ALBERTA PRAIRIE CONSERVATION FORUM

BENEFICIAL MANAGEMENT PRACTICES FOR RENEWABLE ENERGY PROJECTS

Reducing the Footprint in Alberta's Native Grassland, Parkland and Wetland Ecosystems

Photo by M. Neville

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Forward

The Alberta Prairie Conservation Forum (PCF) is a non-profit organization that is committed to conserving native prairie and parkland in Alberta, and raising public awareness of the stewardship challenges faced in maintaining these ecologically important landscapes for future generations. The membership is composed of organizations and individuals with jurisdiction or interests in the prairie and parkland landscapes including government and non-government organizations, landowners, the oil and gas industry, conservation organizations, the agricultural sector and environmental consultants. Every five years, an action plan is developed to focus the activities of the Forum. The current ***Prairie Conservation Action Plan: 2016-2020*** (PCAP) (PCF 2016) focuses on three broad outcomes:

- **Maintain large native prairie and parkland landscapes.**
- **Conserve connecting corridors for biodiversity.**
- **Protect isolated native habitats.**

PCF has in the past provided leadership by increasing public awareness of the potential adverse environmental impacts and cumulative effects of industrial development in native prairie. PCF has facilitated the development of principles and guidelines for minimizing surface disturbance in native prairie within the petroleum industry, with government agencies, industry representatives and interested stakeholders since the early 1990s. PCF has continued to advocate the need for revision of the early principles and guidelines as knowledge of the restoration potential of native prairie increases, and advances in industrial technology to reduce surface disturbance become available.

The prairie region, comprised of the Grassland Natural Region and the Parkland Natural Region of southern Alberta, offers opportunity for renewable energy development. The wind energy industry has become well established and the solar energy industry is poised to expand with Alberta's Climate Leadership Plan. In keeping with the PCF mandate and current PCAP, the PCF contributed to the revision of the aforementioned principles and guidelines to include all industrial activity in native prairie landscapes. In 2016, Alberta Environment and Parks (AEP) released ***Principles for Minimizing Surface Disturbance in Native Grassland - Principles, Guidelines, and Tools for all Industrial Activity in Native Grassland in the Prairie and Parkland Landscapes of Alberta*** (AEP 2016a), in September 2016. A key gap identified was the need for industry-specific beneficial management practices for renewable energy developments. Through development of this document, the intent of PCF is to foster a positive working relationship with the renewable energy industry to assist in drafting practical beneficial management practices that sustain prairie biodiversity at the species, community and ecosystem levels.

Definitions

The following definitions apply when used in the context of this document:

Prairie: A term generally used in Alberta to describe the Grassland and Parkland Natural Regions and the grassland portions of the Montane Natural Subregion.

Policy: A course of action adopted by a government, party, business or individual.

Principles: General theorems that support policy and have numerous special applications across a broad field. The principles provide the foundation to minimizing impacts to native grasslands, with numerous different applications across activity types and Natural Subregions. These principles apply to lands where native plant communities remain intact and functioning. Application of these principles is required on public land and encouraged on private land through landowner consultation.

Guidelines: General rules that provide clarification to support each corresponding principle. The guidelines are not prescriptive and are general in nature to allow industry to develop and apply beneficial management practices appropriate to industry specific development procedures and outcomes. These guidelines can be applied to the full range of landscapes from large tracts of unbroken native grassland and parkland to small remnant native grassland areas within disturbed landscapes.

Beneficial Management Practices: Recommended development procedures and operating practices that provide information to industry of the desired outcome when planning activities and operating on public and private land. Beneficial management practices provide guidance towards shared stewardship, and are not mandatory, or subject to compliance actions.

Source: AER Manual 007 (AER 2014) (AEP, 2016a)

Principles support **policy**,

Guidelines support **principles.**

Beneficial management practices are specific **procedures** that support **guidelines.**

Disclaimer

This document reflects the author's interpretation of the literature review, her experience assisting Alberta Government agencies and the petroleum industry in the development of minimal disturbance principles, guidelines, tools and beneficial management practices, and her interpretation of the feedback from the workshop held with renewable energy stakeholders. The beneficial management practices are intended as a framework for continued engagement by the renewable industry with PCF; providing the opportunity to develop industry specific beneficial management practices based on practical experience, and standardized data collection from monitoring studies.

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Photo by M. Neville

TABLE OF CONTENTS

FIGURES

BACKGROUND AND INTENT

Grassland, Photo Courtesy of MultiSAR

Alberta's Climate Leadership Plan has identified the need to reduce Alberta's dependency on coal electrical generation. This would require a significant increase in the development of renewable energy resources such as wind, solar and other renewables by the year 2030.

Alberta's population is expected to continue to grow to reach six million people by the year 2041, an increase of roughly 1.8 million since 2015. The population is expected to be even more concentrated in urban centers, especially the Edmonton-Calgary corridor where it is expected that 8 out of 10 Albertans will reside (Alberta Treasury Board and Finance 2016). Keeping the projected growth in population in mind, the most important question before us is: how do we meet the energy demand of an increasingly concentrated, mostly urban population in an environmentally sustainable manner?

This document focuses on renewable energy and attempts to open this question for discussion through a review of currently available literature, an overview of the native prairie and parkland landscapes of Alberta, and provides context regarding the development of minimal disturbance principles and guidelines for industrial activity in the native prairie and parkland landscapes of Alberta. Also explored are examples of micro generation projects, decentralized energy systems, renewable energy within the agricultural sector and utilizing existing production and infrastructure from natural gas resources to produce electricity.

The information provided in this document has been compiled through engagement with representatives of the renewable energy sector, comments provided by industry representatives, government agencies and interested stakeholders, following the multi-stakeholder workshop held February 2, 2017 in Airdrie, Alberta, and attendance at the Southeastern Energy Diversification Symposium held at Medicine Hat College, Medicine Hat, Alberta, March 2 and 3, 2017.

The intent is to provide a framework for the development of industry-specific beneficial management practices applicable to the renewable energy sector. The beneficial management practices provided are built on the minimal disturbance principles, guidelines and tools developed by the Government of Alberta for all industrial activity proposed in native prairie and parkland landscapes.

Currently the renewable energy sector contributes approximately 9% of Alberta's electrical generation and transmission requirements. Alberta's Climate Leadership Plan would increase energy production from renewable sources to 30% by 2030. The renewable energy sector is well developed in Europe and the United States and has increased in eastern Canada. Investors and developers from within Canada, Europe, the United States and Asia are interested in the wind and solar renewable energy resources located within the Grassland and Parkland Natural Regions of southern and east central Alberta (Figure 1).

While considered a source of clean energy, wind, solar and other forms of renewable energy can have direct and/or indirect negative environmental impact, particularly if project development or transmission corridors occur within the Grassland and Parkland Natural Regions of southern and east central Alberta (Kestrel Research Inc. 2016, Lancaster et al 2015).

Potential developers are often not aware of the important ecological goods and services the native grassland and parkland landscapes provide for present and future generations. Moreover, they may not be familiar with the principles, guidelines and tools developed and adopted by the Government of Alberta for minimizing industrial surface disturbance in these landscapes.

Two important documents provide the basis for decision making when considering potential renewable energy development in southern and central Alberta:

Principles for Minimizing Surface Disturbance in Native Grassland - Principles, Guidelines and Tools for all Industrial Activity in Native Grassland in the Prairie and Parkland Landscapes of Alberta (AEP 2016a).

The intent of this document is to promote consistent and effective use of pre-site assessments and mitigation planning to reduce the impacts identified for all industrial activity proposed in native grassland and parkland landscapes. The first and most important principle is avoidance of native grassland and parkland ecosystems.

Alberta Wetland Policy (ESRD 2013)

The Alberta Wetland Policy is regulated under the Alberta Water Act. The policy applies to all industrial activity. Compliance is monitored and enforced by AEP. Where development activities have the potential to impact wetlands, the Alberta Wetland Policy promotes avoidance and minimization as the preferred courses of action. Where impacts cannot be avoided or minimized and permanent wetland loss is incurred, wetland replacement is required. The amount of wetland replacement required will reflect the differences in relative wetland value (ESRD 2013).

These documents indicate the need for all industries to implement the principles, guidelines and tools during the planning process to minimize footprint, avoid surface disturbance and to develop industry specific beneficial management practices where potential development in native grassland and parkland ecosystems cannot be avoided.

Examples of Innovative Renewable Energy Projects

Solar Providing Cover for Parking

Solar Combine as Window Shade

Housing Development Utilizing Solar

ECOLOGICAL CONTEXT OF ALBERTA'S NATIVE PRAIRIE

Prairie Landscape, Photo Courtesy of MULTISAR

The prairie region covers an area of 156,318 km^2 or 24% of Alberta (ABMI 2015). The term prairie is uniquely Canadian, adapted from an old French word 'praierie' meaning meadow used by European explorers to describe the open expanses of grassland they encountered on the semi-arid glaciated plains of central North America. Grasslands are the most characteristic vegetation of the southern prairie, intermixed with shrublands in moister sites and wetlands in poorly-drained depressions with forests restricted to coulees and river valleys. North towards the Boreal Forest and west towards the Rocky Mountains aspen forest increases with cooler and moister climate and grassland decreases, becoming restricted to the driest sites. Parkland, a term applied to large estates in England, was used by early settlers to describe the mosaic of native grasslands, aspen woodlands, shrublands and abundant wetlands they encountered in the northern portion of the prairie region.

Native prairie once supported millions of bison, elk, antelope and deer and their predators, including wolves and grizzly bears. Small mammals were abundant, including badgers and ground squirrels, as were huge populations of waterfowl, shorebirds and landbirds. Native prairie is now among the most threatened ecosystems in the world (Sampson and Knopf 1994).

The natural regions and subregions of Alberta provide the provincial ecological context within which resource management activities have been planned and implemented since the 1970s. The natural region and subregion hierarchial relationship is the first level of ecological classification in Alberta.

In Alberta, the prairie region encompasses the Grassland and Parkland Natural Regions and portions of the Rocky Mountain Natural Region (Figure 1). Natural regions are classified into natural subregions each characterized by distinct climatic conditions, physiographic features, soils, vegetation and wildlife populations. Natural subregions of the Grassland Natural Region are the Dry Mixedgrass, Mixedgrass, Foothills Fescue and Northern Fescue. Natural subregions of the Parkland Natural Region in southern Alberta are Central Parkland and Foothills Parkland. A third natural subregion – the Peace River Parkland – occurs in northwestern Alberta. The Montane Natural Subregion occurs at lower elevations in the Rocky Mountain Natural Region. These natural regions and subregions are described in ***Natural Regions and Subregions of Alberta*** (Natural Regions Committee 2006). Understanding the characteristics of natural regions and subregions is important as this provides the fundamental environmental context for past human land use and informs decisions about future land use.

The response to industrial surface disturbance and the potential for restoration success is different for each natural subregion requiring reclamation and recovery strategies unique to each.

GRASSLAND NATURAL REGION

Overall the Grassland Natural Region is characterized by warm dry summers and cool dry winters with conditions moister and cooler towards the north and west. The terrain is comprised of level plains underlain by glacial lake deposits (clay, silt, sand), undulating and rolling plains of glacial till with wetlands in depressions, hills and dunes of wind-blown sand, and valleys sculpted by flowing water, occasionally into badland formations. Elevated bedrock is responsible for significant local relief along the foothills of the Rocky Mountains and in the Milk River Ridge, Cypress Hills, Neutral Hills, Wintering Hills and Hand Hills. Fertile, humus-rich Chernozemic soils are characteristic grading from predominantly shallower and brown in the south and east to deeper and black in the north and west. Solonetzic soils, high in sodium salts and characterized by shallow hardpan, occupy significant areas of low-relief plain. Native vegetation transitions from predominantly mixed grasslands in the south and east, to plains rough fescue grasslands intermixed with aspen forests and willow shrublands in the north, and foothills rough fescue grasslands to the west. Natural lakes are scarce and wetlands occupy less than ten percent of the prairie region, mainly occurring as seasonal wet areas and semi-permanent to permanent marshes associated with landform depressions.

Native prairie ecosystems of the Grassland Natural Region have been lost to urban and rural settlement, agricultural crop production, transportation corridors, oil and gas production and other industrial activity. Disturbance to the remaining native prairie is generally limited by topography and soils unsuited to agricultural crop production. Each of the natural subregions have specific challenges for industrial development requiring site specific reclamation and restoration practices for renewable energy development.

PARKLAND NATURAL REGION

The Parkland Natural Region represents a climatic transition between the Grassland Natural Region and the Rocky Mountain Natural Region to the south and the west (Foothills Parkland Natural Subregion) and the Boreal Natural Region to the north (Central Parkland Natural Subregion). Climate and unique site conditions together define the Peace River Parkland Natural Subregion.

Patches of aspen and willow shrublands mixed with native grasslands are characteristic of the remaining native parkland landscape. Dominant soils are Black Chernozems with level to gently undulating topography. Prior to settlement, these nutrient rich soils supported productive grasslands. Ideally suited for agricultural crop production most of these grasslands have been cultivated. The Parkland Natural Region is the most densely populated and extensively cultivated natural region in Alberta (Natural Regions Committee 2006). The Central Parkland is the most fragmented natural subregion. It is estimated that less than 12% of the original native grassland remains in the Central Parkland Natural Subregion and that similar degradation has occurred in the Northern Fescue Natural Subregion (AEP 2016b).

The Foothills Parkland Natural Subregion occurs as a discontinuous band along the foothills of the Rocky Mountains from the Alberta –Montana Border in the south west corner of the province, to approximately 50 kms north of Calgary. Rolling to hilly native grasslands occur on southerly slopes with aspen woodlands or willow shrublands in low-lying areas or on northerly slopes.

Foothills rough fescue grasslands occur on dry sites with thick black Cheronzemic soils. Aspen forests or willow grovelands occur on moister sites with Dark Gray Chernozems. Short, cool summers at higher elevations are not suited for intensive agricultural cropland. Over 60% of the Foothills Parkland Natural Subregion is used for grazing livestock on native grassland and tame pasture.

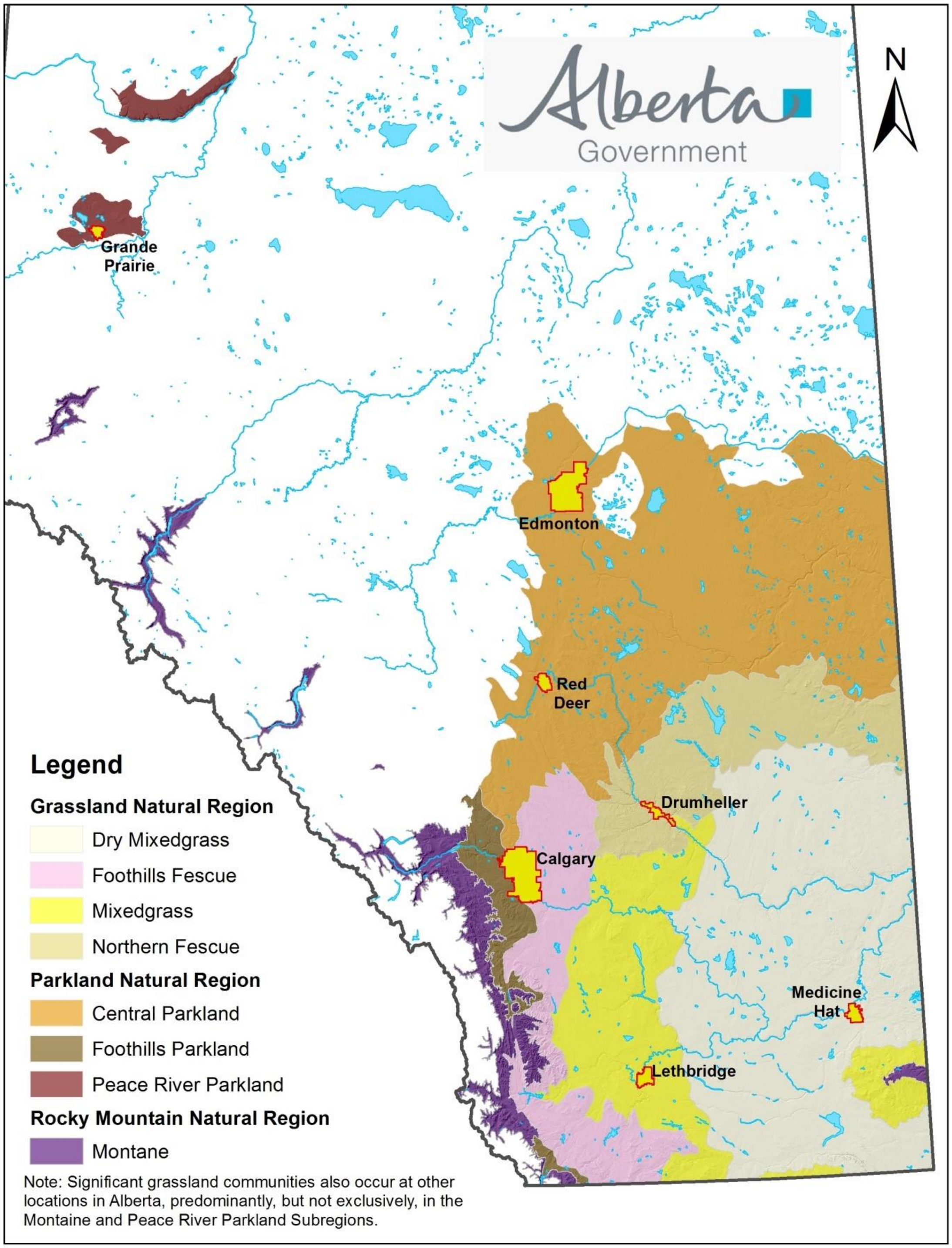
Climate, topography and the nutrient rich soils of the remnant native grassland limit restoration success for renewable energy development in the Parkland Natural Region. Specific guidelines have been developed for all industrial activity in these grasslands. Detailed construction, mitigation and restoration plans are required and industrial activity is expensive.

MONTANE NATURAL SUBREGION

The Montane Natural Subregion occurs on lower slopes and valley bottoms of the front ranges of the Rocky Mountains south of the Bow Valley, in the Porcupine Hills, within the lower valleys of major mountain river valleys north of the Bow Valley and on the uppermost elevations of the Cypress Hills, (Figure 1). Lodgepole pine, Douglas fir and aspen stands occur on easterly and northerly aspects. Native grasslands occur on southerly and westerly aspects. Closed mixedwood and coniferous forests dominated by lodgepole pine occur at higher elevations. Vegetation patterns are complex in response to changes in slope and aspect. Orthic Black Chernozems are the soils typical of the grasslands. These soils support foothills rough fescue plant communities. Wetlands are rare in the Montane Natural Subregion, but rich, often calcareous fens and marshes occur. This natural subregion provides important wildlife habitat and is highly valued for recreational activities (Natural Regions Committee 2006).

Renewable energy development in montane grasslands is limited by short growing season, topography, highly variable moisture conditions, and Chinook winds. Construction and reclamation of the infrastructure required for renewable energy development would require extensive mitigation planning and implementation. Restoration of these grasslands once disturbed is difficult and can be very expensive.

Figure 1. Grassland and Parkland Natural Regions and Montane Natural Subregion



WATER RESOURCES: WETLANDS, WATERCOURSES AND RIPARIAN AREAS

Alberta's prairie landscape lies within the North Saskatchewan, South Saskatchewan and Milk River basins. The Peace River Parkland Natural Subregion lies within the Peace River Basin. These river systems with their tributaries, wetlands and surrounding riparian areas are vital for maintaining ecosystem function in the prairie landscape.

Riparian areas are transitional areas nestled between aquatic areas and the surrounding uplands. They are where water, soils and vegetation interact, such as the floodplains of streams, rivers, the shores of lakes, sloughs and wetlands. Common to all riparian areas are the following features:

- A presence and abundance of water, either on the surface or close to the surface, even when the waterbody may appear dry.
- Vegetation that responds to, requires and survives well with abundant water.
- Soils that are often modified by abundant water and/or high water tables, lake, wetland, stream or river processes (such as sediment deposition and nutrient cycling) and lush, productive and diverse vegetation.

Riparian areas preform vital functions such as trapping and storing sediment, filtering water, storing water, recharging aquifers, flood control, building and maintaining banks and shores, maintaining biodiversity, by providing food, shelter and habitat for fish and wildlife (Hale et al. 2005). Not only do numerous species of waterfowl, shorebirds and other water birds rely on prairie wetlands for breeding habitat or temporary resting sites during migration, but many North American songbirds rely on riparian areas for all or part of their lifecycle. The same is true for prairie mammals and amphibians.

Wetlands are lands saturated with water long enough to promote formation of water altered soils, growth of water tolerant vegetation, and various kinds of biological activity that are adapted to the wet environment. Wetlands are highly diverse, productive ecosystems that provide a host of ecological services and form an integral component of Alberta's diverse landscapes. They play an important role in sustaining healthy watersheds by protecting water quality, providing water storage and infiltration, providing habitat for wildlife, fish and plants, and sustaining biodiversity, (ESRD 2013).

CONSERVATION OBJECTIVES

Prairie Wetland, Photo Courtesy of MULTISAR

Native prairie is valued for its biodiversity, habitat for wildlife, water storage and purification, as a reservoir for carbon and for providing a reliable and high quality source of forage for livestock. It is also valued for less tangible benefits including its aesthetic beauty, the recreational opportunities it provides and preservation of cultural history linked to indigenous people and Alberta's traditional ranching lifestyle.

In the late 1970s and early 1980s findings from decades of research by wildlife biologists, botanists and range scientists working for government and in academia began to converge into a cohesive story with a sad ending - native prairie and many of its wild species were in decline and at risk of being lost because of human activities. The story that was unfolding for wild prairie was not popular. In 1988 the first five-year action plan for prairie conservation (PCAP) was released and the Prairie Conservation Forum (PCF) established, providing a forum for government, academia and non-government organizations with interest in environment, agriculture and energy to work together on conservation initiatives and shared stewardship.

Reports produced through the Prairie Conservation Forum since 1988 can be found on the website (http://www.albertapcf.org). Resources most relevant to renewable energy and native prairie include:

- ***Prairie Conservation Action Plan: 2016-2020*** (PCF 2016).
- ***The Status of Biodiversity in the Grassland and Parkland Regions of Alberta: Preliminary Assessment 2015*** (ABMI 2015).
- ***Landscape Patterns Environmental Quality Analysis*** (O2 Planning and Design 2013).
- ***A Review of Approaches to Assessing Appropriate Placement of Wind Development Phase 1*** (Miistakis Institute, April 2013).
- ***PCF Wind Assessment Project, Phase 2: Proceedings from Needs Assessment Workshop*** (Miistakis Institute, January 2015).

The PCFs 2016-2020 PCAP provides an excellent overview of the importance of maintaining intact native prairie and parkland ecosystems for present and future generations of Albertans. The following is an excerpt from the PCAP and readers are encouraged to download the file from the PCF website (http://www.albertapcf.org) and read the entire report.

Fostering a stewardship ethic around all current and future users of native prairie rangelands is critical to the success of prairie conservation efforts in Alberta. It demands an enlightened understanding of ecological and economic relationships and an ability to resist persistent pressures to fragment land and intensify land use for short-term economic gains. A strong stewardship ethic strives to maintain long-term values and benefits (PCF 2016).

HUMAN LAND USE AND BIODIVERSITY

The Prairie Conservation Forum has partnered with Government of Alberta agencies and conservation organizations to commission two important studies. The purpose and intent is to gain a better understanding of the existing human footprint on the prairie and parkland landscapes and the impact of past, present and future human activity on those landscapes.

Human Land Use

Landscape Patterns Environmental Quality Analysis (O2 Planning and In Design 2013) discusses the use of "pattern-based landscape models," to broadly investigate the relationships between human defined landscape patterns and ecosystem function through an extensive literature review. Ecological thresholds and conservation targets are discussed in the context of pattern-based landscape models.

The report includes an annotated bibliography and is available on the PCF website.

Biodiversity

Biological diversity (biodiversity) is defined as the diversity among living organisms including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species, between species and of ecosystems (Convention of Biological Diversity 1992).

Biodiversity monitoring is a key part of land-use planning when preserving the integrity of native prairie and parkland ecosystems. The Alberta Biodiversity Monitoring Institute (ABMI) measures the health of biodiversity and changes in human land use (i.e. human footprint) in Alberta.

In 2015, PCF engaged ABMI to evaluate the status of biodiversity within the Grassland and Parkland natural regions of Alberta. The subsequent report is entitled ***The Status of Biodiversity in the Prairie and Parkland Regions of Alberta, Preliminary Assessment*** (ABMI 2015). The study area encompasses both natural regions with the exception of the Peace River Parkland Natural Subregion. A summary of this report follows and the reader is encouraged to download and review the entire report from the PCF website.

Temperate native grasslands are among the most threatened ecosystems in the world. In Alberta, as of 2013, 63.1% of native prairie has been converted to other land uses, predominately agriculture at 55.2%. The transportation footprint at 2.8%, the urban and rural footprint at 2.5% and the industrial footprint at 2.3% covered a low percentage area of the region but were widely dispersed across the landscape.

An estimated 60 to 70% of wetlands have been lost in southern Alberta and the current annual rate of wetland losses in the province has been estimated at 0.3 to 0.5%.

CULTURAL AND ECONOMIC IMPORTANCE

The rich, productive environment of the prairie landscapes supported First Nations cultures for thousands of years and was also what attracted European settlers to the region. As a result of settlement, much of the native prairie was converted to agriculture during the first half of the 19th century, creating a proud farming legacy that continues to define the economy and culture of southern Alberta to the present day. Livestock grazing is also an important industry that occurs in large areas of native grassland. Pressure to convert native grassland to other land uses continues as a result of growing human population, intensification of agricultural practices and expanding industrial use (ABMI 2015).

CUMULATIVE EFFECTS MANAGEMENT

Cumulative effects are the combined effects of past, present and reasonably foreseeable future land use activities on the environment. Utility scale renewable energy projects have footprints that when combined with other existing land uses influence cumulative effects management.

Minimum disturbance practices that avoid or reduce the area of surface disturbance are an essential tool in the management of cumulative impacts of native grasslands (Lancaster et al. 2015).

Where wetlands are involved, procedures to avoid, reduce and replace are regulated under the Water Act.

The ***South Saskatchewan Regional Plan*** (Government of Alberta 2014) is the regional plan which covers much of the watershed of the South Saskatchewan River and its tributaries in southern Alberta and includes a large portion of the Grassland Natural Region. The plan states:

> *The Government of Alberta is committed to managing the cumulative effects of development on air, water, land and biodiversity; ensuring the value and benefit of these are sustained at the regional level and contribute to provincial outcomes.*

In articulating policy intent for native grasslands, the plan states:

> *maintaining intact native grasslands and habitat will be a high priority and the overarching intent is to create an interconnected network of conservation areas on Crown land and conservation efforts on private land to sustain and improve overall habitat connectivity for grassland species.*

MINIMAL DISTURBANCE PRINCIPLES AND GUIDELINES

Photo Courtesy of Jane Lancaster

HISTORICAL CONTEXT

The first guidelines crafted to minimize surface disturbance and improve reclamation outcomes for native grasslands were a direct result of the Prairie Conservation Action Plan: 1989-1994 (PCF 1989). The PCAP was used as intervener evidence by a Special Areas landowner during an Energy Resources Conservation Board (ERCB) hearing for a petroleum industry related wellsite and access road. The landowner was opposed to disturbance of plains rough fescue (*Festuca hallii*) grasslands. The hearing recommended agencies collaborate to reduce industrial impact to native grasslands.

The ERCB subsequently joined PCF, resulting in the first guidelines, ERCB Information Letter (IL) 92-12 - ***Guidelines for Minimizing Disturbance in Native Prairie Areas***. As knowledge and experience was gained the guidelines were revised and captured in IL 96-9 - ***Revised Guidelines for Minimizing Disturbance in Native Prairie Areas***. This IL was subsequently revised in 2002 to include parkland areas, ***Principles for Minimizing Surface Disturbance in Native Prairie and Parkland Areas***. These information letters came about through the experience and adaptive learning of multi-stakeholder groups with representatives from government, industry and the prairie conservation community. ***Prairie Oil and Gas, a Lighter Footprint*** (Alberta Environment 2002) was an extension document that provided practical information designed to reduce the impact of oil and gas development. These principles and guidelines have been adopted as standard practice and are commonly implemented by the petroleum industry.

To compliment these guidelines, PCF released ***Minimizing the Effects of Oil and Gas Activity on Native Prairie Alberta***, (Sinton and Prichard 2002) as part of the Occasional Paper series. It raised important questions regarding the potential effects of oil and gas development in native prairie, what the objective of reclamation should be and what can be done to reduce the impact of oil and gas activity.

With establishment of the Alberta Energy Regulator (AER), ***Manual 007: Principles for Minimizing Surface Disturbance in Native Prairie and Parkland Areas*** (AER 2014) was released for the oil and gas industry.

The Government of Alberta recognized the need for a broader application of these principles and guidelines by industry across all sectors developing and operating projects in native grassland landscapes. The desired outcome is to reduce cumulative impacts on grassland ecosystems while allowing industrial activity and renewable developments to occur within a broad multiple use landscape.

In 2015, Alberta Environment and Parks undertook a major review and updating of IL 2002-01 to include all industrial activity, and to incorporate additional experience in both development practices and restoration outcomes. Recognizing the diversity of industrial activity on the landscape, ***Principles for Minimizing Surface Disturbance in Native Grassland, Principles, Guidelines and Tools for all Industrial Activity in the Prairie and Parkland Landscapes of Alberta*** (AEP 2016a) was released in September 2016.

OVERARCHING MINIMAL DISTURBANCE PRINCIPLES

The following principles are intended to reduce disturbance in native prairie or parkland Alberta and apply to lands where native plant communities remain intact and functioning.

1. Avoid disturbing native plant communities.
2. If the disturbance cannot be sited elsewhere, reduce surface land disturbance area.
3. Reduce cumulative impacts.
4. Schedule activities to reduce the impact to soils, native plant communities, wildlife, wetlands and water courses.
5. Incorporate native plant community restoration planning in all phases of development activity.
6. Monitoring and reporting results is critical to improved performance.
7. Retain professional environmental specialists to facilitate the resolution of problems.
8. Convey corporate and government commitment to minimal disturbance to all staff and contractors.
9. Conduct a public consultation program appropriate to the scale of the project.

Many of the principles are requirements for development on public lands, as stated in the standards and conditions of public lands formal dispositions, authorizations and approvals. These principles and guidelines are also appropriate and applicable to other land holders for the promotion and advancement of avoidance and minimal disturbance practices. The need for the development of beneficial management practices that address industry specific development planning, construction, reclamation and operational activities was recognized.

ADDITIONAL DIRECTIVES AND GUIDELINES THAT APPLY TO RENEWABLE ENERGY PROJECTS

Specific Guidance for Rough Fescue Grasslands

Rough fescue grasslands contribute important ecological goods and services to the economy of Alberta. Foothills rough fescue (*Festuca campestris*) grasslands are found in the Foothills Fescue, Foothills Parkland and Montane natural subregions and at upper elevations in the Cypress Hills. Plains rough fescue (*Festuca halii*) grasslands are found in the Northern Fescue and Central Parkland natural subregions and portions of the Mixedgrass Natural Subregion such as the Cypress and Milk River uplands.

The importance of these grasslands has been recognized through the designation of rough fescue as our Provincial Grass emblem. The value of retaining the ecological health and function of these grasslands is acknowledged by the ranching community, government agencies, stewardship groups and through conservation easements on freehold lands. It is also recognized that fragmentation of the remaining fescue grasslands jeopardizes their ecological health, function and operability. Of greatest importance to Albertans is the role rough fescue grasslands play in maintaining surface and groundwater resources. All downstream users benefit from the maintenance of these key ecological services.

There is great uncertainty regarding our ability to restore rough fescue plant communities. Reclamation of disturbances is costly and prone to failure with most disturbances resulting in permanent conversion to non-native plant communities.

Guidance for Plains Rough Fescue Grasslands

Vast tracts of plains rough fescue (*Festuca hallii*) grasslands covered portions of the Mixedgrass, Northern Fescue and Central Parkland natural subregions prior to settlement. Most has been lost to cultivation, transportation, industry, rural and urban development.

The remaining native grasslands in the Central Parkland and Northern Fescue natural subregions are highly fragmented. Preservation of existing tracts is very important to protecting the native plant community ecological integrity and resulting biodiversity. Research has illustrated that plains rough fescue plant communities are difficult as well as costly to restore following industrial disturbance. To provide specific guidance on minimizing surface disturbances in the Central Parkland and Northern Fescue natural subregions, Alberta Parks and Environment released ***Industrial Activity in the Central Parkland and Northern Fescue Grasslands- Strategies for Minimizing Surface Disturbance*** (AEP 2016b).

This document provides specific guidance on minimizing surface disturbance in the highly fragmented remaining native grasslands of east-central Alberta. It describes conservation and reclamation practices to avoid or minimize disturbance to native grassland plant communities that are difficult and costly to restore.

> It is important to recognize the ecological goods and services the remaining plains rough fescue plant communities provide and to avoid disturbance.

Protective Notations on Foothills Rough Fescue Grasslands

Foothills rough fescue grasslands dominate the Foothills Fescue, Foothills Parkland and Montane natural subregions where native grassland continues to remain intact and functioning. These grasslands provide rich habitat for wildlife and provide productive forage for livestock. Public concern regarding the push for energy development in foothills rough fescue grasslands prompted Environment and Sustainable Resource Development (ESRD) to place Protective Notations[1] on specified public lands with native grasslands. The following is a direct quote from:

Information Letter 2009-04 - Foothills Fescue Grassland Information Letter- Principles for Minimizing Surface Disturbance

> *Extensive tracts of foothills rough fescue (Festuca campestris) grassland within the landscape of southwestern Alberta have been lost due to agricultural crop production, industrial development, and urban and rural infrastructure. Alberta Environment and Parks has placed Protective Notations (PNT)[1] on specified public lands known to include large tracts of foothills rough fescue grassland with minimal industrial development. The purpose of the PNT is not to restrict development but to alert industry to the environmental and economic risk. The PNT identifies the expectations for planning and development standards. Public land parcels with PNTs can be determined by SRD Land System Automated Search.* (ASRD 2010a).

Following the release of the Information Letter regarding the protective notation ESRD provided more detailed guidance for industry in the document;

Industrial Activity in Foothills Fescue Grasslands, Guidelines for Minimizing Surface Disturbance (ASRD 2010b). The guidelines were based on results of research on restoration potential and observation of past reclamation practices in foothills fescue grassland plant communities. Key guidelines include:

- Avoid disturbance and fragmentation of the remaining Foothills Fescue Grasslands.
- Where avoidance of foothills fescue plant communities is not feasible, minimize the surface soil disturbance.

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[1] Protective Notations (PNT), are placed by public agencies in consultation with the public land manager to identify land and resources that are managed to achieve particular land use or conservation objectives.

- Control invasive species.
- Construct and reclaim during the dormant season.
- Monitor and maintain the reclaimed sites and implement adaptive management to promote reclamation outcomes.

RIPARIAN, WETLAND AND WATERCOURSE MANAGEMENT

Stepping Back from the Water (ASRD 2012) is a handbook designed to assist municipalities, watershed groups, developers and landowners in Alberta's settled region determine appropriate water body setbacks for development around our lakes, rivers and wetlands. The purpose of the handbook is to assist users with the following:

1. Identifying riparian lands and understanding key riparian area functions.
2. Understanding how setbacks can be applied to create effective riparian buffers.
3. Conserving and managing riparian land.
4. Managing erosion and pollutants associated with new developments.

The importance of maintaining healthy riparian buffers is stressed in the handbook and guidance is provided for determining appropriate setback distance when planning developments (ASRD 2012).

The Alberta Wetland Policy (ESRD 2013) provides the strategic direction and tools required to make informed management decisions in the long-term interests of Albertans.

Not all wetlands are of equal value. Alberta's wetlands are highly diverse in form, function and distribution across the province. Under the ***Alberta Wetland Policy***, wetland value will be assessed based on relative abundance on the landscape, supported biodiversity, ability to improve water quality, importance to flood reduction and human uses. Individual wetlands are assessed against these key criteria and assigned an overall wetland value. Relative wetland value is used to inform wetland management.

Where development activities have the potential to impact wetlands, the wetland policy promotes avoidance and minimization as the preferred courses of action. Where impacts cannot be avoided or minimized and permanent wetland loss is incurred, wetland replacement is required. The amount of wetland replacement required will reflect the differences in relative wetland value (ESRD 2013).

WILDLIFE DIRECTIVES AND GUIDELINES

Wildlife Directive for Alberta Wind Energy Projects (AEP 2016c) summarizes potential wildlife issues associated with wind energy projects, and provides direction for minimizing effects to wildlife and wildlife habitat during the siting, construction, and operation of wind energy projects. The Directive includes the requirement for a minimum of 100 meter setback from any permanent or ephemeral wetland. The Wildlife Management Unit of Alberta Environment and Parks (AEP) is a required referral agency for application to the Alberta Utilities Commission (AUC). An AEP Wildlife Referral Report is required to accompany the application.

Wildlife Guidelines for Solar Energy Projects (AEP 2016d) details pre-construction survey requirements and post-construction monitoring requirements. AEP Wildlife Management Unit is a required referral agency for application to AUC. An AEP Wildlife Referral Report is required to accompany the application.

Recommended Land Use Guidelines for Protection of Selected Wildlife Species and Habitat within Grassland and Parkland Natural Regions of Alberta (ASRD 2011)

Many land use activities can have negative impacts on the quantity and quality of wildlife and wildlife habitat. To retain healthy, functioning ecosystems in Alberta, both now and in the future, it is important to manage the timing and location of human developments and resource extraction activities in ways that minimize adverse effects. Activities that cause a lasting physical alteration to vegetation, soils, and surface/subsurface waters are of particular concern.

The restricted activity dates in the guidelines are based on existing knowledge and research about the seasonality of species' breeding, nesting, and rearing. Restricted activity dates are broad enough to accommodate most year-to-year climatic fluctuations and still provide adequate time for wildlife use of key areas/sites.

Setback distances are based on what experts believe are the thresholds at which human disturbance is likely to cause degradation and possible abandonment of key wildlife areas/sites. Wildlife species have variable tolerances for disturbance intensities, with higher levels of disturbance requiring greater mitigation. Human activities have been divided into three disturbance impact categories (low, medium and high) with setback distances increasing from low to high.

Recommended Land Use Guidelines: Key Wildlife and Biodiversity Zones (ESRD 2015)

Key Wildlife and Biodiversity Zones have been identified and are illustrated on wildlife sensitivity map layers used by Government of Alberta staff when considering project applications (i.e. Landscape Analysis Tool).

Typically, Key Wildlife and Biodiversity Zones occur along major river valleys. Prairie river valleys contain the topographic variation and site productivity conditions that provide increased levels of biodiversity, corridors for wildlife movement and good winter browse and forage for ungulates in proximity to forest and topographic cover. Additionally, south-facing valley slopes have relatively lower snow accumulations and warmer resting sites. The valley landform itself provides protection from high wind chills.

Key Wildlife and Biodiversity Zones play a disproportionately large role in the landscape, given their localized size and distribution, in maintaining the overall productivity of regional ungulate populations and source of biodiversity. These zones ensure that a significant proportion of the breeding population survives to the next year.

Industrial activity within and adjacent to Key Wildlife and Biodiversity Zones adds stress and increases energy drain for animals. Wildlife may be forced to move about more than normal and even relocate to less favorable habitat. This becomes an increasingly significant factor as winter progresses. Industrial activity may also create temporary and permanent access that exposes animals to additional non-industrial disturbances and to greater pressure from predators.

In the interest of maintaining areas of biodiversity and productive ungulate populations in Alberta, industrial land use guidelines must reflect an understanding of the wildlife biology and the importance of key winter ranges for ungulates. The land use guidelines for Key Wildlife and Biodiversity Zones are intended to:

- Protect the long-term integrity and productivity of key ungulate winter ranges and river corridors where ungulates concentrate.
- Protect locally and regionally significant wildlife movement corridors.
- Protect areas with rich habitat diversity and regionally significant habitat types.
- Protect key hiding and thermal cover for wildlife.

Examples of Native Prairie Wildlife

NATIVE GRASSLAND AND PARKLAND RECOVERY STRATEGIES

Alberta Environment and Parks ***2010 Reclamation Criteria for Wellsites and Associated Facilities for Native Grasslands*** (AENV 2010) provides the protocol, monitoring methods and statistical analysis required to apply for reclamation certification. The expected outcome at certification is restoration of ecological health, function and operability.

Ecological restoration is defined as *"the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed"* (Society for Ecological Restoration 2004). In practical terms restoration involves returning a disturbed site to the ecosystem characteristics that existed prior to surface disturbance, usually based on the characteristics of an adjacent reference or control site. The criteria uses native grassland vegetation as an indicator of equivalent land capability, ecosystem function and/or operability (AENV 2010).

Recovery Strategies for Industrial Development in Native Prairie is a series of manuals that provide guidance for reclamation and restoration strategies for each natural subregion in the Grassland and Parkland Natural Regions and the Montane Natural Subregion. The manuals provide guidance for reclamation strategies specific to the ecological range site including post-construction monitoring programs with adaptive management and standardized data collection methods. The manuals were developed through the Alberta Range Resource Management Program (2013, 2014, 2016 and 2017) and are available on the Foothills Restoration Forum website www.foothillsrestorationforum.ca.

Photo by M. Neville

SUSTAINABLE DEVELOPMENT OF RENEWABLE ENERGY IN ALBERTA

Osprey Utilizing Artificial Nesting Platform – Wind Energy Project, Pincher Creek, AB
Photo by M. Neville

Principles for Minimizing Surface Disturbance in Native Grassland - Principles, Guidelines and Tools for all Industrial Activity in Native Grassland in the Prairie and Parkland Landscapes of Alberta (AEP 2016a) indicates the need for industry specific beneficial management practices. Alberta Environment and Parks has developed standardized tools and databases to assist industry in implementing principles and guidelines for minimizing surface disturbance. The tools and databases, available for use in project planning and development, include:

- Alberta's Ecological Land Classification System.
- Grassland Vegetation Inventory/ Primary Land Vegetation Inventory.
- Alberta Conservation Information Management System (ACIMS).
- Fisheries and Wildlife Management Information System (FWMIS).
- Range Plant Community Guides.
- Ecological Site Restoration Risk Analysis.
- Landscape Analysis Tool.

- Range Health Assessment and Riparian Health Assessment Workbooks and Protocol.

Each industry in the renewable energy sector has unique construction codes, safety requirements, and construction timelines. Commitment to the principles and guidelines through organizations such as the Canadian Wind Energy Association (CANWEA) and Canadian Solar Industries Association (CanSIA) and the Canadian Geothermal Energy Association, (CanGEA) is critical to the development of beneficial practices. These organizations provide an important vehicle for information exchange (what works and what doesn't) and shared funding for research and development.

The petroleum industry has made significant progress in reducing the area of disturbance to native prairie and improving restoration potential since the early 1990s. Working with government agencies, prairie conservation groups, landowners and other stakeholders, the petroleum industry has come to recognize the importance of cooperative and sustainable land management of the prairie landscape. Implementing new technology and fostering creativity, the industry has adapted by changing the way drilling projects and the associated infrastructure are planned, constructed, operated and decommissioned. As well, the petroleum industry funds numerous research projects to evaluate the efficacy of minimal disturbance drilling practices, pipeline construction practices and restoration strategies in native prairie, through the Canadian Association of Petroleum Producers Alberta Upstream Petroleum Research Fund.

REGULATORY AND REFERRAL PROCESS FOR RENEWABLE ENERGY PROJECTS IN ALBERTA

The following is a summary of the regulatory process currently governing the approval, operation and decommissioning of renewable energy projects in Alberta with respect to environmental effects.

Alberta Utilities Commission

The Alberta Utilities Commission (AUC), is an independent, quasi-judicial agency of the province of Alberta. The AUC is responsible to ensure that the delivery of Alberta's utility service takes place in a manner that is fair, responsible and in the public interest. The AUC regulates electric, gas and water utilities including wind and solar energy projects pursuant to the ***Alberta Utilities Commission Act***, the ***Hydro and Electric Energy Act*** and the ***Gas Utilities Act***. The AUC is charged to protect social, economic and environmental interests of Alberta when considering these projects (www.auc.ab.ca).

AUC rules are documents setting out requirements or processes to be followed. ***AUC Rule 001, Rules of Practice*** details the process under which the AUC operates. AUC ***Rule 007: Applications for Power Plants, Substations, Transmission Lines, Industrial System Designations and Hydro Developments*** applies to all proposed electricity generating developments with the potential to produce more than 10 megawatts of power. The AUC revises its rules of practice as need arises. It has recently revised Rule 001, effective November 12, 2016, and Rule 007, effective February 1, 2016, to include specific direction for wind and solar energy developments.

The following information is obtained directly from the AUC website (www.auc.ab.ca).

AUC Rule 007: Applications for Power Plants, Substations, Transmission Lines, and Industrial System Designations (AUC 2016)

The following requirements apply:

> *Needs identification document applications by the independent system operator (ISO) must be made pursuant to Section 34 of the Electric Utilities Act, the Transmission Regulation and the Transmission Deficiency Regulation.*
>
> *A Participant Involvement Program must be conducted before an electric facility application can be submitted to the Commission.*
>
> *The applicant must identify any emergency orders issued by Environment Canada which apply to the project area (e.g. the Emergency Order for the Protection of the Greater Sage-Grouse).*
>
> *If the project site occurs within the plan boundaries of a regional land use plan* ***(Alberta Stewardship Act and the Alberta Land Use Framework)*** *which is in force, the applicants for transmission lines and power plants must include information confirming the project is being developed in accordance with the regional land use plan and any impacts on the management frameworks developed pursuant to the applicable regional land use plan.*
>
> *For all power plant applications, a local AEP wildlife biologist must be consulted unless the project is located within an urban area with no nearby wildlife habitat. AUC requires a sign-off from AEP prior to processing any new wind power or solar power applications.*
>
> *With respect to new facilities or alterations that may have historical, archaeological or paleontological impacts, confirm that a* ***Historical Resources Act*** *(Province of Alberta 2013) approval has been obtained or is being applied for. If a historical impact assessment is required,*

briefly describe any historical, archaeological or paleontological sites close to the power plant site.

At a level of detail commensurate with the size and type of potential effect(s) of the project, complete and submit an environmental evaluation of the project and provide a sign-off from AEP addressing the environmental aspects of the project that AEP is satisfied with. An environmental evaluation describes and predicts a project's effects on the environment before the project is actually carried out, and the measures to avoid or mitigate the project's predicted adverse environmental effects and any monitoring proposed to evaluate the efficacy of those measures.

Alberta Environment and Parks

Alberta Environment and Parks (AEP) Wildlife Management Unit is a required referral agency for application to AUC for utility–scale wind and solar energy projects. A Wildlife Referral Report from AEP is required to accompany an application to AUC. AEP Wildlife Management Unit may include other management units in the referral process when issues such as proposed development in native grassland or other sensitive habitat features are identified.

Local Municipal Approval

Municipal approval is required for all renewable energy projects. Many municipalities in southern Alberta have recently amended land use plans and developed by-laws with specific reference to renewable energy development. These can be accessed on the websites of the relevant cities, towns, counties and municipal districts.

For example, the Municipal District of Taber does not permit renewable energy development on tax recovery lands managed by the municipality.

Special Areas, a large area of former tax recovery lands in east-central Alberta administered under the ***Special Areas Act***, has specific policies regarding minimal disturbance in native grasslands and near water bodies. To date renewable energy development is not permitted on native grasslands administered by the Special Areas Board. Requirements for renewable energy development applications are included in the ***Special Areas Land Use Order*** available at www.specialareas.ab.ca.

APPLYING MINIMAL DISTURBANCE PRINCIPLES TO RENEWABLE ENERGY PROJECTS

City of Medicine Hat Concentrated Thermal Demonstration, Photo by M. Neville

AVOID NATIVE GRASSLAND

The first and most important minimal disturbance principle (AEP 2016a) is to avoid disturbance to native grassland plant communities. An obvious option to meet the intent of this principle is to develop renewable energy resources close to or within urban centers where the demand for energy is greatest, and the loss of energy through conventional transmission infrastructure is minimized. Other options include utilizing existing industrial disturbances such as decommissioned petroleum industry infrastructure, reclaimed and revegetated coal mines, marginal cropland or regrassed cultivated lands, and brownfields. This approach requires rethinking how energy is produced, stored and consumed with a shift towards focusing on the local and community level.

CONSIDER AND PROMOTE MICRO-GENERATION

Micro-generation is the small-scale generation of heat and /or electric power by individuals, small businesses and communities to meet their own needs, and as alternatives or supplements to traditional centralized grid-connected power. Focusing on the development of commercial and residential projects and micro-generation projects within urban centres or on previously disturbed lands near urban centres could reduce the amount of utility-scale power developments required.

This definition of micro-generation is quoted directly form the AUC website (www.auc.ab.ca).

> *In Alberta, micro-generation is defined as being the generation of electrical energy from a generating unit with a total capacity of one megawatt (MW) or less, is connected to the distribution system, exclusively uses sources of renewable or alternative energy (such as solar photovoltaic, small-scale hydro, wind, biomass, geothermal and fuel cell) and the electrical energy output is intended to meet all or a portion of the customer's electricity needs. Owners of electrical distribution systems are expected to provide connection services for micro-generators.*

The AUC Micro-Generator Application Guideline (AUC 2013) provides specific direction regarding the application process required for micro-generation projects.

Microgeneration projects are supported by the Government of Alberta through programs such as:

- **Growing Forward 2** On-Farm Solar Photovoltaics Program (Growing Forward 2, 2013-2018).
- **The Alberta Municipal Solar Program** which provides financial rebates to Alberta municipalities who install solar photovoltaics on municipal facilities or land (Municipal Climate Change Action Centre 2016).
- **Residential and Commercial Solar Program** providing homeowners, businesses and non-profit organizations with financial rebates for the installation of rooftop solar panels.

Examples of Micro-generation Projects in Alberta include:

Medicine Hat College

Medicine Hat College has offered a portion of its campus as a test site for renewable energy technology. In 2017 Bluenergy Solarwind Canada will be installing on campus and testing its vertical axis solar photovoltaic wind turbines that produce energy from both wind and solar resources. The College is focused on providing community based solutions that facilitate the transition to renewable energy sources.

Medicine Hat College has integrated renewable energy development training into its trades and technologies programs. The programs provide the opportunity for the technical trades, contracted previously by the petroleum industry, to transition to renewable energy projects. Many technical trade construction workers from the Medicine hat area are familiar with the minimal disturbance principles and guidelines, creating the opportunity for further development of beneficial management practices.

Walmart Sustainable Distribution Center

The Walmart Sustainable Distribution Center in Balzac, Alberta is an example of a large commercial facility designed to reduce the reliance on conventional energy sources. The facility has integrated wind, solar, and waste heat technology to reduce the reliance on conventional energy sources. Examples include:

- Hydrogen fuel cells replace traditional lead acid batteries for material handling vehicles.
- Two 30-kilowatt wind turbines have been installed capable of producing a portion of the energy required.
- Sixteen solar thermal panels provide energy to heat hot water for maintenance and office areas.
- Smart refrigeration units are designed with demand-response capability which allows electricity to be drawn off of the system only when required, with the advantage of being able to draw energy during off peak grid times.
- Waste heat from refrigeration units is used to heat sub-floor in the winter.

Green Acres Hutterite Colony Solar Farm

The Green Acres Hutterite Colony near Bassano, Alberta utilizes a two MW solar farm to supply the energy required to operate its Crowfoot Plastics recycling plant. Crowfoot Plastics recycles the plastic wraps commonly used in agriculture for storing silage into pallets that are sold to make other plastic products. Renewable energy is used to reduce and recycle agricultural waste.

Brant Colony Net Zero Egg Barn

The Brant Hutterite Colony in Vulcan County Alberta operates a chicken egg laying barn that combines innovative energy efficient barn construction and a heat recovery ventilation system with electrical energy requirements produced through solar voltaic panels. The "Net –Zero" concept is designed to reach the point where energy inputs and outputs are balanced.

Renewable Energy for Rural Residences

There is increased interest in utilizing renewable energy resources (solar or wind) to provide all or a portion of the electricity requirements of rural residences. Some micro-generation facilities provide surplus energy into the local electrical grid when available energy exceeds the amount required and obtain energy from the grid when energy demands exceed the amount produced by the renewable facility. Other facilities in remote locations are self-sustaining and not connected to the grid.

These micro-generation facilities are often located within existing farmsteads or adjacent to residences or barns. These facilities reduce the need for additional transmission infrastructure in remote locations, and when located in prairie landscapes reduce the impact to native grasslands and wetlands.

Rural Microgeneration Project Providing Surplus Energy into the Grid, Photo by M. Neville

Rural Off Grid Solar Project, Photo by M. Neville

MOVE TOWARD DECENTRALIZED ENERGY SYSTEMS

Decentralized energy systems are defined as relatively small-scale generation capacities (often a combination of wind, solar, hydro, geothermal, biogas and co-generation) connected to local distribution networks supplying local communities with electricity and in some cases both heat and electricity.

The second component of decentralized energy systems is more efficient use of energy through demand response. Energy is made available to the individual consumer only as it is needed through "smart grid" technology and "smart meters", managed through online applications.

The third component of a decentralized energy is energy storage. Renewable energy production is intermittent, requiring the ability to store the energy produced by intermittent sources during low-consumption hours to be released back into the system during periods of peak demand. Examples include "combined heat and power units" where excess energy produced during low demand is stored as heat and cycled through community-based residential heating systems. As well, industrial produced waste heat can be stored and used to produce electricity during peak demand periods.

Examples of decentralized energy systems currently in operation in Alberta include:

City of Medicine Hat Concentrated Solar Thermal Demonstration

City of Medicine Hat supplies electricity to the residents of Medicine Hat through combined cycle steam turbine generation units. The steam that drives the turbines is produced from burning natural gas, and a heat recovery generator that utilizes waste heat produced in the process. As part of an energy conservation program a 1 MW Concentrated Solar Thermal (CST) demonstration system has been added to the combined cycle system. Thermal energy from a parabolic trough collector field is used to generate steam. The solar steam is combined with the steam produced in the heat recovery steam generator and the combined steam flow is directed to one or both of the existing 33 MW steam turbine generators. The project is the first its kind in a northern climate. Additional information can be found at www.medicinehat.ca.

Lethbridge BioGas

Lethbridge biogas uses an anaerobic digestion process, operating at 38 degrees C for the production of renewable energy from organic residues such as agricultural manures and food processing by-products, readily available within the County of Lethbridge. The biogas generated in two 1.4 MW combined heat and power (CHP) units produces methane gas which is burned in the units to produce electricity into the Alberta grid. The heat captured during the digestion process is used to stabilize the process at its operating temperature, ensuring a consistent supply of renewable energy into the grid. The remaining by-product of the digestion process is used as a high- quality soil amendment for land application, reducing commercial fertilizer requirements and associated costs. Additional information is available at: www.lethbridgebiogas.ca.

Co-generation Energy Projects

Cogeneration is a highly efficient means of generating heat and electric power at the same time. Cogeneration is achieved when a generating plant is constructed in conjunction with an industrial facility (host) that has needs for both the power and the heat energy produced. An example is the 480 MW natural gas-fired cogeneration plant built to meet the substantial steam and electric energy needs of NOVA's petrochemical facility at Joffre in Central Alberta. Excess electricity produced is sold into the grid (www.atcopower.com).

Single purpose thermal electric power plants (coal fired or natural gas) reject approximately 50% of the fuel heat when producing electricity to water bodies or to the atmosphere. Cogeneration can recover this heat by making it available for industrial purposes.

Currently electrical energy produced from cogeneration amounts to approximately 30 percent of the total installed generation capacity. Economically speaking, cogeneration makes considerably more efficient use of an input fuel such as natural gas or biomass to simultaneously generate both electricity and steam or heat for industrial purposes. Cogeneration also substantially reduces greenhouse gas emissions (www.energy.alberta.ca).

BENEFICIAL MANAGEMENT PRACTICES FOR ALL RENEWABLE ENERGY PROJECTS

Wind Energy Project Sited on Cultivation, M. Neville

Principals for Minimizing Surface Disturbance in Native Grassland: Principals, Guidelines and Tools for all Activity in Native Grasslands in the Prairie and Parkland Landscapes of Alberta (AEP 2016a) acknowledges the important role strategic siting and risk analysis play in reducing the impact of industrial activity in native grassland and parkland ecosystems. *The intent of the publication is to promote consistent and effective use of pre-site assessments for all industrial activity* (AEP 2016a).

Many beneficial management practices developed and implemented in the petroleum industry can be adapted to all renewable energy projects. The following is a list of BMPs discussed during the workshop held February 2, 2017 and written comments received from participants and agencies in attendance. The workshop provided input from Government of Alberta agency representatives, municipalities, the renewable energy sector, conservation organizations, and environmental consultants.

All Stages of Project Development

Implement the principles and guidelines with the tools described in ***Principals for Minimizing Surface Disturbance in Native Grassland - Principles, Guidelines and Tools for all Industrial Activity in Native Grassland in the Prairie and Parkland Landscapes of Alberta*** (AEP 2016a) with the goal to avoid native prairie and, where avoidance is not possible, to reduce the area of disturbance and other environmental impacts.

Follow the steps outlined in the Pre-disturbance Site Assessment Flow Chart and accompanying detailed instructions.

Figure 2 – Strategic Siting Risk Analysis Flow Chart

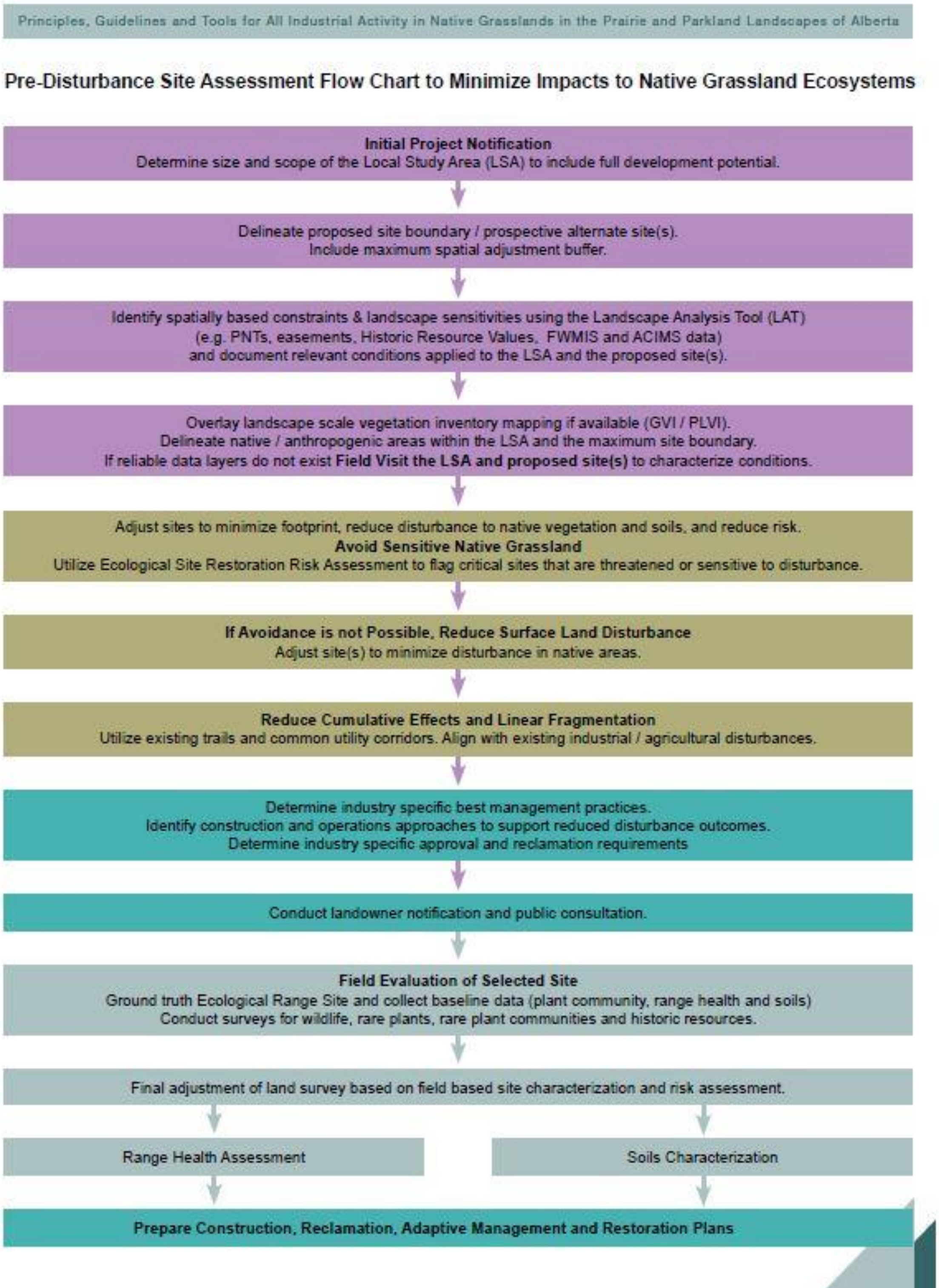


Figure 2 - Strategic Siting Risk Analysis Flow Chart for Native Grassland Communities

Beneficial management practices that are applicable to all renewable energy projects at key stages of project development are suggested as follows.

Planning and Siting

- In the initial project development phase, engage municipal authorities, landowners, companies with existing industrial infrastructure and community stakeholders in the development of an integrated land use management plan. It is beneficial to engage all land users in order to reduce the project footprint. This step could form the basis for the AUC requirement for a participant involvement program.
- Confirm that the proposed project is being developed in accordance with the applicable regional land use plan.
- Ensure the proposed project is being developed in accordance with the municipal by-laws.
- Select a land base in a previously disturbed landscape (land where the soils and native plant communities have already been altered by cultivation, municipal development, transportation corridors, industrial, or other land uses) for the project footprint.
- Avoid large areas of native prairie where industrial development has not occurred.
- Avoid including isolated areas of native prairie, ridge tops, riparian areas, and watercourses and known wildlife corridors within the project footprint.
- On private lands, avoid lands with conservation easements or agreements between a landowner and a conservation interest such as Ducks Unlimited, the Nature Conservancy of Canada, the Southern Alberta Land Trust Society, Alberta Conservation Association, MultiSar (Multiple Species at Risk), the Southern Alberta Land Trust or similar land trusts, MultiSar (Multiple Species at Risk) or other similar conservation agreements.
- Avoid lands listed under the Foothills Rough Fescue Protective Notation (ASRD 2010). Avoid grassland native plant communities in the Montane NSR of the Rocky Mountain Natural Region.
- Avoid plains rough fescue plant communities, located in the Mixedgrass, Northern Fescue and Central Parkland natural subregions.
- Avoid lands that potentially impact historic resources such as archaeological resources, paleontological resources, historic sites or structures, and Indigenous traditional use site(s) defined under the provincial ***Historical Resources Act***.

- Native prairie landscapes are much valued for their unique viewscapes. Address the impact of the development on regional viewscapes during the public information sessions.
- Conduct an ecological site restoration risk analysis throughout the project footprint. Avoid disturbance to areas with low potential for restoration success. Avoid ecological range sites with a high potential for soil erosion.
- Conduct a groundwater impact assessment.
- Loss or degradation of wetlands associated with native prairie must be avoided. Refer to the ***Alberta Wetland Policy*** and ensure the project design is in compliance.
- Reduce the footprint by locating the project as close to existing transmission facilities with load capacity to service the proposed project. Avoid development where new transmission facilities and corridors would be required in native grassland or parkland.
- Within the project footprint, negotiate with companies holding existing industrial infrastructure to utilize existing access roads or trails. Also, consult with landowners and or grazing lease holders regarding the feasibility of using existing farm or ranch trails during construction for either temporary or permanent access.

Construction and Operations

- Once the Pre-disturbance Site Assessment has been completed and the final locations for infrastructure agreed upon, prepare a detailed Environmental Protection Plan.
- Discuss road use agreements for municipal roads with the municipality. Develop a road use agreement with the municipality and a traffic control plan that reduces the impact of construction activities on area residents. Include the agreement and plan in the construction bid documents.
- For all new access requirements within the project footprint, prepare detailed drawings designed to reduce the amount of strip and grade required to construct a low-profile road. Indicate soil handling and storage requirements. Use the beneficial available technology to reduce the disturbance, appropriate for the soils, the heavy loads and the construction requirements.
- Include a traffic control plan for construction activities within the project footprint to reduce the impact to soils, wildlife, livestock and residents.
- Specify the soil handling procedure for the excavation of the connection system and provide typical drawings. The specific soil handling procedure will vary according to the location of the project within the

context of the natural subregion. Refer to the appropriate ***Recovery Strategies for Industrial Development in Native Prairie*** manual (www.foothillsrestorationforum.ca), and the results of the pre-disturbance site assessment soils report to determine the most appropriate soil handling procedure.

- Provide a timeline with conditions for temporary work stoppage, including for adverse weather conditions, clearly defined. Also, ensure all wildlife timing constraints that apply to the project are clearly defined in the construction schedule.
- Prepare a weed control and vegetation management plan. Specify equipment cleaning procedures (where, when and how) and additional vegetation management required during the construction and interim reclamation phase.
- Where disturbance of native prairie occurs, the expected outcome at decommissioning is restoration of ecological health, function and operability. Plan for this expectation during all phases of development, monitor and apply adaptive management to ensure positive results.
- It is important to understand the ecological diversity of the Grassland and Parkland Natural Regions and the Montane Natural Subregion and the unique restoration challenges offered in each natural subregion. Recovery strategies for each natural subregion provide detailed guidance for restoration planning. Manuals to assist industry and stakeholders are available and include: ***Recovery Strategies for Industrial Development in Native Prairie for the Dry Mixedgrass Natural Subregion*** (RRMP 2013), for the ***Mixedgrass Natural Subregion*** (RRMP 2014), for the **Northern Fescue Natural Subregion** (RRMP 2016) and for the ***Foothills Fescue, Foothills Parkland and the Montane Natural Subregions*** (RRMP 2017). The manuals can be downloaded from www.foothillsrestorationforum.ca or ordered in hard copy from the Foothills Restoration Forum.
- Native seed and native plant materials suitable for the project area are often difficult to secure in sufficient quantities. Qualified professional expertise is needed to ensure quality control of seed and plant materials. It is important to order supplies early in the project development phase; hence do not include purchasing of the native seed and plant material as part of the construction contract. Consider harvesting materials from the site prior to construction. Experienced restoration consultants and contractors are required for these tasks and a separate budget may be required.

- Include the Environmental Protection Plan in the construction bid package to ensure potential contractors are aware of its terms and conditions when preparing their bid.
- Convey corporate commitment to the Environmental Protection Plan to all staff and contractors through education and training.
- Engage a suitably qualified and experienced Environmental Monitor to monitor on site all phases of construction and reclamation activities to ensure the Environmental Protection Plan is followed, and the terms and conditions of approval by all regulatory agencies are carried out as specified.
- Prepare a detailed reclamation, restoration and post-construction monitoring plan appropriate to the location of the project within the natural subregion context. The plan must be consistent in its design and implementation through all phases of development and include:
    - Erosion control procedures to stabilize soils during the construction period.
    - Interim reclamation to stabilize and revegetate the surface disturbance during the operation phase.
    - Final reclamation plans for decommissioning and abandonment.
- Monitoring reclamation and restoration progress is important during the operations phase. Adaptive management will be required. Ensure sufficient funds are in annual operating budgets.

Decommissioning and Abandonment

- A "cradle to the grave" restoration planning approach is required to facilitate the recovery pathway at decommissioning and abandonment.
- Ensure site specific records are kept during construction, reclamation and operations phases. Arrange to transfer the records if there is change of ownership of the project.

Range Health Assessment Monitoring, Photo Courtesy of Barry Adams

LOOKING FORWARD

Photo by M. Neville

Alberta's Climate Leadership Plan and Renewable Electricity Program point to significant growth in the renewable energy sector. Renewable energy technology is improving rapidly in efficiency, productivity and cost effectiveness. What is considered the beneficial available technology in the production of renewable energy today may soon be obsolete and unable to compete in a rapidly shifting market place. Wise choices need to be made when siting developments, with consideration of restoration potential at decommissioning and abandonment. Site restoration in native prairie can be very expensive and take a very long time to achieve positive results.

Any industrial activity poses environmental risk and potentially negative impact on the native prairie ecosystems. Avoidance is the first and most effective approach to sustain what remains.

Hard choices are going to have to be made in order to preserve the important ecological goods and services the prairie provides to society. It is generally understood that cumulative effects management is important now; it will be critical in the future. As a society, we need to choose carefully where we allow industrial development to occur.

Transitioning toward diversified energy systems, with community based infrastructure and innovative technology for the storage and efficient use of electricity could be a positive outcome for prairie conservation.

REFERENCES

LITERATURE CITED

Alberta Agriculture and Forestry, 2014. Hydroelectric Power, http://www1.agric.gov.ab.ca

Alberta Biodiversity Monitoring Institute, 2011. Status Report for the South Saskatchewan Planning region Preliminary Assessment. www.abmi.ca

Alberta Biodiversity Monitoring Institute, 2015. The Status of Biodiversity in the Grass-land and Parkland Regions of Alberta, Preliminary Assessment, prepared for the Alberta Prairie Conservation Forum, 2015. 52 pp. www.apcf.org

Alberta Energy Regulator, April 2014. Manual 007: Principles for Minimizing Surface Disturbance in Native Prairie and Parkland Areas. www.aer.ca

Alberta Energy. Electricity Facts. www.energy.alberta.ca , Nov. 30, 2016.

Alberta Environment and Parks (AEP) 2016 b. Industrial Activity in the Central Parkland and Northern Fescue Native Grasslands - Strategies for Minimizing Surface Disturbance. September 1, 2016, Edmonton, Alberta PP 22

Alberta Environment and Parks (AEP). 2016 a. Principles for Minimizing Surface Disturbances in Native Grassland - Principles, Guidelines, and Tools for all Industrial Activity in Native Grassland in the Prairie and Parkland Landscapes of Alberta. September 1, 2016, Edmonton, Alberta PP 34.

Alberta Environment and Parks, (AEP) Wildlife Management Unit. Wildlife Guidelines for Solar Energy Projects. AEP 2016 d. http://www.alberta.ca

Alberta Environment and Parks, Wildlife Management Unit,(AEP) 2016 c. Wildlife Directive for Alberta Wind Energy Projects final draft, http://www.alberta.ca . 40 eps.

Alberta Environment and Sustainable Resource Development, (ESRD) 2015. Recommended Land Use Guidelines: Key Wildlife and Biodiversity Zones.

Alberta Environment and Sustainable Resource Development, (ESRD) 2013. Alberta Wetland Policy. Edmonton, Alberta. 26 pp

Alberta Environment, (AENV) 2010. 2010 Reclamation Criteria for Well sites and Associated Facilities for Native Grassland 125 pp

Alberta Farm Express, Egg-Laying barn produces as much energy as it uses. www.albertafarmexpress.ca.

Alberta Forestry and Agriculture. 2016 Growing Forward 2, On-farm Solar Photovoltaics - on-Farm Energy Management Sub -program accessed. www.growingforward.alberta.ca

Alberta Government, (GoA). 2014, South Saskatchewan Regional Plan 2014-2024. 201 pp, www.landuse.alberta.ca

Alberta Prairie Conservation Forum, 1989. Prairie Conservation Action Plan 1989 - 1994. 38 pp. www.albertapcf.org

Alberta Sustainable Resource Development (ASRD 2010) Industrial Activity in Foothills Fescue Grasslands, Guidelines for Minimizing Surface Disturbance. www.open.alberta.ca

Alberta Sustainable Resource Development, (ASRD) 2011, Recommended Land Use Guidelines for Protection of Selected Wildlife Species and Habitat within Grassland and Parkland Natural Regions of Alberta.

Alberta Sustainable Resource Development, (ASRD) 2012. Stepping Back from the Water: A Beneficial Management Practices Guide for New Development Near Water Bodies in Alberta's Settled Region. 88 pp

Alberta Treasury Board and Finance, 2016. Population Projection, Alberta and Census Divisions, 2016-2041. www.finanace.alberta.ca, 12 pps

Alberta Utilities Commission (AUC) 2011. Hydroelectric Power Generation Development Inquiry. Preceding ID 561, 236 eps

Alberta Utilities Commission 2013. Micro-generator Application Guideline. 39 PPs, www.auc.ab.ca

Alberta Utilities Commission, 2013. AUC Rule 012: Noise Control, http://www.auc.ab.ca

Alberta Utilities Commission, 2013. AUC Rule 24: Rules Respecting Micro-Generation

Alberta Utilities Commission,2016. AUC Rule 007: Applications for Power Plants, Substations, Transmission Lines, and Industrial System Designations http://www.auc.ab.ca

Alberta Wilderness Association, Wildland Advocate Article, February 2008. www.albertawilderness.ca

ATCO Power, Oldman River Hydroelectric Plant. http://www.atcopower.com

ATCO Power. Cogeneration and the Joffre Cogeneration Plant. accessed http://www.atcopower.com

AUC Decision 2003-20, Glacier Power Dunvegan Hydroelectric Project (Report of the EUB-NRCB Joint Review Panel). http://www.auc.ab.ca

AUC Decision 21897-D01-2016, Solar Hybrid Energy Centre GP Inc., Vulcan Solar Project, Oct 25, 2016. http://www.auc.ab.ca

Canadian Geothermal Energy Association (CanGEA) Geothermal Fact Sheet. http://www.cangea.ca

Canadian Solar Industry Association, CanSIA, November 2016.

EDF EN Canada. Vulcan Solar Project public consultation brochure, Nov. 2016

Geothermal Energy Association, Geothermal Energy Basics. accessed from the world wide web, www.geo-erngy.org

Green Energy Futures, Green Acres, the largest solar farm in Western Canada. www.greenenergyfutures.ca

Green Energy Futures, How it Works: Run-of-River hydroelectric power. http://www.greenenergyfutures.ca

Hale,G.,N.Ambrose, A.Bogen, K. Spicer-Rawe, M.Uchikura and E.Saunders. 2005. A Field Guide to Common Riparian Plants of Alberta. Cows and Fish Program. 63 eps.

International Energy Agency (IEA), Technology Roadmap Photovoltaic Energy 2014, www.iea.org 54pp

Lancaster, J., R. Adams, B. Adams and P. Desserud. 2015. Long-term Revegetation Success of Industry Reclamation Techniques for Native Grassland: Foothills Fescue, Foothills Parkland and Montane Natural Subregion; Phase 1 – Literature Review and Case Studies – 2014. Prepared for: Land and Forest Policy Branch, Alberta Environment and Sustainable Resource Development. Available online at: http://www.foothillsrestorationforum.ca

Miistakis Insititute, Greg Chernoff. April 2013. A Review of Approaches to Assessing Appropriate Placement of Wind Development Phase 1. www.albertapcf.org

Miistakis Insititute, Greg Chernoff. January 2015. PCF Wind Assessment Project, Phase 2: Proceedings from Needs Assessment Workshop. www.albertapcf.org

Municipal Climate Change Action Centre, 2016. Alberta Municipal Solar Program. www.mccac.ca

Natural Regions Committee, 2006. Natural Regions and Subregions of Alberta. Compiled by D.J.Downing and W.W. Pettapiece. Government of Alberta. Pub. No. T/852

Neville et al, Range Resource Management Branch, ASRD 2013, Recovery Strategies for Industrial Development in Native Prairie for the Dry Mixedgrass Natural Subregion of Alberta. 134 pp www.foothillsrestorationforum.ca

O2 Planning and Design Inc. 2013. Landscape Patterns Environmental Quality Analysis, prepare for Prairie Conservation Forum et al. 193 pp.

Prairie Conservation Forum (PCF) 2016. Alberta Prairie Conservation Action Plan: 2016-2020. Published by the Prairie Conservation Forum, Lethbridge, Alberta. 30 pp.

Range Resource Management Program, Alberta Environment and Parks, Lancaster et al: Recovery Strategies for Industrial Development in Native Prairie, Northern Fescue Natural Subregion of Alberta, 2016. pp www.foothillsrestorationforum.ca

Range Resource Management Program, Alberta Sustainable Resource Development, Neville et al: Recovery Strategies for Industrial Development in Native Prairie, Dry Mixedgrass Natural Subregion of Alberta, 2013. 131pp www.foothillsrestorationforum.ca

Range Resource Management Program, Alberta Sustainable Resource Development, Neville et al: Recovery Strategies for Industrial Development in Native Prairie, for the Mixedgrass Natural Subregion of Alberta, 2014. 164pp www.foothillsrestorationforum.ca

Republic of South Africa, Department of Environmental Affairs, 2011. EIA Guideline for Renewable Energy Projects. 92pps

Sampson, Fred and Knopf, Fritz. Prairie Conservation in North America, 1994. Other Publications in Wildlife Management. Paper 41. http://www.digitalcommons

Society for Ecological Restoration www.ser.org , definition accessed from website Nov. 26, 2016

U.S. Department of the Interior, Bureau of Land Management(BLM), 2015.Memorandum regarding Performance and Reclamation Bonds required for solar and wind energy projects on BLM Lands.

United Nations Convention on Biological Diversity, 1992. www.cbd.int

Weis, Tim, Alex Doukas and Kristi Anderson. Pembina Institute, 2010. Landowners Guide to Wind Energy in Alberta. 79 pp

REFERENCES

Alberta Energy Regulator, April 2014. Principles for Minimizing Surface Disturbance in Native Prairie and Parkland Areas. www.aer.ca

Alberta Utilities Commission, 2015. Bull Creek Wind Power Project 2014/2015 Supplemental Pre-construction Wildlife Survey Results. www.auc.ab.ca

Alberta Utilities Commission, 2016. Rule 001, Rules of Practice. www.auc.ca

Alberta Utilities Commission, March 2011. Greengage Power Corporation, Blackspring Ridge Wind Project, Decision 2011-085. www.auc.ab.ca

Canadian Geothermal Energy Association 2016, Alberta Geothermal Favourablity Maps and Database. www.cangea.ca

Canadian Geothermal Energy Association. 2016. About Geothermal Energy. www.cangea.ca

Canadian Wind Energy Association, 2015, Wind Energy Development Best Practices for Community Engagement and Public Consultation. 40 eps www.canwea.ca

enerG, Alternative Sources Magazine, Beefing up Alberta Wind Power with Blackspring Ridge. www.altenerg.com

European Wind Energy Association, European Best Practices for Wind Energy Development. 26 pps www.ewea.org

Geothermal Energy Association, 2014. Geothermal Basics. www.geo-energy.org

Glossary of Environmental Assessment Terms and Acronyms Used in Alberta – Updated February 2010. Environmental Assessment Team, Alberta Environment, Edmonton, Alberta. 31 pp.

Irish Wind Energy Association 2012. Best Practices and Guidelines for the Irish Wind Energy Industry. www.iwea.com

Kestrel Research Inc. 2016, Recovery of Foothills Rough Fescue Grassland after Use of Construction Matting on AltaLink Transmission lines. Prepared for AltaLink

Kestrel Research Inc. and Gramineae Services Ltd. 2011. Long Term Recovery of Na-tive Prairie from Industrial Disturbance; Express Pipeline Revegetation Monitoring Pro-ject 2010. Prepared for: Kinder Morgan Canada, TransCanada PipeLines, ConocoPhil-lips Canada and Alberta Sustainable Resource Development Public Lands Division. Available at http://www.foothillsrestorationforum.ca

Special Areas Board, Special Areas Advisory Council, Special Areas Municipal Planning Commission & Palliser Regional Municipal Services. Land Use Order, Special Areas 2,3 and 4, March 2015. www.specialareas.ab.ca

SRD-Fish and Wildlife Division, 2011.Wildlife Guidelines for Alberta Wind Energy Projects.

U.S. Fish and Wildlife Service. U.S. Fish and Wildlife Service Land Based Wind Energy Guidelines, 2012

WhyHydroPower.com, Rediscovering Water as Renewable Energy. Impoundment vs run-of river. www.whyhydopower.com

WhyHydroPower.com Rediscovering Water as a Renewable Energy, Environmental Considerations, Contrasting Reservoir and Streaming Hydropower. www.whyhydopower.com

APPENDIX A: BENEFICIAL MANAGEMENT PRACTICES FOR UTILITY-SCALE WIND POWER PROJECTS

Photo Courtesy of J. Lancaster

Utility scale wind power projects (wind farms) consist of numerous large wind turbines that capture energy from the wind through the movement of large rotor blades atop large towers. The energy is transported from the blades through to a generator housed at the top of the tower, (nacelle). The nameplate or projected capacity of a utility-scale wind turbine indicates the rated electrical power the turbine is capable of generating in MegaWatts (MW). The actual output depends strongly on how well the system is sited and whether or not the particular turbine is suited for wind duration and speed profile of the site (Weis et al. 2010).

Each wind turbine requires a suitably-sized access road for construction of the turbine. The access road may be reduced in size and partially reclaimed during the operations phase. As well a wind farm requires a collection system that collects the energy produced from each turbine through either underground or above-ground cables to a sub-station where the energy can be released into the distribution grid. The area required to construct each turbine varies with type and size of turbine and the site topography, soils and depth to bedrock. Typically, the area required for the construction work space for each turbine is approximately 100 meters by 100 meters, the access road 10 meters wide and, for the collection system, a right-of-way 10 to 15 meters wide by the length required to connect each turbine to the distribution system. Even though the average area required to construct each turbine is relatively small, for the entire project there are usually a number of environmental factors, municipal or landowner requirements and noise setbacks that when combined result in direct effects to multiple sections of land. The total surface area footprint is similar to a conventional and fully developed oil or gas project.

Guidelines and beneficial management practices for utility-scale wind energy development were reviewed from numerous sources including European Wind Energy Association, British Wind Energy Association, Irish Wind Energy Association and the Dutch wind energy industry. In addition, wind energy guidelines of the U.S. Fish and Wildlife Service and the U.S. Department of Interior, Bureau of Land Management (BLM 2015) were reviewed.

Key themes among the guidelines and beneficial management practices reviewed include:

- Community involvement and public consultation.
- Avoiding sensitive landscapes and protected areas.
- Reducing impact on local and regional viewscapes.
- Avoiding impact on cultural resources.
- Avoiding sensitive wildlife habitat.
- Requiring performance and reclamation bonds for wind energy projects, specifically on lands managed by the U.S. Department of the Interior, Bureau of Land Management.

Wildlife Directive for Alberta Wind Energy Projects (AEP 2016c) summarizes potential wildlife issues associated with wind energy projects, and provides direction for minimizing effects to wildlife and wildlife habitat during the siting, construction, and operation of wind energy projects. There is requirement for a minimum of 100 metre setback from any permanent or ephemeral wetland. Alberta Environment and Parks Wildlife Management Unit is a required referral agency for application to AUC. A Wildlife Referral Report from AEP is required with an application.

Beneficial Management Practices for Utility Scale Wind Energy Projects

The beneficial management practices that apply to all renewable energy projects have been previously described in this document.

The following draft beneficial management practices are intended to be used as a starting point to assist the wind energy industry in developing their own specific and more comprehensive BMPs, based on their knowledge of the industry technology, construction procedures, and operational requirements.

Planning and Siting

- In the initial project development phase, engage municipal authorities, landowners, companies with existing industrial infrastructure and community stakeholders in the development of an integrated land use management plan. Local knowledge of the landscape and existing industrial infrastructure can be very useful during the planning phase.
- Confirm that the proposed project is being developed in accordance with the applicable regional land use plan and municipal by-laws.
- Select a land base in a previously disturbed landscape (land where the soils and native plant communities have been altered by cultivation or industrial land use) for the project footprint. Avoid including isolated areas of native prairie, ridge tops, riparian zones, and watercourses within the project footprint.
- On private lands, avoid lands with conservation easements or agreements between a landowner and a conservation interest such as Ducks Unlimited, Nature Conservancy of Canada, Southern Alberta Land Trust Alberta Conservation Association, MultiSar (Multiple Species at Risk) and others.
- Avoid foothills fescue grasslands in the Foothills Fescue, Foothills Parkland and Montane natural subregions including those on public land under protective notation (ASRD 2010). Avoid plains rough fescue plant communities, located mostly in the Mixedgrass, Northern Fescue and Central Parkland natural subregions.
- Avoid lands that potentially impact historic resources such as archaeological resources, paleontological resources, historic sites or structures and Indigenous traditional use site(s) defined under the provincial ***Historical Resources Act***.
- Native prairie landscapes are much valued for their unique viewscapes. Wind turbines are large above ground structures that can be seen for many miles in the prairie landscape. Address the impact of the development on regional viewscapes during the public information sessions.

- Avoid sandy and choppy sand hill ecological range sites, and locations with other potentially erodible soils.
- Follow the terms and conditions of ***Wildlife Directive for Alberta Wind Energy Projects*** (AEP 2016c). Complete the Wind Energy Checklist prior to application to the AUC.
- Conduct a groundwater impact assessment.
- Loss or degradation of wetlands associated with native prairie must be avoided. Refer to the ***Alberta Wetland Policy*** and ensure the project design is in compliance.
- Reduce the footprint by locating the project as close to existing transmission facilities with load capacity to service the proposed project.
- Locate the project near existing transportation corridors (rail or highway) capable of handling the heavy, long loads required for turbine construction.
- Within the project footprint, negotiate with companies holding existing industrial infrastructure to utilize existing access roads or trails. Also, consult with landowners and or grazing lease holders regarding the feasibility of using existing farm or ranch trails during construction for either temporary or permanent access.
- Consider siting facilities on decommissioned petroleum, coal or gravel developments where reclamation certification has been obtained from AEP. Utilize the existing infrastructure for access and the well sites for turbine sites.
- Evaluate the impact of livestock management on reclamation and restoration potential using the range health assessment protocol
- Combine turbine access routes and collection systems in a single right-of-way to reduce fragmentation.
- Select turbine sites with a minimum of topographic relief between sites to reduce the grading, soil handling and reclamation required for access and construction of the turbines.

Construction and Operations

- Once the Pre-disturbance Site Assessment has been completed and the final locations for turbines and associated infrastructure agreed upon, prepare a detailed Environmental Protection Plan.
- Include detailed strip and grade, soil handling and soil storage specifications with typical drawings for turbine sites. Depending on the type of tower, specifications for storage of spoil material removed from the tower excavation may be required. Determine if it can be used to

reduce the grading required for access. Include erosion and sediment control procedures and plans.

- For all new access requirements, prepare detailed drawings designed to reduce the amount of strip and grade required to construct a low-profile road. Indicate soil handling and storage requirements. Use the beneficial available technology to reduce the disturbance, appropriate for the soils, the heavy loads and the construction requirements.
- Include a traffic control plan to reduce the impact to soils, wildlife, livestock and residents.
- Specify the soil handling procedure for the excavation of the connection system and provide typical drawings. The specific soil handling procedure will vary according to the location of the project within the context of the natural subregion. Refer to the appropriate ***Recovery Strategies for Industrial Development in Native Prairie*** manual and the results of the pre-disturbance site assessment soils report to determine the most appropriate soil handling procedure.
- As wind farm construction often spans a twelve month period or more to reach completion, provide a timeline with conditions for temporary work stoppage, including for adverse weather conditions, clearly defined. Also, ensure all wildlife timing constraints that apply to the project are clearly defined in the construction schedule.
- Prepare a plan for weed control and vegetation management. Specify equipment cleaning procedures (where, when and how) and additional vegetation management required during the construction and interim reclamation phase.
- Where disturbance of native prairie occurs, the expected outcome at decommissioning is restoration of ecological health, function and operability. Plan for this expectation during all phases of development, monitor and apply adaptive management to ensure positive results.
- It is important to understand the ecological diversity of the Grassland and Parkland Natural Regions and the Montane Natural Subregion and the unique restoration challenges offered in each natural subregion. Recovery strategies for each natural subregion provide detailed guidance for restoration planning. Manuals to assist industry and stakeholders are available and include: ***Recovery Strategies for Industrial Development in Native Prairie for the Dry Mixedgrass Natural Subregion*** (RRMP 2013), for the ***Mixedgrass Natural Subregion*** (RRMP 2014), for the ***Northern Fescue Natural Subregion*** (RRMP 2016) and for the ***Foothills Fescue, Foothills Parkland and the Montane Natural Subregions*** (RRMP 2017). The manuals can be downloaded from *www.foothillsrestorationforum.ca* or ordered in hard copy from the Foothills Restoration Forum.

- Native seed and native plant materials suitable for the project area are often difficult to secure in sufficient quantities. Qualified professional expertise is required to ensure quality control of seed and plant materials. It is important to order supplies early in the project development phase; hence do not include purchasing of the native seed and plant material as part of the construction contract. Consider harvesting materials from the site prior to construction. Experienced restoration consultants and contractors are required for these tasks and a separate budget may be required.
- Include the Environmental Protection Plan in the construction bid package to ensure potential contractors are aware of its terms and conditions when preparing their bid.
- Convey to all staff and contractors corporate commitment to the Environmental Protection Plan through education and training.
- Engage a suitably qualified and experienced Environmental Monitor to monitor all phases of construction and to ensure the Environmental Protection Plan is followed, and the terms and conditions of approval by all regulatory agencies are carried out as specified.

Reclamation, Monitoring and Adaptive Management

- Prepare a detailed reclamation, restoration and post-construction monitoring plan appropriate to the location of the project within the natural subregion context. The plan must be consistent in its design and implementation through all phases of the project and include:
    - Erosion control procedures to stabilize soils during the construction period.
    - Interim reclamation to stabilize and revegetate the surface disturbance during the operation phase.
    - Final reclamation plans for decommissioning and abandonment.
- Monitoring reclamation and restoration progress is important during the operations phase. Adaptive management will be required. Ensure sufficient funds are included in annual operating budgets.

Decommissioning and Abandonment

- A “cradle to the grave” restoration planning approach is required to facilitate the recovery pathway at decommissioning and abandonment.
- Ensure site specific records are kept during construction, reclamation, and operations phases. Arrange to transfer the records if there is change of ownership of the project.

APPENDIX B: BENEFICIAL MANAGEMENT PRACTICES FOR UTILITY SCALE SOLAR POWER PROJECTS

Example of Solar Farm in Ontario, Canada

Utility-scale solar power projects are large scale systems which concentrate energy from the sun to supply electricity for profit into the electricity grid. There are two types of technology: 1) photovoltaic modules which convert light directly into electricity and 2) concentrated solar power that uses heat to drive a variety of conventional generator systems. Photovoltaic power is by far the most common type of commercial solar power system (www.wikipedia.org).

PV cells are semiconductor devices that generate direct current (DC) electricity. Silicon cells are usually sliced from ingots or castings of highly purified silicon. The manufacturing process creates a charge- separating junction, deposits passivation layers and an anti-reflective coating, and adds metal contacts. Cells are then grouped into modules, with transparent glass for the front, a weatherproof material for the back and often a surrounding frame. The modules are then combined to form strings, arrays and systems. PV can be used for on-grid and off-grid applications of capacities ranging from less than 1 watt to gigawatts. Grid-connected systems require inverters to transform DC power into alternating current (AC). The balance of system includes inverters, transformers, wiring and monitoring equipment, as well as structural components for installing modules, whether on building rooftops or facades, above parking lots, or on the ground. Installations can be fixed or track the sun on one axis (for non- or low-concentrating systems) or two axes (for high-concentrating systems), (IEA 2014).

The ***International Energy Agency Roadmap*** (IEA 2014) suggests the benefit of solar power is in the flexibility of the technology and the opportunities for installation on or near existing structures such as building roof tops, parking lot covers, supermarkets, shopping malls, schools, etc. The report suggests about one half the large deployment of PV predicted would take place on buildings or other structures. In India, solar panels are installed over water canals, producing energy as well as decreasing the amount of evaporation from the canals.

A large footprint of surface disturbance is required for utility scale commercial production into the grid. The land required for a commercially viable power output varies depending on the location, the efficiency of the solar modules, the slope of the site and the type of mounting used (Canadian Solar Industry Association Nov. 2016).

Wildlife Guidelines for Solar Energy Projects (AEP 2016d) details the pre-construction survey requirements and post-construction monitoring requirements. Alberta Environment and Parks Wildlife Management Unit is a required referral agency for application to Alberta Utilities Commission (AUC). A Wildlife Referral Report from the Wildlife Management Unit is required with application to AUC.

Beneficial Management Practices for Utility Scale Solar Energy Projects

The following draft beneficial management practices are intended to be used as a starting point to assist the solar energy industry in developing their own specific and more comprehensive BMPs, based on their knowledge of the industry technology, construction procedures, and operational requirements.

Implement the principles and guidelines using the tools described in ***Principles for Minimizing Surface Disturbance in Native Grassland - Principles, Guidelines and Tools for all Industrial Activity in Native Grassland in the Prairie and Parkland Landscapes of Alberta*** (AEP 2016a) with the goal to avoid native prairie and, where avoidance is not possible, to reduce the area of disturbance and other environmental impacts.

Follow the steps outlined in the Pre-disturbance Site Assessment Flow Chart (Figure 2) and the accompanying detailed instructions (AEP 2016a).

Planning and Siting

- In the initial project development phase, engage municipal authorities, landowners, companies with existing industrial infrastructure and community stakeholders in the development of an integrated land use management plan. It is beneficial to engage all land users in order to reduce the project footprint.

- Confirm that the proposed project is being developed in accordance with the applicable regional land use plan and municipal by-laws.
- Select a contiguous land base in previously disturbed land (land where the soils and native plant communities have been altered by cultivation or industrial land use), for the project footprint. Avoid including isolated areas of native prairie and wetlands and watercourses of all classes within the project footprint.
- Reduce the project footprint by combining solar and wind energy production facilities in a single project with connection to a single power plant and a single connection to the transmission grid.
- On private lands, avoid lands with conservation easements or agreements between a landowner and a conservation interest such as the Nature Conservancy of Canada, the Southern Alberta Land Trust, Alberta Conservation Association, MultiSar (Multiple Species at Risk) and others.
- Avoid foothills fescue grasslands in the Foothills Fescue, Foothills Parkland and Montane natural subregions including those on public land under protective notation (ASRD 2010). Avoid plains rough fescue plant communities located in the Mixedgrass, Northern Fescue and Central Parkland natural subregions.
- Avoid lands that potentially impact historic resources such as archaeological resources, paleontological resources, historic sites or structures and Indigenous traditional use site(s) defined under the provincial ***Historical Resources Act***.
- Native prairie landscapes are much valued for their unique viewscapes. Large solar developments can have significant visual impact in a prairie landscape. Address the impact of the development on regional viewscapes during the public information sessions. Discuss landscape and revegetation plans.
- Avoid sandy, choppy sand hill, and overflow ecological range sites, and locations with other potentially erodible soils.
- Follow the guidelines for required wildlife surveys and post-construction requirements detailed in ***Wildlife Guidelines for Solar Energy Projects*** (AEP 2016d). AEP Wildlife Management Unit is a required referral agency for application to AUC. A Wildlife Referral Report from the Wildlife Management Unit is required with application to AUC.
- Conduct a groundwater impact assessment.
- Avoid siting facilities near springs, wells, livestock watering facilities.
- Avoid areas with perched water tables.

- Loss or degradation of wetlands associated with native prairie must be avoided. Refer to the ***Alberta Wetland Policy*** and ensure the project design is in compliance.
- Locate the project near existing transportation corridors (rail or highway).
- Within the project footprint, negotiate with companies holding existing industrial infrastructure to utilize existing access roads or trials. Also, consult with landowners and or grazing lease holders regarding the feasibility of using existing farm or ranch trails during construction for either temporary or permanent access.
- Consider siting facilities on decommissioned petroleum, coal or gravel developments where reclamation certification has been obtained from AEP. Utilize the existing infrastructure for access and the decommissioned industrial sites for the installation of solar panels.
- Potential loss of agricultural productivity is a concern. Consult with each landowner to discuss the impact of the development on their agricultural operation both in the short term during construction and the long term. Discuss the impact on crop production and grazing management for livestock production. Discuss what measures can be practically implemented to maintain agricultural productivity.
- Combine access routes and the collection system in a single right of way to reduce fragmentation.
- Select sites with a minimum of topographic relief.
- Align the row spacing to reduce the shadow effect behind and between the rows. This will reduce the impact to the native grass species beneath and behind the panels.

Construction and Operations

- Once the Pre-disturbance Site Assessment has been completed and the final locations for solar panel racks agreed upon, prepare a detailed Environmental Protection Plan.
- Specify no-strip, minimal disturbance construction techniques for the installation of the solar racks, access and collection system. Use low impact equipment operating directly on the native grass. Use the beneficial available technology, requiring the least amount of soil disturbance (i.e. screw pile) to anchor the racks. Where possible avoid soil disturbance by using overhead conduits between the arrays of solar panel racks. Consider no-strip ploughed-in conduit installation or a directionally drilled collection system.
- Initiate construction when the native grassland vegetation is dormant, and the soils are dry and or frozen. Complete as quickly as possible.

- Define where access is required for routine operation. Use low impact ATVs between the rows and a low-profile single track leading to the power station.
- Include a traffic control plan to reduce the impact to soils, wildlife, livestock and residents.
- Specify the soil handling procedure for the excavation of the connection system and provide typical drawings. The specific soil handling procedure will vary according to the location of the project within the context of the natural subregion. Refer to the appropriate ***Recovery Strategies for Industrial Development in Native Prairie*** manual, and the results of the pre-disturbance site assessment soils report to determine the most appropriate soil handling procedure. No-strip minimal disturbance construction and natural recovery (no seeding) is the most effective restoration strategy in most natural subregions. Consider the use of interlocking matting or appropriate geotextiles as a temporary buffer to protect the native sod and soils during construction.
- Provide a timeline for construction activities with conditions for temporary work stoppage, including for adverse weather conditions, clearly defined. Also, ensure all wildlife timing constraints that apply to the project are clearly defined in the construction schedule.
- Prepare a plan for weed control and vegetation management. Specify equipment cleaning procedures (where, when and how) and additional vegetation management required during the construction and interim reclamation phase.
- Include the Environmental Protection Plan in the construction bid package to ensure potential contractors are aware of its terms and conditions when preparing their bid.
- Convey to all staff and contractors corporate commitment to the Environmental Protection Plan through education and training.
- Engage a suitably qualified and experienced Environmental Monitor to monitor all phases of construction to ensure the Environmental Protection Plan is followed, and the terms and conditions of approval by all regulatory agencies are carried out as specified.

Reclamation, Monitoring and Adaptive Management

- Where disturbance of native prairie occurs, the expected outcome at decommissioning is restoration of ecological health, function and operability. Plan for this expectation during all phases of development, monitor and apply adaptive management to ensure positive results.
- It is important to understand the ecological diversity of the Grassland and Parkland Natural Regions and the Montane Natural Subregion and the unique restoration challenges offered in each natural

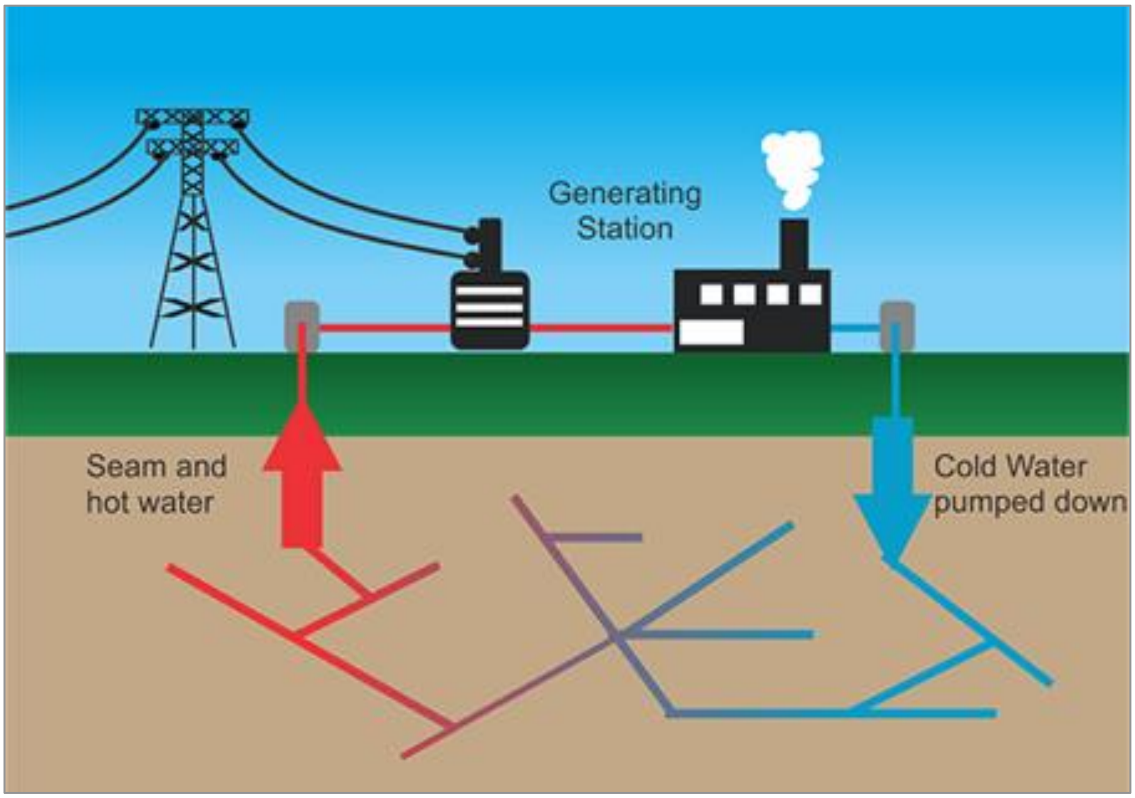
subregion. Recovery strategies for each natural subregion provide detailed guidance for restoration planning. Manuals to assist industry and stakeholders are available and include: ***Recovery Strategies for Industrial Development in Native Prairie for the Dry Mixedgrass Natural Subregion*** (RRMP 2013)***, for the Mixedgrass Natural Subregion*** (RRMP 2014), ***for the Northern Fescue Natural Subregion*** (RRMP 2016) and for the ***Foothills Fescue, Foothills Parkland and the Montane Natural Subregions*** (RRMP 2017). The manuals can be downloaded from www.foothillsrestorationforum.ca or ordered in hard copy from the Foothills Restoration Forum.

- Native seed and native plant materials suitable for the project area is often difficult to secure in sufficient quantity. This requires suitably qualified professional expertise to ensure quality control. Order supplies early in the project development phase and do not include purchasing of the native seed and plant material as part of the construction contract. Consider harvesting materials from the site prior to construction. Experienced restoration consultants and contractors are required for these tasks and a separate budget may be required.
- Prepare a detailed reclamation, restoration and post construction monitoring plan appropriate to the location of the project within the natural subregion context. The plan must be consistent in its design and implementation through all phases of development and include:
    - Erosion control procedures to stabilize soils during the construction period.
    - Interim reclamation to stabilize and revegetate the surface disturbance during the operation phase.
    - Final restoration plans for decommissioning and abandonment. Again specify minimal disturbance procedures.
- Monitoring reclamation and restoration progress is important during the operations phase. Adaptive management will be required. Ensure detailed site specific records are kept and archived. Review on an annual basis.
- Ensure sufficient funds for monitoring and adaptive management are included in annual operating budgets.

Decommissioning and Abandonment

- A “cradle to the grave” restoration planning approach is required to facilitate the recovery pathway at decommissioning and abandonment.
- Ensure site specific records are kept during construction, reclamation and operations phases. Arrange to transfer the records if there is a change of ownership of the project.

APPENDIX C: BENEFICIAL MANAGEMENT PRACTICES FOR UTILITY-SCALE GEOTHERMAL POWER GENERATION PROJECTS



Geothermal Power Generation, Image Courtesy of www.CanGea.ca

A viable geothermal system requires underground heat, permeability and water. Rainwater and snowmelt feed underground thermal aquifers. When hot water or steam is trapped in cracks and pores under a layer of impermeable rock, it forms a geothermal reservoir. Geothermal power generation involves drilling for heated water reservoirs which produce steam used to generate electricity.

Geothermal power plants are similar to nuclear or coal-fired generating plants because the energy source can produce energy at a constant rate, unlike wind and solar which must wait for the wind to blow or the sun to shine. A geothermal plant can also be engineered to be firm, flexible, and load following, and otherwise support the needs of the grid. Most geothermal plants being built now have adjustable dispatching capabilities, as does energy generated using natural gas. This means a geothermal plant can meet fluctuating needs, such as those caused by the intermittency of solar and wind power.

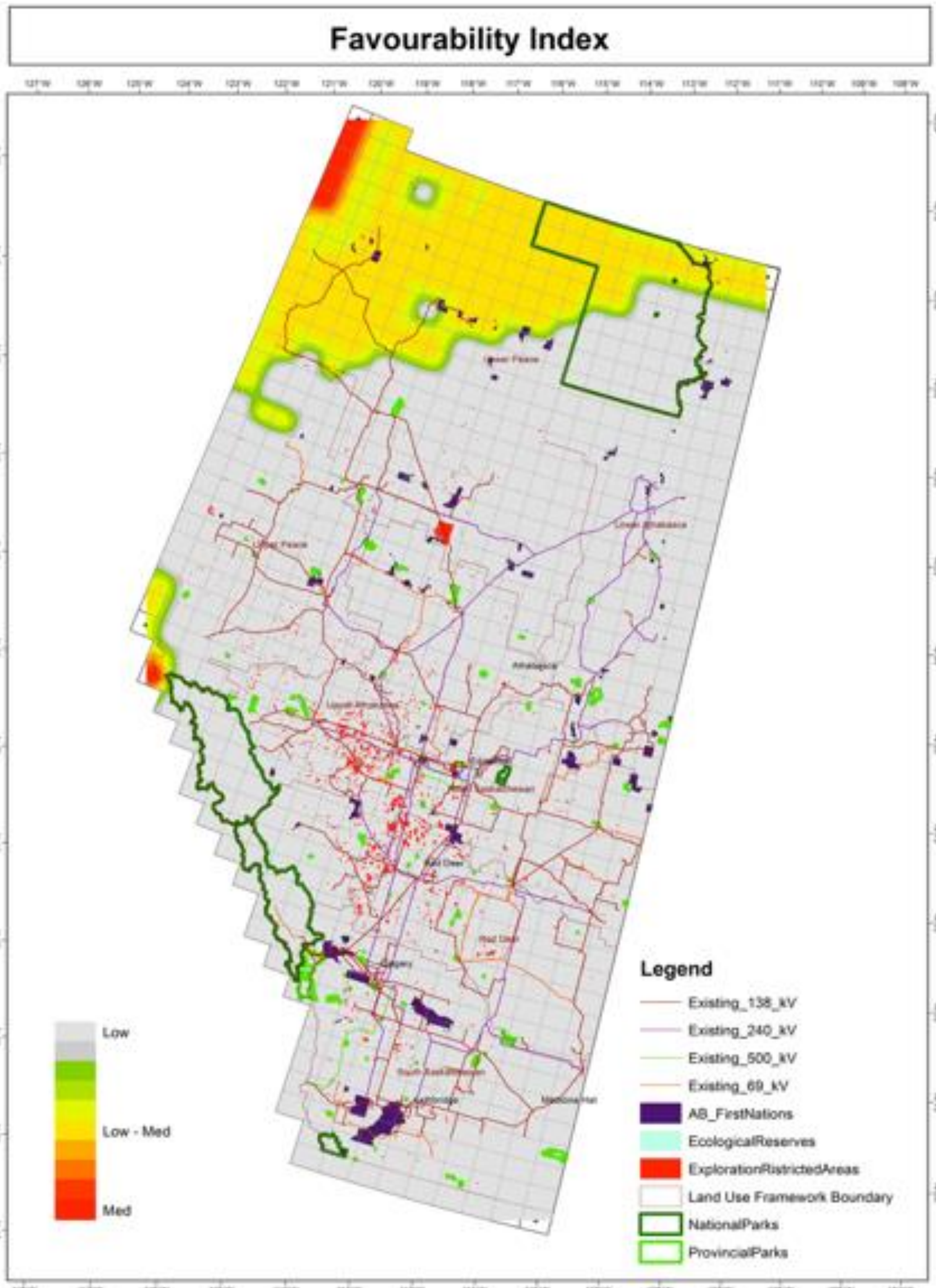
There are three types of geothermal power plants:

1. **Geothermal flash power**: High pressure separates steam from water in a "steam separator" as the water rises and as pressure drops. Water temperature must be above 150 degrees Celsius. The steam is delivered to the turbine, and the turbine then powers a generator. The water is reinjected into the reservoir.
2. **Dry steam power**: Steam alone is produced directly from the geothermal reservoir and is used to run the turbines that power the generator. Temperature must be above 150 degrees Celsius. Because there is no water, the steam separator used in a flash plant is not necessary.
3. **Binary geothermal power plants**: Geothermal water is used in an organic Rankine Cycle system to heat a second liquid that boils at a lower temperature than water, such as isobutane or pentafluoropropane. This is called a working fluid (or "motive fluid"). A heat exchanger separates the water from the working fluid while transferring the heat energy. When the working fluid vaporizes, the force of the expanding vapor, like steam, turns the turbines that power the generators. The geothermal water is then reinjected in a closed loop, separating it from groundwater sources and lowering emission rates further. Binary geothermal power plants have made it possible to produce power from geothermal resources lower than 150 degrees Celsius, (Geothermal Energy Fact Sheet, www.CanGEA.ca).

The **Canadian National Geothermal Database** is an interactive map database, which compiles existing geological information to illustrate areas with potential high geothermal anomalies. Alberta maps indicate subsurface temperatures at various depths from 100 meters to 5500 meters (CanGEA.ca) (Figure 3).

Recently interest has been generated in retrofitting decommissioned and abandoned oil and gas wells in Alberta to generate heat or electric power. CanGEA is currently undertaking a study to determine potential locations based on geological data produced by the oil and gas industry (www.albertaoilmagazine.com).

Figure 3 – Geothermal Map



Source: www.CanGEA.ca

Beneficial Management Practices for Utility-scale Geothermal Energy Projects

The following draft beneficial management practices are intended to be used as a starting point to assist the geothermal energy industry in developing their own specific and more comprehensive BMPs, based on their knowledge of the industry technology, construction procedures, and operational requirements.

Implement the principles and guidelines using the tools described in ***Principles for Minimizing Surface Disturbance in Native Grassland - Principles, Guidelines and Tools for all Industrial Activity in Native Grassland in the Prairie and Parkland Landscapes of Alberta*** (AEP 2016a) with the goal to avoid native prairie and, where avoidance is not possible, to reduce the area of disturbance and other environmental impacts. Follow the steps outlined in the Pre-disturbance Site Assessment Flow Chart and the accompanying detailed instructions (AEP 2016a).

Planning and Siting

- In the initial project development phase, engage municipal authorities, landowners, companies with existing industrial infrastructure and community stakeholders in the development of an integrated land use management plan. It is beneficial to engage all land users in order to reduce the project footprint.
- Support the needs of the transmission grid by combining geothermal generating facilities with solar or wind energy production facilities in a single project with connection to a single power plant and connection to the transmission grid.
- Confirm that the proposed project is being developed in accordance with the applicable regional land use plan and municipal by-laws.
- When planning to retrofit existing decommissioned and abandoned oil or gas wells avoid remote locations far from existing transmission facilities.
- Reduce the footprint by locating the project as close to existing transmission facilities with load capacity to service the proposed project. Within the footprint, locate the plant site as close to existing transmission facilities as possible.
- On private lands, avoid lands with conservation easements or agreements between a landowner and a conservation interest such as the Nature Conservancy of Canada, the Southern Alberta Land Trust Society, Alberta Conservation Association, MultiSar (Multiple Species at Risk) and others.

- Avoid foothills fescue grasslands in the Foothills Fescue, Foothills Parkland and Montane natural subregions including those on public land under protective notation (ASRD 2010). Avoid Plains rough fescue plant communities located in the Mixedgrass, Northern Fescue and Central Parkland natural subregions.
- Ensure project development complies with ***Recommended Land Use Guidelines: Key Wildlife and Biodiversity Zones*** (ESRD 2015). Consider access requirements, siting of permanent facilities and noise generated by the facilities. This would apply to both retrofitted decommissioned well sites and new geothermal generating stations.
- Ensure the soils of abandoned or decommissioned well sites proposed for retrofit are free of pollutants and contaminants.
- Conduct a groundwater impact assessment for both retrofitted decommissioned wells and new geothermal generating stations.
- Avoid siting facilities near springs, wells, livestock watering facilities. Avoid areas with perched water tables.
- Loss or degradation of wetlands associated with native prairie must be avoided. Refer to the ***Alberta Wetland Policy*** and ensure the project design is in compliance.
- Consult with each landowner to discuss the impact the development on their agricultural operation both in the short term during construction and the long term. Discuss the impact on crop production and grazing management for livestock production.
- Combine access routes and the collection system in a single right of way to reduce fragmentation.
- Select sites with a minimum of topographic relief to reduce the grading, soil handling and reclamation required for access and construction of geothermal generating stations.

New Construction, Drilling, Completions and Operations

- Once the Pre-disturbance Site Assessment has been completed and the final locations for associated infrastructure agreed upon, prepare a detailed Environmental Protection Plan.
- Ensure all Alberta Energy Regulator environmental conditions and requirements for drilling and completions are clearly listed in the Environmental Protection Plan, monitored for and complied with during all phases of development.
- Include detailed strip and grade, soil handling and soil storage specifications with typical drawings for new construction geothermal plant sites. Include erosion and sediment control procedures and plans.

- For all new access routes, prepare detailed drawings designed to reduce the amount of strip and grade required to construct a low-profile road. Indicate soil handling and storage requirements. Use the beneficial available technology to reduce the disturbance, appropriate for the soils, heavy loads and construction requirements.
- Include a traffic control plan to reduce the impact to soils, wildlife, livestock and residents.
- Specify the soil handling procedure for the excavation of the connection system and provide typical drawings. The specific soil handling procedure will vary according to the location of the project within the context of the natural subregion. Refer to the appropriate ***Recovery Strategies for Industrial Development in Native Prairie*** manual (www.foothillsrestorationforum.ca), and the results of the pre-disturbance site assessment soils report to determine the most appropriate soil handling procedure.
- Provide a timeline for construction activities with conditions for temporary work stoppage, including for adverse weather conditions, clearly defined. Also, ensure all wildlife timing constraints that apply to the project are clearly defined in the construction schedule.
- Prepare a plan for weed control and vegetation management. Specify equipment cleaning procedures (where, when and how) and additional vegetation management required during the construction and interim reclamation phase.
- Where disturbance of native prairie occurs, the expected outcome at decommissioning is restoration of ecological health, function and operability. Plan for this expectation during all phases of development, monitor and apply adaptive management to ensure positive results.
- It is important to understand the ecological diversity of the Grassland and Parkland Natural Regions and the Montane Natural Subregion and the unique restoration challenges offered in each natural subregion. Recovery strategies for each natural subregion provide detailed guidance for restoration planning. Manuals to assist industry and stakeholders are available and include: ***Recovery Strategies for Industrial Development in Native Prairie for the Dry Mixedgrass Natural Subregion*** (RRMP 2013), for the ***Mixedgrass Natural Subregion*** (RRMP 2014), for the ***Northern Fescue Natural Subregion*** (RRMP 2016) and for the ***Foothills Fescue, Foothills Parkland and the Montane Natural Subregions*** (RRMP 2017). The manuals can be downloaded from www.foothillsrestorationforum.ca or ordered in hard copy from the Foothills Restoration Forum.

- Native seed and native plant materials suitable for the project area are often difficult to secure in sufficient quantities. Qualified professional expertise is needed to ensure quality control of seed and plant materials. It is important to order supplies early in the project development phase; hence do not include purchasing of the native seed and plant material as part of the construction contract. Consider harvesting materials from the site prior to construction. Experienced restoration consultants and contractors are required for these tasks and a separate budget may be required.
- Prepare a detailed reclamation, restoration and post construction monitoring plan appropriate to the location of the project within the natural subregion context. The plan must be consistent in its design and implementation through all phases of development and include:
    - Erosion control procedures to stabilize soils during the construction period.
    - Interim reclamation to stabilize and revegetate the surface disturbance during the operation phase.
    - Final restoration plans for decommissioning and abandonment. Again specify minimal disturbance procedures.
- Monitoring reclamation and restoration progress is important during the operations phase. Adaptive management will be required. Ensure detailed site specific records are kept and archived. Review on an annual basis.
- Ensure sufficient funds for monitoring and adaptive management are in place in annual operating budgets.

Decommissioning and Abandonment

- A "cradle to the grave" restoration planning approach is required to facilitate the recovery pathway at decommissioning and abandonment.
- Ensure site specific records are kept during construction, reclamation and operations phases. Arrange to transfer the records if there is change of ownership of the project.