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CHRISTINA LAKE REGIONAL PROJECT

WILDLIFE
ENVIRONMENTAL SETTING REPORT

Prepared For:
MEG Energy Corp.

Prepared By:
Golder Associates Ltd.

March 2005 **04-1334-001**

EXECUTIVE SUMMARY

MEG Energy Corp. (MEG) is a Calgary-based, private energy company focused on the development and recovery of bitumen, shallow gas reserves and the generation of power in northeast Alberta. MEG is proposing to develop the Christina Lake Regional Project (the Project) on part of the 52 sections of oil sands leases (lease area) that it holds in the area of Christina Lake, Alberta. The Project would be located within the Regional Municipality of Wood Buffalo in northeastern Alberta, approximately 15 km southeast of local Secondary Highway 881 and 20 km northeast of Conklin.

MEG is proposing to develop their oil sands lease area by building and operating the Project utilizing a steam assisted gravity drainage (SAGD) oil recovery technology. The Project would consist of a central processing facility, SAGD wells, co-generation facilities and additional infrastructure. The proposed central processing facility and the co-generation unit would be located adjacent to MEG's approved Pilot facilities located in NE¼ 9 and SE¼ 16, Township 77, Range 5, W4M. The Project would be designed and built to produce 22,000 barrels per day of bitumen (approximately 3,500 cubic metres per day). This production, which would be in addition to the 3,000 barrels of bitumen per day from the pilot operation, would result in a total production of 25,000 barrels of bitumen per day (approximately 4,000 cubic metres per day).

Baseline wildlife surveys were conducted within the lease area and the Terrestrial Resources Local Study Area (LSA) during 2004. Surveys completed included an ungulate aerial survey, an early winter and late winter track count survey, a nocturnal owl call survey, a browse-pellet group transect survey, a bat survey, spring and fall waterfowl, and waterbird aerial surveys, a raptor ground survey, a breeding bird survey, a beaver/muskrat survey and nocturnal amphibian call surveys. Incidental wildlife observations are reported and particular note was made of special status species (i.e., species listed nationally or provincially). First Nation assistants took part in the majority of the scientific programs, and their experience identifying other wildlife sign contributed to the efficiency of the studies.

During the winter ungulate aerial survey, five moose were observed for an estimated population density of 0.07 moose/km^2. Observations included a cow and calf moose pair, one cow moose, and one bull moose with a cow moose on adjacent frozen open water. No woodland caribou or deer were observed during the ungulate aerial survey. Ungulate browse surveys indicated that the graminoid fen (FONG) wetlands type provided the highest percentage of vegetation suitable for browsing by ungulate species. Moose and deer pellets were recorded during the browse-pellet group transect survey. Moose pellet group density was highest within the low-bush cranberry aspen (d1) ecosite phase. Deer pellet group densities demonstrated a preference for the low-bush cranberry aspen (d1) ecosite

phase, an avoidance of the wooded bog (BTNN) wetlands type and neutral habitat use of the treed fen (FTNN) wetlands type.

Winter track surveys indicated that there was a moderate to high abundance of woodland caribou within the lease area compared to other studies conducted within the Oil Sands Region. Moose track density was average compared to other studies conducted within the Oil Sands Region. Deer, wolves, coyotes, lynx, red fox, fisher/marten, weasels, snowshoe hares and red squirrels were all observed at low densities compared to other studies conducted within the Oil Sands Region. No tracks of cougars, bears, wolverines, river otters or minks were observed.

Beaver density was low in the lease area at 0.17 active lodges/km of tributary and no inactive lodges/km of tributary. Muskrat density was high for the Oil Sands Region with 22 push-ups observed (2.06 push-ups/km).

During the bat survey, one adult male little brown bat was captured along a treed fen cutline (FTNN-cutline). Species identified from the echolocation monitoring included *Myotis* spp., hoary bat, red bat and big brown/silver-haired bat. One bat (unknown spp.) was observed incidentally within the lease area during the baseline surveys. Overall, the level of bat activity and capture success was low compared to previous studies in the region.

Four species of owls were heard during the owl call playback survey. The boreal owl was the most abundant followed by the great gray owl, barred owl and great horned owl.

A sharp-shinned hawk, northern goshawk and a merlin were observed during the raptor call-playback survey. Raptors that were observed incidentally included bald eagles, red-tailed hawks, northern harriers, an osprey and an American kestrel.

Watercourses and waterbodies were surveyed for waterfowl within the lease area and along adjacent waterbodies. During the spring waterfowl surveys, six species of dabbling ducks (American wigeon, blue-winged teals, green-winged teals, mallards, northern pintail and northern shovelers) and five species of diving ducks (buffleheads, common goldeneyes, grebe spp., ring-necked ducks and scaup spp.) were observed. During fall surveys, three dabbling ducks (blue-winged teals, green-winged teals and mallards) and five species of diving ducks (buffleheads, common goldeneyes, grebe spp., ring-necked ducks and scaup spp.) were observed. Other waterfowl and waterbirds observed during the waterfowl surveys included American white pelicans, black terns, common terns, American

coots, Canada geese, common mergansers, merganser spp., red-necked grebes, scoter spp., great blue herons, sandhill cranes, lesser yellowlegs and unidentified shorebird species.

During the breeding bird survey, 253 bird observations were recorded comprising 27 species. The ruby-crowned kinglet was the most commonly detected songbird, followed by the gray jay, yellow-rumped warbler, dark-eyed junco and the Tennessee warbler. No listed species were observed. Species richness was moderate overall, with the highest richness occuring within the blueberry jack pine-aspen (b1), Labrador tea-subhygric black spruce-jack pine (g1) and the shrubby swamp (SONS) ecosite phases/wetlands types. Species diversity was highest in the treed fen (FTNN) and the low-bush cranberry aspen-white spruce (d2) ecosite phases/wetlands types.

Boreal chorus frogs, wood frogs, western (boreal) toads and Canadian toads were observed within the lease area during baseline surveys and incidentally. Boreal chorus frogs and wood frogs were almost ubiquitous, occurring in most ecosite phases. Western toads were located in all wetlands types. Frogs and western toads were observed within a variety of waterbody types including lakes, ponds, rivers, creeks, standing water and along disturbed-cutlines.

Important wildlife areas occurring within the LSA were identified. The Project is located within the Christina Caribou Area, a designated caribou range within Alberta. Additionally, Christina Lake has been identified as a Significant Natural Feature and lies adjacent to the Project. Christina Lake provides important waterfowl nesting and furbearer habitat. No important moose areas occur within the vicinity of the Project. One movement corridor for caribou is identified based on baseline results obtained from the Devon Jackfish Project, the EnCana Christina Lake Thermal Pilot Project and from baseline results obtained through this Project's baseline surveys. This north-south corridor exists between the Christina Caribou Area and a calving/summering area south of Christina Lake.

Twenty-one species of special concern (i.e., 'Sensitive', 'May Be At Risk', 'At Risk', 'Undetermined', 'Accidental/Vagrant') (ASRD 2001) were recorded within the lease area. These included the woodland caribou (federally listed as 'Threatened'; COSEWIC 2004), Canada lynx, fisher, cougar, red bat, Canadian toad, western (boreal) toad (federally listed as 'Special Concern'; COSEWIC 2004) and several bird species. Of the special status species observed within the lease area, the woodland caribou is listed as 'At Risk' and the Canadian toad as 'May Be At Risk' provincially. The remaining species are all listed as 'Sensitive', 'Undetermined' or 'Accidental/Vagrant' provincially (ASRD 2001).

ACKNOWLEDGEMENTS

This report was prepared for MEG Energy Corp. (MEG) by Golder Associates Ltd. (Golder) as part of the Project EIA under the direction of Al Siemens.

Staff of Golder conducting field surveys included: Paula Bentham, Stephen Glendinning, Shannon Miller (Winter), Michael Braeuer, Paul Bentham, Warren Fleming, Conrad Pilon, Shannon Attaway (Leggo), Kent Kristensen, Jane Elser, Tony Calverley, Carol Stefan, Dawn Hall and Jessica Sabell. Scott Morice, Alex Contois, Rodney Janvier, Conan Janvier, Elmer McDonald, Wade Janvier, Alfred Janvier and Kerry Bekkattla from Janvier First Nations assisted during the wildlife surveys. Dayna McNeilly from Fort McMurray First Nations (Anzac) assisted during the spring waterfowl survey.

This report was authored by Paula Bentham with the assistance of Warren Fleming, Stephen Glendinning, Carol Stefan, Mark Sherrington, Shannon Attaway and Corey De La Mare. Warren Fleming, Paula Bentham and Corey De La Mare conducted the statistical analysis and data quality assurance. Cori Lausen (Ph.D. Candidate University of Calgary) completed the bat call analysis. Figures were produced by Paul St. Rose and Joel Farah. Martin Jalkotzy served as senior editor and advisor. The report was reviewed by Ian Gilchrist, Tod Collard and John Gulley.

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1 INTRODUCTION

MEG Energy Corp. (MEG) is a Calgary-based, private energy company focused on the development and recovery of bitumen, shallow gas reserves and the generation of power in northeast Alberta. MEG is proposing to develop the Christina Lake Regional Project (the Project) on part of the 52 sections of oil sands leases (lease area) that it holds in the area of Christina Lake, Alberta. The Project would be located within the Regional Municipality of Wood Buffalo in northeastern Alberta, approximately 15 km southeast of local Secondary Highway 881 and 20 km northeast of Conklin.

MEG is proposing to develop their oil sands lease area by building and operating the Project utilizing a steam assisted gravity drainage (SAGD) oil recovery technology. The Project would consist of a central processing facility, SAGD wells, co-generation facilities and additional infrastructure. The proposed central processing facility and the co-generation unit would be located adjacent to MEG's approved Pilot facilities located in NE¼ 9 and SE¼ 16, Township 77, Range 5, west of the fourth meridian (W4M). The Project would be designed and built to produce 22,000 barrels per day of bitumen (approximately 3,500 cubic metres per day). This production, which would be in addition to the 3,000 barrels of bitumen per day from the pilot operation, would result in a total production of 25,000 barrels of bitumen per day (approximately 4,000 cubic metres per day).

Golder was retained by MEG to conduct baseline wildlife surveys to provide background information for the Environmental Impact Assessment (EIA) of their proposed Project. Baseline wildlife surveys were conducted within the lease area, plus a 500 m buffer, during 2004. The surveys consisted of an ungulate aerial survey, early winter and late winter track counts, a nocturnal owl call survey, a browse-transect and pellet group count survey, a bat survey, spring and fall waterfowl and waterbird aerial surveys, a raptor ground survey, a breeding bird survey, a beaver/muskrat aerial survey and nocturnal amphibian call surveys. Incidental wildlife observations were recorded and particular note was made of special status species (i.e., species listed nationally or provincially). First Nation assistants took part in the majority of the scientific programs where their experience identifying tracks and other wildlife sign contributed to the efficiency of the studies.

1.1 STUDY OBJECTIVES

1.1.1 Objectives

The objectives of the wildlife baseline surveys were:

- to assess relative abundance, distribution and habitat use of wildlife within the lease area and the Terrestrial Resources Local Study Area (LSA);
- to identify important wildlife habitat, including local and regional habitat and, if possible, seasonal use and movement corridors; and
- to determine the presence of special status wildlife species within the lease area and LSA.

1.1.2 Approach

Baseline information on relative distribution, abundance and habitat use of wildlife in the LSA and the lease can assist in determining the impact of the Project. The results presented here are used in the EIA to assess potential impacts to wildlife and to recommend mitigation measures. The intent is to use baseline data from this and other studies to determine wildlife species-vegetation type associations.

Different wildlife groups are best studied at different times of the year. This is due to either seasonal activity patterns or methods that require seasonal environmental conditions to study the species (e.g., winter-active mammal snow tracking). The track count survey, ungulate aerial survey and nocturnal owl call survey were conducted in the winter. The spring and summer field programs included a browse-pellet group transect survey, nocturnal amphibian call surveys, aerial surveys for waterfowl, a call playback survey for raptors, a breeding bird survey and a bat survey. Fall surveys consisted of aerial surveys for waterfowl and a beaver/muskrat survey.

Appendix I lists common and scientific names for all species observed during wildlife baseline surveys, or incidentally, within the MEG lease boundary. Scientific names for species not observed but discussed within the text, are provided within the text. All incidental sightings of wildlife are reported in Appendix II. Species that are listed nationally by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2004) or listed provincially by Alberta Sustainable Resource Development (ASRD 2001), are highlighted in

both Appendix I and II. Species of concern observed during baseline surveys are discussed in detail in Section 8.

1.2 STUDY AREAS

The Terrestrial Resources Regional Study Area (RSA) and LSA were chosen by considering all terrestrial components (soil and terrain, terrestrial vegetation, wetlands and forest resources, wildlife and wildlife habitat and biodiversity) and are the same for all of these components.

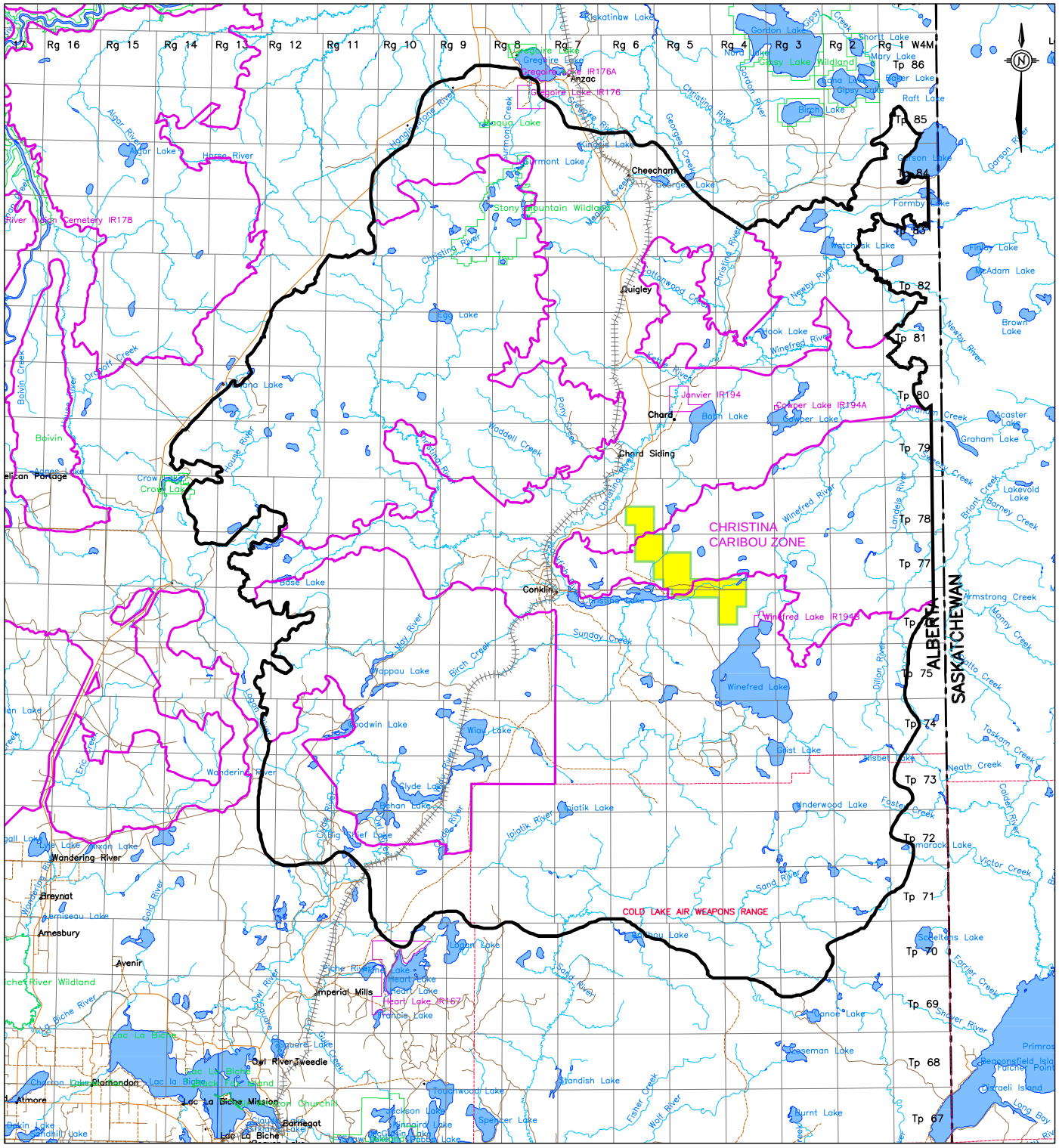
1.2.1 Regional Study Area

The RSA was established to assess the Project within the 1,538,591 ha regional area (Figure 1-1). The RSA boundary was defined with consideration of the following terrestrial resources:

- ecodistrict and/or vegetation classification boundaries;
- geographic areas such as the northern shoulder of the Stony Mountain;
- defined woodland caribou habitat areas (e.g., Christina Caribou areas);
- one female caribou home range; and
- average width of two moose home ranges from oil sands developments.

The RSA is situated primarily within the Central Mixedwood and Boreal Highlands subregions (AENV 1999) of the Boreal Mixedwood and Boreal Highlands ecological areas (Beckingham and Archibald 1996). Within this area, dry and sandy sites are poorly represented and tend to be dominated by jack pine. Black spruce and tamarack dominate the forested wetlands areas and numerous lakes and streams support wetlands vegetation species. Fire has been a prevalent form of natural disturbance throughout the area with many parts of the area now supporting young forest following burns.

Landforms in the subregion are comprised predominantly of ground moraine and hummocky moraine, interspersed with areas of sandy outwash plains and glaciolacustrine plains (AENV 1999). Post-glacial organic deposits overlay glacial and post-glacial mineral deposits in some areas. Overall, the terrain has low relief and a level to undulating surface. Dominant soil orders in this region include Organic, Gray Luvisolic, Brunisolic, and Gleysolic.



LEGEND

- ROADWAY
- RAILWAY
- MEG OIL SANDS LEASE
- TERRESTRIAL RESOURCES REGIONAL STUDY AREA
- CARIBOU ZONE

20 0 20

SCALE 1:1,000,000 KILOMETRES

REFERENCE

ALBERTA NTDB DIGITAL DATA OBTAINED FROM GEOMATICS CANADA, AUGUST 2001. DATUM: NAD 83 PROJECTION: UTM ZONE 12

PROJECT

CHRISTINA LAKE REGIONAL PROJECT

TITLE

TERRESTRIAL RESOURCES REGIONAL STUDY AREA

MEG ENERGY CORP.

PROJECT 04-1334-001.7740			FILE No. Terrestrial Res. RSA	
DESIGN	PB	12/01/05	SCALE AS SHOWN	REV. 0
CADD	JEF	21/01/05		
CHECK	PB	21/01/05		
REVIEW	TC	27/01/05		

FIGURE: 1-1

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1.2.2 Local Study Area

The LSA was established to assess the effects of the Project at the local scale. The LSA encompasses an area of 7,226 ha within Townships 76 and 77, Ranges 4, 5 and 6 west of the 4th Meridian (Figure 1-2). The LSA falls completely within the Central Mixedwood Natural Region of the Boreal Mixedwood ecological area (Natural Subregion) (AENV 1999). The LSA is characterized as having subdued relief and level to very gently undulating topography. Surficial deposits primarily consist of organic materials.

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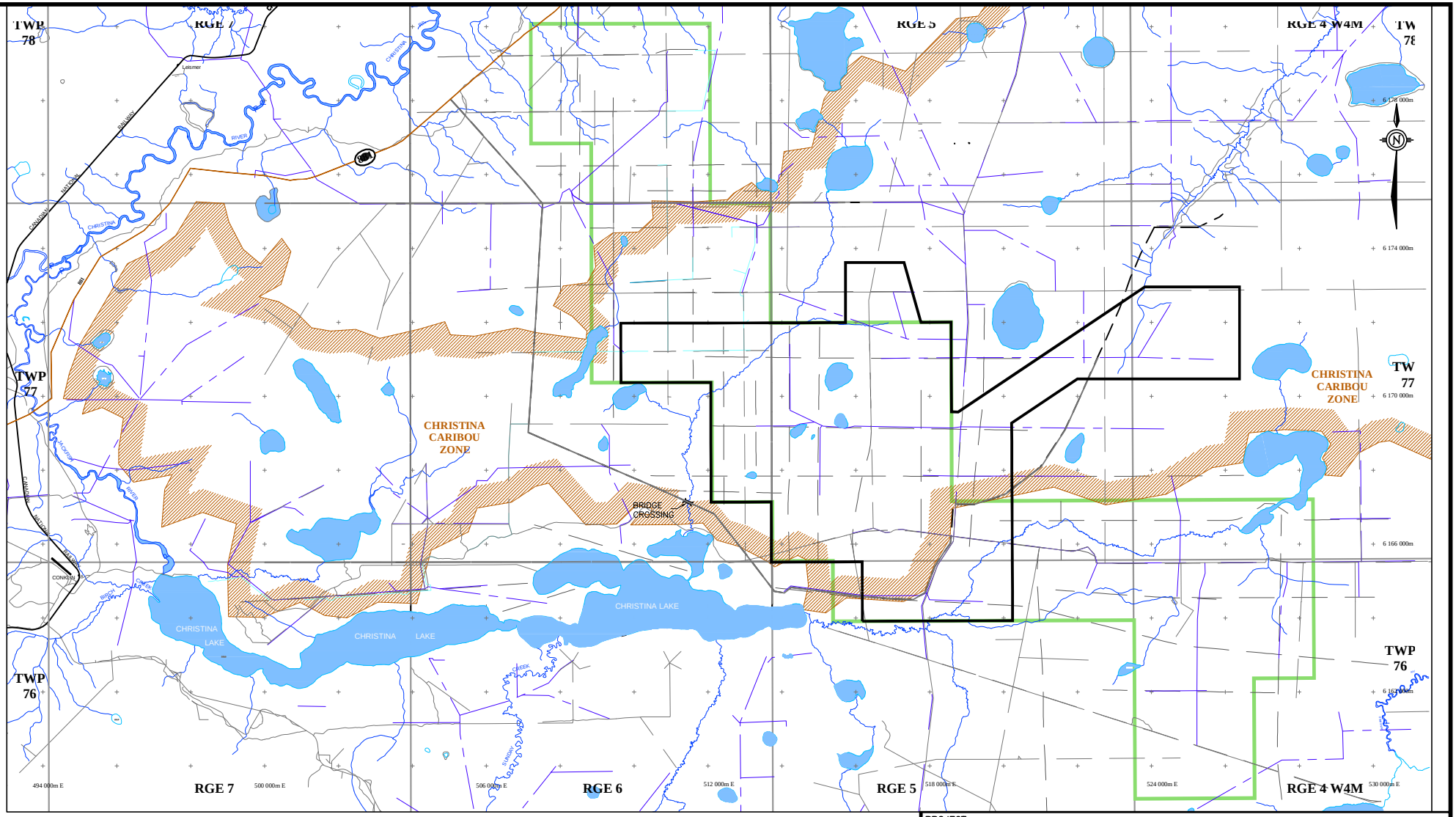

LEGEND

- MEG OIL SANDS LEASE
- EXISTING ACCESS ROAD
- CHRISTINA CARIBOU ZONE
- TERRESTRIAL RESOURCES LOCAL STUDY AREA

3 0 3
SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT

TITLE

TERRESTRIAL RESOURCES LOCAL STUDY AREA

MEG ENERGY CORP.

PROJECT 04-1334-001.7800			FILE No. Terrestrial Res. LSA		
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CADD	SWD	05/07/05			
CHECK	AA	11/07/05			
REVIEW	TC	12/07/05			

FIGURE:1-2

2 METHODS

2.1 EXISTING REGIONAL WILDLIFE DATA AND LITERATURE REVIEW

Previous wildlife studies in the Oil Sands Region provide a pre-development perspective. During the past three decades, a number of wildlife studies have been conducted within the Oil Sands Region. Selected survey results within the region for Key Indicator Resources (KIRs) are summarized in Appendix III. Results from studies conducted within the RSA (e.g., Encana Christina Lake Thermal Project, Devon Jackfish Project) are provided to supplement the baseline surveys conducted for the Project. Historical data from the RSA on species of concern were also obtained through the Alberta Biodiversity/Species Observation Database (BSOD). Information from previous studies (see Appendix III), historical databases (BSOD) and current baseline surveys were used to assist in determining potential impacts and mitigation measures for the Project, and can assist in the development of monitoring programs.

2.2 STUDY TEAM

Field work was conducted by Golder and First Nation assistants from the Chipewyan Prairie Dene First Nations (CPDFN). The participation of the First Nation assistants to the study team was arranged through the help of the Industrial Relations Committee (CPDFN-IRC).

2.3 VEGETATION TYPES SAMPLED

Vegetation types (ecosite phases/wetlands types) were classified according to The Field Guide to Ecosites of Northern Alberta by Beckingham and Archibald (1996) and the Alberta Wetland Inventory (AWI) by Vitt et al. (1997) (Table 2-1). These vegetation types are described in detail in the Terrestrial Resources Vegetation, Wetlands and Forest Resources Environmental Setting Report (Golder 2005b). In some cases (e.g., small sample sizes), vegetation types were pooled into broader land cover classes or vegetation communities during analysis (i.e., Breeding Bird Twinspan analysis). During the baseline wildlife surveys, survey transects and plots were stratified by habitat (ecosite phases/wetlands types), to sample ecosite phases/wetlands types in proportion to their availability on the landscape.

Table 2-1 Correlation of Regional Study Area Land Cover Classes With Local Study Area Ecosite Phases/Wetlands Types

Regional Study Area Class	Local Study Area Ecosite Phases/Wetlands Types	
Land Cover Classes	Boreal Mixedwood[a]	Wetlands Type[b]
coniferous – jack pine dominant	lichen (jack pine) (a1)	n/a
mixedwood – jack pine-aspen dominant	blueberry jack pine-aspen (b1)	n/a
deciduous – aspen/aspen-balsam poplar dominant	dogwood balsam poplar-aspen (e1) blueberry aspen (b2) low-bush cranberry aspen (d1) Horsetail balsam poplar-aspen (f1)	n/a
coniferous – white spruce dominant	blueberry white spruce-jack pine (b4) low-bush cranberry white spruce (d3) dogwood white spruce (e3) horsetail white spruce (f3)	n/a
coniferous – black spruce-white spruce (jack pine) dominant	Labrador tea–mesic jack pine-black spruce (c1) Labrador tea–subhygric black spruce-jack pine (g1) Labrador tea/horsetail white spruce-black spruce (h1)	n/a
mixedwood – aspen-white spruce dominant	blueberry aspen-white spruce (b3) low-bush cranberry aspen-white spruce (d2) dogwood balsam poplar-white spruce (e2) horsetail balsam poplar-white spruce (f2)	n/a
upland shrubland	shrub	shrubby swamp (SONS) shrubby marsh (MONS)
wooded fen	n/a	treed fen (FTNN, FTNR, FFNN, FTPN, FTNI) wooded swamp (STNN) forested swamp (SFNN)
shrubby fen	n/a	shrubby fen (FONS, FOPN)
graminoid fen	n/a	graminoid fen (FONG)
poor wooded fen/wooded bog	n/a	treed bog (BTNI, BTNN, BTNR, BTXC,BTXN) forested bog (BFNN) open bog (BONN) shrubby bog (BONS)
marsh	n/a	graminoid marsh (MONG)
shallow open water	n/a	shallow open water (WONN) flooded areas (NWF)
deep water	n/a	lakes and ponds (NWL) river (NWR)
cutblocks	n/a	n/a
burn	n/a	n/a

[a] Beckingham and Archibald (1996).

[b] Vitt et al. (1997).

n/a = not applicable.

2.4 BASELINE SURVEYS

Baseline surveys were conducted within the lease area to collect site-specific information on wildlife species (Table 2-2). Survey objectives, dates, effort, statistical analyses and weather conditions are outlined for each baseline survey in Table 2-2.

2.5 MAMMAL SURVEYS

2.5.1 Winter Track Count Survey

The objectives of the winter track count surveys were to determine the distribution and relative abundance of ungulates and small and medium sized carnivores. The surveys were designed to provide adequate coverage of the lease area within representative habitat/vegetation types. A late winter track count survey was conducted on March 3, 4 and 5, 2004 and an early winter track count survey was conducted on December 17, 2004. In total, 29.9 km of winter track transects were surveyed (Figure 2-1). The track survey was conducted on foot by two teams comprised of one biologist and one assistant each. The first person (i.e., the "tracker") navigated and identified tracks while the second person recorded data and assisted in identifying tracks when necessary. Transects were walked along a given compass bearing in straight lines as much as possible. All tracks intercepting the transect were recorded.

A single track that intercepted a transect was recorded as one crossing. Where animals of the same species crossed the transect in a "trail", an attempt was made to determine the number of individuals involved. If the number of individuals could not be determined, the observation was recorded as one "trail". If a short distance separated the tracks, each track was recorded individually. In some situations, animals crisscrossed the transect many times over a short distance for bedding, feeding, or other activities. In these situations, tracks were recorded as "networks" for each metre of transects in which this occurred. Major vegetation or landform changes and the vegetation type (overstory and understory as recorded by dominant and subdominant species, to the nearest 10%) were recorded along each transect to determine habitat preferences.

All incidental wildlife sign (e.g., beds, grouse roosting sites) and observations within 5 m on either side of each transect were recorded while conducting the survey (Appendix II) (Murie 1974; Rezendes 1992). Snow thickness and hardness measurements were recorded in the most common vegetation types to determine snow conditions at the time of the survey. Global Positioning Systems (GPS) units were used at transect start and end points, when a transect changed direction, and for marking observed tracks of species of concern.

Table 2-2 Wildlife Baseline Surveys Conducted within the Project Local Study Area

Survey Type	Survey Objectives	Survey Date(s)	# Survey Sites / Length of Transects	Statistical Analysis	Weather Conditions
winter track counts	determine distribution and relative abundance of small to medium sized carnivores and ungulates	3-5 March, 2004 17 December, 2004	29.9 km of transects	Chi-square Bonferroni	Late winter: temperatures ranged from -20 to -5°C, clear skies, light winds, snow depths ranged from 16.5-63.5 cm. Early winter: temperatures ranged from -8 to 5°C, poor snow conditions, high winds, snow depths ranged from 8-26 cm, tracking cancelled due to heavy snowfall.
aerial ungulate	determine population parameters, distribution and habitat use of ungulates	23 February, 2004	50% coverage (sampled 200 m wide strip on either side of helicopter every 400 m)	density cow:calf ratio	Clear (0% cloud cover), 95 to 100 % snow cover, unlimited visibility, with temperatures ranging from - 4 to 8°C.
owl call playback	determine occurrence and relative abundance of owl species	5-7 April, 2004	49 plots	n/a	Temperatures ranged from -3 to 2°C over the three nights. Minimal winds and cloud cover.
browse transect and pellet counts	describe ungulate distribution, and habitat use	4-6 May, 2004	9.8 km pellet transects (2 ha) 64 browse plots	Chi-square	Weather conditions included light snow and rain. Survey was ended prematurely due to snow ground cover.
ground-based raptor	describe raptor species occurrence and habitat use	5 May, 2004 20 May, 2004 23, 24 June, 2004	22 plots	n/a	May 5: temperature was -5°C, cloudy, moderate winds, cancelled due to snow and cold. May 20: temperature 7°C and clear; June 23-24: Temperatures 12 to 20°C and clear.
amphibian call	describe amphibian occurrence and habitat use	17-19 May, 2004 8-10 June, 2004	42 plots	n/a	May: temperatures ranged from -2 to 15°C, clear skies with light winds. June: temperature 5°C, clear skies and light winds.
aerial waterfowl and waterbird	describe waterfowl distribution, abundance and habitat use	21, 28 May, 2004 19, 30 September, 2004	15 lakes (1,068 ha) 9 streams (42 km)	n/a	May: temperatures averaged 3°C with moderate winds and overcast skies. September: temperatures averaged 3°C, high winds and overcast skies.
beaver/muskrat aerial	describe beaver/muskrat occurrence (dams, food caches, push-ups, feeding platforms)	30 September, 2004	15 lakes (1,068 ha) 9 streams (42 km)	n/a	Temperatures of -5°C, high winds and overcast skies.
breeding bird	describe species occurrence, relative abundance and habitat use of songbirds and other bird species	23, 24 June, 2004	57 plots	ANOVA Tukey-Kramer	Temperature averaged 8°C with clear skies and light winds.
bats	describe species occurrence, relative activity and habitat preferences	5, 7 August, 2004	5 mist-net plots 8 detector plots	n/a	Temperatures 8 to 12°C, with fog and light mists, moderate winds, overcast.

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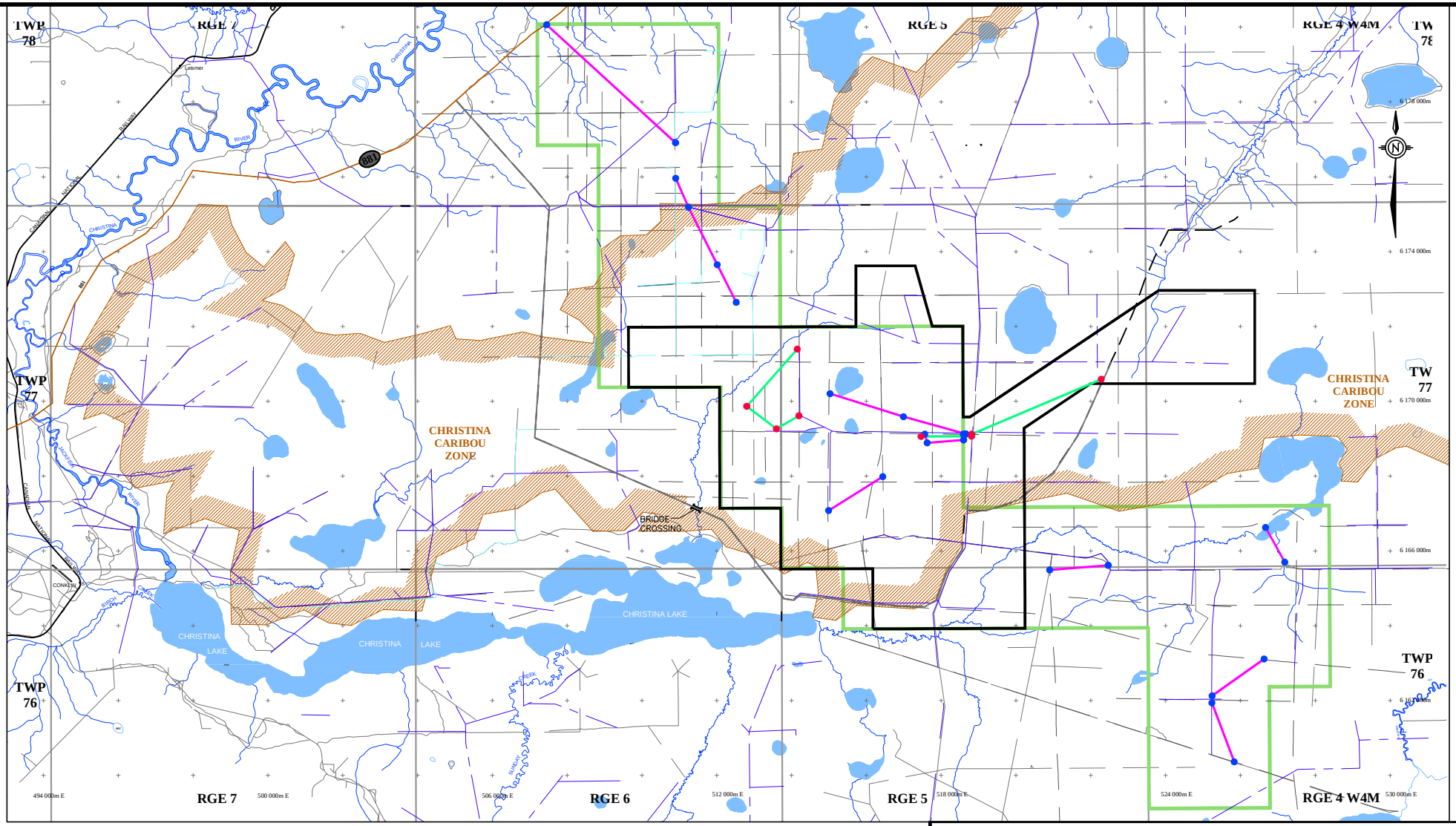


LEGEND

- MEG OIL SANDS LEASE
- EXISTING ACCESS ROAD
- CHRISTINA CARIBOU ZONE
- TERRESTRIAL RESOURCES LOCAL STUDY AREA
- EARLY WINTER TRANSECTS
- LATE WINTER TRANSECTS

3 0 3
SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT

TITLE

EARLY WINTER AND LATE WINTER TRACK COUNT TRANSECT LOCATIONS

MEG ENERGY CORP.

PROJECT 04-1334-001.7740			FILE No. Winter Track Count	
DESIGN	WF	10/01/05	SCALE 1:150000	REV. 2
CADD	JEF	08/07/05		
CHECK	IGG	10/07/05		
REVIEW	TC	12/07/05		

FIGURE: 2-1

Early and late winter tracking results were combined for data analysis to increase sample sizes in each habitat type. Track data were summarized by species by determining the number of tracks per km-track-day in each habitat type:

Tracks per km-day = number of tracks observed

distance (km) * time since last snowfall (days)

In total, 29.9 km of winter track transects were surveyed in 21 habitat types resulting in 68.5 km-days of track data (Table 2-3, Figure 2-1).

Table 2-3 Vegetation Types Sampled During the Winter Track Count Survey

Ecosite Phases/Wetlands Types[(a)]	Map Code	Km Sampled	Km-Days Sampled
lichen jack pine	a1	0.43	1.32
blueberry jack pine-aspen	b1	0.09	0.15
blueberry aspen (white birch)	b2	0.32	0.61
blueberry aspen-white spruce	b3	0.05	0.16
blueberry white spruce-jack pine	b4	0.18	0.33
Labrador tea-mesic jack pine-black spruce	c1	1.63	3.54
low-bush cranberry aspen	d1	2.08	5.79
low-bush cranberry aspen-white spruce	d2	2.09	5.33
low-bush cranberry white spruce	d3	0.56	1.41
dogwood balsam poplar – white spruce	e2	0.04	0.09
Labrador tea-subhygric black spruce-jack pine	g1	4.21	9.61
Labrador tea-horsetail white spruce-black spruce	h1	0.03	0.06
wooded bog	BTNN	4.88	12.01
treed fen	FTNN	9.56	16.21
shrubby fen	FONS	0.91	2.32
shrubby marsh	MONS	0.71	3.13
shrubby swamp	SONS	0.01	0.01
shallow open water	WONN	0.34	1.53
burned forest	burn	0.99	2.98
disturbed-dlearcut or Reclaimed	disturbed-clearcut	0.19	0.41
disturbed-dutline or Road	disturbed-cutline	0.59	1.48
Total		29.9	68.5

(a) Beckingham and Archibald (1996) and Vitt et al. (1997).

Data were analyzed using Chi-square tests and Bonferroni confidence intervals (Byers et al. 1984; Zar 1984) to determine if the relative abundance of each species differed significantly among vegetation types. Where Chi-square tests were significant, Bonferroni confidence intervals were used to determine the relationship between a species and individual vegetation types (i.e., whether a certain vegetation type was significantly preferred or avoided).

2.5.2 Ungulate Aerial Survey

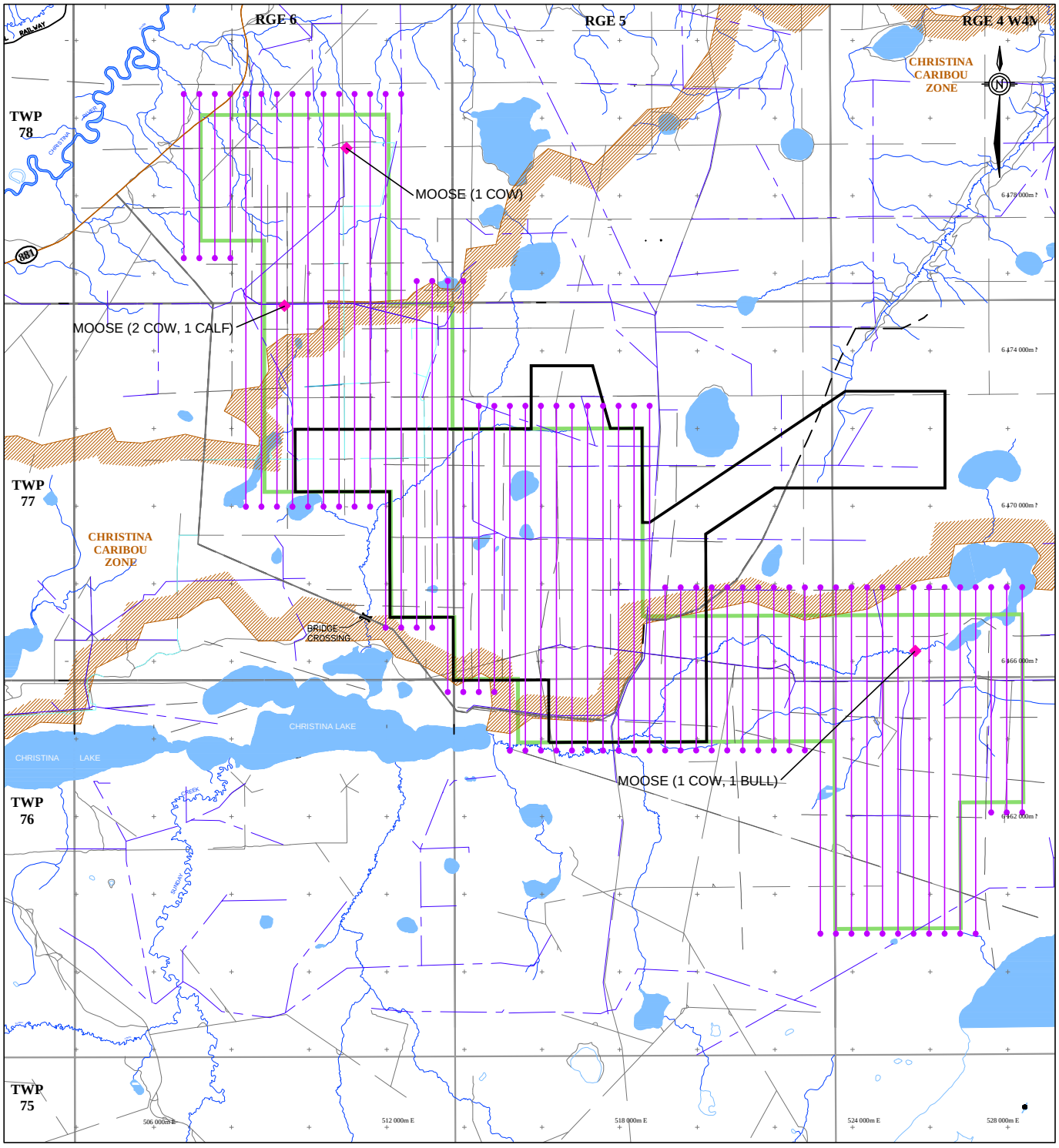
An ungulate aerial survey was conducted on February 23, 2004 to determine population parameters and habitat use for woodland caribou, moose and deer within the lease. The aerial survey was completed by helicopter during favourable weather conditions. Three observers conducted the survey; a biologist acting as a navigator and observer in the front seat, and two additional observers in the back seat. Parallel north – south transects were flown at speeds ranging from 80 to 100 km/h, between 60 and 100 m above the ground. The survey area was flown providing 50% coverage (a 200 m wide survey strip centred on the transect with 400 m between transects) of the lease area plus a 500 m buffer (Table 2-2, Figure 2-2). The total area flown was 178.5 km^2.

Ungulate observations and sign locations were recorded on a 1:50,000 topographic map. For each observation, observers recorded the time, sex, age (if possible), GPS location and ecosite phases/wetlands types. All incidental wildlife sightings, including raptors, furbearers and wildlife tracks were recorded. Weather conditions, including temperature, snow conditions, cloud cover and visibility were also noted for each survey day. If caribou tracks were suspected, the survey team attempted to land and verify the tracks to species.

The ungulate densities in the survey area were estimated by doubling the survey results to account for the 50% coverage of the survey. This correction factor was not applied to the population estimate to account for differential sightability within different habitat types.

2.5.3 Browse Transect and Pellet Group Counts

Browse-pellet surveys provide information pertaining to ungulate distribution and habitat use of the different vegetation and wetlands community types. Browse transects give an indication of the amount of available food for ungulates and the usage of browse by ungulates. These data can be used to refine the forage components of wildlife Habitat Suitability Index (HSI) models. Data from pellet count surveys provide a relative use estimate for each species for every vegetation type traversed and can be used to verify HSI models.



LEGEND

- MEG OIL SANDS LEASE
- EXISTING ACCESS ROAD
- CHRISTINA CARIBOU ZONE
- TERRESTRIAL RESOURCES LOCAL STUDY AREA
- UNGULATE AERIAL TRANSECT
- OBSERVATION LOCATION

3 0 3
SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT

TITLE

UNGULATE AERIAL SURVEY TRANSECTS AND OBSERVATIONS

MEG ENERGY CORP.

PROJECT 04-1334-001.7740			FILE No.	Ungulate Aerial
DESIGN	WF	10/01/05	SCALE 1:150000	REV. 2
CADD	JEF	08/07/05		
CHECK	IGG	10/07/05		
REVIEW	TC	12/07/05		

FIGURE: 2-2

R:\CAD\2004\1322-EA\1334\04-1334-001 MEG\7700\7740\Baseline Figures\Fig 2-2_Ungulate Aerial Survey Transects.dwg Jul 27, 2005 - 10:58am

The browse transect and pellet group count survey was conducted on May 3 and 4, 2004 within the lease area. The survey was timed to occur before leaf flush to increase sightability of pellet groups. Transects were dispersed across the lease area to the greatest extent possible. Survey transect and plot locations are presented in Figure 2-3. The browse-pellet survey was interrupted by snow conditions which covered pellets, reducing the overall survey effort.

Browse transect surveys were conducted within individual vegetation or wetlands polygons. Each time a vegetation classification changed, a new transect segment was initiated. In addition, changes in canopy closure class (i.e., open to closed canopy) or major structural changes (i.e., 5 m tall to 20 m tall) within the same vegetation or wetlands type were also used to divide transect segments. Browse was measured and recorded in plots once within each transect segment (i.e. within each vegetation type traversed). If the vegetation type length was less than 50 m across, the plot was measured at the approximate middle of the segment. If the vegetation type was greater than 50 m across, the browse plot was located 50 m into the segment.

Browse (i.e., plants eaten by deer, moose and caribou, no differentiation by ungulate species) was measured using a 20 m^2 circular plot (2.5 m radius from the centre of the plot). Within each plot, a GPS location was recorded along with the browse availability (% cover of the shrub species within 0.5 to 5 metres height) and browse use (% of stems with evidence of new browse among all shrubs of the same species) for the top three browse species. New browse included browse activity from the past winter and current spring. Sixty-four (64) browse plots were sampled in 14 vegetation types (Table 2-4). Browse utilization is a calculation of the amount of available food plant (e.g., preferred foods such as alder, red-osier dogwood, willow) actually used by ungulates.

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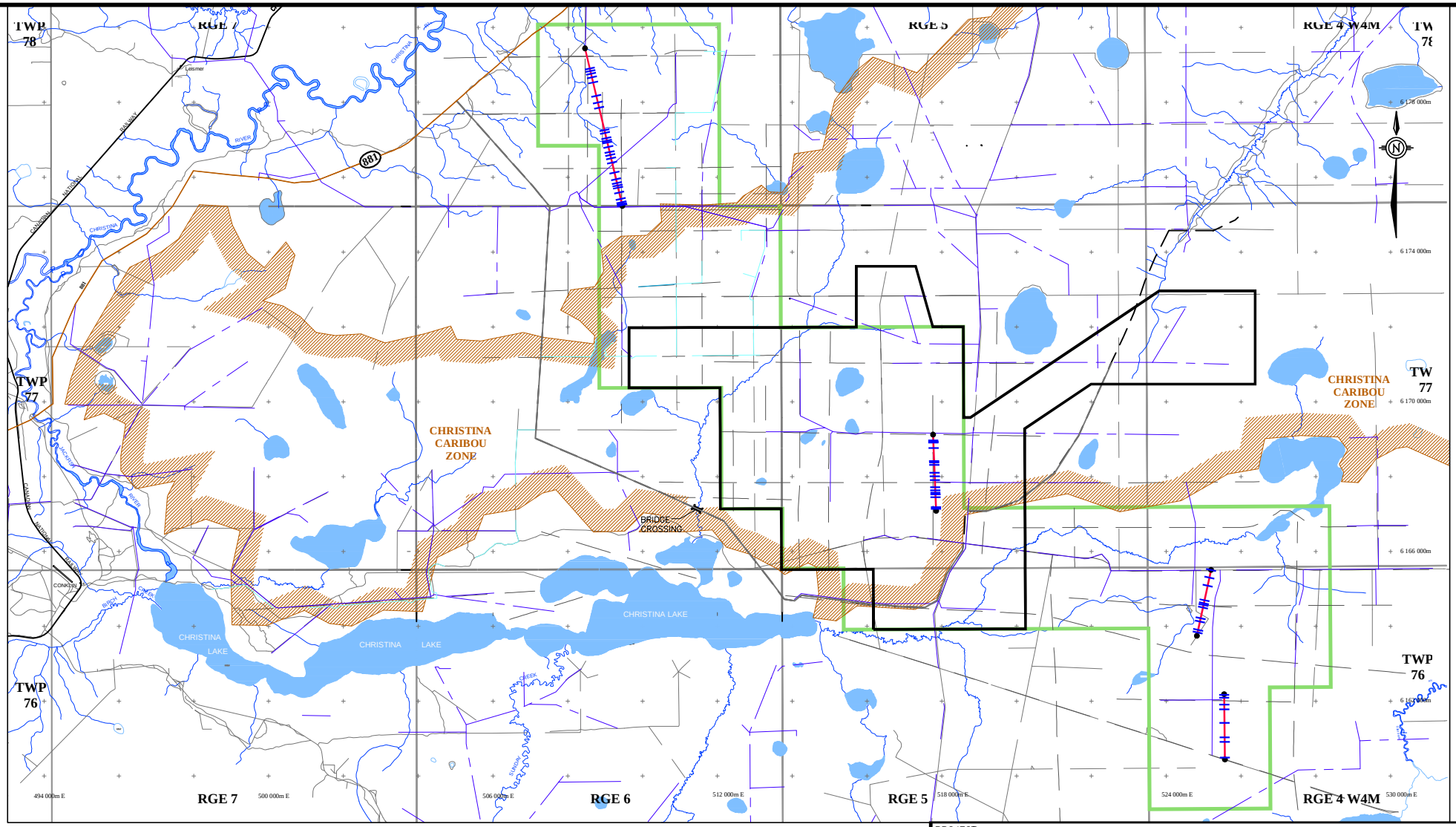


LEGEND

- MEG OIL SANDS LEASE
- EXISTING ACCESS ROAD
- CHRISTINA CARIBOU ZONE
- TERRESTRIAL RESOURCES LOCAL STUDY AREA
- PELLET TRANSECTS
- BROWSE PLOTS

3 0 3
SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT

TITLE

BROWSE TRANSECT AND PELLET GROUP COUNTS SURVEY LOCATIONS

MEG ENERGY CORP.

PROJECT 04-1334-001.7740			FILE No. Browse-Pellet Survey	
DESIGN	WF	10/01/05	SCALE 1:150000	REV. 2
CADD	JEF	08/07/05		
CHECK	IGG	10/07/05		
REVIEW	TC	12/07/05		

FIGURE: 2-3

Table 2-4 Number of Browse Plots by Vegetation Type

Ecosite Phases/Wetlands Types[(a)]	Map Code	Number of Plots
lichen jack pine	a1	1
blueberry jack pine-aspen	b1	2
blueberry aspen (white birch)	b2	1
blueberry white spruce-jack pine	b4	1
Labrador tea-mesic jack pine-black spruce	c1	9
low-bush cranberry aspen	d1	5
low-bush cranberry aspen-white spruce	d2	2
Labrador tea-hygric black spruce-jack pine	g1	5
wooded bog	BTNN	23
graminoid fen	FONG	1
treed fen	FTNN	8
treed swamp	STNN	1
burned forest	burn	4
disturbed; wellpad	disturbed	1
Total		**64**

[(a)] Beckingham and Archibald (1996) and Vitt et al. (1997).

The pellet group count survey was conducted in conjunction with the browse transect survey. Ungulate pellet groups, defined as an association of six or more pellets, were counted within a 2 m strip along each transect (1 m on each side of the transect). Pellet groups were identified by species (i.e., caribou, moose, deer, snowshoe hare). Pellet groups containing less than six pellets were recorded as an incidental sighting. The distance of each vegetation type was recorded along each transect. Vegetation types sampled during pellet surveys are presented in Table 2-5. Scats of grouse, wolf, coyote, red fox and bear were also recorded.

Table 2-5 Length and Area of Pellet Transects by Vegetation Type

Ecosite Phases/Wetlands Types[(a)]	Map Code	Length (m)	Area (m^2)
lichen jack pine	a1	290	600
blueberry jack pine-aspen	b1	210	400
blueberry aspen (white birch)	b2	200	400
blueberry white spruce-jack pine	b4	70	100
Labrador tea-mesic jack pine-black spruce	c1	838	1,700
low-bush cranberry aspen	d1	787	1,600
low-bush cranberry aspen-white spruce	d2	153	300
Labrador tea-subhygric black spruce-jack pine	g1	725	1,500
treed bog	BTNN	4,149	830
graminoid fen	FONG	90	200

Table 2-5 Length and Area of Pellet Transects by Vegetation Type (continued)

Ecosite Phases/Wetlands Types[(a)]	Map Code	Length (m)	Area (m^2)
treed fen	FTNN	1,375	2,800
treed swamp	STNN	74	100
burn	burn	890	1,800
disturbed-cutline, wellpad	disturbed	140	300
Total		**9,991**	**19,980**

(a) Beckingham and Archibald (1996) and Vitt et al. (1997).

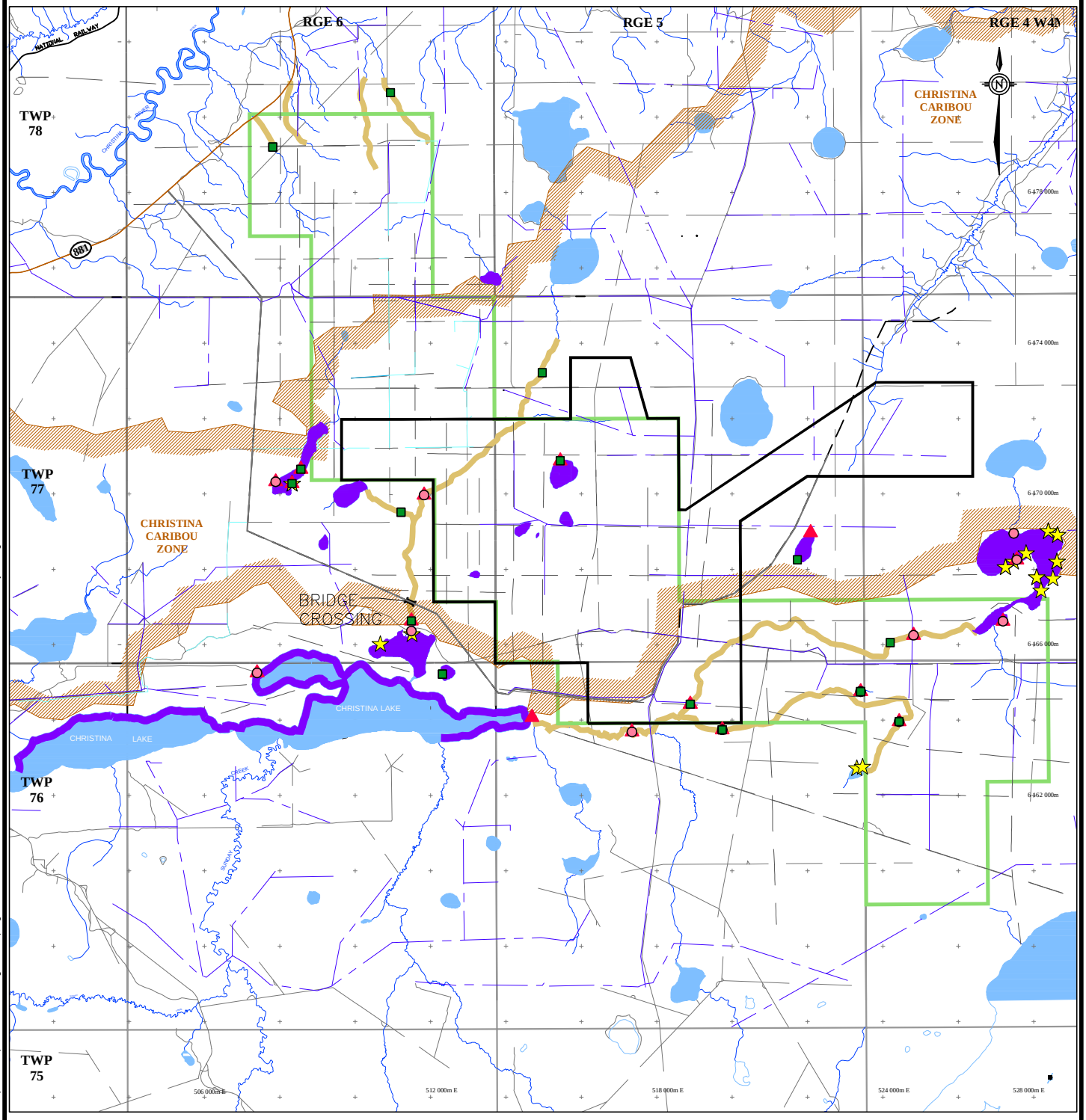
Observed and expected frequencies of browse utilization among sampling stations along each transect were calculated from the average proportion of plant material browsed and available, respectively. Hence, the relative difference between the expected proportion of browse utilized (based on availability) and the observed fraction of browse utilized was used as an utilization index for each vegetation type. The Chi-square (χ^2) goodness-of-fit test, with Yates correction, was used to analyze the effect of vegetation type on browse availability and utilization. If a significant result was obtained, Bonferroni 95% confidence intervals were constructed to determine which vegetation types were used more or less often than expected (Byers et al. 1984).

The pellet data were analyzed in terms of the number of pellet groups/ha for each ungulate species, in each vegetation type. In total, 2 ha of area was assessed for pellet groups across 14 vegetation and wetland types (Table 2-5).

Pellet data were analyzed using Chi-square tests and Bonferroni confidence intervals (Byers et al. 1984; Zar 1984) to determine if the abundance of pellet groups from each species differed significantly among vegetation types. Where Chi-square tests were significant, Bonferroni confidence intervals were used to determine the relationship between a species and individual vegetation types (i.e., whether a certain vegetation type was significantly preferred or avoided).

2.5.4 Beaver/Muskrat Survey

The beaver/muskrat aerial survey was conducted on September 30, 2004 within the lease area and along the north shore of Christina Lake. During the survey, nine tributaries and 15 waterbodies within and surrounding the lease area were examined for signs of beavers and muskrats (Figure 2-4).



LEGEND

- MEG OIL SANDS LEASE
- EXISTING ACCESS ROAD
- CHRISTINA CARIBOU ZONE
- TERRESTRIAL RESOURCES LOCAL STUDY AREA
- WATERBODIES
- STREAMS AND RIVERS
- ACTIVE BEAVER LODGE
- ACTIVE BEAVER DAM
- FOOD CACHE
- MUSKRAT PUSHUP

3 0 3
SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT

TITLE

BEAVER/MUSKRAT AND WATERFOWL AERIAL SURVEY LOCATIONS

MEG ENERGY CORP.

PROJECT 04-1334-001.7740			FILE No.	Beaver/Muskrat
DESIGN	WF	10/01/05	SCALE 1:150000	REV. 2
CADD	JEF	08/07/05		
CHECK	IGG	10/07/05		
REVIEW	TC	12/07/05		

FIGURE: 2-4

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The beaver and muskrat survey followed the methods recommended by Salter and Duncan (1986). All waterbodies and major tributaries were examined for beaver and muskrat sign by three observers from a helicopter. Survey height and speed varied but the typical heights and speeds were 10 m above ground level at 30 km/h above lakes, and 50 m above ground level at 50 km/h above creeks and drainages.

Recorded data included sightings of active and inactive beaver lodges, beaver food caches, beaver dams, muskrat houses, muskrat feeding platforms, muskrat push-ups and sightings of individuals. A GPS location was recorded for each sighting. Only sightings of active beaver lodges and muskrat push-ups were used to calculate beaver and muskrat densities. Dams and food caches are associated with active beaver lodges and muskrat feeding platforms are associated with push-ups.

2.5.5 Bat Surveys

Bat surveys were conducted by capturing bats in mist nets to determine species presence/not detected and by recording echolocation calls to assess activity levels. The purpose of the bat survey was to describe species occurrence, relative activity and habitat preferences of bats within the various vegetation types.

The survey was conducted from August 5 to 7, 2004 in the lease area. The timing of the survey corresponded with the time when young of the year are likely to be flying but before migration to hibernacula has occurred.

2.5.5.1 Capture

Mist nets were set according to recognized guidelines (Vonhof and Hobson 2001) in habitats where capture was likely (e.g., over small streams or channels, beaver ponds and dams and roads or trails surrounded by dense vegetation). In total, five mist netting sites were set in three vegetation types (Table 2-6, Figure 2-5). To prevent the capture of birds in the area, mist nets were opened at sunset. The nets remained open for 2.5 to 3 hours depending on bat activity and weather conditions. Mist net hours are calculated based on the number of active hours per 6 m wide net. For example, a double-high 6 m wide net open for two hours equals four mist net hours. Species, age, sex, forearm length, mass and reproductive condition were recorded for each bat captured.

2.5.5.2 Ultrasonic Detection

Relative bat activity was measured using AnabatII remote systems that consisted of an AnabatII detector (Titley Electronics, Ballina, Australia) connected to a tape recorder (Optimus CTR-116). Detectors were oriented at a 45^{o} angle in order to capture activity from above. Recorder systems were housed in weatherproof containers and mounted 1 m off the ground. Eight bat detectors were established in five vegetation types (Table 2-6, Figure 2-5). Detector/recorder set-ups were generally placed on a narrow cutline in the targeted vegetation type, set a minimum of 50 m from netting areas and were at least 50 m from ecotones. In the case of waterbodies and watercourses, detectors were placed at the edge of the waterbody and directed over the waterbody/watercourse.

Monitoring began at sunset and continued for a minimum of 2.5 hours to capture the period of maximum foraging activity after sunset (Patriquin 2001; Crampton and Barclay 1998).

Table 2-6 Vegetation Types Sampled During Bat Surveys

Ecosite Phases/Wetlands Types[(a)]	Map Code	Mist Net Plots	Mist Net Hours	Detector Plots	Detector Hours
Labrador tea-mesic jack pine-black spruce	c1	-	-	1	4.8
low-bush cranberry aspen-white spruce	d2	-	-	1	4.7
treed bog	BTNN	-	-	1	4
treed fen	FTNN	1	8.5	3	11.9
shrubby swamp	SONS	1	3.0	-	-
graminoid marsh	MONG	3	12.8	-	-
shallow open water	WONN	-	-	1	4.4
Total		**5**	**24.3**	**7**	**29.8**

(a) Beckingham and Archibald (1996) and Vitt et al. (1997).

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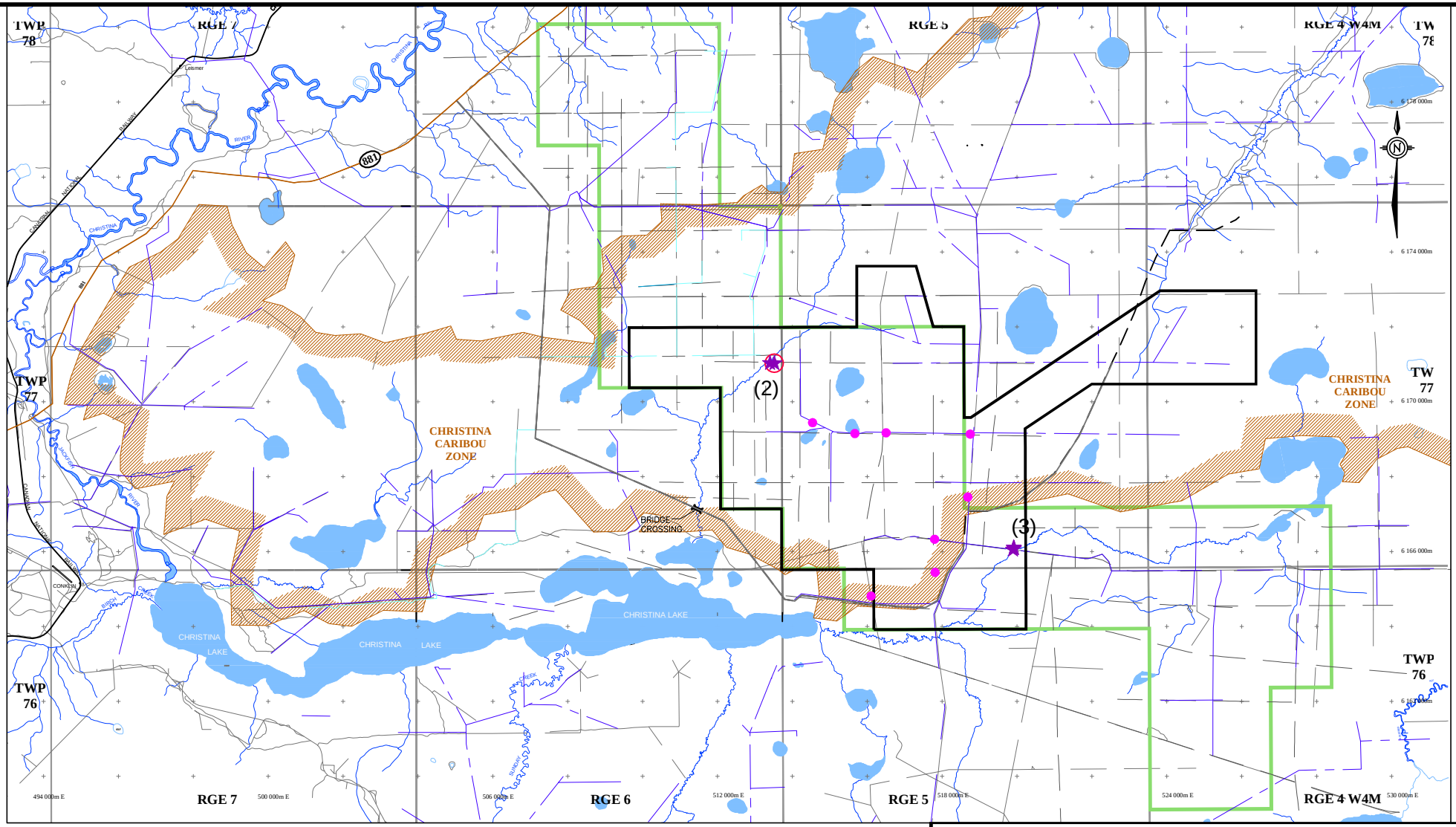

LEGEND

- MEG OIL SANDS LEASE
- EXISTING ACCESS ROAD
- CHRISTINA CARIBOU ZONE
- TERRESTRIAL RESOURCES LOCAL STUDY AREA
- BAT DETECTOR LOCATIONS
- BAT NETTING LOCATIONS
- LITTLE BROWN BAT

3 0 3
SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT

TITLE

BAT SURVEY LOCATIONS AND OBSERVATIONS

MEG ENERGY CORP.

PROJECT 04-1334-001.7740			FILE No. Bat Survey Locations	
DESIGN	WF	10/01/05	SCALE 1:150000	REV. 2
CADD	JEF	08/07/05	FIGURE: 2-5	
CHECK	IGG	10/07/05		
REVIEW	TC	12/07/05		

When bats echolocate they produce a series of vocalizations known as calls. A sequence of calls is known as a single pass. A single pass can be divided into three phases. The beginning of the sequence is the "search phase". As a bat explores a foraging area, the calls are longer in duration and the time between calls is longer. If a bat detects an object, the calls enter the "approach phase", where calls are produced more quickly to provide the bat with information about the object. If the object is suitable prey, the bat then produces a "terminal feeding buzz", a rapid burst of echolocation calls to provide precise information about the insect.

The number of passes detected per unit time provides an index of relative bat activity for plot locations. The number of feeding buzzes detected was used as a relative measure of foraging activity at the plot locations (Griffin et al. 1960).

Call Analysis

Passes recorded on tape were transformed to a visual frequency-time display using a zero crossing analysis interface module (Titley Electronics). Echolocation call characteristics are believed to be species specific (O'Farrell et al. 1999). Larger bat species, including hoary bats, silver-haired bats and big brown bats produce echolocation calls that end around 25 kHz. These calls can be distinguished from smaller species, such as red bats and *Myotis* spp., whose echolocation calls typically end around 35 to 40 kHz.

Big brown and silver-haired bat calls are too similar to be distinguished from each other but can be distinguished from other species; whereas hoary and red bats have unique call features that can be used to identify them from each other plus other species. Because the calls of *Myotis* spp. are so similar, no identification beyond the genus level is possible using zero crossing analysis. To distinguish between and to identify bat species, several variables of search phase calls were measured, including; maximum frequency (the highest frequency of a call), minimum frequency (the lowest frequency of a call), duration, and slope. From these parameters, simple slope was calculated as the difference between the minimum and maximum frequency divided by the duration. The characteristic slope of the call was also calculated, which is the slope of the flattest part (body) of the call.

Call characteristics were then compared to reference calls from the literature (Adams 2003) and from a pre-existing library of echolocation passes obtained from the Anabat System Manual (Corben and O'Farrell 1999), a study conducted in similar habitat and at similar latitude (Patriquin 2001). The use of local reference calls, where possible, minimized potential differences in calls due to geographic variation. A set of criteria established for discriminating between

background noise and calls was used to ensure consistent, accurate measurement of call variables (Patriquin 2001) and the assignment of calls.

2.6 BIRD SURVEYS

2.6.1 Waterfowl and Waterbird Aerial Surveys

Waterfowl aerial surveys to describe waterfowl distribution, abundance, and habitat use in the lease area and along the north shore of Christina Lake were conducted by helicopter on May 21 and 28, and September 19 and 30, 2004. Fifteen waterbodies and nine tributaries were surveyed (Figure 2-4). Waterbodies and watercourses to be surveyed within the lease area were delineated on topographic maps. Surveys were conducted between 7:00 a.m. and 12:00 p.m., during weather conditions that allowed for safe flying and maximum visibility. The helicopter flew at speeds of 50 to 100 km/h and at altitudes of 30 to 100 m above ground level. Survey teams consisted of three observers, recording observations from the front and each side of the helicopter. Communication between observers ensured that counts were not duplicated.

The surveys included observations of any waterfowl that were situated on, or that flew from, wetlands in the lease or LSA. Other data collected included wetlands type and transect number, time, weather conditions, vegetation type and water level. Vegetation along shorelines of all major waterbodies and tributaries was also scanned for raptor nests.

For the spring surveys, waterfowl were recorded according to breeding status. Birds were recorded as lone drakes (LD), flocked drakes (FD), pairs (P), groups (G) and hens (H). For most species, estimating the total number of individuals involved the following assumptions and calculations. The number of lone drakes was multiplied by two as it was assumed that the hen was on the nest. The number of flocked drakes was also multiplied by two because these birds were assumed to have mated earlier in the breeding season. However, these assumptions and calculations were not used to estimate the number of redheads, scaup or ring-necked ducks because the sex ratio in these species is typically male-biased (D. Caswell 1997: pers. comm.).

Waterfowl can be difficult to identify species in the fall because fall plumage is less conspicuous than spring or breeding plumage. For the fall surveys, if individuals could not be identified to species, ducks were identified as either dabbling ducks or diving ducks. Hen:drake calculations were not applied to the fall waterfowl survey data as mating occurs in the spring.

The number of waterfowl observed was compared with waterbody type and size to identify trends in both the spring and the fall surveys.

2.6.2 Owl Call Playback Survey

The owl call playback survey consisted of playing a series of owl calls from audio recordings to elicit responses to determine the presence of species within the lease area. This type of survey is currently the best known method to census owls in extensively wooded areas (Smith 1993) because owls are territorial and will respond to call playbacks, particularly during the breeding season. The calls of smaller owl species were played prior to larger owl species, as larger owls will depredate smaller owls. Playing the calls of larger owls will alert the smaller owls to danger causing them to remain silent or leave the area (Beck and Beck 1988; Takats et al. 2001). Owl calls were therefore played in the following order: boreal owl, great gray owl and barred owl. Other owls (e.g., northern hawk owls [*Surnia ulula*] and short-eared owls [*Asio flammeus*]) do not readily respond to call playback techniques so they were not included on the tape. The presence of these species was determined by visual searches in appropriate vegetation types immediately prior to and following the night-time call surveys. Calls were not played for the great horned owl as these owls readily respond to calls from other owl species.

The owl survey was conducted between April 5 and 7, 2004 within the lease area. A total of 49 survey plots were established in 13 vegetation types (Table 2-7, Figure 2-6). Survey locations were established throughout the study area at intervals of at least 1.5 km to avoid overlap of owl territories (Figure 2-6). Existing roads, trails and seismic lines throughout the lease area were travelled via all-terrain vehicle to access survey locations.

Table 2-7 Vegetation Types Sampled During the Owl Call Playback Survey

Ecosite Phases/Wetlands Types[(a)]	Map Code	Number of Plots
lichen jack pine	a1	2
blueberry jack pine-aspen	b1	1
blueberry white spruce-jack pine	b4	2
Labrador tea-mesic jack pine-black spruce	c1	7
low-bush cranberry aspen-white spruce	d2	3
low-bush cranberry white spruce	d3	1
dogwood balsam poplar-white spruce	e2	1
dogwood white spruce	e3	1
Labrador tea-subhygric black spruce-jack pine	g1	5
wooded bog	BTNN	6
shrubby fen	FONS	6
treed fen	FTNN	10
burned forest	burn	4
Total		**49**

[(a)] Beckingham and Archibald (1996) and Vitt et al. (1997).

During daylight hours, the surveyors identified the vegetation type for each plot to ecosite phases or wetlands type and recorded the location of the survey location with a GPS unit. Surveying was limited to between 0.5 hours after sunset until approximately 3 hours after sunset when the majority of detections can be expected (Takats et al. 2001). A compact disc/tape player was used to broadcast the owl calls. Following the standardized North American sampling protocol (Takats et al. 2001), each survey began with two minutes of silence to listen for calling owls. This was followed by 20 seconds of the first owl call, one minute of silence, 20 seconds of the second owl call, one minute of silence, and the pattern continued until all owl playbacks were completed. The survey ended with a three minute listening period to identify additional owl calls. During each playback, the tape player was turned in different directions (e.g., north, south, east and west) to provide complete coverage at a sampling location. To ensure the best possible results, the Alberta Owl Monitoring Program calls were used to elicit owl responses. The tape ran continuously throughout the call intervals of all species. During silent periods surveyors listened to detect any owls stimulated by the taped calls. Species type, number, direction and approximate distance of the calling owl from the survey (GPS) location were recorded.

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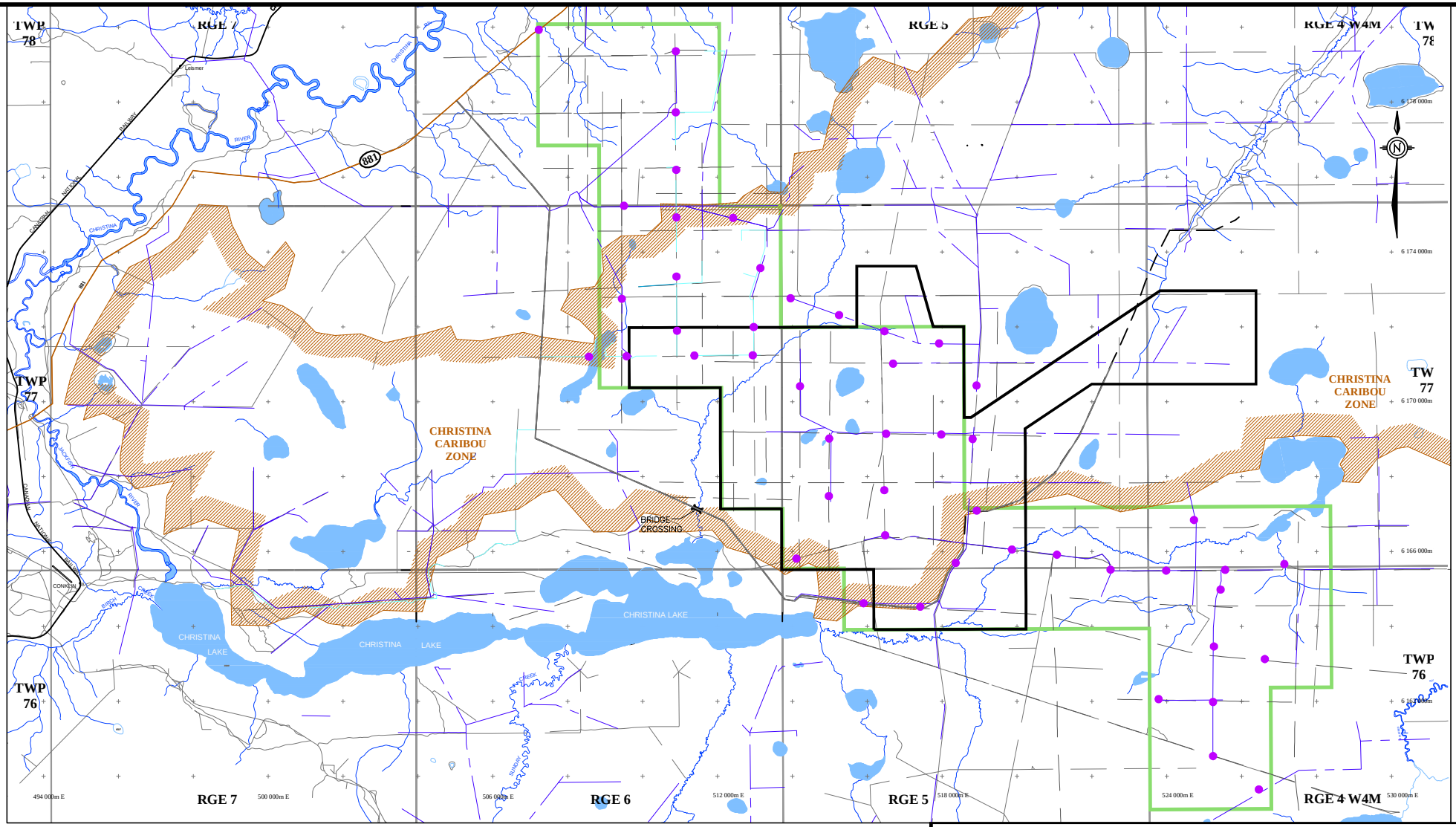

LEGEND

- MEG OIL SANDS LEASE
- EXISTING ACCESS ROAD
- CHRISTINA CARIBOU ZONE
- TERRESTRIAL RESOURCES LOCAL STUDY AREA
- OWL CALL SURVEY LOCATIONS

3 0 3
SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT

TITLE

OWL CALL SURVEY LOCATIONS

MEG ENERGY CORP.

PROJECT 04-1334-001.7740			FILE No.	Owl Call Survey
DESIGN	WF	10/01/05	SCALE 1:150000	REV. 2
CADD	JEF	08/07/05		
CHECK	IGG	10/07/05		
REVIEW	TC	12/07/05		

FIGURE: 2-6

Calls heard during the owl call playback surveys cannot be precisely located within a vegetation type. While the vegetation type of the call playback plot was recorded, calls that were heard from a distance could have come from another vegetation type. Despite this limitation, an attempt was made to determine the vegetation type each owl call came from by plotting the observation azimuth (i.e., the direction at which the owl was heard from) and distance from observer recorded during the survey onto vegetation cover maps. The uncertainty associated with the assignment of vegetation types precluded the use of statistical analyses of owl habitat use.

2.6.3 Raptor Ground Survey

Methods used during the raptor ground surveys (excluding owls) followed the Resources Inventory Committee standards (RIC 2001). Plots were established along cutlines accessed by all-terrain vehicles as well as along browse-pellet and breeding bird survey transects. A minimum distance of 500 m between plots was maintained to prevent counting an individual more than once; however, if raptors were observed in one plot, the next plot was situated 800 m away to minimize disturbance. Other wildlife observations, time, temperature, wind velocity, precipitation and location were also recorded for each survey location. A GPS unit was used to record the geographic location of each survey plot.

Call playback techniques were used to elicit raptor calls in plots surrounded by closed forest habitat. The call play-back technique was used to survey for the sharp-shinned hawk, Cooper's hawk (*Accipiter cooperii*), broad-winged hawk (*Buteo platypterus*) and northern goshawk (in that order). Surveyors waited two minutes before starting each call playback to listen for any spontaneously calling raptors. The sounds developed for the call playback tape included three 20 second intervals of calls for each species followed by a 30 second silence between calls. After each 30 seconds of silence, observers turned the recorder 120º to broadcast, listen and observe in a new direction. A waiting period of two minutes followed the last goshawk call. Species, number, habitat type of origin (i.e., nesting/roosting/hunting), distance and direction (azimuth) from the plot location of observed raptor species were recorded. When a response was elicited, the surveyors discontinued playing the call. Additional calls may frighten the bird, cause it to abandon or alter its territory, or it may alter the time budget of a bird which may interfere with critical breeding behavior (i.e., feeding, courtship, mating).

The call play-back surveys were conducted May 5 and 20, and June 23 to 24, 2004 within the lease area. The timing of the survey corresponded to the raptor breeding season, when raptor species are more territorial and are more likely to respond to calls to defend their territories. Surveys were conducted between 6:00

and 11:00 a.m., which is considered to be the optimum survey period (F. Doyle 2000; pers. comm). Surveying was not conducted when winds were greater than 16 km/h, or when it was raining or snowing, as these factors influence raptor behaviour and the ability of surveyors to hear calls. Inclement weather conditions led to the May 5 survey being re-scheduled. Twenty-two survey plots in six vegetation types were surveyed for raptors within the lease area (Table 2-8 and Figure 2-7).

Table 2-8 Number of Ground Raptor Call Playback Survey Plots by Ecosite Phases/Wetlands Types

Ecosite Phases/Wetlands Types[(a)]	Map Code	Number of Plots
Labrador tea-mesic jack pine-black spruce	c1	3
low-bush cranberry aspen-white spruce	d2	3
low-bush cranberry white spruce	d3	3
Labrador tea-subhygric black spruce-jack pine	g1	3
wooded bog	BTNN	3
treed fen	FTNN	7
Total		**22**

(a) Beckingham and Archibald (1996) and Vitt et al. (1997).

Raptors were only recorded if observed during the survey period. All other raptor calls or observations were recorded as incidental sightings.

2.6.4 Breeding Birds

The breeding bird survey was conducted June 23 and 24, 2004 in accessible areas within the lease. Point counts were used to describe species occurrence, relative abundance and habitat use of songbirds and other bird species within the various vegetation types.

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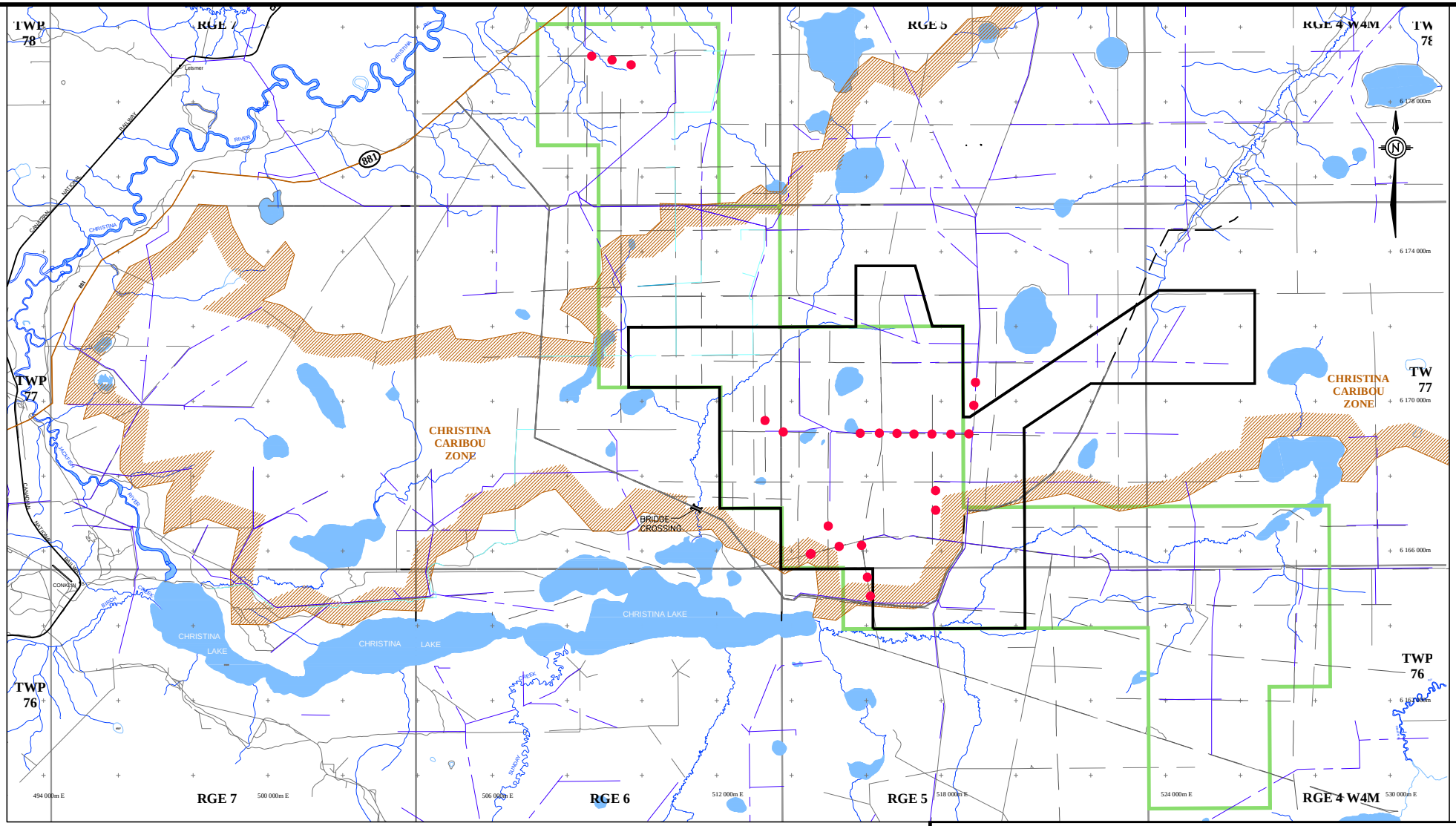

LEGEND

- MEG OIL SANDS LEASE
- EXISTING ACCESS ROAD
- CHRISTINA CARIBOU ZONE
- TERRESTRIAL RESOURCES LOCAL STUDY AREA
- CALL SURVEY LOCATIONS

3 0 3
SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT

TITLE

RAPTOR CALL PLAYBACK SURVEY LOCATIONS AND OBSERVATIONS

MEG ENERGY CORP.

PROJECT 04-1334-001.7740			FILE No. Raptor Call Survey	
DESIGN	WF	10/01/05	SCALE 1:150000	REV. 2
CADD	JEF	08/07/05		
CHECK	IGG	10/07/05		
REVIEW	TC	12/07/05		

FIGURE: 2-7

Surveys were conducted using standard point-count methods (Ralph 1993), consistent with the North American Breeding Bird Survey. Surveys commenced approximately one half-hour before dawn and ended no later than 10:00 a.m. Point counts were conducted a minimum of 100 m from roads and a minimum of 50 m from cutlines. Point count stations were established along transects a minimum of 250 m apart. A compass was used to navigate along a pre-determined compass bearing and a GPS unit was used to record plot location. The first point count location was randomly chosen and was accessed using an all-terrain vehicle. Point count locations are shown in Figure 2-8. At each point count station, the observer waited two minutes to allow the birds to adjust to the observer's presence. A five-minute survey period followed when all species heard or observed were recorded. Observations were divided into those species located within 50 m and species located further away, and those heard within the first three minutes and those heard in the following two minutes.

At each point count location, the date, time, observer, point count number, vegetation type and GPS location were recorded. The survey was not conducted during periods of high winds (i.e., Beaufort Scale greater than 5; trees in leaf sway) or inclement weather that would reduce the likelihood of identifying species. The approximate position of each bird in relation to the observer was illustrated on a sketch map of the point count station. In addition, the abbreviated species name, the sex of individuals and movements of individuals around the point count station were recorded. In total, 57 point counts were conducted in seven ecosite phases/wetland types (Table 2-9, Figure 2-8).

Table 2-9 Number of Breeding Bird Point Counts by Vegetation Type

Ecosite Phases/Wetlands Types[(a)]	Map Code	Number of Point Counts
blueberry jack pine-aspen	b1	1
Labrador tea–mesic jack pine-black spruce	c1	8
low-bush cranberry aspen-white spruce	d2	17
Labrador tea–subhygric black spruce-jack pine	g1	1
wooded bog	BTNN	9
treed fen	FTNN	20
shrubby swamp	SONS	1
Total		**57**

[(a)] Beckingham and Archibald (1996) and Vitt et al. (1997).

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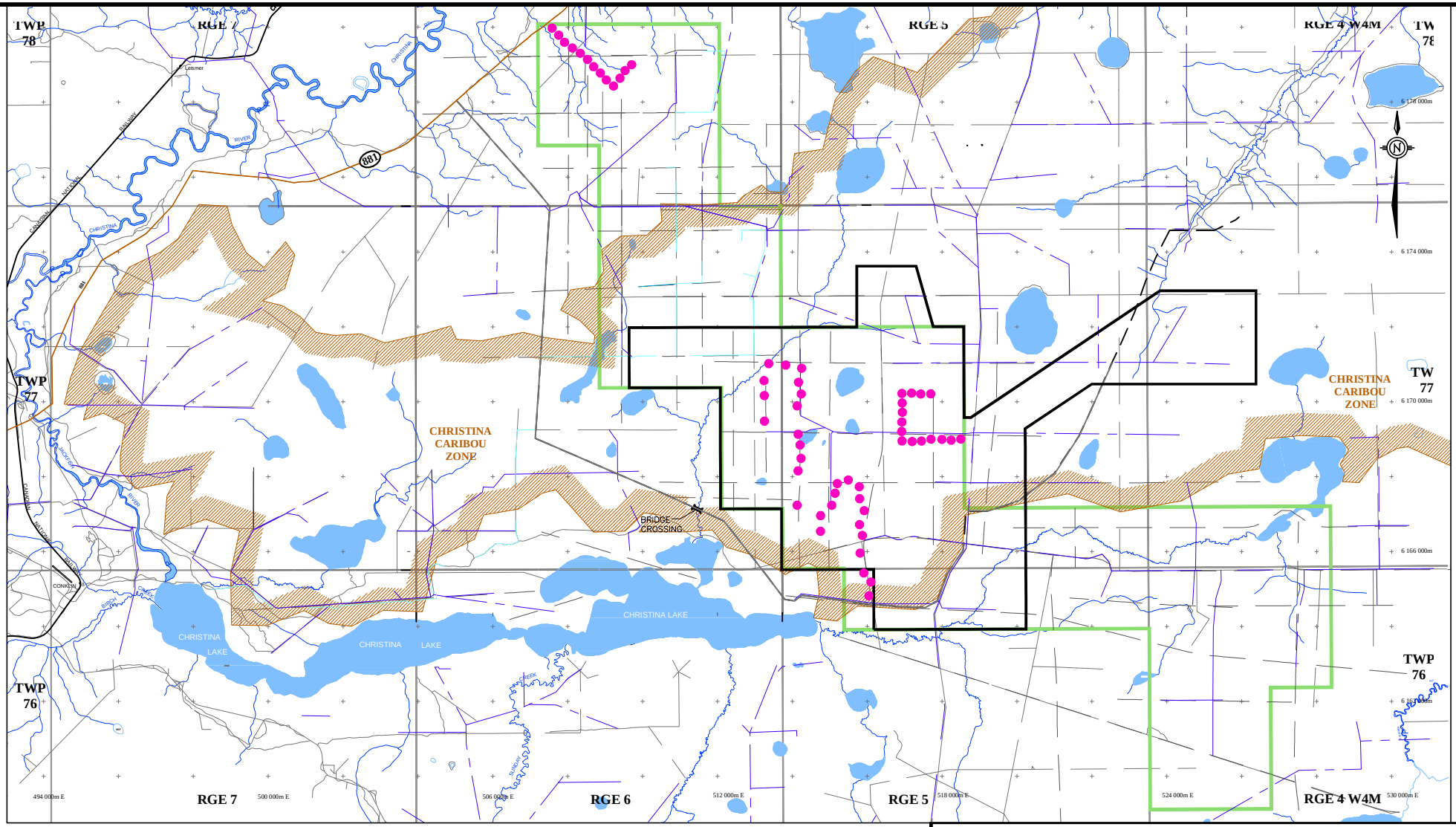

LEGEND

- MEG OIL SANDS LEASE
- EXISTING ACCESS ROAD
- CHRISTINA CARIBOU ZONE
- TERRESTRIAL RESOURCES LOCAL STUDY AREA
- POINT-COUNT LOCATIONS

3 0 3
SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT

TITLE

BREEDING BIRD SURVEY LOCATIONS

MEG ENERGY CORP.

PROJECT 04-1334-001.7740			FILE No. Breeding Bird Survey	
DESIGN	WF	10/01/05	SCALE 1:150000	REV. 2
CADD	JEF	08/07/05		
CHECK	IGG	10/07/05		
REVIEW	TC	12/07/05		

FIGURE: 2-8

Only observations recorded within 50 m were used in the analysis of the data; those greater than 50 m were used for species presence/not detected calculations. The maximum number of detections between the two observation periods (i.e., one to three minutes and three to five minutes) was used in the statistical analysis. Due to the low number of detections for many species, point counts were pooled by vegetation type.

Those species flying through or above the canopy were also recorded. These observations were not included in the analysis but were included in the species presence/not-detected calculations. The movements of the identified species were carefully monitored to minimize the probability of recounting the birds within the same or adjacent plot.

Bird species richness and diversity were calculated using the Shannon-Weiner Index. All bird species detected (except waterfowl and raptors) were used to calculate species richness and diversity for each plot. A one-way analysis of variance (ANOVA) was performed to determine if mean breeding bird richness and diversity per plot were different among vegetation communities. Stand age was not included in these analyses.

Classification of Bird Species and Vegetation Community

Two-way indicator species analysis (TWINSPAN) was performed to classify bird species and vegetation communities. For each vegetation community, the total number of detections for each species was calculated. To weight common and uncommon species equally, data were standardized by dividing the number of detections for a species in a given vegetation community by the maximum number of detections for that species (i.e., standardized values range from 0 to 1). Subsequently, the transformed values were ranked according to the following categories:

- "0" = 0;
- "1" = >0 to 0.10;
- "2" = >0.10 to 0.20;
- "3" = >0.20 to 0.30;
- "4" = >0.30 to 0.40;
- "5" = >0.40 to 0.50; and
- "6" = >0.50 to 1.00.

Thus, each species received a rank based on the relative frequency of occurrence within each vegetation community. These rank scores provide an index of species relative abundance among vegetation communities. Based on the ranked

data, TWINSPAN successively divides species and vegetation communities into smaller groups. Divisions among species groups are based on the species preferences for vegetation type, while separation of vegetation communities is based on the relative abundance in bird species.

2.7 AMPHIBIAN SURVEYS

2.7.1 Amphibian Call Surveys

Amphibian call surveys were conducted to describe amphibian occurrence, relative abundance and habitat preferences in the lease area. A variety of wetlands types and some upland vegetation types were sampled within the lease area to determine habitat use of amphibians. Surveys were conducted May 17 to 19, and June 8 to 10, 2004. Each plot was visited twice during the breeding season to minimize temporal error in identifying amphibian species caused by surveying wetlands too early or too late in the breeding season.

Survey effort was dispersed across the lease area to the maximum extent possible, given the wet and relative inaccessibility of much of the area (Figure 2-9). During daylight hours, plots were selected and information was recorded on waterbody type, distance across waterbody, water temperature, pH, substrate, water depth, surrounding vegetation, nearest sandy soil and GPS waypoint. The wetlands margin at each plot location was searched for signs of amphibians, including egg masses and tadpoles, as well as non-calling species (e.g., salamanders) during daylight hours. Survey plots were located along cutlines and roads at a minimum of 250 m apart to avoid overlap and to ensure that sufficient wetlands were sampled. Plots were accessed using all-terrain vehicles.

Auditory surveys began 0.5 hours after sunset following the protocol used for the North American Amphibian Monitoring Program (AEP and ACA 1997). For each plot, the survey began a minimum of one minute following the surveyors' arrival to allow amphibians to resume activity. The survey consisted of listening for calls of breeding males for ten minutes. Individual amphibian species were identified based on their distinctive calls. An estimate of breeding chorus size was determined by rating the chorus on the following call index scale (Heyer et al. 1994):

- 0: no calls;
- 1: one individual;
- 2: few (some overlapping of calls, but individuals can still be counted);
- 3: several (calls distinguishable but overlapping); and
- 4: large numbers (full continuous chorus).

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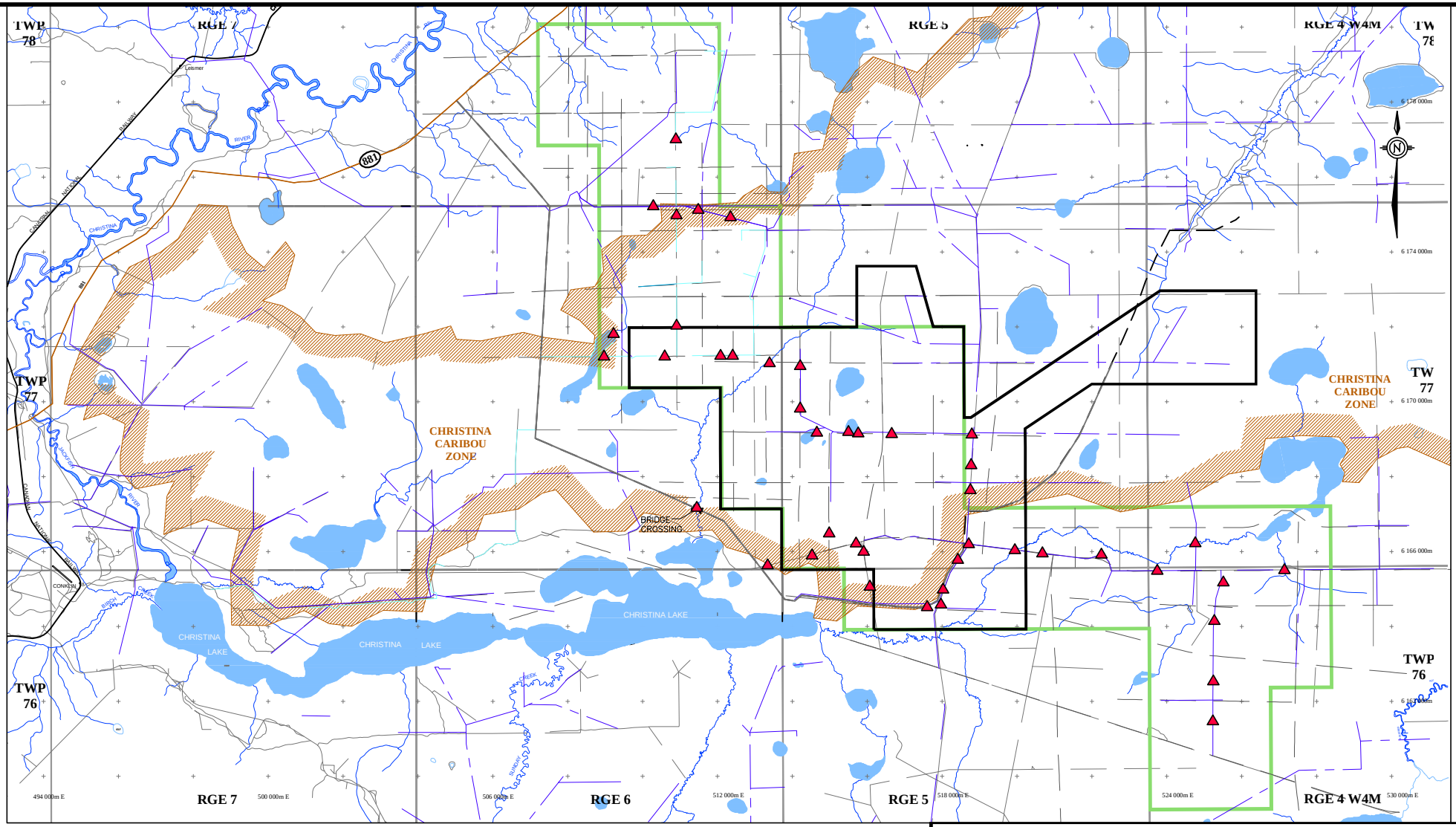

LEGEND

- MEG OIL SANDS LEASE
- EXISTING ACCESS ROAD
- CHRISTINA CARIBOU ZONE
- TERRESTRIAL RESOURCES LOCAL STUDY AREA
- SURVEY PLOT LOCATIONS

3 0 3
SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT

TITLE

AMPHIBIAN SURVEY LOCATIONS

MEG ENERGY CORP.

PROJECT 04-1334-001.7740			FILE No. Amphibian Survey	
DESIGN	WF	10/01/05	SCALE 1:150000	REV. 2
CADD	JEF	08/07/05		
CHECK	IGG	10/07/05		
REVIEW	TC	12/07/05		

FIGURE: 2-9

Calls were further divided on the basis of location. Waterbody types sampled included creeks, lakes/ponds, rivers and standing water (e.g., on cutlines or within wetlands). In total, 40 plots in 11 vegetation types were surveyed (Table 2-10).

Amphibians respond to environmental conditions, including temperature and rainfall. For this reason, weather conditions (air and water temperatures, wind speed, cloud cover and precipitation) were recorded at each site. Surveys were discontinued if air or water temperatures, or wind conditions were judged to interfere with amphibian calls or call perception. Weather conditions were favourable during all amphibian call surveys.

Throughout the survey, all other wildlife sightings (e.g., observations of individuals, nests, roosting sites, feeding sites) were recorded.

Table 2-10 Number of Amphibian Survey Plots by Vegetation Types

Waterbody Type	Ecosite Phases/Wetlands Types[(a)]	Map Code	Number of Plots
creek	blueberry jack pine-aspen	b1	1
	wooded bog	BTNN	1
	wooded fen	FTNN	1
	graminoid marsh	MONG	1
	shrubby marsh	MONS	2
cutline	shrubby marsh	MONS	2
	disturbed cutline	dist	1
lake/pond	lichen jack pine	a1	1
	wooded fen	FTNN	4
river	shrubby marsh	MONS	1
standing water	lichen jack pine	a1	1
	blueberry aspen-white spruce	b3	1
	dogwood balsam poplar-white spruce	e2	1
	wooded bog	BTNN	2
	treed fen	FTNN	9
	graminoid marsh	MONG	1
	shallow open water	WONN	1
	disturbed-cutline	dist	9
Total			**40**

[(a)] Beckingham and Archibald (1996) and Vitt et al. (1997).

2.8 INCIDENTAL WILDLIFE SIGHTINGS

All incidental wildlife sightings including observations, calls, sign and/or scat were recorded during each wildlife survey. These observations have been compiled in Appendix II. The geographic location of any observed 'At Risk', 'May Be At Risk' or 'Sensitive' species (COSEWIC 2004; ASRD 2001) were recorded with a GPS unit. These observations were plotted, including incidental woodland caribou observations.

2.9 IMPORTANT WILDLIFE AREAS

Determination of important wildlife habitat included the following:

- a literature review, including Significant Natural Features/Areas (Westworth 1990), key ungulate zones and caribou management areas adjacent to or within the LSA;
- a review of data collected for this study; and
- determination of important vegetation types within the biodiversity framework.

Several wildlife diversity indices were used to determine important vegetation types for terrestrial vertebrates and baseline fragmentation of the landscape. These indices were used, along with vegetation and terrain indices, in the regional biodiversity ranking as a measure of overall biodiversity for the Oil Sands Region.

2.9.1 Wildlife Movement Corridors

Wildlife movement corridors are important linkages between areas of undisturbed habitat among anthropogenic developments within a region. Animals require corridors for maintaining genetic diversity and population viability. The frequency of use of movement corridors varies greatly among wildlife species. The variation of corridor use varies from once in a lifetime (e.g., during dispersal) to seasonal movements and daily usage (e.g., during daily foraging). Although corridors may not provide suitable habitat for every life requisite of a species (e.g., food and shelter), they may provide the opportunity to move among different habitats so that life requisites can be met (CEMA 2004).

Important wildlife movement corridors occurring within and in proximity to the LSA were assessed based on winter track data and from previous research conducted for the EnCana Project (Golder 2004a) and the Devon Jackfish Project

(Devon 2004). Additionally, the composition and configuration of riparian zones were analyzed for the LSA because these areas may provide movement corridors for wildlife.

2.9.2 Potential Species Richness by Vegetation Type

Richness (number of species) within a vegetation type is a simple measure of diversity. Species richness indices are essentially a measure of the number of species in a sampling unit (Magurran 1988).

To estimate the total species richness of terrestrial vertebrate species (mammal, bird, amphibian, reptile) for each vegetation type, the wildlife species potential was based on habitat associations derived from regional field surveys, professional judgement and the literature, particularly Semenchuk (1992), Smith (1993), and Russell and Bauer (2000). Detailed tables by species group are presented in Appendix II of the Biodiversity Environmental Setting Report (ESR) (Golder 2005a).

The habitat preferences for each species were categorized according to the regional vegetation classes identified from remote sensing imagery. All vegetation types within a regional vegetation class were considered as equivalent because each regional vegetation class is comprised of one or more vegetation types. More details regarding the vegetation classification are presented in the Terrestrial Vegetation and Wetlands ESR (Golder 2005b) and the Biodiversity ESR (Golder 2005a).

Based on the number of species expected to occur in each vegetation type, a richness index was calculated on a scale of 0 to 1. The index reflects the relative richness of potential terrestrial vertebrate species for easy comparison among vegetation types. All vegetation types were evaluated against the vegetation types with the highest species richness value. The relative species richness of terrestrial vertebrate species for each vegetation type was one of the indices used to rank ecosite phases and wetlands types for biodiversity values, as described in the Biodiversity ESR (Golder 2005a).

2.9.3 Habitat Specificity

Habitat specificity refers to the range of habitats that each species is expected to occupy. Some species may not be rare but may only use a narrow range of vegetation types. In addition, some species may use a variety of habitats but for different activities (e.g., foraging and breeding) so vegetation types are not necessarily interchangeable with respect to function.

The number of habitats in which each species was expected to occur was determined from the habitat association tables created for the Oil Sands Region (Golder 2000a). However, vegetation types cannot be ranked because habitat specificity is considered from the species perspective, so these lists were used to create the species overlap results. When completing an impact assessment, it is also valuable to identify the species that occupy only a few vegetation types.

2.9.4 Species Overlap Among Vegetation Types

The proportion of vertebrate species in a vegetation type that are found in other vegetation types provides another measure of habitat specificity. Species common within vegetation types is referred to as species overlap. A vegetation type could be rare in the Oil Sands Region and also contain a high proportion of species that are not found in other ecosystems. The combined score for this vegetation type would be higher than the score for a vegetation type that is rare, but contains a high proportion of species that are also found in other ecosystems. Species overlap was determined for terrestrial and aquatic vertebrates based on the tables developed for species richness and habitat specificity. The number of unique species and the proportion of species that occur in fewer than five other vegetation types were used as an indicator of generalist (i.e., species which uses a variety of habitats) and specialist (i.e., species restricted to less than five vegetation types) species.

2.9.5 Landscape-Level Indicators

Fragmentation analyses is a key method used to assess landscape-level biodiversity potential in the RSA and LSA. The definitions of fragmentation and a description of the specific methods for each analysis and their relation to biodiversity indicators are presented in Appendix I of the Biodiversity ESR (Golder 2005a). Fragmentation analyses were completed to examine how the landscape is partitioned, with respect to natural versus disturbed areas and anthropogenic versus natural disturbance. Fragmentation metrics calculated included class area, number of patches, patch area mean, patch area median, patch size standard deviation, patch size coefficient of variation, total edge, mean patch fractal dimension and mean nearest neighbor.

The natural versus disturbed areas analysis examined how the natural landscape has been divided by baseline disturbance. Natural disturbance areas used in the analysis were defined to include natural areas, water, burns and the disturbance category includes all human-disturbed areas.

The human versus natural disturbance analysis examined the variation in pattern of anthropogenic and natural disturbances. The only natural disturbance measured was burns. The anthropogenic disturbance category included cutblocks, urban (e.g., roads, gravel pits, power lines, municipalities) and industrial (e.g., oil sands facilities and associated infrastructure, gas plants, seismic lines, railways) developments.

2.10 SPECIES OF CONCERN

Species of concern are defined by provincial and federal government agencies. The status of wildlife in Alberta has been ranked nationally (COSEWIC 2004), provincially (ASRD 2001) and regionally (Westworth 2002). At the provincial level, these species are designated as Sensitive, May Be At Risk and At Risk (ASRD 2001). At the federal level species are designated as Endangered, Threatened, Special Concern (vulnerable) or Data Deficient (indeterminate) (COSEWIC 2004). Definitions for status rankings are presented in Section 10.

Key Indicator Resources (KIRs) were selected using the criteria established by CEMA (2001). Criteria used to select wildlife KIRs included the species biological vulnerability, socio-economic importance and logistics. Biological vulnerability criteria included population status, ecological role, sensitivity to development, regulatory importance and habitat specificity. Socio-economic criteria included traditional and cultural importance, subsistence economic importance and consumptive recreational importance. Finally, logistical criteria included ease of monitoring and likelihood of detecting change among a population.

The wildlife species, or species groups, selected as KIRs for the Project included; woodland caribou, moose, black bear, lynx/snowshoe hare, fisher/small mammal, muskrat, beaver, river otter, Canadian toad, ruffed grouse, boreal owl, ducks and geese, pileated woodpecker, old growth forest bird community and the mixedwood forest bird community (Table 2-11). Discussion will focus on these species throughout this report. Habitat for these species will be assessed within the LSA through habitat resource selection determination and within the RSA through habitat suitability index modelling.

Table 2-11 Wildlife Key Indicator Resources Selected for Key Indicator Resources

Mammals	Birds	Amphibians
woodland caribou	ducks and geese	Canadian toad
moose	ruffed grouse	
lynx/snowshoe hare	boreal owl	
black bear	pileated woodpecker	
fisher/small mammal	old growth forest bird community	
muskrat	mixedwood forest bird community	
beaver		
river otter		

3 RESULTS - MAMMALS

3.1 UNGULATES

Ungulates within the LSA include woodland caribou, moose and deer (white-tailed and mule deer [*Odocoileus hemionus*]). Woodland caribou are listed as "At Risk" provincially (ASRD 2001) and 'threatened' nationally (COSEWIC 2004).

3.1.1 Browse Availability and Use

Sixty-four browse plots were sampled in 14 ecosite phases/wetlands types (Table 3-1; Figure 2-4). Results from the browse surveys are shown in Table 3-1. The graminoid fen (FONG) wetlands type provided the most ungulate browse, followed by the low-bush cranberry aspen (d1), blueberry white spruce-jack pine (b4), and the low-bush cranberry aspen-white spruce (d2) ecosite phases, recently burned forest, and the treed fen (FTNN) wetlands type. The amount of available browse cover in these habitats ranged from 26% to 70%. The lichen jack pine (a1) and blueberry aspen (white birch) (b2) ecosite phases provided no available browse.

Table 3-1 Ungulate Browse Utilization by Ecosite Phases/Wetlands Types

Ecosite Phases/Wetlands Types[c]	Map Code	N[a]	Percent Browse Available	Tukey Grouping[b]	Percent Browsed	Tukey Grouping[b]
			%±SE		%±SE	
lichen jack pine	a1	1	0.0±0.0	AB	0.0±0.0	AB
blueberry jack pine-aspen	b1	2	10.0±1.58	AB	1.0±0.50	A
blueberry aspen (white birch)	b2	1	0.0±0.0	AB	0.0±0.0	AB
blueberry white spruce-jack pine	b4	1	40.0±0.0	AB	0.0±0.0	AB
Labrador tea-mesic jack pine-black spruce	c1	9	5.6±0.31	A	0.56±0.14	A
low-bush cranberry aspen	d1	5	52.0±0.77	B	11.2±0.63	B
low-bush cranberry aspen-white spruce	d2	2	30.0±1.58	AB	5.0±1.12	AB
Labrador tea-subhygric black spruce-jack pine	g1	5	8.0±0.68	A	0.0±0.0	A
wooded bog	BTNN	23	6.5±0.16	A	0.0±0.0	A
treed fen	FTNN	8	25.6±0.60	AB	0.0±0.0	A
graminoid fen	FONG	1	70.0±0.0	B	0.0±0.0	AB
Treed swamp	STNN	1	40.0±0.0	AB	0.0±0.0	AB
burned forest	burn	4	27.5±1.25	AB	1.3±0.37	A
Disturbed-wellsite	wellpad	1	20.0±0.0	AB	3.0±0.0	AB
Total		**64**				

[a] N = Number of replicates for each habitat type.
[b] Tukey groupings; habitats with means that are not significantly different have the same letters. AB habitats are not significantly different from either A or B groups.
[c] Beckingham and Archibald (1996) and Vitt et al. (1997).

Highest browse utilization was observed in the low-bush cranberry aspen (d1) ecosite phases, followed by the low-bush cranberry aspen-white spruce (d2) ecosite phases. The remaining ecosite phases and wetland types received little or no browse activity. Statistical analysis of the browse data to determine preference or avoidance of different habitat types could not be completed as sample sizes in all vegetation types were too small.

3.1.2 Woodland Caribou

3.1.2.1 Ungulate Aerial Survey

No woodland caribou were observed within the lease area during the ungulate aerial survey. Although tracks were suspected during the aerial survey, poor tracking conditions prevented track verification to species.

3.1.2.2 Winter Track Count Surveys

During the winter track count survey, 68.5 km-days were sampled in 21 ecosite phases/wetlands types and disturbance areas (Figure 2-1; Appendix IV, Table IV-1). No woodland caribou tracks were observed during the early winter tracking survey. Thirty-five caribou tracks (and associated cratering activity) were observed during the late winter tracking survey. Chi-squared results indicated that caribou significantly preferred the treed fen (FTNN) wetlands type and avoided the wooded bog (BTNN) wetlands type (χ^2=10.3, df=2, $p<0.05$) (Appendix IV, Table IV-2).

Woodland caribou track density was 0.51 tracks/km-track day for the combined early and late winter tracking periods (Appendix IV, Table IV-1). Within the Oil Sands Region, caribou track count survey results have ranged from no tracks to 2.1 tracks/km-track day (Appendix III; Table III-7). Leases immediately south of the Project reported no caribou tracks during winter track count surveys completed in 2002 and 2003 (Devon 2004; Golder 2004a). However, additional track surveys completed as part of the Devon Jackfish Project in 2003, north of Christina Lake, indicated winter caribou use of the area (J. Kansas 2005: pers. comm.).

3.1.2.3 Pellet Group Count Results

Two hectares (0.02 km^2) were assessed for pellet groups in 14 ecosite phases/wetland types (Figure 2-3; Table 2-5). Wooded bog (BTNN) comprised approximately 0.8 ha (36%) of the total area assessed. Labrador tea-mesic jack pine-black spruce (c1), low-bush cranberry aspen (d1), treed fen (FTNN) and Labrador tea-subhygric black spruce-jack pine (g1) ecosite phases/wetlands types

each covered between 0.15 and 0.28 ha (8% and 14%) of the total area surveyed. The remaining 9 ecosite phases/wetlands types all had minimal coverage (Table 2-5).

No woodland caribou pellet groups were recorded during the survey. The lack of observed caribou pellets may be a reflection of the low sampling effort which resulted due to poor weather conditions (i.e., snow cover). By contrast, sixty-eight winter and 38 spring/summer caribou pellet groups were observed north of Christina Lake by Ursus Environmental in 2003 (Devon 2004). Pellet surveys completed for both the EnCana Christina Lake Thermal Project and the Devon Jackfish Project indicated that caribou were a common winter and summer resident in the area south of Christina Lake (Devon 2004; Golder 2004a).

3.1.2.4 Habitat Requirements

The LSA is situated within the Christina Caribou Area, one of several caribou herds that comprise the East Side of the Athabasca Caribou Range (ESAR) (Dzus 2000). The LSA provides suitable habitat for caribou (approximately 70% of LSA is comprised of peatlands), as this species primarily selects peatland-dominated landscapes such as black spruce bogs and black spruce - tamarack fens, while typically avoiding upland areas (Stuart-Smith et al. 1997; Anderson 1999). Caribou in northeastern Alberta also select upland jack pine ridges containing a high abundance of lichens (Schneider et al. 2000). Caribou have been historically recorded in the lease area (BSOD 2004).

Within the LSA, caribou tracks and feeding craters were observed within treed fen (FTNN), Labrador tea-mesic jack pine-black spruce (c1), Labrador tea-subhygric black spruce-jack pine (g1), lichen jack pine (a1) and shrubby fen (FONS) ecosite phases/wetlands types and along disturbed-cutlines. Backtracking indicated that caribou were using the cutlines for movement and foraging in adjacent habitat patches (J. Kansas 2005: pers. comm).

South of the LSA, within the Encana Christina Pilot Project Area, caribou pellets were observed more often than expected within treed fens (FTNN) and >500 m distances from disturbances (Golder 2004a). Within the Devon Jackfish LSA, the majority of winter caribou pellets were observed within treed fens (FTNN), dogwood white birch (e3), blueberry white spruce-jack pine (b4), horsetail balsam poplar-white aspen (f1), graminoid fen, shrubby fens, lichen jack pine (a1) and dogwood balsam poplar – white spruce (e2) ecosite phases (Devon 2004).

3.1.3 Moose

3.1.3.1 Ungulate Aerial Survey

Six moose were observed during the aerial survey (Figure 2-2, Table 3-2). Moose density within the surveyed area was 0.07 moose/km^2. The cow:calf ratio was 1:0.25. Moose were recorded in low-bush cranberry aspen (d1), low-bush cranberry aspen – white spruce (d2), in open water (WONN) and in burnt, shrubby fen (FONS) ecosite phases/wetlands types.

Table 3-2 Number of Moose Observations Recorded During the Aerial Survey (2004)

Ecosite Phases/Wetlands Types[(a)]	Map Code	Number of Moose			
		Cow	Calf	Bull	Total
low-bush cranberry aspen	d1	2	1	0	3
low-bush cranberry aspen–white spruce	d2	1	0	0	1
open water	BTNN	1	0	0	1
shrubby fen	FONS	0	0	1	1
Total		**4**	**1**	**1**	**6**

(a) Beckingham and Archibald (1996) and Vitt et al. (1997).

The density of moose reported in this survey falls within the range of densities reported for other studies in the vicinity of the Project (Appendix III, Table III-1). These densities have ranged from 0.01 moose/km^2 to 0.37 moose/km^2 (mean = 0.19) (Westworth 2002). Aerial surveys in the vicinity have recorded moose densities of 0.16 moose/km^2 in the Devon Jackfish LSA (Devon 2004) and 0.09 moose/km^2 at Christina Lake in 2003 (Golder 2004a), both slightly higher than the density observed during this survey.

3.1.3.2 Winter Track Count Results

Track Densities

Moose track density was 0.34 tracks/km-track day for the LSA (Appendix IV, Table IV-1). This track density is average compared to winter track programs carried out in the Oil Sands Region (Westworth 2002). To the south of Christina Lake, a moose track density of 0.26 tracks/km-track day was observed during the 2002 Devon Jackfish Project surveys (Devon 2004) and no moose tracks were recorded during 2003 surveys for the EnCana Christina Lake Thermal Project (Golder 2004a).

3.1.3.3 Pellet Group Count Results

Pellet group count density for moose within the lease area was 3.0 pellet groups/ha (Table 3-3). Low-bush cranberry aspen (d1) ecosite phases had the most moose pellet groups (6) and the highest pellet density compared to all of the ecosite phases/wetlands types surveyed. Although sample size was too low to detect statistical differences, the results indicate a trend in moose preference for the low-bush cranberry aspen (d1) ecosite phases. Moose pellets were also observed in the wooded bog (BTNN) and Labrador tea-mesic jack pine-black spruce (c1) ecosite phases/wetlands types.

Table 3-3 Mean Pellet Group Density Among Habitat Classes for Moose and Deer

Ecosite Phases/Wetlands Types[(a)]	Map Code	Sample Effort	Pellet Group Density [number/ha]	
		ha	Moose	Deer
lichen jack pine	a1	0.06	0.0	0.0
blueberry jack pine-aspen	b1	0.04	0.0	0.0
blueberry aspen (white birch)	b2	0.04	0.0	0.00
blueberry white spruce-jack pine	b4	0.01	0.0	0.0
Labrador tea-mesic jack pine-black spruce	c1	0.17	6.0	0.0
low-bush cranberry aspen	d1	0.16	38.1	101.7
low-bush cranberry aspen-white spruce	d2	0.03	0.0	130.7
Labrador tea–subhygric black spruce-jack pine	g1	0.15	0.0	0.0
wooded bog	BTNN	0.83	1.2	7.2
graminoid fen	FONG	0.02	0.0	0.0
treed fen	FTNN	0.28	0.0	25.5
Treed swamp	STNN	0.01	0.0	0.0
burned forest	burn	0.18	0.0	5.6
disturbed - cutline	disturbed	0.02	0.0	0.0
disturbed - wellpad	disturbed	0.01	0.0	83.3
Total (ha and Mean Density)		**2.0**	**3.0**	**23.6**

(a) Beckingham and Archibald (1996) and Vitt et al. (1997).

Habitat

During the winter track counts, moose were observed in the low-bush cranberry aspen (d1), low-bush cranberry aspen-white spruce (d2), treed fen (FTNN) and shrubby marsh (MONS) ecosite phases/wetlands types (Appendix IV, Table IV-1). The majority of moose tracks were observed in the shrubby marsh (MONS) wetland type. However, sample sizes were not large enough to determine significant habitat preference/avoidance. The prevalence of moose tracks in wetlands types suggests that moose prefer habitats with potentially high

forage availability, as forage availability may be more important than cover habitat availability. Skinner and Westworth (1981), URSUS and Komex (1997) and Suncor (2000) also indicated that moose tracks were more likely to be found in wetlands types during the winter. Other studies have shown that moose are associated with aspen and mixedwood forests during the winter (Westworth, Brusnyk and Associates 1996b; Westworth and Brusnyk 1982; Golder 1997a,b). These results are consistent with the aerial survey results where moose were visually recorded in upland aspen and deciduous mixedwood ecosite phases, as well as within shrubby fen (FONS) wetlands.

3.1.4 Mule and White-Tailed Deer

Deer are at the northern end of their range in the Oil Sands Region (Smith 1993). Mule deer are traditional residents of the western boreal forest at its southern fringe and are most frequently associated with cleared or disturbed habitat. Populations in the Oil Sands Region are generally small and localized. At one time, white-tailed deer were not found in the Oil Sands Region although recent changes to access and creation of open habitat as a result of human settlement, milder weather, the absence of ungulate competition and scarcity of predators have been hypothesized to have increased white-tailed deer observations within northern regions (Veitch 2001).

3.1.4.1 Ungulate Aerial Surveys

No deer were observed during the ungulate aerial survey. In general, low deer densities have been recorded in the Oil Sands Region (Appendix III, Table III-4).

3.1.4.2 Winter Track Count Survey

Track Densities

The winter track count survey recorded a deer track density of 0.41 tracks/km-track day. Previously in the Oil Sands Region, deer track densities have ranged from no observations to 13.3 tracks/km-track day (Appendix III, Table III-5). Surveys conducted immediately south of the lease recorded deer track densities of 0.7 tracks/km-track day in 2002 and 4.7 tracks/km-track day in 2003 (Devon 2004; Golder 2004a).

3.1.4.3 Pellet Group Density

Deer pellets were observed within the low-bush cranberry aspen (d1), low-bush cranberry aspen-white spruce (d2), wooded bog (BTNN), treed fen (FTNN), burn and disturbed ecosite phases/wetlands types during the pellet count survey

(Table 3-3). The Chi-squared analysis indicated that within the lease area, deer had a preference for the low-bush cranberry aspen (d1) ecosite phases, an avoidance of the wooded bog (BTNN) wetlands type and neither selection nor avoidance of the treed fen (FTNN) wetlands type ($\chi 2 = 48.7$, df = 2, $p<0.05$).

Habitat

During the track count survey, deer tracks were observed in lichen jack pine (a1), Labrador tea-mesic jack pine-black spruce (c1), low-bush cranberry aspen (d1), low-bush cranberry aspen-white spruce (d2), low-bush cranberry white spruce (d3), dogwood balsam poplar – white spruce (e2) and the treed fen (FTNN) ecosite phases/wetlands types. Most tracks were observed in the dogwood balsam poplar – white spruce (e2) ecosite phases. However preference or avoidance of habitat could not be determined statistically. A preference for disturbed areas was reported for deer within the EnCana Christina Lake Thermal Project winter track survey in 2003 (Golder 2004a).

Observations of deer tracks in the Oil Sands Region have been made in a wide variety of ecosite phases/wetlands types; however, most have been in aspen and mixedwood ecosite phases (i.e., blueberry jack pine-aspen [b1], blueberry aspen (white birch) [b2], blueberry aspen-white spruce [b3], low-bush cranberry aspen [d1], low-bush cranberry aspen-white spruce [d2] and dogwood balsam poplar-white spruce [e2]), as well as in the lichen jackpine (a1) ecosite phases (Westworth, Brusnyk and Associates 1996b; URSUS and Komex 1997; Golder 2000b,c; OPTI 2000; AXYS 2001a).

In general, high quality habitat for deer consists of spatially heterogeneous areas (Runge and Wobeser 1975) containing a variety of forage species in proximity to areas that provide suitable cover from weather, predators and insects. Deer benefit from abundant browse and cover along watercourses and may use them as travel corridors during seasonal or dispersal movements (Brewster 1988). Deer prefer terrestrial forest, regenerating areas and riparian areas. Deer are limited by the availability of suitable habitat, winter conditions (i.e., snowfall and temperature) and predation (i.e., natural and human) (Stelfox 1993).

3.2 CANIDS (DOGS)

Canids in the area include grey wolves, coyotes and red foxes.

3.2.1 Wolves

Population

Wolves were recorded at a track density of 0.03 tracks/km-track day during the winter track count survey (Appendix IV, Table IV-1). Track densities observed during other surveys conducted in the Oil Sands Region have ranged from no track observations to 0.38 tracks/km-track day (URSUS and Komex 1997) (Appendix III, Table III-8). Track count surveys for the neighboring Devon Jackfish Project yielded the same wolf track density of 0.03 tracks/km-day, while no wolf tracks were recorded at EnCana's Christina Lake Thermal Project (Devon 2004; Golder 2004a).

Habitat

Tracks were encountered within the Labrador tea-mesic jack pine-black spruce (c1) and Labrador tea-subhygric black spruce-jack pine (g1) ecosite phases. Habitat preference could not be determined due to the low sample size. Wolves tend to prefer open areas and avoid heavy coniferous cover in winter (Penner 1976). In studies where habitat preferences were determined, wolves were observed to prefer willow wetlands and riparian aspen (Westworth and Brusnyk 1982), black spruce/tamarack (Westworth, Brusnyk and Associates 1996b) and upland ecosite phases (Golder 1998a). Wolf habitat preference is likely dependent on the ecosite phases/wetlands types utilized by their prey and ease of travel. Wolves also use cutlines and other linear disturbances for ease of movement (James 1999).

3.2.2 Coyotes

Population

Coyote tracks were recorded at a density of 0.45 tracks/km-track day during the winter track count survey (Appendix IV, Table IV-1). Other surveys in the Oils Sands Region have had results ranging from no observations to 2.23 tracks/km-track day (Appendix III, Table III-9). The adjacent Devon Jackfish and EnCana Christina Lake Thermal Project winter track surveys recorded coyote densities of 1.29 (Devon 2004) and 0.50 tracks/km-track day (Golder 2004a), respectively.

Habitat

Coyote tracks were observed in eight ecosite phases/wetlands types with the highest density occurring in the dogwood balsam poplar-white spruce (e2) ecosite phases. No statistical habitat preference or avoidance could be determined. No track observations were made in disturbed areas. Many of the

track observations made at the nearby Devon Jackfish and the EnCana Christina Lake Thermal Projects occurred along rights-of-way and in reclaimed industrial sites (Devon 2004; Golder 2004a). In other surveys in the Oil Sands Region, coyotes have been observed to prefer disturbed areas (Penner 1976; Golder 1999a), and black spruce/coniferous (Skinner and Westworth 1981) and balsam poplar/jack pine forests (Westworth and Brusnyk 1982; Golder 1997a,b). Coyotes are generalist predators that utilize cleared sites while avoiding densely forested areas (Boyd 1977).

3.2.3 Red Foxes

Population

The density of red fox tracks observed during the winter track surveys was 0.01 tracks/km-track day (Appendix IV, Table IV-1). Fox track densities have ranged from no observations up to 0.95 tracks/km-track day in the Oil Sands Region (Appendix III, Table III-10). Track count surveys conducted for the Devon Jackfish Project recorded a red fox density of 0.10 tracks/km-track day (Devon 2004) and only one incidental observation occurred at EnCana's Christina Lake Thermal Project (Golder 2004a).

Habitat

Fox observations during the winter track count surveys only occurred in the treed fen (FTNN) wetlands type although they have historically been observed in the Oil Sands Region in a variety of ecosite phases/wetlands types (Appendix III, Table III-10). Like wolves and coyotes, red foxes prefer open habitats interspersed with brushy shelter (Pattie and Fisher 1999).

3.3 FELIDS (CATS)

Felids in the Oil Sands Region include the Canada lynx and the cougar (mountain lion). Both lynx and cougars are listed as sensitive by ASRD (2001).

3.3.1 Canada Lynx

Population

Canada lynx densities fluctuate in 10-year cycles in close association with snowshoe hares (Boutin et al. 1995). Thus, lynx densities can fluctuate dramatically depending on where they are in their cycle. Lynx tracks were recorded at a track density of 0.13 tracks/km-track day within the lease area (Appendix IV, Table IV-1). In the Oil Sands Region, track densities have ranged

from no observations to 0.84 tracks/km-track day (Appendix III, Table III-11). Lynx were recorded within the Jackfish LSA at 0.56 tracks/km-track day (Devon 2004) and no observations were made during surveys for the Christina Lake Thermal Project (Golder 2004a). The low track density in the lease area coincides with low densities of snowshoe hares (see Section 3.7.1). Typically, lynx densities will peak about a year after a peak in snowshoe hare numbers (O'Donoghue et al. 1997).

Habitat

Lynx are thought to prefer dense climax boreal forest, although their distribution is tied to that of their most common food, the snowshoe hare (Skinner and Westworth 1981). The majority of lynx tracks observed during this study occurred along disturbed-cutlines. Other observations were made in wooded bog (BTNN), Labrador tea-mesic jack pine-black spruce (c1), low-bush cranberry aspen-white spruce (d2) and Labrador tea-subhygric black spruce-jack pine (g1) ecosite phases/wetlands types. Devon Jackfish winter track counts recorded the highest densities of lynx tracks in tamarack/dwarf birch/sedge and black spruce-tamarack/dwarf birch/sedge wetlands types (Devon 2004).

3.3.2 Cougars

No cougars or cougar sign were observed during field surveys for the Project. However, two cougar families were reported near Conklin in 2004 (G. Moller 2004: pers. comm.). While cougars may be found anywhere in the province, typical cougar range is the Rocky Mountains and foothills of Alberta (Smith 1993). Few cougars or cougar sign have been observed in the Oil Sands Region. Four cougar sightings occurred during the seismic program for Suncor's Firebag In-Situ Project (Suncor 2000). Additional sightings have included two cougars (a female and cub) in the Birch Mountains in 2000, a cougar observed southwest of Fort McMurray in 2000 (J. Songhurst 2000: pers. comm.) and a cougar observed on the EnCana Christina Lake Thermal LSA in 2003 (T. Calverly and J. Elser 2003: pers. comm.). It is suggested that transient cougars may be regular visitors to northern Alberta as several accounts of cougars have been recorded in Wood Buffalo National Park (Gau et al. 2001).

3.4 BEARS

Bears in the Oil Sands Region include black bears and grizzly bears (*Ursus arctos*). Grizzly bears are listed as 'May Be At Risk' in the province (ASRD 2001).

3.4.1 Black Bears

Population

There were no surveys specifically designed for black bears thus, there are no bear population data. However, black bears are common in the Oil Sands Region and are common in and around the lease area (S. Czetwertynski 2004: pers. comm.).

Habitat

Black bears and evidence of bear activity were recorded incidentally within the lease area eight times in the low-bush cranberry aspen-white spruce (d2) ecosite phases, along cutlines and roads and in clearings (Appendix II). No bear scat was recorded during the pellet group survey.

Black bears in the Oil Sands Region have been observed mostly in terrestrial habitats and occasionally in wetlands (Appendix III, Table III-12). Forb and shrub diversity is generally higher in deciduous stands or recently disturbed areas. Westworth and Brusnyk (1982) observed black bears most frequently in balsam poplar, mixedwood and white spruce and found that fen and willow wetlands were avoided.

3.4.2 Grizzly Bears

Grizzly bears are not normally found in the Oil Sands Region. Their range is typically in the Rocky Mountains and foothills of Alberta, with an isolated and small population of grizzly bears in the Swan Hills area (Smith 1993). There have been grizzly bear observations in the Oil Sands Region in 1998, 2000 and 2001 (R. Ramcharita 2001: pers. comm.). During the summer of 2002, grizzly bear sightings were recorded in the Conklin area (S. Tuttle 2001: pers. comm.). No grizzly bears or grizzly bear sign were observed during wildlife surveys within the lease or LSA areas.

3.5 TERRESTRIAL MUSTELIDS (WEASEL FAMILY)

Terrestrial mustelids in the Oil Sands Region include weasels (i.e., least weasels [*Mustela nivalis*] and short-tailed weasel [*Mustela erminea*]) and related family members (e.g., wolverines [*Gulo gulo*], fishers and martens). Wolverines are listed nationally as a species of special concern (COSEWIC 2004) and provincially as 'May Be At Risk' (ASRD 2001). Fishers are listed provincially

as 'Sensitive' (ASRD 2001). The Christina Lake Area has been identified as having provincial significance for furbearer habitat (Westworth 1990).

3.5.1 Wolverines

Population

Wolverines likely occur in the LSA (Poole and Mowat 2001). Wolverines are wide-ranging carnivores that are considered an uncommon carnivore in the Oil Sands Region. Wolverine home ranges are likely in excess of hundreds of square kilometers (e.g., Lofroth 2001). Wolverines or wolverine sign were not observed during wildlife surveys in the lease area. This was consistent with previous Oil Sands Region surveys, reporting either no observations or few observations at very low track densities (Appendix III, Table III-13).

Habitat

Wolverines are thought to prefer undisturbed areas of coniferous forest (Pasitschniak-Arts and Lariviere 1995). They are also believed to be particularly sensitive to human disturbance and avoid disturbed areas (Banci 1994).

3.5.2 Fishers and Martens

Fisher and marten track data were combined, as species identification in the field could not be confirmed because of overlap in their track sizes (J. Hallpenny 2003: pers. comm.).

Population

Fisher/marten tracks were recorded at a density of 0.09 tracks/km-track day (Appendix IV, Table IV-1). In some previous studies conducted in the region, fisher and marten tracks have not been combined. Fisher track densities in previous studies have ranged from <0.1 to 1.52 tracks/km-track day, while marten track densities have ranged from <0.01 to 1.49 tracks/km-track day (Appendix III, Table III-14). Within the Devon Jackfish LSA, fisher/marten tracks were recorded at 0.29 tracks/km-track day (Devon 2004). Tracks were not observed during 2003 EnCana Christina Lake Thermal Project surveys (Golder 2004a).

Habitat

Fisher/marten tracks were observed in three ecosite phases/wetlands types. Highest track densities were in the Labrador tea-subhygric black spruce-jack pine

(g1) ecosite phase (Appendix IV, Table IV-1). No habitat preference or avoidance could be established statistically. Fisher/marten track densities were also highest within the Labrador tea-subhygric black spruce-jack pine (g1) ecosite phase during baseline surveys conducted for the adjacent Devon Jackfish Project (Devon 2004).

Fishers are usually found in middle to late stage coniferous forests (Buskirk and Ruggiero 1994; Powell and Zielinski 1994). In the Oil Sands Region, fishers have been observed in mixedwood, coniferous, riparian areas and wetlands (Appendix III, Table III-14). Marten are thought to prefer the same ecosite phases/wetlands types as fishers (Buskirk and Ruggiero 1994; Powell and Zielinski 1994). In studies where a preference was observed, marten have been found to prefer mixed coniferous, riparian white spruce (Westworth, Brusnyk and Associates 1996b), terrestrial coniferous (Westworth, Brusnyk and Associates 1996a), wooded fen (Golder 2000e), jack pine/aspen and wooded bog (Golder 2000d) habitat.

3.5.3 Weasels

It is difficult to distinguish between the tracks of short-tailed weasels and least weasels; therefore, winter track counts represent a combined count for the two weasel species. Based on species distribution maps, the long-tailed weasel (*Mustela frenata*) does not inhabit the Oil Sands Region (Smith 1993).

Population

Weasels were recorded at a track density of 0.35 tracks/km-track day (Appendix IV, Table IV-1). Weasel track densities have ranged from no tracks to 5.16 tracks/km-track day in the Oil Sands Region (Appendix III, Table III-15). Winter track surveys for Devon Jackfish (Devon 2004) and EnCana-Christina Lake Thermal (Golder 2004a) Projects recorded weasel species track densities of 0.9 and 0.69 tracks/km-track day, respectively.

Habitat

Weasel tracks were observed in nine ecosite phases/wetlands types, but were most abundant in blueberry white spruce-jack pine (b4) ecosite phases, followed by the blueberry aspen (white birch) (b2) ecosite phases. No preference or avoidance of habitat types could be statistically determined. Weasel tracks have been reported in a variety of ecosite phases/wetlands types in the Oil Sands Region, including black spruce muskeg, riparian white spruce and mixedwood areas (Appendix III, Table III-15). In general, weasels prefer riparian, deciduous

and early successional ecosite phases/wetlands types, due in part to the abundance of small mammalian prey usually found in those areas.

3.6 SEMIAQUATIC FURBEARERS

Semiaquatic furbearers in the Oil Sands Region include beavers, muskrats, river otters and minks (*Mustela vison*).

3.6.1 Beavers

Population

During the beaver/muskrat aerial survey, 1,068 ha of waterbodies and 42.4 km of watercourses were surveyed. A total of 12 beaver dams, 18 active beaver lodges and 18 food caches were recorded. Of these sightings, all dams were located on watercourses, 11 lodges were located on waterbodies, seven lodges on watercourses, nine food caches on waterbodies and nine food caches on watercourses (Table 3-4).

Beaver density was calculated as 0.17 active lodges/km and 0 inactive lodges/km of drainage. This density of beaver activity falls within the range of densities reported for other studies in the Oil Sands Region (0 to 1.0 active lodges/km) (Appendix III, Table III-16). However, densities of lodges and food caches on watercourses and waterbodies were lower than in other areas. For example, baseline surveys conducted for the Long Lake Project reported a density of 1.6 active lodges per km surveyed (OPTI 2000). The beaver activity density on waterbodies within the lease area are near the low end of those reported for the Oil Sands area (0.01 active lodges/ha of waterbody).

There were a total of eight incidental sightings of beavers during other wildlife surveys conducted within the lease area. Incidental sightings were recorded in waterbodies, watercourses and the shallow open water (WONN) wetlands type (Appendix II).

Table 3-4 Beaver Observations from Aerial Survey

Sighting	Waterbody	Watercourse	Total	Density	
				Waterbody (per km^2)	Watercourse (per km)
food cache	9	9	**18**	0.84	0.21
lodge	11	7	**18**	1.03	0.17
dam	0	12	**12**	0	0.28

Habitat

Beavers are found throughout the boreal forest. The major habitat requirements of beavers are waterbodies suitable for year-round occupation and an adjacent supply deciduous woods or shrublands (Slough and Sadleir 1977; Todd 1978). Preferred food items include trembling aspen, birch and willow (Banfield 1987). Colonies are most commonly associated with deciduous tree/shrub subclimax or edaphic climax plant communities (Slough and Sadleir 1977). Thus, beavers are expected to occur along watercourses and in marshy areas near trembling aspen stands.

3.6.2 Muskrats

Population

There were a total of 22 muskrat push-ups recorded during the aerial survey, all along waterbody shores. Density of push-ups was high compared to previous studies, at 2.06 push-ups/km^2. Densities of muskrat activity from previous studies in the Oil Sands Region have ranged from 0.00 (Golder 1998a) to 0.54 push-ups/km^2 (Appendix III, Table III-17). Muskrats were not recorded incidentally during other field surveys. Muskrats are found throughout the Oil Sands Region where shallow waterbodies and slow moving watercourses occur.

Habitat

The primary habitat requirements of muskrats are aquatic and semi-aquatic plant growth sufficient for food and cover and water depths adequate for winter foraging beneath the ice. These requirements are met by a variety of wetlands types, especially where emergent vegetation is present (Westworth 1979; Todd 1978; Poll 1980). Emergent plants are used by muskrats for food and lodge construction (Banfield 1987). Graminoid marsh (MONG) wetlands types best suit the forage and habitat requirements of muskrats.

3.6.3 River Otters

Population

River otters were incidentally observed twice during field surveys within the lease area (Appendix II). Both observations occurred at a watercourse surrounded by shrubby marsh (MONS) habitat. The Christina Lake Area has been identified as providing significant furbearer and river otter habitat (Westworth 1990). No river otter tracks were observed during the winter track survey. River otter tracks have been observed at track densities from <0.01 to 1.24 tracks/km-track day in the Oil Sands Region (Appendix III, Table III-18).

Habitat

In other surveys in the Oil Sands Region, river otter tracks were observed in riparian habitat, shoreline, wooded fen (FTNN) and shrubby swamp (SONS) habitats (Appendix III, Table III-18). Tracks are most frequently encountered along the shores of deep waterbodies, watercourses and large marshes. River otters are aquatic carnivores that feed almost exclusively on fish, but have also been known to prey on beavers (Fort McKay First Nations 1994).

3.6.4 Minks

Population

No mink tracks or observations were recorded during field surveys or incidentally within the lease area. Within the Oil Sands Region, track densities for mink have ranged from 0.0 to 0.59 tracks/km-track day (Appendix III, Table III-19). No mink tracks were recorded during surveys at the adjacent Devon Jackfish and Christina Lake Thermal LSAs (Devon 2004; Golder 2004a).

Habitat

Minks are semiaquatic carnivores that hunt in and along watercourses (Rezendes 1992). They are commonly found along stream banks, lakeshores, forest edges and large marshes. Minks have been found to prefer riparian shrub and riparian white spruce communities (Appendix III, Table III-19).

3.7 SMALL MAMMALS

Small mammals occurring within the Oil Sands Region include snowshoe hares, red squirrels, flying squirrels (*Glaucomys sabrinus*), bats, shrews, voles, least chipmunks (*Tamias minimus*), mice and lemmings.

3.7.1 Snowshoe Hares

Population

Within the lease area, snowshoe hares were recorded at a density of 13.3 tracks/km-track day (Appendix IV, Table IV-1). Within the Oil Sands Region snowshoe hare densities have ranged from 0.49 to 112.5 tracks/km-track day (Appendix III, Table III-20). Hare pellets were rare during the pellet survey. Only two hare pellet groups were observed, both within the treed fen (FTNN) wetlands type.

The density of snowshoe hare the lease area coincides with low densities of lynx (see Section 3.3.1). Snowshoe hare populations fluctuate on a nine to 11 year cycle, leading to large variations in track count data from year to year (Boutin et al. 1995).

Habitat

Snowshoe hare tracks were observed within all ecosite phases/wetlands types surveyed, with the exception of the disturbed-cutline, shallow open water (WONN) and shrubby swamp (SONS) wetlands types (Appendix IV, Table IV-1). Snowshoe hares preferred lichen jack pine (a1), Labrador tea-mesic jack pine-black spruce (c1), low-bush cranberry aspen-white spruce (d2), low-bush cranberry white spruce (d3) and Labrador tea-subhygric black spruce-jack pine (g1) ecosite phases. They avoided blueberry aspen (white birch) (b2), low-bush cranberry aspen (d1), shrubby fen (FONS), treed fen (FTNN), wooded bog (BTNN), shrubby marsh (MONS) and shallow open water (WONN) ecosite phases/wetlands types (χ^2=1273; df=14, $p < 0.05$) (Appendix IV, Table IV-2). Snowshoe hares also avoided cutlines and burns.

In previous studies conducted in the region, snowshoe hare tracks were observed in areas with a well-developed shrub layer, including mixedwood and black spruce muskeg (Appendix III, Table III-20).

3.7.2 Red Squirrels

Population

In the lease area, red squirrels were recorded at a track density of 4.6 tracks/km-track day (Appendix IV, Table IV-1). Red squirrel track densities have been recorded from 0.24 to 194 tracks/km-track day within the Oil Sands Region (Appendix III, Table III-21). Track densities were recorded at 9.6 tracks/km-track day for the Devon Jackfish Project and only six incidental observations

occurred during surveys conducted for the Christina Lake Thermal Project (Devon 2004; Golder 2004a).

Habitat

Red squirrel tracks were observed within lichen jack pine (a1), blueberry jack pine-aspen (b1), blueberry white spruce-jack pine (b4), Labrador tea-mesic jack pine-black spruce (c1), low-bush cranberry aspen-white spruce (d2), low-bush cranberry white spruce (d3), dogwood balsam poplar-white spruce (e2), Labrador tea-subhygric black spruce-jack pine (g1), blueberry aspen (white birch) (b2), low-bush cranberry aspen (d1), treed fen (FTNN) and wooded bog (BTNN) ecosite phases/wetlands types.

Significant habitat preferences were found for low-bush cranberry aspen-white spruce (d2) and low-bush cranberry white spruce (d3) ecosite phases (χ^2=380.7 df=12, $p<0.05$). Red squirrels demonstrated significant avoidance of treed fen (FTNN), shrubby fen (FONS), shrubby marsh (MONS) and open water (WONN) wetlands types, as well as for burned areas and disturbed-cutlines (Appendix IV, Table IV-2). Preferred habitat types have a white spruce component in the canopy whereas the avoided habitat types do not. Red squirrels have exhibited a preference for mixedwood in the region though their reliance on coniferous cones for the majority of their food supply usually finds them in conifer-dominated forests.

3.7.3 Flying Squirrels

Population

Flying squirrels were not surveyed for, nor observed incidentally, during the baseline surveys.

Habitat

Northern flying squirrels are associated with old seral stage forests and may occur at highest densities in coniferous stands (Takats et al. 1999).

3.7.4 Least Chipmunk

Population

Least chipmunks were not surveyed for, or observed incidentally, during the baseline surveys. The least chipmunk is widely distributed throughout Alberta (Smith 1993).

Habitat

The least chipmunk feeds on grasses, herbs and insects. In the boreal forest, least chipmunks usually occupy forest edges, openings and mixedwood forest but avoid dense coniferous stands (Banfield 1987). The least chipmunk has previously been observed in the Alberta Pacific FMA/Lac La Biche region within aspen mixedwood forest (Moses and Boutin 2001).

3.7.5 Bats

Population

Five mist-netting sites were operated in three ecosite phases/wetlands types for a total of 24.3 mist-net hours during bat surveys within the LSA (Figure 2-5; Table 3-5). One adult male little brown bat was captured along a cutline in a treed fen (FTNN) wetlands type approximately 100 m from one of the few large watercourses in the LSA. Multiple bats were observed at this site throughout the evening until the insect activity and temperature decreased. Bat calls were also recorded on the remote detectors.

Table 3-5 Number of Passes and Feeding Buzzes Produced by Small and Large Bat Species Groups

Ecosite Phases/Wetlands Types[d]	Map Code	Detector # Plots	*Myotis* spp.[a] passes/ hour	*Myotis* spp. buzzes/ hour	EPFU/ LANO[b] passes/ hour	EPFU/ LANO buzzes/ hour	LASP[c] passes/ hour	LASP buzzes/ hour	LACI[d] passes/ hour	LACI buzzes/ hour
Labrador tea-mesic jack pine-black spruce	c1	1	1.1	0	0	0	0	0	0	0
low-bush cranberry aspen-white spruce	d2	1	9.5	1.7	0.9	0	0	0	0	0
wooded bog	BTNN	1	0	0	0	0	0	0	0	0
treed fen	FTNN[c]	3	1.3	0	0.2	0	0.6	0	0	0
shallow open water	WONN	1	0.2	0	0	0	0	0	1.4	1.2
Mean Totals			**2.4**	**0.3**	**0.2**	**0**	**0.12**	**0**	**0.28**	**0.2**

(a) Based on high similarity of call characteristics, *Myotis* bats were not differentiated by species.

(b) Based on high similarity of call characteristics, big brown (EPFU: *Eptesicus fuscus*) and silver-haired (LANO: *Lasionycteris noctivagans*) bats were not differentiated. Red bat (LASP: *Lasiurus spp.)* and hoary bat *(* LACI: *Lasiurus cinereus*) could be differentiated.

(c) Detectors were placed at four FTNN sites, but one system did not function.

(d) Beckingham and Archibald (1996) and Vitt et al. (1997).

Habitat

The LSA contains a high proportion of black spruce/tamarack habitat, which may account for the relatively low bat activity. Bats generally prefer mature aspen and white spruce forests for both foraging and roosting habitat in the boreal forest (Crampton and Barclay 1998). Previous studies in the Oil Sands Region also indicate that the mixedwood habitats are generally preferred by bats as these areas provide good roosting habitat (Appendix III, Table III-22).

Seven bat detectors were established in five vegetation types (Table 3-5) for a total of 29.8 detector hours. Four species/species groups were identified based on call analysis: *Myotis* spp., big brown/silver-haired, red and hoary bats. The red bat is considered "accidental/vagrant" in Alberta (ASRD 2001), however this species has previously been captured (Golder 2003a) in the Oil Sands Region. The call signatures identified as "red bats" were independently confirmed (M.B. Fenton 2005: pers. comm.). The bat echolocation data can be used only in terms of species presence/not detected and relative activity among habitat types.

The highest bat activity was recorded in the mixedwood aspen-white spruce (d2) ecosite phases (total all species: 10.4 passes/hour), followed by one of the shallow open water sites (WONN; 2.8 passes/hour). Based on time to first activity, the aspen-white spruce habitat seems to be used for roosting while the treed fen habitats were used as transit habitats. Foraging activity was recorded only in the low-bush cranberry aspen-white spruce (d2) and shallow open water (WONN) sites.

All species could not be differentiated based on the call analysis. However, a previous study in the same region suggested northern long-eared bats (*Myotis evotis*) preferred to forage in intact forest and avoided open habitat, while little brown bats preferred to forage along the edge of clear-cuts (Patriquin 2001). Silver-haired bats also preferred open habitat and avoided intact forest (Patriquin 2001). Bats may be limited by suitable roosting habitat, particularly old growth aspen mixedwood (Crampton and Barclay 1998) or coniferous (Banfield 1987; Pybus 1986) stands at a landscape level.

3.7.6 Microtines

With the exception of the bat survey, no new small mammal surveys were conducted within the lease area or LSA. Results from other small mammal field surveys conducted in the Oil Sands Region are presented in Appendix III, Table III-23.

3.7.6.1 Shrews

Shrews are insectivores but may also eat small mammals. Water shrews (*Sorex palustris*) will also consume small fish and amphibian larvae. Shrews are active year-round, with peaks of activity at dusk and dawn (Ealey et al. 1979). They have a high metabolism, consuming over three times their body weight each day (Banfield 1987). Masked (*Sorex cinereus*), dusky (*Sorex monticolus*), water, arctic (*Sorex arcticus*) and pygmy (*Sorex hoyi*) shrews have all been observed within the Oil Sands Region.

Habitat for shrews consists of cool areas associated with dense ground cover. Shrews typically avoid dry sites (Ealey et al. 1979). Masked, pygmy, dusky and arctic shrews use similar ecosite phases/wetlands types (Appendix III, Table III-23). Water shrews prefer habitat within a short distance from streams, lakes and ponds (Smith 1993). Masked, pygmy and water shrews are relatively common within the Oil Sands Region compared to arctic and dusky shrews (Soper 1964; Westworth and Skinner 1977; Westworth 1979).

3.7.6.2 Voles

Three species of voles (i.e., meadow [*Microtis pennsylvanicus*], heather [*Phenacomys intermedius*] and red-backed voles [*Clethrionomys gapperi*]) have been observed within the Oil Sands Region (Appendix III, Table III-23). Voles are herbivores and require mycorrhizal fungi in their diet (Smith 1993). The red-backed vole is one of the most abundant microtine rodents in forested areas of Alberta (Smith 1993) and throughout the Oil Sands Region (Green 1980). Aspen and mixed white spruce-jack pine forest communities provide prime habitat for red-backed voles (AXYS 1996; Green 1980).

The meadow vole is most commonly found in moist habitats with dense grass or sedge ground cover (Green 1980). During field surveys, one vole was observed incidentally (Appendix II).

Heather voles are found in a wide range of areas but tend to inhabit dry open pine/spruce stands, shrubs near forested edges or open grassy areas (Smith 1993). While meadow and red-backed voles are considered abundant throughout the Oil Sands Region, heather voles occur at much lower densities (Green 1980).

3.7.6.3 Mice

Deer mice (*Peromyscus maniculatus*) are considered abundant throughout the Oil Sands Region (Green 1980; Westworth and Skinner 1980). Deer mice are granivorous but also eat herbs and insects. They have a wide range of habitat

preferences including forests, shrublands, grasslands and disturbed areas. Near the LSA, deer mice have been observed to inhabit aspen mixedwood forests (Moses and Boutin 2001, OPTI 2000), deciduous forest, coniferous forest and riparian areas (OPTI 2000). Deer mice are nocturnal and exhibit annual changes in abundance but no seasonal fluctuations in density (Green 1980).

Meadow jumping mice (*Zapus spp*.) occur in lower numbers than deer mice (Green 1980; Westworth and Skinner 1980). This species is also a granivore that will also eat herbs and insects. Meadow jumping mice inhabit grasslands, forest and riparian habitats, in particular moist meadows and areas along watercourses (Smith 1993). Meadow jumping mice have been observed at the OPTI Long Lake Project lease (OPTI 2000), but are considered scarce in the Oil Sands Region (Westworth 1979).

Seven sets of mice tracks were observed in four vegetation types during the winter track count survey in the lease area and LSA. This resulted in a track density of 0.10 tracks/km-track-day (Appendix IV, Table IV-1). Habitat preferences could not be determined because of the small sample size.

3.7.6.4 Lemmings

Although widely distributed, the northern bog lemming (*Synaptomys borealis*) is generally considered uncommon in Alberta (Smith 1993). Most records of the species are based on a single specimen captured during small mammal surveys (Smith 1993). The northern bog lemming occurs at low numbers within the Oil Sands Region (Green 1980; Westworth and Skinner 1980). No lemming tracks were observed during the winter track survey.

The lemming is a herbivore that mainly eats grasses and sedges, as well as mycorrhizal fungi. Preferred habitat consists of riparian zones, wetlands, moist meadows and bogs. Northern bog lemmings have previously been associated with wetlands in the RSA (OPTI 2000).

4 RESULTS – BIRDS

Bird groups occurring within the Oil Sands Region include dabbling ducks, diving ducks, waterbirds, owls, diurnal raptors, terrestrial gamebirds and breeding birds. Birds occurring within the Oil Sands Region that are listed provincially include the peregrine falcon (*Falco peregrinus*) and whooping crane (*Grus americana*), both listed as 'At Risk' and the short-eared owl which is listed as 'May Be At Risk' (ASRD 2001). Federally, whooping cranes are endangered, peregrine falcons are threatened and the short-eared owl is of special concern (COSEWIC 2004).

4.1 WATERFOWL

The Christina Lake Area has been designated as a Significant Natural Feature (Westworth 1990). The area is considered to be regionally significant, providing important waterfowl nesting habitat (Westworth 1990) with high species richness for waterbirds (Found and Hubbs 2004).

During the spring waterfowl surveys, six species of dabbling ducks (American wigeon, blue-winged teals, green-winged teals, mallards, northern pintail and northern shovelers) and five species of diving ducks (buffleheads, common goldeneyes, grebe spp., ring-necked ducks and scaup spp.) were observed within the lease area and along the north shore of Christina Lake (Figure 2-4). Observations of unknown dabblers and divers were also recorded. Other observed waterfowl included American coots, Canada geese, common loons, common mergansers, merganser spp., red-necked grebes and scoter spp. In total 13 confirmed species of waterfowl and 21 species/species groups were observed during the spring waterfowl surveys (Table 4-1). Waterbird species observed during the spring surveys included an American white pelican, black terns, common terns, a great blue heron, sandhill cranes, yellowlegs spp. and other shorebird species.

Species were more difficult to identify during fall waterfowl surveys due to their dull autumn plumages. However, there were three species of dabbling ducks (blue-winged teals, green-winged teals and mallards) and five species of diving ducks (buffleheads, common goldeneyes, grebe spp., ring-necked ducks and scaup spp.) identified. Other waterfowl and waterbirds observed included American coots, Canada geese, common mergansers, a great blue heron, yellowlegs spp. and unidentified shorebird species (Table 4-1).

Table 4-1 Estimated Number of Individuals from Waterfowl and Waterbird Surveys in the Lease Area and along the North Shore of Christina Lake

Bird Types	Number Observed			
	May 21[(a)]	May 28[(a)]	September 19	September 30
Waterfowl				
American coot	34	14	23	3
American wigeon	24	24	0	0
blue-winged teal	154	186	5	3
bufflehead	84	90	91	91
Canada goose	1	8	114	10
common goldeneye	69	24	101	12
common loon	39	24	0	0
common merganser	8	7	1	2
dabbler spp.	14	4	56	4
diver spp.	18	26	147	146
grebe spp.	35	30	4	0
green-winged teal	6	34	0	2
mallard	154	152	7	13
merganser spp.	10	0	0	0
northern pintail	0	0	0	0
northern shoveler	8	23	0	0
ring-necked duck	171	153	0	14
scaup spp.	42	5	15	15
scoter spp.	2	0	0	0
teal spp.	0	0	0	0
unknown duck spp.	0	0	21	5
subtotal	*873*	*804*	*585*	*320*
Waterbirds				
American white pelican	0	1	0	0
black tern	1	1	0	0
common tern	1	2	0	0
great blue heron	0	1	1	0
gull spp.	33	13	0	0
sandhill crane	2	0	0	0
shorebirds spp.	1	3	19	1
yellowlegs spp.	22	20	1	0
subtotal	*60*	*41*	*21*	*1*
Total	**933**	**845**	**606**	**321**

(a) Numbers presented include corrections based on hen:drake ratios, as defined in Section 2.6.1.

Waterfowl and waterbird numbers observed during the baseline surveys completed for the Project are approximately double those counted in the Kirby Thermal Project surveys (Rio Alto 2002). However, numbers were lower than those reported in the Long Lake Project baseline inventory, with densities of

about half of those reported at Long Lake (OPTI 2000). Numbers and species observed were similar to those reported for spring surveys conducted for the adjacent Devon-Jackfish Project (Devon 2004). Numbers of waterfowl observed fluctuate from year to year. Total duck breeding population estimates for northern Alberta, northeast B.C. and the Northwest Territories for 2004 are down 19% from the long term average (USFWS 2004).

Incidental waterfowl and waterbird species were observed throughout the lease area during baseline surveys. Incidental observations occurred near or within watercourses, waterbodies or as flyovers. Incidentals included a sandhill crane, red-necked grebes, redheads, mallards, green-winged teals, lesser yellowlegs, greater yellowlegs, common loons, Canada geese, blue-winged teals, an American bittern, a common tern, a solitary sandpiper, sora and Wilson's snipe (Appendix II). Sandhill cranes and American bitterns are listed as "Sensitive" species within the province (ASRD 2001).

Waterfowl densities on watercourses within the lease area were high during the early spring, but dropped during the late spring survey and for each of the fall surveys (Table 4-2). This reduction in density may be due to the lower water levels in watercourses during the fall surveys. Several of the watercourses were difficult to follow in the fall due to a lack of water, and those waterfowl observed during the surveys were typically found on small beaver ponds along the watercourses.

Table 4-2 Watercourse Waterfowl Density

Survey Time		Length of Watercourses Surveyed (km)	Waterfowl Density in Watercourses
early spring	May 21, 2004	42.4	6.9/km
late spring	May 28, 2004	42.4	6.4/km
early fall	Sept.19, 2004	42.4	2.1/km
late fall	Sept.30, 2004	42.4	0.6/km

A similar pattern was observed for waterfowl densities on waterbodies during the four surveys with densities highest in early spring and lowest in the late fall survey period (Table 4-3). Water levels in all waterbodies surveyed in the fall were similar to conditions in the spring. The lower densities in the fall may indicate greater importance of the lease area for spring migrants or may simply be an indication that the fall migration was occuring over a longer time period (i.e., smaller concentrations of birds).

Table 4-3 Waterbody Waterfowl Density

Survey Time		Area of Waterbodies Surveyed (ha)	Waterfowl Density in Waterbodies
early spring	May 21, 2004	1,067.6	0.54/ha
late spring	May 28, 2004	1,067.6	0.50/ha
early fall	Sept. 19, 2004	1,067.6	0.46/ha
late fall	Sept. 30, 2004	1,067.6	0.27/ha

4.2 OWLS

Population

Forty-nine survey plots were surveyed for owls within 13 ecosite phases/wetlands types (Figure 2-6; Table 2-7). A total of 25 owls were detected during the survey. Boreal owls had the highest number of observations (9), followed by great gray owls (8), barred owls (5) and great horned owls (3) (Table 4-4). Incidental observations included one barred owl in the dogwood white spruce (e3) ecosite phases, five great gray owls in the low-bush cranberry aspen-white spruce (d2) ecosite phases, shrubby fens (FONS) and burns, and two great horned owls within a lichen jack pine (a1) ecosite phases and a treed fen (FTNN) wetlands type (Appendix II). Additionally, two incidental owl observations (one flyover and one snow plunge) of unknown species were made during the other surveys (Appendix II).

Owls are common in the Oil Sands Region but are not considered abundant. The number of owls heard during the owl survey in the LSA was high relative to other surveys in the Oil Sands Region (Appendix III, Table III-24). In comparison, 16 owls were encountered with similar survey effort during baseline surveys completed for the Petro-Canada Meadow Creek Project (Petro-Canada 2001). Higher numbers in the LSA are likely a reflection of a higher proportion of terrestrial habitat suitable for owl nesting, or may be a reflection of prey species abundance at the time of the surveys.

Habitat

Owls were heard in 11 of the 13 ecosite phases/wetlands types sampled. Thirty-six percent of owl detections were heard from a wetlands type, while 64% were heard from upland, burned or disturbed habitats. Owls were most abundant in burned forests, with a total of five detections (20% of total), followed by the wooded bog (BTNN) wetlands type and the Labrador tea-mesic jack pine-black spruce (c1) ecosite phases with four owl detections in each (16% of total)

(Table 4-3). Only one owl was detected in mixedwood forest: a great horned owl in a low-bush cranberry aspen-white spruce (d2) ecosite phases (Table 4-4). Because suitable nesting trees are most likely absent in the burned and wetland areas, it is probable that owls heard from these areas were hunting.

Table 4-4 Owl Species Observation by Likely Ecosite Phases/Wetlands Type

Species	Probable Ecosite Phases/Wetlands Types[(a)]	Map Code	Number of Observations
boreal owl	blueberry jack pine-aspen	b1	1
	Labrador tea-mesic jack pine-black spruce	c1	2
	low-bush cranberry aspen	d1	1
	wooded fen	FTNN	1
	shrubby fen	FONS	1
	burned forest	burn	2
	disturbed-cutline	disturbed	1
		subtotal	*9*
barred owl	lichen jack pine	a1	1
	Low-bush cranberry aspen	d1	1
	wooded bog	BTNN	1
	treed swamp	STNN	1
	burned forest	burn	1
		subtotal	*5*
great gray owl	lichen jack pine	a1	1
	Labrador tea-mesic jack pine-black spruce	c1	1
	wooded bog	BTNN	3
	shrubby fen	FONS	2
	burned forest	burn	1
		subtotal	*8*
great horned owl	Labrador tea-mesic jack pine-black spruce	c1	1
	low-bush cranberry aspen-white spruce	d2	1
	burned forest	burn	1
		subtotal	*3*
Total			**25**

[(a)] Beckingham and Archibald (1996) and Vitt et al. (1997).

4.3 DIURNAL RAPTORS

Population

Three raptors, including a sharp-shinned hawk, a northern goshawk and a merlin, were observed while conducting the diurnal call playback surveys in the lease

area (Table 4-5). During other field surveys there were 14 incidental sightings of raptor species. These observations included bald eagles (5), bald eagle young observed in a nest (2 nests), red-tailed hawks (5), northern harriers (2), osprey (2) and American kestrel (1) (Appendix II). These incidental sightings are only considered indicative of species presence, not population densities, as numbers of individuals cannot be determined.

Table 4-5 Raptor Species Observation by Ecosite Phases/Wetlands Type

Species	Likely Ecosite Phases/Wetlands Types[(a)]	Map Code	Number of Observations
northern goshawk	low-bush cranberry aspen-white spruce	d2	1
merlin	wooded fen	FTNN	1
sharp-shinned hawk	wooded bog	BTNN	1
Total			**3**

(a) Beckingham and Archibald (1996) and Vitt et al. (1997).

Other studies have also recorded low numbers of raptors in the Oil Sands Region (Appendix III, Table III-25). Availability of, and competition for, suitable nesting habitat probably limits raptors. Open abandoned nests are favoured by a variety of raptors, including red-tailed hawks, bald eagles, ospreys and great gray owls (Voous 1988). Competition for foraging habitat and predation, especially on young raptors, may also be contributing to low raptor numbers.

Habitat

The sharp-shinned hawk was observed in a wooded bog (BTNN) wetlands type, the northern goshawk in a low-bush cranberry aspen-white spruce (d2) ecosite phases and the merlin in an treed fen (FTNN) wetlands type (Table 4-5).

4.4 UPLAND GAMEBIRDS

Population

Three species of upland gamebirds commonly occur in the Oil Sands Region: spruce grouse, ruffed grouse and sharp-tailed grouse (*Tympanuchus phasianellus*) (Semenchuk 1992). Willow ptarmigan (*Lagopus lagopus*) may also migrate into the region from the Northwest Territories during the winter months. Upland gamebird species were combined for this analysis because tracks and scat cannot be differentiated between species. No upland gamebird scats were observed during the browse-pellet survey or incidentally. Grouse scat is relatively inconspicuous and difficult to observe unless it is located on downed woody debris.

Upland gamebird tracks were recorded frequently resulting in a track density of 25.1 tracks/km-track-day (Appendix IV, Table IV-1). The track density for upland game birds in the Oil Sands Region has ranged from 0.05 to 10.6 tracks/km-track day in previous studies (Appendix III, Table III-26). There were incidental observations of seven ruffed grouse, two spruce grouse and two unidentified grouse during baseline field surveys within the LSA and lease area (Appendix II).

Habitat

Grouse spp. tracks were observed in lichen jack pine (a1), blueberry aspen (white birch) (b2), low-bush cranberry aspen (d1), low-bush cranberry aspen-white spruce (d2), Labrador tea-subhygric black spruce-jack pine (g1), burn, disturbed-clearing, shrubby fen (FONS) and treed fen (FTNN) ecosite phases/wetlands types (Appendix IV, Table IV-1). Habitat preference could not be established for grouse in the LSA due to limited data.

In general, ruffed grouse are typically found in aspen-dominated and mixedwood forests (Semenchuk 1992). Spruce grouse prefer coniferous and mixedwood forests with muskegs and small openings. Sharp-tailed grouse prefer openings made by fire, man, muskegs and bogs.

4.5 BREEDING BIRDS

During the breeding bird survey, 253 individual birds or flocks of 27 different species were recorded. Ruby-crowned kinglets were the most abundant species detected in the lease area, followed by gray jays, yellow-rumped warblers, dark-eyed juncos and Tennessee warblers. This species list reflects the high proportion of wooded bog (BTNN) and wooded fen (FTNN) found within the lease area. There were no observations of ‘Sensitive’, ‘May Be At Risk’, or ‘At Risk’ species during the breeding bird surveys (ASRD 2001).

Observations beyond the 50 m point count plots were not included in the statistical analyses but are presented as incidental sightings in Appendix II. Waterfowl, raptors, shorebirds (except Common snipe) and grouse were also not included in the breeding bird analyses because of the difficulty in making habitat use associations or reduced ability to detect these species. The statistical analysis included 127 bird detections of 24 different species (Table 4-6).

Species Richness

Five species (21% of species) comprised 62% of the bird observations. Only six species occurred in three or more of the habitat types surveyed and 15 of the

species occurred in only one habitat type. The ruby-crowned kinglet was the most widespread and abundant species, occurring in six of the seven habitat types surveyed (Table 4-6).

Mean species richness was greatest within habitats that were only surveyed once, including the blueberry jack pine-aspen (b1), Labrador tea-subhygric black spruce-jack pine (g1) and shrubby swamp (SONS) ecosite phases/wetland types (Table 4-7). Of the four habitat types that were sampled more than once, the low-bush cranberry aspen-white spruce (d2) ecosite phase had the highest mean richness.

Table 4-6 Breeding Bird Detections by Species and Ecosite Phases/Wetlands Type

Species	Ecosite Phases/Wetlands Types[(a)] Map Codes	Total Number of Observations	Provincial (ASRD) Status
ruby-crowned kinglet	c1, d2, FTNN, b1, g1, BTNN	19	secure
gray jay	BTNN, d2, c1, FTNN	18	secure
yellow-rumped warbler	c1, d2, FTNN, b1, BTNN	17	secure
dark-eyed junco	d2, FTNN, c1	15	secure
Tennessee warbler	d2, BTNN, FTNN, g1	10	secure
palm warbler	FTNN	7	secure
white-winged crossbill	FTNN	7	secure
ovenbird	d2	6	secure
Lincoln's sparrow	FTNN, SONS	5	secure
chipping sparrow	FTNN, BTNN, d2	4	secure
boreal chickadee	FTNN, d2	3	secure
hermit thrush	FTNN	2	secure
red-breasted nuthatch	BTNN, d2	2	secure
red-eyed vireo	d2	2	secure
brown creeper	d2	1	undetermined
common raven	d2	1	secure
Common snipe	FTNN	1	secure
LeConte's sparrow	SONS	1	secure
least flycatcher	d2	1	secure
Swainson's thrush	d2	1	secure
three-toed woodpecker	FTNN	1	secure
white-throated sparrow	FTNN	1	secure
yellow-bellied flycatcher	d2	1	undetermined
yellow-bellied sapsucker	d2	1	secure
Total		**127**	

(a) Beckingham and Archibald (1996) and Vitt et al. (1997).

Statistical analysis (ANOVA) of the richness data indicated that there were no significant differences in richness among the sampled habitat types (F=1.34, P=0.268, df=6). Small sample sizes, particularly for some of the less common ecosite phases/wetlands types, make inferences from this analysis difficult.

Species Diversity

Mean species diversity did not significantly differ among ecosite phases/wetland types (F=1.038, p=0.412, df=6) (Table 4-7). Species diversity was however highest in the treed fen (FTNN) wetlands type, followed by the low-bush cranberry aspen-white spruce (d2) ecosite phases.

Table 4-7 Breeding Bird Species Richness and Diversity by Ecosite Phases/Wetlands Type

Ecosite Phases/Wetlands Types[a]	Map Code	Number of Plots	Mean Richness (± SE)	Mean Diversity[b] (± SE)
blueberry jack pine-aspen	b1	1	2.00±2.00	0.65±0.65
Labrador tea–mesic jack pine-black spruce	c1	8	1.28±0.14	0.39±0.12
low-bush cranberry aspen-white spruce	d2	17	1.50±0.07	0.88±0.06
Labrador tea–subhygric black spruce-jack pine	g1	1	2.00±2.00	0.65±0.65
wooded bog	BTNN	9	1.00±0.11	0.23±0.08
treed fen	FTNN	20	1.42±0.06	1.16±0.05
shrubby swamp	SONS	1	2.00±2.00	0.60±0.60
Total		**57**	**1.86±0.02**	**0.79±0.14**

[a] Beckingham and Archibald (1996) and Vitt et al. (1997).

[b] Species diversity was calculated using the Shannon-Weiner Index (Krebs 1989).

Note: SE = Standard Error.

Similar studies have found that species abundance, richness and diversity are greater in terrestrial hardwood and mixedwood ecosite phases than softwood communities associated with fens and bogs (Westworth and Telfer 1993; Schieck et al. 1995). Species diversity and richness results were relatively low compared to previous results in the Oil Sands Region where mean species richness has ranged from 1.0 to 16 and species diversity has ranged from 0.0 to 7.4 (Appendix III, Table II-27). Results from this survey suggest that the treed fen (FTNN) and low-bush cranberry aspen-white spruce (d2) ecosite phases/wetlands types provide the most important habitats for breeding birds in the LSA based on species richness and diversity. However, due to the small sample sizes, particularly for some habitat types, inferences are difficult to make.

TWINSPAN

TWINSPAN was used to classify the 24 bird species into seven separate groups or guilds. These species groups were associated with three vegetation communities comprised of the seven ecosite phases/wetlands types surveyed (Tables 4-8 and 4-9).

Community A was comprised of the wooded bog (BTNN) wetlands type and the low-bush cranberry aspen-white spruce (d2) ecosite phases. This grouping is not intuitive as it is comprised of both a mixedwood stand and a wetlands dominated by black spruce. These ecosite phases/wetlands types are not generally considered to share similar characteristics or bird communities. Community B is comprised of blueberry jack pine-aspen (b1), Labrador tea-mesic jack pine-black spruce (c1), Labrador tea-subhygric black spruce-jack pine (g1) and treed fen (FTNN) ecosite phases/wetlands types. These habitat types share vegetation characteristics, such as the presence of Labrador tea as a dominant shrub and generally high proportions of coniferous trees. Community C was comprised of the shrubby swamp (SONS) wetlands type.

Table 4-8 Ecosite Phases/Wetlands Types Classified into Vegetation Communities by TWINSPAN

Ecosite Phases/Wetlands Types[(a)]	Map Code	Community Type
wooded bog low-bush cranberry aspen-white spruce	BTNN d2	A
blueberry jack pine-aspen Labrador tea-mesic jack pine-black spruce treed fen Labrador tea-subhygric black spruce-jack pine	b1 c1 FTNN g1	B
shrubby swamp	SONS	C

(a) Beckingham and Archibald (1996) and Vitt et al. (1997).

Of all the bird community groupings, group one had the greatest number of species. All nine species from group one were observed within the low-bush cranberry aspen-white spruce (d2) ecosite phases with the exception of the red-breasted nuthatch, which was also observed within the wooded bog (BTNN) wetlands type. The birds in group five (six species) were also specific to one habitat type; all observed within the treed fen (FTNN) wetlands type. Group seven consisted of one species, a Le Conte's sparrow, observed within one plot surveyed within the shrubby swamp (SONS) wetlands type. Group six also consisted of one bird species, the Lincoln's sparrow, which was observed in the shrubby swamp (SONS) and treed fen (FTNN) wetlands types.

Table 4-9 TWINSPAN Classification of Species' Groups and Vegetation Communities

Group	Species	Ecosite Phases/Wetlands Types[(a)] Map Codes						
		Type A		Type B				Type C
		BTNN	d2	b1	c1	FTNN	g1	SONS
Group 1	brown creeper	0	6	0	0	0	0	0
	common raven	0	6	0	0	0	0	0
	least flycatcher	0	6	0	0	0	0	0
	ovenbird	0	6	0	0	0	0	0
	red-breasted nuthatch	6	6	0	0	0	0	0
	red-eyed vireo	0	6	0	0	0	0	0
	Swainson's thrush	0	6	0	0	0	0	0
	yellow-bellied flycatcher	0	6	0	0	0	0	0
	yellow-bellied sapsucker	0	6	0	0	0	0	0
Group 2	Tennessee warbler	1	6	0	0	1	1	0
Group 3	boreal chickadee	0	4	0	0	6	0	0
	chipping sparrow	3	3	0	0	6	0	0
	gray jay	2	4	0	3	4	0	0
Group 4	dark-eyed junco	0	1	0	1	6	0	0
	ruby-crowned kinglet	3	2	1	2	4	2	0
	yellow-rumped warbler	1	3	2	3	3	0	0
Group 5	Wilson's snipe	0	0	0	0	6	0	0
	hermit thrush	0	0	0	0	6	0	0
	palm warbler	0	0	0	0	6	0	0
	three-toed woodpecker	0	0	0	0	6	0	0
	white-throated sparrow	0	0	0	0	6	0	0
	white-winged crossbill	0	0	0	0	6	0	0
Group 6	Lincoln's sparrow	0	0	0	0	6	0	3
Group 7	Le Conte's sparrow	0	0	0	0	0	0	6

(a) Beckingham and Archibald (1996) and Vitt et al. (1997).

Groups two, three and four consist of species that occur in several habitat types within the Type A and Type B vegetation communities. This suggests that all of these species are to some extent general in their habitat selection, and in most cases, this is supported by the literature (e.g., Fisher and Acorn 1998; Sibley 2000). One exception is the ruby-crowned kinglet that is usually considered to select for bog habitat types or other habitats with high black spruce content (C. Fisher 2004: pers. comm). This deviation may be due to the high proportion of bog and transitional habitat in the lease area overall and is

supported by the high relative abundance of this species observed during the breeding bird study.

Detrended Correspondence Analysis (DCA)

The TWINSPAN results illustrate that a number of the bird groupings were closely associated with one specific ecosite phases/wetlands types (i.e., Group 1 with low-bush cranberry aspen-white spruce (d2) ecosite phases, Group 5 with treed fen [FTNN] wetlands type), while other bird groupings were more closely associated with a few or several habitat types (i.e., Groups 3 and 4). These trends were also evident in the Detrended Correspondence Analysis (DCA) (Figure 4-1).

Ecosite Phases/wetlands types and bird species that are closer together on the DCA plot are more similar to each other than those points that are further apart (ter Braak 1995). The DCA plot illustrates which bird groupings and ecosite phase/wetlands type groupings are better classifications than others. For example, eight of the nine species in Group 1 were found only in the low-bush cranberry aspen-white spruce (d2) ecosite phases, located in the lower left portion of the DCA graph (Figure 4-1). The same pattern occurred for six species in Group 5, all observed within the treed fen (FTNN) wetlands type and located in the lower central portion of the graph. This analysis also indicates that the remaining species could be considered habitat generalists, located on the DCA graph at points less closely associated with particular habitat types. For example, ruby-crowned kinglets, Tennessee warblers and chipping sparrows are all located in the left central portion of the graph, at midpoints between the habitat types in which they were observed.

The DCA analysis generates three axes, two of which can be graphed, based on the associations of birds with various habitat attributes. Axis 1 of the DCA explained 62% of the variation in the bird community structure, (r^2 =0.62), axis 3 explained 8% (r^2 =0.08) and axis 2 explained 5% (r^2 =0.05). Axis 1 and axis 3 generated from the DCA were graphed as they best represent the habitat associations generated by the anlaysis (Figure 4-1). Axis 1 appears to explain a moisture gradient increasing from dry to wet. Axis 1 may also be explained by the height and/or complexity of the tree canopy, with low-bush cranberry aspen-white spruce (d2) (larger aspen and white spruce upland, greater complexity) on the far left of the graph, and decreasing height and/or complexity with shrubby swamp (SONS) on the far right.

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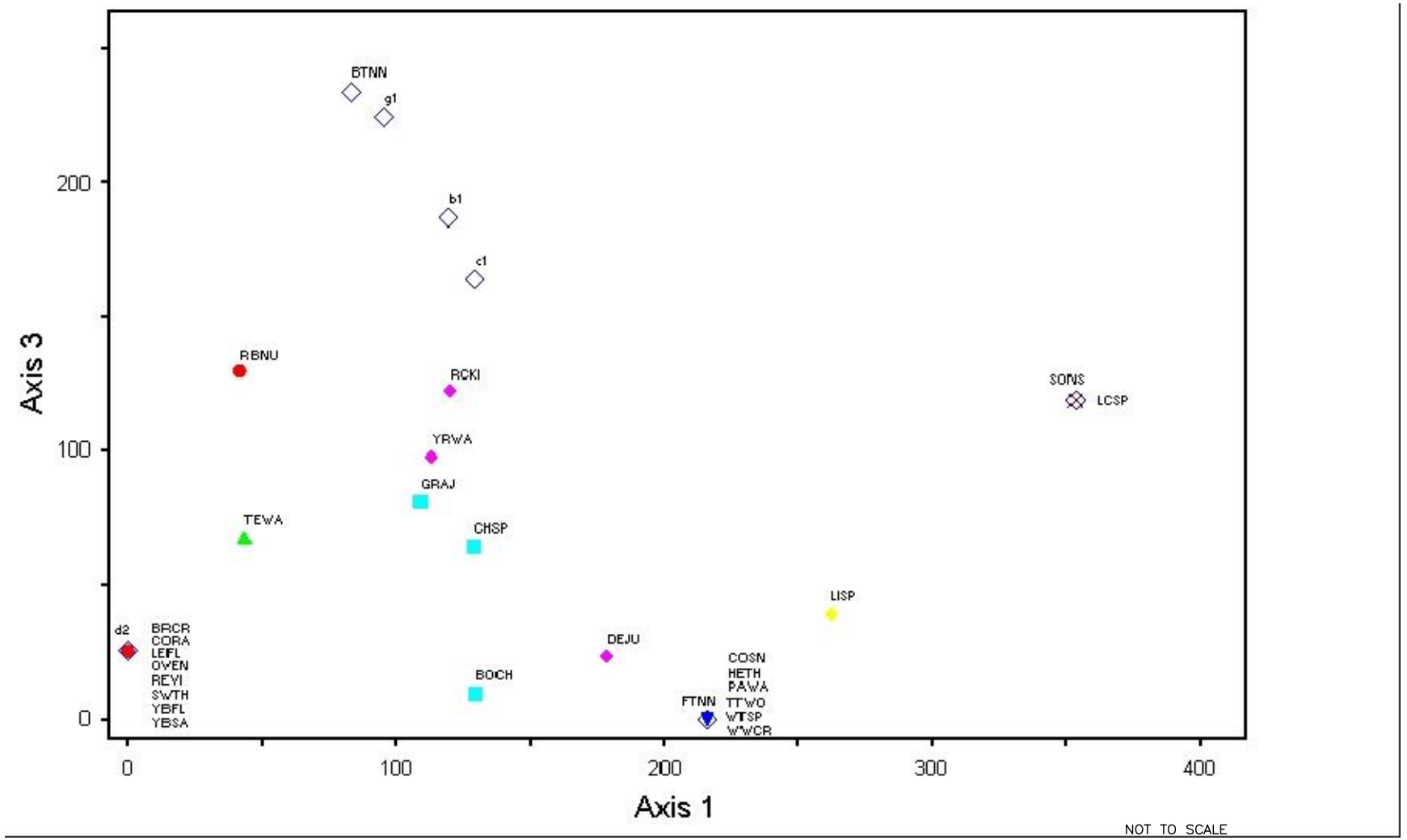


LEGEND

Bird Group
- 1
- 2
- 3
- 4
- 5
- 6
- 7

◇ ECOSITE PHASE/WETLANDS TYPE

PROJECT

CHRISTINA LAKE REGIONAL PROJECT

TITLE

DETRENDED CORRESPONDENCE ANALYSIS (DCA) BY VEGETATION TYPE

MEG ENERGY CORP.

PROJECT 04-1334-001.7740			FILE No.	Detrended Corr.
DESIGN	PB	21/01/05	SCALE AS SHOWN	REV. 0
CADD	JEF	21/01/05		
CHECK	TC	27/01/05		
REVIEW	TC	27/01/05		

FIGURE: 4-1

5 RESULTS - AMPHIBIANS AND REPTILES

Amphibians and reptiles occurring within the Oil Sands Region include wood frogs, boreal chorus frogs, northern leopard frogs (*Rana pipiens*), Canadian toads, western toads and red-sided garter snakes (*Thamnophis sirtalis*). Canadian toads are listed provincially as 'May Be At Risk' (ASRD 2001). Northern leopard frogs are listed provincially as 'At Risk' (ASRD 2001). Western toads are listed provincially as 'Sensitive' (ASRD 2001) and listed federally as 'Special Concern' (COSEWIC 2004).

5.1 AMPHIBIANS

A range of semi-permanent to permanent waterbodies and wetlands are distributed across the lease area and provide good habitat for boreal chorus frogs, wood frogs and western toads (Table 5-1). Forty-one plots were surveyed for amphibians within the lease area (Figure 2-9). Boreal chorus frogs, wood frogs and western toads were recorded during the two amphibian surveys. Boreal chorus frogs, wood frogs, western toads and Canadian toads were also recorded incidentally during other field surveys (Appendix II). Other studies have also indicated that Canadian toads are uncommon in the Oil Sands Region (Appendix III, Table III-28) and that western toads are common adjacent to the LSA (Devon 2004).

Table 5-1 Amphibian Habitat Requirements

Species	Breeding	Summer	Hibernation
boreal chorus frog	favours temporary ponds, will use more permanent sites under some conditions	near water margins; under leaf litter, prone to desiccation; establishes home range	under stumps, leaf litter; glycoprotectant (blood antifreeze) can survive temperatures as low as -6°C
wood frog	uses natural ponds, pits, stream backwaters; will breed in bogs; early breeders, rapid metamorphosis; site fidelity	moist terrestrial community type; prefers canopy closure, wet litter; moves to lowland bogs after breeding; establishes home range; site fidelity	under stumps, leaf litter; glycoprotectant; can survive temperatures as low as -6°C
Canadian toad	wide range of breeding community types: lake margins, slow streams, ponds; site fidelity	waters edge (including lakes and streams); tends to avoid forests; most stay by breeding areas	burrows in loose earth, under frostline; communal areas
western toad	prefers shallow water with a sandy bottom in either permanent or temporary bodies of water (usually pools or small ponds)	around ponds, streams, rivers, and lakes; largely a terrestrial species that may borrow into loose soil or seek shelter in pre-existing burrows of small rodents	dig hibernacula up to 1.3 m deep, below frostline; may use pre-existing burrows of small mammals

Source: Golder 1998a; Russel and Bauer 2000.

Frogs were heard at more plots during the first survey in May than in the second survey in June (Table 5-2). Boreal chorus frogs were heard in 34 plots during the first survey and 19 plots during the second survey. Wood frogs were heard at 39 plots during the first survey and only one plot during the second survey. This is consistent with evidence that wood frogs tend to breed earlier in the spring than boreal chorus frogs. Western toads were heard in approximately the same number of plots during the first and second surveys (20 and 19 plots, respectively).

Table 5-2 Total Number of Plots Amphibians Were Observed In Each Survey

Survey	Number of Plots[(a)]	Amphibians[(b)]	Boreal Chorus Frog	Wood Frog	Western Toad
mid May	41	40	34	39	20
mid June	36	23	19	1	19

(a) Fewer plots were visited in mid June due to wet conditions and accessibility.

(b) Number of plots where amphibian species were heard.

Breeding evidence (eggs) for frogs was observed at six survey sites (disturbed-cutline [2], treed fen [FTNN], graminoid marsh [MONG], and shrubby marsh [MONS] [2]).

Northern leopard frogs were not detected within the lease area. These results are similar to those reported in other studies within the Oil Sands Region (Appendix III, Table III-28).

5.1.1 Habitat

Boreal chorus frogs were almost ubiquitous over both survey periods, occurring in all ecosite phases and wetlands types with the exception of the dogwood balsam poplar-white spruce (e2) ecosite phases (Table 25-3). Wood frogs were found in all wetland types and almost all ecosite phases with the exception of blueberry aspen-white spruce (b3) and the dogwood balsam poplar-white spruce (e2) ecosite phases. Western toads were located in all wetlands types; however they were not recorded in blueberry jack pine-aspen (b1), blueberry aspen-white spruce (b3) and dogwood balsam poplar-white spruce (e2) ecosite phases. The number of frogs and toads recorded in ecosite phase/wetlands type appears to be closely related to sampling effort. Frogs and western toads were observed within a variety of waterbody types and along disturbed-cutlines. The high numbers of western toads corresponds with results obtained from the Devon Jackfish LSA (Devon 2004).

Table 5-3 Amphibian Observations for Each Ecosite Phase / Wetlands Type

Ecosite Phase/Wetlands Types[a]	Map Code	Waterbody Type	Number of Plots with Observations[b]				
			Number of Plots	Boreal Chorus Frog	Wood Frog	Western Toad	Total
lichen jack pine	a1	standing water	1	1	1	0	2
		lake/pond	1	0	1	1	2
blueberry jack pine-aspen	b1	creek	1	1	1	0	2
blueberry aspen-white spruce	b3	standing water	1	1	0	0	1
dogwood balsam poplar-white spruce	e2	standing water	1	0	0	0	0
wooded bog	BTNN	creek	1	1	1	0	2
		standing water	2	2	2	1	5
treed fen	FTNN	lake/pond	4	3	4	4	11
		standing water	9	7	9	5	21
		creek	1	1	1	1	3
graminoid marsh	MONG	standing water	1	1	1	1	3
		creek	1	0	1	1	2
shrubby marsh	MONS	standing water	2	2	2	2	6
		creek	3	3	3	2	8
		river	1	1	1	1	3
shallow open water	WONN	standing water	1	1	1	1	3
disturbed-cutline	dist	standing water	10	10	10	8	28
Total Number of Observations			**41**	**35**	**39**	**28**	**102**

[a] Beckingham and Archibald (1996) and Vitt et al. (1997).

[b] Results from early and late summer surveys combined.

5.2 REPTILES

No snakes were observed incidentally during the field work in the LSA or lease area. This is consistent with previous studies in the Oil Sands Region as garter snake distribution is very patchy and only limited terrestrial habitats provide suitable hibernacula within the LSA.

6 TRADITIONAL KNOWLEDGE

Traditional Ecological Knowledge pertaining to wildlife is provided in Volume 7, Section 7.2 of the MEG Energy Corp. Christina Lake Regional Project Environmental Impact Assessment Report.

7 RESULTS - IMPORTANT WILDLIFE AREAS

On a regional scale, wildlife areas which have been designated as sensitive occur in proximity to the LSA. The LSA is located within the Christina Caribou Area, one of several caribou herds that comprise the East Side of the Athabasca Caribou Range (ESAR) (BCC 2001). Additionally, the LSA is bordered to the south by Christina Lake, which has been designated a Significant Natural Feature as it provides regionally important waterfowl nesting and provincially significant furbearer habitat (Westworth 1990). No important moose areas occur within the vicinity of the Project.

7.1 WILDLIFE MOVEMENT CORRIDORS

Wildlife movement corridors were not specifically identified within the LSA. However, riparian habitats have been identified as the most structurally diverse areas within the landscape, characterized by having high wildlife abundance and as supporting important biodiversity functions (Hannon et al. 2002). Riparian habitats have therefore also been predicted to act as movement corridors for wildlife species (Westworth, Brusnyk & Associates 1996a). Riparian zones are particular vegetation communities that exist generally within 100 m of streams and waterbodies. Vegetation types considered in the riparian analysis included graminoid fen (FONG), shrubby fen (FONS), forested swamp (SFNN), riparian shrubland, shrubby swamp (SONS) and wooded swamp (STNN).

Riparian zones account for 2% of the LSA (70 ha) and are by definition clustered along waterbodies. These riparian zones are distributed as 84 moderate sized (1.7 ± 0.8 ha) but variable (207% AREA_CV) patches along streams unevenly distributed across the landscape. The small mean nearest neighbor value (median of 6.0 m) reflects the narrow widths of watercourses, while the variability in this value (115% ENN_CV) represents the distance between waterbodies. The spatial configuration of riparian zones may facilitate the movement of wildlife species across the landscape within the LSA.

One potential movement corridor for woodland caribou has been identified using winter track and pellet surveys conducted for the Devon Jackfish Project (Devon 2004). A north-south corridor appears to exist between caribou wintering areas within peatland complexes north of Christina Lake (i.e., within and adjacent to the LSA) and spring calving/summer habitats south of Christina Lake (J. Kansas 2005: pers. comm). Caribou appear to move south (either crossing Christina Lake or moving between Christina Lake and Winefred Lake) to calving areas within dense black spruce stands south of Christina Lake near the EnCana SAGD Pilot Project (J. Kansas 2005; pers. comm). Caribou have

been confirmed within the Jackfish LSA during the summer (Devon 2004). Evidence from Golder (2004a) supports this theory, as caribou sign has only been noted on the Encana Christina Lake LSA during the spring and summer.

7.2 SPECIES RICHNESS BY VEGETATION TYPE

Species richness indices indicated that in the RSA, the vegetation types with the highest number of potential vertebrate species (132) include the shrubby swamp (SONS) wetlands type, followed closely (131) by four mixedwood ecosite phases (blueberry aspen-white spruce [b3], low-bush cranberry aspen-white spruce [d2], dogwood balsam poplar-white spruce [e2] and horsetail balsam poplar-white spruce [f2] ecosite phases). Of these types, only the blueberry aspen-white spruce (b3), low-bush cranberry aspen-white spruce (d2) and shrubby swamp (SONS) types occur in the LSA. In general, ecosite phases are likely to contain more species than wetlands types. All vegetation types supported listed species, with the mixedwood ecosite phases potentially supporting the most listed species (23), followed closely by wetlands types (shallow open water, wooded swamps, graminoid marsh and treed fens).

7.3 SPECIES OVERLAP

Based on the habitat specificity of vertebrate species in the RSA, most ecosite phases/wetlands types contain species that also use other habitat types. Some of these habitats are used by habitat generalist species that use a wide range of habitats (e.g., snowshoe hare). Only waterbodies and watercourses support species that occur in only one habitat (i.e., no species overlap).

7.4 HABITAT SPECIFICITY

The number and type of habitats in which each wildlife species was expected to occur was tabulated from detailed habitat association tables (see Appendix II Biodiversity ESR [Golder 2005a]). Table 7-1 summarizes habitat use by species group. Almost half of the bird species in the Oil Sands Region use 10 or fewer vegetation types (i.e., habitat specialists). Most mammal species use a moderate number of different vegetation types (six to 20), with only a few species using a narrower or broader range of habitats. By contrast, amphibians are expected to use a moderate to wide range of habitats.

Table 7-1 illustrates the general trends in species' distribution. However it is valuable to address the habitat specificity for each species individually. Wildlife species with a narrow range of habitat requirements (specialists) are more likely

to be vulnerable to disturbance. In addition, many wildlife species require more than one vegetation type to meet all of their daily and seasonal needs. For example, the Canadian toad migrates to breeding ponds in spring but uses terrestrial habitats during other times of the year (AEP and ACA 1997).

Table 7-1 Summary of Habitat Specificity of Terrestrial Vertebrate Species in the Oil Sands Region

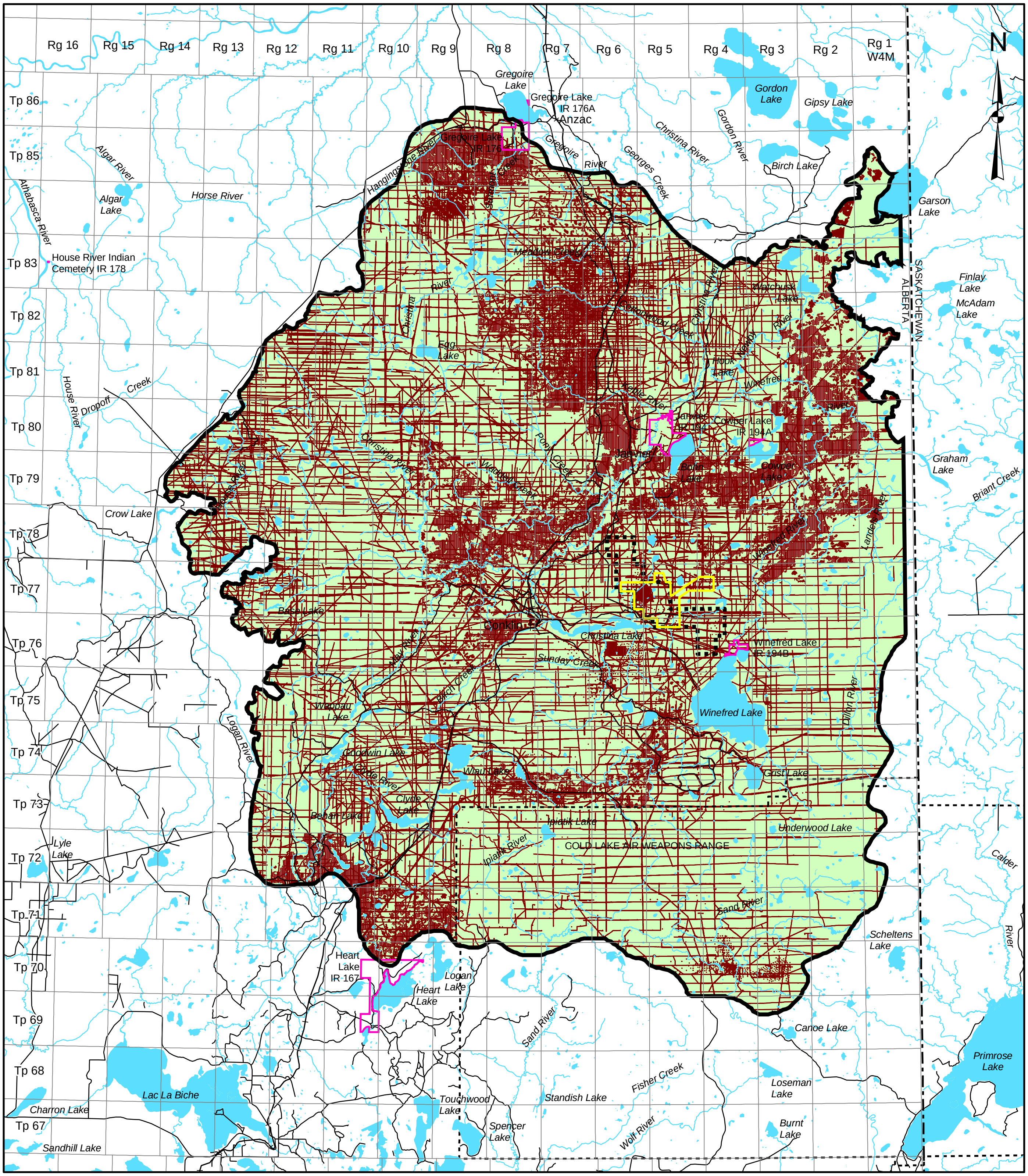
Species Group	Number of Habitat Types Used by a Species (% of Total Species)												
	1 to 5	%	6 to 10	%	11 to 15	%	16 to 20	%	21 to 25	%	>26	%	Total
mammals	1	2.4	9	21.4	7	16.7	13	31.0	7	16.7	5	11.9	42
birds	43	20.0	56	26.0	54	25.1	37	17.2	21	9.8	4	1.9	215
amphibians and reptiles	0	0.0	0	0.0	1	16.7	3	50.0	1	16.7	1	16.7	6
Total	**44**	**16.7**	**65**	**24.7**	**62**	**23.6**	**53**	**20.2**	**29**	**11.0**	**10**	**3.8**	**263**

7.5 LANDSCAPE-LEVEL INDICATORS OF WILDLIFE HABITAT

7.5.1 Fragmentation

Landscape fragmentation was assessed for undisturbed and disturbed areas in the RSA (Table 7-2; Figure 7-1). In this assessment all undisturbed areas, including water and burns, were collectively classified as undisturbed areas. Disturbed areas included all urban (e.g., municipalities and roads) and industrial (e.g., mines, seismic lines, wellpads and pipelines) developments and cutblocks. Fragmentation analysis results for the baseline RSA are as follows:

- There are 19,268 patches of undisturbed areas totalling 1,283,608 ha (i.e., 83% of RSA is undisturbed) compared to 2,236 patches of disturbed areas totalling 254,977 ha (i.e., 17% of RSA is disturbed) of the RSA.
- The mean patch size (± SD) of 66.6 ± 299 ha in undisturbed areas is highly variable (449% AREA_CV) and most patches are small (median patch size of 4.2 ha).



20 0 20

SCALE 1:1,000,000 KILOMETRES

LEGEND

- REGIONAL STUDY AREA
- LOCAL STUDY AREA
- MEG LEASE BOUNDARY
- INDIAN RESERVE
- OPEN WATER
- ROADWAY
- RAILROAD

DISTURBANCE

- UNDISTURBED AREA
- EXISTING DISTURBANCE
- EXISTING LINEAR DISTURBANCE

REFERENCE

Alberta digital data obtained from Geomatics Canada (August 2001), AltaLIS Ltd. (September 2004), Veritas DGC Inc. (July 2004), Alberta Pacific Ltd. (April 2004), LANDSAT 7 ETM Imagery (1988 and 1999), used under license. Saskatchewan digital data obtained from Information Services Corp. (September 2004), used under license.
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 12

PROJECT

CHRISTINA LAKE REGIONAL PROJECT

TITLE

UNDISTURBED AND DISTURBED AREAS IN THE REGIONAL STUDY AREA

MEG ENERGY CORP.

PROJECT No. 04-1334.001.7700			SCALE AS SHOWN	REV. 1
DESIGN	PB	16 Jan. 2005	**FIGURE: 7-1**	
GIS	LDT	11 Jul. 2005		
CHECK	MJ	11 Jul. 2005		
REVIEW	TC	12 Jul.2005		

I:/2004/04-1334-001/mapping/mxd/Wildlife/rsa_bl_nvd.mxd

- Disturbed areas have a larger mean patch size (114± 5,224 ha) than undisturbed areas and these patches are more variable in size (4600% AREA_CV). Like the undisturbed class, most patches are very small (median patch size of 0.6 ha).
- Sixty-eight percent of undisturbed patches provide core area habitat (i.e., interior habitat 100 metres or more from the patch edges).
- Total edge between the undisturbed and disturbed areas is 60,233 km.

The variability in patch size in undisturbed areas and the dominance of very small patches suggests at least some portions of the undisturbed areas in the RSA are highly fragmented by disturbance. However the high proportion of core area (68%) indicates that there are also still several large areas of undisturbed habitat providing habitat for disturbance-sensitive species (e.g., woodland caribou). The large areas of forested habitat still remaining in the RSA are suitable for wildlife species requiring large contiguous areas of forest cover (e.g., woodland caribou, fisher, wolverine, black bear). The areas of non-forested habitat are suitable for many passerine bird species (e.g., Lincoln's sparrow) and mammals (e.g., moose and beaver).

Table 7-2 Fragmentation Analysis in the Regional Study Area

Landscape Metrics	Unit	Undisturbed Area	Disturbed Area[(a)]
class area (CA)	ha	1,283,608	254,977
number of patches (NP)	n/a	19,268	2,236
patch size mean (AREA_MN)	ha	66.6	114.0
patch size median (AREA_MD)	ha	4.2	0.6
patch size standard deviation (AREA_SD)	ha	299	5,244
patch size coefficient of variation (AREA_CV)	%	449	4,600
core area index area weighted mean (CAI_AM)[(b)]	%	68	36
Total Edge	**km**	**60,233**	

(a) Disturbed area includes urban and industrial developments and cutblocks.

(b) Core area index – area weighted mean from FRAGSTATS Version 3 is equivalent to the total core area index from FRAGSTATS Version 2.

Landscape fragmentation in natural and disturbed areas in the LSA was assessed using five fragmentation indices (Table 7-3; Figure 7-2). The patch size index is described using several metrics. A summary of these indices (Table 7-4), include:

- Undisturbed and disturbed areas comprise 93% (6,706 ha) and 7% (519 ha) of the LSA, respectively.

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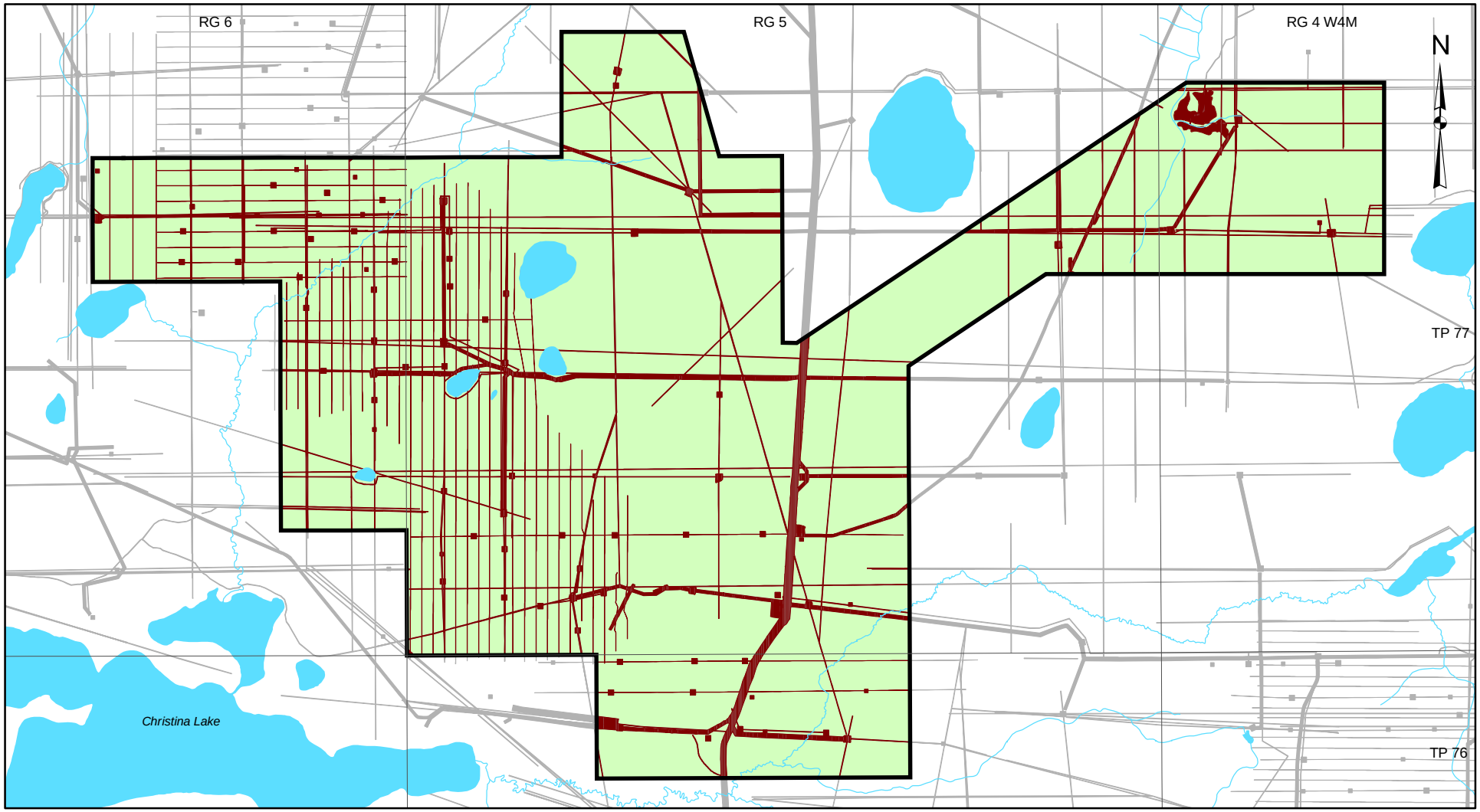


LEGEND

- LOCAL STUDY AREA
- OPEN WATER
- RIVER OR STREAM

DISTURBANCE

- UNDISTURBED AREA
- EXISTING DISTURBANCE (WITHIN LSA)
- EXISTING DISTURBANCE (OUTSIDE OF LSA)

2 0 2
SCALE 1:75,000 KILOMETRES

REFERENCE

Digital data provided by AltaLIS Ltd. (June 2004), Veritas DGC Inc. (July 2004), Alberta Pacific Ltd. (April 2004), Pearson Timberline Ltd. (April 2004), and LANDSAT 7 ETM Imagery (1998 and 1999), used under license.
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 12

PROJECT
CHRISTINA LAKE REGIONAL PROJECT

TITLE
UNDISTURBED AND DISTURBED AREAS IN THE LOCAL STUDY AREA

MEG ENERGY CORP.

PROJECT No. 04-1334.001.7700			SCALE AS SHOWN	REV. 1
DESIGN	MS	12 Jan. 2005		
GIS	LDT	11 Jul. 2005		
CHECK	MJ	11 Jul. 2005		
REVIEW	TC	11 Jul. 2005		

FIGURE: 7-2

- There are 671 undisturbed patches with mean patch size of 10.0 ± 29.3 ha and 40 patches of disturbed areas with a mean patch size of 13.0 ± 66.5 ha.
- Variability in patch size (AREA_CV) is 293% for the natural patches and 512% for the disturbed patches, although patch size median values indicate both classes are dominated by small patches.
- Core area habitat is available in 32% of undisturbed area patches, which indicates the landscape at baseline is highly fragmented by human development.
- Total edge between the natural and disturbed areas is 793 km, due to the high number of linear disturbance features (e.g., seismic lines) in the LSA.

Table 7-3 Fragmentation Analysis in the Local Study Area

Landscape Metrics	Units	Undisturbed Areas	Disturbed Areas[(a)]
class area (CA)	ha	6,706	519
number of patches (NP)	n/a	671	40
patch size mean (AREA_MN)	ha	10.0	13.0
patch size median (AREA_MD)	ha	1.2	0.2
patch size standard deviation (AREA_SD)	ha	29.3	66.5
patch size coefficient of variation (AREA_CV)	%	293	512
core area index area weighted mean (CAI_AM)	%	32.4	n/a
Total Edge (TE)	**km**	**793**	

(a) Disturbed areas include urban and industrial developments.

7.5.2 Human Versus Natural Disturbance

Anthropogenic (i.e., human) and natural disturbances (e.g., fire) were examined to determine the size and shape of disturbances on the landscape at the RSA level. Landscape processes shaping these disturbance types were compared (Table 7-4). The results of this examination are as follows:

- The natural disturbance process most prevalent in the RSA is fire. Older fires (i.e., defined as fires occurring prior to 1980) have occurred throughout of the RSA. A recent large fire occurred since 1990 in northwest portion of the RSA (Figure 7-3).

- Human disturbance area (254,980 ha) is greater than the area recently affected by fire (173,808 ha). Human disturbance is distributed throughout the RSA.
- The mean patch size of human disturbances (0.6 ha) is approximately one-quarter the size of natural process disturbances (2.2 ha) indicating most human disturbances occur as small patches compared to burns.
- The patch size of human disturbance is significantly more variable (4,600% AREA_CV) compared to natural disturbance patches (431% AREA_CV), due to the wide-range in types of human disturbances.
- The shape complexity (FRAC_MN) (1.04 for human disturbance and 1.08 for natural disturbance), shows that both disturbance types are regular in shape, although human disturbances are closer to square and burns are closer to circular. Natural disturbance patches in the RSA have moderate amounts of forest edge compared to more regular-shaped disturbed patches. Higher edge lengths per area result from the complex edges created by wildfires.

Table 7-4 Human Versus Natural Disturbances in the Regional Study Area

Landscape Metrics	Units	Human Disturbance[(a)]	Natural Process Disturbance
class area (CA)	ha	254,980	173,808
number of patches (NP)	n/a	2,236	8,347
patch size mean (AREA_MN)	ha	114.0	20.8
patch size median (AREA_MD)	ha	0.6	2.2
patch size standard deviation (AREA_SD)	ha	5,244	90
patch size coefficient of variation (AREA_CV)	%	4,600	431
shape complexity (FRAC_MN)	%	1.04	1.08
nearest neighbour mean (ENN_MN)	m	145	64

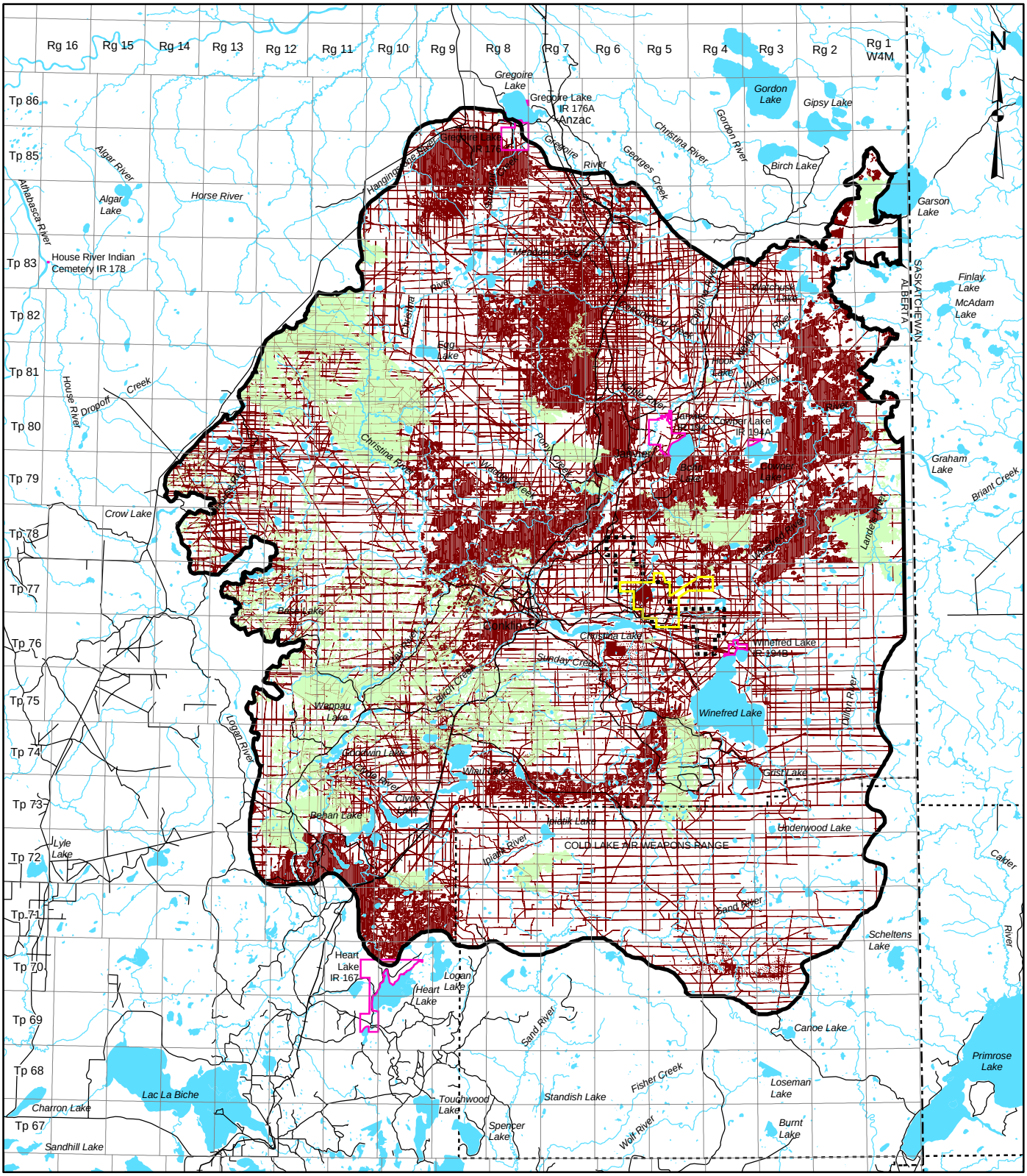
(a) Human disturbance category includes cutblocks, urban and industrial developments.

7.5.3 Non-native and Invasive Species

The house sparrow (*Passer domesticus*) and European starling (*Sturnus vulgaris*) are currently the only non-native wildlife species that have been observed in the Oil Sands Region. These species were observed near oil sands facilities (McKeown 1994) and are common in Fort McMurray. Beyond these human-influenced areas, the European starling has only been reported once during one breeding bird survey in the region (Golder 1997a). Neither the house sparrow nor the European starling was observed during wildlife field surveys conducted within the lease area or the LSA. The absence of these species in the

pre-disturbance landscapes may indicate that these species have not yet encroached into these areas. The increase in distribution of these and other non-native species throughout the region may indicate a change in the community and a potential change in ecosystem function.

Several invasive wildlife species have been identified in the Oil Sands Region. The brown-headed cowbird (*Molothrus ater*) has been reported in natural areas (McLaren and Smith 1985) and has been observed occasionally near oil sands facilities (Golder 2004a). Coyotes, deer and corvids are also native invasive species that have been recorded during field programs in the region. The brown-headed cowbird was not recorded during breeding bird or other wildlife surveys conducted in the LSA. Coyotes, deer and common ravens were observed. The abundance of these species was within the ranges previously recorded during baseline surveys in the region. Other species, such as the American crow (*Corvus brachyrhynchos*) and black-billed magpie (*Pica pica*), were not recorded during breeding bird or other field surveys completed for the Project.



LEGEND

- REGIONAL STUDY AREA
- LOCAL STUDY AREA
- MEG LEASE BOUNDARY
- INDIAN RESERVE
- OPEN WATER
- ROADWAY
- RAILROAD

DISTURBANCES

- NATURAL
- EXISTING DISTURBANCE
- EXISTING LINEAR DISTURBANCE

20 0 20

SCALE 1:1,000,000 KILOMETRES

REFERENCE

Alberta digital data obtained from Geomatics Canada (August 2001), AltaLIS Ltd. (September 2004), Veritas DGC Inc. (July 2004), Alberta Pacific Ltd. (April 2004), LANDSAT 7 ETM Imagery (1988 and 1999), used under license.
Saskatchewan digital data obtained from Information Services Corp. (September 2004), used under license.
Projection: Transverse Mercator Datum: NAD 83 Coordinate System: UTM Zone 12

PROJECT

CHRISTINA LAKE REGIONAL PROJECT

TITLE

HUMAN AND NATURAL DISTURBANCES IN THE REGIONAL STUDY AREA

MEG ENERGY CORP.

PROJECT No. 04-1334.001.7700			SCALE AS SHOWN	REV. 1
DESIGN	PB	16 Jan. 2005		
GIS	LDT	11 Jul. 2005		
CHECK	MJ	12 Jul. 2005		
REVIEW	TC	11 Jul. 2005		

FIGURE: 7-3

I:/2004/04-1334-001/mapping/mxd/Wildlife/rsa_bl_hvn.mxd

8 RESULTS - SPECIES OF CONCERN

8.1 WILDLIFE KEY INDICATOR SPECIES

Key Indicator Resources (KIRs) were selected (Table 2-11) using the criteria established by CEMA (2001).

8.2 SPECIES OF CONCERN WITHIN THE LEASE AREA

Potential species of concern (i.e., includes provincially and federally listed species) occurring within the region are listed in CNRL 2002 (Volume 6, Appendix C, Table C7-2). Species of concern, observed within the lease area as part of this project are presented in Table 8-1. All incidental sightings of wildlife are presented in Appendix II. Locations of species of concern that have been observed in the vicinity of the LSA in the past (BSOD 2004) are shown in Figure 8-1.

Of the 32 species, or species groups, of concern (including KIRs) observed within the lease area, the woodland caribou is the only nationally listed species; it is listed as threatened by COSEWIC (2004) and provincially as 'At Risk' (ASRD 2001). This species therefore falls under the federal government's *Species At Risk Act* (SARA) legislation and the Alberta Caribou Recovery Plan (*not yet released*) which will be applied to provincial crown lands. The Canadian toad is the only species observed listed as 'May Be At Risk' in Alberta (ASRD 2001). The red bat is listed as 'Accidental/Vagrant' and the brown creeper is listed as an 'Undetermined' species (ASRD 2001). All of the other species of concern are listed provincially as 'Sensitive' or 'Secure'. 'Sensitive' species are not considered to be at risk but may require special attention or protection (ASRD 2001).

The following sections describe the main limiting factors for species populations, habitat requirements, observations of species listed by COSEWIC (2004), ASRD (2001) and Project KIRs observed within the lease area or the LSA.

Table 8-1 Species of Special Concern Observed Within the Lease Area and the Project Local Study Area

Species	National Status[(a)]	Provincial Status[(b)]	Project KIR
woodland caribou	threatened	'At Risk'	KIR
moose	---	'Secure'	KIR
black bear	not at risk	'Secure'	KIR
Canada lynx	not at risk	'Sensitive'	KIR
fisher/small mammal	---	'Sensitive'	KIR
snowshoe hare	---	'Secure'	KIR
beaver	---	'Secure'	KIR
muskrat	---	'Secure'	KIR
river otter	---	'Secure'	KIR
cougar	---	'Sensitive'	
red bat	---	'Accidental/Vagrant'	
ducks and geese	n/a	n/a	KIR
American bittern	---	'Sensitive'	
American white pelican	not at risk	'Sensitive'	
northern goshawk	not at risk	'Sensitive'	
sandhill crane	not at risk	'Sensitive'	
bald eagle	not at risk	'Sensitive'	
barred owl	---	'Sensitive'	
boreal owl	not at risk	'Secure'	KIR
great gray owl	not at risk	'Sensitive'	
great blue heron	---	'Sensitive'	
common nighthawk	---	'Sensitive'	
black-backed woodpecker	---	'Sensitive'	
pileated woodpecker	---	'Sensitive'	KIR
black tern	not at risk	'Sensitive'	
brown creeper	---	'Undetermined'	
osprey	---	'Sensitive'	
ruffed grouse	---	'Secure'	KIR
old growth forest bird community	n/a	n/a	KIR
mixedwood forest bird community	n/a	n/a	KIR
western (boreal) toad	special concern	'Sensitive'	
Canadian toad	not at risk	'May Be At Risk'	KIR

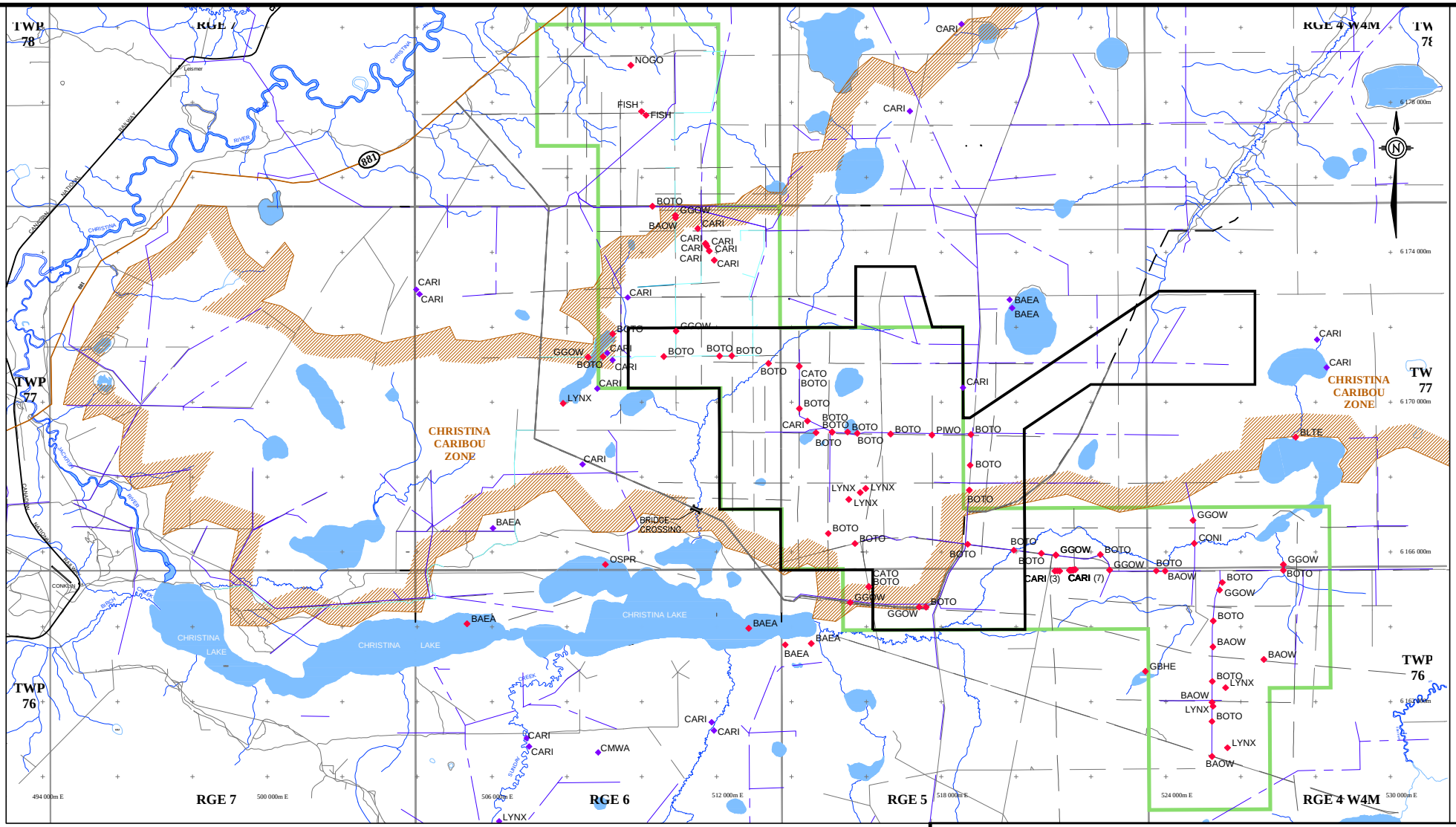
[(a)] COSEWIC 2004.
[(b)] ASRD 2001.
--- = not assessed or secure.
n/a = not applicable.

8.2.1 'At Risk' Species

8.2.1.1 Woodland Caribou

Woodland caribou are listed federally as 'Threatened' by COSEWIC (2004) and as 'At Risk' in Alberta (ASRD 2001). Woodland caribou are also a KIR species for the Project. Woodland caribou sign (tracks, craters) were observed on several occasions during the late winter tracking session. Additionally, one set of caribou tracks was observed within a Labrador tea-subhygric black spruce-jack pine-cutline (g1-cutline) habitat type in May (during amphibian survey 1) and one caribou was observed in March 2004. Caribou tracks were recorded primarily within fen complexes and within jack pine-black spruce forests, as well as on cutlines.

R:\CAD\2004\1322-EA\1334\04-1334-001 MEG\7700\7740\Baseline Figures\Fig 8-1_Wildlife Species of Concern.dwg Jul 27, 2005 - 11:10am



LEGEND

- MEG OIL SANDS LEASE
- EXISTING ACCESS ROAD
- CHRISTINA CARIBOU ZONE
- TERRESTRIAL RESOURCES LOCAL STUDY AREA
- WILDLIFE BSOD OBSERVATION
- WILDLIFE BASELINE OBSERVATION

BAEA	BALD EAGLE
BAOW	BARRED OWL
BBWO	BLACK BACKED WOODPECKER
BLTE	BLACK TERN
BOTO	BOREAL TOAD
CARI	WOODLAND CARIBOU
CATO	CANADIAN TOAD
CMWA	CAPE MAY WARBLER
CONI	COMMON NIGHTHAWK
FISH	FISHER
GBHE	GREAT BLUE HERON
GGOW	GREAT-GRAY OWL
LYNX	CANADA LYNX
NOGO	NORTHERN GOSHAWK
OSPR	OSPREY
PIWO	PILEATED WOODPECKER

3 0 3
SCALE KILOMETRES

PROJECT

CHRISTINA LAKE REGIONAL PROJECT

TITLE

WILDLIFE SPECIES OF CONCERN OBSERVATIONS AND HISTORICAL LOCATION DATA (BSOD)

MEG ENERGY CORP.

PROJECT 04-1334-001.7740			FILE No.	Wildlife Species	
DESIGN	WF	10/01/05	SCALE	1:150000	REV. 2
CADD	JEF	08/07/05	FIGURE: 8-1		
CHECK	IGG	10/07/05			
REVIEW	TC	12/07/05			

As woodland caribou's primary winter food source is lichen, caribou prefer mature to old forests (Dzus 2000). Woodland caribou primarily select peatland-dominated landscapes such as black spruce bogs and black spruce-tamarack fens, while typically avoiding upland areas (Stuart-Smith et al. 1997; Anderson 1999). Caribou in northeastern Alberta also select upland jack pine ridges containing a high abundance of lichens (Schneider et al. 2000). Caribou tend to move into areas of higher tree cover when snow depths increase, as movement and feeding are easier (Fuller and Keith 1981). Caribou have been historically recorded within the provincial Biodiversity Species Observation Database (BSOD) in the lease area (Figure 2-10).

Caribou populations occur at low densities (0.03-0.12 caribou/km^2) and are sparsely distributed across available habitat (Dzus 2000). Although the availability of quality habitat for forage and breeding health are not believed to be limiting for caribou in Alberta (BCC 2003), impacts to caribou populations are believed to result from sensory disturbance of developments and fragmentation leading to habitat avoidance (Dyer 1999), barriers to movement (Dyer et al. 2001) and associated increases in predator mobility and caribou predation (CAPP 2004). In undisturbed landscapes, the major limiting factor for woodland caribou populations is predation (primarily wolf, however other predators include bear, wolverine, coyote and lynx) (Dzus 2000).

8.2.2 'May be at Risk' Species

8.2.2.1 Canadian Toad

The Canadian toad is listed as 'May Be At Risk' in Alberta due to a dramatic decline in its parkland distribution (ASRD 2001). Canadian toads are also a KIR species for the Project. There were two incidental recordings of Canadian toads in treed fen (FTNN) habitats during amphibian call surveys in 2004 within the lease area.

Canadian toads use a wide range of habitat types. During the breeding season, they can be observed near lakes, lake margins, slow streams and ponds. Following the breeding season they tend to move to uplands (Hamilton et al. 1998). Hibernation sites can be communal and involve burrowing below the frost-line in loose earth (typically sandy soils) in upland areas (Hamilton et al. 1998).

The main limiting factor for Canadian toads is habitat loss. The loss of wetlands to development in the Oil Sands Region, well north of the RSA, has resulted in a decrease in the amount of available habitat in northeastern Alberta

(Suncor 2000). A second limiting factor of concern for all amphibians, is the increased levels of deformities in populations (Power et al. 1989).

8.3 'SENSITIVE' SPECIES

8.3.1.1 Canada Lynx

The Canada lynx is a KIR for the Project and is provincially listed as 'Sensitive' (ASRD 2001). Lynx populations exhibit dramatic swings related to the population cycles of its main prey, the snowshoe hare. Overall, the lynx population is believed to be decreasing in the province (ASRD 2001). Reproduction usually begins at one year of age for females with usually two to three kittens born each litter (Pattie and Fisher 1999). Lynx tracks were observed several times in the lease area and lynx were also observed incidentally.

Lynx prefer open mature coniferous forests, advanced successional forest stages and black spruce bogs (Stardom 1989). Habitat selection depends on the availability of prey species, specifically snowshoe hares.

In Alberta, lynx populations are limited by habitat loss and overtrapping. Loss of either lynx or snowshoe hare habitat may have a detrimental effect on the lynx population. The lynx is considered a furbearing species in Alberta and is therefore subjected to trapping pressures. Overtrapping in times of high fur demand limits lynx populations. Currently, lynx prices are considered to be low. Concern has been expressed for the stability of lynx populations if high fur prices coincide with a low period in the population cycle (Stardom 1989).

8.3.1.2 Fisher

Fishers are listed provincially as 'Sensitive' (ASRD 2001) and are a KIR for the Project. While their population status is unknown, it is believed that there are less than 10,000 breeding fishers in Alberta (ASRD 2001). During the late winter tracking surveys, two confirmed fisher tracks were identified within black spruce-pine habitats. Fisher/marten tracks were also observed during winter track count surveys in the lease area and LSA.

Fishers occur most commonly in landscapes dominated by mature coniferous and mixedwood forest cover, with a preference for late seral stage forests (Powell and Zielinski 1994; Smith 1993). Fishers make use of many species of prey ranging from insects to carrion, but the most important food sources are snowshoe hares and other small mammals such as voles (Powell 1993). Food habitat is therefore closely associated with the cover habitats of their dominant prey.

Human activity is a major limiting factor for fishers. Habitat loss as a result of development reduces the amount of suitable habitat within a region and results in a reduced capability of the land to support the resident population (Powell and Zielinski 1994). Fishers are also a furbearing species and as such are limited by trapping when prices for pelts are high (Powell and Zielinski 1994).

8.3.1.3 Cougar

Cougars are provincially listed as 'Sensitive' (ASRD 2001). While cougars may be found anywhere in the province, typical cougar range is the Rocky Mountains and foothills of Alberta (Smith 1993). Few cougars or cougar sign have been observed in the Oil Sands Region. One incidental cougar sighting was reported during 2004 near Conklin (G. Moller 2004: pers. comm.). Additionally, one cougar was observed on the Encana Christina Lake lease in 2003 (T. Calverley and J. Elser 2003; pers. comm).

Cougars are generally associated with mountainous terrain, canyons and rimrock. However, they can be found in a wide variety of habitats from swamps and wooded river valleys to dense coniferous forests (Banfield 1987). The main limiting factor for cougars in Alberta is habitat loss. As development in the province increases, suitable habitat is lost and movement corridors can be blocked. Populations may also be limited by prey availability (ASRD 2001). Loss of habitat and reduction in prey availability may have a detrimental effect on cougars.

8.3.1.4 American Bittern

The American bittern is listed as a 'Sensitive' species in Alberta (ASRD 2001). Although the population in Alberta is unknown, it is suspected to be in decline in some areas of the province (ASRD 2001). One American bittern was observed incidentally during the baseline surveys along a waterbody shoreline.

American bitterns prefer marshes, bogs, swamps and areas with a dense growth of emergent vegetation (Semenchuk 1992; Gibbs et al. 1992). This species will also occur in moist meadows and wet alder or willow thickets. The loss of wetlands due to development is a continued threat to the American bittern. As with most species, the loss of habitat for the bittern can result in a reduction in the reproductive success.

8.3.1.5 Sandhill Crane

The sandhill crane is listed as 'Sensitive' in Alberta, with an unknown population size (ASRD 2001). Sandhill cranes were observed once during baseline surveys within the lease area.

Sandhill crane breeding habitat includes marshes, bogs adjacent to ponds, large marshes with some open water and tall grasses and marshes which are relatively free from human disturbance (Semenchuk 1992). Fens, bogs and large open shallow marshes usually meet these conditions. The major limiting factor for sandhill crane populations is human disturbance (ASRD 2001). As settlement and development increases, areas of suitable habitat have been abandoned as breeding and migratory stopping points. Additionally, the removal of wetlands through development also has been shown to be a limiting factor (Stephen 1979).

8.3.1.6 Barred Owl

Barred owls are uncommon in Alberta and are provincially listed as 'Sensitive', with an estimated number of breeding pairs of less than 1,000 (ASRD 2001). Five barred owls were heard during the owl call playback survey in the lease area. Although population declines have been reported in the parkland areas, population trends in the boreal forest are unknown (ASRD 2001).

There are a variety of limiting factors that can affect the barred owl population in the Oil Sands Region. Barred owls are directly affected by forest fragmentation in that both nest sites and suitable roost and forage habitats may be lost (Takats 1997). As well, great horned owls often move into fragmented areas, preying upon barred owls. Although barred owls are often unsuccessful at constructing their own nests, the availability of nesting cavities is not limiting, as this species is known to utilize stick nests of other raptors (Bent 1961).

8.3.1.7 Great Gray Owl

The great gray owl is listed as 'Sensitive' (ASRD 2001), although its population status within the province is not known. Eight great gray owl observations were recorded during the owl call survey and five owls were recorded incidentally within the lease area.

Great gray owls prefer areas of coniferous, deciduous and mixedwood forests interspersed with bogs, fens and other open spaces (Semenchuk 1992; Duncan 1994). In some areas, tamarack/black spruce communities appear to be the preferred nesting habitat. Habitat loss is the primary limiting factor affecting the great gray owl population in the Oil Sands Region. Habitat loss associated

with development affects this species through loss of suitable nest sites (Bull and Duncan 1993) and loss of prey items that can lead to starvation and death even if suitable nest sites are present (Duncan 1994). Other limiting factors for the great gray owl include collisions with vehicles, shooting, predation by other bird and mammalian species, accidental trapping, and exposure to poisons used to control small mammal populations (Bull and Duncan 1993).

8.3.1.8 Osprey

The osprey is provincially listed as 'Sensitive' (ASRD 2001). Populations in Alberta are unknown (ASRD 2001). Two incidental osprey observations were made along the north shore of Christina Lake during the waterfowl surveys.

Ospreys are typically found in the vicinity of lakes, rivers and sloughs (Semenchuk 1992; Wings Over the Rockies 1999). Nests in these areas are built in tall trees, snags or other tall objects such as poles and towers. Habitat loss and contamination uptake are the two main limiting factors for osprey (Environment Canada 1998). As with other species, the removal of suitable habitat for development can have a dramatic effect on an osprey population in a region. The presence of suitable nest sites is a key factor that can limit osprey populations. In addition, pesticides such as DDT have caused population reductions in osprey (Environment Canada 1998). Since regulations regarding these substances were introduced, populations in areas of suitable habitat have begun to recover.

8.3.1.9 Common Nighthawk

The common nighthawk is listed as 'Sensitive' (ASRD 2001). Although the Alberta population of this species is considered large, there has been an apparent decline in populations (ASRD 2001). Declines may be due to pesticide use and the subsequent affect on food supply (ASRD 2001). One common nighthawk was observed incidentally during field surveys in the lease area.

Common nighthawks nest in or near a wide variety of open or semi-open habitat, including forest clearings, burned areas, fields, gravel pits, barren rock and beaches. They also may breed in urban areas on tar or gravel roofs (Semenchuk 1992). Common nighthawks feed primarily on flying insects (Semenchuk 1992).

8.3.1.10 Black-Backed Woodpecker

The black-backed woodpecker is listed as 'Sensitive' (ASRD 2001). The black-backed woodpecker is an uncommon resident in coniferous forests of Alberta. One black-backed woodpecker was observed during field studies conducted within the lease area (Appendix II).

The black-backed woodpecker inhabits dense mixedwood and coniferous forests. They commonly nest in decaying trees of burns, logged areas, windfalls or openings in bogs, swamps and lake shores (Semenchuk 1992). The black-backed woodpecker is an insectivore, preying primarily on wood-boring insects. Although considered a resident, this species may move southward in the winter (Semenchuk 1992). Habitat loss is likely to be one of the main limiting factors for this species as they require dense conifers as well as open areas with decaying trees for nesting.

8.3.1.11 Pileated Woodpecker

The pileated woodpecker is a KIR species for the Project and is listed provincially as a 'Sensitive' species (ASRD 2001). While its population in the province is stable, its dependence on mature to old growth forests places this species at potential risk to timber harvest activities. However, harvesting practices that retain clumps of mature trees or leave snags for wildlife can be beneficial for pileated woodpeckers. One pileated woodpecker observation was made within the lease area during baseline surveys (Appendix II).

Pileated woodpeckers are widely distributed residents of the boreal forest, most notable for being tree cavity excavators and for their use of bark/wood dwelling insects as their primary food source (Bonar 1995). Consequently, they are associated with mature forest types with high densities of large diameter snags and downed wood (Bull and Meslow 1977). Preferring live aspen or balsam poplar trees, pileated woodpeckers are also known to excavate nests in dead snags and paper birch (Bonar 1995). Therefore, the primary limiting factor for this species is habitat loss due to their dependence on large diameter trees used for nesting.

8.3.1.12 American White Pelican

The American white pelican is listed as a 'Sensitive' species in Alberta (ASRD 2001). Once designated as an 'Endangered' species in Alberta (Semenchuk 1992), populations have increased, allowing the designation of pelicans to be downgraded. One American white pelican was observed during the spring waterfowl surveys.

Typical habitat for the American white pelican is a shallow, turbid lake remote from human activity with extensive shallows near shore and good fish populations (Semenchuk 1992). Nesting occurs in colonies and threats are reduced to the species through the use of comprehensive colony protection (ASRD 2001). Threats to pelicans in the province include the concern over colony protection, drought and possible disease risk (ASRD 2001).

8.3.1.13 Western (Boreal) Toad

The western (boreal) toad is listed as 'Sensitive' species in Alberta (ASRD 2001) and as a species of special concern federally (COSEWIC 2004). Most of the western toad populations in Alberta are documented to be well to the west and south of the LSA (Russell and Bauer 2000). The trend in the western toad population in Alberta is unknown (ASRD 2001). However, many western toads were recorded during the amphibian call surveys and incidentally within the lease area. Many western toads were also documented within the adjacent Devon Jackfish lease (Devon 2004).

The western toad prefers shallow water with a sandy bottom in either permanent or temporary waterbodies (usually pools or small ponds) for breeding habitat. Summer habitat for western toads includes areas around waterbodies and watercourses. However it is largely a terrestrial species that may burrow into loose soil or seek shelter (as well as dig hibernacula) in pre-existing burrows of small rodents (Russell and Bauer 2000). Threats to western toads include pollution and pesticides (ASRD 2001).

8.3.1.14 Black Tern

The black tern is listed as a 'Sensitive' species in Alberta (ASRD 2001). The population of black terns in Alberta is unknown. There have however, been several population declines observed in Saskatchewan and other parts of North America (ASRD 2001). A single black tern was observed during spring waterfowl surveys.

The black tern requires shallow lakes, marshes, sloughs and ponds where there are extensive shallows and emergent vegetation (Gerson 1988; Semenchuk 1992). They generally prefer large deepwater marshes with approximately 50% open water. The major limiting factor for black terns is unknown. However, loss of habitat and pollution, especially on their wintering grounds, have been hypothesized for the decline of the species (Gerson 1988).

8.3.1.15 Great Blue Heron

The great blue heron is a provincially listed 'Sensitive' species. Approximately 75 colonies and 1,500 breeding pairs occur within the province. Two great blue herons were observed during the waterfowl surveys. No colonies are known to occur within the lease or within the LSA.

The great blue heron is predominantly found in areas with shallow open water, swamps and mudflats (Semenchuk 1992). Great blue herons are colonial nesters,

with nest sites located in areas close to foraging habitat and are selected to avoid predation (Butler 1992). Both human disturbance and pesticide/herbicide contamination have been identified as limiting factors for great blue herons (Butler 1992). Repeated disturbance near nest sites can result in nest abandonment and reduction in breeding success. Activities such as logging and road building have had negative effects when occurring within 500 m of great blue heron nest sites (Werschkul et al. 1976).

8.3.1.16 Northern Goshawk

The northern goshawk is listed as a 'Sensitive' species in Alberta (ASRD 2001). The population of this species in Alberta is unknown. One northern goshawk was observed during the raptor call surveys within the lease area.

Habitat requirements for the northern goshawk are limited to mature or old growth forests for nesting and a wide range of forest types and ages for foraging (Semenchuk 1992). Nest site selection is based upon six characteristics; a closed canopy, large tree basal area, northeastern exposure, gentle to moderate slope, the lower third of slopes and mature or old growth forest. The most important limiting factor for northern goshawks is the loss of suitable nest trees and the loss of foraging habitat from logging and development. The northern goshawk is also subject to predation pressures from great horned owls, raccoons (*Procyon lotor*), fishers and humans. Overall, northern goshawk populations are limited by nesting habitat and prey availability.

8.3.1.17 Bald Eagle

Bald eagles are listed as a 'Sensitive' species in Alberta due to low population levels and sensitivity to disturbance when nesting (ASRD 2001). Twelve bald eagles were observed during the baseline surveys, including two young in a nest along the north shore of Christina Lake.

A primary habitat requirement for bald eagles appears to be the presence of a large body of water (Semenchuk 1992; Brownell and Oldham 1985). Nest site preference appears to be associated with deciduous or mixedwood forests containing tall trees and limited crown cover (Brownell and Oldham 1985). A number of limiting factors have been identified for bald eagles, all related to human activity and disturbance. These limiting factors include loss of nest sites through development, disturbance of nest sites during breeding, collisions with power lines, electrocution, shooting, trapping and the ingestion of contaminants (DDE, PCBs, DDT) (Brownell and Oldham 1985).

8.3.2 'Accidental/Vagrant' and 'Undetermined' Species

8.3.2.1 Red Bat

The red bat is listed as an 'Accidental/Vagrant' species in Alberta (ASRD 2001). Red bats were identified using echolocation data during the bat surveys. Only five records of red bats have been confirmed in Alberta, with only one record, prior to this study's observations, occurring in northern Alberta (Golder 2003a).

Red bats inhabit both coniferous and deciduous forests and are often located near open grassy areas (Pattie and Fisher 1999). Although considered 'Accidental' in Alberta, the red bat occupies the boreal forest throughout the rest of Canada and the Oil Sands Region is at the western periphery of its range in Canada.

8.3.2.2 Brown Creeper

The brown creeper is listed as an 'Undetermined' species in Alberta (ASRD 2001). One brown creeper was observed during the breeding bird surveys conducted in the lease area.

The brown creeper winters in Alberta and inhabits mature mixedwood and coniferous forests. Creepers commonly nest under the loose bark of a tree, feeding on insects, spiders and other small invertebrates and occasionally on seeds (Semenchuk 1992). Habitat loss is likely to be one of the main limiting factors for this species.

8.3.3 'Secure' Species

8.3.3.1 Moose

Moose are a KIR species for the Project. Moose are an important indicator as they are a highly sought after for both recreational and subsistence hunting by aboriginal groups (AXYS 2001a). There were several incidental observations of moose (Appendix II) including visual observations of moose, tracks and pellets in the lease area and LSA during the baseline surveys.

Optimal moose habitat consists of shrub and ground strata within deciduous, mixedwood and coniferous forests that offer edge or disturbed areas of early successional vegetation (AXYS 2001a). Previous field work in northern Alberta (Golder 1999a, 2000b) has indicated that major river valleys act as important wintering areas for moose. Disturbance from human land-use activities may result in a loss of habitat effectiveness and linkage for moose populations.

8.3.3.2 Black Bears

Black bears are a KIR for the Project. Black bears and black bear sign were observed incidentally on several occasions during field surveys (Appendix II).

Although found in a variety of habitats, black bears prefer heavily wooded areas and dense bushland. In the Fort McMurray area, black bears have been reported to prefer terrestrial habitats (relative to availability), exhibit high use of aspen-jack pine and aspen-conifer mixedwoods, avoid muskeg and are attracted to dump sites (Fuller and Keith 1980b; Tietje and Ruff 1980). Black bears are omnivorous, eating vegetation such as berries and nuts, fish and small mammals. In the Conklin area, black bears are subject to hunting and trapping pressures that has lowered their densities relative to unhunted bear populations within the Cold Lake Air Weapons Range (S. Czetwertynski 2004: pers. comm.).

8.3.3.3 Snowshoe Hare

Snowshoe hares are a KIR species for the Project, due to their predator-prey relationship with the Canada lynx (see Section 8.2.3.1).

8.3.3.4 Beavers

Beavers are a KIR species for the Project. Beavers, beaver lodges, dams and food caches were observed during the beaver/muskrat and waterfowl surveys within the lease and adjacent areas.

Beavers are widespread and occur in most places where water is deep enough to allow for food storage and access to a lodge under the winter ice (Novak et al. 1987). Beavers are generalists, eating a great number of woody and herbaceous species (Harper 1969). In northern regions, preference is given to the bark of trees and shrubs, particularly aspen and balsam poplar (AXYS 2001a). Federal and provincial governments have established conservation plans for the beaver in cooperation with local trappers. Beavers have been reintroduced into many areas where early trappers eradicated beavers. As a result of reintroductions and improved trapping laws, there has been a tremendous increase in the number of beavers in Canada (ASRD 2001).

8.3.3.5 Muskrat

Muskrats are a KIR for the Project. The muskrat contributes more to the total combined income of North American trappers than any other mammal. This important role in the trapping industry has been studied extensively (Boutin and

Birkenholz 1999). Muskrat push-ups were recorded during the beaver/muskrat aerial survey.

Muskrats typically live in fresh water marshes, marshy areas of lakes, and slow-moving streams. The water must be deep enough so that it will not freeze to the bottom during winter, but shallow enough to permit growth of aquatic vegetation (Boutin and Birkenholz 1999). Cattail and bulrush are favorite foods when present and can constitute up to 80% of a muskrat's diet (Boutin and Birkenholz 1999). Human activities in North America during the last two centuries have not significantly affected the distribution of muskrats (Parker and Maxwell 1980). The largest threat to muskrat populations is through the draining of marshes or swamps for agricultural or other purposes.

8.3.3.6 River Otter

River otters are a KIR for the Project. River otters were observed twice during field surveys, in a watercourse surrounded by shrubby marsh (MONS) habitat (Appendix II). In general, current and historic local abundance of river otters in the Oil Sands Region is high relative to other regions of Alberta.

River otters are aquatic carnivores that feed almost exclusively on fish, but have also been known to prey on beavers (Fort McKay First Nations 1994). Otters primarily occur in and along wooded rivers, ponds and lakes, but sometimes roam far from watersources (Pattie and Fisher 1999). In the past, trapping pressures have reduced the provincial population of river otters (Pattie and Fisher 1999). Other threats to river otter populations include habitat loss, predation and bioaccumulation of contaminants (Westworth 2002).

8.3.3.7 Ducks and Geese

Ducks and geese are a KIR species for the Project. Several species of ducks and geese were observed during the waterfowl surveys and incidentally in the lease area and LSA.

Ducks and geese live in a variety of aquatic habitats including marshes, waterbodies, watercourses and seasonally-flooded grasslands, shrublands and forests. Ducks and geese generally have one brood per year with variable survival rates among populations (i.e., 65 to 80% of ducks may die in first year with survival higher thereafter) (Elphick et al. 2001).

8.3.3.8 Boreal Owl

The boreal owl is a KIR species for the Project. The distribution and population size of this species is largely unknown. Nine boreal owls were heard during the owl call survey within the lease area.

Preferred boreal owl habitats are comprised mainly of coniferous and mixedwood forests (Semenchuk 1992; Kirk 1995; Hayward and Verner 1994). This species nests and breeds in black spruce, white spruce, aspen, poplar, birch and balsam fir (Hayward and Verner 1994; Kirk 1995). Boreal owls may begin breeding their first year, having a typical clutch size of two to eight eggs within one to two broods per year (Elphick et al. 2001). The main limiting factor for boreal owl populations is the availability of nest cavities and food supply (Kirk 1995). Boreal owls require mature to old growth coniferous and deciduous trees for suitable nest cavities. The removal of suitable habitat has the potential to severely limit the boreal owl population within a region.

8.3.3.9 Ruffed Grouse

The ruffed grouse is a KIR species for the Project and is listed as 'Secure' in Alberta (ASRD 2001). The ruffed grouse was observed incidentally seven times and unidentified grouse tracks were observed durring the winter track surveys.

The ruffed grouse is most typically associated with deciduous and mixedwood habitats, especially those with dense undergrowth and scattered clearings which provide nesting sites for females (Johnsgard 1973). As opportunistic feeders, ruffed grouse may feed on buds, catkins, twigs, fleshy fruits and insects (Semenchuk 1992). Although the ruffed grouse is widespread in Alberta, it's abundance is focussed in the central region of the province (Semenchuk 1992). The ruffed grouse is of significant importance to the First Nations and recreational hunters in the region.

8.3.3.10 Old Growth Forest Bird Community

The old growth forest bird community is a KIR species group for the Project. The old growth forest community is dominated by large mature white spruce, often with a component of large aspen, balsam poplar and sometimes balsam fir or black spruce. Variable canopy closure, multiple layers and abundance of standing and fallen dead wood often characterize the old growth forest community. Typical bird species include the Cape May warbler, winter wren, red-breasted nuthatch, white-winged crossbill, pine siskin, black-throated green warbler and woodpeckers (CEMA 2001). Although these birds are commonly

associated with old growth forests, they are also known to occur in other forest stand types such as mixedwoods and to a lesser extent deciduous.

8.3.3.11 Mixedwood Forest Bird Community

The mixedwood forest bird community is a KIR species group for the Project. The mixedwood forest is characterized by a canopy of mature white spruce and aspen but may also contain mature jack pine and other deciduous species. Typical species in this community include western tanagers, Tennessee warblers, white-throated sparrows, hairy woodpeckers and Swainson's thrushes (CEMA 2001). These bird species will also occur in other forest types.

9 CLOSURE

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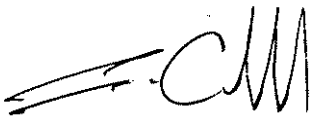

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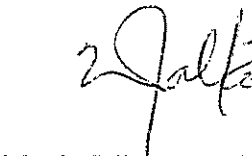

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10 GLOSSARY OF TERMS AND ABBREVIATIONS

10.1 GLOSSARY OF TERMS

Accidental/ Vagrant	Any species occurring infrequently and unpredictably in Alberta, (i.e., outside its usual range). These species may be in Alberta due to unusual weather occurrences, an accident during migration or unusual breeding behavior by a small number of individuals. If a species appears in Alberta with increasing predictability and more frequently, it may eventually be given a different rank. Changes in "Accidental/Vagrant" species may be a good indicator of general ecosystem or climatic changes.
At Risk	Any species known to be "At Risk" after formal detailed status assessment and designation as "Endangered" or "Threatened" in Alberta.
AREA_CV	Patch Size Coefficient of Variation (=PSCV of FRAGSTATS 2)
AREA_MD	Patch Size Median
AREA_MN	Patch Size Mean (=MPS of FRAGSTATS 2)
AREA_SD	Patch Size Standard Deviation
Baseline	A surveyed condition that serves as a reference point on which later surveys are coordinated or correlated.
Biodiversity	The variety of organisms and ecosystems that comprise both the communities of organisms within particular habitats and the physical conditions under which they live.
Canopy	An overhanging cover, shelter or shade. The tallest layer of vegetation in an area.

CEMA	Cumulative Environmental Management Association – An association of oil sands industry, other industry, regional community representatives, regulatory agencies and other stakeholders designed to develop systems to manage cumulative effects associated with developments in the Oil Sands Region.
Christina Lake Area	Identified as having regionally significant wildlife habitat/features of the eastern boreal forest region. Significant natural features have been evaluated for their environmental significance. The Christina Lake Area has environmental significance for woodland caribou habitat, waterfowl breeding habitat and furbearer habitat.
Community	Pertaining to plant or animal species living in close association or interacting as a unit.
Conifers	White and black spruce, balsam fir, jack pine and tamarack.
CA	Class Area
CAI_AM	Core Area Index Area Weighted Mean (=TCAI of FRAGSTATS 2)
DCA	Detrended Correspondence Analysis. An ordination technique used to visually determine species and site relationships.
Diversity	The variety, distribution and abundance of different plant and animal communities and species within an area.
Drake	A male duck.
Echolocation	High frequency sounds (25 to 120 kHz) produced by bats that are beyond the range of human hearing (20 Hz to 25 kHz). These sounds are produced with great intensity. Echoes resulting from sound returning from objects in the bat's environment provide information to the bat.

Ecosite	Ecological units that develop under similar environmental influences (climate, moisture and nutrient regime). Ecosites are groups of one or more ecosite phases that occur within the same portion of the moisture/nutrient grid. Ecosite is a functional unit defined by the moisture and nutrient regime. It is not tied to specific landforms or plant communities but is based on the combined interaction of biophysical factors that together dictate the availability of moisture and nutrients for plant growth.
Ecosite Phases	A subdivision of the ecosite based on the dominant tree species in the canopy. On some sites where the tree canopy is lacking, the tallest structural vegetation layer determines the ecosite phases.
Ecosystem	An integrated and stable association of living and non-living resources functioning within a defined physical location.
Edge	Where plant communities meet and where plant communities meet a disturbance.
Endangered	A species facing immediate extinction or extirpation.
Environmental Impact Assessment	A review of the effects that a proposed development will have on the local and regional environment.
Escarpment	A cliff or steep slope at the edge of an upland area. The steep face of a river valley.
ENN_CV	Euclidean Nearest Neighbour Median (=NNMD of FRAGSTATS 2)
Forest	A collection of stands of trees that occur in similar space and time.
Forest Fragmentation	The change in the forest landscape, from extensive and continuous forests.

Fragmentation	The process of reducing size and connectivity of stands of trees that compose a forest.
FRAC_MN	Mean Patch Fractal Dimension (=MPFD of FRAGSTATS 2)
Habitat	The place where an animal or plant naturally or normally lives and grows, for example, a stream habitat or a forest habitat.
Habitat Generalist	Wildlife species that can survive and reproduce in a variety of habitat types (e.g., red-backed vole).
Habitat Suitability Index (HSI) Model	Analytical tools for determining the relative potential of an area to support individuals or populations of a wildlife species. They are frequently used to quantify potential habitat losses and gains for wildlife as a result of various land use activities.
Indeterminate	A species for which there is insufficient scientific information to support status designation.
KIRs	Key indicator resources are the environmental attributes or components identified as a result of a social scoping exercise as having legal, scientific, cultural, economic or aesthetic value.
Landscape	A heterogeneous land area with interacting ecosystems.
Listed Species	Listed species are those species that are provincially or federally identified as potential species of concern.
Mature Forest	A forest greater than rotation age with moderate to high canopy closure; a multi-layered, multi-species canopy dominated by large overstorey trees; some with broken tops and other decay; numerous large snags and accumulations of downed woody debris.

May be at Risk	Any species that "May be at Risk" of extinction or extirpation and is therefore a candidate for detailed risk assessment.
Modelling	A simplified representation of a relationship or system of relationships. Modelling involves calculation techniques used to make quantitative estimates of an output parameter based on its relationship to input parameters. The input parameters influence the value of the output parameters.
Movement Corridor	Travel way used by wildlife for daily, seasonal, annual and/or dispersal movements from one area or habitat to another.
Muskeg	A soil type comprised primarily of organic matter. Also known as bog peat.
NP	Number of Patches
Overwintering Habitat	Habitat used during the winter as a refuge and for feeding.
Population	A collection of individuals of the same species that potentially interbreed.
Relative Abundance	The proportional representation of a species in a sample or a community.
Replicate	Duplicate analyses of an individual sample. Replicate analyses are used for measuring precision in quality control.
Richness	The number of species in a biological community (e.g., habitat).
Riparian Area	A geographic area containing an aquatic ecosystem and adjacent upland areas that directly affects it.
Scale	Level of spatial resolution.

Secure	A species that is not "At Risk", "May be at Risk", or "Sensitive."
Sensitive	Any species that is not at risk of extinction or extirpation but may require special attention or protection to prevent it from becoming at risk.
Sensory Disturbance	Visual, auditory, or olfactory stimulus which creates a negative response in wildlife species.
Special Concern (Vulnerable)	A species is of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Species	A group of organisms that actually or potentially interbreed and are reproductively isolated from all other such groups; a taxonomic grouping of genetically and morphologically similar individuals; the category below genus.
Species Abundance	The number of individuals of a particular species within a biological community (e.g., habitat).
Species Distribution	Where the various species in an ecosystem are found at any given time. Species distribution varies with season.
Species Diversity	A description of a biological community that includes both the number of different species and their relative abundance. Provides a measure of the variation in number of species in a region. This variation depends partly on the variety of habitats and the variety of resources within habitats and, in part, on the degree of specialization to particular habitats and resources.
Species Richness	The number of different species occupying a given area.
Stand	An aggregation of trees occupying a specific area and sufficiently uniform in composition, age, arrangement and condition so that it is distinguishable from trees in adjoining areas.

Stand Age	The number of years since a stand experienced a stand-replacing disturbance event (e.g., fire, logging).
Succession	A series of dynamic changes by which one group of organisms succeeds another through stages leading to a climax community.
Successional Stage	A stage or recognizable condition of a forest community that occurs during its development from bare ground to climax.
Threatened	A species likely to become endangered if limiting factors are not reversed.
TWINSPAN	Two-Way Indicator Species Analysis. A technique used to classify bird species and vegetation communities.
Undetermined	Any species for which insufficient information, knowledge or data is available to reliably evaluate its general status.
Wetlands	Term for a broad group of wet habitats. Wetlands are transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands include features that are permanently wet, or intermittently water-covered such as swamps, marshes, bogs, muskegs, potholes, swales, glades, slashes and overflow land of river valleys.

10.2 ABBREVIATIONS

%	Percent
<	Less than
>	More than
°C	Temperature in degrees Celsius
AGL	Above ground level
AEP	Alberta Environmental Protection
ANOVA	Analysis of Variance
ASRD	Alberta Sustainable Resource Development
AWI	Alberta Wetland Inventory
BSOD	Alberta Biodiversity/Species Observation Database
CEMA	Cumulative Environmental Management Association
cm	Centimetre
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CPDFN	Chipewyan Prairie Dene First Nations
DCA	Detrended Correspondence Analysis
df	Degrees of Freedom
e.g.	For example
EIA	Environmental Impact Assessment
ESA	Environmentally Significant Area
ESAR	East Sise of the Athabasca River Caribou Range
et al.	Group of authors
F	Statistical test using F distribution to determine if significant differences between 2 means
g	Grams
Golder	Golder Associates Ltd.
GPS	Global Positioning System
ha	Hectares
HSI	Habitat Suitability Index

i.e.	That is
IRC	Industrial Relations Commitee
kg	Kilogram
KIRs	Key Indicator Resources
km	Kilometre
km^2	Square kilometre
L or l	Litre
LSA	Local Study Area
m	Metre
MEG	MEG Energy Corp.
n	Number
N/A and n/a	Not applicable
The Project	Christina Lake Regional Project
P-value	The probability of quantifying the strength of the evidence against a null hypothesis
RIC	Resources Inventory Commitee
RSA	Regional Study Area
SAGD	Steam Assisted Gravity Drainage
SARA	Species at Risk Act
SE	Standard Error
spp.	Species
TWINSPAN	Two-way Indicator Species Analysis
U.S.	United States
W4M	West of the 4^{th} Meridian
wt%	Weight percentage

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APPENDIX I

COMMON NAMES, SCIENTIFIC NAMES AND STATUS OF SPECIES OBSERVED WITHIN THE MEG ENERGY CHRISTINA LAKE REGIONAL PROJECT

Table I-1 Common Names, Scientific Names and Status of Wildlife Species Observed on the MEG Energy lease and within the LSA

Common Name	Scientific Name	National Status	Provincial Status [(a)]
MAMMALS			
bat spp.	*Myotis spp.*	---	---
beaver	*Castor canadensis*	---	secure
black bear	*Ursus americanus*	not at risk	secure
Canada lynx	*Lynx canadensis*	not at risk	sensitive
cougar	*Felis concolor*	---	sensitive
coyote	*Canis latrans*	---	secure
deer spp.	*Odocoileus spp.*	---	---
fisher/marten	*Martes spp.*	---	---
grey wolf	*Canis lupus*	not at risk	secure
little brown bat	*Myotis lucifugus*	---	secure
big brown bat	*Eptesicus fuscus*	---	secure
red bat	*Lasiurus spp.*	---	accidental/vagrant
silver-haired bat	*Lasionycteris noctivagans*	---	secure
hoary bat	*Lasiurus cinereus*	---	secure
marten	*Martes americana*	---	secure
moose	*Alces alces*	---	secure
weasel spp.	*Mustela spp.*	---	---
muskrat	*Ondatra zibethicus*	---	secure
vole spp.		---	---
red fox	*Vulpes vulpes*	---	secure
red squirrel	*Tamiasciurus hudsonicus*	---	secure
river otter	*Lutra canadensis*	---	secure
mice spp.		---	---
fisher	*Martes pennanti*	---	sensitive
snowshoe hare	*Lepus americanus*	---	secure
white-tailed deer	*Odocoileus virginianus*	---	secure
woodland caribou	*Rangifer tarandus*	threatened	at risk
AMPHIBIANS/REPTILES			
boreal chorus frog	*Pseudacris triseriata*	---	secure
western (boreal) toad	*Bufo boreas*	special concern	sensitive
Canadian toad	*Bufo hemiophrys*	not at risk	may be at risk
wood frog	*Rana sylvatica*	---	secure
BIRDS			
American bittern	*Botaurus lentiginosus*	---	sensitive
American coot	*Fulica americana*	not at risk	secure
American kestrel	*Falco sparverius*	---	secure
American white pelican	*Pelecanus erythrorhynchos*	not at risk	sensitive
American wigeon	*Anas americana*	---	secure
bald eagle	*Haliaeetus leucocephalus*	not at risk	sensitive
barred owl	*Strix varia*	---	sensitive
black-backed woodpecker	*Picoides arcticus*	---	sensitive
black-capped chickadee	*Parus atricapillus*	---	secure
black tern	*Chlidonias niger*	not at risk	sensitive
blue-winged teal	*Anas discors*	---	secure
blue jay	*Cyanocitta cristata*	---	secure

Table I-1 Common Names, Scientific Names and Status of Wildlife Species Observed on the MEG Energy lease and within the LSA (continued)

Common Name	Scientific Name	National Status	Provincial Status [(a)]
boreal chickadee	*Parus hudsonicus*	---	secure
boreal owl	*Aegolius funereus*	not at risk	secure
brown creeper	*Certhia americana*	---	undetermined
bufflehead	*Bucephalus albeola*	---	secure
Canada goose	*Branta canadensis*	---	secure
chipping sparrow	*Spizella passerina*	---	secure
common goldeneye	*Bucephala clangula*	---	secure
common loon	*Gavia immer*	not at risk	secure
common merganser	*Mergus merganser*	---	secure
common nighthawk	*Chordeiles minor*	---	sensitive
common raven	*Corvus corax*	---	secure
common redpoll	*Carduelis flammea*	---	secure
common tern	*Sterna hirundo*	not at risk	secure
common yellowthroat	*Geothlypis trichas*	---	secure
dabbler spp.		---	---
dark-eyed junco	*Junco hyemalis*	---	secure
diver spp.		---	---
duck spp.		---	---
falcon spp.	*Falco spp.*	---	---
gull spp.	*Larus spp.*	---	---
gray jay	*Perisoreus canadensis*	---	secure
great blue heron	*Ardea herodias*	---	sensitive
great gray owl	*Strix nebulosa*	not at risk	sensitive
great horned owl	*Bubo virginianus*	---	secure
greater yellowlegs	*Tringa melanoleuca*	---	secure
grebe spp.	*Podiceps spp.*	---	---
green-winged teal	*Anas crecca*	---	secure
grouse spp.		---	---
hermit thrush	*Catharus guttatus*	---	secure
lapland longspur	*Calcarius lapponicus*	---	secure
LeConte's sparrow	*Ammodramus leconteii*	---	secure
least flycatcher	*Empidonax minimus*	---	secure
lesser yellowlegs	*Tringa flavipes*	---	secure
Lincoln's sparrow	*Melospiza lincolnii*	---	secure
mallard	*Anas platyrhynchos*	---	secure
merganser spp.	*Mergus spp.*	---	---
merlin	*Falco columbarius*	not at risk	secure
mourning warbler	*Oporornis philadelphia*	---	secure
northern goshawk	*Accipiter gentilis*	not at risk	sensitive
northern harrier	*Circus cyaneus*	not at risk	secure
northern pintail	*Anus acuta*	---	secure
northern shoveler	*Anas clypeata*	---	secure
northern waterthrush	*Seiurus noveboracensis*	---	secure
osprey	*Pandion haliaetus*	---	sensitive
ovenbird	*Seiurus aurocapillus*	---	secure
owl spp.		---	---

Table I-1 Common Names, Scientific Names and Status of Wildlife Species Observed on the MEG Energy lease and within the LSA (continued)

Common Name	Scientific Name	National Status	Provincial Status [(a)]
palm warbler	*Dendroica palmarum*	---	secure
pileated woodpecker	*Dryocopus pileatus*	---	sensitive
pine siskin	*Carduelis pinus*	---	secure
raptor spp.		---	---
red-breasted nuthatch	*Sitta canadensis*	---	secure
red-eyed vireo	*Vireo olivaceus*	---	secure
red-necked grebe	*Podiceps grisegena*	not at risk	secure
redhead	*Aythya americana*	---	secure
red-tailed hawk	*Buteo jamaicensis*	not at risk	secure
ring-necked duck	*Aythya collaris*	---	secure
ruby-crowned kinglet	*Regulus calendula*	---	secure
ruffed grouse	*Bonasa umbellus*	---	secure
sandhill crane	*Grus canadensis*	not at risk	sensitive
scaup spp.	*Aythya spp.*	---	---
scoter spp.	*Melanitta spp.*	---	---
sharp-shinned hawk	*Accipiter striatus*	not at risk	secure
shorebird spp.		---	---
snow bunting	*Plectrophenax nivalis*	---	secure
solitary sandpiper	*Tringa solitaria*	---	secure
sora	*Porzana carolina*	---	secure
spruce grouse	*Dendragapus canadensis*	---	secure
Swainson's thrush	*Catharus ustulatus*	---	secure
teal spp.	*Anas spp.*	---	---
Tennessee warbler	*Vermivora peregrina*	---	secure
three-toed woodpecker	*Picoides tridactylus*	---	secure
white-throated sparrow	*Zonotrichia albicollis*	---	secure
white-winged crossbill	*Loxia leucoptera*	---	secure
Wilson's snipe	*Gallinago gallinago*	---	secure
Wilson's warbler	*Wilsonia pusilla*	---	secure
woodpecker spp.		---	---
yellow-bellied flycatcher	*Empidonax flaviventris*	---	undetermined
yellow-bellied sapsucker	*Sphyrapicus varius*	---	secure
yellowlegs spp.	*Tringa spp.*	---	---
yellow-rumped warbler	*Dendroica coronata*	---	secure

[(a)] Status definitions were presented in Section 8.0.

"---" Indicates species not currently considered to be at risk; however, official status has not been determined.

APPENDIX II

INCIDENTAL WILDLIFE SIGHTINGS

Table II-1 Incidental Wildlife Sightings

Species	Number	Alberta Status[a]	Federal Status[b]	CEMA Priority[c]	Type of Observation	Habitat[d]
Birds						
American bittern	1	sensitive	not listed	---	visual	lake shore
American kestral	1	secure	not listed	---	visual	near stream
bald eagle	11	sensitive	not at risk	priority 3	nest, visual	lake (Christina Lake north shore)
barred owl	1	sensitive	not listed	---	call	e3
black-backed woodpecker	1	sensitive	not listed	---	visual (feeding)	d1
black-capped chickadee	1	secure	not listed	---	call	MONS
blue-winged teal	5	secure	not listed	---	visual	stream
blue jay	1		not listed	---	flyover	stream
boreal chickadee	2	secure	not listed	---	call	g1, FTNN
Canada goose	134	secure	not listed	---	flyover	lake, WONN
chipping sparrow	4	secure	not listed	---	song	g1, FTNN, c1, BTNN
common goldeneye	6	secure	not listed	---	visual	lake
common loon	5	secure	not at risk	priority 3	visual, call, nest	lake, stream
common nighthawk	1	sensitive	not listed	---	call	MONS/c1(burn)
common raven	7	secure	not listed	---	call	d2, BTNN, stream edge
common redpoll	4	secure	not listed	---	visual	FTNN
common tern	1	secure	not at risk	---	visual	lake
common yellowthroat	1	secure	not listed	---	song	FTNN
dark-eyed junco	8	secure	not listed	---	call	FTNN, g1, BTNN, c1
falcon spp.	2	---	---	---	visual, flyover	stream
gray jay	7+	secure	not listed	---	visual, call	MONS, d2, g1, FTNN, BTNN
great gray owl	5	sensitive	not at risk	---	call	d2 (3), FONS, burn
greater yellowlegs	1	secure	not listed	---	call	pond
great horned owl	2	secure	not listed	---	call	FTNN, a1
green-winged teal	1	secure	not listed	---	visual	stream
grouse spp.	2	---	---	---	tracks, pellets	d2, BTNN
hermit thrush	8	secure	---	---	call,	FTNN, g1, a1, burn, BTNN
lapland longspur	4	secure	not listed	---	visual	cutline
LeConte's sparrow	3	secure	not listed	---	song	MONS,

[a] ASRD 2001;

[b] COSEWIC 2004;

[c] CEMA 2001 with updates from Westworth 2002.

Table II-1 Incidental Wildlife Sightings (continued)

Species	Number	Alberta Status[a]	Federal Status[b]	CEMA Priority[c]	Type of Observation	Habitat[d]
Lincoln's sparrow	2	secure	not listed	---	song	FTNN, BTNN
lesser yellowlegs	2	secure	not listed	---	visual, call	FTNN, cutline
mallard	10	secure	not listed	---	visual	stream (MONG), lake
mourning warbler	1	secure	not listed	---	song	c1,
northern harrier	3	secure	not at risk	---	visual	FTNN, MONS
northern waterthrush	1	secure	not listed	---	song	d2
osprey	2	sensitive	not listed	---	visual	lake (Christina Lake north shore)
ovenbird	8	secure	not listed	---	song	d2
owl spp.	2	---	---	---	plunge, flyover	FTNN, WONN
palm warbler	2	secure	not listed	---	song,	c1, FTNN
pileated woodpecker	1	sensitive	not listed	priority 2	flyover	d3
pine siskin	5	secure	not listed	---	flyover	BTNN, FTNN
raptor spp.	2	---	---	---	flyover	WONN
redhead	2	secure	not listed	---	visual	stream
red-breasted nuthatch	3	secure	not listed	---	song	d3, d2
red-eyed vireo	2	secure	not listed	---	song	d2
red-necked grebe	7	secure	not at risk	---	visual, call, nest	lake
red-tailed hawk	5	secure	not at risk	---	visual, flyover	d2, FTNN, WONN
ruby-crowned kinglet	32	secure	not listed	---	call, song	BTNN, c1, d2, FTNN, g1
ruffed grouse	7	secure	not listed	priority 2	drumming, feeding on cutline	d2, cutline, BTNN
sandhill crane	1	sensitive	not listed	---	flyover	c1
snow bunting	8	secure	not listed	---	flyover	FTNN
solitary sandpiper	1	secure	not listed	---	visual	cutline
sora	1	secure	not listed	---	call	WONN
spruce grouse	2	secure	not listed	---	visual (courtship)	g1, cutline
stick nest	1	---	---	---	visual	b2
Swanson's thrush	12	secure	not listed	---	song	d2, c1, FTNN
Tennessee warbler	4	secure	not listed	---	song	BTNN, FTNN, d2
white-throated sparrow	3	secure	not listed	---	song	burn (g1), FTNN, BTNN

Table II-1 Incidental Wildlife Sightings (continued)

Species	Number	Alberta Status[a]	Federal Status[b]	CEMA Priority[c]	Type of Observation	Habitat[d]
white-winged crossbill	33	secure	not listed	---	visual, flyover, call	d3, FTNN, d2, c1, g1, BTNN
Wilson's snipe	13	secure	not listed	---	call, flyover	FTNN, MONG, c1, d2, BTNN
Wilson's warbler	1	secure	not listed	---	song	FTNN
woodpecker spp.	2	---	---	---	call, feeding	BTNN
yellow-bellied sapsucker	1	secure	not listed	---	call	d3
yellow-rumped warbler	5	secure	not listed	---	song	d2, FTNN
Mammals						
bat spp.	1	---	---	---	flyover	cutline
beaver	8	secure	not listed	priority 2	lodge, visual	WONN, lake, stream
black bear	8	secure	not at risk	priority 2	marking, scat, visual, tracks	d2, cutline, road, clearing
Canada lynx	4	sensitive	not at risk	priority 1	tracks	c1, b2, BTNN
cougar	2 families	sensitive	not listed	---	visual	Near Conklin
coyote	13	secure	not listed	---	tracks, call, remains, visual	BTNN, g1, surrounding lake (FTNN), cutline, WONN
deer spp.	5	---	---	---	tracks, visual	c1, g1, d2, cutline
gray wolf	9	secure	not at risk	priority 3	tracks, call, scat	BTNN, cutline, FONS surrounding lake, c1
moose	16	secure	not listed	priority 1	tracks, pellets, visual	BTNN, d2, cutline, FTNN, g1, e2, c1, MONS
red squirrel	4	secure	not listed	---	visual (midden), auditory	c1, d2
river otter	2	secure	not listed	priority 2	visual, tracks	MONS (stream)
snowshoe hare	3	secure	not listed	priority 1	visual, pellets	cutline, c1
vole spp.	1	---	---	---	visual	
white-tailed deer	1	secure	not listed	---	visual	d2
woodland caribou	2	**at risk**	**threatened**	priority 1	tracks, visual	g1, cutline
Amphibians						
boreal chorus frog	10+	secure	not at risk	---	call	FTNN, SONS
wood frog	15	secure	not listed	priority 3	call, visual	MONS, FTNN, SONS, ditch
western (boreal) toad	6	sensitive	special concern	---	visual, call	cutline, g1
Canadian toad	1	**may be at risk**	not at risk	priority 1	call	FTNN

APPENDIX III

SUMMARY OF WILDLIFE SURVEY RESULTS FROM THE OIL SANDS REGION

Table III-1 Moose Aerial Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Results (individuals/km^2 unless otherwise noted)	Habitat	Reference
1969 to 1985	Alberta Environment	west of CLAWR	0.21 to 0.54	n/a	Gunderson and Rippin (1981) cited in BP Resources (1985)
1973	Alberta Environment	Athabasca and Muskeg Rivers	0.50	n/a	Bibaud and Archer (1973)
1975 to 1976	Syncrude Lease 17	L6, 22, 17, 86 and 23	0.23	preferred tall shrub, deciduous and avoided mixedwood in early winter; preferred tall shrub and avoided coniferous in late winter	Penner (1976)
1977	AOSERP	Athabasca and Muskeg River area	0.03 in muskeg 0.23 in aspen 0.27 in river bottom	n/a	Cook and Jacobsen (1978)
1977 to 1978	AOSERP	AOSERP Study Area	0.26 in March 0.28 in December 0.19 in February	n/a	Hauge and Keith (1981) as reported in Conor Pacific (1998)
1978	Syncrude	L17 and 22	0.10	n/a	Hauge and Keith (1981)
1978 to 1979	Esso	Cold Lake	0.14 to 0.18	n/a	Esso (1979)
1978 to 1981	Alberta Environment	Marguerite-Marie Lakes	0.25 to 0.34	n/a	Gunderson and Rippin (1981) cited in BP Resources (1985)
1979 to 1980	Syncrude	L17, 22 and 23	0.13 in December 0.23 in February	December most in mixedwood, black spruce-muskeg and shrub February most in deciduous and mixedwood	Westworth (1980)
1980	Canstar Project 80	L88 and 89	0.10 in December	most in riparian shrub and black spruce-muskeg	Skinner and Westworth (1981)
1981	Dome Petroleum Ltd	Primrose lake Lease	0.17	n/a	Roe (1984) cited in Suncor (1995)
1981 to 1982	Canstar Lease	L9 and 33	0.33 in early winter 0.32 in late winter	most in mixedwood, aspen and willow wetlands in early winter most in willow wetland, mixedwood, black spruce and aspen in late winter	Westworth and Brusnyk (1982)
1983	AOSTRA	AOSTRA Study Area	0.18 in February	n/a	Green (1983) as reported in Conor Pacific (1998)
1985	Alberta Environment	Cold Lake/Beaver river	0.52	n/a	Penner and Ealey, cited in Suncor (1995)
1986	OSLO	OSLO Project Area	0.11 in early winter 0.07 in late winter	n/a	Salter and Duncan (1986)
1991	Esso Resources Ltd.	Cold Lake	0.14	n/a	Brusnyk et al. (1991) cited in Esso (1997)
1992 to 1993	Alberta Environment	Cold Lake	0.10	n/a	AENV, Fish and Wildlife Division, cited in Esso (1997)
1995	Solv-Ex	L5	0.01 in March	n/a	BOVAR-CONCORD Environmental (1995)

Table III-1 Moose Aerial Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (individuals/km^2 unless otherwise noted)	Habitat	Reference
1995	Syncrude Aurora North	L12, 13 and 34	0.10 in January	most in black spruce-tamarack	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, Lease 23 and Steepbank Mine	L86/17 and 23	0.20 in February 0.32 in December	preferred closed deciduous, closed mixedwood and avoided closed jack pine, closed white spruce, mixed coniferous, black spruce, wetlands shrub complex and disturbed habitat in February; avoided closed jack pine, closed white spruce and mixed coniferous in December	Westworth, Brusnyk & Associates (1996a)
1996	Steepbank Study Area	L97, 25 and 19	0.24 in February 0.24 in December	preferred closed deciduous, closed mixedwood and avoided closed jack pine, closed white spruce, mixed coniferous, black spruce, wetlands shrub complex and disturbed habitat in February avoided closed jack pine, closed white spruce and mixed coniferous in December	Westworth, Brusnyk & Associates (1996a)
1998	Suncor Firebag Project	L85	0.2 in February	most in FTNN	Suncor (2000)
1999	Mobil Lease 36	L36	0.22 in February	most in FONS, FTNN and FT/STNN	Golder (1999b)
1999 to 2000	Petro-Canada Mackay River	L75	0.37 in December 0.17 in February	found mostly in d1	AXYS (2000a)
2000	Canadian Natural Paw Project	–	0.07	n/a	CNRL (2000)
2000	PanCanadian Christina Lake Thermal Project Study Area	L207	0.04 in late winter	three in BTNN and two in FTNN	Golder (2000f)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	0.22 in mid winter 0.25 in late winter	only in d1, b1 and disturbed in mid winter most in d1 and d2 in late winter	Golder (2000d)
2000	OPTI Long Lake Project	L27	0.20 in January 0.28 in March	most observations in FTNN and BTNN	OPTI (2000)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	0.08 in February	two moose observed in FTNN	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	0.21 in February	most observations in FTNN, d2 and e1	Petro-Canada (2001)

Table III-1 Moose Aerial Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (individuals/km^2 unless otherwise noted)	Habitat	Reference
2001	Shell Jackpine Mine – Phase 1	L13 East	0.21	most observations in FTNN, h1, SONS and d2	Golder (2002b)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	0.15	most observations in d1, d2 and e1	CNRL (2002)
2002	Petro-Canada Meadow Creek Aerial Ungulate Survey	L58 and L81	0.10 in February	observed in BTNN, SONS, FTNN, d1, d2 and d3 ecosite phases/wetlands types.	Golder (2002b)
2003	Petro-Canada Meadow Creek Aerial Caribou Survey	L58 and L81	0.13 in February	observed in d3, g1, BTNN, SONS, and WONN ecosite phase/wetlands types.	Golder (2003b)
2002	Suncor South Tailings Pond Project	L19 and L10	0.1	observed in b3 and FTNN	Golder (2003a)
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	0.16	most observations in closed aspen forest	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	0.09	observed in d2 and FONS	Golder (2004a)
2004	MEG Energy	Tp76-78, R4-6	0.07	Observed within d1, d2, BTNN and FONS	Present study

Table III-2 Moose Productivity in the Oil Sands Region

Year	Project	Area/Lease	Cow:Calf Ratio	Reference
1975 to 1976	Syncrude Lease 17	L6, 22, 17, 86 and 23	10:5.6	Penner (1976)
1979 to 1980	Syncrude	L17, 22 and 23	10:6.2 in December 10:4.3 in February	Westworth (1980)
1980	Canstar Project 80	L88 and 89	10:3 in December	Skinner and Westworth (1981)
1981 to 1982	Canstar Lease	L9 and 33	10:3.0 in early winter 10:3.2 in late winter	Westworth and Brusnyk (1982)
1995	Syncrude Aurora North	L12, 13 and 34	10:7.1 in January	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, Lease 23 and Steepbank Mine	L86/17 and 23	10:8.3 in February 10:6.4 in December	Westworth, Brusnyk & Associates (1996a)
1996	Steepbank Study Area	L97, 25 and 19	10:4.3 in February 10:3.5 in December	Westworth, Brusnyk & Associates (1996a)
1999	Mobil Lease 36	L36	10:1.7	Golder (1999b)
1999 to 2000	Petro-Canada Mackay River	L75	10:6.3 in December 10:7.8 in February	AXYS (2000a)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	10:10	Golder (2000d)
2000	OPTI Long Lake Project	L27	10:8	OPTI (2000)
2001	Petro-Canada Meadow Creek Project	L58 and L81	10:5	Petro-Canada (2001)
2001	Shell Jackpine Mine – Phase 1	L13 East	10:1.1	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	10:3.5	CNRL (2002)
2002	Petro-Canada Meadow Creek Aerial Ungulate Survey	L58 and L81	10:6.7	Golder (2002b)
2003	Petro-Canada Meadow Creek Aerial Caribou Survey	L58 and L81	10:7.5	Golder (2003b)
2002	Suncor South Tailings Pond Project	L19 and L10	10:5	Golder (2003a)
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	10:6.4	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	10:2.5	Golder (2004)
2004	MEG Energy	Tp76-78, R4-6	10:2.5	Present study

Table III-3 Moose Track Count Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Results (tracks/km-track day)	Habitat Preference	Reference
1975 to 1976	Syncrude Lease 17	L6, L22, 17, 86 and 23	0.14	preferred tall shrub; avoided coniferous and disturbed areas	Penner (1976)
1980	Canstar Project 80	L88 and 89	0.63	preferred riparian shrub; avoided jack pine and open muskeg	Skinner and Westworth (1981)
1981 to 1982	Canstar Lease	L9 and 33	0.33	preferred willow and riparian aspen; avoided jack pine, white spruce, black spruce and riparian white spruce	Westworth and Brusnyk (1982)
1995	Solv-Ex	L5	no observations	n/a	BOVAR-CONCORD Environmental (1995)
1995	Syncrude Aurora North	L12, 13 and 34	0.11[(a)]	preferred cleared aspen; avoided mixedwood forest, willow wetlands riparian balsam poplar, riparian white spruce and riparian shrub	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, Lease 23 and Steepbank Mine	L86/17, 23, 97, 25 and 19	0.22 in February 0.65 in December	February: avoided jack pine, white spruce, mixed coniferous mixedwood, shorelines and fen December: avoided closed black spruce and open tamarack fen	Westworth, Brusnyk & Associates (1996a)
1997	Muskeg River Mine	L13	0.26	no preference most tracks observed in closed mixedwood-white spruce dominant	Golder (1997a,b)
1997	Suncor	L19, 25 and 97	0.29 in January 0.30 in February 0.19 in March	January: avoided upland February: preferred riparian, avoided escarpment March: no preference	Golder (1998a,b)
1997	Suncor	L29	0.03 in January 0.0 in February	January: no preference February: no preference	Golder (1998a,b)
1997	Mobil Lease 36	L36	0.32	most observations in black spruce –tamarack and tamarack black spruce bogs and fens	URSUS and Komex (1997)
1998	Suncor Firebag Project	L85	0.41	preferred BTNN, BFNN, FONS and FTNN/FFNN avoided b4, c1, d3 and g1	Suncor (2000)
1998 to 99	Suncor Wildlife Monitoring	L86/17, 19, 25 and 97	0.0 in reclaimed 0.46 in riparian area beside disturbance	n/a	Golder (1999a)
2000	ATCO Pipeline	Muskeg River	mean: 2.0	most common in cutblock, also common in FONS, d1 and d2	AXYS (2000b)

Table III-3 Moose Track Count Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (tracks/km-track day)	Habitat Preference	Reference
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	0.37	preferred e1; avoided d2, g1, BTNN and FTNN	Golder (2000d)
2000	Albian Sands Lease 13 West	L13	0.56 in upland 0.60 in riparian	vegetation preferences not available due to lumping by landform	Golder (2000c)
2000	Suncor Wildlife Monitoring	L86/17, 97/25	0.0 in Lease 86/17 1.68 in Lease 25/97	only riparian corridors sampled	Golder (2000b)
2000	OPTI Long Lake Project	L27	0.25	no preference most tracks observed in the d2 and FTNN ecosite phase/wetlands types	OPTI (2000)
2001	Gulf Surmont In-situ Oil Sands Project		no overall tracks/km-track day provided	highest track densities in e2; also observed in b2, c1, d1, d2, e3, f1, g1, BTNN, FTNN, FONS and FONG	AXYS (2001a)
1999 to 2001	Albian Sands Lease 13 West	L13 West	mean densities: 0.56 in January 1999/2000 0.21 in January 2000/2001 0.16 in February 2000/2001	surveys conducted in riparian and upland habitat no evidence of use of riparian areas as movement corridors	Golder (2001a)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	0.57 in February	No preference; most tracks observed in d2 and c1 ecosite/wetlands types, but also observed in b3 and cutlines	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	0.52	tracks observed in c1, e1, BTNN, STNN; preference observed for BTNN, avoidance of FONS	Petro-Canada (2001)
2001	Shell Jackpine Mine – Phase 1	L13 East	0.47	tracks observed in b4, FTNN, g1 and shrubland	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	0.16	tracks observed in d2, d3, cutblock and burn; preference observed for burn, avoidance of d3	CNRL (2002)
2002	Suncor South Tailings Pond Project	L19 and L10	0.72	tracks observed in FONS, FONG, and d2	Golder (2003a)
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	0.26	highest track density in e1	Devon (2004)

Table III-3 Moose Track Count Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (tracks/km-track day)	Habitat Preference	Reference
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	no fresh tracks observed	old track observed in riparian creek area	Golder (2004a)
2004	Suncor Monitoring Five Year Report	L86/17 and Steepbank / Millennium	0.59	surveys conducted in natural sites	Golder (2004b)
2004	MEG Energy	Tp76-78, R4-6	0.34	no preferences determined, tracks observed within MONS, d1, d2 and FTNN	Present study

Table III-4 Deer Aerial Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Species	Results (individuals/km^2 unless otherwise noted)	Habitat	Reference
1975 to 1976	Syncrude Lease 17	L6, 22, 17, 86 and 23	combined	one mule deer observed	Athabasca River	Penner (1976)
1978 to 1979	Esso	Cold Lake	combined	0.14	n/a	Esso 1979 as reported in BP Resources et al (1985)
1980	Canstar Project 80	L88 and 89	combined	no observations	n/a	Skinner and Westworth (1981)
1978 to 1981	Alberta Environment	Marguerite-Marie Lakes	combined	0.28 in 1979 to 0.50 in 1981	n/a	Gunderson and Rippin (1985) as reported in BP Resources et al (1985)
1981 to 1982	Canstar Lease	L9 and 33	mule deer	no observations	n/a	Westworth and Brusnyk (1982)
1981 to 1982	Canstar Lease	L9 and 33	white-tailed deer	0.01 in early winter no observations in late winter	in mixedwood, white spruce and aspen not available for late winter	Westworth and Brusnyk (1982)
1983 to 1985	Alberta Environment	west of CLAWR	combined	0.31 in 1984 to 0.44 in 1985.	n/a	Gunderson and Rippin (1985) as reported in BP Resources et al (1985)
1984	Alberta Environment	Sand River valley	combined	0.20	n/a	Gunderson (1984) as reported in CNRL (2000)
1984	Alberta Environment	south of CLAWR	combined	0.44	n/a	Gunderson (1984) as reported in CNRL (2000)
1993	Alberta Environment	Cold Lake Region	combined	0.53	aspen, shrubland and shrubby fen	AENV (1993) as reported Esso 1997
1995	Solv-Ex	L5	combined	no observations	n/a	BOVAR-CONCORD Environmental (1995)
1995	Syncrude Aurora North	L12, 13 and 34	white-tailed deer	0.08	most in cleared peatland, riparian shrub and black spruce-tamarack	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, L23 and Steepbank Study Area	L86/17, 23, 97, 25 and 19	white-tailed deer	February: 2 individuals December: 5 individuals	both in deciduous forest 2 in mixedwood and 3 in deciduous forest	Westworth, Brusnyk & Associates (1996a)
1998	Suncor Firebag Project	L85	combined	no observations	n/a	Suncor (2000)
1999	Mobil Lease 36	L36	white-tailed deer mule deer	0.02 in February no observations	one d1 ecosite phase	Golder (1999b)
1999 to 2000	Petro-Canada Mackay River	L75	white-tailed deer	0.15 in December 0.04 in February	most common in d1	AXYS (2000a)

Table III-4 Deer Aerial Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Species	Results (individuals/km^2 unless otherwise noted)	Habitat	Reference
2000	PanCanadian Christina Lake Thermal Project	L207	white-tailed deer	0.02 in late winter	three in c1 ecosite phase	Golder (2000f)
2000	Canadian Natural PAW Project	–	combined	0.03	observed in b1 and d2 ecosite phase	CNRL (2000)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	mule deer	no observations	n/a	Golder (2000d)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	white-tailed deer	no observations in January 0.03 km^2 in March	only in b1 ecosite phase in March	Golder (2000d)
2000	OPTI Long Lake Project	L27	combined	0.12 km^2 in January; and not observed in March	observations recorded in the d1, d2 and d3 ecosite phase/wetlands types	OPTI (2000)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	n/a	no observations	n/a	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	white-tailed deer	0.03	two individuals observed in the d2 ecosite phase/wetlands type	Petro-Canada (2001)
2001	Shell Jackpine Mine – Phase 1	L13 East	combined	no observations	n/a	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	white-tailed deer mule deer	0.17 0.01	WTDE observed mostly in disturbed habitat, primarily cutblocks, also observed in d3, e1, and MONS Mule deer observed in d1 and d2	CNRL (2002)
2002	Petro-Canada Meadow Creek Aerial Ungulate Survey	L58 and L81	white-tailed deer	0.06 in February	Observations occurred within upland areas; majority in d2 and one observation in b3	Golder (2002b)
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	white-tailed deer	0.12	most observations in upland habitats (mixed jack pine-aspen, aspen, mixed aspen-white spruce and jack pine)	Devon (2004)

Table III-4 Deer Aerial Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Species	Results (individuals/km^2 unless otherwise noted)	Habitat	Reference
2003	Petro-Canada Meadow Creek Aerial Caribou Survey	L58 and L81	white-tailed deer	0.04 in February	Observations occurred within upland areas; d2 and d1 ecosites	Golder (2003b)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	white-tailed deer	0.17	observations in a1 and g1	Golder (2004a)
2002	Suncor South Tailings Pond Project	Voyageur	combined	no observations	n/a	Golder (2003a)
2004	MEG Energy	Tp76-78, R4-6	combined	no observations	n/a	Present study

Table III-5 Deer Track Count Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Species	Results (tracks/km-track-day unless otherwise noted)	Habitat Preference	Reference
1975 to 1976	Syncrude Lease 17	L6, L22, 17, 86 and 23	combined	no observations	n/a	Penner (1976)
1980	Canstar Project 80	L88 and 89	combined	one deer track observed	n/a	Skinner and Westworth (1981)
1981 to 1982	Canstar Lease	L9 and 33	combined	one individual observed	only in mixedwood forest	Westworth and Brusnyk (1982)
1995	Solv-Ex	L5	combined	no observations	n/a	BOVAR-CONCORD Environmental (1995)
1995	Syncrude Aurora North	L12, 13 and 34	white-tailed deer	0.26	preferred aspen forest and cleared peatland; avoided jackpine, black spruce/ tamarack, fen wetland, riparian balsam poplar, riparian white spruce and riparian shrub	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, Lease 23 and Steepbank Mine	L86/17, 23, 97, 25 and 19	white-tailed deer	0.09 in February 0.14 in December	preferred closed deciduous forest	Westworth, Brusnyk & Associates (1996a)
1997	Muskeg River Mine		combined	no observations	n/a	Golder (1997a,b)
1997	Suncor Winter Wildlife	L19, 25, 29 and 97	combined	no observations	n/a	Golder (1998a,b)
1997	Mobil Kearl Lake	L36	combined	0.04	tracks observed in aspen, aspen-white spruce and jack-pine	URSUS and Komex (1997)
1998	Suncor Firebag Project	L85	combined	no observations	n/a	Suncor (2000)
1998 to 1999	Suncor Wildlife Monitoring	L86/17,19, 25 and 97	combined	0.57 in reclaimed 0.0 in riparian area beside disturbance	n/a	Golder (1999a)
2000	ATCO Pipeline	Muskeg River	combined	mean: 0.9	most common in d2 and e2	AXYS (2000b)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	white-tailed deer	0.33	most in a1, b1, d2, e1 and e2	Golder (2000d)
2000	Albian Sands Lease 13 West	L13	combined	0.08 in upland 0.02 in riparian	only in aspen dominated only in aspen dominated	Golder (2000c)
2000	Suncor Wildlife Monitoring	L86/17 and 97/25	combined	0.37 in Lease 86/17 0.57 in Lease 25/97	only riparian corridors sampled	Golder (2000b)
2000	OPTI Long Lake Project	L27	combined	0.75	preferred d2; avoided d1, FTNN	OPTI (2000)

Table III-5 Deer Track Count Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Species	Results (tracks/km-track-day unless otherwise noted)	Habitat Preference	Reference
2001	Gulf Surmont In-situ Oil Sands Project	–	combined	No overall tracks/km-track day provided	highest track densities in a1 and e2; also found in b1, b2,b3, d1, d2, d3, e1, e3, f1, h1, FONS and FTNN	AXYS (2001a)
1999 to 2001	Albian Sands Lease 13 West	L13 West	combined	mean densities: 0.08 in January 1999/2000 1.45 in January 2000/2001 0.39 in February 2000/2001	surveys conducted in riparian and upland habitat no evidence of use of riparian areas as movement corridors	Golder (2001a)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	combined	0.2	one track observed in SONS	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	combined	1.45	preferred b1 and d2; avoided g1, BTNN and FONS	Petro-Canada (2001)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	combined	0.07	Tracks observed in d1, d2, d3 and BTNN	CNRL (2002)
2001	Jackpine Mine – Phase 1	L13 East	combined	no observations	n/a	Golder (2002a)
2002	Suncor South Tailings Pond Project	L19 and L10	combined	no observations	n/a	Golder (2003a)
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	combined	0.74	highest track density in f1	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	combined	4.66	preferred disturbed areas	Golder (2004a)
2004	Suncor Monitoring Five Year Report	L18/67 and Steepbank / Millennium	combined	0.34	surveys conducted in natural sites	Golder (2004b)
2004	MEG Energy	Tp76-78, R4-6	combined	0.41	No preferences; tracks observed within d1, d2, d3, e2, c1, a1, FTNN	Present study

Table III-6 Caribou Aerial Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Results (individuals/km^2 unless otherwise noted)	Habitat	Reference
1975-76	Syncrude Lease 17	L6, 22, 17, 86 and 23	no observations	n/a	Penner (1976)
1976-78	AOSERP	Birch Mountains	4.17/100 km^2 in winter	black spruce occupied most heavily year round, while aspen or aspen conifer mixes were used very little	Fuller and Keith (1981)
1980	Canstar Project 80	L88 and 89	no observations	n/a	Skinner and Westworth (1981)
1981-82	Canstar Lease	L9 and 33	no observations	n/a	Westworth and Brusnyk (1982)
1995	Solv-Ex	L5	no observations	n/a	BOVAR-CONCORD (1995)
1995	Syncrude Aurora North	L12, 13 and 34	no observations	n/a	Westworth, Brusnyk and Associates (1996a)
1996	Suncor Mine, L23 and Steepbank Study Area	L86/17, 23, 19, 25, 29 and 97	no observations	n/a	Westworth, Brusnyk and Associates (1996b)
1998	Firebag Project	L85	no observations	n/a	Suncor (2000)
1999	Mobil Lease 36	L36	no observations	n/a	Golder (1999b)
2000	PanCanadian Christina Lake Thermal Project	L207	no observations	n/a	Golder (2000f)
2000	True North Fort Hills Oil Sands Project	L5 and 52	no observations	n/a	Golder (2000d)
2000	CNRL PAW Project	CLAWR	6 observations	observed in c1/g1	CNRL (2000)
2000	CNRL PAW Project	CLAWR	telemetry survey data	primarily observed in FTNN or FTNR, BTNN, BTNI, BTNR, BTXC, c1 or g1, and a1	CNRL (2000)
2000	OPTI Long Lake Project	L27	0.00/km^2 in January; 0.01/km^2 in March; and 11 incidental observations of caribou sign	deciduous, fen and pond [(a)]	OPTI (2000)
2001	Petro-Canada Meadow Creek Project	L58 and L81	0.35 in February	wooded fen	Petro-Canada (2001)
2001	Rio Alto Kirby Project	Kirby Oil Sands Leases	no observations aerially; 26 incidental observations	c1 and g1, e1, BTNN, FONS, FTNN, MONS, and WONN	Rio Alto (2002)

Table III-6 Caribou Aerial Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (individuals/km^2 unless otherwise noted)	Habitat	Reference
2001	Shell Jackpine Mine – Phase 1	L13 East	no observations	n/a	Golder (2002a)
2001	CNRL Horizon Project	L6, 7, 10, 18, 25	no observations	n/a	CNRL (2002)
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	no direct observations	forage sight and tracks observed in treed fen and shrubby bog	Devon (2004)
2002	Petro-Canada Meadow Creek Project	L58 and L81	0.03 in February	treed bog	Golder (2002b)
2003	Petro-Canada Meadow Creek Project	L58 and L81	0.15 in February	BTNN, FONG, c1, FTNN, MONG, MONS and disturbance (wellpads, cutlines)	Golder (2003b)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	no observations	n/a	Golder (2004a)
2004	MEG Energy	Tp76-78, R4-6	no observations	n/a	present study

Table III-7 Caribou Track Count Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Results (Tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
1975-76	Syncrude Lease 17	L22, 17, 86 and 23	no observations	n/a	Penner (1976)
1981	Canstar Project 80	L88 and 89	no observations	n/a	Skinner and Westworth (1981)
1982	Canstar Lease	L9 and 33	0.01	only in mature mixedwood forest	Westworth and Brusnyk (1982)
1995	Solv-Ex	L5	no observations	n/a	BOVAR-CONCORD (1995)
1995	Syncrude Aurora North	L12, 13 and 34	no observations	n/a	Westworth, Brusnyk and Associates (1996b)
1996	Suncor Mine, L23 and Steepbank Study Area	L86/17, 23, 19, 25, 29 and 97	no observations	n/a	Westworth, Brusnyk and Associates (1996a)
1997	Shell Muskeg River mine	L13	no observations	n/a	Golder (1997a,b)
1997	Suncor Wildlife Monitoring	L19, 25, 29 and 97	no observations	n/a	Golder (1998b)
1998	Firebag Project	L85	no observations	n/a	Suncor (2000)
1998-99	Suncor Wildlife Monitoring	L86/17,19, 25 and 97	no observations	n/a	Golder (1999a)
2000	True North Fort Hills Oil Sands Project	L5 and 52	no observations	n/a	Golder (2000d)
2000	Albian Sands Lease 13 West	L13	no observations	n/a	Golder (2000c)
2000	Suncor Wildlife Monitoring	L86/17 and 97/25	no observations	only riparian corridors sampled	Golder (2000b)
2000	OPTI Long Lake Project	L27	11 incidental observations of caribou sign	deciduous, fen and pond	OPTI (2000)
2001	Gulf Surmont In-situ Oil Sands Project	L42, 71, 72 and 90	incidental observations in g1, c1, BTNN and FONS	n/a	AXYS (2001a)
2001	Petro-Canada Meadow Creek Project	L58 and L81	2.1	tracks observed in d1, BTNN, FONS; a preference was observed for the d1 and avoidance of d2 and BTNN	Petro-Canada (2001)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	no observations	n/a	Rio Alto (2002)

Table III-7 Caribou Track Count Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (Tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
2001	Shell Jackpine Mine – Phase 1	L13 East	no observations	n/a	Golder (2002a)
2001	CNRL Horizon Project	L6, 7, 10, 18, 25	no observations	n/a	CNRL (2002)
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	no observations	n/a	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	no observations	n/a	Golder (2004a)
2004	MEG Energy	Tp76-78, R4-6	0.51 (35 individual tracks)	preference for FTNN, avoidance of BTNN, also occurred within a1, c1, cutline, FONS, g1	present study

n/a = not applicable

Table III-8 Wolf Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
1970 to 1975	Traplines	Fort McMurray area	0.14 animals/ 100 km^2 trapped	n/a	Boyd (1977)
1975 to 1976	Syncrude Lease 17	L6, L22, 17, 86 and 23	0.07	no preference	Penner (1976)
1975 to 1978	AOSERP	northeastern Alberta	winter densities 1/92 km^2 to 1/198 km^2	n/a	Fuller and Keith (1980a)
1980	Canstar Project 80	L88 and 89	0.01	only in jack pine and black spruce-muskeg	Skinner and Westworth (1981)
1981 to 1982	Canstar Lease	L9 and 33	0.04	preferred willow wetlands and riparian aspen; avoided balsam poplar, jack pine, white spruce and riparian white spruce	Westworth and Brusnyk (1982)
1995	Solv-Ex	L5	no observations	n/a	BOVAR-CONCORD Environmental (1995)
1995	Syncrude Aurora North	L12, 13 and 34	0.05	preferred black spruce/tamarack; avoided aspen forest and mixedwood forest	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, Lease 23 and Steepbank Mine	L86/17, 23, 97, 25 and 19	0.14 in December 0.09 in February	avoided closed mixedwood	Westworth, Brusnyk & Associates (1996a)
1997	Muskeg River Mine	L13	no observations	n/a	Golder (1997a,b)
1997	Suncor Winter Wildlife	L19, 25 and 97	0.31 in January 0.0 in February 0.0 in March	January: preferred upland, avoided escarpment	Golder (1998a,b)
1997	Suncor Winter Wildlife	L29	no observations	not available	Golder (1998a,b)
1997	Mobil Lease 36	L36	0.38	most in lake shore emergent habitat and along main roads	URSUS and Komex (1997)
1998	Suncor Firebag Project	L85	no observations	n/a	Suncor (2000)
1998 to 1999	Suncor Wildlife Monitoring	L86/17,19, 25 and 97	0.09 in reclaimed 0.08 in riparian area beside disturbance	n/a	Golder (1999a)
2000	ATCO Pipeline	Muskeg River	mean: 0.5	most common in FONG, h1 and d1	AXYS (2000b)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	no observations	n/a	Golder (2000d)
2000	Albian Sands Lease 13 West	L13	0.01 in upland 0.04 in riparian	n/a	Golder (2000c)
2000	Suncor Wildlife Monitoring	L86/17 and 97/25	0.0 in Lease 86/17 0.11 in Lease 25/97	only riparian corridors sampled	Golder (2000b)

Table III-8 Wolf Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
2000	OPTI Long Lake Project	L27	0.01	tracks observed in the d2 and h1 ecosite phase/wetlands types	OPTI (2000)
2001	Gulf Surmont In-situ Oil Sands Project	–	no overall tracks/km-track day provided	observed at low densities in d1, e1, e2, f1, FONS, FTNN and FONG	AXYS (2001a)
1999 to 2001	Albian Sands Lease 13 West	L13 West	mean densities: 0.03 in January 1999/2000 0.04 in January 2000/2001 0 in February 2000/2001	surveys conducted in riparian and upland habitat no evidence of use of riparian areas as movement corridors	Golder (2001a)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	0.13	tracks observed in b2, d2 and FONS ecosite / wetlands types	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	0.07	two sets of tracks observed in d2	Petro-Canada (2001)
2001	Jackpine Mine – Phase 1	L13 East	0.03	three sets of tracks in d2	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	0.08	tracks observed in b1, d1, d2, d3, FONS and cutblock	CNRL (2002)
2002	Suncor South Tailings Pond Project	L19 and L10	0.03	tracks observed in e2 ecosite phase; no habitat prefences determined	Golder (2003a)
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	0.03	tracks observed in a1, d1, i2 and k2	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	no observations	n/a	Golder (2004a)
2004	Suncor Monitoring Five Year Report	L18/67 and Steepbank / Millennium	0.15	surveys conducted in natural sites	Golder (2004b)
2004	MEG Energy	Tp76-78, R4-6	0.03	Tracks observed in c1, g1	present study

Table III-9 Coyote Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Results (Tracks/km–track day unless otherwise noted)	Habitat Preference	Reference
1970 to 1975	traplines	Fort McMurray area	0.44 animals/ 100 km^2	n/a	Boyd (1977)
1975 to 1976	Syncrude Lease 17	L22, 17, 86 and 23	0.29	preferred disturbed habitat; avoided aspen, aspen-willow/alder and black spruce-willow	Penner (1976)
1978	Syncrude Alsands	general Syncrude Lease area	0.29	n/a	Alsands (1978)
1979	Esso Cold Lake Production Project	–	0.35 individuals/km^2	n/a	Esso (1979)
1980	Canstar Project 80	L88 and 89	0.10	preferred black spruce-muskeg; avoided aspen, open muskeg and riparian shrub	Skinner and Westworth (1981)
1981 to 1982	Canstar Lease	L9 and 33	0.13	preferred balsam poplar and jack pine; avoided aspen, white spruce willow and fen	Westworth and Brusnyk (1982)
1995	Solv-Ex	L5	0.72	most tracks in jack pine and black spruce	BOVAR-CONCORD Environmental (1995)
1995	Syncrude Aurora North	L12, 13 and 34	0.09	avoided cleared aspen and willow wetlands	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, Lease 23 and Steepbank Mine	L86/17, 23, 97, 25 and 19	0.45 in December 0.13 in February	preferred closed deciduous; avoided closed jack pine/white spruce, open black spruce and shoreline	Westworth, Brusnyk & Associates (1996a)
1997	Shell Muskeg River Mine	L13	0.10	most found in closed balsam poplar, closed mixedwood-white spruce dominant and closed white spruce	Golder (1997a,b)
1997	Suncor Winter Wildlife	L19, 25 and 97	0.24 in January 0.0 in February 0.0 in March	January: preferred upland	Golder (1998a,b)
1997	Suncor Winter Wildlife	L29	0.06 in January 0.03 in February	January: no preference February: no preference	Golder (1998a,b)
1997	Mobil Lease 36	L36	0.06	no preference	URSUS and Komex (1997)
1998	Suncor Firebag Project	L85	0.03	no preference	Suncor (2000)
1998 to 1999	Suncor Wildlife Monitoring	L86/17, 19, 25 and 97	2.23 in reclaimed 1.75 in riparian area beside disturbance	n/a	Golder (1999a)

Table III-9 Coyote Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (Tracks/km–track day unless otherwise noted)	Habitat Preference	Reference
2000	ATCO Pipeline	Muskeg River	mean: 0.6	most common in d3	AXYS (2000b)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	0.02	only in d2, e1, e2 and shrub	Golder (2000d)
2000	Albian Sands Lease 13 West	L13	0.03 in upland 0.11 in riparian	n/a	Golder (2000c)
2000	Suncor Wildlife Monitoring	L86/17 and 97/25	0.68 in Lease 86/17 0.89 in Lease 25/97	only riparian corridors sampled	Golder (2000b)
2000	OPTI Long Lake Project	L27	0.26	no preference; however most tracks were recorded in the FTNN, SONS, d2, d1 and STNN ecosite phase/wetlands types	OPTI (2000)
2001	Gulf Surmont In-situ Oil Sands Project	-	No overall tracks/km-track day provided	found in most ecosite phase/wetlands types (b1,b2, b3, c1, d1, d2, d3, e2, e3, f1, f2, h1, BTNN, FTNN, FONS and FONG)	AXYS (2001a)
1999 to 2001	Albian Sands Lease 13 West	L13 West	mean densities: 0.08 in January 1999/2000 0.74 in January 2000/2001 0.17 in February 2000/2001	surveys conducted in riparian and upland habitat no evidence of use of riparian areas as movement corridors	Golder (2001a)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	0.13	no preferences; however, most tracks observed in the d2 and g1 ecosite/wetlands types	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	0.57	almost all tracks observed in d2 ecosite phase/wetlands type, but three sets observed in BTNN; preferred d2, avoided BTNN and FONS	Petro-Canada (2001)
2001	Jackpine Mine – Phase 1	L13 East	0.01	one set of tracks in FTNN	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	0.20	tracks observed in b1, d2, d3, e3, g1, h1, FTNN, FONS and BTNN; preference for d2, avoidance of d1 (no observations)	CNRL (2002)

Table III-9 Coyote Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (Tracks/km–track day unless otherwise noted)	Habitat Preference	Reference
2002	Suncor South Tailings Pond Project	L19 and L10	0.60	Tracks observed in d2 and FTNN ecosite/ wetlands types; no habitat prefences determined	Golder (2003a)
2002	Devon- Jackfish Project	Tp 75,76-R 6 W4	1.29	highest densities in k3 and reclaimed industrial sites	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	0.50	most tracks observed along rights-of-way and in BTNN	Golder (2004a)
2004	Suncor Monitoring Five Year Report	L18/67 and Steepbank / Millennium	1.62	surveys conducted in natural sites	Golder (2004b)
2004	MEG Energy	Tp76-78, R4-6	0.45	Highest density in e2, also occurred in a1, b4, c1, d2, d3, e2, FTNN, g1	present study

Table III-10 Red Fox Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
1970 to 1975	traplines	Fort McMurray area	0.59 animals/ 100 km^2 trapped	n/a	Boyd (1977)
1975 to 1976	Syncrude Lease 17	L6, L22, 17, 86 and 23	0.02	most found in disturbed habitat and forested black spruce	Penner (1976)
1980	Canstar Project 80	L88 and 89	0.08	avoided aspen and open muskeg	Skinner and Westworth (1981)
1981 to 1982	Canstar Lease	L9 and 33	0.02	avoided aspen, white spruce, fen and willow wetlands	Westworth and Brusnyk (1982)
1995	Solv-Ex	L5	0.95	most tracks in aspen and aspen-white spruce	BOVAR-CONCORD Environmental (1995)
1995	Syncrude Aurora North	L12, 13 and 34	0.01	found in mixedwood forest, fen wetlands, cleared peatland, riparian white spruce and riparian shrub	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, Lease 23 and Steepbank Mine	L86/17, 23, 97, 25 and 19	0.02	only in closed deciduous, disturbed and mixed coniferous	Westworth, Brusnyk & Associates (1996a)
1997	Muskeg River Mine	L13	no observations	n/a	Golder (1997a,b)
1997	Suncor Winter Wildlife	L19, 25 and 97	0.05 in January 0.02 in February 0.0 in March	January: no preference February: no preference	Golder (1998a,b)
1997	Suncor Winter Wildlife	L29	no observations	n/a	Golder (1998a,b)
1997	Mobil Lease 36	L36	0.01	tracks recorded in closed black spruce and dwarf birch-willow shrubland	URSUS and Komex (1997)
1998	Suncor Firebag Project	L85	0.01	only in c1, FONS and FTNN/FFNN	Suncor (2000)
1998 to 1999	Suncor Wildlife Monitoring	L86/17, 19, 25 and 97	0.03 in reclaimed 0.23 in riparian area beside disturbance	n/a	Golder (1999a)
2000	ATCO Pipeline	Muskeg River	mean: 0.1	observed in e2 and d1	AXYS (2000b)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	0.03	found in d2, d3 and shrub	Golder (2000d)
2000	Albian Sands Lease 13 West	L13	0.31 in upland 0.10 in riparian	n/a	Golder (2000c)

Table III-10 Red Fox Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
2000	Suncor Wildlife Monitoring	L86/17 and 97/25	0.0 in Lease 86/17 0.39 in Lease 25/97	only riparian corridors sampled	Golder (2000b)
2000	OPTI Long Lake Project	L27	0.19	most tracks observed in the h1 and d2 ecosite phase	OPTI (2000)
2001	Gulf Surmont In-situ Oil Sands Project	–	No overall tracks/km-track day provided	one observation in b2 ecosite phase	AXYS (2001a)
1999 to 2001	Albian Sands Lease 13 West	L13 West	mean densities: 0.15 in January 1999/2000 0 in January 2000/2001 0.01 in February 2000/2001	surveys conducted in riparian and upland habitat no evidence of use of riparian areas as movement corridors	Golder (2001a)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	no observations	n/a	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	0.36	observed in b1, b3, c1, d2, e2 and BTNN	Petro-Canada (2001)
2001	Shell Jackpine Mine – Phase 1	L13 East	0.03	observed in BTNN	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	one set of tracks observed	tracks observed in SONS	CNRL (2002)
2002	Suncor South Tailings Pond Project	L19 and L10	no observations	n/a	Golder (2003a)
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	0.10	not able to determine preference	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	only 1 incidental observation	n/a	Golder (2004a)
2004	MEG Energy	Tp76-78, R4-6	0.01	unable to determine preference, observed in FTNN	present study

Table III-11 Canada Lynx Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
1970 to 1975	traplines	Fort McMurray area	3.37 animals/100 km^2 trapped	n/a	Boyd (1977)
1975 to 1976	Syncrude Lease 17	L6, L22, 17, 86 and 23	0.002	only in black spruce	Penner (1976)
1980	Canstar Project 80	L88 and 89	0.06	preferred black spruce-muskeg; avoided aspen, mixedwood, open muskeg, riparian shrub and riparian white spruce	Skinner and Westworth (1981)
1981 to 1982	Canstar Lease	L9 and 33	0.13	preferred aspen and riparian aspen; avoided jack pine, white spruce, black spruce, fen and willow wetlands	Westworth and Brusnyk (1982)
1985	BP Resources (Wolf Lake)	–	0.1 individuals/km^2	n/a	BP Resources et al. (1985)
1995	Solv-Ex	L5	0.24	only in black spruce	BOVAR-CONCORD Environmental (1995)
1995	Syncrude Aurora North	L12, 13 and 34	no observations	n/a	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, Lease 23 and Steepbank Mine	L86/17, 23, 97, 25 and 19	no observations in December 0.01 in February	only in closed deciduous, mixed coniferous, black spruce-tamarack and disturbed	Westworth, Brusnyk & Associates (1996a)
1997	Muskeg River Mine	L13	no observations	n/a	Golder (1997a,b)
1997	Suncor Winter Wildlife	L19, 25 and 97	0.0 in January 0.02 in February 0.05 in March	February: no preference March: no preference	Golder (1998a,b)
1997	Suncor Winter Wildlife	L29	no observations	n/a	Golder (1998a,b)
1997	Mobil Lease 36	L36	no observations	n/a	URSUS and Komex (1997)
1998	Suncor Firebag Project	L85	no observations	n/a	Suncor (2000)
1998 to 1999	Suncor Wildlife Monitoring	L86/17, 19, 25 and 97	no observations	n/a	Golder (1999a)
1999	AEC Foster Creek SAGD Project	–	no overall tracks/km-track day provided	tracks found in coniferous forest (jack pine/black spruce, treed bogs and shrubby fens	AXYS (1999)
2000	ATCO Pipeline	Muskeg River	mean: 3.2	most common in FONG, and FONS	AXYS (2000b)

Table III-11 Canada Lynx Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	0.01	found in d2 and e2	Golder (2000d)
2000	Albian Sands Lease 13 West	L13	0.13 in upland 0.14 in riparian	n/a	Golder (2000c)
2000	Suncor Wildlife Monitoring	L86/17 and 97/25	0.0 in Lease 86/17 0.04 in Lease 25/97	only riparian corridors sampled	Golder (2000b)
2000	OPTI Long Lake Project	L27	0.50	most tracks were recorded in the d2, d1, FTNN and h1 ecosite phase/wetlands types	OPTI (2000)
2001	Gulf Surmont In-situ Oil Sands Project	–	no overall tracks/km-track day provided	found in most ecosite phase/wetlands types (a1, b1, b2, b3, c1, d1, d2, d3, e2, e3, g1, h1, BTNN, FTNN, FONS and FONG)	AXYS (2001a)
1999 to 2001	Albian Sands Lease 13 West	L13 West	mean densities: 0.14 in January 1999/2000 0.21 in January 2000/2001 0.28 in February 2000/2001	surveys conducted in riparian and upland habitat no evidence of use of riparian areas as movement corridors	Golder (2001a)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	0.25	no preference observed, tracks found in b3, g1, FONS, FTNN, STNN	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	0.34	found most commonly in the BTNN and g1, but also observed in BFNN, c1, STNN	Petro-Canada (2001)
2001	Shell Jackpine Mine – Phase 1	L13 East	0.54	preferred d2; avoided FONS	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	0.84	tracks observed in b3, d1, d2, d3, e3, g1, BTNN, FTNN, FONS, STNN, SONS and WONN; preference for d1, avoidance of d2, FONG, SONS and burn	CNRL (2002)
2002	Suncor South Tailings Pond Project	L19 and L10	0.41	tracks observed in d2 ecosite phase; with habitat prefence for d2 and avoidance of FONS determined	Golder (2003a)
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	0.56	highest track densities in k1 and j1	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	not observed	n/a	Golder (2004a)
2004	Suncor Monitoring Five Year Report	L18/67 and Steepbank / Millennium	0.08	surveys conducted in natural sites	Golder (2004b)
2004	MEG Energy CLRP	Tp76-78, R4-6	0.13	no preferences, highest densities in disturbed-cutline, BTNN	present study

Table III-12 Black Bear Survey Results within the Oil Sands Region

Year	Project	Area/ Lease	Results	Reference
1976	Alberta Environment	Cold Lake	0.38 bears/km^2	Ruff et al. (1976)
1977	AOSERP	Fort Hills/ L5, 14 and 52	1 bear/2 to 4 km^2	Fuller and Keith (1977)
1978	AOSERP	Fort Hills/ L5, 14 and 52	1bear/4 to 5.6km^2	Young (1978)
1980	AOSERP	Fort Hills/ L5, 14 and 52	25-50/100 km^2 (telemetry)	Fuller and Keith (1980a)
1981 to 1982	Canstar Lease	L9 and 33	highest use in balsam poplar, mixedwood and white spruce; jack pine and black spruce habitats were low, while fen and willow wetlands were avoided	Westworth and Brusnyk (1982)
1982	Cold Lake	not available	18-25/100 km^2 (telemetry)	Young and Ruff (1982)
1998	Suncor Firebag Project	L85	12 incidental observations of individuals or sign	Suncor (2000)
2000	Canadian Natural PAW Project	–	incidental observations in black spruce/jack pine, jack pine/aspen, treed fen, shrubby fen, aspen/white spruce, poor fen/bog, shrubby swamp, jack pine and cutblocks	CNRL (2000)
2000	OPTI Long Lake Project	L27	7 incidental observations of individuals or sign	OPTI (2000)
2001	Gulf Surmont In-situ Oil Sands Project	–	12 incidental observations of individuals or sign in b2, d1, d2, e2, f1, d1 and FONS	AXYS (2001a)
2001	Petro-Canada Meadow Creek Project	L58 and L81	9 incidental observations of individuals or sign in b1, d1, d3, e1	Petro-Canada (2001)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	8 incidental observations in b3, e2, and BTNN	Rio Alto (2002)
2001	Shell Jackpine Mine – Phase 1	L13 East	5 incidental observations in MONS, d2 and d3	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	14 incidental observations in b1, d1, d2	CNRL (2002)
2002	Suncor South Tailings Pond Project	L19 and L10	7 incidental observations in d2 ecosite phase and cutblocks	Golder (2003a)

Table III-12 Black Bear Survey Results within the Oil Sands Region (continued)

Year	Project	Area/ Lease	Results	Reference
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	no observations	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	4 observations of bear or evidence of bear.	Golder (2004a)
2004	MEG Energy	Tp76-78, R4-6	8 incidental observations or evidence of bear within d2 and along cutlines	present Study

Table III-13 Wolverine Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
1970 to 1975	traplines	Fort McMurray area	0.01 animals/ 100 km^2 trapped	n/a	Boyd (1977)
1975 to 1976	Syncrude Lease 17	L6, L22, 17, 86, 23	0.01	only in aspen and mixedwood	Penner (1976)
1979	Syncrude Lease 17	L17	estimated 0.08 individuals/100km^2	n/a	Westworth & Associates (1979)
1980	Canstar Project 80	L88 and 89	0.005	only in black spruce-muskeg	Skinner and Westworth (1981)
1981 to 1982	Canstar Lease	L9 and 33	no observations	n/a	Westworth and Brusnyk (1982)
1995	Solv-Ex	L5	no observations	n/a	BOVAR-CONCORD Environmental (1995)
1995	Syncrude Aurora North	L12, 13 and 34	no observations	n/a	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, Lease 23 and Steepbank Mine	L86/17, 23, 97, 25 and 19	no observations	n/a	Westworth, Brusnyk & Associates (1996a)
1997	Muskeg River Mine	L13	no observations	n/a	Golder (1997a,b)
1997	Suncor Winter Wildlife	L19, 25 and 97	no observations	n/a	Golder (1998a,b)
1997	Mobil Lease 36	L36	0.01	in a black spruce burn and along seismic line through white spruce-aspen mixedwood	URSUS and Komex (1997)
1998	Suncor Firebag Project	L85	no observations	n/a	Suncor (2000)
1998 to 1999	Suncor Wildlife Monitoring	L86/17,19, 25 and 97	no observations	n/a	Golder (1999a)
2000	ATCO Pipeline	Muskeg River	no observations	n/a	AXYS (2000b)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	no observations	n/a	Golder (2000d)
2000	Albian Sands Lease 13 West	L13	no observations	n/a	Golder (2000c)
2000	Suncor Wildlife Monitoring	L86/17 and 97/25	no observations	n/a	Golder (2000b)
2000	OPTI Long Lake Project	L27	no observations	n/a	OPTI (2000)
1999 to 2001	Albian Sands Lease 13 West	L13 West	no observations	n/a	Golder (2001a)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	no observations	n/a	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	no observations	n/a	Petro-Canada (2001)
2001	Jackpine Mine – Phase 1	L13 East	no observations	n/a	Golder (2002a)

Table III-13 Wolverine Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	no observations	n/a	CNRL (2002)
2002	Suncor South Tailings Pond Project	L19 and L10	no observations	n/a	Golder (2003a)
2002	Devon- Jackfish Project	Tp 75,76-R 6 W4	no observations	n/a	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	no observations	n/a	Golder (2004a)
2004	Suncor Monitoring Five Year Report	L18/67 and Steepbank / Millennium	0.004	surveys conducted in natural sites	Golder (2004b)
2004	MEG Energy	Tp76-78, R4-6	no observations	n/a	Present study

Table III-14 Fisher and Marten Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Species	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
1970 to 1975	traplines	Fort McMurray Area	fisher	0.43 animals/ 100 km^2 trapped	n/a	Boyd (1977)
1975 to 1976	Syncrude Lease 17	L6, L22, 17, 86 and 23	fisher	0.06	no preference	Penner (1976)
1986	OSLO	OSLO Project Area	fisher	No overall track count/km-track day provided	tracks were found in bogs, shrublands and fens	Duncan et al. (1986)
1995	Solv-Ex	L5	fisher	1.52	most tracks in jack pine, white spruce and aspen-white spruce	BOVAR-CONCORD Environmental (1995)
1995	Syncrude Aurora North	L12, 13 and 34	fisher	0.02 in January	most in riparian balsam poplar	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, Lease 23 and Steepbank Mine	L86/17, 23, 97, 25 and 19	fisher	0.21 in December 0.04 in February	preferred black spruce tamarack; avoided upland coniferous/ mixedwood	Westworth, Brusnyk & Associates (1996a)
1997	Suncor Winter Wildlife	L29	fisher	0.0 in January 0.29 in February	February: no preference	Golder (1998a,b)
1997	Suncor Winter Wildlife	L19, 25 and 97	fisher	0.02 in January 0.59 in February 0.15 in March	January: no preference February: prefer upland, avoid riparian and escarpment March: no preference	Golder (1998a,b)
1997	Mobil Lease 36	L36	fisher	0.09	most in treed fens and bogs	URSUS and Komex (1997)
1998	Suncor Firebag Project	L85	fisher	0.61	avoided b1, b2, d2 and d3	Suncor (2000)
1998 to 1999	Suncor Wildlife Monitoring	L86/17, 19, 25 and 97	fisher	0.03 in reclaimed 1.64 in riparian area beside disturbance	n/a	Golder (1999a)
2000	ATCO Pipeline	Muskeg River	fisher	mean: 0.6	most common in b1, also common in FTNN and FONS	AXYS (2000b)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	fisher	0.14	found in b1, d1, d2, BTNN and FTNN	Golder (2000d)
2000	Albian Sands Lease 13 West	L13	fisher	0.81 in upland 1.16 in riparian	no landform preference	Golder (2000c)
2000	Suncor Wildlife Monitoring	L86/17 and 97/25	fisher	0.0 in Lease 86/17 0.46 in Lease 25/97	only riparian corridors sampled	Golder (2000b)

Table III-14 Fisher and Marten Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Species	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
2000	OPTI Long Lake Project	L27	fisher	0.45	d2, h1	OPTI (2000)
1999 to 2001	Albian Sands Lease 13 West	L13 West	fisher	mean densities: 1.02 in January 1999/2000 0.47 in January 2000/2001 0.77 in February 2000/2001	surveys conducted in riparian and upland habitat no evidence of use of riparian areas as movement corridors	Golder (2001a)
2001	Petro-Canada Meadow Creek Project	L58 and L81	fisher	0.74	most often in d2 and e2 ecosite phase/wetlands types but also found in b1, e1, BTNN, STNN	Petro-Canada (2001)
2001	Gulf Surmont In-situ Oil Sands Project	–	fisher	no overall tracks/km-track day provided	highest densities in a1, also found in b2, c1, d1, d2, d3, e2, e3, g1, h1, FTNN and FONS	AXYS (2001a)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	fisher	0.06	no preference but tracks observed in b3, c1, g1	Rio Alto (2002)
2001	Shell Jackpine Mine – Phase 1	L13 East	fisher	1.00	most often in FTNN, FONS, STNN, BTNN; incidentally observed on four occasions in h1, STNN, FTNN and FONG ecosite phase/wetlands types	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	fisher	0.19	tracks observed most often in d2, also observed in d3, g1 and cutblock	CNRL (2002)
1970 to 1975	traplines	Fort McMurray area	marten	animals/100 km^2 trapped	n/a	Boyd (1977)
1995	Solv-Ex	L5	marten	0.08	only in black spruce	BOVAR-CONCORD Environmental (1995)
1995	Syncrude Aurora North	L12, 13 and 34	marten	0.15 in January	preferred mixed coniferous and riparian white spruce; avoided black spruce- tamarack, open tamarack-bog birch, fen wetlands, willow wetlands, riparian balsam poplar, riparian shrub and cleared peatland	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, Lease 23 and Steepbank Mine	L86/17, 23, 97, 25 and 19	marten	0.04 in December 0.10 in February	preferred upland coniferous	Westworth, Brusnyk & Associates (1996a)

Table III-14 Fisher and Marten Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Species	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
1997	Suncor Winter Wildlife	L29	marten	0.38 in January 1.16 in February	January: avoided d1, d2, d3, shrub and WONN February: avoided a1 and d1	Golder (1998a,b)
1997	Suncor Winter Wildlife	L19, 25 and 97	marten	0.36 in January 0.35 in February 0.44 in March	January: avoided upland February: no preference march: preferred escarpment and avoid riparian	Golder (1998a,b)
1997	Mobil Lease 36	L36	marten	1.03	most in riparian willow shrubland, white spruce – aspen mixedwood and white spruce	URSUS and Komex (1997)
1998	Suncor Firebag Project	L85	marten	1.33	preferred FTNN/FFNN and avoided FONS	Suncor (2000)
1998 to 1999	Suncor Wildlife Monitoring	L86/17, 19, 25 and 97	marten	0.03 in reclaimed 1.49 in riparian area beside disturbance	n/a	Golder (1999a)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	marten	0.42	preferred b1 and BTNN avoided d1, d3, e1, g1, shrub and sons	Golder (2000d)
2000	Albian Sands Lease 13 West	L13	marten	0.28 in upland 0.50 in riparian	no landform preference	Golder (2000c)
2000	ATCO Pipeline	Muskeg River	marten	mean: 1.8	most common in BTNN and shrubby bog, also common in d3 and h1	AXYS (2000b)
2000	Suncor Wildlife Monitoring	L86/17 and 97/25	marten	0.0 in Lease 86/17 0.54 in Lease 25/97	only riparian corridors sampled	Golder (2000b)
2000	OPTI Long Lake Project	L27	marten	0.02	tracks observed in the d2 and FTNN ecosite phase/wetlands types	OPTI (2000)
1999 to 2001	Albian Sands Lease 13 West	L13 West	marten	mean densities: 0.41 in January 1999/2000 0.52 in January 2000/2001 1.02 in February 2000/2001	surveys conducted in riparian and upland habitat no evidence of use of riparian areas as movement corridors	Golder (2001a)

Table III-14 Fisher and Marten Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Species	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
2001	Gulf Surmont In-situ Oil Sands Project	–	marten	no overall tracks/km-track day provided	highest densities of tracks found in e2 and g1, also found in b1, d1, d2, e3, f1, h1, BTNN, FONS and FTNN	AXYS (2001a)
2001	Petro-Canada Meadow Creek Project	L58 and L81	marten	0.57	most often observed in b3 and d2 but also observed in c1, g1, e1 and BTNN	Petro–Canada (2001)
2001	Shell Jackpine Mine – Phase 1	L13 East	marten	0.46	most observed in FTNN, b1, BTNN and FONS	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	marten	0.42	most observed in d2, also observed in d1, d3, e3, g1, BTNN, FTNN, FONS and STNN	CNRL (2002)
1997	Shell Muskeg River Mine	L13	combined	1.26	preferred closed balsam poplar, closed mixedwood, open and closed aspen	Golder (1997a,b)
1981	Canstar Project 80	L88 and 89	combined	0.05	no preference	Skinner and Westworth (1981)
1982	Canstar Lease	L9 and 33	combined	0.12	preferred mixedwood; avoided white spruce, black spruce, willow, fen and willow wetlands	Westworth and Brusnyk (1982)
1999	AEC Foster Creek SAGD Project	–	combined	tracks observed	n/a	AXYS (1999)
2000	OPTI Long Lake Project	L27	combined	0.47	d2, h1	OPTI (2000)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	combined	0.17	tracks observed in b3, c1, d2, g1	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	combined	1.40	most often observed in d2, b3, e2 and BTNN; preferred d2 and avoided FONS	Petro-Canada (2001)
2001	Shell Jackpine Mine – Phase 1	L13 East	combined	1.75	most often observed in FTNN, FONS, BTNN and STNN; preferred FTNN, avoided d2 and h1	Golder (2002b)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	combined	0.97	most often observed in d2 (high effort), e3 and d1 but no significant preference or avoidance of habitat types	CNRL (2002)
2002	Suncor South Tailings Pond Project	L19 and L10	combined	0.85	most often observed in FONS wetlands type, also observed in BTNN, d2, and FTNN; preference for FONS and avoidance of d2 determined	Golder (2003a)

Table III-14 Fisher and Marten Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Species	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	combined	0.29	highest track densities in g1	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	combined	no observations	n/a	Golder (2004a)
2004	Suncor Monitoring Five Year Report	L18/67 and Steepbank / Millennium	combined	1.45	surveys conducted in natural sites	Golder (2004b)
2004	MEG Energy	Tp76-78, R4-6	combined	0.09	No preferences could be determined but recorded within g1, BTNN, FTNN	present study

Table III-15 Weasel Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
1970 to 1975	traplines	Fort McMurray area	1.92 animals/ 100 km^2 trapped	n/a	Boyd (1977)
1975 to 1976	Syncrude Lease 17	L6, L22, 17, 86 and 23	1.47	preferred aspen-willow/alder, treed black spruce and tall shrub; avoided black spruce-willow and disturbed	Penner (1976)
1980	Canstar Project 80	L88 and 89	1.14	preferred black spruce muskeg; avoided jack pine and open muskeg	Skinner and Westworth (1981)
1981 to 1982	Canstar Lease	L9 and 33	0.27	preferred willow; avoided balsam poplar, jack pine, white spruce and riparian white spruce	Westworth and Brusnyk (1982)
1985	OSLO	OSLO Project Area	no overall track count/km-track day provided	low densities in forested and unforested habitats, high use of logged areas.	Duncan et al. (1986)
1995	Solv-Ex	L5	1.75	most tracks in black spruce and jack pine	BOVAR-CONCORD Environmental (1995)
1995	Syncrude Aurora North	L12, 13 and 34	1.22	preferred black spruce- tamarack, open tamarack bog birch and cleared peatland; avoided aspen forest, mixedwood forest, mixed coniferous, fen wetlands, willow wetlands and riparian white spruce	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, Lease 23 and Steepbank Mine	L86/17, 23, 97, 25 and 19	5.16 in December 0.83 in February	preferred black spruce-tamarack, open black spruce, open tamarack/fen and fen; avoided closed jack pine, closed mixedwood, wetlands shrub complex, disturbed and shoreline	Westworth, Brusnyk & Associates (1996a)
1997	Muskeg River Mine	L13	1.12	preferred closed mixedwood-white spruce dominant and closed mixedwood; avoided closed balsam poplar, open and closed aspen, closed mixed coniferous	Golder (1997a,b)
1997	Suncor Winter Wildlife	L29	0.80 in January 0.78 in February	January: avoided Shrub, BTNN and WONN February: preferred BTNN; avoided a1, d1, d2, d3 and h1	Golder (1998a,b)
1997	Suncor Winter Wildlife	L19, 25 and 97	0.71 in January 0.48 in February 0.00 in March	January: prefer riparian avoid escarpment February: no preference	Golder (1998a,b)

Table III-15 Weasel Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
1997	Mobil Lease 36	L36	0.2	most in tamarack forest and riparian willow shrubland	URSUS and Komex (1997)
1998	Suncor Firebag Project	L85	1.0	preferred FONS; avoided a1, b1, b2, d1, d2 and d3	Suncor (2000)
1998 to 1999	Suncor Wildlife Monitoring	L86/17, 19, 25 and 97	0.16 in reclaimed 1.75 in riparian area beside disturbance	n/a	Golder (1999a)
2000	ATCO Pipeline	Muskeg River	mean: 2.1	most common in h1	AXYS (2000b)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	0.31	preferred FTNN; avoided a1, b1, d1, d3, e2 and BTNN	Golder (2000d)
2000	Albian Sands Lease 13 West	L13	no observations	n/a	Golder (2000c)
2000	Suncor Wildlife Monitoring	L86/17 and 97/25	0.40 in Lease 86/17 0.78 in Lease 25/97	only riparian corridors sampled	Golder (2000b)
2000	OPTI Long Lake Project	L27	0.46	tracks mainly were observed in the FTNN, d2 and h1 ecosite phase/wetlands types	OPTI (2000)
1999 to 2001	Albian Sands Lease 13 West	L13 West	no observations	n/a	Golder (2001a)
2001	Gulf Surmont In-situ Oil Sands Project	–	no overall tracks/km-track day provided	found in b1, b2, d2, e3, f1, f2, g1, h1 and FTNN	AXYS (2001a)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	0.38	no preference, most commonly observed in g1 and FTNN; one set of tracks each observed in STNN and disturbed	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	0.48	observed in c1, g1 and BTNN ecosite phase/wetlands types	Petro-Canada (2001)
2001	Shell Jackpine Mine – Phase 1	L13 East	0.67	observed in d2, FONS, FTNN, h1, SONS and STNN; preferred FTNN, avoided d2 and STNN	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	0.65	observed in b3, d1, d2, d3, e1, e3, g1, BTNN, FTNN, FONG, FONS, STNN, SONS, and cutblock; avoided e3	CNRL (2002)
2002	Suncor South Tailings Pond Project	L19 and L10	1.00	observed in FONS, FTNN, FONG and d2; preference for FONS and FTNN; avoided d2	Golder (2003a)

Table III-15 Weasel Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	0.9	highest track densities in k3	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	0.69	most observations in FTNN	Golder (2004a)
2004	Suncor Monitoring Five Year Report	L18/67 and Steepbank / Millennium	0.53	surveys conducted in natural sites	Golder (2004)
2004	MEG Energy	Tp76-78, R4-6	0.35	no preferences; most abundant in b4 and b2	present study

Table III-16 Beaver Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Results	Reference
1970 to 1975	traplines	Fort McMurray area	12.9 animals/ 100 km^2 trapped	Boyd (1977)
1975 to 1976	Syncrude Lease 17	L6, L22, 17, 86 and 23	0.14 to 1.0/km river or creek; 1.9/km^2	Penner (1976)
1978	AOSERP	AOSERP Study Area	0.32 active lodges/km of stream and 0.14 active lodges/km of lakeshore	Searing (1979)
1978	AOSERP	AOSERP Study Area	0.40 active lodges/km of stream	Gilbert et al. (1979) as reported in Conor Pacific (1998)
1978	Syncrude	L17 and 22	0.32 food caches/km^2 0.26 active lodges/km^2	Westworth (1978) as reported in Conor Pacific (1998)
1979	Syncrude	L17 and 22	0.29 food caches/km^2 0.23 active lodges/km^2	Westworth (1979) as reported in Conor Pacific (1998)
1980	Canstar Project 80	L88 and 89	0.11 active lodges/km^2 or 0.16/km Muskeg River	Skinner and Westworth (1981)
1981	Canstar Lease	L9 and 33	0.42 active lodges/km^2	Westworth and Brusnyk (1982)
1983	AOSERP	AOSERP Study Area	0.81 food caches/km^2 0.94 active lodges/km^2	Green (1983) as reported in Conor Pacific (1998)
1984	Syncrude	L17 and 22	0.44 food caches/km^2	Pauls (1984) as reported in Conor Pacific (1998)
1985	OSLO	OSLO Project Area	0.32 food caches/km^2	Salter and Duncan (1986)
1985	BP Resources	Wolf Lake	0.2 active lodges/km in wetlands	BP Resources et al. (1985)
1985	BP Resources	Wolf Lake	0.3 active lodges/km for shoreline 0.6 active lodges/km for creeks	Young and Bjornson (1985)
1986	Syncrude	L17 and 22	0.52 food caches/km^2	Pauls and Arner (1987) as reported in Conor Pacific (1998)
1988	Syncrude	L17 and 22	0.42 food caches/km^2	Pauls (1989) as reported in Conor Pacific (1998)
1991	Syncrude	L17 and 22	0.46 food caches/km^2	Pauls (1991) as reported in Conor Pacific (1998)
1996	Aurora Mine	L12, 13 and 34	0.09 active lodge and food caches/km^2 and 0.57 active lodge and food caches /km^2 on the previous Alsands Site	Fort McKay Environmental Services (1996)
1998	Mobil Lease 36	L36	0.37 active lodges/km^2	Golder (1999c)
1999	OPTI Long Lake Project	L27	0.61 active lodges/km^2 or 1.6 active lodges/km	OPTI (2000)

Table III-16 Beaver Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results	Reference
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	0.02 active lodges/ha of lake 0.02 inactive lodges/ha of lake 0.00 active lodges/km of tributary 1.14 inactive lodges/km of tributary	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	0.08 active lodges/ha of lake 0.20 active lodges/km of drainage	Petro-Canada (2001)
2001	Shell Jackpine Mine – Phase 1	L13 East	0.69 active lodges/km of tributary 0.66 inactive lodges/km of tributary	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	0.05 active lodges/ha of lake 0.08 inactive lodges/ha of lake 1.17 active lodges/km of tributary 1.27 inactive lodges/km of tributary	CNRL (2002)
2002	Suncor South Tailings Pond Project	L19 and L10	0.78 active lodges/km of tributary 1.17 inactive lodges/km of tributary	Golder (2003a)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	3 incidental sightings during other surveys on the LSA	Golder (2004a)
2004	MEG Energy Christina Lake Regional Project	Tp76-78, R4-6	0.84 food caches/km^2 of lake (0.008/ha) 1.03 active lodges/km^2 of lake (0.010/ha) 0.21 food caches/km of stream 0.17 active lodges/km of stream	present study

Table III-17 Muskrat Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Results	Reference
1970 to 1975	traplines	Fort McMurray area	6.13 animals/ 100 km^2 trapped	Boyd (1977)
1975 to 1976	Syncrude Lease 17	L6, L22, 17, 86 and 23	estimate of 0.3 - 2.5 muskrats/ha	Penner (1976)
1980	Canstar Project 80	L88 and 89	0.03 houses/km^2 (6 houses observed within the 176 km^2 study area)	Skinner and Westworth (1981)
1981 to 1982	Canstar Lease	L9 and 33	0.02 houses/km^2 (6 houses in 387 km^2 study area)	Westworth and Brusnyk (1982)
1983	Syncrude	Syncrude Project Area	39 muskrat houses, common on Ruth Lake and Horseshoe Lake	Murray and Pauls (1983)
1984	Syncrude	Syncrude Project Area	48 muskrat houses recorded	Pauls (1984)
1986	Syncrude	Syncrude Project Area	25 muskrat lodges recorded, most on Horseshoe lake	Pauls and Arner (1987)
1989	Syncrude	Syncrude Project Area	64 houses recorded, most on Horseshoe lake	Pauls (1989)
1990	Syncrude	Syncrude Project Area	no observations	Pauls (1991)
1991	Syncrude	L17, L22	low number observed	Pauls (1991)
1996	Aurora Mine	L12, 13, 34	no observations	Fort McKay Environmental Services Ltd (1996)
1997	Suncor Winter Wildlife	L29	no observations	Golder (1998a,b)
1997	Mobil Lease 36	L36	0.21 houses/km^2 and 0.84 feeding platforms/km^2	URSUS and Komex (1997)
2000	OPTI Long Lake Project	L27	0.54 push ups/km^2	OPTI (2000)
2000	Canadian Natural PAW Project	–	muskrat houses were observed in shrubby fen and shallow open water with wetlands	CNRL (2000)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	0.01 push-ups/ha of lake 0.29 push-ups//km of tributary	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	0.00 push-ups/km^2	Petro-Canada (2001)
2001	Shell Jackpine Mine – Phase 1	L13 East	no observations	Golder (2002a)

Table III-17 Muskrat Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results	Reference
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	0.02 push-ups/ha of lake 0.07 push-ups//km of tributary	CNRL (2002)
2002	Suncor South Tailings Pond Project	L19 and L10	no observations	Golder (2003a)
2004	MEG Energy Christina Lake Regional Project	Tp76-78, R4-6	2.06 push-ups/km of tributary	present study

Table III-18 River Otter Track Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
1970 to 1975	traplines	Fort McMurray area	0.12 animals/ 100 km^2 trapped	n/a	Boyd (1977)
1975 to 1976	Syncrude Lease 17	L6, L22, 17, 86 and 23	0.0007	n/a	Penner (1976)
1980	Canstar Project 80	L88 and 89	0.01(all) 0.06 (riparian)	only in riparian habitat	Skinner and Westworth (1981)
1981 to 1982	Canstar Lease	L9 and 33	0.0005	n/a	Westworth and Brusnyk (1982)
1985	BP Resources	Cold Lake	general observations	n/a	BP Resources et al. (1985)
1995	Solv-Ex	L5	no observations	n/a	BOVAR-CONCORD Environmental (1995)
1995	Syncrude Aurora North	12, 13 and 34	0.02	only in riparian shrub, fen and willow wetlands	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, Lease 23 and Steepbank Mine	L86/17, 23, 97, 25 and 19	0.01	only in shoreline	Westworth, Brusnyk & Associates (1996a)
1997	Muskeg River Mine	L13	0.01	only in riparian shrub dominant	Golder (1997a,b)
1997	Suncor Winter Wildlife	L19, 25, 29 and 97	no observations	n/a	Golder (1998a,b)
1998	Suncor Firebag Project	L85	no observations	n/a	Suncor (2000)
1998 to 1999	Suncor Wildlife Monitoring	L86/17,19, 25 and 97	0.0 in reclaimed 0.04 in riparian area beside disturbance	n/a	Golder (1999a)
2000	ATCO Pipeline	Muskeg River	mean: 0.6	most common in FONG	AXYS (2000b)
2000	Canadian Natural PAW Project	–	incidental observations	n/a	CNRL (2000)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	0.02	found in FTNN and SONS	Golder (2000d)
2000	Albian Sands Lease 13 West	L13	0.0 in upland 0.11 in riparian	n/a	Golder (2000c)
2000	Suncor Wildlife Monitoring	L86/17 and 97/25	0.0 in Lease 86/17 0.06 in Lease 25/97	only riparian corridors sampled	Golder (2000b)
2000	OPTI Long Lake Project	L27	1 set of old tracks observed	mixedwood	OPTI (2000)

Table III-18 River Otter Track Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
1999 to 2001	Albian Sands Lease 13 West	L13 West	mean observations: 0.07 in January 1999/2000 0.10 in January 2000/2001 0.01 in February 2000/2001	surveys conducted in riparian and upland habitat no evidence of use of riparian areas as movement corridors, however, the animal's ecology suggests a preference for riparian areas	Golder (2001a)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	0.02	one set of tracks observed in WONN	Rio Alto (2002)
2001	Gulf Surmont In-situ Oil Sands Project	–	no overall tracks/km-track day provided	found in F1 and FONG	AXYS (2001a)
2001	Petro-Canada Meadow Creek Project	L58 and L81	0.05	tracks observed in d2 and e1	Petro–Canada (2001)
2001	Shell Jackpine Mine – Phase 1	L13 East	no observations	n/a	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	0.02	observed in SONS and WONN	CNRL (2002)
2002	Suncor South Tailings Pond Project	L19 and L10	no observations	n/a	Golder (2003a)
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	1 observed track in g1	n/a	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	1 set of tracks observed incidentally	n/a	Golder (2004a)
2004	MEG Energy Christina Lake Regional Project	Tp76-78, R4-6	2 incidental observations	stream/MONS	present study

Table III-19 Mink Track Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Results (Tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
1970 to 1975	traplines	Fort McMurray area	2.26 animals/ 100 km^2 trapped	n/a	Boyd (1977)
1975 to 1976	Syncrude Lease 17	L6, L22, 17, 86 and 23	0.1	most in riparian, aspen-willow and deciduous dominated mixedwood[(a)]	Penner (1976)
1980	Canstar Project 80	L88 and 89	0.10	preferred riparian shrub; avoided aspen, jack pine, black spruce muskeg and open muskeg	Skinner and Westworth (1981)
1981 to 1982	Canstar Lease	L9 and 33	0.10	preferred willow wetlands; avoided aspen, balsam poplar, mixed wood, jack pine, white spruce and black spruce	Westworth and Brusnyk (1982)
1995	Solv-Ex	L5	no observations	n/a	BOVAR-CONCORD Environmental (1995)
1995	Syncrude Aurora North	L12, 13 and 34	0.22 in January	preferred riparian shrub; avoided aspen and mixedwood forest, jack pine, mixed coniferous, black spruce-tamarack, fen and willow wetlands, riparian balsam poplar and cleared peatland	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, Lease 23 and Steepbank Mine	L86/17, 23, 97, 25 and 19	0.02	most in wetlands shrub complex	Westworth, Brusnyk & Associates (1996a)
1997	Muskeg River Mine	L13	0.03	only in riparian shrub dominant	Golder (1997a,b)
1997	Suncor Winter Wildlife	L29	0.59 in January no observations in February	January: avoided a1, d3, d1, d2, h1, FTNN, BTNN and WONN	Golder (1998a,b)
1997	Suncor Winter Wildlife	L19, 25 and 97	no observations	n/a	Golder (1998a,b)
1997	Mobil Lease 36	L36	0.01	only in riparian willow shrubland	URSUS and Komex (1997)
1998	Suncor Firebag Project	L85	0.01	only in FONS and FTNN/FFNN	Suncor (2000)
1998 to 1999	Suncor Wildlife Monitoring	L86/17, 19, 25 and 97	0.13 in reclaimed 0.19 in riparian area beside disturbance	n/a	Golder (1999a)
2000	ATCO Pipeline	Muskeg River	mean: 0.4	most common in FONG	AXYS (2000b)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	no observations	n/a	Golder (2000d)
2000	Albian Sands Lease 13 West	L13	0.00 in upland 0.07 in riparian	n/a	Golder (2000c)

Table III-19 Mink Track Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (Tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
2000	Suncor Wildlife Monitoring	L86/17 and 97/25	0.0 in Lease 86/17 0.02 in Lease 25/97	only riparian corridors sampled	Golder (2000b)
2000	OPTI Long Lake Project	L27	0.02	tracks observed in wooded fen (FTNN) wetlands type	OPTI (2000)
1999 to 2001	Albian Sands Lease 13 West	L13 West	mean densities: 0.05 in January 1999/2000 0.00 in January 2000/2001 0.15 in February 2000/2001	surveys conducted in riparian and upland habitat no evidence of use of riparian areas as movement corridors, however, animal's ecology suggests a preference for riparian areas	Golder (2001a)
2001	Gulf Surmont In-situ Oil Sands Project	–	no overall tracks/km-track day provided	found in riparian communities (f1 andf2) and FONG	AXYS (2001a)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	no observations	n/a	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	0.02	observed in e1	Petro-Canada (2001)
2001	Shell Jackpine Mine – Phase 1	L13 East	no observations	n/a	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	one set of tracks observed	observed in e3	CNRL (2002)
2002	Suncor South Tailings Pond Project	L19 and L10	no observations	n/a	Golder (2003a)
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	n/a	8 tracks encountered, 6 of which occurred in k3 associated with lower order streams	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	no observations	n/a	Golder (2004a)
2004	MEG Energy Christina Lake Regional Project	Tp76-78, R4-6	no observations	n/a	present study

Table III-20 Snowshoe Hare Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Results (tracks/km-track day)	Habitat Preference	Reference
1975to 1976	Syncrude Lease 17	L6, L22, 17, 86 and 23	2.94	preferred aspen-willow/alder, mixedwood, forested black spruce and tall shrub; avoided aspen-balsam poplar, jack pine, treed black spruce, black spruce-willow, dwarf birch-tamarack, riparian and disturbed	Penner (1976)
1980	Canstar Project 80	L88 and 89	21.15	preferred mixedwood, black spruce-muskeg and riparian white spruce; avoided aspen, jack pine and open muskeg	Skinner and Westworth (1981)
1981 to 1982	Canstar Lease	L9 and 33	76.2	preferred aspen and balsam poplar; avoided mixedwood, white spruce, black spruce, willow, fen, willow wetlands and riparian aspen	Westworth and Brusnyk (1982)
1986	OSLO	–	no overall track count/km-track day provided	track densities were greatest in aspen-dominated, pine dominated mixed and spruce forests	Duncan et al. (1986)
1995	Solv-Ex	L5	14.69	most tracks in aspen-white spruce and white spruce	BOVAR-CONCORD Environmental (1995)
1995	Syncrude Aurora North	L12, 13 and 34	3.53 in January	preferred mixed coniferous and black spruce-tamarack; avoided cleared aspen, aspen and mixedwood forests, jack pine, open tamarack bog-birch, fen and willow wetlands, riparian balsam poplar and riparian shrub	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, Lease 23 and Steepbank Mine	L86/17, 23, 97, 25 and 19	4.14 in December 0.49 in February	preferred closed jack pine, closed mixedwood, closed mixed coniferous-black spruce dominant and open black spruce; avoided closed white spruce, closed deciduous, black spruce tamarack, open tamarack/fen, wetlands shrub complex, disturbed, shoreline and fen	Westworth, Brusnyk & Associates (1996a)
1997	Muskeg River Mine	L13	22.36	preferred closed jack pine, closed white spruce, closed balsam poplar, closed mixed conifer-black spruce dominant, closed mixedwood-white spruce dominant and closed black spruce bog; avoided wetlands shrub complex, open black spruce bog, riparian shrub dominant, open and closed aspen	Golder (1997a,b)
1997	Suncor Winter Wildlife	L29	0.98 in January 5.80 in February	January: preferred d2; avoided a1, d3, d1, h1, Shrub, BTNN and WONN February: preferred d2; avoided d1, d3, FTNN and BTNN	Golder (1998a,b)
1997	Suncor Winter Wildlife	L19, 25 and 97	12.41 in January 15.98 in February 3.53 in March	January: preferred upland avoided riparian February: preferred upland avoided riparian and escarpment March: preferred upland avoided riparian	Golder (1998a,b)
1997	Mobil Lease 36	L36	3.99	most in closed canopy black spruce, white spruce, black spruce-tamarack bog and white spruce-aspen mixedwood; avoided aspen stands	URSUS and Komex (1997)

Table III-20 Snowshoe Hare Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (tracks/km-track day)	Habitat Preference	Reference
1998	Suncor Firebag Project	L85	8.96	preferred b4 and BTNN/BFNN; avoided a1, b2 and FONS	Suncor (2000)
1998 to 1999	Suncor Wildlife Monitoring	L86/17, 19, 25 and 97	10.41 in reclaimed 23.29 in riparian area beside disturbance	n/a	Golder (1999a)
2000	ATCO Pipeline	Muskeg River	mean: 204.7	most common in h1	AXYS (2000b)
2000	Canadian Natural PAW Project	–	incidental observations	found in aspen, jack pine/aspen, shrubby fen, treed fen, aspen/white spruce, black spruce/jack pine	CNRL (2000)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	10.13	preferred d2, g1 and FTNN; avoided b1, d1, e1 and SONS	Golder (2000d)
2000	Suncor Wildlife Monitoring	L86/17 and 97/25	10.85 in Lease 86/17 17.78 in Lease 25/97	only riparian corridors sampled	Golder (2000b)
2000	OPTI Long Lake Project	L27	90.90	preferred d2, d3, SONS and STNN; avoided e1, FONS, h1 and shrub	OPTI (2000)
2001	Gulf Surmont In-situ Oil Sands Project	–	no overall track count/km-track day provided	found in all habitats except e1. Highest track counts were found in b3 and a1	AXYS (2001a)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	112.5	preferred b1, d3, e2, g1, STNN; avoided b3, d1, d2, FONS, MONG, MONS, WONN and disturbed	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	48.77	preferred b3, c1, f1, g1, SONS; avoided b2, d1, d2, BTNN, FONS, FTNN, MONG, STNN and cutlines	Petro–Canada (2001)
2001	Shell Jackpine Mine – Phase 1	L13 East	88.26	preferred b4, c1, FTNN, g1, h1, MONS and STNN	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	44.57	preferred b1, b3, d1, g1, h1, BTNN,FTNN, FONS, STNN, and seismic line; avoided b4, d2, e1, e3, FONG, MONG, cutblock and road	CNRL (2002)
2002	Suncor South Tailings Pond Project	L19 and L10	19.37	observed in d2, FTNN, e3, FONS, BTNN, h1, e2, and disturbed (cutblock); significant preference for d2 and e3; avoided e2, BTNN, FONG, FONS, cutline/disturbance	Golder (2003a)
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	23.2	highest track densities in a1,c1,i2,k1,h1,g1 and j1	Devon (2004)

Table III-20 Snowshoe Hare Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (tracks/km-track day)	Habitat Preference	Reference
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	0.67	observed in BTNN,d2 and g1	Golder (2004a)
2004	Suncor Monitoring Five Year Report	L18/67 and Steepbank / Millennium	12.87	surveys conducted in natural sites	Golder (2004b)
2004	MEG Energy Christina Lake Regional Project	Tp76-78, R4-6	13.3	Preference for a1, c1, d2, d3, g1; avoided b2, d1, FONS, FTNN, BTNN, MONS and WONN	present study

Table III-21 Red Squirrel Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
1970 to 1975	traplines	Fort McMurray	49.6 animals/ 100 km^2 trapped	n/a	Boyd (1977)
1975 to 1976	Syncrude Lease 17	L6, L22, 17, 86 and 23	2.33; 1.19 squirrels/ha based on a midden study	preferred mixedwood, white spruce, jack pine and forested black spruce; avoided aspen, black spruce-willow, tall shrub, dwarf birch-tamarack, riparian and disturbed	Penner (1976)
1980	Canstar Project 80	L88 and 89	2.08	preferred aspen, mixedwood, jack pine and riparian white spruce; avoided black spruce-muskeg, open muskeg and riparian shrub	Skinner and Westworth (1981)
1981 to 1982	Canstar Lease	L9 and 33	1.59 in February	preferred mixedwood avoided aspen, balsam poplar, willow, fen, willow wetlands and riparian aspen	Westworth and Brusnyk (1982)
1986	OSLO	OSLO Project Area	no overall track count/km-track day provided	track densities were greatest in pine, spruce and mixedwood forests and in bogs, no tracks were observed in aspen forest, shrubland and fens	Duncan et al. (1986)
1995	Solv-Ex	L5	6.89	most in white spruce	BOVAR-CONCORD Environmental (1995)
1995	Syncrude Aurora North	L12, 13 and 34	0.63 in January	preferred mixed coniferous and riparian white spruce; avoided cleared aspen, aspen forest, open tamarack-bog birch, fen and willow wetlands, riparian balsam poplar and shrub and cleared peatland	Westworth, Brusnyk & Associates (1996b)
1996	Suncor Mine, Lease 23 and Steepbank Mine	L86/17, 23, 97, 25 and 19	2.78 in December 0.42 in February	preferred closed jack pine and closed mixed coniferous-black spruce dominant; avoided black spruce-tamarack, open black spruce, open tamarack fen, wetlands shrub complex, disturbed, shoreline and fen	Westworth, Brusnyk & Associates (1996a)
1997	Muskeg River Mine	L13	5.65	preferred closed white spruce, closed mixedwood-white spruce dominant; avoided closed mixed wood, closed mixed coniferous-black spruce dominant, open and closed fen	Golder (1997a,b)
1997	Suncor Winter Wildlife	L29	0.35 January 0.24 in February	January: preferred d2; avoided a1, h1, Shrub, FTNN, BTNN and WONN February: no preferences	Golder (1998a,b)

Table III-21 Red Squirrel Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
1997	Suncor Winter Wildlife	L19, 25 and 97	0.62 in January 3.18 in February 9.86 in March	January: preferred riparian; avoided upland February and March: preferred escarpment; avoided upland	Golder (1998a,b)
1997	Mobil Lease 36	L36	2.62	most in white spruce-aspen mixedwood, jack pine, white spruce, black spruce-aspen and black spruce-tamarack	URSUS and Komex (1997)
1998	Suncor Firebag Project	L85	1.00	preferred b4, c1 and BTNN/BFNN; avoided b2, g1, FONS and FTNN/FFNN	Suncor (2000)
1998 to 1999	Suncor Wildlife Monitoring	L86/17, 19, 25 and 97	2.77 in reclaimed 15.64 in riparian area beside disturbance	n/a	Golder (1999a)
2000	ATCO Pipeline	Muskeg River	mean: 13.8	most common in d3, also common in h1	AXYS (2000b)
2000	Canadian Natural PAW Project	–	incidental observations	found in poor fen/bog, treed fen, black spruce/jack pine, aspen/white spruce and white spruce/black spruce	CNRL (2000)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	0.31	preferred BTNN; avoided d1, e1, g1, Shrub and SONS	Golder (2000d)
2000	Suncor Wildlife Monitoring	L86/17 and 97/25	0.23 in Lease 86/17 0.30 in Lease 25/97	only riparian corridors sampled	Golder (2000b)
2000	OPTI Long Lake Project	L27	1.25	preferred d3; avoided d1, FTNN and shrub	OPTI (2000)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	3.70	Preferred d2 and g1; avoided FONS and FTNN	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	2.50	preferred d2; avoided BTNN and FONS	Petro-Canada (2001)
2001	Shell Jackpine Mine – Phase 1	L13 East	0.47	observed in a1, b4, c1, d2, d3, FTNN, g1 and h1; observed incidentally in a1, b1, b3, c1, d1, d2 and FONS	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	2.31	Observed in b1, b3, d1, d2, d3, e1, e2, e3, h1, BTNN,FTNN, STNN, burn and cutblock; avoided d1, g1, BTNN, FTNN, FONS, STNN, SONS, burn and cutblock	CNRL (2002)

Table III-21 Red Squirrel Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Results (tracks/km-track day unless otherwise noted)	Habitat Preference	Reference
2002	Suncor South Tailings Pond Project	L19 and L10	3.57	observed in d2, e3, FTNN, e2 and BTNN; preference for e3; avoided BTNN and FTNN	Golder (2003a)
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	9.6	highest track densities in d3,e2 and h1	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	6 incidental observations during other surveys on the LSA	n/a	Golder (2004a)
2004	MEG Energy Christina Lake Regional Project	Tp76-78, R4-6	4.57	Preferred d2, d3; avoided FTNN, FONS, MONS, WONN	present study

Table III-22 Bat Survey Results within the Boreal Mixedwood Forests of Alberta

Year	Project	Area	Activity Results	Bat Captures	Habitat Use	Reference
1993 to 1994	MSc Research	Lac La Biche, AB	1933 passes (passes/hr n/a) *Myotis* spp[(a)], silver-haired, big brown and hoary bats	99 bats (bat /net-night n/a) little brown (80), northern long-eared (1), silver-haired (17) and hoary (1) bats	captured and detected primarily in old and mature aspen mixedwood forest	Crampton and Barclay (1998)
1999 to 2000	MSc Research	EMEND (near Peace River, AB)	2193 passes (1.6 passes/hr): little brown, northern long-eared and silver-haired bats	56 bats (0.31 /net-night): little brown (41), northern long-eared (13) and silver-haired (2) bats	captured in aspen dominant and white spruce dominant forest in cutlines, above puddles and ponds; detected in aspen dominat, white spruce dominant and mixedwood forests within open patches and closed canopies	Patriquin (2001)
2000	Gulf Surmont Supplemental Wildlife Surveys		161 passes (35 passes/hr): *Myotis* spp.[(a)] , hoary, big brown and silver-haired bats	30 bats (0.24 /net-hr): little brown (25), hoary (3) and silver-haired (2) bats;	n/a	AXYS (2001a)
2000	Bat Surveys of Central and Northwestern AB	Caribou River, AB	11.4 passes/hr[(b)] (total n/a): detected *Myotis* spp[(a)] and larger spp.[(c)]	0 bats	dry mixedwood subregion	Vonhof and Hobson (2001)
2000	Bat Surveys of Central and Northwestern AB	Rainbow Lake, AB	15 passes/hr[(b)] (total n/a): detected *Myotis* spp.[(a)] and larger spp.[(c)]	2 bats over 4 nights: northern long-eared bats	wet mixedwood subregion	Vonhof and Hobson (2001)
2000	Bat Surveys of Central and Northwestern AB	Sousa Creek, AB	39 passes/hr[(b)] (total n/a): *Myotis* spp.[(a)] and larger spp.[(c)]	11 bats over 6 nights: little brown (2), northern long-eared (6) and big brown (3) bats	wet mixedwood subregion	Vonhof and Hobson (2001)
2000	Bat Surveys of Central and Northwestern AB	Wabaska River, AB	19.8 passes/hr[(b)] (total n/a): *Myotis* spp.[(a)] and larger spp.[(c)]	10 bats over 7 nights: little brown (7), northern long-eared (2) and big brown (3) bats	central mixedwood subregion	Vonhof and Hobson (2001)

Table III-22 Bat Survey Results within the Boreal Mixedwood Forests of Alberta (continued)

Year	Project	Area	Activity Results	Bat Captures	Habitat Use	Reference
2001	Bat Surveys in Northeastern AB	northeastern AB	approximately 270 passes (ca. 8.78 passes/hr): detected *Myotis* spp.[(a)], larger spp.[(c)] and hoary bats	36 bats (0.23 bat/net-hr): little brown (31), northern long-eared (3) and silver-haired (2) bats	little brown bats captured primarily above water, northern long-eared bats captured in cutlines and silver-haired bats captured above water; no habitat for echolocation calls provided	Schowalter (2001) Hubbs and Schowalter (2003)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	380 passes (15.3 passes/hr): *Myotis* spp.[(a)], larger spp.[(c)] and little brown bats	4 bats (0.06 bat/net-hr): little brown bats	captured in e2 cutline; detected primarily in FONG and BTNN	Rio Alto (2002)
2001	Petro-Canada Wildlife Surveys	L58 and L81	45 passes (2.2 passes/hr): *Myotis* spp.[(a)] and large spp.[(c)]	1 bat (0.01 bat/net-hr): silver-haired	captured above water in MONG; detected primarily in d2 as well as in MONS, MONG and BTNN.	Petro-Canada (2001)
2001	Shell Jackpine Mine – Phase 1 Wildlife Surveys	L13 East	101 passes (3.9 passes/hr): *Myotis* spp.[(a)], larger spp.[(c)] and little brown bats	6 bats (0.13 bat/net-hr): northern long-eared (5) and little brown (1) bats	captured in b1, d1 and d2 cutlines; detected primarily in e2-cutline and SONS, as well as d1 forest, b1, d1 and d2 cutlines, FONS and STNN.	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	323 passes (15.3 passes/hr); *Myotis* spp.[(a)], larger spp.[(b)], little brown and northern long-eared bats	4 bats (0.08 bat/net-hr): little brown (1), northern long-eared (2) and silver-haired (1) bats	captured in a1-cutline and MONS; detected primarily in MONS, as well as in a1 and e1 forest and cutlines	CNRL (2002)
2002	Suncor South Tailings Pond Project	L19 and L10	28 passes and 2 feeding buzzes (1.88 passes/hr); *Myotis* spp.[(a)], larger spp.[(b)], little brown bats	7 captures; red (1), northern long-eared (4), little brown (2) bats	captured in d2 and h1 ecosites along cutlines; red bat captured in h1 disturbance and first red bat captured in northern Alberta	Golder (2003a)
2004	MEG Energy Christina Lake Regional Project	Tp76-78, R4-6	2.9 passes/hr, 0.5 buzzes per hour; *Myotis* spp., big brown/silver haired, red and hoary bats	1 capture; little brown bat	Captured in FTNN wetlands type along cutline; passes and feeding buzzes produced within c1, d2, FTNN and WONN	present study

(a) *Myotis* species were difficult to differentiate by echolocation calls, therefore they were sometimes grouped as *Myotis* spp.

(b) Numbers were extrapolated from figures and represent approximate mean values.

(c) Larger bat species could not be differentiated on basis of echolocation calls, therefore they were grouped as larger spp. This group may include silver-haired and big brown bats.

n/a = Not applicable.

Table III-23 Small Mammal Survey Results within the Oil Sands Region

Small Mammal Species	Year	Project	Area/Lease	Abundance (# captures/100 trap nights unless otherwise noted)	Habitat Association	Reference
masked shrew	1979	Syncrude	L17	abundant	n/a	as reported in Westworth (1979)
	1979	Syncrude	Oil Sands Region	present	n/a	Michielson and Radvanyi (1979)
	1997	Muskeg River Mine Project	L13	4 to 17	margins of moist fields, bogs, marshes and moist or dry woods, including mixedwood and upland coniferous	Golder (1997a)
	1980	AOSERP	Oil Sands Region	common	aspen and willow habitats	as reported in Green (1980)
	1995	Alberta Environment Centre/Canadian Forest Service. Alberta Land and Forest Service	Alberta Pacific FMA/Lac La Biche	n/a	aspen mixedwood	Stelfox (1995)
	2000	Gulf Surmont In-Situ Oil Sands Project	—	3	b2,d1,d3	AXYS (2001a)
dusky shrew	1995	Alberta Environment Centre/Canadian Forest Service. Alberta Land and Forest Service	Alberta Pacific FMA/Lac La Biche	n/a	aspen mixedwood	Stelfox (1995)
	2000	Gulf Surmont In-Situ Oil Sands Project	—	2	e3 and h1	AXYS (2001a)
water shrew	1979	Syncrude	L17	common	wet margins of lakes, streams, and muskegs	as reported in Westworth (1979)
arctic shrew	1979	Syncrude	L17	scarce	n/a	as reported in Westworth (1979)
	1997	Muskeg River Mine Project	L13	n/a	bogs, marshes and grassy clearings	Golder (1997a)

Table III-23 Small Mammal Survey Results within the Oil Sands Region (continued)

Small Mammal Species	Year	Project	Area/Lease	Abundance (# captures/100 trap nights unless otherwise noted)	Habitat Association	Reference
arctic shrew (cont)	1995	Alberta Environment Centre/Canadian Forest Service, Alberta Land and Forest Service	Alberta Pacific FMA/ Lac La Biche	n/a	aspen mixedwood	Stelfox (1995)
	2000	Gulf Surmont In-Situ Oil Sands Project	—	1	FONS	AXYS (2001a)
pygmy shrew	1979	Syncrude	L17	common	n/a	as reported in Westworth (1979)
	1980	AEOSERP	Oil Sands Region	common	aspen and willow habitats	as reported in Green (1980)
	1997	Shell Muskeg River Mine Project	L13	uncommon	wooded areas (mixedwood), bogs, wet meadows and clearings within forests	Golder (1997a)
	2000	Gulf Surmont In-Situ Oil Sands Project	—	4	d1, FONS and FONG	AXYS (2001a)
least chipmunk	1997	Muskeg River Mine Project	L13	n/a	clearings, forest edges and disturbed areas	Golder (1997a)
	1993	University of Alberta	Alberta Pacific FMA/ Lac La Biche	n/a	aspen mixedwood	Moses and Boutin (2001)
red-backed vole	1979	Syncrude	L17	9.3 to 19.1	n/a	as reported in Westworth (1979)
	1980	AOSERP	Oil Sands Region	abundant	forest and shrub-dominant habitats, balsam poplar, aspen and jack pine communities	as reported in Green (1980)
	1984	Syncrude Mildred Lake	L17 and 22	n/a	prefer balsam poplar, mixedwood and tamarack forest	Syncrude (1984)
	1993	University of Alberta	Alberta Pacific FMA/ Lac La Biche	n/a	aspen mixedwood	Moses and Boutin (2001)
	1997	Muskeg River Mine Project	L13	n/a	disturbed areas, mixedwood, riparian, upland coniferous forests and wetlands	Golder (1997a)

Table III-23 Small Mammal Survey Results within the Oil Sands Region (continued)

Small Mammal Species	Year	Project	Area/Lease	Abundance (# captures/100 trap nights unless otherwise noted)	Habitat Association	Reference
Red-backed vole (cont)	2000	OPTI Long Lake Project	L27	n/a	deciduous, upland coniferous, mixedwood forests, riparian areas and wetlands	OPTI (2000)
	2000	Gulf Surmont In-Situ Oil Sands Project	—	38	B2,b3,d1,d2,d3, e1, e3, h1, BTNN, FONS and FONG	AXYS (2001a)
	2002	Suncor Reclamation Monitoring	86/17	1	e2	Golder (2003c)
	2004	Suncor Monitoring Five Year Report	L18/67 and Steepbank / Millennium	1.3 / trap night	n/a	Golder (2004b)
heather vole	1993	University of Alberta	Alberta Pacific FMA/ Lac La Biche	n/a	aspen mixedwood	Moses and Boutin (2001)
Meadow vole	1979	Syncrude	L17	common-abundant	n/a	as reported in Westworth (1979)
	1979	AOSERP	Oil Sands Region	n/a	forest and shrub-dominant habitats. Moist habitats with dense grass or sedge cover	Green (1979)
	1984	Syncrude Mildred Lake	L17 and 22	n/a	prefers successional areas, willow shrub and tamerack forests	Syncrude (1984)
	1993	University of Alberta	Alberta Pacific FMA/ Lac La Biche	n/a	aspen mixedwood	Moses and Boutin (2001)
	1997	Alsands Region	L13	n/a	n/a	Fort McKay Environment Services Ltd (1997)
	1997	Muskeg River Mine Project	L13	n/a	clearings, wet meadows with grass cover, disturbed areas, mixedwood, riparian, upland conifer forest and wetlands	Golder (1997a)
	2000	OPTI Long Lake Project	L27	n/a	riparian	OPTI (2000)
	2000	Gulf Surmont In-Situ Oil Sands Project	—	5	b2,d1, h1 and FONS.	AXYS (2001a)

Table III-23 Small Mammal Survey Results within the Oil Sands Region (continued)

Small Mammal Species	Year	Project	Area/Lease	Abundance (# captures/100 trap nights unless otherwise noted)	Habitat Association	Reference
meadow vole (continued)	2002	Suncor Reclamation Monitoring	86/17	7	shrubby grassland	Golder (2003c)
	2004	Suncor Monitoring Five Year Report	L18/67 and Steepbank / Millennium	2.5 / trap night	n/a	Golder (2004b)
deer mouse	1979	Syncrude	L17	abundant	n/a	as reported in Westworth (1979)
	1979	Syncrude	Oil Sands Region	abundant	n/a	Michielson and Radvanyi (1979)
	1979	AOSERP	not available	n/a	grasslands and early successional habitats	Green (1979)
	1980	AEOSERP	not available	n/a	forest and shrub-dominant habitats and recently disturbed areas (e.g. cutblocks)	Green (1980)
	1984	Syncrude Mildred Lake	L17 and 22	n/a	most abundant in aspen, balsam poplar or mixedwood forests	Syncrude (1984)
	1993	University of Alberta	Alberta Pacific FMA/ Lac La Biche	n/a	aspen mixedwood	Moses and Boutin (2001)
	2000	OPTI Long Lake Project	L27	n/a	deciduous, coniferous and mixedwood forests and riparian	OPTI (2000)
	2000	Gulf Surmont In-Situ Oil Sands Project	—	16	a1,b2, b3, d1 and d2	AXYS (2001a)
	1993	University of Alberta	Alberta Pacific FMA/ Lac La Biche	n/a	aspen mixedwood	Moses and Boutin (2001)
	2002	Suncor Reclamation Monitoring	86/17	38	e1, e2, deciduous-willow, deciduous misc., mixedwood grassland, mixedwood willow, shrubby grassland	Golder (2003c)
	2004	Suncor Monitoring Five Year Report	L18/67 and Steepbank / Millennium	30 / trap night	n/a	Golder (2004b)

Table III-23 Small Mammal Survey Results within the Oil Sands Region (continued)

Small Mammal Species	Year	Project	Area/Lease	Abundance (# captures/100 trap nights unless otherwise noted)	Habitat Association	Reference
meadow jumping mouse	1997	Muskeg River Mine Project	L13	n/a	grasslands, riparian meadows, clearings, forest edges	Golder (1997a)
	2000	OPTI Long Lake Project	L27	n/a	riparian	OPTI (2000)
northern bog lemming	1997	Muskeg River Mine Project	L13	n/a	wet forested areas, bogs, riparian and wetlands	Golder (1997a)
	2000	OPTI Long Lake Project	L27	n/a	wetlands	OPTI (2000)

n/a = Not applicable.

Table III-24 Owl Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Species (Abundance)	Habitat	Reference
1997	Shell Muskeg River Mine	L13	boreal owl (7)	mixedwood, trembling aspen	Golder (1997b)
			great horned owl (1)	black spruce stand	
			Incidentals: great gray owl (4)	unknown	
1998	Steepbank River Valley, Shipyard Lake, & L25 and 29 Uplands	L25 and L29	great gray owl (1)	STNN	Golder (1998b)
			Incidentals: great gray owl (1)	a1	
			northern hawk owl (1)	BTNN	
1998	Suncor Project Millennium	L97/25	great gray owl (1)	STNN	Golder (1998a)
			Incidentals: great gray owl (2)	riparian area, a1	
2000	Firebag Project	L85	great horned owl (7)	FONS, FTNN, d2, g1, h1	Golder (2000e)
			great gray owl (1)	FONS	
			boreal owl (5)	FTNN, g1	
			barred owl (4)	FTNN, d2, g1	
			Incidentals (1998):		
			great gray owl (n/a)	e1	
			great horned owl (n/a)	f2, BTNN	
			northern hawk owl (n/a)	FTNN, c1	
			unknown owl (n/a)	FTNN, BTNN, e1	
2000	Canadian Natural PAW Project	CLAWR	great-horned owl (10)	shrubby fen, poplar/aspen, aspen/white spruce, white spruce, poor fen/bog, treed fen	CNRL (2000)
			northern-hawk owl (2)	aspen/white spruce, poplar/aspen	
			boreal owls (3)	aspen/white spruce, white spruce/jack pine	
			short-eared owl (1)	shrubby fen	
			northern saw-whet owl (1)	poplar/aspen	
			barred owl (1)	white spruce	
2000	OPTI Long Lake Project	L27	great horned owl (16)	b3, d1, d2, g1, BTNN, SONS	OPTI (2000)
			great gray owl (4)	b2, b3, BTNN	
			boreal owl (10)	g1, BTNN	
			barred owl (15)	b2, b3, d1, d2	

Table III-24 Owl Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Species (Abundance)	Habitat	Reference
2001	Gulf-Surmont In-Situ Oil Sands Project	L42, 71, 72 and 90	Barred owl (14)	b1, b2, d1, d2, h1, i1, j1	AXYS (2001a)
			boreal owl (1)	i1	
			great horned owl (25)	b1, b2, d1, d2, e1, i1, j1	
			long-eared owl (1)	k3	
			Incidentals:		
			barred owl (27)	a1, b1, b2, c1, d1, e1, h1, i1, j1	
			boreal owl (6)	d2, i1, j1, k1	
			great gray owl (7)	d1, e1, i1, k2, k3	
			great horned owl (34)	b1, b2, d1, d2, e1, i1, j1	
			long-eared owl (2)	f1, k3	
			northern saw-whet owl (2)	c1, d1	
2001	Albian Sands Muskeg River Mine Project Wildlife Assessment	L13	great horned owl (1)	b4	Westworth Associates (2001)
			Incidentals: great horned owl (5)	shrubland, d1, unknown	
			great gray owl (1)	j2	
2001	PanCanadian Christina Lake Thermal Project Wildlife Monitoring	L207	great horned owl (5)	f3, FTNN	Golder (2001b)
			boreal owl (3)	e3, c1/g1, FTNN	
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	great horned owl (10)	b1, d2, g1, FTNN	Rio Alto (2002)
			boreal owl (2)	b1, d2	
2001	Petro-Canada Meadow Creek Project	L58 and L81	great horned owl (4)	b1, g1, SONS	Petro-Canada (2001)
			great gray owl (1)	d2	
			boreal owl (2)	SONS, FONG	
			barred owl (5)	b3, c1, d2, g1, FTNN	
2001	Shell Jackpine Mine – Phase 1	L13 East	great horned owl (5)	d2, BTNN, FTNN	Golder (2002a)
			great gray owl (1)	BTNN	
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	great horned owl (24)	d2, d3, BTNN, FTNN, cutblock	CNRL (2002)
			boreal owl (14)	a1, d2, BTNN, FTNN	
			barred owl (8)	b1, d2, e3	
2002	Suncor South Tailings Pond Project	L19 and L10	boreal owl (11)	d1, d2, h1, FONS, FTNN, STNN	Golder (2003a)
			barred owl (2)	d3, SONS	
			great gray owl (1)	BTNN	
			great horned owl (1)	b3	
			northern saw-whet owl(1)	STNN	

Table III-24 Owl Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Species (Abundance)	Habitat	Reference
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	boreal owl (19) northern saw-whet owl(4) great horned owl (4) barred owl (1) *incidentals* great gray owl(1)	not reported	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	boreal owl (4) northern saw-whet owl (8) *incidentals* boreal owl (3) great gray owl (2) great-horned owl (3) northern saw-whet owl (4)	BTNN,b2 and g1 BTNN,FTNN,d2,e2 and g1	Golder (2004a)
2004	Suncor Monitoring Five Year Report	L18/67 and Steepbank / Millennium	boreal owl (13) great gray owl (3) barred owl (1)	aspen-white spruce; black spruce; white spruce – aspen; black spruce- birch and black spruce-aspen black spruce and black spruce - tamarack cutblock area – aspen-white spruce	Golder (2004b)
2004	MEG Energy Christina Lake Regional Project	Tp76-78, R4-6	boreal owl (9) barred owl (5) great gray owl (8) great horned owl (3)	c1, burn, b1, d1, FTNN, FONS, disturbed a1, burn, BTNN, d1, STNN BTNN, FONS, a1, c1, burn c1, d2, burn	present study

Table III-25 Raptor Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Species (Abundance)	Habitat	Reference
1996	Suncor Steepbank Mine	L 19/25	broad-winged hawk (1) northern goshawk (1) northern harrier (1) bald eagle (1) bald eagle nest (1) unidentified accipiter (1) *Incidentals:* red-tailed hawk (1) northern harrier (1) sharp-shinned hawk (2) American kestral (1) bald eagle (3) sharp-shinned hawk (2) broad-winged hawk (1) northern harrier (1)	riparian deciduous forest over Athabasca river near Athabasca river east bank of Athabasca R. aspen grove near Beaver River open sb-Labrador tea closed shrub complex hab. adjacent to aspen cutblock adjacent to aspen cutblock near Athabasca River east of wetlands 2 east side of Ruth Lake north end of reservoir	Westworth, Brusnyk & Associates (1996c)
1997	Shell Muskeg River Mine	L13	*Incidentals:* red-tailed hawk (undisclosed number)	unknown	Golder (1997a)
1998	Suncor Project Millennium	L97/25	bald eagle (1) red-tailed hawk (1) *Incidentals:* red-tailed hawk (undisclosed number)	unknown lake area unknown	Golder (1998a)
1998	Mobil Lease 36	L36	*Incidentals:* bald eagle (2)	unknown	Golder (1999c)
2000	Firebag Project	L85	*Incidentals (1998);* northern harrier (n/a) rough-legged hawk (n/a) *Incidentals (1999):* northern harrier (2)	 FONS BTNN BTNN; FONS	Suncor (2000)
2000	Canadian Natural PAW Project	CLAWR	*Incidentals*: goshawks red-tailed hawk northern harrier ospreys	 marsh, treed fens jackpine/aspen, shrubby swamp shrubby swamp, deep water near a pond	CNRL (2000)

Table III-25 Raptor Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Species (Abundance)	Habitat	Reference
2000	OPTI Long Lake Project	L27	No observations during ground survey. Incidental observations include: broad-winged hawk (2) Cooper's hawk (1) northern goshawk (9) northern harrier (6) osprey (2) red-tailed hawk (2) sharp-shinned hawk (1)	 mixedwood mixedwood mixedwood, ponds, Gregoire R., Sb bog, willow, deciduous fen, mixedwood, ponds Canoe Lake, Kiskatinaw Lake Gregoire R., fen Dogwood (e1)	OPTI (2000)
2001	Gulf-Surmont In-Situ Oil Sands Project	L42, 71, 72 and 90	northern goshawk (10) Incidentals: Cooper's hawk (1) Sharp-shinned hawk (2)	d2, e2, h1, e1, d1 d1 d1, k2	AXYS (2001a)
2001	Albian Sands Muskeg River Mine Project Wildlife Assessment	L13	northern harrier (3) sharp-shinned hawk (9) northern goshawk (3) broad-winged hawk (11) red-tailed hawk (15) American kestral (9) merlin (5)	j2 e2, d1, Lt-Sb d1 d1, d2, f1 b4, d1, b1 k2 b3	Westworth Associates Environmental Ltd. (2001)
2001	PanCanadian Christina Lake Thermal Project Wildlife Monitoring	L207	broad-winged hawk (1) unknown species (1)	FTNN f3	Golder (2001b)
2001	Firebag Project Supplemental	L85	northern harrier (3)	b3, j1, b4	Golder (2000e)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	red-tailed hawk (3) northern harrier (1) sharp-shinned hawk (1) Swainson's hawk (2) Unknown (1)	b1, FTNN FTNN FTNN c1 d1	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	northern goshawk (2) northern harrier (1) unknown (3)	g1, BTNN c1 BTNN, FTNN	Petro-Canada (2001)

Table III-25 Raptor Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Species (Abundance)	Habitat	Reference
2001	Shell Jackpine Mine – Phase 1	L13 East	northern goshawk (1) American kestrel (1)	STNN FONS	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	bald eagle (2) osprey (2)	MONG MONG	CNRL (2002)
2002	Suncor South Tailings Pond Project	L19 and L10	American kestral (1) broad-winged hawk (1) northern harrier (1)	clearcut clearcut STNN	Golder (2003a)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	Cooper's hawk (1) *incidentals* northern harrier(1) red-tailed hawk(1) sharp-shinned hawk(1)	d2	Golder (2004a)
2004	MEG Energy Christina Lake Regional Project	Tp76-78, R4-6	sharp-shinned hawk (1) northern goshawk (1) merlin (1) *Incidentals* bald eagle (5) northern harrier (2) osprey (2) American kestral (1)	BTNN d2 FTNN	Present study

Table III-26 Grouse Survey Results within the Oil Sands Region

Year	Project	Area	Results (Tracks/km-track day)	Habitat Preference	Reference
1995	Solv-Ex	L5	3.04	most in aspen and aspen-white spruce[(a)]	BOVAR-CONCORD Environmental (1995)
1997	Muskeg River Mine	L13	1.71	preferred wetlands shrub complex; avoided closed mixedwood, closed mixed coniferous and riparian shrub dominant	Golder (1997a,b)
1997	Suncor Winter Wildlife	L29	0.36 January 0.99 in February	January: preferred FTNN; avoided d1, d3, h1, BTNN, Shrub and WONN February: preferred FTNN; avoided a1, d3, d2, d1 and BTNN	Golder (1998a,b)
1997	Suncor Winter Wildlife	L19, 25 and 97	0.19 in January 0.30 in February 0.05 in March	did not show a landscape preference	Golder (1998a,b)
1997	Mobil Lease 36	L36	0.36	most in white spruce-aspen and aspen-white spruce mixedwood forests[(a)]	URSUS and Komex (1997)
1998	Suncor Firebag Project	L85	10.60	preferred FONS and FTNN/FFNN; avoided a1, b1, b2, b4, c1, d1, d2, d3 and g1	Suncor (2000)
1998 - 1999	Suncor Wildlife Monitoring	L86/17, 19, 25 and 97	1.76 in reclaimed 2.06 in riparian area beside disturbance	not determined	Golder (1999a)
2000	ATCO Pipeline	Muskeg River	mean: 3.1	most common in d3, also common in FTNN	AXYS (2000b)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	0.07	preferred STNN and SONS; avoided a1, b1, d1, d2, d3, e1, e2, g1, Shrub and BTNN	Golder (2000d)
2000	Suncor Wildlife Monitoring	L86/17 and 97/25	4.55 in Lease 86/17 0.63 in Lease 25/97	only riparian corridors sampled	Golder (2000b)
2000	OPTI Long Lake Project	L27	0.14	most tracks observed in the d2 and h1 ecosite phase/wetlands types	OPTI (2000)
2001	Rio Alto Kirby Project	Kirby Lease	0.17	tracks observed in d2 and FTNN	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	0.34	most tracks observed in the d2 and b1 ecosite phase/wetlands types	Petro-Canada (2001)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	0.33 (upland game birds)	Observed mostly in d2, followed by d1, b3, d3, e3, STNN and burn	CNRL (2002)
2001	Jackpine Mine – Phase 1	L13 East	0.19 (upland game birds)	observed in b3, d2, d3	Golder (2002a)
2002	Suncor South Tailings Pond	L19 and L10	0.38 (upland game birds)	observed in d2, FONS, cutblock	Golder (2003a)

Table III-26 Grouse Survey Results within the Oil Sands Region (continued)

Year	Project	Area	Results (Tracks/km-track day)	Habitat Preference	Reference
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	1 ruffed grouse and 4 spruce groused observed incidentally	n/a	Golder (2004a)
2004	MEG Energy	Tp76-78, R4-6	0.60	observed in a1, b2, d1, d2, g1, FONS, FTNN	present study

(a) Not statistically significant.
n/a = Not applicable.

Table III-27 Breeding Bird Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Richness [range]	Diversity [range]	Listed Species [Observed Only]	Reference
1997	Shell Muskeg River Mine	L13	6.30 – 16.0 [(a)]	1.50 – 2.50	blackburnian warbler Cape May warbler	Golder (1997a)
1998	Suncor Project Millennium	L97/25	2.17 – 4.40	0.67 – 1.36	bay-breasted, blackburnian, black-throated green, Canada and Cape May warblers western tanager	Suncor (1998)
1998	Firebag Project	L85	9.1 – 9.3 ***	1.5 – 1.8 ***	Blackburnian, Canada and Cape May warblers	Suncor (2000)
2000	OPTI Long Lake Project	L27	1.56 – 3.13	0.35 – 0.97	bay-breasted warbler Cape May warbler western tanager	OPTI (2000)
2000	Canadian Natural PAW Project	CLAWR	1.60 – 2.80	0.30 – 0.90	bay-breasted warbler Cape May warbler	CNRL (2000)
2000	TrueNorth Fort Hills Oil Sands Project	L5 and 52	n/a	n/a	Cape May warbler bay-breasted warbler	AXYS (2001b)
2001	Gulf Surmont In-situ Oil Sands Project	L42, 71, 72 and 90	47 total richness	1.00 – 17.0	bay-breasted, black-throated green, Canada and Cape May warblers western tanager	AXYS (2001a)
2001	Firebag Project Supplemental	L85	1.00 – 4.50	0.90 – 3.05	none observed	Golder (2000e)
2001	Canadian Natural PAW Project Supplemental	CLAWR	2.70 – 4.60	1.30 – 3.30	bay-breasted, black-throated green, Canada and Cape May warblers	CNRL (2000)
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	1.00 – 5.00	0.00 – 3.60	western tanager	Rio Alto (2002)
2001	Petro-Canada Meadow Creek Project	L58 and L81	1.00 – 4.00	0.00 – 2.51	Cape May warbler western tanager	Petro-Canada (2001)
2001	Shell Jackpine Mine – Phase 1 Project	L13 East	1.00 – 7.00	0.00 – 6.15	bay-breasted, Canada, and Cape May warblers western tanager	Golder (2002a)
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	2.17 – 6.33	0.75 – 5.12	bay-breasted, black-throated green, Canada and Cape May warblers black-backed woodpecker pileated woodpecker western tanager	CNRL (2002)

Table III-27 Breeding Bird Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Richness [range]	Diversity [range]	Listed Species [Observed Only]	Reference
2002	Suncor 86/17 Wildlife Monitoring	86/17	6.33 – 7.57	5.72 – 7.42	black-throated green warbler horned grebe great blue heron sandhill crane western tanager	Golder (2003c)
2002	Suncor South Tailings Pond	***	2.14 – 2.72	0.89 – 1.41	bay-breasted warbler pileated woodpecker Cape May warbler western tanager	Golder (2003a)
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	48 total richness	1.00 – 3.80	black tern pileated woodpecker Cape May warbler black-throated green warbler bay-breasted warbler Canada warbler western tanager	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	39 total richness	2.8-5.5 (mean diversities)	pileated wood-pecker short-billed dowitcher Cape May warbler	Golder (2004a)
2004	Suncor Monitoring Five Year Report	L18/67 and Steepbank / Millennium	5.42 – 6.58 (2002) 4.14 – 5.08 (2003)	4.13 – 5.55 (2002) 2.89 – 3.95 (2003)	horned grebe great blue heron sandhill crane common nighthawk pileated woodpecker Canada warbler western tanager	Golder (2004b)
2004	MEG Energy Christina Lake Regional Project	Tp76-78, R4-6	1.84 – 1.88 (mean richness)	0.65 - 0.93 (mean diversities)		present study

(a) - Methods used were different than from the present study.

Table III-28 Amphibian Survey Results within the Oil Sands Region

Year	Project	Area/Lease	Species	Habitat	Reference
1995	Suncor Steepbank Mine	L 19/25	woodfrog (7)	unknown	Westworth, Brusnyk & Associates (1996d)
			boreal chorus frog (364+)	most within a sedge wetlands type with aspen/poplar	
1996	Shipyard Lake	L25	striped chorus frog (n/a)	unknown	Golder (1996)
			wood frog (n/a)	unknown	
1998	PanCanadian Christina Lake Thermal Project Supplementals	L207	boreal chorus frog (29)	e2, FTNN, FONS, WONS	Golder (2001b)
			boreal toad (17)	e2, FTNN, FONS	
			wood frog (2)	e2	
2000	Firebag Project	L85	*Incidentals (1998):* boreal chorus frog (n/a)	d1, d2, FONS, FTNN, h1	Suncor (2000)
			wood frog (n/a)	d2, FONS, FTNN	
2000	Canadian Natural PAW Project	CLAWR	boreal chorus frog (116.5)	MONG, SONS, FONG, FTNN, clearing	CNRL (2000)
			wood frog (40.34)	MONG, SONS, FONG, FTNN, clearing, FONS	
			Canadian toad (6)	MONG, FONG	
			western (boreal) toad (0.5)	MONG	
2000	PanCanadian Christina Lake Thermal Project	L207	boreal chorus frog (34)	d2, FONS, FTNN, MONG, SONS	Golder (2000f)
			boreal toad (16)	a1, f1, FTNN, MONG, SONS	
			wood frog (19)	a1, e2, e3, FONS, FTNN, MONG, SONS	
2000	OPTI Long Lake Project	L27	boreal frog (25)	b2, b3, d1, d2, d3, e3, g1, BTNN, FONS, FTNN, MONS, STNN	OPTI (2000)
			wood frog (16)	b3, d2, e3, BTNN, FONS, FTNN, MONS, STNN	
2001	PanCanadian Christina Lake Thermal Project Supplementals	L207	boreal chorus frog (26)	f2, f3, g1, BTNN, FTNN, FONS, FONG, MONG, SONS, clearcut	Golder (2001b)
			wood frog (22)	f2, f3, g1, BTNN, FTNN, FONS, FONG, MONG, SONS, clearcut	
			boreal toad (19)	f3, g1, BTNN, FTNN, FONS, FONG, MONG, clearcut	
2001	Firebag Project Supplemental	L85	boreal chorus frog (18)	ephemeral pond, permanent creek	Golder (2000e)
			wood frog (7)	ephemeral pond	

Table III-28 Amphibian Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Species	Habitat	Reference
2001	Rio Alto Kirby Project	Kirby Oil Sands Lease	boreal chorus frog (154)	b1, b4, c1, d1, d2, g1, disturbed, BTNN, FONS, FTNN, MONG, MONS, SONS, STNN, WONN	Rio Alto (2002)
			wood frog (149)	b4, c1, d1, d2, g1, disturbed, BTNN, FONS, FTNN, MONG, MONS, SONS, STNN, WONN	
			boreal toad (81)	c1, d1, d2, g1, disturbed, BTNN, FONS, FTNN, MONG, MONS, SONS, STNN, WONN	
2001	Petro-Canada Meadow Creek Project	L58 and L81	boreal chorus frog (41)	b3, c1, d2, BTNN, FONG, FONS, FTNN, MONG, MONS, shrubland, SONS, STNN	Petro-Canada (2001)
			wood frog (82)	b1, b3, c1, d2, g1, BTNN, FONG, FONS, FTNN, MONG, MONS, shrubland, SONS, STNN	
2001	Shell Jackpine Mine – Phase 1	L13 East	boreal chorus frog (28)	b2, d2, FTNN, FONG, FONS,MONS, MONS/SONS, MONS/STNN, STNN, SONS, WONN	Golder (2002a)
			wooded frog (28)	b2, d2, FTNN, FONG, FONS,MONS, MONS/SONS, MONS/STNN, STNN, SONS, WONN	
2001	Canadian Natural Horizon Project	L6, 7, 10, 18, 25	boreal chorus frog (56)	a1, b3, d1, d2, e1, e2, h1, BTNN, FONS, FTNN, MONG, MONS, SONS, STNN, cutblock, landfill	CNRL (2002)
			wood frog (49)	b3, e1, e2, BTNN, FONS, FTNN, MONG, MONS, SONS, STNN, cutblock	
			Canadian toad (12)	a1, d2, BTNN, FTNN, MONS, SONS, STNN, landfill	
2002	Suncor Reclamation Monitoring	86/17	Canadian toad (24) wood frog (17) boreal chorus frog (236)	Reclamation vegetation classes mixedwood willow and mixedwood grassland. WOFR and BCFR also observed in deciduous willow	Golder (2003c)
2002	Suncor South Tailings Pond	L19 and L10	wood frog (15) boreal chorus frog (25)	d2, d3, FTNN, SONS, STNN	Golder (2003a)

Table III-28 Amphibian Survey Results within the Oil Sands Region (continued)

Year	Project	Area/Lease	Species	Habitat	Reference
2002	Devon-Jackfish Project	Tp 75,76-R 6 W4	boreal chorus frog (many) wood frog (many) western toad (many)	not reported	Devon (2004)
2003	EnCana-Christina Lake Thermal Project	Tp76,R5,6 W4	boreal chorus frog (194) wood frog (41) boreal toad (119)	most observations in FTNN and FONS	Golder (2004a)
2004	Suncor Monitoring Five Year Report	L18/67 and Steepbank / Millennium	wood frog (53) boreal chorus frog (636) Canadian toad (83)	reclaimed sites	Golder (2004b)
2004	MEG Energy Christina Lake Regional Project	Tp76-78, R4-6	western (boreal) toad (28) wood frog (39) boreal chorus frog (35) Canadian toad incidental	most observations within standing water along cutlines, followed by FTNN; also recorded in a1, b1, b3, BTNN, MONG, MONS, WONN	present study

APPENDIX IV

WINTER TRACK COUNT RESULTS AND CHI-SQUARE RESULTS

Table IV-1 Number of Tracks/Km-Track Day Observed for Each Wildlife Species by Ecosite Phase/Wetlands Type

Ecosite Phase	Metres	Km-Track Days	Total Tracks	CARI	COYO	DESP	FIMA	WOLF	GROU	LYNX	MICE	MOOS	REFO	RESQ	SNHA	UNKN	WESP
a1	423	1.32	127	1.52	3.04	0.76	0.00	0.00	3.80	0.00	0.00	0.00	0.00	4.56	82.10	0.00	0.76
b1	87	0.15	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.60	13.20	0.00	0.00
b2	321	0.61	17	0.00	0.00	0.00	0.00	0.00	3.30	0.00	3.30	0.00	0.00	18.17	1.65	0.00	1.65
b3	54	0.16	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	61.73	0.00	0.00
b4	183	0.33	24	0.00	3.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.54	42.94	0.00	3.07
BTNN	4879	12.01	176	0.00	0.00	0.00	0.17	0.00	0.00	0.25	0.00	0.00	0.00	5.33	8.66	0.00	0.25
burn	994	2.98	6	0.00	0.00	0.00	0.00	0.00	1.01	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.34
c1	1634	3.54	142	2.54	1.69	1.13	0.00	0.28	0.00	0.28	0.28	0.00	0.00	3.67	29.93	0.28	0.00
d1	2080	5.79	68	0.00	0.00	1.90	0.00	0.00	1.21	0.00	0.00	1.04	0.00	4.14	3.45	0.00	0.00
d2	2090	5.33	288	0.00	1.88	1.13	0.00	0.00	1.88	0.19	0.19	0.19	0.00	15.38	33.01	0.00	0.19
d3	561	1.41	101	0.00	2.83	2.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.76	41.74	0.00	0.00
Disturbed-Clearcut/Re-claimed	192	0.41	6	0.00	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	0.00	0.00	50.00	0.00	0.00
Disturbed-cutline	591	1.48	7	4.89	0.00	0.00	0.00	0.00	0.00	0.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00
e2	44	0.09	17	0.00	11.36	11.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.45	125.00	0.00	0.00
FONS	911	2.32	12	0.43	0.00	0.00	0.00	0.00	3.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.29
FTNN	9557	16.21	94	0.80	0.12	0.12	0.06	0.00	0.12	0.00	0.00	0.19	0.06	0.99	2.78	0.00	0.56
g1	4211	9.61	305	0.42	0.31	0.00	0.63	0.10	0.31	0.31	0.31	0.00	0.00	5.10	23.83	0.00	0.42
h1	29	0.06	16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	275.86	0.00	0.00
MONS	705	3.13	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.15	0.00	0.00	1.60	0.00	0.00
SONS	10	0.01	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WONN	341	1.53	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**29,897**	**68.49**	**1437**	**0.51**	**0.45**	**0.41**	**0.09**	**0.03**	**0.60**	**0.13**	**0.10**	**0.34**	**0.01**	**4.57**	**13.3**	**0.01**	**0.35**

CARI Woodland Caribou
COYO Coyote
DESP Deer Species
FIMA Fisher/Martin
WOLF Grey Wolf
GROU Grouse/Ptarmigan Species
LYNX Canada Lynx
MICE Mouse Species
REFO Red Fox
RESG Red
SNHA Snowshoe Hare
WESP Weasel Species
UNKN Unknown Species

Table IV-2 Summary of Wildlife Ecosite Phase / Wetlands Type Preferences and Avoidances, as Determined From Winter Track Count Survey

Ecosite/Wetlands Types [(a)]			
Species	**Preferred**	**Avoided**	**Chi Squared Value**
woodland caribou	FTNN	BTNN	(χ^2=10.3, df=2; p<0.05)
red squirrel	d2 d3	burn disturbed-cutline FTNN FONS MONS WONN	(χ^2=380.7, df=12; p<0.05)
snowshoe hare	a1 c1 d2 d3 g1	b2 burn d1 disturbed-cutline FONS FTNN BTNN MONS WONN	(χ^2=1273.2, df=14; p<0.05)

a1 lichen jack pine
g1 Labrador tea-subhygric black spruce-jack pine
b2 blueberry aspen (white birch)
c1 Labrador tea-mesic jack pine-black spruce
d1 low-bush cranberry aspen
d2 low-bush cranberry aspen-white spruce
d3 low-bush cranberry white spruce
e1 dogwood balsam poplar-aspen
f3 horsetail white spruce

burn burned forest
FTNN treed fen
WONN shallow open water
FONS shrubby fen
MONS shrubby marsh
BTNN wooded bog