13 BIODIVERSITY

13.1 Introduction

The objective of this section is to evaluate the effects of the Mackenzie Gas Project (the project) on biodiversity. Biodiversity encompasses the variety of life at all levels of organization, from the genetic to the landscape level and all the ecological and biological processes by which these levels are connected (Biodiversity Convention Office 1996).

Components of biodiversity have been assessed separately and quantitatively in Volume 5, Biophysical Impact Assessment (see Section 7, Fish and Fish Habitat, Section 8, Soils, Landforms and Permafrost, Section 9, Vegetation, and Section 10, Wildlife). The intent of the biodiversity assessment is to summarize overall potential effects of the project on biodiversity, through a qualitative discussion.

A combination of factors is discussed because biodiversity is not simply a function of the number of species present but rather includes an evaluation of the function of ecosystems and the effects that the project may have on it (Chapin 2000).

13.1.1 Summary of Findings

The biodiversity assessment investigated project effects at the following levels:

- landscape level
- ecosystem (vegetation community) level
- species level

13.1.1.1 Landscape Level

Changes in biodiversity at the landscape level were assessed by examining potential changes in landscape patterns and fragmentation because of the project. Landscape pattern refers to the natural distribution of landscape features such as uplands and wetlands, whereas fragmentation describes the degree and extent of partitioning of habitat types, for example, because of clearing the pipeline right-of-way.

The project extends across a broad range of landscapes but has a limited footprint of disturbance within any one landscape type. No significant changes to landscape pattern are predicted at the regional level. At the local level there is a predicted loss of uncommon landforms, such as patterned ground, eskers, kames and outwash plains, in the Tundra and Transition Forest ecological zones, and an associated loss of uncommon vegetation communities.

Loss of these landforms is not predicted to significantly affect wildlife species of concern or species distribution at the landscape level. Effects are expected on individual animals, but regionally, populations are expected to remain sustainable because their productivity will not be altered by the project.

No landscape level effects are predicted for vegetation or wildlife because of habitat fragmentation or barriers to movement created by project components. In particular, reclamation of the pipeline right-of-way following construction is expected to restore wildlife movement patterns and to reduce the effects of local habitat fragmentation.

13.1.1.2 Ecosystem (Vegetation Community) Level

Vegetation communities were used as the basis for the assessment of changes to ecosystem at a local level. Effects on soil quality because of construction activity could affect vegetation composition, structure and productivity, thereby affecting wildlife distribution and abundance. However, these effects are expected to be localized and will not disproportionately affect any particular vegetation community.

Table 13-1 summarizes, by ecological zone and vegetation class, the area that will be disturbed by the project. The area of each vegetation class affected by project development is low and there are no disproportionately large effects on any relatively uncommon vegetation classes or vegetation types of concern. Effects on the dry saxifrage tundra vegetation class, which is associated with granular substrates, are predicted to be disproportionately large relative to their extent in the LSA. However, losses of the dry saxifrage tundra vegetation class in the RSA because of the project are predicted to be only 0.15% compared to its regional distribution of 2.9%. Given the small area of each vegetation class that will be affected, effects on the distribution of vegetation classes on the landscape are predicted to be low.

The effects of the project on vegetation health are considered not significant. Air emission levels around compressor stations and facilities along the pipeline corridor are relatively small, and none of the mapped vegetation communities or rare plants will be significantly affected.

Dust deposition is expected to occur during the construction phase of project facilities; however, the effects are expected to be localized and seasonal.

Table 13-1: Project Disturbance by Vegetation Class and Ecological Zone

Ecological Zone	Vegetation Class[1]	Baseline Area[2] (ha)	Percentage of Ecological Zone[3] (%)	Project Disturbance	
				Area (ha)	Proportion of Baseline[4] (%)
Tundra	Dwarf shrub heath	267,455	10.62	261	0.10
	Riparian shrub	240,090	9.53	101	0.04
	Upland shrub (all)	221,668	8.80	285	0.13
	High-centred polygons	141,911	5.63	168	0.12
	Black spruce/ground birch	93,681	3.72	5	0.01
	Low-centred polygons	83,648	3.32	52	0.06
	Dry saxifrage tundra	72,355	2.87	108	0.15
	Riparian sedge-cotton-grass	63,059	2.50	32	0.05
	Delta sedge-cotton-grass	60,740	2.41	32	0.05
	Sedge-cotton-grass tussock	55,722	2.21	99	0.18
	Delta low-centred polygons	55,231	2.19	51	0.09
	Delta shrub	48,069	1.91	29	0.06
	Riparian black spruce/shrub	17,324	0.69	9	0.05
	Water emergents	2,761	0.11	0	0.00
	Recent burn < 2 years since burn	17	0.00	0	0.00
	Total	1,423,729	56.51	1,231	0.09
Transition Forest	Black spruce/ground birch	257,420	30.30	377	0.15
	Recent burn < 2 years since burn	126,163	14.85	1	0.00
	Upland black spruce/lichen	73,541	8.66	101	0.14
	Shrub fen	58,580	6.90	83	0.14
	Black spruce-tamarack	45,669	5.38	50	0.11
	Upland shrub (all)	42,872	5.05	69	0.16
	Dwarf shrub heath	38,023	4.48	1	0.00
	White spruce-black spruce-paper birch/green alder	35,252	4.15	30	0.09
	Graminoid fen	32,803	3.86	59	0.18
	Water emergents	20,435	2.41	2	0.01
	Black spruce/Labrador tea/cloudberry	14,610	1.72	4	0.03
	2 - – 10 years since disturbance	5,413	0.64	0	0.00
	Willow-river alder	326	0.04	0	0.00
	Total	751,107	88.44	776	0.10

Table 13-1: Project Disturbance by Vegetation Class and Ecological Zone (cont'd)

Ecological Zone	Vegetation Class[1]	Baseline Area[2] (ha)	Percentage of Ecological Zone[3] (%)	Project Disturbance		
				Area (ha)	Proportion of Baseline[4] (%)	
North Taiga Plains	g1/h2 combined black spruce-tamarack and black spruce/ground birch/red bear	953,602	30.89	1,760	0.18
	Upland white spruce-Alaska birch	440,898	14.28	559	0.13
	2 - 10 years since disturbance	313,291	10.15	825	0.26
	g1/h2 combined black spruce-tamarack and black spruce/ground birch/red bear	252,782	8.19	386	0.15
	d3/d4 combined white spruce/stair-step moss and white spruce-black spruce/shrubby cinquefoil	157,629	5.11	286	0.18
	Upland white spruce-Alaska birch	148,340	4.80	92	0.06
	Recent burn < 2 years since burn	137,269	4.45	100	0.07
	k3/k4 combined graminoid wetland /ground birch/water sedge wetland	132,423	4.29	251	0.19
	k3/k4 combined graminoid fen/ground birch/water sedge wetland	77,938	2.52	92	0.12
	Black spruce/cloudberry-lichen bog	55,290	1.79	48	0.09
	Water emergents	33,760	1.09	5	0.01
	d3/d4 combined white spruce/stair-step moss and white spruce-black spruce/shrubby cinquefoil	20,538	0.67	22	0.11
	Riparian willow-grey alder	14,841	0.48	7	0.05
	Black spruce/cloudberry-lichen bog	8,054	0.26	3	0.04
	Herbaceous/graminoid	470	0.02	0	0.10
	Total	2,747,126	88.99	4,435	0.16
South Taiga Plains	g1/i1 combined black spruce-tamarack and black spruce/ground birch	994,714	25.27	1,104	0.11
	2 – 10 years since disturbance	618,562	15.72	630	0.10
	k4/k5 combined	492,199	12.51	564	0.11
	Black spruce/cloudberry-lichen bog	477,457	12.13	400	0.08
	d2/d5 combined aspen/white spruce/low-bush cranberry and white spruce-black spruce-paper birch/green	362,799	9.22	532	0.15
	Upland Jack pine	252,554	6.42	342	0.14
	d3/d4 combined white spruce/stair-step moss and black spruce-white spruce/stair-step moss	182,492	4.64	241	0.13
	Graminoid fen	166,291	4.23	202	0.12
	Water	151,490	3.85	18	0.01
	Aspen/prickly rose/fireweed	109,887	2.79	182	0.17
	Leatherleaf/bog rosemary-peat moss	40,046	1.02	20	0.05
	Recent burn <2 years since burn	30,697	0.78	0	0.00
	Water emergents	9,740	0.25	2	0.02

Table 13-1: Project Disturbance by Vegetation Class and Ecological Zone (cont'd)

Ecological Zone	Vegetation Class[1]	Baseline Area[2] (ha)	Percentage of Ecological Zone[3] (%)	Project Disturbance	
				Area (ha)	Proportion of Baseline[4] (%)
South Taiga Plains (cont'd)	Riparian willow-red-osier dogwood	8,671	0.22	4	0.05
	Herbaceous/graminoid	5,115	0.13	2	0.05
	Total	3,902,715	99.18	4,244	0.11

NOTES:
1. Vegetation community or cover type identified through satellite imagery and field inspection.
2. Area of the vegetation class within the RSA.
3. Proportion of the ecological zone occupied by each vegetation class. Total for all classes does not equal 100% because non-vegetation land cover classes in each ecological zone have not been included.
4. Proportion of the baseline vegetation class area affected by the project.

Effects on wildlife at the vegetation community level have been addressed by evaluating the potential effects on wildlife habitat. Of the known key ecosystem resources, e.g., breeding and denning sites, moulting and migration areas, the only site-specific feature that might be affected is habitat at glaciofluvial and aeolian borrow sites. The loss of these features is a concern because they are regionally uncommon and provide nesting and denning resources and important forage habitats along the pipeline corridor.

Loss of habitat might also occur indirectly if animals avoid suitable habitat because of sensory disturbance from project activities and facilities. Individual animals are expected to either move away or become accustomed to the disturbance. However, this is not expected to significantly affect ecosystem conditions.

No bird species were significantly affected, including colonies of waterfowl and shorebirds in the Kendall Island Bird Sanctuary (KIBS). As a protected area that includes important bird habitat, KIBS will not be affected in its function as a refuge for large bird populations or its importance as a regional contributor to the tundra ecosystem. Other special habitats and areas, such as Holmes Creek, were evaluated and are affected by the project.

Barren-ground caribou movement and potential grizzly bear mortality are the two most important potential effects predicted in the wildlife impact assessment. Although not considered significant, both effects will have the potential to change predator-prey dynamics in localized areas and cause local change to ecosystem structure and function. Mitigation measures have been designed to reduce the potential project effects on these species (see Section 10, Wildlife). Volume 7, Environmental Management, describes wildlife monitoring programs that will be implemented.

13.1.1.3 Species Level

Site clearing will result in the direct loss of vegetation. While individual plants and vegetation communities will be lost, effects on population viability are not expected to be significant.

Although occasional incidents resulting in the death of individual animals are likely, no significant effects on wildlife populations are predicted.

Mitigation measures have been designed to reduce the potential direct and indirect causes of mortality or reduced productivity and to maintain population viability and species-level biodiversity (see Section 9, Vegetation, Section 10, Wildlife, and Volume 7, Environmental Management).

13.2 Assessment Approach

Potential effects on biodiversity are discussed at three levels of organization: landscape, vegetation community and species. The potential effects on genetic components of biodiversity are not assessed separately but are captured in the discussions of the higher levels of organization. For example, assessment of changes in species distribution and abundance at the landscape and vegetation community level also includes the potential effects on gene flow and genetic diversity of species.

The landscape level addresses the composition and pattern of vegetation types and landforms on a regional scale. Landscape composition focuses on the variety and abundance of vegetation types and landforms, while landscape pattern considers the physical distribution of vegetation types and landforms. These two aspects of a landscape can independently, or in combination, affect ecological processes and organisms' use of the landscape (McGarigal and Marks 1995).

Ecosystems are a dynamic complex of plants, animals and microorganisms and their non-living environment interacting as a functional unit (Environment Canada 1995). Vegetation communities were used as the ecosystem unit because they have specific characteristics that support a particular group of species.

The species level focuses on the factors that could affect life history components of a species. Life history refers to the key activities that each individual must succeed in to live to its full age and reproduce. It also relates to the ability of a species to recover from disturbance.

Details of components of biodiversity are dealt with quantitatively in related disciplines (see Section 8, Soils, Landforms and Permafrost, Section 9, Vegetation, and Section 10, Wildlife). Therefore, the assessment in this section is a qualitative discussion of the key issues and the potential project effects on overall biodiversity and ecosystem conditions.

13.2.1 Key Issues

The following key issues, related to biodiversity, were developed from community meetings, technical workshops, existing traditional knowledge, existing environmental assessments and professional judgement:

- ecosystem and habitat loss
- habitat fragmentation and barriers to movement
- habitat or species ability to recover
- response to edge effects
- species distribution
- invasive and non-native species

- changes to special management areas
- response to noise, lighting and vibrations
- water pollution quality and air emissions
- species of concern

These issues are addressed under the appropriate key questions, with several issues covered under two or more questions.

13.2.2 Key Questions

Biodiversity issues can be addressed by answering three key questions about the effects of the project on the environment. The questions are posed in terms of how the project could affect biodiversity at:

- the landscape level
- the vegetation community level
- the species level

Table 13-2 shows the relationship between key questions, key issues and biodiversity components. Effect pathway diagrams were developed to show the various ways by which project activities could affect biodiversity at the landscape, vegetation community and species levels.

Table 13-2: Key Questions, Related Issues and Biodiversity Components

Key Question	Related Key Issue	Potentially Affected Biodiversity Component
How will the project affect biodiversity at the landscape level?	• habitat fragmentation • barriers to movement	• species distribution • species of concern • landscape patterns • ecosystem conditions
How will the project affect biodiversity at the vegetation community level?	• vegetation and habitat loss • invasive and non-native species • noise, lighting, vibrations • water quality and air emissions	• species distribution • species of concern • changes to special management areas • ability of habitats to recover • ecosystem conditions
How will the project affect biodiversity at the species level?	• invasive and non-native species • noise, lighting, vibrations • water quality and air emissions	• species of concern • ability of species to recover • ecosystem conditions

13.2.3 Study Area

This biodiversity assessment refers to the local and regional study areas established to assess the geographic extent of project effects on terrestrial resources (see Section 9, Vegetation).

13.2.4 Qualitative Assessment Approach

The assessment of potential project effects on biodiversity is qualitative but uses quantitative assessment results from related disciplines, previous assessments and professional judgement. Linkages to other disciplines are made through effect pathways.

13.3 Effects at the Landscape Level

13.3.1 Effect Pathways

Figure 13-1 illustrates the pathways through which biodiversity might be affected at the landscape level. Site clearing, facility and infrastructure construction, and operations result in fragmentation of the landscape and might create barriers to species movement. These changes affect landscape patterns that might alter species distribution and populations, ultimately affecting ecosystem conditions and biodiversity.

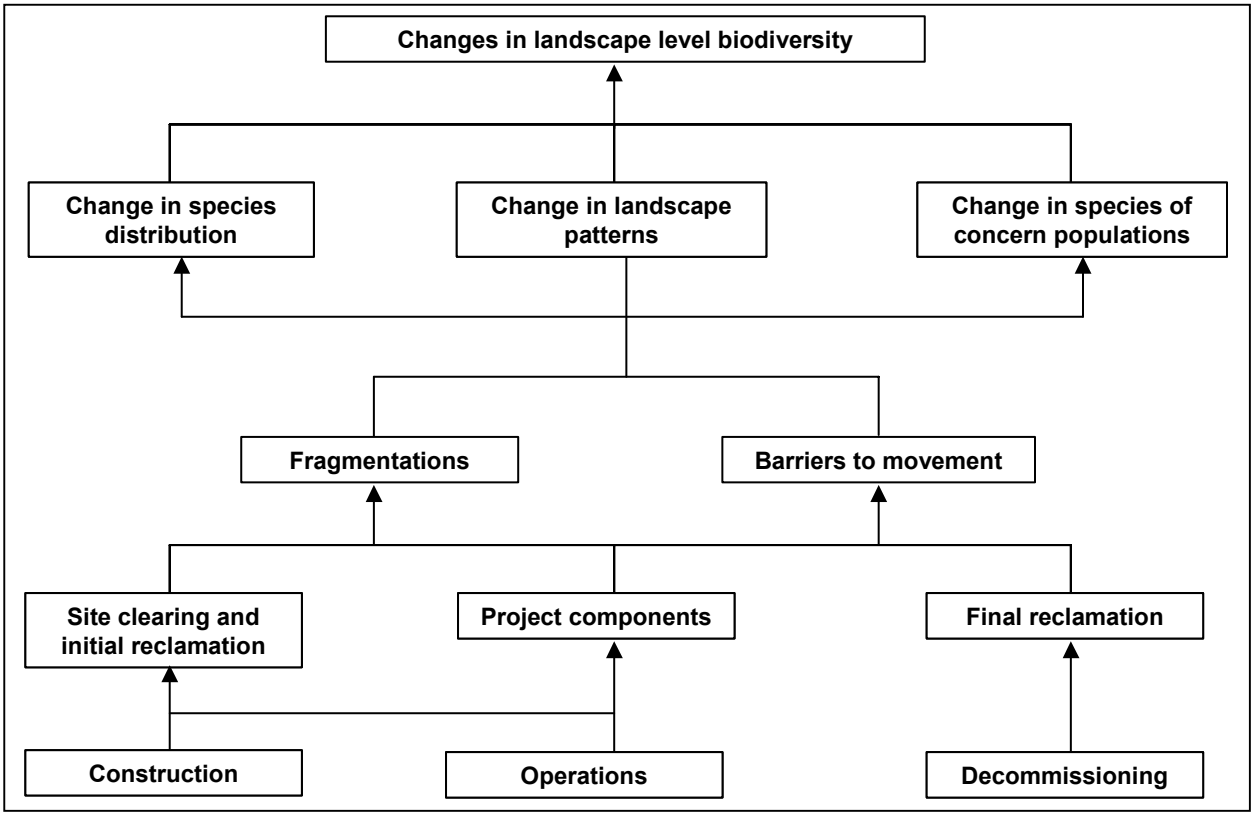

Figure 13-1: Change in Landscape Level Biodiversity

13.3.2 Project Design and Mitigation

The following describes project components and activities that could affect biodiversity and ecosystem conditions during the life of the project. A discussion is provided on mitigation that will be undertaken to reduce any effects on biodiversity (see Section 8, Soils, Landforms, and Permafrost, Section 9, Vegetation, and Section 10, Wildlife, for mitigation strategies, and Volume 2, Project Description, for details of project design).

13.3.3 Landscape Level Assessment

Ecosystem and Habitat Loss

There is a predicted loss of uncommon landforms at the local level, i.e., patterned ground, eskers, kames and outwash plains (see Section 8, Soils, Landforms and Permafrost) that are common in most of Canada but could be uncommon in some parts of the study area. These landforms often support uncommon vegetation communities and rare plants and provide denning sites for mammals.

Loss of vegetation communities associated with these uncommon landforms is permanent and disproportionate to their availability on the landscape (see Section 9, Vegetation). The effects of the loss of individual rare or unusual plants on species distribution, gene flow and genetic diversity are currently unknown, but are not expected to be significant.

Loss of these landforms is not predicted to significantly affect wildlife species of concern or species distribution at the landscape level. Impacts are expected to affect individual animals, but regionally, populations are expected to remain sustainable because their productivity will not be altered by the project.

Habitat Fragmentation and Barriers to Movement

Changes to landscape patterns also result from fragmentation caused by vegetation loss and construction of project components, particularly facilities and above-ground pipelines. The magnitude of effects on vegetation communities, including vegetation communities of concern, at the landscape level is predicted to be low.

No landscape level effects on wildlife are predicted because of habitat fragmentation or barriers to movement created by project components. There is a potential effect on barren-ground caribou movements caused by above-ground pipelines in the Parsons Lake field and by construction of pipelines and facilities, though the potential change in species distribution and predator-prey dynamics is predicted to be local and is unlikely to change productivity of caribou populations at the landscape level.

To reduce the probability that project elements will disrupt wildlife movement during construction and operations, particularly for caribou, environmental management techniques will be implemented (see Volume 7, Section 3.7, Wildlife Management).

The decommissioning stage of the project might include removing project components and re-contouring affected terrain. Removing project components would eliminate physical barriers to wildlife movement. Active reclamation practices will initiate early successional plant communities to:

- re-establish connectivity surrounding disturbance
- reduce fragmentation effects on the landscape

13.4 Effects at the Ecosystem Level

13.4.1 Effect Pathways

Effects at the ecosystem level have been explained using vegetation communities as indicators of ecosystem conditions. Figure 13-2 illustrates the pathways through which biodiversity might be affected at the vegetation community level. Project construction and operations could change:

- soils and landforms
- water quality and air emissions
- vegetation community composition
- structure and productivity

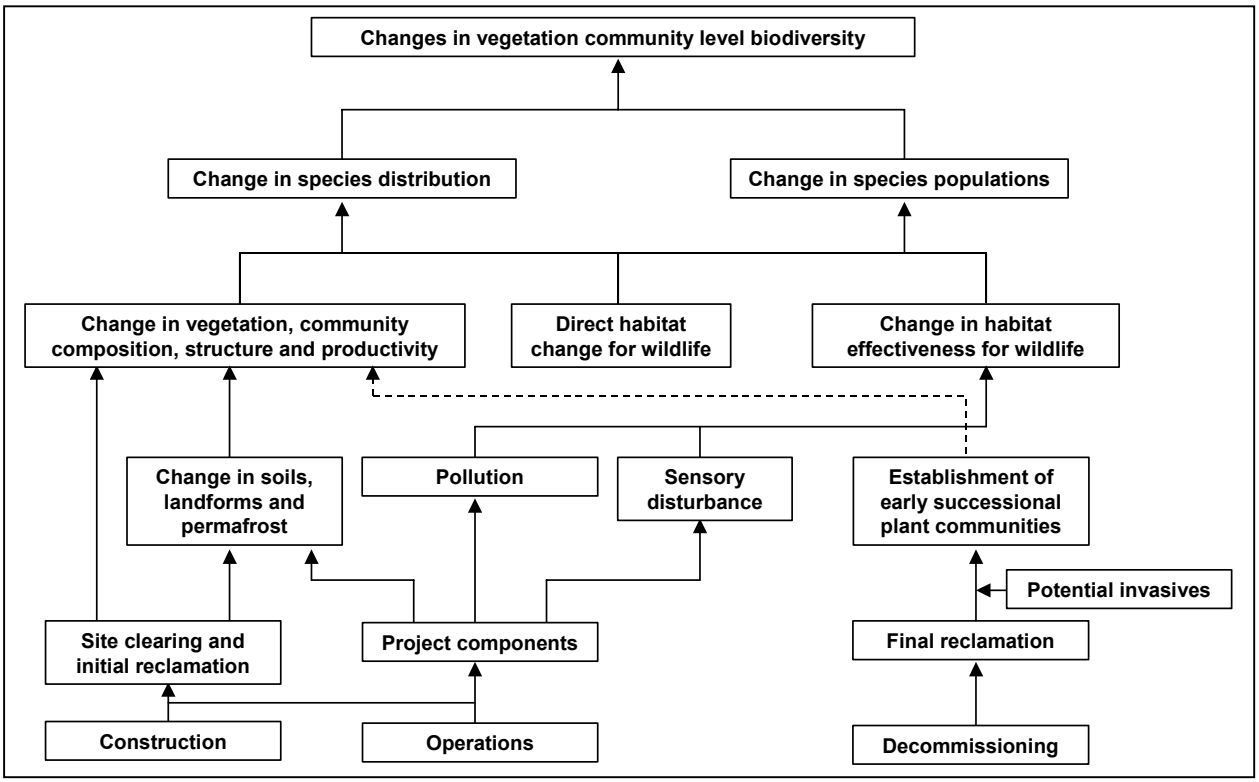

Figure 13-2: Changes in Vegetation Community Level Biodiversity

Loss or alteration of vegetation and sensory disturbance from project components could affect wildlife at the vegetation community level through direct habitat loss or reduced habitat effectiveness.

Reclamation practices would initiate the re-establishment of vegetation communities, but could introduce invasive and non-native species or change the community composition. These changes in vegetation communities and wildlife

habitat could alter species distribution and abundance, and change ecosystem conditions and biodiversity.

13.4.2 Project Design and Mitigation

This section describes project components and activities that could affect biodiversity at the vegetation community level during the life of the project. It presents a brief discussion on mitigation that will be undertaken to reduce any effects on biodiversity (see Section 8, Soils, Landforms and Permafrost, Section 9, Vegetation, and Section 10, Wildlife, for mitigation strategies and Volume 2, Project Description, for details of project design features).

13.4.3 Vegetation Community Level Assessment

13.4.3.1 Soils

The main issues and effects identified for soil quality include potential:

- changes in drainage
- soil loss
- alteration of soil physical and chemical properties

These effects are localized in the Transition Forest Ecological Zone LSA and the North Taiga Plains Ecological Zone LSA (see Section 8, Soils, Landforms and Permafrost). These effects on soil quality could affect ecosystem function by changing vegetation composition, structure and productivity, thereby affecting wildlife distribution and abundance. However, these effects are expected to be localized and will not disproportionately affect any vegetation community.

13.4.3.2 Vegetation

Ecosystem and Habitat Loss

Site clearing will result in the direct loss of vegetation types and communities in the LSA. There will be low magnitude losses of vegetation associations that contribute to biodiversity through high species richness or high numbers of unique species. However, the impacts to vegetation are not considered to be significant because less than 5% of any vegetation type will be lost because of the project (see Table 13-1, shown previously). Losses of smaller, unmapped, communities of concern are also predicted to be of low magnitude, with the possible exception of vegetation associated with granular deposits. Losses of vegetation types and communities associated with granular materials are predicted to be disproportionately greater than their extent in the LSA. Where possible, protection measures and environmental management techniques such as avoidance, propagation or transplantation will be used to reduce impacts on

uncommon plant communities (Volume 7, Section 4.5.2, Conceptual Rare and Uncommon Plant Community Mitigation).

Species Distribution

The distribution of plant species is directly related to the distribution of the corresponding vegetation communities. Only the dry saxifrage tundra community is disproportionately affected in the LSA. However, the regional distribution of this vegetation community and associated plant species will not be disproportionately affected because only 0.15% of this community type will be directly affected compared to its regional distribution of 2.9%.

Response to Edge Effects

Changes in microclimate from site clearing create changes in vegetation community structure along cleared edges. These edge effects can be positive, neutral or negative depending on the species. Over time, these edges along with other cleared areas are predicted to develop into functioning, self-sustaining native plant communities, although this goal may take up to 30 years to achieve and may also result in a change in community composition or a vegetation community different from the original.

Invasive and Non-Native Species

The presence of reclamation and non-native species is predicted to persist into the far future, however, the magnitude of these effects is predicted to be low. Surveys in northern environments have reported that non-native species have less success invading neighbouring native plant communities, even with use of non-native seed mixes for reclamation (National Research Council 2003). The effect of these changes on biodiversity function are unknown, however, it is likely that these effects will be localized in extent and managed through the project environmental management plan (Volume 7, Environmental Management). Consequently, this potential change in vegetation community composition is considered not significant.

Air Emissions

In northern regions of Alaska, there have been minimal effects of air quality on vegetation communities (National Research Council 2003). Although some vegetation communities are more sensitive to air emissions, e.g., lichens the air emissions associated with oil and gas developments have generally have been lower than are expected to be harmful to plants.

The effects of project air emissions at the vegetation community level are considered to be local but not significant (see Section 9, Vegetation). Dust deposition is expected to occur at all project facilities, but the effects will be

seasonal and local in extent. No significant effects have been predicted on known rare plant communities.

Habitat Ability to Recover

The ability of a habitat to recover is dependent on factors such as vegetation community type, climate and disturbance type. It is predicted that vegetation communities that develop over long periods of time, e.g., fens and bogs, that are located in more northern latitudes, or that have permanent alterations, e.g., gravel pads, borrow sites, will take longer to recover. The only habitats that may be disproportionately affected are those associated with patterned ground, eskers, kames and outwash plains (see Section 8, Soils, Landforms and Permafrost). Some of these vegetation classes will be permanently altered because of borrow site extraction.

Impacts to vegetation communities will be reduced through implementation of environmental management techniques such as avoidance, drainage control or restoration, reclamation, and seasonal restrictions on use (see Volume 7, Section 3, Environmental Management Plans).

13.4.3.3 Wildlife

Ecosystem and Habitat Loss

Effects on wildlife from changes in vegetation at the community level have been addressed by evaluating the potential effects of the project on wildlife habitat. Of the known key wildlife habitats, habitat associated with glaciofluvial and aeolian deposits is the only site-specific affected feature that is regionally uncommon. Glaciofluvial and aeolian deposits provide nesting and denning resources and important forage habitats along the pipeline corridor.

Indirect habitat loss is also likely to occur because of avoidance of suitable habitat due to real or perceived barriers, including sensory disturbance from project activities and facilities. It is expected that the effect will be greater during construction and the initial stages of operations, because activity and sensory disturbance will be greatest during the construction stage.

Environmental management techniques will be implemented to minimize direct and indirect impacts to wildlife habitat (see Volume 7, Section 3.7, Wildlife Management).

Species Distribution

The distribution of wildlife species is related to the distribution and availability of their preferred habitats. Locally, habitats associated with patterned ground, eskers, kames and outwash plains might be disproportionately affected and could influence local distribution of species using these habitats for denning and

foraging. Indirect habitat loss, as discussed above, could also potentially affect species distribution, but these effects are predicted to be local and greatest during the construction stage.

Species of Concern

No species of concern will be significantly affected by the project (see Section 10, Wildlife). However, impacts to barren-ground caribou movements and potential grizzly bear mortality were two issues of concern highlighted in the wildlife impact assessment. As a result, mitigation measures have been designed to specifically manage potential impacts from the project on these two species (see Volume 7, Section 3.7, Wildlife Management).

Changes to Special Management Areas

Areas of conservation status and unique habitat types were evaluated in the regional study areas. No bird species will be significantly affected, including colonies of waterfowl and shorebirds in KIBS. As a protected area that includes important bird habitat, KIBS will not be affected in its function as a refuge for large bird populations or in its importance as a regional contributor to the tundra ecosystem.

Other special habitats and areas, such as Holmes Creek, were evaluated and will not to be affected by the project. Mitigation measures will alleviate important effects on such habitat areas, and no unique habitat will be critically affected.

Response to Edge Effects

Changes in microclimate from site clearing create changes in the vegetation community structure along cleared edges with a corresponding change in wildlife use patterns. These edge effects can be positive, neutral or negative depending on the species. As the pipeline right-of-way will remain cleared for the life of the project and reclamation is expected to take up to 30 years, these edge effects will persist into the far future. However, mitigation measures such as roll back and slash berms across the pipeline right-of-way have been designed to minimize these effects where possible (see Volume 7, Section 3, Environmental Management Plans, and Section 4, Environmental Protection Plan).

Invasive and Non-native Species

The introduction of invasive species and presence of reclamation species is predicted to persist into the far future. However, the magnitude of these effects is predicted to be low as the effects will be localized around project elements. Management plans to restrict establishment or encroachment of these species have been developed (see Volume 7, Section 3, Environmental Management Plans). Consequently, this change in wildlife habitat is likely to be not significant.

Response to Noise, Lighting and Vibrations

Sensory disturbance from project activities and facilities could influence wildlife use of habitat. As a result, guidelines to reduce sensory disturbance to wildlife have been developed and include detailed siting assessment of project facilities within important wildlife habitat, creating visual barriers to facilities, and placing restrictions on aircraft use (see Volume 7, Section 3, Environmental Management Plans).

13.5 Effects at the Species Level

13.5.1 Effect Pathways

Figure 13-3 illustrates the pathways through which biodiversity might be affected at the species level. Construction and operations of the project could result in direct and indirect mortality of individuals. Reclamation practices will initiate the re-establishment of vegetation communities, but could introduce invasive and non-native species. Reclamation monitoring programs will be designed to identify invasive species along with appropriate remedial measures.

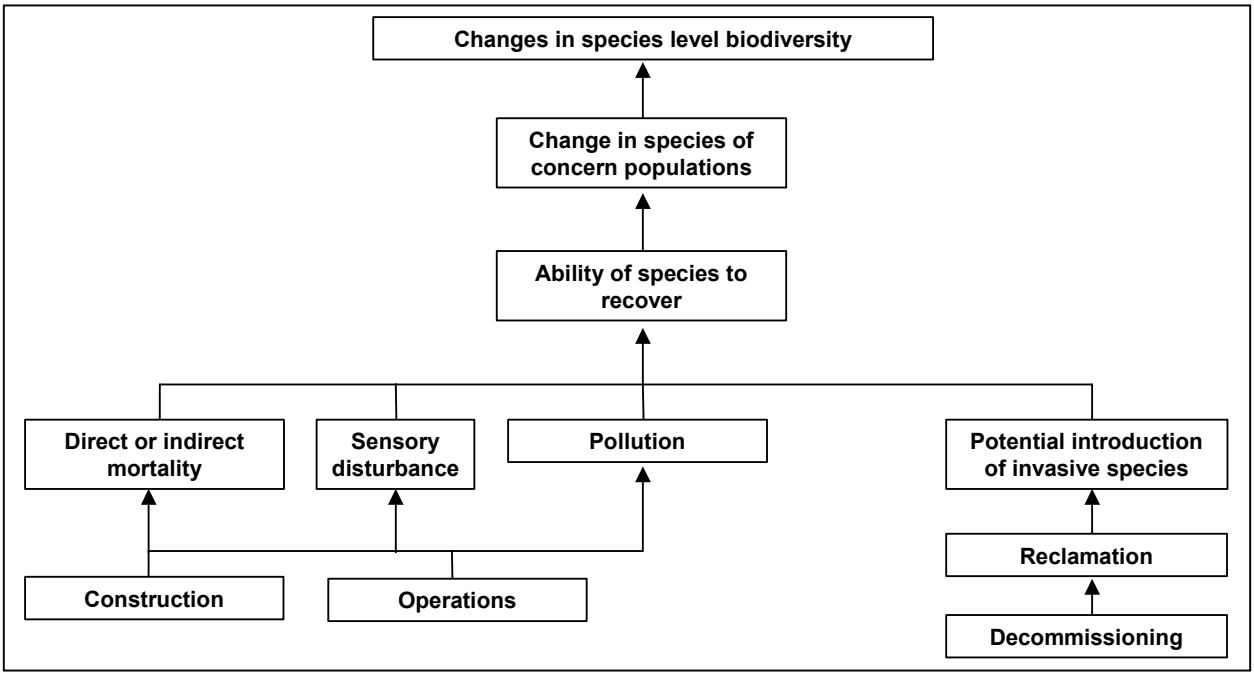

Figure 13-3: Changes in Species Level Biodiversity

13.5.2 Project Design and Mitigation

This section describes project components and activities that could affect biodiversity and ecosystem function at the species level during the life of the project. It presents a brief discussion on mitigation measures that might be undertaken to reduce effects on biodiversity (see Section 8, Soils, Landforms and Permafrost, Section 9, Vegetation, and Section 10, Wildlife, for mitigation strategies, and Volume 2, Project Description, for details of project design features).

13.5.3 Species Level Assessment

Species' Ability to Recover

The ability for a species to recover is linked to reproduction and mortality rates, which can be influenced by indirect stressors and direct mortality.

Stress or displacement of species can be caused by:

- sensory disturbance (i.e., noise, lighting and vibrations)
- dust and air emissions
- competition with introduced invasive or non-native species

Sensory Disturbance

Increased stress levels as a result sensory disturbance from project elements can affect the condition and reproductive output of wildlife. However, the direct relationship between sensory disturbance and quantified effects on productivity of wildlife populations is unknown. The effects of noise, lighting and vibrations from project activities will be managed (see Volume 7, Section 3, Environmental Management Plans), therefore, the effects are expected to be localized and to not significantly affect productivity of wildlife populations.

Dust and Air Emissions

Dust deposition is expected to occur at all project facilities, but the effects will be seasonal and local in extent. The effects of the individual loss of rare plants on biodiversity are not known but are unlikely to result in a significant effect to rare plant populations.

The effect will be localized around project components and is unlikely to affect wildlife populations.

Mitigation measures have been designed to reduce the potential direct and indirect causes of mortality or reduced productivity and to maintain population viability and species-level biodiversity (Volume 7, Environmental Management).

Invasive and Non-Native Species

The presence of invasive or non-native plant and wildlife species can decrease productivity by increasing competition for resources and modifying site conditions. The environmental management plan is designed to restrict colonization of these species (see Volume 7, Section 3, Environmental Management Plans). As a result, it is unlikely that invasive and non-native species will have a significant effect on plant or wildlife species' productivity or ability to recover.

Mortality

Site clearing will result in the direct loss of vegetation and affect rare vegetation species, though the effects are not predicted to be significant. Mitigation measures have been designed to avoid species of concern where possible (see Volume 7, Section 4, Environmental Protection Plan). Site-specific pre-disturbance surveys and avoidance or propagation and transplant techniques will be implemented to minimize impacts to species of concern.

Direct wildlife mortality because of project activities is not expected to affect wildlife populations, including species of concern. Although there will likely be occasional incidents resulting in the death of individual animals, mitigation measures to avoid direct mortality (see Volume 7, Section 3, Environmental Management Plans) will be implemented. Therefore, no significant effects on wildlife populations are predicted (see Section 10, Wildlife).

References

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