Oregon's High Desert and Wind Energy

Opportunities and Strategies for Responsible Development




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Hells Canyon Preservation Council
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Western Environmental Law Center
WildEarth Guardians

Oregon Natural Desert Association (ONDA) is a nonprofit conservation organization that exists to protect, defend, and restore Oregon's native desert ecosystems for current and future generations.

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Executive Summary

Oregon's high desert has world-class wildlife and wildland values that deserve protection. Likewise, the region has outstanding wind power resources that could be developed as part of state and national efforts to create energy independence and develop clean sources of renewable energy. Oregonians have the opportunity to develop wind energy responsibly. The key to successful development will be siting wind power strategically in areas suitable for wind power facilities after taking into account other valuable resources in those areas. As interest in constructing utility-scale wind power facilities increases, siting decisions that allow wind power to be developed in a way that protects special landscapes and sensitive wildlife will mutually benefit wind power companies, government entities, local communities, and the larger public.

This report provides an initial analysis of wildlife habitats and landscapes sensitive to wind developments throughout Oregon's high desert. Some of these lands and species are sufficiently sensitive or unique to require the exclusion of wind energy development altogether, while other categories would permit wind energy development if certain best practices are implemented. By overlaying wind resource potential with these other natural values, a picture emerges showing where wind power development will have the least social conflict and environmental impact.

Considerations for Wildlife

Many types of wildlife are known or expected to be sensitive to industrial wind power development. Because of the propensity for wind turbines to kill birds through collisions with spinning blades and bats from air pressure trauma is established, it is preferable to site turbines in areas where there is low concentration of bird and bat activity. Roads, powerlines and other developments associated with wind projects can also lead to habitat fragmentation and the displacement of wildlife from preferred habitats, particularly for sensitive species such as Greater sage-grouse (*Centrocercus urophasianus*).

Potential impacts on big game in areas such as winter range have been suggested by studies examining ungulate reactions to various types of infrastructure and disturbance similar to what may be encountered during development and/or operation of a wind development site. Potential impacts on small mammals remain poorly understood and more study is needed to reach definitive conclusions. Overhead powerlines and other infrastructure can lead to an increase in perching and nesting sites for predatory birds, significantly increasing the predation risk to small mammals and birds in the area.

It is important to consider that existing traditional land protection categories may not be sufficient to protect critical wildlife populations. It is important also to consider impacts that occur in the airspace. Placement of turbines in low value habitats and developed landscapes can cause significant impacts if the airspace is used by high concentrations of birds or bats. It is critical to consider both the terrestrial habitat and wildlife usage of the airspace.

Sensitive Landscapes

Oregon is known throughout the world for its iconic western landscapes. Many of these, like national parks, wilderness areas, and wilderness study areas, have been placed off-limits to industrial activities by federal law or regulation. Others, such as roadless areas and Areas of Critical Environmental Concern, have limited protective designations which would tend to hinder the timely development of wind projects and might preclude development in some cases. There is a third category of lands, Citizen Proposed Wilderness, which may lack formal protection at present but have a high public profile, strong scenic values, and sensitive wildlife habitat and therefore development would potentially face stiff public opposition.

Historical and cultural sites and trails are typically protected by federal law which requires that the sites as well as their historic settings be protected. Overall, open spaces in Oregon are highly valued, which means that projects that do not impair prominent viewsheds are less likely to face opposition. By steering wind projects away from lands where industrial development would be controversial, wind developers can reap the benefits of maintaining their "green" credentials and achieve a speedier approval process that enjoys strong and broad public support.

Prioritizing Wind Power Development in Oregon

When sensitive resources are overlaid with wind power potential on a map of Oregon, it becomes apparent that some areas are unlikely prospects for wind energy due to low winds or multiple environmental sensitivities, while other areas have strong wind resources according to National Renewable Energy Laboratory (NREL) data and fewer resource conflicts.

For the purposes of this analysis, some lands were treated as "exclusion areas" because legal restrictions associated with state and/or federal law effectively preclude development of these areas. Other areas were treated as "high conflict" areas because of wildlife habitat values, federal designations, and/or citizen proposed wilderness areas that are likely or known to be incompatible with industrial scale wind development. "Moderate conflict" areas included a variety of areas where additional and in some cases extensive mitigation and monitoring would be required as part of any proposed development (see Table 1). For mapping purposes, "moderate conflict" areas were included with "low conflict" areas. Conflict levels within 3 miles on each side of existing transmission lines were reduced one level to acknowledge the potential advantages and benefits of developing projects along pre-existing transmission lines rather than in currently unfragmented habitats.

There are approximately 6.8 million acres of land in the study area that have low or moderate potential for environmental or social conflict, 13.6 million acres with high potential for conflict and 3.8 million acres that are currently excluded from development. As illustrated in Map 1, there are approximately 467,000 acres of low to moderate conflict areas that our analyses show have high wind resource (NREL Class 3 or greater). There are an additional 927,000 acres that have similarly high wind resource but have potentially high natural resource or social conflicts. Approximately 691,000 acres with high wind resource potential are currently excluded from development.

Map 2 outlines currently proposed wind projects and illustrates whether these projects are proposed in high, moderate or low conflict areas. Appendix A includes maps showing the proposed projects on a county-by-county basis.

Table 1. Summary of environmental and social conflicts used in mapping analysis

Exclusion Areas	**High Conflict Areas**	**Moderate Conflict Areas**
Wilderness Areas	Sage-grouse leks-3 mile buffer	Sage-grouse leks-5 mile buffer
Wilderness Study Areas	Research Natural Areas	TNC Portfolio Sites
Steens Mountain Cooperative Management and Protection Area (CMPA)	Steens Mountain Geothermal/Mineral Withdrawal Area	State of Oregon Conservation Opportunity Areas
State Scenic Waterways	Citizen Proposed Wilderness	High Desert Trail
State and **National Wildlife Refuges**	Areas of Critical Environmental Concern	Historic Trails
BLM-VRM Class I	BLM-VRM Class II	
National Parks/Monuments	Bighorn Sheep Habitat	
Wild and Scenic Rivers	Sensitive Bat Habitat	
USFS Roadless Areas		

Site-specific research and a growing understanding of wind development impacts may reveal unforeseen impacts in these areas however we encourage developers and permitting authorities to first consider development in these areas. By doing so, Oregon will be able to reach our renewable energy goals while ensuring that Oregon's outstanding landscapes and fully functioning ecosystems are preserved.

In developing wind projects, we also propose the following siting recommendations:

1) Conduct at least two years of pre-development environmental studies using standardized methods which demonstrate the proposed site's comparative limited use by, and importance to, sensitive wildlife and plant species. These studies should pay special attention to breeding and rearing habitat, movement corridors and habitat connectivity.

2) Exclude from wind power siting and transmission line construction consideration the following areas: National Parks, Wildlife Refuges, USFS Roadless Areas, Wilderness,

Wilderness Study Areas, Important Bird Areas and areas within 3 miles of greater sage-grouse leks.

3) Establish support from county government and from municipalities located within 5 miles of a project.

4) Avoid viewshed impacts on historic trails and sites, National Parks, Wilderness, Wild and Scenic Rivers and other high-value recreation areas including the Steens Mountain Cooperative Management and Protection Area and Hart Mountain National Wildlife Refuge.

5) Prioritize potential wind development sites located near existing power transmission infrastructure, final customers, or areas of previously disturbed or converted lands such as agricultural fields.

6) Conduct comprehensive evaluations of conditions and resources at potential sites consistent with the Oregon Columbia Plateau Ecoregion Wind Energy Siting and Permitting Guidelines.

7) Prepare studies, development and mitigation plans and conduct the permitting process to ensure protection of natural resources by following the Oregon Energy Facility Siting Council's site certification process or a local process that involves an equivalent level of mandatory and enforceable resource protection standards and that considers cumulative impacts of wind development throughout Oregon's high desert.

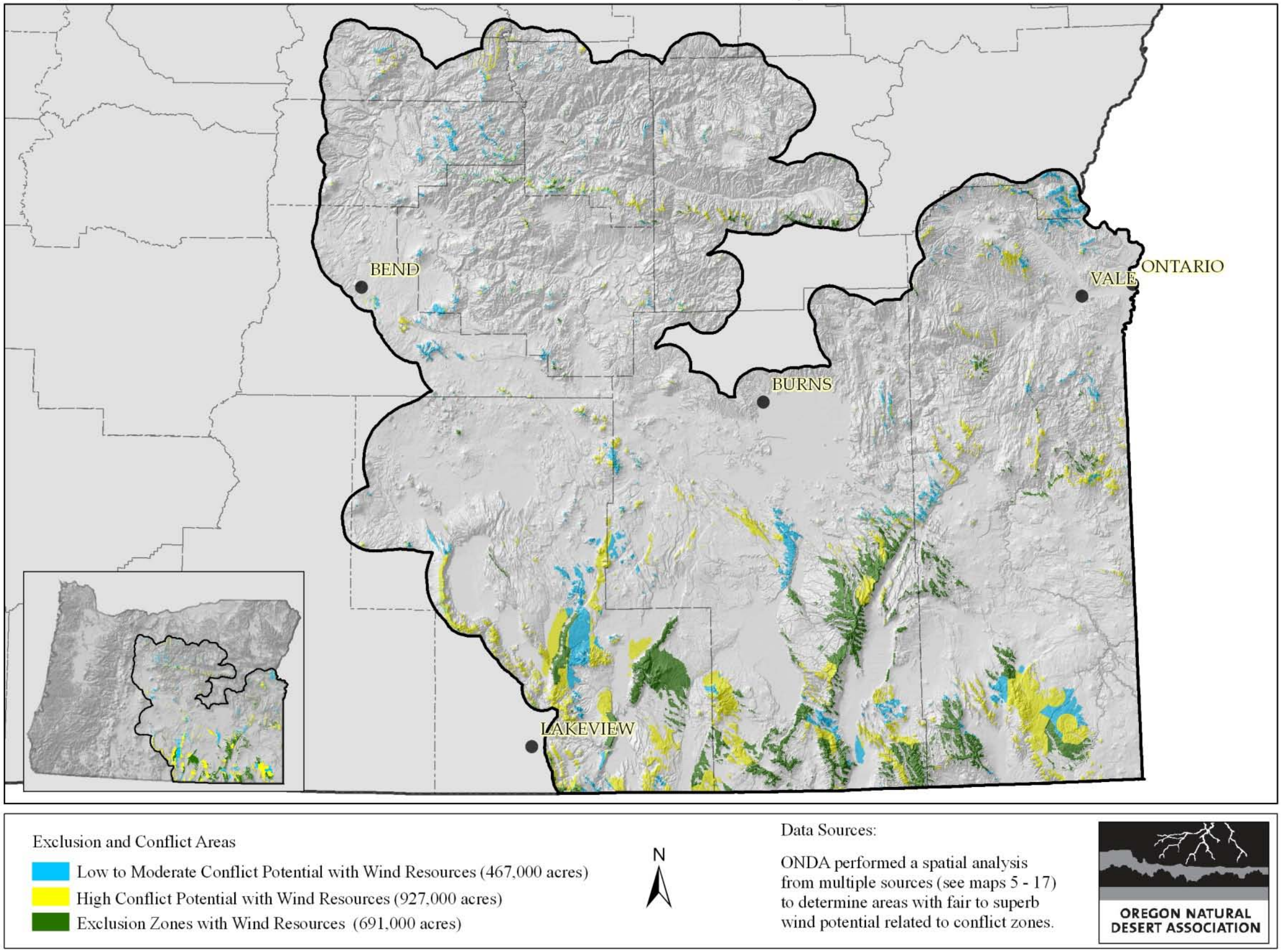
Conclusion

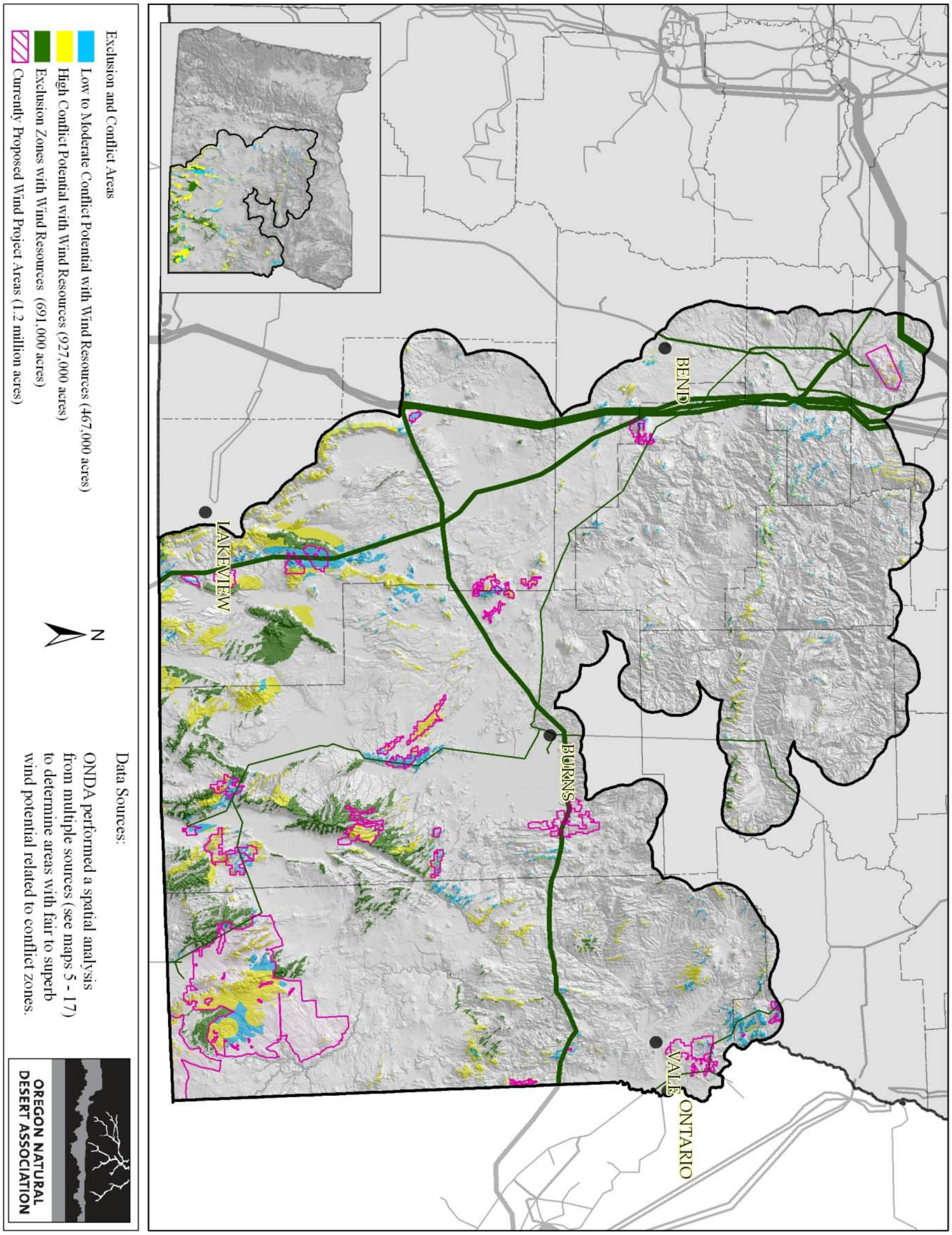
Developing wind energy within Oregon's high desert in a way that is sensitive to wildlife and protects important landscapes can be achieved. This report identifies both areas of high development potential and a proposed process for moving forward. We suggest that these areas be considered first for wind development and that within these areas, previously disturbed habitats such as cropland be prioritized. This report is intended to be a work in progress; vulnerable species may have been overlooked during completion of this report and as our understanding of wind development grows, such research should be incorporated into decision-making and planning. Oregon's high desert is an area that is relatively understudied and there are gaps or biases in the report due to data unavailability. We have done our best to draw relevant studies from both Oregon's high desert and beyond to address this insufficiency. This report is not meant to substitute for on-the-ground studies but to provide initial guidance that will be further informed by future research and local studies.

Lastly, as outlined in the report, wind development needs to be considered in terms of cumulative effects. Currently, projects are being approved on an individual basis with no collective evaluation of social and environmental impacts. We are concerned that such an approach could have significant impacts on wildlife and landscape connectivity. We strongly encourage a planned approach to wind development that includes prioritizing development of transmission lines in locations that encourage wind and other renewable energy development in areas with lower social and environmental conflicts. Wind energy promises to play a significant role in providing clean energy and strong job creation in areas that need it most but it must not be done in a way that fails to recognize and address its true costs.

Map 1

Wind Power Resource Analysis




Map 2
Wind Power Resource Analysis
BEND
LAKEVIEW
BURNS
VALE
ONTARIO
N
Exclusion and Conflict Areas
Low to Moderate Conflict Potential with Wind Resources (467,000 acres)
High Conflict Potential with Wind Resources (927,000 acres)
Exclusion Zones with Wind Resources (691,000 acres)
Currently Proposed Wind Project Areas (1.2 million acres)
Data Sources:
ONDA performed a spatial analysis
from multiple sources (see maps 5 - 17)
to determine areas with fair to superb
wind potential related to conflict zones.
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Introduction

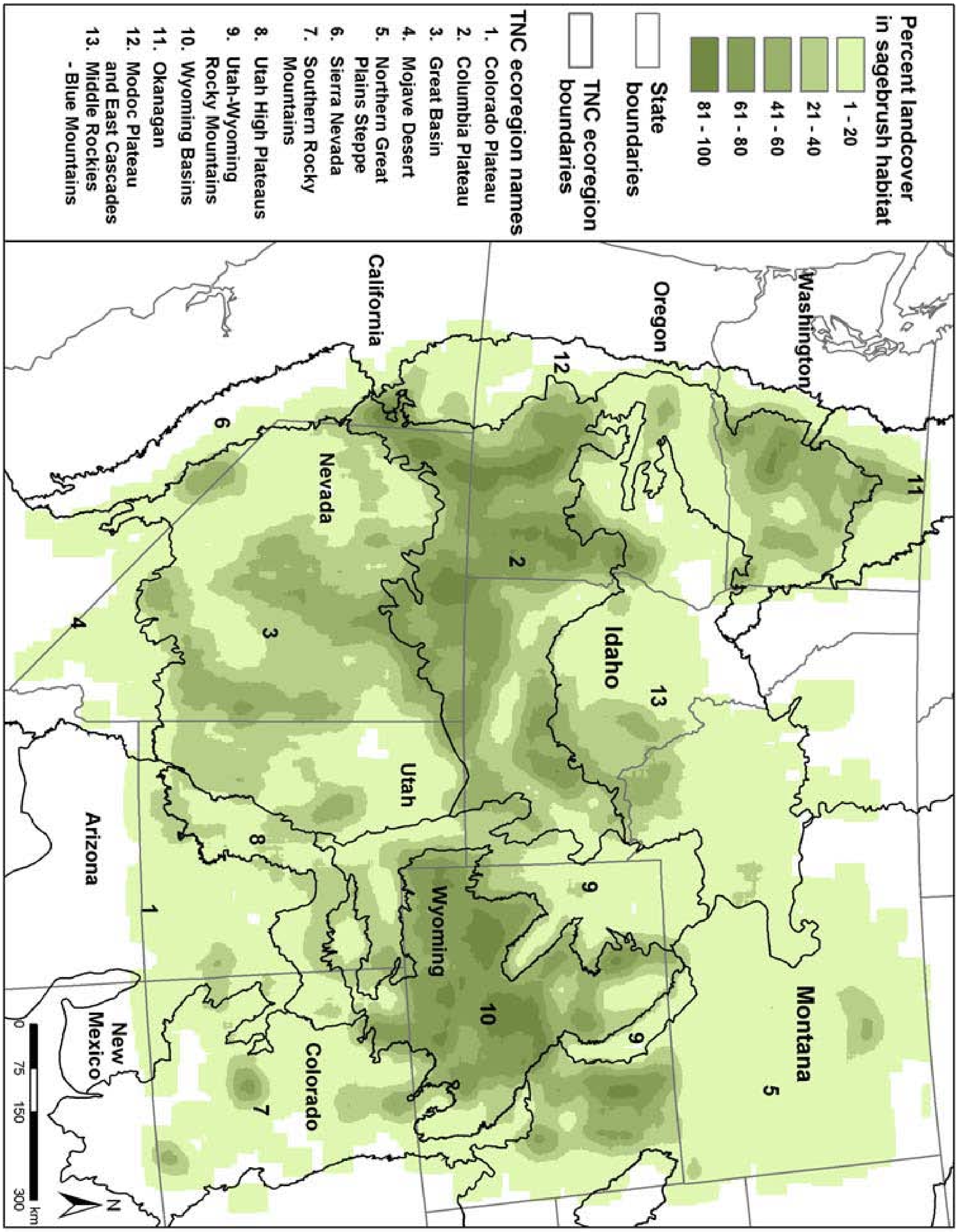
Across Oregon and the country, there is an unprecedented surge in renewable energy development from sources such as wind, solar and geothermal. Proposals for wind development have become particularly common with over a dozen projects proposed in Eastern Oregon during 2008. With the State of Oregon committed to supplying 25 percent of the state's electric power from new renewable sources by 2025 and US Department of Energy's (USDOE) goal of producing 20 percent of US energy production from wind by 2030 (USDOE 2008), proposals for new wind development are likely to continue in Oregon's high desert.

Although wind energy is prominently featured in the nation's quest for green energy, it is important to remember that there are several other sources of green energy that are also potentially available in Oregon's high desert including solar and geothermal. A later report will likewise analyze the potential impacts and benefits from these other potential energy sources. In addition, small-scale energy projects are also becoming more viable and thus may foster future development associated with individual homes and already developed urban areas.

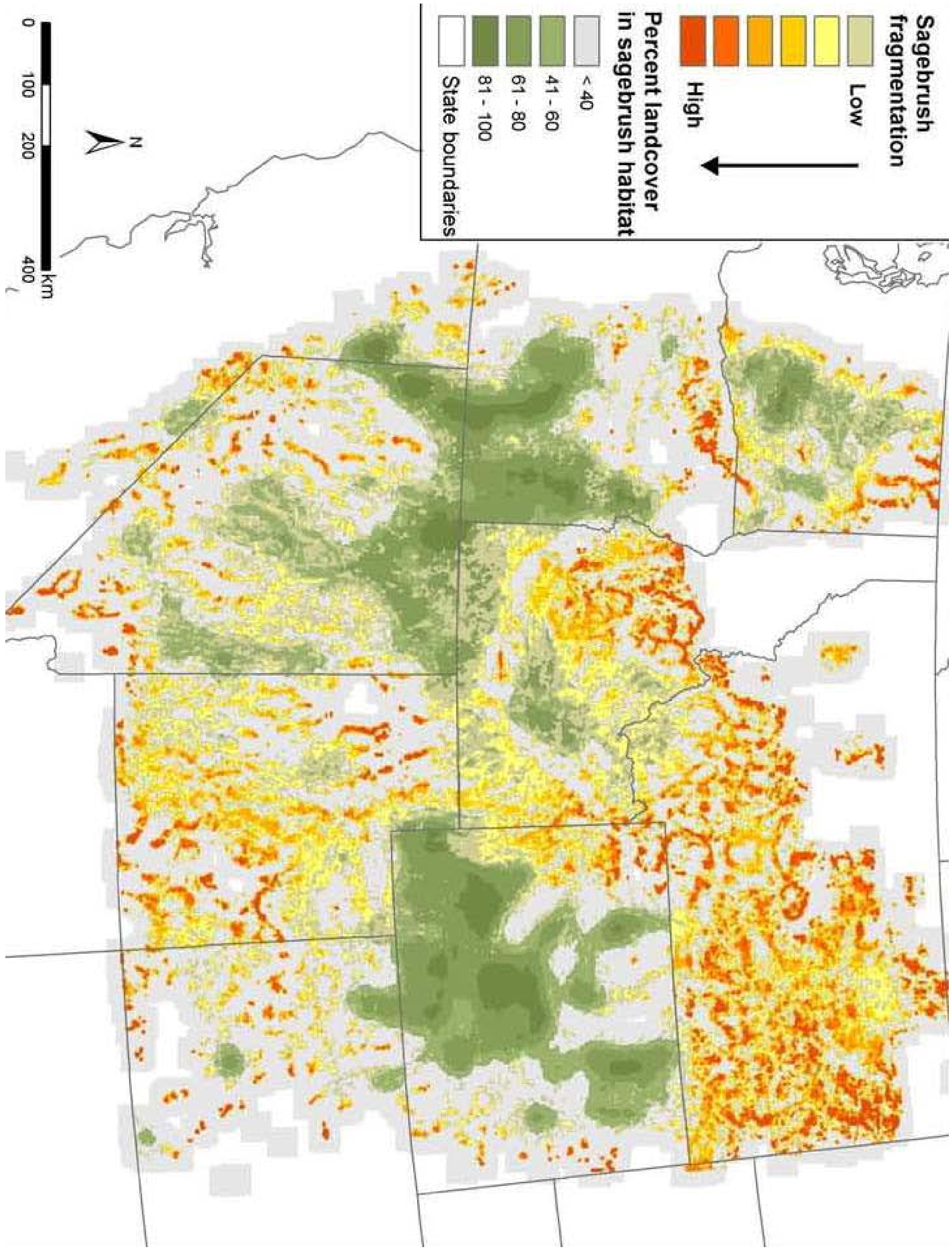
Although Oregon ranks 23rd in wind energy potential among US states, it ranks 8th in current wind capacity among all states with a 438 mW capacity (Wind Today, 2008). Wind potential exists in Oregon's high desert, both on private lands and, on public lands managed by the Bureau of Land Management (BLM). To-date, wind development in the region has been largely confined to wheat fields and other already developed lands. The more recent push for large-scale wind energy development in currently undeveloped areas poses impacts to sensitive wildlife species and iconic landscapes and therefore more potential for public concern.

Photo 1. Wind turbines in Sherman County (C. Miller)

The development of industrial energy generation and new transmission lines in southeast Oregon would likely degrade wildlife habitat, ecological communities, and fragment important areas of the remaining sagebrush steppe ecosystem. Noss et al. (1995) identified the sagebrush steppe as the 3rd most degraded ecosystem of the United States. Another review (Sagebrush Sea, 2007) identified numerous threats to the sagebrush ecosystem including fragmentation by utility corridors and roads. Within the shrub-steppe ecosystem, southeastern Oregon is an area of relatively unfragmented habitat and very high bird and mammal species diversity (Maps 3 and 4). Therefore, the biological value of the region is of national significance.



MAP 3. Distribution of sagebrush (from Knick et al. 2003). Map depicts percent of land cover within 25-km radii of each map cell dominated by tall sagebrush, produced by resampling the base map to a 2.5 km resolution ***[REPRODUCED FROM DOBKIN AND SAUDER 2004:6]***



Map 4. Sagebrush distribution is highly fragmented and much less extensive than large-scale maps suggest. The map depicts the ratio of the percent of land cover containing sagebrush (Map 1) to the amount of perimeter with other habitats. Dark-green areas indicate extensive distribution of sagebrush as the dominant feature in the landscape (area is much larger that perimeter), grading into gray areas (small area, small perimeter), and crossing a threshold at which fragmentation of sagebrush patches (low area, high perimeter) becomes the dominant landscape feature. Small-scale measures of perimeter were estimated by resampling the base map to a 500-m resolution and measuring the proportion of total edge between sagebrush and other habitat patches within 2.5 km of each map cell. ***[REPRODUCED FROM DOBKIN AND SAUDER 2004:7]***

Wind facilities cover a large area and require extensive road systems and transmission corridors. The impacts of wind developments on biodiversity is still largely unknown although a growing number of studies have documented impacts of wind development on wildlife, particularly birds and bats (Kunz et al. 2007, Stewart et al. 2007). These impacts have been caused by:1) destruction and fragmentation of habitat; 2) displacement of species caused by turbines, transmission lines and other associated development; and 3) direct mortality.

Concerns regarding human health disturbances have been raised by people living in the vicinity of wind developments, however, in many cases these concerns have not been substantiated by scientific research. Complaints and testimonies have typically focused on noise, flicker, vibrations, and lighting disturbances created by wind farms (Pedersen and Waye 2004). The impact and range of impact was found by residents to be much more significant than were originally described by developers. Other more acute safety concerns focus have focused on lightening strikes on wind towers, ice thrown from blades, and the growing number of documented cases of collapsing or "exploding" turbines/towers (Galbraith 2008).

To ensure that unnecessary conflict and impacts are avoided, this report outlines an approach to developing wind energy that protects open space and native ecosystems and is an asset to local communities. We believe that the thoughtful siting of wind energy facilities, creation of permitting processes that ensure adequate evaluation and mitigation of impacts, and the adoption of Best Practices can ensure that wind energy development is successful and avoids unnecessary conflicts with other public interests.

The intent of this report is to provide a blueprint for wind power development in Oregon's high desert by outlining: 1) potential conflicts between wind development and social and environmental values; 2) where wind might be developed while minimizing impacts to other resources; 3) where development shouldn't be attempted due to the high level of conflicts inherent to a particular site; 4) best practices for wind development; and 5) process guidelines that will ensure that the public is adequately involved in project permitting.

It is our hope that this report will help guide wind power planning on a regional scale so that wind power generation can be expedited and fostered in areas with the least conflict, while ill-advised forays into Oregon's most sensitive desert landscapes will be prevented. If wind power development is pursued in this manner, controversy and protracted conflicts can be avoided to the mutual benefit of the industry, our lands and wildlife, and the people of Oregon.

Wind Power and the Solution to Global Climate Change

Wind power generation is seen as part of a solution to the problem of global climate change. Global climate change is driven by the production of carbon dioxide (CO_2) and other "greenhouse gases" (IPCC 2007). Global climate change is a serious environmental crisis, causing rising sea levels, disappearance of certain habitats, changes in patterns of droughts and floods, and serious losses in biodiversity worldwide. To the extent that wind power displaces forms of electrical generation that emit greenhouse gases, it can be part of the solution to global climate change.

While the coal industry touts the potential of “clean coal,” all coal-fired electrical generation in the U.S. at the present time is “dirty” from the perspective of carbon dioxide emissions, because there is presently no commercial coal-fired power plant in the United States that is sequestering its carbon dioxide to prevent emissions of CO_2. In 2005, electrical power generation produced 39 percent of all CO_2 emissions in the United States (National Research Council 2007). Demand for electricity continues to escalate in the United States, and the increase in wind power development may not keep pace with the overall increase in demand. As a result, the increase in wind energy may not result in an overall decrease in carbon dioxide and other pollutants due to a projected escalation demand for energy (National Research Council 2007).

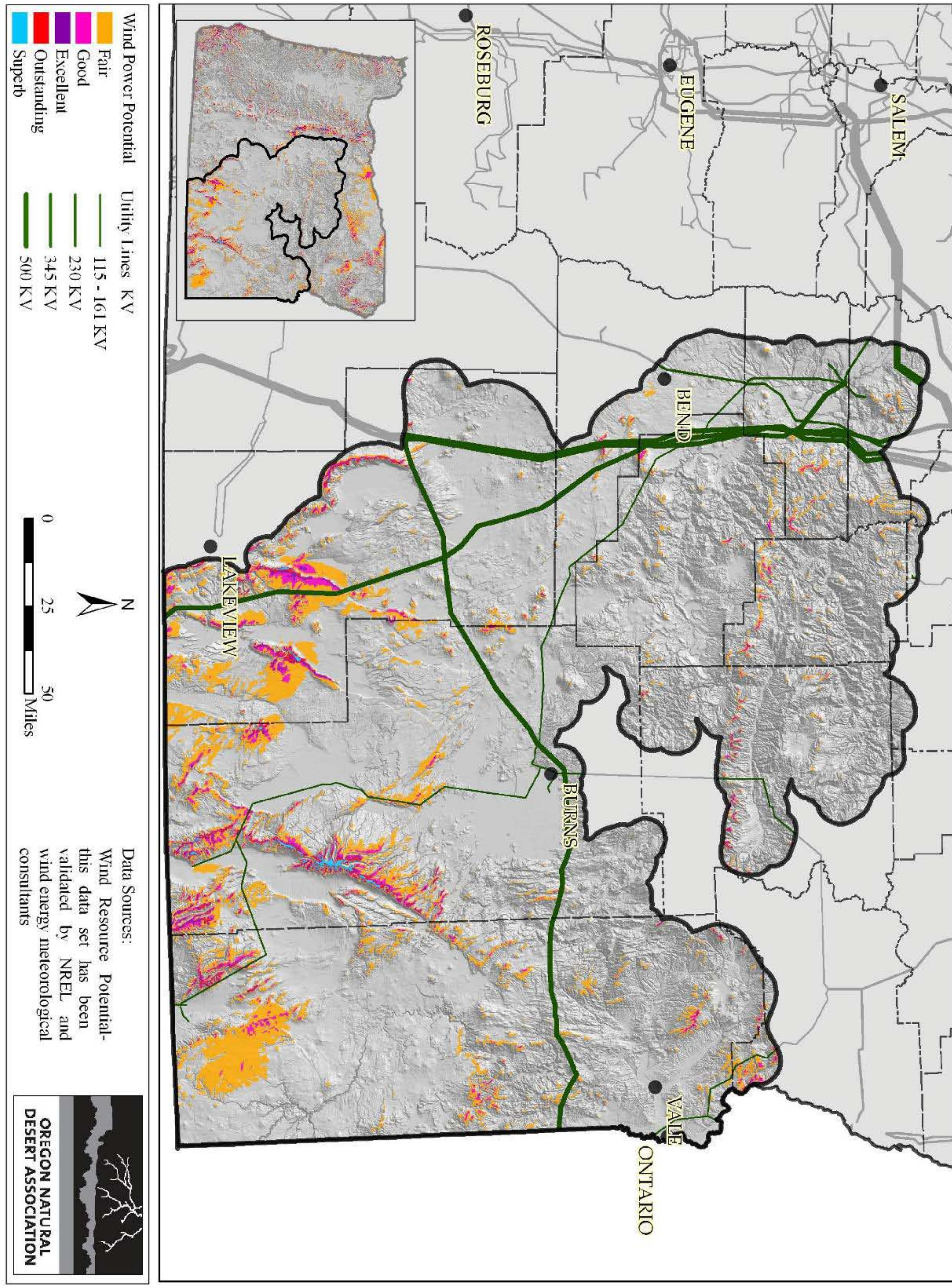
It is clear that it is in the best interests of Americans to replace fossil fuels with clean, sustainable energy sources. It is equally clear that Oregon residents have a strong interest in ensuring that a major increase in industrial wind energy is done intelligently by siting wind power facilities in areas where impacts to sensitive and treasured natural resources will be minimized.

The American Wind Energy Association (2000) projected that if all economically feasible land sites for wind energy development were installed with wind turbines, the resulting generation would supply approximately 20 percent of the nation’s electricity needs. Certainly, not all sites that are economically feasible are suitable for wind power development from an environmental or social perspective, so it is likely that wind energy will ultimately become a somewhat smaller percentage of overall electricity production in the United States. But wind energy does represent a potentially important part of a clean energy future in which it is complemented by a number of other renewable energy sources.

For the purposes of this report, we conducted analyses of likely locations for wind energy development using the National Renewable Energy Lab (NREL) wind power class 3 or higher, since those classes have the greatest potential of generating wind power with large turbines (Map 5). Technological advancements including the development of larger turbines are now allowing the development of areas with lower wind resource value.

The Economic Advantages of Wind Power

In Eastern Oregon, where historically resource extraction-based economies have experienced significant declines, wind power generation creates a potential source of steady income and highly skilled jobs, making it an asset to local communities. For local economies, wind power creates more economic input per kilowatt than either coal or gas-fired electricity generation



Map 5 Wind Power Potential and Electric Transmission Lines
SALEM
EUGENE
ROSEBURG
BEND
LAKEVIEW
BURNS
VALE
ONTARIO
Wind Power Potential
Fair
Good
Excellent
Outstanding
Superb
Utility Lines KV
115 - 161 KV
230 KV
345 KV
500 KV
N
0 25 50
Miles
Data Sources:
Wind Resource Potential- this data set has been validated by NREL and wind energy meteorological consultants
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(Tegen 2006). Wind power is a different type of energy industry that promises to employ well paid professionals who will become long-term members of local communities and yield long-lasting and steady streams of income to local economies. Thus, wind power development is much more economically sustainable than oil and gas development. Recent studies have shown that recreation and scenery provided by public lands are essential components of a quality of life that attracts and retains people and their business to western communities (Headwaters, 2008) and therefore development that balances these values with development will ultimately provide more sustainable economies.

A Blueprint for Smart Wind Development

The key to smart and responsible wind development is pairing economically-viable siting choices with methods of development that minimize conflicts between utility-scale wind power projects and sensitive wildlife and landscapes. The potential for wind turbines to kill birds and bats has been documented (Kunz et al. 2007, Kuvlesky et al 2007, Stewart et al. 2007). This potential can be minimized by siting turbine facilities away from areas where birds and bats concentrate their flying activities, such as mating and nesting sites, roosting areas, and migration flyways.

Because wind power facilities are industrial developments, often on a very large scale, they have the potential to fragment habitats and displace sensitive wildlife to other areas. Special consideration must be given in long-term planning to the fact that this fragmentation is cumulative, increasing with future development and concentration of additional sites and associated infrastructure. The wind industry and land and wildlife managers will need to develop an understanding of which species in the region are most affected by wind projects and avoid siting projects in the most sensitive areas.

Finally, there is a social element to where, how fast, and how much wind energy development is appropriate. Wind energy development should avoid the most treasured landscapes and areas, get buy-in from local communities before constructing facilities next door, and moderate the pace and scale of wind development so that the open spaces and untamed character of the Oregon desert landscape are not threatened and citizens are satisfied with the outcomes of development.

This report was developed in part using Geographic Information Systems (GIS) technology to illustrate sensitive resources and areas with the best wind power potential. The accompanying text describes the potential conflicts with wind energy development as well as Best Practices to minimize these conflicts. The analysis is based on available sensitive species data which is not a substitute for site-specific data that will need to be collected at sites prior to development. This report should be viewed as a first draft and will be updated as necessary.

This report is also designed to be a review of the scientific literature on wind power and its impacts, as a resource for industry, planners, and the public. We rely heavily in this report on studies that have been conducted across the nation on impacts of wind energy and the properties of sensitive wildlife in formulating our recommendations. Large-scale wind energy development is a relatively new phenomenon, and we rely on peer-reviewed science whenever it is available and supplement it with unpublished studies and monitoring reports that are more widely available.

Special Landscapes

There are certain special landscapes which, due to their iconic qualities, pristine nature, and biological or recreational values are not compatible with industrial use. Many of these lands have received official designations while others have not yet been officially recognized by federal and state agencies or by Congress. This section will address landscapes that enjoy special designations that preclude wind energy development by law or regulation, or where wind energy development is likely to be incompatible because these areas have been designated for other priorities. Private land inholdings exist within several of the areas described below. Because development of these lands would compromise the ecological integrity of these areas, we likewise recommend that these private lands not be considered for wind development. Viewsheds from these areas should likewise be avoided by siting turbine arrays behind intervening topography. Historic and cultural areas are discussed in a later section.

National Parks, Monuments, Refuges and Conservation Areas

National Park system units including both National Parks and National Monuments are managed under a strong legal mandate which directs the federal government to "protect and preserve" these lands and their natural resources "for the use and enjoyment of the public." National Park units are precluded from industrial development. Wind energy development would not be allowed by law in these units regardless of their wind energy potential. The Newberry Crater National Monument and the three units of the John Day Fossil Beds National Monument are two such federally-designated areas located in eastern Oregon.

Photo 2. Steens Mountain (Bruce Jackson)

Similarly, special management areas, such as the Steens Mountain Cooperative Management and Protection Area (CMPA), were established and are administered by BLM to protect specific resources. Congress passed the Steens Act and created the CMPA in 2000 to protect and restore the "long-term ecological integrity" of Steens Mountain. Utility-scale wind power development is inconsistent with the protection and restoration of the biological integrity of Steens Mountain and because the Steens Act of 2000 prohibits the construction of energy facilities on federal lands within the CMPA and geothermal/mineral withdrawal area. We recommend that the Steens Mountain and similar special management areas be viewed as areas off-limits to wind development.

Several wildlife refuges exist in Oregon's high desert including Hart Mountain National Antelope Refuge, Malheur National Wildlife Refuge, and Summer Lake State Wildlife Area. These areas provide critical habitat for shorebird and waterfowl species sensitive to direct impacts from wind turbines and habitat fragmentation. Management for these areas is inconsistent with wind development and they should likewise be considered off-limits to development (Map 6).

Wilderness and Wilderness Study Areas

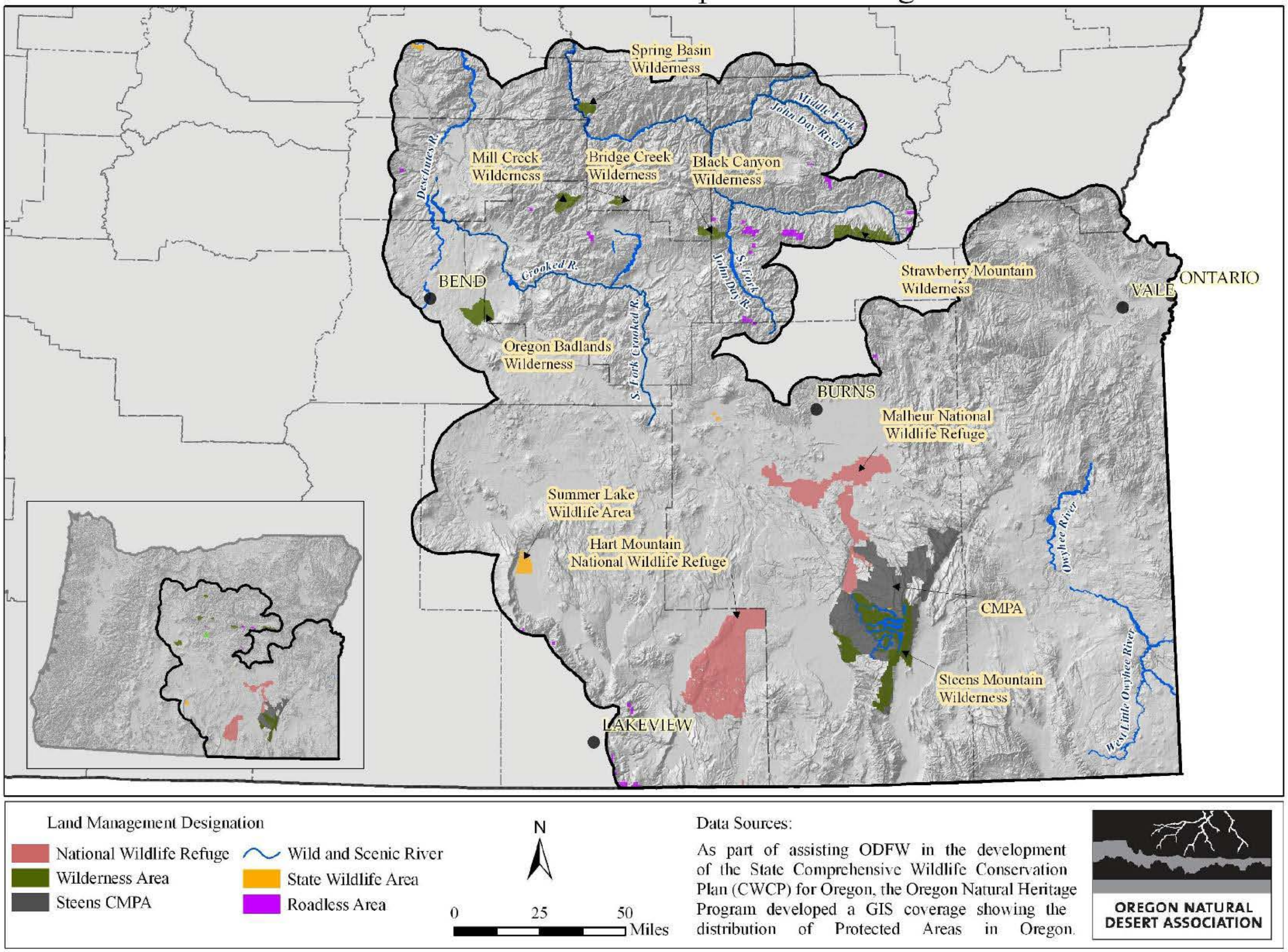
Some lands in Oregon have been designated by Congress as Wilderness under the 1964 Wilderness Act. By law, wilderness areas are public lands that appear to be affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable.

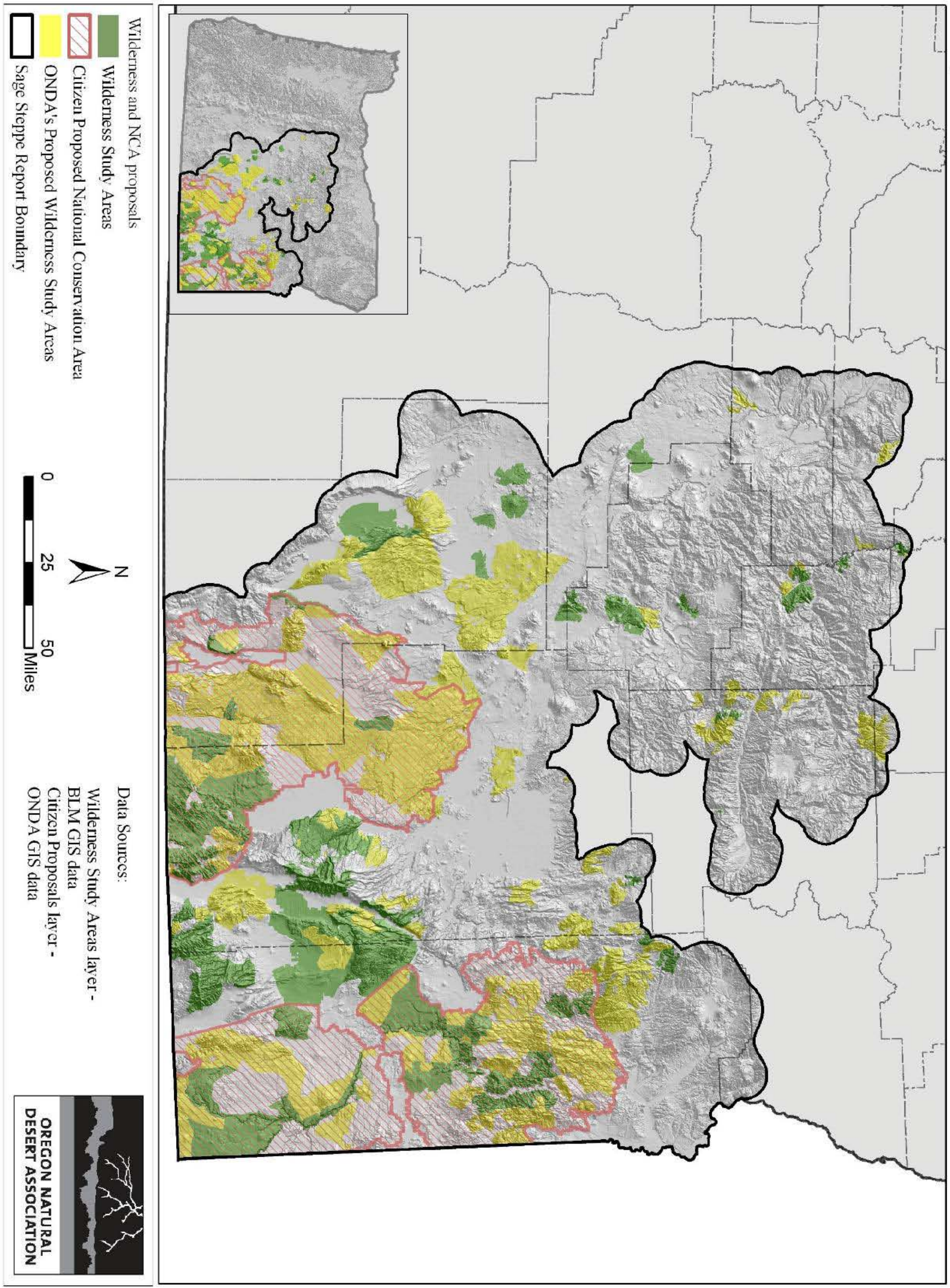
In 1976, the Bureau of Land Management (BLM) was directed by Congress to inventory its lands for wilderness qualities and establish Wilderness Study Areas (WSAs) for congressional consideration under the Federal Land Policy and Management Act. Eighty-one WSAs have been established in Oregon (Map 7). These WSAs are also classified as Visual Resource Management Class I by the BLM, in which the goal is "to preserve the existing character of the landscape" (BLM Handbook H-8410-1).

In addition to the backcountry recreation values present in wilderness, these areas frequently possess important fish and wildlife habitat. For example, Kershner et al. (1997) found that adult density, size, and habitat quality were greater for Colorado River cutthroat trout in wilderness areas compared to adjacent roaded lands. Large predators as well as game animals such as elk are threatened by the disappearance of large, roadless tracts of habitat that serve as security areas. Edge and Marcum (1991) found that elk use was reduced within 1.5 km of roads, except where there was topographic cover. Gratson and Whitman (2000) found that hunter success was higher in roadless areas than in heavily roaded areas, and that closing roads increased hunter success rates. Cole et al. (1997) found that reducing open road densities led to smaller elk home ranges, fewer movements, and higher survival rates. Thus, roadless areas have come to provide important security habitat for elk. In addition, Van Dyke et al. (1986) found that "areas where there is continuing, concentrated human presence or residence are essentially lost to the [mountain] lion population."

Map 6

Federal and State Special Designations




Map 7 Proposed Wilderness and National Conservation Areas
Wilderness and NCA proposals
Wilderness Study Areas
Citizen Proposed National Conservation Area
ONDA's Proposed Wilderness Study Areas
Sage Steppe Report Boundary
N
0 25 50 Miles
Data Sources:
Wilderness Study Areas layer - BLM GIS data
Citizen Proposals layer - ONDA GIS data
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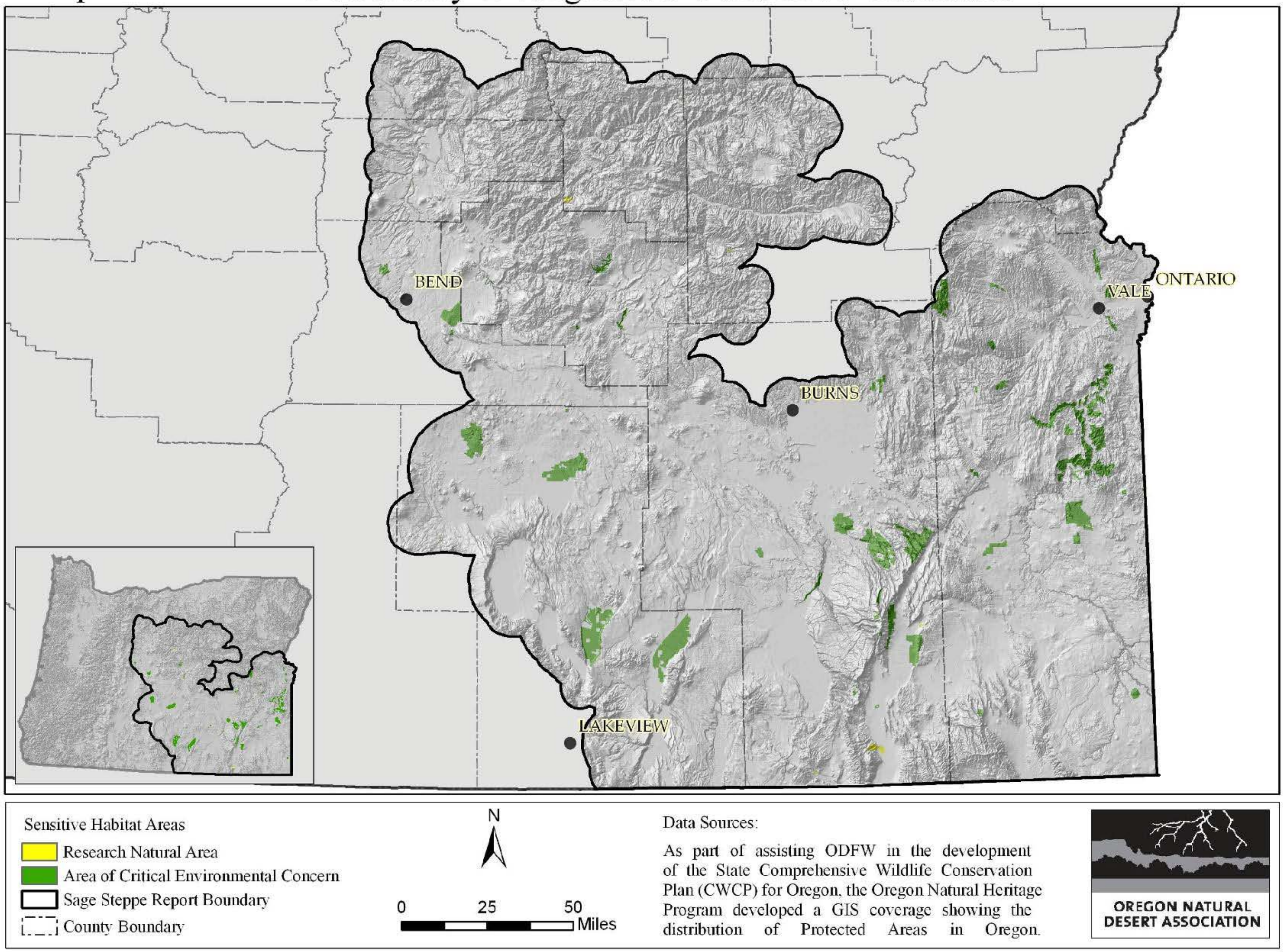
Map 8 Federally Designated Sensitive Habitats



Data Sources:
As part of assisting ODFW in the development of the State Comprehensive Wildlife Conservation Plan (CWCP) for Oregon, the Oregon Natural Heritage Program developed a GIS coverage showing the distribution of Protected Areas in Oregon.

Under the Wilderness Act of 1964 and the Federal Lands Policy Management Act of 1976, developments such as roads and wind turbines are not permitted in WSAs and Wilderness, and thus these areas should not be considered for wind power development regardless of their potential.

Photo 3. The Badlands (Greg Burke)

Citizens' Proposed Wilderness

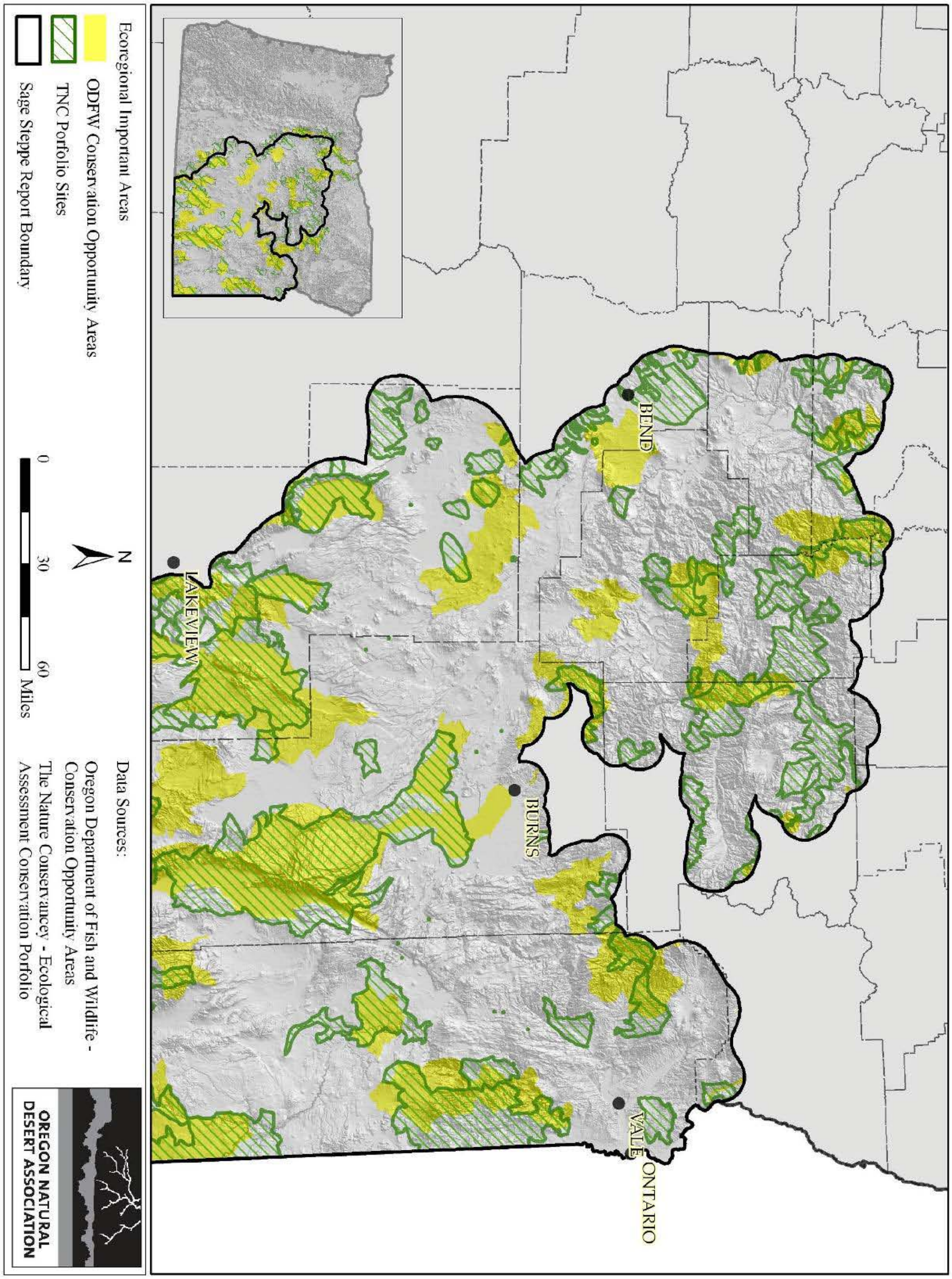
Citizens' proposed wilderness areas in eastern Oregon have been field inventoried and found to possess wilderness characteristics that would make them suitable for formal designation under the Wilderness Act. These areas, typically on BLM lands, may have been excluded from the initial round of Wilderness Study Area designations in the late 1970s due to faulty initial inventories, failures by BLM to examine the areas in question as potential wilderness, or changes in land ownership or physical conditions on the ground which now qualify an area for wilderness consideration. Citizens' proposed wilderness areas represent Oregon's most pristine and outstanding examples of unprotected public lands. There are some of these areas that may be developable after extensive study, mitigation planning, and consultation with conservation organizations and management agencies (Map 7).

Areas of Critical Environmental Concern and Other Special Management Areas

Federal law directs the BLM to establish Areas of Critical Environmental Concern (ACECs) and to protect the sensitive resources for which these lands were designated. Over the years, a number of ACECs have been established under the land use planning process, and others have been proposed in management plans that are currently being revised (Map 8). The designation of ACECs does not confer a uniform set of protection measures; instead each ACEC has its own mandatory set of rules and regulations.

Photo 4. Owyhee Canyonlands (Scott Ericksen)

While most ACECs do not address wind energy development directly, indeed, most were designated before wind power was recognized as a possibility in Oregon, wind energy development in these areas is likely to pose significant challenges and require longer and more expensive permitting processes. Because it will be difficult to show that utility-scale wind power development will be consistent with the protection of resources for which the ACECs were designated (such as Lake Abert and Warner Wetlands which are home to migratory birds), we recommend that ACECs be viewed as avoidance areas by the wind industry.


Map 9
Ecoregional Conservation Plans
BEND
LAKEVIEW
BURNS
VALE
ONTARIO
Ecoregional Important Areas
ODFW Conservation Opportunity Areas
TNC Porfolio Sites
Sage Steppe Report Boundary
N
0 30 60 Miles
Data Sources:
Oregon Department of Fish and Wildlife - Conservation Opportunity Areas
The Nature Conservancy - Ecological Assessment Conservation Porfolio
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Best Practices for Special Landscapes

Exclude and buffer these areas from development

Special landscapes in the categories described above should be exempted from consideration for wind power development in order to preserve the attributes for which these lands have received special designations. Viewsheds from these areas should likewise be avoided by siting turbine arrays behind intervening topography or at an adequate distance to avoid visual impacts.

Ecoregional Conservation Plans and Conservation Opportunity Areas

Most conservation plans focus on a single species or a small subset of species, typically those which are unusually charismatic or a species that is the subject of hunting or fishing. The designation of lands in protected areas such as national parks and wilderness also contains biases, over-representing certain habitat types (such as alpine meadows) while other habitat types (like playas and sand dunes) tend to be under-represented (Merrill et al. 1996). However, when considering the conservation of entire ecosystems and the wide array of plants and wildlife they support, it is preferable to take an ecoregional approach because the distribution of plants and wildlife rarely respect arbitrary political designations like state lines and field office boundaries. In Oregon, several ecoregional plans provide a framework for conservation of ecosystems on a large scale, and core habitats and connecting corridors identified in these plans warrant extra caution when planning and siting wind power facilities (Map 9).

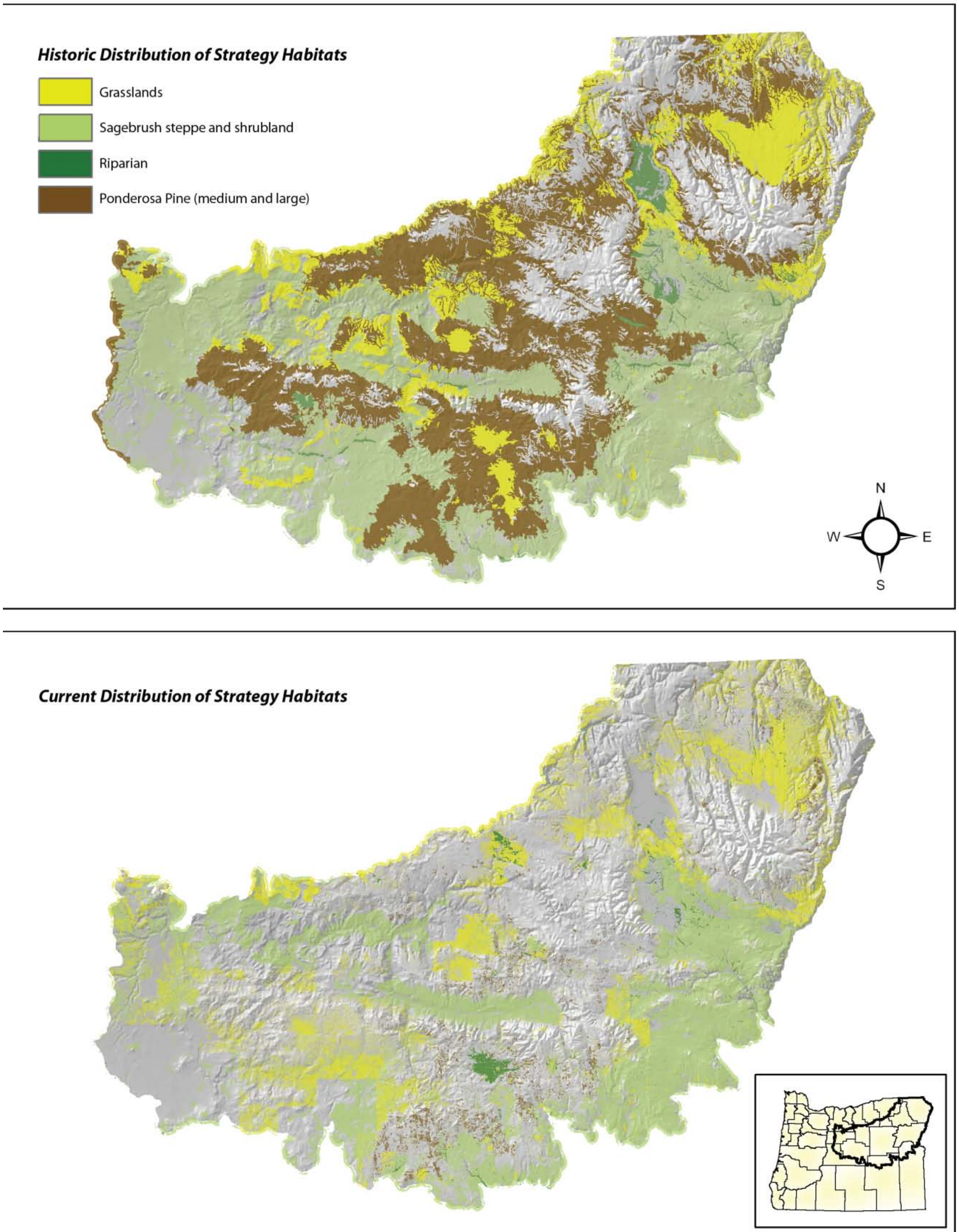
The Oregon Conservation Strategy, the state's wildlife action plan, adopted by the Oregon Fish and Wildlife Commission in 2006, identifies eight ecoregions within Oregon. Two of these ecoregions, North Basin and Range and Blue Mountains, fall within the shrubsteppe extent discussed in this report.

Blue Mountains Ecoregion

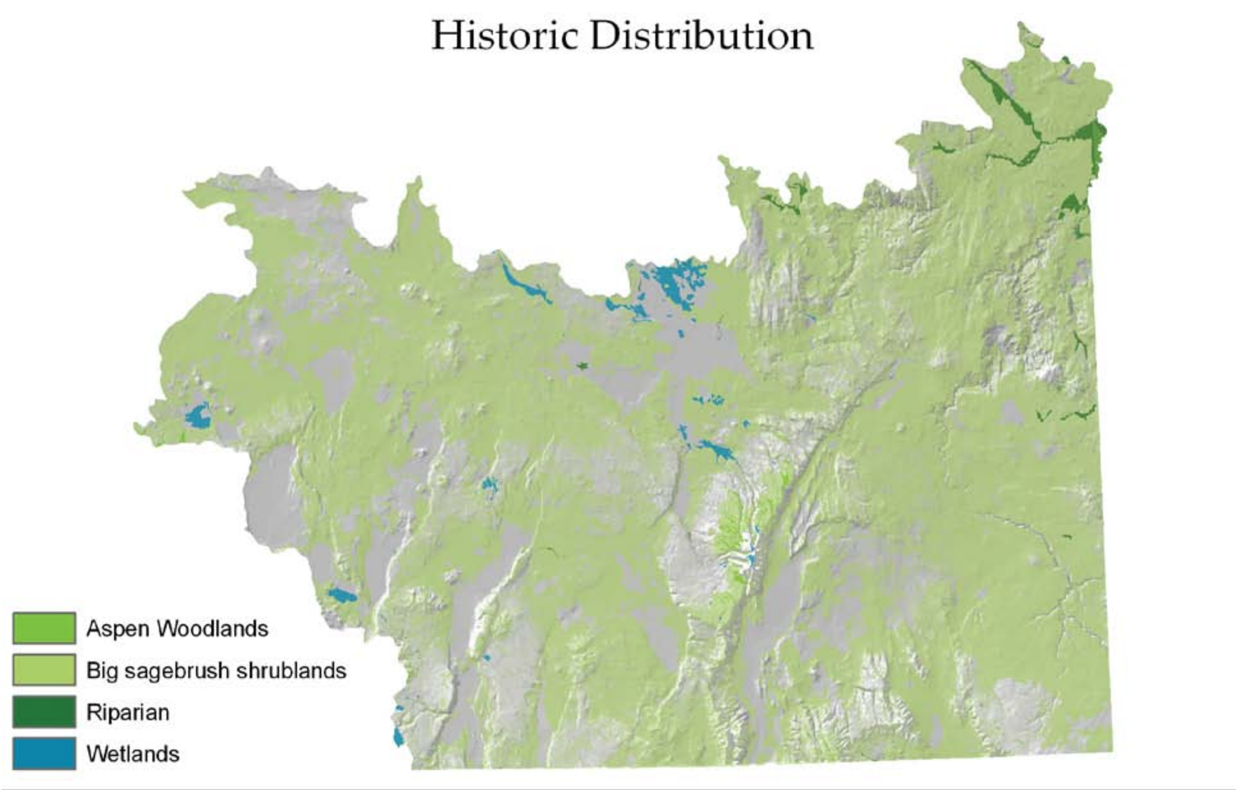
The Blue Mountains ecoregion is the largest ecoregion in Oregon and contains a diverse complex of habitat including sagebrush steppe (Map 10). This ecoregion contains some of the largest intact native grasslands in the state although habitats have been impacted by changes in ecological processes due to fire suppression, selective harvest practices, and unsustainable grazing. These changes have exposed areas to increased invasive species and increased vulnerability to wildfire in shrub-steppe habitats (ODFW 2006). The ecoregion encompasses several Conservation Opportunity Areas which provide important habitat for a range of sensitive plant and wildlife species.

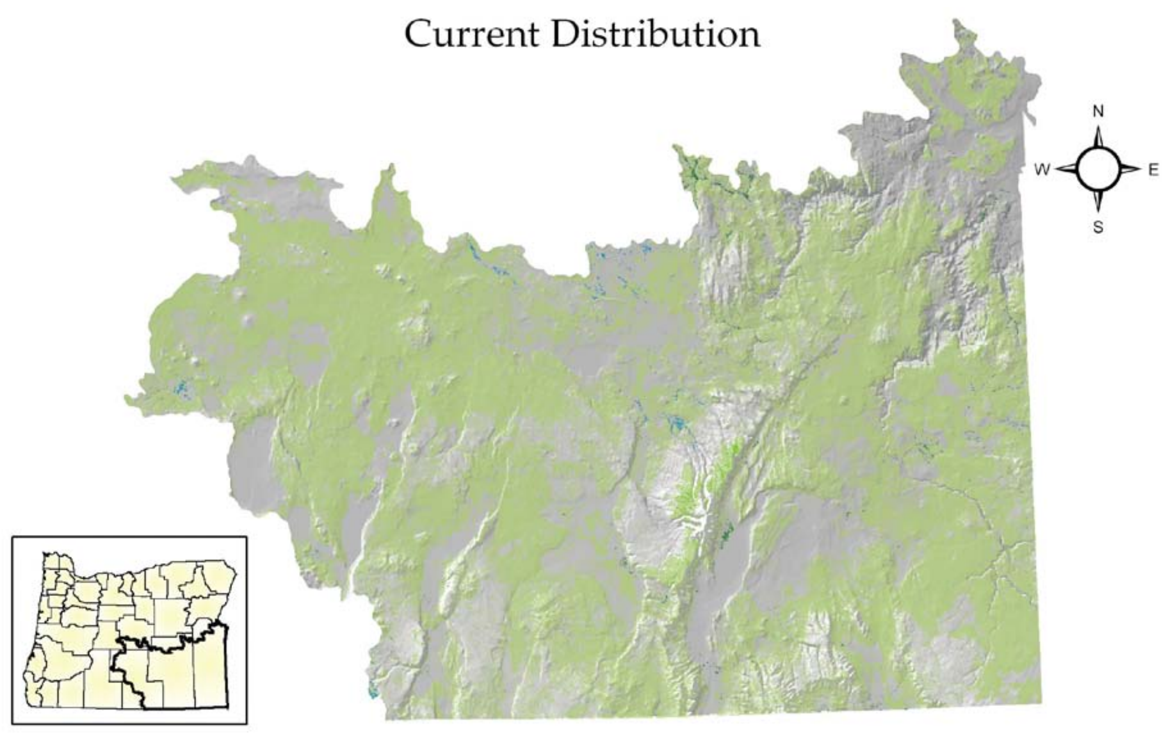
North Basin and Range Ecoregion

The Northern Basin and Range ecoregion covers the southeastern portion of the state, from Burns south to the Nevada border and from Christmas Valley east to Idaho (Map 11). As described by the Oregon Conservation Strategy, the area consists of "numerous flat basins separated by isolated mountain ranges. Several important mountains are fault blocks, with gradual slopes on one side and steep basalt rims and cliffs on the other side. The Owyhee



MAP 10. Historic and current distribution of Blue Mountains Ecoregion habitat types.
(MAP REPRODUCED FROM THE OREGON CONSERVATION STRATEGY. Page 103)
Data Source: Oregon Natural Heritage Information Center, 2004.





MAP 11. Historic and current distribution of Basin and Range Ecoregion habitat types.
(MAP REPRODUCED FROM THE OREGON CONSERVATION STRATEGY; Page 204)
Data Source: Oregon Natural Heritage Information Center, 2004.

Uplands consists of a broad plateau cut by deep river canyons. Elevations range from 2,070 feet near the Snake River to more than 9,700 feet on Steens Mountain." (ODFW 2006).

Best Practices for Ecoregional Conservation Areas and Conservation Opportunity Areas

We recommend that great caution be exercised when siting wind projects in or near ecorregional conservation areas or conservation opportunity areas. These areas provide core habitat and population connectivity for a variety of species. Any proposed development should recognize and not impair the values for which these areas were designated.

Protecting Birds of Prey

Birds of prey have been shown to suffer direct impacts from wind turbines (see page 37 for impacts to sage-grouse and page 48 for impacts to other types of birds). One of the first large-scale wind energy facilities was sited at Altamont Pass in the foothills east of San Francisco Bay. Altamont Pass is a raptor nesting concentration area that also served as a flyway for winter migrations (Thelander and Rugge 2000). Due to the high concentration of birds in this area, the level of fatalities for golden eagles (*Aquila chrysaetos*) and other birds struck by turbine blades rose so high that the facility became famous as "the bird blender". Most of the wind power facilities that followed had much lower rates of bird fatalities, but the reputation of wind turbines as killers of birds has been a difficult one for the industry to escape. The Altamont project highlights the importance of proper siting a facility. The negative public perception created through the siting of this project in an area of high bird concentrations, particularly for golden eagles and other raptors, has made it more difficult for other projects to get started nationwide.

Photo 5. Golden Eagle (G. Wuerthner)

Birds of prey are simultaneously among the most visible and charismatic birds, as well as being more vulnerable to wind turbine fatalities than many other types of birds. At Tehachapi Pass in California, Anderson et al. (2004) found that red-tailed hawks (*Buteo jamaicensis*), American kestrels (*Falco sparverius*), and great horned owls (*Bubo virginianus*) showed the greatest risk of collision of all bird species. At Altamont Pass, Thelander and Rugge (2000) reported that golden eagles, red-tailed hawks, and American kestrels were killed with greatest frequency. In Minnesota, Osborn et al (2008) reported that the American kestrel was at highest risk of wind turbine mortality, spending 31% of flying time at heights within the blade-swept area of wind turbines. Smallwood and Thelander (2005) found that burrowing owls (*Athene cunicularia*) were also highly susceptible to turbine-related mortality, and estimated 181 to 457 burrowing owls were killed per year at the Altamont Pass facility.

Smallwood and Thelander (2005) were able to determine that bird species that spent the most time flying through turbine-swept areas had the highest mortality rates. At the Foote Creek Rim facility, birds that spent the greatest proportion of time flying through rotor-swept heights included raptors and waterfowl (Johnson et al. 2000). These bird groups were found to have the highest risk of turbine collision in California (Osborn et al. 2008).

Wind turbine mortalities can potentially result in population declines in raptor species with the highest turbine strike caused mortality rates. Hunt et al. (1998) found that the golden eagle population was declining and that wind turbine strikes accounted for 38% of mortalities. Even if projects kill primarily non-territorial “floater” birds rather that territorial breeders, population declines can result because stable populations of breeders rely on an abundant supply of floaters to replace birds lost to other sources of mortality (Hunt 1998).

It does not appear that raptors make behavioral adjustments to wind power facilities that reduce fatality rates over time. Indeed, Smallwood and Thelander (2005) found that per-capita risk of raptor fatalities for individual birds actually increased over the 15 years of study, even as raptor densities decreased.

The position of turbines within a tower array does not appear to have a consistent correlation with raptor mortality. For example, Anderson et al. (2004) reported that turbines located at the center of multi-turbine strings experienced higher raptor fatality rates. Meanwhile, the Predatory Bird Research Group (1995) found that end-row turbines produced greater fatality totals at Altamont Pass. Thelander and Rugge (2000) found no relationship between fatality rates and edge or center of array at the same Altamont Pass location.

The type of wind turbine also does not have a clear relationship to rates of raptor mortality. According to the Predatory Bird Research Group (1995), both red-tailed hawks and golden eagles were recorded perching on lattice-type wind generation towers at Altamont Pass. Both species avoided perching on tubular towers but red-tailed hawks were occasionally recorded perching on the catwalks and ladders of such towers in this study. Thelander and Rugge (2000) later found no difference between raptor fatality rates at lattice towers versus tubular towers at Altamont Pass, and Smallwood and Thelander (2005) even found that raptor fatalities at Altamont Pass were greater for tubular towers and larger-rotor turbines. Anderson et al. (2004) found that vertical axis turbines of the FloWind type used at Tehachapi Pass had similar bird fatality rates to horizontal-axis (propeller-style) turbines. Thus, it appears that more modern wind turbines offer no particular advantage in reducing raptor mortality.

It is unclear whether a high density of wind turbines increases or decreases raptor mortalities. Dense clusters of turbines and “wind wall” configurations (parallel rows of wind turbines closely aligned to each other but with alternating tower heights) killed fewer raptors than scattered turbines (Smallwood and Thelander 2005). However, fatality results at Tehachapi Pass suggest that high density sites cause greater fatality rates than low density of turbines (1 turbine per 100 meters), but this difference was not statistically significant (Anderson et al. 2004). More study is needed to determine whether advantages can be gained by altering the density of turbine arrays.

The National Research Council (2007) reported that raptor mortality rates in California per megawatt of installed capacity have been much higher than at other wind facilities across the nation. But Smallwood and Thelander (2005) pointed out that rates of bird fatalities per unit bird/time at Altamont Pass were similar to other turbine facilities, but the much greater bird densities at Altamont Pass drives the high level of fatalities there. According to these researchers:

> "To assert that the APWRA [Altamont Pass Wind Resource Area] is anomalous in its bird mortality may be misleading when comparing it to other wind energy facilities. While a relatively large number of raptors are killed per annum in the APWRA, the ratio of the number killed to the number seen during behavior observations is similar among wind farms where both rates of observation have been reported. It appears, based on the research reports reviewed for this project, that when comparing wind energy facilities birds tend to be killed at rates that are proportional to their relative abundance among wind farms."

This highlights the critical importance of avoiding raptor concentration areas when siting wind energy facilities. In areas where there are concentrated raptor nest sites, there will be elevated raptor activity as at Altamont Pass, with higher raptor mortality rates. This is of particular concern in cases where raptor nests may be upwind of turbine sites, and strong prevailing wind would have the tendency to carry fledgling raptors with underdeveloped flight skills straight into turbine swept areas.

Raptors can function as keystone species (National Research Council 2007), potentially controlling populations of prey species and inducing trophic cascades. Thus, impacts to these classes of species could result in collateral impacts at the ecosystem level. A certain level of avian mortality is virtually unavoidable with wind power projects, but intelligent siting of turbine arrays should minimize the level of mortality from the project. Such impacts should be minimized by taking the following steps in the siting and operation of wind power facilities.

For the purposes of this report, maps are presented which outline the distribution of raptor species known to be particularly sensitive to wind turbines (e.g. golden eagles and ferruginous hawks (*Buteo regalis*)). It is important to note that detailed data collection has not taken place throughout Oregon's high desert; that said, certain areas are known to contain high winter concentrations of raptors including the Klamath Basin, Fort Rock Basin extending to Christmas Valley, Silver Lake Basin, Chewaucan Basin (including Summer Lake and Lake Abert), and the Warner Valley (J. Fleischer personal communication). Pre-development monitoring of local raptor populations will be essential to any wind development project.

Best Practices for Birds of Prey

Avoid Siting Turbines Near Raptor Concentration Areas

The Buffalo Ridge wind project in agricultural lands of southwest Minnesota showed low bird mortality rates (0.33 to 0.66 fatalities per turbine per year), likely due to its siting in a lower bird density area (Osborn et al. 2000). These researchers admonished that even a well-sited facility will kill some birds, but siting considerations can be employed to minimize raptor mortalities. At Wyoming's Foote Creek Rim wind facility, only eight percent of bird mortalities between 1998 and 2002 were raptors (Young et al. 2003). This has been attributed to several factors, including low density of raptor nest sites. By avoiding raptor nest concentration areas and migration flyways, raptor fatalities can be minimized.

Avoid Siting Wind Power Facilities in Canyons, Passes, and Other Migration Pathways

Siting turbines in canyons, passes, peninsulas and along ridgelines increases the risk of fatalities for migrating birds. In Montana, Harmata et al. (2000) found that more migrating birds passed over valleys and swales than over high points; while migrating birds tended to avoid passing over high points during headwinds, low passes received greatest use by migrating birds overall. Smallwood and Thelander (2005) found that golden eagles at the Altamont Pass facility were killed disproportionately by turbines sited in canyons. Thayer (2007) recommended, "Don't site wind turbines in canyons" to prevent excessive golden eagle fatalities. We concur with this recommendation, and it should be implemented as a best management practice for wind projects.

Engage in Pre-siting Surveys and Monitoring

Pre-siting surveys of bird habitat use and migration pathways should be undertaken several years prior to the determination of tower locations and arrays. In addition, pre-siting surveys of raptor nesting and winter concentration areas should be undertaken and these areas should be avoided for wind turbine siting. According to Morrisson (2006), "Such pre-siting surveys are needed to appropriately locate wind farms and minimize the impacts to birds." According to Mabee and Cooper (2004), "Seasonal patterns of nocturnal migration are critical to identify when collisions with wind turbines may be most expected." Analysis of bird migration data allowed the company to position its turbines to minimize mortality in the Stateline project of southeastern Washington. Migration patterns should be analyzed prior to the initiation of project construction, and turbines should be sited to avoid them.

Require Setbacks from Windward Rims

At Altamont Pass, Hoover and Morrisson (2005) reported that kiting behavior was most frequently observed on steep windward slopes, and selected for the tallest peaked slopes; slopes where this behavior occurred had a disproportionate amount of red-tailed hawk mortality. In the context of the Foote Creek Rim project, Johnson et al. (2000) also reported higher than expected raptor use of rim edge habitats, and for this project SeaWest implemented a setback of at least 50 meters from the rim for wind turbines to reduce raptor mortality; larger setbacks are likely necessary.

Minimizing Impacts to Bats

Initially, bird mortality was perceived as the most important impact of wind energy projects, but more recently it has come to light that wind turbine facilities can be a major source of bat fatalities as well (Arnett et al. 2008, Kunz et al. 2007b). Bats can function as keystone species (National Research Council 2007), potentially controlling populations of insects and inducing trophic cascades. Thus, projects that cause major impacts to bat populations could also destabilize ecosystem function. Kunz et al. (2007b) reported that bat fatalities at wind power facilities ranged from 0.8 to 53.3 bats per megawatt per year, with the highest mortality rates in forested areas. Taller towers with greater rotor-swept area showed greater bat mortality rates than smaller wind turbines in the same region (Arnett et al. 2008). As the trend within the industry is toward taller wind turbines with larger propellers, it is expected that risk to bats will increase further over time.

Bats may be more vulnerable to mortality at wind power facilities than birds because bats seem to be attracted to operating turbines. Arnett (2005) hypothesized that hoary bats may confuse turbine movements for flying insects and be drawn toward operating turbine blades. Johnson et al. (2004) also hypothesized that turbines attracted foraging bats in the agricultural lands of southwestern Minnesota. The attraction of bats to wind turbines during feeding was validated experimentally by Horn et al. (2008), with foraging bats approaching and pursuing moving turbine blades and then being trapped by their vortices of air. Bats sustain potentially fatal injuries not only from turbine strikes but also from potentially deadly decompression associated with air pressure gradients cased by spinning turbines (Arnett et al. 2008).

Bats are long-lived and have slow reproductive rates and thus are likely to suffer population declines (GAO 2005, National Research Council 2007). According to a resolution from the North American Society for Bat Research (2008), “Because bats have exceptionally low reproductive rates, making them susceptible to population declines and local extinctions, bat fatalities at wind facilities could pose biologically significant cumulative impacts for some species of bats unless solutions are found.” In cases where bat populations are suffering from other population or habitat stressors, wind turbine siting in key bat habitats can contribute cumulative detrimental impacts on the population. This possibility has become much more likely with the rapid spread of the fungal infection known as "white-nose syndrome" in the eastern United States (Veilleux 228). Experts now believe that white-nose syndrome will soon reach western populations as well, and could cause calamitous population declines and even regional extirpations.

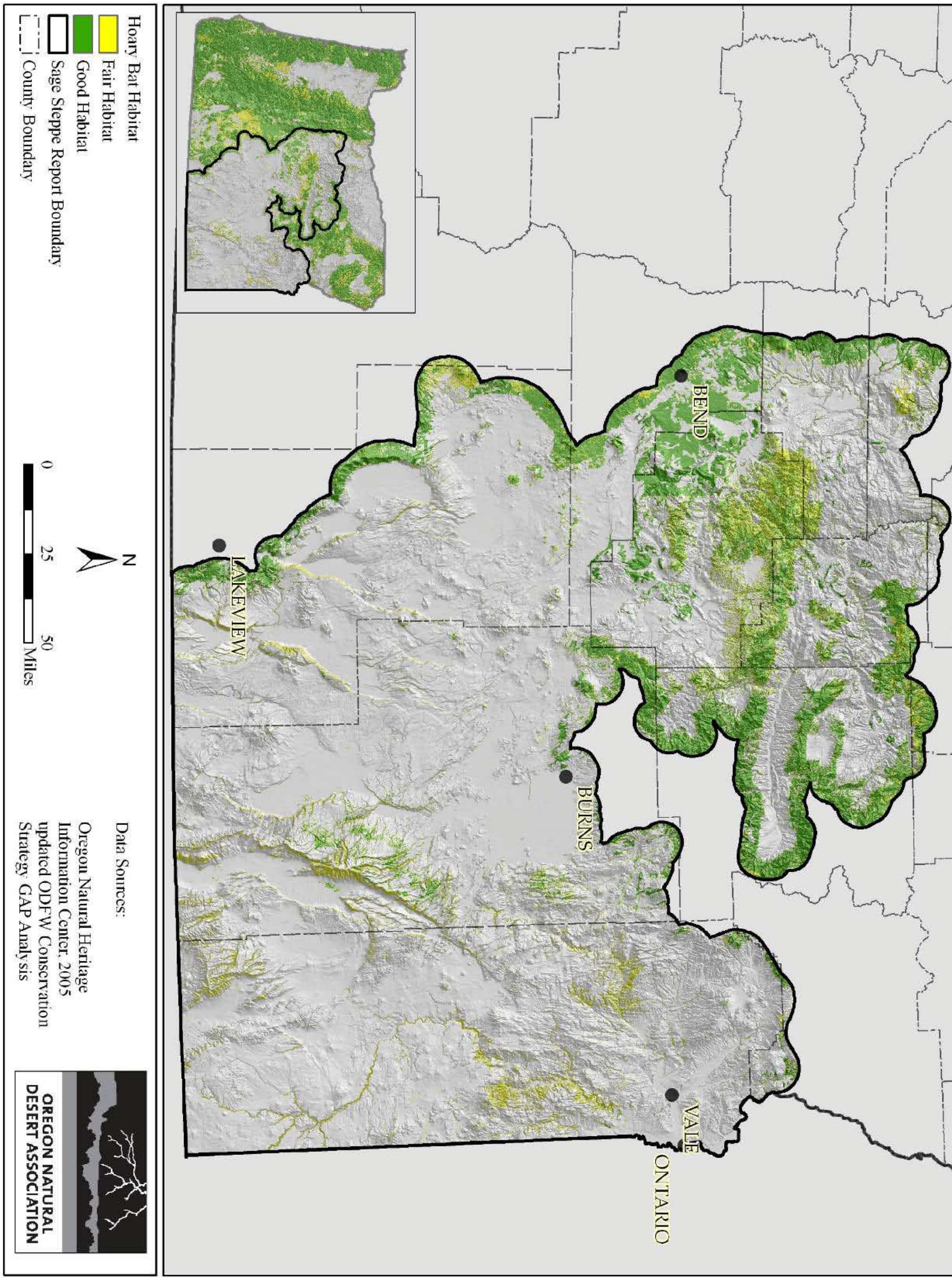
Almost 75 percent of all bats killed by wind turbines nationwide are made up of three species of tree-roosting, migratory bats from the genera *Lasiurius* and *Lasionycteris*: the foliage-roosting eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), and tree cavity-dwelling silver-haired bat (*Lasionycteris noctivagans*) (Kunz et al. 2007a, Arnett et al. 2008). Hoary and silver-haired bats dominated bat mortalities at wind facilities sited in open steppe habitats of the interior Columbia Basin (Johnson et al. 2003, Erickson et al. 2003). Johnson et al. (2004) found that hoary bats dominated wind turbine fatalities at the Buffalo Ridge wind facility, even though big brown bats were the most numerous resident population. In the Rocky Mountains, 89 percent of wind turbine bat mortalities are hoary bats (Kunz et al. 2007a). Of the tree-roosting bat species, the hoary bat (Map 12) and silver-haired bat (Map 13) are native to Oregon and are found throughout the state. Both species are considered species of concern by state and federal authorities.

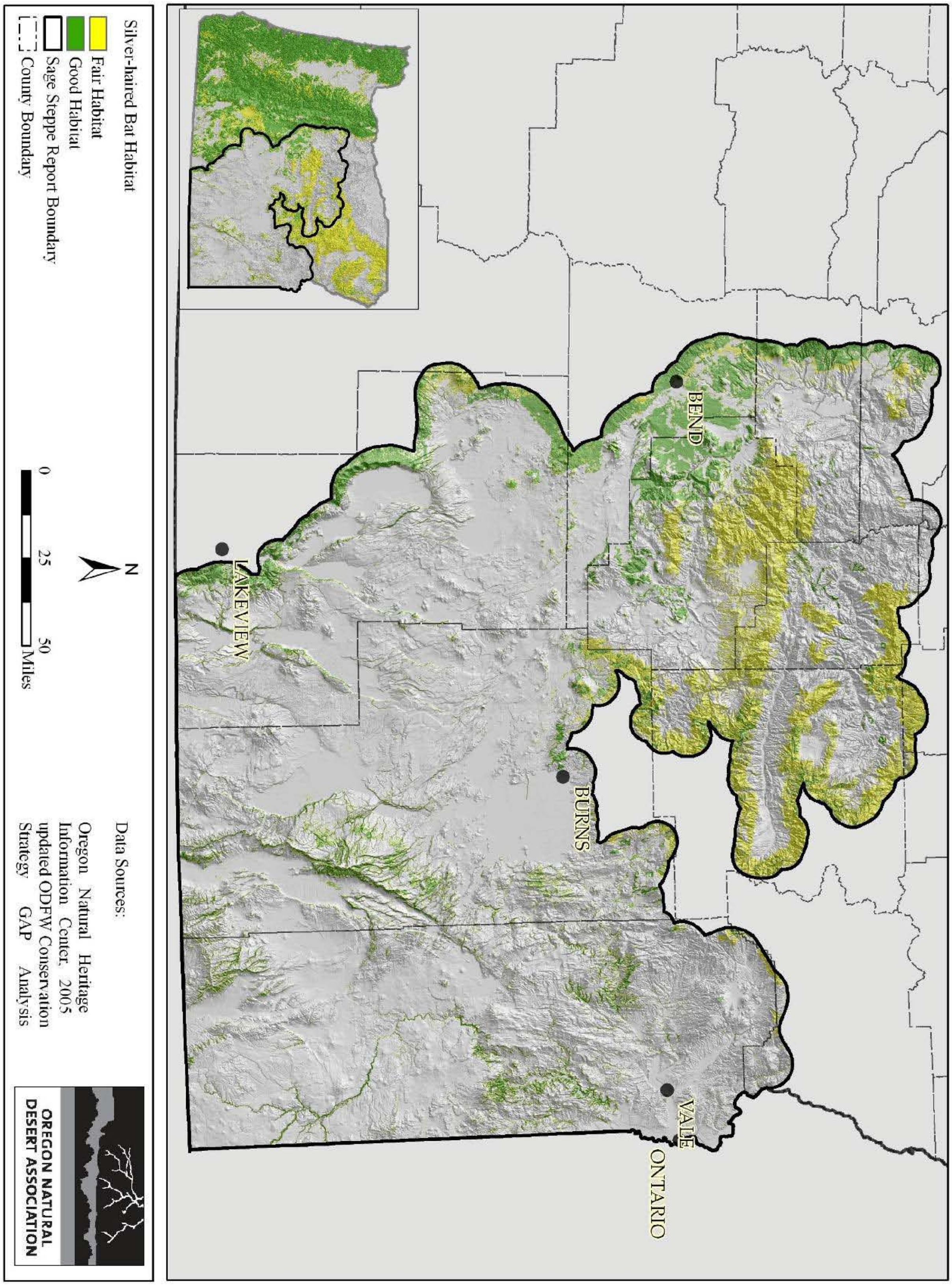
Key habitats for these species are highly variable depending on geographic location. In the western United States, including Oregon, riparian cottonwoods (*Populus spp*) and aspen (*Populus tremuloides*) stands are particularly important for red and hoary bats, whereas large old-growth type conifers are more frequently used by the silver-haired bat (Barclay et al. 1988; Vonhof and Barclay 1996; Betts 1998; Parsons et al. 2003; Kalcounis-Ruppell et al. 2005). Everette et al. (2001) documented hoary bat use of cottonwood groves for roosting on the Rocky Mountain Arsenal near Denver.

In Saskatchewan, Willis and Brigham (2005) found that hoary bats selected as roost trees conifers of similar size to the overall forest canopy that were protected from the wind. Because these species roost in woodlands of all types, bat roosting habitat is indexed by woodland cover types for the purposes of this report.

Wind projects planned in or near woodlands will thus have a greater likelihood of high bat mortality rates. Some of the highest levels of bat mortality were recorded at the Mountaineer wind power facility in the forested mountains of West Virginia, where an estimated 21 bats per night were struck (Horn et al. 2008). Nicholson (2003) reported an estimated 28.5 bats per turbine per year killed at the Buffalo Mountain wind power facility in Tennessee.

Fiedler (2004) reported that bat fatalities in 2004 at a wind power facility in mixed hardwood forest in eastern Tennessee were an order of magnitude greater than at 8 other facilities in the region, and blamed siting on a prominent ridgeline surrounded by forests with rocky outcrops for


Map 12
Hoary Bat Habitat
BEND
LAKEVIEW
BURNS
VALE
ONTARIO
Hoary Bat Habitat
Fair Habitat
Good Habitat
Sage Steppe Report Boundary
County Boundary
N
0
25
50
Miles
Data Sources:
Oregon Natural Heritage
Information Center, 2005
updated ODFW Conservation
Strategy GAP Analysis
OREGON NATURAL
DESERT ASSOCIATION


Map 13
Silver-haired Bat Habitat
BEND
LAKEVIEW
BURNS
VALE
ONTARIO
Silver-haired Bat Habitat
Fair Habitat
Good Habitat
Sage Steppe Report Boundary
County Boundary
N
0
25
50
Miles
Data Sources:
Oregon Natural Heritage Information Center, 2005
updated ODFW Conservation Strategy GAP Analysis
OREGON NATURAL DESERT ASSOCIATION

the higher bat mortality at this site and the Mountaineer wind power facility. The National Research Council (2007) found that bat fatalities are higher for eastern sites on forested ridges, although similarly high fatality rates have been shown for croplands in Iowa and southwestern Alberta. Johnson et al. (2004) found that turbines located near woodlands also experienced higher levels of bat activity at the Buffalo Ridge facility in southwestern Minnesota. Arnett (2005) hypothesized that hoary bats may confuse turbine movements for flying insects and be drawn toward operating turbine blades, and that foraging areas such as forests may be particularly problematic in this regard. Arnett (2005) found that bat fatalities were concentrated at both the ends and centers of turbine strings. Numerous studies have found that bat fatalities at turbines lit by red FAA lights and unlit turbines were similar (see, e.g., Johnson et al. 2004, Arnett 2005, Horn et al. 2008).

Best Practices for Bats

Siting Turbines in Open Habitats Rather Than Woodlands

Placement of wind power facilities in woodlands should be undertaken with great caution, and old-growth forests should be avoided entirely. Wind turbines sited at least 1 mile from woodland habitats, whether they be cottonwood, conifer, juniper, or aspen, will have lower probability of high bat mortality rates. Acoustic, radar, and/or thermal imaging surveys for bats should be undertaken to determine population sizes and occupied habitats for hoary and silver-haired bats in and near the project area prior to site selection, and foraging habitats and migration pathways used by these species. Turbine arrays should be designed to avoid identified areas of concentrated bat use.

Bat Mortality Monitoring

Bat mortality monitoring should be a standard protocol for wind turbine operations. Arnett (2005) reported that weekly carcass searches underestimated fatality rates due to high scavenger removal rates, and this researcher recommended carcass searches rotating through a subset of the turbines, so that there are some carcass data coming in each day.

Shutdowns to Avoid Bat Migrations

Johnson et al. (2004) found that bat mortalities are highest in late summer and early fall, coincident with migration periods. If turbines are sited across migration routes or between roosting and feeding areas, then these turbines should have seasonal shutdowns during the migration season(s) or period(s).

Gearing Turbines to Cut In at 6 Meters per Second

In low-wind conditions, bats may not detect turbine blades in time to avoid collisions (Kunz et al. 2007a). Arnett (2005) found that bat fatalities occurred more often on low-wind nights when turbines were still operating, and fatalities increased just before and after the passage of storm fronts. In a later study, Arnett et al. (2008) reported elevated bat mortality from turbine collisions when wind speeds are light (<6 km/hr) and before and after the passage of storm fronts. Cryan (2008) recommended increasing blade 'cut-in' speed to wind velocities greater than 6 meters per second and mandatory shutdown during high risk periods or seasons. Thus, turbines should be set to have a minimum 'cut-in' speed of 6 meters per second to avoid the increased mortality risk to bats at slow turbine speeds.

Conservation of Sage-grouse

Greater sage-grouse (*Centrocercus urophasianus*) were once found in most sagebrush (*Artemisia* spp.) habitats east of the Cascades in Oregon. Populations have fluctuated markedly since the mid-1900s with notable declines in populations from the 1950s to early 1970s. Declines in sage-grouse populations are largely attributed to habitat destruction, degradation and fragmentation (Dobkin 1995). Oregon sage-grouse populations and sagebrush habitats likely comprise nearly 20% of the North American range-wide distribution (Connelly et al. 2004) and therefore the conservation of Oregon sage-grouse populations has national implications for the survival of this sensitive species (Map 14).

Photo 6. Sage-grouse (Cal Elshoff)

The Greater sage-grouse population has declined as much as 45–80 percent over the past 20 years due to habitat destruction, degradation and fragmentation, with the current breeding population estimated at 140,000 individuals, representing only about eight percent of historic numbers (Connelly and Braun 1997). A 2004 survey by state and federal scientists found that sage-grouse are in long-term decline, with the report concluding it was "not optimistic about the future of sage-grouse because of long-term population declines coupled with continued loss and degradation of habitat and other factors." (Connelly et al. 2004). Preserving areas of intact habitat is critical to avoid the loss of this species.

Recognizing that Oregon is an area of critical importance for the species' survival, Oregon's Department of Fish and Wildlife (ODFW) has adopted a conservation strategy for the sage-grouse (Hagen 2005), underscoring that human activities and structures decrease the quality of sage-grouse habitat and can result in habitat loss and direct bird kills. The strategy recommends that land management agencies carefully evaluate actions that could lead to harm to sage-grouse habitats. Specifically, new energy development and associated transmission projects "should avoid surface occupancy within 3.2 km (2 mi) of known/occupied sage-grouse habitat" and follow “existing utility corridors and rights-of-ways to consolidate activities to reduce habitat loss, degradation, and fragmentation by new construction” (Hagen 2005; pp 83-84).

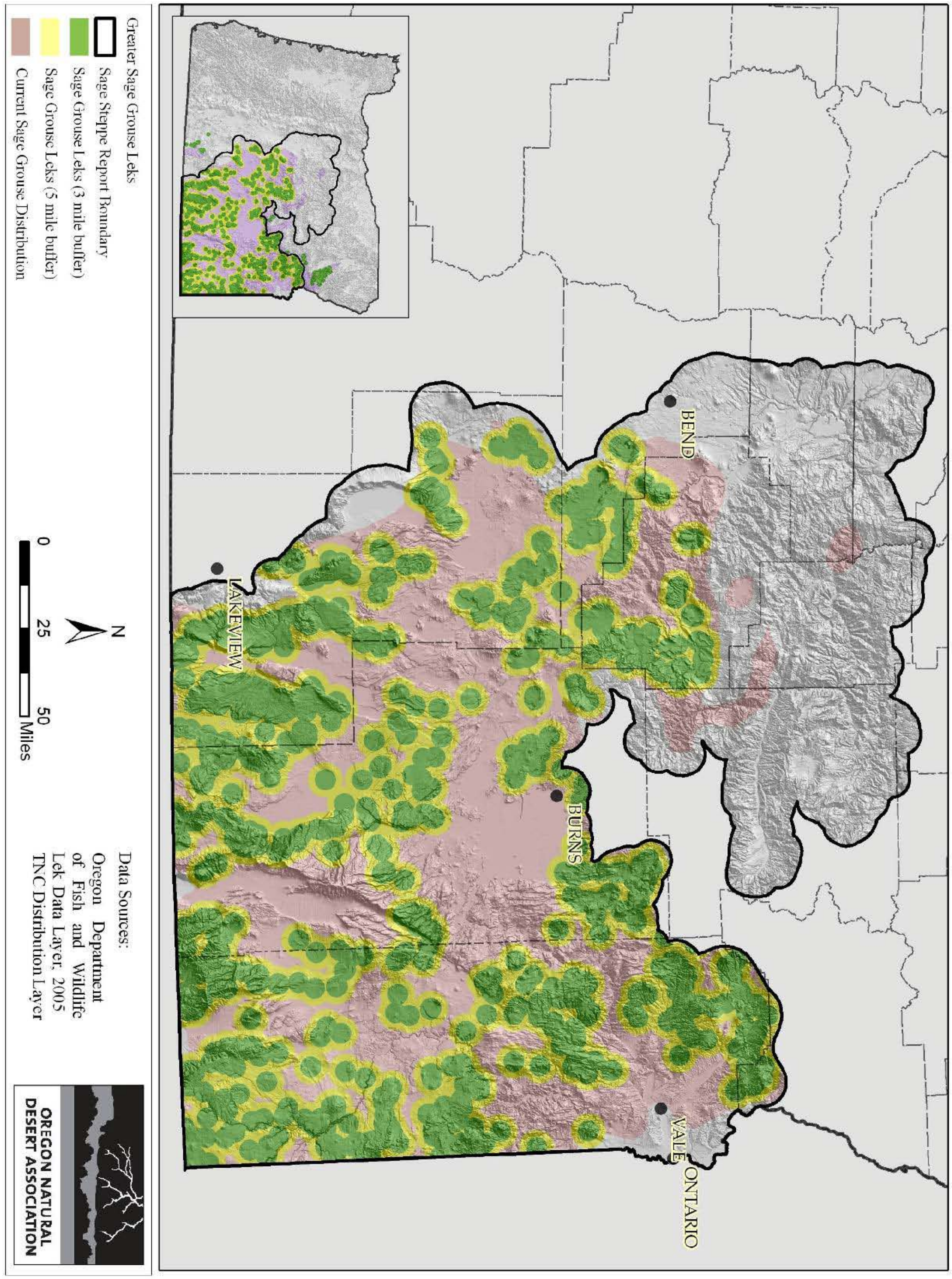
If energy projects and their associated transmission lines cannot be built immediately adjacent to existing transmission lines, ODFW recommends that planners “seek to minimize disturbance to known breeding, nesting, and brood-rearing habitats by placing power line corridors >3.2 km from these areas.” ODFW’s strategy highlights the importance of preserving habitat integrity and connectivity, noting that,

> “Habitat loss and fragmentation are probably the 2 leading causes for the long-term decline in sage-grouse. Current and future land management will need to examine landscape patterns of sagebrush habitat and seek strategies to ensure that large connected patches of sagebrush are present. The implementation of the connectivity model and habitat monitoring techniques suggested in the Plan will help minimize the impacts of habitat loss and fragmentation” (Hagen 2005: 84).

Similar guidance, stressing the importance of maintaining intact habitat, is found in the BLM’s National Sage-grouse Habitat Conservation Strategy and BLM’s guidelines regarding Special Status Species such as sage-grouse. In December 2007, the U.S. District Court for the District of Idaho ordered the USFWS to evaluate properly whether the Greater sage-grouse should be listed as threatened or endangered under the Endangered Species Act. The FWS has begun its new review of the sage-grouse’s status.

Sage-grouse may be negatively impacted by wind energy development, both from the standpoint of direct mortality from collisions and from displacement from favored habitats due to behavioral avoidance of tall structures and associated development. Much of what is known about the tolerance of sage-grouse to industrial development is derived from studies on oil, gas, and coalbed methane development. Sage-grouse have lost the vast majority of their original population numbers and are sensitive to human disturbance. To the extent that wind power development also involves habitat fragmentation, road construction, and human activity and vehicle traffic associated with maintenance, some of the impacts recorded in the context of oil and gas development likely apply to wind power developments.

The area within 3 miles of a sage-grouse lek is crucial to both the breeding activities and nesting success of local sage-grouse populations. Oregon research shows that most nests occur within 5 miles of a lek while 80% of nests occur within 3 miles of a lek (ODFW Letter to Crook County Planning Commission, 2-23-09). Accordingly, the USFWS recommends a no-development policy within 5 miles of a lek to stem long-term declines in sage-grouse populations (USFWS 2003; Manville 2004). In an effort to preserve 80% of the population, the State of Oregon has established a policy of no development within 3 miles of a lek (Hagen 2005).


Map 14
Greater Sage Grouse Breeding Sites
BEND
LAKEVIEW
BURNS
VALE
ONTARIO
Greater Sage Grouse Leks
Sage Steppe Report Boundary
Sage Grouse Leks (3 mile buffer)
Sage Grouse Leks (5 mile buffer)
Current Sage Grouse Distribution
N
0
25
50
Miles
Data Sources:
Oregon Department of Fish and Wildlife
Lek Data Layer, 2005
TNC Distribution Layer
OREGON NATURAL DESERT ASSOCIATION

Autenreith (1985) described the lek site as “the hub from which nesting occurs”. Grouse exhibit strong fidelity to individual lek sites from year to year (Dunn and Braun 1986). During the spring period, male habitat use is concentrated within 2 km of lek site (Benson etal. 1991). Other researchers found that 10 of 13 hens nested within 1.9 miles of the lek site during the first year of their southern Idaho study, with an average distance of 1.7 miles from the lek site; 100 percent of hens nested within 2 miles of the lek site during the second year of this study, with an average distance from lek of 0.5 mile (Hulet et al. 1986). In Montana, Wallestad and Pyrah (1974) found that 73 percent of nests were built within 2 miles of the lek, but only one nest occurred within 0.5 mile of the lek site. Holloran (2005) found that 64 percent of sage-grouse nested within 3.1 miles of a lek in western Wyoming while Walker et al. (2007) found that sage-grouse habitat within 4 miles of a lek site was important to the persistence of the lek. Because leks sites are used traditionally year after year and represent selection for optimal breeding and nesting habitat, it is crucially important to protect the area surrounding lek sites from impacts.

Although the impacts of wind energy development on sage-grouse have thus far received little attention, the impacts of development on sage-grouse have been well-studied. Like oil and gas development, wind energy development involves the construction of facilities and road networks, resulting in a level of habitat fragmentation that is similar to full-field oil and gas development. Wind turbines are very tall structures, and are therefore expected to trigger avoidance behaviors in grouse not associated with oil and gas development except during the drilling stage. Transmission towers and overhead transmission lines associated with wind power developments will likely also result in sage-grouse avoidance and provide perches for predators. Unnatural noise from spinning turbines may be equal to or greater than noise associated with oil and gas development, potentially contributing to sage-grouse dispersal away from wind power facilities. On the other hand, vehicle traffic may be less heavy in wind power facilities than in oil and gas fields, and thus the avoidance of wind power facilities due to vehicle traffic may be less than for oil and gas fields. Given the absence of scientific studies of the impacts of wind power facilities on sage-grouse, known impacts of oil and gas development may be instructive.

Lessons to be Learned from Oil and Gas Development

In a study near Pinedale, Wyoming, sage-grouse from disturbed leks where gas development occurred within 3 km of the lek site showed lower nesting rates (and hence lower reproduction), traveled farther to nest, and selected greater shrub cover than grouse from undisturbed leks (Lyon 2000). According to this study, impacts of oil and gas development to sage-grouse include: (1) direct habitat loss from new construction; (2) increased human activity and pumping noise causing displacement; (3) increased legal and illegal harvest; (4) direct mortality associated with reserve pits; and (5) lowered water tables resulting in herbaceous vegetation loss. Pump and compressor noise from oil and gas development may reduce the effective range of grouse vocalizations; low-frequency noise from wind turbines could have a similar effect. A consortium of eminent sage-grouse biologists recommended, “Energy-related facilities should be located

>3.2 km from active leks." And Dr. Clait Braun, an expert on sage-grouse, has recommended even larger buffers of 3 miles from lek sites, based on the uncertainty of protecting sage-grouse nesting habitat with smaller buffers.

Walker et al. (2007) found that coalbed methane development within 2 miles of a sage-grouse lek had negative effects on lek attendance. Holloran (2005) found that active drilling within 3.1 miles of a lek reduced breeding populations, while wells already constructed and drilled within 1.9 miles of the lek reduced breeding populations. Both Holloran (2005) and Walker et al. (2007) documented the extirpation of breeding populations at active leks as a result of oil and gas development in the Upper Green River Valley and Powder River Basin, respectively. Road construction related to energy development is a primary impact on sage-grouse habitat from habitat fragmentation and direct disturbance perspectives. Rowland et al. (2006) modeled sage-grouse distribution, and reached the following conclusions:

> "The secondary road network is a highly significant factor influencing processes in this landscape and is being developed and expanded rapidly across much of the [project area]. Secondary roads are being built as part of the infrastructure to support non-renewable energy extraction. For example, within the Jonah Field in the Upper Green River Valley, >95 percent of the area had road densities >2 mi/mi^2." (Internal citations omitted). [Furthermore,] "The dominant feature affecting output of the sage-grouse disturbance model was secondary roads, which occupy nearly 8 percent of the study area and are presumed to negatively influence an even larger extent."

Holloran (2005) also found significant impacts of road traffic on sage-grouse habitat use in the Pinedale Anticline gas field, concluding that habitat effectiveness declined in areas adjacent to roads with increasing vehicle traffic, documenting the secondary effect referenced by Rowland et al (2006).

Anemometer Towers and Sage-grouse: A Case Study

Even the erection of anemometer towers to test for wind energy potential can cause abandonment of key sage-grouse habitats, as exemplified by the Cotterel Mountain wind project in Idaho. Windland Incorporated was granted rights-of-way by BLM to construct seven meteorological towers, 30 to 150 feet in height and topped with anemometers to measure wind velocity for a commercial wind power feasibility study, along the length of Cotterel Mountain, Idaho in July of 2001 (BLM 2001). Anemometers went into operation the same year (Windland Inc. 2005). In October of 2003, permission to construct an eighth tower was granted (BLM 2003).

As of 2003, there were 9 known sage-grouse leks on Cotterel Mountain, five of which were newly identified that year (Reynolds 2004). On average, 21.5 birds were observed on the leks as a whole, and five leks were used consistently by breeding birds, with a population estimated at less than 50 breeding males. Overall population estimates were 64 to 72 individuals in 2004 and 59 to 66 individuals in 2005 (Reynolds and Hinckley 2005). In spring 2006, the population of sage-grouse on Cotterel Mountain had declined to 16 individuals and seven of nine leks were unoccupied. During this same period, sage-grouse populations elsewhere in the county exhibited steady population trends in 2004 and 2005 and only a very slight dip in 2006 (Collins and Reynolds 2006). It is instructive that the Cotterel Mountain sage-grouse population crashed following installation of anemometer towers across the crest of Cotterel Mountain, while populations elsewhere in Cassia County held relatively steady.

Similarly, subsequent declines in sage-grouse numbers in Oregon at the Sage Hen Hills lek following the construction of a transmission line within 0.5 miles of the lek site raises additional concerns regarding the compatibility of sage-grouse and electrical transmission. The lek had an average of 41 males until 1980. A 500kv powerline was constructed between 1980 and 1982. Since 1981, there has been an average of 5 males per year with no males observed since 2006. This decline occurred during a period of time (1980-1988) when statewide sage-grouse population reached "very high levels" (ODFW, 2008). This displacement from habitat is consistent with the findings in other areas.

Best Practices for Grouse

Avoiding Turbine and Road Construction in Breeding, Nesting, and Winter Habitats

Because wind turbines represent tall structures which sage-grouse are believed to avoid behaviorally, the erection of a wind power facility in, or adjacent to, sage-grouse habitat potentially leads to the abandonment of that habitat by grouse. For this reason, the USFWS (2003, *and see* Manville 2004) recommends siting wind turbine facilities at least 5 miles away from the leks of prairie grouse, which includes the sage-grouse. We support these recommendations and the precautionary approach they adopt in the absence of firm evidence that utility-scale wind power generation is compatible with maintaining sage-grouse habitat function. The same caution should apply to known wintering habitats. Areas within 3 miles of sage-grouse leks are considered as areas with high potential for conflict with areas between 3-5 miles of sage-grouse leks are considered as areas of moderate conflict (Map 14). These recommendations also apply to the placement of anemometer stations.

Burying Powerlines in Grouse Breeding, Nesting, and Winter Habitats

Transmission towers serve as perches for hunting raptors in addition to potentially causing abandonment of sage-grouse habitats through behavioral avoidance. An unpublished study found that sage-grouse habitat use increased with distance (up to 600 meters) from powerlines (Braun, unpublished data, in Strickland 2004). All transmission lines (including high-voltage DC lines) sited within 5 miles of a grouse lek or within ½ mile of winter habitat should be buried. We recommend avoiding active sage-grouse leks by not less than 5 miles unless the turbines would be masked from view of the lek by intervening topography.

Avoiding Impacts to Big Game

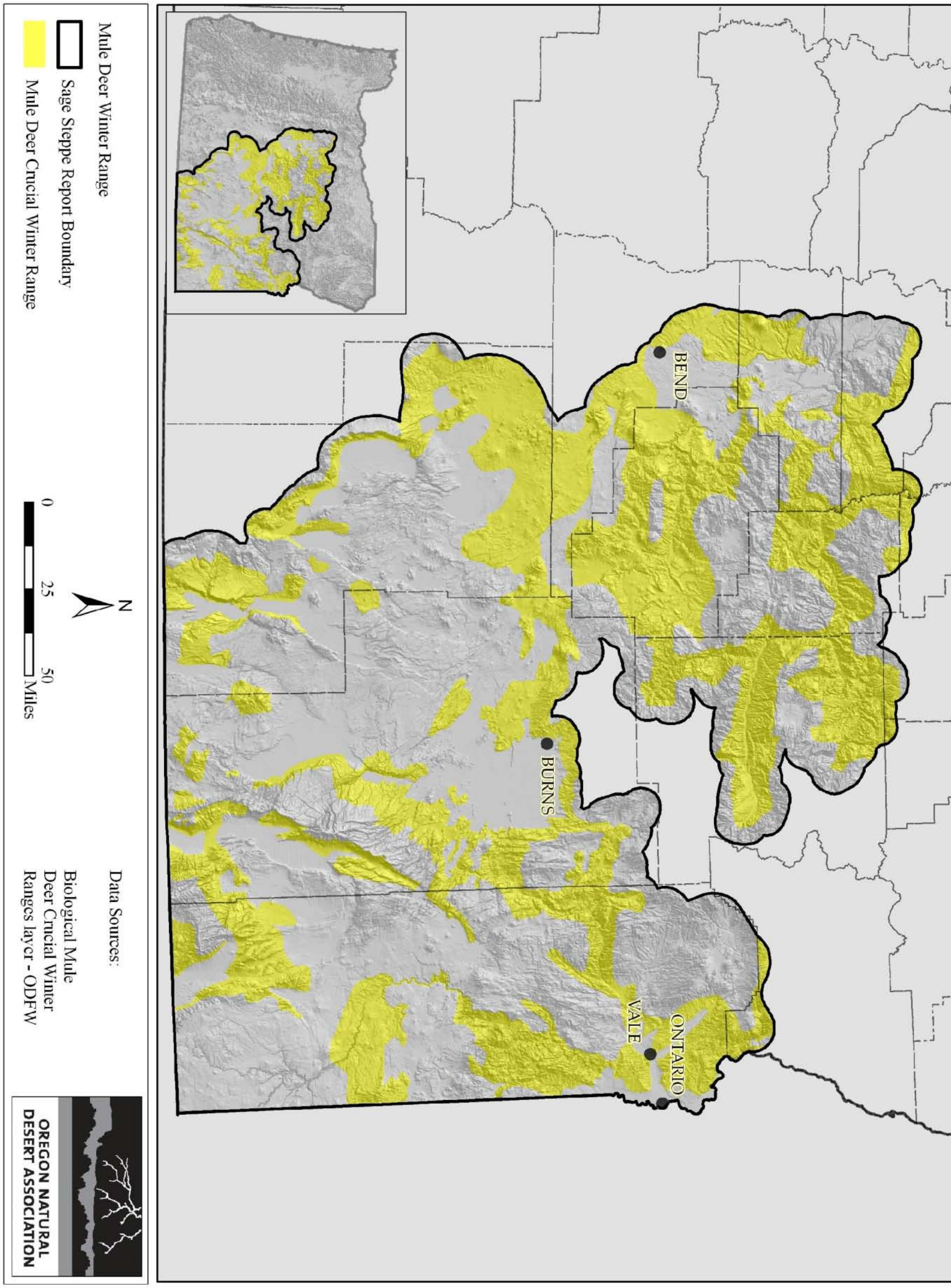
Pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), Rocky Mountain elk (*Cervus elaphus nelson*) and bighorn sheep (*Ovis Canadensis*) are found throughout Oregon's high desert (Maps 15, 16, and 17). There have been no scientifically rigorous hypothesis tests concerning the impacts unique to wind energy development on big game. According to the National Wind Coordinating Council, "Wind farms also may disrupt wildlife movements, particularly during migrations. For example, herd animals such as elk, deer and pronghorn can be affected if rows of turbines are placed along migration paths between winter and summer ranges or in calving areas" (NWCC 2002).

It is widely agreed that construction-related activities are likely to displace wildlife from their native ranges. It is also important to consider that the impacts of energy development on elk and (to a lesser extent) mule deer have been studied, but for other big game animals, it will be necessary to infer potential impacts using the studied species until more specific scientific research can be conducted. These studies show that big game is negatively impacted by the construction, ongoing disturbance and fragmentation associated with energy development projects.

Photo 7. Rocky Mountain elk(L. Stumpf)

A number of studies have shown that elk avoid open roads (Grover and Thompson 1986, Rowland et al. 2000). Edge and Marcum (1991) found that elk use was reduced within 1.5 km of roads, except where there was topographic cover. Gratson and Whitman (2000) found that hunter success was higher in roadless areas than in heavily roaded areas, and that closing roads increased hunter success rates. On the Black Hills, elk chose their day bedding sites to avoid tertiary roads and even horse trails (Cooper and Millspaugh 1999). Cole et al. (1997) found that reducing open road densities led to smaller elk home ranges, fewer movements, and higher survival rates. Road networks associated with wind development would be expected to displace elk, and thus wind power facilities should avoid the most sensitive habitats and migration corridors.

On winter ranges, elk are highly susceptible to disturbance. They are so sensitive to human disturbance that even cross-country skiers can cause significant stress to wintering animals (Cassirer et al. 1992). Ferguson and Keith (1982) found that while cross-country skiers did not influence overall elk distribution on the landscape, elk avoided heavily-used ski trails. Disturbance during this time of year can be particularly costly, since the metabolic costs of


Map 15
Mule Deer Crucial Winter Ranges
BEND
BURNS
VALE
ONTARIO
Mule Deer Winter Range
Sage Steppe Report Boundary
Mule Deer Crucial Winter Range
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Data Sources:
Biological Mule Deer Crucial Winter Ranges layer - ODFW
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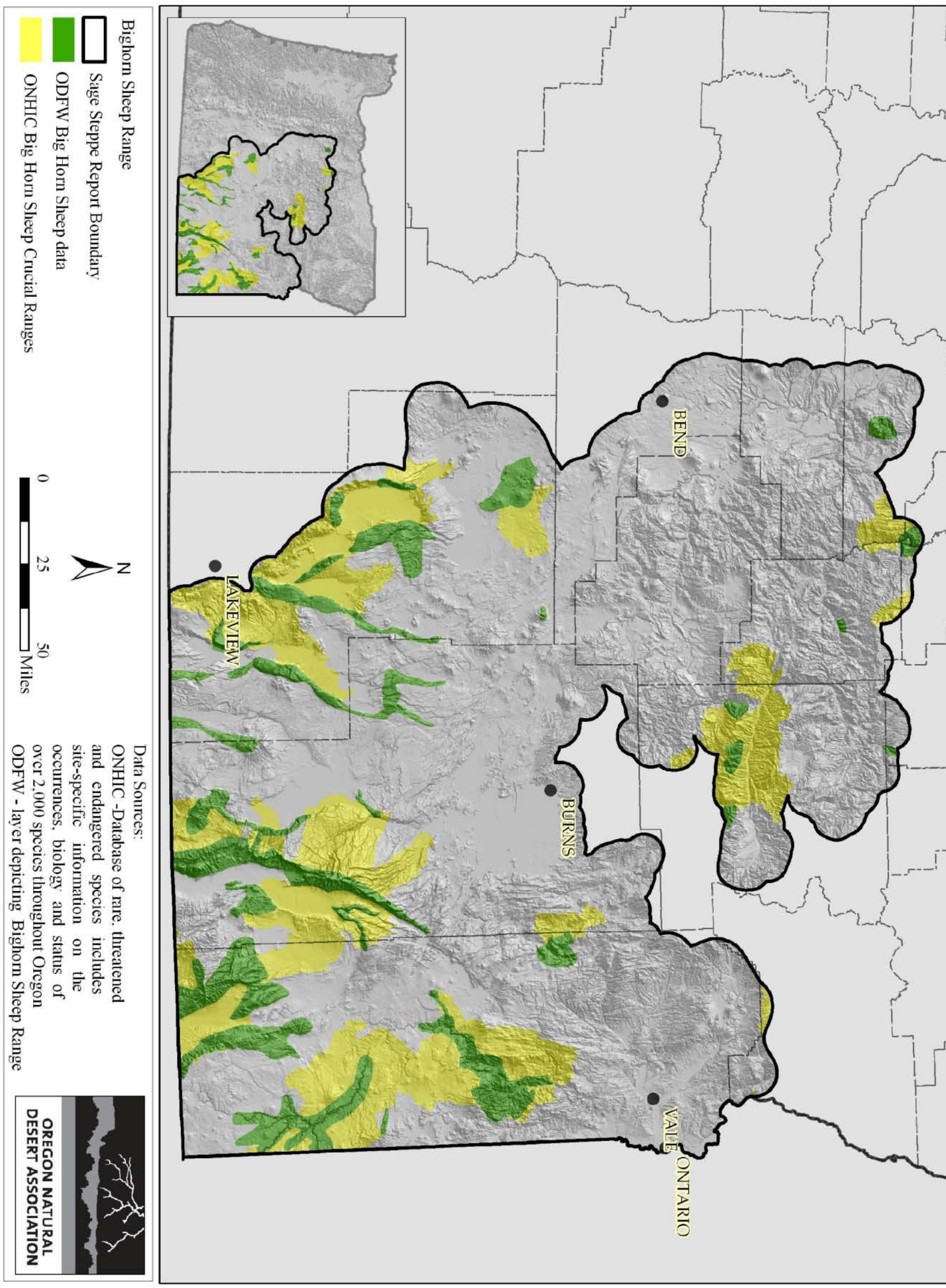
Map 16
Bighorn Sheep Crucial Ranges
BEND
LAKEVIEW
BURNS
VALE
ONTARIO
Bighorn Sheep Range
Sage Steppe Report Boundary
ODFW Big Horn Sheep data
ONHIC Big Horn Sheep Crucial Ranges
N
0
25
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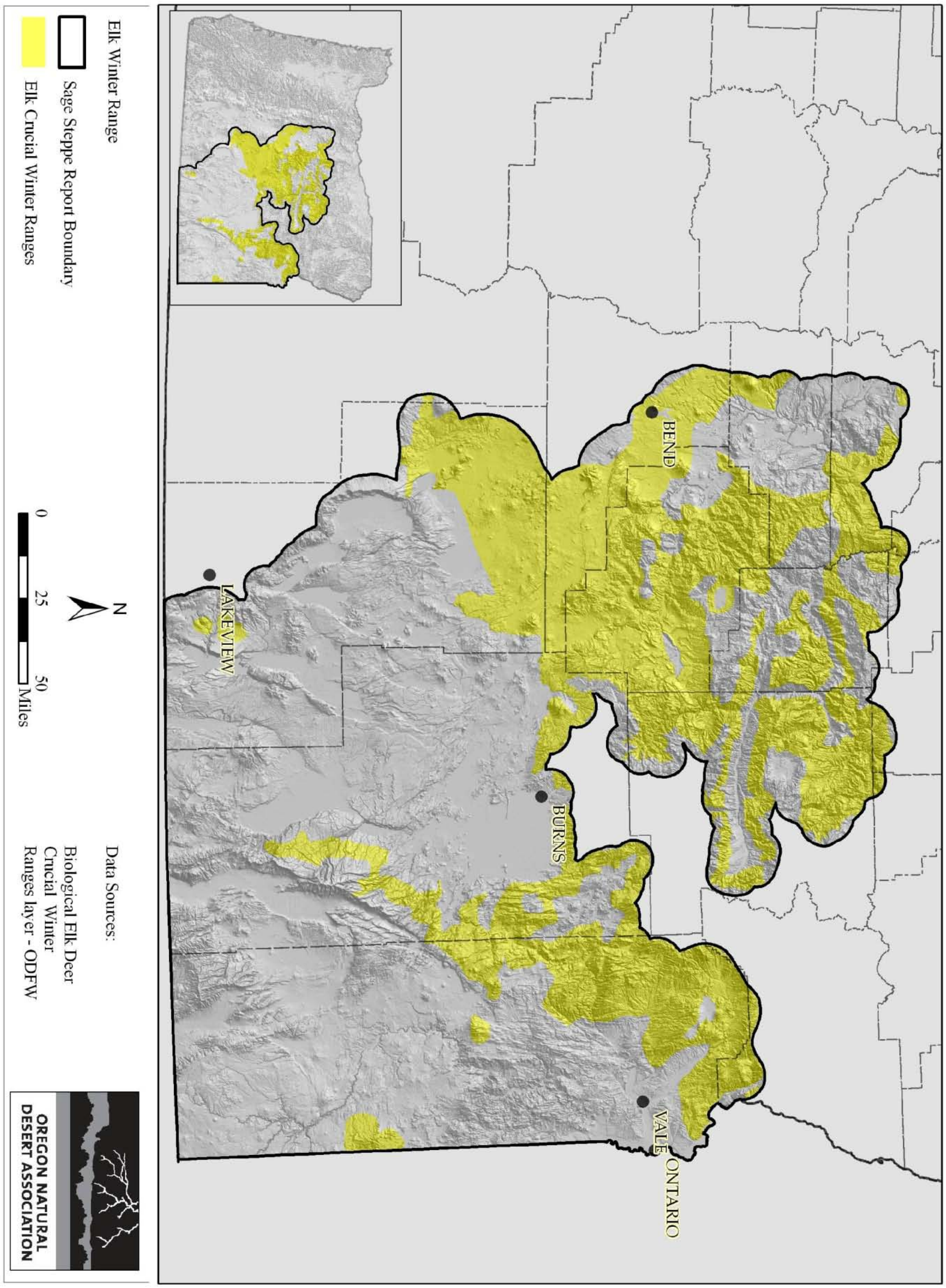
Miles
Data Sources:
ONHIC -Database of rare, threatened and endangered species includes site-specific information on the occurrences, biology and status of over 2,000 species throughout Oregon
ODFW - layer depicting Bighorn Sheep Range
OREGON NATURAL DESERT ASSOCIATION


Map 17
Elk Crucial Winter Ranges
BEND
LAKEVIEW
BURNS
VALE
ONTARIO
Elk Winter Range
Sage Steppe Report Boundary
Elk Crucial Winter Ranges
N
0
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Data Sources:
Biological Elk Deer
Crucial Winter
Ranges layer - ODFW
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locomotion are up to five times as great when snows are deep (Parker et al. 1984). To the degree that wind power facilities involve human presence in crucial ranges during the most sensitive time periods, these developments may tend to displace elk from their preferred habitats into marginal ranges, where habitat conditions may be poor or where they may be forced to compete with resident animals already at or near their carrying capacity.

Several studies have shown that elk abandon calving and winter ranges in response to oilfield development and this has potential implications for utility-scale wind power development. In mountainous habitats, the construction of a small number of oil or gas wells caused displacement of elk from substantial portions of their winter range (Johnson and Wollrab 1987, Van Dyke and Klein 1996) and drilling in the Wyoming Range displaced elk from their traditional calving range (Johnson and Lockman 1979, Johnson and Wollrab 1987). In the sagebrush habitats of the Red Desert, Powell (2003) found that elk avoid lands within 1.5 kilometers of roads and gas well sites during the summer and lands within 0.6 miles during the winter. Sawyer and Neilson (2005) found a similar response to roads during their subsequent investigation in the same area.

For mule deer, Sawyer et al. (2005) found that well field development caused abandonment of mule deer crucial winter ranges for years at a time, and ultimately resulted in a 46 percent decline in mule deer populations. Herds in undeveloped areas showed a much smaller decline over the same period; the affected population has yet to recover to pre-disturbance levels. Migration corridors may in some cases be equally important to large mammals and are potentially susceptible to impacts from wind energy development. With this in mind, big game migration corridors should be accorded similar level of conservation as winter and parturition ranges.

Best Practices for Big Game Crucial Ranges and Migration Corridors

Test Initial Projects before Approving Additional Development in Crucial Habitats

The first projects to be constructed within big game crucial ranges or migration corridors should be accompanied by rigorous scientific studies to determine the level of tolerance of big game for wind power facilities. These studies should: 1) Test the null hypotheses that construction activities have no effect on wildlife habitat selection and describe the area of avoidance if displacement occurs; 2) Test the same hypothesis for operation activities; 3) Determine population level effects, if any; and 4) Determine how long it takes for animals to resume using the wind power facility site. Such studies should use Before-After-Control formats for maximum scientific rigor. If these studies indicate that displacement of big game from a type of sensitive range or migration corridor by wind power development is not significant, then other wind power projects should be free to proceed in that type of range or migration corridor.

Perform Construction Activity Outside the Sensitive Season

Wind power facility construction activities should not occur within 2 miles of crucial ranges or migration corridors during the period of use by wildlife.

Seasonally Restrict Vehicles and Human Presence

Portions of the wind energy facility inside crucial winter ranges or migration corridors should be closed to vehicle use and human presence must be minimized during their period of use by wildlife.

Stewardship for Other Sensitive Wildlife

Wind power projects can affect sensitive wildlife through direct mortality, habitat loss and fragmentation, and displacement of wildlife from preferred habitats due to disturbance. The key to minimizing these impacts is to site wind power facilities in areas of relatively low habitat importance and low likelihood of conflict.

Direct Mortality of Migratory Birds

Wind turbines arrays have the potential to be major sources of migratory bird mortality. Birds have relatively poor hearing, and human ears can detect wind turbines at roughly twice the distance as birds can (Dooling 2002). Mc-Crary et al. (1983, 1984) estimated that 6,800 birds were killed annually at the San Gorgonio wind facility in California. Erickson et al. (2001) reported in a California study that 78 percent of mortalities were songbirds protected by the Migratory Bird Treaty Act, while only 3.3 percent of bird mortalities were unprotected, non-native species such as rock doves (*Columba livia*) or starlings (*Sturnus vulgaris*). At Wyoming's Foote Creek Rim wind facility, 92 percent of bird mortality between 1998 and 2002 was comprised of passerines, or small songbirds (Young et al. 2003).

While it is correct to point out that many other types of human activities have killed substantially more birds than have wind turbines to date, fatalities from turbine collisions are additive to all other stressors of bird populations, which may already be imperiled by other human-caused factors. The 2009 USFWS State of the Birds report found that 25 percent of the species in the United States are experiencing significant declines (including grassland and aridland birds). For these species, it is necessary to consider wind power in the context of cumulative impacts because even low mortality rates attributed to wind power can be significant to a species seeing reductions because of cumulative impacts from multiple sources.

The National Research Council (2007) points out that while turbine fatalities are currently a small portion of human-caused bird mortalities nationwide, locally these mortalities can have important impacts on bird populations. A review of numerous avian and wind studies noted that waterfowl and shorebirds were among those most impacted by wind energy (Stewart et al. 2007).

Woodlands may have greater sensitivity from the perspective of songbird mortality. The National Research Council (2007) found that "Total bird fatalities per turbine and per MW [megawatt] are similar for all regions examined in these studies, although data from the two sites evaluated in the eastern United States suggest that more birds may be killed at wind-energy facilities on forested ridge tops than in other regions." This is not always the case, however: not one dead bird was found by Keppinger (2002) during mortality monitoring at a Vermont turbine facility sited in rolling forested country.

Nocturnal migrations of songbirds should be identified as part of the baseline analysis for wind power projects. Bird migrations often occur at night (Mabee et al. 2006). The highest percentage of fatalities attributable to nocturnal migrants was 48 percent at Wyoming's Foote Creek Rim wind power facility (Erickson et al. 2001). Wind turbines extend into the lowest strata of bird migration with most migrating birds flying at heights above turbine facilities (Kerlinger 2002). Birds may maintain altitude after crossing ridgetops (Mabee et al. 2006), suggesting that wind turbine arrays with the tops of blades positioned lower than nearby ridgetops could result in lower rates of mortality for migratory birds.

Accurate mortality monitoring and before-and-after habitat use studies should be a basic part of all wind facility operations, and have been for many wind power programs to-date. Estimates of bird mortality can be biased by the efficiency of searchers to locate dead birds and by the rates at which scavengers remove the carcasses. Both of these factors vary widely among wind power sites (Morrisson 2002). Searcher efficiency at the Foote Creek Rim was estimated at 90 percent for medium and large birds and 60 percent for small birds based on experimental trials (Young et al. 2003). Arnett (2006) found that trained dogs had a much higher efficiency of finding bird mortalities (71-81 percent) versus human searchers (14-40 percent) in the eastern U.S.

Habitat Impacts for Birds

In addition to sage-grouse, several other species are dependent on sagebrush ecosystems and sensitive to habitat changes. These species include Brewer's sparrow (*Spizella breweri*), Sage sparrow (*Amphispiza belli*), and Sage thrasher (*Oreoscoptes montanus*) (Rotenberry and Knick 1999; Knick and Rotenberry 2000). Dobkins and Sauder (2004) found that numerous shrub-steppe bird species were already at-risk due to existing habitat fragmentation. In this review, southeast Oregon was found to have relatively high species richness for upland birds compared to other shrub-steppe habitats throughout the West (Map 18).

Photo 8. Black-necked stilt ((*Himantopus mexicanus*) (Greg Burke)

Wind turbine arrays are likely to result in further habitat fragmentation and the displacement of sensitive wildlife away from developed areas. Leddy et al. (1999) found that the Buffalo Ridge wind project area had a density of grassland passerines four times lower than surrounding habitats, indicating that songbirds avoid wind turbine arrays in their habitat selection. Fragmentation of shrubsteppe habitats has a particularly strong negative impact on birds. Knick and Rotenberry (1995) found that sage sparrows and sage thrasher populations decreased with decreasing patch size and percent sagebrush cover, and reached the following conclusion:

> "Our results demonstrate that fragmentation of shrubsteppe [habitats] significantly influenced the presence of shrub-obligate species. Because of restoration difficulties, the disturbance of semiarid shrubsteppe may cause irreversible loss of habitat and significant long-term consequences for the conservation of shrub-obligate birds."

Kerley (1994) similarly found that small patches had fewer shrub-nesting species than large patches, and the green-tailed towhee, an interior sagebrush species, was entirely absent from small patches.

Wind turbine facilities can contribute to habitat fragmentation, potentially displacing some species. The Searsburg facility in Vermont showed a decline in interior forest birds and an increase in edge adapted birds such as robins and jays using the area, likely associated with the clearings constructed for turbine towers and roads (Kerlinger 2002).

Morrisson (2006) summed up habitat impacts as follows: "For wind developments, issues of habitat involve (1) outright loss because of development, (2) indirect impacts because of disturbance (i.e., the animal will no longer reside near the development), and (3) disruption in animal passage through or over the development because of the addition of towers and turbines." The American Society of Mammalogists (2008) has recognized that wind power projects lead to habitat fragmentation and wildlife displacement. Many of these impacts are avoidable through proper siting, according to the National Research Council (2007): "To the extent that we understand how, when, and where wind-energy development most adversely affects organisms and their habitat, it will be possible to mitigate future impacts through careful siting decisions." Another important factor is indirect habitat loss as a result of increased human presence, noise, or motion of operating turbines (NWCC 2002).

Small Mammals

A number of small mammals associated with shrub-steppe ecosystems are known to be declining or rare. These include pygmy rabbit (*Brachylagus idahoensis*), Washington ground squirrel (*Spermophilus washingtoni*), and kit fox (*Vulpes macrotis*). Remarkably little is known about the distribution or population status of most small mammal species in shrub-steppe ecosystems. Research suggests that many of these species exist only as small, disconnected populations (Yensen and Sherman 2003) and thus are sensitive to disturbance. A recent review of existing data found that a number of small mammal species associated with shrub-steppe ecosystems are already at-risk due to habitat fragmentation (Dobkins and Sauder 2004). Among these species, southeast Oregon was found to have relatively high diversity of upland and riparian mammals compared to other areas throughout the West (Map 18).

Impacts of wind power projects to burrowing rodents are uncertain. Some studies indicate that wind power development can be compatible with burrowing mammals. At Altamont Pass, some species of burrowing rodents and rabbits clustered around turbine towers, attracting foraging raptors (Smallwood and Thelander 2005). Johnson et al. (2000) found that populations of prairie dogs (*Cynomys*) and ground squirrels showed no apparent decline in response to wind turbine construction and operation at Foote Creek Rim.

Photo 10. Pygmy rabbit (E. Rees)

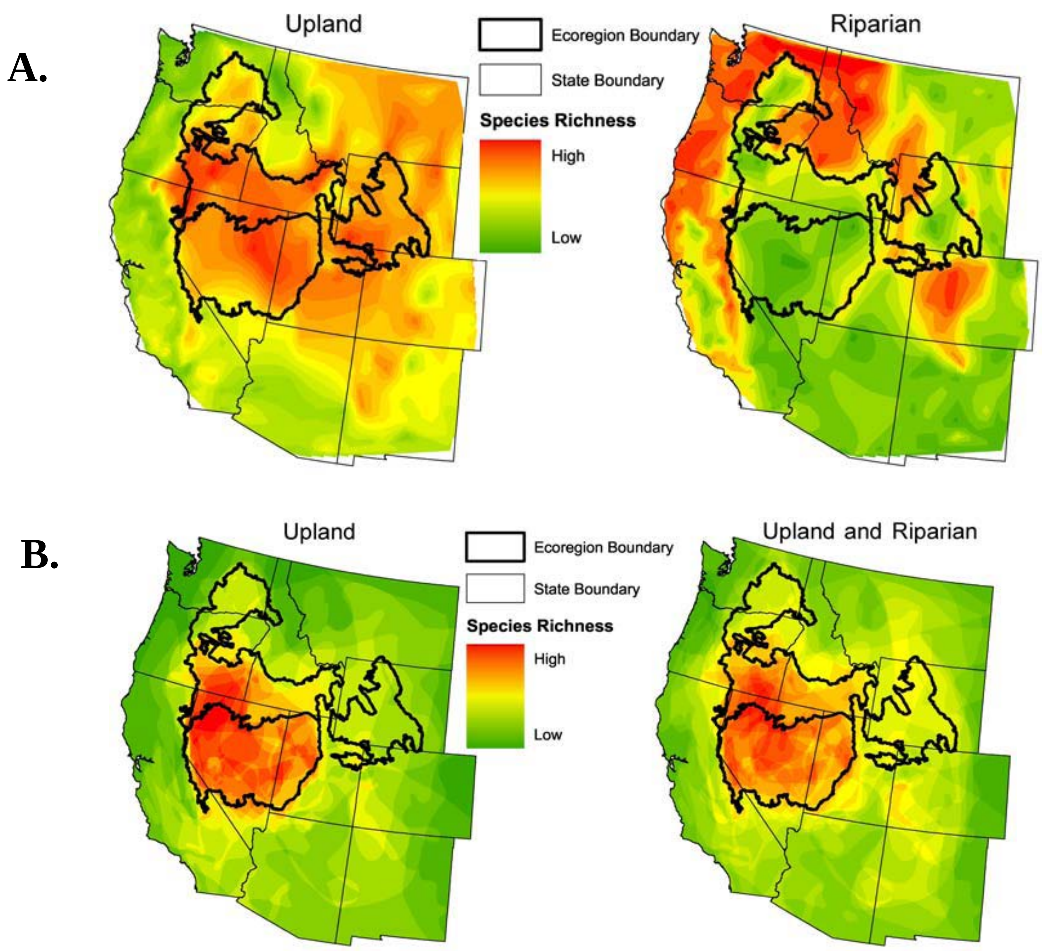
On the other hand, fragmenting small mammal habitat can have negative consequences. Pygmy rabbits have suffered population declines over the past several decades and several groups have petitioned the USFWS to protect this diminutive species under the Endangered Species Act. Purcell (2006) noted that the conversion of big sagebrush communities to energy production sites can creates a concern for pygmy rabbits. Katzner (2004) indicated that habitat fragmentation can reduce the size, stability and success of pygmy rabbit populations because these animals are reluctant to cross open habitats. Roads and wellpads clearly fall into this category.

There have been numerous studies showing that an increase in perches and nesting sites associated with the construction of buildings, transmission poles and other infrastructure leads to increases in raptor and corvid populations. Such inflated populations can result in unnaturally high predation of resident rodents, birds and other prey species.

Best Practices for Other Sensitive Species

Conduct Pre-siting Wildlife Surveys to Determine Optimum Siting

Morrisson (2006) is one of many researchers that have conducted studies of bird habitat utilization and migration patterns in advance of wind energy development. By determining the habitat use on the project scale, turbines can be sited away from high-value bird habitats. This researcher concluded, “Such pre-siting surveys are needed to appropriately locate wind farms and minimize the impacts to birds.” Surveys should be applied generally, and will be particularly important for projects sited in natural habitats.



Map 18. Geographic patterns in bird and small-mammal communities of the western shrubsteppe.**

(*A*) *Species richness for 21 upland and 11 riparian shrubsteppe bird species, based on presence-absence data from the Breeding Bird Survey. Maximum species richness on these maps is 21 species for upland birds and 11 species for riparian birds.*

(*B*) *Species richness for small mammals based on historical range maps for 18 upland species only, and for 24 upland and riparian species combined. Maximum species richness on these maps is 13 species for upland mammals alone, and 18 species for upland and riparian mammals combined. Small sample size prevented meaningful separate analysis of riparian mammals.*

*****REPRODUCED FROM Dobkin and Sauder 2004:21.***

Avoid Rodent Control Programs to Mitigate Raptor Mortalities

Rodent control programs to reduce prey availability have been ineffective in reducing raptor mortality at Altamont Pass (Smallwood and Thelander 2005, GAO 2005). Given the potential sensitivity of the small mammal populations in Oregon's shrub-steppe ecosystems, programs to reduce or eliminate rodent populations to reduce mortality rates of hunting raptors will likely result in a net environmental loss.

Requiring Unguyed Meteorological Towers

Meteorological towers associated with wind power facilities also can be a major source of avian and bat mortality. Guyed meteorological towers show a 3 times higher fatality rate than turbines themselves at Wyoming's Foote Creek Rim facility, with collisions with guy wires primarily responsible for bird deaths (Young et al. 2003). The Nine Canyon wind project in Washington used an unguyed meteorological tower, which resulted in no recorded bird or bat fatalities (Erickson et al. 2003). Meteorological towers should be of the free-standing, unguyed variety to minimize additional avian and bat mortality.

Aesthetic Values and the Human Element

Bisbee (2005) remarked that "Popular visual aesthetic preferences are the primary obstacle to obtaining the emission reductions and other benefits wind power offers." Historically, concerns about visual impacts, particularly in the vicinity of towns, have sparked high levels of concern. According to Gipe (2005),

> "Opinion surveys show that wind has high public support, but a worrisome NIMBY ["Not In My Back Yard"] factor. This support erodes once specific projects are proposed. Because support is fragile and can be squandered by ill-conceived projects, the industry must do everything it can to insure that wind turbines and wind power plants become good neighbors. One means for maximizing acceptance is to incorporate aesthetic guidelines into the design of wind turbines and wind power plants."

According to Cownover (2007), "The size, number, scale, motion and visual prominence of wind turbines makes visual mitigation nearly impossible and communities are faced with challenges in embracing green technology while protecting landscape views they value." In a Riverside County (California) survey regarding the San Gorgonio wind facility, most residents were ambivalent about whether wind energy

Photo 11. Pike Creek Canyon, Steens Mountain (G. Burke)

development was worth the aesthetic cost, while the remainder was evenly split between supporters and opponents of the wind facility (Gipe 2005).

It is critically important for the proponents to implement projects in a way that engenders public support rather than backlash, both to ease acceptance of projects and to ensure that future wind projects do not engender immediate resistance. According to Pasqualetti (2000),

> "If developers are to cultivate the promise of wind power, they should not intrude on favored (or even conspicuous) landscapes, regardless of the technical temptations these spots may offer. Had this been an accepted admonition twenty years ago, the potential of the San Gorgonio Pass might have carried with it the threat of public backlash sufficient to cause more farsighted developers to hesitate. This argues for a more careful melding of land use, scenic values, public opinion, and environmental regulations with the technical considerations of each site."

Pasqualetti added, "Such spatial realities, even if amplified by only a few vocal objectors, can rob momentum and dull enthusiasm for renewable energy." In New York State, the Town of Warren (2006) established lands within 5 miles and lands within 8 miles of turbine sighting as the area of visual impact analysis. Sterzinger et al. (2003) also used a 5-mile viewshed radius, while the National Research Council (2007) recommended a 10-mile radius for examining viewshed impacts of wind projects and a 15-mile viewshed analysis for particularly important overlooks.

Sterzinger et al. (2003) determined that while it is commonly assumed that wind power development will lower property values for neighboring residents, the empirical evidence shows no reduction in property values for wind energy zones versus areas unaffected by wind development. Hoen (2006) found no property value impacts of wind energy facility construction at a small town in upstate New York, and argued that property values are an independent index of aesthetic quality.

The scale of the project, particularly if that scale is highly visible, is a critical aesthetic factor. National Research Council (2007) warned, "A project that dominates views throughout a region is more likely to have aesthetic impacts judged unacceptable than one that permits other scenic or natural views to remain unimpaired throughout the region." The Danish wind power program has gained broad acceptance, in part because it is based on a number of small (1 to 30 turbine) projects. The National Wind Coordinating Council (2002) suggested that, "Fewer and wider-spaced turbines may present a more pleasing appearance than tightly-packed arrays."

Among the recommendations of Gipe (2005) are maintaining aesthetic uniformity within an array (utilizing the same number of blades, similar turbine shapes), avoiding dense turbine spacing, and using low-contrast paint schemes to make the turbines less obtrusive. According to Pasqualetti (2000), "Open space remains the West's greatest attribute and attraction, the inalienable right of all those with the luck to have been born there or—as some believe—the sense to have moved there." One study showed that visibility of wind turbines increased annoyance levels in survey respondents (van den Berg et al. 2008).

The National Research Council (2007) has outlined a process for evaluating the conditions under which the aesthetic impacts of a proposed wind project might become unacceptable or "undue" in regulatory terms, considering the following factors:

- Has the applicant provided sufficient information with which to make a decision? These would include detailed information about the visibility of the proposed project and simulations (photomontages) from sensitive viewing areas.
- Are scenic resources of local, statewide or national significance located on or near the project site? Is the surrounding landscape unique in any way? What landscape characteristics are important to the experience and visual integrity of these scenic features?
- Would these scenic resources be significantly degraded by the construction of the proposed project?
- Would the scale of the project interfere with the general enjoyment of scenic landscape features throughout the region? Would the project appear as a dominant feature throughout the region or study area?
- Has the applicant employed reasonable mitigation measures in the overall design and layout of the proposed project so that it fits reasonably well into the character of the area?
- Would the project violate a clear, written community standard intended to protect the scenic or natural beauty of the area? Such standards can be developed at the community, county, region, or state level.

Project proponents who can answer these questions to the satisfaction of the public will not only be better able to clear regulatory hurdles but also will be better able to gain local support for wind power projects. In addition, wind energy producers who provide electricity free or at reduced rates to local communities might experience less opposition and controversy surrounding wind projects on locations visible from town.

Historical and Cultural Resources

The National Historic Preservation Act's regulations state that an "adverse effect" to historic properties results from the "[p]hysical destruction of or damage to all or part of the Property," "[a]lteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation, and provision of handicapped access, that is not consistent with the Secretary's standards for the treatment of historic properties [36 CFR part 68] and applicable guidelines" or the "[c]hange of the character of the property's use or of physical features within the property's setting that contribute to its historic significance." [36 C.F.R. § 800.5(a)(2)(i-ii, iv)]. Wind power facilities can cause significant impacts to the settings of historical and cultural sites listed on or eligible for the National Register of Historic Places. Wind facilities are seen by the viewer as symbols of technological development (Gipe 2005) and thus are incompatible with historic settings. It would be very difficult to minimize or mitigate the impacts of a wind power array on the setting of a historic property. The best way to avoid this thorny issue is to site wind facilities in such a way that intervening topography masks them from view from historic trails and sites (Map 19).

Visual Resources Management

In its long-term land-use plans, the BLM typically outlines areas where maintaining visual resources is a management priority. In Oregon, wind power development would be precluded by regulation in BLM Visual Resource Management Class I areas (Map 20) which seeks to "preserve the existing character of the landscape." Many if not all areas in this class are Wilderness Study Areas and thus are already precluded from development. It would also be very difficult for a utility-scale wind project to meet the requirements of Visual Resource Management Class II as well. These requirements state:

> "The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape." (BLM Manual H-8410-1)

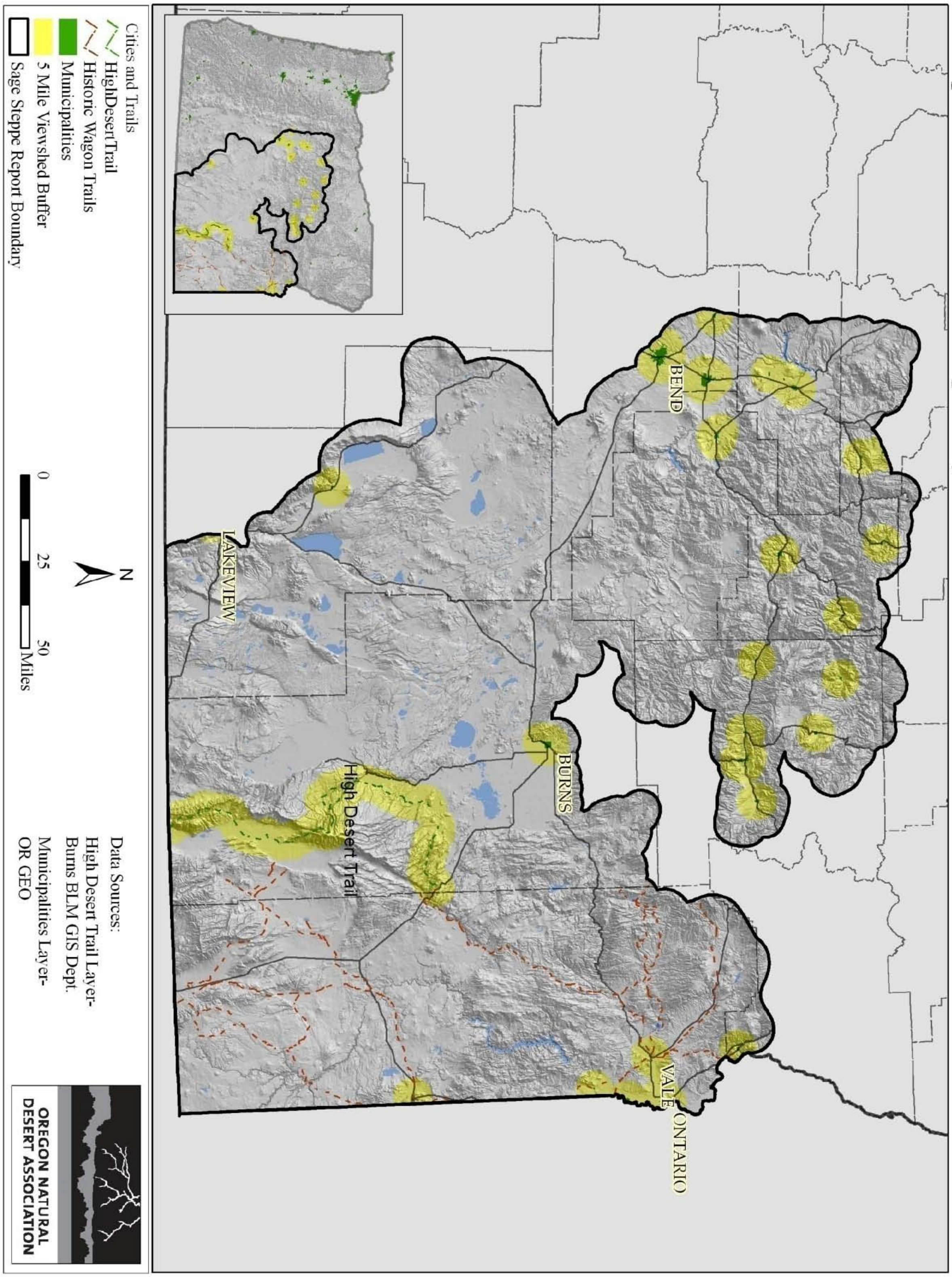
Best Practices for Protecting Aesthetic, Historic Values

Getting Local Buy-In for Projects within 5 Miles of a Town

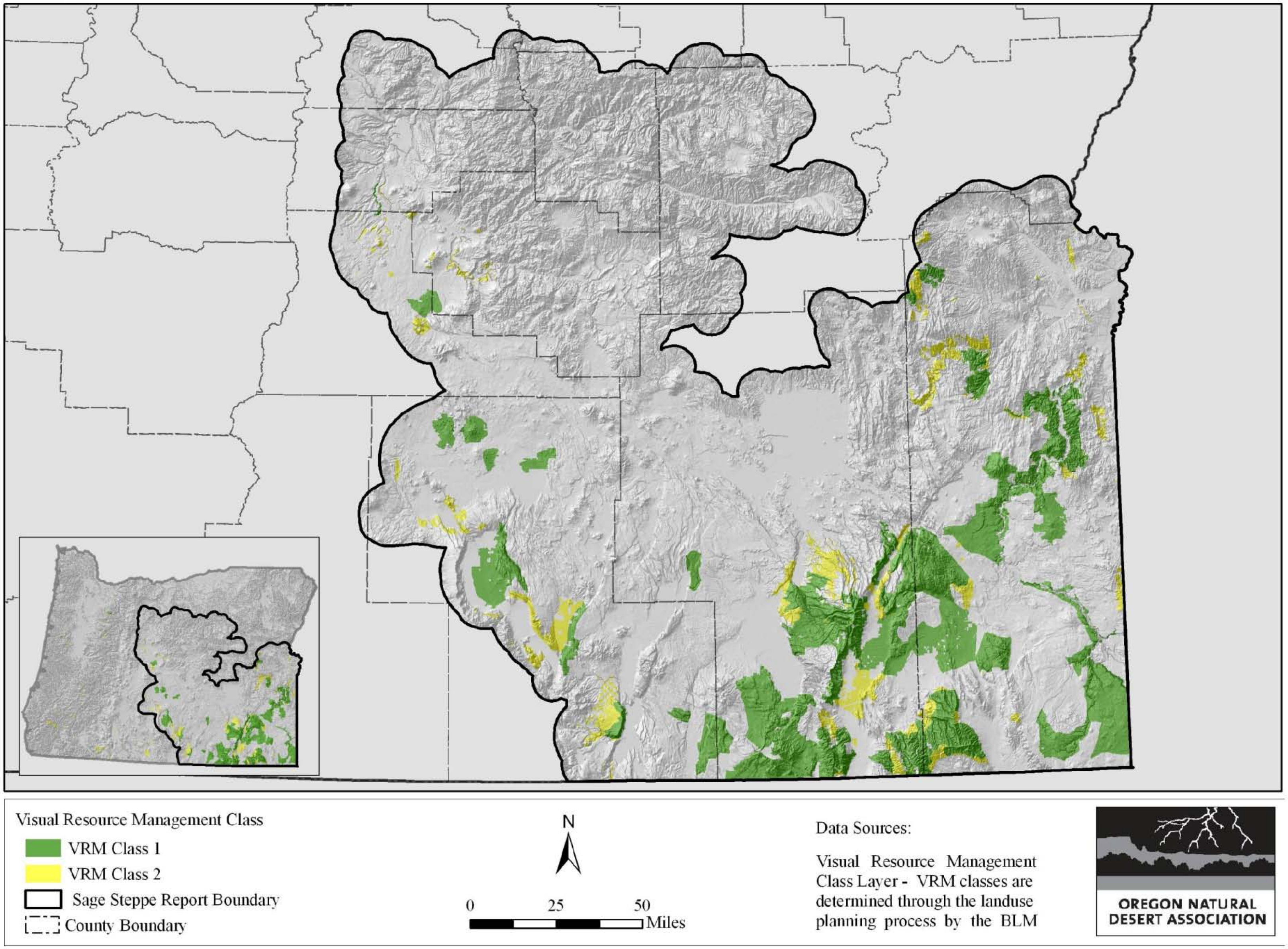
An open and inclusive public process benefits wind energy development by allowing public concerns to be addressed and gaining buy-in from neighboring communities. Hasty permitting projects with accelerated timelines result in trouble for wind power projects (NWCC2002). For lands within 5 miles of established towns, we recommend siting wind facilities in areas screened from view by intervening topography, and where this is not possible, getting formal buy-in from the local community via resolutions of approval from elected town bodies.

Minimizing the Impacts of Noise and Shadow Flicker near Dwellings

Impacts of turbine noise and shadow flicker should also be considered, particularly in cases where residents live very close to the proposed turbine array. Turbine noise is generally a factor only within 0.5 mile of the turbine site (National Research Council 2007). In a Netherlands study, van den Berg et al. (2008) found that when noise increased from 30 dBA to 45 dBA, respondents showed increased annoyance. Noise and shadow flicker have been identified as issues in Europe (National Research Council 2007), and shadow flicker has been recognized as a


Map 19 Municipality Viewsheds and Historic Trails
BEND
BURNS
LAKEVIEW
VALE
ONTARIO
High Desert Trail
Cities and Trails
HighDesertTrail
Historic Wagon Trails
Municipalities
5 Mile Viewshed Buffer
Sage Steppe Report Boundary
N
0
25
50
Miles
Data Sources:
High Desert Trail Layer-
Burns BLM GIS Dept.
Municipalities Layer-
OR GEO
OREGON NATURAL
DESERT ASSOCIATION

Map 20 BLM Visual Resource Management Classes



distraction to drivers and a potential safety hazard in some countries (MSU 2004). For projects sited away from primary access roads and human dwellings, these impacts should be of minor concern.

Shielding the Viewsheds of Historic Properties from Wind Turbines

Within 5 miles of important historic sites and trails, we recommend using great caution by siting wind power facilities only in areas that are visually screened from view from the historic property.

Consulting with Tribes on Traditional Cultural Properties

Wind energy companies should undertake formal consultation with Native American tribes to identify Traditional Cultural Properties, and these should be accorded a similar level of respect and protection as historic trails and sites.

Wind Power Potential and Siting Considerations

To-date, the wind power potential of a site has been the principle (and often the only) consideration driving the siting of wind turbine arrays in Oregon. Map 5 displays the wind power potential of Oregon on a coarse scale. The higher the numerical rating, the stronger the potential is estimated to be for wind energy generation. Areas with a rating of Class 4 or higher are typically viewed as commercially viable however areas rated at Class 3 are now also viable due to improvements in wind turbine efficiency.

The Value of Siting Wind Power in Areas of Few Environmental Conflicts

When all of the sensitive wildlife habitats and high-value landscapes are factored in, Oregon offers a great deal of wind power potential without building turbines in areas that entail heavy impacts or social conflicts. Map 1 shows areas with low to moderate resource concerns and commercial wind power potential. We recommend prioritizing utility-scale wind power in these areas. In addition, these areas are the best candidates for additional electrical transmission capacity to support the growth of the renewable energy industry.

Based on our recommendations, nearly a half-million acres of Oregon's high desert would be suitable for wind power development and have low to moderate potential for environmental or social conflict. Sage-grouse habitats coupled with existing protections for federally-designated conservation areas including Wilderness and Wilderness Study Areas are the primary driver of recommended exclusions.

Adding Value by Siting Wind Energy in Impacted Areas

The first screens in determining where wind energy should be sited should be wind energy potential and avoidance of sensitive habitats and landscapes. Once this first screen has been analyzed, the impacts of wind energy development can be further reduced by siting turbine arrays on lands that have already been heavily impacted by another form of industrial use. Thus, if wind energy must be sited in an area where cautions are indicated, siting facilities in industrialized areas will reduce the chances of resource conflicts. Siting wind towers in areas that are already impacted helps to protect open space, which is a legitimate value even in areas where habitat values are low and aesthetic concerns are not preeminent.

Agricultural Lands

Wind energy is compatible with farming and livestock grazing (Elliott and Schwartz 1993), and the National Wind Coordinating Council (2002) considers agriculture as "a wind-compatible resource." Because wind developments typically take less that 2 percent of the land out of agricultural production and yield additional sources of revenue, they may be especially attractive to private agricultural landowners (Gordon 2004). In a Netherlands study, van den Berg (2008) found that respondents with direct economic benefits were more accepting of wind turbines from visual and noise perspectives. This suggests that siting turbines on private lands may entail greater acceptance as landowners realize direct benefits while the public does not perceive direct compensation for the development of utility-scale wind projects on public lands. Thayer (2007) asserted, "Wind energy development on scenic public lands is less appropriate than wind farming on private rangeland because wind power provides more of a boost for productive farm/ranch management with less controversy over resource/aesthetic controls."

In particular, crop fields that support a monoculture of non-native vegetation tend to provide ecologically impoverished fauna and low biodiversity. Leddy et al. (1999) recommended siting wind turbines in crop fields, which already have reduced densities of grassland birds. In general, bird fatalities at sites located in agricultural croplands have been at the lower end of the spectrum. At the Nine Canyon site, built in wheat fields and grazing lands of central Washington, Erickson et al. (2003) estimated 3.59 bird fatalities per turbine per year and 3.21 bat fatalities per turbine per year, for a total of 133 birds and 119 bats per year for the entire facility. We recommend crop fields as priority areas for wind turbine siting while private grazing lands typically retain a much greater native habitat value and should not be considered sacrifice zones for the purposes of priority wind power facility siting. Leddy et al. (1999) observed that the siting of wind turbines on Conservation Reserve Program lands may cancel out the habitat value of these lands for songbirds. However, feed lots would definitely qualify as areas where wind turbine siting would add minimal additional impact and could be priority sites for wind development.

General Best Management Practices

Transmission Lines

Wind power development is also more economical when sited close to existing transmission lines, particularly for smaller projects. Larger wind projects may generate sufficient electricity to require (and justify) long spur lines of their own. In Oregon, most long-distance transmission lines are already heavily committed, leaving little capacity to carry wind power to distant markets. Thus, the construction of major new electrical transmission lines will be necessary to accommodate any major increase in wind power development. Major new transmission projects sited in areas of high wind power potential are likely to stimulate the construction of new wind power projects nearby. With this in mind, we encourage the construction of major new lines dedicated to wind power transmission into areas of low wildlife and cultural sensitivity, and avoiding the siting of major new lines through zones where wind power development would cause major resource conflicts.

Powerline towers are likely to concentrate raptor nesting and perching activities, to the potential detriment of prey species. Transmission towers may be particularly attractive as nest sites for ravens. Steenhof et al. (1993) reported that 133 pairs of ravens had colonized transmission towers on a single stretch of powerline in Idaho during its first 10 years of existence. Gilmer and Wiehe (1977) found that nest success for ferruginous hawks was slightly lower for transmission towers than other nest sites, and noted that high winds sometimes blew tower nests away. Steenhof et al. (1993) also found that transmission tower nests tended to be blown down, but found that nest success was not lower on towers for ferruginous hawks and was significantly higher on towers for golden eagles. In North Dakota, Gilmer and Stewart (1983) found that ferruginous hawk nest success was highest for powerline towers and lowest for nests in hardwood trees. Thus, although powerlines can be designed to minimize impacts to raptors, these corridors should be sited more than 2 miles away from pygmy rabbit colonies and sage-grouse leks to prevent major impacts to these sensitive prey species. When avoidance is not feasible, burial of the powerlines provides an option that avoids most of the impacts inherent to overhead power lines.

Avoiding Impacts to Sensitive Soils

Depending upon siting, soil erosion may be a concern. According to the National Research Council (2007), “The construction and maintenance of wind-energy facilities alter ecosystem structure, through vegetation clearing, soil disruption and potential for erosion, and this is particularly problematic in areas that are difficult to reclaim, such as desert, shrubsteppe, and forested areas.” We recommend siting wind turbine facilities and access routes away from steep (greater than 25 degrees) or unstable slopes or areas with high erosion potential.

Lower-Impact Access Routes

Improved gravel roads have been used in some cases for access to wind turbines in wind power facility settings, while in other cases (particularly in croplands) jeep trails, or no access route at all, are the rule. In most cases, gravel access roads will not only be unnecessary but will also increase the level of project impacts (from dust pollution to wildlife disturbance). We recommend the use jeep trails or no access routes at all to individual turbine towers within a facility development. Vehicle traffic within the turbine array can be further minimized by siting control stations and other related facilities at the near edge of the development to minimize unnecessary vehicle traffic through the turbine arrays.

Appropriate Permitting and Pre-Application Site Evaluation

Wind energy development has the potential to adversely affect important resources that make eastern Oregon's desert unique. Responsible siting of wind power facilities will avoid harm to wildlife, scenic and other resources. This requires robust pre-application site evaluation and an adequate permitting process. Some mitigation of impacts may be possible by applying best practices in designing and operating wind power facilities. Ensuring that site evaluation and mitigation are adequate falls on the shoulders of government agencies that issue permits to develop wind power sites. In Oregon, the responsibility for issuing permits for wind power facilities is split among several jurisdictions. BLM or the Forest Service must approve facilities located on federal lands. On private lands, facilities with an average generating capacity of 105 MW or larger must obtain a site certificate from the Oregon Energy Facility Siting Council (EFSC), while smaller facilities are usually permitted through a county land use process. Smaller facilities that, cumulatively, cause effects that are similar to a single larger facility require an EFSC site certificate.

The divided responsibility for approving wind power projects has resulted in non-uniform standards for evaluating impacts on species, their habitats, and other resources in Oregon. These inconsistencies led to the development of the Oregon Columbia Plateau Ecoregion Wind Energy Siting and Permitting Guidelines (Guidelines), a set of voluntary siting and permitting guidelines designed to avoid or minimize impacts of wind energy facilities on wildlife resources (http://www.rnp.org/resources/OR%20wind%20siting%20guidelines%2008Sept29.pdf).

The Guidelines apply in the northern part of Oregon. Similar guidance should be developed for other parts of the state where wind energy development is in its early stages, including Oregon's high desert. The Guidelines contain a number of specific recommendations for thoughtful and deliberate evaluation of potential wind power facilities. These include:

- Conducting pre-application biological surveys to identify the species (plants and animal) and habitats within the project boundary, after input and consultation with resource agencies.
- Obtaining two (or more years) of seasonal data on wildlife impacts before deciding whether to submit a permit application where (1) use of the project site by the avian groups of concern is estimated to be high, (2) there is little existing relevant data regarding seasonal use of the wind project site or on nearby areas of similar habitat type, and/or (3) the wind project is especially large and/or complex. Many of eastern Oregon's potential wind power sites fall into one of these three categories.
- Conducting pre-project assessment (while preparing the permit application) of potential bird and bat mortality and potential wildlife displacement.

- Using the Oregon Department of Fish & Wildlife's Habitat Mitigation Policy to characterize habitats into habitat categories and to avoid or mitigate impacts consistent with the Policy's mitigation goals for each habitat category.
- Conducting post-construction monitoring to determine wildlife mortality and wildlife displacement, and use such monitoring to determine potential additional mitigation and operational changes in consultation with resource agencies and permitting authorities.

Because the Guidelines provide clear pre-application and pre-construction steps to inventory and help avoid harmful effects to wildlife, we recommend that developers of wind power projects in eastern Oregon follow the principles outlined in the Guidelines until such time as other regionally-specific guidance is available. Permitting authorities should also consider requiring developers to comply with the Guidelines as the current consensus on "best practices" for wind power development in Oregon.

The state EFSC siting process also includes significant requirements for pre-application notice and comprehensive evaluation of the impacts and viability of a proposed wind power development. Notably, EFSC's regulations include mandatory requirements that a developer conduct studies and consult with the ODFW regarding potential impacts to wildlife and propose measures to avoid, reduce or mitigate adverse impacts in accordance with ODFW's mitigation goals. Evaluation of impacts and of potential mitigation that comply with ODFW's standards is a pre-application condition, ensuring that information is available to the permitting agency and the public at the earliest possible stage in the permitting process.

Oregon's counties do not have a uniform process for reviewing land use permit applications for smaller projects, and, in some cases, do not have any standards against which to measure whether an impact to wildlife or other resources is acceptable or unacceptable. We recommend that the counties consider adopting the ODFW mitigation goals as wildlife protection standards in their land use ordinances for power project developments.

For projects where it can be determined early that there may be significant resource conflicts, we recommend that counties require the developer to obtain a site certificate from EFSC, even if the project will have a generating capacity below 105 MW. This will allow the counties and the state to most efficiently apply scarce resources and ensure that uniform, state-wide standards are being used for all projects with significant resource impacts. Also, because of the importance of ensuring against adverse impacts in the design, construction and operation of wind energy facilities, projects permitted at the county level should be required to submit applications that cover all of the topics outlined in the EFSC regulations, to ensure a level playing field for all developers and adequate, pre-application study of potential impacts. Lastly, we recommend that the Counties and the Oregon Legislature consider amending the land use planning statutes to allow an exception to the 150-day statutory deadline for evaluating land use applications for energy facility siting to ensure that there is sufficient time for reviewing often-complex project applications.

Conclusion

By following the recommendations in this report, decision makers and the wind industry can minimize conflicts with sensitive resources and minimize the potential for controversy. In this way, Oregon wind energy can enjoy the broadest popular support possible and make approvals for future projects faster and easier. Doing wind power the right way provides immediate and obvious benefits by protecting sensitive wildlife and key landscapes, but also benefits the wind industry by streamlining clean wind energy projects.

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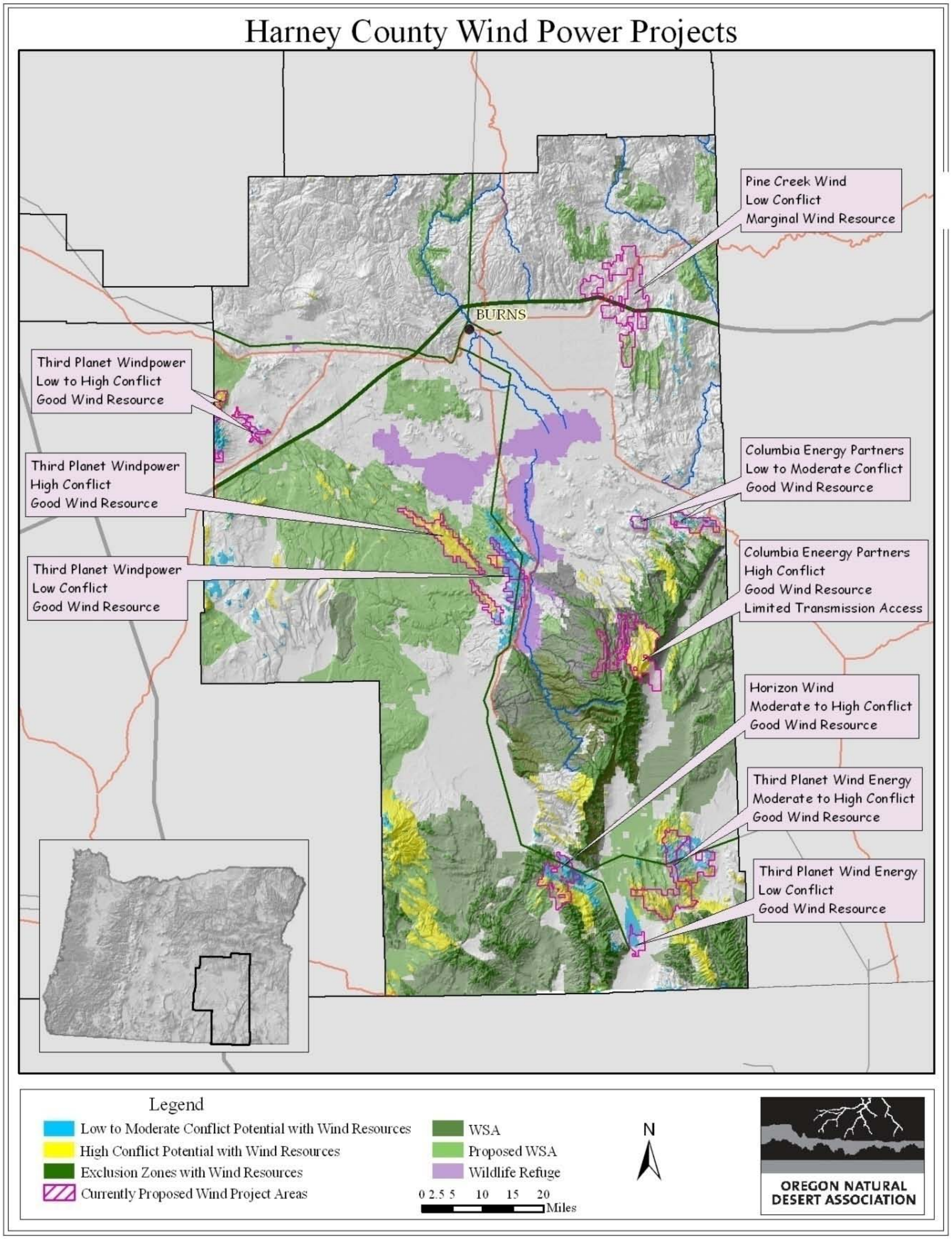
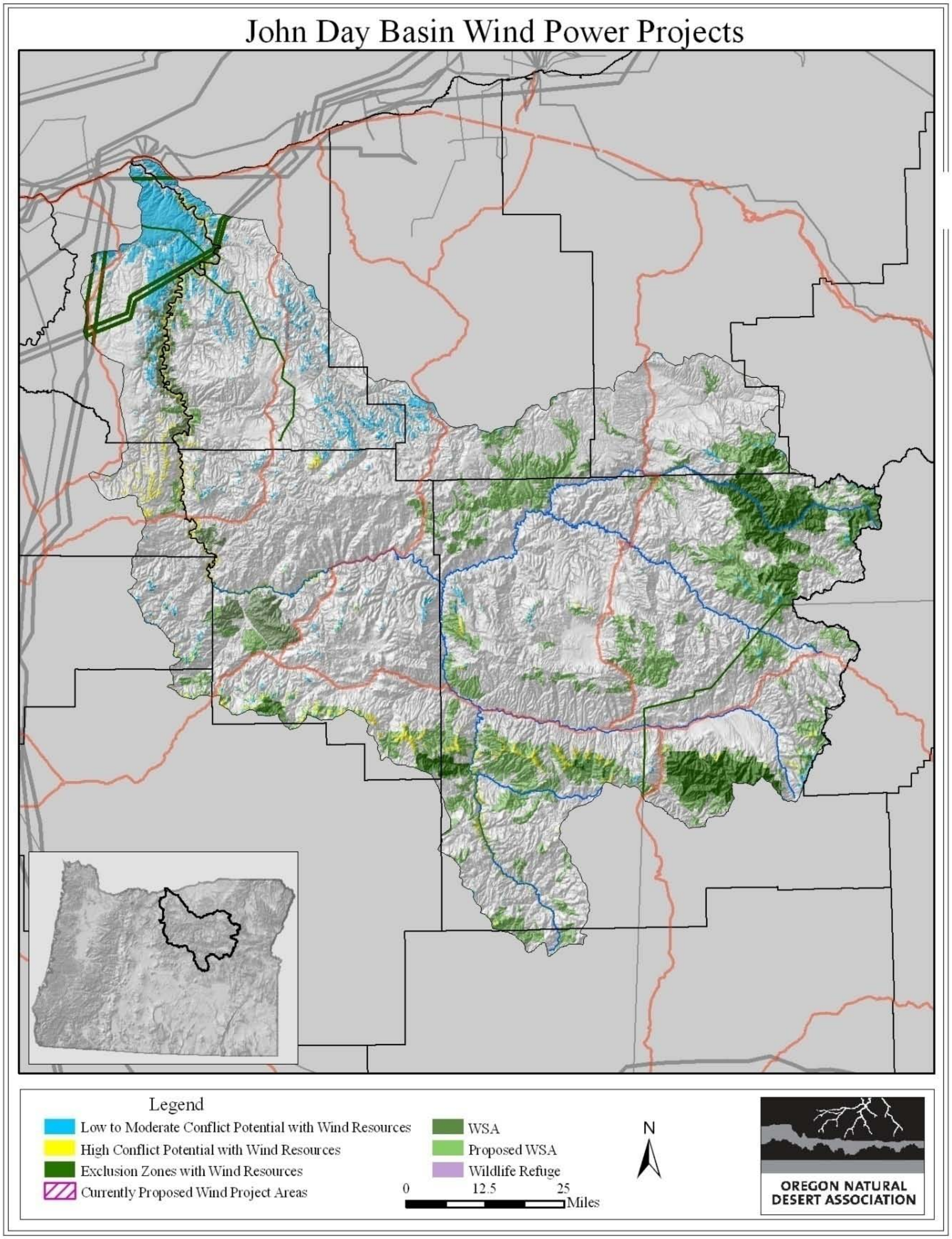
APPENDIX A - COUNTY MAPS


Harney County Wind Power Projects
BURNS
Pine Creek Wind
Low Conflict
Marginal Wind Resource
Third Planet Windpower
Low to High Conflict
Good Wind Resource
Third Planet Windpower
High Conflict
Good Wind Resource
Third Planet Windpower
Low Conflict
Good Wind Resource
Columbia Energy Partners
Low to Moderate Conflict
Good Wind Resource
Columbia Eneergy Partners
High Conflict
Good Wind Resource
Limited Transmission Access
Horizon Wind
Moderate to High Conflict
Good Wind Resource
Third Planet Wind Energy
Moderate to High Conflict
Good Wind Resource
Third Planet Wind Energy
Low Conflict
Good Wind Resource
Legend
Low to Moderate Conflict Potential with Wind Resources
High Conflict Potential with Wind Resources
Exclusion Zones with Wind Resources
Currently Proposed Wind Project Areas
WSA
Proposed WSA
Wildlife Refuge
0 2.5 5 10 15 20 Miles
N
OREGON NATURAL DESERT ASSOCIATION


John Day Basin Wind Power Projects
Legend
Low to Moderate Conflict Potential with Wind Resources
High Conflict Potential with Wind Resources
Exclusion Zones with Wind Resources
Currently Proposed Wind Project Areas
WSA
Proposed WSA
Wildlife Refuge
0
12.5
25
Miles
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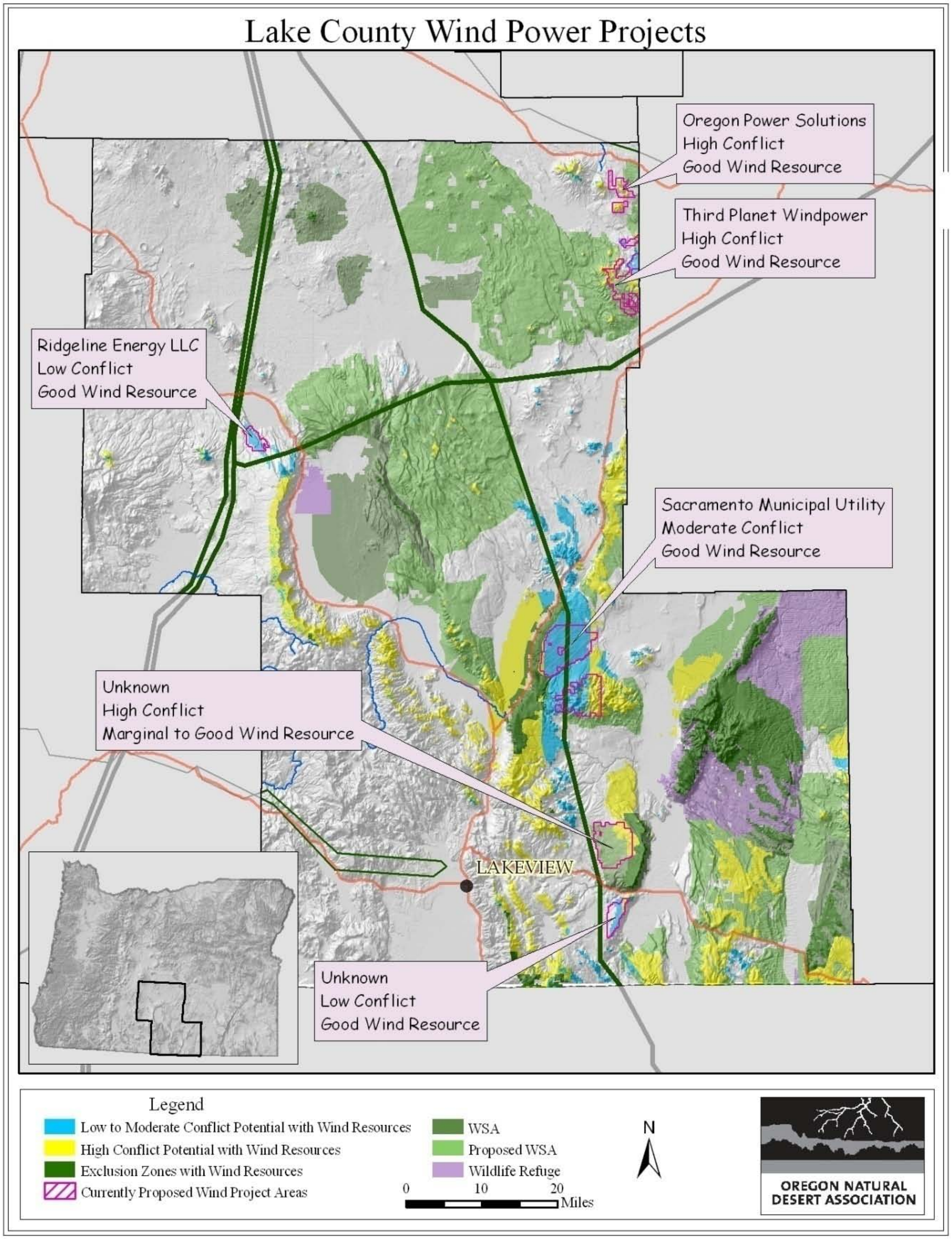
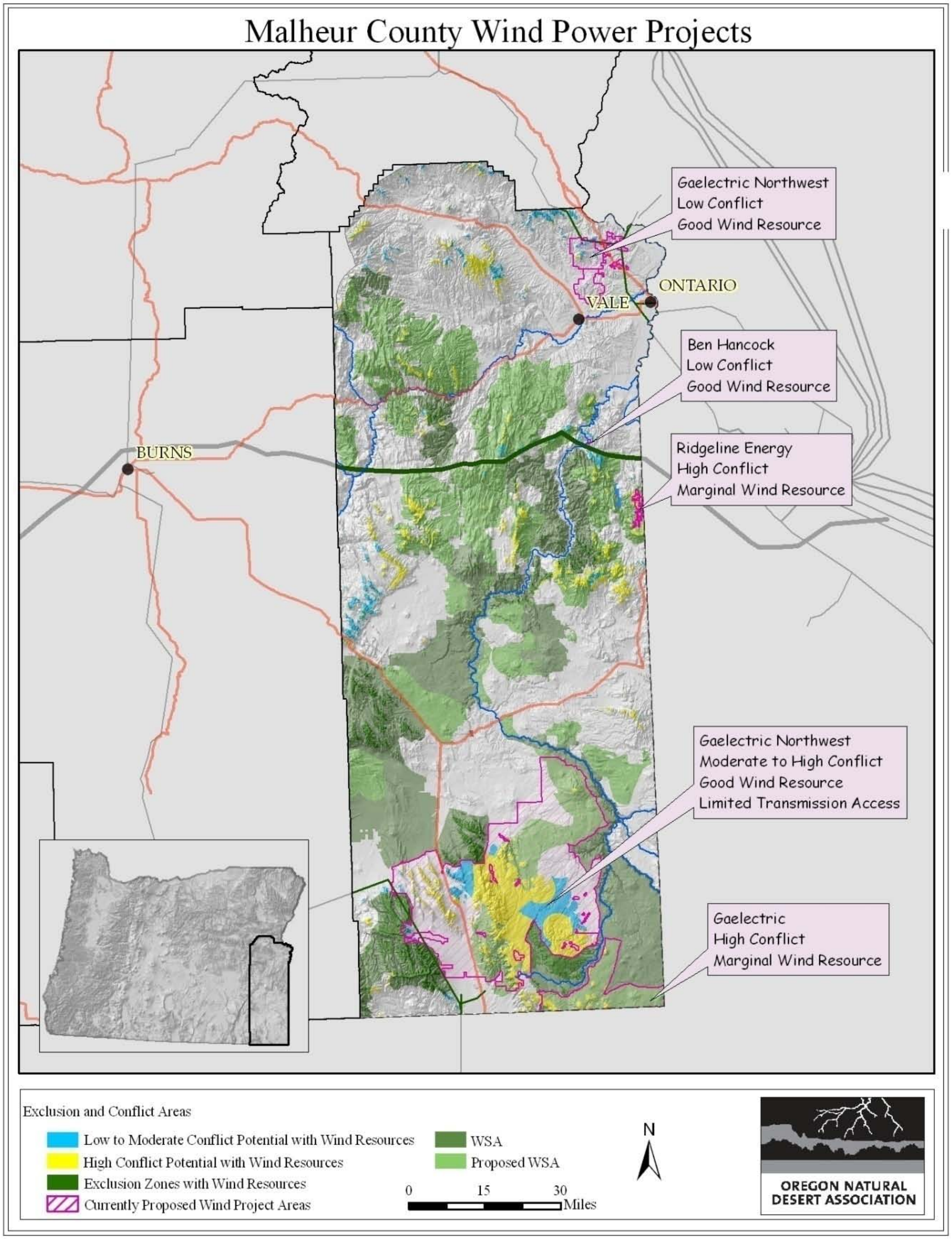
OREGON NATURAL DESERT ASSOCIATION



Lake County Wind Power Projects
Oregon Power Solutions
High Conflict
Good Wind Resource
Third Planet Windpower
High Conflict
Good Wind Resource
Ridgeline Energy LLC
Low Conflict
Good Wind Resource
Sacramento Municipal Utility
Moderate Conflict
Good Wind Resource
Unknown
High Conflict
Marginal to Good Wind Resource
LAKEVIEW
Unknown
Low Conflict
Good Wind Resource
Legend
Low to Moderate Conflict Potential with Wind Resources
High Conflict Potential with Wind Resources
Exclusion Zones with Wind Resources
Currently Proposed Wind Project Areas
WSA
Proposed WSA
Wildlife Refuge
0 10 20 Miles
N
OREGON NATURAL DESERT ASSOCIATION


Malheur County Wind Power Projects
Gaelectric Northwest
Low Conflict
Good Wind Resource
ONTARIO
VALE
BURNS
Ben Hancock
Low Conflict
Good Wind Resource
Ridgeline Energy
High Conflict
Marginal Wind Resource
Gaelectric Northwest
Moderate to High Conflict
Good Wind Resource
Limited Transmission Access
Gaelectric
High Conflict
Marginal Wind Resource
Exclusion and Conflict Areas
Low to Moderate Conflict Potential with Wind Resources
High Conflict Potential with Wind Resources
Exclusion Zones with Wind Resources
Currently Proposed Wind Project Areas
WSA
Proposed WSA
N
0 15 30 Miles
OREGON NATURAL DESERT ASSOCIATION