated will be constructed under Phase II.

The cultural resources effects assessment report (BHE 2008) concluded that construction of the 124-turbine wind energy facility would add visual elements to the landscape that may not be in keeping with the area’s historic patterns of settlement. Based on the locations of known architectural resources in the historic structures APE, BHE indicated that the Phase I Project could thereby constitute an adverse effect for 26 out of the 51 eligible resources identified in that APE. These resources include 3 Historic Districts, 4 churches, 5 cemeteries, 1 school house, and 13 individual properties (BHE 2008). BHE concluded that turbine construction would result in a semi-permanent change to the rural landscape, including immediate visual changes. The visual changes would affect the setting, feeling, and association of the rural landscape, resulting in adverse visual and cultural effects within some portions of the Phase I Cultural Resource APE. Though only 67 of those turbines were actually installed in the Phase I Project, and it cannot be determined from the BHE (2008) report whether the 67 turbines actually affect all of the 26 NRHP-eligible resources, it is assumed herein for the purpose of this DEIS that all of the 26 cultural resources have views of one or more of the Phase I turbines. Therefore, the operation of those turbines constitutes a significant adverse effect on those resources.
The assessments of the Phase II Project on cultural resources considered a total of 47 new turbine locations, including 33 primary and 14 alternate locations. The assessments included reconnaissance-level reviews within the 5-mi historic structure APE to identify structures that were potentially eligible for listing on the NRHP, and that could have their viewsheds altered if the Phase II wind turbines were constructed (Gray & Pape, 2011a and 2011b). Gray & Pape (2011b) used the electronic viewshed analysis from Saratoga (2011) to determine if any of the Phase II wind turbines would be visible from the historic-period resources they identified. They also used the acoustical assessments by Acentech Inc. (Acentech 2011) to evaluate the effect of noise on eligible historic resources. The assessment of effects report for the Phase II Project archaeological resources was completed in March 2012 (Gray and Pape 2012). On April 6, 2012, the West Virginia SHPO concurred with this effects analysis (WVDCCH 2012).

The assessment of archaeological resources included a desktop analysis and an archaeological reconnaissance survey of the direct Phase II APE, defined as the estimated potential area of temporary and permanent ground disturbance associated with the Project construction (CRA 2011). Results and conclusions of both the historic structure and archaeological assessments for Phase II are summarized below. The Service concurs with the determinations below, except as otherwise noted.

**Historic Properties**

- Of the 206 historic-period resources identified by Gray & Pape (2011a and 2011b, 2012) within the non-overlap 5-mi Phase II APE, only 2 were determined to be NRHP-eligible by the SHPO. The Service concurs. These are: (1) the Mt. Urim Baptist Church and associated cemetery on County Route 17 in Nicholas County; and (2) the Duo Historic District on Duo Rd in Greenbrier County.
- Gray & Pape (2012) conclude that the Phase II Project will not have an adverse visual or acoustical effect on the Mt. Urim Baptist Church because existing vegetation screens views of the church, and because noise levels during construction and operation will be masked by existing ambient noise. The Service questions whether absence of trees sometime in the future would make a significance difference in visual effect, especially at the Mt. Urim churchyard where trees blocking turbine views are in the foreground (USFWS 2012). For this reason, the Service will send the effects report to the Mt. Urim Church and invite their participation in the MOA, should they have concerns.
- The Duo Historic District may have views of from 1-30 Phase II wind turbines, depending on the vantage point from within the district, with the majority of the district expected to have views of 1-10 turbines. Gray & Pape (2011b) conclude that, due to the scale of the Phase II Project, the addition of permanent industrial-type visual elements to the rural landscape will constitute an adverse visual effect for the Duo Historic District. The Service concurs with the findings in the report that the Duo Historic District will have additional turbines within its viewshed, which add cumulatively to existing viewshed effects from Phase I. These new visual effects to the Duo District must be mitigated through the development of an MOA with interested parties.
- The Duo Historic District is expected to experience temporary noise effects during construction of the Phase II Project, but day-to-day operation of the wind energy facility is not expected to exceed existing ambient sound levels at this location. The Service concurs there will be no adverse noise effects to historic structure cultural resources as a result of the Phase II Project.
- Though the landscape within the Phase II APE typically undergoes change on a regular basis as a result of farming, mining, and lumbering activities, the permanent change to the rural landscape that will result from the construction and operation of the 33 Phase II wind turbines constitutes a visual effect that alters the setting, feeling, and association or the rural landscape. The Phase II Project will introduce industrial elements to the landscape that, when combined with the Phase I Project, will erode the traditional landscape and in turn affect the cultural heritage of the local residents. Consequently, Gray & Pape (2011b) conclude that, in addition to the adverse visual

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47 The “non-overlap” is the area within the Phase II cultural APE that does not overlap with the Phase I cultural APE.
effects, the Phase II Project will have adverse cultural effects within the APE. The Service concurs.

Archaeological Resources

- Based on desktop analyses and reconnaissance field surveys of the direct archaeological resources APE for Phase II, CRA (2011) found no evidence of NRHP-eligible resources, and concluded that the that majority of APE has a low probability to contain archaeological sites, especially those that would qualify for inclusion on the NRHP.
- CRA (2011) listed 4 previously-recorded sites located within or near the APE, all located on ridgetops and landforms with slopes less than 15-20% and in areas mapped as Mandy channery silt loam. These 4 prehistoric sites were previously identified by CRA in the assessment of the Phase I Project, and each was determined by the WVSHPO to be not eligible for the NRHP. No further examination of the sites was recommended by CRA or WVSHPO.
- CRA (2011) recommends further survey of ridgetops and other landforms with slopes less than 20%, with specific attention to the areas of Mandy channery silt loam soil type not examined during the prior surveys.

The SHPO concurred with these findings by letter dated October 26, 2011, and requested preparation of an MOA. The Service concurred by e-mail to the SHPO and BRE on November 4, 2011. Although no NRHP-eligible archaeological resources were identified within the expected ground-disturbance footprint of the Phase II Project, their existence cannot be ruled out, and therefore the Service recommends that further pre-construction surveys be conducted to confirm that these types of cultural resources either do not exist and will therefore not be affected by Project construction, or if found, will be avoided if possible, and mitigated if they cannot be avoided. As with construction of the BRE Phase I Project, a “Phase II” archaeological survey to include on-the-ground testing in the ground-disturbance footprint will occur prior to construction of the 33 turbines and supporting facilities. An MOA will be developed among BRE, SHPO, the Service, interested tribes, and other interested parties to ensure that archaeological resources are properly studied and avoided or mitigated.

Mitigation for Phase II Construction and Project Operation

The effects of construction-generated noises will be mitigated by typical construction practices (Acentech 2011), including:

- Conducting most activities in daylight hours;
- Limiting nighttime work to relatively quiet activities;
- Restricting pile-driving activities to daytime during weekdays;
- Using effective exhaust mufflers in proper working condition;
- Requiring contractors to comply with federal limits on truck/equipment noise;
- Conducting any blasting (if required) in accordance with standard industrial practices and project-specific requirements established by the WVPSC, with the overall goal of reducing potential impacts to nearby residences; and
- Carefully selecting only 33 out of the 47 turbine locations, with consideration to minimizing impacts (primarily visual) to cultural resources.

Similar to the Phase I Project, the Phase II Project will incorporate the following mitigation measures into its design and operation, some of which help mitigate the visual effects to cultural historic structures and direct disturbance-type effects to archaeological resources:

- BRE developed the wind farm layout so that turbines were located at least a mi from existing residences;
- In part to limit the aesthetic effect of the wind farm, the turbines will not be illuminated, except as required by FAA regulations, and except for a low voltage lights on a motion sensor at the entrance door to each turbine;
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- Turbines will be coated/painted a non-reflective and non-obtrusive off-white color;
- Turbines will be similar in design and size, including tower height, and all turbines comprising Phase II will be consistent in color and blade rotation direction;
- Existing roads will be used for construction and maintenance where possible, minimizing new road construction;
- Access roads created for the Project will be located along ridge tops when possible to minimize visible cuts and fills;
- Temporarily disturbed areas in wooded areas will be allowed to re-vegetate naturally to the maximum extent possible while still allowing for access and maintenance of the Project; and
- The ground-disturbance areas of the Phase II Project will be surveyed prior to construction, and NRHP-eligible archaeological resources will be avoided by ground-disturbance activities. As a result, adverse effects to archaeological resources by the Phase II Project will be mitigated through avoidance.

The Service and BRE are in discussions with WVSHPO and the Catawba Nation to develop another MOA (as described for Phase I) to address and mitigate for any additional effects of the 33-turbine expansion area.

100-Turbine Project Decommissioning
Decommissioning of the existing 100-turbine Project would be similar in character to the activities associated with construction. Decommissioning would not impact any area previously undisturbed during construction. The duration for decommissioning is likely to be significantly shorter than that for construction of the two Projects. In accordance with the impact criteria above, Project decommissioning would have significant beneficial effects on those NRHP-eligible historic structure cultural resources with views of the 100 turbines as they are dismantled and removed from view.

Proposed Action Summary
In 2 separate studies, Gray & Pape analyzed the effects of the 124-turbine Phase I Project (O’Bannon and Sweeten 2007) and the 47-turbine Phase II Project (Gray & Pape 2011, 2012) on cultural resources. Though a 100-turbine combined Project was not analyzed as a whole, the effects outlined in the Phase I and Phase II studies can be used to approximate the visual, noise, and cultural effects of the Proposed Action alternative, which would include 100 turbines in total. Operation of the 100-turbine Project would be expected to have adverse visual effects on approximately 26 NRHP-eligible resource within the combined Phase I/Phase II APE. Noise from Phase II construction may temporarily affect some nearby NRHP-eligible resources, but it is expected that noise from day-to-day operation of the 100-turbine Project will not cause adverse effects because it is not expected to exceed ambient levels at any of the NRHP-eligible resources. Gray & Pape (2011b) conclude that the visual effects of the 100-turbine Project would result in an erosion of the traditional landscape, and consequently, in adverse cultural effects related to setting, feeling, and association with the rural landscape.

Based on the Impact Criteria, it is predicted that implementation of the Proposed Action will have significant adverse (major) effects on cultural resources. These effects would result from some wind turbines being visible from NRHP-eligible historic property resources, and from the overall visual changes within the Cultural Resource APE affecting the setting, feeling, and association of the rural landscape. Noise from Phase II construction may temporarily affect some nearby NRHP-eligible resources, but it is expected that noise from day-to-day operation of the 100-turbine Project will not affect any cultural resources. Though no NRHP-eligible archaeological resources were identified within the expected ground-disturbance footprint of the Phase II Project, their existence cannot be ruled out and therefore further pre-construction surveys are recommended to confirm that these types of cultural resources either do not exist and will therefore not be affected by Project construction, or if found, will be avoided if possible, and mitigated if they cannot be avoided. It is expected that these follow-up archaeological studies and resulting consultation will be addressed in the MOA.
5.12.2.3 Alternative 3: ITP and HCP with Additional Covered Species

Under Alternative 3, effects on cultural resources from the construction of the Phase II Project, the 100-turbine operation, mitigation measures, and decommissioning would be the same as those described for the Proposed Action. Based on the Impact Criteria, it is predicted that implementation of Alternative 3 will have significant adverse effects on cultural resources. These effects result from some wind turbines being visible from NRHP-eligible historic property resources, and from the overall visual changes within the Cultural Resource APE affecting the setting, feeling, and association of the rural landscape. Noise from Phase II construction may temporarily affect some nearby NRHP-eligible resources, but it is expected that noise from day-to-day operation of the 100-turbine Project will not affect any cultural resources. Though no NRHP-eligible archaeological resources were identified within the expected ground-disturbance footprint of the Phase II Project, further pre-construction surveys are recommended to confirm that these types of cultural resources do not exist and will therefore not be affected by Project construction or if found, will be avoided or mitigated.

5.12.2.4 Alternative 4: ITP and HCP for Phase I Only

Under Alternative 4, effects from the 67-turbine operation, mitigation measures, and decommissioning on cultural resources would be the same as those described for the No-Action Alternative.

Under Alternative 4, no new turbines would be constructed, so there would be no new impacts, direct or indirect, positive or negative, to cultural resources. Since no additional Project construction would take place, direct and indirect effects on cultural resources would be limited to those associated with Phase I O&M and decommissioning. Mitigation would therefore be limited to that previously implemented for Phase I. Ongoing impacts to up to 26 identified NRHP-eligible historic structure cultural resources would continue to occur from the operation of Phase I until decommissioning. Decommissioning of the existing 67 turbines would not directly impact any area previously undisturbed during construction, and therefore effects on archaeological resources would be avoided. By not constructing the 33 turbines of the Phase II Project, overall effects of the wind energy Project on cultural resources would be mitigated through avoidance and minimization under the Alternative 4.

5.13 Communications

This section evaluates the potential Project effects on communications facilities and systems in Greenbrier and Nicholas Counties. No significant issues specifically relating to telecommunications were identified during the public scoping process. However, the Project activities must comply with the Federal Communications Commission’s rules and policies. The Project’s potential effects to communications resources include:

- Interference to microwave, TV, radio, cellular and telephone communications service, and land mobile radio reception; and
- Inconvenience to local businesses and residents.

5.13.1 Impact Criteria

The WVPSC requires an Applicant to identify and describe a proposed facility’s potential effects to telephone line utilities. However, the WVPSC does not require that an Applicant evaluate and describe the potential for the facility to interfere with radio, TV, or telephone reception. Wind projects have the potential to create problems for certain communication systems on which the public is dependent. Effects of the Proposed Action or alternatives on communications resources would be significant if users are prevented from relying on systems that should be available to them.
5.13.2 Direct and Indirect Effects Presented by Alternative

5.13.2.1 Alternative 1: No-Action Alternative

Under the No-Action Alternative, the proposed 33 turbines and HCP would not occur. Additionally, an ITP pursuant to Section 10(a)(1)(B) of the ESA would not be issued for the existing BRE Project. There would be no new construction.

Phase I Operations

Microwave Paths. Wind turbines can interfere with microwave paths by blocking or partially blocking the line-of-sight path between microwave transmitters and receivers. Beech Ridge hired Comsearch to identify microwave telecommunication systems that traverse the Phase I area. Using Wind Power GeoPlanner software, the firm made a geographical representation of registered fixed microwave beam paths in the 960 megahertz (MHz) to 23 gigahertz (GHz) frequency band range. Because microwave communication is a line-of-sight technology, potential interference of microwave telecommunication signals can be avoided by locating the wind turbines outside of the microwave communications profile. Comsearch calculated a Worst Case Fresnel Zone for each of the microwave beam paths in the area. The middle of the path is where the widest (the worst case) Fresnel Zone appears. The microwave beam paths were then overlaid on topographic base maps for the Project study area and turbines were sited to avoid these paths.

Turbines in the Phase I Project would not affect microwave paths as identified in the Project area at the time of the survey.

Television. Potentially, wind turbines can block television broadcast signals or affect television reception by introducing reflections or “ghosting” to the images broadcasted. If necessary and appropriate, BRE would resolve television interference problems by improving the person’s antenna, changing the antenna location, or installing relays to re-transmit and boost the affected signal. Installing satellite television would be another possible option. Television reception issues would be dealt with on a case-by-case basis by working with any affected residents to identify the best solution.

Cellular and Two-way Radio. There is no evidence that wind turbines interfere with individual cell phones or two-way radio communications. In fact, turbine maintenance personnel often use cell and radio equipment to perform their work. The turbines are not likely to introduce problems with two-way radios if the towers are not adjacent to the microwave transmitting and/or receiving antennas. In some areas, cell phone antennae have been installed on the turbine towers. As such, problems with cellular and 2-way radio communication are not expected to result from Phase I operations.

Wireless Internet. Wireless system reliability and performance is strongly affected by the strength of an incoming signal. To maximize signal strength, links are usually designed with a clear line-of-sight between antennae. A wireless customer may have a reliability and/or performance issue if the path between antennae is blocked by a turbine tower, or if a turbine blade intersects the signal path. This may be solved in a similar manner as the television issue. If necessary and appropriate, BRE will work with any affected landowners within the Project area to remedy any degradation in their broadband wireless internet service regardless of alternative pursued.

No-Action Alternative Summary

For siting the Phase I turbines, BRE avoided identified microwave paths. Additionally, BRE is committed to addressing any Project interferences with communications systems as they arise and on a case-by-case basis. Under the No-Action Alternative, effects to communications resources are expected to be minor and would be easily mitigated should they be identified. Users of existing communications resources are not expected to be prevented from relying on these systems that should be available to them.
5.13.2.1 Alternative 2: Proposed Action

Under the Proposed Action, BRE will construct the proposed 33 turbines and associated infrastructure and operate the 100-turbine Project according to the Project HCP. The Service will issue an ITP pursuant to Section 10 (a)(1)(B) of the ESA for the Project, and avoidance, minimization, and conservation efforts will be implemented as described in the HCP and specified in the ITP.

Phase II Construction

Construction activities associated with the 33-turbine Project could begin to affect communications systems as soon as 1 or more turbines are up and able to interfere with broadcast signals. BRE has not yet conducted a study to locate microwave paths in the Phase II Project area. However, BRE intends to avoid blocking microwave paths, and turbines eventually will be sited to avoid microwave paths. Should other communications systems become impacted during construction, BRE is committed to addressing these issues as they arise and on a case-by-case basis as discussed for the No-Action Alternative operations.

100-Turbine Operations

Potential effects to communications systems associated with Proposed Action operations will be as described for the No-Action Alternative but with the addition of 33 turbines in the Phase II Project area. However, site specific modeling of the microwave paths for Phase II of the Project has not been completed. Impacts to microwave transmissions would require minor modifications to siting if an impact is discovered. Should other communications systems become impacted during operations, BRE is committed to addressing these issues as they arise and on a case-by-case basis as discussed for the No-Action Alternative operations.

100-Turbine Decommissioning

Decommissioning is not expected to result in impacts to communications resources. The dismantling of the Project would not create any new interference with broadcasted signals.

Proposed Action Summary

For siting the Phase II turbines, BRE will avoid microwave paths when they have been identified. Additionally, BRE is committed to addressing any Project interferences with communications systems as they arise and on a case-by-case basis. Under the Propose Action, effects to communications resources would be minor and easily mitigated should they be identified. Users of existing communications resources will not be prevented from relying on these systems that are typically available to them.

5.13.2.2 Alternative 3: ITP and HCP with Additional Covered Species

Under Alternative 3, an ITP pursuant to Section 10 (a)(1)(B) of the ESA would be issued for development of the BRE Project. The Phase II 33 turbines would be constructed as described for the Proposed Action. Under this alternative, BRE’s Curtailment Plan and RMAMP would be modified to implement a 6.5 m/s cut-in speed as opposed to 4.8 m/s as the initial rate for curtailment. Furthermore, all 100 turbines would operate at 6.5 m/s from 30 minutes before sunset through 15 minutes after sunrise during the period April 1 through October 15.

Phase II Construction

Under Alternative 3, impacts to communications associated with Phase II construction would be as described for the Proposed Action. Construction activities could begin to affect communications systems as soon as 1 or more turbines are up and able to interfere with broadcast signals. BRE has not yet conducted a study to locate microwave paths in the Phase II Project area. However, BRE intends to avoid blocking microwave paths, and turbines eventually will be sited to avoid microwave paths. Should other communications systems become impacted during construction, BRE is committed to addressing these issues as they arise and on a case-by-case basis as discussed for the No-Action Alternative operations.

100-Turbine Project Operation
Potential effects to communications systems associated with Alternative 3 operations would be as described for the No-Action Alternative but with the addition of 33 turbines in the Phase II Project area. However, site specific modeling of the microwave paths for Phase II of the Project has not been completed. Impacts to microwave transmissions would require minor modifications to siting if an impact is discovered. Should other communications systems become impacted during operations, BRE is committed to addressing these issues as they arise and on a case-by-case basis as discussed for the No-Action Alternative.

**100-Turbine Decommissioning**
Decommissioning is not expected to result in impacts to communications resources. The dismantling of the Project would not create any new interference with broadcasted signals.

**Alternative 3 Summary**
For siting the Phase II turbines, BRE would avoid microwave paths when they have been identified. Additionally, BRE is committed to addressing any Project interferences with communications systems as they arise and on a case-by-case basis. Under Alternative 3, effects to communications resources would be minor and easily mitigated should they be identified. Users of existing communications resources will not be prevented from relying on these systems that are typically available to them.

**5.13.2.3 Alternative 4: ITP and HCP for Phase I Only**
Under Alternative 4, BRE would not construct the proposed 33 turbines and associated Phase II infrastructure. BRE would operate the 67-turbine Project according to the Project HCP. The Service will issue an ITP pursuant to Section 10 (a)(1)(B) of the ESA for the Project, and avoidance, minimization, and conservation efforts will be implemented as described in the HCP and specified in the ITP. There would be no new construction.

**Phase I Operations**
Potential effects to communications systems associated with Alternative 4 would be as described for the No-Action Alternative. BRE conducted site specific modeling of the microwave paths in Phase I and used this information to site the 67 turbines to avoid blocking microwave paths. Microwave paths would not be affected. Should other communications systems become impacted during operations, BRE is committed to addressing these issues as they arise and on a case-by-case basis as discussed for the No-Action Alternative.

**Phase I Decommissioning**
Decommissioning is not expected to result in impacts to communications resources. The dismantling of the Project would not create any new interference with broadcasted signals.

**Alternative 4 Summary**
For siting the Phase I turbines, BRE avoided identified microwave paths. Additionally, BRE is committed to addressing any Project interference with communications systems as they arise and on a case-by-case basis. Under Alternative 4, effects to communications resources would be minor and easily mitigated should they be identified. Users of existing communications resources are not expected to be prevented from relying on these systems that are typically available to them.

**5.14 Transportation**
No issues specifically relating to transportation were identified during the public scoping process. Potential transportation issues would largely be associated with wind project construction and the increased amount of traffic that is likely to result during this time. These include the potential for accidents, increased road congestion, increased traffic noise, and increased vehicular emissions, all of which are fairly standard construction-related concerns.
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5.14.1 Impact Criteria
The WVPSC requires that an Applicant describe traffic levels attributable to Project construction and operations on roadways within 1 mi and 5 mi of the Project area and any plans to mitigate traffic effects (CSR §150-30-3.1.m.5.). This analysis looked at a 2005 traffic study conducted by Potesta and projected future traffic volumes on affected roads in the absence of the Project to estimate significant increases in traffic levels on roads within 5 mi of the Project. Increased traffic associated with construction of Phase II of the Project is temporary and therefore will not reach the threshold of significance. If 100 or more vehicles were added to the system as part of operations, this would exceed the systems design capacity. This would create a significant adverse impact to transportation resources. The number of vehicle trips represented by 100 vehicles would change the character and function of roads in this low traffic volume region. While construction of Phase II will require more vehicles than this, the roads will be upgraded, signaled, and repaired as appropriate during construction to handle this volume. These mitigative measures will not be in place during Project operations.

Predicted local population levels can be used in estimating future traffic volumes. Table 4-26 shows the historic population change for Greenbrier and Nicholas counties from 2000-2010. Greenbrier County showed only minimal growth (0.2%) and Nicholas County showed a decrease in population numbers (-1.3%) since 2000.

5.14.2 Direct and Indirect Effects Presented by Alternative

5.14.2.1 Alternative 1: No-Action Alternative

Phase I Operations
No transport of materials would take place. It is anticipated that 20 vehicles would be used for performing O&M (i.e., a total of 20 vehicles would access Phase I daily) and average 1 trip to each turbine per day to perform maintenance duties. This would raise the Average Daily Traffic (ADT) value along County Route 1 from 400 to 440. The ADT value along County Route 10/1 would have increased from 30 to 70, assuming each vehicle would have visited each turbine daily.

Phase I Decommissioning
Removal of Project components is likely to be similar to those during construction of the facility. Potesta prepared a traffic study in 2005 to comply with WVPSC rules associated with the originally proposed Beech Ridge Wind Energy Project of 124 turbines in 2005. As such, “Project” in this section refers to all activities and components associated with 124 turbines. Impacts associated with decommissioning are expected to be less than those presented for the 124 turbine Project. Impacts are expected to include a similar number of vehicles; however, they will be present and working within the study area for less time. Potesta (2005b) presented ADT information for public roads located within a 5-mi radius of the site for the pre-construction, construction, and post-construction phases of development. The ADT information was further broken down for public roads within a 1-mile radius of the site for the pre-construction, construction, and post-construction phases of the Project. ADT values for each phase were developed by utilizing information provided by the WVDOT and Beech Ridge Energy LLC. Access to the Project was from Exit 156 of Interstate 64, along U.S. Route 60 to Rupert, then along County Route 1 to the construction staging area near Clearco (Potesta 2005b).

A total of 36 public roads were found to be in the study area, 6 of which were within 1 mile of the Project. County Route 1 was the primary route used for delivering equipment, materials, and labor to the Project site. The pre-construction ADT value at the outside edge of the study area along County Route 1 leading to the staging area near Clearco was 400. County Route 10/1 had a preconstruction ADT of 30. This route was used to transport equipment and supplies within the Project area. Phase I was anticipated to have little to no influence on the remaining routes in the study area.

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ADT data represent the number of axles rather than the number of vehicles. The WVDOT considers 2 axles to represent 1 ADT; therefore, a truck with 4 axles will increase the ADT count by 2.
Traffic during construction was affected by the number of trucks needed to transport necessary equipment and supplies to the Project site. Trucks hauling equipment to the site ranged in size from small double axel commercial trucks to oversized trucks hauling wind turbine segments that required pilot vehicles. Project schedule and construction phase information provided by Beech Ridge Energy LLC indicated that approximately 3,400 trucks were required to deliver all the components of the Project. A similar amount of truck traffic is anticipated during decommissioning.

In order to approximate the impact of construction personnel vehicles on the ADT, it was assumed that an average of 100 vehicles carried construction personnel to and from the site on a daily basis.

County Route 1 was the most affected road in the study area due to supplies being delivered and construction personnel traveling to the staging area near Clearco. The ADT value for the proposed 12-week period thought to be needed for construction of 124 turbines would have increased by 522 per day to 922 along County Route 1 between Rupert and Clearco.

The 5.8-mi stretch between the proposed wind turbines B 10 and E 19 of County Route 10/1 would have been the only other significantly affected roadway in the study area due to traffic within the site. Nearly half of the planned wind turbines would have required access from this 5.8-mi stretch of County Route 10/1. Assuming the supplies would have been hauled from the staging area through the site to each turbine, the ADT value for the 12-week period would have been increased by 361 per day to 391 on County Route 10/1.

The increase in ADT for Phase I construction was mitigated by having a relatively short construction duration. This measure could be applied during decommissioning, shortening this duration of impact as well. Further mitigation was included following the WVDOT requirements for oversized loads, and meeting further WVDOT requirements that may be specific to the site area. It is also important to note that the above impacts were described for a 124 turbine facility; reducing the number of turbines to 67 may have reduced the overall impact by as much as 46%.

The main access road for equipment delivery would be County Road 1 North of Rupert. Beech Ridge will be using existing roads wherever possible. Approximately 60 miles of road will be required for the Project. Forty-five of these miles will be on existing road. Beech Ridge will construct access roads complying with special conditions that may be developed in individual landowner agreements. During decommissioning, roads will be utilized that were used during construction. Since restoration of roadways has occurred as part of minimization of environmental impacts; these roads will require improvements from operational road conditions to facilitate decommissioning. These roads will be located to minimize disturbance and maximize transportation efficiency by avoiding sensitive resources and steep topography.

On January 14, 2009, Beech Ridge entered into an agreement with the WVDOT under which they are required to submit a decommissioning plan. It is reasonable to expect that the nature of traffic during decommissioning would be similar to that of the Phase I construction. During the construction phase, several types of light, medium, and heavy-duty construction vehicles traveled to and from the site. Approximately 42 large truck trips per day and up to 120 small-vehicle (pickups and automobiles) trips per day occurred during peak construction periods. Concrete, aggregate, and miscellaneous delivery trucks occurred intermittently during the peak time of the foundation and tower assembly.
5.14.2.2 Alternative 2: Proposed Action

Phase II Construction
Impacts to transportation during construction of Phase II under Alternative 2 will be similar to those associated construction of Phase I. The ADT will likely be similar as originally modeled by Potesta (2005b). However, there will be fewer trips since only 33 turbines will be constructed. Phase I construction did not interrupt transportation facilities within 5 mi of the Phase I and Phase II Project area.

100- Turbine Project Operations and Decommissioning
No additional vehicles beyond the 20 noted above will be needed to maintain and operate the facility. Decommissioning as described for Phase I included 124 turbines; as such, decommissioning 100 turbines will have less impact than described by Potesta (2005b). Decommission will require fewer trips than originally modeled.

From 2000 to 2009, Greenbrier County showed a 0.2% rate of growth in population. In the same time frame, Nicholas County’s population decreased by -1.3%. As such, growth of both counties over the 25-year permit term is expected to be minimal and not be a significant factor in contributing to additional transportation stresses.

Proposed Action Summary
Under Alternative 2, there would be direct and indirect transportation effects associated with construction of the 33 turbine expansion, Project operations, and decommissioning of the 100-turbine Project. Operational impacts are expected to not differ from existing conditions. Construction effects to transportation are likely to be similar as described for construction of the original 67-turbine Project; however, the duration of the impact is expected to be much shorter in duration. Decommissioning is expected to have a similar number of ADTs, however, they will occur for a shorter duration as compared to the modeled 124 turbine Project and longer than the No-Action Alternative. Transportation direct and indirect effects are expected to be minor.

5.14.2.3 Alternative 3: ITP and HCP with Additional Covered Species

Under Alternative 3, impacts to transportation resources would be as described for Alternative 2 construction, O&M, and decommissioning. Transportation direct and indirect effects are expected to be minor.

5.14.2.4 Alternative 4: ITP and HCP for Phase I Only

Under Alternative 3, transportation impacts would be as described for the No-Action alternative. There would be minor adverse effects associated with these activities.

5.15 Safety and Security

This section evaluates the Project’s potential effects on health and safety in the Project area. Safety issues cited included concerns about potential increases in noise, light, and shadow flicker impacts on human health caused by the turbines; and ice throws associated with turbines (i.e., safe set-backs).

5.15.1 Impact Criteria

The WVPSC rules (150 CSR 30) specify the Applicant must provide maps illustrating the Project’s proximity to various features within 1 mi and 5 mi. With regard to analyzing safety and security at a wind project, features of issue include major population centers, major transportation routes, utility corridors,
The Proposed Action or any alternative will have the potential to affect the safety and security of the human environment. Effects will be significant should any of the features listed above be at a measurable risk to tower collapse, turbine blade shear, ice throw, or excessive shadow flicker or noise. Measurable risk for these hazards is based on identified setbacks. Effects will be significant should any of the features listed above be at a risk to fire. Risk of exposure to fire is based on precautionary measures, emergency access, and distance from hazard.

5.15.2 Direct and Indirect Effects Presented by Alternative

5.15.2.1 Alternative 1: No-Action

Under the No-Action Alternative, the proposed Phase II Project and HCP would not be implemented. Additionally, an ITP pursuant to Section 10 (a)(1)(B) of the ESA would not be issued for Phase I operation or Phase II construction and operation. BRE would continue to operate Phase I under the current restrictions indicated in the Settlement Agreement to avoid bat mortality. The 67-turbine Project will operate in such a manner that no take of listed species would occur, thus precluding the need for an ITP. From November 16 through March 31 (winter months), the 67 turbines would be operated 24 hours per day. From April 1 to November 15 (non-winter months), the turbines would be operated from one-quarter hour after sunrise to one-half hour before sunset (daylight hours). The existing forest management land uses would be maintained at the proposed Phase II turbine locations.

Phase I Construction
Phase I construction impacts are fully analyzed in association with cumulative impacts in Section 5.16 since these effects have already occurred and do not contribute to the direct or indirect effects associated with this analysis of environmental consequence analysis. No new construction would occur under this alternative; hence there would be no health and safety effects associated with construction.

Phase I Operations
Operation-related effects include ice throw, tower collapse, blade shear; stray voltage and electrocution, fire, lightning, and shadow flicker. Operational effects also include noise, which is addressed in Section 5.2.

Ice Throw. Under certain weather conditions, ice can accumulate on rotor blades and subsequently break free and either is thrown or falls to the ground. Ice build-up on the blades of an operating turbine will lead to additional vibration caused by the weight of the ice and aerodynamic imbalance. Commercial turbines possess vibration monitors that will trigger a shutdown should the vibrations exceed a specific level (Garrad Hassan 2007). In this situation, most turbines will restart only when the ice has thawed and fallen straight to the ground near the base. Although less common, ice can be thrown when it begins to melt and turbine blades begin to rotate again.

Although limited, field observations of ice throw indicated most fragments fell within 100 m (330 ft) of the turbine base (Morgan et al. 1998). Near Kincardine, Ontario, a wind project operator conducted 1,000 turbine inspections between December 1995 and March 2001 and documented 13 occurrences of ice. Ice fragments on the ground were within 100 m (330 ft) from the turbine base and most fragments were found within 50 m (165 ft) (Garrad Hassan 2007). Garrad Hassan (2007) conducted a risk assessment and found a negligible risk of ice throw at distances beyond 220 m (726 ft) from the turbine.

The Phase I turbines are a minimum of 3,600 ft from permanent residences and at least 450 ft from a public ROW. County Route 10/1 is located within 425 ft of the nearest turbine. Although ice throw could attain this distance, most documented instances of ice throw are less than 425 ft. Generally speaking, Project setbacks will adequately protect the public from falling ice. In addition, unauthorized public access to the site is limited. Based upon observations and risk calculations of ice throw, modern turbine
technological controls, the Project’s siting criteria, and control of public access to the turbine sites, it is not anticipated that the Project will result in any measurable risks to the health and safety of the general public due to ice shedding.

**Tower Collapse and Blade Shear.** Occurrences of tower collapse and blade failure are potentially dangerous yet extremely rare. Most instances of blade throw and turbine collapse were reported during the early years of the wind industry (CWEC 2006). Technological improvements and mandatory safety standards for turbine design, manufacturing, and installation have largely eliminated incidences of structural failure. Modern commercial-scale turbines are certified according to international engineering standards developed as a result of past structural failures. CWEC (2006) provides a literature review of turbine blade failure. When compared to blade failure rates of turbine models from the 1980s and 1990s, the overall blade failure rate of modern utility-scale turbines has declined by a factor of three.

Incidences of turbine collapse or blade throw have generally been the result of design defects during manufacturing, poor maintenance, control system malfunction, or lightning strikes. Most often it is a combination of factors. Anecdotal evidence suggests that the most common cause of blade failure is human error when adjusting control systems (Garrad Hassan 2007). Manufacturers have reduced this factor through limiting human adjustments that can be made in the field (Garrad Hassan 2007).

There are no standard setback distances in the wind industry today. Rademakers and Bram (2005) analyzed documented incidences of turbine failure in Europe and derived the following distances:

- 500 m (1,650 ft) was the maximum throw distance for small blade parts and tips
- 150 m (495 ft) was the maximum confirmed throw distance of an entire blade. [Distances of 400 m and 600 m (1,320 ft and 1,980 ft) for entire blades were also reported but these values were not confirmed.]
- The risk zone is approximately equal to one-half the rotor diameter for rotor or nacelle collapse
- The risk zone is equal to the height of the tower plus one-half the rotor diameter for entire tower collapse fails.

The Phase I turbines are a minimum of 1,000 ft from permanent residences and at least 450 ft from a public ROW. This may not adequately protect the public from incidences of structural failure. However, unauthorized public access to the site is limited. Based upon observations and risk calculations of structural failure, modern turbine technological controls, the Project’s siting criteria, and control of public access to the turbine sites, it is unlikely that the Project will result in risks to the health and safety of the general public due to tower collapse or blade shear.

**Stray Voltage, Electrocution, Electromagnetic Fields.** Proper electrical installation and grounding practices prevent stray voltage from occurring. BRE has indicated the Project’s electrical collection system meets applicable design and safety regulations, is properly grounded, has adequate spacing from other electrical cables, and is not connected to local distribution lines. Based on this assumption, the Project will not have any adverse impacts on human health and safety due to stray voltage.

Electric fields are created by changes in voltage: the higher the voltage, the stronger the resultant electric field. Magnetic fields are created when electric current flows: the greater the current, the stronger the magnetic field. An electric field will exist even when there is no current flowing. Electromagnetic fields (EMF) above certain levels can trigger biological effects. Experiments indicate that short-term exposure of EMF at the levels present in the environment or home does not cause any apparent detrimental effects in healthy individuals (WHO 1999). Exposures to higher levels that might be harmful are restricted by national and international guidelines.

Current research focuses on long-term low-level exposure and potential biological responses. Studies involving electromagnetic fields in humans have had weak positive results and are inconsistent among each other (WHO 1999). Studies alone typically cannot establish clear cause and effect relationships;
they detect only statistical associations between exposure and disease, which may or may not have been caused by the exposure. Currently, most human health authorities agree that the biological effects of low-level electromagnetic fields, if they exist at all, are likely to be very small (WHO 1999).

National standards for exposure to EMF generally draw from the guidelines set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP). The ICNIRP’s exposure limits for the public are 5 kiloVolts per meter (kV/m) for electric field and 100 microteslas (µT) for magnetic field (WHO 1999). Electric field levels directly beneath transmission power lines can be as high as 10 kV/m. At a 50-m to 100-m (165-ft to 330-ft) distance, the fields are normally at levels that are found in areas away from high-voltage power lines (WHO 1999). In addition, house walls substantially reduce the electric field levels from those found at similar locations outside the house.

EMF at a wind project can originate from the collection system, turbine generators, transformers, and underground network cables. The primary source of EMF from the Project is the generation lead lines used to connect the Project substation to the existing Allegheny Power Grassy Falls substation. This generation lead line is approximately 14.2 mi and comes within 1,000 ft of residences. Given the distance of the 138-kV line from nearby homes, the generation lead line is not likely to emit electric fields that exceed the limit of 5 kV/m set by the ICNIRP at any residences.

Fire, General Safety, and Emergency Response. Turbines sit on solid steel-enclosed tubular towers. Electrical equipment is located in the towers and pad-mounted transformers. The only tower access is through a solid steel door that is locked when not in use.

Beech Ridge prepared emergency response plans that comply with Occupational Safety and Health Administration (OSHA) regulations. All construction and operational personnel will be trained to handle emergency situations that could arise at the site.

Beech Ridge has had ongoing communications with the Greenbrier 911 center, the Greenbrier County Emergency Management Agency, and the Greenbrier County Fire and Emergency Responders Association. Fire protection in the Project area is primarily provided by volunteer fire departments, including those in Renick, Richwood, Rupert, and Williamsburg. Beech Ridge is working directly with these local fire departments to determine if additional training, equipment, and funding is needed to respond to emergency situations. Beech Ridge will enter into an agreement with the fire districts if necessary. Emergency training will be provided to the construction crews by experienced contractors to handle situations if they arise at the site. Local fire and ambulance services will be called to the site to provide emergency medical response. Turbine construction access roads will increase emergency access to the Project area. During operation, the Project will not present a risk of fire. The turbines, towers, and other equipment are for the most part metal and are not easily combustible. Additionally, the minimum amount of vegetation will be removed from the vicinity of electrical gear and connections to allow for the safe operation of all electrical equipment associated with the site, while at the same time minimizing the loss of vegetation. As discussed in detail below, all wind turbines will be properly protected from lightning and electrically grounded.

Lightning Protection and Grounding. An electrical grounding system is installed at each turbine to prevent damage caused by lightning strikes and provide grounding for electrical components. The buried grounding system was designed in context with local soil conditions and their electrical conductivity to ensure lightning dissipation. The grounding system complies with all applicable state and local electrical codes.

Shadow Flicker. Shadow flicker from wind turbines occurs when moving turbine blades pass in front of the sun creating alternating changes in light and shadows. These flickering shadows can be annoying to anyone who happens to perceive them due to their distracting nature. Shadow flicker impacts are related to the proximity of a wind turbine to an observer and light intensity (usually provided by sunshine). Shadow flicker becomes less noticeable at distances beyond 1,000 ft, except at sunrise and sunset when shadows are lengthened (NRC 2007). For a typical wind turbine, there may be up to 300 hours in a year
that experience shadow flicker. At approximately 4,500 ft, shadow flicker cannot be observed as a distinct effect.

There is some public concern that flickering light can have negative health effects, such as triggering seizures in people with epilepsy. Flicker frequency is dependent on rotor frequency, which is around 0.5 Hz to 1.0 Hz (NRC 2007). According to epilepsy research, frequencies below 10 Hz are unlikely to cause epileptic seizures (British Epilepsy Foundation 2010).

No state or national standards exist for frequency or duration of shadow flicker from wind turbine projects. However, studies and guidelines from Europe and Australia have suggested a threshold of 30 hours of shadow flicker per year to indicate a significant effect, that is, a measure of when shadow flicker is likely to become an annoyance (Dobesch and Kury 2001, Danish Wind Industry Association 2003, Sustainable Energy Authority Victoria 2003).

Travelers along nearby roads could experience shadow flicker from turbines while driving, which could be problematic. However, overall exposure to the Project’s shadow flicker would be comparatively minimal and not substantially different from shadow flicker associated with the sun shining through trees, utility poles, and other obstructions. Residences are located more than 3,500 ft from the Project. Shadow flicker associated with the Project is not likely to affect residences and communities.

Phase I Decommissioning
Potential effects of Project decommissioning on human safety and security will largely extend to site workers. Safety concerns associated with wind project decommissioning are similar to those associated with removing other vertical structures. Workers and others on the Project site have the potential to sustain injuries from colliding with large moving equipment and vehicles, stumbling over materials and debris, and falling from heights or into open excavations.

During decommissioning, BRE will continue to implement regular safety training and use of appropriate safety equipment. As required by the WVPSC rules (150 CSR 30), BRE will continue to address issues such as personal protective equipment, site maintenance and waste disposal, fire prevention, and safe work practices.

The potential effects of decommissioning to safety and security will be temporary and localized. Activities associated with decommissioning the Phase I turbines are not expected to significantly adversely affect human safety and security.

Phase I Avoidance and Minimization
For constructing and operating Phase I, BRE implemented the following measures to avoid and minimize potential impacts to human safety and security.

- Proper grounding techniques within and around all electrical components to eliminate the occurrence of stray voltage, electrocution, and fire.
- Emergency training provided to the construction and operations crews by experienced contractors.
- BRE prepared emergency response plans that comply with OSHA regulations. Appropriate training provided to workers to conduct all activities and handle materials safely, and recognize risks associated with the Project construction and operations.
- Coordinating with local emergency service personnel to ensure that they are aware of the location and nature of the Project.
- Safety signing is posted around all towers (where necessary), transformers, and high voltage facilities, and along roads in conformance with applicable state and federal regulations.
- Turbine towers were placed a minimum of 450 ft (1.1 times total turbine height) from all public ROW, with the exception of one tower that is 425 ft from County Route 10/1.
- Turbine towers were placed a minimum of 3,500 ft from non-participating residences to avoid potential effects associated with noise and shadow flicker.
Security measures taken during construction and operation of the Project include temporary (safety) and permanent fencing, warning signs (including signs warning of high voltage), and locks on equipment and wind power facilities.

No-Action Alternative Summary
The Phase I Project as implemented under the No-Action Alternative poses minor effects to human safety and security. The Project is in a remote location, and Project components are located with significant setbacks from residences. All turbines are further than 3,500 ft from residences, and most turbines are more than 1.0 mi from residences. There is 1 public road, County Route 10/1, located 425 ft from the nearest turbine. This road has limited use (ADT = 30 vehicles). All other public roads are more than 4,000 ft from wind turbines. Effects to safety and security associated with implementation of the No-Action Alternative are expected to be minor.

5.15.2.2 Alternative 2 - Proposed Action
Effects on human health and safety associated with Phase I of the Project (aside from those operational impacts associated with operation of the 100-turbine Project) are described in Section 5.15 – Cumulative Effects.

Phase II Construction
As part of Phase II construction BRE will continue to implement regular safety training and use of appropriate safety equipment. As required by the WVPSC rules (150 CSR 30), BRE will address issues such as personal protective equipment, site maintenance and waste disposal, fire prevention, and safe work practices. These construction practices will be reviewed in and modified as necessary since the current operations may create additional exposure risks.

Beyond the general construction issues described in section 5.15 for the Phase I Project, adverse impacts on human health and safety are not anticipated for constructing the Phase II Project. Like Phase I, Phase II is located in an area of low population density. Project construction is not likely to have substantial impacts on the security and safety of the local settlements and communities. Predicted noise levels for construction will not exceed the ambient noise levels that already occur in the area (Acentech 2011). All construction personnel will be trained to handle emergency situations if they occur. During construction, contractors will be required to develop their own Emergency Response Plan and training program for their employees. The Project will continue to adhere to applicable electrical codes and standards.

Assuming proper planning and monitoring of typical construction-related health and safety risks, construction of the Project will have no substantial adverse impacts on human health and security.

100-Turbine Operations
Potential operation-related effects to human safety and security for Phase II would be as described for Alternative 1. Beyond the general operations issues described above for the Phase I Project, adverse impacts on human health and safety are not anticipated in association with the operation of the 33 additional turbines in Phase II. Like Phase I, Phase II is located in an area of low population density. Predicted noise levels for operation will not exceed the ambient noise levels that already occur in the area (Acentech 2011).

BRE will implement safety and security measures described for Phase I during the operation of the 100-turbine Project, including temporary (safety) and permanent fencing, warning signs (including signs warning of high voltage), and locks on equipment and wind power facilities. All maintenance personnel will be trained to handle emergency situations should they occur. The Project will continue to adhere to applicable electrical codes and standards.

100-Turbine Decommissioning
Project decommissioning will have similar effects on human health and security as those described for Alternative 1. Potential effects of Project decommissioning on human safety and security will largely extend to site workers. Safety concerns associated with wind project decommissioning are similar to those associated with removing other vertical structures. Workers and others on the Project site have the potential to sustain injuries from colliding with large moving equipment and vehicles, stumbling over materials and debris, and falling from heights or into open excavations.

During Project decommissioning, BRE will continue to implement regular safety training and use of appropriate safety equipment. As required by the WVPSC rules (150 CSR 30), BRE will continue to address issues such as personal protective equipment, site maintenance and waste disposal, fire prevention, and safe work practices.

The potential effects of Project decommissioning to safety and security will be temporary and localized. Activities associated with decommissioning the Phase I turbines are not expected to significantly adversely affect human safety and security.

**Avoidance and Minimization**

To avoid and minimize risks to human safety and security, measures described for Alternative 1 apply to Phase II construction and the 100-turbine operation and maintenance along with the measures itemized below.

- Phase II turbine towers will be placed a minimum of 3,500 ft (1,067 m) from non-participating residences and 450 ft (137 m) (1.1 times the total height) from public ROW. These distances will exceed minimum setbacks considered safe to minimize the danger from ice throw from turbine blades, as well as to reduce potential impacts from noise and shadow flicker.
- Phase II turbine towers will be placed a minimum of 545 ft from public ROW. These distances are considered safe to minimize the danger from ice throw from turbine blades on the lightly traveled public roads that cross the Project area.
- Security measures will be taken during the construction and operation of the Project, including temporary (safety) and permanent fencing, gates, warning signs (including signs warning of high voltage), and locks on equipment and wind power facilities.
- Once BRE completes construction, it will install gates to restrict public access to all of the turbine locations. The substation and O&M building will be fenced as required for public safety, but no other fencing is proposed at this time. The public will continue to have access to portions of the Project area via public roads and private roads that are regularly open to the public.

**Proposed Action Summary**

The Project as implemented under Alternative 2 poses minor effects to human safety and security. The Project is in a remote location, and Project components are located with significant setbacks from residences. All turbines are further than 3,500 ft from residences, and most turbines are more than 1.0 mi from residences. There is 1 public road, County Route 10/1, located 425 ft from the nearest turbine. This road has limited use (Average Daily Traffic = 30 vehicles). All other public roads are more than 4,000 ft from wind turbines. Effects to safety and security associated with implementation Alternative 2 are expected to be minor. There would be major effects in the unlikely event of blade throw.

**5.15.2.3 Alternative 3: HCP and ITP for Additional Covered Species**

Under Alternative 3, effects to safety and security associated with construction, operation, and decommissioning will be as described for Alternative 2 - Proposed Action, which includes Phases I and II. As for the Proposed Action, implementation of Alternative 3 is expected to cause minor risks to human safety and security. There would be major effects in the unlikely event of blade throw.

**5.15.2.4 Alternative 4: ITP and HCP for Phase I Only**

Under Alternative 4, effects to safety and security associated with construction, operation, and decommissioning will be as described for the No-Action Alternative. There will be no new construction, so
future safety issues will be confined to operations and decommissioning. Beyond the general operations issues described above for the No-Action Alternative, adverse impacts on human safety and security are anticipated to be minor, with exception of an unlikely event of blade throw. The Project is located in an area of low population density. Predicted noise levels for operation will not exceed the ambient noise levels that already occur in the area (Acentech 2011).

Assuming proper planning and monitoring of typical operations-related health and safety risks, Alternative 4 will have no substantial adverse impacts on human safety and security. Safety and security measures described for Phase I will be taken for Project operations, including temporary (safety) and permanent fencing, warning signs (including signs warning of high voltage), and locks on equipment and wind power facilities. All maintenance personnel will be trained to handle emergency situations should they occur. The Project will continue to adhere to applicable electrical codes and standards. There would be major effects in the unlikely event of blade throw. Overall Alternative 4 is not expected to pose a high likelihood of significant risks to human safety and security.

5.16 Cumulative Effects

The CEQ and DOI regulations for implementing NEPA define cumulative effect as the “impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR § 1508.7).” In other words, certain impacts, while insignificant by themselves, have the potential to accumulate over time and to combine with other insignificant and significant effects to affect the environment, either positively or negatively.

5.16.1 General Methodology

The cumulative effects analysis in this DEIS is based on the following elements.

- Defines the geographic area in which the environmental effects of the Proposed Project and alternatives will occur. Geographic areas differ depending on the environmental resource considered.
- Lists and describes past, present, and reasonably foreseeable future actions that have or are expected to have impacts in the existing and proposed Project area and the cumulative effects analysis area.
- Summarizes the potential effects of the Project and alternatives in the analysis area.
- Describes the combined direct and indirect effects of the Proposed Action or alternative and the effects of past, present and reasonably foreseeable actions. These effects are described as being either temporary or long term and as being minor, moderate, or major.

5.16.2 Past, Present, and Reasonably Foreseeable Future Actions

The following sections identify past, present, and reasonably foreseeable future actions of other projects that may have cumulative environmental effects in combination with those of the Proposed Action or alternatives.

5.16.2.1 Past and Present Actions

As described in Chapter 4 Affected Environment, the Project area is located in the southern portion of the Allegheny Mountains and surrounded by lands that are largely undeveloped and sparsely populated. The landscape is extensively forested, mountainous terrain that experiences industrial-scale resource extraction on private lands and recreational use, preservation, and moderate timber harvesting on public lands (predominately the Monongahela National Forest).

This analysis relies on the environmental conditions that were present at the time the Phase I construction was initiated (early 2009) to indicate the impacts of past actions. These were the existing
This cumulative effects analysis does not attempt to quantify the effects of past actions for all affected resources. A record of all past actions and values of impact would be impractical and overly expensive to obtain and analyze. It would be nearly impossible to isolate individual past actions that continue to have residual impacts on the Project area and surrounding landscape. This analysis largely looks at past actions as a whole, which is more conducive to capturing all the residual effects of past human actions and natural events. Additionally, public scoping for this action did not request detailed information on individual past actions.

The cumulative effects analysis area varies by resource. For most resources, the Project area and surrounding region encompass the analysis area. The region extends to some reasonable limit based on the resource of concern, for example, a 1- or 5-mi buffer or the 63,000 acres of managed forest surrounding the Project. Analysis areas are defined for each resource in their appropriate sections.

Past and present activities occurring in the Project area and surrounding region that likely contribute to cumulative effects include:

- BRE’s 67-turbine Project construction and other existing wind energy projects in the eastern U.S.;
- Timber harvesting on private commercial forests and public National Forest lands;
- Surface coal mining;
- Natural gas exploration, extraction, and transport;
- Mountain-top mining and valley fill; and
- Recreational activities on the National Forest and on private lands.

Because construction of the 67 turbines has already occurred, the effects associated with Phase I construction are not part of the action of any alternative considered. Therefore, the 67-turbine construction impacts are addressed as cumulative effects.

**5.16.2.2 Reasonably Foreseeable Actions**

As for past actions, the cumulative effects analysis area for reasonably foreseeable future actions varies by resource. For most resources, the Project area and surrounding region encompass the analysis area. The region extends to some reasonable limit based on the resource of concern, for example, a 1- or 5-mi buffer or the 63,000 acres of managed forest surrounding the Project. For a few resources, such as avian and bat resources, the analysis area is significantly larger due to their distinct mobility. Analysis areas are defined for each resource in their appropriate sections.

Future activities likely to occur in the Project area and surrounding region that potentially could contribute to cumulative effects include:

- Timber harvesting on private lands and National Forest lands;
- Strip-mining operations;
- Natural gas exploration, extraction, and transport;
- Commercial and residential developments;
- Wind energy projects in the eastern U.S. and eastern Canada;
- Linear utility and transmission line corridor projects;
- Road construction; and
- Habitat restoration and enhancement, and vegetation management projects on National Forest.

Because of the level of concern, this cumulative effects analysis attempts to quantify the effects of present and reasonably foreseeable future wind projects on bird and bat populations, with particular focus on mortality.
5.16.3 Cumulative Effects by Project Type

Generally, similar types of projects often result in similar effects. Land use and habitat conversions, construction activities, vegetation removal, habitat loss and alteration, pollutant emissions, hazardous materials release, erosion and sedimentation, and other effects, tend to be comparable in character within project types. The environmental effects often associated with a project type are discussed below.

5.16.3.1 Timber Harvesting

Forest covers 12 million acres in West Virginia and 98% of forests are considered timberland; of which 88% is private ownership and 12% is in public ownership (Griffith and Widmann 2003). Timberland decreased by 112,500 acres from 1989 to 2000 (Griffith and Widmann 2003). In 2007, primary wood-processing mills in West Virginia processed 138.8 million cubic feet (ft³) of wood harvested from the state (Piva and Cook 2011). Another 50.5 million ft³ of the industrial roundwood harvested in West Virginia was sent to primary wood-processing mills in other states and countries (Piva and Cook 2011).

Effects associated with timber harvesting include:

- Vegetation removal and habitat alteration;
- Altered plant and animal species composition;
- Local effects to air quality due to dust and vehicle emissions;
- Sedimentation and erosion from disturbed soils; and
- Creation of roads.

Forest products are important part of West Virginia’s industry and economy with over 500 companies directly involved in state-based forest product operations. Employment in wood products and furniture industries rose from 6,500 in 1980 to 11,800 in 2004 (Piva and Cook 2011).

5.16.3.2 Strip-Mining

Contour mining is the method of strip mining used to extract coal from the steep hillsides in the Project area and in other parts of the Appalachians. Contour mining makes cuts on the slope where the coal seam is located. Overburden is used to fill the cuts, but this becomes problematic as overburden tends to “swell” as compaction increases. Often the overburden is disposed at the heads of valleys, which causes its own sets of problems.

Effects of strip mining include:

- Soil erosion and reduced productivity;
- Risks to water quality in proximal streams and rivers;
- Alteration of groundwater hydrology;
- Destruction of habitat for plants and animals;
- Creation of roads; and
- Local or regional impacts to air quality from dust and particles.

5.16.3.3 Natural Gas Exploration, Extraction, and Transport

In West Virginia and Pennsylvania, companies are actively drilling or leasing Marcellus Shale properties. As of July 2010, there were 1,421 Marcellus wells and 1,008 permits in West Virginia. Higginbotham et al. (2010) estimates that in 2009 development of the Marcellus Shale formation accounted for the creation of 7,600 jobs and $2.35 billion in business volume in West Virginia. If development increases 20% each year, the industry has the potential to grow and create 20,000 new jobs by 2015 (Higginbotham et al. 2010). The gas industry has grown and is expected to continue to have major impacts to economic conditions in West Virginia.
Drilling gas wells in the Marcellus shale formation and other shale gas resources requires unconventional methods as compared to traditional gas extraction. Horizontal drilling and hydraulic fracturing use great amounts of water for the extraction process, and then this water must be treated. Hydraulic fracturing, as primarily used in this region, is the process of forcing large volumes of water with added sand and chemicals down the drilling pipe and out through holes created by explosions into the shale to crack it open and expedite the release of gas. The drilling site is often a 4- to 5-acre area that is used for siting the drill, storing equipment, and storing and treating water. Once the well is installed, aboveground infrastructure includes the well and a small compression system on a site that is usually less than 1 acre.

Natural gas is transported by pipelines, linear underground conduits that require trenching to bury the pipe. The construction area is larger than the actual pipeline ROW to allow for equipment, pipe laydown, and staging areas. Much of this land is reclaimed after construction. Aboveground infrastructure includes compressor stations, valves, and metering, power lines, and other operations facilities.

Effects associated with gas extraction from the Marcellus shale deposits include:

- Water withdrawal and risk of contamination to water supply;
- Vegetation removal and habitat conversion; disturbance and displacement of wildlife;
- Loss of cultural resources;
- Altered aesthetics;
- Potential for altered plant and animal species composition;
- Changes in visual quality; and
- Threats to public health and safety.

### 5.16.3.4 Mountaintop Mining and Valley Fills

Mountaintop mining largely occurs in eastern Kentucky, southern West Virginia, western Virginia, and eastern Tennessee. This type of surface mining involves the removal of mountaintops to expose coal seams, and disposing the overburden in adjacent valleys (valley fills). The terrain is often steep and overburden disposal sites are limited.

In their Programmatic EIS, the USEPA (2005) identified the following environmental issues associated with mountaintop mining and valley fills based on the results of studies conducted on 1,200 stream segments:

- An increase of minerals in the water -- zinc, sodium, selenium, and sulfate levels may increase and negatively impact fish and macroinvertebrates (aquatic insects), leading to less diverse and more pollutant-tolerant species;
- Streams in watersheds below valley fills tend to have greater base flow (e.g. the primary groundwater flow into the stream channel and does not include surface runoff);
- Streams are sometimes covered up with fill;
- Wetlands are, at times inadvertently and other times intentionally, created; these wetlands provide some aquatic functions, but are generally not of high quality;
- Forest fragmentation;
- Compacted soils on reclamation sites and slow recovery of woody vegetation;
- Changes in wildlife species composition from forest species to that of dry grasslands; and
- Potential social, economic and heritage issues.

### 5.16.3.5 Commercial and Residential Development

The Greenbrier County future land use map indicates relatively little area designated for growth expansion. Growth areas are targeted largely in and around Lewisburg and along US Route 60 from Clintonville to Rainelle (Greenbrier County 2010). Information could not be located on future development in Nicholas County. This analysis assumes that development in Nicholas County will be similar in
character to that of Greenbrier County, and will consist of relatively small-scale development in a few locations.

Commercial and residential development in the 2 counties would have similar effects and include:

- Construction results in localized and temporary increases in air emissions (nitrogen oxides and particulate matter), traffic, and noise;
- Permanent changes in land use and altered hydrology; and
- Increased area of impervious surfaces and use of pesticides and fertilizers for landscaping.

The potential cumulative effects of these types of developments depend upon their timing of occurrence. Currently, the timing of these residential or commercial developments is uncertain.

5.16.3.6 Wind Energy Projects

As of June 2012, West Virginia had 5 operating wind power projects: Mountaineer, Mt. Storm, Beech Ridge, Laurel Mountain, and Pinnacle. The New Creek project has been permitted by the WVPSC but has not begun turbine construction. A second Mount Storm project (west of the existing Mount Storm project) has been permitted but there are currently no plans for construction. All of these projects are located approximately 100 to 120 mi northeast of the BRE Project.

Pennsylvania has 16 commercial wind energy projects operating and 4 under construction. Maryland has 2 commercial land-based wind energy projects operating. Tennessee currently has 1 operating commercial wind energy project.

Effects of wind energy project construction include:

- Temporary increase in vehicle and dust emissions;
- Temporary increase in noise;
- Temporary and possibly permanent disruption in wildlife patterns from construction activities;
- Potential losses in biological, cultural, and physical resources at places of ground disturbance, that is for access roads and turbine foundations; and
- Temporary disruption of local traffic patterns and road use.

Most construction effects can be mitigated through site-specific BMPs and other mitigation measures.

Effects of wind energy project operations effects include:

- Mortality and injury to birds and bats from turbine strikes and barotrauma;
- Mortality to birds from electrocution along power lines; and
- Visual effects to cultural resources and recreational activities.

Post-construction impacts are often monitored to assess the extent of wildlife mortality caused by operation of the project.

BRE Phase I (67 Turbines)

Prior to establishment of an ITP nexus, construction of the existing 67 turbines, transmission line, and other Project appurtenances disturbed 386 acres of predominately managed forest. Project facilities are maintained on 50 acres for the life of the Project; the remaining 336 acres have been allowed to revert back to forest (see Table 5-35).
Table 5-35. Estimates of total ground disturbance associated with Phase I construction and operation of the Beech Ridge Wind Energy Project. Temporarily affected acres are those areas cleared, reclaimed, and then allowed to revert to forest. Permanently affected acres are those areas cleared and converted to Project facilities for the life of the Project.

<table>
<thead>
<tr>
<th>Disturbance type</th>
<th>Phase I – 67 turbines</th>
</tr>
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<tbody>
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<td>Temporary (acres)</td>
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<td>Turbine assembly areas/pads 1</td>
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<td>Existing roads to be upgraded 2</td>
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<td>New access roads to be constructed 3</td>
<td>43</td>
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<td>Staging area and concrete batch plant 4</td>
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<td>Electrical and communication line trenches 5</td>
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</tr>
<tr>
<td>Substation, O&amp;M building, permanent MET towers 7</td>
<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>336</td>
</tr>
</tbody>
</table>

1 Assumes a 150-ft radius during construction minus 40-ft x 120-ft crane pad plus a 20-ft radius permanently maintained area for operational purposes.
2 Assumes existing road width to be increased by an additional 40 ft during construction and reclaimed to 16 ft wide for Project operations.
3 Assumes new roads to be 60 ft wide during construction and reclaimed to 16 ft wide for Project operations.
4 Phase I staging area and batch plant were located in agricultural and reclaimed following construction. Same area will be used for Phase II and reclaimed following construction.
5 Disturbance areas for those portions of electrical collection system solely used for that purpose are not located in road ROW. Trenches up to 4 ft wide during construction; all trenches to be completely reclaimed for Project operations.
6 Existing transmission line is 14 mi, of which 11.5 mi runs through native habitat. Permanent impact includes an 8-ft access road. Phase II will require 1.6 mi of supplementary line. Construction includes a 100-ft ROW; permanent ROW is a 50-ft ROW.
7 Assumes 1 acre for substation, 2 acres for O&M building, and 1.5 acres for 4 permanent MET towers (2 for each Phase).

Phase I Components. Phase I has several primary components, including wind turbines, access roads, transmission and communication equipment, storage areas, and control facilities. These components are discussed below.

Wind Turbines
The GE 1.5-MW turbine has a nameplate rating of 1,500 kilowatts (kW). Each turbine is equipped with a wind speed and direction sensor that communicates to the turbine’s control system when sufficient winds are present for operation. The turbine features variable-speed control and independent blade variable pitch to assure aerodynamic efficiency and function as an aerodynamic control system. The GE 1.5-MW turbine begins operation in wind speeds of approximately 3.5 m/s (8 mph) and reaches its rated 1.5 MW capacity at a wind speed of approximately 12.5 m/s (28 mph). The turbine is designed to operate in wind speeds up to approximately 25 m/s (56 mph) and can withstand sustained wind speeds of more than 45 m/s (100 mph). The color of all turbines, blades, and towers is white; the rotation direction, as an observer faces the turbines, is clockwise.

Each turbine includes a SCADA communications system that permits automatic, independent operation and remote supervision, allowing continuous control of the wind Project to ensure optimal and efficient operation and early troubleshooting of problems. SCADA data provide detailed operating and performance information for each wind turbine, and BRE maintains a database tracking each wind turbine’s operational history.

Other specifications of the GE 1.5-MW turbine include:

- gearbox with 3-step, planetary spur gear system;
• double-fed, 3-phase asynchronous generator;
• a fail-safe braking system that includes electromechanical pitch control for each blade (3 self-contained systems) and a hydraulic parking brake that operates in a fail-safe mode, whereby the braking system is engaged in case of load loss on the generator;
• a redundant braking system including both aerodynamic over-speed controls (including variable pitch, tip, and other similar systems) and mechanical brakes; and
• electromechanically driven yaw system with wind direction sensor and automatic cable unwind.

**Rotor, Hub, and Nacelle.** The rotor consists of 3 blades attached to a hub. The rotor blades are constructed of fiberglass and epoxy or polyester resin. The cast iron hub connects the rotor blades to the main shaft and transmits torque. The hub is attached to the nacelle, which houses the gearbox, generator, brake, cooling system, and other electrical and mechanical systems.

The GE 1.5 MW SLE wind turbine uses a maximum 77-m (252-ft) rotor diameter with a rotor swept area of approximately 4,654 m² (50,095 ft²). The rotor speed is from 11.0 to 22.2 rpm, and all rotors rotate in the same direction.

**Towers.** The 67 GE 1.5 MW SLE turbine nacelles are mounted on freestanding monopole tubular steel towers with a hub height of 80 m (262 ft). Maximum height of rotor is 118 m (387 ft) above ground. Each tower consists of 3 sections manufactured from steel plates. All welds are made in automatically controlled power welding machines and are ultrasonically inspected during manufacturing per American National Standards Institute specifications. All surfaces are sandblasted and multiple layers of coating are applied for protection against corrosion. Access to the turbine is through a lockable steel door at the base of the tower. The steel door at the base of each tower also includes a low voltage safety light on a motion sensor for entry.

**Foundations.** The turbine towers are connected by anchor bolts to an underground concrete and rebar foundation. Geotechnical surveys and turbine tower load specifications dictate final design parameters of the foundations. A typical spread footer has a similar footprint to the tower diameter at grade, but may spread out below grade to as much as 49 ft x 49 ft in size. This type of footer was used throughout the 67-turbine phase. A typical deep foundation is placed on an area approximately 25 ft x 25 ft. All foundations consist of anchor bolts, concrete, and reinforcing rebar. Certain specific site conditions required subgrade modification to support the foundation.

**Access Roads**
Approximately 16 mi of existing roads have been upgraded, and approximately 12 mi of new access roads were partially constructed in anticipation of the full 100-turbine Project. Completed access roads are approximately 16 ft wide. During construction, primary component haul roads were typically 20 ft wide, and turbine/crane access roads were typically 60 ft wide to provide needed space for crane movement and operation and additional drainage features. Road width typically increased in steeper areas due to cuts and fills for road construction and stabilization on slopes. BRE worked with the landowners in utilizing existing roads and locating new access roads to minimize disturbance and avoid sensitive resources and steep topography to the extent possible while maximizing transportation efficiency.

**Communications and Collection System**
Inside the base of each turbine tower, a control panel houses communication and electronic circuitry. At the base of each turbine, a step-up transformer is installed to raise the voltage from 575 V or 690 V to distribution line voltage (34.5-kV). Generated electricity moves through an underground collection system to the Project substation. Both power and communication cables were or will be buried in trenches a minimum of 4 ft deep. An estimated 32 mi of underground collection system was installed for the 67-turbine Project.

**Substation / Operations and Maintenance Facility**
The Project’s 34.5-kV/138-kV substation is owned by BRE; substation construction and operation meet industry standards. The substation is similar to substations used on transmission systems in the region. The substation main transformer is installed on an 11 ft x 17 ft concrete pad, and the main control building is installed on a 15 ft x 33 ft concrete pad within a 1-acre parcel of land centrally located within the Project (Figure 1-2). The substation houses those electrical facilities to step-up medium voltage power from the collection system to high voltage for delivery to the 138-kV transmission line. The majority of the yard is covered with crushed rock. The substation is enclosed with a 7-ft high chain-link fence topped with 3 strands of barbed wire; total fence height is 8 ft. Access gates are locked at all times, and warning signs are posted for public safety.

The Project O&M facility is located separately from the Project 34.5-kV/138-kV substation (Figure 1-2). The O&M building is approximately 60 ft x 102 ft, constructed of concrete, and located on a concrete slab. The O&M building contains all necessary plumbing and electrical collections needed for typical operation of offices and maintenance shop. Electric, water, telephone, and septic system utilities are provided on-site. Permits for the installation of the septic system and the water wells were acquired through the local health department.

**Meteorological Towers and Transformers**

Two permanent, guyed MET towers were erected for the 67-turbine phase. Permanent MET towers are 80 m (262 ft) tall and installed on 1-m (3.3-ft) diameter pier foundations. Foundations were drilled using a truck-mounted drill rig and then filled with concrete.

Transformer foundations were constructed using standard cut-and-fill procedures and pouring concrete in a shallow slab or using a precast structure set on appropriate depth of structural fill.

**Transmission Line**

From the Project substation, the Project’s 138-kV overhead transmission line runs northwest into Nicholas County where it ties into the existing Allegheny Power Grassy Falls Substation located on State Route 20. The Grassy Falls Substation is referred to as the Point of Interconnect and is the location where energy generated by the Project connects to Allegheny Power’s existing transmission system.

The transmission line was constructed in 2009 and 2010 and is approximately 14 mi long. The construction ROW was 100 ft wide; the permanent ROW is 50 ft wide. The ROW was routed through previously impacted areas, such as reclaimed surface mines, existing power line ROWs, and managed forest land to minimize impacts to streams, wetlands, and other sensitive natural resources.

The transmission line includes 156 poles spaced approximately 500 ft apart. Transmission line poles consist of primarily single steel poles secured as necessary with guy wires. Pole Numbers 154 and 156 are H-frame structures, and Pole Number 155 is a 3-pole structure. Pole heights range from 61 to 88 ft. Poles were set into a drilled hole in soil or rock and then backfilled with select stone and granular soil fill. Setting depth was 10% of the pole length plus 2 ft or deeper as specified by the design engineer. The poles support both the steel-reinforced aluminum electrical conductor line and a composite fibre optic ground wire.

### 5.16.4 Cumulative Effects by Resource

For each resource, the analysis below first identified the appropriate geographical area considered. The geographic context when considering cumulative impacts is different for each of the resource areas and is based on:

1. Identifying a geographic area that includes resources potentially affected by the proposed Project: and
2. Extending that area, when necessary, to include the same and other resources affected by the combined impacts of the Project and other actions.
The environmental effects of the past, present, and reasonably foreseeable activities were analyzed for that resource accordingly. The Project’s effects to that resource were then evaluated in the context of the cumulative effects contributed by other projects. Cumulative impact analysis considers impacts that are due to past, present, and reasonably foreseeable actions. This analysis determines cumulative analysis using the following:

1. Whether the environment has been degraded, and if so, to what extent;
2. Whether ongoing activities in the area are causing impacts; and
3. The trends for activities and impacts in the area.

Considering the past, present, and reasonable foreseeable future actions provides a needed context for assessing cumulative impacts. The inclusion of other actions occurring in proximity to the proposed action is a necessary part of evaluating cumulative effects.

For considering the significance of cumulative effects, the impact criteria for each resource are as described for direct and indirect effects (in Sections 5.1 through 5.14). For some resources the spatial extent changes for the cumulative effects analysis. For example, for birds, the impact criteria are the same, but the spatial scale for cumulative effects is expanded to include much of the eastern U.S. due to the large area covered by migrant birds. Similarly, for bats, the impact criteria are the same, but the spatial scale for cumulative effects is expanded to include all the Appalachian Recovery Unit for the Indiana bat.

5.16.4.1 Geology and Soils

The cumulative effect analysis area for geologic and soil resources is the Project area. Recent past and ongoing ground-disturbing activities in the Project area include construction of Phase I of the Project, timber operations, surface mining, oil and gas exploration, road construction and maintenance, and low-density residential development. Surface mining has had and continues to contribute long-term adverse impacts on the 63,000 acres of commercial forest lands adjacent to the Project and on the surrounding region.

Past and Ongoing Effects Impacts

Phase I Project: Construction and Implemented Avoidance and Minimization Measures. Phase I construction affected 386 acres of soil; 50 of those acres are affected for the life of the Project (Table 3-2). All temporarily disturbed areas were graded to the approximate original contour. Reclaimed areas were stabilized using appropriate erosion control measures (grading, reseeding) and in compliance with the Project's SWPPPs. The SWPPPs include standard sediment control practices to minimize erosion.

BRE implemented BMPs during construction of the Phase I Project to minimize soil erosion. Practices included containing excavated material, protecting exposed soil and stabilizing restored material, and re-vegetating areas to be reclaimed. To the fullest extent practicable, BRE used previously disturbed sites for new roads and turbine locations. Ground disturbance was limited to that which was necessary for safe and efficient construction. All temporarily disturbed areas were restored to the approximate original contour and reclaimed in accordance with easement agreements.

No construction or routine maintenance activities were conducted where soil was too wet to adequately support construction equipment (i.e., if such equipment created ruts in excess of 4 in deep). Certified weed-free straw mulches, certified weed-free hay bale barriers, silt fences, and water bars were used to control soil erosion. Soil erosion control measures were and continue to be monitored, especially after storms, and are repaired or replaced as necessary. Construction activities in areas of moderate to steep slopes (>15-20%) were avoided when possible.

Timber Harvesting and Mining. Much of the land in the Project area was extensively harvested in the first half of the 20th Century, and logging resumed as forest stands became merchantable timber. The Project area has been actively mined for several decades. Some of the strip mines are currently active, and new
activities are being permitted. Timber harvesting and mining are currently ongoing and expected to continue on lands surrounding the BRE Project. In turn, these 2 activities will continue to affect local soils and geology.

Future Effects
Reasonably foreseeable future actions that could affect soils and geology in the Project area include surface mining, oil and gas exploration, timber operations, and road improvement and maintenance. Although it is uncertain, it is possible that some of these activities could be large and cause extensive disturbance to area soil and geologic resources. Importantly, if they do occur these activities would be conducted in compliance with state and federal rules and regulations to minimize impacts. Large projects on private lands would likely be subject to review by municipalities and possibly state and federal agencies. Any approvals by regulatory bodies would be conditioned to require compliance with BMPs to avoid and minimize potential impacts to soil and geologic resources, such as soil erosion.

Beech Ridge Wind Energy Project. Under the No-Action Alternative (Alternative 1) and Alternative 4, the decommissioning of the 67-turbine Project would contribute minor cumulative effects to soils and geology in the form of soil erosion and sedimentation as soils are disturbed to remove Project components. These impacts would be avoided and minimized to the extent practicable and are anticipated to be minor.

The Proposed Action (Alternative 2) and Alternative 3, which both include the addition of Phase II, have the potential to result in soil erosion, sedimentation, displacement, and loss of soil productivity. However, these impacts would be avoided and minimized to the extent practicable and are anticipated to be minor.

Summary of Cumulative Effects to Geology and Soils
Combined with past, ongoing, and reasonably foreseeable future impacts, any of the considered alternatives is not likely to result in major cumulative impacts to geology and soil. However, activities in the Project area, other than the considered alternatives, have and continue to have major impacts to soil and geologic resources. Based on the extent and nature of the ground disturbance, the effects of surface mining have and continue to have major cumulative effects on soil and geologic resources in the Project area.

5.16.4.2 Noise
The cumulative impacts analysis area for noise is the Project area and a 1-mi buffer. This is based on the analysis area addressed in the noise studies conducted for the Project (Acentech 2006, 2011). The cumulative effects analysis considered potential noise-generating projects and activities that occurred in the recent past, that are in place, and that could occur in the foreseeable future in addition to the Project facility. Recent past and on-going noise-producing activities in and near the Project area include timber operations, surface mining, oil and gas exploration, road construction and maintenance, and residential building construction. Each of these individual activities occurring alone does not create adversely noisy conditions. However, if happening concurrently these activities can develop into significantly noisy conditions.

Past and Ongoing Effects
Phase I Project: Construction and Implemented Avoidance and Minimization Measures

Phase I construction included noise associated with rock blasting, excavating, hauling, grading, concrete mixing, tower erection, and vehicle traffic noise. Representative Leq values associated with the equipment used to perform these construction activities are provided in Acentech (2006, provided in Appendix C, Report C-1; see Table 4). Construction activities were audible at residences. For a typical construction workday, Acentech (2006) estimated sound levels to be 54 dBA at 1,550 ft. (the nearest
permanent residence) and 41 dBA at 4,000 ft. (see Appendix C, Report C-1, Figure 19) illustrates estimated maximum Ldn sound levels during construction over the entire 124-turbine Project area.

Construction of the 67 turbines occurred in stages, so construction noise occurred over a longer period than originally predicted. However, construction noise was temporary in nature and produced sounds already familiar to communities within hearing distance. The overall noise impacts beyond 1,000 ft of any construction activity were not significant. A value of 54 dBA during the daytime is not considered to be excessive (USEPA 1978), and this value does not exceed the threshold 5 dBA above the estimated ambient noise.

The following mitigation measures were employed during the construction of the 67-turbines.

- Construction activities primarily took place during daylight hours, and were limited during church hours.
- Contractors used standard noise buffers on all equipment and trucks.
- Contractors used pile driving equipment with least noise impact and restricted pile driving during the weekdays from 7 a.m. to 7 p.m.
- When necessary, blasting was confined to daylight hours and followed all state and federal rules and regulations. The community was notified in advance of any blasting activity.
- Effective exhaust mufflers in proper working condition were installed on all engine-powered construction equipment. Mufflers found to be defective were replaced promptly.
- Contractors were required to comply with federal limits on truck noise and ensure their employee and delivery vehicles were driven responsibly.

The Project installed GE 1.5sle wind turbine generators. This model 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; and
- Quieted-design rotor blades.

In addition, the Project installed high-efficiency, reduced-noise transformers.

Timber Harvesting and Mining. Much of the land in the Project area was extensively harvested in the first half of the 20th Century, and logging resumed as forest stands became merchantable timber. The Project area has been actively mined for several decades. Some of the strip mines are currently active, and new activities are being permitted. Timber harvesting and mining are currently ongoing and expected to continue on lands surrounding the BRE Project. These 2 activities have generated and continue to generate noise associated with vehicular traffic, heavy equipment operation, chainsaws and other power equipment, and rock blasting.

Future Effects
Reasonably foreseeable future actions that could have noise impacts in the Project area and its 1-mi buffer include surface mining, oil and gas exploration, timber operations, and road improvement and maintenance.

Beech Ridge Wind Energy Project. Under the No-Action Alternative, Project operation would include noise produced by 67 turbines spinning in ample wind (3.5 m/s or greater) day and night from November 16 through March 31 and during the day from April 1 through November 15. Similarly, Alternative 4 Project operation would include noise produced by 67 turbines in ample wind (3.5 m/s) at night, as well as during the day, from April 1 through November 15 under the terms specified in BRE’s Curtailment Plan. Turbine operation noise in the Phase I Project is not expected to have major adverse effects on the
surrounding environment (Acentech 2006, 2011). Under the No-Action Alternative and Alternative 4, turbines would not add cumulatively to noise associated with continuing and on-going sounds in the Project area. During most periods, the turbines would not be audible above the ambient noise and noise generated by silvicultural practices, mineral exploration and extraction, and small construction projects.

Implementation of the Proposed Action or Alternative 3 would contribute additional noise during construction of the 33-turbines, and operation and decommissioning of the 100-turbines. During construction and decommissioning, these sounds would add noise to the Project area and 1-mi buffer and result in increased short-term disturbance to sensitive receptors. The noise impacts for the 33-turbine operation are described in Section 5.2. The noise generated by wind turbines would be continuous for the life of the Project (approximately 25 years). Turbine noise is considered primarily a local effect, and the likelihood of widespread adverse reactions to Project noise is considered small (Acentech 2006, 2011). It is anticipated that Project turbine noise would result in minimal adverse cumulative impacts for all alternatives.

Summary of Noise Cumulative Effects
The amount of noise generated by activities other than the wind Project area is expected to increase in the Project area or within its 1-mi buffer. The addition of turbine noise is not estimated to be greater than the measured ambient noise in either Phase I or Phase II. Cumulative effects associated with noise are expected to be minor.

5.16.4.3 Air Quality and Climate
The cumulative impacts analysis area for air quality includes Greenbrier and Nicholas Counties. The cumulative effects analysis considered potential emissions-producing projects and activities that occurred in the recent past, that are in place, and that could occur in the foreseeable future in addition to the Project facility. Recent past and on-going emissions-producing activities in and near the Project area include timber operations, surface mining, oil and gas exploration, road construction and maintenance, and vehicular traffic. Each of these individual activities likely does not produce significant levels of pollutants. However, collectively these activities can emit significant levels of pollutants.

Past and Ongoing Effects
Phase I Project: Construction and Implemented Avoidance and Minimization Measures
During the site preparation and construction phases, air quality may have been temporary affected due to the operation of construction equipment and vehicles. Impacts occurred as a result of emissions from engine exhaust, fugitive dust generation during earth-moving and vegetation removal, and travel on unpaved roads. Dust causes annoyance and deposits on surfaces at certain locations or residences. These impacts were short-term and localized.

BRE operated under a permit from the WVDEP’s Division of Air Quality for operating a concrete batch plant and for constructing the 67 turbine foundations. Particulate matter and aggregate and sand dust emissions are the primary pollutants of concern during the manufacture of concrete. For the most part, emissions were fugitive in nature. The only point source emission would have occurred from the transfer of cement and pozzolan material (added to concrete to increase certain material properties and reduce material costs) to silos, and these would have been vented through a fabric filter. Fugitive dust was generated during the transport of sand and aggregate, truck and mixer loading, vehicle traffic at the plant and on unpaved roads, and wind erosion from sand and aggregate storage piles.

Construction of the 67-turbine Project did not emit 25,000 metric tons or more of carbon dioxide-equivalent of greenhouse gases. The concrete batch plant was a temporary source of air pollutants.

During construction of Phase I, BRE implemented standard BMPs to minimize the amount of dust generated by construction activities. All construction vehicles were maintained in good working condition to minimize emissions from construction-related activities. Roads were watered as needed throughout the
duration of construction activities to suppress dust on unpaved roads (public roads as well as private access roads).

Timber Harvesting and Mining. Much of the land in the Project area was extensively harvested in the first half of the 20th Century, and logging resumed as forest stands became merchantable timber. The Project area has been actively mined for several decades. Some of the strip mines are currently active, and new activities are being permitted. Timber harvesting and mining are currently ongoing and expected to continue on lands surrounding the BRE Project. Dust and engine exhaust from the operation of logging and mining equipment has affected and continues to affect air quality in Greenbrier and Nicholas Counties.

General Vehicle Emissions. Based on available information (WVDEP 2008, 2009), the air quality in Greenbrier in recent years has not been in attainment for ozone based on the revised NAAQS standards and the new WVDEP rule.

Future Effects
Reasonably foreseeable future actions that could affect air quality in Greenbrier and Nicholas Counties include surface mining, oil and gas exploration, timber operations, and road improvement and maintenance. It is possible that Greenbrier County could experience ozone levels that exceed the revised NAAQS standards.

Beech Ridge Wind Energy Project. Under the Proposed Action and Alternative 3, there would be a slight adverse cumulative impact in general air quality within the Project area. This impact would be due to vehicle and equipment emissions from constructing the 33 turbines. Under all alternatives, there would be a slight adverse impact to air quality within the Project area from deconstructing the project during decommissioning. These effects from construction and subsequent deconstruction would be temporary and relatively short-term.

Operating wind turbines themselves create no emissions. Each of the 4 alternatives considered in this DEIS will require light vehicle travel to operate the Project. Project operations will contribute minor cumulative effects to local air quality associated with vehicle emissions. Project operations would contribute cumulatively to offset electricity produced from those plants that use fossil fuels and create emissions.

Summary of Cumulative Effects to Air Quality and Climate
Implementation of any of the considered alternatives will not result in major cumulative effects to air quality. Activities other than those associated with the Project will not have major cumulative effects to air quality.

5.16.4.4 Water Resources

Due to the limited geographical extent of the estimated impacts of the Project to water resources, the water resources cumulative effects analysis area comprises groundwater, surface water, floodplains, wetlands, and Waters of the U.S. within the 6,860-acre BRE leased area (see Figure 1-2, Figure 1-4, Figure 4-4, and Figure 4-5).

Past and Ongoing Effects
Phase I Project: Construction and Implemented Avoidance and Minimization Measures
Groundwater. A well was installed for the O&M facility, as the use of local water is necessary to accommodate Project employees. BRE installed a well within the Project site to provide water for the concrete batch plant. Concrete was used for constructing the O&M building, substation, and Phase I turbine foundations. According to BRE, 589,425 gallons of groundwater was used to prepare the concrete. No impacts to groundwater resources were identified in association with Phase I construction.
Surface Water. In a letter dated October 3, 2006 (see Appendix 4.C), the USACE confirmed that activities associated with the construction of the transmission line will meet the requirements for a Nationwide Permit (NWP) 12 for utility lines under Section 404 of the CWA. This NWP was reauthorized on March 19, 2007. In a letter dated May 6, 2008, the USACE verified the proposed transmission line is still approved under NWP 12.

On May 22, 2006, BRE informed the USACE that no impacts to jurisdictional wetlands or Waters of the U.S. would occur within the proposed construction area for Phase I wind turbines. The October 3, 2006 letter from the USACE noted that Phase I wind turbines would not be placed in areas containing Waters of the U.S. Because no Waters of the U.S. were anticipated to be affected by Phase I, a Section 404 permit was not required for any other construction activities associated with the approved Phase I turbines.

Phase I Project turbines, substation, and transmission line avoided 100-year floodplains. The transmission line crosses a floodplain in the area of Grassy Falls along Grassy Creek (Figure 4-4), yet no poles were placed within the actual floodplain. Originally, the transmission line construction plans included 11 temporary culvert crossings at perennial and intermittent streams. These culvert crossings were not implemented; equipment worked up to streams and went around to the other side using existing roads. No permanent impacts to wetlands or Waters of the U.S. resulted from construction of the 67 turbines, transmission line, substation, O&M Building, or access roads.

Surface water is drawn from streams and ponds and used for dust suppression on unpaved roads. According to BRE, 2,209,285 gallons of surface water were used to compact the soil for the substation and water roads during Phase I construction and the first 2 years of operation. During Phase I construction and initial operation, BRE has been implementing BMPs outlined in their SWPPPs to protect surface water quality. Conditions contained in the permits require 1) weekly inspections and inspections after 0.5 inch or greater rainfall, and 2) prompt reporting and repair of any problems with silt fences or other erosion control measures. Major effects to surface water resources have not been identified in the Project area, but they could have occurred if water withdrawals for dust suppression occurred in small, high-elevation streams and withdrawals exceeded recharge rates.

Activities Other Than the Project. Recent past and on-going activities include silvicultural practices, surface mining, oil and gas exploration, road construction and maintenance, and the development of single residences. These activities can have effects on streams, wetlands, and groundwater related to erosion and sedimentation if BMPs are not effectively implemented. Unlike most of these other activities, oil and gas exploration involves drilling and can impact groundwater. In the Project area, surface mining may have been the greatest source of water quality impacts, particularly if overburden was placed at the heads of valleys and allowed to enter high-elevation streams. The extent of valley fills in the Project area is unknown.

Future Effects

Beech Ridge Wind Energy Project. Implementation of any considered alternative has the potential to affect surface water resources. For the Proposed Action or Alternative 3, BRE estimates they will use approximately 32,625 gallons of surface water annually for dust suppression during operations. Implementation of the No-Action Alternative and Alternative 4 will use same amount or less due to the Project being smaller. Water withdrawals from small, intermittent streams for road-dust suppression may result in significant alteration of the quantity or quality of water and habitat conditions if withdrawals exceed stream flow volumes. Should water withdrawals modify hydrologic conditions in headwater streams, impacts on water resources would be considered significant. If water withdrawal activities occur at larger perennial streams that can support the volumes withdrawn, implementation of any considered alternative will have a minor contribution to cumulative effects to water resources in the Project area.

Activities Other Than the Project. Foreseeable future actions in the Project area for the next 25 years would include timber harvesting, surface mining, oil and gas exploration, road construction, and maintenance. Timber harvesting and road construction will employ BMPs to avoid violating state federal
rules for water resource protection. No major land developments are currently proposed in the Project area. Large projects on private lands would be subject to town and state review and possibly federal review. Any approvals would require compliance with WVDEP rules for minimizing environmental impacts to water resources.

Summary of Cumulative Effects to Water Resources
Surface mining in the Project area will continue to pose the greatest threats to water resources. It is uncertain to what extent water resources will be affected by surface mining and other activities in the Project area. Based on the best available information, the multiple activities in the Project area could have moderate cumulative effects to water resources.

5.16.4.5 Vegetation
The 63,000-acre tract owned by a timber company is the cumulative effects analysis area for addressing lost or altered vegetation and habitat resulting from implementation of the Proposed Project and alternatives. This is because we have an understanding of the nature of the impacts that occur on the tract and can assess cumulative effects to vegetation qualitatively to a reliable extent. The character of tract, including the BRE Project area, is reasonably similar throughout.

Past and Ongoing Effects
Past and ongoing actions affecting vegetation communities include timber harvesting, surface mining, oil and gas extraction, small-scale agriculture, and single residences. Impacts to mature forests from timber harvesting would recover in a relatively short period of time (<80 years). Approximately 647 acres were disturbed recently within and around the Project area due to the landowner’s timber harvesting. Forested areas affected by surface mining, even if they are reclaimed, would take longer to recover (>100 years). Houses and agriculture convert forests for as long as those developments are maintained.

Phase I Project: Construction and Implemented Avoidance and Minimization Measures. Phase I construction activities affected approximately 386 acres of vegetation and disturbed habitats. More than 95% of this was forest primarily managed for timber production. Activities associated with creating work areas, laydown areas, turn-around areas, and road expansions disturbed the greatest amount of habitat. Phase I facilities are sited on 50 acres for the life of the Project, and 336 acres were reclaimed and allowed to revegetate.

BRE implemented the following BMPs during construction of Phase I to protect soil and vegetation resources.

- Excavated material was contained, stabilized, and protected.
- Surface disturbance was limited to that which was necessary for safe and efficient construction.
- All surface-disturbed areas were restored to the approximate original contour and reclaimed in accordance with easement agreements.
- Removal or disturbance of vegetation was minimized through site management (e.g., by utilizing previously disturbed areas, designating limited equipment/materials storage yards and staging areas, scalping) and reclaiming all disturbed areas not required for operations.

No construction or routine maintenance activities were conducted where soil was too wet to adequately support construction equipment (i.e., if such equipment created ruts in excess of 4 inches deep). Certified weed-free straw mulches, certified weed-free hay bale barriers, silt fences, and water bars were used to control soil erosion. Soil erosion control measures were monitored, especially after storms, and were repaired or replaced when needed. Surface disturbance was limited to that which was necessary for safe and efficient construction. All surface-disturbed areas will be restored to the approximate original contour and reclaimed in accordance with easement agreements. Construction activities in areas of moderate to steep slopes (15-20%) were avoided, where possible.
Roads, portions of roads, crane paths, and staging areas not required for operation and maintenance were restored to their original contours and made impassable to vehicular traffic. Reclaimed areas were contoured, graded, and seeded as needed to promote successful revegetation, to provide for proper drainage, and to prevent erosion. The seed mixtures to be used for Phase II were used for Phase I reclamation (see Table 5-6). BRE maintains those areas needed for O&M and clears potential tree growth. Tree planting was and is not included in the reclamation plan.

To install the transmission line, contractors worked up to riparian areas and then went around to work from the other side. Riparian areas were not affected during construction.

Future Effects
Reasonably foreseeable future actions in the vegetation analysis area for the next 25 years include timber harvesting, oil and gas exploration, and surface mining. Conversely, it is also reasonable to expect some active agricultural lands may become inactive and revert to native habitats within the 25-year time frame. Some new road development may occur to provide future access to timberlands and minerals.

_Beech Ridge Wind Energy Project._ The Project footprint's impacts to vegetation will consist of the conversion of forested lands to built structures and associated infrastructure for the life of the Project. Under the No-Action Alternative and Alternative 4, the 67-turbines affected 386 acres of forested habitat, of which 50 acres are affected for the life of the Project. Phase I operation contributes no additional impacts to vegetation. Decommissioning may necessitate the removal of small amounts of reclaimed vegetation to allow crane access for dismantling turbines and MET towers.

Under the Proposed Action and Alternative 3, construction of the proposed 33 turbines would affect 145 acres of forested habitat, of which 21 acres would be affected for the life of the Project. Phase II operation would not contribute additional impacts to vegetation. The 100-turbine project will remove 71 acres of land forest production for the life of the Project.

Cumulatively, the 100-turbine Project would affect approximately 460 acres of mostly deciduous forest habitat (~93%). This represents 0.73% of the 63,000-acre commercial timber tract in which the Project resides, and represents 0.30% and 0.05% of the deciduous forest within 5 mi and 20 mi of the Project, respectively (see HCP, Section 4.1.1).

The combined amount of vegetation that would be impacted by the 100-turbine Project and the existing developments along with any anticipated future developments is considered a minor effect. Naturally occurring plant populations will not be reduced in numbers below levels for maintaining viability at local or regional level. There will not be substantial loss or degradation of soil stabilization services. There will not be a substantial loss or degradation of habitat for a rare, threatened, or endangered animal species. BRE will implement BMPs to avoid and minimize the advancement of invasive species that results in substantial replacement of native species.

**Summary of Cumulative Effects to Vegetation Resources**
Timber harvesting and surface mining will continue to affect vegetation resources in the 63,000-acre parcel for the life of the Project. The amounts of these kinds of disturbances are unknown. Based on the best available information, the multiple activities on the tract could have moderate cumulative effects to vegetation resources. Naturally occurring plant populations may experience localized reduction in numbers below levels for maintaining viability at local.

There may be localized substantial losses in soil stabilization services. There may be a substantial loss or degradation of habitat for a rare, threatened, or endangered animal species. There may also be extensive areas that become infested with noxious weeds. Based on the best available information, the ongoing commercial timber activities in the landowner's 63,000-acre tract could have moderate cumulative effects to vegetation resources.
5.16.4.6 Wildlife and Fisheries

The 63,000-acre commercial timber land surround the Project area is the cumulative effects analysis area for addressing impacts to general wildlife and fisheries resulting from implementation of the considered alternatives and other occurring activities. This is because we have an understanding of the nature of the impacts that occur on this tract and can assess cumulative effects to wildlife and fisheries qualitatively to a reliable extent. The habitat composition is relatively consistent throughout the tract. Deciduous forest >26 years old is the dominant vegetation type (>93%); other habitats occur in small patches that are relatively evenly dispersed (Figure 5-1).

Past and Ongoing Effects

Phase I Project: Construction and Implemented Avoidance and Minimization Measures

Phase I construction activities affected approximately 386 acres of primarily deciduous forest habitat and a small amount of other habitat types (mostly previously disturbed sites). The forests on the landowner’s 63,000-acre tract are managed primarily for timber production. Activities associated with creating work areas, laydown areas, turn-around areas, and road expansions disturbed the greatest amount of habitat. Phase I facilities are sited on 50 acres for the life of the Project, and 336 acres were reclaimed and allowed to revegetate.

Habitat removal had unavoidable impacts such as mortality and habitat loss. The newly created roads may also lead to increased accessibility of the tract by hunters, fisherman, and poachers.

Effectively implemented BMPs avoided erosion and sedimentation to avoid impacts to streams and aquatic habitats. However, surface water is drawn from streams and ponds and used for dust suppression on unpaved roads. According to BRE, 2,209,285 gallons of surface water were used to compact the soil for the substation and water roads during Phase I construction and the 2 years of operation. An unknown proportion was drawn from a few high-elevation streams. Water withdrawals from small, intermittent streams for road-dust suppression may have resulted in significant alteration of the quantity or quality of water and habitat conditions if withdrawals exceeded stream flow volumes. Water withdrawals that modify hydrologic conditions in headwater streams can impact habitat for fish and other aquatic organisms. This would be a major adverse effect. Several of the streams that drain the Phase I Project area have been designated trout streams by the WVDEP.

To address potential effects to wildlife and fisheries, BRE prohibited hunting, fishing, dogs, or possession of firearms by its employees and its designated contractor(s) in the Project area during construction. These prohibitions were carried forward to include Project operation and maintenance. BRE has advised project personnel regarding speed limits on roads (25 mph) to minimize wildlife mortality due to vehicle collisions. Potential increases in poaching were minimized through employee and contractor education regarding wildlife laws. If violations are discovered, the offense will be reported to the WVDNR, and the offending employee or contractor will be disciplined and may be dismissed by BRE and/or prosecuted by the WVDNR. Travel is restricted to designated roads; no off-road travel will be allowed except in emergencies.

For Phase I design, BRE incorporated recommendations found in the document Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines (USFWS 2003a) and the Wind Turbine Guidelines Advisory Committee recommendations (USFWS 2010). Turbine layout avoided further fragmenting wildlife habitat through the use, where practical, of previously disturbed lands. BRE avoided constructing new roads by using existing roadways and addressed aquatic resources through the use of an SWPPP.
Figure 5-1. Aerial view of the Beech Ridge Energy Wind Project area.
Activities Other Than the Project. Recent past and on-going actions that affect wildlife and fisheries primarily include timber harvesting, surface mining, oil and gas development, small agricultural development, road construction and maintenance, and single residences. Impacts to general wildlife from timber harvesting and surface mining have resulted in losses in mature forest for varying lengths of time. Surface mining affected forests of multiple ages and would result in protracted periods of habitat for recovery especially in the absence of any reclamation and vegetation restoration. Residential and agricultural development converted habitat that will be maintained as such until these developments are abandoned.

The above list of activities can impact streams, wetlands, and groundwater that can, in turn, affect fisheries. These activities can result in erosion and sedimentation. Unlike other activities, oil and gas exploration involves drilling and can impact groundwater. In the Project area, surface mining may have had the greatest effects on water quality, particularly if overburden was placed at the heads of valleys. The extent of valley fills in the Project area is unknown.

Future Effects
Beech Ridge Wind Energy Project. Under the No-Action Alternative and Alternative 4, the 67 turbines affected 386 acres of forested habitat, of which 50 acres are affected for the life of the Project. Phase I operation would displace those animals that may avoid the Project due to incidences of human intrusion, presence of turbines, or habitat made unsuitable by the development. Project operation may include some erosion and sedimentation in streams from the road system. Decommissioning may necessitate the removal of small amounts of reclaimed vegetation to allow crane access for dismantling turbines and meteorological towers. Decommissioning would also involve ground disturbance to remove Project elements. Effectively implemented BMPs would avoid and minimize impacts to streams from erosion and sedimentation.

Under the Proposed Action and Alternative 3, construction of the proposed 33 turbines would affect 145 acres of forested habitat, of which 21 acres would be affected for the life of the Project. Phase II operation would not contribute additional impacts to vegetation. The 100-turbine project will remove 71 acres of forested habitat for the life of the Project. The 100-turbine Project operation would displace those animals that may avoid the Project due to incidences of human intrusion, presence of turbines, or habitat made unsuitable by the development. Project operation may include some erosion and sedimentation in streams from the road system. Decommissioning may necessitate the removal of small amounts of reclaimed vegetation to allow crane access for dismantling turbines and meteorological towers. Decommissioning would also involve ground disturbance to remove Project elements. Effectively implemented BMPs would avoid and minimize impacts to streams from erosion and sedimentation.

Cumulatively, the 100-turbine Project would affect approximately 460 acres of mostly deciduous forest habitat (~93%). This represents 0.73% of the 63,000-acre commercial forest tract in which the Project resides, and represents 0.30% and 0.05% of the deciduous forest within 5 mi and 20 mi of the Project, respectively (see HCP, Section 4.1.1).

The combined amount of vegetation that would be impacted by the 100-turbine Project and the existing developments along with any anticipated future developments is considered a minor effect. Native animal populations will not be reduced in numbers below levels for maintaining viability at local or regional levels. The amount of affected forested habitat is relatively small compared to the prevalence of forest in the 63,000 acre tract. The Project temporarily affected 460 acres for a relatively short period of time. The Project will occupy 71 acres for 25 years. Therefore, the Project would have minor cumulative effects to general wildlife that depend on mixed-age forest in the 63,000-acre tract.

Any of the considered alternatives has the potential to adversely affect fisheries and aquatic habitats if streams are used as water sources for dust-suppression.

Activities Other Than the Project. Reasonably foreseeable future actions in the Project area for the next 25 years that may affect general wildlife and fisheries resources include timber harvesting, surface mining, oil and gas exploration, further development of single residences, and some small agriculture. It is
reasonable to expect some active agricultural lands may become inactive and revert to native habitats within the 25-year time frame. Some new roads are likely to be constructed to access timberlands and minerals.

Road maintenance projects would employ BMPs to protect water resources. Any large projects on private lands would be subject to town and state review and possibly federal review. Any approvals would require compliance with WVDEP rules for minimizing environmental impacts to water resources and fisheries habitat. Surface mining is likely to continue to pose the greatest risks to fisheries resources, particularly if overburden is deposited at the heads of valleys.

**Summary of Cumulative Effects to Wildlife and Fisheries**

Timber harvesting and surface mining will continue to affect wildlife and terrestrial habitats in the 63,000-acre parcel for the life of the Project. The amounts of these kinds of disturbances are unknown. Based on the best available information, the multiple activities in the tract could have moderate cumulative effects to wildlife dependent on mature forest. Conversely, the replacement of mixed-age forest (predominately >26 years old) with early-successional forest provides habitat for those animals that rely on scrub-shrub and herbaceous cover.

Surface mining in the Project area will continue to pose the greatest threats to aquatic habitats. It is uncertain to what extent streams in the tract are affected by surface mining and other activities. Based on the best available information, the multiple activities in the Project area could have moderate cumulative effects to water resources. The effects of water withdrawal for the Project, if conducted to avoid artificially dry conditions, will add a minor cumulative effect to the moderately adverse effects in the 63,000 acres tract associated with the other industrial activities.

**5.16.4.7 Avian Resources**

**Geographic Scale and Type of Impact**

Due to their extraordinary range of mobility, the geographic scope for evaluating cumulative effects to birds could be at the continental scale. For the purposes of this DEIS, the analysis area for avian resources considers cumulative effects at the Project level and at a regional level.

**Wind Projects and Mortality.** The existing project has killed birds and the proposed project expansion has the potential to kill additional birds. This cumulative effects analysis primarily focuses on mortality impacts attributable to the Project in the context of other existing and planned wind facilities and potential future wind development in the northeastern U.S.

We used 3 Bird Conservation Regions to define the spatial scale for the cumulative effects to all birds (Figure 5-2). Bird Conservation Regions (BCRs) are described in USFWS (2008a) and are endorsed by the North American Bird Conservation Initiative as the basic units within which all-bird conservation efforts will be planned and evaluated (as cited in USFWS 2008a). The goal of the North American Bird Conservation Initiative is for BCRs to ultimately function as the primary units within which biological issues are resolved at a landscape scale that allows for configuration of sustainable habitat for bird populations. BCRs 28, 13, and 14 were selected to represent the geographic scope for the cumulative effects analysis area for avian resources. These 3 BCRs encompass 380,737 mi² and are sufficiently large for a landscape level cumulative effects analysis. BCR 28 includes the Project and the Mid-Atlantic Highlands region. BCRs 13 and 14 are the 2 BCRS to the north of the Project, and it is not unreasonable to assume that birds that may occur in BCRs 13 and 14 could interact with turbines in the Project area. Additionally, Partners in Flight have summarized breeding bird population data by BCRs (PIF and RMBO 2004).

Hence, bird mortality estimates can be taken into context with the most current estimates of bird numbers. Therefore, we found the use of these 3 BCRs to be appropriate for assessing cumulative effects to avian resources.
Other Sources of Mortality. Because there is so much interest in the Project’s potential to kill birds, this analysis also considers other sources of bird mortality. Anthropogenic elements that are known to cause avian mortality are discussed briefly, and this discussion is in a more general sense and not confined to a region. This is largely due to how the current data have been treated to provide estimates, which are most often provided on a national scale.

There are other substantial anthropogenic sources of bird mortality that are not discussed here because they involve different types of power generation. Among these sources of mortality are activities associated with coal power generation and oil and gas extraction and nuclear power generation. Hunting is also not included in this analysis because, even though it is a substantial source of mortality for some bird groups, it is a regulated activity.
Habitat Loss and Displacement. The proposed Project has the potential to displace birds due to Project presence and habitat alteration. These effects are analyzed for the Appalachian region in West Virginia to remain in the context of a similar habitat type.

Temporal Scope
The temporal dimensions of this analysis included past and present actions, and reasonably foreseeable future sources of mortality and habitat impacts that may occur during the 25-year operation of the Project.

Wind Energy Development and Avian Mortality
Estimates of bird mortality from man-made causes vary widely and are not known with a high degree of certainty, based in part on differences in methodology and limitations of sampling designs. Many human-caused bird mortality factors are not systematically monitored or assessed. These numbers do, however, provide ballpark estimates of the relative magnitude of various sources of mortality. Table 5-36 provides estimates of annual avian mortality from anthropogenic causes, including wind turbines.

On a national scale, Erickson et al. (2005) estimated that wind turbines are responsible annually for 0.01-0.02% of all avian fatalities due to human structures. Likewise, the National Research Council (2007) estimated that bird deaths caused by turbines accounted for less than 1% of the total anthropogenic bird deaths in 2003.

The National Wind Coordinating Collaborative Wildlife Workgroup estimated that turbines killed roughly 58,000 birds per year in the U.S. in 2009 (NWCC 2009 statistic as cited in Manville 2009). Manville (2009) provided a higher estimate (440,000 birds per year) based on an attempt to correct data for seasonality, duration and intensity of searches, search area, and other biases. These 2 estimates should be considered “ballpark” approximations based on many assumptions and uncertainties.

Table 5-36. Estimated annual avian mortality from anthropogenic causes in the U.S.

<table>
<thead>
<tr>
<th>Mortality source</th>
<th>Estimated annual mortality</th>
<th>% of overall mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collisions with buildings (including windows)</td>
<td>97-1,200 million</td>
<td>17-66</td>
</tr>
<tr>
<td>Collisions with power lines</td>
<td>130-174 million</td>
<td>10-23</td>
</tr>
<tr>
<td>Legal harvest</td>
<td>120 million</td>
<td>7-21</td>
</tr>
<tr>
<td>Depredation by domestic cats</td>
<td>100 million</td>
<td>6-18</td>
</tr>
<tr>
<td>Automobiles</td>
<td>50-100 million</td>
<td>9-18</td>
</tr>
<tr>
<td>Pesticides</td>
<td>67 million</td>
<td>4-12</td>
</tr>
<tr>
<td>Communication towers</td>
<td>4-50 million</td>
<td>1-3</td>
</tr>
<tr>
<td>Oil pits</td>
<td>1.5-2 million</td>
<td>0.1-0.3</td>
</tr>
<tr>
<td>Wind turbines</td>
<td>20,000-440,000</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Total mortality</td>
<td>569.5-1,813 million</td>
<td></td>
</tr>
</tbody>
</table>

Source: Various cited in Erickson et al. (2005), Thogmartin et al. (2006), and Manville (2009).

The total number of MW and turbines at currently operating projects, projects under construction, and proposed projects as of April 2012 were used to quantify bird mortality induced by existing and near future wind power projects in all states within the cumulative effects analysis area. For those proposed projects where either the number of MW or number of turbines has yet to be determined, it was assumed that the turbines are 1.5-MW turbines. This analysis included commercial wind projects with 2 or more turbines. We recognize that residential and small-scale industrial turbines kill birds (Anderson 2009, Dunes Nature Center and Preserve, unpublished data). However, this analysis did not consider residential or small-scale industrial turbines. Post-construction monitoring results at small-scale sites are not as extensive or readily available as those from large-scale projects. Additionally, this analysis did not consider proposed Atlantic offshore wind projects in the U.S.
Publicly-available mortality studies from existing wind projects in the Eastern U.S. were reviewed to generate an average and range of avian fatality. It should be noted that annual estimates of mortality are actually estimates of mortality for the study duration and not a full calendar year. Few studies have sampled project mortality for the full calendar year. Studies typically sample during peak periods of activity for birds and bats. Fiedler et al. (2007) sampled from April through December at a wind power site in Tennessee and reported zero bird mortality from mid-October to late December 2005; however, turbines were searched infrequently during this time period (1-3 x per month) and were not searched during January through March. Since many birds migrate to warmer climates during the winter, we would expect a lower overall bird mortality rate during winter than during the rest of the year. During winter, we would expect some level of mortality of raptors and other overwintering birds; however, due to lack of studies during this time frame, we have no basis for estimating these rates. Therefore, we have not attempted to estimate mortality for the timeframes when mortality studies have not been conducted. Accordingly, when this analysis refers to annual mortality estimates the reader should remember this technically means mortality for the duration of the study timeframes, which is usually April through mid-November for the eastern U.S. This time frame captures overall peak bird activity for most species (during breeding and migration seasons) and provides a basis for comparing relatives rates of mortality across alternatives. We recognize that this time frame misses late migrating and overwintering raptors, as well as winter-breeding raptors.

Post-construction mortality surveys have not been conducted for the Project since all 67-turbines came on line in 2010. Because birds collide with stationary towers, it is assumed that the Project has caused some mortality, but no mortality rate is available. In Section 5.7.2.1, we used estimated mortality rates from 14 post-construction studies to derive a mean and range of mortality that could potentially result from implementation of the 4 alternatives. The average mortality rate is 5.32 birds per turbine per year based on results from 14 studies conducted at 8 wind projects located on forested ridgelines in the mid-Atlantic region. Table 5-14 provides a summary of the bird mortality estimates for the 67- and 100-turbine Projects. Based on this rate, we estimate the 100-turbine BRE facility will result in 532 bird deaths per year. Based on this annual mortality estimate, the Project is expected to kill 13,000 birds over a 25-year period. Confidence intervals from the studies provide a full range of possible mortality estimates from a low of 0 birds per turbine per year to a high of 15.69 birds per turbine per year. Applying these values, the 100-turbine project would potentially result in annual mortalities ranging from 0 to 1,569 birds per year; however, we would expect overall Project mortality to be closer to the mean than the extreme ends of variation.

Because bird mortality rates from wind power vary considerably across habitat types, we did not assume that all northeastern wind power projects would kill birds at the same rate calculated for the BRE Project in the Mid-Atlantic Highlands. Hence, in evaluating cumulative effects to birds in the 3 BCRs, we used a greater number of studies to capture the full variability of habitat types, bird composition, and mortality rates in the northeastern U.S.

Table 5-37 presents the level of survey effort, results, and estimates of annual mortality based on publicly available data from 22 studies at 13 different wind farms in the eastern U.S. To make results as comparable as possible, we selected these studies based on the following criteria: (1) searches conducted from spring through fall (covering at least April to mid-October) when most bird mortality is expected to occur;\(^{49}\) (2) turbines searches daily; and (3) mortality rates based on contemporaneous equations adjusted for searcher efficiency and scavenger removal trials. These criteria reduce bias associated with short study periods, infrequent searches, and older fatality formulas, all of which can underestimate mortality (Huso 2011).

\(^{49}\) We made one exception to include the Maple Ridge, New York, 2006 study, which missed the spring migration period (Jain et al., 2007). This site had a relatively high bird mortality rate, 9.59 birds per turbine, despite a shorter field season than other studies. We felt that eliminating this site would bias the overall average for the flyway. Realistically, had this site included spring migration, the fatality rate would likely have been even higher. Thus our overall average for the flyway is somewhat low, but not as low as if we had excluded the site altogether.
We note that estimated mortality rates from these studies do not represent actual fatality rates in the analysis area. Our approach assumes that all sites are equal with their potential to kill birds. Realistically, different sites and different turbines vary in the amount that they would contribute to regional bird mortality. Study periods, sources of sampling bias, and method of calculating estimates also vary across studies. We know of no valid way to correct for or standardize these differences. Despite these limitations, this methodology represents a reasonable approach to using the best scientific information available from which to make inferences about cumulative bird mortality in the analysis area.

We used the results of these 22 post-construction studies to derive an average mortality rate for the eastern U.S. When more than one mortality rate was provided in the same study, we used the higher estimate (worst-case scenario) when it met the selection criteria above. For example, at the Casselman and Locust Ridge II sites, we used the higher Huso estimator, as opposed to the lower Shoenfeld estimator (Table 5-37).

Based on the results of 22 post-construction studies, using the higher estimator from a study when more than one estimator was used, the average mortality rate is 4.92 birds per turbine per year for 12 wind projects located in the eastern U.S. across multiple habitat types.
Table 5-37. Results and estimates of annual avian mortality based on publicly available data from 22 studies at 12 different wind farms in the eastern U.S.

<table>
<thead>
<tr>
<th>Site and state</th>
<th>No. turbines</th>
<th>Habitat</th>
<th>Dates surveyed</th>
<th>Mortality rate</th>
<th>CI rate</th>
<th>Annual mortality range based on CI</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mount Storm, West Virginia</td>
<td>132</td>
<td>forested ridgeline</td>
<td>Mar 23 – Oct 8, 2009</td>
<td>8.74</td>
<td>5.12-12.77</td>
<td>676-1,686</td>
<td>Young et al. (2009b, 2010a)</td>
</tr>
<tr>
<td>Mount Storm, West Virginia</td>
<td>132</td>
<td>forested ridgeline</td>
<td>Apr 16 - Oct 15, 2010</td>
<td>6.74</td>
<td>3.92-10.03</td>
<td>517-1,324</td>
<td>Young et al. (2010b, 2011c)</td>
</tr>
<tr>
<td>Mount Storm, West Virginia</td>
<td>132</td>
<td>Forested ridgeline</td>
<td>Apr 12 – Oct 15, 2011</td>
<td>8.49</td>
<td>6.59-12.36</td>
<td>870-1,635</td>
<td></td>
</tr>
<tr>
<td>Casselman, Pennsylvania</td>
<td>23</td>
<td>forested ridgeline</td>
<td>Apr 19 - Nov 15, 2008</td>
<td>2.27</td>
<td>0.88-3.92</td>
<td>20-90</td>
<td>Arnett et al. (2009a), Librandi-Mumma and Capouillez 2011</td>
</tr>
<tr>
<td>Locust Ridge II, Pennsylvania</td>
<td>51</td>
<td>forested ridgeline</td>
<td>Apr 1 – Nov 15, 2010</td>
<td>1.51</td>
<td>0.64-2.61</td>
<td>33-133</td>
<td>Arnett et al. (2011)</td>
</tr>
<tr>
<td>Site 2-14, Pennsylvania</td>
<td>nr</td>
<td>forested ridgeline</td>
<td>Apr 1 – Nov 15, 2008</td>
<td>6.50</td>
<td>3.80-10.10</td>
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<td>Librandi-Mumma and Capouillez (2011)</td>
</tr>
<tr>
<td>Site 2-14, Pennsylvania</td>
<td>nr</td>
<td>forested ridgeline</td>
<td>Apr 1 – Nov 15, 2009</td>
<td>5.00</td>
<td>0.00-6.90</td>
<td>--</td>
<td>Librandi-Mumma and Capouillez (2011)</td>
</tr>
<tr>
<td>Site 2-10, Pennsylvania</td>
<td>nr</td>
<td>forested ridgeline</td>
<td>Apr 1 – Nov 15, 2009</td>
<td>1.30</td>
<td>0.00-3.20</td>
<td>--</td>
<td>Librandi-Mumma and Capouillez (2011)</td>
</tr>
<tr>
<td>Site 6-3, Pennsylvania</td>
<td>nr</td>
<td>forested ridgeline</td>
<td>Apr 1 – Nov. 15, 2007</td>
<td>1.80</td>
<td>nr</td>
<td>--</td>
<td>Librandi-Mumma and Capouillez 2011</td>
</tr>
<tr>
<td>Site 6-3, Pennsylvania</td>
<td>nr</td>
<td>forested ridgeline</td>
<td>Apr 1 – Nov. 15, 2008</td>
<td>2.40</td>
<td>nr</td>
<td>--</td>
<td>Librandi-Mumma and Capouillez 2011</td>
</tr>
<tr>
<td><strong>Average rate (n=14)</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>4.61</strong></td>
<td><strong>0-12.77</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Studies that searched daily and used modified Shoenfeld estimator*

*Studies that searched daily and used Jain estimator*
<table>
<thead>
<tr>
<th>Site and state</th>
<th>No. turbines</th>
<th>Habitat</th>
<th>Dates surveyed</th>
<th>Mortality rate</th>
<th>CI rate</th>
<th>Annual mortality range based on CI</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinton, New York</td>
<td>67</td>
<td>agricultural, woodland</td>
<td>Apr 15 - Nov 15, 2009</td>
<td>1.50</td>
<td>1.24-1.75</td>
<td>83-117</td>
<td>Jain et al. 2009f</td>
</tr>
<tr>
<td>Ellenburg, New York</td>
<td>54</td>
<td>agricultural, woodland</td>
<td>Apr 15 - Nov 15, 2009</td>
<td>5.69</td>
<td>4.87-6.50</td>
<td>263-351</td>
<td>Jain et al. 2010a</td>
</tr>
<tr>
<td><strong>Average rate (n=8)</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>4.22</strong></td>
<td><strong>1.40-10.06</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Studies that searched daily and used Huso estimator</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Casselman, Pennsylvania</td>
<td>23</td>
<td>forested ridgeline</td>
<td>Apr 19 - Nov 15, 2008</td>
<td>4.69</td>
<td>1.25-14.31</td>
<td>29-329</td>
<td>Arnett et al. (2009a)</td>
</tr>
<tr>
<td>Locust Ridge II, Pennsylvania</td>
<td>51</td>
<td>forested ridgeline</td>
<td>Apr 1 – Nov 15, 2010</td>
<td>2.20</td>
<td>0.82-4.52</td>
<td>42-232</td>
<td>Arnett et al. (2011)</td>
</tr>
<tr>
<td><strong>Average rate (n=4)</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>4.90</strong></td>
<td><strong>0.82-15.69</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall bird fatalities/turbine/year using the higher estimator for the study when more than one estimator was used (n = 22).</td>
<td></td>
<td></td>
<td></td>
<td><strong>Average rate (n=22)</strong></td>
<td><strong>4.92</strong></td>
<td><strong>0.0-15.69</strong></td>
<td></td>
</tr>
</tbody>
</table>
Table 5-38 provides the total number turbines that are currently operational and under construction in the 13 states as of April 2012. It should be noted that 3 states do not have wind projects with 2 or more turbines operating or under construction. Information is based on databases that were updated in the first half of 2011 (AWEA 2011).

Table 5-38. Total number of turbines and estimated bird mortality at operational and under construction wind facilities in 13 states in the eastern U.S. States are those included in the Bird Conservation Regions 13, 14, and 28 as defined in USFWS (2008a) plus Indiana. Turbine numbers were provided by AWEA (2012).

<table>
<thead>
<tr>
<th>State</th>
<th>Operational turbines</th>
<th>Turbines under construction</th>
<th>Total # turbines</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York</td>
<td>862</td>
<td>76</td>
<td>938</td>
</tr>
<tr>
<td>Indiana</td>
<td>798</td>
<td>125</td>
<td>923</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>443</td>
<td>264</td>
<td>707</td>
</tr>
<tr>
<td>West Virginia</td>
<td>319</td>
<td>8</td>
<td>327</td>
</tr>
<tr>
<td>Maine</td>
<td>207</td>
<td>0</td>
<td>207</td>
</tr>
<tr>
<td>Ohio</td>
<td>64</td>
<td>154</td>
<td>218</td>
</tr>
<tr>
<td>Maryland</td>
<td>51</td>
<td>0</td>
<td>51</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>48</td>
<td>24</td>
<td>72</td>
</tr>
<tr>
<td>Vermont</td>
<td>27</td>
<td>21</td>
<td>48</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>22</td>
<td>25</td>
<td>47</td>
</tr>
<tr>
<td>Tennessee</td>
<td>18</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>New Jersey</td>
<td>5</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Virginia</td>
<td>0</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td><strong>Total Turbines</strong></td>
<td><strong>2,864</strong></td>
<td><strong>716</strong></td>
<td><strong>3,580</strong></td>
</tr>
<tr>
<td><strong>Estimated annual bird fatality for northeastern U.S. based on 4.92 birds per turbine per year</strong></td>
<td><strong>14,091</strong></td>
<td><strong>3,523</strong></td>
<td><strong>17,614</strong></td>
</tr>
</tbody>
</table>

Source: AWEA (2012)

It is important to note that Indiana was included in our turbine estimates even though it is not within our analysis area. Energy statistics in the U.S. are analyzed by sector, and all of Indiana is grouped with eastern states (Figure 5-3), and we do not have the resources to separate Indiana’s influence on turbine growth trends in our analysis area. It is important to note that the inclusion of turbines from Indiana adds more than 900 turbines to our analysis area which results in an overestimate of the effect of turbines on bird populations in BCRs 28, 13, and 14.
Currently, 2,864 turbines are estimated to be operating in the analysis area. Approximately, 716 turbines are under construction bringing the total to 3,580 turbines. West Virginia represents approximately 9% of the total projects (operating and under construction) for the cumulative effects analysis area.

We used 4.92 birds per turbine per year as the mortality rate, based on the results of the 22 monitoring studies shown in Table 5-37, to quantify current and near future avian mortality in the analysis area. Applied to the current operational and near-future operational wind facilities within the analysis area, annual bird fatalities would be 17,614 birds per year. The proposed Project is estimated to kill 532 birds.

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50 All calculations were performed using a computer spreadsheet application. Discrepancy among spreadsheet values and hand-calculated values is due to rounding of numbers within the application. Differences are not considered to be significant as these values are purely to illustrate estimates from a single possible scenario among many potential outcomes.
annually (based on the regional average rate of 5.32 birds per turbine per year). This value represents approximately 3% of the total annual mortality from wind turbines for the analysis area in the near future. For the near future mortality, Table 5-39 provides the number of affected individuals within birds groups; percentages were based on available data from wind projects in the eastern and Midwestern U.S.

**Table 5-39.** Estimated annual near-future fatalities by bird group for the total operational and under construction projects in the cumulative effects analysis area based on a rate of 4.92 birds per turbine per year and the estimated 3,580 turbines operating and under construction.

<table>
<thead>
<tr>
<th>Bird group</th>
<th>% of total fatalities</th>
<th>No birds per turbine per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passerine</td>
<td>73.6%</td>
<td>12,964</td>
</tr>
<tr>
<td>Unknown species</td>
<td>11.6%</td>
<td>2,043</td>
</tr>
<tr>
<td>Raptor</td>
<td>5.6%</td>
<td>986</td>
</tr>
<tr>
<td>Waterfowl</td>
<td>4.5%</td>
<td>793</td>
</tr>
<tr>
<td>Gamebird</td>
<td>2.2%</td>
<td>388</td>
</tr>
<tr>
<td>Shorebird</td>
<td>1.5%</td>
<td>264</td>
</tr>
<tr>
<td>Seabird</td>
<td>0.6%</td>
<td>106</td>
</tr>
<tr>
<td>Owl</td>
<td>0.4%</td>
<td>70</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.0%</td>
<td>17,614</td>
</tr>
</tbody>
</table>


If wind energy development stopped with the near future capacity provided in Table 5-38, projects in the cumulative effects analysis area would kill approximately 450,000 birds during the 25-year operation of the BRE Project (~18,000 birds per year x 25 years). Realistically, wind energy development is predicted to expand over the next 25 years throughout the US. The number of additional wind-generated MW into year 2035 was estimated in an effort to project reasonably foreseeable future conditions and associated increases in bird mortality.

Choosing the year 2035 was based on information provided by the U.S. Energy Information Administration’s (EIA) Annual Energy Outlook 2011 (USEIA 2011a), which presents long-term projections of energy supply through 2035. Based on results from the U.S. EIA’s National Energy Modeling System (USEIA 2011b), we were able to derive estimates for wind project development in the U.S. and Canada.

The wind-electric module projects the availability of wind resources and cost and performance of wind turbine generators. The wind turbine data are expressed in the form of energy supply curves that provide the maximum amount, capital cost, and capacity factor of turbine generating capacity that could be installed in a region in a year based on available land area and wind speed. The model also evaluates the contribution of wind capacity to meet the power system reliability requirements. The data are divided among 8 regional reliability entities51 that encompass all of the interconnected power systems of the contiguous United States, Canada, and a portion of Baja California in Mexico.

Relative to BCRs 28, 13, and 14, there are 2 regional reliability entities that comprise all or most of the 13 states in the analysis area (Figure 5.3). Regional reliability entities are often subdivided into market module regions. This analysis looked at data from 4 market module regions. Generating capacity by electric power sector provided the values in gigawatts (GW) for each region from years 2009 to 2035.

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51 The North American Electric Reliability Corporation oversees the 8 regional reliability entities. This is the organization certified to establish and enforce standards for the bulk-power system to ensure reliability.
These values were then used to determine the number of MW projected for future development. The analysis assumed that all turbines would be 1.9 MW in size, the average size of turbines counted in Table 5-38, which were based on the data provided by AWEA (2012). The 1.9 MW turbine sized was used to determine the number of turbines in the future landscape.\textsuperscript{52}

Based on this approach, there would be 5,079 and 5,163 turbines in the eastern U.S. in years 2012 and 2035, respectively. The number of turbines built and under construction in the analysis area (3,580 turbines, Table 5-38) is significantly lower than this number. It is important to note, the number of turbines estimated using the USEIA (2012) information is the result of an attempt to illustrate a trend generated from statistics based on energy markets rather than what is happening in reality. The gW values provided by the USEIA (2012) models reflect the generating capacity of wind projects in each market module region to be used by power grids in the U.S. Hence, the MW values are artificially high. However, we recognize that the growth trends illustrated by the data are realistic.\textsuperscript{53} Therefore, we used this same development trends in the 4 market module regions to estimate wind power development in the analysis area, but we used the actual number of operating and under construction turbines to inform the model.

In the eastern U.S., the USEIA predicts that wind project development will grow very little in the next 15 years (through 2025) and then will experience some growth due to regional increases in the northeast and mid-Atlantic through 2030 (Figure 5-4) (USEIA 2012).

\textsuperscript{52} The current market trend is for building larger turbines with greater nameplate capacity than the current 1.5 to 2.0 MW turbines typically used today. If this market trend continues, our estimate of turbine buildout in 2037 may overestimate the number of turbines as the same generating capacity could be met with fewer but larger turbines. Larger (taller) turbines may kill more birds. We have not attempted to correct for this in our analysis as there are no studies available to determine bird mortality for the as yet unmanufactured possibly taller turbines.

\textsuperscript{53} Turbine growth trends are extremely difficult to predict. We recognize there are other possible growth scenarios. One scenario predicts an approximate 51\% increase in wind turbine generated MW capacity in the next 10 years in West Virginia, Maryland, Pennsylvania, Virginia and part of North Carolina, but does not predict trend any farther into the future,(NERC 2011). This scenario also recognizes the high degree of uncertainty in predicting growth trends and states that predictions are optimistic and could be off by plus or minus 50\%. For these reasons, we did not use this scenario.
Figure 5-4. Estimated number wind turbines in the northeastern U.S. through year 2035 based upon electricity generating capacity for wind projects. Source data: USEIA (2012), AWEA (2012).

The rate of growth illustrated in Figure 5-4 appears realistic, and it is possible that the number of wind turbines to be realized in 2035 will not be significantly different than the number estimated. Suitable locations to construct wind projects in the energy sectors we examined are limited by the amount of available windy land. Also, as new projects come on line, older projects will be decommissioned. Although, the projected growth rate for wind project development is provided through the 2035 and the BRE Project is expected to run until 2037, we assumed that the number of turbines in 2037 would not be significantly different than that estimated for 2035. So, the annual mortality rate number of birds killed per year would not change drastically after year 2035.

We estimated the amount of bird mortality caused by wind projects in the cumulative effects analysis area from the year 2012 (the soonest the 100-turbine Project would come on line) to year 2037 (Figure 5-5). Turbine numbers are predicted to increase from 3,580 to 3,639 during this 25-year period. Using the estimated mortality rate of 4.92 birds per turbine per year, wind projects in the analysis area will kill on average roughly 17,750 birds annually and roughly 461,000 birds cumulatively over a 25-year period.
Figure 5-5. Estimated projections of bird mortality by wind turbines in the Bird Conservation Regions 28, 13, and 14 through year 2037.


It is important to place these numbers into context of the total bird population. Partners in Flight estimated a total breeding population for all landbirds (which includes songbirds and raptors) of 5 billion birds in the U.S. and Canada based on data collected during the 1990s (Blancher et al. 2007). This estimate should be considered a very rough “ballpark” figure. The authors note that this is likely a conservative total, as densities from Breeding Bird Censuses suggest the total could be 2 to 3 times higher in some regions (Rosenberg and Blancher 2005). Using these numbers as conservative ballpark approximations, cumulative wind power mortality of roughly 461,000 birds in the northeastern U.S. (BCRs 28, 13, and 14) over 25 years represents a small fraction (roughly 0.009%) of the most current estimate of roughly 5 billion breeding landbirds in the U.S. and Canada. The average annual cumulative wind power mortality rate of 17,800 birds for the eastern U.S. represents an even smaller fraction of the roughly 5 billion breeding landbirds currently estimated in the U.S. and Canada (0.004%). While the number of breeding landbirds likely has decreased since 1995, even if the total number was reduced by 50%, the average annual wind power mortality would still be a very small fraction (0.002%) of the total breeding landbirds in the U.S. and Canada.

Admittedly these are very small percentages. The sheer number of birds projected to be killed by wind power in the analysis area is sizeable, but represents a small impact compared to total bird populations in the U.S. and the analysis area, and compared to other sources of cumulative mortality (569.5 million to 1.8 billion bird deaths per year annually from bird collisions with buildings, windows, power lines, communication towers, etc., Table 5-36). However, the relatively small percentage contribution to bird mortality by wind power does not diminish the need to reduce sizeable sources of bird mortality from all sources when practicable. If all wind power projects monitored bird mortality and implemented measures to reduce it, their contribution to cumulative mortality would be reduced.

54 Attempts to estimate the total bird population in the U.S. have been made in the past. McAtee (1931 as cited in Thogmartin et al. 2006) estimated 2.6 billion breeding birds in the U.S. Wing (1956 as cited in Thogmartin et al. 2006) estimated 5.6 billion birds in summer and 3.75 billion in winter. The American Ornithologists’ Union (1975 as cited in Thogmartin et al. 2006) estimated 10 billion breeding birds in the U.S. and a fall population of 20 billion.
Cumulative Effects of Turbine Operations of the Proposed Project and Alternatives

Based on the average rate of 5.32 birds per turbine per year from 14 post-construction monitoring studies in the mid-Atlantic region, both Alternative 2 and Alternative 3 are estimated to kill roughly 13,300 birds for the term of the 25-year permit. Of the total mortality estimated for the analysis area, the contribution from BRE’s 100-turbine Project is relatively small, 3% (Table 5-40). Because there are fewer turbines, Alternative 1 and Alternative 4 are estimated to kill roughly 9,000 birds; approximately 2 % of the total cumulative impact to birds from wind projects in the analysis area.

Table 5-40. Projected cumulative avian mortality for the Beech Ridge Wind Energy Project in relationship to estimated wind power production projected for years 2012 through 2037 in BCRs 28, 13, 14.

<table>
<thead>
<tr>
<th>Installation</th>
<th>No. Turbines</th>
<th>Average annual mortality</th>
<th>Cumulative mortality for 25 years</th>
<th>Cumulative mortality relative to wind projects in the analysis area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 1: No-Action</td>
<td>67</td>
<td>356 (^1)</td>
<td>8,911 (^1)</td>
<td>2%</td>
</tr>
<tr>
<td>Alternative 2: Proposed Action</td>
<td>100</td>
<td>532 (^1)</td>
<td>13,300 (^1)</td>
<td>3%</td>
</tr>
<tr>
<td>Alternative 3: Additional Covered Species</td>
<td>100</td>
<td>532 (^1)</td>
<td>13,300 (^1)</td>
<td>3%</td>
</tr>
<tr>
<td>Alternative 4: Phase I Only</td>
<td>67</td>
<td>356 (^1)</td>
<td>8,911</td>
<td>2%</td>
</tr>
<tr>
<td>Wind projects in analysis area</td>
<td>3,580-3,639 (^3)</td>
<td>17,748 (^2)</td>
<td>4461,440 (^2)</td>
<td>100%</td>
</tr>
</tbody>
</table>

\(^1\) Based on calculated average of 5.32 birds per turbine per year derived from results of 14 mortality studies conducted at wind energy facilities in the mid-Atlantic region.

\(^2\) Based on the average mortality of 4.92 birds per turbine per year, derived from results of 22 post-construction mortality studies conducted at wind energy facilities in the eastern U.S.

\(^3\) Number of turbines estimated from the USEIA (2012) model and turbines operating and under construction in 2012 (AWEA 2012) (see Figure 5-4).

Table 5-41 provides estimates of annual Project mortality in year 2037 (the end of the Permit term) for 9 birds of conservation concern known to have been killed at wind power projects in the eastern U.S. Table 5-41 also includes golden-winged warblers, for which there have been no documented mortalities to date. We used the average mortality rate for the Eastern U.S. of 4.92 birds per turbine per year, as well as the projected number of turbines (3,639) operating in the analysis area by 2037. Based on this method, we predict wind projects will affect less than 0.1% of the most current estimated bird population sizes in the analysis area of any of these species in 2037. It is important to note that the most current bird population estimates in the table reflect 1995 data, and some species have declined in the intervening years; however, data for the 2000 to 2010 timeframe are not yet available, and we would compound many biases in the data if we tried to predict population sizes in 2037. Our end-of-permit annual mortality estimate was applied to a single population value in time (1995 population estimate), and the calculation does not include other variables often used in population dynamics such as recruitment and other sources of mortality. Despite these limitations, the results do indicate a relatively low risk for significant population declines caused by wind power. Even if our predicted mortality rate was as high as 15.69 birds per turbine per year (the high end of confidence intervals of observed rates at wind power projects in the Eastern U.S.), wind projects in 2037 would affect roughly 0.3% or less of the most current estimated population sizes of bird species of concern in the analysis area.

\(^{55}\) We have not attempted to estimate cumulative bird mortality associated with MET towers at wind power projects as there are too many unknown variables: number of permanent versus temporary MET towers, tower heights, and number of guyed versus ungued towers. These variables can greatly influence bird mortality rates, ranging from little to no mortality at short ungued towers, to 5 times greater mortality at tall guyed towers than turbines. Given the large number of turbines involved in the cumulative effects analysis, addition of MET towers would be unlikely to significantly change overall predictions of cumulative mortality.

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Table 5-41. Estimates of annual cumulative turbine mortality compared to rough population estimates for Birds of Conservation Concern at wind energy projects in the northeastern U.S. (Bird Conservation Areas 28, 13, and 14) at the end of the permit term for the Beech Ridge Energy Wind Project, based on a mortality rate of 4.92 birds per turbine per year vs. 15.69 birds per turbine per year and 3,639 turbines projected in 2037.

<table>
<thead>
<tr>
<th>Species</th>
<th>BCRs 28, 13, and 14 population</th>
<th>Proportion of total fatalities</th>
<th>Maximum mortality in 2037 based on rate of 4.92 birds per turbine per year</th>
<th>Percent of population affected</th>
<th>Maximum mortality in 2037 based on rate of 15.69 birds per turbine per year</th>
<th>Percent of population affected</th>
<th>Breeding Bird Survey trend 1966-2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue-winged warbler</td>
<td>229,000</td>
<td>0.00562</td>
<td>99</td>
<td>0.04</td>
<td>321</td>
<td>0.14</td>
<td>Stable</td>
</tr>
<tr>
<td>Cerulean warbler</td>
<td>475,000</td>
<td>0.00152</td>
<td>27</td>
<td>0.006</td>
<td>87</td>
<td>0.02</td>
<td>Declining</td>
</tr>
<tr>
<td>Black-billed cuckoo</td>
<td>177,000</td>
<td>0.00910</td>
<td>163</td>
<td>0.09</td>
<td>520</td>
<td>0.29</td>
<td>Declining</td>
</tr>
<tr>
<td>Kentucky warbler</td>
<td>250,000</td>
<td>0.01124</td>
<td>201</td>
<td>0.08</td>
<td>642</td>
<td>0.26</td>
<td>Declining</td>
</tr>
<tr>
<td>Canada warbler</td>
<td>217,000</td>
<td>0.01124</td>
<td>201</td>
<td>0.09</td>
<td>642</td>
<td>0.30</td>
<td>Stable, decline in Appalachian</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mountains, declining elsewhere</td>
</tr>
<tr>
<td>Prairie warbler</td>
<td>268,000</td>
<td>0.00152</td>
<td>27</td>
<td>0.01</td>
<td>87</td>
<td>0.03</td>
<td>Declining</td>
</tr>
<tr>
<td>Bay-breasted warbler</td>
<td>352,000</td>
<td>0.01124</td>
<td>201</td>
<td>0.06</td>
<td>642</td>
<td>0.18</td>
<td>Stable</td>
</tr>
<tr>
<td>Red crossbill</td>
<td>29,000</td>
<td>0.00152</td>
<td>27</td>
<td>0.09</td>
<td>87</td>
<td>0.30</td>
<td>Stable</td>
</tr>
<tr>
<td>Wood thrush</td>
<td>6,250,000</td>
<td>0.01124</td>
<td>201</td>
<td>0.003</td>
<td>642</td>
<td>0.01</td>
<td>Declining</td>
</tr>
<tr>
<td>Golden-winged warbler</td>
<td>30,300</td>
<td>0</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Unknown</td>
<td>Declining</td>
</tr>
</tbody>
</table>

1 Estimates of breeding populations by BCRs taken from Partners in Flight Landbird data base (PIF and RMBO 2004). These data are based on an average of Breeding Bird survey data from 1990-1999 and are considered to represent the population size in 1995 (PIF and RMBO 2004), the mid-point of the range over which BBS data were averaged to arrive at the estimates. As explained in the text, updated population estimates for 2000-2009 are not yet available and it is not feasible to predict populations in 2037 with confidence due to biases in the data and lack of variance measurements.

2 Proportion of birds killed by species based on totals from post-construction surveys at Mount Storm Wind Energy Facility, Grant County, West Virginia (Young et al. 2009, 2010, 2011c). If species not documented at Mount Storm facility, proportion was based on totals from all wind mortality surveys in the East (as compiled by Stantec.).

3 Derived by multiplying projected turbines in 2037 (3,639) x 4.92 average annual bird fatality (from Table 5-37) x the species composition proportions in column 4.

4 Derived by multiplying projected turbines in 2037 (3,639) x 15.69 birds per turbine per year (high end of variation from Table 5-37) x the species composition proportions in column 4.


6 A small number of golden-winged warblers were assumed to be killed by the Project in the direct/indirect effects section of this DEIS because breeding golden-winged warblers occur on the Project site. For the cumulative effects analysis we did not assume golden-winged warblers would be killed at other wind power projects because we do not know how many current or future projects may be built within their breeding range. Post-construction monitoring results to date have not reported golden-winged warbler fatalities. Because golden-winged warbler interactions with turbines would happen infrequently due to their rarity, the probability of finding a fatality is low.
As noted earlier, due to energy sector groupings we were unable to extract from our turbine numbers more than 900 turbines from Indiana outside of our analysis area which results in an overestimate of the effect of turbines on bird populations in BCRs 28, 13, and 14. This is especially true for the Canada warbler, golden-winged warbler, bay breasted warbler, and red crossbill, all which do not breed in Indiana. We therefore made an adjustment to the bird population sizes for species of concern by adding their estimated populations in Indiana to those in BCRs 28, 13, and 14. This resulted in addition of 5,000 blue-winged warblers, 20,000 Cerulean warblers, 3,000 black-billed cuckoos, 50,000 Kentucky warblers, 14,000 Prairie warblers, and 250,000 wood thrushes to the population sizes for the analysis area. Even with this adjustment for Indiana, the annual Project mortality in year 2037 using the high mortality rate of 15.69 birds per turbine per year would still be roughly 0.3% or less of the most current estimated population sizes of any of the species.

Strict interpretation of these mortality estimates is cautioned for several reasons. The predicted fatality rates assume that there would be no advancements in deterrent techniques or other methods to reduce mortality. It is highly unlikely that as wind turbine technology advances no advancements would be made in deterrent techniques and other approaches to reduce bird mortality. Secondly, our predicted increases in future wind development were not based on expectations and assumptions related to technological, economic, and policy factors. Policies such as the production-tax and investment-tax credits (PTC and ITC), renewable portfolio standards, carbon taxes, emissions cap-and-trade programs, emissions regulations, incentives to reduce energy consumption, and others can have large impacts on wind development rates and are highly uncertain on a year to year basis.

These cumulative fatality estimates for the northeastern U.S. are based on only 1 attempt to understand potential cumulative impacts to birds. We recognize there are likely to be multiple interacting and changing future conditions that cannot be known or understood at the present time. However, this approach uses the best available information to illustrate an effect of the growing wind industry and its added source of avian mortality.

**Anthropogenic Sources of Avian Mortality Other than Wind Power Facilities**

Discussed below are estimates of anthropogenic sources of bird mortality for the U.S. in general. Table 5-36 provides annual mortality levels of birds due to anthropogenic sources in the U.S. We recognize that the national level is not the cumulative effects analysis area selected for birds in this DEIS. However, similar data down-scaled to the eastern U.S. are not available.

**Communication Towers.** Avian collisions with communication towers in the U.S. present a significant source of annual mortality, particularly for nocturnally migrating songbirds; namely warblers, vireos, and thrushes (Erickson et al. 2005). As of June 2003, 93,000 towers were listed with the Federal Communication Commission Antenna Structure Registry Database. However, the actual number of towers is probably much higher and is constantly increasing (Manville 2005). Erickson et al. (2005) suggest the number of communication towers in the U.S. may be as high as 200,000 towers; and that 5,000 to 10,000 new towers are being built each year. Cellular, radio, and television towers range in height from less than 100 ft to over 2,000 ft (Kerlinger 2000). Mortality estimates range from 4-5 million to 40-50 million birds per year in the U.S. and involve over 230 species (Shire et al. 2000, Kerlinger 2000, Manville 2005, Erickson et al. 2005, Thogmartin et al. 2006). Collisions occur throughout the year though are most frequently documented during migration periods. Studies indicate fatality rates are highest at taller, guyed towers (Gehring et al. 2009, 2011); and that pulsating beacons and steady burning FAA obstruction lighting influence higher collision rates than towers lit with flashing or white strobe beacons only (Erickson et al. 2005, Gehring et al. 2009, 2011). During nights with fog or low cloud-ceiling heights, nocturnal migrants are believed to become disoriented by strobe and/or steady burning lights on towers (Erickson et al. 2005). Estimates of mean annual collisions per tower have ranged from 82 birds per year

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56 A renewable portfolio standard (RPS) is a state policy that requires electricity providers to obtain a minimum percentage of their power from renewable energy resources by a certain date. Currently there are 24 states plus the District of Columbia that have RPS policies in place.
at a 250-m (825-ft) tower in Alabama, to 3,199 birds per year at a 305-m (1000-ft) tower in Wisconsin (Erickson et al. 2005).

**Buildings.** In 1995 there were an estimated 4,579,000 commercial buildings and 93.5 million residential houses in the U.S. as of 1986 (Erickson et al. 2005). Estimates of collisions with buildings and windows suggest a range of 3.5 million to 1,200 million bird deaths per year (Erickson et al. 2005, Thogmartin et al. 2006); the American Bird Conservancy suggests these numbers may be higher (ABC 2011). The literature indicates that the vast majority of avian building and window collisions involve passerines (Erickson et al. 2005). A study conducted in 1996 in Toronto, Ontario estimated 733 avian fatalities per building per year (Erickson et al. 2005). A study of avian collisions with residential windows indicated that avian fatalities range from 0.65 to 7.7 birds per house per year (Erickson et al. 2005). Collisions with other tall structures such as smoke stacks are estimated to result in tens to hundreds of thousands of collisions.

**Power Lines.** Manville (2005) estimated that there is collectively 500,000 mi of transmissions lines in the U.S. There is an estimate of 116,531,289 distribution poles in the U.S; however, an accurate estimate of the collective distance of distribution lines is not feasible. Limited estimates indicate the length to be in the millions of mi (Manville 2005). In general, avian collision and electrocution mortality at power transmission and distribution lines are not systematically monitored and are subject to observational biases. Collision estimates range from hundreds of thousands to 175 million birds annually, and estimates of electrocutions range from tens to hundreds of thousands of birds annually. Raptors, particularly eagles, are most commonly reported for collision or electrocution with transmission or distribution lines in the U.S. (Manville 2005). The species composition of birds involved in power line collisions is largely dependent on location. For example, power lines located in wetlands have resulted in collisions of mainly waterfowl and shorebirds; while power lines located in uplands and away from wetlands have resulted in collisions of mainly raptors and passerines (Erickson et al. 2005, Manville 2005).

**Legal Harvest.** Banks (1979 as cited in Thogmartin et al. 2006) estimated that 120 million game birds are legally harvested by hunters each year in the U.S. Generally wildlife managers try to regulate harvest levels by setting bag limits such that hunting does not contribute to population declines.

**Vehicles and Airplanes.** Vehicle strikes are estimated to result in 50 million to 100 million avian fatalities per year (Thogmartin et al. 2006). Numbers and species involved in vehicle collisions are dependent on habitat and geographical location (Erickson et al. 2005). Including both United States Air Force and civil aircraft strikes, it is estimated that over 28,500 avian collisions occur each year (Erickson et al. 2005). The majority of bird species involved in airplane strikes includes gulls, waterfowl, and raptors (Erickson et al. 2005).

**Pesticides.** Based on data collected in the 1980s and 1990s, approximately 160 million acres of cropland in the U.S. are treated with pesticides each year. Consequently, 67 million birds (10% of the 672 million birds estimated to be exposed) die in the U.S. annually due to pesticide exposure (Pimental et al. 1991 as cited by Erickson et al. 2005, USFWS 2000). Other estimates indicate 72 million pesticide-related avian fatalities per year (USFWS 2002). One study indicated that there are 0.1 to 3.6 avian fatalities per acres of pesticide-treated cropland (Mineau 1988 as cited by Erickson et al. 2005).

**Domestic Cats.** Dauphiné and Cooper (2009) estimate that 117 to 157 million feral and free-ranging domestic cats within the U.S. kill at least 1 billion birds annually. Based on this estimate and others (Manville 2005, Erickson et al. 2005), cat predation is considered the most significant anthropogenic source of bird mortality in the U.S. (Dauphiné and Cooper 2011). Butchart et al. (2006) cited domestic cats as significant threats to rare, threatened, and endangered birds and sources of species extinction worldwide.

**Habitat Loss and Displacement**

In the Appalachian Region of West Virginia, including the Project area, avian resources have experienced impacts associated with timber harvesting, surface mining, oil and gas development, urbanization, agriculture, and residential development. All of these activities are likely to continue into the reasonably
foreseeable future. Timber harvesting and surface mining result in losses or changes in forested habitat for varying lengths of time. These activities often include extensive road networks, which are likely to be expanded in the future to access mature timberlands and minerals. Timber harvesting results in mature forest bird communities being replaced with young forest bird communities. Surface mining results in the longest period for recovery especially in the absence of any reclamation and vegetation restoration. It should be noted, surface mining sites that have been reclaimed often convert to habitat used by grassland birds, species uncommon to extensively forested landscapes.

Agriculture activities, urbanization, and residential development convert habitat for the length of time that the development is maintained. Development that results in pavement (asphalt, concrete) results in an extreme conversion of habitat with a very slow recovery rate unless pavement is removed. Conversely, some active agricultural lands may become inactive and revert to native habitats within the 25-year time frame. No known major road projects are currently proposed in the Project area that would involve significant conversion of native habitats.

Reasonably foreseeable future actions in the Project area for the next 25 years that would affect avian resources include timber harvesting, surface mining, oil and gas exploration, further development of single residences, and some small agriculture.

Past and Ongoing Effects Associated with the Beech Ridge Wind Energy Project

**Phase I Project Operations.** The existing 67-turbines began operation in March 2010. For the first 2 years of operation, pursuant to a court order and stipulation, the turbines were turned off at night during the bat active season. There is a possibility that the limited operations in 2010 and 2011 decreased risk to birds because the turbines were not spinning at night. However, birds are known to collide with both stationary and moving objects, and results of studies currently do not suggest that take minimization strategies for bats also reduce bird mortality.

Beginning on April 1, 2012, and extending through November 15, 2012, at the latest, the turbines are allowed under a modified stipulation to generate electricity at wind-speeds above 6.9 m/s. Many species of birds fly at these wind speeds. There is a possibility that the limited operations protocol in 2012, which increases the amount of time that turbine blades are spinning in the birds’ potential airspace, will increase the risks to night-time migrating birds as compared to the risks associated with no night-time operations during the April 1 through November 15 periods in 2010 and 2011. Very preliminary results from monitoring of turbines during April 2012 suggest that the 6.9 m/s cut-in speed designed to reduce bat mortality may be having little to no effect on bird mortality. For the purposes of this DEIS, the Service does not assume that turning turbines off at night or implementing the 6.9 m/s strategy reduces collision risk for birds. Hence, we do not assume that the limited operations protocol implemented in 2012 will increase bird mortality as compared to those years (2010 and 2011) when turbines did not operate at night from April 1 to November 15.

Using the average mortality rate of 5.32 birds per turbine per year for the Mid-Atlantic region, we estimate the 67 turbines will have killed 356 birds per year, or a total of 1,068 birds over 3 years (by the time of a permit decision in late 2012.) Similar to studies of other similarly situated wind power projects, we assume most of the birds killed are or will be migrating passerines (Table 5-10).

**Phase I Project: Construction and Implemented Avoidance and Minimization Measures**

Phase I construction converted 386 acres of predominately forested habitat to 336 acres of grass-forb and scrub-shrub habitat and 50 acres of grass-forb habitat and developed facility. The converted habitat does not occur as large, expansive openings but as strings of roughly circular forest openings that are approximately 2 acres, smaller but similar to the openings that already occur in the landscape. The temporary conversion of 336 acres of mature forest in a forested landscape is not a significant impact.

If conducted during the breeding season, certain Phase I construction activities most likely destroyed nests and killed or harmed young birds that are not yet fully mobile. These would be local effects, and
mortality did not likely result in adverse effects to populations of those species affected. The Service understands that most tree removal operations occurred from November 16 to March 31, which would have avoided the peak bird breeding period.

Increased noise and human activity associated with construction likely resulted in some short-term displacement for most birds that avoid areas affected by such disruptions. However, due to the existing disturbance resulting from timber harvesting, most birds in the Phase I Project area likely are accustomed to a certain amount of disturbance. Noise and disturbance impacts related to Phase I construction were minor.

BRE incorporated a number of measures into Project design, construction, and operation to avoid and minimize potential impacts to avian resources as itemized below.

- The Project was sited in a previously disturbed landscape and avoids critical habitats for sensitive species.
- The avian risk assessment and pre-construction surveys determined the Project site does not contain unique habitats or avian communities to avoid creating excessive risks to birds.
- Project facilities were located to avoid (1) documented locations of listed birds, (2) known local bird migration pathways and daily movement flyways, and (3) areas where birds are highly concentrated.
- Storm water management practices implemented did not result in creating water bodies that may attract birds to the Project area.
- Turbines and Project appurtenances were built on uplands and avoided surface water features and designated floodplains.
- Roads, portions of roads, crane paths, and staging areas not required for operation were contoured, graded, and seeded as needed to promote successful revegetation.
- The transmission line was designed to span riparian areas and minimize impacts to riparian vegetation.
- Existing roads and previously disturbed lands were used where feasible to reduce vegetation impacts within the Project area. Surface disturbance was limited to that which is necessary for safe and efficient construction.

Future Effects Associated with the Beech Ridge Wind Energy Project

67-Turbine Project
Under the No-Action Alternative and Alternative 4, the 67-turbines affected 386 acres of forested habitat, of which 50 acres is affected for the life of the Project. Phase I operation would displace those birds that may avoid the Project due to incidences of human intrusion, presence of turbines, or habitat made unsuitable by the development. Project operation is likely to result in bird mortality. The extent of mortality would be less than that associated with Proposed Action and Alternative 3 because there are fewer turbines (Table 5-40). Decommissioning may necessitate the removal of small amounts of reclaimed vegetation to allow crane access for dismantling turbines and meteorological towers. Decommissioning would also result in short-term disturbance which could displace or harm birds.

The combined amount of vegetation that would be impacted by the 67-turbine Project and the existing developments along with any anticipated future developments is considered a minor effect. The amount of affected forested habitat is relatively small compared to the prevalence of forest in the Appalachian region of West Virginian. The Project temporarily affected 336 acres for a relatively short period of time. The Project will occupy 50 acres for 25 years. The Project would have minor cumulative effects to birds that depend on mature forest in the region.

Other activities would remove similar habitats in the West Virginia mountains. However, the amount of forest habitat in mountains has not declined significantly in recent decades (Griffith and Widmann 2003). The 67-turbine Project and other activities would have minor adverse effects to ridgeline forested habitat in West Virginia.
Phase I of the Project (67 turbines) is estimated to kill 356 birds annually. Populations of common species would not be reduced in numbers below levels for maintaining viability at local or regional levels. This number contributes cumulatively to mortality associated with other wind Projects and other deadly activities. Significant mortality of rare local breeding populations, such as golden-winged warblers, would be of concern should it occur; however, the APP and its adaptive management framework is designed to monitor bird mortality annually, and to respond to it by changing Project operations and/or mitigating for it should significant mortality of any migratory bird species occur.

100-Turbine Project. Under the Proposed Action and Alternative 3, construction of the proposed 33 turbines would affect 145 acres of forested habitat, of which 21 acres would be affected for the life of the Project. Phase II operation would not contribute additional impacts to vegetation and habitat. The 100-turbine Project will remove 71 acres of forested habitat for the life of the Project. The 100-turbine Project operation would displace those birds that may avoid the Project due to incidences of human intrusion, presence of turbines, or habitat made unsuitable by the development. Decommissioning may necessitate the removal of small amounts of reclaimed vegetation to allow crane access for dismantling turbines and MET towers. Decommissioning would also involve ground disturbance to remove Project elements. Decommissioning would also result in short-term disturbance, which could displace or harm birds.

The combined amount of vegetation that would be impacted by the 100-turbine Project and the existing developments along with any anticipated future developments is considered a minor effect. Native animal populations will not be reduced in numbers below levels for maintaining viability at local or regional levels. The amount of affected forested habitat is relatively small compared to the prevalence of forest in the 63,000 acre tract. The Project temporarily affected 460 acres for a relatively short period of time. The Project will occupy 71 acres for 25 years. The Project would have minor cumulative effects to the habitat of birds that depend on mature forest in the Appalachian region of West Virginia.

Under Alternative 2 and Alternative 3, the 100-turbine Project is estimated to kill 532 birds annually. Populations of common species would not be reduced in numbers below levels for maintaining viability at local or regional levels. This number contributes cumulatively to mortality associated with other wind Projects and other deadly activities. Significant mortality of rare local declining breeding populations, such as golden-winged warblers, would be of concern, should it occur; however, the APP and its adaptive management framework is designed to monitor bird mortality annually, and to reduce it and/or mitigate for it, should significant mortality of any migratory bird species occur.

Summary of Cumulative Effects to Birds
None of the alternatives considered is expected to cause naturally occurring populations of common birds to be reduced to numbers below levels for maintaining viability at local or regional levels. The alternatives would not result in substantial losses or degradation of habitat for a rare, threatened, or endangered animal species. None of the alternatives is expected to result in substantial changes in habitat conditions producing indirect effects that cause naturally occurring populations to be reduced in numbers below levels for maintaining viability at local or regional levels. The conversion of 460 acres of managed forest habitat to forest openings and developed land cannot be considered a major loss of this habitat type given the Project is located on more than 63,000 acres of managed forest habitat in an extensively forested landscape.

Project mortality will contribute cumulatively to other sources of mortality, such as other wind projects. Species with high collision rates that are already compromised by other factors and exhibiting decreasing trends would be affected more than common species with secure populations, yet the effect is currently predicted to amount to a fraction of a percent of any population of a bird species of conservation concern. These small percentages of wind power mortality are a cumulative effect which contributes slightly to many other sizeable sources of human-caused bird mortality. The small percentage contribution from wind power does not diminish the need to reduce sizeable sources of bird mortality when practicable.
The APP for all alternatives includes a monitoring plan and adaptive management framework designed to monitor bird mortality for the life of the Project to test the effectiveness of curtailment in reducing bird mortality, and to respond to significant bird mortality should they occur through additional monitoring, changes in operations, and/or offsite mitigation or research. Thus the Proposed Project and all alternatives include measures to reduce their contribution to cumulative bird mortality.

5.16.4.8 Bats

For the purposes of this DEIS, the cumulative effects analysis area for bats is the Mid-Atlantic Highlands, which includes the states of West Virginia, Maryland, Pennsylvania, Virginia, and North Carolina. For the most part, the Mid-Atlantic Highlands includes the spatial extent of the Appalachian Mountain Recovery Unit for the Indiana bat and eastern range of the Virginia big-eared bat. In addition, it also includes a substantially wide area relative to the Project area to consider the population-level effects to all other cave-roosting bats and tree-roosting migratory bats. The cumulative effects analysis used a 25-year timeframe based on the requested duration for the ITP. The selected spatial and temporal scales provide a reasonable assessment of potential future conditions and cumulative impacts that can be expected.

The bat species evaluated for cumulative effects include species covered under the Project HCP: Indiana bat and Virginia big-eared bat; as well as the non-covered bat species that have the potential to occur in the Project area: northern long-eared bat, eastern small-footed bat, little brown bat, tri-colored bat, big brown bat, hoary bat, silver-haired bat, and eastern red bat.

The cumulative effects analysis for bats considers the effects of wind projects associated with land clearing for roads, turbine pads, and transmission lines (habitat-related impacts), and Project operation (injury and mortality). Other actions beyond wind projects that may have similar types of effects to bats are also addressed.

As described in Section 5.8.2.1, the impacts to bats from wind facilities in North America and elsewhere are well documented. The cumulative impacts of mortality on both a spatial and temporal scale could have long-term population effects on certain species of bats (Kunz et al. 2007a), especially those considered to be rare and/or likely to be declining. The cumulative impacts on all bat species from all anthropogenic events and wide spread disease (such as WNS effects on cave bats) warrant consideration. In particular, the Service is concerned about several bat species believed to be susceptible to white-nose syndrome: the northern long-eared bat (76 Federal Register 38095), eastern small-footed bat (76 Federal Register 38095), little brown bat, tri-colored bat, big brown bat, hoary bat, silver-haired bat, and eastern red bat.

The biological significance of population level impacts is strongly dependent on the life-history strategies of a species. Life-history characteristics of a given population determine the degree to which its viability is affected by increased mortality. Organisms whose populations are characterized by low birth rate, long life span, naturally low mortality rates (Pianka 1970), high trophic level, and small geographic ranges are likely to be most susceptible to cumulative, long-term impacts on population size, genetic diversity, and ultimately, population viability (McKinney 1997, Purvis et al. 2000 as cited in NRC 2007).

With some variation, bats as a group have relatively long life spans and produce relatively few offspring compared with other small mammals. This is probably related to a combination of low extrinsic mortality (e.g., low predation), reproductive constraints, and other characteristics (Barclay and Harder 2003). Bats are atypical among mammals because they have small body sizes but are long-lived (Barclay and Harder 2003).

Given these stressors and life history traits, we consider the mortality of bats caused by turbine collision or barotrauma to be an additive effect to other stressors adversely affecting population levels (such as disease, predation, and habitat loss and degradation which decreases reproduction and survival). For example, if a population of cave bats in a region was thought to have declined by 85% due to WNS, and mortality from the proposed project was expected to kill another 1% of those bats, and other existing and foreseeable wind power projects in the region were expected to kill an additional 4%, then the multiple
sources of mortality together would result in the loss of 90% of the population bats. Assuming that these bat populations, with low reproductive potential, would not rebound to original levels during the 25-year life time of the project, then impacts of the project would be considered major. Such losses likely would indicate that further losses from wind power mortality would significantly affect the capacity of bats to recover.

A moderate to major source of mortality from wind power would be expected to cause a substantial additive impact that would be expected to contribute to population declines of WNS-affected bats at the local or regional scale. Since many cave-dwelling bats are already experiencing moderate to significant population declines from WNS, it can be assumed that any moderate to major cave bat mortality or habitat modifications would have significant impacts on these bats. A negligible or minor cumulative effect would cause a minor or discountable additive impact that would not be expected to contribute to population declines at the local or regional level.

Such losses also may significantly affect the capacity of insectivorous bats to perform an important ecosystem function, given that bats in the eastern U.S. are highly insectivorous and each individual bat eats thousands of insects per night (Boyles et al. 2011). Therefore, any impact with the potential for a moderate to major population level impact on bats at a local or regional scale could be significant to ecosystem function. The population level impacts of the cumulative effects from wind farms, disease, and other sources of human induced habitat modification or mortality are poorly understood, by themselves, but collectively are having significant impacts on bat populations. The effect of bat population level changes on overall ecosystem services (e.g. insect control, prey for other species, etc.) provided by bats, collectively or by each species, is difficult to quantify. Ecosystem services are uniquely tied to human environments in crop production, human health, and a host of other poorly understood connections.

Summary of Cumulative Effects to Bats from Forest Loss, Fragmentation, and Displacement
The action alternatives and No-Action Alternative either have created or will create forest openings in association with roads and turbines. This activity would possibly remove roost trees of those bat species that roost in trees; alternatively, these forest openings may improve foraging conditions for some species. While it is likely that the creation of the forest gaps is a cumulative effect on bat populations, there is no information available for which this form of habitat modification can be accurately predicted to determine an impact on bat populations. The habitats of the various bat species are generally comprised of those biotic and abiotic factors that allow an individual to occupy a site. Bats occupy and respond to their environments at many different spatial and temporal scales to fulfill the various stages of their life histories. Evaluating bat-habitat relationships at 1 scale can be misleading through ignoring particular spatial or temporal scales. For instance, creation of roads through dense forest may serve to provide more habitat for bat foraging, while at the same time exclude roosting habitat as some bat species have been known to avoid areas with dense trees at certain times of the year (Zimmerman and Glanz 2000).

Effects of Past Project Construction
We first consider the cumulative effects of past Project construction on bat habitat. Construction of Phase I of the Project, including the transmission line, substation, O&M building, and most access roads and collection and communications lines, was completed in August 2010. Approximately 8 mi of new roads were constructed for Phase I. The magnitude of impact on local bats communities likely varied based on the quality and quantity of habitat removed and the availability of alternate habitat of comparable quality and character. Approximately 336 acres of forest was converted to grassland/scrub shrub habitat that likely served as foraging and roosting habitat for a variety of bat species at various phases of their lifecycle. The site contains a mix of oaks, maples, black locust, and black cherry, approximately 79% of which are greater than 26 years old and 19% of which are less than 26 years old.

In some cases, conversion from forested to non-forest habitat could result in short- or long-term benefits to local bat communities, depending upon the configuration of the surrounding forested landscape and the individual species present. For example, forest gaps and clearings create additional foraging opportunities, as documented by higher levels of bat activity in fields, edges, and clearings (Hayes and Loeb 2007). These types of gaps are created from the linear nature of the access roads and turbine pads.
created for the wind facility. This apparent enhancement of foraging habitat is possibly a function of reduction in clutter, rather than enhancement of insect (prey) habitat. Clutter in forest stands such as boles, branches, and foliage may affect bat foraging by impeding detection and pursuit of prey (Owen 2004) for some species. However, some species of bats in the region are interior forest feeders, while others prefer feeding in gaps and along forested edges and riparian corridors. Clutter-adapted foraging and vegetation gleaning species such as northern long-eared bat and Indiana bat are likely more abundant where forest canopy cover increases and forest canopy gap size decreased, whereas the opposite is true for open-adapted foraging species such as big brown bat and hoary bat (Ford et al. 2005).

Creation of forest gaps and clearings has been recommended as a management technique for some species (Krusic et al. 1996), but not all bat species in the eastern U.S. would benefit from such practices (Owen et al. 2003). Prey density in patch cuts has found to be similar to that of uncut areas, suggesting that clutter is more likely to influence bat use of a habitat depending on a bat's morphological characteristics (Lacki et al. 2007). Larger species such as big brown bats, hoary bat, red bat, silver-haired bats have been shown to be more active along skidder trails, forest roads, and hiking trails whereas smaller species (e.g., tricolored bats) tend to be more active in forest interiors and this is thought to primarily driven by the amount of clutter (Lacki et al. 2007).

The potential increase in foraging habitat through the creation of open areas is not likely to substantially benefit bats in the Project area due to the current abundance of this type of habitat. Displacement of bats could occur as a result of animals avoiding spinning turbine blades or increased anthropogenic effect associated with daytime maintenance activities that could reduce the suitability of roosting areas. It is unknown whether or not bats roosting or migrating in close proximity to operating wind turbines become habituated to their presence or whether they become displaced by them.

Bat mortality associated with Project phase I construction was likely minimal. Most of the trees were cleared during winter when bats are hibernating, thus avoiding direct mortality of tree-roosting bats. The factors associated with changes in habitat quality and availability are more likely a greater influence on bats than is direct mortality associated with tree clearing activities. No studies to date have measured the rate at which bat disperse ahead of forest cutting operations. Trees that are cleared in the winter avoid mortality of bats. The lack of documentation is likely the result of the infrequency of the direct impact on bats, the cryptic natures of the site specific events, and the inability to replicate any rigorous scientific study (Lacki et al. 2007).

Effect of Past and Ongoing Timber Harvesting and Mining

Much of the land in the Project area was extensively harvested in the first half of the 20th Century, and logging resumed as forest stands became merchantable timber. In addition, a portion of the Project area has been actively mined for several decades. Some of the strip mines are currently active, and new activities are being permitted. There are substantial timber and mining activities ongoing throughout the Mid-Atlantic Highlands. Mining and timbering will affect bats in the same manner as described for the cumulative construction impacts described above. These 2 activities will continue to affect local and regional bat resources.

Their life history characteristics make bats susceptible to the cumulative effects of a wide variety of human activities within the landscape. Effects to habitat are likely additive because bats are long-lived and have low fecundity. A single habitat type can provide different services to bats at different times. Landscape context is an important consideration. Habitat loss may not be an issue associated with the construction of wind power project in a heavily forested landscape. Bats that use contiguous forests would not find wooded habitat limiting. Conversely, the creation of linear openings in a contiguous forest may increase foraging or migration habitat for some species (Grindal and Brigham 1998, Menzel et al. 2005); this modification may have ramifications related to increased mortality risk (Kunz et al. 2007a). If bats that forage along forest edges become attracted to these open areas proximal to turbines, they may be at increased risk for collision.
Therefore, when considering the vast mosaic of habitat modifications that occur from wind power development, agricultural rotations, mineral exploration and extraction, residential and commercial development, and utility corridors, it is difficult to quantify the additive effect of wind project development on bats. The additional impacts from habitat modifications associated with the proposed action when taken in context over the spatial extent of the extensively forested Mid-Atlantic Highlands and over 25 years is expected to be minor.

**Cumulative Effects to Bats from Project Operations**

**Effect of Past and Ongoing Project Operations.** The existing 67-turbines began operation in March 2010. For the first 2 years of operation, pursuant to a court order and stipulation, the turbines were turned off at night during the bat active season. During this time, the risk of mortality for all bats was fundamentally zero because turbine blades were not spinning when bats were active. Beginning on April 1, 2012, and extending through November 15, 2012, at the latest, the turbines are allowed under a modified stipulation to generate electricity at wind-speeds above 6.9 m/s.

One must account for risk to bats during this time. Although it is unlikely that the limited operations protocol for up to 7.5 months in 2012 will kill listed bats (few individuals would be exposed to the turbines), there is still a risk to unlisted bats which are more numerous than listed bats and thus have greater potential exposure to the turbines. Although fewer bats fly at these high wind speeds, unlisted bat fatalities have occurred at wind power projects on nights when wind speeds exceeded 6.9 m/s (Stantec 2010, 2011; Redell et al. 2006).

Turbines curtailed at cut-in-speeds of 6.5 m/s have reduced bat mortality by an average of 76% (Good et al. 2011; Arnett et al. 2011). We therefore assume that some mortality of unlisted bats will occur during 2012 but will be reduced by at least 76% compared to the regional average of 26.11 bats/turbine/year at unrestricted turbines (i.e., a mortality rate of 6.27 bats/turbine/year under the 6.9 m/s cut-in-speed). We estimate that 420 unlisted bats will be killed at the Phase I Project from April 1 through November 15, 2012 (67 turbines x 6.27 bats/turbine/year). Of these, we would expect the majority to be tree-roosting migratory bats, which are more susceptible to wind power projects than cave-dwelling bats.

**Operational Effects of Other Ongoing and Near Future Projects.** To estimate bat mortality from other existing and near future projects, we used the data set from the 14 comparable post-construction studies conducted from 2003 to 2011 at 8 existing wind facilities on forested ridgelines and escarpments in the Mid-Atlantic Highlands (Table 5-17 and Table 5-18). Applying the mean rate of 26.11 bat fatalities per turbine to the total number of wind turbines operational and under construction within the Mid-Atlantic Highlands (1,104 turbines), yielded nearly 29,000 bat fatalities per year (Table 5-42). These estimates do not include avoidance and minimization measures that are being implemented to reduce mortality, including operational curtailment and feathering at some projects, because the degree to which these measures are being implemented is unknown.
Table 5-42. Estimates of near-future annual bat mortality in Mid-Atlantic Highlands.

<table>
<thead>
<tr>
<th>State</th>
<th># Turbines operational and under construction</th>
<th>Estimated annual bat mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Virginia</td>
<td>327</td>
<td>8,538</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>707</td>
<td>18,460</td>
</tr>
<tr>
<td>Virginia</td>
<td>19</td>
<td>496</td>
</tr>
<tr>
<td>Maryland</td>
<td>51</td>
<td>1,332</td>
</tr>
<tr>
<td>North Carolina</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,104</strong></td>
<td><strong>28,826</strong></td>
</tr>
</tbody>
</table>

1 Source: AWEA (2011)

2 Uses rate of 26.11 bats per turbine per year, which is the average rate from 14 post-construction studies described in Table 5-17 and Table 5-18.

At commercial wind facilities where post-construction monitoring studies were conducted, the highest fatality rates are among the tree-roosting migratory bats and tri-colored bat. Wind projects operating in the near future in the analysis area are estimated to kill annually more than 20,000 tree-roosting migratory bats and more than 4,700 tri-colored bats (Table 5-43).

Table 5-43. Near-future bat mortality by species based on proportions of species documented at commercial wind projects in the Mid-Atlantic Highlands, 2003-2009.

<table>
<thead>
<tr>
<th>Species</th>
<th>Percentage</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Migratory tree bats:</td>
<td>70.0</td>
<td>20,178</td>
</tr>
<tr>
<td>Hoary bat</td>
<td>31.9</td>
<td>9,195</td>
</tr>
<tr>
<td>Red bat</td>
<td>27.8</td>
<td>8,013</td>
</tr>
<tr>
<td>Silver-haired bat</td>
<td>10.3</td>
<td>2,969</td>
</tr>
<tr>
<td>Cave bats:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tri-colored bat</td>
<td>16.4</td>
<td>4,727</td>
</tr>
<tr>
<td>Little brown bat</td>
<td>8.7</td>
<td>2,508</td>
</tr>
<tr>
<td>Big brown</td>
<td>3.2</td>
<td>922</td>
</tr>
<tr>
<td>Northern long-eared bat</td>
<td>0.4</td>
<td>115</td>
</tr>
<tr>
<td>Unidentified bats:</td>
<td>1.3</td>
<td>375</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0</strong></td>
<td><strong>28,826</strong></td>
</tr>
</tbody>
</table>


Cumulative Impacts of Future Turbine Operations. If wind power development in the Mid-Atlantic Highlands during the next 25 years were to remain at the capacity described in Table 5-42 (1,104 turbines), cumulative bat fatalities (averaging 26.11 bats per turbine) would be roughly 720,625. This would not be a realistic assumption.

Data provided by the USEIA (2011b, 2012) on predicted increases in future energy demands and production of renewable energy were used to estimate future potential wind power generation in the Mid-Atlantic Highlands and associated bat mortality. According to the USEIA, wind energy accounted for 4% of energy consumption in 2008 and 9% of the total renewable energy consumption (which includes hydroelectric, geothermal, solar/photovoltaic, and biomass energy production), or 16% of non-hydroelectric renewables (USEIA 2011b). More than any other previous year, the U.S. wind industry installed over 9,900 MW of new generating capacity in 2009 (up from 8,800 in 2008) with 38 manufacturing facilities brought online, announced, or expanded (largely due to incentives related to the Recovery Act of 2009). At the end of 2009, the installed capacity of wind power in the U.S. was just over...
35,000 MW (35 GW) (AWEA 2010). While the rate of generation production increased steadily over the past several years, the rate of growth slowed in 2010 due to availability of capital.

We used the projected rate of growth of wind generating capacity in the next 25 years in the 2 market sectors that contain the Appalachian Mountain Recovery Unit (USEIA 2012) and the known number of turbines operating and under construction to estimate the number of turbines from years 2012 to 2037. Based on the data provided in USEIA (2012), wind power development in the Mid-Atlantic Highlands is not predicted to increase significantly in the next 25 years (Figure 5-6). There will be roughly 1,120 turbines operating in the Mid-Atlantic Highlands by 2037.

**Figure 5-6.** Estimated number wind turbines in the Mid-Atlantic Highlands through year 2037 based upon electricity generating capacity for wind projects. Source data: USEIA (2012), AWEA (2012).

The estimated installed capacity for each year was multiplied by the average mortality to predict cumulative regional bat mortality over the next 25 years. Assuming that there are no operational constraints placed on this estimated installed capacity per year and that the average mortality is 26.1 bats per turbine per year, it is estimated that roughly 29,100 bats would be killed on average each year and 756,500 bats would be killed cumulatively in the Mid-Atlantic Highlands during the term of the permit (Table 5-44). Based on proportions of mortality by species taken from post-construction data, annual mortality is expected to be composed of roughly 20,800 tree-roosting bats and 8,300 cave-dwelling bats.

This mortality estimate assumes that no increase of minimum cut-in speed occurs or any other avoidance and minimization measures are employed to reduce mortality. Preliminary studies have shown that bat mortality can be reduced significantly by raising the minimum turbine operational cut in speed (Arnett 2008); however, it is highly uncertain how many turbines would be curtailed in the future. This estimate therefore represents one possible scenario of the cumulative effects of wind project development on bats in the Mid-Atlantic Highlands. This analysis does not take into account the strong possibility that WNS will result in a significant decrease in the number of cave-dwelling bats that interact with wind turbines.

Under the No-Action Alternative 1, there is expected to be no effect on bats. Under the No-Action Alternative, the 67-turbine Project would operate as described in the Court Order and Settlement Agreement. Turbine operations would stop 30 minutes after sunset to 15 minutes after sunrise from April 1 through November 15. Because the seasonal and nightly shutdowns correspond to times when bats are...
active, there would be no bat mortality associated with Project operation. Therefore, there would be no cumulative effect on bats as result of implementation of the No-Action Alternative.

The Proposed Action, operating with feathered blades below the raised cut-in speed of 4.8 m/s, is estimated to kill 1,305 bats per year and 32,638 bats over the 25-year term. This is roughly 4% of the total bat mortality for the Mid-Atlantic Highlands by the year 2037 (Table 5-44), assuming that the other projects are not operating under reduced cut in speeds for bat protection and that mortality rates are 26.11 bats per turbine per year across the region.

Implementation of the adaptive management plan established as part of the HCP will ensure that at least a 50% reduction in bat mortality is achieved through changes in the operations of the Project under the Proposed Action. Reduction of mortality under the adaptive management plan could be higher than 50% as well.

Table 5-44. Projected bat mortality for the Beech Ridge Wind Energy Project in relationship to estimated wind power production projected for years 2012 through 2037 in the Mid-Atlantic Highlands.

<table>
<thead>
<tr>
<th>Installation</th>
<th>No. Turbines</th>
<th>Average annual mortality</th>
<th>Cumulative mortality for 25 years</th>
<th>Cumulative mortality relative to that of MAH projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative 1: No-Action</td>
<td>67</td>
<td>0</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Alternative 2: Proposed Action</td>
<td>100</td>
<td>1,305 (^1)</td>
<td>32,638</td>
<td>4.3%</td>
</tr>
<tr>
<td>Alternative 3: Additional Covered Species</td>
<td>100</td>
<td>627 (^2)</td>
<td>15,666</td>
<td>2.1%</td>
</tr>
<tr>
<td>Alternative 4: Phase I Only</td>
<td>67</td>
<td>874 (^1)</td>
<td>21,862</td>
<td>2.9%</td>
</tr>
<tr>
<td>Wind projects MAH</td>
<td>1,104-1,119</td>
<td>29,094 (^1)</td>
<td>756,448</td>
<td>-</td>
</tr>
</tbody>
</table>

\(^1\) Based on calculated average of 26.11 bats per turbine per year derived from results of 14 mortality studies conducted at wind energy facilities in the mid-Atlantic region and the assumption that modified operations will reduce mortality by 50%.

\(^2\) Based on calculated average of 26.11 bats per turbine per year derived from results of 14 mortality studies conducted at wind energy facilities in the mid-Atlantic region and the assumption that modified operations will reduce mortality by 76%.

\(^3\) Number of turbines estimated from the USEIA (2011b) model over the 25-year period.

Cumulative bat mortality by species in the Mid-Atlantic Highlands is shown in Table 5-45. Over 500,000 migratory tree dwelling bats and 200,000 cave dwelling bats are predicted to be killed cumulatively from years 2012 to 2037, assuming no curtailment measures are in place.
Table 5-45. Cumulative bat mortality by species estimated for wind projects in the Mid-Atlantic Highlands from years 2012 to 2037. Species' proportions are based on those derived from post-construction studies conducted at commercial wind projects in the Mid-Atlantic Highlands in years 2003 to 2009.

<table>
<thead>
<tr>
<th>Species</th>
<th>Percentage</th>
<th>Cumulative fatalities in years 2012-2037</th>
</tr>
</thead>
<tbody>
<tr>
<td>Migratory Tree Bats:</td>
<td>70.0</td>
<td>529,514</td>
</tr>
<tr>
<td>Hoary bat</td>
<td>31.9</td>
<td>241,307</td>
</tr>
<tr>
<td>Red bat</td>
<td>27.8</td>
<td>210,293</td>
</tr>
<tr>
<td>Silver-haired bat</td>
<td>10.3</td>
<td>77,914</td>
</tr>
<tr>
<td>Cave Bats:</td>
<td>28.7</td>
<td>217,101</td>
</tr>
<tr>
<td>Tri-colored bat</td>
<td>16.4</td>
<td>124,057</td>
</tr>
<tr>
<td>Little brown bat</td>
<td>8.7</td>
<td>65,811</td>
</tr>
<tr>
<td>Big brown</td>
<td>3.2</td>
<td>24,206</td>
</tr>
<tr>
<td>Northern long-eared bat</td>
<td>0.4</td>
<td>3,026</td>
</tr>
<tr>
<td>Unidentified bats</td>
<td>1.3</td>
<td>9,834</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
<td>756,448</td>
</tr>
</tbody>
</table>


This analysis is based on the best available scientific information in an attempt to understand potential cumulative impacts to bats. The actual numbers will be influenced by multiple interacting and changing future conditions that cannot be known or understood at the present time. This analysis is an attempt to understand the large-scale and long-term impacts of wind project development on local and regional bat populations. However, to understand the biological implications of future bat mortality requires knowledge of baseline populations. Unfortunately, there is limited information on current population estimates for most bat species in North America at local, regional, and continental scales (O’Shea et al. 2003, Kunz et al. 2007a). Conventional means of monitoring wildlife populations are inadequate for studying most species of North American bat species (Weller and Lee 2007). Population trend data that exist are biased toward listed bats because they are based primarily on winter hibernacula counts of caves known to be occupied by Indiana and Virginia big-eared bats. These winter cave counts also do not account for species that do not hibernate in caves, such as tree foliage- and cavity-roosting, long-distance migrants.

Cumulative Effects to Endangered Bats

*Indiana Bat and Virginia Big-Eared Bat.* As described in Section 5.8.2.1., the impacts to bats from wind facilities in North America and elsewhere are well documented. The cumulative impacts of such mortality on both a spatial and temporal scale could have long-term population effects on certain species of bats (Kunz et al. 2007b). Potential Indiana bat and Virginia big-eared bat fatalities resulting from collisions with wind turbines raise concerns about cumulative impacts that could affect local or regional populations as wind energy development continues in the Mid-Atlantic Highlands.

The Indiana bat fatality modeling results are sensitive to the ratio of Indiana bat to little brown bat used. The model assumes that fatalities of Indiana bat and little brown bat, the most common *Myotis* fatality at wind turbines, occur with equal probability in the Project area and equally over time. Site mist netting surveys did not detect Indiana bats during the study periods. Nonetheless, based on the 2005 acoustic data and other available information (listed in DEIS in Section 4.8.2.1, and as per the Court Opinion), this DEIS assumes the Project area is or will be utilized by Indiana bats at times and that take of Indiana bats will occur at some point during the 25-year operating life of the turbines. The model implemented in the Project HCP used the ratio of Indiana bats to little brown bats from mist-netting surveys conducted at sites in West Virginia where the species composition at the site was unknown prior to the survey.

For the purposes of this DEIS, it is assumed that raising the cut-in speed to 4.8 m/s would lead to a 50% reduction in bat mortality at the site. However, we cannot assume the same operational modifications will
be implemented at all existing and future in wind projects in the analysis area. As per the Project HCP’s estimates, we assumed the Project’s 100 turbines will affect the maximum number of Indiana bats and Virginia big-eared bat for the 25-year permit term, i.e., 70 and 14 individuals, respectively. To estimate the number of Indiana bat fatalities for the proposed Project, the HCP described the ratio of Indiana bats to little brown bats (0.0081 to 1.00) based on population estimates for both species in West Virginia. We assumed that this ratio would be the same for our cumulative effects analysis area. To illustrate a worst-case scenario, we used the high-end estimate for little brown bat fatalities (12.9%). Annual fatality for little brown bats would be approximately 3,718 individuals (12.9% of 28,826, the average annual mortality for all wind projects in the analysis area in any year from 2012 to 2037). Using the ratio of 0.0081 to 1.00, the annual wind project mortality for Indiana bats in the analysis area would be approximately 30 Indiana bats, and cumulatively, wind projects will take 753 Indiana bats for the term of the permit. The annual take of 30 bats is 0.9% of the 2011 population for the Appalachian Mountain Recovery Unit (32,358; USFWS 2011b). The Service observed an increase in the Appalachian Mountain Recovery Unit population from 2007 to 2009 (USFWS 2011b). However, this trend is not expected to continue due to the spread of WNS, a fungus that has killed over 5.5 million bats (USFWS 2012).

This analysis assumed all things are equal for all existing and future projects in the analysis area. This includes the premise that Indiana bats are likely to be taken, the ratio of Indiana bats and little brown bats is the same, and projects will not implement avoidance and minimization measures. One might assume that as Indiana bat populations decrease, the number of individuals killed from turbine collision will also decrease; this might also be assumed to be the case for little browns bats. However, the risk of mortality to an individual WNS survivor remains the same when a bat enters the rotor-swept area. In New York where WNS was first discovered, we have not yet seen a decrease in Myotis fatalities at wind power projects despite declining Myotis populations. Therefore, wind projects in the analysis area may continue to pose risk to the same percentage of the Indiana bat population for the life of the Project. The effects of wind project mortality will be additive to that of WNS, but not nearly as significant as WNS.

The BRE HCP states that available information on the distribution of Virginia big-eared bat indicates the Project could take between 0 and 1.0 Virginia big-eared bat per year; curtailment will reduce this take by 50% and take will be closer to 0.5 individuals per year. The likelihood of take is very low based on known distribution and the limited dispersal range of the species. Furthermore, no Virginia big-eared bats have been detected on or near the Project site during mist-netting and cave surveys. There has been no mortality of Virginia Big-eared bats at other wind projects by which to develop take estimates. Only 2 wind projects have been built within the range of Virginia big-eared bat, Mountaineer in Thomas County, West Virginia and Mount Storm in Grant County, West Virginia. However, both of these projects are outside the normal commuting distance of Virginia big-eared bats occupying the closest active hibernacula.

We are not able to predict where future wind projects will be located. Depending on where they are built, they could pose a low to high risk of take of Virginia big-eared bats. Known caves make ideal centers of activity. These bats roost, brood, and winter in these caves and tend to range within short distances (<6 mi). Therefore, any future Projects built within a 6-mi radius of occupied hibernacula would pose the greatest risk. Considering the small areal extent of these 6-mi radii, compared to the large area encompassed by the mid-Atlantic Highlands, we conclude the likelihood of significant mortality of Virginia big-eared bats from future wind power projects is relatively low.

**Biological Significance of Wind-Related Indiana Bat and Virginia Big-Eared Bat Mortality.** Despite substantial limitations of the data on which assumptions were based, it is important to attempt to understand the large-scale and long-term impacts of this mortality to local and regional populations. To understand the implications of future bat mortality requires knowledge of baseline populations. Unfortunately, there is little information on current population estimates for most bat species in North America on local, regional, and continental scales (O’Shea et al. 2003, Kunz et al. 2007a). Conventional means of monitoring wildlife populations are inadequate for studying most species of North American bat species (Weller and Lee 2007); population trend data that exist are based primarily on winter hibernacula counts, which do not account for species that do not hibernate in caves, such as foliage- and cavity-roosting long-distance migrants. Because of their long-standing endangered status and the ability to
monitor their populations via hibernacula counts, there is a greater understanding of current population levels for Indiana bats than for any other species, as well as how populations have changed over the past 45 years.

In terms of adult survival rates, there is some evidence that a differential survival rate between the sexes may occur (Humphrey and Cope 1977, LaVal and LaVal 1980). Based on 23 years of banding data, Humphrey and Cope (1977) hypothesized there are 2 distinct survival phases of adult Indiana bats: 1) annual survival rates from 1 to 6 years after banding were constant at approximately 75.9% and 69.9% for females and males, respectively; and 2) from 6 to 10 years after banding there was a lower, constant annual survival rate of 66.0% and 36.3% for females and males, respectively. Following 10 years, the survival rate for females dropped to only 4%; the authors suggested the lower rate may have been attributable to increased costs of migration and reproduction during old age, or due to sampling error, as a very small number of females remained alive after 10 years. Indiana bats have been known to live much longer, with the oldest known Indiana bat captured 20 years after it was first banded (LaVal and LaVal 1980). Limited observations from banded individuals of other species suggest that they may live for more than 30 years; 1 little brown bat was found 34 years after banding (Davis and Hitchcock 1995).

As previously noted, to understand the biological significance of population level impacts to bats from wind facilities, it is important to consider their unique life-history strategies (Barclay and Harder 2003). Organisms whose populations are characterized by low birth rate, long life span, naturally low mortality rates (i.e., K-selected species, Pianka 1970), high trophic level, and small geographic ranges are likely to be most susceptible to cumulative, long-term impacts on population size, genetic diversity, and ultimately, population viability (McKinney 1997, Purvis et al. 2000, as cited in NRC 2007).

Although bat species demonstrate considerable variation in traits such as fecundity, age of maturity, and longevity, as a group they have relatively long life spans and produce relatively few offspring compared with other small mammals; which may be due to low extrinsic mortality (e.g., low predation), reproductive constraints, or other characteristics (Barclay and Harder 2003). Bats are atypical among mammals with respect to their life histories because of their small body size but are long life (Barclay and Harder 2003). The probability of extinction in bats has been linked to several of these characteristics (Jones et al. 2003).

Cumulative Effect of WNS
This cumulative effects analysis includes the effects of WNS, a malady of unknown origin that is killing cave-dwelling bats in unprecedented numbers in the northeastern U.S. This affliction was first documented at 4 sites in eastern New York in the winter of 2006-07, but photographic evidence emerged subsequently of apparently affected bats at an additional site, Howe’s Cave, collected the previous winter in February 2006. Data suggest that a newly identified fungus (Geomyces destructans) (Gargas et al. 2009) is responsible, at least in part, for the impacts and mortality associated with WNS (Blehert et al. 2009). WNS is a disease caused by Geomyces destructans that produces skin lesions on the wing and other membranes of bats (Turner et al. 2011). Infection has been documented in big brown bat, small-footed bat, little brown bat, northern long-eared bat, Indiana bat, and tri-colored bat (Turner et al. 2011).

Overall mortality rates (primarily of little brown bats) have ranged from 81% to over 97% at several of the sites where data have been collected for at least 2 years (Hicks et al. 2008). While little brown bats appear to be the most affected of the cave-wintering bat species in the Northeast, Indiana bats have also been greatly impacted by WNS. It is important to note, however, that most of these species do not form large clusters in the winter, as little brown bats and Indiana bats do, and so they are not easily counted. Therefore, we have poor baseline estimates for other species at most sites by which to compare post-WNS abundance estimates.

As of May 2012, WNS has been confirmed in 20 states and 4 Canadian provinces (USFWS 2012d) with mortality rates reaching up to 100% at many sites. Through the winter of 2008/09, the distribution of WNS was mainly along the Appalachian Mountain range, which coincides with numerous bat hibernacula. However, in 2010 and 2011, WNS made a significant jump westward and was confirmed or suspected to occur far west of the Appalachian Mountains.
Based on observations of continued mass-mortality at several sites, the Service anticipates the loss of Indiana bats to continue in the Northeast and mid-Atlantic regions. The degree to which climate or other environmental factors may influence the spread of WNS, or the severity of its impact on affected bats, is unknown. At this time, there is no concrete evidence of resistance to WNS among survivors, although some affected hibernacula continue to support low numbers of bats 5 years into WNS exposure, and a few hibernacula have substantially lower mortality levels than most. If current trends for spread and mortality at affected sites continue—and there is currently no indication that they will not—WNS threatens to drastically reduce the abundance of many species of hibernating bats in much of North America in what may only be a matter of years. Population modeling indicates a 99% chance of regional extinction of the little brown bat within the next 16 years due to WNS (Frick et al. 2010a). The closely related Indiana bat is just as vulnerable to regional extinction (if not more so) due to its smaller range-wide population and social behavior traits that increase the risk of bat-to-bat transmission. The declining mortality rates at some New York hibernacula and the apparent resistance of European Myotis species to *Geomyces destructans* suggest that some level of resistance among some North American species may exist or develop within North American myotis species. Population estimates made pre- and post-WNS for New York, Pennsylvania, Vermont, Virginia, and West Virginia for the 6 affected species show dramatic declines in population numbers (Table 5-46). The little brown bat and northern long-eared bat have experienced the most drastic reductions of their populations (91% and 98% population reductions respectively). Small-footed bats have experienced the lowest WNS induced population change (-12%). For all affected bats collectively, hibernating bats in New York, Pennsylvania, Vermont, Virginia, and West Virginia have experienced WNS induced population declines of 88%.

**Table 5-46.** WNS induced population changes of 6 species of hibernating bats in New York, Pennsylvania, Vermont, Virginia, and West Virginia.

<table>
<thead>
<tr>
<th>Species</th>
<th>Change in survey counts pre-WNS to post-WNS ¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Little brown bat</td>
<td>-91%</td>
</tr>
<tr>
<td>Indiana bat</td>
<td>-72%</td>
</tr>
<tr>
<td>Northern long-eared bat</td>
<td>-98%</td>
</tr>
<tr>
<td>Small-footed bat</td>
<td>-12%</td>
</tr>
<tr>
<td>Tricolored bat</td>
<td>-75%</td>
</tr>
<tr>
<td>Big brown bat</td>
<td>-41%</td>
</tr>
<tr>
<td><strong>GRAND TOTAL(all bats affected)</strong></td>
<td><strong>-88%</strong></td>
</tr>
</tbody>
</table>

¹ Source: Turner et al. (2011)

Much of the data used to estimate potential mortality of bats at wind farms were collected pre-WNS. As populations of WNS-affected species decrease, it is possible that rates of turbine mortality may decrease as well. Reduction in population numbers reduces exposure for mortality since there are less bats interacting with turbines. A linear relationship between average mortality rates and population estimates may be a logical and best guess scenario; however, it discounts smaller regional population fluctuations or reduction of population levels to a point that risk is minimal. The total number of bats killed goes down as populations decrease, but risk remains unless the population is zero. Worst case models using vital rates derived from mean declines in the first 3 years of infection and persisting at the observed third-year mean decline of 45% per year thereafter lead to a 99% chance of regional extinction of little brown bat within the next 16 years (Frick et al. 2010). Therefore over the term of the permit, it is possible that there would be little to no mortality occurring from the BRE project since some species such as the little brown bat may be so regionally rare or absent. On the other hand, WNS survivors that pass through the rotor-swept area would still be at risk of mortality.

**Risk Assessment of Cumulative Effects to Bats**
Due to the lack of long-term mortality studies at wind facilities, it is unknown whether or not bat mortalities will decline to negligible levels as bat populations decline, related to WNS or other causes, or if mortality rates will be substantial (Kuvlesky et al. 2007). Migration patterns of bat species, which are largely unknown, will influence regional-scale mortality or how the deaths of migrating individuals will affect populations at maternity colonies to which they belong. Unfortunately this type of information is nearly impossible to obtain. Thus, the population level responses for bats remain uncertain.

There is concurrence among the various sources of information on bat mortality that there would likely be a cumulative effect on bats at the population level. However, there is also a great amount of uncertainty regarding the magnitude of this risk to bats. A brief weight of evidence analysis was conducted for the various measurement and assessment endpoints used in determining significance and magnitude of risk to bat populations. A description of this analysis is presented in Appendix F (Report F-3). The level of concurrence among measurement endpoints was used to determine whether or not various measurement endpoints generally predicted similar levels and magnitudes of risk. Each measurement endpoint was plotted on a matrix where the columns present the weights assigned in a weighting analysis, and the rows present the likelihood of risk for each measurement endpoint, as shown in Table 5-47. Agreements or divergences among measurement endpoints are readily observed using this matrix, enabling interpretation of the results of various survey methods with respect to particular assessment endpoints. When viewed together, the measurement endpoints used in determining significance criteria are low, yet the overall magnitude of risk to populations is undetermined. Exceptions to this are potential major population level impacts to tree-roosting migratory bats and potential moderate population level impacts to cave-dwelling bats from wind farms in general as presented in the literature. However, these findings should be given low/medium weight in making an overall decision about cumulative significance criteria. Overall the assurance in assigning significance criteria for impacts resulting from the various alternatives is made with a consistently high degree of uncertainty with regard to the magnitude of risk. However there is a great deal of agreement that there is risk to populations to both tree roosting and cave dwelling bats at some level.
Due to the combined cumulative effects of WNS on cave bat species, habitat modifications from other activities, the presence of multiple wind farms in the region, it is expected that the Proposed Action will have a cumulative effect resulting in additive mortality of non-listed bat populations. The biological significance of this impact is highly uncertain due to the lack of population data for non-listed bats, uncertainty regarding whether or not bat mortalities will decline to negligible levels as bat populations decline, and unpredictable future policy decisions that affect the growth of the wind power industry (such as production-tax and investment-tax credits, renewable portfolio standards, carbon taxes, emissions cap-and-trade programs, emissions regulations, and incentives to reduce energy consumption).

Cumulative Effects Summary
Under the No-Action Alternative (Alternative 1), cumulative impacts to bats would not be significant. As it currently operates, the 67-turbine Project is not likely to kill bats or significantly modify suitable habitat in any manner. There would be some impact associated with either avoidance or displacement should bats react to the presence of turbines.

The Proposed Action (Alternative 2) and Alternative 3, which both include the addition of Phase II, add to effects associated with tree-removal. All 3 action alternatives will contribute cumulatively to effects associated with bat mortality. By 2037, the cumulative impact of wind power projects is predicted to result in mortality of roughly 756,500 bats within the mid-Atlantic Highlands.

The effect of cumulative mortality on tree-roosting migratory bat populations is highly uncertain because estimates of current population sizes are unknown. However, their mortality at wind power projects is significantly higher than that experienced by cave-dwelling bats and is considered an additive effect to
other stressors adversely affecting population levels (such as disease, predation, and habitat loss and degradation which decreases reproduction and survival. The cumulative effect of wind power mortality on slowly reproducing cave-dwelling bats is also additive to already high mortality caused by WNS.

Bat mortality could be reduced by 50% or more if all wind power projects implemented effective curtailment strategies. The Proposed Action, and Alternatives 2 and 3 include curtailment measures to significantly reduce the individual project’s contribution to cumulative bat mortality, and to mitigate for it through off-site habitat protection in perpetuity that removes threats of human disturbance, logging, and development.

5.16.4.9 Land Use and Recreation

The cumulative effects analysis area for land use and recreation encompasses the 6,860-acre leased area and its 5-mi buffer.

Past and Ongoing Effects Impacts
Some of the past actions to affect land use that have occurred over the last 5 to 10 years include commercial land development, mining, industrial forestry, oil and gas development, agriculture, and transportation network development. The land use context in Greenbrier and Nicholas Counties has not changed significantly in recent years. However, commercial and residential development around Lewisburg and along US Route 60 from Clintonville to Rainelle (Greenbrier County 2010) contributes incremental changes to existing land uses.

Phase I Built Project: The primary land use in the Project area prior to construction of Phase I was timber management. Approximately 440 acres of deciduous forest was removed by construction of Phase I. Those areas will not be replaced by harvestable timber by the end of the permit term.

Future Effects
Foreseeable future actions for the next 25 years would include all current activities associated with commercial land development, mining, industrial forestry, oil and gas development, agriculture, and transportation network development. Shale gas development has the potential to make the greatest changes in land use in the 2 counties.

Development of the Project would permanently alter 71 acres of industrial forest for the life of the Project. Alternatives 1 and 4 will have only slightly less impact to land use than Alternatives 2 and 3. The differences in land use associated with implementation of the various alternatives are minimal. When combined with the alterations produced by other resource extraction activities, such as mining and gas development this would produce a minor cumulative impact on land use in Greenbrier and Nicholas Counties.

The proposed Project’s operations could have moderate effects to recreation and tourism associated with turbine noise, Project visibility, and shadow flicker. Recreational uses include those primarily associated with outdoor activities in undeveloped landscapes, such as hiking and hunting. Timber harvesting and mineral extraction are past and on-going activities that will continue to also affect recreational activities, but the Project area is an industrial forest and mining dominated landscape which has been in active operation for decades. The Project is a new industrial activity that may affect recreational users positively or negatively.

The proposed Project (considering any of the implemented alternatives) would have a minor incremental component to overall cumulative effects to recreation in the analysis area. Cumulative impacts to land use will primarily be associated with the increase of natural gas development in the region. When combined with past activities and those anticipated in the foreseeable future, minor cumulative effects to land uses are expected.
5.16.4.10 Socioeconomics

For socioeconomics issues, the cumulative effects analysis area encompasses Greenbrier and Nicholas Counties. Principal past activities that would incrementally add to the cumulative impact include the existing timber industry, oil and gas development, and coal mining industry. These activities are foreseeable future actions that will continue to influence socioeconomic conditions in the 2 counties. The number of full time jobs is 7 under Alternatives 1 and 4, and 10 under Alternatives 2 and 3. The short term effects of temporary construction jobs and economic impacts are expected to be negligible when considering the large scale of other employers in the region.

There would be relatively moderate differences in the amount of tax differentials among the alternatives. BRE’s federal tax contribution for the 67 turbines will be $400,000. With the addition of the proposed 33 turbines, the contribution is likely to be well above $400,000 based on the applicable tax rate. If at any point the estimate is below $400,000 then Beech Ridge will make up that difference in a supplemental payment.

BRE estimates the state tax payment will be slightly less than the $200,000 originally estimated because this estimate was based on the construction of 124 turbines. However, BRE expects it to be similar for the 100 turbine project, especially if the larger turbines are used for the expansion.

Past and Ongoing Effects Impacts

Phase I Project: BRE is an equal opportunity employer and employed local contractors as much as possible (based on skill set needed and local availability) during construction of Phase I. The Phase I Project provided jobs, money to local commercial businesses (through direct purchases of goods and services), and additional federal and state tax revenues.

Concerns were also raised through the scoping process about potential impacts of Phase I on local property values. Sixty-seven operational turbines will impact both noise levels and aesthetics in the immediate area. Noise and visual impacts are discussed in Sections 5.2 and 5.10, respectively. The indirect effect of these operational aspects may or may not have influenced property values. No local or regional studies have been completed to determine if impacts have occurred.

Hoen et al. (2009) collected data on almost 7,500 sales of single-family homes situated within 10 mi of 24 existing wind facilities in 9 different U.S. states. This serves as one of the most complete studies on changes in home values conducted by an unbiased party. The conclusions of the study are drawn from 8 different pricing models, as well as both repeat sales and sales volume models. The various analyses are strongly consistent in that none of the models uncovers conclusive evidence of the existence of any widespread property value impacts that might be present in communities surrounding wind energy facilities. Specifically, neither the view of the wind facilities nor the distance of the home to those facilities is found to have any consistent, measurable, and statistically significant effect on home sales prices (Hoen et al. 2009).

Tourism is a major component of Greenbrier County’s economy; the county ranks fifth in the state for overall travel spending, behind 4 counties offering gaming (e.g., casinos). The Greenbrier County Convention and Visitors Bureau Annual Report for the 2008-2009 Fiscal Year reported that visitors to the county spent $214 million in 2008. The industry provides 2,460 jobs in the county which impart nearly $87 million in earnings. Tourism generates over $1.8 million in local government revenue and $14.2 million in state revenue (Greenbrier County Convention and Visitors Bureau 2009). Tourists seeking outdoor recreational activities (e.g., hiking, camping, hunting, and fishing) in a relatively undisturbed forested landscape may not choose to visit the Project area due to the turbines. However, some tourists may also travel to the area due to access to both activities; outdoor recreation and to visit the facility to be exposed to and learn about the country’s renewable energy program in person.

The Project (all alternatives considered) will have cumulative effects on the region in the form of economic benefits that have positive social implications for the area. These impacts are attributed to the
financial return in the form of employment and payroll, lease payments, and local tax revenue. The Project will also provide economic benefits in the form of competitively priced electric energy and clean, renewable power in West Virginia. Wind-generated power offers unique advantages over fossil fuel-generated energy that are long-term.

Short-term job creation and economic benefit of ancillary services (e.g., lodging, meals) likely occurred primarily during construction of the Phase I Project. This short-term economic benefit would also occur during construction of Phase II of the project. Longer term job creation and service procurement likely increased as a result of the Phase I construction, however Phase II will likely lead to very limited full time job growth above that experienced from Phase I operation since no additional long term jobs are expected. The Project, along with other potential wind power projects being considered in the region do work to create skilled job base crucial to further growth of local labor in the wind power industry. Also, the proposed Project and other wind energy projects could have the incremental impacts through stabilization of or reduced energy prices, which could result in long-term savings for the ratepayers.

As of February 2012, there were 2,845 Marcellus wells drilled or permitted in West Virginia (West Virginia Geologic and Economic Survey 2012). The employment impact of Marcellus Shale development for 2010 was estimated to be between 7,600 and 8,500 additional jobs depending upon the growth rate used (Higginbotham et al. 2010).

Future Impacts
Employment in the West Virginia natural gas industry has risen over time. From 2001 to 2009, total oil and natural gas employment, which is the summation of the employment in all natural gas sectors, increased by 34% (Higginbotham et al. 2010). The main contributor in the increase in total employment in the natural gas industry is increased employment in the support activities for the oil and gas operations sector (Higginbotham et al 2010). The number of additional jobs created in 2015 was estimated to be between 6,600 and 19,600. The employee compensation impacts range from less than $300 million each year with no growth to approximately $890 million in 2015 with 20% growth each year (Higginbotham et al 2010). Growth of the local economy in the future is expected to be driven by natural gas exploration both directly and indirectly through various support services.

Combined with other potential wind power projects in the region, further development of the Marcellus Shale exploration, and other possible future energy projects, implementation of all of the alternatives would have a minor beneficial cumulative effect associated with implementation of the No-Action Alternative or any of the action alternatives.

5.16.4.11 Visual Resources
The cumulative effects analysis area for visual resources is the combined area of the Phase I and Phase II 20-mi VRA study areas as defined by Saratoga (2005, 2011). This includes all areas located within 20 mi of the outermost Phase I wind turbines and the proposed Phase II turbines (i.e., including the 33 proposed and 14 alternate locations). The 20-mi buffer represents the effective geographic area within which there is a possibility that some portion of the wind energy Project would be visible from a given location and directly contribute to cumulative effects. The analysis also includes those other cumulative visual effects within the 20-mi APE.

Past and Ongoing Effects Impacts
Phase I Project: Visual impacts during Phase I construction were temporary and generally limited to the 300-ft cranes used to erect the wind turbines and the forest clearing and construction activities associated with roads, transmission lines, turbine pads, and laydown areas. Four to 6 cranes moved across the Phase I footprint area during construction, and might have been periodically visible from some nearby areas within the viewshed. The Phase I Project incorporated the following mitigation measures into its design and operation:
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- BRE developed the wind farm layout so that turbines were located at least 1 mi from existing residences;
- In part to limit the aesthetic effect of the wind farm, the turbines were not illuminated, except as required by FAA regulations, and except for a low voltage lights on a motion sensor at the entrance door to each turbine;
- Turbines were coated/painted a non-reflective and non-obtrusive off-white color;
- Turbines were similar in design and size, including tower height, and all turbines comprising Phase I were consistent in color and blade rotation direction (clockwise);
- Existing roads were used for construction and maintenance where possible, minimizing visual impacts caused by new road construction;
- Access roads created for the Project were located along ridge tops when possible to minimize visible cuts and fills; and
- Temporarily disturbed areas in wooded areas were allowed to re-vegetate naturally to the maximum extent possible while still allowing for access and maintenance of the Project.

The viewshed maps from the Phase I VRA report (Saratoga 2005; see Appendix G, Report G-1, Figure 2, Sheets 1 through 4), prepared prior to Phase I construction, illustrated the geographic areas within which there would be a high probability that one or more of the 124 proposed turbines would be visible. Subsequent field reconnaissance by Saratoga in 2005 evaluated the accuracy of the viewshed maps and revealed that there were few locations in the viewshed where a significant number of turbines would be clearly visible. These field evaluations included traveling highways and visiting readily accessible topographic highpoints to identify representative open views of the Phase I Project area. Further evaluations included photographs taken from 13 publically-accessible locations to illustrate visibility with the naked eye, followed by photo simulations at 5 of these sites. The photo simulations superimposed renderings of the (then-proposed) 124 wind turbine generators, factoring in the effects of topography, vegetation, time-of-day, sunlight, and haze. Locations photographed during the field evaluation for visual impacts are listed below. Asterisks indicate locations selected for photo simulations.

- County Route 17 – East of Williamsburg* (4 mi from Project)
- Trout Road – Williamsburg Medical Center
- Intersection of County Routes 9 and 10* (3.3 mi from Project)
- Cold Knob
- County Route 4/5 – Lewisburg
- Ann Avenue
- US Route 60 – Sweet Grass Village
- US Route 60 – North of I-64
- Intersection of US 60 and County Route 60/12* (12.0. mi from Project)
- County Route 223 – South of Highway 39/55* (3.5 mi from Project)
- Droop Mountain Battlefield State Park* (7.4 mi from Project)

With the effects of vegetative and topographic screening factored in, the report concluded that the overall visibility of the proposed Project would be minor, and that there would be little visibility of the Phase I Project within the 5-mi viewshed, with a slight increase in visibility between 7 and 18 mi. Within the 5-mi viewshed, most visibility would occur in the Trout and Williamsburg areas. The report predicted there would be a few small pockets of potential visibility, primarily towards the south and southeast of the Project along portions of roadways (e.g., US 219) and adjacent open fields. The report stressed that the viewshed assessments did not distinguish between visibility of entire turbines verses the top 6 inches of the blade, so the viewshed maps likely exaggerated the extent of true visibility.

Note that only 67 of those turbines have been constructed, so the actual visual effects of the Phase I Project are different than those estimated by Saratoga (2005). Though a visual resource assessment has not been completed for the 67 built turbines, it is reasonable to assume that the actual extent of visual impacts from the built Project would be less than Saratoga reported for the proposed 124-turbine Project they evaluated.
Saratoga (2005) confirmed that views of the 124 proposed Phase I turbines would be limited and largely confined to the eastern half of the VRA APE. Potential views from the western half of the APE would likely be extremely limited and fleeting in nature due to screening, distance, and the effects of typical atmospheric conditions (i.e., haze, fog, rain). The 2005 viewshed and field review analyses indicated that the Project generally would not be visible from the scenic and recreational resources within the APE, with the exception of Droop Mountain Battlefield State Park where less than 7% of the turbines were expected to be visible (Saratoga 2005; refer to Appendix G, Report G-1, Figure 3, Sheets 9 and 10). One of the photo simulations shows the view from a point near County Route 223, approximately 3.5 mi from the Project (Saratoga 2005; refer to Appendix G, Report G-1, Figure 3, Sheets 7 and 8). From that location, approximately 70% of the Project would be visible, but the report noted that this location is not accessible by vehicle and is not identified as publicly accessible. From the photo simulations, Saratoga (2005) further concluded:

1. With few exceptions, only a small portion (less than 15%) of the proposed Project would be seen from most views, even those that are most open;
2. The vertical form of the turbines are similar to existing landscape elements (e.g. silos, utility poles, fence posts, building edges);
3. From most locations, vegetation and topography screen a significant portion of the proposed Project;
4. Turbine form, color, and layout reduce the potential visual impact;
5. The optical effect of distance reduce the visibility and dominance of the proposed turbines; and
6. The effects of past, current, and future logging operations detract from the aesthetic value of existing views.

In the Phase II VRA, Saratoga (2011) included photo simulations from several viewpoints within the Phase I APE where the existing 67 turbines are visible. The existing conditions photos for these simulations illustrate the actual visual effects of the Phase I turbines, as constructed. The following figures from the Saratoga (2011) report offer representative photographic views of the Phase I turbines from various distances on clear days. This report is included in Appendix G of this EIS.

**Table 5-47.** Photographic views of Phase I turbines from various distances.

<table>
<thead>
<tr>
<th>Approximate distance from Phase I turbines (mi)</th>
<th>Figure references in Saratoga (2011) (^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 - 1</td>
<td>A2-A, A5-A</td>
</tr>
<tr>
<td>6</td>
<td>A7-A</td>
</tr>
<tr>
<td>9</td>
<td>A4-A</td>
</tr>
<tr>
<td>14</td>
<td>A9-A</td>
</tr>
</tbody>
</table>

\(^1\) See Appendix G, Report G-2.

Saratoga (2011) concluded that the Phase I turbines add a noticeable vertical element to the landscape when visible from highpoints and vistas within 10 mi of the Project, but turbines become much less noticeable beyond 10 mi. The red flashing FAA aviation obstruction lights on some of the Phase I turbines are visible night-time elements in the study area, but the relatively low intensity does not result in perceptible illumination of the sky.

**Other Actions.** In their VRAs of the Phase I and Phase II Projects, Saratoga (2005, 2011) concluded that the effects of past, current, and on-going logging operations detract from the aesthetic value of existing views; and the predominantly forested lands of the region are continually in a dynamic state varying from mature vegetation to cleared lots. Gray & Pape (2011b) report that the visual character of wind turbines is similar to the coal mining activity that has been taking place near the town of Duo, and that the existing Phase I Project is not necessarily out of character with the area’s historic patterns of settlement, farming, mining, and logging. These traditional land use activities affect the visual character of the area and
region, but their associated visual changes are more cyclical in nature, as forests, fields, and reclaimed mines experience dynamic states of disturbance.

Future Impacts

It is expected that the traditional uses of farming, logging, mining, and rural residential development will continue to occur in the foreseeable future, and these activities will affect the visual character of the area in much the same way as the recent past. However, it is reasonable to assume that the pace and extent of mining, logging, or development could increase or decrease in the future in response to local, regional, and national trends, and that activities such as oil and gas exploration and extraction activities could increase. These changes would be expected to adversely affect the area's visual character, possibly in a significant way depending on the extent of change.

The Phase II Project has the potential to affect the visual character of the landscape either positively or negatively depending on an individual's perception. The Phase II Project would incrementally add to overall impacts when combined with past actions and reasonably foreseeable future actions. This section addresses the potential cumulative visual impacts that may primarily arise from interactions among the Proposed Action and alternatives and the visual effects of other projects or activities that convert forest either permanently or temporarily to other land uses.

The cumulative impact to visual resources associated with implementation of Alternative 1 and Alternative 4 are equal. The Phase II VRA (Saratoga 2011) addresses the effects of the 67 built turbines, and more accurately reflects the Phase I impacts. No past wind projects have been identified as having visual effects on the regional character of the landscape within the visual APE. Other existing and on-going projects in the area that could contribute to cumulative visual effects include tree removal, residential subdivisions, mining, and natural gas exploration, and small commercial development (primarily manufacturing). All of these development activities could contribute incrementally to cumulative visual impacts in the form of interruptions in forest cover. These actions will not have such extensive vertical effects as wind turbines.

The same cumulative impacts to visual resources are expected for implementation of Alternative 2 (Proposed Action) and Alternative 3. The visual APE is affected by activities that create forest openings, both permanent and temporary. The Proposed Action will not dramatically alter the overall visual matrix of the region. Cumulative visual impacts associated with other wind projects are not anticipated in the APE. No other known projects with similar visual effects (structures that extend vertically for 300 feet or more) are planned in the analysis area in the next 25 years. The largest contribution of impacts in the region will likely be from additional natural gas well exploration in the region. As of February 2012, there were 1,572 Marcellus wells completed and 1,273 Marcellus well permits in West Virginia (West Virginia Geological and Economic Survey 2012). In the immediate area of the Project, many of the wells are west of the Greenbrier-Nicholas County line (West Virginia Geological and Economic Survey 2012). There will also be continued large scale timber harvesting that will continue in the region (Piva and Cook 2011).

A total of 68 visually sensitive sites were identified by Saratoga (2011) within the Phase II APE. Potential visibility of at least some portions of the Phase II Project was indicated for 32 of these sites. Saratoga (2011) suggested visibility from several of these resources will be localized, short duration, or non-existent, and concluded that overall visibility of the Phase II Project would be limited to small areas distributed throughout the visual resource APE, with up to 97% of the APE screened from view of the turbines.

The primary change to the visual character as result of construction will be the change in forested matrix of the landscape. Project construction is anticipated to result in a total disturbance of approximately 531 acres of land, of which 145 acres will be disturbed during Phase II construction. Of this 531 acres used to construct Phase I and Phase II of the Project, 647 acres were previously disturbed in the Project area as part of ongoing commercial timber operations. The majority of the area (79%; 557 acres) disturbed as part of Project-related activities was deciduous forest and therefore provided the dominant visual matrix in...
the region. The forested area was predominantly greater than 26 years of age and will not revert to the same visual matrix during the 25-year term of the permit.

Approximately 71 acres (10%) will be required to maintain roads, turbine pads, and substation facilities. Much of this area will not be visible within the APE due to screening from adjacent forest and the rolling topography. The turbines themselves are unique structures in the visual environment. However, they do share some characteristics with other vertical structures such as silos, utility poles, fence posts, and building edges. Considering Project impacts in relation to other visual impacts in the region, it is determined that implementation of any of the 4 alternatives would have a minor cumulative effect on overall visual resources in the APE. Note that cumulative visual effects on NRHP-eligible cultural resources are evaluated under a different set of criteria, and are specifically addressed in Section 5.16.4.12 below.

5.16.4.12 Cultural Resources

The analysis area for cumulative effects to cultural resources is the 6,860-acre leased area and the combined area of the Phase I and Phase I cultural resources assessment study areas as defined by O’Bannon and Sweeten (2007) and Gray & Pape (2008, 2011a, 2011b, 2012), which equates to a 5-mi buffer around the outermost existing and proposed turbines. Since it was determined that the Project had the potential to contribute to cumulative visual effects in a 20-mi buffer of the Project area, cumulative effects to cultural resources are likely impacted in a similar manner. This rationale is based on the visual effect that the Project could have on cultural resources.

Past and Ongoing Effects Impacts

Phase I Project, Historical Structures: An assessment of potential effects from the Phase I Project on historical structure cultural resources (BHE 2008) documented visual, noise, and cultural effects as the types of effects from the Phase I Project. The assessment of effects resulted in the identification of 20 locations where the construction of the Phase I Project could result in adverse visual effects to NRHP-eligible historic properties. These included 3 historic districts, the Duo Historic District, the Williamsburg/Trout Historic District, and the Friars Hill Historic District, as well as individual properties both within and beyond the boundaries of these historic districts. For the purpose of this analysis, any visibility of a turbine was considered an adverse effect. Note that BHE’s assessment of effects was based on the original proposal that included 124 wind turbines.

BHE (2008) concluded that none of the NRHP-eligible historic properties were located in the direct Project area, and therefore none would be directly impacted by the construction of the Phase I Project. Only one eligible historic property, the Duo Historic District, was found to be located within 1 mi of the closest turbine of the Phase I Project. Acoustical analysis indicated that the noise levels associated with the construction and operation of this turbine would be masked by existing ambient noise levels. It was concluded, therefore, that the turbine would have no adverse noise effect on this historic district. It was also concluded that construction of the 124 turbine wind energy facility would add visual elements to the landscape that may not be in keeping with the area’s historic patterns of settlement, and based on the locations of known architectural resources in the historic structures APE, the Phase I Project could thereby constitute an adverse effect to the 20 eligible resources that would have views of the turbines. Turbine construction would result in a semi-permanent change to the rural landscape, including immediate visual changes. The visual changes would affect the setting, feeling, and association of the rural landscape, resulting in adverse visual and cultural effects within some portions of the Phase I APE.

Along with their assessment of effects report, BHE submitted a draft MOA to WVSHPO on February 15, 2008, to address the adverse effects on 20 NRHP-eligible historic buildings and structures within the APE. As compensation for these potential adverse effects, the MOA: (1) provided 6 copies of the Architectural Investigations report for the Beech Ridge Energy facility (dated March 6, 2007) in hard-copy and electronic format, for deposit in local public libraries and historical societies; (2) provided for a one-time monetary payment of $10,000 for future assistance in historic preservation-related activities conducted by the Greenbrier Historical Society or the Williamsburg Historical Foundation; and (3)
contained detailed information regarding archaeological surveys that would be conducted once design had sufficiently advanced to the point where ground disturbing activity was known. The WVSHPO signed the MOA on July 31, 2008; Beech Ridge Energy, LLC signed on August 4, 2008. Appendix K of this DEIS contains a copy of the MOA.

Archaeological Resources: On behalf of BRE, CRA conducted a phase I archaeological survey for the Phase I Project. The survey was completed during the summer and early fall of 2008 within the direct APE, which was defined as the footprint of the ground disturbing activities associated with the wind turbines, construction layout areas, access roads, substation, operations facility, and transmission line. A report (CRA 2009) and 3 subsequent addendums (i.e., to address changes and additions to the ground disturbance footprint of the Phase I Project) were submitted by CRA between January 2009 and April 2010 (CRA 2009, 2010; reports provided in Appendix K). Based on the results of the phase I archaeological surveys, CRA recommended that there were 3 new archaeological sites within the direct APE that were NRHP-eligible. The recommendation suggested warranted protection by keeping all Project facilities 100 ft or more from eligible sites. The WVSHPO concurred with the report findings and indicated that if the resources were avoided by the construction activities, it was the opinion of WVDHC\footnote{The WVSHPO responded to BRE by letter regarding the initial report and addendums. WVSHPO response letters were dated: March 9, 2009; April 17, 2009; October 29, 2009; April 21, 2010.} that the Phase I Project would have no effects on the resources. As the Phase I Project was constructed, NRHP-eligible archaeological resources were avoided by ground disturbance activities. As a result, adverse effects to archaeological resources by the Phase I Project were entirely avoided. It is assumed that archaeological resources would be completely avoided through similar avoidance measures in the construction of Phase II. It is expected that these follow-up archaeological studies and resulting consultation will be addressed in the MOA.

Other Actions. In their visual resource assessments of the Phase I and Phase II Projects, Saratoga (2005, 2011) concluded that the effects of past, current, and on-going logging operations detract from the aesthetic value of existing views, and the predominantly forested lands of the region are constantly in a dynamic state varying from mature vegetation to cleared lots. Impacts to cultural resources are likely impacted by these activities that have similar impacts to visual resources. Gray & Pape (2011b) report that the visual character of wind turbines is similar to the coal mining activity that has been taking place near the town of Duo, and that the existing Phase I Project is not necessarily out of character with the area’s historic patterns of settlement, farming, mining, and logging. It is therefore conceivable that if the wind energy project can have a significant adverse effect on cultural resources, traditional land use activities such as logging, mining, and oil and gas extraction could produce similar visual, noise and cultural effects to an extent that they would be considered individual or cumulative impacts to NRHP-eligible historic structure resources. These traditional land use activities not only have cumulative effects as a visual impact, but also through direct impacts associated with land disturbance.

Other potential ground disturbing and visually intrusive projects would include timber harvesting, oil and gas exploration and extraction, existing and future housing developments, and on-going agricultural activities. The 20-mi VRA APE is largely dominated by forest clearing activities and oil and gas extraction operations.

No other known projects with similar visual effects (structures that extend vertically for 300 feet or more) are planned in the analysis area in the next 25 years. The largest contribution of impacts to cultural resources in the region will likely be from additional natural gas well exploration, forestry, and mining. There are currently 1,421 Marcellus natural gas wells drilled in West Virginia with 1,008 permits under evaluation (Marcellus Shale Coalition 2010). Large-scale timber harvesting operations will also continue in the region (Piva and Cook 2011). Strip mining and residential development is not expected to increase dramatically during the 25-year permit term. Other projects in the cumulative effects area could include additional overhead transmission lines, telecommunications towers, or single residential or industrial wind turbines.
Future Impacts

It is expected that the traditional uses of farming, logging, mining, gas exploration and extraction, and rural residential development will continue to occur in the foreseeable future, and these activities will affect cultural resources primarily though changes in the visual character of the area. This will occur in much the same way as the recent past. However, it is reasonable to assume that the pace and extent of mining, logging, or development could increase or decrease in the future in response to local, regional, and national trends, and that activities such as oil and gas exploration and extraction activities could increase. Assuming these types of changes have the ability to adversely impact cultural resources, they could contribute to cumulative adverse effects if they were to occur close to or within sight of the identified NRHP-eligible resources.

The Phase II Project has the potential to affect cultural resources through noise, land clearing, construction, and changing the visual character of the area. The Phase II Project would incrementally add to overall cultural resource impacts when combined with past actions and reasonably foreseeable future actions. Potential cumulative cultural impacts may arise from interactions among the Proposed Action and alternatives and the cultural effects of other projects or activities causing noise, land clearing, construction, or changes to the visual character of the area on NRHP-eligible resources in the cumulative effects analysis area (i.e., 5-mi buffer from outermost turbines and the 6,860-acre leased area).

Under both Alternative 1 (No-Action) and Alternative 4, cumulative cultural effects would be primarily limited to those caused by existing, on-going land use activities in the area (i.e., primarily logging, mining, oil and gas explorations) and the construction and operation of the Phase I Project. Architectural cultural resources with views of the Phase I Project, including approximately 20 NRHP-eligible sites (BHE 2008), would experience cumulative visual effects from Alternatives 1 and 4. Visual effects on cultural resources are limited to sites where wind turbines are visible from the resource. BHE (2008) concluded that the Phase I Project would have adverse visual and cultural effects to the 20 sensitive cultural resources with views of the Project. These NRHP-eligible sites would also be exposed to visual impacts associated with logging, mining, and other traditional activities. Cumulatively, the visual impacts of the 67-turbine Project and the visual impacts from logging, mining; and other land changing activities affect the feeling, setting, and association of the rural landscape. These cumulative effects on cultural resources would constitute a moderate cumulative effect on cultural resources under Alternatives 1 and 4, and as noted in Section 5.11.1, visual impacts to NRHP-eligible resources are considered significant adverse effects.

Under both Alternative 2 (Proposed Action) and Alternative 3, the effects to historic structure and archaeological cultural resources would be very similar to those expected under Alternative 1 or Alternative 4 due largely to avoidance and minimization. BRE and its consultants analyzed potential effects to properties located within 5 mi of the 33 turbines for Phase II (Gray & Pape 2012). The effects report for the Phase II Project architectural resources was completed in March 2012 (Gray and Pape 2012), and on April 6, 2012, the West Virginia SHPO concurred with the effects analysis (WVDCH 2012). The Service is in agreement that there are two NRHP-eligible properties within the APE of the expansion area: the Mt. Urim Baptist Church and Cemetery, and the Duo Historic District. The report concluded that the Mt. Urim Church will not be adversely affected by the Project because existing vegetation screen views of the church and noise levels during construction and operation will be masked by existing ambient noise. The Service questioned whether absence of trees sometime in the future would make a significance difference in effect, especially at the Mt. Urim churchyard where trees blocking turbine views are in the foreground (USFWS 2012b). For this reason, the Service will send the effects report to the Mt. Urim Church and invite their participation in the MOA should they have concerns.

The Service concurs with the findings in the report that the Duo Historic District will have additional turbines within its viewshed, which add cumulatively to existing viewshed effects from Phase I. These new visual effects to the Duo District must be mitigated through the development of an MOA with interested parties.

In addition to architectural effects, both Alternative 2 and Alternative 3 have the potential to affect archaeological cultural resources in areas where ground disturbance will occur. Phase I construction did
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not affect any known archaeological resources due to avoidance measures following pre-construction surveys in the disturbance areas. Surveys for archaeological resources will be conducted in ground-disturbance areas prior to Phase II construction. Impacts will be avoided to the maximum extent possible and mitigated if unavoidable. This process will be described in the MOA developed among the interested parties.

In the context of the dynamic local landscape that makes up the Phase I and Phase II Project areas (i.e., an area of approximately 300 mi²), historical and on-going land uses such as mining, oil and gas extraction, and logging affect the visual character and the feeling, setting, and association of the rural landscape. It is reasonable to assume that, together, these land uses produce moderate cumulative effects to NRHP-eligible historic structure resources in the viewsheds of these structures. The visual and cultural effects of wind turbines on historic structure resources are similarly limited to sites where the turbines are visible from the resource. BHE (2008) concluded that in the Phase I Project would have adverse visual and cultural effects to 20 sensitive cultural resources, and Gray & Pape (2011b) concluded that no additional historic structure cultural resources would be affected by Phase II. Given a relatively small number of NRHP-eligible cultural resources with views of the wind turbines over this large area, and the fact that these cultural resources and others would continue to experience the effects of historical and foreseeable on-going visual changes in the landscape from logging and mining, it is reasonable to conclude that the cumulative visual and cultural effects would continue to be moderate under Alternatives 2 and 3.

5.16.4.13 Communications
The cumulative impacts analysis area for telecommunications encompasses the Project area and nearby air space. Little or no impacts to communications facilities are anticipated to occur as a result of the proposed Project. As described in Section 5.12, Project construction and operations will have negligible effects on microwave paths, television reception, cellular and 2-way radio reception, or wireless internet reception. No other similar facilities with similar potential to disrupt telecommunications are anticipated to be constructed in the Project area or nearby for the next 25 years. Hence, there would be negligible cumulative effects to communications facilities.

5.16.4.14 Transportation
The cumulative impacts analysis area for transportation resources encompasses the ground facilities (roads, bridges, and railways) and airport facilities. Phase I construction did not interrupt transportation facilities within 5 miles of the Phase I and Phase II Project area.

Past and Ongoing Effects
Phase I Project: Built Project Impacts and Implemented Mitigation
The increase in ADT for Phase I was mitigated by having relatively short construction duration. Further mitigation was included following the WVDOT requirements for oversized loads, and meeting further WVDOT requirements that may be specific to the site area.

Phase I Project Operations and Maintenance. Once construction of Phase I was complete, the traffic associated with its operation was limited to operational maintenance vehicles. It was anticipated that 20 vehicles would enter the site each day for operational activities. This would have raised the ADT value along County Route 1 from 400 to 440. The ADT value along County Route 10/1 would have increased from 30 to 70, assuming each vehicle would have visited each turbine daily.

Future Effects
Similarly, BRE does not anticipate road closures during Phase II construction. However, construction will add to the amount of heavy truck traffic associated with turbine component delivery. Project maintenance during operations will necessitate light truck traffic that will largely be conducted on the Project area and not on state or county maintained roads. The increase in traffic and heavier loads during Project decommissioning would produce a minimal cumulative impact as facility components are delivered to
areas for proper disposal. This will be primarily in the form of road wear and tear and inconvenience to other road users.

Project layout will not affect airport facilities. There would be no cumulative effects to regional airport operations. The expansion of shale gas development has the potential to impact transportation systems in the area. No other large industrial expansion is predicted, nor is there to be an unusual increase in housing developments and population expansion that would result in increased wear and tear on existing roads beyond what would normally be expected.

Traffic and transportation resources common in the area include logging, mining, and drilling trucks. The added traffic loads are expected to have negligible cumulative effects on transportation within 5 mi of the Project area from past and ongoing activities.

5.16.4.15 Environmental Justice

None of the Project alternatives considered would be expected to adversely impact low-income or minority populations in Greenbrier and Nicholas counties.

Based on the type of development and use associated with the Project expansion, the rural demographics of the surrounding area, and the overall policies and planning recommendations contained in the Greenbrier County Comprehensive Plan, the effects of the Proposed Action on socioeconomic resource will be largely positive in nature. Temporary and permanent employment opportunities will be provided to support the local residents, businesses, and economy. Additional tax revenues will be generated to benefit local and state government programs. Existing industry (logging, mining) will be allowed to continue largely unimpeded by the Project. The Project will not displace any existing housing, or conflict with Greenbrier County’s Comprehensive or Land Use Plans. No site-specific study was conducted to assess the Project’s effects on property values. Based on some general studies in other regions and countries, evidence does not suggest that the Project will have a significant impact on the values of nearby properties. There are also no studies addressing the Project’s expected effects on future construction of new housing (e.g., second homes) in the area. Overall, socioeconomic effects are predicted to be positive, and could be viewed as significant in regard to the creation of some relatively well-paying temporary and permanent jobs within this rural area of West Virginia (particularly Nicolas County) that currently experiences median incomes below the state-wide average.

Future development of natural gas reserves in the region will likely have a positive economic effect in the Greenbrier and Nicholas counties, as well as the entire region. These activities are not expected to have a disproportionate effect on low income or minority populations. Cumulatively, there is expected to be a negligible cumulative impact on minority or low income populations resulting from implementation of the No-Action or action alternatives.

5.16.4.16 Safety and Security

The cumulative effects analysis area for health and safety issues encompasses the 6,860-acre Project area. The Project poses little risk to the public’s health and safety. Construction and operations workers at the Project will be exposed to risk, but this is expected to be minimal and does not significantly contribute to the cumulative safety and security concerns in the region. The Project’s health and safety plan addresses all measures to be implemented to avoid risk to worker safety.

Past and Ongoing Effects Impacts

Phase I Construction: Safety concerns associated with wind project construction are similar to those associated with constructing other tall structures. Workers and others on the Project site have the potential to sustain injuries from colliding with large moving equipment and vehicles, stumbling over materials and debris, falling from heights or into open excavations, and electrocution.
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BRE implemented regular safety training and use of appropriate safety equipment. As required by the WVPSC rules (150 CSR 30), BRE addressed issues such as personal protective equipment, site maintenance and waste disposal, fire prevention, and safe work practices.

Beyond the general construction issues described above, the Phase I Project construction had no adverse impacts on health and safety. The Phase I Project is located in an area of low population density. Project construction had no substantial impact on security and safety of the local settlements and communities. Construction noise was determined to be similar in character and level of that which already occurs in area. All construction personnel were trained to handle emergency situations if they occurred. During construction, contractors were required to develop their own Emergency Response Plan and training program for their employees. The Project adhered to applicable electrical codes and standards.

Phase I Operations: Operation-related effects include ice throw, tower collapse, blade shear; stray voltage and electrocution, fire, lightning, and shadow flicker. Operational effects also include noise, which is addressed in Section 5.2.

The Phase I turbines are a minimum of 1,000 ft from permanent residences and at least 450 ft from public ROW. This may not adequately protect the public from some of these safety concerns. However, unauthorized public access to the site is limited. Based upon observations and risk calculations of structural failure, modern turbine technological controls, the Project’s siting criteria, and control of public access to the turbine sites, it is unlikely that the Project will result in risks to the health and safety of the general public.

EMF at a wind project can originate from the collection system, turbine generators, transformers, and underground network cables. The primary source of EMF from the Project is the generation lead lines used to connect the Project substation to the existing Allegheny Power Grassy Falls substation. This generation lead line is approximately 14.2 mi and comes within 1,000 ft of residences. Given its size of 138 kV, the generation lead line is not likely to emit electric fields that exceed the limit of 5 kV/m set by the ICNIRP.

There is some public concern that flickering light can have negative health effects, such as triggering seizures in people with epilepsy. Flicker frequency is dependent on rotor frequency, which is around 0.5 Hz to 1.0 Hz (NRC 2007). According to epilepsy research, frequencies below 10 Hz are unlikely to cause epileptic seizures (British Epilepsy Foundation 2010).

No state or national standards exist for frequency or duration of shadow flicker from wind turbine projects. However, studies and guidelines from Europe and Australia have suggested a threshold of 30 hours of shadow flicker per year to indicate a significant effect; that is, a measure of when shadow flicker is likely to become an annoyance (Dobesch and Kury 2001, Danish Wind Industry Association 2003, Sustainable Energy Authority Victoria 2003).

Travelers along nearby roads could experience shadow flicker from turbines while driving, which could be problematic. However, overall exposure to the Project’s shadow flicker would be comparatively minimal and not substantially different from shadow flicker associated the sun shining through trees, utility poles, and other obstructions. Residences are located more than 3,500 ft from the Project. Shadow flicker associated with the Project is not likely to affect residences and communities.

Considering recent past impacts that occurred in the Project area, timber harvesting and mineral development have the potential to pose threats to safety and security. Injuries and fatalities are more likely to occur in association with logging and mining activities as indicated in hours-based rates of fatal injury risk per standardized length of exposure (US Bureau of Labor Statistics 2009) than in association with constructing and operating a wind project. In 2010, fires accounted for 35% of on-the-job fatalities in West Virginia (US Bureau of Labor Statistics 2011). This includes the 29 fatalities from the Upper Big Branch mining disaster.
The potential impacts resulting from future conditions is likely similar to the current safety and security risks. The No-Action, Proposed Action, and other action alternatives are expected to have negligible cumulative effects to safety and security in the affected area.

5.17 Unavoidable Adverse Effects

Pursuant to NEPA regulations (40 CFR 1502.16), this DEIS identifies significant environmental effects that cannot be avoided if the proposed Project is implemented. Issuance of the ITP with Full Implementation of the HCP and APP is likely to result in bat and avian mortality, which is unavoidable. The mortality rates estimated for the Project mortalities would be considered adverse effects to individual bats and birds. The estimated levels of loss caused by the Project have the potential to result in significant adverse effects to tree-roosting migratory bats at the population level, but this is uncertain due to the lack of knowledge surrounding populations of tree-roosting migratory bats. The Project has the potential to kill regionally rare birds, and could have effects to small, local, breeding populations of declining species, such as the golden-winged warbler. Losses in the local populations of rare birds would be an unavoidable adverse effect. The Project has a moderate to high likelihood of taking eagles, which can be reduced and mitigated. Any eagle mortality would be a significant adverse effect. In the APP, BRE has addressed measures to implement in the event of eagle mortality.

Phase I of the Project has had an adverse effect on the integrity and character of certain architectural resources that are NRHP-eligible and will continue to affect these resources for the life of the Project under all alternatives. The WVDCH considered visual impacts to NRHP-eligible architectural resources within view of Phase I to be significant and required BRE to contribute funding to a local historic district as part of an MOA. The Proposed Action and Alternative 3 would add additional turbines to the viewshed from construction of the Phase II turbines, and would cumulatively add to existing Phase I adverse visual effects to certain architectural resources that are NRHP eligible. These adverse visual effects from Phase II would continue to affect those resources for the life of the project until decommissioning. Phase II effects will be addressed through development of a new MOA with interested parties.

5.18 Short-Term Uses and Long-Term Productivity

Pursuant to NEPA regulations (40 CFR 1502.16), this DEIS considers the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. The short-term uses of the environment associated with the action alternatives would include those typically found with construction activities. There would be short-term effects to air quality, noise, and biological resources. Short-term effects can be compared to the long-term benefits of the action alternatives, i.e., the production of clean, renewable energy for the State of West Virginia for at least 25 years.

Implementation of the Proposed Action or any of the 3 action alternatives would include applying the mitigation and conservation measures described in the Project HCP, APP, and in this DEIS. These measures (on-site or off-site habitat protection and management in perpetuity) would bring long-term benefits to local populations of the Indiana bat and Virginia big-eared bat.

Under the Proposed Action or Alternative 3, of the 531 acres of mixed-age forest cleared for both phases, 460 acres would undergo natural forest succession for 25 years or more after construction, before reaching the original condition at harvest. The Project would convert 71 acres of forested habitat to built facilities for the life of the Project. This will have long-term effects to forest productivity on the 71 acres. After the 25-year project operating life of the project, these 71 acres would be reclaimed during decommissioning and permitted to recover. It would take another 25 years or more after decommissioning before these areas reached the original condition, if not harvested sooner by the landowner. The presence of the Project is not likely to prevent silvicultural activities or hinder forest productivity in the surrounding industrial forest.

Under the No-Action Alternative and Alternative 4, of the 386 acres of mixed-age forest cleared for Phase I, 336 acres would undergo natural forest succession for 25 years or more after construction before reaching the original condition at harvest. The Phase I Project has converted 50 ac of forested habitat to
built facilities for the life of the Project. This will have long-term effects to forest productivity on the 50
acres. After the 25-year project operating life of the project, the 50 acres would be reclaimed during
decommissioning and permitted to recover. It would take another 25 years or more after
decommissioning before these areas reached the original condition, if not harvested sooner by the
landowner. The presence of the Phase I Project is not likely to prevent silvicultural activities or hinder
forest productivity in the surrounding industrial forest.

In addition, long-term unavoidable impacts associated with operation and maintenance of each of the four
alternatives would include changes in community character due to the visibility of the project and a
potential minor increase in noise levels at some receptor locations (residences) near the project area.

5.19 Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained such as the extinction of a
species or the removal of minerals. Irretrievable commitments are those that are lost for a period of time
such as the temporary loss of timber productivity in forested areas that are kept clear for use as a power
line ROW or road. These commitments represent losses to future options. This terminology often applies
to the use of non-renewable resources such as minerals, fuels, or cultural resources, or to those factors
that are renewable only over long periods of time, such as soil productivity.

Because the Project has potential to kill birds and bats, there are potential long term impacts to the
restoration of potentially declining populations. With respect to losses in endangered bats, compensation
may serve to fully mitigate this impact, but there is an opportunity cost and added risk associated with the
death of endangered bats. The loss of birds and bats in association with the Project would be an
irretrievable commitment of resources for the life of the Project and perhaps for considerably longer,
especially for species, such as bats, that have low reproductive capacities.

Under the Proposed Action or alternative 3, the Project would change the use of approximately 71 acres
of managed forest for the life of the Project. Production and use of timber products that would ordinarily
occur will be replaced with built facilities. Thus the loss of forest products during this time would be
irretrievable. However, turbines would be removed during decommissioning, and the land would be
restored to grasses, which over time would be expected to undergo natural succession, changing to a
shrub-dominated community in approximately 10 years and eventually to a forest in 25 years; such land
use would be reversible.

The Project affects the integrity and atmosphere of architectural resources that are NHRP-eligible. For all
alternatives, turbines would continue to affect the atmosphere of these historic sites for the life of the
Project. This would be an irretrievable commitment of these resources in that 25-year period.

One other irreversible commitment worth noting for all alternatives is the loss of soil productivity resulting
from conversion of forest land to access roads, turbine pads, and buildings for 25 years. Even when this
area is reclaimed during decommissioning, the loss of soil productivity could only be renewed over a long
period of time.

5.19.1 Direct and Indirect Effects Presented by Alternative

5.19.1.1 Alternative 1: No-Action Alternative

Under the No-Action Alternative, irretrievable commitments would be the alteration of 386 acres of
deciduous forests, loss of interior forest for wildlife, loss of animals during construction and operation.
Forest habitat would be allowed to regenerate in some temporarily disturbed areas and for the entire
Project area following decommission (25 operational years). Forest animals lost during construction would
recover to some extent. The Project would change the use of approximately 50 ac of managed forest for
the life of the Project. Production and use of timber products that would ordinarily occur will be replaced
with built facilities. The loss of forest products during this time would be irretrievable. However, turbines
would be removed during decommissioning, and the land would be restored to grasses, which overtime
would be expected to undergo natural succession, changing to a shrub-dominated community in approximately 10 years and eventually to mature forest in 25 years; such land use would be reversible.

The Phase I Project affects the integrity and atmosphere of architectural resources that are NHRP-eligible. Turbines would continue to affect the atmosphere of these historic sites for the life of the Project. This would be an irretrievable commitment of these resources in that 25-year period.

5.19.1.2 Proposed Action – ITP with Full Implementation of HCP

Irreversible and irretrievable commitments as a result of implementing the Proposed Action would be the alteration of 531 acres of deciduous forests, loss of interior forest for wildlife, loss of animals during construction and operation. Forest habitat would be allowed to regenerate in some temporarily disturbed areas and for the entire Project area following decommissioning (25 operational years). Forest animals lost during construction would recover to some extent. However, operational impacts to wildlife would be on-going for the life of the Project; they include killing birds and bats. Conservation measures implemented through protection of habitat would attempt to mitigate losses of endangered bats.

The Project would change the use of approximately 71 acres of managed forest for the life of the Project. Production and use of timber products that would ordinarily occur will be replaced with built facilities. The loss of forest products during this time would be irretrievable. However, turbines would be removed during decommissioning, and the land would be restored to grasses, which overtime would be expected to undergo natural succession, changing to a shrub-dominated community in approximately 10 years and eventually to mature forest in 25 years; such land use would be reversible.

5.19.1.3 Alternative 3: Additional Covered Species Addressed in ITP and Habitat Conservation Plan

Irretrievable and irreversible commitments under Alternative 3 would be for the same resources as described under the Proposed Action. Operational impacts include the potential to take endangered bats. However, increased conservation measures may further offset the estimated loss through protection of habitat and funding for research and monitoring activities. Operational restrictions would be modified to increase cut-in speeds which may reduce overall mortality. Further restricted operations over a longer season and for entire nights may further reduce the likelihood of mortality of endangered bats and all bats.

5.19.1.4 Alternative 4: ITP with Full Implementation of Habitat Conservation Plan for Phase I Only

Irretrievable and irreversible commitments under Alternative 4 would be for the same resources as described under the No-Action Alternative. In addition, operational impacts include the potential to kill endangered bats, unlisted bats, and birds. Conservation measures through protection of habitat for listed bats would attempt to offset losses of endangered bats.