Appendix IX

Key Issues for Final Plan Phase – Detailed Descriptions

Land &Water Habitat Fragmentation, Degradation, Loss and Conversion

Definition

Habitat fragmentation, degradation, loss and conversion are a concern for land, lakes and streams. On land, fragmentation refers to changes in the landscape pattern resulting from human activities, primarily as a result of habitat conversion. The land is converted to many different uses and activities, including: agriculture, forest harvest, residential, road construction and numerous other factors. Fragmentation results in smaller patch sizes, increased edge, and an overall 'simplification' of the landscape. The nature of fragmentation varies across Minnesota, from the characteristic checkerboard pattern of farm fields with isolated woodlots in agricultural regions of the state, to broadleaf forests perforated by 1-5 acre lots in the broadleaf forest region of the state, to aspen-conifer forests with interspersed 40-80 acre clear-cut sections in northern Minnesota. In aquatic ecosystems, fish habitat fragmentation and outright loss result from removal of downed trees, or aquatic vegetation, alteration of shorelines (e.g. installing rip rap) and the removal of riparian wetlands.

Issue

Habitat degradation is also frequently associated with fragmentation, resulting in a greatly reduced complexity of habitat structure, functions and values. There are many known effects, and probably an equal number of unknown effects of habitat fragmentation, degradation and loss. Among these are a direct loss of habitat for species that require large tracts of prairie, or forest land ("interior" forest is required by many bird and some mammal species) and for fish species that require floating vegetation or wetlands for breeding and juvenile rearing, increased predation associated with increased edge (for terrestrial species) and with loss of floating and submerged vegetation (for aquatic species), and increased opportunities for the spread and establishment of invasive species. Presently, the loss of lake shoreline habitat is a major issue regarding aquatic habitat. As the patch size of fragments become smaller, the population sizes of organisms living within the fragments also decreases. Population size is the critical factor in maintaining viable plant and animal populations and as they decline, species become more susceptible to local or regional extinction. Less well understood are the long term consequences of fragmentation, including the resilience of natural communities to respond to environmental stress, and in particular their ability to adapt to climate change (e.g. maintain overall species composition and productivity).

Key Questions

- What is the relationship between the remaining large intact tracts of land and the ongoing changes in land ownership patterns?
- What parts of the forest, agricultural and aquatic resources of Minnesota are most 'at-risk' in terms of increasing rates of habitat fragmentation?
- What are effective social and economic incentives for aquatic and land habitat protection and restoration?
- What policies are needed to reduce habitat loss, degradation, and fragmentation?

Data Sources

There are numerous data sets available to assess these habitat and landscape fragmentation issues, including the classified Landsat imagery available statewide through the MN DNR Gap program, the NRRI and UM forest classifications, and the airphoto-based land classification of the Twin Cities region available through the Metropolitan Council. The DNR has some data and spatial information on aquatic habitat, with some limited data on floating and rooted vegetation and shoreline habitat. The DNR also has lake bathymetric maps, although these need to be updated.

Outcome

The identification of 'at-risk' land and aquatic habitats in the agricultural, forested, and mixed land use regions of the state, as well as trends in habitat fragmentation over time. Recommend changes to land and aquatic habitat management policies that promote multi-owner coordination to maintain large parcels, reduce rates of habitat fragmentation and loss in key areas through conservation easements and other policies, and link changes in landscape structure to key land, water, fish and wildlife resources.

Value

High. Habitat fragmentation, degradation and loss are arguably the most important issues facing the conservation and preservation of Minnesota resources. The issue is complicated by the fact that large habitats are already highly subdivided and are managed by many public and private landowners, with vastly different management objectives. Moreover, fragmentation associated with changes in infrastructure is largely irreversible: roads, docks, and building developments become persistent features of the landscape. Consequently, it is critical to understand these fundamental changes to Minnesota's habitats. Moreover, if Minnesota is to maintain its native biological diversity and provide sound decision-making for its natural resource extractive industries, a solid understanding of the distribution of its land and water habitats base is critical.

Land Use Practices

Definition

Land use practices includes the full spectrum of human activities on the land from conservancy and restoration through agricultural, extraction, alteration and all forms of urban and shoreland development and redevelopment. The previous issue deals directly with fragmentation, conversion, degradation and loss of land and water habitat, as one distinct set of consequences associated with human activities. In this context, land use practices refers to the manner in which a use, or activity is conducted on a particular parcel of land.

Issue

The ways in which land is used to support human activities have both direct and indirect effects on all of the natural resource systems. Land conservation and restoration activities are known to yield positive effects. Some forms of extraction and land alteration can permanently destroy preexisting natural resources. It is also true that the patterns and density of development, the interrelationships between different uses and construction

and development practices combine to have major effects on energy consumption, air and water quality, and transportation.

Key Questions:

- What additional opportunities exist for acquisition and management of land conservancies throughout Minnesota and which are the best approaches for financing conservation strategies?
- Are current regulations adequate to mitigate for the loss of natural resource systems due to extraction and land alteration activities?
- Can the benefits of compact and higher density developments be sufficiently quantified to overcome local political opposition?
- Which of the many low impact development (LID) practices are the most effective and how can local officials and the development community be encouraged and motivated to implement them?
- How can the new Green Star Energy code be best implemented and what are realistic expectations for its effects?
- Within the existing Federal regulatory framework, how can we structure a set of regulatory and policy pressures along with systems of Best Management Practices (BMPs) to achieve responsible and sustainable development and redevelopment patterns that minimize and mitigate environmental degradation?

Data Sources

The Minnesota Land Cover Classification System (MLCCS) is available to many communities within the Twin Cities Metropolitan Area and in other select areas in the State. Where available, this tool provides excellent information regarding the existing pattern of natural resource systems, and opportunities to establish key linkages in multi-purpose greenway corridors. The MnDNR has some information on the effects of mining on natural systems. The Urban Land Institute (ULI) has extensive information on urban land patterns and ULI and the APA and the AIA and others have a rapidly growing body of information about the benefits of conservation development, and low impact development techniques. The MPCA and the Builders Association of the Twin Cities have reference materials on the costs and benefits associated with energy conservation in buildings. The MPCA, builders, cities, and watershed districts have experience and data on shaping regulations and implementing BMPs.

Outcomes

- A better understanding of the economic costs and ecological benefits of strategic conservation investments;
- A critical evaluation of the opportunities and benefits associated with improved regulation of major land altering uses and activities;
- A clear, objective compilation of the benefits of compact development patterns and conservation development practices to support local land use policy makers;
- Solid documentation of the costs and benefits associated with specific low impact development techniques and references to model standards and ordinances that have been proven effective in different contexts;
- Information to support the wide scale application of energy saving building and development practices.

Value

High. There is a rapidly expanding volume of information in each of these areas, but it has not been distilled, synthesized and packaged in ways that will make it accessible and understandable to local governments, builders, developers and regulators. The potential for affecting significant reductions in the adverse effects of land use practices are very significant.

Impacts on Resource Consumption

Definition

Non-sustainable Resource Consumption is specifically defined as follows:

- the consumptive use of groundwater at extractive rates that exceed the rate of recharge;
- the irretrievable loss, exceeding natural soil replacement rates, of land due to wind and water erosion that is the result of human industrial, agricultural, and land use practices.
- the extraction of materials such as minerals, sand, and gravel are considered inherently non-sustainable where these practices cause irretrievable loss of native habitats such as forest, prairie or unique wetland/stream areas or cause loss of land function that can not be reversed in the time scale of human generations.

Impacts to wildlife, land, and water quality due to the non-sustainable extraction of timber resources and irretrievable loss of land due to changes in land use are addressed under other key issues (e.g. Land &Water Habitat Fragmentation, Degradation & Loss).

Issues

The results of recent studies show that water consumption is expected to exceed the renewable supply in multiple Minnesota counties in the foreseeable future. Large-scale production of corn-based ethanol currently places significant demand on groundwater resources in some areas of Minnesota. Future biofuels production is expected to make significant new demands on groundwater sources. Non-sustainable consumption of groundwater can negatively impact water chemistry, low flows in surface waters, and important discharges to fens and other wetlands. Climate change is expected to exacerbate the problems by increasing water demand and reducing water storage.

A significant amount of land is lost due to anthropogenic causes. Industrial, agricultural, and development practices frequently result in the loss of soil at rates that exceed the capacity for natural processes to replace those losses. Changes in the intensity of agricultural practices due to increased production of biofuels and other public policies may result in increased soil erosion. Development patterns, agricultural practices, and public policies will also affect streambank and shoreland erosion and loss. Soil erosion is a major concern in some areas of Minnesota including the southeast, the Coteau, as well as river bluffs and steep slopes throughout the state. Wind erosion is significant in western Minnesota, especially the Red River Valley. Climate change is expected to exacerbate these problems because of more frequent severe storms.

Mining can be a temporary use of land. However the degree to which the land is changed varies depending on the size and depth of the mining operation. Mining, in its various forms, has the potential to permanently

destroy diverse native plant communities (which can not be replicated/reconstructed through mining reclamation processes), change landform characteristics, impact and change watersheds and water quality, as well as significant viewsheds.

In Minnesota, gravel mining operations are generally under the jurisdiction of local government. The township, city and/or county in which the operation is located may have specific regulations for development, operation, or reclamation of a pit. There are no statewide requirements or funds for the reclamation of gravel pits in Minnesota. Sand and gravel operations, including reclamation, are most directly handled at the local government (township, city, and/or county) level. Plans for the reclamation of currently active gravel operations may be included as part of the mining plan developed by the pit operator, and may (or may not) be required by a local government. While there are no state funds for gravel pit reclamation, 28 counties administer the Aggregate Material Tax (Minn. Stat. 298.75). In these counties, 10 percent of the tax raised from current gravel operations is set aside for the reclamation of abandoned gravel pits on public land. (Source: MN DNR Land & Minerals Division).

Key Questions

- Address critical data gaps, such as:
  - » Improved quantification water consumption rates
  - » Better define the location and characteristics of groundwater resources
  - » Better understand what volume of water is renewable
  - » Understand and quantify the impacts of drainage and other land use practices on rates of recharge
- Understand and quantify the impacts of climate change on water demand and rates of recharge
- Understand and quantify the impacts of new demands on groundwater sources because of large-scale biofuel production (overlap with Energy Production & Land Use)
- Focus on geographic areas with supply and demand conflicts and evaluate resource management options
- Investigate new means to quantify sustainable supplies
- Develop the comprehensive water management framework needed to manage water supply on a long-term, sustainable basis as required by law, including the routine water resource mapping, monitoring, and assessment activities required to support the framework
- Understand and quantify the impacts of climate change on soil loss and related agricultural practices
- Address data gaps to facilitate modeling of soil erosion and loss
- Identify critical areas and regions where soil loss is greatest and can best be reduced through policy changes
- Evaluate the soil erosion and loss impacts of public policy options related to biofuels, agricultural practices, shoreland development, and land use Best Management Practices
- Map the intersection of high quality natural areas and other sensitive/unique resources and high value mineral resources
- Development of consistent mine reclamation standards and enforcement at the local, regional, and state level that balance extraction and preservation of sensitive/unique natural features for metallic (iron & non-ferrous) and industrial (sand, gravel, kaolin, etc.) mining operations.

Data Sources

- Data of water supply and demand is available through a number of federal, state, and other agencies, including:
  - » U.S. Geological Survey (USGS)
  - » MN Environmental Quality Board

- » MN Department of Natural Resources
- » MN Geological Survey (MGS)
- » MN Department of Health
- » Met Council

The most current and relevant document on this subject is from the EQB – "Use of Minnesota's renewable water resources: Moving toward sustainability": Biennial state assessment of the availability of water to meet the state's long range needs, April 4, 2007.

- The University of Minnesota, Environmental Quality Board, USGS and others have extensive Geographic Information System data that support identification of areas sensitive to soil erosion (e.g. a map is included in the Land section of the Preliminary Plan for this SCPP project). Remote sensing data and air photos, including LIDAR data, can also be instrumental for soils and crop management, as well as natural area identification and management.
- There are a variety of existing data sources directly or indirectly related to mining that can serve as resources, including:
  - » MnDNR Lands and Minerals Division, including the Hibbing Drill Core Library (one of the finest facilities of its kind in the world.)
  - » University of Minnesota - Minnesota Geological Survey and Natural Resources Research Institute Information on mineral resources. The MGS and NRRI have a wide variety of data at the local, regional, and state level on geology/mineral resources, including the County Geologic Atlas series. These data sets can be particularly helpful in GIS format, which allows cross-referencing of other GIS data (e.g. quality natural areas).
  - » United States Geological Survey has Minnesota state minerals information
  - » Minnesota Department of Revenue: The latest edition of the Minnesota Mining Tax Guide, which contains information on many aspects of mining production and taxes.

Outcomes

- To better understand:
  - » the location, extent, and characteristics of groundwater resources,
  - » new and existing demands for water from various sectors,
  - » the interaction between various public policies and their impacts on water supply and demand,
  - » the effects of climate change on water demand and rates of recharge.

Based on this understanding, recommend changes to public policies and move toward the comprehensive water management framework needed to manage water supply on a long-term, sustainable basis as required by law.

- Address research gaps and improve modeling approaches to support and estimate the impacts of recommended changes to public policies to reduce and minimize soil loss due to anthropogenic causes.
- Develop a clearer understanding of the areas where there is an intersection between high quality natural areas and other sensitive/unique resources, and high value mineral resources. Development of consistent mine reclamation standards and enforcement at the local, regional, and state level that balance extraction and preservation of sensitive/unique natural features for metallic (iron & non-ferrous) and industrial (sand, gravel, kaolin, etc.) mining operations.

Value

- The importance of water supply to human health and economic activities cannot be overstated. A 2007 EQB-DNR assessment evaluated current and future water demand, as well as renewable water resources available at the county scale. While the analysis did not take into account those waters flowing into a county, the results signal that water allocation has already become a serious issue in some locations. The results indicate that water consumption in 2005 may exceed renewable supply levels in one county and take more than half of such supplies in three other counties, all in the metropolitan region. By 2030, the same four metro counties are expected to be at or above renewable resource levels and another three in the northwest quadrant of the growth corridor well above the 50 percent consumption level.
- The importance of soil is obvious. Changes to public policy have the potential to change trends in soil loss fairly quickly. Overall improvement to the resource will take some time to be manifest.
- Understanding where the potential conflicts between mining and sensitive/unique natural features occur and proactively planning for them enables balance between the need for raw materials for human economic purposes and sustaining areas that support high concentrations of biodiversity/unique values.

Toxic Contaminants

Definition

Chemicals regulated because of human or wildlife toxicity. For our purposes, the definition of contaminants also includes Criteria air pollutants, "legacy" toxic chemicals, emerging toxic chemicals (including endocrine disruptors (EDCs) and pharmaceuticals), pesticides (includes herbicides and insecticides), and mercury.

Issue

Depending on the dose, all these chemicals can cause harmful effects in humans and wildlife. For example, mercury occurs in fish, and excess fish consumption (above that of Minnesota Department of Health (MDH) advice) places one at risk for neurotoxicity. Other contaminants can cause cancer, reproductive effects, respiratory disease, developmental and behavioral deficits, and birth defects. While we have some regulatory structure to manage many of these compounds, the emerging contaminants are of most concern since they are not regulated and the risk they pose are not fully understood. For example, we have clear evidence for estrogenic effects on fish caused by environmental estrogens in water and it is likely that other contaminants have comparable effects.

Key Questions

- Are current policies protective of public health and wildlife, i.e. are exposures to these chemicals causing excess risk to humans and to fish/wildlife?
- What policies are needed for emerging contaminants to protect the public and ecological health?

Data Sources

The Minnesota Pollution Control Agency (MPCA) has data on Criteria air pollutants; also some data on water and sediments for legacy and emerging contaminants. MDH has fish concentration data, and drinking water concentration data. MDA has data on pesticides in groundwater. USGS has data on pesticides in air, rain, water, and fish. Data gaps include actual exposures of these compounds, and effects on populations (as opposed to individual) of wildlife.

Outcomes

- » To provide a trend of contaminants over time and to compare these trends to benchmarks and/or health outcomes. Based on this research, recommend changes to:
- » agricultural policies (MDA regulates pesticides; they could also regulate animal operations for pharmaceuticals in their wastewater discharges);
- » drinking water policies (e.g. MDH can require monitoring of emerging contaminants and set max contamination levels);
- » other environmental policies under the purview of the MPCA (e.g. discharge permits for effluents containing pharmaceuticals and endocrine disruptors).

Value

High. While the state agencies collect significant amounts of data, none has compiled the "big picture" across media, or extended the overall picture to evaluate the effectiveness of state policies on contaminant exposures.

Transportation

Definition

Transportation includes infrastructure networks that enable and support personal (passenger) and commercial (freight) traffic. From the perspective of natural resources, transportation networks and the vehicles they carry directly or indirectly cause significant impacts on land, water and air.

Issues

In 1900, there was a total of 11 miles of paved highways in the United States, all of which were on the east coast. After World War II, widespread economic prosperity, relatively inexpensive fuel and new lifestyle choices enabled people to choose greater distances between work, home and other needs such as the grocery store – the new scale of human life was now measured by the automobile.

This has resulted in a remarkable expansion of transportation networks to accommodate increasingly longer and more frequent vehicle trips. Over the course of the last 100 years in Minnesota, the transportation network has expanded to meet the needs of urban and agricultural economies, as well as the desire to recreate and build second homes closer to "wilderness".

Expansion of transportation infrastructure has also directly or indirectly resulted in substantial alteration of natural areas, including the fragmentation of land/habitat, alteration of natural water movement, and other affects. For example, vehicular traffic is responsible for significant contributions to particulate and greenhouse gas pollutant loads. Passenger cars and light trucks account for about 2/3 of all emissions. Every gallon of gasoline burned produces almost 20 pounds of CO_2. According to the Environmental Protection Agency (EPA), the average minivan emits almost 16,800 pounds of CO_2 into our air each year.

Vehicle miles of travel (VMT) are also increasing. According to the US Environmental Protection Agency between 1996 and 2007, VMT and related emissions increased by a factor of 25%. In the United States and in Minnesota, cars and light trucks emit 25% of the human-caused CO_2 emissions (estimated to be 81% of all greenhouse gas emissions) as well as a suite of other contaminants related to the combustion or partial

combustion of fuels. This growth in emissions is projected to triple by 2030. (Source: http://www.epa.gov/ttn/naaqs/ozone/areas/vmt/vmtmngf.htm.)

general characteristics of types of transportation and vehicles:

- Cars and trucks generally carry 1 - 6 on a fixed network of roads independently to numerous destinations.
- Commercially-operated trucks move 2 or more tons freight on the same network in a relatively systematic scheduled pattern.
- The majority of buses in operation are diesel powered and run on relatively fixed routes and schedules, carrying 1 -100 people.
- While recent improvements to diesel engines have allowed retrofits to occur in some metropolitan systems, not all Minnesota systems can afford these cleaner and more fuel efficient busses.
- Light and heavy rail transportation carry 1 - 100 people by diesel and electric power on a fixed track network running on integrated schedules to a fixed and relatively limited number of destinations.
- Air traffic creates carbon, hydrocarbon, and particulate matter emissions in the air and nearby water bodies. Airport areas also generate noise and vibration impacts.
- Motorized water travel includes both passenger and freight modes:
  - » Motorized recreational watercrafts have wave surface water impacts and contribute to shoreland erosion.
  - » Boaters also bring invasive exotic species such as Eurasian milfoil which impacts fish and aquatic plant life
  - » Water freight service potentially transports invasive species to the Mississippi River and Lake Superior, which are critical continental transportation corridors that provide access to both aquatic and marine environments.

Research Questions

While one can look at many things related to transportation since its impacts are so pervasive, our questions focus on the following areas: greenhouse gas emissions related to road transportation; other land and air based issues in relation to 2020 benchmarks (items 1-5 following); and the issue of water-based transportation enabling the introduction or expansion of invasive species (item 6 below).

- Comprehensive Policy
  - » Are emissions reduction benchmark goals sufficiently supported by other transportation policies to realize expected reductions and their associated benefits?
- Fuels Fix
  - » Will it be sufficient to provide an ecological 'fuels-fix' (e.g. the adoption of subsidies for cellulosic fuel production from perennial polycultures such as prairie/Conservation Reserve Program lands and the stabilization or reduction of subsidies for corn-based ethanol) by the time of the benchmarking in 2020? Will the public and commercial vehicle owners replace their vehicles soon enough to enable widespread use of that are adapted to the use of new fuels?
  - » Will newer vehicle or fuel technologies such as plug-in hybrids have greater or lesser overall benefits (e.g. mercury-based technological challenges to recycling) for ecological, land and hydrological conditions?
- Integrative Scenarios – Beyond Fuels
  - » What other scenarios need to be assessed relative to integrative changes to re-balance in the transportation infrastructure, that would support the achievement of these CO2 and other emissions reductions and also realize composite enhancement to the environment and public health intended

by the adoption of the benchmarks? For example, in the current context of climate change and enlarged populations moving over networks, can these benchmarks be met without transit-enhanced, and logistics-controlled freight policies?

  - » If benchmarks are met, will these reductions allow for the adaptation of resources to maintain ecological and human health, while preserving access, freight service, and mobility? Or is it necessary to examine some measure of integrated planning and design for efficiency and a targeted reduction in resource consumption?

- Climate Change, Growth, Adaptation, Mitigation
  - » What policies are needed to examine the impacts of expanding the roadway transportation network and enlarging transportation corridors in the context of adaptation and species conservation vs. mitigations of species movement?
- Modal Mix – Fuel for the movement of the many from the network
  - » What role can transit, especially in metropolitan areas and especially fixed rail and non-gasoline/electrically-powered modes/vehicles, play in reducing all environmental impacts stemming from the increase in vehicle miles of travel (VMT) that is part of urban and suburban growth, both on greenfields and in existing neighborhoods and communities?
- Continental and International Transport: Invasive Species
  - » What (if any) new policies, monitoring, or enforcement are needed to control interstate and international transport of invasive species into the Mississippi River and Lake Superior?
  - » What issues relative to transport of invasive species are emerging as result of changing regional and global economies?

Data Sources

MnDOT has data on centerline VMT for certain classifications of roadways based upon land coverage data and other research about urbanization and road construction. We may be able to model VMT for roadways and streets not measured by types and acres of urbanization. VMT trends are organized by county by the US EPA for Ozone depletion estimates. http://www.epa.gov/ttn/naaqs/ozone/areas/vmt/vmtmngf.htm. http://www.mnclimatechange.us/ewebeditpro/items/O3F11914.pdf (Minnesota emissions data based on FHWA Highway Statistics).

Outcome

- To identify or create transportation modeling protocols and outline the factors needed for modeling.

Value

High. The value of conducting this research will be very high if the research results in clear policies and implementation strategies on a statewide level and in key areas where transportation infrastructure and the environment are vulnerable.

Energy Production and Land Use

Definition

Human activities related to the extraction, production and consumption of energy, including fossil fuels and renewable energy sources.

Issue

Energy extraction, production and consumption have an important influence on natural resources in Minnesota. Fossil fuel derived energy is a major contributor of carbon dioxide (a greenhouse gas) and other pollutants that influence climate change, as well as nutrient loading, and air quality issues. In turn, energy-related by-products influence human health, the condition of natural areas, and fish and wildlife they support. As humans continue to consume a finite and diminishing amount of fossil fuels, biofuels such as cellulosic ethanol are being considered among the alternatives to partially replace them. Commercial demonstration of cellulosic ethanol is expected by 2012, with cellulosic ethanol viewed as the only viable alternative to replace 30% of current U.S. petroleum use (Source: National Renewable Energy Laboratory).

However, there is much that we do not know about the potential influence of the type and extent of biomass cropping systems and renewable energy production on Minnesota's natural resources and recreational opportunities. Important questions need to be answered in order to properly plan for these changes. Minnesota is in a unique position as a leader in biofuel research and development of diverse perennial cropping systems and to lead the nation in maximizing multiple benefits from this new opportunity.

Key Questions

- What are the potential effects of biomass energy production systems on Minnesota's fish, wildlife, land and water resources, and recreation opportunities? Including:
  - » Monoculture stands (native or nonnative species)
  - » Diverse perennial cropping systems, especially diverse prairie plantings
- What are the effects of renewable energy production structures such as large wind turbine (farms) and related infrastructure on wildlife?

Data Sources

Biomass and other sources of renewable energy are receiving dramatically increased attention in recent years. Biomass and biofuels research is evolving quickly, resulting in rapid changes in knowledge and available technologies. The University of Minnesota Initiative for Renewable Energy and the Environment (IREE) was launched in 2004 and serves as a center point for data and research in the upper Midwest. Dr. David Tilman from the U of MN has also conducted important research into the multiple benefits of utilizing diverse prairie plantings for biomass fuel production and carbon sequestration. Likewise, the U. S. Department of Energy National Renewable Energy Laboratory (NREL) conducts research, funds pilot projects, and compiles existing data on renewable energy subjects.

Numerous studies document that wind turbines cause direct mortality of birds and bats through rotor (blade) strikes. However, the indirect impacts of wind turbines, as well as utility tower structures on grassland wildlife mortality (e.g. wind turbines providing aerial predator perches) or avoidance of otherwise suitable habitat

appears to be poorly understood. Pending improved research, the U.S. Fish & Wildlife Service published Interim Guidance for Avoiding & Minimizing Wildlife Impacts from Wind Turbines (2003): http://www.fws.gov/habitatconservation/wind.pdf .

Outcomes

- To gain a clearer understanding of potential biomass cropping systems and wind energy production on Minnesota's natural resources, recreational opportunities, and climate change. Fully achieving the potential multiple benefits of biofuels will also require consideration of economic benefits, as well as adaptation of the state's infrastructure network and policies.
- Through monitoring of wind turbine/farms constructed in planted grasslands and/or remnant prairie, it could be determined whether they influence grassland bird species mortality (by providing aerial predator perches) and/or cause avoidance by wildlife of otherwise suitable habitat (effectively fragmenting habitat).

Value

High. The value of this research is high since the potential for multiple benefits to Minnesota's natural resources appears to be remarkably significant. Strategically planting perennial cover has the potential to greatly benefit land, water, fish, and wildlife in the state and provide expanded recreational opportunities in addition to producing fuel and fostering economic vitality.

Invasive Species

Definition

Undesirable aquatic and terrestrial species, accidentally or intentionally introduced into Minnesota, that either disrupt native plants, animals and their habitat, or are a nuisance to human activities. Serious invasive species in the state span many taxonomic groups, including terrestrial and aquatic plants, insects and aquatic invertebrates, fish, and pathogens.

Issue

Invasive species are a growing threat to Minnesota's fish, wildlife, and land resources. Some invasive species displace or kill native species and others become so dominant in aquatic or land habitats that they degrade habitats of desirable species.

Prevention, eradication and control are the three main options for addressing this issue. It is extremely difficult to prevent entry of new invasive species into the state and also quite challenging to stem the spread of new invaders within the state. It is rarely possible to eradicate a new invader. Methods for environmentally sensitive, effective and affordable control of established invasive species are few and usually require long-term commitment of financial and human resources.

Invasive species tend to be more successful than native species in disturbed environments. Therefore, other drivers of change discussed in the Preliminary Plan can exacerbate invasive species problems. For instance, climate change may increase the spread and harmful effects of invasive species. Other issues we might investigate in the Final Plan, such as habitat fragmentation, degradation, and loss, would also relate to the spread and impacts of invasive species.

Key Questions

- How can Minnesota strengthen current efforts to prevent the entry of new invasive species into the state?
- What are policy options for reducing the spread of invasive species within Minnesota? Work on this question should focus on major pathways of spread.

Data Sources

DNR and MDA databases on occurrence of invasive species include: DNR—aquatic invasive species, terrestrial invasive species (mostly plants), and the agency keeps track of sightings of terrestrial invasive animals; MDA—terrestrial invasive plants (extensive for noxious weeds, now adding emerging weeds), and terrestrial invasive insects. DNR has been collecting occurrence data on state managed lands, with the data most complete now for state parks and trails and much left to collect for state forests (i.e., the majority of state managed acreage) and wildlife management areas. State parks and trails are beginning to use existing data to develop invasive species management plans. General pathways of spread are known for many invasive species, state agencies have limited data on pathways (e.g., DNR water craft inspections), and the federal Animal and Plant Health Inspection Service (APHIS) maintains some information on pathways for weeds and insects. For invasive species that may enter the state through the Great Lakes, Minnesota Sea Grant has major programs on public education, reporting of new invaders, and monitoring of federal policy developments. A major gap is the lack of statewide data on total public and private annual expenditures to control invasive species and economic value of harm they cause to natural resources.

Outcome

- Recommend changes to policies and outreach efforts to reduce entry and spread of invasive species.
- Recommend priorities for improving data collection on economic impacts and pathways of spread.

Value

High. A fresh look at state-wide policy options would help address the rapidly growing frustration that current efforts are failing to reduce entry and the in-state spread of invasive species. This would complement fundamental scientific research, funded by a variety of agencies, on new methods for environmentally sensitive control of established invasive species.