Energy Development

Wind energy development in Wyoming (Tony Hoch)

Bottom two photos courtesy of WGFD

Table of Contents

Background

Wyoming is a top U.S. domestic exporter of energy, supplying the nation with more than 10 quadrillion (thousand million million or 10^{15}) BTUs of energy per year (Surdam 2008). Wyoming domestic energy exports account for half of all energy exported by states within the U.S. and surpasses the exports of many major energy exporting nations (Surdam 2008). Specifically, Wyoming is a leading producer of coal, natural gas, crude oil, and wind-power (National Mining Association 2008, U.S. Energy Information Administration 2010, Elliott et al. 1991, Lawrence 2007). The minerals industry is by far the largest single contributor to Wyoming's economy.

Wyoming's role in supplying the nation's energy will likely increase in the future, although with recent declines in prices, energy development has slowed. Still, Wyoming has some of the largest untapped energy resources in the country, with the most significant constraint on enhanced energy production being a lack of adequate transportation options, transmission lines, and pipeline capacity.

Hundreds of thousands of acres of federal minerals are currently leased for coal extraction in Wyoming, and oil and gas leases total many millions more (Bureau of Land Management 2008). The Department of Interior (DOI) has suspended coal leasing until the DOI has a chance to review current rules regarding leasing. Concurrently, the DOI is also reviewing the leasing of federal fluid minerals. It is uncertain what the impact will be on development in the future.

Wind energy development has also increased. Wyoming has a high potential for on-shore wind energy sites (Bureau of Land Management 2010). Wind energy is an important focus of efforts to reduce national dependence on foreign oil and federal energy policy that emphasizes reductions in carbon emissions. The Wyoming Infrastructure Authority, in conjunction with transmission developers, is currently studying a conceptual design capable of collecting as much as 12,000 megawatts (MWs) of new electric generation within the state. The majority of this new generation is expected to come from wind turbines.

Increasing energy demands, diminishing fossil fuel reserves, and concerns over carbon emissions may lead to an increase in nuclear energy. Wyoming has the nation's largest uranium reserves (Department of Energy 2003). The World Nuclear Association estimates a substantial increase in uranium demand over the next 20 years.

Wyoming also has vast reserves of unconventional energy resources. It is estimated that oil shale found in the Green River Formation, located in northwest Colorado, southwest Wyoming, and northeast Utah, contains over two trillion barrels of oil, which is equivalent to one to two times the total world oil reserves (Bureau of Land Management 2010a). The Bureau of Land Management (BLM) instituted a moratorium on oil-shale development in the early 1980s, largely because the technology to extract the oil economically was lacking. Congress directed the BLM in 2006 to lift the moratorium and began accepting nominations for oil-shale research projects. In 2013, the BLM signed a Record of Decision (ROD) for the Allocation of Oil Shale and Tar Sands Resources on Land Administered by the BLM in Colorado, Utah, and Wyoming. The ROD opened approximately 292,000 acres in Wyoming for commercial oil shale leasing.

The state also has enormous potential to develop shale gas, deep gas, bypassed under-pressure gas, coal gasification, and coal-to-liquid energy sources (Surdam 2008) although this potential has been largely undeveloped despite existing technologies. Wyoming also has excellent geologic features to sequester carbon dioxide in the form of structural traps with saline reservoirs, depleted compartmentalized gas accumulations, and deep coal deposits (Surdam 2008).

Wyoming has geothermal resources which could be commercially developed for energy production in a number of locations in the state,

including the northwest, central, and southwest portions of the state. Wyoming's solar energy development potential is also strong statewide, although both solar and geothermal energy sources remain largely undeveloped in the state at this time (Nielsen et al. 2002). A helium production facility has been built near Big Piney. The plant is designed to produce 200 million standard cubic feet of helium per year initially, with expectations for future expansion to 400 million standard cubic feet per year (Gasworld 2014). The Wyoming State Geological Survey has conducted an inventory and prioritization of all Wyoming geologic sites capable of sequestering commercial quantities of CO_2. The research identified the Rock Springs Uplift as the most promising geological CO_2 sequestration site in Wyoming. A CO_2 sequestration project is also underway at Rands Buttes by Big Piney.

Figure 4.

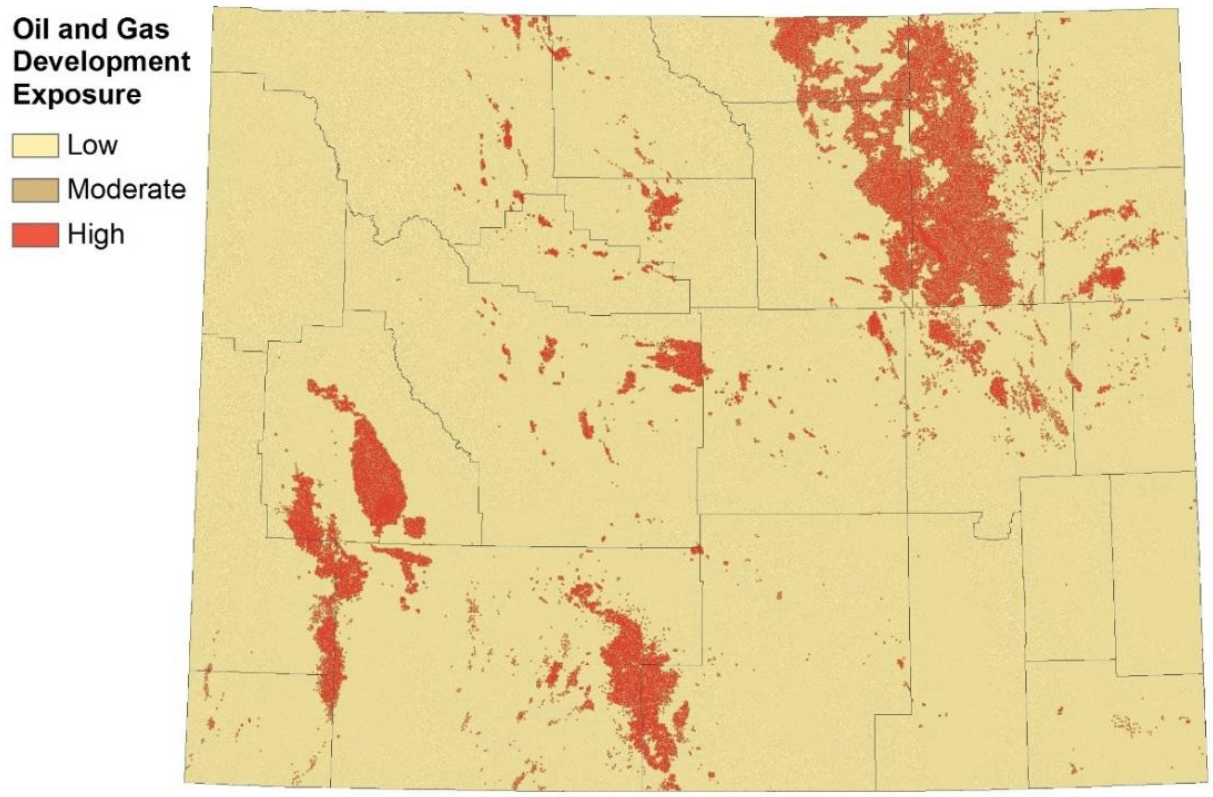
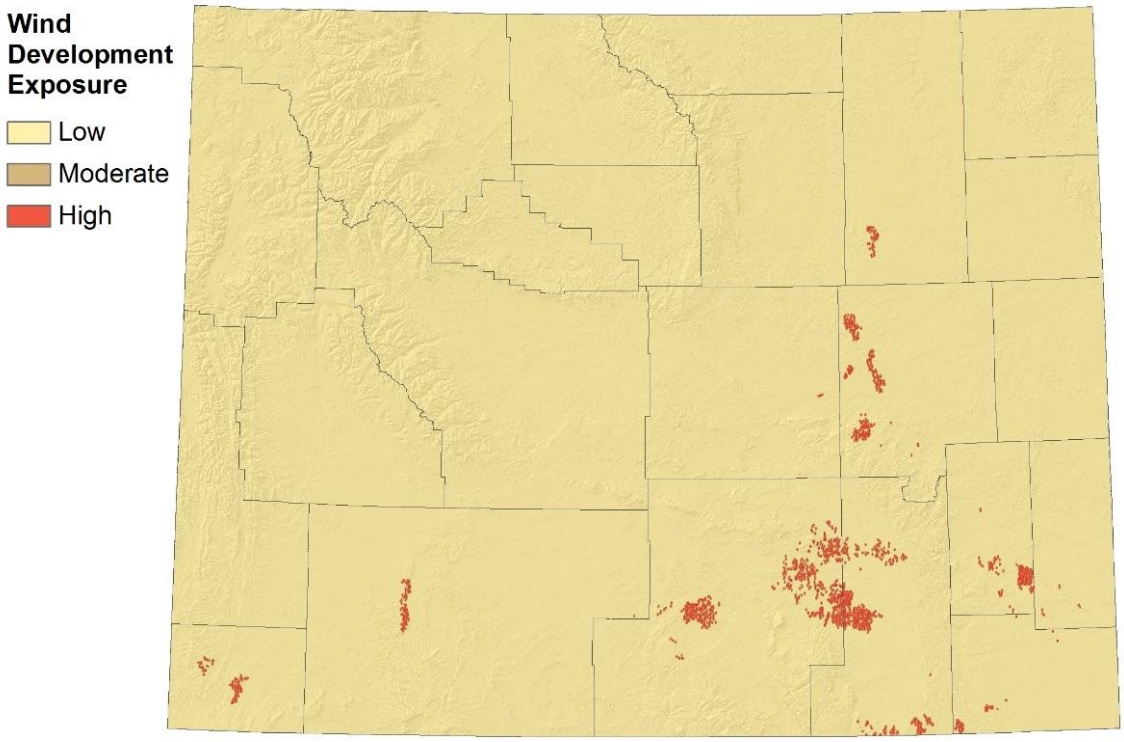


Figure. 5



Exposure to oil and gas or wind energy development represents the relative impact of energy development on the landscape and was calculated for all 30-meter raster cells across Wyoming. Cell values ranged from 0, which reflects minimal potential for impact, to 1, which reflects complete conversion of native habitat. The scores ranging from 0 to 1 were assigned to categories as follows: low (<0.33), moderate (0.34-0.66), and high (>0.67) (Pocewicz et al. 2014). Exposure to energy development includes existing wells or turbines (2010), as well as projected development (2030). Existing development was represented using point datasets of oil and gas wells (Wyoming Oil and Gas Conservation Commission 2010) and wind turbines (O'Donnell and Fancher 2010). Future development projections were based on spatial models representing the likelihood of potential development, combined with published growth projections used to populate the highest probability locations with oil and gas well or wind turbine points, while excluding those areas where each development type would be legally prohibited (Copeland et al. 2013). The energy development exposure raster datasets were created from the well or turbine points by assigning a maximum disturbance (value=1) at existing or projected points and applying a logistical decay to zero over a distance of 1 km (Pocewicz et al. 2014).

References cited:

Copeland,et al. 2013, O'Donnell and Fancher. 2010, Pocewicz, et al. 2014, . Wyoming Oil and Gas Conservation Commission. 2010.

Scope and Challenges of Energy Development and Wildlife Conservation

Access to affordable and reliable power is important to our nation's economy and security and contributes to the prosperity and quality of life of its citizens. Energy development is Wyoming's leading source of revenue and is responsible for thousands of jobs in the state (Wyoming Department of Employment 2010). Continued, well-planned energy development will play a central role in the futures of both Wyoming and the nation.

Like nearly all forms of disturbance, energy development, particularly during certain stages, has some level of impact on wildlife. The significance of the impact depends upon the amount, intensity, and duration of the disturbance; the specific locations and arrangements of the disturbance; and the ecological importance of the habitats affected (Wyoming Game and Fish Department 2010a). Small, isolated disturbances within less important habitats can often be of little consequence, but may have cumulative impacts. Larger-scale developments within habitats that are crucial to the survival or reproduction of wildlife can be significant if not mitigated.

Oil and gas development produces potential adverse effects. These include: direct loss of habitat, physiological stress to wildlife, disturbance and displacement of wildlife, habitat fragmentation and isolation, alteration of environmental functions and processes (e.g., stream hydrology, water quantity/quality), introduction of competitive and predatory organisms, and secondary effects created by work force assimilation and growth of service industries (Wyoming Game and Fish Department 2010b). Concerns over air quality have also arisen in areas of intense oil and gas development (Jacus and DiLuigi 2010).

The collective area of disturbance from oil and gas development may encompass a small percentage of the land; however, human disturbances associated with each facility (well pad, road, overhead power line, etc.,) can cause stress and avoidance by wildlife in surrounding areas (Wyoming Game and Fish Department 2010a). Zones of avoidance may extend over a mile for mule deer (Sawyer et al. 2008), over half a mile for elk on open winter range (Brekke 1988, Hayden-Wing Associates 1990; Hiatt and Baker 1981; Johnson and Lockman 1979), and up to several hundred yards for some raptor species during egg laying and early incubation (Fyfe and Olendorff 1976, White and Thurow 1985). Declines in the use of leks by male sage-grouse have been associated with decreasing distance to natural gas related disturbances, increasing levels of disturbance and noise, and greater levels of traffic (Holloran 2005). Similarly, nesting females avoided areas with high densities of producing gas wells and brooding females avoided producing wells (Holloran 2005).

As densities of wells, roads, and facilities increase, habitats within and near well fields can become progressively less suitable for some species of wildlife, until most animals no longer use the area or animals that do use the affected areas are subjected to increased physiological stress (Wyoming Game and Fish Department 2010a). Areas of intensive activity or construction may become barriers to animal movement, including inhibiting animals from reaching crucial winter ranges and habitats important for reproduction (Sawyer 2010). Animal numbers can increase in areas surrounding development which may raise the risk of density-dependent effects, such as range over-utilization or disease transmission, which can lower survival and reproduction (Sawyer et al. 2006). Greater road numbers and densities may also increase both the legal and illegal harvest of wildlife.

Aquatic habitats can be impacted by energy development if roads and development sites affect the infiltration rate of water, through increasing the velocity and quantity of water running across the landscape, and potentially increasing erosion and sediment deposition into nearby waterways (Wyoming Game and Fish Department. 2010b). These changes may result

in decreased pool depths, decreased riffle area, less diversity in channel substrate, and increased bank erosion. These changes along with direct effects from increased sediment loading can affect macro invertebrate populations and diversity and decrease fish habitat (Wyoming Game and Fish Department 2010b). A common impact is a decrease in gravel and cobble used by spawning fish (Wyoming Game and Fish Department 2010b).

The overall health of an aquatic habitat is a reflection of the condition of the entire watershed including the uplands, riparian corridor, and the stream channel. Disturbances to upland plant communities can impact wildlife by influencing water quantity and quality as well as associated flow regimes (Wyoming and Game and Fish Department 2010b). Also, changed physical conditions, such as stabilized flow regimes and reduced sediment loads, can create environments favorable for the establishment and spread of nonnative species which may be detrimental to native wildlife.

Some researchers have proposed similar impacts on wildlife from wind energy to those possible with oil and gas development (Becker et al. 2009). Wind power requires an amount of space per unit of power that is second only to that required by bio fuels (Kiesecker et al. 2009, Surdam undated). Unlike oil and gas development, bird and bat strikes are commonly associated with wind energy facilities. For other species of wildlife that inhabit open landscapes, such as pronghorn and sage-grouse, the behavioral and resulting population responses to wind energy development are currently unknown but being studied.

Wind towers range from 212 feet to over 260 feet tall with blade sweeps of between 328 to more than 400 feet above ground level (Wyoming Game and Fish Department 2010b). Injury and mortality to birds is known to occur from strikes during flight with wind turbine rotor blades, monopoles, power lines, guy wires, and other related structures (Kunz et al. 2007, Winegrad 2004). Most species of birds are at risk of collision, although studies have shown that specific groups of birds in particular habitats, under certain weather conditions, or in large densities are more at risk than others, including raptors, migrating birds, wading birds, and waterfowl (Wyoming Game and Fish Department 2010b). Nearly 90% of bat fatalities occur in late summer and early fall, during the peak of fall migration (Keeley et al. 2001, Erickson et al. 2002, Johnson 2005). Migrating and commuting bats often follow linear features in the landscape, and may be drawn to ridges where wind energy facilities are commonly located (Erickson et al. 2002, Kunz 2004). The physical characteristics of wind turbines might also attract bats.

Energy booms are also often accompanied by human population growth in nearby towns and cities, which can lead to additional wildlife conservation challenges. These secondary effects arise from additional housing, service industries, transportation corridors, and other infrastructure (Wyoming Game and Fish Department 2010a). Private lands available for housing subdivisions are often located along valley bottoms and waterways that frequently provide crucial winter range, travel corridors, and reproductive sites for wildlife.

Further information about potential impact for energy development to wildlife, as well as mitigation and monitoring recommendations for individual and groups of wildlife species, can be found within the Wyoming Game and Fish Department's (WGFD) *Recommendations for Development of Oil and Gas Resources within Important Wildlife Habitats* and *Wildlife Protection Recommendations for Wind Energy Development in Wyoming*. Links to download copies of these documents are located in the Literature Cited section of this chapter.

Current Initiatives to Incorporate Wildlife Conservation into Energy Development

Sage-grouse Conservation

In Wyoming, a significant amount of the state's coal, natural gas, and oil production, as well as area that would support commercially developable wind energy (Class 4 or higher) exist within sage-grouse current range (Clark 2009). Greater sage-grouse have been petitioned to receive protection under the Endangered Species Act. In March 2010, the U.S. Fish and Wildlife Service (USFWS) ruled the species status warranted, but precluded; meaning that the greater sage-grouse meets the criteria to be listed as threatened, but there are other species that have higher priority. Most recently, in September 2015, the U.S. Fish and Wildlife Service determine the species not warranted for listing. The listing of the sage-grouse under the Endangered Species Act would have significant negative consequences for Wyoming's economy and future energy development within the state. Impacts to the energy sector alone could be greater than 22 billion (Stoellinger, T. Taylor, D. 2016). Efforts to conserve the sage-grouse are at the forefront of energy-development wildlife conservation planning and mitigation efforts and will likely have a positive impact on other sagebrush-associated wildlife species. Associated science and management innovations could likely be applied to other wildlife species and habitats in the future.

The following section lists some of the most significant sage-grouse conservation efforts in Wyoming related to energy development. Additional information about sage-grouse and sagebrush habitat conservation work can be found in the Sage-grouse Species Account and the Sagebrush Shrublands Habitat Type.

Sage-grouse Core Area Strategy

In 2007, in response to the possibility of listing the greater sage-grouse under the Endangered Species Act, Governor Freudenthal formed the Sage-grouse Implementation Team (SGIT). First among the SGIT's recommendations was extensive statewide mapping of sage-grouse habitats and habitat enhancement efforts. In 2008, Governor Freudenthal issued Executive Order 2008-2, which constituted Wyoming's Core Area Strategy. Governor Freudenthal reissued the Executive Order in 2010 (E.O. 2010-4). Governor Mead issued his Sage-Grouse Executive Order in 2011 (E.O. 2011-5) and updated it in 2015 (E.O. 2015-4). The subsequent orders were similar but improved on the previous orders. New development within Core Population Areas would only be authorized when it could be demonstrated the activity will not cause declines in greater sage-grouse populations. Incentives would be provided to encourage development outside Core Population Areas and to enhance reclamation in habitats adjacent to Core Population Areas. The Core Area Strategy was designed to demonstrate to the U.S. Fish and Wildlife Service that Wyoming had a mechanism in place to ensure the viability of the species across its range in Wyoming.

Bureau of Land Management Instructional Memorandums on Sage-grouse

In 2009, the Washington D.C. Office of the BLM issued Instruction Memorandum WO-2010-071 to ensure environmentally responsible development within the range of the Gunnison and greater sage-grouse. The memorandum instructed that nominated oil and gas, oil shale, and/or geothermal lease parcels would be withheld or deferred from sale as needed, pending additional land-use planning and/or further NEPA analysis. All new leases would include notices that more stringent restrictions may be required as future sage-grouse conservation needs are identified. Conditions of Approval (COAs) may be attached to new Applications for Permits to Drill (APD) that could be more stringent than restrictions identified in Resource Management Plans (RMPs) and existing lease stipulations if needed to protect sage-grouse habitats. In RMP revisions and amendments, areas could be excluded from energy development if they are identified as priority habitats necessary to support sage-grouse populations. New right-of-

way applications for wind energy development would also be screened to alert applicants that authorization could be delayed until additional research on impacts for wind energy development on sage-grouse has been completed to demonstrate if development can occur without causing declines to affected populations. Lastly, transmission corridors would be rerouted to avoid high priority habitats necessary to support sage-grouse populations.

In September 2015, the BLM and U.S. Forest Service issued Records of Decision and Approved Resource Management Plan Amendments for Greater Sage-Grouse to confirm sage-grouse conservation in conjunction with Governor Mead's Sage-Grouse Executive Order.

Sage-Grouse Local Working Groups
Eight local working groups were established as a result of the 2003 Wyoming Greater Sage-Grouse Conservation Plan drafted by the Wyoming Sage-Grouse Working Group. The purpose of Local Sage-Grouse Working Groups (LWGs) is to develop and facilitate implementation of local conservation plans for the benefit of sage-grouse, their habitats, and whenever feasible, other species that use sagebrush habitats. The plans will identify management practices and the financial and personnel means to accomplish these practices, within an explicit time frame, for the purpose of improving sage-grouse numbers and precluding the need for listing under the Endangered Species Act.

Candidate Conservation Agreements (with Assurances)
Also, in response to a potential listing decision, the U.S. Fish and Wildlife Service in coordination with state and federal partners developed the Greater Sage-Grouse Candidate Conservation Agreement with Assurances for Ranch Management (CCAA). The Greater Sage-Grouse CCAA is a voluntary agreement between a private landowner and the U.S. Fish and Wildlife Service that utilizes a suite of habitat conservation measures to benefit both sage-grouse and the landowner's existing agricultural operation. The CCAA addresses the primary threat to sage-grouse identified by the U.S. Fish and Wildlife Service, which is loss of habitat. Subsequently, the BLM and U.S. Forest Service developed a Candidate Conservation Agreement (CCA) to apply to federal lands. As of June 2016, Wyoming has completed 40 CCAAs and 24 CCAs, enrolling over 1.5 million acres in these conservation agreements.

Federal Energy Development Permitting
Bureau of Land Management Wind Programmatic Environmental Impact Statement (PEIS)
The BLM initiated the development of a Wind Programmatic EIS (PEIS) in the fall of 2003 for BLM lands in the 11 western states, including Wyoming, as part of a renewable energy resource assessment. A Programmatic EIS evaluates the environmental impacts of broad federal agency actions such as the setting of national policies or the development of programs. The final Wind PEIS was completed in 2005. Among the outcomes of the Wind PEIS was the development of best management practices, which address wind energy siting, construction, and mitigation activities to reduce adverse environmental impacts. These best management practices are being incorporated into the BLM Wind Energy Development Policy as additional guidance for BLM field offices for wind project-specific Plans of Development (PODs) and/or as right-of-way (ROW) authorization stipulations. Copies of the final Wind PEIS can be found at http://windeis.anl.gov/documents/fpeis/index.cfm.

Bureau of Land Management Leasing Reform
In May 2010, the BLM issued Instruction Memorandum 2010-117, which made modifications to existing leasing policy in order to ensure environmental protection of important natural resources on BLM lands while also aiding in the orderly leasing and development of oil and gas resources. The BLM will develop Master Leasing and Development Plans that consider important natural resource values prior to leasing in areas where intensive new oil and gas development is

anticipated. Each potential lease sale will undergo increased internal and external coordination, public participation, and interdisciplinary review of available information. Appropriate mitigation measures will be identified. Additionally, there will be confirmation of Resource Management Plan (RMP) compliance. When needed, site visits will occur to supplement or validate existing data.

Furthermore, the BLM issued interim draft guidance to its field offices on the implementation of Section 390 of the Energy Policy Act of 2005. Under NEPA, federal agencies may use categorical exclusions to approve projects on federal land without conducting extensive environmental reviews if it is determined that the projects will not have significant environmental impacts. The draft guidance establishes a process for considering individual actions that normally would be categorically excluded, but are of a nature or intensity that they warrant further environmental analysis before permitting.

Best Management Practices and Development Guidelines

Wyoming Game and Fish Department Energy Development Recommendations

In 2004, the WGFD produced *Recommendations for Development of Oil and Gas Resources within Important Wildlife Habitats* to identify thresholds of oil and gas development that could impair important wildlife habitats, recommend planning and management considerations to avoid or minimize impacts, and recommend mitigation activities to offset or compensate adverse effects. This document has been revised and updated several times, most recently in April 2010. Recommendations are intended to be applied to important wildlife habitats including big game winter ranges, sage-grouse habitats, priority watersheds, and others identified on maps available from the WGFD website at: https://wgfd.wyo.gov/WGFD/media/content/PDF/Habitat/Habitat%20Information/Wind%20Energy%20Development/Wildlife-Protection-Recommendations-for-Wind-Energy-Development.pdf. A similar document, *Wildlife Protection Recommendations for Wind Energy Development in Wyoming*, was approved by the Wyoming Game and Fish Commission in 2010. Sage-grouse habitat protection recommendations for significant surface-disturbing activities are addressed in the Sage-grouse Core Area implementation recommendations available on the WGFD website.

U.S. Fish and Wildlife Service Land-Based Wind Energy Guidelines

Completed in 2014, the Land-Based Wind Energy Guidelines provide a structured, scientific process for addressing wildlife conservation concerns at all stages of land-based wind energy development. They also promote communication among wind energy developers and federal, state, and local conservation agencies and tribes. Copies of the guidelines can be obtained at: http://www.fws.gov/habitatconservation/wind.pdf. Wyoming-specific USFWS guidelines are also available http://wyia.org/wp-content/uploads/2011/01/usfws-guidance-wy-wind-energy-draft-11-09-2010.pdf/.

.

Bureau of Land Management Wind Energy Program Policies and Best Management Practices (BMPs)

In June 2005, the BLM established policies and BMPs regarding the development of wind energy resources on BLM lands. The policies provide guidance for how wind energy development activities are administered and indicate required stipulations, best management practices, and mitigation measures that are to be incorporated into project-specific PODs and ROW authorizations. https://www.blm.gov/wo/st/en/prog/energy/wind_energy.html

Electric Transmission Line Guide for State Fish and Wildlife Agencies

The Association of Fish and Wildlife Agencies' Wind and Transmission Subcommittee created *Electric Transmission Line Guide for State Fish and Wildlife Agencies* (Association of Fish and

Wildlife Agencies 2010). The document includes information on how state wildlife agencies can become engaged in the transmission planning and citing process and how agency staff can best provide guidance for proposed projects. It also provides specific wildlife recommendations, an overview of the transmission industry, and web links to additional resources.

Bureau of Land Management Reclamation Policy
In 2009, the BLM established a Wyoming Reclamation Policy in coordination with BLM specialists, WO-310, the Wyoming Governor's Office, the University of Wyoming, local governments, and professionals from private industry. The policy provides guidance for the modification, preparation and/or review of all reclamation plans. The policy outlines 10 requirements for reclamation plans which are necessary as part of the permit process for federal actions authorized, conducted, or funded by the BLM that disturb vegetation and/or mineral/soil resources: (https://www.blm.gov/style/medialib/blm/wy/resources/efoia/IMs/2009.Par.54664.File.dat/wy2009-022.pdf).

Wyoming Wind Legislation
Recent increases in the amount and rate of wind energy development in Wyoming prompted the Wyoming Legislature in 2010 to enact new legislation. Legislation significant for wildlife conservation includes SEA0038 which expands the jurisdiction of the Industrial Siting Council (ISC) over facilities to include wind energy facilities which consist of 30 or more towers or which are expanded to include 30 or more towers. The legislation also requires the ISC to establish rules for decommissioning, site-reclamation standards, and bonds to ensure these standards are sufficiently met. Also, the potential development impacts to wildlife including threatened, endangered, rare, or other species identified in Wyoming's State Wildlife Action Plan must be disclosed.
HEA0048 places a moratorium on the exercise of eminent domain for the purpose of erecting collector systems associated with wind energy projects. The moratorium is effective until June 30, 2011, or until new legislation establishing additional conditions for the use of condemnation for collector systems associated with wind energy projects is enacted.
HEA0064 requires all facilities generating more than 0.5 megawatts of electricity from wind power to obtain a permit from every county in which the facility is located. This legislation also establishes the minimum standards that counties must apply when issuing the required permits. Permitting requirements include the development of waste management, site reclamation, and decommissioning plans, and descriptions of any environmental, social, or economic effects. Lastly, HEA0018 imposes upon the energy company a tax of one dollar per megawatt hour, which goes into effect three years after the turbine first produces electricity.

Energy Development Research, Planning, and Conservation Projects
State and Regional GIS Wildlife Decision Support Systems
The WGFD and the University of Wyoming's Wyoming Geographic Information Science Center (WyGISC) have finalized the Wyoming Interagency Spatial Database and Online Management (WISDOM) System for housing and disseminating GIS natural resource data. The project is focused on two key elements: 1) organizing and centralizing the storage of data from a variety of sources, and 2) establishing an Internet-based mapping system to provide access to this data to partners and the public. Wyoming's WISDOM will eliminate the need to contact multiple agencies and individuals for data and will provide data-quality assurances for conservation and development planning and analysis.

This effort is linked to the Western Governors' Wildlife Council's effort to establish a Western Regional Wildlife DSS to map crucial habitats across the West. In 2008, the Western Governors Association called for decision support systems to be established in each state that would compile information at scales useful for analyzing proposed energy, land use, and transportation projects, as well as support

climate-change adaptation efforts. Presently, the Western Governors' Wildlife Council has developed definitions for crucial wildlife habitats and has presented states with guidelines to facilitate the establishment of regionally compatible systems.

In 2016, Wyoming released a new web-based GIS decision support tool called Natural Resource and Energy Explorer (NREX). NREX was developed through an agreement between the Governor Mead's Policy Office and WyGISC as a result of an objective from the administration's 2013 Energy Strategy.

The goal of NREX is to develop a web-mapping tool to enable discovery and assessment of energy, infrastructure, environmental, wildlife, cultural, and socioeconomic assets for user-defined, project-scale areas of interest in the state. This web-based tool incorporates interactive mapping and geographic information system query and analytical capabilities. The primary target audience for which the NREX tool will be designed is a group of end-users with basic fluency in the use and application of geographic information systems and geospatial data. End users represent developers, conservationists, natural resource managers, and/or local government planners with interests in assessing potential place-based resource allocation concerns. NREX will replace the external, public version of WISDOM.

Wyoming Wind Conflict Map

The Governor's Planning Office produced a wind energy development conflict map in 2009. Wind for power generation is ranked from Class 1 (the lowest) to Class 7 (the highest). In general, wind power Classes 4 or higher are considered viable for generating wind power from turbines. The wind power conflict map was produced by evaluating Class 4–7 winds in Wyoming, as modeled by the National Renewable Energy Laboratory (NREL), against areas where statute, regulation, or federal agency resource management plans would likely prohibit development activities[1] as well as where the protection of natural resource values are a high priority that require a very high mitigation standard that would need to be met prior to allowing development[2]. Location of sensitive species' priority habitats, Sage-grouse Core Population Areas, big game crucial winter ranges, national wildlife refuges, and state wildlife management areas were included in the evaluation in the mapping process.

Western Governors' Western Renewable Energy Zones Initiative

The Western Renewable Energy Zones Initiative (WREZI) is a collaborative effort between the Western Governors and the U.S. Departments of Energy, Interior, and Agriculture; the Federal Energy Regulatory Commission; Canadian provincial premiers; renewable energy developers; tribal interests; utility planners; environmental groups; and government policymakers. The focus area is the Western Interconnection electricity grid which covers 12 western states including Wyoming, as well as portions of Canada and Mexico. In its first phase, a report has been created that identifies areas with low environmental impacts for the development of large-scale renewable resources and associated high-voltage transmission lines. Additional refinements are planned which will identify crucial wildlife habitats. Future work will focus on facilitating the efficient delivery of energy from renewable resource areas to population centers throughout the Western Interconnection.
http://www.westgov.org/rtep/219-western-renewable-energy-zones

[1] Included in this category are: state parks, National Park Service lands, National Forest System lands (including National Grasslands), National Wildlife Refuges, Wilderness Study and Visual Resource Management Class I areas, BLM lands with a no-surface occupancy stipulation for sage-grouse, and state wildlife habitat management areas.

[2] Included in this category are: sage-grouse core areas, BLM Visual Resource Management Class II areas, BLM Areas of Critical Environmental Concern, BLM Rawlins Resource Management Plan –Wind Avoidance Areas, and big game crucial winter ranges.

The Nature Conservancy's Development by Design
The Nature Conservancy's (TNC) Development by Design blends landscape-level conservation with the mitigation hierarchy—first avoid, then minimize/restore, and finally offset—to improve mitigation efforts. This is accomplished in a four-step process: 1) develop a landscape conservation plan (or use an existing conservation plan); 2) blend landscape conservation planning with mitigation hierarchy to evaluate conservation and development conflicts; 3) determine the residual impacts associated with development and select an optimal offset portfolio; and 4) estimate the offset contribution to conservation goals.
In Wyoming, TNC's Energy by Design has been used to prioritize project funding for the Jonah Interagency Mitigation and Reclamation Office and will similarly assist for mitigation planning for Continental Divide-Creston, Hiawatha, and Pinedale Anticline oil and gas fields.
http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/wyoming/howwework/energy-by-design-in-wyoming.xml

Wyoming Landscape Conservation Initiative
The Wyoming Landscape Conservation Initiative (WLCI) was created in 2007 as a multi-agency and stakeholder initiative designed to maintain and enhance wildlife habitat and other resource values in the face of intensive energy development and other changes. The WLCI has brought together diverse groups to work toward common goals across a 19-million-acre area. Through the WLCI, partners are conducting science-based research and monitoring, completing habitat enhancements and restoration, encouraging effective reclamation and mitigation practices, identifying and prioritizing landscape-scale conservation work, and promoting grazing practices which benefit wildlife, ranchers, and open-space conservation. Projects have included fence modifications and exclosure fencing, prescribed burns, riparian enhancements, invasive species treatments, river restoration, and conservation easements. Initial funding has come through federal appropriations. http://www.wlci.gov/

Offsite Reclamation Funds
The Jonah Interagency Mitigation and Reclamation Office (JIO) was created by the Jonah Project Record of Decision. Its purpose is to provide overall management of on-site monitoring and off-site mitigation activities primarily focusing on pronghorn and greater sage-grouse in the vicinity of natural gas developments near Pinedale, Wyoming. Encana Oil & Gas (USA) and BP America Production Company committed $24.5 million in compensatory (off-site) mitigation. Encana designated $16.5 million of the fund to be used to mitigate wildlife impacts, while the remaining $8 million could be used to mitigate other resource impacts, perform monitoring, or accomplish other activities. Similar mitigation activities are underway for other oil and gas fields, including the Continental Divide-Creston, Hiawatha, and Pinedale Anticline.
http://www.wy.blm.gov/jio-papo/

USFWS – Strategic Habitat Conservation – Adaptive Management Framework
Strategic Habitat Conservation (SHC) is an adaptive resource management framework used by the USFWS to determine how and where to apply conservation efforts to achieve desired outcomes. SHC incorporated elements of biological planning, conservation design and delivery, monitoring, and research. In response to a request by the WGFD and industry, the USFWS is applying SHC principles to develop an alternative to standard timing stipulations that would provide additional conservation benefits to raptors, while allowing industry to drill year-round. Along with industry, the USFWS is focusing survey efforts in a small pilot project area (~100 square miles) to record forage availability (i.e., to map white-tailed prairie dog towns, ground squirrel colonies) and raptor nest sites. Data collected in 2010, in conjunction with historic data and habitat models, will be used to convert standard timing stipulations into no-surface occupancy areas—where no activity (e.g., drilling) will be permitted. In exchange for not drilling in the areas designated as most important to raptors, the other areas will be open to year-round drilling with no development activity buffer

around active nest sites. Results from 2010 survey and mapping efforts may determine if this alternative is feasible and could be applied to other species and projects.

Assessment of Wildlife Vulnerability to Energy Development Project (AWVED)
The Wyoming Chapter of the Nature Conservancy, Wyoming Natural Diversity Database, and WGFD conducted research to evaluate the vulnerability of Wyoming terrestrial SGCN and habitats to oil, gas, and wind development. Vulnerability was determined by evaluating each species' potential exposure and sensitivity to energy development. Exposure was evaluated through a GIS analysis that overlayed distribution maps of SGCN with areas of known and projected energy development. Sensitivity was determined by examining habitat and behavioral attributes of SGCN, as well as reviewing existing impact studies. Research gives an indication of which species and taxonomic groups are potentially vulnerable to development, and also helps to direct future research to address information gaps. The AWVED project was funded jointly by the United States Geological Survey, Wyoming Landscape Conservation Initiative, and WGFD and can be viewed at: http://www.nature.org/media/wyoming/wyoming-wildlife-vulnerability-assessment-June-2014.pdf.

Interstate Agency-Industry-NGO Research Collaborative on Wind Energy Development Effects on Sage-grouse
State wildlife agencies from Wyoming, Idaho, California, and Oregon have convened the wind industry, academia, and NGOs to develop a focused research initiative. This initiative will work to maximize efficiencies and leverage funding that will focus specific research to better understand the potential impacts of wind development on sage-grouse across their range. This initiative has developed coordinated research questions and protocols and solicited study proposals to replicate studies across the sage-grouse range to foster predictability of impacts from wind development on sage-grouse. For the foreseeable future, the initiative will primarily address research gaps regarding the impacts of wind turbines and associated infrastructure[3]. Additional objectives include: coordinate study results into a comprehensive analysis of impacts across sage-grouse range, ensure peer review of studies is completed and outreach of results is conducted, and provide the science needed to inform wind developers of federal and state agency wind-development stipulations and mitigation strategies while accommodating the need for adaptive management as new science findings occur.

Thunder Basin Grasslands Prairie Ecosystem Association
Among the most notable partnerships between landowners, natural resource agencies, and non-profit organizations is the Thunder Basin Grasslands Prairie Ecosystem Association. The Association was established in 1999 as a landowner-driven effort to develop an ecosystem management plan for species of concern while balancing these needs with sustainable economic and social activities. Members in the Association include private property owners within a designated 931,192-acre landscape in eastern Wyoming. Areas of interest include management activities related to ranching, coal, coal-bed methane, oil, and gas production, and the conservation of wildlife.

Wyoming Game and Fish Department Industry Reclamation and Wildlife Stewardship Awards
The WGFD established the Industry Reclamation and Wildlife Stewardship Awards in 2006. The awards recognize companies and agencies whose primary mission is not wildlife-related, yet who have significantly contributed to the maintenance, restoration, or enhancement of wildlife, wildlife habitat, or recreation. Past recipients include Anadarko Petroleum Corporation, Encana Oil & Gas (USA) Inc., Yates Petroleum Corporation, Rio Tinto Energy America, Bridger Coal Company, Lower Valley Energy, PacifiCorp's M&M Ranch, Fidelity Exploration and Production

[3] Including turbines, meteorological towers, guyed wires, and short-haul transmission within the annual home range of sage-grouse being studied.

Company, Marathon Oil Company, North Antelope Rochelle Mine, Powder River Coal Company; Antelope Coal Mine, and Rio Tinto Energy America. Two consultants who work with energy companies on wildlife-related issues have also been honored: Jim Orpet, Intermountain Resources and Gwyn McGee, Jones and Stokes.

Examples of projects that have received recognition include using black-tailed prairie dogs as a tool for reestablishing mountain plover habitat, creative use of water produced as part of gas extraction for wildlife habitat enhancements, providing wildlife recreational opportunities on energy company-owned land and reservoirs, wildlife monitoring studies, reclamation work, and placing conservation easements on reclaimed mined lands.

Governor Mead's Energy Strategy
In 2013, Governor Mead introduced his administration's energy initiative, *Leading the Charge: Wyoming's Action Plan for Energy, Environment, and Economy*. The plan recognizes energy development as the state's top industry and seeks to balance energy, environment, and economic priorities in Wyoming through strategic initiatives and objectives. Strategies and objective were developed in conjunction with public stakeholders. Several of the specific objectives are directly or indirectly related to wildlife and habitat conservation including developing an Energy Atlas GIS Decision Support Tool; federal agency cooperation and coordination with the state of Wyoming and local governments in the NEPA process; review of state oil and natural gas environmental regulations; exerting state influence on Endangered Species Act issues; sage-grouse studies; Wyoming State Water Strategy and Management Plan; develop a state of Wyoming reclamation standard; develop a state of Wyoming off-site mitigation framework; and incentives for development in non-core sage-grouse habitat.

In 2015, Governor Mead began a similar public process to develop additional initiatives with plans to update the Energy Strategy in 2016.

Wyoming Cooperative Fish and Wildlife Research Unit
The Wyoming Cooperative Fish and Wildlife Research Unit is housed at the University of Wyoming and conducts ecological research to help better understand, manage, and conserve animal populations, including research related to energy development issues. Most recently, the coop unit has supported the founding of the Migration Initiative, whose goal is to advance the understanding, appreciation, and conservation of Wyoming's migratory ungulates. Migration corridors are impacted by energy development projects in some parts of the state, particularly western Wyoming.

BLM Powder River Basin Restoration Program
The Powder River Basin Restoration (PRBR) program is a collaborative partnership to restore and enhance sage-grouse habitat on a landscape level in the Powder River Basin (PRB).

The BLM High Plains District Office PRBR program was developed to form partnerships with local cooperators, federal and state agencies, private landowners, and industry to work collaboratively on sage-grouse habitat restoration. PRBR is focusing on areas affected by federal oil and gas leasing that has occurred over the past decade in the PRB in northeastern Wyoming. The goals of the PRBR are:

- Build partnerships to restore habitat for the greater sage-grouse on a large landscape or watershed level.
- Integrate habitat improvement programs and projects implemented by partners to leverage funding to enhance sage-grouse habitat reclamation.
- Facilitate the sharing of data/data collection methods, monitoring data/methods, and best management practices.

The strategy of this initiative requires a coordinated effort which includes forming a consortium of landowners, industry, and agency partners who can integrate their respective habitat improvement programs with BLM efforts focused on reclamation of abandoned

coalbed natural gas (CBNG) wells. The partnership will provide funding sources and technical assistance for a community-based approach to restoration that goes above and beyond regulatory or industry requirements with minimal to no-cost to landowners. The result of this coordinated effort will be to restore a larger landscape or watershed area rather than the smaller areas the BLM requires through the plug and abandon process. Partners will contribute technical expertise and/or financial support focused on the long-term reclamation of abandoned CBNG wells and their infrastructure. There will be an emphasis on restoring and enhancing sage-grouse habitat. Conserving and enhancing sage-grouse habitat also benefits many other species, as well as livestock forage production. By integrating the implementation of these independent programs, there are opportunities to leverage both the technical expertise and financial contributions so that greater results are achieved.

Mitigation

WGFC MitigationPolicy

In 2012, the WGFC approved a mitigation policy to support the Department's commitment to early communication with project developers, permitting agencies, and land management agencies to avoid and minimize adverse impacts to wildlife during the course of project and land use planning. The mitigation approaches in the policy include: 1) resource maintenance and 2) resource compensation. Resource Maintenance is emphasized and may be achieved through avoiding, minimizing, rectifying, or reducing adverse impacts to wildlife through project planning. Compensation is achieved through the development and implementation of measures to replace or provide substitute resources to address impacts, which may include financial compensation.

The policy identifies and defines mitigation categories (irreplaceable, vital, high, or moderate) for specific wildlife and habitat resources and thereby provides direction to the Department in its project and land use planning recommendations. The policy was updated by the WGFC in 2016 to designate migration corridors as "vital" and add migration stopover areas and migration bottlenecks to the "vital" category, as well.

State of Wyoming Greater Sage-Grouse Compensatory Mitigation Framework

Executive Order 2015-4 Greater Sage-Grouse Core Area Protection issued by Governor Mead in July 2015 includes an attachment outlining basic requirements for compensatory mitigation related to unavoidable impacts in sage-grouse core areas. Subsequently, Governor Mead issued a more specific compensatory mitigation framework in late 2015 to further define compensatory mitigation as a strategy. The key components of the strategy, namely "credits" and "debits", took shape over several months of meetings and negotiations with state, federal, and private entities. The framework was finalized and went into full effect in June 2016. Accordingly, Governor Mead provided direction to 10 state agencies to implement the policy. The Governor also corresponded formally with the BLM, U.S. Forest Service, and U.S. Fish and Wildlife Service regarding the policy and the need for consistency across permitting agencies and land managers.

Pathfinder Ranches and the Sweetwater River Conservancy

In 2015, the U.S. Fish and Wildlife Service approved the nation's largest conservation bank and first bank for greater sage-grouse. The Sweetwater River Conservancy is the private operator of the bank, which is located on the Pathfinder Ranches located west of Casper, Wyoming. A conservation bank is a piece of property that is permanently protected and managed with regard to the natural resource values within that property. It functions to offset adverse impacts to a species which occurs elsewhere, and is often referred to as off-site compensatory mitigation. These lands are conserved and permanently managed for species that are listed under the Endangered Species Act, have been designated a candidate for listing, or are a species of conservation concern. The creation of conservation banks in Wyoming is guided by a review team comprised of

representatives from state and federal agencies and private landowners. The Pathfinder Ranch initially contains approximately 55,000 deeded acres that may be sold as "credits" to offset development that occurs elsewhere. When a credit is sold, a permanent conservation easement is placed on that acreage precluding certain types of future development.

2015 Obama Presidential Memorandum
In November 2015, President Obama issued a *Presidential Memorandum: Mitigating Impacts from Development and Encouraging Related Private Investment.* The memo supports positive environmental outcomes in conjunction with economic development, infrastructure development, and national security through planning and emphasizing a hierarchy of avoidance, minimization, and compensation measures. President Obama directed the Departments of Defense, Interior, Agriculture, Environmental Protection , and the National Oceanic and Atmospheric Administration to follow the mitigation hierarchy and moreover to develop and adopt a mitigation plan. The memo supports the use of conservation banks to offset impacts in advance of development activities, as well promoting incentives for restoration and enhancement of natural resources on public lands.

Current Challenges for Improving Wildlife Conservation Efforts Associated with Energy Development

Incomplete understanding of the effects of energy development on wildlife species and habitats.
It can be difficult to fully understand the effects of energy development on both species and habitats especially given variations in the type, pace, and intensity of energy development; local site conditions; changes in energy development technologies; and the influence of other factors including weather and natural wildlife population fluctuations. Monitoring protocols have not been established for many wildlife species including SGCN. Immediate monitoring needs, such as responding to potential ESA listings, often drive monitoring efforts, diminishing resources directed toward understanding the larger effects of development on ecological systems and the success of mitigation efforts.

Difficulties in identifying specific goals and performance indicators by which to develop conservation plans and quantify the success of mitigation efforts.
It is difficult to establish performance indicators to evaluate the success of mitigation efforts given the diverse, changing, and incomplete understanding of the effects of energy development. There is also a lack of consensus on the timeframe or benchmarks by which success should be evaluated. Although improvements have been made, there can be a lack of standardization on how various variables are measured. A significant amount of wildlife mitigation and enhancement techniques pertain to riparian areas and wetlands, which tend to be geographically limited and defined. It can be more challenging to establish effective performance indicators in habitat types that occur on a landscape scale, such as sagebrush.

A diverse array of maps identifying important wildlife habitat are currently available to help guide energy development; however, they are often species-specific or wildlife-group-specific and can vary by organization. Further maps are needed that specify areas of multiple conservation values, including areas needed for sustaining populations of sensitive species, big game crucial winter ranges and migration corridors, and intact portions of representative habitat types.

Lack of understanding and investigation into cumulative impacts.
Currently, Environmental Assessments and Environmental Impact Statements are applied on a project-by-project basis. This results in potentially underestimating the cumulative impacts of multiple concurrent or sequential projects. To be effective, development planning and analysis should include more emphasis on

an evaluation of impacts for multiple forms of development as well as successive projects for a single type of energy development.

It is often difficult to keep Bureau of Land Management Resource Management Plans sufficiently updated and specific to meet the needs for effective mitigation and conservation planning.
BLM RMPs are often very general and do not typically evaluate site-specific impacts. Consequently, information provided to decision-makers can be inadequate for them to use in formulating effective mitigation plans, lease stipulations, or conservation areas. Once written, there can be limited flexibility to accommodate new information collected post-RMP development. Additionally, at this stage, energy development rights have often already been issued, typically making modifications difficult. Rapidly changing technologies and threats can also cause RMPs to quickly become outdated.

Lack of follow-up and enforcement in meeting monitoring and stipulation requirements.
The BLM often does not have the time or resources to monitor industry actions and compliance. State regulatory agencies also do not have adequate resources for follow-up or enforcement efforts where requirements or standards are not met. Kniola and Gil (2005) documented 84% of coal-bed methane wells and facilities in NE Wyoming that did not comply with reclamation standards and other conditions of approval.

Inadequate bonding system to ensure sufficient funds for the future decommissioning and reclamation of energy-development sites.
Lease development bonding is often tied to the original developer; however, leases may change hands multiple times. The type of company that secondarily acquires a lease may change over the lifetime of the lease, including companies that specialize in primary, secondary, and tertiary extraction, as well as salvage and scrap operations for energy-development equipment and infrastructure. Some of these companies go out of business or declare bankruptcy prior to the land being fully reclaimed, making accountability for reclamation difficult.

Recommended Conservation Actions

Advance efforts that identify important wildlife habitats and areas of potential energy development to guide development and conservation planning.
Careful, statewide planning will be critical in future development and minimizing its impacts on Wyoming's wildlife. Currently, multiple regional, statewide, and local habitat mapping efforts are ongoing including the Sage-grouse Core Area Strategy; TNC's Development by Design; WGFD's Strategic Habitat Plan Crucial Areas, and Wind Conflict Maps, among others. Continued attention should be directed toward involving federal and state agencies, industry, landowners, and conservation organizations on cooperatively refining and consolidating these maps. In addition to habitat identification, vulnerability assessments that identify areas of current and projected energy development, as well as other habitat stressors such as rural subdivision, invasive species, and climate change, should be incorporated into mapping efforts. These mapping activities will allow development planning to be conducted on a landscape or watershed scale so that wildlife conflicts can be identified early in the process to facilitate avoidance of impacts (high mitigation priority) and develop appropriate on- and off-site mitigation measures for unavoidable impacts.

Efforts should continue to support state and regional decision support systems to house and disseminate GIS data.
WyGISC's WISDOM, WGFD's internal analysis tool, and Natural Resource and Energy Explorer (NREX), which is an external, public tool, should be further established and associated data made easily accessible to

agencies, industry, government officials, and the public for energy development and wildlife conservation planning. These web-based GIS applications will facilitate the development and updating of maps identifying priority wildlife conservation and energy development areas described above. GIS analysis is also particularly effective for identifying and understanding the cumulative impacts of multiple development projects. Efforts should continue through the Western Governors' Western Regional Wildlife Support System to ensure Wyoming's web-based GIS tools are compatible with those of the surrounding states to facilitate planning multi-state energy transmission and infrastructure developments. Consideration should be given to the appointment of a Geographic Information Office who would oversee the collection, storage, and dissemination of GIS data for state or federal natural resource projects approved in Wyoming.

Monitoring efforts should be both designed to scientific standards, including having treatment and control sites, and formulated to answer specific questions.
The purpose of monitoring should be more clearly defined to evaluate the impacts of energy development and the success of mitigation efforts. The type and level of monitoring needs should be tailored to the specific attributes of the development project and the ecological sensitivity of the site. A framework for establishing this approach is found in the monitoring recommendations within the WGFD's *Recommendations for Development of Oil and Gas Resources within Important Wildlife Habitats* (Wyoming Game and Fish Department 2010a) and *Wildlife Protection Recommendations for Wind Energy Development in Wyoming* (Wyoming Game and Fish Department 2010b). WLCI has also begun compiling information to assist in the establishment of effective energy-development–wildlife-monitoring protocols and plans to serve as a clearing house for this information in the future. Increasing WLCI capacity in this role, or alternatively creating regional or statewide monitoring committees composed of agency personnel, industry, and scientists who have strong backgrounds in monitoring, should be considered. Monitoring plans could be voluntarily submitted to these committees for review. While accounting for the site-specific nature and purposes of monitoring, monitoring definitions should be standardized to the greatest degree possible to allow more accurate comparisons of WDS impacts on a landscape or watershed scale. It is particularly important to establish baseline data on wildlife and habitat conditions prior to energy development in order to be able to monitor future impacts.

Cumulative impact analyses should be used in decision making.
Environmental Assessments and Environmental Impact Statements are applied on a project-by-project basis. Cumulative impacts analyses of identified resource concerns are required as part of the NEPA process. The cumulative impacts analysis of a particular resource involves identifying an appropriate analysis area that typically extends beyond the area of the project itself. The impacts of existing, ongoing, and reasonably foreseeable activities within that analysis area are evaluated in conjunction with the proposed project. Energy development results in long-term direct and indirect impacts on the landscape, and the additive effects of multiple projects in the same region could lead to population level impacts on wildlife, including exhausting the carrying capacity of unimpacted habitat. Cumulative impacts analyses should be fully considered in land management agency project planning and decision making.

Habitat mitigation and monitoring requirements should be based on desired ecological outcomes.
Governor Mead finalized a greater sage-grouse compensatory mitigation framework in 2016, which developed "debit" and "credit" criteria for sage-grouse mitigation. Many of the concepts outlined in this document could be used for the conservation of other species, as well. The policy follows U.S. Fish and Wildlife Service and Bureau of Land Management compensatory mitigation guidance. The compensatory mitigation system is built on

conservation durability, accounting for indirect impacts, assessing current credit condition, assessing risk of development on the credit, potential threats to the credits, as well as other risk and habitat stability factors. A key component of the policy is to ensure the mitigation benefits are in place prior to the impact occurring on the landscape and for at least as long as the impacts exists on the landscape.

Developing a statewide mitigation framework to reclaim or maintain key habitat and natural resources has been identified as an objective for Wyoming Governor's Matthew Mead's Action Plan Energy, Environment, and Economy (2013). The focus will be on the reclamation, rehabilitation and conservation efforts in the places that are most likely to be adversely impacted by development. Measurable documentation of acres maintained or improved as habitat for species of concern could be tracked on an annual basis by the Wyoming Game and Fish Department.

Additional research and coordination should occur to maximize the benefits of on- and offsite mitigation.
The effectiveness of reclamation and mitigation efforts should be reviewed. Offsite mitigation should be used only in addition to, not as a replacement for, onsite mitigation. Attention needs to be placed on further refining goals for mitigation, as well as associated monitoring, in order to evaluate the effectiveness of habitat mitigation and enhancement programs. Offsite mitigation planning needs to consider landscape-level, cumulative impacts. Connectivity, both in terms of animals that migrate seasonally as well as corridors between localized population segments, should be incorporated into mitigation planning. The Nature Conservancy's Development by Design (see Current Initiatives) has been applied to establish prioritization processes to rank proposed mitigation projects for the Jonah Interagency Office and Pinedale Anticline Project Offices.

Efforts should be made to review and consolidate recommendations both within and between agencies to minimize conflicting or unnecessary regulations.
Research should be conducted on mechanisms to allow federal and non-federal minerals (oil and gas) to co-mingle, while retaining the ability to account for each separately. This would reduce the need for duplicating infrastructure to transport these materials. Currently, BLM regulations do not allow federal and non-federal mineral to co-mingle in order to allow for independent accounting. Additionally, single-point source regulations designed to limit pollution can reduce the amount of directional drilling occurring at one drilling site. This results in the construction of multiple drill sites as well as associated roads and infrastructure to extract the same amount of oil and gas while not reducing overall pollution rates.

There should be greater follow-up and enforcement regarding meeting monitoring and stipulation regulations.
The BLM and Forest Service have responsibility for monitoring development stipulations within their jurisdictions. The Wyoming Oil and Gas Conservation Commission assumes this responsibility on private and state-owned lands. The pace of energy development can overwhelm both agencies and industry with the permitting process, leaving few resources available for monitoring and enforcement. The pace of permitting should be reviewed if development is proceeding so quickly as to preclude adequate monitoring, or if mitigation measures cannot be instituted. Alternatively, industry could contribute financial resources for third-party monitoring if agency resources are inadequate.

Monitoring should be based on RMP development thresholds and stated desired future outcomes in lease agreements or on agency/private landowner goals if on private or state owned land. Protocols should be developed by field investigation to determine critical elements to be monitored. A clearinghouse for monitoring requirements based upon lease/APD language could be

developed. Future permitting should be based on past performance.

Review reclamation bonds annually and ensure that when leases are transferred they are sufficient relative to reclamation needs.
Governor Mead's 2013 Energy Strategy identified state bonding review as a key initiative. To date, this initiative has not been completed.

Continued efforts should be made to develop and implement technologies and techniques to minimize energy-development impacts on wildlife.
Current technologies that have been used to reduce energy development wildlife impacts include using smaller rigs, directional drilling, oak mats, and purpose-built rigs. Whenever possible, supporting infrastructure, including power transmission lines and pipelines, should be placed in already existing corridors to reduce the cumulative impacts to wildlife.

More training opportunities should be provided for wildlife biologists and natural resource agency personnel to enhance their understanding of energy development techniques and issues. Conversely, energy industry personnel should have more educational opportunities regarding wildlife and biological issues on which agency personnel often base their recommendations.

Evaluating/Monitoring Success

Trends in wildlife populations should be monitored to learn more about the impacts of energy development and to ensure specified mitigation goals are met.
Continued effort needs to be made to conduct research to understand the potential impacts of energy development on species and habitats where little information exists. New forms of development will require additional research. Results of the AWVED project (see Current Initiatives, page II – 2 – 13) will provide guidance as to which species are likely to be impacted by energy development and where additional research is needed.

The long-term effectiveness of reclamation and mitigation measures should be monitored.
Long-term studies should be established to evaluate and compare the effectiveness of various mitigation techniques. Efforts should be made to continually integrate monitoring data into adaptive management strategies, including making individual and compiled results available to industry and agencies to improve energy-development and mitigation techniques. Opportunities to enable agencies, conservation organizations, and energy companies to collaboratively interact and contribute data should be identified.

The University of Wyoming's Reclamation and Restoration Center (WRRC) has provided the state with expertise and support on various projects and efforts.

The location, rate, and extent of energy development should continue to be tracked on a statewide basis to assist in identifying cumulative impacts, evaluating the integrity of wildlife priority areas, and updating conservation plans.
The establishment of a centralized GIS database for biological and energy development information should assist in achieving this goal.

Literature Cited

ASSOCIATION OF FISH AND WILDLIFE AGENCIES ENERGY AND WILDLIFE COMMITTEE. 2010. Electric transmission line guide for state fish and wildlife agencies. Draft, March 2010.

CLARK, A. 2009. My backyard or yours? Where are the turbines set to go? Wyoming Wind Symposium. August 13–14, 2009.

COPELAND, H. E., A. POCEWICZ, D. E. NAUGLE, T. GRIFFITHS, D. KEINATH, J. EVANS, AND J. PLATT. 2013. Measuring the effectiveness of conservation: A novel framework to quantify the

benefits of sage-grouse conservation policy and easements in Wyoming. PLoS ONE 8:e67261.

BECKER, J. M., C. A. DUBERSTEIN, J. D. TAGESTAD, AND J. L. DOWNS. 2009. Sage-grouse and wind energy: biology, habits, and potential effects of development. Prepared for the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Wind & Hydropower Technologies Program under Contract DE-AC05-76RL01830.

BREKKE, E. B. 1988. Using GIS to determine the effects of CO2 development on elk calving in south-central Colorado. USDI-BLM Technical Note 381. USDI-Bureau of Land Management, Denver, CO.

BUREAU OF LAND MANAGEMENT. 2008. Public Land Statistics 2008, Volume 192. BLM/BC/ST-07/001+1165. Washington, DC.

———. 2010a. Oil shale and tar sand resources. http://ostseis.anl.gov/guide/index.cfm

———. 2010b. Wyoming renewable energy office brochure. BLM/WY/GI-10/021+1430.

CASPER STAR-TRIBUNE. 2010. Wyoming helium plant construction on track. October 2, 2010. http://trib.com/news/state-and-regional/article_5b155c5d-7e44-5f6e-8f75-d4bd0ec9334f.html

CASPER STAR-TRIBUNE. 2009. Uranium sales would hurt Wyoming industry. October 12, 2009. http://trib.com/news/opinion/editorial/article_a69058ab-76c4-546f-b867-9380b3f1c50c.html

DEPARTMENT OF ENERGY. 2003. Uranium industry annual survey: schedule A, uranium raw material activities (1984–2002) and form EIA-851A, domestic uranium production report. Energy Information Administration, Form EIA-858.

ELLIOTT, D. L., L. L. WENDELL, AND G. L. GOWER. 1991. An analysis of windy land areas and wind potential in the contiguous United States. Pacific Northwest Laboratory, PNL-7789.

ERICKSON, W., G. JOHNSON, D. YOUNG, D. STRICKLAND, R. GOOD, M. BOURASSA , K. BAY, AND K. SERNKA. 2002. Synthesis and comparison of baseline avian and bat use, raptor nesting and mortality information from proposed and existing wind developments. Cheyenne, WY. WEST, Inc.

FYFE, R. E. AND R. R. OLENDORFF. 1976. Minimizing the dangers of nesting studies to raptors and other sensitive species. Canadian Wildlife Service. Occas. Paper No 23.

GASWORLD 2014. News release. http://www.gasworld.com/helium-production-begins-at-big-piney/2003892.article

HAYDEN-WING ASSOCIATES. 1990. Response of elk to Exxon's field development in the Riley Ridge area of western Wyoming, 1979–1988. Final Report prepared for Exxon Company, U.S.A. and Wyoming Game and Fish Dept., Cheyenne, WY.

HIATT, G. S. AND D. BAKER. 1981. Effects of oil/gas drilling on elk and mule deer winter distributions on Crooks Mountain, Wyoming. Unpublished report, Wyoming Game and Fish Dept, Cheyenne, WY.

HOLLORAN, M.J. 2005. Greater Sage-Grouse (Centrocercus Urophasianus) Populations Response to Natural Gas Field Development in Western Wyoming. Phd, University of Wyoming Department of Zoology and Physiology,

JACUS, J. R. AND D. A. DILUIGI. 2010. Go west young man? Air quality developments affecting western oil and gas exploration and production. Natural Resources & Environment 24 (4) 20–24.

JOHNSON B. K. AND D. LOCKMAN. 1979. Response of elk during calving to oil/gas drilling activity in Snider Basin, Wyoming. WGFD Report.

JOHNSON, G. D. 2005. Review of bat mortality at wind energy developments in the 985 United States. Bat Research News 46:45–49.

KEELEY, B., S. UGORETZ, AND D. STRICKLAND. 2001. Bat ecology and wind turbine considerations. *in* Proceedings of the National avian-wind power planning meeting 4:135–146. Washington: National Wind Coordinating Committee.

KIESECKER, J. M, H. COPELAND, A. POCEWICZ, AND B. MCKENNEY. 2010. Development by design: blending landscape-level planning with the mitigation hierarchy. Frontiers in Ecology and the Environment. 8: 261–266.

KNIOLA, B .E. AND J. S. GIL. 2005. Surface compliance of coal bed natural gas (CBNG) development in north central Wyoming. USDI Bureau of Land Management, Buffalo Field Office.

KUNZ, T. H. 2004. Wind power: bats and wind turbines. Pages 50-56 *in*: S. S. Schwartz, editor. Proceedings of the Wind Energy and Birds/Bats Workshop: Understanding and Resolving Bird and Bat Impacts; 2004 May 18-19; Washington, D.C. Washington: RESOLVE, Inc.

KUNZ, T. H., W. B. ARNETT, B. M. COOPER, W. P. ERICKSON, R. P. LARKIN, T. MABEE, M. L. MORRISON, M. D. STRICKLAND, AND J. M. SZEWCZAK. 2007. Assessing impacts of wind

energy development on nocturnally active birds and bats: a guidance document. Journal of Wildlife Management 71:2449–2486.

LAWRENCE, F. J. (ED). 2007. The oil and gas producing industry in your state. Independent Petroleum Association of America, Washington, D.C. Vol. 75, No. 17.

NATIONAL MINING ASSOCIATION. 2008. Mining Statistics. Washington, DC.

NIELSEN, J., S. INNIS, L. KAAS POLLOCK, H. RHOADS WEAVER, AND A. SHUTAK. 2002. Renewable energy atlas of the West: a guide to the region's resource potential. Land and Water Fund of the Rockies, ISBN 0-9721568-0-1.

O'DONNELL, M. S., AND T. S. FANCHER. 2010. Spatial mapping and attribution of Wyoming wind turbines. U.S. Geological Survey, Denver, Colorado.

POCEWICZ, A., H. E. COPELAND, M. B. GRENIER, D. A. KEINATH, AND L. M. WASHKOVIAK. 2014. Assessing the future vulnerability of Wyoming's terrestrial wildlife species and habitats. The Nature Conservancy, Wyoming Game and Fish Department, Wyoming Natural Diversity Database, Lander, Wyoming.

SAWYER, H. R. 2007. *Final report for the Atlantic Rim mule deer study*. Prepared for the BLM, WGFD, and Anadarko Petroleum Co. http://www.west-inc.com/reports/big_game/AR_report_final.pdf.

SAWYER, H., R. NIELSON, D. STRICKLAND, AND L. MCDONALD. 2008. Final report for the Sublette mule deer study (phase II): long-term monitoring plan to assess potential impacts of energy development on mule deer in the Pinedale Anticline Project Area. Western Ecosystems Technology, Inc. Cheyenne, WY.

SAWYER, H., R. NIELSON, F. LINDZEY, AND L. MCDONALD. 2006. Winter habitat selection by mule deer before and during development of a natural gas field. Journal of Wildlife Management 70:396–403.

STATE OF WYOMING DEPARTMENT OF REVENUE. 2009. Annual Report. Cheyenne, WY. http://revenue.state.wy.us/PortalVBVS/uploads/Department%20of%20Revenue%20%2010.29.2009.pdf

Stoellinger, T. Taylor, D. 2016. Economic Impact to Wyoming's Economy From A Potential Listing of the Sage Grouse. University of Wyoming College of Agriculture and Natural Resources. Haub School of Environment and Natural Resources. Report to Office of Governor Matthew Mead.

SURDAM, R. H. 2005. Wyoming's economic future: planning for sustained prosperity. Wyoming Geological Survey, Cheyenne. Undated Microsoft® Office PowerPoint® presentation.

SURDAM, R. H.. 2008. Wyoming energy development in the context of the global energy economy. Wyoming State Geological Survey Challenges in Geologic Resource Development No. 6. ISBN 1-8884589-48-0.

U.S. ENERGY INFORMATION ADMINISTRATION, 2010. HTTP://WWW.EIA.GOV/STATE/STATE_ENERGY_PROFILES.CFM?SID=WY.

WHITE, C. M. AND T. L. THUROW. 1985. Ferruginous hawks and geothermal development. Annual Report to the U.S. Dept. of Energy, Idaho Operations Office, Idaho Falls, ID and EG&G Idaho, Inc., Idaho Falls, ID.

WINEGRAD, G. 2004. Why avian impacts are a concernin wind energy development. Pages 22–24 *in* Proceedings of the wind energy and birds/bats workshop: understanding and resolving bird and bat impacts. Washington, D.C. May 18–19, 2004. Prepared by 1287 RESOLVE, Inc., Washington, D.C., S. S. Schwartz, editor.

WYOMING ACTION PLAN ENERGY, ENVIRONMENT, AND ECONOMY (2013). https://issuu.com/energy_strategy/docs/wy_energy_strategy?e=8164076/2618210

WYOMING DEPARTMENT OF EMPLOYMENT. 2010. June 2010 employment statistics.

WYOMING GAME AND FISH DEPARTMENT. 2010a. Recommendations for development of oil and gas resources within important wildlife habitats. Version 6. Cheyenne, WY.

WYOMING GAME AND FISH DEPARTMENT. 2010b. Wildlife protection recommendations for wind energy development in Wyoming. Cheyenne, WY.

WYOMING OIL AND GAS CONSERVATION COMMISSION. 2010. Wyoming Oil and Gas Well Files. Casper, Wyoming.

Additional Resources

Bureau of Land Management – Wyoming State Office
5353 Yellowstone Road,
Cheyenne WY 82009
PO Box 1828,
Cheyenne, WY 82003-1828
Phone: (307) 775-6256
http://www.blm.gov/wy/st/en.html

Office of State Lands and Investments
Herschler Building, 3rd Floor West
122 West 25th Street
Cheyenne, WY 82001
Phone: (307) 777-7331
http://lands.wyo.gov/

Petroleum Association of Wyoming
951 Werner Court, Suite 100
Casper, WY 82601
Phone: (307) 234-5333
http://www.pawyo.org/

The Nature Conservancy in Wyoming
258 Main Street, Suite 200
Lander, WY 82520
Phone: (307) 332-2971
http://www.nature.org/wherewework/northamerica/states/wyoming/

U.S. Fish and Wildlife Service
Wyoming Field Office
5353 Yellowstone Road, Suite 308A
Cheyenne, WY 82009
Phone: (307) 772-2374

U.S. Forest Service R2/R4
Wyoming Capitol City Coordinator
Herschler Building 3 West, Room 3603
122 West 25th Street
Cheyenne, Wyoming 82002-0600
Phone: (307) 777-60870

Wyoming Department of Environmental Quality
Herschler Building
122 West 25th Street
Cheyenne, WY 82002
Phone: (307) 777-7937
http://deq.wyoming.gov/

Wyoming Game and Fish Department
Habitat Protection
5400 Bishop Blvd
Cheyenne, WY 82006
Phone: (307) 777-4506
https://wgfd.wyo.gov/

Wyoming Geographic Information Science Center (WyGISC)
Department 4008,
1000 East University Avenue
University of Wyoming
Laramie, WY 82071
Phone: (307) 766-2523
http://www.uwyo.edu/wygisc/

Wyoming Mining Association
2601 Central Avenue
Cheyenne, WY 82007
P.O. Box 866
Cheyenne, WY 82003
Phone: (307) 635-0331
http://www.wyomingmining.org/

Wyoming Natural Diversity Database
Dept. 3381, 2nd Floor, Wyoming Hall
1000 East University Avenue
Laramie, WY 82071
Phone: (307) 766-3023
http://www.uwyo.edu/wyndd/

Wyoming Oil and Gas Commission
2211 King Boulevard
Casper, WY 82602
P.O. Box 2640
Casper, WY 82602
Phone: (307) 234-7147
http://wogcc.state.wy.us/

State and Federal Energy Development Regulations

Wyoming Statewide Rules
The Wyoming Oil and Gas Conservation Commission (WOGCC) issues state-wide rules and regulations to govern the development of oil and gas in Wyoming. Current WOGCC rules and regulations can be accessed through the links below or through the *Rules/Statutes* page on the WOGCC's website (http://wogcc.state.wy.us/). These rules and regulations apply to the drilling and mining of private, state, and federally owned minerals. The intent of WOGCC rules and regulations are to prevent waste and to conserve mineral resources, as well as to protect human health and the environment. This is accomplished through designating extraction methods which are designed to avoid soil or water contamination at drilling or producing locations. Compliance with state rules does not relieve the owner or operator of the obligation to comply with applicable federal, local or other state permits or regulatory requirements.

National Environmental Policy Act
National Environmental Policy Act (NEPA) requires federal agencies to integrate environmental values into their decision making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions. Under NEPA, there are three steps that can occur regarding energy development projects: 1) scoping, 2) developing an Environmental Assessment (EA), 3) and/or developing an Environmental Impact Statement (EIS). The scoping notice identifies issues and concerns that will need to be analyzed in an EA or EIS. A written EA analyzes how a proposed federal action might affect the environment. If no significant effects are determined, the agency issues a finding of no significant impact (FONSI). The FONSI may address measures which an agency will take to reduce (mitigate) potentially significant impacts to an insignificant level. In some circumstances, an EA does not need to be done prior to doing an EIS. If the federal agency or the project proponent already suspects that the environmental consequences may be significant, the EA process can be bypassed and the process goes directly to developing an EIS. In these circumstances significant time and money is saved by bypassing the EA step. An EIS is a more detailed evaluation of the proposed action and alternatives that discusses the potentially significant effects and consequences. The public, other federal agencies and outside parties may provide input into the preparation of an EIS and then comment on the draft EIS when it is completed. If a federal agency anticipates that an undertaking may significantly impact the environment, or if a project is environmentally controversial, a federal agency may choose to prepare an EIS without having to first prepare an EA. Additional information on NEPA can be found at: https://www.epa.gov/nepa

National Environmental Policy Act (NEPA) – Categorical Exclusion Reviews
Categorical exclusions are "a category of actions which do not individually or cumulatively have a significant effect on the human environment … and for which, therefore, neither an environmental assessment nor an environmental impact statement is required." The Council on Environmental Quality (CEQ) developed the categorical exclusion process to decrease the paperwork and time associated with NEPA compliance. The categorical exclusions for Mineral Management Services (MMS) activities are listed in the MMS Manual.

The CEQ acknowledges that occasionally exceptions to a categorical exclusion may be needed. As a result, the CEQ requires all agencies to develop procedures to determine whether a normally excluded action may have a significant environmental effect. The Categorical Exclusion Review (CER) determines whether a proposal that is categorically excluded may meet any of the Department's extraordinary circumstances criteria.

Federal Mineral Leasing
The Bureau of Land Management manages the nation's publicly owned mineral estate, including its leasing, and is also the federal

agency responsible for conducting NEPA analyses for the mineral leasing activities that the agency approves. The Wyoming BLM State Office and WGFD entered into a memorandum of understanding (MOU) in 1990 to guide the cooperative input and consideration of wildlife resource values on BLM lands. Appendix 5G of that MOU deals specifically with coordination and cooperation related to oil and gas development activities.

Consideration of environmentally sensitive areas and other resources are addressed in two ways within the BLM federal leasing program: "no leasing" and "leasing with restrictive stipulations." "No leasing" is prescribed for specific areas only through a congressional mandate or through the BLM planning process when a determination on a given land-use plan is made not to lease in a specific area.

To limit conflicts with the variety of resources encountered on federal lands, the Wyoming BLM state office has developed Lease Notices and four standard types of stipulations that can be attached to a lease. Notices and stipulations are attached as part of a lease when the environmental and planning record demonstrates a necessity for them. The notices and stipulations are in addition to the terms of the lease as printed on the lease form, and once attached, become an integral part of the lease. The stipulation format includes the categories of: 1) no surface occupancy (NSO), 2) timing or seasonal restrictions, 3) controlled surface use, and 4) special administrative stipulations. In all cases, definitive use of the stipulations will require identification of specific resource values to be protected.

A Controlled Surface Use (CSU) stipulation is applied, on all or portions of a lease, where use and occupancy is allowed (unless restricted by another stipulation), but identified resource values require special operational constraints that may alter the lease terms. These could include prohibiting certain types of activities and/or occupancy unless suitable mitigation can be determined and agreed upon by the BLM and the operator. The CSU is different from the NSO, which totally prohibits surface occupancy, and from timing stipulations, which limit when operations may occur.

Special administrative stipulations are those stipulations provided by another agency or organization, such as the US Forest Service or Bureau of Reclamation. They are used in situations where standard stipulations do not adequately address a specific concern, surface management plan, or an agency regulation or policy.

"Exceptions" can be applied on a case-by-case basis. Exceptions are one-time exemptions from lease stipulations for a specified portion of a leasehold and for a specified period of time. Existing stipulations continue to apply to all other sites and time periods within the leasehold. Exceptions are approved by the BLM Area Manager in coordination with the WGFD.

"Modifications" fundamentally change the provisions of a lease stipulation, either temporarily or for the period of the lease. A modification may, therefore, include an exemption from, or alteration to, a stipulated requirement. Depending on the specific modification, the stipulation may or may not apply to all other sites within the leasehold. Modifications are approved by the BLM Deputy State Director for Minerals and Lands with consultation from the WGFD.

The Federal Onshore Oil and Gas Leasing Reform Act (FOOGLRA) of 1987 further provides for a 30-day public review opportunity before approving or substantially changing terms of a lease or varying lease stipulations. The level and intensity of public involvement is usually based on specific circumstances.

Federal Land Management Agency Planning Documents

The BLM's umbrella planning document for general resource and land use management direction for an administrative area unit is the Resource Management Plan (RMP). The RMP provides management direction for the BLM's oil and gas leasing, exploration, and development process and specific direction for

the application of stipulations to oil and gas leases. The RMP also provides direction for conditions of approval (COAs) that are intended to guide the exploration and development stages of oil and gas activities. Similarly, each National Forest and Grassland is governed by a management plan in accordance with the National Forest Management Act (NFMA) http://www.fs.fed.us/emc/nfma/index.htm. These plans set management, protection, and use goals and guidelines. Monitoring conditions on a forest or grassland ensures projects are done in accordance with plan direction, and determines effects that might require a change in management. The US Forest Service determines where and under what conditions oil and gas leasing can occur on National Forest lands. The BLM then determines whether or not NEPA requirements have been met before the BLM offers the Forest Service oil and gas leases for sale at auction.

Mineral Activity on Wyoming State Lands
The State Board of Land Commissioners through the Mineral Leasing Section of the Office of State Lands and Investments is responsible for establishing rules and regulations for lands owned by the state of Wyoming. The Mineral Leasing Section is also responsible for providing information to the public and private sectors concerning state mineral lease availability and individual lease status.

U.S. Environmental Protection Agency and Wyoming Department of Environmental Quality
The U.S. Environmental Protection Agency (EPA) is a federal agency whose mission is to protect human health and the environment through regulation, research, and outreach related to pollutants in the environment. The Wyoming Department of Environmental Quality (DEQ) is a state agency, not directly affiliated with the EPA, which answers to the Governor and Legislature of the State of Wyoming. DEQ develops and implements regulations and policies in response to federal guidelines and in regards to direction from the Legislature and the Governor. Many DEQ programs have been designed to meet the EPA's requirements, so that DEQ is delegated the authority to enforce many of the EPA's environmental programs. By maintaining delegation, DEQ keeps the management of environmental programs within the state, allowing the development of regulations and policy to better meet the specific needs of Wyoming. The EPA retains oversight of any DEQ programs that implement federal requirements. DEQ is responsible for enforcing state and federal environmental laws, including the Clean Air Act, Clean Water Act, National Pollutant Discharge Elimination System (NPDES), Environmental Quality Act, Resource Conservation and Recovery Act (RCRA), Superfund Amendments and Title III Reauthorization Act (SARA), and Federal Surface Mining Reclamation and Control Act.

Wind Energy Development
Wind projects constructed in Wyoming, which consist of 30 or more towers or which expand to include 30 or more towers, regardless of land ownership, require a permit from the Wyoming Industrial Siting Council (WISC). W.S. 35-12-110 (b) requires WGFD to provide information and recommendations to the WISC regarding the impacts of industrial facilities including wind projects subject to WISC jurisdiction and a specific recommendation as to whether the WISC should issue a permit.

Like oil and gas, NEPA also applies to the development of wind energy and associated infrastructure on federal lands. A POD is a plan of development for individual wind energy development projects. Energy companies seeking to develop a wind power project on BLM-administered lands are required to develop a project-specific POD that incorporates best management practices and other appropriate existing BLM mitigation and guidance conditions developed to minimize or reduce environmental effects to other resources. PODs typically include a site plan showing the locations of turbines, roads, power lines, other infrastructure, and additional areas of short and long-term disturbance. ROW authorization can apply additional mitigation measures to address

site- and species-specific issues for individual projects related to but not included in a wind energy development POD. Examples include meteorological test towers, connecting transmission lines, and support and maintenance facilities.