Best Management Practices for Pipeline Construction in Native Prairie Environments

October 2003

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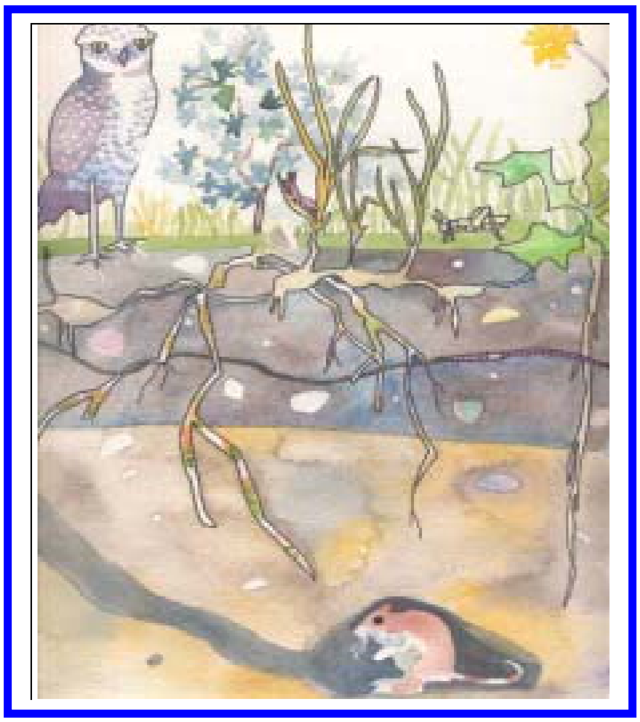
Best Management Practices

For

Pipeline Construction

In Native Prairie Environments



A Guide for Minimizing the Impact of Pipeline Construction
On the Native Prairie Ecosystem

Alberta Environment

Alberta Sustainable Resource Development

Best Management Practices for Pipeline Construction in Native Prairie Environments

A Guide for Minimizing the Impact of Pipeline Construction on the Native Prairie Ecosystem

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Disclaimer:
This guide is intended to provide users with up-to-date information about best management practices for pipeline construction on native prairie.

The opinions, findings and recommendations expressed in this report are those of the author and do not necessarily reflect the views of government, industry, consultants or academics. Mention of trade names, commercial products or machinery does not constitute endorsement, or recommendation for use.

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This document represents the compilation of many ideas put into practical application by skilled and dedicated operators in the pipeline industry. The author would like to acknowledge and thank industry for their willingness to put new ideas into practice and for expanding the field of reclamation science. A special thanks to Ted Dunn, Don Litle and John Ness. They bring years of experience to the pipeline industry and were never afraid to accept new challenges and new ideas.

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1 BACKGROUND

Petroleum development activities in the Western Sedimentary Basin have caused and continue to cause considerable disturbance to remaining native prairie ecosystems. Native prairie environments are valued and utilized by numerous stakeholders. Livestock producers depend on native prairie grasslands to provide valuable grazing opportunities on both publicly owned and deeded lands. Alteration of these sustainable grasslands, through improperly planned petroleum development activities, can delay the recovery time and alter the productivity of these valuable grasslands.

Native prairie ecosystems are also valued by the general public for their aesthetic appeal, for their recreation potential, for educational purposes and as critical habitat for wildlife, including endangered species. Continued successful petroleum development must consider multi-stakeholder concerns and strive to incorporate innovative planning, defensible environmental science and implement site-specific best management practices (BMP) to achieve sustainable resource development. Petroleum development activities must be implemented in partnership with land based stakeholders.

Photo 1 The importance of native prairie. Cypress Hills, south of Medicine Hat.

1.1 The Need for the Manual

Alberta Environment (AENV) and Alberta Sustainable Resource Development (ASRD) continue to work with the petroleum industry to improve construction and reclamation practices that minimize impacts of development activities in native prairie environments. Research projects funded by both industry and government agencies have identified less intrusive ways of managing construction activities in native prairie landscapes. Research has been put into practice through a series of publications generated to inform all industry stakeholders about minimum disturbance practices. These publications include guidelines, information letters, books and manuals. The need to ensure that all operators are using the same information was the incentive for the development of this manual. The manual is also intended to inform landowners, interested stakeholders, public and operators of the expectations of regulatory agencies and legislation for pipeline construction and reclamation activities in native prairie environments.

A workshop initiated and supported by AENV and ASRD and organized by Gramineae was held in Claresholm, Alberta on February 15, 2002. The purpose of the workshop was to bring stakeholders together to discuss the conservation and reclamation goals for pipeline construction and reclamation in native prairie environments, current pipeline construction practices and to brainstorm possible improvements to pipeline construction and reclamation practices. An issue list based on field observations by AENV, ASRD and the Special Areas Board was prepared prior to the workshop.

The workshop was advertised on the Canadian Land Reclamation Association website and the Canadian Association of Petroleum Producers website. Pipeline construction contractors were also invited to participate so that their input and concerns could be included in the process. The workshop was very well attended and the turnout far exceeded the expectations of the planners. Approximately 175 people attended including pipeline construction contractors, representatives from energy producing and transmission companies, environmental planners, environmental inspectors and reclamation contractors. The Western Stock Growers Association represented the agricultural sector. First Nations were also in attendance.

Representatives of AENV, ASRD and the Special Areas Board all gave presentations on their regulatory responsibilities. The contractor retained by AENV and ASRD to develop the manual presented a draft outline of the manual to facilitate discussion. In the afternoon the attendees were divided into nine breakout sessions, each with a facilitator who promoted discussion and recorded the comments from the group. The facilitators were chosen for their experience in environmental impact analysis and their construction experience in native prairie environments.

Each group was asked to discuss a set of questions based on current pipeline construction issues and the conservation and reclamation goals for pipeline construction in native prairie. The breakout sessions generated valuable input for the preparation of this manual. A summary of the discussions and input received from interested stakeholders who could not attend has been summarized in Appendix 9.1 Workshop Summary.

Marilyn Neville, AENV and ASRD would like to thank the facilitators and all the participants for their valuable input and support in the preparation of this manual.

Photo 2 Express Pipeline - South Saskatchewan River Crossing.

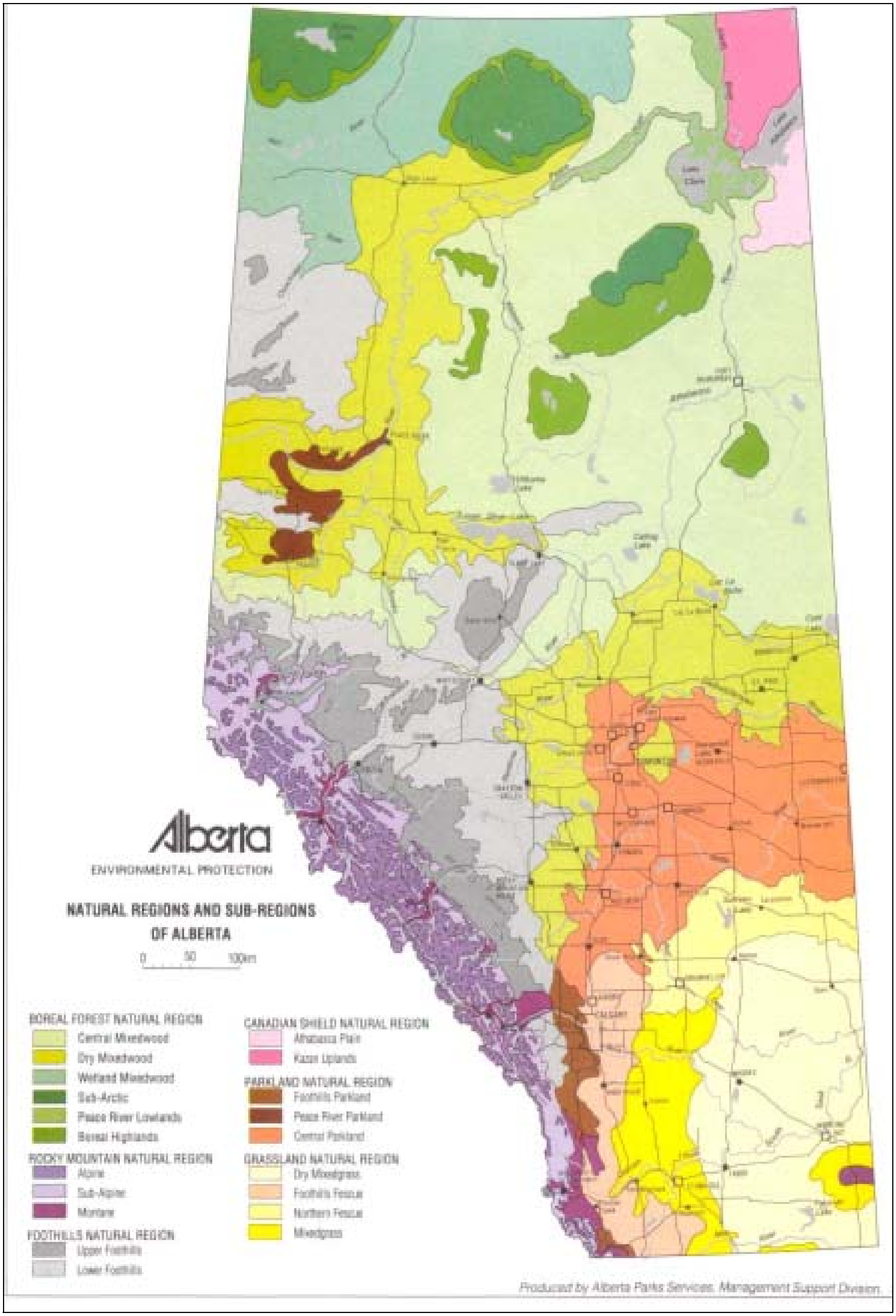
1.2 What are Best Management Practices?

Best management practices (BMPs) have been developed for many activities that affect our lives. They serve as planning tools that detail practices that, if implemented effectively, increase the chances of meeting the long-term goals of conservation and reclamation of each project. In addition, BMPs identify areas where improvement is needed and explore possible solutions. The goal of *Best Management Practices for Pipeline Construction in Native Prairie Environments* is the development and use of procedures by operators that protect and conserve all aspects of our diminishing prairie environment.

1.3 Application of the Best Management Practices

The BMPs in this document provide useful guidance to development in all native prairie environments. Operators are encouraged to implement them where appropriate. On public land and some Class 1 pipelines requiring a Conservation and Reclamation approval from AENV, some of the BMPs are requirements of the disposition or approval.

Photo 3 Express Pipeline, South Saskatchewan River Crossing


Alberta
ENVIRONMENTAL PROTECTION
NATURAL REGIONS AND SUB-REGIONS
OF ALBERTA
0
50
100km
BOREAL FOREST NATURAL REGION
Central Mixedwood
Dry Mixedwood
Wetland Mixedwood
Sub-Arctic
Peace River Lowlands
Boreal Highlands
ROCKY MOUNTAIN NATURAL REGION
Alpine
Sub-Alpine
Montane
FOOTHILLS NATURAL REGION
Upper Foothills
Lower Foothills
CANADIAN SHIELD NATURAL REGION
Athabasca Plain
Kazan Uplands
PARKLAND NATURAL REGION
Foothills Parkland
Peace River Parkland
Central Parkland
GRASSLAND NATURAL REGION
Dry Mixedgrass
Foothills Fescue
Northern Fescue
Mixedgrass
Produced by Alberta Parks Services, Management Support Division.

2 OVERVIEW OF NATIVE PRAIRIE GRASSLANDS AND PARKLANDS IN ALBERTA

Native grassland and parkland communities are very diverse in Alberta. Native vegetation communities have developed over time in response to soil moisture, climate, topography and soil characteristics. Alberta landscapes have been mapped into Natural Regions and Sub-regions based on native vegetation communities and soils. Native prairie vegetation is encountered in areas mapped within the Grassland and Parkland Natural Regions (Achuff 1994). It is very important that pipeline construction project managers understand the native grassland community types in construction areas at the planning stage in order to design and implement the most effective construction procedures to conserve and restore the grassland to its pre-disturbance productive capability.

2.1 Rare Plants and Rare Plant Communities

A rare plant species is any native plant that exists in low numbers or in very restricted areas. Many factors determine the distribution of rare plant species. Some rare Alberta species may have developed or persisted as isolated populations in areas not affected by glaciation. Other species are peripheral and found at the edge of their geographic range. Endemic species are restricted to a specific geographic area and disjunct species are populations separated from the main range of their species by 500 kilometers or more. A few of Alberta's rare plant species have wide distribution within North America but are uncommon wherever they are found (Kershaw et al. 2001). Operators should be aware that rare plants and rare plant communities exist in both the Grassland and Parkland Natural Regions. The Alberta Natural History Information Centre (ANHIC) maintains a database of known rare plant locations and rare plant communities of concern.

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Photo 4 Few flowered Asters, South Saskatchewan River Valley, Alberta

2.2 Dry Mixed Grass Sub-region

The Dry Mixed Grass Sub-region is located in the southeastern portion of the province, from Hanna and Bassano south to the United States border and east to the Saskatchewan border. General features include:

- This sub-region is the most arid in the province and has severe limitations for plant growth due to climate and soil moisture conditions.
- The characteristic soils of the Dry Mixed Grass Sub-region are Brown Chernozems. Brown Solonetz soils are common in the extreme southeast of the sub-region and in a large area north of Dinosaur Provincial Park.
- The topography is generally subdued with only a few minor uplands.
- The Sub-region is drained by several major rivers that have carved deeply into the bedrock in some places. This has exposed Cretaceous shales and sandstones, creating extensive badlands. Badlands present challenges for pipeline construction due to potential slope erosion and paleontological resources.
- In undisturbed native prairie, native plants tend to be widely spaced to conserve moisture and nutrients. Between plants, the soil surface is protected by a cover of mosses and lichens that seal the surface of the soil preventing soil erosion and conserving moisture.
- Needle and thread grass and blue grama grass associations tend to dominate dry, upland sites. These species are specifically adapted to arid conditions. The plants respond to moisture when it is available and survive periods of drought by becoming dormant.
- Moister sites tend to be dominated by needle and thread grass and blue grama grass with native wheat grasses and western porcupine grass associations. These sites are generally more productive due to increased soil nutrients and moisture.
- Needle and thread grass, western wheat grass and blue grama grass associations tend to dominate Solonetzic soil sites. The rooting structure of the vegetation has adapted to the thin topsoil overlying hardpan clays.
- Saline sites tend to be dominated by western wheat grass and salt grass species. Species encountered on these sites are specially adapted to the high salt content in the soils. Distinguish between Solonetzic sites and saline sites.
- Sandy soils and sand dunes tend to be dominated by needle and thread grass, prairie sand reed grass, June grass and a variety of low shrubs such as sagebrush, wolf willow, western snowberry and prickly rose. These sandy sites have very diverse vegetation that is adapted to rapidly drained, coarse textured soils. Plant rooting structures anchor the sand particles and prevent soil erosion.

2.3 Mixed Grass Sub-region

The Mixed Grass Sub-region is located west of the Dry Mixed Grass Sub-region within a defined rise in elevation in the prairie landscape. The western boundary of this region is the transition to the Foothills Fescue Natural Sub-region and the northern boundary is the transition to the Northern Fescue Sub-region. The Mixed Grass Sub-region is also found on the lower slopes of the Cypress Hills and the Sweetgrass Hills. General features of this sub-region are:

- Topography is generally subdued with only a few minor uplands. The few permanent streams are well defined. There are important areas of glaciolacustrine sand plains and fine-textured glaciolacustrine lake deposits that can pose challenges for pipeline construction.
- Characteristic soils of the Mixed Grass Sub-region are Dark Brown Chernozems.
- The Mixed Grass Sub-region receives more moisture (approximately 20%) than the Dry Mixed Grass Sub-region and undisturbed soils are generally more fertile.
- Because of this, much of the grassland in this Sub-region has been lost to agricultural crop production. The remnant native prairie in this region is generally located on less productive soils.
- The impact of grazing livestock has altered species composition leading to less productive native plant communities in some areas. Weeds and non-native species are a concern in overgrazed or recovering native pastures.
- Needle and thread grass and blue grama grass tend to dominate upland sites. Native wheat grasses increase their dominance on sites with increased available moisture.
- Coarse textured sandy soils tend to support needle and thread grass, western porcupine grass, native wheat grasses, June grass and Indian rice grass.
- Mid and lower slope sites tend to support northern wheat grass and green needle grass in response to increased moisture and soil fertility.

2.4 Foothills Fescue Sub-region

The Foothills Fescue Sub-region is located to the west of the Mixed Grass Sub-region and to the east of the Foothills Parkland and Montane Sub-regions. This band extends north from the United States border up to the Central Parkland Sub-region. There are also disjunct areas on the lower slopes of the Sweetgrass Hills, the Milk River Ridge and the upper slopes of the Cypress Hills and the Eagle Butte area. These disjunct areas are transition zones that contain both foothills and plains rough fescue. General features of this sub-region are:

- Topography is subdued in the eastern portion of the sub-region, with frequent uplands and steep slopes along the western boundary. Rivers and permanent creeks are well defined.

- Soils are predominantly Dark Brown and Black Chernozems. Elevations are much higher than the surrounding grasslands.
- The climate is strongly affected by chinook winds. Wind erosion is a concern for pipeline construction. Rapid freeze and thaw cycles during chinooks can cause problems during winter pipeline construction.
- Annual precipitation is the highest in the entire Grassland Natural Region.
- The dominant plant species in this sub-region tends to be foothills rough fescue, a densely tufted bunch grass. Rough fescue is highly valued for pasture by the ranching community. Rough fescue "cures on the stem", providing nutritious winter pasture for cattle and valuable winter range for wildlife such as elk and mule deer.
- The rough fescue community is the most mature community capable of self-perpetuation under the prevailing climatic and soil conditions. It reproduces primarily through setting seed and then only when conditions are right (every few years). Rough fescue seed for reclamation must be "wild harvested" and suitable seed is often not available.
- The growth points located in sheaths at the base of rough fescue are susceptible to damage during the active growing season.
- Rough fescue communities are very diverse and productive. Rough fescue is usually dominant and tends to be found growing with Idaho fescue, Parry's oat grass in the foothills and intermediate oat grass in the Cypress Hills. Associated grasses tend to be June grass, northern wheat grass, awned wheat grass and western porcupine grass. These grasslands also support a wide variety of native forb species.
- ANHIC has listed several rare plant communities within this sub-region on the Preliminary Plant Community Tracking List.

2.5 Northern Fescue Sub-region

The Northern Fescue Sub-region extends in a broad band to the north of the Dry Mixed Grass Sub-region, south of the Central Parkland Sub-region and west to the northern boundaries of the Mixed Grass and Foothills Fescue Sub-regions. Drumheller, Coronation and Consort are located in this sub-region.

There is very little undisturbed native prairie left in this sub-region. The remnant native prairie is found in geographically separated islands such as the Hand Hills in the central and eastern portions of Alberta. These islands of rough fescue prairie are surrounded by cultivation, forage crops and recovering native prairie. Every effort should be made to avoid disturbing these remnants. ANHIC has listed five community types within this Natural Sub-region on its Watch List. General features of this sub-region include:

- Topographically, the Northern Fescue Sub-region is characterized by gently rolling terrain. The most common landforms are low-relief ground moraine and hummocky moraine. Areas of outwash and sand plains, dune fields and fine-textured glaciolacustrine deposits occupy a smaller but significant amount of the landscape. Eroded plains are important in the Sullivan Lake area.

- Stream drainage is part of the Saskatchewan River system, except for a large area of internal drainage in the Sounding Creek basin. Few stream valleys dissect the sub-region but those with permanent flows are usually well incised.
- The predominant soils are Dark Brown and Black Chernozems, with Brown Solonetz soils extending through the center of the sub-region in a broad band north of Hanna. Solonetzic soils require special handling during pipeline construction.
- Northern fescue sites are dominated by plains rough fescue. Plains rough fescue is similar to foothills rough fescue, except that the bunches are smaller and it is shorter in stature, with slightly rhizomatous roots. These allow the plants to reproduce vegetatively.
- Plains rough fescue seed must be “wild harvested” and suitable seed is often not available.
- Sandy upland sites tend to be dominated by plains rough fescue, June grass, needle and thread grass and sand grass species.
- More mesic sites tend to be dominated by plains rough fescue and western porcupine grass.
- Solonetzic sites tend to support plains rough fescue, western porcupine grass and native sedge species.

2.6 Central Parkland Sub-region

The Central Parkland Sub-region extends in a broad arc between the Grassland Natural Region to the south and the Dry Mixed Wood Sub-region of the Boreal Forest Natural Region to the north. It is a transition region with groves of aspen interspersed with open grasslands in the south, to aspen forest broken by grassland openings, to closed aspen forest in the northern portion of the sub-region. Many of the grassland communities have been replaced by agricultural crops. General features of this sub-region include:

- Topographic features are diverse throughout the region. Characteristic terrain is rolling to moderately steep, with steep slopes encountered in the major river valleys.
- Numerous permanent streams cut across the sub-region. Lakes and a wide variety of permanent wetlands are scattered throughout the sub-region. Many of the lakes and wetlands are slightly-to-strongly saline.
- The climate in the Parkland Natural Region is cooler than in the Grassland Natural Region, with higher annual precipitation.
- Black and Dark Brown Chernozem soils predominate under grassland vegetation while Dark Grey Chernozems and Luvisols are most common in moister aspen woodlands. Dark Brown Chernozems occur under woodland vegetation on sandy parent materials. A strip of Brown Solonetz soils runs through the centre of the sub-region from Vegreville through Beaverhill Lake and into the Sullivan and Dowling Lakes areas. Coarse textured sandy soils are encountered in the Wainwright area.

- Vegetation in this sub-region resembles vegetation associations in the Northern Fescue Sub-region. Plains rough fescue tends to dominate most sites with western porcupine grass. Western porcupine grass, June grass and western wheat grass tend to be dominant on Solonetzic sites.
- Two major forest types are encountered in this sub-region: trembling aspen on dry upland sites; balsam poplar in the moister depressions in the south and balsam poplar in the more closed canopy forest in the north. Both forest types are characterized by a dense, species-rich understory. It is important when constructing pipelines in this sub-region to preserve the biodiversity of the forested areas as well as the grassland communities.
- ANHIC has listed several rare plant communities within this sub-region on the *Preliminary Plant Community Tracking List*.

2.7 Foothills Parkland Sub-region

The Foothills Parkland Sub-region occupies a narrow band along the eastern edge of the foothills from Calgary south to the Porcupine Hills and from Pincher Creek south to the U.S. border in Waterton Lakes National Park. The Foothills Parkland is a transitional region between the grasslands of the Foothills Fescue Sub-region and the forests of the Montane Sub-region. As in the Central Parkland Sub-region there is a continuum from grassland with aspen and willow groves, to forest with grassland openings, to closed deciduous forest. General features include:

- The topography is complex, often changing abruptly within short distances. Steep slopes are encountered, often associated with the numerous permanent streams that cross the region. Extensive river terraces occur in some areas.
- Predominant soils in the grassland areas are Dark Brown and Black Chernozems. Regosolic soils occur on active stream floodplains while Gleysolic soils occur on wetland sites.
- Climate is similar to the Foothills Fescue Sub-region, with slightly higher annual precipitation. Climate is strongly affected by chinook winds and subject to rapid changes in temperature. Both wind and water erosion can be of concern to pipeline construction.
- Grassland communities are similar to the Foothills Fescue Sub-region. Rough fescue and oat grass species tend to be dominant on upland sites with diverse forb species.
- Aspen communities are interspersed with rough fescue grasslands in the uplands. Balsam poplar communities occur on moister sites. Willow groves are encountered extensively in the northern portion of the sub-region on imperfectly-to-poorly-drained sites associated with drainages and north aspects. The understory of all three communities is very diverse and it is important to conserve these communities.
- This sub-region contains many rare plants at the northern limit of their range. ANHIC has also listed Rare Plant Communities within this sub-region on the *Preliminary Plant Community Tracking List*.

2.8 Peace River Parkland Sub-region

The Peace River Parkland is located in the Grande Prairie and Peace River Areas mainly associated with broad upland hills and river valleys. A narrow band of Parkland extends from just west of Peace River, following the Peace River valley on the north side and south into the Spirit River and Rycroft areas, including the Birch Hills. The parkland area encountered in the Grande Prairie area is separated to the north by the sub-alpine Saddle Hills.

Broad, gently rolling plains with scattered upland and deeply incised river valleys, characterizes the Peace River Parkland. Most of the original extensive grasslands of this sub-region have been cultivated and only small, scattered remnants remain in native prairie vegetation. ANHIC has listed the native grassland communities on the *Preliminary Plant Community Tracking List*. These isolated native grasslands are notable for their disjunct occurrence and the presence of species that have a more southerly or western distribution. Every effort should be made to avoid these communities.

- This sub-region has shorter, cooler summers and longer, cooler winters than the other Parkland Sub-regions. It also has more precipitation and less wind.
- Soils of the remaining native grasslands are mostly Solonetzic while the forested portions occur on Luvisolic soils.
- The dominant native grassland species on Solonetzic soils include: native sedge species, intermediate oat grass, western porcupine grass and bearded wheat grass. Grasslands on steep, south-facing slopes tend to be dominated by western porcupine grass, native sedge species and pasture sage. Other common species include: Columbia needle grass, June grass, green needle grass and native forb species.
- Upland forests of this sub-region are very similar to the surrounding Mixed Wood Boreal Forest. They are dominated by aspen and white spruce with lesser amounts of balsam poplar, especially on wetter sites. It is important to conserve the biodiversity of the forested areas within this sub-region as well.

Grassland and Parkland Natural Regions

Photo 5 Dry Mixedgrass Sub-region

Photo 6 Mixedgrass sub-region

Photo 7 Foothills Fescue Subregion

Photo 8 Northern Fescue Subregion

Photo 9 Foothills Parkland Subregion

Photo 10 Central Parkland Subregion

3 OVERVIEW OF NATIVE PRAIRIE SOILS IN ALBERTA

Native prairie soils present unique challenges to pipeline construction. Unlike cultivated soils where topsoil depths are relatively constant, prairie topsoils blanket the landscape in a wavy pattern. Topsoil depths and types encountered follow the natural processes of wind and water erosion within the landscape. Prairie soils are important for nutrient and moisture cycling and provide the growth medium for uniquely adapted prairie vegetation. Native prairie soils are primarily classified within the Chernozemic, Regosolic or Solonetzic Orders.

3.1 Chernozemic Soils

Chernozemic soils (loamy surface soils) have a humus-rich topsoil layer relative to the subsoil and are developed and maintained by the growth of prairie grasses and forbs. Thickness depends primarily on texture within a soil zone. Topsoil depths are variable, with increasing thickness from drier to wetter climates and respond mainly to aspect and landscape position. Chernozems can vary from well-to-imperfectly drained in response to the underlying parent material and landscape position. Coarse fragment content in the subsoils can be of concern in some areas. Compaction can also be an issue for construction if finer textured subsoils are present. When stripped for construction purposes loamy textured topsoil may be subject to water erosion or to wind erosion during periods of drought.

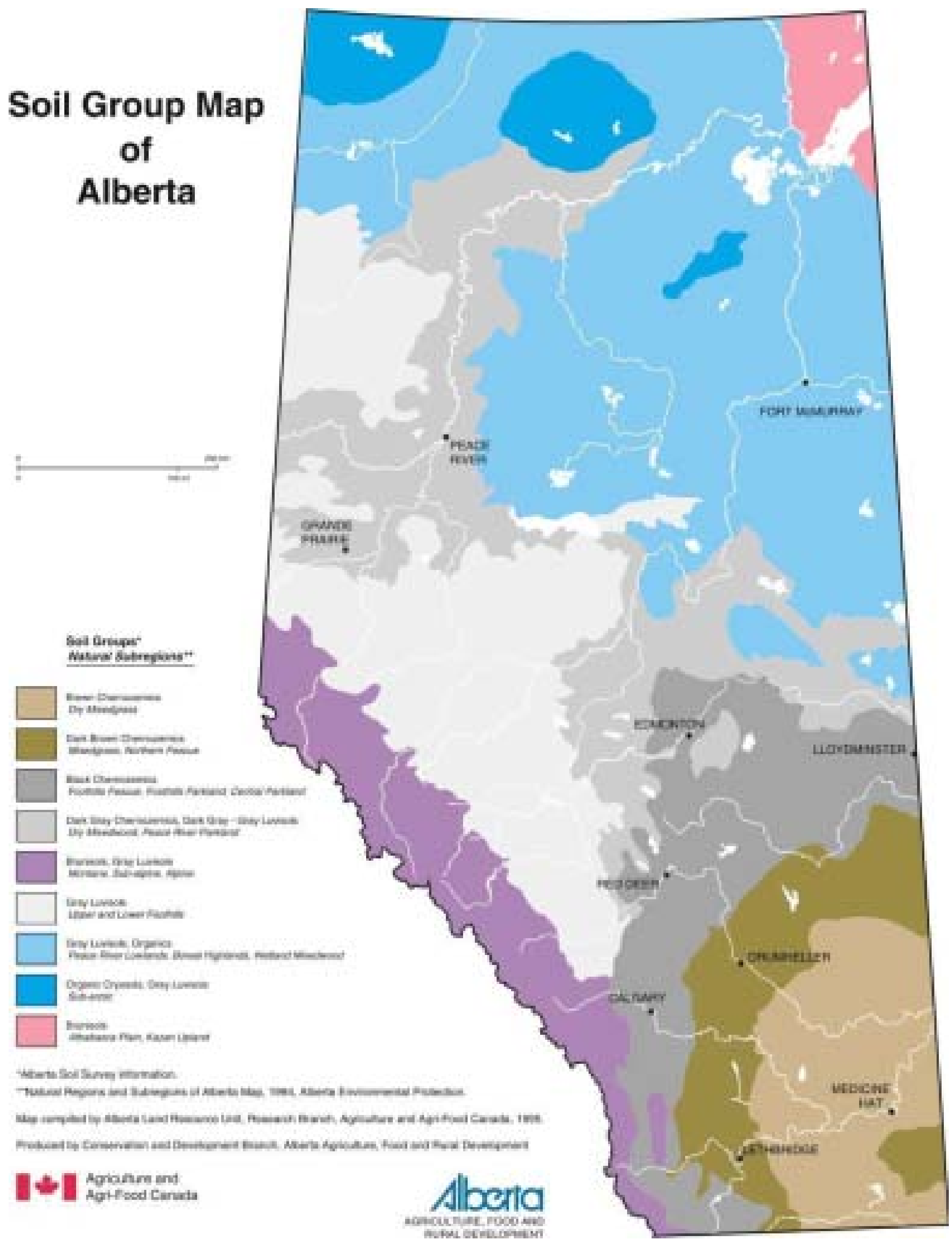
3.2 Solonetzic Soils

Solonetzic soils (saline or alkaline soils) have distinct physical and chemical characteristics resulting from a combination of the processes of salinization by alkaline salts and desalinization and leaching within the soil. Solonetzic soils are found under a vegetation cover of grasses and forbs, frequently with a high percentage of alkali-tolerant plants. The topsoil layer is variable in thickness and is often shallow to non-existent in “prairie blow-outs.” The subsoil is characterized by a columnar or prismatic structure, (hardpan) that is very hard when dry and very plastic, sticky and prone to compaction when wet.
Construction challenges posed by these soils include:

- Topsoil salvage and replacement due to highly variable thickness of topsoils
- Rough micro-topography.
- Compaction and ponding are concerns as construction can alter the natural drainage, both vertical and horizontal.
- Over-stripping or mixing of the topsoil and subsoils can result in the degradation of topsoil quality (chemical and physical) due to the incorporation of deleterious subsoil materials, often limiting the growth of vegetation.
- Poor color contrast between topsoil and subsoil.

3.3 Regosolic Soils

Regosolic soils associated with coarse textured materials, steep slopes and river valley terraces are soils with poorly developed ongoing profiles and in native prairie tend to be coarse textured and rapidly drained. They can be characterized by a weakly developed organic topsoil layer. Subsoils are weakly developed to non-existent. Native vegetation communities found on coarse textured Regosols are uniquely adapted to the coarse texture and low nutrient values. When stripped for construction purposes the soils are prone to wind erosion until sustainable vegetation has been re-established. Trenching in sandy soils may give rise to unstable trench walls.



4 CONSERVATION AND RECLAMATION GOALS FOR PIPELINE CONSTRUCTION IN NATIVE PRAIRIE

There is confusion in industry with respect to what "conservation" means with regards to pipeline construction in native prairie and parkland environments. **"Conservation",** as defined by the *Environmental Protection and Enhancement Act (EPEA)***,** refers to **"the planning, management and implementation of an activity with the objective of protecting the essential physical, chemical and biological characteristics of the environment against degradation."** *EPEA* also states that lands "**must be reclaimed to equivalent land capability.**" Equivalent land capability is defined in *EPEA* as "the ability of the land to support various land uses after reclamation is similar to the ability that existed prior to any activity being conducted on the land, but the ability to support individual land uses will not necessarily be equal after reclamation."

Public land managers in Alberta have established the following goal for reclaiming prairie and parkland landscapes: "**to promote the re-establishment of sound ecological function and the eventual restoration of the original range of variability in biological structure and diversity"** (Sinton and Pitchford, 2002).
AENV, ASRD and the Special Areas Board have agreed to the following conservation and reclamation goals for pipeline construction in native prairie and parkland environments:

4.1 Goal 1: Avoid Sensitive Landscape Features and Habitats

Projects should avoid disturbance to native prairie areas where possible. Project planners should consider all possible routing options, including rerouting the project to adjacent cultivated lands or to tame pasture where feasible. If it is not possible to avoid native prairie, it is recommended that project planners select a route that avoids impact to:

- **Avoiding native prairie.**
- **Sensitive landscape features** such as coulee and river valleys subject to natural erosion, unstable slopes, active sand dunes, wetlands, active "blowouts" in Solonetzic soils, developed springs and natural groundwater discharge sites.
- **Sensitive wildlife habitat features** such as nesting sites for burrowing owls, nesting sites for raptor species, seasonal wetlands used by migrating water fowl, hibernacula used by prairie snake species and wooded areas used for shelter by ungulates.
- **Historic resource sites.** They are an integral part of Alberta's cultural heritage. Once destroyed they are lost forever. All proposed pipeline projects that cross undisturbed native prairie have the potential of encountering cultural artifacts within the proposed routing. Alberta Community Development maintains a *Significant Sites List of Known Historic Resource Sites*.
- **Rare plants and their habitats**. The Alberta Natural History Information Centre (ANHIC: 780-427-5209) has a database that lists known rare plant locations within the province.

4.2 Goal 2: Minimize the Disturbance

The second conservation and reclamation goal is to minimize disturbance and reduce impacts to all the components of the native prairie ecosystem. This goal can be achieved by:

- **Avoiding native prairie**.
- **Reducing the "footprint" size**. The "footprint" of a pipeline project located in native prairie can be substantially reduced during route selection by utilizing existing rights of ways and access trails designing for the shortest route, choosing the appropriate soil handling procedure for the size of pipe installed and implementing a strict traffic control plan during all phases of construction.
- **Using seasonal variations in climate to the best advantage**. Implementing construction activities during suitably dry and/or frozen ground conditions can reduce impacts to native prairie vegetation and soils. Seasonal variations in climate are widespread throughout the Grassland and Parkland Natural Regions and Sub-regions. For example, some Sub-regions are affected by chinook winds, while others are not. Total annual precipitation is also highly variable within the Sub-regions. It is important to plan pipeline projects to take advantage of seasonal variations in climate within project areas. Pipeline construction activities implemented when prairie soils are wet substantially increase disturbance to soils and native prairie vegetation. Construction activities conducted under unsuitable soil moisture conditions can also increase reclamation efforts required and time needed to return lands to an equivalent land capability.
- **Using the most appropriate construction equipment and the best technology available** for the size of pipe installed. Reclamation efforts and time required to return lands to an equivalent land capability are directly related to the amount of surface disturbed during construction.
- **Reducing cumulative effect of multiple pipelines in the prairie landscape.** AENV, ASRD, the Alberta Energy and Utilities Board, the Special Areas Board, landowners and stakeholders are concerned about fragmentation of native prairie environments due to poor integration of pipeline projects by multiple pipeline operations.

4.3 Goal 3: Conserve Prairie Soils

Topsoil is one of the most important resources in a functioning native prairie ecosystem. Considering the amount of time required for its natural development, it should be considered a non-renewable resource. Prairie topsoils contain the seed bank of native prairie vegetation species, organic material, essential nutrients and the micro-flora and fauna that promote the growth of specially adapted prairie vegetation. It is important to limit the disturbance to soils as much as possible. Disturbed prairie soils are subject to active wind and water erosion until revegetation has been achieved. Revegetation of degraded prairie soils due to pulverization or compaction is difficult and the return of equivalent land capability may be impossible.

4.4 Goal 4: Conserve Prairie Vegetation

Native prairie vegetation is uniquely adapted to soil, landscape and climatic conditions. Native prairie vegetation is an integral part of the native prairie ecosystem, building and nurturing native prairie soils, controlling wind and water erosion and providing habitat for prairie wildlife. Native prairie vegetation is self-sustaining and through the process of natural succession, adapts to changing environmental conditions. Maintaining the integrity of native grasslands is the most sustainable and productive land use possible since these lands are not generally suitable for agriculture. Native grasslands provide essential habitat for wildlife and are a valued sustainable resource for the livestock industry in Alberta.

Native grasslands of Alberta contain numerous rare plants and rare plant communities that are important for the preservation of biodiversity on a global, national and provincial scale. They are uniquely adapted to the location in which they are found. They are valued for their aesthetic beauty and educational potential by numerous stakeholders.

Some native prairie plant communities can adapt readily to surface disturbance however, it may be very difficult or impossible to facilitate recovery of rare plants or communities, while others require many years to re-establish to pre-disturbance species composition and density. The process of recovery simply takes time to restore the productive capability of the native prairie landscape.

4.5 Goal 5: Conserve Prairie Wildlife and Fisheries Habitat

Alberta is fortunate to have tracts of undisturbed native prairie and parkland that provide habitat for a diverse wildlife population. The prairie and parkland regions provide specific habitat requirements for numerous wildlife species. Migratory birds come to breed, nest and nurture their young in specific habitat requirements. Ungulates move within the landscape to obtain suitable forage, find shelter, mate, give birth and rear their young. ASRD Fish and Wildlife have developed timing restrictions for development activities and offset requirements for known habitat features. These guidelines are based on scientific observation and the need to conserve habitat requirements for species of concern.

4.6 Goal 6: Conserve Historical Resources

Various historical resources occur within the undisturbed native prairie and parkland landscapes. Historical resources in Alberta are defined within the *Alberta Historic Resources Act* as "**any work of nature or of man that is primarily of value for its paleontological, archaeological, prehistoric, historic, cultural, natural scientific or aesthetic interest**." These resources are non-renewable and are part of the rich cultural heritage of all Albertans. Alberta Community Development (2001) maintains a data-base that should be consulted to determine if any designated historic sites (i.e., Provincial Historic Resources, Registered Historic Resources) or other significant historical resources are situated within proposed project areas. Alberta Community Development reviews development plans within buffer zones around designated historic sites.

4.7 Goal 7: Conserve Grazing Capacity

Most of Alberta's native grasslands, with the exception of some protected areas, are utilized for livestock grazing. Newly reclaimed rights of way (ROW) can disrupt grazing patterns, as cattle are attracted to the right-of-way by the succulent new growth. If ROWs are seeded to agronomic species such as crested wheat grass or smooth brome, long term grazing patterns can be altered since agronomic species are palatable to livestock at different times from the adjacent native species. Altered grazing patterns can affect the grazing capacity within a given field and can result in impacts to reclaimed soils through excessive trampling. Project planners are advised to consult with landowners and land managers to ensure that the grazing capacity is not altered permanently. Specific reclamation procedures should be implemented to reduce the impact of grazing livestock on the newly reclaimed ROW, that seeded plant species fit rangeland management needs and that the grazing capacity is returned to the pre-construction level over time.

4.8 Goal 8: Set the Stage for Eventual Restoration

The term restoration in native prairie environments means the re-establishment of sound ecological function and the eventual restoration of the original range of variability in biological structure and diversity. Pipeline projects should be carefully planned to achieve this goal. It is easier and more cost effective to plan for eventual restoration in the initial stage of development than it is at the time of abandonment. Project planners are encouraged to implement a "cradle to the grave" concept for all aspects of the development, including the operations phase. Assessment and documentation of the pre-construction biological structure and diversity is very important and provides a baseline for monitoring activities and assessment at abandonment. ROW planning with minimum disturbance techniques, education and supervision of pipeline contractors, suitable reclamation procedures and monitoring are best management practices that set the stage for eventual restoration.

4.9 Goal 9: Prevent the Spread of Non-native Invasive Species

Non-native invasive plants take nutrients and moisture from the soil that would otherwise be available for native plants. The *Native Plant Revegetation Guidelines for Alberta* (Sinton-Gerling, 2001) defines non-native invasive species as: "noxious and restricted weeds, designated as such in Alberta's *Weed Control Act*, or by the local municipality". Problem forages were introduced purposefully by humans for crop/forage production purposes and either invade or persist in native plant communities. Introduced forage plants that have been identified as invasive or persistent in the southeastern mixed grass prairie areas of Alberta include crested wheatgrass and sweetclover. In the moister central parkland and in the foothills, timothy, smooth brome and reed canarygrass have been identified as problem plants (*Problem Introduced Forages on Prairie and Parkland Reclamation Sites,* C&R/IL/01-6).

Nuisance weeds are generally not of concern on native prairie sites unless the infestation limits germination and development of desired native species on-site. Nuisance weeds of special Sub-regional concern include: oxeye daisy, downy brome, Japanese brome and rattail fescue. Non-native invasive species can retard the process of natural succession by out-competing the native vegetation on ROWs, and by altering livestock grazing patterns both on and off ROW.

Photo 11 Avoid Sensitive Landscape Features and Habitats

Photo 12 Minimize the Disturbance

5 PIPELINE CONSTRUCTION ISSUES

5.1 Current Pipeline Construction Issues

While it is acknowledged that pipeline construction practices have greatly improved in recent times, the impact to the native prairie landscape remains critical due to the increased volume of projects. Cumulative extent of disturbed area and increased fragmentation of prairie landscapes. The following are environmental issues that still need to be addressed in pipeline construction. These issues have been identified by concerned stakeholders and government regulatory authorities:

- Loss of native vegetation species diversity.
- Non-native species invasion.
- Loss of habitat for wildlife.
- Fragmentation of vegetation and habitat.
- Altered grazing patterns for livestock.
- Scalping of native vegetation and soils.
- Uneven topsoil stripping in rough micro-topography.
- Excessive roach height and width over the trench.
- Incomplete topsoil and subsoil retrieval from storage areas.
- Topsoil loss due to wind and water erosion.

- Alteration of natural landscape topography and drainage patterns and disruption of normal groundwater flows.
- Fire control is also a serious concern to the landowners and occupants of native rangelands. Wildfires caused by construction related activities can have serious impact on ranching operations, particularly during periods of drought.
- Diminishing extent of undisturbed native prairie.
- Improved vehicle access to undisturbed native prairie and sensitive areas.

Photo 14 An example of an unacceptable level of surface disturbance.

Photo 15 The type of equipment used must be appropriate for the soils and the timing of construction.

5.2 Issues Specific to Large Diameter Pipelines: 610 mm to 1219 mm (24 inch to 48 inch outside diameter)

Large diameter pipelines transport large volumes of petroleum products for domestic and international consumption. Installation of large diameter pipelines often requires looping of existing, older lines in a common pipeline corridor. Depending on when the adjacent loop was constructed, topsoil quality and quantity on shared workspace may be of concern. Prior to 1978 there was no requirement to salvage and conserve topsoil. Also, prior to 1992 agronomic seed was commonly used to revegetate pipelines in native prairie environments. Therefore, shared workspaces may contain invasive non-native species of concern, such as crested wheat grass. Other issues specific to large diameter pipeline construction include:

- Use of larger, heavier equipment to handle installation safely.
- Difficulty in bending large diameter pipe to conform to topography results in wider, deeper trenches and additional grading. Additional workspace is required to store soils.
- A larger, wider trench is required with more pipe displacement and more excavated spoil.
- More grading is required due to safety restrictions for larger heavy equipment.
- More traffic on the ROW due to increased manpower and inspection requirements.

Photo 16 Lowering in large diameter pipe.

5.3 Issues Specific to Mid-sized Laterals and Sales Lines: 508 mm to 219.1 mm (8 inch to 20 inch outside diameter)

Lateral pipelines carry petroleum products from production fields to central facilities for processing or to large diameter pipelines for transmission to domestic or international markets. Sales lines are generally smaller in diameter and shorter in length than laterals and are constructed to carry product from a central location in a producing field to a delivery point for sales. Pipeline construction issues in native prairie for mid-sized lateral and sales lines include:

- When looping existing older ROWs, topsoil quality and quantity on existing ROWs or existing loop can be of concern for reclamation.
- Sharing workspace with existing access roads is a good way to minimize the disturbance. However, offset requirements (distance between pipeline and roadbed), traffic control, soil handling and grading requirements need to be carefully planned.
- Acquiring approval to share workspace on existing ROWs with other energy producing and transmission companies can minimize the disturbance. Careful planning is needed to ensure the long-term environmental commitments of both companies are agreed to and complied with during the construction and operational phases.
- Minimizing project footprint by carefully planning for anticipated product volumes.
- Weeds and non-native invasive plants can be of concern when following access roads and older existing rights-of-way.
- Extra workspace requirements on typically narrow standard ROW widths need to be carefully planned when proposed routes follow existing ROWs and access roads.
- Heavy equipment needs to be matched to the size of pipe installed and terrain sensitivity.

5.4 Small Diameter Pipelines and Gathering Systems: 168.3 mm to 50.8 mm (6 inch to 2 inch outside diameter)

Small diameter gathering systems bring product from producing wells to a central location for transmission to the point of sales. Small diameter pipelines also transport and deliver sweet gas for sales in rural areas (rural gas co-ops). Plough-in projects and projects that do not meet the 2690 index (length in kilometres x outside diameter of pipe in millimetres) are classified as Class 2 pipelines and are exempt from AENV's Conservation & Reclamation (C&R) approval process.

The only requirement for environmental assessment on small pipelines is the Siting Information Report (SIR) on public land. *C&R/IL/00-7 Notification for Class 2 Pipelines on Private Lands* explains the notification process on private lands. The notification is sent directly to AENV regional offices. It is important that these forms are completed by suitably qualified personnel with clear understanding of the conservation and reclamation goals for native prairie environments.

Planners should have experience in environmental impact assessment and practical experience in small diameter pipeline construction. Planners should make every effort to develop construction plans that are based on landscape, soil and vegetation assessments on the ROW and from experience gained from comparable projects in the area. Construction issues for small diameter gathering systems include:

- Minimizing the amount of fragmentation of native prairie vegetation communities by utilizing previously disturbed areas (access roads and trails, existing pipeline ROWs, farm trails, etc.).
- Inadequate environmental pre-construction information. Pre-construction soils and vegetation assessments and as-built information from nearby comparable projects can enable pipeline project managers and contractors to determine the best method of construction and installation on a site-specific basis.
- Urgency of construction. The economic need to tie-in and produce from recently drilled wells often dictates the timing of flow line construction. This can lead to construction in less than ideal conditions.
- Determining when the plough-in method is suitable to minimize the total disturbance. The plough-in method is not suited to all soil or climatic conditions. While it is recognized as a very good minimal disturbance technique in most native prairie areas, frozen ground conditions, Solonetzic soils and some rocky subsoils can make ploughed in installation very difficult, often resulting in disturbance larger than conventional trenched pipelines.
- Minimizing native sod disturbance by minimizing traffic volume and ensuring minimal impact by traffic tires and tracks.
- Choosing the most appropriate type and size of equipment when trenching in pipelines.
- Choosing the most appropriate soil handling procedure to minimize the impact to the native prairie sod when implementing trenched installations.
- Eliminating excessive roach height.
- The cumulative effect of multiple small diameter pipelines in the prairie landscape over time is of concern to AENV, ASRD, the Alberta Energy and Utilities Board, the Special Areas Board, landowners and stakeholders with an interest in the native prairie environment.

Photo 17 Minimizing disturbance with mid-sized pipe (16 inch pipe)

Photo 18 Minimizing disturbance with small diameter pipe

6 BEST MANAGEMENT PRACTICES

Best Management Practices define practices that, if implemented effectively, will ensure that conservation and reclamation goals for the native prairie environment are achieved. They provide operators with best construction procedures for pipeline construction and reclamation. Site-specific planning by qualified personnel is necessary for all pipeline projects in native prairie, regardless of the size of pipeline or the regulatory requirements. Equally important is expert and informed supervision at every stage of construction. Operators need clear instructions when going to bid, so they can implement the mitigation required in a cost-effective manner.

6.1 Right of Way Planning

ROW planning is one of the primary tools that should be used by operators to minimize impacts of pipeline projects in native prairie environments. Documents which should be used for project planning include: *Petroleum Industry Activity on Native Prairie and Parkland Areas, Guidelines for Surface Disturbance*, (EUB, 2001); and *Prairie Oil and Gas: A Lighter Footprint* (Sinton 2001). Copies of the EUB guidelines are available from:

Information Services
Alberta Energy Utilities Board
640-5th Avenue S.W.
Calgary, AB T2P 3G4
Or on-line at: www.eub.ab.ca

Copies of *A Lighter Footprint* are available from:

Alberta Environment Information Centre
Main Floor, 9920-108 Street
Edmonton, Alberta T5K 2M4
Or on-line at: www3.gov.ab.ca/env/info/infocentre/PubDtl.cfm?ID=1613

Native prairie can be encountered in small isolated units or in large continuous blocks. Avoidance of native prairie through the consideration of all possible alternate routes is the best way industry can reduce the cumulative impact of oil and gas developments on the native prairie environment. The planning process involves a number of stages including information gathering, stakeholder involvement, route selections, determining cumulative imports, construction procedures, quality assurance, contingencies and monitoring.

6.1.1 Information Gathering

There is considerable information available on the internet to assist planners and operators to determine potential impacts of a specific project on native prairie ecosystems. AENV and ASRD have developed websites containing information about potential impacts to native prairie ecosystem and mitigation required on a site-specific basis. These websites are continually updated. It is recommended that operators and planners consult these websites early in the project planning stage to fully understand the level of impact assessment and mitigation required on a site-specific basis.

Best Management Practices include the following:

6.1.1.1 Review of All Available Information and Data-bases

- **The Alberta Prairie Conservation Forum website, www.albertapcf.ab.ca**, can be used to determine if a proposed pipeline project will encounter native prairie in the Grassland Natural Region. The **Native Prairie Vegetation Baseline Inventory** found at this website is an interactive data-base with a quarter section (160 acre) resolution. Each quarter section in the inventory has a minimum of 15% native vegetation to qualify as native prairie. A similar baseline inventory is currently being compiled for the Parkland Natural Region.
- Air photos or satellite imagery are useful to locate sensitive landforms and habitat features and existing surface disturbances within the proposed pipeline project area in the planning stage. This imagery can be used to compile environmental alignment sheets for regulatory application and for use in the field during construction.
- Soil maps are available for all deeded and public lands within the White Area of Alberta. These are available in many libraries. Electronic versions are available at AGRASID.
- Information on construction-related issues at the soil series level is available in RRTAC 93-7.
- The Alberta Prairie Conservation Forum website can also be used to determine whether a project will potentially cross an **Environmentally Significant Area (ESA**). ESA's are reconnaissance level inventories identifying Alberta's significant, rare, sensitive and unique natural features. ESA inventories are available for all rural municipalities in prairie and parkland Alberta. An interactive map is available on the website. Reports on each ESA can be ordered on-line.
- The **Land Status Automated System (LSAS)** can be consulted to get information about surface restrictions on public lands (i.e., protective and consultative notations). LSAS information may be obtained, for a fee, by contacting: Calgary Information Centre, Alberta Energy, 3rd Floor, Monenco Place, 801 - 6th Ave, S.W., Calgary, AB. T2P 3W2, Telephone (403) 297-6324; Fax: (403) 297-2576

- **Alberta Community Development (www.cd.gov.ab.ca/preserving/parks/lrm)** has a valuable land resource manual that provides information on permitted end land uses within Alberta's Provincial Parks and Protected Areas. It also includes information about historical resources.
- On public lands there is a requirement to consult the **ANHIC Rare Plant Tracking List and Rare Plant Community Tracking List** (Allen, 2001; ANHIC, 2000), found on the **ANHIC Website (www.cd.gov.ab.ca/preserving/parks/anhic)** for all pipeline projects regardless of size. For Class 1 pipelines, if rare plants or rare plant communities are listed within the project area, a rare plant survey conducted by a qualified botanist is required on public land. The results of the rare plant survey and proposed mitigation must be included in the C&R application. For Class 2 pipelines on public land, ANHIC must be consulted and any rare plant occurrences or rare plant communities listed in the project area must be listed on the Siting Information Report. Early in the planning process it is important to discuss the rare species that might be encountered and the mitigation proposed with the public land manager. The public land manager will decide if a rare plant survey is required. When planning a pipeline project in native prairie on private land, it is important to discuss rare plant issues with the landowner and to obtain approval before proceeding with investigations and surveys.
- **The ASRD, Fish and Wildlife website at** www3.gov.ab.ca/srd/fishwl.html provides information about critical wildlife issues and habitat needs. The document, *Recommended Land Use Guidelines for Protection of Selected Wildlife Species and Habitat Within Grassland and Parkland Natural Regions of Alberta,* (ASRD Fish and Wildlife Division, 2001) describes wildlife timing restrictions and offset requirements for species of concern.
- The *Code of Practice for Pipelines and Telecommunication Lines Crossing a Water Body*, (AENV, 2001), and *Code of Practice for Watercourse Crossings*, (AENV, 2001), available on the AENV and EUB websites provide specific guidelines for watercourse crossings.
- Project managers should also consult the federal *Fisheries Act* and the *Navigable Waters Protection Act,* available on the Government of Canada website at: www.ec.gc.ca

Once a thorough review of all available information has been completed, an **environmental issues list** should be compiled for the proposed project. This list can be used to ensure that mitigation for each environmental issue is documented and implemented during each phase of the project.

6.1.1.2 Surveys

The following field surveys are recommended to determine site-specific mitigation requirements to ensure the conservation and reclamation goals for native prairie can be met. These surveys provide the information necessary to determine the most effective minimal disturbance construction techniques and the most appropriate reclamation and revegetation techniques:

- **Soil surveys** are necessary for all pipeline projects, regardless of size and type of pipeline installed and the scope of the project. It is necessary to understand the physical and chemical properties of soils encountered on a site-specific basis in order to identify appropriate minimal disturbance soil handling procedures. Undisturbed native prairie soil characteristics can be highly variable within the landscape. Often a number of different soil-handling procedures are required on a project area to ensure that equivalent capability can be met. The soil survey should identify all areas where special soil handling is required. Soil information and handling plans should be accessible during construction and kept on file throughout the life of the pipeline. The survey can provide useful information during the operations phase should remedial reclamation be necessary. The soil survey can also be used as a pre-disturbance baseline for monitoring reclamation success at abandonment.
- **Vegetation inventories** are necessary for all pipeline projects. Native prairie plant communities are very diverse within the prairie landscape. A range of plant communities may be encountered within pipeline projects, regardless of size. The ability of individual communities to withstand construction impacts and recover over time is highly variable. Pre-disturbance vegetation inventories are necessary to make informed decisions on construction and soil handling procedures on a site-specific basis. For example, species composition, reproductive capability of the dominant species and quality of the sod layer are important factors in determining how to preserve species diversity. An understanding of native plant life cycle characteristics is necessary to predict whether a given plant community will be able to recover from construction impacts. Vegetation inventories are necessary for final route selection by providing the information necessary to avoid communities that are difficult to reclaim. Vegetation inventories are also necessary to develop revegetation and erosion control strategies.
- **Rare plant surveys** are required if rare plants have been listed in the project area. *Alberta Native Plant Council Guidelines for Rare Plant Surveys*, (Lancaster, 2000), www.anpc.ab.ca/guide.html provides the current guidelines for conducting rare plant surveys.
- **Pre-construction weed and invasive species surveys** provide valuable baseline information for revegetation strategies, post-construction monitoring and vegetation management programs.
- **Wildlife field surveys** are necessary if species classified as "at risk", "may be at risk", or "sensitive" are listed within the project area. It is important to contact the regional ASRD Fish and Wildlife office. Regional biologists have access to an internal database, Biodiversity Species Observation Data-base (BSOD) that

can provide project planners with additional information on wildlife species in the project area. Wildlife surveys can provide key input into final route selection by determining off-set requirements for denning and nesting sites and other habitat features. Wildlife surveys also assist project planners in developing construction schedules.

- **Fisheries assessments** may be necessary in accordance with the *Code of Practice for Pipelines and Telecommunication Lines Crossing a Water Body,* (AENV, 2001).
- **Historic Resource Impact Assessments** may be necessary at the discretion of Alberta Community Development.

Photo 19 Vegetation survey

Photo 20 Wildlife survey

Photo 21 Historic resource impact mitigation

6.1.2 Stakeholder Involvement

Communication with stakeholders is important in planning successful pipeline projects. A complete database about local conditions can be developed. Many operators have regular "open houses" that provide local stakeholders and the general public with information on upcoming development plans. These open houses keep the local residents informed and allow the local regulatory authorities, industry stakeholders and environmental groups with an interest in the area to comment, discuss their concerns and provide valuable local knowledge and advice.

Best management practices include:

- **Communication with regulatory authorities** early in the planning stage allows industry to understand the requirements that will be placed on the disposition or approval or to learn more about general regulatory requirements. Their knowledge of the local area can provide valuable input in the planning process.
- **Communication with other industry stakeholders** in the project area can reduce the cumulative effects of development activities on the native prairie landscape through shared workspace on rights of way and by using shared access roads and trails. Useful knowledge can be gained from other local industry players regarding minimum disturbance construction procedures as well as reclamation and revegetation success.
- **Communication between companies and pipeline contractors** early in the project planning process is important. Pipeline contractors need to be fully aware of all aspects of the environmental mitigation required for the specific pipeline project. Lead-time is required to schedule the most appropriate construction equipment and the skilled operators required for a successful pipeline project. Pipeline contractors with experience in native prairie pipeline projects can accurately predict construction and reclamation costs and are familiar with the regulatory requirements.
- **Communication with non-governmental organizations** (NGOs) such as the Society of Grassland Naturalists can alert project planners to locally contentious issues and project specific concerns. Maintaining good relations with NGOs can facilitate issue resolution in a pro-active manner.
- **Communication with landowners –** landowners and managers whose operations will be impacted by proposed projects must be consulted and involved regularly throughout planning, construction and operation stages.

6.1.3 Pipeline Rights of Way are Partnerships in Land Use

Pipeline ROW agreements are partnerships in land use with the landowners or land managers. The livestock industry in the province of Alberta is dependent on the sustainable management of our native prairie resources. Native grass benefits from well managed grazing and would deteriorate over time without grazing or natural wildfires. The cattle industry remains the largest sustainable agricultural industry in the province of Alberta. Ranchers spend countless hours and resources caring for and improving Alberta's native rangeland. A unique example is Special Areas, where abandoned tax recovery lands have been returned to sustainable native rangeland. Landowners and land managers are aware of the importance of the petroleum industry in Alberta. Well maintained partnerships between ranchers and the operators increase the potential for sustainable development.

Best Management Practices for developing and maintaining this crucial relationship include the following:

- **Early project notification**. Call ahead and make an appointment to discuss the proposed pipeline project.
- **Incorporate their concerns into project planning**. Ranchers can provide valuable information about sensitive features such as springs, proposed or developed watering sites, riparian habitat improvement initiatives (e.g., Cows and Fish) or other areas they wish to protect.
- **Discuss the impact the proposed pipeline will have on their ranching operation**. Discuss the proposed construction schedule and accommodate their range management programs.
- **Discuss proposed construction and reclamation/revegetation procedures**. Landowners and land managers can provide valuable information about procedures that have been successful or unsuccessful in their area.
- **Show the rancher the weed survey and get written agreement on what was found.** This avoids potential conflicts about the origin of weeds. It is also important to discuss weed control strategies.
- **Discuss reasonable compensation for their loss of production and inconvenience.** A pipeline construction project represents a loss of sustainable forage for the rancher until such time as the ROW has been reclaimed to equivalent land capability. The project may also interfere with his ranching operation or long term plans. Compensation should reflect the anticipated length of time the rancher could be affected by lost grazing, resources and inconvenience to his operations.
- **Prepare and implement an effective Wildfire Control Plan.** Wildfires caused by industrial activity represent a loss of available forage to livestock operations. The lost forage must be replaced elsewhere in the range and the affected grasslands may have to be taken out of the grazing management system until fully recovered.
- **Address any concerns that might arise in a timely manner**. Discuss weed control plans and work with the rancher to ensure the recently reclaimed ROW is allowed to recover in a sustainable manner and to the satisfaction of the rancher.
- **Be a good neighbor, take ranchers' concerns for wildfires seriously, pick up all construction garbage and leave the gates shut.**

Photo 23 Wild fire control is an important issue to ranchers during periods of drought. In this photo a water truck accompanies the welding crew.

6.1.4 Route Selection

Once the general route has been defined and the Project Manager is informed of the biophysical constraints within the project area, the route can be adjusted to minimize the impact to the native prairie environment using the following **Best Management Practices**:

- **Avoid native prairie.**
- **Use existing ROWs, access roads, traditional farm trails** or other previous disturbances where possible. Following this guideline reduces fragmentation of the remaining native prairie.
- **Avoid unstable terrain**. Unstable terrain encountered in river valleys, coulees and badlands can increase pipeline construction costs and if not properly addressed can lead to pipeline integrity problems and off ROW impacts ongoing reclamation concerns.
- **Avoid sensitive habitat features for wildlife**. Adjusting the ROW location to maintain the setback requirements for identified habitat features such as occupied burrowing owl nesting sites, minimizes impacts on species of concern.
- **Identify and avoid soil units that are difficult to reclaim** by consulting baseline soil maps and conducting soil surveys. Site-specific soil surveys also enable project planners to make informed decisions on best procedures for soil handling and best construction equipment.
- **Identify plant communities and rare plants** to help project planners make informed decisions on soil handling, reclamation and revegetation techniques. ANHIC should be consulted to determine if rare plants have been recorded in the project area. ANHIC provides guidelines for conducting rare plant surveys and planning mitigation should avoidance not be possible. Information on range condition and local livestock grazing management also allows planners to make informed decisions on construction, reclamation and revegetation requirements.
- **Submit a Historic Resources Overview**, as required by the *Alberta Historical Resources Act,* for each Class 1 pipeline project proposed, to Alberta Community Development (ACD). Upon review of the Historic Resource Overview, ACD can require a Historic Resource Impact Assessment to be conducted by a qualified archaeologist. The archaeologist surveys the proposed route in the field and makes recommendations including: avoidance through reroutes, narrowing the ROW to avoid significant features, the excavation of cultural materials that cannot be avoided and/or other mitigation designed to conserve cultural artefacts. The Historic Resource Impact Assessment is submitted to ACD for review and approval. Class 2 pipelines crossing deeded land require clearance for Significant Sites from ACD. For Class 2 pipelines crossing public lands, the public lands manager consults the *Significant Sites List* as part of the referral process. If Significant Sites are listed within the proposed route, then the public lands manager, in consultation with ACD, makes recommendations. These could include the need for a Historic Resources Impact Assessment to be conducted by

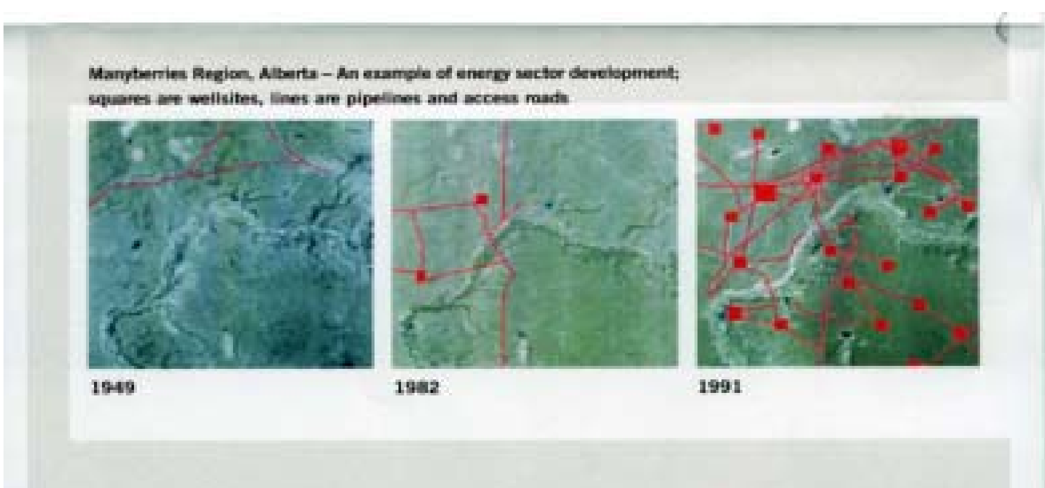
a qualified archaeologist. In some circumstances a qualified paleontologist may be required to assess paleontological concerns.

6.1.5 Cumulative Effects

The cumulative effect of petroleum activities in native prairie is of concern to AENV, ASRD, the Alberta Energy and Utilities Board, the Special Areas Board and non-industry stakeholders. Careful planning of ROWs and co-operation among industry stakeholders within the pipeline project area is essential to reduce fragmentation of native prairie.

Best management practices include the following:

- **Develop co-operative relationships** with other operators in the project area.
- **Work together to protect and conserve environmental resources in the area of development.** Share information on known locations of species of concern (e.g., wildlife, vegetation, rare plant locations, soils concerns, etc.).
- **Share workspace** on existing ROWs.
- **Develop integrated resource development** plans with other producers and stakeholders. Explore ways of reducing fragmentation and impacts through development of dedicated pipeline corridors.
- **Predict and plan pipeline capacity** to meet the current and future needs of all producers in the area where possible.
- **Develop co-operative access management plans**.
- **Develop co-operative vegetation management plans.**
- **Share information on reclamation and revegetation success**. If appropriate, use the same revegetation procedures (e.g., the same seed mix or natural recovery, if appropriate) and develop reclamation plans with the land managers that are consistent for all industry stakeholders in the project area.



6.1.6 Quality Assurance

Many operators have developed quality assurance programs to ensure environmental compliance during and after construction. Quality assurance is key to a successful pipeline project in native prairie ecosystems, regardless of project size or regulatory requirements. It is recommended that operators develop a **"Cradle to the Grave"** approach for all projects located in native prairie environments.

Best Management Practices include the following:

- **Obtain all detailed, site-specific environmental assessment information** needed to make informed decisions.
- **Use qualified quality assurance personnel** and managers who are familiar with performance objectives and conservation and reclamation goals for native prairie**,** for environmental impact assessment.
- **Compile an environmental issues list** early in the project planning stage to guide operators in planning appropriate practices and identify possible non-compliance issues. The list can also be referred to during the operations and reclamation phases to ensure environmental compliance.
- **Develop a well-documented conservation and reclamation plan,** regardless of the size of the project.
- **Develop an environmental protection plan (EPP) for use during construction.** An EPP describes practices necessary to protect and conserve natural resources within the ROW. It is a work plan that specifies how the work will be conducted to ensure regulatory compliance. It is important to include contingency plans should unforeseen circumstances arise during construction. The EPP should be provided to the pipeline contractor in the bid package (large and medium size pipelines), or as part of contract negotiations (small pipelines) to enable the contractor to accurately provide costs and to ensure that the equipment required is available.
- **Develop project specific pipeline contracts** to provide the information necessary for contractors to submit informed bids and to implement the procedures specified in a cost-effective manner. The EPP should be included in the pipeline contract documents.
- **Provide environmental education and training for contractors, inspectors and operations personnel** to facilitate meeting conservation and reclamation goals. Conduct environmental pre-job meetings for company field representatives, inspection staff and all pipeline construction workers.
- **Maintain regular communication** with regulatory authorities, landowners and land managers: It is important to let them know what is happening and why.
- **Provide environmental inspectors** with the authority to shut down work or modify plans when non-compliance issues arise during construction. Qualified on-site supervision during construction and reclamation allows informed decisions to be made on-site to solve problems that might arise during construction and reclamation.

- **Document the implemented procedures.** Evaluate the success of the procedures used and make recommendations for future improvement. The evaluation should be summarized in a concise environmental as-built document that can be referred to for future similar projects to ensure continuous improvement.
- **Ensure environmental compliance during the operations phase** through communication of environmental issues to operations personnel. Any additional maintenance work (e.g., dig-ups for pipeline repairs) requires the same level of environmental protection and mitigation. Operations personnel need to be thoroughly familiar with conservation and reclamation goals. Companies need to have qualified environmental inspectors onsite for every phase of the project to ensure continuing compliance.
- **Evaluate reclamation and revegetation success** post-construction to ensure the process of recovery is progressing toward eventual restoration. Evaluate the success of the mitigation measures implemented during construction. Monitoring for revegetation success provides the opportunity for continual improvement. *Reclamation Assessment Criteria for Pipelines at Abandonment* (draft 2001) details the level of assessment required for obtaining a reclamation certificate at abandonment. The access road criteria from the *Reclamation Criteria for Wellsites and Associated Facilities – 1995 Update* (AEP, 1995) can also be used to assess reclamation success on pipelines. Projects should be planned and implemented to meet these criteria.

6.2 Construction Schedule

Proper construction schedules can significantly reduce impacts on the native prairie ecosystem. Critical breeding and birthing seasons for wildlife species of concern must be avoided. Project planners should also consult the local ASRD Fish and Wildlife Branch and the landowner or public land manager to discuss the project-specific effect of construction on winter habitat requirements for ungulates.

Prairie grassland communities are least impacted by construction when the plants have gone into dormancy and are not actively growing. Prairie grasses and forbs respond to available moisture and warm temperatures in spring and continue to grow as long as adequate soil moisture is available. When moisture reserves are depleted and summer temperatures rise, perennial plants go into dormancy. Prairie annuals germinate in spring, quickly develop seed and then die, leaving seed to be naturally dispersed, under suitable conditions. Project schedules should avoid critical growth periods (spring to mid-summer) of prairie plants.

Construction under suitably dry or frozen ground conditions can significantly reduce impact to native prairie soils. Saturated soils are prone to compaction, rutting and admixing during pipeline construction. Failure to address this issue can result in unacceptable levels of disturbance, loss of topsoil and increased reclamation costs. Operators should include **Voluntary Shut Down Criteria** in pipeline construction contracts to provide contractors with clear operating directions (C&R/IL/98-4, *Voluntary Shut Down Criteria for Construction Activity or Operations*). When considering construction under frozen ground conditions, project planners need to consider the climatic patterns of the project area, and determine the best construction procedure for handling frozen soils.

Best Management Practices include the following:

- **Construct when native vegetation is dormant (late summer, fall).**
- **Construct when prairie soils are suitably dry or frozen**.
- **Include Voluntary Shut Down Criteria in pipeline contract documents.**
- **Assess the impact of planned construction procedures on frozen prairie soils.**
- **Avoid construction during the critical breeding and birthing period for wildlife species of concern.**
- **Assess the impact of construction on fisheries resources** as required by Alberta Environment's *Code of Practice for Water Course Crossings* (AENV, 2001).

Photo 24 Snow and frozen ground conditions minimize the impact to native prairie vegetation.

6.3 Weed and Non-native Invasive Species Control

The control of noxious and restricted weeds on pipeline ROWs is the responsibility of the operator under the *Weed Control Act.* Responsibility remains with the operator from the initial pipeline construction phase, through the operating phase, until a reclamation certificate has been obtained at abandonment.

Weeds thrive in disturbed soils, often hampering the growth of desirable species. Invasive agronomic species often out-compete desired native species for soil moisture and nutrients (C&R/IL/01-6, *Problem Introduced Forages on Prairie and Parkland Reclamation Sites).* Weeds and aggressive agronomic species are of concern to landowners and lease holders in native rangelands. Weeds can lead to decreased forage production and quality and can potentially spread off ROW. Aggressive agronomic species in native prairie can also alter grazing patterns and affect off ROW productivity.

The following **Best Management Practices** assist project managers to understand the extent of problem vegetation on a site-specific basis and to plan efficient maintenance programs during the operational phase:

- **Consult the landowner/manager and obtain information about weed presence**, distribution and management program on the operation.
- **Conduct a pre-construction survey for weeds and invasive non-native species**. Mitigation can be designed for known weed locations during construction. A pre-construction weed survey is a valuable baseline for vegetation management programs and to avoid conflicts with other users about weed origin (refer to: WAR, Weed Awareness for Reclamation, found on the AENV website).
- **Contact the local Municipal or County Agricultural Field person** to determine weeds of concern and weed control programs in the local area. Municipalities also have the ability to upgrade weed classification (e.g., from nuisance to noxious) so it is important to check on the local classification.
- **Ensure all vehicles and construction equipment arrive on-site clean,** free of dirt and vegetative materials. Cleaning equipment reduces the chance of transporting weed seeds from one project to another. Re-cleaning equipment after leaving identified weed-infested sites reduces the chance of spreading the infestation through a larger area. Cleaning equipment following passage through cultivation or improved pastures seeded to aggressive agronomic species reduces the spread of undesirable species into native rangeland. Attach stickers to equipment to indicate that it has been cleaned.
- **Ensure all seed used for revegetation meets the requirements of the *Native Plant Revegetation Guidelines for Alberta*.** Test individual lots of seed for weeds and aggressive agronomic species prior to purchase and mixing and retain the Certificates of Seed Analysis for each species used on file. Note that use of *Canada No. 1 Certified Seed* does **not** mean the seed is weed free.

- **Ensure that straw used for erosion control or separation barriers is clean.** There is a potential for straw crimping to be a serious source of weeds on industrial disturbances. There are some preventative measures that can be taken. Straw may be inspected as a standing crop before harvest where possible. Straw can be purchased at a time when within-field inspection is possible and then stored for use in the following year. To further reduce the risk of weed introduction through straw, bales from the outside edge of the field should not be purchased. This portion of the field is at greatest risk from weed invasion. If field inspection is not possible, the purchaser may request that the straw seller open several bales and roll them out for inspection. Straw can also be sampled and sent to a seed analysis lab to determine weed content
- **Monitor post-construction revegetation**. Discuss proposed weed control with landowners and local regulatory authorities. Project managers should be aware of lands requiring special management. These lands include lands with organic farming status or Nature Conservancy caveats. The use of chemical herbicides can be prohibited or restricted on these lands.

Photo 25 Weeds on the right of way

6.4 General Construction Best Management Practices

The following is a list of **Best Management Practices** that pertain to all pipeline construction projects regardless of size and scope in native prairie environments:

- **Ensure all approvals are in place** prior to the commencement of construction activities.
- **Notify the appropriate regulatory authorities**, landowners and land managers prior to the commencement of construction activities.
- **Restrict all activities to the surveyed ROW**, approved extra workspace and approved off ROW access.
- **Educate all personnel about environmental issues and mitigation.**
- **Locate all stockpiling areas, service yards or other facility sites required for construction in areas with low sensitivity to disturbance** (existing disturbances, cultivated land, or tame pasture).
- **Identify features that require special mitigation** (e.g., rare plant or historic resource sites) in the field with signs, flagging or temporary fencing to ensure avoidance during construction until the mitigation required can be implemented. Remove all signage, flagging and temporary fencing at the end of construction.
- **Ensure that wildlife timing restrictions are adhered to** during construction through monitoring and signage where required.
- **Ensure all construction equipment and vehicles arrive clean** and free of dirt and vegetative material. A sticker system can be used to identify equipment and vehicles that have been inspected for cleanliness.
- **Ensure the size of the trenching equipment is compatible with the stripped width** and the size of the pipe.
- **Check all equipment for fuel leaks**, hydraulic leaks and other sources of possible soil contaminants.
- **Ensure the contractor has a hazardous material and spill response plan** in place, is properly equipped to deal with leaks and spills and has adequately trained employees.
- **Ensure the contractor has a fire control plan in place** and that the employees are adequately trained for wildfire prevention and control.
- **Continuously collect and dispose of construction garbage** and debris, remove it from the right-of-way and ensure it is separated according to disposal method and disposed of at the nearest approved industrial waste facility (EUB, 1996).
- **Notify the Cultural Facilities Division of Alberta Community Development** if a previously unidentified archaeological site or artifact is identified during construction. Work in the immediate area must be shut down until the site is examined by a qualified archeologist and permission to proceed is granted by Cultural Facilities and Historical Resources Division of Alberta Community Development.

6.5 Soil Handling Alternatives

6.5.1 General

On-site soil surveys are strongly recommended for all pipeline projects, regardless of size or regulatory requirements. Native prairie soil characteristics can vary significantly from place to place. A soil survey can supply the information necessary to make informed decisions regarding soil handling and conservation procedures. Soil surveys can assist project managers and pipeline contractors to choose the best type of equipment and procedures for a specific project.

To make informed decisions it is necessary to consider the following factors:

- Soil units encountered by the pipeline ROW, including topsoil quality and erosion potential, topsoil depths, subsoil quality, coarse fragment content and depth to bedrock.
- Sod quality and sod condition. Will the vegetation withstand the type of equipment required to install the pipeline? While the quality of the sod may be good, the condition of the sod may not be able to withstand the impact of construction due to drought conditions.
- Size of pipe or the trench width if multiple pipes are to be installed.
- Terrain and grading requirements.
- Micro-topography.
- Weather conditions during construction.
- **Safety is always a key issue in determining the handling procedure and type of topsoil stripping.**

Minimal disturbance topsoil conservation procedures that have been developed and implemented on native prairie pipeline projects in recent years are included in sections 6.5.2 and 6.5.3. Construction drawings have also been included. Operations should continue to improve existing procedures as well as develop new ones to reduce both the impact on native prairie soils and maintain the integrity of native prairie ecosystems.

6.5.2 Large and Mid-sized Diameter Pipelines

Industry should develop “strip and grade plans” for large and mid-sized diameter pipeline projects. Documentation included in conservation and reclamation applications generally indicate the preferred minimum topsoil stripping width based on topographic class. It is important for industry to agree on site-specific changes that the contractor may require in the field for safety requirements. Stripping widths should not be increased for the purpose of general convenience.

Best Management Practices include:

- **Develop a site-specific "strip and grade plan"** in the field with the pipeline contractor based on the minimum stripping widths recommended in the regulatory application. It is important to include the environmental inspector or authorized company environmental representative, the chief inspector, the contractor's strip and grade foreman and the contractor's spread boss in this process. The purpose of the strip and grade plan is to identify site-specific areas where the contractor has valid safety concerns. Document any changes on a site-specific basis and communicate these changes to the regulatory authorities prior to the commencement of construction activities.
- **Trench line stripping** means conserving the topsoil within an area that corresponds to the width of the anticipated excavated trench. Salvaged topsoil and excavated spoil are stored on unstripped sod on either side of the excavated trench. Trench line stripping is only recommended for small diameter welded steel pipelines conventionally installed and mid-sized diameter pipelines under suitable soil and landscape conditions. Stripping is usually conducted using a hydraulic step blade mounted on a grader or suitably sized bucket and track hoe. It is important to strip a bit wider than the width of the trench excavated with the wheel ditcher. This prevents a loss of topsoil into the trench and allows additional stripped area for feathering spoil. Operators should use the smallest size of wheel ditcher possible within safety limits. When using a track hoe for stripping, a digging bucket modified with a sharpened steel plate welded across the ripping teeth can strip a narrower width than most conventional cleanup buckets.
- **Blade width stripping** means stripping the topsoil over the trench line the width of a grader blade. Blade width stripping is recommended for mid-sized pipelines, (8 inch to 20 inch OSD) preferable in flat to rolling terrain, with good quality sod and no side hills. Blade width stripping can also be implemented for large diameter pipelines (24 inch to 30 inch OSD), in flat to gently rolling terrain with good quality sod.
- **Double blade width stripping** involves stripping blade width over the trench and travel lane on the work side to facilitate safe passage of equipment and vehicles in rough micro-topography. It is recommended for both large (24 inch to 30 inch OSD) and mid-sized diameter pipelines in suitable terrain.
- **Trench and spoil side stripping** means stripping the topsoil from the trench plus the spoil storage area. Trench and spoil side stripping is recommended for large and mid-sized diameter pipelines when sod quality is poor, where salts are present in the subsoil (problems where 3-lift is required), or the micro-topography is rough, making retrieval of subsoil difficult.
- **Trench and work side stripping** means stripping topsoil from the trench and the workside of the ROW. Excavated spoil is stored on unstripped sod. Trench and work side stripping is recommended for large diameter pipelines where the micro-topography is too rough for the safe passage of equipment, the quality of the sod is poor, or where the topsoil is prone to pulverization or compaction. There should be no salts in the subsoil and sod quality on the spoil side should be of sufficient quality to withstand retrieval.

- **Use special equipment** to salvage frozen topsoils, or topsoils hardened by the lack of moisture and hot sun. Conventional stripping procedures often result in admixing of the soils under these adverse conditions due to the inability of conventional equipment to adequately separate the topsoil from the subsoil. Conventional ripping or discing techniques do not have the depth control needed to separate the topsoil from the subsoil without resulting in an unacceptable level of admixing. Frozen topsoil cutters have been developed to penetrate the frozen or hardened topsoil, increasing depth control during salvage operations. Frozen topsoil cutters are readily available.
- **Control wind erosion during construction.** Droughty, erosion-prone soils require wind erosion protection. The application of a suitable soil tackifier (product has been tested and approved for use in a pipeline construction and reclamation setting) is often necessary to prevent topsoil loss. Application of a tackifier following topsoil removal is more cost effective than repeated watering of topsoil windrows and piles. The volume of water required for repeated watering is not an acceptable use of this limited resource in the native prairie environment. If blade width or double blade width stripping has been implemented, other options include: flattening the windrows to reduce the erosion-prone surface and **reducing the time between stripping and replacement**. Overworking the soils with repeated equipment passes increases the erosion potential. In rough fescue grasslands, vegetation and root mass should be kept intact to reduce erosion potential.
- **Control water erosion during construction.** Sudden storm events on the prairie can lead to loss of topsoil. Topsoil piles should be stored well above all seasonal drainages encountered. Breaks in topsoil windrows, corresponding with breaks in spoil storage windrows, should be installed where cross ROW drainage is anticipated during sudden storm events. Poorly drained Solonetzic soils are of particular concern. Storm water management plans are recommended for all river and creek crossings.

Photo 26 Applying soil tackifier to prevent wind erosion

Photo 27 Blade width stripping

Photo 28   Double blade width stripping

6.5.3 Small Diameter Pipelines and Flowlines

The cumulative effect of small diameter pipeline construction in native prairie is well recognized by stakeholders and government regulatory authorities, particularity in shallow gas development projects where numerous wells are tied to central sales lines or numerous oil wells are tied to central batteries. The infrastructure required producing and operating numerous wells on the native prairie landscape results in fragmentation of the native prairie ecosystem.

The petroleum industry has attempted to offset fragmentation through development of specific technology, including ploughing-in of pipelines of up to 6 inches in diameter. Because less environmental damage is expected, ploughed-in pipelines have been given special regulatory treatment, including:

- Exemption from the requirement to obtain a reclamation certificate; and
- Exemption in the *Activities Designation Regulation* from the requirement to obtain an approval under the *Environmental Protection and Enhancement Act (EPEA).* **Notwithstanding these exemptions, ploughed-in pipelines are still regulated under *EPEA* and operators are required to properly conserve and reclaim their ROW.**

However, lack of pre-construction on-site assessment of soils and the use of this procedure in frozen ground conditions, Solonetzic soils and wet soil conditions have resulted in some ploughed-in pipelines with surface disturbance that exceeds conventional pipeline construction methods.

Ploughed-In Pipelines (C&R/IL/01-4) describes the concerns observed in the field by AENV and ASRD staff.
To minimize the surface disturbance when installing small diameter pipelines the following **Best Management Practices** apply:

- **Consider the timing of construction -** winter under frozen ground conditions or summer under suitably dry conditions. Less impact to the vegetation occurs in winter conditions if there is snow cover deep enough to reduce the impact of tracked equipment. Construction by any method should not occur when the soils are wet. Periods of persistent drought can cause problems in Solonetzic soils.
- **Identify all soils-related issues on a site-specific basis.** For example, if coarse fragments (gravel or cobble) are identified in the subsoil, then equipment capability needs to be assessed before an informed choice can be made.
- **Consider the size and type of pipe.** Ploughing-in steel pipe effectively requires optimal soil conditions. Additional bulldozers are required to rip the soil and tow the plough, increasing the surface disturbance.
- **Consider all construction and installation options**. The plough-in method is very effective in minimizing disturbance but is not suited to all soil, topographic or climatic conditions. A no-strip procedure combined with a ditch-witch, a chain ditcher or a small wheel ditcher may be effective in minimizing the total disturbance to the native prairie.
- **Companies should conduct an Environmental Risk Analysis**, weighing the environmental issues, with the costs associated with various construction options including remedial reclamation if construction problems arise. This process allows companies to choose the method of construction that minimize the disturbance to native prairie and reduce unnecessary costs.
- **Develop contingency plans,** discuss them with the regulatory authority and include them on the project notification form. If a procedure is not working and is causing unacceptable disturbance, stop and re-evaluate the procedure, contact the regulatory authority and then implement the contingency plan before additional damage occurs.
- **Have qualified on-site supervision**. Pipeline contractors are under contract to get the job done. When things go wrong they need an informed company representative to assess the site and to implement the change orders necessary to reduce further impact.

- **Trench line stripping** is recommended for small diameter welded steel pipelines conventionally installed. It is important to strip a bit wider than the width of the excavated trench to avoid topsoil loss during trench excavation. The extra width provides sufficient area to feather excess spoil on either side of the trench during backfill and prior to topsoil replacement. This procedure when combined with adequate compaction of replaced spoil material will reduce excessive roach height.
- **No-strip pipeline installation means** excavation and storage of the trench materials without stripping the topsoil. No-strip may be an option when specific installation techniques will significantly reduce the impact to the prairie vegetation on either side of the pipeline trench and where the subsoil and spoil to trench depth does not possess adverse physical or chemical properties. However, all other options should be weighed before choosing no-strip. Operators should be aware that no-strip pipelines likely require more detailed assessment at certification to show that equivalent capability has been met. The no-strip method is also suitable for areas of shallow topsoil or no defined topsoil, where salvaging the topsoil (surface soil) will result in significantly increased disturbance to the existing native vegetation or increased erosion potential (no net benefit).

Photo 29 Trench line stripping in frozen ground conditions

Photo 30 No-strip pipeline construction can reduce the impact to the native prairie vegetation.

6.6 Vegetation Protection

Site-specific vegetation protection is required to meet all of the conservation and reclamation goals in native prairie environments.

6.6.1 Sod Salvage and Partial Sod Salvage

Operators continue to develop innovative minimal disturbance construction techniques that maintain the integrity of native prairie ecosystems. Sod salvage is one minimal disturbance construction technique that deserves serious consideration. Salvaging and replacing sod should be considered on a site-specific basis where maintaining species diversity cannot be accomplished by conventional construction and reclamation techniques. Sod salvage may be appropriate in areas that have:

- Rough fescue grassland of high conservation value, when suitable wild-harvested rough fescue seed is not available.
- Rare plants and rare plant communities of concern.
- Unique habitat for rare plants and wildlife, when avoidance is not possible.
-

Sod salvage means separating sod from subsoil, in a manner and depth that retains the top growth and the majority of surface roots as intact as possible for replacement during final cleanup. Sod salvage field trials (Petherbridge, 2000) have been conducted at several pipelines and during a recent road construction project by Alberta Transportation (Western Rangeland Consultants, 2000). This report indicates that sod can be successfully salvaged and replaced under suitable environmental conditions. The quality of sod is a critical factor for success of this procedure. Sod should be free of weeds and invasive non-native species. There should be sufficient soil moisture during storage and after replacement for sod salvage to be successful. Sod salvage sites may need to be protected from grazing livestock.

Photo 31 Sod Salvage

Partial sod salvage is another procedure that is currently under investigation. In this procedure, sod and topsoil are carefully stripped with a backhoe or front end loader, leaving the sod as intact as possible for replacement during final cleanup. In areas with thicker topsoil (> 15 cm), a two-stage process can be used where the sod portion is salvaged and placed separately from the underlying non-sod portion of topsoil. This procedure reduces the dilution of the native seed bank and plant propagules contained in the litter and top 5 centimetres of topsoil. It is useful in vegetation communities that are difficult to re-vegetate by conventional reclamation procedures.

Photo 32 Partial sod salvage in shallow topsoils

Photo 33 Topsoil and sod is replaced keeping the sod as intact as possible. Sod was stripped and replaced within 48 hours.

6.6.2 Use of Soil Separation Materials

Soil separation materials can be used to minimize scalping of the native sod and facilitate recovery of spoil and topsoil from storage areas in terrain where recovery and replacement is difficult. A variety of woven geotextiles with high tensile strength are available for this purpose. It is important to choose the right product for the site-specific application. Suppliers have qualified staff that can recommend the best product for a site-specific application. Non-woven fabrics are not suited to this application as they make removal very difficult for equipment operators and laborers.

Best Management Practices include the following:

- **Use woven geotextiles to facilitate crossing of seasonal drainages** or seasonal wetlands where avoidance is not possible.
- **Use woven geotextiles to protect historic resource features** or rare plant sites where avoidance is not possible.
- **Use snow to create a barrier between spoil and sod, or topsoil and sod.** This works best when the time between excavation and replacement is minimized and temperatures remain below freezing. If snow is bladed to create a more level working surface, care must be taken to ensure the underlying vegetation is not scalped.
- **Use wood chips (obtained from localized ROW clearing activities) or straw** that meets the requirements for straw crimping on native prairie to create a barrier between spoil and sod and stored topsoil and sod, in areas with rough micro-topography.

Photo 34 Woven geotextile used to facilitate the crossing of a seasonal drainage.

6.7 Minimizing Grading in the Prairie Landscape

ROW grading should not be implemented for general convenience but should reflect identified safety concerns. Salvage and grade plans prepared on-site with input provided by the pipeline contractor, company field inspection personnel and environmental inspectors can facilitate consensus on both safety and environmental issues.

Directional drilling techniques can be used to avoid disturbance to sensitive features or unstable landforms that cannot be avoided and to avoid disturbance to riparian habitat adjacent to water course crossings.

There are a variety of techniques available to bore under roadways or foreign line crossings. These techniques can be used to install pipe under unavoidable sensitive landforms such as rare plant sites or archaeological sites.

Best Management Practices include the following:

- **Careful route selection and avoidance**. Consider all possible routing alternatives.
- **Consider all possible construction alternatives.** Determine whether it is possible to directional drill or bore sensitive or unstable features.
- **Consider reducing the grading requirements by installing pre-welded sections on steep slopes.** This method is referred to as “stove piping”. The procedure involves pre-welding the pipe on level ground on top of the slope. The length of pre-welded pipe is then lowered down the slope using rollers and winches and installed in the trench with side booms.
- **Reduce grading requirements by using spoil from the trench to construct temporary crossings of seasonal drainages.** Geotextile fabric (fabric designed to provide a separation barrier between the sod and the excavated spoil) is installed on the surface of the bed and banks, a suitably sized culvert is installed and the geotextile is covered with spoil from the trench line to create a vehicle crossing, reducing the total disturbance to the bed and banks. Spoil, culvert and geotextile are removed during final cleanup.
- **Obtain off ROW access** to direct all but essential equipment around features that would otherwise have to be graded.
- **Reduce grading requirements in sand hills** by flattening topsoil berms into a level working surface for welding the pipe.
- **Dispose of drill or bore cuttings** in accordance with Alberta Energy Utilities Board Guide 50, *Drilling Waste Management* and document practices. Drilling fluid waste should be disposed of on cultivated lands, not on native prairie.

Photo 35 Grading was substantially reduced using minimal disturbance construction procedures

6.8 Watercourse Crossings

Watercourses are extremely important in the native prairie landscape, regardless of size. Seasonal drainages and ephemeral wetlands are important as they provide habitat for wildlife, especially for species of concern. Seasonal wetlands and drainages retain runoff for slow release over time in an arid landscape. The native vegetation found in seasonal drainages is unique in its ability to withstand the impact of runoff and sudden storm events, controlling the velocity of the flow and preventing erosion. Rare plants are often found in this environment. Alteration can have impact to dependent species both adjacent to the ROW and those far removed from the project area.

Prairie river and creek valleys are often the last islands of native prairie ecosystems in an ocean of cultivated lands. Riparian zones support diverse wildlife species, offering critical shelter for population maintenance. The riparian zone in a prairie landscape is the "filter" that removes sediment from overland flows. This zone protects and enhances habitat for remaining fishery resources. **Watercourses are the life-blood and circulatory system of native prairie and parkland landscapes.**

Best Management Practices include the following:

- **Follow the *Code of Practice for Temporary Diversion of Water for Hydrostatic Testing* (AENV, 2000).**
- **Follow the *Code of Practice for Release of Water From Hydrostatic Testing of Petroleum Liquid and Gas Pipelines.***
- **Follow the *Code of Practice for Pipelines and Telecommunications Lines Crossing a Water Body* (AENV, 2001).**
- **Follow the *Code of Practice for Water Course Crossings* (AENV, 2001).**
- **Use horizontal directional drilling technology** where technically feasible. Avoid impact to the riparian zone where possible.
- **Reduce the grading requirements where possible**. Implement a storm water management plan during construction.
- **Restore the riparian zone when it cannot be avoided** and when open cut techniques have been used. Where appropriate employ "soil bioengineering techniques" (live staking, brush layering, etc.). Ensure that procedures implemented during construction do not inhibit growth and encroachment of the native shrub vegetation.
- **Consider the aesthetic value of prairie and parkland river valleys.** If disturbance to the river valley cannot be avoided, it is necessary to develop a reclamation plan for approach slopes that minimizes the disturbance and visual impacts of the pipeline ROW in the surrounding landscape.

Photo 36 Horizontal directional drilling procedures reduced the impact to the river and approach slopes.

Photo 37 Recontouring the seasonal drainages minimized the impact to the river valley.

6.9 Traffic Control

Minimal disturbance soil handling techniques rely on the ability of the unstripped prairie sod to withstand the impact of construction equipment and vehicles. One effective method of reducing impacts to unstripped prairie sod is traffic control.

Best Management Practices include the following:

- **Plan the sequence of activities carefully** and limit access to the ROW to essential vehicles and equipment.
- **Secure and utilize off ROW access** such as existing roads and trails. This practice can effectively reduce the number of vehicles and equipment required to travel the work side of the ROW.
- **Set and enforce speed limits** on the ROW.
- **Utilize the ditch line as the primary travel lane** before it is trenched and when backfill is completed.
- **Use multi-passenger vehicles** to transport equipment operators and labourers to their worksite on the ROW.
- **Obtain extra workspace to route vehicles** and equipment around sensitive features such as seasonal drainages that might otherwise require grading.
- **Use all terrain vehicles** such as quads for foreman and inspection staff instead of trucks.
- **Avoid unnecessary turning of tracked equipment** such as bulldozers, track hoes and side booms. Avoiding unnecessary wheel spin with wheeled vehicles and equipment.
- **Protect soils susceptible to pulverization** (i.e., soil structure degraded through altered structure and loss of soil organic material) and rutting by the use of geotextiles with a spoil cap or soil tackifiers that can be driven on, or by applying a layer of clean straw (that has been inspected for weeds and invasive non-native species) to the driving lane.
- **Use low ground pressure** and low impact wheels and tracks.

6.10 Backfill and Final Clean-up

Once the pipe is safely installed in the trench, it is important to carefully plan backfill and final cleanup procedures.

Best Management Practices include the following:

- **Consider using specialized equipment** (e.g., Shaker Padder, Ossie Padder or Dyna Padder) for backfill where coarse fragments are encountered in trench materials. It is important to use low impact support equipment when using specialized equipment.
- **Reduce the time frame between topsoil stripping and replacement** as much as possible to minimize impact to prairie vegetation and soils.
- **Use well trained and experienced equipment operators.**

- **Use track hoes equipped with clean-up buckets to shade the pipe** (initial backfill procedure) and replace the bulk of the spoil. Leave a minimum of 10 to 15 centimetres of spoil on the sod for removal by specific procedures (e.g., Prairie Protector blades, harrowing, rangeland sweepers).
- **Conduct final cleanup when soils are dry and unfrozen**. Final clean up should be delayed until spring when spoil can be adequately compacted in the trench and spoil and topsoil can be removed from the sod surface more accurately.
- **Compact the spoil in the trench to prevent an elevated roach**. For projects with trench-line stripping, the wheels of a suitably sized grader can be used to compact spoil in the trench. Specialized packer equipment is also available.
- **Remove spoil and stored topsoil to eliminate scalping of native sod**. Track hoes equipped with "twist wrists" (a bucket attachment that allows the bucket to be manipulated horizontally as well as vertically) and a small cleanup bucket can also effectively remove spoil and topsoil from the prairie sod. "Prairie Protector" blades (epoxy resin blades) mounted on the blade of a suitably sized grader, or mounted on the cleanup bucket of a hoe are quite effective in eliminating scalping.
- **Replace soils with adverse chemical properties** within the area from which they were removed (do not spread outside the excavated site).
- **Use harrows or a bobcat equipped with a modified street sweeper** to remove excess spoil from the storage area prior to topsoil replacement.
- **Re-contour graded portions of the ROW to match the surrounding landforms and drainage patterns.** Erosion is a natural process that occurs in native prairie badlands and river valleys. Recontouring the grade material to restore the pre-disturbance drainage patterns can be more effective than trying to control erosion from altered drainage patterns. It is important to provide adequate erosion protection (installing suitable geotextiles) where surface drainage crosses the trench line and to prevent surface drainage from flowing down trench line.
- **Maintain subtle local drainage patterns** in the prairie landscape and ensure that the drainages are not blocked.
- **Re-distribute salvaged topsoil carefully over the stripped area.** The size and type of equipment used and the number of passes that are needed to replace topsoil is key to reclamation success. Overworking prairie soils can result in increased pulverization, loss of organic matter and increased erosion potential.
- **Pick surface rock to match the stoniness level of the surrounding landscape**. Use picked rock to line the bed of seasonal drainages, create habitat piles for small mammals and herptiles, or determine suitable disposal options (offer large attractive rocks to landscaping firms, use rock to armour dug-outs). Creating new disturbances in native prairie to dispose of rock should be the last disposal option.

6.11 Native Prairie Revegetation Options

Sustainable vegetation growth on reclaimed sites is very important for wind and water erosion control and post-reclamation land use. Extensive research has been conducted to determine preferred methods of revegetating disturbances in the native prairie ecosystem. It is important to maintain local vegetation species diversity. *The Native Plant Revegetation Guidelines for Alberta,* (Native Plant Working Group, 2001), provides guidelines for revegetating surface disturbances in the various natural regions and sub-regions of Alberta. These guidelines apply to all pipeline surface disturbances in native prairie and native parkland ecosystems in the province of Alberta. It is important to discuss revegetation plans with landowners, land managers and leaseholders. They need to understand what is proposed, the timeline for recovery and how it affects their intended use of the resource.

6.11.1 Natural Recovery (No Seeding)

Natural recovery is a term used to describe a revegetation strategy that relies on the native seed bank and plant propagules contained in topsoil to revegetate the surface disturbance. Native plants on either side of the disturbance also provide a seed source and allow encroachment to take place over time through germination and vegetative reproduction. There is generally no seeding requirement or simply light seeding of an annual crop to prevent erosion.

Photo 38 Natural recovery in abandoned cultivation. Cypress Hills

The natural recovery option has gained popularity for some site types in recent years because of concerns about biodiversity and the lack of suitable native seed for revegetation. Use of minimum disturbance construction techniques has become an important component of successful natural recovery plans. C&R/IL/02-2, *Assessing Natural Recovery Sites in Native Plant Communities*, indicates natural recovery may be an appropriate option under the following conditions:

- Risk of soil erosion is low or the site is protected by light seeding of an annual crop and/or with erosion control products.
- There are adequate plant propagules in the topsoil. The best way to ensure this is to replace salvaged topsoil as quickly as possible.
- The amount of non-native species in the surrounding vegetation is insignificant or can be controlled.
- Restricted or noxious weeds are not a problem.
- Health of the range surrounding the disturbed area is good and can provide plant propogules

Best Management Practices include the following:

- **Consider the width of the disturbance**. Vegetation on ROWs with trench width disturbance only tends to recover more rapidly than on pipelines where the disturbance is much wider.
- **Consider the surface erosion potential**. Landscape position is important as well as the erosion potential of soils. Landscapes that have high erosion potential may not be good candidates for natural recovery.
- **Ensure that the adjacent native prairie is in good to excellent range condition**. Traditional range management practices need to be considered as well. Ideally the adjacent pasture should not be grazed during the early spring and summer when vegetation is actively growing and setting seed. If the pasture is grazed during the spring/summer timeframe, the ROW may need to be fenced. The size of the pasture and stocking rate also determines whether fencing is needed.
- **Ensure natural recovery sites and surrounding areas are free of persistent weeds and non-native invasive plants (e.g., crested wheat grass).**
- **Ensure that revegetation from the seedbank or other sources (e.g., tree seeds) is not hindered by other site factors** (e.g., soil moisture/drought, soil chemistry, etc.).

Photo 39   Natural recovery in Northern fescue grasslands.

6.11.2 Assisted Natural Recovery

Assisted natural recovery involves the use of non-native annual crops such as fall rye, flax, winter wheat, oats and barley to provide early cover for erosion control and shade for re-establishing native plants. Re-Green, a sterile hybrid of wheat crossed with wheat grasses has also been used on a trial basis. These non-native plants are non-invasive and non-persistent in the prairie ecosystem. It is important to seed at low rates to prevent too much competition for light and moisture.

Best Management Practices include:

- **Apply all of the Best Management Practices for natural recovery listed above**.
- **Apply an annual cover crop** at 1/10th (one tenth) the recommended agricultural seeding rate to erosion-prone sites. Drill seed with a rangeland drill where practical to ensure the seed is planted at the proper depth.
- **Apply a cover crop to natural recovery sites where the disturbance exceeds trench width.**
- **Consider the grazing management surrounding the site.** Grazing livestock are attracted to cover crops. On narrow disturbances (trench width stripped or no-strip), livestock attracted to the ROW can improve the seedbed for natural recovery by firming and imprinting the surface of the soil. Larger disturbances need to be carefully assessed in consultation with the landowner/land manager. Under certain circumstances it may be appropriate to fence the site.
- **Get a Seed Analysis Certificate.** Approval under the *Canada Seeds Act, (Canada No 1 Certified Seed),* does not mean the seed is weed free.

Photo 40 Assisted natural recovery seeded to fall rye and flax.

6.11.3 Native Seed Mixes

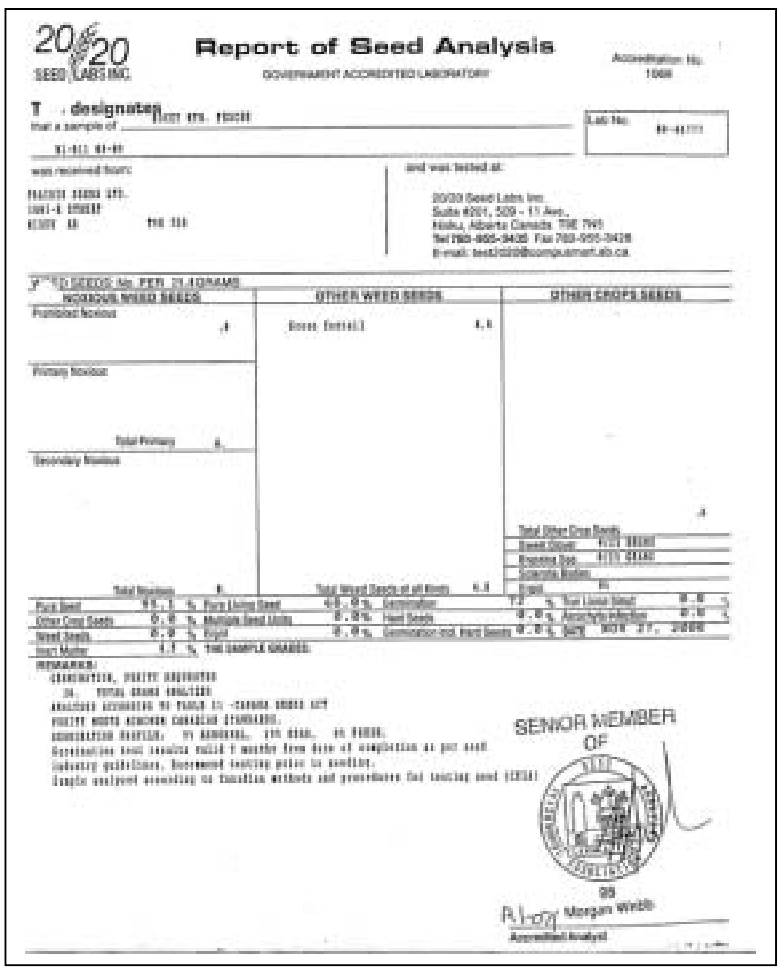
The *Native Plant Revegetation Guidelines for Alberta* (Native Plant Working Group, 2001) and *Establishing Native Plant Communities* (Smreciu et. al., 2002) provide specific direction for the use of native seed. *A Guide to using Native Plants on Disturbed Lands* (Gerling et. al., 1996) is also very useful when designing native seed mixes. It is recommended that a reclamation specialist with experience in designing native seed mixes be consulted when planning native prairie pipeline projects where native seed is used. The reclamation specialist needs to be consulted early in the project planning process as sourcing the appropriate seed as well as testing and obtaining Certificates of Seed Analysis (required to obtain approval from the regulatory authorities on public land) takes time.

Best Management Practices include the following:

- **Conduct a vegetation inventory** to determine what species should be in the seed mix. The native seed mix must be compatible with the surrounding native vegetation.
- **Consult the *Native Plant Revegetation Guidelines for Alberta*** to determine commercially available native species for the Grassland and Parkland Natural Regions. Suitable substitutions are listed in this document.
- **Apply the "buffer concept"** to sites where weeds or non-native invasive plants are encountered on, or adjacent to, the ROW. For example, a new pipeline constructed in native prairie beside an old ROW seeded to crested wheat grass could be seeded to a competitive mix of native species. The new replanted strip may serve as a buffer between the native prairie and the crested wheat grass.
- **Obtain Certificates of Seed Analysis** for each lot of each native species proposed in the seed mix (prior to mixing). Double sampling ensures more accurate results. Native seed must be free of weeds and non-native invasive species. Discuss the mix proposed with the landowner or land manager and obtain their approval. Submit a copy of the Certificates of Seed Analysis if requested and ensure a copy is retained in the project file. Note that approval under the *Canada Seeds Act, (Canada No 1 Certified Seed),* does not mean the seed is weed free.
- **Target optimal seeding conditions**. Native seed can be expensive and some species are in short supply. Planting early in the spring or in the fall after the first hard frost is recommended to achieve optimal results.
- **Ensure a firm seed bed.** A firm seed bed with good seed to soil contact is important. Rolling and imprinting following seeding is recommended. Specialized seeding equipment (e.g., Kinsella Accuroller) is available that can accomplish this in one operation. Steep slopes not suited to conventional equipment can be broadcast and harrowed and then imprinted with the tracks of a bulldozer. Bulldozer tracks should be perpendicular to the slope.

- **Make sure erosion-prone soils have erosion protection on a site-specific basis.**

Photo 41 Erosion control options: erosion control fabric, hydromulch and straw crimping



20/20 SEED LABS INC.

Report of Seed Analysis

GOVERNMENT ACCREDITED LABORATORY

Accreditation No. 1068

T... designates that a sample of

Lab No.

was received from:

and was tested at:

20/20 Seed Labs Inc.
Suite #201, 509 - 11 Ave.,
Nisku, Alberta Canada T9E 7N5
Tel 780-955-3435 Fax 780-955-3428
E-mail: seed2020@compusmart.ab.ca

NOXIOUS WEED SEEDS	OTHER WEED SEEDS	OTHER CROPS SEEDS
Prohibited Noxious		
Primary Noxious		
Total Primary		
Secondary Noxious		Total Other Crop Seeds
Total Noxious	Total Weed Seeds of all Kinds	Ergot

Pure Seed	%	Pure Living Seed	%	Germination	%	True Loose Smut	%
Other Crop Seeds	%	Multiple Seed Units	%	Hard Seeds	%	Ascochyta Infection	%
Weed Seeds	%	Ergot	%	Germination incl. Hard Seeds	%	Date	
Inert Matter	%	THE SAMPLE GRADES:					

REMARKS:

SENIOR MEMBER OF

Morgan Webb
Accredited Analyst

6.12 Post-construction Erosion Control Options

Industry is encouraged to conduct an erosion risk assessment to determine if post-construction erosion control measures are required on a site-specific basis. Pre-construction soil reports detail the erosion potential of soils encountered along the ROW. Local climatic conditions and current weather patterns encountered during construction should also be factored into the risk assessment. The width of the stripped area also is a large factor in determining risk. Generally, large and mid-sized diameter pipelines pose more risk of erosion due to stripping and grading requirements. Small diameter pipelines pose less risk however, steep slopes, water crossings, pulverized soils and erosion-prone sandy soils can present erosion concerns. Ploughed-in pipelines are not exempt from the risk of post-construction erosion. Areas where sod has been scalped by tracked equipment and steep slopes require erosion risk assessment.

Best Management Practices include:

- **Conduct a post-construction erosion risk assessment**. Consider the erosion potential of soils, vegetation quality adjacent to the ROW, local climatic and current weather patterns and the width of the disturbance on a site-specific basis.
- **Use locally available material for erosion control where possible**. Where brush or trees have been cleared, use this material for erosion control, providing it does not conflict with the intended land use. It can be spread back across the disturbance and walked into the soil with a bulldozer. Wind erosion barriers can also be constructed with salvaged sagebrush or similar woody species. Salvaged brush can be dug into soil to modify the effect of the wind on erosion-prone soils.
- **Imprint (create surface roughness) the soil surface** as an effective means of reducing erosion potential. Imprinting also provides micro-sites for seedling germination. Imprinting can provide an effective means of erosion control on natural recovery sites. Specialized equipment is available for large-scale projects (e.g., Dixon Land Imprinter, Kinsella Accuroller). Seeding and imprinting the soil surface with a suitably sized tracked dozer can be effective for steep slopes and small areas. On steep slopes, growser cleats should run perpendicular to the slope. On small flat areas tracks should run perpendicular to the prevailing winds or potential surface flows.
- **Use appropriate erosion control fabrics on a site-specific basis**. There are numerous erosion control fabrics (jute or coir) available on the market that can effectively protect sites from wind and water erosion. It is important to choose the most effective and appropriate product for a given site. Suppliers have qualified erosion control specialists that can provide this expertise.
- **Use annual crops to provide erosion control where appropriate.**

- **Carefully plan erosion control berms in prairie river valleys.** Altering existing natural drainage patterns can cause additional erosion concerns both on and off site. Erosion berms are designed to direct and to discharge surface flow from the disturbed ROW and onto stable, well vegetated ground. Often there is insufficient vegetation to accept the discharged flow without causing additional erosion off-site. Re-contouring slopes to match the surrounding landforms and restoring the pre-construction drainage patterns is very important. It is recommended that a qualified geo-technical engineer be consulted to assess slope stability issues.
- **Properly apply mulch and soil tackifiers** to provide erosion control and facilitate germination on a site-specific basis. The site should be seeded first to ensure seed to soil contact. Imprinting the soil surface after seeding provides surface roughness for improved adherence of the soil tackifier. It is important to consider the available water supply when considering this technique and to plan off ROW access for tanker trucks and the hydromulcher.
- **Crimp straw on erosion-prone soils** to reduce wind erosion potential and prevent soil moisture loss. Guidelines for inspecting and selecting suitable straw quality are included in section 6.3 of this document.

Photo 42 Aspen, salvaged from clearing operations, was used to control erosion on this natural recovery site.

Photo 43 A dozer is used to firm the seed bed and imprint the surface of the soil following seeding operations.

6.13 Reducing Grazing Impacts

To ensure reclamation and revegetation success on prairie pipeline projects, the impact of grazing animals on newly reclaimed ROW must be considered. Cattle and wildlife can be attracted to succulent growth on the recovering ROW in an otherwise arid landscape.

Best Management Practices include:

- **Involve the landowner or land manager in the decision-making process.** Find out when the cattle will be grazing in the project area. Less damage will occur if grazing is initiated towards the end of the growing season when the vegetation is going into dormancy.
- **Adequately compensate the rancher for the loss of production.** Ensure that compensation adequately reflects the time frame for recovery.
- **Determine range condition.** The impact is substantially greater in an overgrazed pasture than one in good-to-excellent range condition.
- **Consider the width of disturbance.** Impacts of grazing increase as the disturbance width increases. Graded areas often require protection.
- **Consider revegetation procedures** (seeded, assisted natural recovery, natural recovery).
- **Consider the type of livestock.** Horses and sheep cause more damage to newly recovering plants than cattle.
- **Consider field size and stocking rate.** Small pastures are most prone to impact as the ROW affects more of the productive capacity of the field. Impacts are smaller in large pastures with low stocking rates. Try to negotiate deferred grazing, offer to buy feed, or rent pasture to replace forage production losses.
- **Negotiate proper grazing management for the area.** In areas of low rainfall, high intensity short duration grazing is appropriate on a site-specific basis. The duration of impact is thereby reduced allowing vegetation to recover.
- **Seed native species that are compatible with the surrounding native vegetation.**
- **Ask the landowner or land manager to place salt and mineral supplements well away from the ROW.**
- **Consider temporary fencing** if the ROW is located close to traditional watering or livestock handling sites.
- **Consider temporary electric fencing in situations where cattle herds are rotated to different pastures along the ROW.** This method has been very successful on a number of pipeline projects.

- **Install temporary fencing (or permanent fencing with cattle crossovers) in over-grazed pastures or erosion prone sites** if other options for ROW protection are not possible. Fencing must be carefully planned with the landowner or land manager. Traditional access to watering sites must not be blocked and fences must be carefully constructed so that calves cannot be trapped. Breaks in fencing should be located in low-lying areas where vegetation is more resilient to trampling.
- **Consider using a wildlife browsing repellent** where native shrub transplants are installed. "Skoot" is a water-based non-toxic, bitter tasting substance that has been successfully used in the Pincher Creek area (Deb Everts, pers comm). The repellent is sprayed on shrubs in spring and fall.

Photo 44 Assisted natural recovery on a small diameter pipeline seeded to fall rye and flax. The seeded crop controls soil erosion and provides forage for the cattle. The cattle firm the seedbed and provide microsites for natural recovery.

6.14 The Importance of Monitoring Programs

It is important for industry to monitor the progress of newly reclaimed ROWs. Operators are responsible for control of noxious and restricted weeds on the ROW under the *Weed Control Act.* Operators are subject to municipal regulations, including all phases of pipeline operation, until reclamation certification is obtained at abandonment. Operators are also responsible for preventing and controlling erosion on ROWs under the *Environmental Protection and Enhancement Act*, and sediment control under the provincial *Code of Practice for Watercourse Crossings* and federal *Fisheries Act.*

Monitoring programs can identify environmental non-compliance issues and evaluate on-going revegetation success. Regular monitoring facilitates mitigation of environmental non-compliance issues in a timely manner. Operators are encouraged to compile an **Environmental Issues List** during the planning phase. This list can be used to evaluate environmental compliance during construction, reclamation and operation phases of the pipeline project.

Monitoring is important for the continual improvement of native prairie construction, reclamation and revegetation techniques. Monitoring reports can provide crucial information about successful procedures. A common database needs to be created and maintained to assist industry in project planning and to identify areas where research is needed. The Canadian Energy Pipeline Association (CEPA) or the Alberta Pipeline Environmental Steering Committee (APESC) should consider taking on this task.

Personnel involved in implementing monitoring programs in native prairie need to be familiar with conservation and reclamation goals for native prairie and understand multi-stakeholder concerns. They should be experienced and suitably qualified to assess erosion, soils, wildlife, reclamation and revegetation concerns.

Best Management Practices for monitoring newly reclaimed ROWs in native prairie include the following:

- **Monitor erosion-prone sites** until sufficient native vegetation has re-established to prevent erosion.
- **Address all identified erosion and siltation issues promptly.**
- **Assess the ROW for weeds and non-native invasive species.** More than one assessment is usually required to ensure adequate control of early spring, summer and winter annual weeds. Consult the landowner/land manager and local agricultural fieldman to discuss proposed control measures.
- **Monitor the progress of native revegetation and natural succession.** It is important to remember that there are no quick solutions. The process is dependent on climate and soil moisture conditions. Studies indicate 3 to 5 years are needed to ensure adequate vegetation re-establishment on prairie sites.

- **Allow at least two full growing seasons before recommending remedial seeding.** Native seed generally takes longer to germinate. Some native seed does not germinate until it has been exposed to temperature and light cycles that break its dormancy.
- **Monitor rare species mitigation.** It is important to evaluate the success of proposed mitigation for wildlife species of concern and rare plants. The knowledge that is gained benefits future projects and should be reported to ANHIC.
- **Hold educational field tours** for regulatory and industry personnel, landowners, land managers and NGOs.

Photo 45 The importance of monitoring programs.

7 RESEARCH AND CONTINUAL IMPROVEMENT

Operators are encouraged to continue developing creative conservation and reclamation procedures to facilitate the implementation of Best Management Practices. AENV and ASRD continue to encourage research projects and field trials designed to reduce impacts to native prairie ecosystems. Areas where research and technological advancement are needed include:

- Sod salvage techniques;
- Further development of the native seed industry, including wild harvested seed;
- More information about the use of native prairie shrubs and tree species for riparian habitat restoration;
- The use of soil bioengineering techniques for riparian habitat restoration and for slope stabilization;
- Continual improvement of plough-in technology;
- Continual improvement of horizontal directional drilling technology;
- Continued research and development in cost effective erosion control methods; and
- Continued research and evaluation of mitigation for wildlife and rare plant species of concern.

Operators have come a long way in the last five years in mitigating the effects of pipeline construction in native prairie environments. Continual improvement combined with shared knowledge and experience will improve the ability of operators to attain conservation and reclamation goals for pipeline construction in native prairie.

Photos 46,47 Research continues in sod salvage.

8 SPECIALIZED EQUIPMENT AVAILABLE

Photo 48 Frozen topsoil cutter.

Photo 49 Frozen topsoil cutter mounted on a dozer.

Photo 50 Low impact chain wheel ditcher.

Photo 51 Step blade mounted on a grader.

Photo 52 Prairie Protector Blade mounted on a grader blade.

Photo 53 Oscillating harrows.

Photo 54 Kinsella Accuroller - seeds, packs and imprints the right of way.

9 APPENDICES

9.1 Workshop Summary

A workshop organized by Gramineae Services Ltd. and supported by Alberta Environment (AENV) and Alberta Sustainable Resource Development (ASRD) was held in Claresholm, Alberta on February 15, 2002. The purpose of the workshop was to bring all industry stakeholders together to discuss the conservation and reclamation goals for pipeline construction as well as reclamation in native prairie environments, current pipeline construction practices and possible improvements to pipeline construction and reclamation practices. An issue list based on field observations by AENV, ASRD and the Special Areas Board was prepared prior to the workshop.

Representatives of AENV, ASRD and the Special Areas Board gave presentations on their regulatory responsibilities. The contractor retained by AENV and ASRD to develop the manual presented a draft outline to facilitate discussion. In the afternoon, the attendees were divided into nine breakout session groups, each with a facilitator, (to promote discussion and to record the comments from the group). The facilitators were chosen for their experience in environmental impact analysis and their construction experience in native prairie environments. Each group was asked to discuss a set of questions based on current pipeline construction issues and the conservation and reclamation goals for pipeline construction in native prairie. The breakout sessions generated valuable input for the preparation of this manual. A summary of the discussions and input received from interested stakeholders who could not attend has been summarized in the following sections.

Marilyn Neville, AENV and ASRD would like to thank all the participants for their valuable input and support in the preparation of this manual. A special vote of thanks goes out to Linda Jones of the Canadian Land Reclamation Association for assistance in organizing the workshop and to the following list of facilitators for their assistance in gathering the practical information from the workshop participants for incorporation into this manual:

Frank Osterwoldt	Fieldstone Environmental Resource Consultants
Al Looten	Al Looten Contracting and Inspection Services
Darcy Janko	Kermode Environmental Services
Rob Morin	AXYS Environmental Consulting
Jane Lancaster	Kestrel Research
Rob Durward	Enpro
David Walker	David Walker and Associates
Bob Faye	Can-Ag Enterprises
Todd Moss	Tera Environmental Consultants

9.1.1 Large Diameter Pipeline Groups

9.1.1.1 What procedures do you propose to reduce the loss of native species diversity on a site-specific basis?

1 More interpretive investigation during planning phases: determine exact location, determine projected impact of construction, determine if plant is truly rare or needs special treatment, determine if mitigation is practical and do cost/benefit analysis, evaluate alternate routing, off right of way compensation, habitat and enhancements after construction.
2 Need consistency during life cycle of facility (e.g., digups to be handled in the same manner as construction).
3 Prior to construction conduct as many mitigative measures as possible such as transplanting, seed collection, sod salvage and incorporate remaining mitigative techniques by site in contract document.
4 Where applicable during construction, fence protected areas and attach "do not disturb" signage; distribute information to foremen and inspectors detailing locations of site and mitigative techniques; use appropriate equipment to implement mitigative technique; ensure transplanted plants or salvaged sod receives timely watering; enforce a traffic control plan including moving equipment around site; conduct seed harvesting on or off right of way and plant on disturbed portions of right of way; enhance plant habitat if possible during cleanup.
5 Control erosion; sod preservation; topsoil salvage.
6 Worker safety issues have to be planned with environmental design.
7 Stripping and grading plan.
8 Insulation above pipe.
9 Topsoil in lay-up area compacted with sheep's foot packer.
10 Competent equipment operators with proper machines.
11 Get footprint decreased by planning whole operation (e.g., lease site, pipeline, road).
12 Get different regulatory bodies to work together.
13 Dormant season construction is recommended.
14 Preplanning must include long-term range management and range issues.
15 More staff for public lands for inspection, range management and during planning.

9.1.1.2 How do you propose to reduce the impact of non-native species invasion?

1 Work towards a universal rating system for weeds and aggressive plants.
2 Treat known weed issues prior to construction.
3 Thorough cleaning of equipment prior to arrival on right of way and attaching stickers to indicate that an inspection has been conducted prior to use of equipment.
4 Incorporate selected cleaning stations after passing through a weed infestation.

5 Conduct post-construction monitoring and weed treatment if necessary.
6 Use hay mulch versus imported straw if used for erosion control or soil barriers.
7 Enforce a traffic control plan.
8 Analyze seed certificates to ensure unspecified species are acceptable.
9 Use non-native species that are sterile or short lived for short-term erosion control that do not prevent prairie grasses re-establishing.

9.1.1.3 How do you propose to reduce the loss of habitat for wildlife?

Insufficient time to discuss in both groups.

9.1.1.4 How do you propose to reduce the impact of grazing on the newly reclaimed right of way?

Insufficient time to discuss in both groups.

9.1.1.5 What can we do to eliminate scalping of the native vegetation and soils?

Develop a grader blade that has small sections and can be set to specific ground pressures using springs.

9.1.1.6 What can we do to eliminate uneven stripping of topsoils in rough micro-topography?

1 Determine if this is truly a significant issue.
2 Conduct more detailed soil surveys prior to construction and identify areas that require special stripping and handling.
3 Use qualified, independent inspectors.
4 Strategically store stripped topsoil such that it is not lost in depressions during removal, storage and replacement.

9.1.1.7 What can we do to eliminate possible subsidence or unacceptable crown height over the trench?

1 In frozen soil conditions, leave final cleanup until the spring.
2 Change the roach profile to incorporate a notch or depression to catch moisture.
3 Feather roach but don’t leave more than 1” depth beyond ditchline.
4 Prioritize - is high roach better than sod disturbance or vice versa?
5 Combination of large and small equipment; roach heights should subside in one year.
6 More tolerance for rough surface to reduce erosion, deter traffic and increase biodiversity.

9.1.1.8 How can we prevent pulverization of the soils on the unstripped workside?

1 Implement a traffic control plan.
2 Use straw or wood chips as the boundary layer on top of the sod.
3 Water the right of way at night to tighten up the soil.

4 Travel on ditchline prior to its excavation.
5 Construct during the winter.
6 Extend Better Management Practices to all pipelines.
7 Drive on geotextiles.
8 Use organic mulch.

9.1.1.9 How can we improve on the incomplete removal of spoil and topsoil from the storage areas, especially in areas of rough micro-topography?

1 Use good operators and the appropriate equipment.
2 Experiment with different equipment (e.g., serrated blades, rotors for grader blade).
3 General consensus that it was acceptable to leave approximately 1” of subsoil on surface and tine harrow it rather than scalp.
4 Lay spoil on geotextile.
5 Place spoil on organics (e.g., straw mulch where working room is limited).
6 Use snow as separator where space is limited.

9.1.1.10 How can we assure complete removal in areas where the spoil has chemical properties that limit the growth of native plants?

Leave spoil with adverse chemical properties in original location (e.g., don’t spread it outside of saline area).

9.1.1.11 How do we deal with rocks and gravels brought to the surface in the spoil?

1 Leave rocks in piles to create small animal/reptile habitat rather than disturb other sod to bury rocks.
2 Bury rocks; use rocks to reduce erosion.

9.1.1.12 What are practical solutions to controlling wind and water erosion? What are creative and cost effective solutions?

1 Use weed-free straw and crimp.
2 Hire a consultant to ensure proper strategy and implementation.
3 Use temporary erosion blanket.
4 Use soil tackifier.
5 Rough ground, avoid smoothing the surface of the topsoil during replacement, just to make it look nice.
6 Just in time grading.
7 Cleanup tight behind construction.

9.1.1.13 Other General Comments

1 Cultural resources are pressed for assessment time - ditch filled in too fast.
2 Small diameter lines not properly assessed.

9.1.2 Mid-sized Laterals and Sales Lines Discussion Groups

9.1.2.1 What procedures do you propose to reduce the loss of native species diversity on a site-specific basis?

1. Planning: minimize extent of disturbed area; pre-disturbance survey to identify species diversity.
2. Consider sharing rights of way to minimize cumulative effects; consider joint ownership of rights of way.
3. Integrated planning with other producers and pre-plan line capacity. Build one 12” versus two 6”.
4. Construction: use new technology and equipment.
5. Sod salvage time constraints (e.g., sod storage).
6. More detail on where different vegetation seeding should be done is required.
7. Financial benefits for companies who comply; penalties for companies who do not comply with regulations.
8. Compliance: compare pre-disturbance with post-disturbance to determine compliance. Industry to post bonds to ensure compliance.
9. Pipelines to use similar procedures for reclamation certificates as currently used for well sites.
10. Enforcement and inspections are restricted by lack of regulatory staff.
11. Detailed pre-construction assessment at the <u>right time of year.</u>
12. Up front meeting with regulators to understand issues.
13. Tax incentives for preplanning and bonds for reclamation.
14. Reroute around sensitive sites; narrow down right of way where possible.
15. Understanding of equipment limitations and capabilities is needed.
16. Minimize the disturbance through grade planning.
17. Use road bore technology to avoid sensitive features.
18. Consider sod salvage with timing restrictions.
19. Avoidance: Don’t do anything - <u>work around.</u>
20. Over build to avoid looping - regulators may not allow it.
21. Equipment selected to minimize disturbance (e.g., directional drill - crews getting experienced).
22. Sod salvage - reference Montana Coal Mine equipment - sod cutters; use sod salvage to preserve native-use species (e.g., Fort Mackay) and move sod to other location.
23. Use concept of no net loss for species and replace in other area.
24. Public compensation to property owners for forcing preservation of native species.
25. Food security measures - equipment clean, spill protection, standard operating procedures, HASEP style manual (reference CFIA & AB. Ag. Requirements).
26. Examine/evaluate weed certificate of analysis as “Certified” seed designation not good enough.
27. Emphasize the use of <u>local straw</u>.

28 Erosion control blankets should be in-country source.
29 S.A.R.A. and provincial wildlife legislation to protect endangered species and liability with pipeline owner.
30 Reduce stripping widths.
31 Plough-in bigger pipe may be an option depending on weather and soil conditions.
32 Loss of vegetation is directly related to practices used with respect to soil loss and disturbance.
33 What is the minimal disturbance to do the job and conserve vegetation?
34 Soils issue: great dependence on soils information and survey. Significant differences in topsoil depths are important.
35 All same goals and guidelines should apply, regardless of pipe size or regulation.
36 First step is planning.

9.1.2.2 How do you propose to reduce the impact of non-native species invasion?

1 Native harvesting/seed collection; need mature prairie to harvest.
2 Look at combination and interaction of native seeding techniques.
3 Need to compile existing information on native species use/applications.
4 Non-native species not always a problem (e.g., nurse crops assist native species invasion).
5 Need balance between erosion control and native species re-establishment.
6 Pre-planning/timing/equipment/operators: training courses (e.g., PITS).
7 Site supervision/soils handling training; info. sharing; “tickets” for operators - training certification and documentation (may need legislation).
8 Reclamation criteria.
9 Mowing adjacent right of way prior to construction.
10 Vegetation management for invasive species.
11 Equipment cleaning.
12 Cattle management.

9.1.2.3 How do you propose to reduce the loss of habitat for wildlife?

1 Planning/routing/use of corridors.
2 Pre-disturbance assessments to avoid sensitive areas.
3 Diagram: information/communication/planning/enforcement.
4 Off site compensation - but does not solve specific problem. Not replacement by has some merits on site-specific basis.
5 Preplanning; avoidance and mitigation.
6 Know timing restrictions.
7 Research cumulative effects.
8 Artificial nests and burrows for hawks and owls.
9 Transplants.
10 Narrow down right of way.
11 Planning and identification of key wildlife habitat.

12 Timing of activity (e.g., post nesting season).
13 Proactive pre-construction survey.
14 Need environmental inspectors for Class 1 and 2.
15 Narrow up through treed areas.
16 Know timing restrictions (e.g., migratory birds).
17 Spend money on mitigation.
18 Develop grade plan for specific site.
19 Have personnel onsite to make decisions during construction.

9.1.2.4 How do you propose to reduce the impact of grazing on the newly reclaimed right of way?

1 Cover crops require fencing – maintenance needs.
2 Timing of grazing restrictions.
3 Use of salt blocks to direct cattle away from the right of way.
4 Communication especially with landowners and land managers.
5 Non-palatable grass protection for early growth.
6 Spraying grazing deterrent on the right of way.
7 Fencing - allows faster restoration.
8 Providing feed for required time frame.
9 Keep animals out completely.
10 Landowner agreement for proper rotation.
11 Temporary fencing.
12 Flag no access areas.
13 In “brittle” areas of low rainfall, negotiate proper grazing/management for the area; recognize the role grazing animals play in assisting revegetation on a long-term basis (ref. Norm Ward Western Stock Growers’ Association for details). High intensity for short duration grazing is appropriate on a site-specific basis.
14 Electric fencing.
15 Improve communication with landowner (water, salt lick, etc.).
16 Compensation to landowner for loss of production.
17 Support rotational grazing.
18 Choose species that match adjacent plants.

9.1.2.5 What can we do to eliminate scalping of the native vegetation and soils?

1 More research on the impacts on vegetation is needed.
2 Choice of equipment and operator expertise is key.
3 Packing snow along as a barrier.
4 Clean straw as a barrier.
5 Use prairie protector blades.
6 Harrowing low areas where subsoil cannot be removed.
7 Increase stripping width.
8 Use sweeper (modified street sweeper on Bobcat).
9 Use hoe with cleanup bucket or blade with serrated edge and with a good patient operator.
10 Skilled operators and diligence of work.

11 Put trench material on top of geotextile, then roll spoil material back into trench.
12 Problem: Contractors don't have a reason to choose the best equipment. Budgets prepared by owner companies dictate the consequences. Industry needs to include total lifecycle cost of whole resource development.
13 Is there research on subsoil being left? Leave a few cm. of subsoil and let prairie grow through it. Accept a certain amount of admixing by leaving subsoil in place.
14 Native prairie protector still scalps.
15 Sweeper is effective by blowing excess away. With the 2" of topsoil left with no grass growing through, the sweeper is the solution.
16 Variability of soil elevations makes it difficult not to scalp.
17 At what point is vegetation sacrificed to preserve topsoil and vice versa? Is there any way to structure and identify each type of area?
18 Very site specific and directly related to soil chemistry for revegetation success.
19 Consider no stripping where ditch width is less than 14".

9.1.2.6 What can we do to eliminate uneven stripping of topsoils in rough micro-topography?

1 Planning!
2 Soil survey: discuss with operators.
3 More communication between operator/inspector/soil surveyors.
4 On-site supervision (check for understanding).
5 Need enforcement to make sure practices are followed.
6 Reduce speed! (dollar and management commitment).
7 Explain costs of fixing problems.
8 Technology: operators need to be trained on new equipment (e.g., prairie protector).
9 Education: more field days to demonstrate equipment.
10 Match equipment to construction/reclamation expectations.
11 Be as selective as possible in stripping topsoil (micro-topography).
12 Good operators and proper equipment selection.
13 More of a concern in areas of poor subsoils.
14 Use dozers with longer tracks or graders.
15 Consider not stripping, less total disturbance.
16 Determine acceptable levels of over stripping.
17 Don't strip in those areas.
18 Choice of equipment; skilled operators and diligence of work.
19 Use two lifts where needed to get all of "A" horizon.
20 Divide linear right of way into topographic sections to work instead of working from a linear perspective.
21 Almost impossible to do an efficient job stripping - shovel is efficient; must accept percentage of admixing and topsoil losses during salvage and replacement.

22 Use step blade or small machinery (e.g., banjos, hoes with cleanup buckets, small dozers).
23 Stripping trench area only is very difficult.
24 Stripping minimizes total admixing.
25 For even surface, need grading and stripping for undulating landscape.
26 With blowout stripped, leave spoil, and strip only a stretch of workside.
27 Time and costs are saved with preplanning for micro-sites.
28 Use pre-construction grade plan.
29 Applications must have some lee-way: provides more field flexibility; however regulators do not want “wishy - washy” statements (e.g., for 6” diameter use trench width stripping (24” wide ditch) and for 10” diameter use blade width stripping (3m wide stripping);
30 Sandy soils must be stripped.
31 No strip in clay soils is an option. No strip implies fewer invasions by weeds, more sod integrity left.
32 Plough or hoe trench with natural recovery.
33 Customize a step-blade with a set width for a given diameter of pipe (e.g., 24” wide for 6” pipe, 3 m for 10” pipe).
34 No strip scenario results in less invasion opportunities, more sod integrity left.

9.1.2.7 What can we do to eliminate possible subsidence or unacceptable crown height over the trench?

1 Need for knowledge sharing; should be specified in approval.
2 Backfill under better soil conditions and in small phases/pack in lifts (smaller equipment for less weight).
3 Water the trench line.
4 Disposal (cast aside).
5 Install breaks in roach.
6 Predict compaction capabilities of each soil group (e.g., clay versus sand, etc.).
7 Proper equipment selection.
8 Compact ditch spoil during backfill.
9 Timing of final cleanup in non-frozen conditions.
10 Pack ditch with rubber-tired equipment to minimum roach height.
11 Excessive soil moisture increases problems.
12 Sand padding adds to problem of excess trench spoil.
13 Hauled in fill to fix subsidence is a questionable practice.
14 Add breaks in roach everywhere to maintain surface hydrology.
15 Roach is preferred to sloughing.

9.1.2.8 How can we prevent pulverization of the soils on the unstripped workside?

1 Enforce traffic control and minimize return trips.
2 Low ground pressure types of equipment and rubber-tracked equipment should be specified in the approval.
3 Progressive stripping.
4 Lay straw through areas of high sensitivity to pulverization that prevents sod from breaking up.
5 Water right of way workside following cleanup.
6 Stripping the topsoil and sod layer implies control, versus pulverizing and wind erosion.
7 Shut down criteria.
8 Construct during frozen ground conditions.
9 Use specialized equipment (wider tracks, low pressure tires), Floaters, Foremosts, etc.
10 Tackifiers on driving area may not work.
11 Watering dry right of way.
12 Geotextile with spoil or fill on top of driving area.
13 Stringing trucks are highest impacts - use blade width stripped area for stringing.
14 Widen right of way to decrease impact on one lane.
15 Shut down rules should be stronger.
16 Use environmental inspectors for Class 1 and 2 pipelines.

9.1.2.9 How can we improve on the incomplete removal of spoil and topsoil from the storage areas, especially in areas of rough micro-topography?

1 Equipment needs (e.g., brooms/protectors).
2 Leaving some may be acceptable in site-specific conditions (check pre-disturbance survey).
3 Need for operator training/experience.
4 Hand labor.
5 Train the people doing the work.
6 Specialized equipment (articulating bucket), then harrow.
7 Seed the areas.
8 Leave in place and monitor.
9 Use geotextile or impermeable liner; use snow or straw as buffer.
10 Equipment selection (e.g., hoe with cleanup bucket better than a dozer), sweeper, prairie protector.
11 Minimize spoil by having appropriate ditch size for pipe size.
12 Strip storage areas.

9.1.2.10 How can we assure complete removal in areas where the spoil has chemical properties that limit the growth of native plants?

1 Soil testing to see if there are problems first.
2 Seeding with salt tolerant species.
3 Store poor chemical spoil away from sensitive areas.

4 Chemical counteraction of toxic soil, (soil amendments).
5 Adverse chemical properties: strip 20 to 30 cm (A, B and part of C) and accept admixing (unless Solonetzic soil at surface).
6 Site-specific assessment: get specific requirements for specific conditions from soil surveys within each type of area; soil surveys very necessary and need to be provided to contractors; “need better soils info”.
7 Best practices manual should include soils and vegetation information.
8 Regulators require information up front to decide on best practices and allow site-specific flexibility. Detailed info.also helps contractors for bids. Soil survey is cheap and better in the long run.

9.1.2.11 How do we deal with rocks and gravels brought to the surface in the spoil?

1 Truck in material after rock removal.
2 Remove rock – aesthetics.
3 HRIA interpretations (rock alignments, circles, piles).
4 Use as erosion control on slopes, etc.
5 Rock padding machine (ozzie padder).
6 Leave in place if it minimizes the disturbance.
7 Pick rocks, pick rocks, pick rocks!
8 Use specialized equipment (e.g., ozzie padder).
9 Rock: use ozzie padder to avoid importing sand.
10 Replace rocks on right of way, equivalent to off right of way rock.
11 Send to gravel pits; place back in trench; haul to rough broken coulees, bury with cover.
12 What about loss of volume with rock removal? Do you have to haul in fill?

9.1.2.12 What are practical solutions to controlling wind and water erosion? What are creative and cost effective solutions?

1 Use of nurse crops; tackifiers.
2 With straw crimping/bales there are weed issues.
3 Erosion control blankets/fiber cloth, etc.
4 Minimizing disturbance should be primary control.
5 Enviro berms are useful for erosion and siltation control. They need to be maintained to be effective.
6 Seeding with cover crop.
7 Placement of topsoil along workside and flatten out.
8 Decrease length of time soil is exposed.
9 Use geotextiles and erosion control fabrics.
10 Tackifiers and mulches.
11 Erosion berms.
12 Water on clay soils to set up a crust and stop wind erosion.
13 Seed in a pioneer plant and let succession occur.
14 Seed in sterile annuals for cover and let succession occur.
15 Minimize disturbance and leave root structures.
16 Use proper Better Management Practices designed for erosion and sediment control.

17 Reduce traffic and access.

9.1.2.13 Other General Discussion

1 There is a need for more information sharing in the pipeline industry. Pipeline association should be formed (industry, regulators, consultants, landowners, academics).
2 Need more technical information on germination requirements for native vegetation.
3 Prairie research (institute) leads to info. Sharing/leading to practical applications of existing/new knowledge which can lead to legislation/ enforcement.
4 Supervision on the up front activities: better planning and more inspection; environmental awareness prior to construction; better information going in.
5 Require documentation of results of various methods in different areas (as-builts and monitoring); required results to be posted in place where others can share it.
6 Government regulators must facilitate a method to share info (e.g., internet).
7 Landowners require compensation for loss of productivity even if many years into future.

9.1.3 Small Diameter Pipeline Groups

9.1.3.1 What procedures do you propose to reduce the loss of native species diversity on a site-specific basis?

1 Avoidance during route selection.
2 Must ask question of what timeline you are looking at.
3 There is a lack of formal pre-disturbance assessment requirements. Industry needs to know how to balance between level of assessment and scope of projects. As wells are drilled and added, the scope of a project changes quickly.
4 Transferability of area operating agreements: is it easy; does it work?
5 Consistency between regulatory expectations and application of rules (Public/Green areas and consistency to improve).
6 Ensure a code of practice is dependent on soil type, etc.
7 Pre-screen sites (with regulator, etc.) before actual site assessment.
8 Up front communication at big picture level.
9 Site-specific: Check ANHIC; conditions in approval based on Siting Information Report. You have to know what is there.
10 Narrow ditchline; minimize stripping.
11 Narrow down native grasslands using Prairie Conservation Forum Map.
12 Use natural recovery as much as possible.
13 When choosing not to seed on small disturbances, choice depends on size of disturbance and quality of range at the site.

14 Site can have 10 to 25 species but most seed mixes only have 5 species. More species are required.
15 Nurse crop to allow natural recovery of natives.
16 Strip a "seed bank" sod layer versus no strip.
17 If you include scalping, the disturbance can often be 5 to 7 meters wide.
18 There should be no grading of side hills.
19 On rougher topography, no strip is better.
20 Reduce scalping by pulling soils back in winter.
21 In frozen ground conditions, rip soil in levels so that less topsoil is falling in, less compaction with repeated passes; Tickle ripping - repeated passes to break through frost.
22 Assess how many lifts should be used. Dollars spent up-front need to save dollars at the end. Every lift of soil stripped has an environmental cost (e.g., need place to store soil).
23 In summer, zero stripping topsoil falling into hole (approximately 10%).
24 In drought conditions (no info.); no moisture to hold soil.
25 Use hydro mulch as cows and wildlife trample tackifier.
26 Quality of work done in the field is an issue. Quality control is needed.
27 Ploughing is an excellent choice in some areas and poor choice in others (e.g., salts, rocks, frozen soil) and you must consider pipe material (e.g., plastic or steel).
28 With small inch lines there is high dependency on site-specific conditions but not much requirement for up front assessment.
29 Broad approaches with contingency plans - how can code of practice provide guidelines for contingencies?
30 Can geotextiles be laid down and equipment work on top? Some experience shows lots of damage to soil and vegetation when removed. Suitable when sandy, dry conditions.
31 3 to 5 year program for revegetation which takes into account climate changes such as drought, etc.

9.1.3.2 How do you propose to reduce the impact of non-native species invasion?

1 Do not use invasive species (e.g., crested wheat).
2 Pre-construction assessment is important as a record of what was there previously (e.g., weeds).
3 Clean equipment at original site.
4 Contract to companies in the area as equipment stays in the same general area.
5 If seeding, use high quality clean seed and get seed lots approved, then blend.
6 Select native seed mixes for reclamation specific to eco-region.
7 Seed at beginning of March in drought conditions.
8 Seed harvesting may be practical in some circumstances.
9 No seeding may be warranted in some cases to allow natural recovery.
10 Go away from seeding and use natural recovery, or use short term cleam nurse crop (fall rye/flax).rse crop (fall rye / flax);
11 Cattle graze seeded rights-of-way.

12 A big issue is the network of small inch pipelines in native areas so it is much better to use natural recovery methods such as seed harvest / collection methods on right of way prior to construction.
13 Natural recovery is not suitable if erosive topography or source of invasive species, etc.
14 A debate took place with regards to using new versus existing rights of way, new disturbance versus expanding zone of undesirable species. No consensus was reached.

9.1.3.3 How do you propose to reduce the loss of habitat for wildlife?

1 Consider all species.
2 Minimize the footprint. Plan common access, right of way, minimize disturbance at drilling pad.
3 Appropriate timing of construction for the wildlife issues.
4 Directional drill or bore watercourse crossings and/or spend money doing good re-contouring, etc. This implies economics.
5 Avoid or minimize disturbance.
6 Follow timing restrictions; complete a preliminary wildlife check.
7 Consider compensation for areas where disturbance cannot be avoided.
8 Decide how critical habitat is and if necessary, may need to go around it.
9 Need access to rare species data in planning phases.
10 Widening corridors may increase predation.
11 Let trees grow back on small diameter pipelines.

9.1.3.4 How do you propose to reduce the impact of grazing on the newly reclaimed right of way?

1 Negative consequences - loss of vegetation followed by risk of erosion.
2 Minimize disturbance and use natural recovery.
3 Safety hazards if wildlife and/or livestock drawn to right of way near roads.
4 Fencing.
5 Field rotation; benefits to grazing include: weed control, packing of right of way for firm seed bed, creation of micro sites to hold moisture and allow for good germination.
6 Disturbance is so minimal that cattle don't trample.
7 Electric fencing.
8 Deferred grazing.
9 Match equipment to job which helps minimize disturbance.
10 Efficient seeding techniques and timing of seeding.
11 More hydro mulching on right of way and vegetation will come up which helps to keep moisture in and keep cattle off.
12 Wildlife like young shoots.

5.1.3.5 What can we do to eliminate scalping of the native vegetation and soils?

1 No stripping implies no scalping.
2 Reduce scalping by turning blade around and "float" over sod / vegetation.
3 Accept some spoil left on the surface (site-specific, will disappear in time).
4 Prairie protector only works under some conditions; main issue is the acceptability of spoil; prairie protector attachments.
5 Need good operators.
6 See plough comments in section 6.
7 Use backhoes with articulating buckets.
8 4" or 6" pipe welded to bucket - no scalping but may compact soil depending on moisture levels.
9 Grader with prairie protector or reversed blade.
10 Leave some subsoil/topsoil on surface.
11 Skilled operators.
12 Orientation of operators and supervisors.

9.1.3.5 What can we do to eliminate uneven stripping of topsoils in rough micro-topography?

1 Planning: see what works and what doesn't in area (talk to local public lands managers).
2 If stripping topsoils, backhoes with various bucket attachments most successful - narrow cleanup bucket and good operator.
3 Feather the roach.
4 Sand - work in wet conditions.
5 Majority of areas are no strip (Public Lands).
6 Stripping facilitates two areas where scalping may occur: both sides of ditch.
7 No strip should be only option.
8 Face mixing if you strip or not;
9 Localized issue needs to be dealt with on a contingency basis.
10 For small diameter pipelines, the plough technique is a practical and effective way of minimizing stripping, scalping and roach issues.

Factors affecting the success of ploughing include:

1 Equipment type - different points on plough for different soils and conditions, D8 / D9 with tow assistance in rough topography; solid plough for most conditions and vibratory plough for rocky conditions.
2 Soils - typically no soils information to help contractor select proper equipment, ploughing difficult with rocky areas / hardpan / variable clays.
3 Season - winter conditions not suitable for ploughing, pre-ripping soils results in large over stripped clods creating large disturbance.

4 Wet or dry soil conditions - ripping in moist conditions causes scalping and ripping of sod. Ploughing in low areas may bring up large clods or turn sod over burying sod into plough line. In dry conditions plough may leave large mound on both sides of plough line.
5 Late summer and early fall best time to use plough.

General Plough comments:

1 Eliminates disturbance from stripping and excavating.
2 May be beneficial in Solonetzic soils due to mixing horizons and providing a growth medium.
3 Typically no seeding required.
4 More monitoring is required to assess results.
5 Typically eliminates roach concerns.
6 More useful for 6" and under.
7 Few or no soil studies completed for plough operations.
8 Not very successful in winter conditions due to pre-ripping requirements.
9 No strip and plough in winter.

9.1.3.6 What can we do to eliminate possible subsidence or unacceptable crown height over the trench?

1 Narrow trench implies it is harder to get spoil back in trench.
2 Scarifier and roller/packer that fits in trenchline.
3 Ditch width and proper packer.
4 Minimize snow mixed with spoil.
5 Contour issues affect vegetation and erosion management and then pipeline visible for a long time afterwards. Better with no roach and return to dress up right of way if subsidence occurs.
6 Monitoring and follow up may take several years before totally done.
7 Frozen soil - how much to put back implies final clean-up after breakup (don't pack spoil in trench when frozen).
8 Compact ditch line with graders.
9 Specialized compactor wheels for narrow ditch.
10 Feather spoil over wider area - use chain link fence with concrete block weights.
11 Use length of chain link fence with concrete blocks to level roach out; probably do more damage than leaving the soil.
12 Eliminate roach since it sheds water - no moisture.
13 To pack small ditch, use piece of pipe attached to a bucket.
14 Haven't had problems with salt accumulations on sunken ditch.
15 No strip on Solonetzic soils.

9.1.3.7 How can we prevent pulverization of the soils on the unstripped workside?

1 Use existing access or existing trails. Need disposition on whatever you use on Public Lands.
2 Consider long term versus short-term access needs.

3. Put pipeline in well site access.
4. Access management plan - stay within designated access right of way.
5. Control speed.
6. Limit vehicle and equipment passes.
7. Use quads.
8. Double right of way width and spread out traffic.
9. For permanent access road, drop gravel into ruts for ongoing access and then after prairie reclaims across it.
10. Use straw on right of way but there are availability and weed concerns - not favored generally.
11. Generally travel lane stripping not done on small inch.
12. Traffic controls (quads, wheeled pull equipment, weather shut down criteria).
13. Late fall/winter construction.
14. Water right of way.

9.1.3.8 How can we improve on the incomplete removal of spoil and topsoil from the storage areas, especially in areas of rough micro-topography?

1. Use backhoe with articulating attachment and cleanup bucket.
2. Use straw as buffer between sod and spoil.

9.1.3.9 Also, how can we assure complete removal in areas where the spoil has chemical properties that limit the growth of native plants?

1. Need to do a cost/benefit analysis (i.e., Is it better to leave some spoil or to scalp?).
2. 3 lift approach leads to extra stripping width and extra width of right of way. Is this appropriate for small inch project?
3. Get over it (i.e., accept some time frame to reclamation).
4. Site-specific.
5. Suitable equipment for job and conditions.
6. Remove most of spoil during backfill and leave remaining to dry out, then light harrow to break up and then remove soil.
7. Caution when doing spring cleanup as moisture at sod/soil interface and compaction may lead to scalping when soil is removed from sod.

9.1.3.10 How do we deal with rocks and gravels brought to the surface in the spoil?

1. Use for erosion control, for example armoring the bed of seasonal drainages.
2. Pick to equivalent off right of way conditions.
3. Remove rocks off site. Maybe the landowner has a use for them (i.e., armoring dugouts).
4. Place rock to its natural surroundings. Vegetation conceals large amount of surface rock in native vegetation.

5 Public Lands don't want more rocks on the surface than are found in the surrounding landscape.
6 Bury rocks; put on edge of sloughs for nesting birds.
7 Sell the big ones to landscape companies.
8 Place in bell holes (e.g., road crossings).

9.1.3.11 What are practical solutions to controlling wind and water erosion? What are creative and cost effective solutions?

1 Rip rap to armor bed and banks of seasonal drainages.
2 Drill/bore to avoid big slopes. Costs are worth it.
3 Erosion berms (ensure proper placement).
4 Temporary pipeline during well testing.
5 Tile or gravel in trench if seepage encountered.
6 Watering may provide temporary crust for wind erosion control.
7 Imprinting with Kinsella accuroller or cultipacker.
8 Sod salvage and replacement.
9 Keep animals off by using roll back. Use grid pattern with large diameter trees.
10 Place straw bales or twig plantings for site-specific erosion control.
11 Straw crimping sandy soils (test straw for weeds, buy off landowner).
12 One electric wire fence to keep cattle off.
13 Seed annual crops on erosive sites.
14 Use wild grass straw for straw crimping.
15 Use fall rye and flax as a cover crop. Animals can graze it, it's cheap, and cattle will eventually leave the flax alone.
16 Use geotextile. Ensure they're placed properly to avoid cattle trampling.

9.2 The Regulatory Framework in Alberta

9.2.1 The Role of the National Energy Board

Under the *National Energy Board Act*, the National Energy Board (NEB) has jurisdiction over any pipelines that cross an international or provincial boundary. The National Energy Board is a quasi-judicial board with the mandate to review all applications received under the Act, and to determine if approval of the application is in the best interest of all Canadians. The NEB is governed by the *Canadian Environmental Assessment Act, (CEAA)*, with regards to the legislation concerning environmental impact assessment and review. The NEB prepares an Environmental Screening Report with input provided from provincial and national regulatory agencies, to provide the Board with the information necessary to make an informed decision.

9.2.2 The Role of the Alberta Energy and Utilities Board

The Alberta Energy and Utilities Board (EUB) is an independent, quasi-judicial agency of the Government of Alberta, whose mission is to ensure that the discovery, development and delivery of Alberta's resources take place in a manner that is fair, responsible and in the public interest. Among other responsibilities pertaining to pipelines, the EUB reviews pipeline applications and works in conjunction with other provincial and federal government agencies as needed to understand and address environmental issues.

9.2.3 The Role of Indian Oil and Gas Canada

Indian Oil and Gas Canada (IOGC) is a separate agency under the Federal Department of Indian Affairs and Northern Development (DIAND). IOGC administers oil and gas development activities on established First Nations reserves where land disposition has been approved by the First Nation and operates under the federal *Indian Oil and Gas Act and Regulations.* Sec. 4c of the *Indian Oil and Gas Regulations* makes provincial environmental legislation a condition of any license or lease.

9.2.4 Alberta Environment's Role in Pipeline Construction and Reclamation

9.2.4.1 Mandate

The mandate of Alberta Environment is to ensure that land specified under the *Environmental Protection and Enhancement Act (EPEA)* is properly conserved, remediated and reclaimed. Under this Act, land must be reclaimed to "equivalent land capability". Equivalent land capability is defined, as "the ability of the land to support various land uses after reclamation is similar to the ability that existed prior to any activity being conducted on the land, but the ability to support individual land uses will not necessarily be equal after reclamation."

The obligation to conserve is required by Part 6 of *EPEA*. Conservation, as defined by *EPEA*, refers to the "planning, management and implementation of an activity with the objective of protecting the essential physical, chemical and biological characteristics of the environment against degradation". This means that the complete impact of each development activity must be examined as to what practice or procedure best achieves equivalent land capability in the long term.

9.2.4.2 Alberta Environment's Responsibilities for Conservation and Reclamation

AENV's responsibilities with regard to the construction and reclamation of pipelines include:

- Establishing conservation, remediation and reclamation criteria;
- Establishing requirements for watercourse crossings and pipeline crossings;
- Issuing pipeline construction approvals if the pipe exceeds the 2690 index (C&R approval: length of pipeline in kilometres times the diameter of the outside of the pipe in millimetres);
- Receiving notification of intent to build a pipeline, prior to application to the Alberta Energy and Utilities Board (EUB);
- Receiving notification prior to construction kick-off;
- Receiving notification under the Water Act, *Code of Practice for Water Course Crossings;*
- Responding to landowner complaints during construction, operation and reclamation stages;
- Undertaking enforcement as necessary; and
- Issuing reclamation certificates for abandoned pipelines on application;

Communication with the AENV Reclamation Inspector can provide valuable input on pipeline project design.

9.2.5 The Role of Alberta Sustainable Resource Development in Pipeline Construction and Reclamation

9.2.5.1 Mandate

Alberta Sustainable Resource Development (ASRD) is responsible for the management of Alberta's public lands, forest management, forest industry development and the conservation management of Alberta's fish and wildlife populations. The Public Lands Division is responsible for administering and managing public land use and allocation under the authority of the *Public Lands Act* and associated regulations.

9.2.5.2 The Role of the Public Lands Division

All applications for public land use, such as a Pipeline Agreement (PLA), are submitted to the Dispositions and Technical Services Branch (DTS) of ASRD. The terms "Green Area" and "White Area" are being phased out as the types of land uses on a parcel of land are being emphasized, rather than an arbitrary geographic boundary.

Requirements on former Green and White Area public lands will be standardized where practical as processes are reviewed and modified. Currently the applicant is required to submit Siting Information Reports (SIR) on former White Area public land or an Environmental Field Report (EFR) on former Green Area public land with the application. Class 1 pipelines do not require an SIR/EFR as a C&R application is required. The SIR/EFR (or C&R application) provides the public lands manager with the information to make agency referrals, appropriate to the project. The application is then referred to the district Public Lands office or the district Forest Area office.

9.2.5.3 The Referral Process

The public lands manager also contacts other agencies with an interest in the land. Such agencies may include: ASRD's Fish and Wildlife Division, Alberta Transportation and Alberta Community Development. These agencies provide the land manager with issues of concern with regard to the proposed land use application.

The public lands manager, (i.e. Public Lands Officer or the Forest Officer), is the "integrator" of all land use concerns and reviews input received from referral agencies to arrive at an "integrated land use decision". The land manager forwards the recommendations and conditions for approval to the Disposition and Technical Services Branch. The approval gives the applicant the authority to enter and occupy the public lands for the purposes described by the land use disposition. Failure to meet the conditions of approval listed on the PLA is a contravention of the *Public Lands Act* and is subject to enforcement under the Act. The public lands manager issues reclamation certificates for pipelines on public lands within their jurisdiction.

9.2.6 The Special Areas Board

The Special Areas Act was passed in 1938 to establish a provincial crown agency known as the Special Areas Board. The Board was established to lease out the 1.4 million acres of tax recovery lands in addition to the 1.5 million acres of public lands located in east central Alberta for use by and the stabilization of, the regional community.

9.2.6.1 Mandate

The mandate of the Special Areas Board is to undertake any programs that lead to the rehabilitation of the land or betterment of the quality of life of the residents of the Special Areas. The *Special Areas Act* empowers the Minister of Municipal Affairs with the authority of the *Public Lands Act* for public land responsibilities and the *Municipal Government Act* for municipal functions. The *Special Areas Act* allows the Minister to delegate powers and duties to the Chairman of the Special Areas Board.

The *Special Areas Act* provides for a single Crown Agency to manage the large amount of provincial public lands (an asset for all Albertans), along with the tax recovery lands (an asset of the people of the Special Areas). Broad land use control powers are still needed due to the fragile and sensitive nature of these lands.

To date, the Special Areas regional government has been widely supported by the local residents as a form of administration that suits this area. This support is due to Special Area's ability to balance local and provincial interest in public land and provide cost effective and responsive municipal services.

9.2.6.2 The Role of the Special Areas Board in the Pipeline Application and Approval Process

The role of the Special Areas Board is very similar to the role of the public lands manager in ASRD. The application and referral process is very similar. Approvals are issued directly by the Special Areas Board. Conditions of approval are placed on applications and are compatible with the current land use guidelines for Special Areas. The approval gives the applicant the authority to enter and occupy the lands for the purposes described by the land use disposition. It should be noted that AENV issues reclamation certificates for Special Areas land.

9.3 Recent Guidelines and Information

The Alberta Environment website located on the internet at www3.gov.ab.ca/env/info/infocentre/publist.cfm and the Alberta Energy and Utilities Board website: www.eub.gov.ab.ca/bbs/products/products.htm can be used to access the most current Guidelines and Conservation and Reclamation Information Letters (C&R/IL's). These publications provide direction to industry concerning current regulatory requirements. As reclamation is a developing science, with improvements in technology occurring on a regular basis, the websites provide a quick access to the most current information available. Many C&R Information Letters can be down loaded and printed. The Information Centre offers an on-line ordering system for guidelines and documents too large to be downloaded.

Alberta Environment, Alberta Sustainable Resource Development and the Alberta Energy and Utilities Board have developed the following information for petroleum development activities in native prairie environments:

- *Establishing Native Plant Communities*, 2003
- *Prairie Oil and Gas: A Lighter Footprint*, 2001
- *Common Plants of the Western Rangelands*, Cathy Tannas, AAFRD, 2nd edition, Olds College Press, 2001
- *Native Plant Revegetation Guidelines for Alberta*, February 2001
- *Petroleum Industry Activity on Native Prairie and Parkland Areas, Guidelines for Surface Disturbance,* September 2000
- *A Guide to Using Native Plants on Disturbed Lands*, 1996

Conservation and Reclamation Information Letters are developed by AENV and ASRD to address issue-specific concerns and expectations with regards to development activities. The following is a list of current C&R Information Letters relevant to pipeline development activities in native prairie environments:

- *Assessing Natural Recovery Sites in Native Plant Communities,* 2002
- Public Lands Update on Purity of Native Seed, C&R/IL/draft
- *Weed Awareness for Reclamation (WAR)*, an on-line slide show to heighten awareness on weed issues: www3.gov.ab.ca/env/protenf/landrec/documents/WeedAwarenessforReclamation.pdf
- *Reclamation Assessment Criteria for Pipelines*, 2001 draft
- *Pipeline Reclamation Certificate Applications*, C&R/IL/01-12
- *Two Year Trial of Pipeline Reclamation Assessment Criteria*, C&R/IL/01-11
- *Problem Introduced Forages on Prairie and Parkland Reclamation Sites*, C&R/IL/01-6
- *Ploughed-in Pipelines*, C&R/IL/01-4
- *Notification for Class 2 Pipelines on Private Land*, C&R /IL/00-7
- *Voluntary Shutdown Criteria for Construction Activity or Operations*, C&R/IL/98-4
- *Winter Soil Evaluations*, LCRC/IL92-2

Communication and information is key to the implementation of successful pipeline projects. AENV and ASRD are constantly working with industry to improve pipeline construction practices. Information exchange between government agencies and the pipeline industry provides the opportunity for continual improvement.

9.4 Ideas for Future Regulatory Direction

The workshop held in Claresholm, Alberta provided the opportunity for AENV, ASRD and industry to reflect on future regulatory direction. The need for clear guidelines with consistent non-compliance standards emerged as the major issue of concern for both industry and the regulatory authorities. The summary of the breakout sessions indicates the level of concern expressed by the participants. Ideas for future regulatory direction that emerged from the discussion groups include:

- The need for AENV and ASRD to work together and agree on consistent regulatory requirements.
- The need for qualified and independent environmental inspection.
- Enforcement and inspections are restricted by lack of regulatory staff.
- There should be financial benefits for companies who comply and penalties for companies who do not.
- Industry to post bonds to ensure compliance.
- Tax incentives for preplanning and bonds for reclamation.
- Over-build to avoid looping, regulatory change may be needed.
- Use concept of no net loss of species.
- Need for knowledge sharing.
- Enforcement of traffic control should be a mandatory condition of approval.
- Formal pre-disturbance assessment requirements should be instituted.
- Consistency between regulatory expectations and formal regulatory requirements necessary.

9.5 Environmental Check List for Pipeline Construction in Native Prairie Environments

The following check list has been developed to assist industry in planning pipeline projects located in native prairie environments.

Environmental Check List for Pipeline Construction in Native Prairie Environments

Size of pipe _____mm X length of proposed project __________KM
Start LSD___________________ End LSD___________________
Sweet gas_______ Sour gas__________
Application: EUB___ NEB____IOAG____
Natural region(s) and sub-regions involved: ________________________
____

Can native prairie be avoided through route selection?	Yes	No
Are protected areas involved?	Yes	No
Are Environmentally Sensitive Areas involved?	Yes	No
Have soils maps been consulted?	Yes	No
Has a soils survey been conducted?	Yes	No
Have native vegetation communities been defined?	Yes	No
Has ANHIC been consulted for known rare plant locations or rare plant communities of concern?	Yes	No
Is a rare plant survey required?	Yes	No
Has a weed or invasive plant survey been conducted?	Yes	No
Has a Historical Resources Overview been conducted?	Yes	No
Is a Historic Resource Impact Assessment required?	Yes	No
Are wildlife species at risk, or may be at risk involved?	Yes	No
Is a wildlife survey required?	Yes	No
Are water crossings involved?	Yes	No
Is a fisheries assessment required?	Yes	No
Has public consultation been conducted?	Yes	No
Have other industry stakeholders been contacted?	Yes	No
Have the regulatory authorities been contacted?	Yes	No
Have non-government organizations raised concerns?	Yes	No
Do landowners or land managers have concerns?	Yes	No
Have all concerns been addressed?	Yes	No
Has an environmental issues list been prepared?	Yes	No
Has native prairie been avoided to the extent practical?	Yes	No
Have existing disturbances been used to the extent practical?	Yes	No
Has unstable terrain been avoided?	Yes	No
Do wildlife timing restrictions apply?	Yes	No

Is rare plant mitigation required?	Yes	No
Have the cumulative effects been addressed?	Yes	No
Is a quality assurance program in place?	Yes	No
What is the proposed timing of construction? ______________________________		
Voluntary Shut Down Criteria: has it been included in the pipeline contract?	Yes	No
What soil conservation measures are proposed? ___________________________		
What vegetation conservation measures are proposed? _____________________		
What revegetation strategy is proposed? ___________________________________		
Is native seed required?	Yes	No
Has the native seed been inspected and ordered?	Yes	No
Have Seed Analysis Certificates been obtained and filed for all seed lots?	Yes	No
Has erosion control been addressed?	Yes	No
Has an Environmental Protection Plan been developed?	Yes	No
Has the EPP been included in the pipeline contract?	Yes	No
Has the best available technology been incorporated	Yes	No
Is a traffic control plan in place?	Yes	No
Is a wildfire control plan in place?	Yes	No
How will environmental quality control be handled?____		
Has a post-construction monitoring program been developed?	Yes	No
Has the environmental issues list been discussed with the field staff operating the pipeline?	Yes	No
Have construction staff had an educational session?	Yes	No
Have qualified environmental inspectors been hired to oversee construction and reclamation?	Yes	No

9.6 Qualifications for Environmental Planners and Inspectors

Qualifications for environmental planners and environmental inspectors have long been a topic of discussion among industry and regulatory stakeholders throughout Canada. The Petroleum Industry Training Service has been offering two courses: *Environmental Planning for Linear Development* since 1989 and *Pipeline Environmental Inspection* since 1990. These courses provide an overview of current pipeline environmental issues and regulatory requirements with practical guidance in "how to" plan and inspect pipeline projects. Extensive manuals are provided with the courses that can be referred to by participants both in the field and when preparing applications. These courses while very useful do not provide any certification or professional accreditation.

The environmental issues with respect to pipeline developments in native prairie encompass all aspects of the native prairie environment and while some of these issues are constant for all pipeline developments, others are very specific, requiring specific skill sets. For example, knowledge of native prairie vegetation and wildlife species is needed and an understanding of the Conservation and Reclamation Goals for the native prairie environment is required. Knowledge of specific native prairie reclamation and revegetation procedures is also required.

9.6.1 Environmental Planning for Pipeline Construction in Native Prairie

Environmental planning for pipeline developments located in native prairie can be conducted by individual consultants or by teams of environmental specialists, each contributing to the assessment and mitigation planning within their specific area of expertise. Generally the scope and environmental sensitivity of the project dictates how the project is planned and whether specific expertise (e.g., a qualified botanist for a rare plant survey or a wildlife biologist qualified to assess herptile habitat requirements) is required.

Environmental planners generally have post-secondary degrees in the natural sciences (e.g., geography, soils, wildlife, or botany) or specific degrees in natural resource management, environmental design, forestry or land reclamation. It is equally important that environmental planners have pipeline construction experience in native prairie environments. It is necessary to understand the capability of pipeline construction equipment and how pipelines are constructed in order to adequately design environmental impact mitigation. Environmental project planners should have an understanding of the multi-stakeholder native prairie issues and an appreciation of the need for native prairie conservation. The following skill sets are required for successful environmental planning of pipeline projects in native prairie:

1. **An understanding of the conservation and reclamation goals for native prairie;**
2. **Vegetation impact assessment:** the ability to identify native prairie vegetation species and community types, identify weeds and non-native invasive species, assess range condition, evaluate plant health, vigor and sod quality, identify rare plant species and rare plant communities of concern. Rare plant surveys require a qualified botanist with experience in rare plant identification and mitigation planning. Knowledge of the *Native Plant Revegetation Guidelines for Alberta* is required. Native revegetation mixes should be designed by a native vegetation specialist experienced in this area.
3. **Soils conservation**: the ability to identify and classify soils using the Canadian System of Soil Classification; the ability to identify land use, land management, landforms, surficial deposits, assess erosion potential, topographic concerns, site drainage, groundwater discharge areas, surface stoniness and sub-surface coarse fragment content, vegetation characteristics, surface salinity and on the basis of site observation, identify soil management. Depending on the scope of the project, qualified soils specialists or consulting firms specializing in soil surveys are often required.
4. **Wildlife impact assessment**: the ability to identify prairie wildlife species and their habitats; an understanding of the prairie wildlife issues according to the *General Status of Alberta Wild Species,* ASRD Fish and Wildlife Division 2000 and the *Recommended Land Use Guidelines for Protection of Selected Wildlife Species and Habitat Within the Grassland and Parkland Natural Regions of Alberta,* ASRD Fish and Wildlife Division, 2001.
5. **Reclamation planning:** the ability to interpret soils, vegetation and wildlife survey information; design appropriate minimal disturbance soil handling and construction procedures. The ability to assess erosion potential and specify erosion control as required, also the ability to design and specify the most appropriate reclamation and revegetation procedures based on best management practices.
6. **Understanding of the *Codes of Practice for Watercourse Crossings***, *the Code of Practice for Pipelines and Telecommunication Lines Crossing a Water Body and the Code of Practice for the Temporary Diversion of Water for Hydrostatic Testing of Pipelines, and the Code of Practice for the Release of Hydrostatic Test Water from Hydrostatic Testing of Petroleum Liquid and Gas Pipelines* under the *Water Act.*

9.6.2 Environmental Inspection for Pipeline Construction in Native Prairie

The role of an environmental inspector is to interpret and enforce environmental specifications and ensure the project is implemented in compliance with the regulatory terms and conditions for approval. To be effective, an environmental inspector must be independent of the pipeline contractor as they are required to inspect and evaluate the work conducted by the pipeline contractor for the transmission or energy resource development company. Environmental inspectors must have the authority to shut down pipeline construction activities that could result in regulatory non-compliance until resolution of the issue can be reached.

Environmental inspectors come from many disciplines including the natural sciences, engineering and agriculture. It is essential that they have pipeline construction experience, particularly in native prairie. They require a general knowledge of all the natural sciences and an understanding of the conservation and reclamation goals for the native prairie environment. They should be familiar with minimal disturbance construction techniques and all of the regulatory requirements. They should possess strong communication skills and the ability to communicate with pipeline construction workers, project managers and regulatory authorities. They need to be able to evaluate equipment efficiency and operator skill, and to provide specific direction and guidance to the project manager and the contractor when a specific activity needs to be modified.

While the skill sets described above for environmental planners also apply to environmental inspectors, a more general knowledge within each skill set can be just as effective. More emphasis on personal communications skills combined with pipeline construction and reclamation experience is required for environmental inspection. The following skill sets are required for successful environmental planning of pipeline projects in native prairie:

1 **An understanding of the conservation and reclamation goals for native prairie**;
2 **The ability to identify native prairie vegetation** and native prairie vegetation community types, weeds and non-native invasive species;
3 **The ability to determine topsoil from subsoil and subsoil from parent material** and to ensure the soils are properly stripped, conserved and replaced;
4 **The ability to identify compaction, pulverization and erosion potential** in the soils on a site-specific basis during construction;
5 **The ability to identify non-compliance issues before they occur** and to negotiate resolution of the issue with the pipeline contractor and the regulatory authorities;
6 **An understanding of minimal disturbance pipeline construction procedures** and the ability to interpret the procedures to the pipeline contractor and heavy equipment operators;

7 **The ability to identify prairie wildlife species and their habitats,** an understanding of the prairie wildlife issues according to the *General Status of Alberta Wild Species*, ASRD Fish and Wildlife Division 2000 and the *Recommended Land Use Guidelines for Protection of Selected Wildlife Species and Habitat Within the Grassland and Parkland Natural Regions of Alberta*, ASRD Fish and Wildlife Division, 2001;

8 **The ability to implement pro-active environmental education** on the right of way and through meetings with the project manager, pipeline contractor and pipeline activity inspectors;

9 **An understanding of native prairie reclamation and revegetation procedures**, and the ability to inspect the implementation of these procedures on a site-specific basis;

10 **An understanding of the *Codes of Practice for Watercourse Crossings;*** *the Code of Practice for Pipelines and Telecommunication Lines Crossing a Water Body; the Code of Practice for the Temporary Diversion of Water for Hydrostatic Testing of Pipelines; the Code of Practice for the Release of Hydrostatic Test Water from Hydrostatic Testing of Petroleum Liquid and Gas Pipelines* under the *Water Act*; and the ability to monitor all construction activities to ensure compliance under the *Water Act.*

10 GLOSSARY OF TERMS

Abandonment
The permanent dismantlement of a facility so it is permanently incapable of its intended use. This includes the removal of associated equipment and structures.

Acceptable Risk
A risk which is so small, whose consequences are so slight, or whose associated benefits (perceived or real) are so great, that persons or groups in society are willing to take or be subjected to that risk.

Admixing
Blending or mixing of topsoil with subsoil.

Agronomic
A non-native plant developed using agronomic methods. Of or relating to the science of agronomy (the practice of field-crop production and soil management).

Alkaline Soil
A soil that has a pH greater than 7.0.

Bedrock
The solid rock that underlies soil and the regolith (unconsolidated mantle of weathered rock and soil material overlying solid rock) or that is exposed at the surface.

Best Management Practices
Planning guidelines that detail practices to be implemented to meet the long-term goals of a successful project. Best Management Practices define the goals, identify current areas where improvement is needed and explore possible solutions.
Procedures that protect and conserve all aspects of the diminishing prairie environment.

Biodiversity
Totality of the richness of biological variation, ranging from within-species genetic variation, through sub-species, to communities and the pattern and dynamics of these on the landscape.

Broadcast Seeding
Scattering seed on the surface of the soil. Contrasts with drill seeding that places the seed in rows in the soil.

Brush Layering
Refers to watercourse bank restoration. The use of live cuttings taken from native shrubs (willow species), spread across an excavated pad and covered with soil. The cuttings root down into the soil, increasing bank stability and providing riparian habitat.

Chernozemic
An order of soils that have developed under xerophytic or mesophytic grasses and forbs, or under grassland-forest transition vegetation, in cool to cold, sub-arid to sub-humid climates. The soils have a dark-coloured surface (Ah, Ahe, or Ap) horizon and an A or C horizon, or both, of high base saturation. The order consists of the Brown, Dark Brown, Black, and Dark Grey great groups.

Class 1 Pipeline
Alberta Environment's administrative definition for a pipeline requiring approval under the *Environmental Protection and Enhancement Act (EPEA)* and regulations for conservation and reclamation and any other *EPEA* designated activities (i.e., release of substance and waste management). Pipelines with index number (pipe outside diameter in millimeters multiplied by its length in kilometers) of 2690 or greater require an *EPEA* approval.

Class 2 Pipelines
Pipelines with index number (pipe outside diameter in millimeters multiplied by its length in kilometers) of less than 2690. Class 2 pipelines do not require an *EPEA* approval. Class 2 pipelines are expected to adhere to the environmental protection guidelines contained in *EPEA*. The guidelines provide the necessary direction to achieve conservation and reclamation. Class 2 pipelines are subject to environmental protection orders and must meet the criteria for reclamation certification.

Coarse Textured (soil)
The texture exhibited by sands, loamy sands and sandy loams but not including very fine sandy loam. A soil containing large quantities of these textural classes.

Common Species
A species widely distributed and easily found within a given area.

Community
Populations of plants or animals living and interacting with one another in a given area.

Compaction
The moving of soil particles closer together by external forces. In the compaction process, individual soil particles are packed closer together and soil aggregates are crushed, thus greatly reducing porosity. The major causes of soil compaction are: (1) natural consolidation during soil forming processes (e.g., the weight of glaciers during the ice ages); (2) trampling by animals and humans; (3) natural shrinkage of soil upon drying; (4) use of heavy equipment.

Companion Crop
A crop sown with another crop. Refers to the use of non-invasive annual or winter annual seed such as wheat, flax or fall rye to provide erosion control and initial cover for natural recovery sites. Preferred to the term "nurse crop".

Conservation (soil)
Protection of the soil against physical loss by erosion or against chemical deterioration; that is, excessive loss of fertility by either natural or artificial means.
A combination of all methods of management and land use that safeguard the soil against depletion or deterioration by natural or man-induced factors.

Contouring
The process of shaping the land surface to fit the form of the surrounding land.

Corridor
In a landscape, a narrow strip of land that differs from the matrix on either side. Corridors may be isolated strips, but are usually attached to a patch of somewhat similar vegetation.

Cover
The area of ground covered by all living (including stems and leaves) and dead (litter) plant material that is produced naturally on a site, expressed as a percentage of the total area. Bare soil is not cover. Also known as ground cover.

Crimping
A soil stabilization technique that presses spread straw into the soil creating an artificial stubble. Crimping decreases surface erosion and creates a favorable micro-environment for plants.

Degradation (soil)
The changing of a soil to a more highly leached and weathered state, usually accompanied by morphological changes such as a decline in soil quality. Processes include wind and water erosion, salinity, organic matter depletion, acidification and compaction.

Direct Seeding
Seeding with minimum disturbance and maximum surface residue retention.

Directional Drilling
Refers to crossing a watercourse without disturbance to the bed and banks. A pilot hole is drilled into bedrock from an entry location to an exit location located above the bed and banks of the watercourse using a horizontal directional drilling rig. Once the pilot hole is drilled and reamed to accommodate the size of pipe to be installed, the pipe is pulled through the reamed drill path.

Disjunct Species
Populations separated from the main range of other species by 500 kilometers or more.

Disturbed Land
Land on which excavation has occurred or upon which overburden has been deposited, or both.

Diversity
The richness of species within a given area. Diversity includes two distinct concepts, richness of species and evenness in the abundance of the species.

Drift
All material moved by glaciers and by the action of melt water streams and associated lakes.

Drill Seeding
Planting seed with a seed drill in relatively narrow rows, generally less that 30 cm. apart

Ecological Management
Derivation of goods or services from or beneath ecosystems in ways that respect ecological integrity. It is a bio-centered approach to resource use in which human needs are met if the ecosystem's ability to manage itself is not compromised, focusing on the management of human activities more strongly than other ecosystem components.
Derivation of goods or services from or beneath ecosystems in ways that consider and (it is believed) do not seriously affect ecological integrity. Ecosystem management is a human-centered approach to resource use which aims at manipulation of ecosystem components and assumes sufficient knowledge of how ecosystems work.

Ecosystem
A complex of living organisms and their environment linked by energy flows and material cycling. An ecological community considered together with the nonliving factors of its environment as a unit.

Eluvial
Soil material that has been transported via suspension or solution to another soil horizon via the downward movement of water.

Endemic Species
Restricted to a specific geographic area.

Environmentally Significant Areas
Areas of Alberta's rare, sensitive and unique natural features.

Equivalent Land Capability
The ability of the land to support various land uses after reclamation is similar to the ability that existed prior to any activity being conducted on the land, but the ability to support individual land uses will not necessarily be equal after reclamation. (Regulatory definition).

Erosion
The wearing away of the land surface by running water, wind, ice, other geological agents, activities of man or animals and including such processes as gravitational creep. Erosion may be either normal or accelerated; the latter being brought about by changes in the natural cover or ground conditions, including those due to human activity.

Exotic Species
Plant species which are not native to the province and which are not native within the natural region.

Exploration
Any operations on or over land or water to determine geologic or other conditions underlying the surface of land or water that results in surface disturbance or that may cause an adverse effect but excludes any exploration that is the subject of a permit, license or approval under the Exploration Regulation (Ab. Reg. 423/78).

Exploratory Well
A well into an area where petroleum has not been previously found or one targeted for formations above or below known reservoirs.

Fill
Depth to which material is to be placed (filled) to bring the surface to a predetermined grade. Also, the material itself.

Flow Line
Pipe, usually small diameter and buried, through which oil or gas travels from the well to a processing facility.

Forage
Unharvested plant material that can be used as a feed by domestic animals. Forage may be grazed or cut for hay.

Forb
A herbaceous plant which is not a grass, sedge, or rush.

Forest Land
Land bearing a stand of trees at any age or stature, including seedlings and of species attaining a minimum of 6 feet average height at maturity or land from which such a stand has been removed but on which no other use has been substituted.

Furrow
A channel worked into the surface of the soil by an implement such as a plough or hoe.

Geotextile
Refers to a specifically designed cloth used as a separation barrier between unstripped sod and excavated spoil material during pipeline construction. Following spoil replacement the geotextile is removed, leaving the sod layer intact. Geotextiles are used in other scenarios as well to facilitate erosion control on newly reclaimed areas.

Glaciolacustrine
Material deposited in glacial lake melt water and later exposed either by lowering of the water level or by uplifting of the land. These sediments range in texture from sands to clay.

Gleysolic
An order of soils developed under wet conditions and permanent or periodic reduction. These soils have low chromas, or prominent mottling, or both, in some horizons. The great groups Gleysol, Humic Gleysol, and Luvic Gleysol are included in the order.

Grazing System
A plan that schedules when and where livestock are to graze in order to accomplish a desired result.

Great Group
A category in the Canadian system of soil classification. It is a taxonomic grouping of soils having certain morphological features in common and a similar pedagonic environment.

Green Area
That part of Alberta shown outlined and coloured green on the map annexed to a Ministerial Order dated April 15, 1989 and made pursuant to Section 10 of the *Public Lands Act* (Regulatory definition), as that order is amended from time to time, or any order made in substitution for that order, as amended from time to time.

Ground Cover
Any living or dead vegetative material producing a protective mat on or just above the soil surface.

Groundwater
That water which at any particular time is either passing through or standing in the soil and underlying strata and is free to move under the influence of gravity.

Habitat
The natural environment of an organism.

Habitat Type
The basic unit of vegetation classification in the system developed by R. Daubenmire and used in the northern United States and southern Canada, defined as an area capable of producing similar plant communities at climax. Vegetation stands included within a habitat type are not necessarily dominated by climax ecosystems.

Hardpan
A hardened soil layer in the lower A or in the B soil horizon caused by cementation of soil particles with organic matter or with materials such as silica, sesquioxides, or calcium carbonate. Hardpans are usually associated with Solonetzic soils. The hardness does not change appreciably with changes in the moisture content and pieces of the hard layer do not slake in water.

Humus
The fraction of the soil organic matter that remains after most of the added plant and animal residues have decomposed. It is usually dark coloured.
The more or less stable fraction from the decomposed soil organic material, generally amorphous colloidal and dark coloured.

Illuvial
Soil material that has been moved from one soil horizon to another (usually a lower one) by precipitation from solution or deposition from suspension.

Invasive Plant
A plant that has moved into a habitat and reproduced so aggressively that it has displaced the original structure of the vegetation community.

Landforms
The various shapes of the land surface resulting from a variety of actions such as deposition or sedimentation (eskers, lacustrine basins), erosion (gullies, canyons) and earth crust movements (mountains).

Landscape
All the natural features such as fields, hills, forests, water, etc., which distinguish one part of the earth's surface from another part. Usually that portion of land or territory which the eye can see in a single view, including all its natural characteristics.

Leaching
The removal of soil material in solution by the downward or lateral percolation of water.

Live Staking
Refers to a stream bank reclamation technique where individual native willow or poplar cuttings are carefully tamped into the soil. The cuttings take root and grow, providing bank stabilization and riparian habitat.

Looping
Construction of a pipeline paralleling an existing pipeline. The loop provides additional transportation capacity and may or may not extend the full length of the previous pipeline.

Lower Subsoil
The soil material lying below the upper subsoil.

Luvisolic
An order of soils that have eluvial (Ae) horizons and illuvial (Bt) horizons in which silicate clay is the main accumulation product. The soils developed under forest of forest-grassland transition in a moderate to cool climate. The Grey Luvisol great group is the most common in western Canada.

Mesic
Organic materials at a stage of decomposition between that of fibric and humic materials; peat soil material with >10% and <40% rubbed fibres; mesic material usually is classified in the von Post scale of decomposition as class 5 or 6. Mesic can also refer to a medium soil moisture condition.

Micro-fauna
The part of the animal population consisting of individuals that are too small to be clearly distinguished without the use of a microscope. It includes protozoa and nematodes.

Micro-flora
Plants that are too small to be distinguishable without the aid of a microscope. Plants in this category include algae, bacteria and fungi.

Minimal Disturbance
Reducing the area of disturbance from the survey perimeter (maximum) to that deemed necessary to safely conduct the activity as well as ensuring the maintenance of equivalent soil capability.

Mitigation
The process of rectifying an impact by repairing, rehabilitating or restoring the affected environment; or the process of compensating for the impact by replacing or providing substitute resources or environments.

Muck
Fairly well decomposed organic soil material relatively high in mineral content, dark in colour and accumulated under conditions of imperfect drainage.

Mulch
Any material such as straw, sawdust, woodchips, leaves or loose soil that is spread on the soil surface to protect the soil and plant roots from the effects of raindrops, wind erosion, soil crusting, freezing and evaporation.

Native Landscape
A landscape that contains assemblages of plants and plant communities that are indigenous to a particular region.

Native Prairie
An area of unbroken grassland or parkland dominated by non-introduced species.

Native Species
Native plant species are those that are indigenous to a particular region. They were in the landscape prior to Euro-American settlement or have extended their range since then without human intervention. Native species are recognized for their intrinsic value as part of natural forest, grassland, montane and wetland ecosystems (Alberta Native Plant Council, 2002).

Natural Area
An area that is in a largely undisturbed condition, characterized by plant and animal species native to the area.

Natural Recovery/Natural Revegatation
Natural re-establishment of plants on disturbed land. Relies on revegetation from the topsoil (seed bank) or invasion from adjacent lands. May be combined with straw crimping or planting of annuals to provide erosion control.

Natural Seeding (volunteer)
Natural distribution of seed over an area.

Noxious Weed
A designation in Alberta for weeds that have the ability to spread rapidly and cause severe crop losses and economic hardship. These weeds must be controlled to prevent further establishment and spread.

Nuisance Weeds
A designation in Alberta for weeds that are common to the province. They are early successional plants. They can be found on nearly all land throughout the province, and as such are very difficult to eradicate. They can cause significant economic losses but are so biologically suited that they cannot effectively be eradicated. Every attempt should be made to prevent the spread of nuisance weeds.

Operator (oil and gas)
The company or individual responsible for managing an exploration, development or production operation.

Order (soil)
A category in the Canadian System of Soil Classification. All the soils within an order have one or more characteristic in common.

Organic Matter
The organic fraction of the soil; includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms and substances synthesized by the soil population. It is usually determined on soils that have been sieved through a 2.0 mm sieve. It is estimated by multiplying the soil organic carbon content by 1.724.

Overburden
Materials of any nature, consolidated or unconsolidated, that overlie a deposit of useful materials.

Overstripping
The intentional stripping of the upper subsoil with the topsoil. This would only be done where incorporation of the upper subsoil would not significantly degrade the quality of the topsoil. This procedure may be suitable for areas with a shallow topsoil layer and good quality upper subsoil.

Parent Material
The unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of a soil is developed by pedogenic processes.

Peripheral Species
Species found at the edge of their geographic range.

Permeability (soil)
The ease with which gases, liquids, or plant roots penetrate or pass through a bulk mass of soil or a layer of soil. Since different horizons of soil vary in permeability, the particular horizon under question should be designated.

Pipeline
A pipe for the transmission of any substance and installations in connection with that pipe; a sewer or sewage system and installations in connection with that sewer or sewage system; or an underground pipe that contains telecommunication lines. (Regulatory definition).

Ploughing-in
Refers to small diameter pipelines installed using a pipeline plough. The plough creates a furrow to trench depth and installs the pipeline into the furrow. Surface disturbance is reduced by eliminating the need for excavation and replacement of topsoil and spoil from the pipeline trench.

Prairie Blow-out
A small area from which topsoil and often subsoil material has been removed by wind.

Preplanning
Process of foreseeing reclamation problems and determining measures to minimize off-site damages.

Propagule
A part of a plant that implants a new individual (e.g., seed, rhizome).

Public Land
All lands designated under the *Public Lands Act*.

Pulverization
The degradation of topsoil structure through repeated mechanical action (repeated vehicle or heavy equipment passage). Pulverization of topsoil can lead to a loss of organic material and admixing with underlying soil horizons.

Range Land
Land where the potential natural vegetation is predominantly grasses, grass-like plants, forbs, or shrubs, where natural herbivory was an important influence in its pre-civilization state and that is more suitable for management by ecological rather than agronomic principles.

Rare Species
A species not widely distributed and not easily found within a given area. Rare species include, but are not necessarily limited to, endangered, threatened or vulnerable species.

Reclamation
The process of reconverting disturbed land to its former or other productive uses.
All practicable and reasonable methods of designing and conducting an activity to ensure: stable, non-hazardous, non-erodible, favourably drained soil conditions and equivalent land capability. The stabilization, contouring, maintenance, conditioning or reconstruction of the surface of land and any other procedure, operation or requirement specified in the regulations. (Regulatory definition).

Regosolic
An order of soils having no horizon development or development of the A and B horizons insufficient to meet the requirements of the other orders.

Rehabilitation
Implies that the land will be returned to a form and productivity in conformity with a prior land use plan, including a stable ecological state that does not contribute substantially to environmental deterioration and is consistent with surrounding aesthetic values.

Remediation
The removal, reduction, or neutralization of substances, wastes or hazardous material from a site so as to prevent or minimize any adverse effects on the environment now or in the future.

Restoration
The process of restoring site conditions as they were before the land disturbance.

Revegetation
The establishment of vegetation that replaces original ground cover following land disturbance.

Rhizomatous Roots
Roots that have elongated, usually underground, horizontal or ascending root-like stems; a form of vegetative reproduction.

Right of Way
An easement in lands belonging to others that is obtained by agreement or lawful appropriation for public or private use.

Riparian
Refers to terrain, vegetation or simply a position adjacent to or associated with a stream, flood plain, or standing water body.

Ripping
The act of breaking, with a tractor-drawn ripper or long angled steel tooth, compacted soils or rock into pieces small enough to be excavated or moved by other equipment as a scraper or dozer. A tillage operation used to break up plough pans or other impermeable layers. Often a chisel is used to break up the soil to a depth of half a meter and at spacings of one meter. Ripping will also improve infiltration and percolation of water into the soil and thus improve vegetative growth.

Rip Rap
Broken rock, cobbles, or boulders placed on earth surfaces, such as the face of a dam, bank of a stream or lining drainage channels, for protection against the action of water.

Risk Analysis
The process of hazard identification and risk estimation. In addition to the qualitative aspects of hazard identification, risk analysis includes a quantitative description of risk based on risk assessment techniques.

Risk Assessment
Risk analysis and option evaluation. In addition to the scientific considerations involved in risk analysis, risk assessment includes consideration of such factors as risk acceptability, public perception of risk, socio-economic impacts, benefits and technical feasibility. It forms the basis for risk management.

Roach
A slight elevation left over the pipeline trench to allow for the anticipated subsidence of the excavated materials.

Runoff
The portion of the total precipitation on an area that flows away through stream channels. Surface runoff does not enter the soil. Groundwater runoff or seepage flow from groundwater enters the soil before reaching the stream.

Saline Soil
A non-alkali soil containing soluble salts in such quantities that they interfere with the growth of most crop plants. The conductivity of the saturation extract is greater than 4 dS/m, the exchangeable sodium percentage is less than 15, and the pH is usually less than 8.5. State in soil caused by the presence of soluble salt (ions such as Na, Ca, K, Mg, Cl, So4) yielding an electrical conductivity of at least 2 dS/m.

Salinization
The process of accumulation of salts in soils.

Sand
A soil particle between 0.05 and 2.00 mm in diameter.

Seedbed
The soil prepared by natural or artificial means to promote the germination of seed and the growth of seedlings.

Scalping
Refers to the removal of, or significant damage to, the native sod layer during removal and replacement of spoil or topsoil stored on unstripped native sod.

Solonetzic
An order of soils developed mainly under grass or grass-forest vegetative cover in semiarid to sub-humid climates. The soils have a stained brownish or blackish solonetzic B (Bn, Bnt) horizon and a saline C horizon. The order includes the Solonetz, Solodized Solonetz and Solod great groups.

Spoil
The excavated material from the pipeline trench, following topsoil removal.

Spoil Side
That portion of the right of way allocated for storage of material excavated from the ditch as well as for duff and/or surface material.

Strip and Grade
Refers to removing the topsoil and grading the subsoil to a profile suitable for the safe operation of pipeline construction equipment.

Stove Piping
Refers to installing pre-welded sections of pipe through narrowed right of way working space to minimize the impact to adjacent landforms.

Subsoil
The soil material found beneath the topsoil but above the bedrock.
Technically, the B horizon; broadly, the part of the profile below plough depth.

Succession
The natural sequence or evolution of plant communities, each stage dependent on the preceding one and on environmental and management factors.

Tackifier
A glue-like material that is added to water and sprayed on the surface of disturbed topsoil for the purpose of preventing topsoil loss due to wind erosion.

Topography
The shape of the ground surface such as hills, mountains, or plains. Steep topography indicates steep slopes or hilly land; flat topography indicates flat land with minor undulations and gentle slopes.

Topsoil
The uppermost part of the soil ordinarily moved in tillage or its equivalent in uncultivated soils and normally ranging in depth from 5 cm to 45 cm.

Trenching
The excavation of subsoil from the pipeline trench.

Understory Species
A species found in one of the lower vegetation layers within a plant community. Commonly shrub, grass or moss.

Upper Subsoil
The soil material found immediately below the topsoil.

Von Post Humification Scale
Scale describing peat moss in varying stages of decomposition ranging from H1, which is completely unconverted, to H10, which is completely converted.

White Area
That part of Alberta that is not in the Green Area. (Regulatory definition).

Wild Harvest
The collection of native seed from undisturbed native plants.

Working Side
That portion of the right of way designated for construction activities, access and construction materials.

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12 PHOTO CREDITS

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Photo number	Photographer	Company	Area
Photo 1	Jane Lancaster	EnCana Oil and Gas Co. Ltd.	Cypress Hills, Cypress Pipeline
Photo 2	OJ Pipelines	Express Pipeline	South Saskatchewan River crossing
Photo 3	Darcy Janko	Express Pipeline	South Saskatchewan River crossing
Photo 4	Jane Lancaster	EnCana Oil and Gas Co. Ltd.	North Suffield Pipeline
Photo 5	Jane Lancaster	Kestral Research Inc.	Dry Mixedgrass prairie
Photo 6	Michael Wood	EBA Engineering	Mixedgrass Prairie
Photo 7	Marilyn Neville	Gramineae	Foothills Fescue, Waldron Ranch
Photo 8	Lorne Cole	Special Areas Board	Northern fescue, Neutral Hills
Photo 9	Marilyn Neville	Gramineae	Foothills Parkland, Chain Lakes
Photo 10	Barry Cole	ASRD Public Lands	Central Parkland
Photo 11	Laurie McCallum	ASRD Porcupine Lookout	Watercolor painting
Photo 12	Darcy Janko	Express Pipeline	Rattlesnake Coulee
Photo 13	Heather Bishop	TransCanada	Foothills north of Cochrane
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Photo 15	Cam Faminow	Ghostpine Environmental	Dry Mixedgrass
Photo 16	David Walker	TransCanada	Great Sand Hills
Photo 17	John Ness	EnCana Oil and Gas Co. Ltd.	North Suffield Pipeline
Photo 18	Jamie Kereliuk	AENV	Dorothy area, south of Drumheller
Photo 19	Marilyn Neville	Express Pipeline	Dry Mixedgrass
Photo 20	Rick Lauzon	AXYS Environmental	Medicine Hat Area
Photo 21	Allison Landals	FMA Historic Resource Consultants	Express Pipeline, Jenner
Photo 22	Paul Marty	Artist, Pincher Creek	Pastel drawing
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Photo 28	Marilyn Neville	Express Pipeline	South of Medicine Hat

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Photo 30	Marilyn Neville	Bow River Pipelines	Enchant area
Photo 31	Marilyn Neville	Express Pipeline	Cypress Hills
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Best Management Practices:

Protecting our valuable natural resources for future generations.