PetroCanada's Sullivan Field Development Plan

Environmental Assessment Review Focusing on Soils and Vegetation

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Report Organization

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Executive Summary

A critical review of PetroCanada's Environmental Assessment (EA) for the Sullivan Field Development Plan was undertaken with a focus on implications for soils and vegetation.

Soils in the local study area (LSA) - a 1 km-wide corridor centered on the project development area (PDA) - are highly sensitive to predicted project disturbance. About 40% of the LSA is unstable terrain. About 40% of soils in the LSA are shallow enough depth to bedrock (< 2m) that pipeline trenching may require ripping or blasting. Over 80% of the LSA has soils at moderate to very high risk of water erosion assessed with respect to slope gradient and soil texture. Over 80% of the LSA has soils rich enough in silt and clay that risk of compaction and rutting is high to very high. Reclamation suitability of over 60% of the LSA is rated as fair to unsuitable due to high coarse fragment content. Because of the high sensitivity of soils in the LSA, both in level and extent, there is a considerable risk and uncertainty regarding PC's ability to successfully address construction and reclamation challenges.

There is a very high percentage of natural vegetation over the regional study area indicating high ecological integrity. Less than 5% of the LSA is anthropogenic disturbance. Vegetation types of high conservation interest or high sensitivity to disturbance are native montane and subalpine grasslands (13% of the LSA), old growth forest (7%) and riparian forest, shrub and herbaceous plant communities (13%). Native vegetation on and near the PDA would be lost or altered indefinitely through clearing, non-native species invasion and soil impacts.

Four vascular plants on the provincial tracking list are reported – limber pine, shrubby beard tongue, alpine foxtail and spoon-leaf moonwort. Spoon-leaf moonwort and limber pine are predicted to be adversely impacted by the project.

Rare plant survey appears to be inadequate. Rare plant survey was combined with vegetation community sampling which may have resulted in insufficient effort spent searching for rare plants during the 17 days of field work in June and August 2006. Non-vascular plant species are not included. A reasonable list of rare vascular plant species potentially occurring in the area is lacking. Criteria for selection of sites for rare plant survey and timing are not defined and information on "communities" surveyed is not included. Most of the rare plant survey sites appear to be along Highway 532 near Savanna Creek and in the vicinity of the Sullivan gas wells, although routes for gathering pipelines were not surveyed. Relatively few sites were sampled along the trunk line between Pekisko Creek and Highway 532 and a ten-kilometer section of the trunk line between Eden Valley IR and Pekisko Creek was not surveyed at all. Under-surveyed sections are the most pristine and inaccessible parts of the project area which are potentially at risk of the most adverse effects from the project.

Results and analysis of 31 range health assessments and more detailed range community classification, which appear to have comprised the majority of field work, are not provided in the EA or in the EA Update. Reviewing and understanding this baseline information would inform assessment of the environmental implications of the proposed project.

Weeds and non-native species were found at 67 forest and grassland sites surveyed. Information is not provided on the spatial distribution of non-native invasive species in the LSA or ecological and land use factors which may be influencing that distribution. Non-native species invasion into areas of native vegetation due to proposed project disturbances

and subsequent activities (e.g. pipeline maintenance) is not addressed although this is potentially a significant adverse effect in the long term.

Reclamation and revegetation strategies are proposed in the EA, but detailed plans have yet to be developed. Mitigation and reclamation measures proposed by PetroCanada are not well documented and do not guarantee restoration to native community.

Only one development option is considered in the EA although PetroCanada has superficially considered alternatives particularly with respect to trunk line routing that might be expected to have less impact on sensitive soils and vegetation. Full assessment of alternatives would be important information for the Energy Resources Conservation Board to consider in its determination if the project, as proposed, is appropriate and in the public interest.

1.0 Introduction

I have reviewed PetroCanada's (PC) Environmental Assessment for the Sullivan Field Development Plan (March 2007) (EA), the EA Update (September 2007) and Sullivan Area Development plan update (February 2008) with a focus on implications for soils and vegetation. This review was done at the request of the Big Loop Group who are preparing for a hearing on the project before the Energy Resources Conservation Board.

Part of the context for my review is *ERCB IL93-9 Oil and Gas Developments Eastern Slopes (Southern Portion)*. IL 93-9 requires that sufficient detail is provided with respect to proposed projects in the southern portion Eastern Slopes to "ensure that the overall scope and potential impacts of the development, if permitted, are clearly understood". According to IL 93-9 "the level of detail expected in any environmental assessment will vary with project stage, the ultimate scope of development, the relative sensitivity of the proposed development area and the extent of other existing and potential developments (both energy and non-energy related) in the area."

2.0 Project Description

The EA deals with a project development plan specifying one development option. The project proposal is for five existing and proposed sour gas well pads in the Sullivan field, 17-km gathering system of pipelines, a central compression and dehydration facility, 11-km of new permanent access roads, a sweet gas supply line paralleling the trunk line, and a 37-km trunk line to transport gas from the Sullivan field to a tie-in point in the Savanna Creek field that is lined to the Coleman gas plant. Operation is anticipated to last up to 40 years. The EA states "no future development is planned along the proposed trunk line" (p. 3-11).

Direct disturbance footprint of soils and vegetation will include the following (EA Sec 3):

- Five well pads from 17,000 – 30,000 m^2 in size with a maximum cut-and-fill depth of 10.5 m.
- Drilling waste disposed by land-spraying while drilling (LWD). Area affected is not indicated (EIS p. 3-16). Note that LWD is not allowed on native grasslands on public lands.
- Clearing of 160 m x 160 m (25,600 m^2) site for a central facility with compressors, dehydrator, sour water storage tanks, flare system.

- Right of way clearing for new access roads about 20 m wide but wider along steep hillsides. If a pipeline parallels a road, total cleared width for road and pipeline would be up to 40 m.
- Right of way clearing for pipelines up to 25 m wide.
- A trench approximately 1.5 m wide and at least 1.2 - 1.5 m deep to bury gathering pipelines (9 – 22 cm in diameter), and perhaps deeper and wider for the trunk line (27 cm in diameter) with adjacent sweet gas line (9 cm in diameter). Rock encountered would be ripped or blasted.
- Four highway crossings constructed either by boring or open-cut crossing.
- 40 to 50 watercourse crossings, about half accomplished with directional drilling and half with open cuts.
- Bridges, permanent and temporary, for vehicles constructed across most watercourses as well as culverts for intermittent creeks, ephemeral draws and springs.
- Five camps to support work crews, construction equipment parking areas, materials storage areas
- Construction traffic including feller buncher, skidders, delimber, up to 70 pieces of heavy equipment, drilling rigs, fuel and service trucks and numerous pickup trucks. Construction would be carried out in all seasons, including the growing season.
- Reclamation activities including long-term monitoring of reclamation success
- Operation activities including road maintenance, activity at central facility (workers, water hauling), periodic physical inspection of pipelines using ground access (at least twice annually along trunk line using ATVs)
- Decommissioning and abandonment

Following release of the EA in March 2007, more detailed design of the trunk route was undertaken including re-routing four sections of the trunk line. A portion of the trunk line from PC Operations Yard (SW22-04-14 W5) to the Savanna Creek Compressor Station, following an existing PC pipeline ROW, was removed from the project description.

Direct disturbance footprint of the project as presented in the original EA is estimated at 140 ha (EA p.12-19), however it is not clear if all affected areas are included in that estimate (i.e. construction camps, construction equipment parking sites, construction material storage sites, LWD sites, total areas of cut and fill).

For soils and vegetation, PC defines the Proposed Development Area (PDA) as the construction footprint of the various project components (EA p.11-3, p. 12-3). The Local Study Area (LSA) (about 5500 ha) is defined as a 1 km-wide corridor centered on the PDA that allows for minor modification of the PDA. It is assumed that Project effects on soils will be restricted to the LSA and most of the effects on vegetation. A larger Regional Study Area (RSA) was also defined for vegetation for the purposes of cumulative effects assessment.

Questions specific to disturbance footprint

What is the total direct disturbance footprint (PDA) of the proposed project and where will it occur?

Where will land spraying while drilling occur?

3.0 Sensitivity of Soils

Surficial materials in the LSA are mostly colluvium (42%) and moraine (38%). There are lesser amounts of glaciological (8%), fluvial (7%), bedrock (2%), organic (1%) and water (<1%) (App I-8). The most common soils are brunisols (48%) followed by chernozems (20%), regosols (15%), luvisols (8.9%) and minor amounts of gleysols, podzols, and mesisols.

PC assessed terrain and soils with respect to terrain stability, depth to bedrock, erosion risk and reclamation suitability (EA Sec 11 and App I). Results are summarized in Table 1 in terms of sensitivity of soils to development in the LSA.

The assessment indicates that a large majority of the area that would be directly disturbed by the proposed development is sensitive to water erosion and/or compaction and rutting. Steep slopes, fluvial channels and active gullies are at risk of erosion. Soils high in clay or silt content, including those developed on clay-rich morainal parent material, are at risk of compaction and rutting.

Table 1: Sensitivity of soils to development in the local study area (LSA)
(from information provided in EA Sec 11 and App I)

	Not Sensitive (% of LSA)	Sensitive (% of LSA)	Considerations
Terrain Stability	59% stable	10% potentially unstable 31% unstable	Mass movements are associated with unstable areas.
Depth to Bedrock	57% >2 m	31% 1-2 m 12% <1m	The pipe must be buried at least 1.2 - 1.5 m deep and be buffered from bedrock.
Water Erosion Risk	14% low	38% moderate 34% high 14% very high	Risk is related to slope gradient and soil texture.
Compaction and Rutting Risk	3% low	16% moderate 50% high 31% very high	Silt and clay soils are at higher risk than sandy soils.
Reclamation Suitability	36% good	48% fair 16% unsuitable	The main risk factor is high coarse fragment content.

About 40% of the project area is at risk of mass movement including slumps, earth flows, debris slides and gullying.

Depth to bedrock is less than two metres for about 40% of the project area, suggesting there may be insufficient depth to adequately bury the proposed pipeline and buffer it from

bedrock. A trench 1.2-1.5 m deep and 1.5 m wide is required to install the gathering lines (p. 3-28). The depth of trench for the trunk line is not indicated in the EIS.

Reclamation success in over 60% of the project area is threatened by high coarse fragment content in the soils.

Because of the high level and extent of soils sensitivity in the LSA, there is a high degree of risk and uncertainty regarding PC's ability to successfully address construction and reclamation challenges.

Questions specific to soils

How much of the trunk line will require ripping or blasting of bedrock to achieve sufficient trench depth for the pipeline?

4.0 Sensitivity of Vegetation

The landscape is described as having "a very high percentage of natural vegetation configured in large well-connected patches" and a diversity that is "very high in comparison to other areas in the region" (EA p. M-47). "By almost all measures of landscape pattern, this is an area of high ecological integrity."

Ninety-five percent of the LSA is natural vegetation; 55% occupied by Montane forests (poplar, lodgepole pine, spruce), 25% by Subalpine forests (lodgepole pine, spruce-fir) and 15% by grasslands, shrublands and nonvegetated areas (EA Table J-6). About 5% of the LSA is anthropogenically disturbed areas. Native vegetation on the final PDA would be lost or altered indefinitely through clearing, soil impacts and non-native species invasion.

Vegetation types/ecosite phases and structural stages in the Local Study Area (LSA) (5502 ha) were mapped and classified by PC using Alberta Vegetation Inventory (AVI) and Ecological Land Classification (ELC) data for forests, description of forest ecosites by Archibald et. al. (1996) and aerial photograph interpretation of grasslands and shrublands. Data was also used from vegetation survey of 48 plots for cover-point sampling in the larger Regional Study Area in September 2005 (EIS p. 12-7). Additionally, some data on vegetation types was collected at 81 (?) unique locations during rare plant surveys and rangeland and riparian health assessments in the LSA during June 7-14, August 15-25 and September 28 2006 (EA Figure J-3 and Table J5-1). Important to note is that not all the PDA was surveyed. A 10 km segment of the proposed trunk line from the Eden Valley IR to Pekisko Creek was accessed at only a few locations by helicopter in September 2006. In addition field surveys were not undertaken along access roads (11 km) and gathering pipelines (17 km).

Some vegetation types of particular conservation interest or sensitivity, portions of which will potentially be lost to the development, include:

- Grasslands dominated by rough fescue, bluebunch wheatgrass, hairy wild rye and/or bearberry. These occupy about 13% of the LSA. Trunk line routing has attempted to avoid grasslands. About 8% of bluebunch wheatgrass grasslands mapped on the proposed ROW would be lost (EA p.12-19). A rare grassland community (Allen 2008) - Subalpine rough fescue-hairy wild rye - occurring near the southern end of the trunk line

route would be impacted (EA p.12-19). There are several rare grassland communities in the Montane and Subalpine of southwestern Alberta on the provincial tracking list (Allen 2008). Five foothills rough fescue (*F.campestris*) community types have been listed as SU (status unknown), S1 and S2S3. The EIS notes that grassland communities in the LSA frequently have invasive non-native species.

- Limber pine woodland. Individual limber pine in fescue grassland are reported in the northern part of the LSA, however a woodland community is not documented. Five limber pine woodland communities occurring in the Montane and Subalpine are on the provincial ecological community tracking list (Allen 2008).

- Riparian forest, shrub and herbaceous communities occurring on imperfectly and poorly drained soils. These occupy about 13% of the LSA. Vegetation communities include spruce-fir/horsetail forest, spruce/thimbleberry-pine grass forest, balsam poplar forest, willow shrubland and sedge meadow (EA Table J-7). Several riparian communities in the Montane and Subalpine are on the provincial ecological community tracking list (Allen 2008) but none are reported for the LSA. Riparian communities are particularly susceptible to compaction, rutting and water erosion.

- Old growth forest (coniferous and mixedwood stands 120 years and older), occupying about 7% of the LSA. Old growth forests are of conservation interest because of their restricted distribution.

<u>Questions specific to vegetation survey</u>

Clarify vegetation sampling design and number and distribution of sample locations for all surveys.

> PC states “A total of 155 field surveys were completed (Table J-1 summarizes survey types, numbers of sites and dates).” Please explain. more fully. A review of Figure J-3 and Table J-1 indicates 48 sites surveyed in 2005 and 80 in 2006.

Gaps in vegetation survey were identified for a 10 km segment of the proposed trunk line from the Eden Valley IR to Pekisko Creek and for access roads (11 km) and gathering pipelines (17 km). Have these gaps been addressed?

Were plant communities on the ANHIC list potentially occurring in the study area listed and targeted during field survey?

Does limber pine woodland occur in the LSA?

What is the confidence of having detected plant communities on the provincial tracking list occurring in the LSA?

5.0 Rare Plant Survey

It is standard procedure for professional botanists undertaking rare plant survey to develop a list of rare species that potentially occur in the study area and to familiarize themselves with the key identifying characters, habitats, life history and phenology of those species prior to field work. This information is needed to design and undertake a survey that meets the guidelines for rare plant surveys developed by the Alberta Native Plant Council (Lancaster 2000). The EA fails to provide documentation that these important steps were completed prior to field work.

- The EA contains a list of 205 vascular plant species reportedly provided by ANHIC in response to a 2006 request for occurrences in southwestern Alberta west of Highway 22 and from Highway 66 (west of Calgary) to the AB-MT border (EA Table J3-1 and Table J4-1). This list however includes numerous species that are not known to occur within those boundaries. For example, species known only from southeastern Alberta such as prairie false dandelion (*Nothocalais cuspidata*), hoary goosefoot (*Chenopodium incanum*) and little-seed rice grass (*Oryzopsis micrantha*) are on the list as well as species known only from west central Alberta such as Sitka columbine (*Aquilegia formosa*), northern bent grass (*Agrostis mertensii*) and nodding sedge (*Carex misandra*). It is therefore unclear what vascular plant species were being targeted during field survey for this project.

- Non-vascular plant species on the provincial tracking list were not included in the rare plant survey; an explanation for why they were omitted is not provided.

- PC does not provide information on the phenology of species that would be targeted during rare plant survey. Such information would be critical to ensure appropriate timing of the rare plant surveys. . Rare plant survey occurred over 17 days during June 7-14 and August 15-25. By mid-August, when most of the survey effort occurred, many species would no longer be in flower and may be difficult to identify with confidence.

- PC states that areas were chosen for rare plant survey "that were expected to have a high potential for rare plants based on a review of the habitats of the species presented in the regional ANHIC list". PC however does not provide information on habitats of rare plant species that may occur in the study area except to generally state that most would be expected in the alpine. Many species on the list of rare plant occurrences in southwestern Alberta (EA Table J3-1 and Table J4-1) are indicated as occurring in Natural Regions in which they do not occur. For example western red cedar (*Thuja plicata*) and big sagebrush (*Artemisia tridentata*) are indicated as occurring in the alpine.

PC's approach to the field component of rare plant survey was to select 66 specific sites within the LSA for field visit over a total of 17 days in 2006 - 34 sites during June 7-14 and 32 sites during August 15-25. The average is 3-4 sites per day and 2-3 hours per site. Criteria for site selection were that the site was within the PDA and "to obtain samples of both small microsites and common community types" (EA p. J-15). The map of vegetation survey locations (EA Figure J-3) suggests that most of the rare plant survey sites were in the vicinity of the Sullivan gas wells and along Highway 532 near Savanna Creek. Relatively few sites were sampled along the trunk line between Pekisko Creek and Highway 532. A ten-kilometer section of the trunk line between Eden Valley IR and Pekisko Creek was not surveyed for rare plants.

Rare plant survey was combined with vegetation community description and range health assessments. Field methods are described as follows (EA p. J-15):

> "At each survey site, the vascular rare plant specialist conducted a random meander walk in the plant community and compiled a species list until no new species were found. Identified species were compared to lists of potential and reported species acquired from ANHIC for the region encompassing the LSA as well as Rare Vascular Plants of Alberta. Specimens requiring further examination or species confirmation were collected, with the exception of plants where seed heads or flowers required for identification to species level were unavailable or where plant populations were small (i.e., no more than one in 20) (Lancaster 2000)….
>
> Other data collected to augment information about rare plant survey sites included percent cover of tree and shrub species in the canopy, subcanopy, tall shrub and low shrub layers; diameter at breast height (dbh) and height of trees in the canopy and subcanopy; percent cover of herbaceous and nonvascular species; percent cover of bare ground and water present, slope, slope position, aspect, soil moisture, vegetation structure, vegetation type and UTM coordinates. Sites were photographed."

The approach of confining search to discrete plant communities and describing community characteristics is appropriate for vegetation community or ecological land classification but may not be well suited to finding rare plant occurrences. According to the ANPC guidelines (Lancaster 2000 p. 4):

> "Traditional quantitative methods that focus on vegetation community classification are inappropriate and inefficient for rare plant surveys. Quantitative vegetation analysis techniques tend to represent dominant vegetation species on a site and focus effort on small portions of a study area. Rare plants tend to have small discrete populations or to be thinly scattered on a landscape. They are more likely to be found by concentrating search effort in covering a larger area.
>
> Ecological land classification studies can give context and clues but they are not well linked to rare plant occurrences. Microhabitats, ephemeral habitats, unusual landscape features and transition zones between habitats are important sites for rare plants. These fine scale biotic patterns occur within and between larger, mappable vegetation units. Rare plant sites are often closely linked to substrate, seasonal water patterns, small-scale landscape features and particular plant associations….
>
> Rare plant searches cover a study area more thoroughly than quantitative methods. Search effort is focused inspecting as many of the fine scale biotic patterns, unusual plant associations and landscape features as possible while still checking some portions of each dominant habitat or plant association. All sites and features with high probability of supporting rare species should be checked."

There is insufficient information in the EA to clearly understand rare plant search effort.

Four rare plants were found during rare plant survey, three during 2006 and one during 2007 (EA p.12-13 and EA Update p. 31). They are:

- Limber pine (*Pinus flexilis*) (S2 G5) in a fescue-dominated grassland on a south-facing slope along an existing access road to a wellsites at 7-7 and 7-8 in the Sullivan gas field. Other
- Shrubby beard tongue (*Penstemon fruticosus*) (S2 G4) near the re-routed Pekisko Creek crossing location

- Alpine foxtail (*Alopecurus alpinus*) (S2 G5) in a modified grassland 450 m northeast of the proposed trunk line ROW about 3.6 km northwest of Indian Graves Provincial Recreation Area.
- Spoon-leaf moonwort (*Botrychium spathulatum*) (S2 G3) on a sparsely vegetated south-facing slope in the high subalpine on an existing fuel gas pipeline ROW upslope of Hwy 532. Further surveys are proposed for spring 2007 to determine extent of the population.

Information in the EA regarding project effects on these rare plant populations is as follows:
- Spoon-leaf moonwort is on the proposed trunk line ROW and may be lost because workspace through the area is constrained (EA p.12-24). Site-specific grading and spoil storage plans or transplant are identified as options to be considered.
- Limber pine may be impacted by a proposed gathering pipeline ROW in the Sullivan gas field (EA p. 12-24). A full survey of the PDA, which has high potential for occurrence of limber pine, has not been completed.
- Shrubby beard tongue at the re-routed Pekisko Creek crossing will be flagged to ensure avoidance during construction.
- The location of alpine foxtail will not be affected by the Project since it is 450 m from the proposed trunk line ROW (EA p. 12-13).

Questions specific to rare plants

Can PC provide a reasonable list of rare species potentially occurring in the project area which were the focus of rare plant survey? Why were non-vascular plants excluded?

Can PC provide information used to determine the range of habitats that were included in rare plant? Were sites and features with higher probability of supporting rare species identified?

Was information compiled on phenology of target species to determine appropriate timing of survey? What target species would not be visible in the late August survey?

Can PC provide information on the types of habitats and polygons sampled as part of the rare plant survey, their size and distribution and the timing of the survey in these habitats?

Has the gap in rare plant survey along 10 km of the northern portion of the trunk line been addressed? If so, how?

Given that there were modifications to the PDA after the 2006 survey, was additional rare plant survey undertaken of proposed re-routes? If so, how?

What were the qualifications and experience of the botanist(s) conducting the rare plant survey and are they confident that there was adequate search effort? Is additional rare plant survey needed?

Was further survey conducted on the spoon-leaf moonwort population location as proposed (EA 12-24)? What mitigation is planned?

Was a full survey of the PDA and LSA in potential limber pine habitat conducted and potential losses identified (EA p. 12-24)?

How would PC address potential impacts on shrubby beard tongue near the Pekisko Creek crossing during project operation?

6.0 Rangeland and Riparian Health

Rangeland health assessments were conducted at 31 sites and riparian health assessments at 10 sites within the proposed PDA in August and September 2006 (including helicopter access to the northern portion of the proposed trunk line route). The reasons for conducting these assessments are not clearly defined in the EA; although it is suggested that they provide a method to evaluate plant community diversity (EA p.12-4).

Rangeland and riparian health assessment methods have been developed in Alberta to provide land managers a standardized approach to assessing the ability of rangelands and riparian areas to perform key ecological functions that translate to health (Fitch et al. 2001, Adams et al. 2005). They are tools for clarifying whether an issue or problem exists. Results help in making management choices regarding sustainable land use. There is a distinction between rangeland and riparian assessment and inventory, which is a more in-depth and comprehensive analysis of ecosystem function.

The 10 sites where riparian health assessment occurred were four on North Twin Creek (which parallels Hwy 532), one on each of Greenfield, Salt and Corral creeks and three on unnamed creeks. The results are two sites healthy, four healthy with problems and four unhealthy (EA p. J-20, J-27, Table J-10). Areas of degraded health had increaser plant species and higher than acceptable percentages of bare ground. Factors identified as contributing to degradation of health are grazing pressure (noted at five sites) and recreational off-road vehicle use (noted at three sites). Of note is that recreational off-road vehicle use was occurring in an area (North Twin Creek) where access control signs are posted (EA p. J-27).

Results of the 31 range health assessments and more detailed range community classification are not made available in the EA (p. 12-7).

<u>Questions specific to range and riparian health assessment</u>

Why were range and riparian health assessments conducted?

Are the results yet available regarding range health assessments and more detailed range community classification?

What geographic patterns in range and riparian health were detected? Did sites more removed from linear disturbances tend to be healthier?

How have the results been used by PC in project evaluation and planning?

What recommendations would PC make regarding improving rangeland and riparian health in the area?

7.0 Invasive Non-Native Species

Weeds and non-native invasive species were found at 67 of 81 sites that underwent rangeland and riparian health survey and rare plant species survey (EA p. J-34). They occurred in both forest and grassland sites (EA p. J-36). The non-native invasive species most commonly found are Kentucky bluegrass, timothy, dandelion, clover, creeping red fescue and smooth brome. Information is not provided on the geographic distribution of non-native invasive species or ecological and land use factors which may be influencing that distribution.

The EA does not address the indirect disturbance of non-native species invasion into native vegetation from proposed project disturbances.

It is noted that several invasive non-native species (especially Kentucky bluegrass, timothy and smooth brome) may cause difficulties for restoration of native plant communities (EA p. J-15 and J-36). Invasion by non-native species is identified as a challenge particularly in restoring rough fescue grasslands (EA p. J-36). The EA notes that the quality of late season forage for livestock and wildlife is adversely affected when native rough fescue grasslands are converted to modified communities.

A study in Glacier National Park found alien species invasion of ungrazed foothills rough fescue grasslands occurred up to 100 metres from both paved two-lane roads and unimproved dirt roads, with further invasion anticipated over time (Tyser and Worley, 1992). Timothy and Kentucky bluegrass were particularly common among 15 non-native species. Non-native species richness declined away from roads. Management recommendations by these researchers are to avoid road-building in bunch grass communities and to intensively monitor and manage alien flora where roads already exist.

There is little information available on non-native species invasion in foothills forest environments from linear disturbances. Understories of aspen and balsam poplar forests in southwestern Alberta are prone to becoming dominated by invasive non-native species, particularly Kentucky bluegrass and smooth brome, because the underlying mesic, fertile soils are preferred sites for establishment of these species (Thompson and Hansen 2003). Invasion is exacerbated by heavy grazing pressure.

Researchers suggest that an invasive species management approach that targets a whole landscape is preferable to a species-by-species, or site-by-site approach. Providing relatively undisturbed habitat and preventing further habitat degradation and fragmentation can provide a highly cost-effective defense against invasive species (Marvier et al. 2004).

Questions specific to non-native invasive species

What patterns in distribution of non-native invasive species were detected in terms of ecological and land use factors in the study area based on the vegetation survey data collected by PC?

Did sites closer to roads, trails or other industrial disturbances tend to have higher frequency and cover of non-native invasive species? Was there a pattern of continuing invasion from linear disturbances?

How would PC propose to address issues regarding invasion of non-native species from project disturbances including loss of biodiversity in forest and grassland communities and potential loss of late season forage in native grasslands?

8.0 Mitigation and Reclamation

It is unlikely that native vegetation will be restored, at least in the short term, on project disturbances.

Areas of native vegetation converted to well pads, roads and central facility sites will be used for several decades of operations and are unlikely to be restored. A native seed mix is proposed for drainage ditches (p. B-26).

Pipeline ROWs will be cleared of vegetation and fully stripped of topsoil to 25m in width, except perhaps in two areas of native grassland. Trenches will be dug at least 1.5 m deep and 1.5 m wide often involving ripping and blasting of rock (EA p.B-21). In addition there will be areas used for construction camps and equipment/material storage which will experience clearing of vegetation and/or stripping.

A large proportion of the PDA is expected to be underlain by silt/clay-rich soils which will be subject to compaction and rutting by heavy equipment and other vehicles during the construction and operations phases. Revegetation of these areas will be difficult. A large proportion of the PDA is expected to be underlain by soils with high coarse fragment content which are also very difficult to revegetate. The large number of stream crossings that are contemplated imply the need for extensive cut and fill and bridge construction in areas subject to slope instability and water erosion. Re-establishing vegetation to stabilize these riparian areas is another difficult challenge.

It is unlikely that areas of rough grassland disturbed by the project would be restored even in the long term. A study of revegetation of rough fescue grassland on pipelines in southwestern Alberta found good recovery only when minimum disturbance trench-only stripping techniques were used on narrow pipelines and construction occurred outside the growing season (Desserud 2006). There was little to no recovery, even after several decades, on pipelines constructed without using these techniques.

According to the EA (p. 12-24): “The goal of reclamation and revegetation is *typically* to establish a self-sustaining community of species native to the area to discourage the invasion of non-native species and persistence of weed species”. Elsewhere in the EA (p. B-23) it is stated: “The intent of the revegetation strategy is to meet the requirements of the draft reclamation criteria for well sites and associated facilities in forested lands in the Green Area (ASRD 2007)”. This ASRD document is not included in the list of references.

Reclamation and revegetation strategies are proposed in the EA, but detailed plans have yet to be developed. Some measures that are proposed or may be used include:

- Spreading roots and stumps over the ROW to decrease erosion potential (EA B-20).
- Installing berms and rollback for steep slopes in forested areas (EA B-20).
- Laying erosion control fabric over replaced trench spoil prior to topsoil replacement to prevent topsoil loss in areas of high coarse fragment content or bedrock (p. B-21).
- Using native seed mixes to revegetate disturbed areas not required for operations activities. Different seed mixes will be used for coniferous forest, deciduous forest, grassland and subalpine areas (EA p. B-24-26).

- Shrub plantings and willow stakes in riparian areas (p. 12-17).

To mitigate against spread of invasive non-native species, PC is considering requiring cleaning of construction and operation equipment, sourcing clean seeds, implementing a vegetation management plan and continued problem vegetation monitoring (p. 12-17). These measures are not clearly or fully defined in the EA.

A recent report prepared for the Land Division of Alberta Sustainable Resource Development identifies gaps in revegetation strategies for various natural subregions in Alberta (Gramineae Services Ltd. 2007). Gaps identified for the subalpine and montane natural subregions pertinent to PC's proposed project include the following (p. 44-45):

- There is no supporting data that the rough fescue grasslands found in the Blairmore and Morley Foothills eco-districts can be successfully restored;
- Weeds and non-native species invasion is of particular concern following industrial disturbance in the Montane subregion;
- Best Management Practices and minimal disturbance construction techniques need to be developed for oil and gas exploration and developments, including production phase facilities such as pipelines, access roads and product processing facilities;
- Guidelines for the timing of construction activities are required and need to be clearly defined;
- The effectiveness of erosion control methods such as contour furrowing, roll back and spreadback and the use of erosion and sediment control devices should be monitored and the results reported to SRD;
- At present there is considerable negative impact to the recovery of existing disturbances such as seismic lines, reclaimed RoWs and access trails by recreational all terrain vehicle users. Continued support for Forest Land Use Zones is required;
- Access management plans that include all land uses need to be developed to reduce disturbance and habitat fragmentation for focal wildlife species and Species at Risk;
- Clearly defined access management plans are required due to increased recreational activity;
- Further research is required to determine suitable revegetation species that will stabilize erosion prone soils, while allowing the process of natural succession to occur through encroachment;
- Further research is required to determine suitable revegetation strategies that will reduce non-native species invasion within the disturbance and reduce the edge effect in adjacent non-disturbed native plant communities;
- The use of tree and shrub transplants propagated from locally available seed sources or cuttings to restore wildlife habitat requires monitoring and documentation to determine the most effective procedures.

<u>Questions specific to mitigation and reclamation</u>

What is PC's reclamation goal?
Can the draft reclamation criteria for well sites and associated facilities in forested lands in the Green Area (ASRD 2007) be made available to interveners?

How much rough fescue grassland and other grassland types will potentially be destroyed from direct and indirect effects of the project? What are the implications for grazing by wildlife and livestock?

Are there any innovative minimal disturbance techniques proposed for use in this project? If so, what are they, how will they be implemented and what evidence is there that they will be effective?

PC is proposing to use berms, roll back and spreadback on steep slopes and erosion control fabric in areas of high coarse fragment content. What information is available on the effectiveness of these techniques?

What information is available on the effectiveness of using shrub plantings and willow stakes?

How confident is PC in its ability to control invasive non-native species on disturbances and prevent spread into native vegetation? Is there information available from other industrial developments in the montane and subalpine natural subregions that demonstrates effectiveness of the measures proposed?

9.0 Alternatives to the Project

This is not a "conceptual future plan subject to revision" (IL 93-9 p. 4) although a conceptual approach by PC prior to submitting a defined development plan may have been more appropriate. Alternatives, particularly with respect to the trunk line routing, are possible and have been suggested. According to the EA (p. iv), PC evaluated six trunk line corridors to transport gas from the Sullivan field to a tie-in point in the Savanna Creek field. Options included a western route paralleling HWY 940 and a route which would take gas along HWY 541 and across mostly cultivated land to the Mazeppa Gas Plant east of High River (PC Development Update Feb 2008). PC states "The proposed trunk line route was selected because it offers a balance of environmental, land use, safety, constructability, operability and Projects cost considerations." (EA p. iv)

Intuitively, one would expect that constructing the trunk line along existing linear developments (i.e. Hwy 940 or HWY 541) and across cultivated land will have significantly less environmental impact compared to the proposed trunk line route which is through a relatively pristine large block of public land. Baseline information and adequate assessment of the alternatives with respect to costs and benefits are not provided in the materials available for review; hence informed comment on the relative implications of alternative routes including relative impacts on vegetation and soils and is not possible.

Full assessment of alternatives would be important information for the Board to consider in its determination if the project, as proposed, is appropriate and in the public interest.

<u>Questions specific to alternatives</u>

What information (environmental and other) was used by PC in evaluating alternatives to the proposed trunk line? Is the full analysis available for public review?

10.0 References

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