BIODIVERSITY

Fort McKay
Specific Assessment

Fort McKay
Industry Relations Corporation

March 2010

Contents

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Appendix

8.0 Biodiversity

8.1 Fort McKay Concerns Related to Biodiversity

Fort McKay has existed on their Traditional Lands for generations and the Community places great value on the land and all that the land supports. Fort McKay has major concerns associated with the "loss of land" due the development of numerous large oil sands operations on the Community's Traditional Lands.

Biodiversity was selected as a (valued) component for the Fort McKay Specific Assessment because biologically diverse landscapes are a critical component of the "land" that contribute to and support Fort McKay's cultural values such as tradition, self-reliance, self-determination, cohesion, rootedness, peace, connectedness and purpose (HEG 2009, Fort McKay IRC 2010a).

Natural landscapes, consisting of uplands, wetlands and aquatic systems, provide the land base on which the Community of Fort McKay undertakes traditional activities such as hunting, trapping, fishing and the gathering of plants for food and medicine. These landscapes are also intrinsic to the raising of children and education of community members. Accessible and healthy land is vital to Fort McKay's ability to sustain its values and culture.

As traditional users of the land, Fort McKay is concerned with the sustainable use of biological resources within its Traditional Lands. Fort McKay is also concerned with the conservation of biological diversity at all levels, including genetic, species, ecosystem and landscapes. Numerous plant, wildlife and aquatic species are important to the culture of Fort McKay. The community also recognizes that healthy ecosystems are important in the landscape as these ecosystems interact with and support all living organisms as well as abiotic functions. Community members feel that industrial development within Fort McKay's Traditional Lands has been adversely affecting the amount and quality of land, including wildlife, plants and ecosystems. A substantial amount of development has occurred within Fort McKay's Traditional Lands, particularly since the late 1990s. There is concern that the adverse effects will increase as development continues to proceed. Fort McKay community members have consistently expressed concerns about the impacts of these developments on the land, air and water (Healing the Earth Strategy, Fort McKay IRC 2010b). They have also expressed the need to assess effects based on conditions that existed in the 1960s prior to industrial development in the Fort McKay's Traditional Lands.

The purpose of this assessment is to predict the potential environmental effects of Shell Canada Limited's (Shell's) proposed Jackpine Mine Expansion and Pierre River Mine Projects on biodiversity with respect to the Community of Fort McKay.

8.2 Fort McKay Specific Assessment Approach to Biodiversity

8.2.1 Introduction

Fort McKay has seen large tracts of their Traditional Lands be developed by oil sands operators, beginning in the late 1960s. The community considers the condition of the land prior to any development as an important and relevant baseline to which all effects of development should be compared in order to understand and potentially mitigate and accommodate the changes occurring to their lands and their ability to exercise their rights. In addition to measuring effects of the Projects on biodiversity at the time of project application (i.e., Shell's baseline) this assessment has been structured to compare the Jackpine Mine Expansion and Pierre River Mine applications with conditions that existed prior to the industrial development of oil sands. Information about biodiversity in Fort McKay Traditional Lands prior to industrial development is not available in the same format and detail as is available for most subsequent time intervals that are included in this assessment. However, measurement of some biodiversity indicators is possible. For instance, a biodiversity potential ranking has been applied to the regional land cover types and local ecological cover classes (i.e., AVI ecosite phase and wetland types) that have been mapped for the vegetation portion of this Fort McKay Specific Assessment (***Section 7 - Vegetation***).

Since spatial data concerning the distribution of ecological land cover classes is not currently available for the future development scenarios, this assessment has been limited to the ranking of biodiversity potential in the land cover classes and with the discussions regarding the composition and distribution of these units in the future landscape. Measurement of certain biodiversity indicators or landscape metrics, such as mean patch size, number, core area, and edge, that have been undertaken by Shell (2007) during the assessment of the local study area are not available for the analysis of future development scenarios.

While Fort McKay's Traditional Lands extend beyond the current area of oil sands development, the majority of this development occurs close to the community of Fort McKay and the Athabasca River. A Forty Township Study Area (FTSA), that includes the two proposed mine areas and the Community of Fort McKay, has been used in this assessment. This 379,641 hectare (ha) study area straddles the Athabasca River and includes the lower portions of the MacKay River, Ells River, Joslyn Creek, Tar River, Calumet River, Pierre River, Asphalt Creek, Gymundson Creek, Big Creek, Firebag River, Fort Creek and Muskeg River watersheds. As a result, the FTSA study area encompasses many areas of high value and use by Fort McKay (Healing the Earth Strategy, Fort McKay IRC 2010b).

The FTSA is intended to provide information on biodiversity indicators for land centered on the Community of Fort McKay for use in the assessment of the effects of the proposed Projects on biodiversity. Fort McKay requested that Shell provide biodiversity potential ranking and landscape metrics data based on regional

ecological land cover classes (Landsat) and Alberta Vegetation Inventory (AVI) for the FTSA. A description of the two ecological formats is provided in *Section 7 – Vegetation*.

Several cases/scenarios have been used to present and analyze biodiversity data for the FTSA (Table 8-1).

Table 8-1: Assessment Case/Scenarios and Data Availability

Assessment Case/Scenario	Biodiversity Potential based on AVI Format (Ecosite Phase and Wetland Classes)	Biodiversity Potential Based Regional Ecological Land Cover Classification (Landsat)
Pre-Development Scenario	no	yes
Late-1990s Scenario[1]	yes	no
Base Case[2]	yes	yes
Base Case + Jackpine Mine Expansion	yes	yes
Base Case + Pierre River Mine	yes	yes
Application Case (both mines)	yes	yes
Application Case-closure	yes	yes
Planned Development Case (PDC)	no	yes
Planned Development Case-closure (far future)	no	yes

Note:

[1]The Late 1990s Scenario is intended as a surrogate for Pre-Development for data presented and analyzed in the AVI format.

[2]Fort McKay's intent was to analyze a Current Scenario (approximately 2007) as well as a Pre-Development Scenario and this has been done for other components of this assessment (e.g., air quality, cultural heritage). However, Current Case vegetation mapping was not available. Base Case is the closest case to the current situation since it includes current disturbances plus approved (but not yet developed) projects.

The Pre-Development Scenario represents conditions prior to the occurrence of industrial development and is based on the condition of vegetation resources in the 1960s. It was prepared in the regional ecological land cover (ELC) data format based on Landsat data. It was not possible for Shell to develop AVI mapping (ecosite phase and wetland) and associated interpretations based on the classification for the Pre-Development Scenario for the FTSA due to time constraints, and lack of data from that period.

The Late1990s Scenario is a presentation of vegetation cover and interpretations based on the classification (i.e., biodiversity potential) in the AVI data format as it existed in the late 1990s. This scenario was developed for the FTSA as a surrogate for pre-development. It represents conditions before a number of the newer mines were created; however, Syncrude's Mildred Lake and Aurora North, Suncor (Fee Lot 2 and Lease 86/17) and a number of other disturbances (i.e., roads, pipelines, cutlines, sawmills and wellsites) were developed by this time.

The Base Case represents vegetation cover and disturbance associated with all existing and approved development up to 2007. Application Cases consider the Base Case conditions plus the development associated the Pierre River Mine and Jackpine Mine Expansion individually as well as the both mines together (the Projects). The Application Case-closure represents vegetation cover as it is proposed after reclamation and closure has been completed for the Projects.

The Planned Development Case represents vegetation cover in the study area assuming that all planned and approved projects have been developed (i.e., projects are cleared and operating) at that point in time. Planned Development Case-closure represents the conditions that are expected in the study area after all projects have been reclaimed. Mapping and data in the Planned Development Case and Planned Development Case-closure are based on regional land cover mapping and future cases are based on non-spatial data from Conservation and Reclamation Plans.

8.2.2 Potential Impacts to Biodiversity

Many of the Community's core values are intrinsically linked to the land and the availability of land to carry out traditional activities. Fort McKay's approach to assessing biodiversity considered the effects of the Projects on the following key components of the biodiversity and associated indicators:

- Effects to biodiversity potential—at the ecosystem level the assessment considered the effects of the Projects to biodiversity potential due to the changes in the distribution of ecosystems mapped in the FTSA at the regional and local scale.
- Effects to the landscape level indicators—at the landscape level the assessment considered the effects of the Projects to the distribution and composition of land cover classes or vegetation types in the FTSA.

8.2.3 Data Sources, Types and Limitations

8.2.3.1 Sources

Data used in this assessment has been provided by one principal source. Shell provided specific environmental data for the FTSA to Fort McKay (as prepared by Golder Associates Limited 2009). This environmental data is based (in part) on information presented in the *Application for Approval of the Jackpine Mine Expansion and Pierre River Mine Project* (Shell 2007). Fort McKay has also used data and information directly from Shell's Jackpine Mine Expansion and Pierre River EIA and Application in this specific assessment.

8.2.3.2 Data Types

Biodiversity data have been presented and assessed in the *Application for Approval of the Jackpine Mine Expansion and Pierre River Mine Project* (Shell 2007).

At the local scale for the Application, Alberta Vegetation Inventory (AVI) data was used in preparation of the ecological land cover classification and mapping within the local study areas (LSAs). A total of 56 land cover classes were mapped in the LSAs for the 2007 Application including 29 upland ecosites phases, 18 wetland classes, four miscellaneous vegetation types, three non-vegetated types and two disturbances types.

Terrestrial vegetation and wetlands were also mapped for a Regional Study Area (RSA) in the 2007 Application. This ecological land cover mapping was developed using a combination of satellite imagery and GIS/remote sensing software. A total of thirteen land cover classes that belong to four broad groups were mapped in the RSA: terrestrial vegetation (six classes), wetlands (three classes), miscellaneous cover types (two classes) and disturbances (two classes).

The regional land cover classes, ecosite phases, wetland types and disturbed classes used to describe the FTSA and local areas have been ranked for high, moderate and low biodiversity potential using a method developed by Golder Associates Ltd (Golder). This method ranks these land cover units based on their contribution to the biodiversity of the study area. Ranking is based on combined indices that consider the contribution of five measurements of biological diversity. These five components include: rarity of vegetation type on the landscape, plant and wildlife rare species potential, plant and wildlife species richness, species overlap, and structural complexity (Shell 2007). A complete description of this biodiversity potential ranking system is provided in the *Biodiversity Environmental Setting for the Shell Canada Limited Jackpine Expansion and Pierre Rive Mine Project* (Golder 2007).

In addition to the original LSAs and RSA formats used and presented in the 2007 Application, biodiversity data analysis have been prepared by Shell for the FTSA at the request of Fort McKay for use in this specific assessment (Golder 2009).

Data Limitations

Cumulative and incremental impacts—lack of pre-development data for terrestrial resources (soils and vegetation) in the Fort McKay traditional territory for use in assessment of potential regional effects of industrial development has been a concern to Fort McKay. Fort McKay has noted that the cumulative assessments completed for oil sands project EIA's consider Baseline to be the date of initiation of a project (including current disturbances and approved projects) and not conditions in Fort McKay Traditional Territory prior to industrial development. The FTSA is intended to provide detailed ecological information for a block of land centered on the Community of Fort McKay and the proposed Projects. Mapping and data for this FTSA has been prepared in two formats: AVI based mapping, similar to that prepared for the Projects LSAs, and Landsat based mapping (using broad ecological land cover types) as per the RSA mapping. Preparation and use of detailed mapping

for some scenarios/cases in the FTSA has assisted with the assessment of the potential effects of these Projects on the Community.

Effects thresholds—there is a lack of regional criteria and/or thresholds for measuring the effects associated with development on key indicators such as total patch area or biodiversity potential. Regional criteria should be developed/ established by multi-stakeholder process. Clearing of land and disturbance of aquatic ecosystems is the most visible direct impact to biodiversity.

Modeling—the relationships between ecological lands cover class (regional or ecosites phases and wetlands types) and indicators such as biodiversity potential is often difficult to express. Assessing the potential effects of development on specific indicators often necessitates the use of models. The subsequent grouping of multiple parameters into classes based on potential (i.e., high, moderate and low potential) is generally required to spatially assess the impacts of development as it is difficult to assess numerous individual species. However, this process leads to the use of subjective decision- making in modeling the distribution of indicators such as biodiversity potential. For instance, should one indicator of biological diversity (i.e., rare vegetation type) be weighed greater than other parameter or measurements?

Significance interpretations—use of numeric scoring to rate factors such as magnitude, duration, geographic extent, reversibility, and frequency of effects and summing for overall score is subjective. These overall scores must then be assessed as low, moderate or high consequence and as significant or not significant. Lack of thresholds makes assessment of effects more difficult and subjective.

Lack of spatial data for Planned Development and Planned Development–closure cases — the lack of spatial data that reflect future scenarios as presented in Reclamation and Closure plans for areas beyond the LSA prevents spatial analysis of post closure scenarios for biodiversity landscape level indictors related to heterogeneity and fragmentation (i.e., mean/median patch size, number of patches, core area, edge).

Reclamation uncertainty—mitigation for effects to vegetation resources and biodiversity is provided through reclamation. Unless otherwise noted, the assessment of effects to biodiversity indicators in the Application Case-closure is based on Shell's assumption that reclamation will be successful in creating the ecosites and wetlands as documented in the C, C&R Plan (Shell, 2007) or in the Planned Development Case-closure using plans developed for all other existing and approved projects within the FTSA. Because upland sites can be created with reclamation the effects to upland sites are considered reversible. Shell's assumption of reversibility is also dependent on the ability of these sites to restore "equivalent capability". Historically, in the oils sands region, reclamation success for forested ecosystems as been narrowly defined as restoring equivalent forest productivity; measurements of success for other end land uses (wildlife, traditional use) are not presently defined. Assessment for many of the indictors assumes that mitigation/reclamation will restore equivalent ecosystems or vegetation

assemblages that can provided the full range of functions, values and structure (i.e., gene flow, nutrient cycling, biological productivity and diversity, habitat for rare plants or traditional plants, community structure and wildlife habitat). There is uncertainty with respect to the ability of reclamation to restore full functions and values including species diversity, total species richness or specific rare plant habitat at the ecosystem level. In addition, no technology is presently available to restore organic wetlands (muskeg; see ***Section 10 – Reclamation***). Therefore, the effects of disturbance to wetlands, especially peatlands, are considered irreversible.

The effects to some indicators are considered partially reversible in this assessment. For example, the effect of disturbance on certain biodiversity potential classes which contain a mixture of upland and wetland ecosystems, are considered as partially reversible because reclamation cannot mitigate for the loss of the wetland component.

Uncertainty also exists around the time that will be required to develop and restore equivalent structure or function on sites following reclamation activities. The timeline required to develop these attributes will vary greatly. Due to the life span of the Projects, reclamation, where effective, will not provide mitigation for disturbance of the land for a minimum of two to three generations of Fort McKay Community members.

While some of Shell's reclamation specific assumptions are used for this assessment, overall Fort McKay has many concerns about reclamation and these are discussed in detail in ***Section 10 – Reclamation***. While reclamation is necessary, Fort McKay does not consider it to be sufficient mitigation for losses to traditional resources and Fort McKay's opportunities to access those resources.

8.2.4 Biodiversity Study Area

Study areas used in the assessment of biodiversity are identical to those described for Vegetation in ***Section 7.3.4***. Study areas include a Forty Township Study Area (FTSA), which is analogous to a regional study area and the two local study areas for the Jackpine Mine Expansion and the Pierre River Mine.

8.2.5 Biodiversity Key Indicators and Receptors

Key indicators of the Community's ability to sustain its values, as identified in the CHA Baseline (Fort McKay IRC 2010a), include hunting, trapping, fishing, berry picking, visiting, raising of children, education, and work for Fort McKay. Stressors that affect the Community's ability to sustain key indicators include access to land, loss of land, and pollution.

Indicators that can be used to measure the effects of loss of land include area and percent of land disturbed; and abundance, distribution and quality of vegetation. Several of these indicators are directly related to the concept of biological diversity. The effects of loss/disturbance of land, including terrestrial, wetland and aquatic

areas, can be measured through indicators that estimate biodiversity potential and through measurement or analysis of landscape metrics such as heterogeneity and fragmentation.

Receptors include all species, ecosystems and landscape level assemblages of ecosystems present in Fort McKay's Traditional Lands. In this section, these receptors have been considered or assessed through the measurement of changes to biodiversity potential at the ecosystem level and to the abundance and composition of land cover classes in the landscape.

Changes at the individual species level have been discussed or assessed at the local level (LSA) in the *Environmental Assessment of the Jackpine Mine Expansion and Pierre Rive Mine Project* (Shell 2007) and in other sections of this specific assessment (e.g., ***Section 6 – Wildlife***). Species-level biodiversity assessments are generally not available for the regional study area or FTSA. At the ecosystem level, the change in the abundance of individual ecosite phases or wetland types has been discussed in the vegetation section (***Section 7 - Vegetation***). Biodiversity potential at the ecosystem level is addressed in this section.

Landscape level indicators, such as heterogeneity are assessed through the abundance and distribution of patches in the FTSA landscape. These patches can reflect specific habitat types, such as ecosite phases and wetland types, regional land cover types or broad categories such a terrestrial, wetland, disturbed, water, riparian or forest. Heterogeneity data have been presented and assessed for the Pre-Development Scenario, Base Case and Application Case since detailed spatial data (i.e., vegetation cover mapping) is available for the Projects. However, landscape level analysis for the Planned Development Case and Planned Development Case–closure are more general and only consider heterogeneity in terms of total patch area as a portion of the FTSA.

Heterogeneity and fragmentation are terms used to describe the arrangement of habitats (or habitat patches) within the landscape and the affects of change or disturbance on these habitats or patches. In this assessment, the term "patch" may be used to refer to specific habitat types (i.e., ecosite phases or wetland types) or to higher level classification units such as terrestrial forest, wetland or riparian area. Heterogeneity is used to depict the concept of habitat patch distribution and abundance within a given landscape. As the pattern of patches is reduced or simplified, the landscape becomes more homogeneous (McComb 1999). At the landscape level, fragmentation is the process in which a given area is divided into smaller and more geometrically complex and isolated pieces or fragments. Fragmentation may occur as a result of natural process or human activities. Fragmentation is strongly linked to loss of habitat associated with land clearing and development.

8.2.6 Biodiversity Assessment Criteria

Assessments of project effects on biodiversity for EIAs commonly consider criteria such as magnitude of disturbance, geographic extent, frequency of occurrence, duration of impacts, and whether an effect is reversible (i.e., it can be reversed through some type of mitigation). As discussed above, thresholds to measure the effects of development have not been established for the oil sands region. This Fort McKay Specific Assessment used the same criteria as were used to assess the impacts of the Project(s) in the Jackpine Mine Expansion and Pierre River Applications (Shell 2007; Table 8-2). However, some revisions were made to the rating and scoring system used for the duration and reversibility criteria to reflect Fort McKay's perspective on effects assessment. In this assessment, the FTSA has been substituted for the RSA.

As per the Shell Canada Limited (2007) EIA, the environmental significance (consequence) rating combines the results of the numerical score assigned to each of the impact criteria with the exception of direction, into one rating. Direction is measured as positive, negative or neutral and is not assigned a score. The rating for the component being assessed is then place in one of four categories that describe the environmental significance (consequence) as follows:

- ***Negligible***—0 to 5 (a **green** situation): generally associated with effects that are of negligible magnitude; or effects of low magnitude, local in extent and reversible.
- ***Low***—6 to 10 (a **green** situation): associated with effects of low magnitude that is reversible.
- ***Moderate***—11 to 15 (a **yellow** situation): associated with effects of moderate magnitude that are irreversible; or effects of low magnitude, that are local extent, irreversible and far future in duration; or effects of low magnitude, regional extent, irreversible, far future in duration.
- ***High***—>15 (a **red** situation); associated with effects of moderate magnitude, local in extent, far future in duration and irreversible; moderate magnitude, regional in extent, far future duration, irreversible and of medium frequency; high magnitude, local in extent, irreversible or partially reversible and long-term or far future in duration; high magnitude and regional in extent.

A high rating is considered to be significant (a red situation). The ratings of environmental consequence into green-yellow-red situation categories are specific to this Fort McKay assessment and were not used by Shell in their EIA.

Table 8-2: Criteria and Numerical Scores – Significance Assessment of Project Activities to Biodiversity

Criterion	Rating	Numerical Score	Description
Direction	Positive	Na	The ultimate long-term trend of the effect is positive
	Neutral	Na	The ultimate long-term trend of the effect is neutral
	Negative	Na	The ultimate long-term trend of the effect is adverse
Magnitude	Negligible	0	<1% change on the measurement end point
	Low	+5	<10% change in the measurement end point
	Moderate	+10	10 to 20% change in the measurement end point
	High	+15	>20% change in the measurement end point
Geographic Extent	Local	0	Effects restricted to the LSA
	Regional	+1	Effects extends beyond the LSA into the FTSA
	Beyond Regional	+2	Effects extended beyond the FTSA
Frequency	Low	0	Effect occurs only once
	Medium	+1	Effect occurs intermittently
	High	+2	Effect occurs continuously
Duration	Short-term	0	Effect is limited to <3 years
	Medium-term	+1	Effect occurs 3 to 10 years
	Long-term	+2	Effect extends 10-20 years
	Far future	+3	Effect extends for one to several generations beyond the life of the Project (>20 years)
Reversibility	Irreversible	+3	Effect is not reversible over time
	Reversible	-3	Effect is reversible over time
	Partially reversible	0	Effect is only partially reversible over time

Notes:
Direction: describes the ultimate long-term trend of the effect (positive, negative or neutral).
Magnitude: describes the intensity, or severity of an effect. Definitions of magnitude are unique to the characteristics of the measured parameter or variable.
Geographical Extent: The area within which an effect of a defined magnitude occurs.
Frequency: the number of times during a project or a specific project phase that an effect may occur.
Duration: considers the length of time over which an environmental impact occurs and affects the community of Fort McKay. It considers all phases of the Project(s) including construction, operations, reclamation and closure. It also considers the time for the environmental component to recover from the disturbance.
Reversibility: the likelihood that a measurable parameter will recover from an effect, including through active management techniques such as reclamation.

Source: adapted from the Introduction to EIA, Jackpine Mine Expansion and Pierre River Mine Project (Shell Canada Limited 2007).

8.2.7 Fort McKay's Healing the Earth Strategy

Fort McKay's Healing the Earth Strategy (HTES; Fort McKay IRC 2010b) has four strategies (***retain***, ***reclaim***, ***improve*** and ***offset***) that the Community supports with regard to addressing environmental issues. Mining results in the clearing of land and the alteration of the physical characteristics (i.e., parent material, soil type, drainage patterns and nutrient pathways) that create and support biological diversity on the landscape. Of the four tenants of the Healing the Earth Strategy, the biodiversity component relies heavily on reclamation to at least partially address the direct effects associated with the loss and disturbance of the "land" and its associated biological diversity. The community of Fort McKay has consistently stated that the goal of reclamation should be to restore disturbed land to as close as possible to its original condition. This includes "replacing a diversity of plants (including medicinal plants and berries) and re-creating wetlands, bogs and muskeg" (HTES, Fort McKay IRC 2010b).

The tenants of retention and offset are important strategies to accommodate for the effects of mining but will not address the need to restore species and/or ecosystems on disturbed lands. It is necessary to restore ecosystems on disturbed lands that provide for diverse landscape with a full range of uses and functions. Effects to biological diversity can also be reduced if the tenant to improve practices or technologies can provide ways to reduce the direct footprint of the mines (i.e., improved tailings management or reduce the size of end pit lakes) and other landscape disturbances (e.g., seismic).

8.3 Biodiversity Impact Assessment

8.3.1 Stressors on Biodiversity

The principal stressor that adversely affects biodiversity is land disturbance. This disturbance has the potential to affect genetic diversity, remove species and ecosystems and alter landscapes and their associated functions and values.

8.3.2 Fort McKay Baseline Conditions

8.3.2.1 Pre-Development Scenario

Species Level

Species level data for the FTSA in the Pre-Development Scenario is not presented in this assessment.

Ecosystem Level – Biodiversity Potential

Each of the ecological land cover classes used in the preparation of Landsat based mapping for the FTSA have been assigned to the high, moderate, low and very low

(non-ranked) biodiversity potential class. This regional ecological land cover classification includes six terrestrial forested classes, three wetland classes, water, as well as burn, cutblock and disturbance classes (Appendix 8-1, ***Table-1***; adapted from 5.3-5, Golder 2009). Biodiversity potential in the FTSA based on the regional land cover classification system is illustrated in Figure 8-1 (same as Figure 5.3-4, Golder 2009).

The four class ranking system differs from the three levels of biodiversity potential (i.e., high, moderate and low) used by Shell (2007) in the Project Application. In this assessment, the land cover classes that were not assigned a biodiversity score were separated from the low biodiversity potential class to form the very low class. These unranked classes include disturbances, cutblocks and burns.

The high ranked biodiversity potential area consists of two wetland classes. This high ranked class accounts for approximately 28% of the FTSA in the Pre-Development Scenario (Appendix 8-1, ***Table 2***; adapted from Table 5.3-4, Golder 2009). The majority of this high ranked land is covered by treed fens.

Lands rated with moderate biodiversity include one wetland class, three terrestrial forest classes and water. These five classes covered about 37% of the FTSA before industrial activity began. The treed bog/poor fen and the mixed aspen – white spruce classes cover slightly greater than 75% of the moderate potential class. Waterbodies covered about 7% of the land in Pre-Development Scenario.

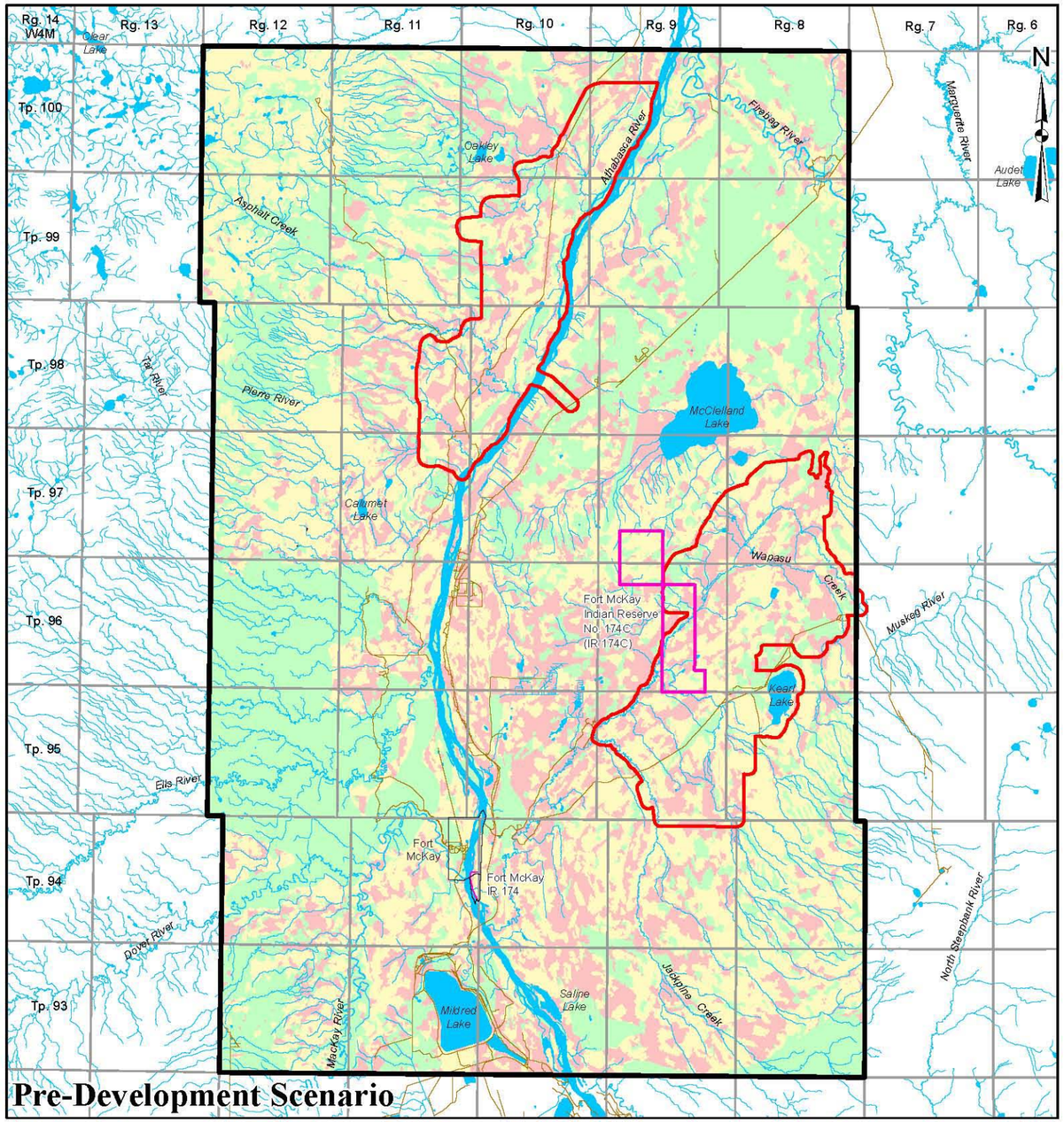
Three upland regional land clover classes are ranked with low biodiversity potential. The total area occupied by land cover classes with low potential covered about 24% of the FTSA at pre-development.

Three land cover classes are included in the very low (un-ranked) category; these include the burn, cutblock and disturbance/urban/industrial regional cover classes. Nearly all of the area ranked as low potential fell in the burn class at pre-development.

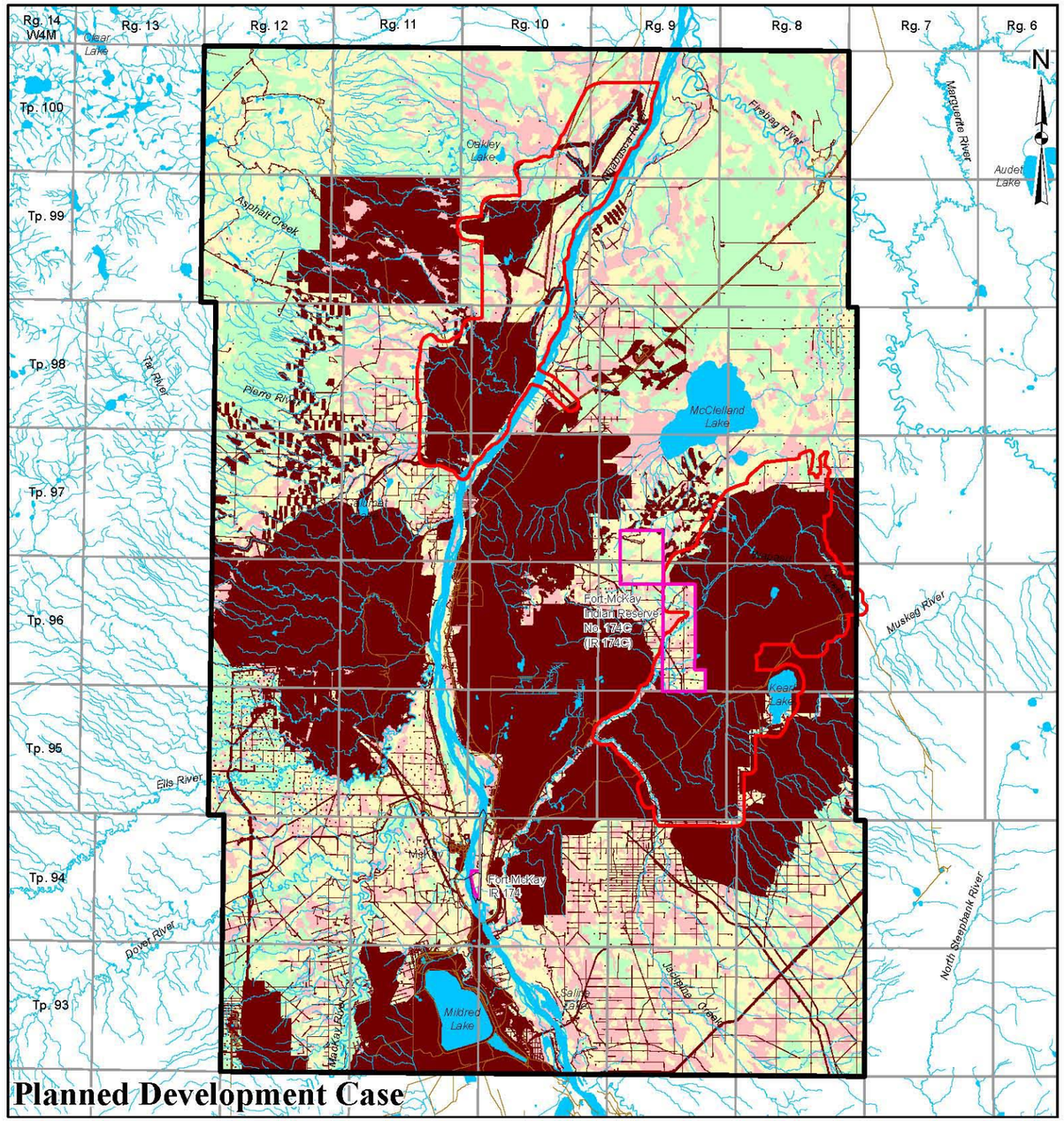
Landscape Level

As a whole, the FTSA contained a greater amount of wetlands (45%) than terrestrial (upland; 42%) cover in the Pre-Development Scenario (Appendix 8-1, ***Table 3***; adapted from Table 5.4-25, Golder 2007). Disturbed land, which consisted almost entirely of burns, and waterbodies accounted for 11% and 3%, respectively of the FTSA. A very small area (<1%) of the FTSA was not classified for pre-development since the Landsat image was covered by clouds.

Distribution of riparian areas and old growth can also be used as a patch type to measure landscape level effects. These class areas are discussed as an indicator in the vegetation section of this assessment (***Section 7 – Vegetation***).



Pre-Development Scenario



Planned Development Case

LEGEND

- FORT MCKAY 40 TOWNSHIP BLOCK
- TERRESTRIAL LOCAL STUDY AREA
- INDIAN RESERVE
- OPEN WATER
- PUBLIC ROADWAY

BIODIVERSITY POTENTIAL

- HIGH
- MODERATE
- LOW

DISTURBED

- DISTURBANCE AREA
- LINEAR DISTURBANCE

10 0 10

SCALE 1:400,000 KILOMETRES

REFERENCE

Alberta digital data obtained from AltaLIS Ltd. (September 2004), IHS Energy Ltd. (August 2006), used under license.
Projection: UTM Zone 12 Datum: NAD 83

PROJECT

JACKPINE MINE EXPANSION & PIERRE RIVER MINE PROJECT

TITLE

BIODIVERSITY POTENTIAL IN THE FORT MCKAY 40 TOWNSHIP BLOCK (LANDSAT)

PROJECT No. 08-1346-0006.5722			SCALE AS SHOWN	REV. 0
DESIGN	JG	15 Jan. 2009		
GIS	JH	09 Feb. 2009		
CHECK	MJ	27 Feb. 2009		
REVIEW	TC	02 Mar. 2009		

FIGURE 8-1

I:\CLIENTS\SHELL\08-1346-0006\mapping\mxd\5722\BiodiversityNRLCC_PreDev_vs_PDC_BioPot.mxd

Six terrestrial regional class covers were defined for the FTSA. Median patch size for the six terrestrial land cover classes ranged between 13.1 and 17.6 ha in the Pre-Development Scenario (Appendix 8-1, ***Table 4***; Table 5.4-12 in Golder 2009). The deciduous aspen – balsam polar class covered the greatest amount of area (48,444 ha) in 781 patches; the coniferous jack pine – black spruce cover class occupied 2,556 ha in 97 patches.

Mean patch size for the three regional wetland classes ranged from 9.2 to 20.4 ha (Appendix 8-1, ***Table 5***; Table 5.4-13 in Golder 2009). With a mean patch size of 9.2 ha, the non-treed wetland class covered approximately 38,387 ha at pre-development in 1,233 patches. The treed bog/poor fen and treed fen cover classes were similar in class area at 64,280 and 68,822 ha, respectively, and in median patch size, 20.4 ha and 17.4 ha, respectively. The water cover class occupied 9,852 ha over 219 patches in pre-development; the median size of these patches was 3.1 ha.

Statistics for two regional land cover classes were prepared for the FTSA; these include the burn and human disturbed classes. The human disturbance class includes both cutblocks and urban/industrial disturbances. The burn class covered 40,062 ha over 11 patches for a median size of 854.7 ha at pre-development (Appendix 8-1, ***Table 6***; 5.4-14, Golder 2009). Only two disturbances covering 2 ha were identified in the Pre-Disturbance Scenario.

8.3.2.2 Late 1990s Scenario

Ecosystem Level - Biodiversity Potential

The Late 1990s Scenario is based on the ranking of AVI (ecosite and wetlands) used for mapping vegetation in the two local study areas in the Jackpine Mine Expansion and Pierre River Mine Project (Shell 2007) and discussed in ***Section 7*** of this assessment. Distribution of the biodiversity potential classes in the Late 1990s Scenario is demonstrated in Figure 8-2 (Figure 5.3-1, Golder 2009).

Approximately 14% of the FTSA is ranked with high biodiversity potential in the Late 1990s Scenario (Appendix 8-1, ***Table 7***; adapted from Table 5.3-1, Golder 2009). Four wetland types are ranked as having high biodiversity potential; these include two fen types, one marsh (MONG) and the shrubby swamp type (SONS) (Appendix 8-1, ***Table 8***; adapted from Table 5.3-2, Golder 2009). No terrestrial ecosite phases are ranked as having high biodiversity potential. The wooded fen class (FTNN) accounts for the large majority (83%) of the area ranked with high biodiversity potential.

Moderate ranked lands cover about 16% of the FTSA in the Late 1990s Scenario. Land with moderate ranked biodiversity potential includes five wetland types, eight ecosites phases (upland forest), lakes and littoral area. The shrubby fen wetland type accounts for nearly one-half of the total moderate ranked area.

The majority (61%) of the FTSA is ranked as having low biodiversity potential in the Late 1990s Scenario. Low ranked classes include one natural wetland class (BTNN), 32 upland ecosites phases, which are mapped in the three natural subregions, plus miscellaneous classes such shrubland and river.

The very low ranked (unranked) group includes lands that have been burned, subject to recent forest harvesting (cutblocks) or are considered as disturbances. A total of 8% (31,223 ha) of the FTSA were ranked with very low biodiversity potential in the late-1990's. A total of 25,303 ha were considered as disturbed in the Late 1990s Scenario. The majority (81%) of this very low ranked area was occupied by the disturbance class. Disturbances covered approximately 7% of the FTSA in total in the Late 1990s Scenario.

Landscape Level

Landscape level analyses have not been completed for the FTSA using the AVI ecosite phase and wetland type mapping and data. As a result, statistics such as mean/median patch size, patch number, core area and edge are not available for the Late 1990s Scenario in the FTSA.

8.3.2.3 Base Case

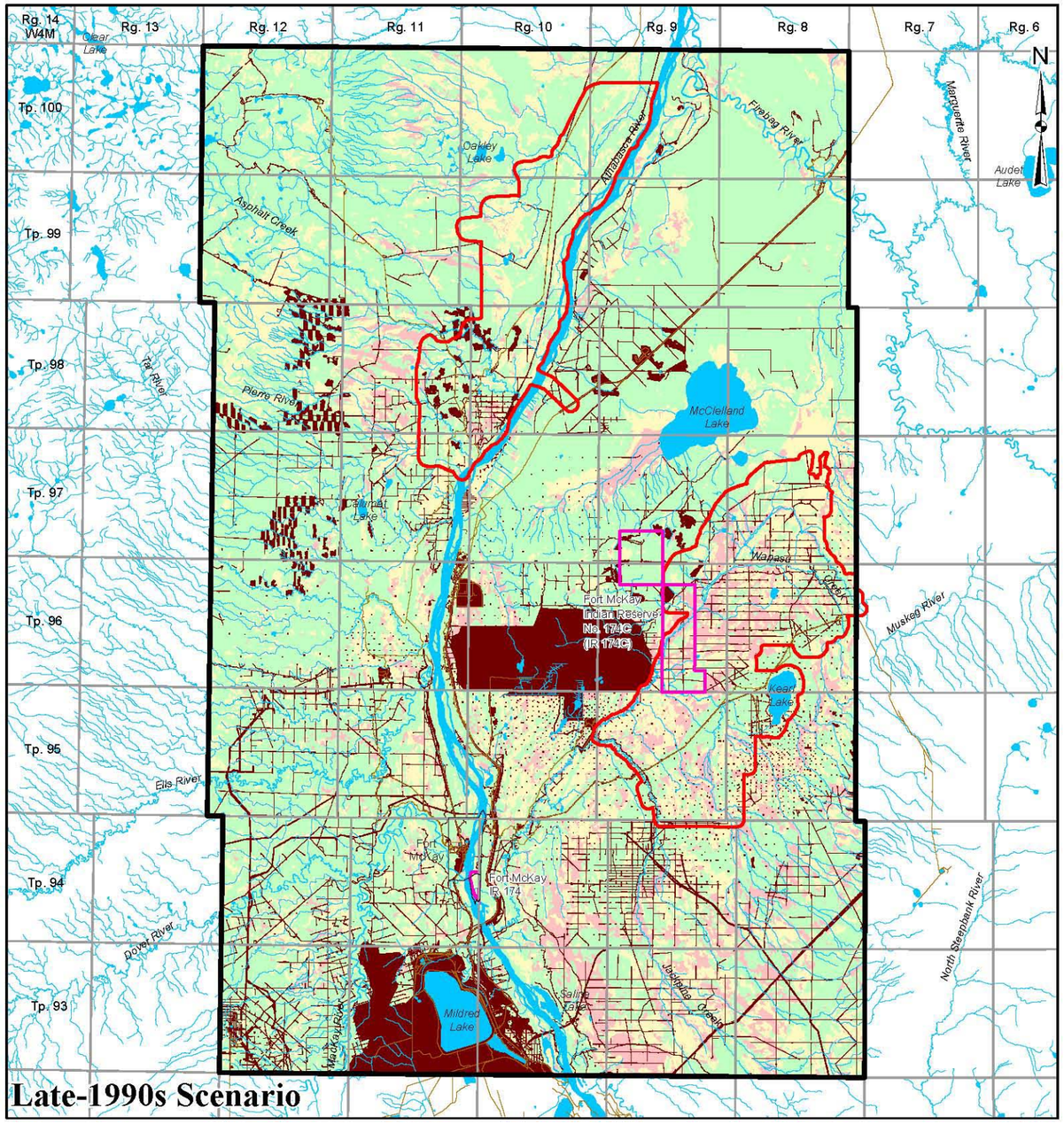
Ecosystem Level - Biodiversity Potential (Landsat)

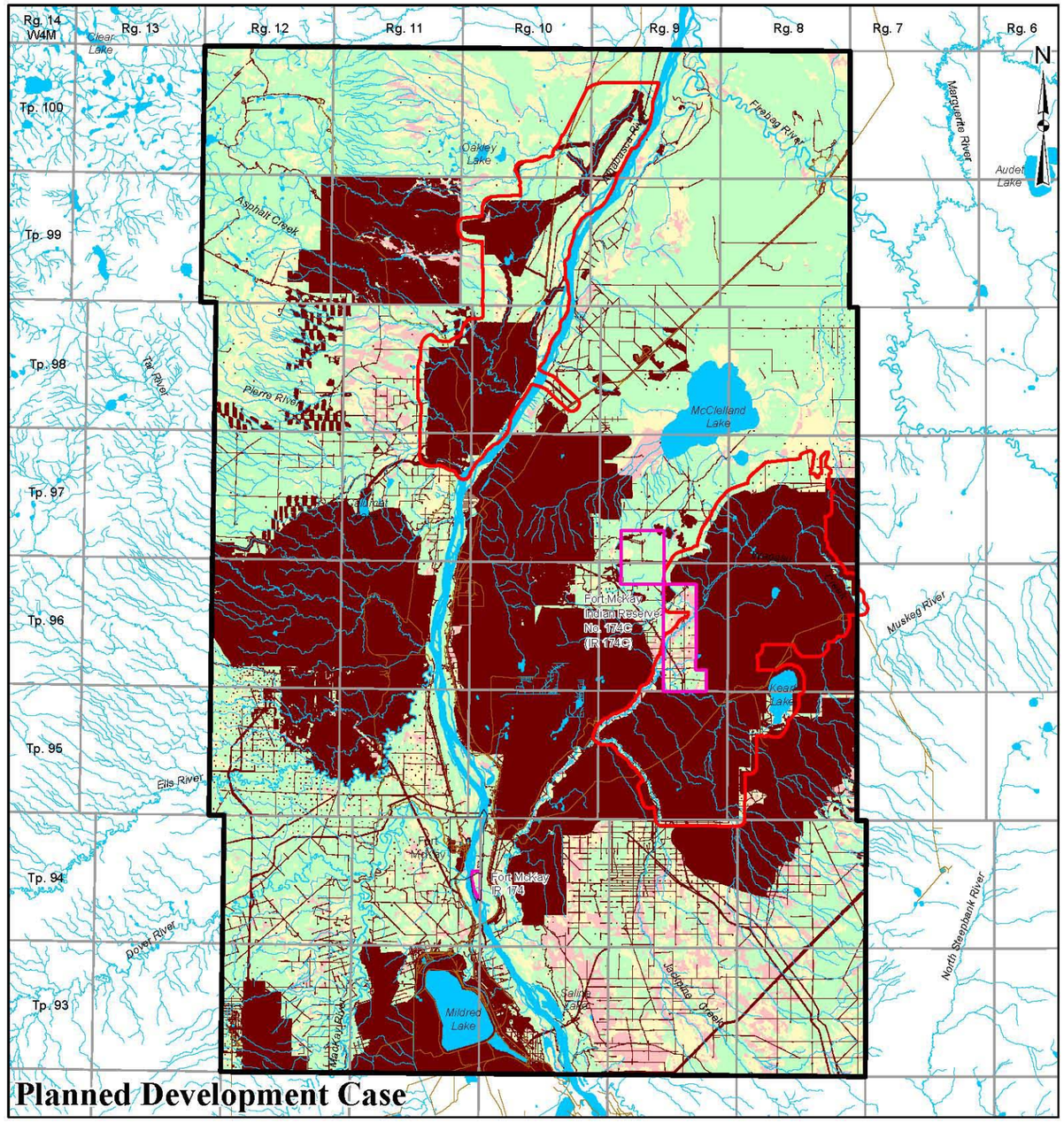
The area covered by regional cover classes having high biodiversity potential in the Base Case is 79,145 ha (Appendix 8-1, ***Table 2***) or 21% of the FTSA area. Lands ranked with high biodiversity potential have decreased in area by 26% between the Pre-Development Scenario and the Base Case.

The area occupied by regional cover classes with moderate biodiversity potential also decreased between the beginning of industrial development and the Base Case. Moderate ranked classes occupy about 113,642 ha or 30% of the FTSA in the Base Case. This represents a decrease of about 20% since pre-development.

The area occupied by regional land cover classes with low biodiversity potential decreased by 10% in the Base Case compared to Pre-Development Scenario conditions. These low ranked classes occupied 22% of the FTSA in the Base Case.

The area occupied by very low (unranked) regional land cover classes increased from 11% to 28% between the Pre-Development Scenario and the Base Case. This represents an increase of 162% in these very low ranked lands. Disturbances increased in size to 93,217 ha or 89% of the total of very low potential ranked lands in the Base Case.





LEGEND

- FORT MCKAY 40 TOWNSHIP BLOCK
- TERRESTRIAL LOCAL STUDY AREA
- INDIAN RESERVE
- OPEN WATER
- PUBLIC ROADWAY

BIODIVERSITY POTENTIAL

- HIGH
- MODERATE
- LOW

DISTURBED

- DISTURBANCE AREA
- LINEAR DISTURBANCE

10 0 10

SCALE 1:400,000 KILOMETRES

REFERENCE

Alberta digital data obtained from AltaLIS Ltd. (September 2004), IHS Energy Ltd. (August 2006), used under license.
Projection: UTM Zone 12 Datum: NAD 83

PROJECT

JACKPINE MINE EXPANSION &
PIERRE RIVER MINE PROJECT

TITLE

BIODIVERSITY POTENTIAL IN THE FORT MCKAY 40 TOWNSHIP BLOCK (AVI)

PROJECT No. 08-1346-0006.5722			SCALE AS SHOWN	REV. 0
DESIGN	JG	15 Jan. 2009		
GIS	JH	09 Feb. 2009		
CHECK	MJ	27 Feb. 2009		
REVIEW	TC	02 Mar. 2009		

FIGURE 8-2

I:\CLIENTS\SHELL\08-1346-0006\mapping\mxd\5722\BiodiversityAVI_l90s_vs_PDC_BioPot.mxd

Biodiversity Potential (AVI Data)

Based on the AVI data set, the area covered by ecosite phases and wetland types with high biodiversity potential is 38,568 ha or 10% of the FTSA in the Base Case (Appendix 8-1, *Table 7*). While the total area occupied by the high ranked classes differs from the Landsat based classification, the change since the Late 1990s Scenario represents a decrease of 27% in these high ranked areas.

The area covered by ecosite phases and wetland types with moderate biodiversity potential is approximately 49,423 ha, which represents about 13% of the FTSA. The area occupied by ecosite phases and wetland types with moderate potential has decreased by about 21% since the Late 1990s Scenario.

Land area occupied by ecosite phases, wetland types and other cover classes with low biodiversity potential is 51% (192,638 ha) of the FTSA in the Base Case. The total area occupied by cover types with low potential decreased by about 17% since the Late 1990s Scenario.

Land cover types with very low (unranked) biodiversity potential increased by 217% to 99,004 ha in the Base Case as compared to the Late 1990s Scenario; the large majority of the very low ranked area consists of the disturbance class.

Landscape Level (Landsat)

Terrestrial regional land cover classes occupy 37% of the FTSA in the Base Case. Terrestrial land cover class area has decreased by 12% in the FTSA since pre-development. Wetland regional cover classes have declined from 45% at the Pre-Development Scenario to 33% in the Base Case; the decrease in total wetland class area represents a loss of 26% of the resource between the Pre-Development Scenario and the Base Case. The area covered by water bodies declined from 3% of the FTSA at pre-development to 2% in the Base Case; this represents a decline of 7% of the resource over the time period. The disturbed-land cover class, which occupied 11% of the FTSA in pre-development, increased by 162% to cover 28% of the FTSA in the Base Case.

The area of each of the six terrestrial regional land cover classes decrease in the Base Case when compared to in the Pre-Development Scenario. As a result of development and fragmentation during this period the number of patches present in the FTSA has increased for each of the land cover classes while the median patch size decreased in area (Appendix 8-1, *Table 4*). Decreases in median patch size vary from 58% to 80% when compared to pre-development. For instance, the number of patches of the most abundant class, deciduous aspen - balsam poplar in the Pre-Development Scenario, has increased by 2.5 times (154%) in the Base Case while the median patch size has decreased by 80% from 13.1 to 2.6 ha. The area of each of the three regional wetland land cover classes also decreased in the Base Case.

The number of patches for each of the three wetland classes in the FTSA landscape increased substantially in the Base Case while the median size of the patches decreased (Appendix 8-1, *Table 5*). For example, the number of treed fen patches increased from 1,116 in the FTSA at pre-development to 2,990 at Base Case, while the median patch size decreased by 81% from 17.4 to 3.3 ha. During the period between the Pre-Development Scenario and the Base Case, the number of human caused disturbances has increased from 2 to 1,857 while the area has increased from 2 to 100,978 ha. The median size of human disturbances in the Base Case is 0.3 ha.

8.3.3 Impacts to Biodiversity

8.3.3.1 Application Case

Ecosystem Level - Biodiversity Potential (AVI)

Land area occupied by wetland types with very high biodiversity potential will decrease by 14% (5,417 ha) as a result of the Projects in the FTSA (Appendix 8-1, *Table 7*). Losses will occur in three of the four wetland types however the largest decrease is expected in the wooded fen type (FTNN; Appendix 8-1, *Table 8*). No upland ecosite phases have been rated with high biodiversity potential. Biodiversity potential in the Application Case has also been compared to the conditions that existed in the FTSA during the late 1990s . Wetland types with high biodiversity potential will decrease by 38% (19,942 ha) in the Application Case when compared to the Late 1990s Scenario. These losses will continue through closure and will not be mitigated since these wetland types will not be replaced through reclamation. However, changes at Application Case–closure compared to the Late 1990s are not discussed since this closure scenario only addresses reclamation associated with the Projects and not with other developments that have occurred over the time period. A discussion of the net changes (all existing and planned projects) at closure compared to pre-development is presented below in Section 8.3.3.2.

The area covered by ecosite phases and wetland types with moderate biodiversity potential will decrease by about 11% (5,485 ha) in the Application Case when compared to the Base Case. Losses occur in 10 of the 12 cover types that are present in the FTSA in the Base Case. An increase (8%) in the area occupied by land cover units with moderate biodiversity will occur in the Application Case closure. At closure, the area occupied by seven of the ecosites phases and wetland types with moderate potential will decrease, changes will be neutral for two cover units, and increases in area will occur for six of the cover types. It should be noted that the increase in moderate ranked land occurs largely due to the creation of lakes and littoral zones associated with end pit lakes and not with re-establishment of all units included in the moderate class.

Land with moderate biodiversity potential will decrease by 30% (18,582 ha) in the Application Case when compared to conditions in the Late 1990s Scenario.

Following closure, the area of moderate ranked sites will be 15% less than present in the Late 1990s Scenario.

The area covered by ecosite phases, wetland types and other classes with low biodiversity potential will decrease by 4% (8,499 ha) in the Application Case as compared to the Base Case. This loss is spread across 24 of 35 cover types present in the Base Case. An increase (7%) in the area of low biodiversity potential sites will occur in the Application Case at closure Fort McKay considers this change as an adverse effect since high and moderate ranked lands are replaced with low ranked areas. At net decrease will occur for several individual ecosite phase and wetland types however this is offset by the substantial increase that occurs for five cover types (i.e., c, d and g ecosites and reclaimed shrubland).

In the FTSA, ecosite phase and wetland types with low potential will decrease by 21% (48,662 ha) in the Application Case when compared to the late 1990s. A net loss of 12% of land with low biodiversity potential occurs when the Application Case closure is compared to the late 1990s conditions.

Land cover types with very low (unranked) biodiversity potential increase by about 20% (19,404 ha) as a result of the Application when compared to the Base Case. The area covered by some unranked classes (i.e., burned wetlands and uplands, cutblocks) will decline while the area covered by disturbances increases based on the footprint of the Project. At closure, a net decrease of 12% of the area of very low ranked lands will occur in comparison to the Base Case; this change is considered positive since very low ranked disturbed lands are reclaimed with low and moderate ranked land cover types. The area of the land ranked as very low biodiversity potential is directly related (inversely proportional) to changes in disturbance land cover classes; the area of very low ranked land increases as natural land cover classes with high to low potential are disturbed during the operations phase and decreases at closure as disturbed lands are reclaimed.

When compared to the Late 1990s Scenario, the amount of land found in the very low class will have increased in the Application Case by about 279% (87,185 ha). The area of land ranked with very low potential will be reduced following closure of the Application Case but the area of very low ranked land will still be greater (180%) than was present in the Late 1990s Scenario.

Statement of Significance (Application versus Base Case)

- The decrease (14%) in land with high biodiversity potential represents a negative in direction, moderate magnitude, local, far future, partially reversible (since some non-peatland wetlands can be replaced) and low frequency effect (10+0+3-0+0=13) which is scored as an adverse effect of moderate environmental consequence (a **yellow** situation) when compared to the Base Case. The loss remains similar at closure and is also scored as a moderate environmental consequence.

- The decrease (11%) in land with moderate biodiversity potential represents a negative in direction, moderate magnitude, local, far future, reversible and low frequency effect (10+0+3-3+0=10) that is scored as an adverse effect of low environmental consequence (a **green** situation) when compared to the Base Case. The increase (8%) that occurs at closure represents a positive, low magnitude, local, far future, reversible, and low frequency effect (5+0+3-3+0=5) of negligible environmental consequence.
- The decrease in land with low biodiversity potential that occurs in the Application Case represents a negative, low magnitude (4%), local, far future, reversible and low frequency effect (5+0+3-3+0=5) of negligible environmental consequence (a **green** situation).
- The increase in land with low biodiversity potential that occurs in the Application Case at closure is a positive in direction, low magnitude (7%), local, far future, reversible and low frequency effect (5+0+3-3+0=5) of negligible environmental significance (a **green** situation).
- The increase in land with very low biodiversity potential in the Application Case is considered as a negative, moderate magnitude (20%), local, far future, reversible and low frequency (10+0+3-3+0=10) adverse effect of low environmental consequence (an **green** situation) when compared to the Base Case. Note: the effect is nearly of high magnitude, which would result in moderate consequence (a **yellow** situation). The decrease in very low potential land that will occur in the Application Case closure is a moderate magnitude (12%), local, reversible, far future, and low frequency positive effect (10+0+3-3+0=10) of low environmental consequence.

Statement of Significance (Application Case versus Late 1990s Scenario)

- The decrease in land with high biodiversity potential since the late 1990s represents a high magnitude (38%), regional, far future, partially reversible and medium frequency adverse effect (15+1+3-0+1=20) of high significance (a **red** situation). This loss is expected to remain similar at closure since reclamation cannot replace the most common wetland types that have high biodiversity potential.
- The decrease in land with moderate biodiversity potential that will occur in the Application Case as compared to the Late 1990s Scenario is considered as a negative, high magnitude (30%), regional, far future, reversible, and moderate frequency adverse effect (15+1+3-3+1=17) of high environmental significance (a **red** situation).
- The decrease in land area with low biodiversity potential that will occur in the Application Case as compared to the Late 1990s Scenario represents a negative, high magnitude (21%), regional, far future, reversible, and moderate frequency adverse effect of high environmental significance (a **red** situation).

- The increase in land with very low biodiversity potential that will occur in the Application Case when compared to the Late 1990s Scenario is a high magnitude (279%), regional, far future, reversible, and moderate frequency adverse effect (15+1+3-3+1=20) of high environmental significance (a **red** situation).

Landscape Level

Shell (2007) identified five patch types (i.e., wetland types or ecosite phases) that were present in the LSA in the Base Case that will be removed due to the Project and not replaced during closure. These include: shrubby bogs (BONS; 1 ha), wooded permafrost bogs with collapse scars (BTXC; 89 ha), forested fens (FFNN; 2 ha), patterned fens (FTPN; 415 ha) and jack pine-tamarack complexes (14 ha). The total area of the five patch types that will be permanently lost in the LSA is about 521 ha.

Approximately 3,458 ha of new shrubland land cover types, covering 7% of the LSA, are to be created at closure. Landscape level biodiversity (ecosystem richness) will be reduced in the LSA at closure as a result of the Project.

The Projects will not result in the total loss of any patch type, as used in the AVI classification, within the FTSA (see Vegetation Section, Appendix 7-1, ***Table 6***). The change in patch area that occurs for the individual patch types in the FTSA at closure is highly variable. Loss in patch area occurs for fifteen patch types and ranges from <1 to 20%. A net increase in patch area occurs for twelve ecosite phases; these increases range between 2.8 to 663% at closure. A net loss in patch area occurs for 11 of the 12 wetland types mapped in the FTSA. These losses range from about 3% to 15% of the area present in the Base Case. Losses are greatest for the shrubby fen (FONS) and wooded fen (FTNN) types. The area covered by burns in the FTSA is predicted to be much less in the FTSA at closure, while the miscellaneous cover class such as shrubland will increase by 182%. The area occupied by the lake class will be 128% greater at closure.

Terrestrial regional land cover classes will occupy about 35% of the FTSA in the Application Case and 41% at closure (Appendix 8-1, ***Table 3***). Approximately 3% (4,467 ha) of the terrestrial cover classes will be disturbed by the Project (Appendix 8-1, ***Table 9***; adapted from Table 5.4-25, Golder 2009). The Project (Application Case-closure) will result in a net increase of the terrestrial cover class by 12% (16,781 ha) compared to the Base Case. Terrestrial land cover will be 15% less in the Application Case and 2% less in the Application Case-closure when compared to the Pre-Development Scenario. The regional wetland cover class will occupy about 29% of the FTSA in the Application Case and 30% at Application Case-closure. Total wetland cover in the Pre-Development Scenario was about 45% of the FTSA. The Project (Application Case) will result in the net loss of about 12% (14,828 ha) of the total wetland area present in the Base Case. Wetland cover will be 35% less in the Application Case as compared to the Pre-Development Scenario. At Application Case-closure, total wetland area will decrease by 10% when compared to the Base Case and by 33% as compared to pre-development. The area occupied

by the water class will decrease by approximately 1% in the Application Case. However, at Application Case-closure, the area occupied by water will increase by about 75% (6,866 ha) due to the creation of end pit lakes as compared to the Base Case. The total area classified as disturbed has increased by about 2105 in the Application Case as compared to pre-development conditions. The disturbed class, as a result of the Project, will increase by about 18% (19,369 ha) as compared to the Base Case. In the Application Case-closure, the area of disturbed land will decrease by about 11% as disturbed areas are reclaimed.

The Project will result in a more homogeneous landscape in the FTSA due to the net increase in terrestrial and water land cover classes and net decrease in loss of wetland class area. In general, larger patches of certain terrestrial upland types are expected in the reclaimed landscape. However, natural wetlands are expected to be less abundant and of smaller patch size due to fragmentation of the landscape and subsequent increase in terrestrial area at closure.

The effects of the Projects to the landscape heterogeneity are assessed based on changes to cover class area in each of the scenario/cases for the FTSA. The patch type with the greatest decrease in class area, typically the wetland patch, is used to assess significance.

Statement of Significance

- The decreases (3% and 12%) in the terrestrial and wetland land cover classes, respectively in the Application Case and associated increase (18%) in disturbed area represent a moderate magnitude, local, far future, partially reversible and low frequency adverse effect (10+0+3-0+0=13) of moderate significance (a **yellow** situation) when compared to the Base Case.
- At Application Case-closure, the net increase in the terrestrial class (12%) and decrease (10%) in the area of the wetland class and the subsequent decrease (11%) in disturbed class also represent a moderate magnitude, local, far future, partially reversible, and low frequency adverse effect (10+0+3-0+0=13) of moderate significance (a **yellow** situation).
- When compared to the Late 1990s Scenario the Application Case results in a net decrease (15 and 35%) in terrestrial and wetland area, respectively. This is a high magnitude, regional, far future, partially reversible, and moderate frequency adverse effect (15+1+3-0+1=20) of high significance (a **red** situation).
- A net decrease of 2% and 33% occurs in terrestrial and wetland cover, respectively in the comparison of Application Case-closure to the Pre-Development Scenario. This is a high magnitude, regional, far future, partially reversible, and moderate frequency adverse effect (15+1+3-0+1=20) of high significance (a **red** situation).

8.3.3.2 Planned Development Case

Ecosystem Level – Biodiversity Potential (Landsat)

The PDC considers the proposed Projects plus existing, approved and planned developments within the assessment area.

Wetland types with high biodiversity potential are expected to cover about 66,879 ha in the PDC. This represents a decrease of 15% in the cover of these high biodiversity potential sites when compared to the Base Case (Appendix 8-1, ***Table 1***). A net loss of 38% (40,334 ha) of wetlands with high biodiversity potential is observed when the PDC is compared to pre-development conditions.

In the PDC - closure, the amount of land occupied by the high potential wetland types is expected to increase by 9% over the Base Case. Within the high biodiversity potential class, the area occupied by treed fens is expected to decline, while the area of the non-treed wetland type is predicted to significantly increase following closure and reclamation. However, it should be noted that most of the non-treed wetlands present in the FTSA prior to disturbance contain peat substrates while those in the reclaimed landscape are most likely to be non-peatland (i.e., equivalent to the marsh or shrub wetlands). While the structure of these non-treed wetlands may be similar at closure, species composition and abundance may differ significantly between the pre-development non-treed fens and the reclaimed wetlands. As a result, the ecological functions and values provided by these reclaimed wetlands may also differ greatly from those present in the pre-development landscape. When the PDC - closure is compared to pre-development conditions a net loss of 19% of the high biodiversity potential sites is predicted. If the reclamation of non-treed wetlands does not successfully restore equivalent biodiversity potential as predicted by Shell (2007) the loss of high biodiversity sites will be much greater in area and carry more significance.

Lands with moderate biodiversity potential will decrease by 14% (15,919 ha) when compared to the Base Case and by 31% (43,654 ha) when compared to the Pre-Development Scenario. Decreases of greater than 25% occur in three of the five regional land cover classes rated with moderate potential.

The amount of land ranked with moderate biodiversity potential is predicted to increase by 40% (45,975 ha) in the PDC - closure when compared to the Base Case. The area of the three terrestrial (forested) regional land cover classes is expected to increase substantially in the closure landscape along with the water class while the area occupied by the treed bog/poor fen class (i.e., a peatland) is expected to decrease. A 13% (18,240 ha) increase in the area of moderate ranked lands is predicted in the PDC - closure when compared to the Pre-Development Scenario conditions. As in the comparison to the Base Case, substantial increases occur in the terrestrial and water classes while a significant loss of the wetland land cover class occurs.

Lands with low biodiversity potential will decrease by 13% (10,601 ha) in the PDC when compared to the Base Case. A decrease of 21% of low ranked lands occurs when the PDC is compared to the Pre-Development Scenario. Losses will occur in all three terrestrial (forested) land cover classes.

In the PDC-closure, the area of land occupied by land cover classes with low biodiversity potential will increase by 46% (37,771 ha) over the Base Case. The area of low ranked lands will increase by 32% (28,909 ha) when compared to pre-development. These increases occur as units with high and moderate biodiversity potential are replaced with low ranked units in the closure landscape.

Fort McKay would consider replacement of low ranked land cover classes with low ranked lands as a neutral effect, but considers the increase in low ranked lands at the expense of the high and moderate ranked areas as an adverse effect.

The area occupied by the very low biodiversity class will increase by a further 37% (38,787 ha) in the PDC when compared to the Base Case and by 258% (103,520 ha) when compared to the Pre-Development Scenario. These increases occur due to the clearing of land for the Project and other planned developments. The area occupied by the very low ranked class will decrease in the PDC - closure scenario as industrial lands are reclaimed. A decrease of 87% (91,059 ha) will occur between PDC - closure and the Base Case. The area occupied by very low ranked lands in the PDC - closure scenario will be 66% (26,326 ha) less than present at pre-development as the area covered by the burn class is converted to other classes.

Statement of Significance

- The decrease (15%) in land with high biodiversity potential in the PDC represents a negative, moderate magnitude, regional, far future, partially reversible, and moderate frequency adverse effect (10+1+3-0+1=15) of moderate environmental consequence (a **yellow** situation) compared to the Base Case. The decrease in area of lands with high potential biodiversity that will occur in the PDC compared to the Pre-Development Scenario is a negative, high magnitude (38%), regional, far future partially reversible, moderate frequency adverse effect (15+1+3-0+1) of high environmental significance (a **red** situation).

- The increase in the area of lands with high biodiversity potential in the PDC-closure when compared to the Base Case is a low magnitude (9%), regional, far future, partially reversible, and moderate frequency effect (5+1+3-0+1=10) of low significance. The loss of high potential lands that occurs in the PDC-closure when compared to the Pre-Development Scenario is a negative, moderate magnitude (19%), regional, far future, partially reversible, moderate frequency adverse effect (10+1+3-0+1=15) of moderate environmental significance (a **yellow** situation). It should be noted that the magnitude is very close to the high category, which would result in a high significance rating (a **red** situation). The results will be adverse and highly significant if reclamation is not successful in

restoring equivalent biodiversity potential in a relatively small portion of the 14,233 ha non-treed wetlands to be reclaimed in the PDC-closure scenario.

- The decrease in lands with moderate biodiversity potential in the PDC is a negative, moderate magnitude (14%), regional, far future, reversible, and moderate frequency adverse effect (10+1+3-3+1=12) of moderate environmental consequence (a **yellow** situation) when compared to the Base Case. The decrease in moderate ranked lands in the PDC-closure when compared to the Pre-Development Scenario is a negative, high magnitude (31%), regional, far future, reversible, and moderate frequency adverse effect (15+1+3-3+1=20) of high environmental significance (a **red** situation).
- When compared to the Base Case, the increase in lands with moderate biodiversity potential in the PDC-closure is a positive, high magnitude (40%), regional, far future, reversible, and moderate frequency effect (15+1+3-3+1=17) of high environmental significance. The increase in moderate ranked lands at PDC-closure when compared to pre-development is a positive, moderate magnitude (13%), regional, far future, reversible, and moderate frequency effect (10+1+3-3+1=12) of moderate environmental consequence.
- The decrease in lands with low biodiversity potential that will occur in the PDC, when compared to the Base Case, is a negative, moderate magnitude (13%), regional, far future, reversible and moderate frequency adverse effect (10+1+3-3+1=12) of moderate environmental consequence (a **yellow** situation). The decrease of low ranked lands that will occur in the PDC compared to pre-development is a negative, high magnitude (21%), regional, far future, reversible, and moderate frequency adverse effect (15+1+3-3+1=17) of high environmental significance (a **red** situation).
- When compared to the Base Case, the increase in lands with low biodiversity potential in the PDC-closure is a high magnitude (46%), regional, far future, reversible, and moderate frequency adverse effect (15+1+3-3+1=17) of high environmental consequence (a **red** situation). The increase in low ranked land in the PDC-closure when compared to the Pre-Development Scenario is a positive, high magnitude (32%), regional, far future, reversible and moderate frequency adverse (15+1+3-3+1=17) of high environmental significance (a **red** situation). The positive increase in low ranked lands should be viewed as adverse since cover classes of moderate and high biodiversity potential are being replaced with a lower ranked class.

Landscape Level

Terrestrial land cover classes will occupy about 31% of the FTSA in the Planned Development Case (Appendix 8-1, ***Table 9***). In the PDC, terrestrial land cover will have declined by 14% (19,917 ha) when compared to the Base Case and by 25% when compared to pre-development conditions. In the PDC-closure scenario, the

terrestrial class is expected to cover 57% of the FTSA. The areas of terrestrial land cover will increase by 55% following closure of all projects when compared to the Base Case and by 36% when compared to the Pre-Development Scenario.

At the regional mapping scale, the wetland class will cover approximately 28% of the FTSA in the Planned Development Case (Appendix 8-1, ***Table 9***). All existing projects and other planned developments (PDC) will result in the net loss of 15% and 37% of the wetland area when compared to the Base Case and Pre-Development Scenario, respectively. The wetland class will occupy 34% of the FTSA landscape in the PDC-closure. Based on the data available, the total area of the wetland class in the PDC-closure will be equivalent (i.e., net increase of 1%) to the Base Case following reclamation. A discussion of this outcome is provided in the vegetation section (***Section 7***). The net area of wetlands in the FTSA is expected to decrease by 25% in the PDC-closure when compared to the pre-development landscape.

The water land cover class will occupy about 2% of the FTSA in the PDC, which is approximately equivalent to the Base Case. The area of water in the PDC is about 8% less than found in the Base Case. The area of water bodies in the FTSA will increase substantially in the landscape of the FTSA following completion and closure of all projects due to the creation of end pit lakes. In the PDC-closure, the water class is expected to occupy about 6% (23,619 ha) of the FTSA. This increase in the area of water bodies represents a net increase of 158% and 140% when compared to the Base Case and Pre-Development Scenario.

The area of the disturbed class will increase to 38% of the FTSA in the PDC. The net increase in disturbed land will be 37% (38,787 ha) and 258% (103,520 ha) when compared to the Base Case and Pre-Development Scenario, respectively. The area occupied by the disturbed class will decrease as projects are closed and reclamation is completed. The area occupied by the disturbed class will decrease by 87% in the PDC-closure as compared to the Base Case and by 66% when compared to the Pre-Development Scenario. It should be noted that the large majority of the disturbed class consisted of burns; the disturbed land at closure will consist of a mixture of anthropogenic disturbances, cutblocks and burns.

The above discussion indicates that the Project is expected to change landscape heterogeneity in the FTSA. The landscape will become more homogeneous as the area of the terrestrial class increases while a net decrease in wetland class occurs. An analysis of the regional and local AVI data, as provided in the vegetation section (***Section 7***), indicates that the area occupied by terrestrial land cover classes will increase. All of the terrestrial regional land cover classes will increase in the PDC-closure landscape.

Statement of Significance

- In the PDC, the net decrease of 14% in the terrestrial class and 15% in the wetland class when compared to the Base Case results in a moderate magnitude,

regional, far future, partially reversible, moderate frequency adverse effect (10+1+3-0+1=15) of moderate significance (a **yellow** situation).

- In PDC-closure, a net increase (55% and 1%) occurs in the terrestrial and wetland class respectively when compared to the Base Case. This represents a high magnitude, regional, far future, partially reversible, and low frequency adverse effect (15+1+3-0+1=20) of high significance (a **red** situation).
- When compared to the Pre-Development Scenario the Planned Development Case will result in a net loss of terrestrial (25%) and wetland (37%) classes in the landscape. This change represents a high magnitude, regional, far future, partially reversible, and moderate frequency adverse effect (15+1+3-0+1=20) of high significance (a **red** situation).
- The cover of the terrestrial class will increase by 36% while the cover of the wetland class will decrease by 26% in the PDC-closure compared to the Pre-Development Scenario. This change represents a high magnitude, regional, far future, partially reversible, and moderate frequency effect (15+1+3-0+1=20) of high significance (a **red** situation).

8.4 Conclusions

A summary of the environmental consequences of the Projects (Application) as well as the Planned Development Case on biodiversity is provided in Table 8-3.

Land ranked with high biodiversity declines in the FTSA as a result of the Projects. Effects of moderate magnitude and consequence are observed in both the Application Case and Application Case-closure. A significant adverse effect is demonstrated when the cumulative changes of clearing in the Application Case is compared to the Late 1990s Scenario. The net loss of land with high biodiversity potential in the PDC is a moderate consequence in comparison to the Base Case, however the loss to high ranked land in the PDC compared to the Pre-Development Scenario is significant and adverse. Some disturbed area is expected to be reclaimed to land with high biodiversity potential following reclamation and closure. As a result, the net decrease and consequence in the PDC-closure when compared to the Base Case is low. The consequence to high ranked land is moderate for the loss that occurs from the Pre-Development Scenario to PDC-closure. The magnitude of loss is very near to creating an adverse effect for this indicator.

It should also be noted that the low and moderate consequences in the PDC-closure are dependent on reclamation restoring biodiversity values comparable to pre-disturbance conditions. Although Shell (2007) has high confidence in the biodiversity rankings assigned to each ecosite phase, wetland type or regional land cover type there is only low to moderate confidence in the reclamation of these vegetation types at closure. Since a very large portion of the high ranked land consists of peat-based wetlands that cannot be effectively reclaimed and that biodiversity ranking is dependent on the return of multiple biological characteristics

Table 8-3: Summary of Effects to Biodiversity

Indicator	Application Case to Base Case		Application Case - Closure to Base Case		Application Case to Late 1990s Scenario		PDC to Base Case		PDC to Pre-Development Scenario		PDC-Closure to Base Case		PDC-Closure to Pre-Development Scenario	
	% Change	Consequence	% Change	Consequence	% Change	Consequence	% Change	Consequence	% Change	Consequence	% Change	Consequence	% Change	Consequence
Ecosystem Level														
High Biodiversity Potential	-14	moderate	-14	Moderate	-38	high	-15	moderate	-38	high	-9	low	-19	moderate
Moderate Biodiversity Potential	-11	low	+8[c]	Negligible	-30	high	-14	moderate	-31	high	+40	high	+13	moderate
Low Biodiversity Potential	-4	negligible	+7	Negligible	-21	high	-13	moderate	-21	high	+46	high	+32	high
Very Low Biodiversity Potential [a]	+20	low (adverse)	-12	low (positive)	+279	high (adverse)	+37	high	+258	high	-87	high (positive)	-66	high (positive)
Landscape Level														
Heterogeneity	-3/-12[b]	moderate	+12/-10	moderate	-15/-35	high	-14/-15	moderate	+55/+1	high	-25/-37	high	+36/-26	high

[a] The very low class includes disturbances, cutblocks and burned areas; the area of this class increases during construction and operation phases (as high, moderate and low ranked areas are developed) and decreases following closure as disturbed areas are reclaimed.

[b] The numbers in the % change column for the heterogeneity indicator represent the % change to the terrestrial and wetland classes, respectively.

[c] Consequences with a positive direction have not been color coded in this table but are included for the sake of completeness unless they are considered as adverse. While an increase in the area occupied by an indicator may result in a positive change based on Shell's assumptions regarding mitigation / reclamation at closure, the rating does not consider the potential uncertainties associated with reclamation. While upland sites can be reclaimed, the ability of these sites to restore equivalent capability for Fort McKay traditional use (*Section 10*) or other values (such as biodiversity potential) has not been proven.

(i.e., based on the evaluation of five indices including rare vegetation type, total species richness, rare species potential, species overlap and structural complexity), Fort McKay has low confidence that reclaimed wetlands will restore high biodiversity values, equivalent to pre-disturbance conditions, across many tens of thousands of hectares of the landscape for many generations (see ***Section 10 – Reclamation***). A more conservative approach, especially in the ranking of biodiversity potential associated with wetlands, may result in finding adverse and significant effects to biodiversity potential for several generations. The assessment found that the effect to lands with moderate biodiversity potential is low and negligible in the Application Case and Application Case-closure compared to the Base Case. The loss of moderate ranked land is adverse and significant in the Application Case when compared to the Late 1990s Scenario. The decrease in moderate ranked lands in the PDC results in a low consequence effect. However, a significant adverse effect is associated with the cumulative losses of moderate ranked lands in the PDC compared to the Pre-Development. A net increase in the area of land with moderate biodiversity potential that occurs in the PDC-closure compared to the Base Case is a positive, significant effect. A positive increase of moderate consequence is observed in the PDC-closure when compared to the Pre-Development Scenario. Increases in the area of moderate ranked land at closure are the result of the increase in terrestrial (forested) cover classes that occur following reclamation.

A significant and adverse effect is demonstrated for the low biodiversity potential indicator when the Application Case is compared to the cumulative losses that have occurred since the Late 1990's Scenario. The net decrease that occurs between the PDC and the Pre-Development Scenario also results in an adverse and significant effect. The net increase in low ranked lands that occurs in the PDC-closure when compared to the Base Case and Pre-Development Scenario both result in a significant and adverse effect. This result is considered as adverse since there will be a substantial net increase in the area of low ranked lands during reclamation.

At the landscape level an increase in terrestrial land cover in combination with a decrease in wetland cover result in a more homogeneous landscape for several scenario and cases. A significant and adverse effect is observed for the Application Case when the cumulative changes in class area are compared to Pre-Development. The net changes in class area that occur in the Planned Development Case compared to the Pre-Development Scenario and for the PDC-closure compared to both the Base Case and the Pre-Development Scenario are also significant and adverse.

8.5 Shell's Proposed Mitigation and Monitoring

As with the other terrestrial valued ecosystem components, reclamation is proposed as the key mitigation measure used to minimize the residual effects of the Projects on biodiversity (Shell 2007). The Closure, Conservation and Reclamation (C,C&R) Plan, prepared for each of the Jackpine Mine Expansion and Pierre River Mine

Projects, provides the details of closure and reclamation activities. The basic goals of the C,C&R Plans are presented in Section 7.1.3 of the Application and summarized in *Section 7.7* of this report. Reclamation is intended to return the landscape to equivalent capability through the optimization the values of watershed, forest productivity, fish and wildlife habitat and traditional use.

Shell has also stated a commitment to continued and active participation in CEMA Working Groups and to involvement in research programs such as Canadian Oil Sands Network for Research and Development (CONRAD).

8.6 Fort McKay's Overall Conclusions and Recommendations

8.6.1 Conclusions

Diverse and naturally vegetated landscapes are a critical component of the "land" that contribute to and support Fort McKay's cultural values. A diverse landscape of upland, wetland and aquatic ecosystems provides the land base on which the Community of Fort McKay undertakes traditional activities.

This Fort McKay Specific Assessment has demonstrated that adverse effects of low to moderate consequence will occur to specific biodiversity indicators as a result of the Projects in the Application Case and at Application Case-closure. The development of Pre-Development and Late 1990s Scenarios for the Fort McKay Specific Assessment has proven to be an important tool for Fort McKay as it has allowed for the cumulative assessment of development in the FTSA from a baseline that is meaningful and relevant to Fort McKay. The use of these scenarios has allowed for the verification of many of the negative changes that Fort McKay Community members have observed on their Traditional Lands since the 1960s. Significant adverse effects to several biodiversity indicators have been demonstrated when the Project and Planned Development Cases are compared to the late 1990s and pre-development. A summary of some of the key findings is as follows:

- The Jackpine Mine Expansion and Pierre River Mine Projects will result in the direct disturbance and loss of 22,284 ha of land. This includes the loss of 7,337 ha of upland forest over 28 ecosites phases and 11,942 ha of wetlands across at many as 18 wetland types
- The incremental effects of the Projects in the Application Case – closure are of negligible to moderate consequence when compared to the Base Case. Moderate adverse effects are demonstrated for the high biodiversity potential class and for landscape heterogeneity at closure.
- Adverse effects of high significance (**red** situation) are observed on all biodiversity indicators when cumulative effects of the Projects and all developments that have occurred through the Application Case are compared to the Late 1990s Scenario.

- Effects of moderate environmental consequence (**yellow** situation) are observed for biodiversity indicators (i.e., high, moderate and low biodiversity potential classes and to heterogeneity) when the PDC is compared to the Base Case.
- Significant adverse effects (high/**red** situation) are observed for all biodiversity indicators when the PDC is compared to pre-development.
- Significant increases in the abundance of moderate and low ranked biodiversity classes occur in the PDC-closure when compared to the Base Case. Fort McKay considers the increase in land with low ranked potential to be adverse and significant since higher ranked lands are replaced in the landscape. A significant adverse effect is also demonstrated for the landscape heterogeneity indicator.
- A significant adverse increase in the abundance of the low ranked biodiversity class and landscape heterogeneity indicator occurs in the PDC-closure compared to pre-development. Although the decrease in the area of the high ranked biodiversity class is considered as moderate consequence it is very near to the magnitude that would create a significant effect.

Collectively, these effects demonstrate that significant changes will occur to biodiversity in the FTSA landscape following reclamation and closure of the existing and approved developments. The landscape will consist of far more upland, much less wetland (muskeg) and a greater number of large waterbodies (i.e., pit lakes). These collective changes are well demonstrated by the significant adverse change in the heterogeneity indicator in the PDC–closure when compared to the Base Case and the Pre-Development Scenario.

Reclamation, while necessary, does not fully mitigate the effects to biodiversity for a number of reasons. The post-closure landscape will become more homogenous as the complex pattern of natural ecosites and wetlands that existed in the pre-development landscape are replaced with greater areas of upland and less wetland. While one of the basic goals of Shell's mitigation plan is to restore equivalent capability through reclamation, this goal cannot be achieved on the landscape level since peatlands, which comprise the large majority of wetland types in the FTSA, cannot be replaced with reclamation. Significant effects to several wetland indicators are observed in all assessment scenarios (see ***Section 7***). The changes in the composition and abundance of habitat patches in FTSA that will occur following closure will have significant effects to biodiversity indicators in the FTSA. There will be a loss of biodiversity potential, reflected through a significant increase in the amount of low ranked land following closure, even if the assumption of reclamation restoring "equivalent capability" is accepted. There is further risk that reclamation will not restore the full range of ecosystem structure, function and value (i.e., species richness, rare element potential, structural complexity) that is required to create equivalent capability at the ecosite phase or wetland type patch level because of uncertainties associated with reclamation. Returns to pre-disturbance levels of diversity on reclaimed areas have not yet been demonstrated at the ecosystem or landscape level. Further discussion of uncertainties associated with reclamation

such as mitigation are provided in ***Section 7 - Vegetation*** and ***Section 10 – Remediation*** of this specific assessment.

8.6.2 Recommendations

The effects of the changes to biodiversity will be experienced into the very far future for both the resource and the Community of Fort McKay. The following recommendations are proposed by Fort McKay to at least partially and potentially moderate the effects of the Projects and future disturbances within the Fort McKay's Traditional Lands:

8.6.2.1 Project-Specific Recommendations

- If this project is approved, areas be identified and designed within the proposed mine plans that could potentially support the development of peat lands (fens or bogs) over the very long term. Shell should be required to undertake research and development work on its Jackpine Mine site on peatland reclamation. Wetlands are critical to the concept of an equivalent and diverse post-closure landscape for the Community of Fort McKay.
- Reclamation techniques are improved or developed, for a full range of upland and wetland types, to mitigate for the effects of disturbance to species, ecosystem and landscape level biodiversity.
- Reclamation criteria for Shell's mine sites incorporate successful establishment of traditional plants within the disturbed areas, with monitoring and progress reporting to the regulators and Fort McKay. Design and implementation of a program to monitor the potential effects of surficial aquifer drawdown in wetlands adjacent to the Projects, including the lenticular patterned fen near McClelland Lake.
- The development and implementation by Shell of a program to salvage and relocate known occurrences of rare (vascular) species to areas outside of the Project footprints. This program should also evaluate the potential to re-introduce rare species into reclaimed areas.

8.6.2.2 Cumulative Effects Recommendations

- In assessing the environmental effects of the Projects on biodiversity, reclamation should not be accepted as a full and effective mitigation measure in the absence of proven wetland (peatland) reclamation technology. Reclamation, even if capable of restoring some types of wetlands, does not mitigate the loss of biodiversity in Project areas during the decades required for mining, closure and reclamation efforts.
- Establishment of enforceable criteria for the measurement of success and reclamation for all end land uses, including for wildlife habitat, traditional land

use and forestry. There is uncertainty with respect to ability of current reclamation practices and objectives to restore equivalent ecosystems that provide a range of functions including species diversity, full range of traditional use plants, or rare plants. This uncertainty needs to be addressed and resolved.

- The establishment of criteria to assess disturbance of ecosystems and landscapes with thresholds established for disturbance of key vegetation indicators in Fort McKay's Traditional Lands and oil sands region, in consultation with Fort McKay
- Establishment of limits on the amount of development necessitating ground disturbance that can occur within Fort McKay's Traditional Lands and the oil sands region, in consultation with Fort McKay.
- Establishment of protected areas to preserve and retain traditional land use opportunities and associated resources in proximity to the Community, in consultation with Fort McKay.
- Further mitigation measures and accommodation strategy be developed in consultation with Fort McKay: reclamation does not provide effective mitigation for the project-specific or cumulative loss of Traditional Lands and resources upon which Fort McKay's culture and rights depend.

8.7 References

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