Consultant Report #11 – Wildlife

Part A - Baseline

Baseline Wildlife Resources in the Great Divide SAGD Expansion Project Study Area

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1.0 Introduction

As part of a phased development of its oil sands lease (approximately 153 km^2), Connacher Oil and Gas Ltd. (Connacher) is submitting an application to expand its existing steam assisted gravity drainage (SAGD) operations (Project). In support of this application, Westworth Associates Environmental Ltd. (now Stantec Consulting Ltd.) conducted baseline wildlife surveys on these leases for use in the preparation of an Environmental Impact Assessment (EIA) for the Project. The following report presents the results of these wildlife baseline surveys.

1.1 PROJECT DESCRIPTION

Connacher is the owner and operator of two SAGD developments known as the Great Divide Pod One SAGD Project (Pod One) and Great Divide Algar SAGD Project (Algar). The projects are designed to produce 10,000 barrels (bbl), or 1,600 m^3 of bitumen/day each. Connacher is proposing to expand production capacity of the Algar project by approximately 3,800 m^3 of bitumen/day. Once expansion is complete and operational, the combined production capacity will be about 44,000 bbl/d or 7,000 m^3/day of bitumen. Based on currently identified resources within the lease, the production level will be sustainable for 25 years. Connacher proposes to construct the Project using the same bitumen extraction and processing components presently used at Pod One and Algar. Bitumen will be extracted from the oil sands reservoir using a SAGD process, which involves drilling a pair of horizontal wells. Multiple wells are usually drilled from a single well pad to minimize disturbance. The three phases of the Project will result in additional well pads and associated gathering pipelines, access roads and transmission lines, borrow pits and topsoil storage sites (Table 1-1). Phase 1 development will increase production by 24,000 bbl/d to a full lease production rate of 44,000 bbl/d, while Phase 2 development will maintain full lease production of 44,000 bbl/d, as the older wells dry up. Phase 3 development is expected to involve further drilling to sustain full levels of productions.

Table 1-1
Length, area or number of new components in the three Expansion phases

Component	Phase 1	Phase 2	Phase 3
Aboveground pipeline (km)	9	18	17
Access road (km)	4	18	17
Road/utility corridor (ha)	47.0	91.4	84.6
Well pads (number)	9	12	19
Well pads (ha)	41.9	53.0	69.0
Borrow pits (ha)	27.4	40.6	28.7
Remote sumps (ha)	19.3	4.0	4.0
Lay down (ha)	9.9	0	0

1.2 PROJECT LOCATION

The study area. which is located approximately 70 km south of Fort McMurray, is bisected by Highway 63 (Figure 1-1). Other nearby communities include Mariana Lake 20 km to the south, Anzac to the northeast and Conklin to the southeast.

1.3 LOCAL STUDY AREA

The local study area (LSA) was defined as the 15,371 ha lease area. All baseline wildlife surveys were conducted within the LSA to assess the potential effects of the Project on wildlife and their habitats.

1.4 ENVIRONMENTAL SETTING

The Project is located within the Central Mixedwood Subregion of the Boreal Forest Natural Region. This subregion, which occupies 25% of Alberta, is characterized by a mosaic of aspen and white spruce on uplands, with jack pine on coarse soils, and black spruce / tamarack bogs and fens in lowlands (Natural Regions Committee 2006). Understory vegetation of upland stands is primarily shrubs and forbs such as prickly rose, low-bush cranberry, bunchberry, wild sarsaparilla and dewberry. Bogs and fens typically have understories of Labrador tea, dwarf birch, black spruce and tamarack (Beckingham and Archibald 1996). The Central Mixedwood Subregion has numerous small lakes and extensive wetlands, the latter of which are predominantly shrubby fens. Land use within this Subregion includes forest harvesting, petroleum exploration and development, traditional activities such as hunting, fishing and trapping, and some limited agricultural activity.

The LSA is dominated by black spruce and jack pine forests, and shrubby bogs in lowland areas. These habitats are valuable for a number of wildlife species at risk, most notably woodland caribou, which is considered “At Risk” in Alberta. Upland forest is scarce in the LSA, and limited to the central and northern areas of the LSA. In 1995, a wildfire burned a large proportion of the LSA (88%) and surrounding area, and thus most of the vegetation is in early successional stages.

Common mammals in the Central Mixedwood Subregion include moose, snowshoe hare, red squirrel, red-back vole, black bear and ermine (Natural Regions Committee 2006). Species such as woodland caribou, wolf, Canada lynx, wolverine and fisher are locally distributed. Beaver is considered a keystone species responsible for the creation of many productive ponds, swamps and meadows used by a variety of other species. The Subregion supports a broad diversity of avian species, ranging from rare songbirds such as the black-throated green warbler to the sandhill crane and northern goshawk. Other species at risk include herptiles such as Canadian toad, western toad and red-sided garter snake.

1.5 OBJECTIVE

The primary objective of the baseline wildlife surveys were to describe and map existing wildlife resources in the LSA, including herptiles, birds and mammals, their use of habitats in the LSA. Special attention was paid to those species listed provincially as “At Risk”, “May Be At Risk” and “Sensitive” provincially (ASRD/AE 2005), all species listed federally in Schedule 1 of the *Species at Risk Act*, and as “At Risk” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

2.0 Methods

Baseline wildlife surveys conducted for the Project involved a number of tasks including delineating wildlife habitat types, summarizing of existing wildlife information, identifying the potential occurrence of wildlife species at risk, and, field sampling. The methods used during each of these tasks are described below.

2.1 WILDLIFE HABITAT DELINEATION

Baseline vegetation data for the LSA (GDC 2010) were collected prior to the development of the Algar Project. Vegetation classification was based on Beckingham and Archibald (1996) which incorporates vegetation, soil, site, and productivity information to classify ecosystems to ecosite phase (e.g., c1 or g1). From a wildlife perspective, ecosite phases were grouped into a number of broader habitat classes based on vegetation species composition, moisture regime, topographic position, and general value to wildlife. Habitat classification followed previous groupings used by Komex (2005) and AXYS (2001a). Because of the varying importance of young and mature/old forests for wildlife, stand age was also incorporated into the habitat classes. "Young" forest was defined as anything that had been burned in 1982 or 1995, whereas "old" referred to unburned forest. Burned polygons were confirmed using Alberta Vegetation Inventory (AVI) data, satellite imagery, ASRD fire history data and ground surveys. Polygons were considered burned if over one-half of the polygon was modified by fire. If there was no date of origin for a forested polygon and it was not burned, the polygon was considered old. Most of the unburned (old) habitat was >80 years, with the exception of deciduous-dominated forest which was considered old if >60 years.

2.2 EXISTING INFORMATION

Various sources of information were reviewed to obtain background information on wildlife use of the LSA and surrounding area including:

- Alberta Sustainable Resource Development (ASRD). Christine Found and Todd Powell, Area Biologists with ASRD in Lac La Biche and Fort McMurray were consulted regarding issues associated with wildlife, particularly woodland caribou.
- Fish and Wildlife Management Information System (FWMIS);
- Alberta Natural Heritage Information System (ANHIC);
- Alberta Caribou Committee (ACC);
- Various baseline inventories and EIAs conducted in the region including Connacher's Great Divide Project and the Gulf-Surmount Project (AXYS 2001b) located 50 km east of the LSA.

2.3 SPECIES OF CONCERN

Species of concern are often considered in wildlife assessments because of their status and sensitivity to changes in habitat. By managing the landscape for species of concern, habitat may also be conserved for other less sensitive wildlife species. The following section reviews provincial and federal status rankings that were used to identify wildlife species of concern in the LSA.

2.3.1 General Provincial Status

The status of all wildlife species occurring in Alberta is ranked after consultation with wildlife professionals and analysis of available data (ASRD 2009a). The provincial ranking system acts as an important first step in determining which species are designated ”At Risk” or “May Be At Risk” and therefore, require detailed status evaluations. These species would be given priority when being considered for ”Endangered” or ”Threatened” status by the Committee on the Status of Endangered Species in Canada (COSEWIC). Table 2-1 defines the general status categories used to rank wildlife species in Alberta. The rank is based on a number of criteria, including abundance and distribution, trend, and threats to both species and their habitats.

Table 2-1
Definitions of general status categories used for classifying wildlife in Alberta[1].

Rank	Definitions
At Risk	Any species known to be ‘At Risk’ after a formal detailed status assessment.
May Be At Risk	Any species that ‘May Be At Risk’ of extinction or extirpation, and is therefore a candidate for detailed risk assessment
Sensitive	Any species that is not at risk of extinction or extermination but might require species attention or protection to prevent it from becoming at risk.
Secure	A species that is not ‘At Risk’, ‘May Be At Risk’ or ‘Sensitive’
Undetermined	Any species for which insufficient information, knowledge or data is available to reliably evaluate its general status.
Not Assessed	Any species that has not be examined for The General Status of Alberta Wild Species 2000 report.
Exotic/Alien	Any species that has been introduced because of human activities.
Extirpated/Extinct	Any species not longer thought to be present in Alberta (‘Extirpated’) or no longer believed to be present anywhere in Alberta (‘Extinct’).
Accidental/Vagrant	Any species occurring infrequently and unpredictably in Alberta, i.e. outside its usual range.

[1] Source: AE/ASRD (2005).

2.3.2 Legislated Provincial Status

The Alberta *Wildlife Act* provides legal protection for species considered to be “Threatened” or “Endangered” in the province (Table 2-2). The *Wildlife Act* charges the Endangered Species Conservation Committee with the task of evaluating the status of potentially threatened or

endangered wildlife. Species that are classified as "Threatened" or "Endangered" under the *Wildlife Act* are protected from harm, either directly or indirectly in Alberta.

Table 2-2
Definitions of legal status categories[1] under the Alberta *Wildlife Act*.

Alberta Legal Status	Definition
Extinct	A species that no longer exists.
Extirpated	A species no longer existing in the wild in Alberta but occurring elsewhere in the wild.
Endangered	A species facing imminent extirpation or extinction.
Threatened	A species likely to become endangered if limiting factors are not reversed.
Species of Special Concern	A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Data Deficient	A species for which there is insufficient scientific information to support status designation.

1 Source: Fish and Wildlife Division (2008).

2.3.3 Federal Status

Species ranked provincially 'At Risk' or 'May Be At Risk' could be considered candidates for a more detailed assessment by COSEWIC (COSEWIC 2007). COSEWIC was established within the *Species at Risk Act* (SARA) as an independent body of experts responsible for identifying and assessing species to be considered at risk of extinction. Assessment by COSEWIC is the first step toward protecting species at risk, federally. Priority is given to species that might be at risk of extirpation or extinction throughout Canada. Species designated by COSEWIC (Table 2-3) to be at risk of extinction are then eligible for federal protection by the government. Species that are ranked as either "Special Concern", "Threatened" or "Endangered" are offered certain protections under SARA. Protective measures include among other things general prohibitions, commitments to recovery, protection of critical habitat, and management for species of "Special Concern". General prohibitions provide immediate protection to species on federal lands, aquatic species, and migratory birds. These prohibitions can also apply to listed species on all lands through a safety net process, and on federal lands for species listed by provincial and territorial governments.

2.3.4 Cumulative Environmental Management Association Ranking

The Cumulative Environmental Management Association (CEMA) is a multi-stakeholder, consensus-based forum that provides a framework and information network for cumulative effects assessment projects in the Athabasca oil sands region of northeastern Alberta. CEMA has identified a number of species of concern in Alberta which fall under one of three categories (Table 2-4): Priority 1, Priority 2 and Priority 3. Priority 1 species are considered most important for future monitoring initiatives.

Table 2-3
Definitions of federal status categories[1] for wildlife in Canada.

Rank	Definitions
Extinct	A wildlife species that no longer exists.
Exterminated	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered	A wildlife species facing imminent extinction or extirpation.
Threatened	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern	A wildlife species that might become 'Threatened' or an 'Endangered' species because of a combination of biological characteristics and identified threats.
Data Deficient	A wildlife species for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction.
Not at Risk	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.

[1] Source: COSEWIC (2007).

Table 2-4
List of Priority 1-3 wildlife species[1] identified by the CEMA.

Priority 1	Priority 2	Priority 3
Canadian toad	Black bear	Wood frog
Moose	American beaver	Grey wolf
Woodland caribou	River otter	Bald eagle
Muskrat	Ducks and geese	Common loon
Fisher/red-backed vole	Ruffed grouse	Deciduous forest bird community
Canada lynx/snowshoe hare	Mixedwood forest bird community	Wetlands forest bird community
Old-growth bird community	Pileated woodpecker	Pine forest bird community
	Boreal owl	Early successional bird community
		Northern goshawk
		Broad-winged hawk

[1] Source: CEMA (2001).

2.4 TRADITIONAL AND LOCAL KNOWLEDGE

Mr. Romeo Gauthier, whose registered trapline encompasses a large portion of the LSA, was consulted for background information on present and historical wildlife use within the LSA and surrounding area. Mr. Gauthier also accompanied biologists during some wildlife surveys, providing valuable information on wildlife use of the area. Connacher also conducted traditional ecological knowledge/traditional land use studies with local First Nations and Metis groups within and around the LSA (Connacher 2010, Appendix 7).

2.5 FIELD SURVEYS

Field surveys were conducted for amphibians, breeding birds, raptors, owls, waterbirds, and mammals. A subset of the data collected during these field surveys was also used for the Algar Project application. Most of these surveys were concentrated on the main portion of the LSA (i.e., 131 km^2) because the north extension area was added after the 2007 field season. However, aerial surveys and track surveys were conducted in the north extension area during the 2007/08 winter. Since the Project does not overlap the north extension area, further surveys were not considered necessary but will be conducted as required in the future.

2.5.1 Great Divide POD One Project Reconnaissance Wildlife Survey

A reconnaissance-level field survey was conducted on May 19 and 20 2005 for Connacher's Great Divide POD One Project located in Sections 16, 17, 20 and 21, Township 82 – Range 12 – W4M. The survey was used to document the potential occurrence of any wildlife species of special concern in the vicinity of the proposed footpring based on direct observation and habitat suitability. The survey area, which extended 1 km outwards from the centre of the proposed footprint, was selected for two reasons: 1) caribou in northeastern Alberta have been reported to avoid well sites by up to 1,000 m and roads by up to 250 m (Dyer 1999); and 2) the creation of cutlines and access roads fragments key habitat.

Surveys were completed along three transects: 1) south (448600 6217750) to north (448600 6220750); 2) north (448600 6220750) to southeast (449750 6218250), and; 3) west (450200 6219200) to south of the Central Plant (448500 6218250). Wildlife sightings (visual or auditory) and / or sign (e.g., scat, tracks, and feathers) were recorded along transects Using Universal Transverse Mercator (UTM) coordinates. A digital camera was used to record images of the general habitat and important habitat features or wildlife sign. Assessment of habitat suitability was focused on identification of vegetation species preferred by caribou, including black spruce, larch, and jack pine although other important wildlife habitat features (e.g., dens, old-growth forest, etc.) were also noted.

2.5.2 Amphibian Surveys

Prior to initiating field work, amphibian survey stations were identified using satellite imagery of the LSA. Stations were located at all lakes, ponds and wetlands that could be identified from satellite imagery and AVI mapping. Some additional survey stations were included after a ground reconnaissance identified other suitable amphibian habitat. It was assumed that amphibians could be heard up to 800 m from each station under ideal conditions (i.e., no wind or precipitation), so amphibian stations were positioned up to 1.6 km apart although there was some overlap of the stations depending on the location of wetlands. This overlap was considered during data analysis.

Amphibian surveys are most effective when conducted between one-half hour after sunset and 0200 hrs. Surveyors travelled by all-terrain vehicle to the survey stations, where they listened

for five minutes following a five minute wait period after arrival at the station. The compass bearing and approximate distance to each group of calling amphibians was recorded. The station UTM, bearing and average distance were used to compute the approximate location of the amphibians. The number of amphibians at each station was recorded based on three detection categories: 1 = 1-10 individuals (individuals can be easily detected); 2 = 11-20 individuals (individuals can still be detected, but calls are overlapping); 3 = >20 individuals (calls of individuals cannot be distinguished).

2.5.3 Breeding Bird Surveys

2.5.3.1 Field Surveys

Breeding bird surveys were conducted using the modified fixed-radius method which involved surveying 50 m radius circular plots (Bibby et al. 1993) established in representative habitat types in the LSA. Survey stations were located within a single habitat type at least 100 m from an “edge”, which was defined as the juxtaposition of two significantly different habitat types or structural stages (e.g., structural stages 2 and 5).

Breeding bird surveys were conducted one-half hour before sunrise until approximately 1030 hrs but were suspended if winds were >20 km/hr. Following arrival at each survey station, a five minute “quiet” time was initiated to allow for any disturbances in accessing the site to subside. At each survey station, both acoustic and visual records of songbird species were recorded over a ten minute period. Birds observed outside the 50 m point-count radius were recorded as incidental observations.

2.5.3.2 Data Analysis

Breeding bird data were summarized in several ways. All birds detected within the 50 m point-count radius were included in the analyses. To provide information on relative species abundance, the average density of each species detected within the 50 m point-count radius was calculated. The data were then summarized by habitat type with the average density of breeding birds in each habitat type calculated as the number of territories/40 ha. Total species richness and diversity were also calculated. In addition, bird species diversity (BSD) was calculated using the Shannon-Wiener (Shannon and Wiener 1963) Index, as follows:

$$BSD = - \sum_{i=1}^{SN} p_i \ln(p_i)$$

where p is the relative abundance of the i th species relative to the population of birds of all species (N). The Shannon-Wiener Index takes into account the number of species within a habitat as well as the relative abundance of each species in that same habitat. Therefore, relatively rare species receive a lower weight than species that are regularly observed. A high BSD value represents a habitat type with numerous individuals of many species whereas a low BSD value represents habitats with a low abundance of only few species.

2.5.4 Nocturnal Owl Surveys

Systematic acoustical surveys were used to identify species, distribution and relative density of owls occurring in the LSA. Eight owl species could potentially occur in the LSA (Table 2-5), including one species that "May Be At Risk" and two species considered "Sensitive" in Alberta. The surveys involved broadcasting owl calls to which many species of owl respond. Acoustical owl surveys do not capture species that do not respond to call play-back, including snowy owl, northern hawk owl, great gray owl and short-eared owl although non-responsive owls were recorded as incidental observations during other survey conducted in the LSA (between December 6, 2006 and March 8, 2007).

Table 2-5
Owl species that could occur within the LSA.

Common Name[1]	Provincial Status	COSEWIC	SARA	CEMA Priority
Great horned owl	Secure	Not listed	Not listed	Not listed
Snowy owl[2]	Secure	Not at risk	Not listed	Not listed
Northern hawk owl	Secure	Not at risk	Not listed	Not listed
Barred owl	Sensitive	Not listed	Not listed	Not listed
Great gray owl	Sensitive	Not at risk	Not listed	Not listed
Short-eared owl	May Be At Risk	Special Concern	Schedule 3 - Special Concern	Not listed
Boreal owl	Secure	Not at risk	Not listed	Priority 2
Northern saw-whet owl	Secure	Not listed	Not listed	Not listed

[1] For scientific names, refer to Appendix 1.
[2] Does not breed in study area; occurs only as a winter visitor.

Thirty-eight survey stations were established along access routes (e.g., winter roads and seismic lines) throughout the LSA. Stations were established at least 1.6 km apart to maximize listening coverage and distribution of surveys points in the LSA. Each station had a broadcast radius of 800 m, with little overlap between stations.

Surveys began one half-hour after sunset and were conducted between 2015 hrs and 0200 hrs. The following information was recorded at each station prior to broadcasting: UTM coordinates, temperature, wind speed (Beaufort scale), presence/absence of aurora borealis. Prior to starting the broadcast survey, a two minute quiet period was used by the field crew to allow any disturbance effects to subside and to listen for owls that might have already been calling. If an owl was calling upon arrival, the direction and estimated distance of the owl from the recording station was recorded. After the quiet period, broadcast calls were initiated using a Sony PSYC or similar CD player and a CD with recorded owl calls. The recording consisted of 20 seconds of calling followed by one minute of silence for each of the following six species of owl: saw-whet owl, boreal owl, long-eared owl, barred owl, great gray owl, and great horned owl. Although great gray owls do not respond to call playback, owls respond more readily to calls from other species (Beck and Beck *in* Holroyd and Takats 1997), so this species was included.

The approximate locations of the owls were calculated from the UTM coordinates of the survey station from which the owl was heard, the direction and average estimated distance of the owl from the station. This results in an approximate location only, and did not allow for accurate categorization of owls by habitat type. Owls respond to the broadcast calls by calling and moving towards the survey station (Takats et al. 2001), and therefore, the location at which the owl was heard calling was not necessarily the habitat in which it was prior to the broadcast call. In addition, owls may be responding from up to 400 m away, which may result in error in distance estimates. The density of owls detected during the owl surveys was calculated by dividing the total number of owls of each species by the total area surveyed although the density of incidentally observed owls could not be reliably calculated.

2.5.5 Raptor Surveys

Because of the inconspicuous nature of forest raptors, an effective method for surveying this species group is to use broadcast calls to elicit a vocal or visual response, similar to the method used for owls (Rosenfeld et al. 1985, Kennedy and Stahlecker 1993, Resource Inventory Committee 1996, Resource Inventory Committee 2001). Broadcast stations were established along access routes to efficiently survey as much suitable nesting habitat (i.e., mature stands of ≥ 80 years) as possible. However, stations were also established in young forest and open areas to achieve as much coverage as possible in the area. Broadcast stations were set up approximately 800 m apart and were surveyed between 0700 hr and 1900 hr, when forest raptors are active. Each survey station covered an area of approximately 500 m radius.

Upon arrival at survey station, a two minute period of silence was observed before beginning the broadcasts to allow for disturbance effects to subside. After the quiet period, broadcast calls were initiated using a Sony PSYC or similar CD player and a CD with recorded raptor calls. The recording played at each broadcast station consisted of a sequence of 30 seconds of calling followed by 30 seconds of silence, 10 seconds of calling, 30 seconds of silence, 10 seconds of calling, 30 seconds of silence, 10 seconds of silence and finally, 30 seconds of silence for each species. Calls were broadcast in the following order: 1) sharp-shinned hawk, 2) Coopers hawk, 3) broad-winged hawk, 4) northern goshawk, and 5) great-horned owl. Forest hawks respond to the territorial call of the great horned owl (Mosher and Fuller 1996), so this call was also incorporated at the end of the calling sequence to increase the probability of a raptor response. At each 10 second calling interval, the portable CD player was rotated 120 degrees to maximize broadcast effectiveness and survey radius in all directions. The total playing time at each broadcast station was approximately 15 minutes plus two minutes of initial silence.

The exact locations of calling raptors were determined where possible. Raptors often respond from large distances and raptor locations can sometimes be accurately determined using triangulation. However, a triangulation position is not always obtained because some raptors stop calling after the initial bearing is recorded. Raptor locations in such instances were based on a single bearing and distance was estimated in the field. Besides vocal calls, other types of responses by raptors to broadcast calls include flybys and flushing from nearby forest cover. These responses also indicate presence and habitat use within the broadcast survey radius.

2.5.6 Waterbird Surveys

Systematic surveys were used to characterize the waterbird community in the LSA. Based on a review of existing information, a number of "Sensitive" species (AE/ASRD 2005) could potentially occur in the LSA (Table 2-6).

Table 2-6
Sensitive waterbird species that could occur in the LSA.

Common Name[1]	Provincial Status	COSEWIC	SARA
American bittern	Sensitive	Not listed	Not listed
Black tern	Sensitive	Not at risk	Not listed
Great blue heron	Sensitive	Not listed	Not listed
Horned grebe	Sensitive	Not listed	Not listed
Lesser scaup	Sensitive	Not listed	Not listed
Pied-billed grebe	Sensitive	Not listed	Not listed
White-winged scoter	Sensitive	Not listed	Not listed
Sandhill crane	Sensitive	Not listed	Not listed

[1] For scientific names, refer to Appendix 1.

The American bittern is found in freshwater wetlands with tall, emergent vegetation, tending to prefer beaver-created wetlands (Gibbs et al. 1992). The black tern nests in large, shallow freshwater marshes with emergent vegetation, such as the margins of lakes (Dunn and Agro 1995). The great blue heron is relatively adaptable, preferring to nest in trees or bushes near water and feeds in slow-moving freshwater (Butler 1992). Both the horned and pied-billed grebes are associated with small to medium sized freshwater ponds and marshes with dense emergent vegetation such as sedges, rushes and cattails, and nearby open water for foraging (Muller and Storer 1999, Stedman 2000). In contrast, white-winged scoters use large freshwater or brackish lakes and permanent ponds, preferring lakes with shrub-covered islands which are often used for nesting (Brown and Fredrickson 1997). The sandhill crane selects isolated open marshes or bogs, surrounded by shrubs and forest (Tacha et al. 1992).

Prior to initiating the field survey, waterbird survey stations were established at all lakes and ponds distinguishable from aerial photographs of the LSA, resulting in 9 survey locations. Each waterbody was surveyed from one or two vantage points on the water's edge. A spotting scope was used to search the entire waterbody and shoreline for waterfowl, waterbirds and shorebirds. The waterbodies were scanned until observers felt confident that all birds had been counted. Birds were distinguished by species and sexed and aged where possible. Waterbirds were also recorded incidentally during other wildlife surveys conducted in the LSA.

2.5.7 Winter Aerial Ungulate Surveys

Systematic aerial surveys were used to determine abundance and distribution of ungulates within the LSA (excluding the north extension area) during the 2006/07 winter period. Aerial surveys were also repeated during the early winter of 2007/08, but included north extension area. All aerial surveys were conducted between December and March. Ungulate population size and structure is often measured in the winter, because ungulates are more easily observed, and sex-age composition can be determined accurately.

A Bell 206B Jet Ranger helicopter was used for all aerial surveys. The helicopter flew approximately 100 m above ground at an airspeed averaging 90 km/hr. Observers included a navigator/observer in the left front seat and two observers seated in the rear of the aircraft. Survey transects were oriented in an east-west direction and spaced at 800 m intervals, resulting in a survey strip width of 400 m (200 m per side). This design allowed 50% survey coverage of the LSA.

When animals were located, the helicopter circled the location to obtain a GPS position and to ensure that all animals were counted. Species, number, age and sex of individuals observed, time of observation and habitat type were recorded. Moose were sexed by the presence of antlers on males (early winter) and a white vulval patch on females. The sex of caribou was determined based on antler and vulval patch characteristics in a manner similar to moose. Age was estimated from size and behaviour (association of calves with females). Identifiable tracks and other animal sign were also recorded during aerial surveys. Wildlife observed outside of transects were recorded as incidental observations. A track log of flight lines was maintained during the course of the aerial surveys.

2.5.8 Winter Tracking Surveys

Winter track count surveys were used to determine the relative abundance, distribution and habitat associations of mammals and upland game birds in the LSA. Although winter track surveys cannot be used to reliably estimate wildlife densities, they provide an indication of wildlife distribution and relative abundance. An early winter survey of the LSA (excluding the north extension area) was conducted from December 6-9, 2006, following a snowfall on December 5, 2006. A late winter survey of the LSA (excluding the north extension area) was also conducted from February 24-27, 2007, following a snowfall on February 23, 2007. An early winter track survey was conducted in the north extension area on December 11, 2008.

The winter tracking surveys were conducted along transects established within representative wildlife habitat types in the LSA. Although attempts were made to locate transects in homogeneous habitat types, any changes in habitat that occurred along transects were noted. Habitats were selected for inclusion in the survey in proportion to their availability in the LSA.

All wildlife tracks encountered were recorded every 25 m along the track transect. Snow depths were recorded every 50 m for the first 250 m of the transect. Wildlife tracks were identified to

species when possible, habitat type was noted and the number of sets of tracks recorded. The exact number of individuals could not always be determined for hare and squirrel 'runs' so track categories of five tracks/hare run, and three tracks/squirrel run were used in calculating track densities. In addition, since several species with similar tracks cannot be easily differentiated in the field they were combined for analysis (e.g., white-tailed deer/mule deer and ruffed grouse /spruce grouse).

The number of days since snowfall during track surveys ranged from one to four days for all the track surveys. To account for track accumulation and variable transect length, the data were converted to a standardized measure as follows:

$$\text{Relative Track Density} = \frac{\text{Number of tracks}}{\text{Length (m)} \times \text{Days since snowfall}}$$

The relative track density of each species was calculated by habitat type. Track densities for each 25 m section were calculated and average all sections for each habitat type. This method accounted for transects which bisected several different habitat types. Track densities were calculated for early and late winter surveys combined to increase sample sizes.

2.5.9 Bat Surveys

Bats were surveyed using several different methods. ANABAT detectors were used to record and later identify species or groups of species by their ultrasonic echolocation call. Advantages to this technique are that it is non-invasive, of low disturbance to bats, and allows for the collection of a large dataset using minimal resources. The major disadvantage is that species of the genus *Myotis* cannot reliably be distinguished by their calls. To collect more information on species composition and population characteristics, mist nets were used to capture bats. By capturing bats, data on species, sex, age and general health can be recorded. The primary disadvantage of this survey technique is that bats may experience trauma associated with handling. This trauma can be reduced by using fully qualified, experienced personnel to handle the bats, as suggested by Alberta Bat Action Team (Vonhof 2006).

A number of potential mist net locations and echolocation stations were identified using aerial photos and AVI maps. The best mist net locations were considered to be near waterbodies and open areas surrounded by trees or snags and other potential roost sites. Echolocation stations were placed every 800 m along access routes. Mist nets were set up at least one hr before sunset, and opened around sunset. Ten nets of different lengths (9 m, 12 m and 18 m) were established at each site.

Each net was visited every 15 minutes throughout the evening. Echolocation surveys began one-half hour after sunset and continued until approximately 0200 hrs. Surveyors travelled by ATV to each station, waited one minute to allow for disturbance to subside, and then used the ANABAT detector to record any bats flying around the station. These data were later analyzed

using Analook 4.9j (Corben 2004) and a Discriminant Function Analysis to determine species and groups.

2.5.10 Wildlife Camera Monitoring

In conjunction with the caribou mitigation and monitoring program (refer to Section 4 of the wildlife assessment), 24 remote cameras were placed throughout the LSA between August and December 2008. The focus of this program was to monitor woodland caribou and other wildlife use in the vicinity of Project facilities and elsewhere in the LSA. Wildlife cameras have been used in many wildlife monitoring studies (e.g., Jacobson et al. 1997, Moruzzi et al. 2002, Dobson et al. 2003, Callaghan et al. 2006, Moen and Lindquist 2006, Dunne 2007), and are considered an effective means of continuously monitoring wildlife with minimal disturbance. The remote cameras (PC RapidFire Professional Covert Color IR, © Reconyx) use infrared technology for taking colour photographs during the day and monochrome photos at night, without a disruptive flash.

Prior to camera placement, an aerial survey was conducted in August 2008 to identify wildlife trails and areas of prime caribou habitat. Since August 2008, wildlife cameras have been deployed in 38 locations throughout the LSA, with 32 cameras active at the end of the first year of monitoring in November 2009. Some cameras were removed from the field because of clearing activities for the Algar Project and high levels of activity along some roads in the winter. Distance of cameras from the footprint ranged from 0 m to 1,774 m. Remote cameras were placed along wildlife trails or potential travel corridors such as cutlines or winter roads. Whenever possible, cameras were placed in areas of high quality caribou habitat, with mature black spruce and abundant terrestrial or arboreal lichen.

Wildlife cameras were checked approximately every three or four months. Following each check, data were downloaded including wildlife images, the date and time the images were taken, number of individuals and number of passes in front of the camera. It was generally assumed that each animal recorded was a different individual, unless unique markings permitted identification. Exceptions to this included territorial birds, such as sandhill cranes and spruce grouse, which were recorded multiple times throughout the season, and were considered to represent the same individuals.

The number of camera days was calculated by summing the number of days each remote camera was functioning. Remote cameras may have stopped functioning as a result of full compact flash cards, low battery levels or damage from machinery or wildlife. Cameras were also considered non-functional if the lenses were obscured by snow or tree branches, or if the camera was shifted by wildlife so that it was no longer directed appropriately. A relative index of wildlife frequency at each camera was calculated by dividing the number of individuals by camera days (Dunne 2007) annually and seasonally based on caribou biology (Dyer et al. 2001; Table 2-7).

The data were summarized by calculating the mean frequency of each species annually and for all seasons, and using Mann Whitney and Kruskall Wallis tests to determine significant differences among seasons. Statistical analyses could not be conducted for species that were only detected a few times throughout the year. All statistical analyses were performed in SPSS 16.0 (SPSS 2007), and used a p-value of 0.05.

Table 2-7
Seasons used in the analyses of the wildlife camera data.

Season	Start Date	End Date
Early winter	16 November	21 February
Late winter	22 February	30 April
Spring (calving)	1 May	30 June
Summer	1 July	15 September
Fall (rut)	16 September	15 November

2.5.11 Incidental Wildlife Observations

Incidental wildlife observations were recorded during all surveys by recording the UTM coordinates and a description of the observation (e.g., species, sex, and number). Incidental observations also included those by the Caribou Sighting Program run collaboratively by Connacher and ConocoPhilips Canada during the 2007/08 winter.

2.6 BIODIVERSITY

Biological diversity, or biodiversity, is often defined as the “variety and variability among all living organisms and the ecological complexes in which they occur” (Probst and Crow 1991). It includes diversity within individuals, species, populations, and ecosystems, as well as all of the relationships among these groups (Alberta Biodiversity Monitoring Institute 2007). Biological diversity is an important component of ecological integrity, or the intactness of an ecosystem. A high level of biodiversity is critically important to the resilience and recovery capabilities of species, populations and ecosystems to disturbance and for that reason, biodiversity has become an essential tenant of conservation biology.

2.6.1 Biodiversity Assessment

Biodiversity was defined as the number of bird, mammal and herptile (amphibian or reptile) species that could potentially use habitat in the LSA. The general wildlife habitat types were considered too broad for the biodiversity assessment, and therefore ecosite phases and stand ages were used. Waterbodies (NWL) were assumed to include some surrounding vegetation, and were therefore of value to wildlife species that use riparian areas. Habitat use was defined as nesting for most birds, and year-round living for mammals, amphibians and reptiles. Wildlife occurrence and biodiversity was summarized by ecosite phase and stand age for all species

potentially occurring in the LSA (Appendix 2). Species lists were not limited to those detected in the LSA during baseline surveys because detection may have been restricted because of low densities, irruptive occurrence or survey timing (i.e., summer surveys would not detect species occurring in the LSA only during the winter). Resources used to determine species occurrence and habitat use included Pattie and Hoffman (1992), Semenchuk (1992), Smith (1993), Fisher and Acorn (1998), Pattie and Fisher (1999), Federation of Alberta Naturalists (2007), and The Birds of North American Online (http://bna.birds.cornell.edu/bna/species).

The total number of potential birds, mammals and herptiles were summed for each ecosite phase and stand age (e.g. young C1, old E2). Because polygons in the vegetation database could be composed of up to two ecosite phases, a weighted average of biodiversity was calculated with a GIS for each polygon. Biodiversity values were then classified into the following classes: high (>78), moderate-high (59-78), moderate (48-58), moderate-low (30-47) and low (5-29). The areal extent of each biodiversity class was also calculated and summarized.

3.0 EXISTING ENVIRONMENT

3.1 WILDLIFE HABITAT

Young habitats were the most abundant types in the LSA under baseline conditions (Figure 3-1). The most common habitats were young mixed coniferous and young shrubby bog/fen (Table 3-1). Both types were dominated by burned spruce snags and regenerating jackpine. Old shrubby bog/fen was also relatively abundant, and found primarily in the southern portion of the LSA where the 1995 Mariana Lake burn was less extensive. Treed bog/fen, which is considered high quality habitat for woodland caribou, accounted for 4.8 – 6.7% of the LSA. Unforested types, including sedge meadow, marsh and waterbody, accounted for only 2.0% of the entire LSA. Disturbance, including the Great Divide Project, airstrip, gas well pads, the highway and transmission line, totaled 430.6 ha or 2.8% of the LSA at baseline.

Table 3-1
Wildlife habitat types present in the LSA at baseline conditions.

Habitat Types	Ecosite Phases	Age	Area (ha)	Cover (%)
Treed bog/fen	i1, j1, k1	Young	743.2	4.8
		Old	1,022.4	6.7
Shrubby bog/fen	i2, j2, k2	Young	3,679.1	23.9
		Old	1,701.2	11.1
Mixed coniferous	b4, c1,d3, e3, f3, g1, h1	Young	4,879.0	31.7
		Old	1,249.0	8.1
Mixedwood	b1,d2, e2, f2	Young	913.6	5.9
		Old	331.2	2.2
Deciduous	b2, d1, e1, f1	Young	68.8	0.4
		Old	72.5	0.5
Sedge meadow	k3	N/A[1]	199.6	1.3
Marsh	l1	N/A	3.0	<0.1
Waterbody	NWL, NWR	N/A	76.3	0.5
Disturbance	CIP, CIU, CIW, AIG, AIH, AII	N/A	430.6	2.8
Totals			**15,369.5**	**100.0%**

[1] N/A – Not applicable.

Wildlife habitat data differ slightly from that originally provided because disturbance features (e.g., well pads and other clearings) were digitized from aerial photos and added to the disturbance polygons in the AVI database. These additional disturbance features were considered important in assessing baseline wildlife use in the LSA, and for habitat modelling.

3.1.1 Wildfire History

The LSA has a history of wildfires that have created a mosaic of age classes and structures (Figure 3-2). The LSA was not burned between 1920 and 1959, but has been extensively burned since the 1980's (Table 3-2). In 1982, a wildfire burned 21.4% of the LSA, primarily in the southern portion. Except for a small portion of the LSA (12.4% in the south), the entire study area was burned in 1995 during the Mariana Lake fire. There are, however, residual unburned patches of habitat scattered throughout the LSA, which provide important mature or old-growth habitat features some species of wildlife.

Table 3-2
Proportion of the LSA affected by wildfire since the 1960s.

Years	Area (ha)	Proportion of LSA %
1960 - 1969	919.5	6.0
1970 - 1979	270.3	1.8
1980 - 1989	3,249.9	21.4
1990 - 1999	13,331.3	87.6
2000 - 2008	0.0	0.0

3.2 DATABASES AND EXISTING INFORMATION

Searches of the FWMIS wildlife database revealed that several species of concern have been detected in or near the LSA. In 1997, a woodland caribou (unknown sex) was observed within Connacher's Great Divide Project Area (i.e., prior to development), on the west side of Highway 63. In addition, a woodland caribou of unknown sex was recorded just west of the LSA in 1992. An adult female caribou was observed near the large lake in the centre of the LSA in 2005. Sightings of caribou are not surprising given that the LSA occurs within the East Side of the Athabasca River (ESAR) caribou range (Figure 1-1). There is also evidence that boreal toads inhabited creeks near Highway 63 both south and north of the LSA.

The ANHIC wildlife database did not have any records of rare or listed species on or within 10 km of the LSA. The lack of recorded observations in the database likely reflects the lack of previous surveys in the LSA and does not indicate the absence of rare or listed species.

Telemetry data for the ESAR herd were provided by the ACC (Anne Hubbs and Curtis Stambaugh, ASRD). Caribou telemetry points, which were available for Townships 80-84, Ranges 10-13, W4M, were collected using VHF collars on a number of caribou between 1992 and 2008. The locational accuracy of these data varies from 100 m to 5 km (A. Hubbs, 2008, personal communication). Even with these limitations, it is apparent that caribou have used the LSA and larger RSA over the past 16 years (Figure 3-4). However, it is unclear whether the widespread 1995 Mariana Lake fire affected caribou distribution, although Dalerum et al. (2007) reported that wildfire had no effect on the extent of caribou home range in Alberta.

Several wildlife studies conducted on or near the LSA were used as additional background wildlife information for the Project. Baseline data collected for Connacher's Great Divide Project was used to supplement information gathered during baseline surveys conducted for the current Project. In addition, winter track count data from the nearby Gulf-Surmount project area (50 km east of the LSA, AXYS 2001b) were used for comparative purposes.

3.2.1 Wildlife Species of Concern

Special status species that could occur in the LSA were identified using various sources including The General Status of Alberta Wild Species (AE/ASRD 2005), the CEMA, the COSEWIC (2007) and published range maps and species accounts. Based on a review of this information, 56 listed wildlife species may occur in the LSA (Table 3-3).

Table 3-3
Summary of special status wildlife species that could occur in the LSA.

Common Name	Recorded in LSA?	Provincial Status	COSEWIC	SARA	CEMA Priority
Herptiles:					
Canadian toad	No	May Be At Risk	Not At Risk	Not Listed	Priority 1
Red-sided garter snake	No	Sensitive	Not Listed	Not Listed	Not Listed
Wood frog	Yes	Secure	Not Listed	Not Listed	Priority 3
Western toad	Yes	Sensitive	Special Concern	Schedule 1 – Special Concern	Not Listed
Mammals:					
American beaver	Yes	Secure	Not Listed	Not Listed	Priority 2
Black bear	Yes	Secure	Not Listed	Not Listed	Priority 2
Canada lynx	Yes	Sensitive	Not At Risk	Not Listed	Priority 1
Fisher	Yes	Sensitive	Not Listed	Not Listed	Priority 1
Wolverine	Yes	May Be At Risk	Special Concern	No Status	Not Listed
Gray wolf	Yes	Secure	Not At Risk	Not Listed	Priority 3
Hoary bat	Yes	Sensitive	Not Listed	Not Listed	Not Listed
Moose	Yes	Secure	Not Listed	Not Listed	Priority 1
Muskrat	Yes	Secure	Not Listed	Not Listed	Priority 1
Northern long-eared bat	No	May Be At Risk	Not Listed	Not Listed	Not Listed
Silver-haired bat	?	Sensitive	Not Listed	Not Listed	Not Listed
River otter	Yes	Secure	Not Listed	Not Listed	Priority 2
Wolverine	No	May Be At Risk	Special Concern	Not Listed	Not Listed
Woodland caribou	Yes	At Risk	Threatened	Schedule 1 - Threatened	Priority 1
Birds:					
American bittern	No	Sensitive	Not Listed	Not Listed	Not Listed
Bald eagle	No	Sensitive	Not At Risk	Not Listed	Priority 3
Barred owl	Yes	Sensitive	Not Listed	Not Listed	Priority 1

Common Name	Recorded in LSA?	Provincial Status	COSEWIC	SARA	CEMA Priority
Bay-breasted warbler	No	Sensitive	Not Listed	Not Listed	Priority 1
Black tern	No	Sensitive	Not At Risk	Not Listed	Not Listed
Black-backed woodpecker	No	Sensitive	Not Listed	Not Listed	Not Listed
Blackburnian warbler	No	Sensitive	Not Listed	Not Listed	Priority 1
Black-throated green warbler	No	Sensitive	Not Listed	Not Listed	Priority 1
Boreal owl	Yes	Secure	Not At Risk	Not Listed	Priority 2
Broad-winged hawk	No	Sensitive	Not Listed	Not Listed	Priority 3
Brown creeper	No	Sensitive	Not Listed	Not Listed	Priority 1
Canada warbler	No	Sensitive	Threatened	Not Listed	Priority 2
Cape May warbler	No	Sensitive	Not Listed	Not Listed	Priority 1
Common loon	Yes	Secure	Not At Risk	Not Listed	Priority 3
Common nighthawk	Yes	Sensitive	Threatened	Not Listed	Not Listed
Common yellowthroat	Yes	Sensitive	Not Listed	Not Listed	Not Listed
Connecticut warbler	No	Sensitive	Not Listed	Not Listed	Priority 3
Eastern phoebe	No	Sensitive	Not Listed	Not Listed	Not Listed
Great blue heron	No	Sensitive	Not Listed	Not Listed	Not Listed
Great grey owl	Yes	Sensitive	Not At Risk	Not Listed	Not Listed
Green-winged teal	Yes	Sensitive	Not At Risk	Not Listed	Priority 2
Horned grebe	No	Sensitive	Not Listed	Not Listed	Not Listed
Least flycatcher	Yes	Sensitive	Not Listed	Not Listed	Priority 3
Northern goshawk	Yes	Sensitive	Not At Risk	Not Listed	Priority 3
Northern harrier	Yes	Sensitive	Not At Risk	Not Listed	Not Listed
Northern hawk owl	Yes	Sensitive	Not Listed	Not Listed	Not Listed
Northern pintail	No	Sensitive	Not Listed	Not Listed	Priority 2
Olive-sided flycatcher	Yes	Secure	Threatened	Not Listed	Priority 3
Osprey	No	Sensitive	Not Listed	Not Listed	Not Listed
Pied-billed grebe	No	Sensitive	Not Listed	Not Listed	Not Listed
Pileated woodpecker	No	Sensitive	Not Listed	Not Listed	Priority 2
Ruffed grouse	No	Secure	Not Listed	Not Listed	Priority 2
Rusty blackbird	No	Sensitive	Special Concern	Schedule 1- Special Concern	Priority 3
Sandhill crane	Yes	Sensitive	Not At Risk	Not Listed	Not Listed
Sharp-tailed grouse	Yes	Sensitive	Not Listed	Not Listed	Not Listed
Short-eared owl	No	May Be At Risk	Special Concern	Schedule 3 - Special Concern	Not Listed
Sora	Yes	Sensitive	Not Listed	Not Listed	Not Listed
Western tanager	Yes	Sensitive	Not Listed	Not Listed	Priority 1
White-winged scoter	No	Sensitive	Not Listed	Not Listed	Priority 2
Yellow rail	No	Undetermined	Special Concern	Schedule 1 - Special Concern	Not Listed

3.3 TRADITIONAL ECOLOGICAL KNOWLEDGE

Mr. Romeo Gauthier of Fort McMurray, Alberta, provided some anecdotal information on wildlife use of LSA. Mr. Gauthier has owned a trapline in the LSA since 1998 and has observed an abundance of wildlife in his trapping area. He has noted that activity associated with development in the LSA appears to be increasing wildlife movement and that caribou used southern portions of the LSA in the past, particularly in summer. Mr. Gauthier has observed an increase in moose over the last few years, as well as high numbers of wolf tracks. The LSA appears to support a broad range of species, including black bears (particularly near the lakes), wolverine (near the lakes in the northern section of the LSA), fisher, fox and lynx. Relatively few fisher have been trapped recently, and there have been very few signs of river otter.

Interviews were conducted with a number of traditional land users, including members of the Fort McMurray Métis Local 1935, Willow Lake Métis Local 780, Chipewyan Prairie Dene First Nation (CPDFN), Heart Lake First Nation, Fort McMurray First Nation, and Chard Métis Local 214. Comments regarding their knowledge of wildlife within the LSA and concerns regarding potential impacts of the expansion Project and other developments were recorded. Information provided by traditional land users was incorporated into the wildlife baseline report and considered during the assessment of Project-related effects. Participants confirmed that a broad diversity of wildlife use the LSA including moose, caribou, lynx, fox, coyote, marten, mink, black bear, fisher, grizzly, otter, rabbit, beaver, muskrat, deer, ducks, geese, grouse, and bats. There is concern that caribou trails are being disrupted by seismic lines and roads, and that lichen will be lost with development. Participants also indicated that caribou were much less common in the area than in the past and suggested wildlife are avoiding the area because of increased traffic and noise. Predators, including black bears, grizzly bears, lynx, wolves and cougars are abundant in the LSA. There was also concern regarding loss of wildlife and declining populations, as well as the cumulative effects of development on wildlife, particularly for caribou.

3.4 FIELD SURVEYS

3.4.1 Great Divide Project Reconnaissance Surveys (May 2005)

Reconnaissance wildlife surveys conducted for in the Great Divide Project (OSL #60) area in 2005 indicated that moose, deer and black bear were common (Table 3-4). Some caribou sign was also recorded and a juvenile caribou was observed near the site of the existing Central Processing Plant on the west side of Highway 63.

3.4.2 Amphibian Surveys

Eleven stations were surveyed between 2015 hrs and 2400 hrs on May 25, 2007 (Figure 3-4). Surveys were focused in the northeast corner of the LSA, where most of the suitable amphibian habitat was located. Survey stations were centered on a waterbody, but were also assumed to include all habitats within 800 m of the station (Figure 3-4). Amphibians may also use wet

forests during their life cycle, and so these habitats were included incidentally in these surveys. Amphibian surveys were conducted under ideal survey conditions with low wind and noise levels, and temperatures between 5 and 10° C. Surveys were conducted in late May to maximize the probability of detecting Canadian toads, which have been recorded in the Lac La Biche area in mid to late May (Garcia et al. 2004). Survey timing was also appropriate for western toads, which call between April and June (Environment Canada 2006). Almost all of the waterbodies in the LSA were surveyed, as well as over 30% of the marsh habitat and 41% of the sedge meadow habitat (Table 3-5). A relatively large proportion of bog and fen habitat occurs in the LSA which could provide suitable breeding habitat for amphibians.

Table 3-4
Summary of mammalian and avian sign recorded in the Great Divide Project area.

Species	Type of Sign			Totals
	Scats	Tracks	Other	
Moose	28	12	1	41
Deer spp.	19	6	0	25
Black bear	12	3	0	15
Ruffed grouse	2	0	1	3
Woodland caribou	2	2	1	5
Grey wolf	1	1	0	2
Coyote	1	2	0	3
Sandhill crane	0	1	0	1

Table 3-5
Areal extent of amphibian habitat assessed during amphibian surveys in the LSA.

Habitat	Area Surveyed (ha)	Area Available (ha)	Proportion Surveyed (%)
Young shrubby bog/fen	362.8	3,679.1	10.0
Old shrubby bog/fen	95.5	1,701.2	5.6
Young treed bog/fen	94.5	743.2	12.7
Sedge meadow	81.9	199.6	41.0
Waterbody	75.1	76.3	98.4
Old treed bog/fen	41.9	1,022.4	4.1
Marsh	0.9	3.0	30.7
Totals	**752.6**	**7,424.8**	**10.1**

Habitat in the LSA was also categorized into seven wetland classes (GDC 2010, Table 3-6), that accounted for 49.8% of the area. The most common wetland type was wooded bog (BTNN), followed by open fen with shrub (FONS) and open fen with low shrub cover (FONG). Forested swamp and wood swamp classes were not surveyed. A relatively small proportion of the total

available wetland was surveyed but surveys were focused on areas where the likelihood of detecting breeding amphibians was thought to be greatest.

Table 3-6
Area of wetland classes (GDC 2010) assessed during amphibian surveys in the LSA.

Wetland Class	Description	Area Surveyed (ha)	Area Available (ha)	Proportion Surveyed (%)
BTNN	Wooded bog (open canopy between 6 – 70% cover) with no permafrost or internal lawns	438.1	4,147.1	10.6
SFNN	Forested swamp with >70% canopy cover (Sb, Lt)	0.0	149.3	0.0
FONS	Open fen with no permafrost or patterning and shrub cover >25%	90.4	1,193.5	7.6
FONG	Open fen with no permafrost, patterning or internal lawns (shrub cover ≤25%)	82.1	208.6	39.4
FTNN	Wooded fen (open canopy between 6 – 70% cover) with no patterning or internal lawns	78.0	1,863.1	4.2
STNN	Wooded swamp (open canopy between 6 – 70%)	0.0	9.5	0.0
MONG	Marsh with >25% emergents	1.1	3.2	35.3
Totals		**689.7**	**7,574.3**	**9.1**

Amphibians were recorded at 10 of the 11 survey stations. Two species were detected, including wood frog and chorus frog, which is similar to results from other projects in the oil sands region (Westworth, Brusnyk and Associates 1996a, Golder 2000, Suncor 2000, AXYS 2001b). The species detected most often was the boreal chorus frog (Table 3-7), which was recorded at all but one amphibian survey station (Figure 3-4). Wood frogs were recorded at two stations during the May surveys, but appeared to be more common later in the summer when noted as incidental observations.

Table 3-7
Locations and numbers of amphibians recorded in the LSA, May 2007.

Species	Number	Zone	Easting	Northing
Boreal chorus frog	1 -10	12U	454252	6221696
	1 – 10	12U	457640	6222108
	11 – 20	12U	452478	6217975
	11 – 20	12U	455982	6221877
	11 – 20	12U	452899	6221832
	11 – 20	12U	452353	6220929
	11 – 20	12U	452127	6220272
	11 – 20	12U	452064	6220435
	11 – 20	12U	451773	6219738
	11 – 20	12U	451581	6218352
	11 – 20	12U	449031	6218421
	11 – 20	12U	449215	6218625

Species	Number	Zone	Easting	Northing
	1 – 10	12U	452453	6218308
	1 - 10	12U	452687	6222410
	1 – 10	12U	450557	6220840
Wood frog	11 - 20	12U	449118	6218573
Boreal toad	1 - 10	12U	455885	6223741

A single boreal toad was observed along the edge of a winter road in July 2007, at the northern edge of the LSA adjacent to a proposed borrow pit and soil/topsoil pile (Figure 3-4). At the time of the sighting, the winter road was characterized as wet graminoid surrounded by regenerating black spruce and pine forest. This species can disperse a large distance from waterbodies (Wind and Dupuis 2002), and therefore, the toad may have been far from potential breeding habitat. No Canadian toads were recorded in the LSA during surveys despite ideal timing and survey conditions, suggesting either that there is little habitat for this species in the LSA or that survey effort was insufficient to detect this rare species. Neither Canadian nor western toads were recorded at Meadow Creek (PetroCanada 2001) or Firebag (Suncor 2000), although Canadian toads were noted at Surmont by AXYS (2001b).

3.4.3 Breeding Bird Surveys

Sixty-three breeding bird stations were surveyed between June 13 and 17, 2007 (Figure 3-5) in 11 habitat types throughout the LSA (Table 3-8). While all habitats were surveyed, sampling occurred in proportion to the availability of each type in the LSA. Location of survey stations was also dependent on access and size and configuration of habitat patches (i.e., each station was placed so that it was at least 100 m from the edge of another habitat type). Disturbed and waterbody habitats were not sampled during the breeding bird surveys; however, the latter type was surveyed during the waterbird surveys in May 2007.

Table 3-8
Habitat types surveyed during breeding bird surveys in the LSA.

Wildlife Habitat	No. Stations	Area Surveyed (ha)	Area Available (ha)
Young mixed coniferous	16	12.6	4,879.0
Young shrubby bog/fen	10	7.9	3,679.1
Young mixedwood	7	5.5	913.6
Old shrubby bog/fen	6	4.7	1,701.2
Old treed bog/fen	6	4.7	1,022.4
Young treed bog/fen	6	4.7	743.2
Sedge meadow	5	3.9	199.6
Old mixed coniferous	3	2.4	1,249.0
Old deciduous	2	1.6	72.5
Marsh	1	0.8	3.0
Young deciduous	1	0.8	68.8
Totals	**63**	**49.5**	**14,531.4**

Fifty-two avian species were recorded during the breeding bird surveys including incidental observations (i.e., outside the 50 m point-count radius; Table 3-9). Thirty-nine songbird species were recorded, which is similar to or higher than other projects in the oil sands (e.g., Suncor 2000, Petro Canada 2001, IORVL 2006). Several of these species, including least flycatcher, common yellowthroat and western tanager, are considered "Sensitive" in Alberta, while the olive-sided flycatcher is listed as "Threatened" by COSEWIC. A number of waterbirds and shorebirds were also recorded, including common loon, Canada goose, sandhill crane, sora, greater and lesser yellowlegs, Wilson's snipe, killdeer, common tern and an unidentified duck species.

Table 3-9
Summary of bird species recorded during breeding bird surveys conducted in the LSA.

Common Name[1]	Common Name	Common Name	Common Name
Common loon	Olive-sided flycatcher	Golden-crowned kinglet	Common yellowthroat
Canada goose	Western wood-pewee	Ruby-crowned kinglet	Wilson's warbler
Duck sp.	Yellow-bellied flycatcher	Hermit thrush	Western tanager
Sharp-shinned hawk	Alder flycatcher	American robin	Chipping sparrow
Sandhill crane	Least flycatcher	Tennessee warbler	Clay-colored sparrow
Sora	Dusky flycatcher	Orange-crowned warbler	Le Conte's sparrow
Killdeer	Eastern kingbird	Yellow warbler	Song sparrow
Greater yellowlegs	Philadelphia vireo	Magnolia warbler	Lincoln's sparrow
Lesser yellowlegs	Gray jay	Yellow-rumped warbler	Swamp sparrow
Yellowlegs sp.	Common raven	Palm warbler	White-throated sparrow
Wilson's snipe	Tree swallow	Blackpoll warbler	Dark-eyed junco
Common tern	Black-capped chickadee	American redstart	Brown-headed cowbird
Northern flicker	Boreal chickadee	Mourning warbler	Purple finch
Woodpecker sp.			

[1] For scientific names, refer to Appendix 1.

White-throated sparrow was the most commonly detected species, and was recorded in all habitats except for young deciduous (Table 3-10). Dark-eyed junco and alder flycatcher were also relatively abundant, with both also occurring in all habitats but young deciduous. Other common species included palm warbler, hermit thrush, Tennessee warbler and yellow-rumped warbler, which were also frequently recorded in other oil sands leases (Suncor 2000, PetroCanada 2001, IORVL 2006). Among the listed species, common yellowthroat, olive-sided flycatcher and western tanager were the most frequently detected. Common yellowthroats were most abundant in bog/fen habitats, which tend to be wet and relatively open, as preferred by this species (FAN 2007). Olive-sided flycatchers tend to favour bogs and muskeg, as well as burned areas with snags (Semenchuck 1992). The LSA apparently provides an abundance of suitable habitat for this federally "Threatened" species. Western tanagers are typically found in open coniferous and mixedwood forests, and occasionally deciduous stands (FAN 2007). In the

LSA, this species occurred in young mixed coniferous (2), old shrubby bog/fen (1), and old deciduous (1). The sora is a bird of wetlands and sedge meadows (FAN 2007), which reflects habitat use in the LSA. Least flycatchers prefer edges of open deciduous or mixedwood forest, as well as burned areas (FAN 2007), such as the young regenerating forest in the LSA.

Table 3-10
Summary of bird densities recorded in the LSA.

Species	Density (territories/40 ha)	Species	Density (territories/40 ha)
White-throated sparrow	46.91	Song sparrow	2.43
Dark-eyed junco	44.48	Tree swallow	2.43
Alder flycatcher	42.87	Wilson's snipe	2.43
Palm warbler	16.18	Western wood-pewee	2.43
Hermit thrush	15.37	Swamp sparrow	1.62
Tennessee warbler	11.32	Yellowlegs spp.	1.62
Common yellowthroat	8.09	Yellow warbler	1.62
Yellow-rumped warbler	7.28	Brown-headed cowbird	0.81
Chipping sparrow	6.47	Blackpoll warbler	0.81
Ruby-crowned kinglet	6.47	Clay-coloured sparrow	0.81
Gray jay	5.66	Common loon	0.81
Olive-sided flycatcher	5.66	Common raven	0.81
Mourning warbler	4.85	Eastern kingbird	0.81
Boreal chickadee	4.04	Golden-crowned kinglet	0.81
Least flycatcher	4.04	Killdeer	0.81
Lincoln's sparrow	4.04	Le Conte's sparrow	0.81
Western tanager	4.04	Lesser yellowlegs	0.81
Greater yellowlegs	3.24	Magnolia warbler	0.81
Wilson's warbler	3.24	Northern flicker	0.81
American robin	2.43	Philadelphia vireo	0.81
Orange-crowned warbler	2.43	Sora	0.81
Purple finch	2.43	Woodpecker spp.	0.81

The overall density of songbird territories in the LSA was 278 breeding territories/40 ha (Table 3-10). This density of breeding male songbirds is high relative to other boreal songbird densities that have been recorded in northeastern Alberta. For example, 194 breeding territories/40 ha were recorded east of the Athabasca River in the Oilsands region (IORVL 2006), 202 breeding territories/40 ha were recorded in central Alberta west of the Athabasca River (AXYS 1999b), and 183 breeding territories/40 ha were recorded east of the Athabasca River (AXYS 2001b). Other reported densities in the region included 173 breeding territories south of Fort McMurray (AXYS 2000), 163 breeding territories/40 ha southwest of Fort MacKay (AXYS 1999c), and 142 breeding territories/40 ha in the Cold Lake area (AXYS 1999a).

Highest songbird densities were recorded in old treed bog/fen, marsh and deciduous habitat types (Table 3-10). The latter two types, however, had only one or two stations each and therefore caution should be used when interpreting these results. Sedge meadow, old mixed coniferous and young deciduous also had relatively high densities of breeding bird territories. Shrubby bog/fen of all ages, young mixedwood and young treed bog/fen had the lowest densities. Similar to Suncor (2000), there were no apparent differences in songbird richness or diversity between lowland (bog/fen) and upland habitats, although other studies have reported higher richness in upland hardwood and mixedwood forests (Schieck et al. 1995; Westworth, Brusnyk and Associates 1996b). As suggested by Petro Canada (2001), these unexpected results may be related to lower sample size in upland habitats.

As previously mentioned, many of the "Sensitive" species recorded tend to prefer bogs, fens, open habitats and burns, all of which are abundant in the LSA. No old-growth dependent warblers, such as black-throated green warbler or Cape May warbler, were detected. This is either related to a lack of suitable habitat or paucity of survey stations in old upland stands. In general, ground gleaners such as Lincoln's sparrow, Wilson's warbler, common yellowthroat and Le Conte's sparrow, were relatively common in the LSA, and are indicative of young forests (Kirk et al. 1996).

Table 3-11
Summary of bird density, species richness, and diversity index (Shannon-Wiener Index) by habitat type in the LSA.

Habitat Type	No. Stations	Density (Territories/40 ha)	Species Richness	Diversity Index
Young mixed coniferous	16	262.1	23	1.081
Young shrubby bog/fen	10	234.4	15	1.006
Young mixedwood	7	262.1	14	0.984
Old shrubby bog/fen	6	237.8	15	1.069
Old treed bog/fen	6	356.7	16	1.087
Young treed bog/fen	6	229.3	15	1.072
Sedge meadow	5	315.9	19	1.209
Old mixed coniferous	3	305.7	12	1.009
Old deciduous	2	356.7	9	0.888
Marsh	1	356.7	7	0.845
Young deciduous	1	289.8	4	0.602
Totals	**63**	**278.2**	**44**	**1.269**
Young forest	40	259.9	31	1.155
Old forest	17	305.7	25	1.212
Totals[1]	**57**	**273.5**	**35**	**1.213**

[1] Excluding unforested types (marsh and sedge meadow).

Breeding bird data were also summarized by stand age (i.e., young or old forest, excluding marsh and sedge meadow from the analysis; shrubby bog/fen was assumed to be a forested type because of the presence of black spruce and tamarack). Results indicated that density of breeding territories was higher in old forests than in young stands, as was species diversity (Table 3-11). This is consistent with the findings of Kirk et al. (1996), who reported that the density of neotropical migrants (the majority of birds detected in the LSA) increased with forest age. The results emphasize the importance of avoiding development within remaining areas of old unburned forest within the LSA whenever possible.

3.4.4 Nocturnal Owl Surveys

Owl surveys were conducted on March 28 and 29, 2007 at 31 stations established throughout the LSA (Figure 3-6). No stations were located in the north extension area, which was not part of the LSA at the time the surveys were conducted. Winds were generally fairly strong on both nights (up to 20 km/hr) and likely affected survey results by limiting the broadcast and observer detection range. The 31 survey stations covered 39.3% of the LSA. Habitat types were surveyed in close proportion to their availability throughout the LSA (Table 3-12), with the exception of old coniferous and treed bog/fen habitats, some of which occurred in the north extension area and was not sampled.

Table 3-12
Area of wildlife habitat assessed during owl surveys in the LSA

Habitat	Area Surveyed (ha)	Area Available (ha)	Proportion Surveyed (%)
Young mixed coniferous	2,209.8	4,879.0	45.3
Young shrubby bog/fen	1,344.2	3,679.1	36.5
Old shrubby bog/fen	563.4	1,701.2	33.1
Young mixedwood	508.5	913.6	55.7
Old mixed coniferous	358.6	1,249.0	28.7
Old treed bog/fen	317.7	1,022.4	31.1
Young treed bog/fen	255.1	743.2	34.3
Old mixedwood	123.3	331.2	37.2
Disturbance	110.9	430.6	25.8
Sedge meadow	85.8	199.6	43.0
Waterbody	55.7	76.3	73.0
Old deciduous	27.0	72.5	37.2
Young deciduous	20.6	68.8	29.9
Marsh	1.1	3.0	36.7
Totals	**5,981.6**	**15,370**	**39.3**

Two owl species were recorded in the LSA during the nocturnal owl surveys: great horned owl (3 detections) and boreal owl (4 detections) (Figure 3-6; locations are approximate based on direction and distance class estimates). Similar results were reported at CNRL Kirby (2008), while barred owls and great gray owls were recorded in addition to great horned and boreal owls at Suncor Firebag (2000). At the Meadow Creek project (Petro Canada 2000), barred owls were the most frequently recorded species during call playback surveys, followed by great horned owl, boreal owl and great gray owl. Two northern saw whet owls were recorded incidentally during other surveys (Petro Canada 2000).

Three additional species were detected incidentally during other surveys conducted in the LSA (Figure 3-7) including six northern hawk owls (an additional two observations just south of the LSA boundary), one boreal owl, one barred owl and one great gray owl (an additional observation south of the LSA). Of the five species detected within the LSA, two are considered "Sensitive" in Alberta: barred owl and great gray owl. Unfortunately, the UTM coordinates of the barred owl was not recorded in the field, so the exact location is not known.

The northern hawk owl was the most commonly detected species in the LSA, with all detections occurring incidentally during other field surveys and site visits. The northern hawk owl breeds in moderately dense coniferous or mixedwood forests bordering marshes or other open areas (Duncan and Duncan 1998). Fire is considered important in providing nest sites (i.e., snags, burnt or rotted-out cavities), improving small mammal habitat and open hunting habitat. The LSA likely provide high quality nesting habitat for the northern hawk owl because of the prevalence of burnt, regenerating coniferous forest, although many of the birds observed during the late winter surveys may move further north to breed.

The boreal owl was the second most common species recorded in the LSA. This species is typically associated with old forest stands with an abundance of dying trees that provide natural cavities or woodpecker cavities for nesting (Heinrich et al. 1999). Home range sizes tend to be highly variable, and are usually larger during winter. Average summer home ranges vary between 296 ha and 1,182 ha (Palmer 1986, Hayward et al. 1993).

Great horned owl was the third most common species detected in the LSA. The great horned owl uses a wide range of habitat types in North America, including the boreal forest north to the treeline, deserts and suburban areas (Houston et al. 1998). Great horned owls forage on mice, rabbits, grouse, fish and even skunks (Fisher and Acorn 1998). Territory sizes are reportedly fairly large (average of 483 ha in Kluane, Yukon), while the home ranges of non-territorial birds is even larger (e.g., 725 ha) and is likely correlated with prey availability (Rusch et al. 1972).

A single barred owl was observed in the LSA during the early winter track surveys. No barred owls responded to broadcast calls during the nocturnal owl surveys. This species most often inhabits forested areas, and prefers large unfragmented tracts of forest (Mazur and James 2000). In Alberta, barred owls tend to select old mixedwood forest (Takats 1998), and maintain relatively large home ranges year-round. Annual home ranges can approach 1,000 ha in size, while breeding home ranges vary from 149 to 321 ha (Mazur and James 2000).

A single great gray owl was heard during the quiet period prior to broadcasting calls at a survey station. A great gray owl was also observed just south of the LSA during bat surveys conducted in July, 2007. The great gray owl prefers boreal forest with sphagnum bogs, fens and other open spaces for foraging. The density of birds tends to vary greatly and is influenced by food supply and nest site availability, about which little is known (Bull and Duncan 1993).

3.4.5 Forest Raptor Surveys

Raptor surveys were conducted from May 23 - 26, 2007 at 25 broadcast stations established in the LSA (Figure 3-8). These stations represented a survey area 1,822 ha for forest raptors in the LSA. Each survey plot was 78.5 ha in size and all contained several different habitat types (Table 3-13). Surveys were generally centered in older forest types, but site selection was affected by access. Most of old mixedwood forest was located in the northern portion of the LSA and was therefore not surveyed for forest raptors.

Table 3-13
Area surveyed by habitat type during forest raptor surveys conducted in the LSA.

Habitat	Area Surveyed (ha)	Area Available (ha)	Proportion Surveyed (%)
Young shrubby bog/fen	425.5	3,679.1	11.6
Young mixed coniferous	381.6	4,879.0	7.8
Old shrubby bog/fen	236.1	1,701.2	13.9
Young mixedwood	215.1	913.6	23.5
Old mixed coniferous	151.4	1,249.0	12.1
Young treed bog/fen	140.8	743.2	18.9
Old treed bog/fen	112.9	1,022.4	11.0
Sedge meadow	50.8	199.6	25.5
Disturbance	48.1	430.6	11.2
Waterbody	37.1	76.3	48.6
Old mixedwood	9.0	331.2	2.7
Young deciduous	7.8	68.8	11.3
Old deciduous	6.1	72.5	8.4
Old mixedwood	0.0	331.2	0.0
Totals	**1,822.2**	**15,370**	**11.9**

No raptors responded to the broadcast call surveys; however, two red-tailed hawks and a merlin were recorded incidentally. Another unidentified forest raptor was also recorded during the May field surveys. The most notable raptor observation was made on October 9, 2008 when a northern goshawk was recorded in the southeast corner of the LSA in a patch of mature white spruce and birch (Figure 3-7). Raptors are believed to be present in low numbers in the oil sands region, and are likely limited by availability of, and competition for, suitable nesting habitat

(Suncor 2000, Petro Canada 2001). The most commonly recorded raptor species in the region were northern goshawks, northern harriers and red-tailed hawks, followed by eagles and ospreys (Suncor 2000, AXYS 2001b, Petro Canada 2001).

3.4.6 Waterbird Surveys

Waterbird surveys were conducted on May 25 and 26 2007 between 0800 and 1900 hours. All waterbodies (six) in the LSA were surveyed (Figure 3-9). Surveys were conducted under good conditions, with excellent visibility. Nine species of waterbirds were recorded during the field surveys (Table 3-14). Overall, common loon and ring-necked duck were the most common species recorded (Table 3-14). Both greater and lesser yellowlegs were also relatively common in the LSA. Greater yellowlegs prefer bogs, sedge meadows and beaver ponds for nesting, while lesser yellowlegs breed in grassy ponds and open forests (FAN 2007, Fisher and Acorn 1998), all of which are relatively common habitats in the LSA.

Table 3-14
Species observed during the waterbird surveys conducted in the LSA.

Lake	Common Name	Number of Birds				Density (birds/ha)
		Male	Female	Pair	Unknown	
1	Blue-winged Teal			1		2.8
	Bufflehead			1		
2	Common Loon			1		0.2
	Lesser Yellowlegs				1	
3	Common Loon				2	0.2
	Mallard				2	
	Bonaparte's Gull				2	
4	Common Loon			1		0.5
5	Common Loon			1		0.6
	Mallard			1		
	Green-winged Teal			1		
	Ring-necked Duck			2		
	Greater Yellowlegs				1	
	Yellowlegs sp.				4	
6	Ring-necked Duck	2	1			10.9

The highest number of species was recorded on Lake 5 (Table 3-14), which was also the largest waterbody surveyed. Lakes 4 and 6 each had a single species (common loon and ring-necked duck, respectively). Waterbird density was calculated for each lake by dividing the total number of waterbirds recorded by the area of each waterbody (Table 3-14). Lakes 1 and 6 had the smallest area and the highest density of waterbirds. Lakes 3 and 5 were the largest waterbodies, and had densities of 0.2 and 0.6 waterbirds/ha, respectively.

Other waterbird species were also recorded during other wildlife surveys conducted in the LSA including solitary sandpiper, killdeer, Wilson's snipe and sandhill crane. Sandhill crane was the only "Sensitive" species incidentally detected. The area likely provides relatively good habitat for the sandhill crane, as it is relatively remote and dominated by bogs and shrubs.

Overall, waterbird diversity and abundance was fairly low in the LSA. Potential reasons include insufficient food resources or lack of suitable nesting habitat compared to the prairies. Habitat conditions in spring 2007 were considered the best they had been in many years in the prairie and parkland regions (DUC 2007a), while summer forage was rated as highly abundant (DUC 2007b). Given these excellent conditions in central and southern Alberta, most waterfowl likely selected these areas for breeding. In addition, most waterbodies in the LSA are relatively small, and may not be capable of supporting large numbers of waterbirds.

3.4.7 Aerial Ungulate Surveys

Three aerial surveys of the LSA were conducted over a two year period (Table 3-15). Conditions during all surveys were considered highly favourable for sighting ungulates. Visibility was high due to clear weather conditions, presence of complete snow cover and the openness of the habitat (e.g., recently burned). In 2006/07, 65.7 km^2 of LSA was surveyed while in 2007, 76.2 km^2 was surveyed, representing approximately 50% coverage of the LSA.

Table 3-15
Details of aerial ungulate surveys conducted throughout the LSA

Survey	Date	Temp (°C)	Wind (kph)	Visibility	Area Surveyed (km^2)
2006/07 Surveys					
Early Winter	02-Dec-06	-33	<5	Clear	65.7
Late Winter	09-Mar-07	-2	25	Clear	65.7
2007/08 Surveys					
Early Winter	06/07-Dec-07	-23	15	Clear	76.2

During the 2006 early winter aerial survey, 22 moose were recorded in the LSA, for an overall density of 0.34 moose/km^2 (Table 3-16, Figure 3-10). The sex ratio was 36 bulls:100 cows and most females (64%) had calves. Only eight moose were observed during the late winter survey conducted in 2006/07 for a density of 0.12 moose/km^2 (Table 3-16, Figure 3-11). A single bull and five cows were observed, with two of the cows having one calf each (i.e., 40 calves:100 cows). Moose densities were again higher in early winter during the December 2007 aerial survey. Fourteen cows, two bulls and 13 calves were recorded, for a density of 0.38 moose/km^2 (Table 3-16, Figure 3-12). The ratio of calves to cows was extremely high, while the bull:cow ratio was the lowest of all three surveys.

Table 3-16
Results of aerial surveys conducted in the LSA

Survey	Moose	
	Density (moose/km^2)	Sex Ratio (bull:cow:calf)
December 2006	0.34	36:100:64
March 2007	0.12	20:100:40
December 2007	0.38	14:100:93

The densities and demographics of moose recorded in the LSA are within the ranges reported by ASRD (2006). Typical moose densities in Moose Management Unit 8 range from 0.10 – 0.62 moose/km^2, while bull:cow and calf:cow ratios range from 27- 87 bulls and 35 – 54 calves:100 cows. Moose population density in Wildlife Management Unit (WMU) 512, located immediately south of WMU 519, in which the LSA is located, was reported to be 0.19 moose/km^2 in 2005, with 40 bulls and 53 calves:100 cows (January 31 – February 3, Found 2005). Calf:cow ratios were relatively high during the early winter surveys, but lower in late winter, possibly related to predation or snow depths that prohibited movement by calves.

Low moose numbers in late winter could be related to several factors. Hauge and Keith (1981) reported that moose in northeastern Alberta tended to occupy lowlands in early winter, but moved back to upland habitats as snow depth increased in late winter. Since most of the LSA was composed of lowland habitat, it is likely that many moose moved out of the area in late winter. In addition, increased seismic activity throughout much of the LSA in late winter (March 2007) may have caused many moose to temporarily vacate the area. Further, low moose numbers could be related to hunting and predation pressure that either forced moose to move out of the area or reduced population numbers.

Since the total area surveyed is relatively small on a regional scale, caution should be used when drawing conclusions regarding the moose population in the region. However, given that three surveys were conducted over two years, there is a reasonable amount of data at the local scale and can make some inferences on moose in the LSA. A sex ration of 30 bulls:100 cows typically allows for an antlered-only resident moose season (Found 2005, ASRD 2009b). In two of the three aerial surveys, the ratio of bulls was substantially less. This may indicate either that aboriginal hunting (both cows and bulls tend to be harvested equally, Found 2005) is relatively low, or alternatively, that licensed hunting is exceeding capacity. Calf recruitment, however, appears to be quite high, despite the relatively low numbers of bulls in the LSA. As Found (2005) commented, long term population monitoring in the area will be required to properly determine the cause of moose population trends and demographics.

Neither caribou nor wolves were directly observed in either the early or late winter aerial surveys conduct in 2006 or 2007. However, caribou tracks were observed in several locations throughout the LSA, including the southeast portion of the LSA in early winter and the northwest corner in late winter. Seismic crews were working just south of the caribou tracks in the latter area, which suggests that the animals may have moved north and west, away from the

disturbance. In their study of the response of caribou to geophysical exploration, Penner and Duncan (1983) found little evidence of short-term impacts, other than potentially lower movement rates. Overall, caribou appeared to be tolerant of seismic activity and did not abandon their traditional winter range. These results indicate that any movement away from seismic activity in the LSA was likely temporary and unlikely to have significant impacts on caribou. Indeed, subsequent data collected during the wildlife camera monitoring program confirms that although caribou occur infrequently in the LSA during the winter, they are relatively common during the remainder of the year. It is unclear if this trend is directly attributed to disturbance associated with seismic exploration, or also related to forage availability, snow conditions, or other factors.

Incidental observations of ungulate presence in the LSA included a single cow moose just south of the LSA in December 2006, and 15 moose (nine cows, five calves and one bull) in March 2007. Incidental observations of ungulates during the December 2007 surveys included 25 moose: 6 bulls, 3 cows and 8 cow/calf pairs. Several small herds of caribou (total of 12 animals) were observed 12-15 km south of the LSA during the 2006/07 early winter surveys. Older caribou tracks in the southern portion of the LSA were recorded during the same survey. In December 2007, three caribou were observed just south of the LSA; one group of two and a single individual.

One pack of 15 wolves (density 0.22 wolves/km^2) was observed within the LSA in December 2007, just north of the Great Divide plant (Figure 3-12). Wolf pack size in northeastern Alberta ranges between two and 13 individuals during the winter (Fuller and Keith 1980), with larger packs during the winter months (ASRD 2009c). The observation of such a large wolf pack in the LSA may reflect the relatively high density of moose, the wolf's primary prey species. Wolf abundance may also be relatively high because of improved access in the area, with features such as roads and seismic lines providing relatively easy travel routes. The presence of a wolf pack in the area has important implications for woodland caribou, an alternate prey species.

3.4.8 Winter Track Surveys

One-hundred-fifteen transects were surveyed in the LSA between December 2006 and December 2007 (Figure 3-13), representing a total survey effort of 62.8 km (Table 3-17). Transects were located in all habitat types except old mixedwood (Table 3-17), although habitats were generally sampled in proportion to their availability in the LSA (Table 3-17). The most frequently sampled habitats were young mixed coniferous and young shrubby bog/fen, which were found to have the highest species richness, along with old shrubby bog/fen and old treed bog/fen. There was a significant positive correlation (two tailed Spearman Correlation test, $R=0.89$, $p<0.01$) between total length of transect surveyed in each habitat type and species richness, indicating that the number of species detected increased with survey effort. Track frequency, however, was not affected by transect length, although a larger sample size is expected to yield more representative results.

Track frequency (tracks/km/day) was much higher in old treed bog fen habitat compared to other types (Table 3-17). Average track frequency was also relatively high in young and old mixed coniferous. Track frequency was lowest on waterbodies, which was expected since these features do not provide forage or shelter for wildlife, and are likely just used for travel. Other low use habitats were the sedge meadow, old deciduous and disturbance types. When habitat types were divided into young and old forest, results indicated that track frequency was higher in old stands, although the same number of species was detected in age classes. These data suggest that remnant patches of old forest are important for wildlife in the LSA.

Table 3-17
Summary of winter track survey results in the LSA

Habitat Type	Length (m)	Track Frequency (tracks/km/day)	Species Richness	Average Snow Depth (cm)
Young mixed coniferous	18,550	14.6	14	42.8
Young shrubby bog/fen	14,850	7.5	11	43.1
Old shrubby bog/fen	8,025	9.5	11	42.6
Young mixedwood	4,500	12.2	8	41.3
Old mixed coniferous	4,300	19.3	9	38.2
Old treed bog/fen	3,875	27.2	11	46.5
Young treed bog/fen	3,425	5.0	9	46.0
Waterbody	2,675	2.1	4	43.0
Sedge meadow	1,250	6.6	5	45.4
Old deciduous	500	8.8	5	46.6
Young deciduous	500	11.0	3	39.0
Disturbance	350	9.3	3	No data
Old mixedwood	0	n/a	n/a	n/a
Totals	**62,800**	**14.6**	**15**	**42.8**
Young forest	**41,825**	**10.1**	**13**	**42.4**
Old forest	**16,700**	**16.2**	**13**	**43.5**

Snow depth is important because many wildlife species have difficulty moving through very deep snow, and may either travel beneath it (e.g., mustelids) or avoid the area entirely (e.g., deer). In either case, track frequency may be relatively low under conditions of deep snow. It was expected that snow depths would be highest in open and deciduous habitats, where there was no coniferous canopy to break the snow fall. This was not evident as snow depth was similar among all habitat types (Table 3-17).

3.4.8.1 Mustelids

Five mustelid species (weasels) were recorded during the winter track surveys including ermine, American marten, mink, least weasel, and fisher (Table 3-18). Ermine and marten were the

most commonly detected species, while least weasel, mink, and fisher were uncommon. Of these five species, only fisher is considered "Sensitive" in Alberta.

Ermine were recorded in all habitat types surveyed except disturbance (Table 3-18). Highest track densities were recorded in sedge meadow (4.4 tracks/km/day) and old mixed coniferous (3.4 tracks/km/day). Ermine were also relatively common in other coniferous habitats, such as old treed bog/fen (2.7 tracks/km/day) and old shrubby bog/fen (2.4 tracks/km/day) but were more abundant in old than young coniferous habitats. Track frequency was twice as high in the LSA compared to the Gulf Surmont study area 50 km away (1.0 tracks/km/day, AXYS 2001b). Ermine prefer coniferous, mixed or riparian stands (Pattie and Fisher 1999), but in the LSA may have found more abundant forage resources (e.g., red-back voles) in the older habitats.

Table 3-18
Track frequency of mustelid species in the LSA.

	Track Frequency (tracks/km/day)				
Habitat Type	**Ermine**	**American Marten**	**Mink**	**Least Weasel**	**Fisher**
Disturbance	0.00	4.8	0.0	0.0	0.7
Old deciduous	2.5	0.0	0.0	0.0	0.0
Old mixed coniferous	3.4	2.1	0.0	0.0	0.0
Old shrubby bog/fen	2.4	0.8	0.0	<0.1	0.0
Old treed bog/fen	2.7	9.3	0.0	0.0	0.2
Sedge meadow	4.4	0.3	0.0	0.0	0.0
Waterbody	0.8	0.0	0.2	0.0	0.0
Young deciduous	2.0	0.0	0.0	0.0	0.0
Young mixed coniferous	2.0	3.6	0.0	<0.1	0.1
Young mixedwood	1.5	2.4	0.0	0.0	0.0
Young shrubby bog/fen	1.6	1.4	0.0	0.0	<0.1
Young treed bog/fen	1.6	0.8	0.0	0.4	0.0
Average	**2.1**	**2.1**	**<0.1**	**<0.1**	**0.1**

Marten were recorded in all but three of the habitat types surveyed (young and old deciduous, and waterbody). Marten track density was particularly high in old treed bog/fen (9.3 tracks/km/day). This type along with other coniferous habitats provide excellent winter habitat for martens because the canopy provides excellent thermal cover and snow interception. Marten usually prefer mature coniferous forests with numerous dead trunks and branches (coarse woody debris and snags) that provide cover for its rodent prey (Pattie and Fisher 1999). The young, regenerating forest in the LSA has a relatively high density of snags (400 – 600 snags/100 ha), and marten track density had a significant positive correlation (r=0.402, p=0.000) with snag density (determined from the AVI database). Overall track frequency was much higher in the LSA than the 0.1 tracks/km/day observed in the Gulf Surmont study area (AXYS 2001b), where this species was most abundant in coniferous-dominated mixedwood forest.

Mink were detected only once, along the shoreline of a waterbody (Table 3-18). Mink are usually associated with riparian communities and lowland drainage habitat types (Pattie and Fisher 1999). In the Gulf Surmont area, mink were detected in deciduous and mixedwood forests and graminoid fen (AXYS 2001b).

Least weasels were recorded in three habitat types including young treed bog/fen, young mixed coniferous and old shrubby bog/fen (Table 3-18). They were most abundant in young treed bog/fen, but so few tracks were observed overall (6 tracks), habitat associations could not reliably be inferred for this species. In the Gulf Surmont area, least weasel tracks were noted in various habitats, but were most common in white spruce/black spruce stands (AXYS 2001b). Least weasels use a variety of habitats from open farmlands to woodlands in isolated areas. Prey abundance (e.g., voles, mice, insects) tends to determine least weasel presence (Pattie and Fisher 1999).

Fisher is a “Sensitive” species in Alberta (AE/ASRD 2005) and a Priority 1 CEMA species (Table 2-6). Fisher typically occurs in dense forest in late successional stages (Pattie and Fisher 1999), which provide high quality denning, foraging and cover habitat. During winter track surveys conducted in the LSA, fisher was recorded in four habitat types. Surprisingly, track frequency was highest in disturbance habitat (edge of a well pad, Table 3-18). This high frequency was a result just a single set of tracks recorded over a relatively short length of transect. Fisher tracks were recorded along more transects in old treed bog/fen, which is considered high quality for this species, and in young mixed coniferous habitats.

3.4.8.2 Large Carnivores

Tracks of three large carnivores, coyote, grey wolf and lynx, were detected during field surveys (Table 3-19). Of these species, the two canids were the most frequently recorded, whereas lynx were relatively uncommon.

Table 3-19
Track frequency of large carnivores recorded in the LSA.

	Track Frequency (Tracks/km/day)		
Habitat Type	**Coyote**	**Grey Wolf**	**Lynx**
Disturbance	0.0	0.0	0.0
Old deciduous	0.0	0.0	0.0
Old mixed coniferous	0.0	0.0	0.1
Old shrubby bog/fen	0.4	0.1	0.0
Old treed bog/fen	0.3	0.3	0.0
Sedge meadow	0.0	0.0	0.0
Waterbody	0.0	0.8	0.0
Young deciduous	0.0	0.0	0.0
Young mixed coniferous	0.3	0.1	<0.1

Habitat Type	Track Frequency (Tracks/km/day)		
	Coyote	Grey Wolf	Lynx
Young mixedwood	0.7	0.0	0.0
Young shrubby bog/fen	0.4	0.0	<0.1
Young treed bog/fen	0.2	0.0	0.0
Average	**0.2**	**0.1**	**<0.1**

Although never particularly abundant, coyote tracks were more widely distributed among habitat types than other carnivores; they were detected in six of the 12 habitat types surveyed. Track densities were highest in young mixedwood (0.7 tracks/km/day) and shrubby bog/fen of all ages. These habitats provide relatively high quality winter cover and prey species such as snowshoe hare. Coyote track frequency in the Gulf Surmont area was 0.5 tracks/km/day overall, and most abundant in deciduous stands (AXYS 2001b). Coyote are habitat generalists and will use a broad diversity of habitats depending on prey availability and accessibility.

Grey wolf tracks were detected in four habitat types, but were most often observed on waterbodies (0.8 tracks/km/day). Wolves were most likely using waterbodies as unobstructed travel routes, particularly if they were travelling through windswept portions of frozen lakes. Grey wolf tracks were also noted along access routes throughout the LSA. Grey wolf tracks (three sets) were also recorded in the Algar PDA during a site tour on March 8, 2007. Wolves typically use access routes such as packed seismic lines or plowed roads for travel during periods of deep snow (Dyer 1999). Wolf tracks were also observed at low densities (0.1 tracks/km/day) in the Gulf Surmont area in a variety of habitats (AXYS 2001b).

Canada lynx were detected infrequently (0.03 tracks/km/day) in the LSA. Tracks were observed in just three habitats (old mixed coniferous, young mixed coniferous and young shrubby bog/fen). It was expected that since lynx are largely dependent upon snowshoe hare, lynx would select habitats with high hare densities. Indeed, the track surveys indicate that snowshoe hare frequency was relatively high in old mixed coniferous, indicating that lynx preference of this habitat type is related to prey availability. In contrast, snowshoe hare tracks were most common in old treed bog/fen, but lynx tracks were not recorded in this habitat type. Lynx prefer to hunt in moderately dense shrub (Fuller et al. 2007), and the old treed bog/fen may have been too dense for effective hunting. Lynx were much more widespread throughout the Gulf Surmont area and occurred in almost all habitat types (AXYS 2001b). Snowshoe hare densities were also much higher during the 2000 surveys conducted in the Surmont area compared to the LSA. Such results are not unexpected, as the population cycle of the snowshoe hare, which is synchronous throughout most of North America, peaks every nine to ten years (Boutin 1995).

3.4.8.3 Ungulates

Three ungulate species or groups were recorded during winter track counts including moose, deer and woodland caribou. Moose were the most frequently detected ungulate (0.9 tracks/km/day), followed by deer (0.4 tracks/km/day) and woodland caribou (0.01

tracks/km/day). Moose were recorded in all habitat types surveyed except for disturbance, waterbody and young deciduous (Table 3-20). Moose track densities were highest in old deciduous (3.7 tracks/km/day), which provides deciduous shrubs, such as willow and dogwood that are used as forage by moose. Moose were also relatively abundant in old treed bog/fen and sedge meadow. Although moose typically prefer upland habitats, they move into lowland bogs/fens in early winter under low snow depth conditions (Hauge and Keith 1981). Moose tracks were recorded more frequently in the LSA than in the Gulf Surmont area, where average track frequency was 0.5 tracks/km/day (AXYS 2001b).

Deer tracks were observed in six of the 12 habitat types. Densities were highest in the old treed bog/fen (2.0 tracks/km/day), young mixed coniferous (1.0 tracks/km/day), and young mixedwood (1.0 tracks/km/day) type (Table 3-20). Deer may have been attracted to young conifer because this habitat type was burned in 1995 and the regenerating shrubs provide suitable forage. The presence of deer in old treed bog/fen was unexpected, and potentially detrimental to caribou through the attraction of wolves. David Latham, in Croucher (2007) reported the recent increase in white-tailed deer and their use of peatland bogs in northeastern Alberta. In the Gulf Surmont area, deer tracks were abundant (3.4 tracks/km/day), and were most frequent in jack pine and mixedwood forests (AXYS 2001b). Deer were extremely rare in bog and fen types in the Surmont area, possibly because of the relative abundance of more suitable upland habitat, deeper snow or smaller deer populations in 2001 compared to 2007.

Table 3-20
Track frequency of ungulates in the LSA

	Track Frequency (Tracks/km/day)		
Habitat Type	**Moose**	**Deer spp.**	**Woodland Caribou**
Disturbance	0.0	0.0	0.0
Old deciduous	3.7	0.0	0.0
Old mixed coniferous	1.1	0.5	0.0
Old shrubby bog/fen	0.4	0.2	0.0
Old treed bog/fen	1.9	2.0	0.0
Sedge meadow	1.7	0.0	0.0
Waterbody	0.0	0.0	0.0
Young deciduous	0.0	0.0	0.0
Young mixed coniferous	0.6	1.0	<0.1
Young mixedwood	1.0	1.0	0.0
Young shrubby bog/fen	0.4	0.1	0.0
Young treed bog/fen	0.5	0.0	0.0
Average	**0.9**	**0.4**	**<0.1**

Woodland caribou are considered “At Risk” in Alberta and “Threatened” in Canada. Caribou tend to occur at very low densities, and the likelihood of detecting them during the track surveys was quite low. Woodland caribou were recorded at only one location in young conifer habitat.

Caribou typically prefer mature forest with abundant lichen, and may avoid burn areas because of the lack of forage (Dunford 2003), particularly during winter. The caribou recorded in our surveys may have been moving between remnant patches of older forest.

Deep snow will affect ungulate use of an area. Snow depths of 30 – 40 cm can limit the distribution of deer (Wallmo and Gill 1971). Deer tracks, however, were recorded along transects with an average snow depth of 37.5 cm. Habitat types in which snow depth was near or below the theoretical threshold were predominantly younger stands. Snow depths recorded in the LSA during the track surveys were unlikely to restrict movements of moose or caribou.

3.4.8.4 Rodents, Lagomorphs and Grouse

Red squirrels were recorded in the LSA, as well as snowshoe hare and grouse (Table 3-21). Of these species, snowshoe hare was the most common, and as such, likely functions as an important prey base for many species in the LSA. Snowshoe hare, a Priority 1 CEMA species because of its association with lynx and other predators (Hoover et al. 1999), was one of the most common species identified during the winter track surveys. Snowshoe hare were found in ten of the 12 habitat types. Track frequencies were highest in old treed bog/fen (8.4 tracks/km/day), young deciduous (7.0 tracks/km/day), and old mixed coniferous (4.8 tracks/km/day). These values were considerably lower than those reported during surveys conducted in the Gulf-Surmount area (77.4 tracks/km-day) located approximately 50 km east of the LSA. Snowshoe hare tend to be cyclic (Boutin et al. 1995), and therefore population numbers vary greatly among years. Snowshoe hare are typically found in dense shrub thickets or the forest understory with species such as willow, alder, rose, saskatoon, and conifer (Pattie and Fisher 1999). Such shrub species are commonly found in deciduous forests and in shrubby bogs or fens.

Table 3-21
Track frequency of rodents, lagomorphs and grouse in the LSA.

Habitat Type	Track Frequency (Tracks/km/day)		
	Red Squirrel	Snowshoe Hare	Grouse spp.
Disturbance	0.0	0.0	0.0
Old deciduous	0.7	0.5	0.0
Old mixed coniferous	6.4	4.8	0.6
Old shrubby bog/fen	1.7	1.4	1.3
Old treed bog/fen	1.7	8.4	0.2
Sedge meadow	0.4	0.2	0.0
Waterbody	0.4	0.0	0.0
Young deciduous	2.0	7.0	0.0
Young mixed coniferous	1.9	3.6	0.6
Young mixedwood	1.3	2.8	0.0
Young shrubby bog/fen	0.7	1.6	0.7
Young treed bog/fen	0.2	0.4	0.6
Average	**1.5**	**2.6**	**0.3**

Red squirrel are a major prey item for a number of species including northern goshawk (Schaffer 1998), marten (Takats et al. 1999), and fisher (Olsen et al. 1999), and were one of the most commonly detected species during the winter track counts. They were detected in 11 of the 12 habitats surveyed; the only sites where they were not observed were disturbed features (Table 3-21). In general, red squirrels were detected infrequently in young and open habitats, such as sedge meadows and young bog fen habitat. Red squirrels prefer habitats with relatively high coniferous cover, although densities were relatively high in deciduous-dominated habitats in the LSA. Red squirrel tracks were more frequently recorded (7.6 tracks/km/day) in the Gulf Surmont area (AXYS 2001b), possibly because of the presence of a higher proportion of mature spruce compared to the LSA.

Three grouse species (ruffed grouse, spruce grouse and sharp-tailed grouse) occur in the LSA. Grouse tracks were recorded in six of the 12 habitat types (Table 3-21) with the highest recorded in old shrubby bog/fen (1.3 tracks/km/day) and young shrubby bog/fen (0.7 tracks/km/day). Spruce grouse prefer coniferous habitats with dense shrubs, while ruffed grouse typically occur in deciduous forests. Sharp-tailed grouse tend to use more open areas surrounded by deciduous shrub and trees (Moyles 1981) including wetlands, grassy clearings, or even bogs. Because the highest track densities occurred in coniferous or shrubby habitat types, most tracks were likely lmade by spruce grouse or sharp-tailed grouse.

3.4.9 Bat Surveys

Bats were surveyed in the LSA on July 22 and 23, 2007 using both mist netting and echolocation techniques. Mist nets were set up at two locations in the LSA (Figure 3-14). These sample sites were selected because of their high potential for bat activity and because of accessibility. Ten nets were used at each site ranging from 6 m to 18 m in length. Nets were continuously monitored for approximately 5 hrs each night, but no bats were captured or observed. These results are similar to other sites in the oil sands region (Petro Canada 2001, CNRL 2008), likely because of the lack of suitable habitat. Bats prefer mature aspen and coniferous forest (Crampton and Barclay 1998), and it is believed that the black spruce bog/fen that is dominant throughout the landscape in the LSA is not effective habitat for bats. Over both survey nights, a total of 29 stations were surveyed for bat echolocation calls using the ANABAT detector (Figure 3-14). Three bat species or groups were recorded. Two of the bats were classified as either big brown bat or silver-haired bat, but could not be further distinguished because of similarities in their echolocation calls. The third bat was a hoary bat.

Hoary bats prefer to roost alone in coniferous trees, leaving their day-time roosts after dark to forage on insects high above the canopy (ASRD 2007a). Silver-haired and hoary bats are both considered “Sensitive” in Alberta. Big brown bats roost communally, often in buildings (ASRD 2007b), while silver-haired bats roost beneath bark, amongst leaves, in abandoned bird nests or in hollow trees (ASRD 2007c). In southern British Columbia, both big brown bats and silver-haired bats preferred roosting in hollows in live trembling aspen, but also used conifer snags to a lesser degree (Vonhof and Gwilliam 2007). All of these bats forage nocturnally on insects.

3.4.10 Wildlife Camera Monitoring

A report of the Project pre-disturbance monitoring program was included in Section 4 (Mitigation and Monitoring) of the Project wildlife assessment. A brief summary of the results is presented below. Figure 3-15 shows the location of the wildlife cameras in the LSA.

Results indicate that on an annual basis, woodland caribou were the most frequently detected species in the LSA (Table 3-22). These results are in contrast to the winter track and aerial surveys, during which very few caribou or caribou sign, were recorded. This difference is attributed to several factors: 1) clearing activities associated with seismic exploration in 2006-2007 may have discouraged caribou from using the LSA; 2) wildlife cameras provide constant monitoring and improved chances of recording elusive species on a year round basis, or; 3) environmental factors, such as snow depth. Statistically, moose and caribou were recorded significantly more frequently ($p<0.050$) than all other species. Caribou were significantly more common in spring, summer and fall ($p<0.050$) than winter, although high variance in caribou frequency among the cameras during the fall may have affected results. Moose were the second most frequently detected species in the LSA, and were most common in spring and summer (Table 3-22). A relatively high number of predators were also recorded by the wildlife cameras, particularly wolves, black bears, lynx and coyotes. There was a high degree of overlap among caribou, moose and predators, suggesting that ungulate predation rates may be relatively high.

Table 3-22
Relative frequency of wildlife recorded by wildlife cameras in the LSA.

Species	Animals/Day x 100					
	Early Winter	Late Winter	Spring	Summer	Fall	Annual
Moose	0.79[a]	0.47[a]	2.53[b]	2.92[b]	0.67[a]	1.87
Woodland caribou	1.55[cd]	0.24[c]	2.33[ab]	3.53[a]	9.20[bd]	3.37
White-tailed deer	0[a]	0[a]	0.88[b]	1.22[b]	0.06[a]	0.46
Wolf	0.03[a]	1.80[a]	0.26[a]	0.59[a]	0.34[a]	0.60
Coyote	0.05[b]	0.92[a]	0.61[ac]	0.07[bc]	0.06[b]	0.38
Red fox	0.03[a]	0.36[a]	0.37[a]	0.19[a]	0.25[a]	0.26
Black bear	0[c]	0.20[bc]	2.49[a]	1.11[a]	0.24[b]	0.91
Canada lynx	0[a]	0.13[a]	0.13[a]	0.14[a]	0.03[a]	0.10
Snowshoe hare	0.50[a]	0.84[b]	0.13[a]	0.11[a]	0.10[a]	0.41
American marten	0.03	0.29	0.09	0	0.03	0.08
River otter	0	0.04	0	0	0	0.01
Mustelid spp.	0	0	0	0.04	0.02	0.01
Red squirrel	0	0.21	0.05	0	0.09	0.07
Mouse spp.	0	0.04	0	0	0	0.01
Willow ptarmigan	0.03	0	0	0	0	0.01

Species	Animals/Day x 100					
	Early Winter	Late Winter	Spring	Summer	Fall	Annual
Spruce grouse	0	0.25	0.26	0.06	0.23	0.16
Sharp-tailed grouse	0	0.08	0	0	0	0.02
Sandhill crane	0[a]	0.17[a]	0.81[b]	0.74[a]	0[a]	0.37
Gray jay	0	0.17	0.09	0.04	0	0.05
Hermit thrush	0	0	0.04	0	0	0.01
Common raven	0	0	0	0.03	0	0.01
Greater yellowlegs	0	0	0.04	0	0	0.01
Canada goose	0	0	0.14	0	0	0.02
Wilson's snipe	0	0	0.07	0	0	0.01
Unknown spp.	0.12	0.20	0.57	0.62	0.31	0.44
Unknown bird spp.	0	0	0	0.31	0.05	0.08
Total	**3.13[a]**	**6.39[c]**	**11.88[b]**	**11.70[b]**	**11.66[ac]**	**9.72**

[abc] – Different superscript letters indicate significant difference between seasons for a species.

A number of avian species were also recorded by the wildlife cameras, with sandhill crane the most frequently detected species (Table 3-22). Although cranes, considered “Sensitive” in Alberta, were observed individually or in pairs in the spring, most pairs had one or two chicks by mid-July. Spruce grouse were also relatively common birds in the LSA and were detected throughout the year. Other birds included gray jay, sharp-tailed grouse, willow ptarmigan and several shorebirds.

3.4.11 Incidental Wildlife Observations

A number of mammals, amphibians, and birds were recorded incidentally during wildlife surveys conducted in the LSA. Six species of mammals (black bear, coyote, deer, wolf, moose and woodland caribou) were recorded, primarily through observation of tracks or scat (Table 3-23, Figures 3-16 and 3-17). These data include records from the Caribou Monitoring Stations, other sightings reported by Connacher employees, and all observations recorded during field surveys, including the wildlife cameras.

Table 3-23
Incidental mammalian and amphibian observations recorded during wildlife surveys conducted in the LSA.

Species	Number	Type	Date	Zone	Easting	Northing
Black bear	1	Tracks	16-Jun-07	12	449288	6221625
Black bear	1	Tracks	17-Jun-07	12	449569	6218474
Black bear	1	Visual	22-Jul-07	12	450879	6216716
Coyote	1	Tracks	17-Jun-07	12	449271	6218276
Coyote	1	Tracks	27-Feb-07	12	449278	6216745

Species	Number	Type	Date	Zone	Easting	Northing
Deer sp.	1	Tracks	17-Jun-07	12	449271	6218276
Grey wolf	1	Tracks	17-Jun-07	12	447816	6222456
Grey wolf	2	Tracks	24-Feb-07	12	455183	6221885
Moose	1	Pellets	16-Jun-07	12	449861	6222123
Moose	1	Pellets	16-Jun-07	12	447830	6222856
Moose	1	Pellets	16-Jun-07	12	446735	6223310
Moose	4	Tracks	26-Feb-07	12	448007	6221928
Moose	1	Visual	06-Dec-08	12	449619	6217410
Western toad	1	Visual	22-Jul-07	12	455885	6223741
Wood frog	2	Auditory	22-Jul-07	12	452687	6222410
Wood frog	1	Auditory	22-Jul-07	12	450557	6220840
Woodland caribou	3	Tracks	14-Jun-07	12	459513	6213022
Woodland caribou	1	Tracks	17-Jun-07	12	449271	6218276
Woodland caribou	1	Tracks	17-Jun-07	12	449569	6218474
Woodland caribou	1	Tracks	17-Jun-07	12	454200	6218492
Woodland caribou	1	Tracks	17-Jun-07	12	453439	6218330
Woodland caribou	1	Carcass	17-Jun-07	12	452757	6220589
Woodland caribou	1	Tracks	22-Jul-07	12	457044	6223372
Woodland caribou	1	Visual	05-Dec-08	12	457862	6213842
Woodland caribou	5+	Tracks	05-Dec-08	12	456677	6212702
Woodland caribou	1+	Tracks	05-Dec-08	12	459682	6213548
Woodland caribou	1+	Tracks	05-Dec-08	12	456096	6216712

A number of different bird species were recorded in the LSA at various times throughout the past several years (Table 3-24, Figure 3-7). Several of these species are considered "Sensitive" in Alberta including the common nighthawk, sandhill crane and great gray owl. Common nighthawks were very active during the evening when bat surveys were conducted, and appeared to be quite common in the LSA. More common species included black-backed chickadee, chipping sparrow and Wilson's snipe.

Table 3-24
Incidental bird observations recorded during other wildlife surveys in the LSA.

Species	Number	Type	Date	Zone	Easting	Northing
Black-capped chickadee	1	Unclassified	6-Dec-06	12	449029	6221388
Boreal chickadee	1	Unclassified	7-Dec-06	12	455652	6218740
Chipping sparrow	1	Visual	23-Jul-07	12	451681	6219559
Common nighthawk	4	Auditory	23-Jul-07	12	451681	6219559
Common nighthawk	1	Auditory	23-Jul-07	12	451899	6219985
Common nighthawk	1	Auditory	23-Jul-07	12	452386	6221182
Common nighthawk	1	Auditory	23-Jul-07	12	452262	6220709
Common nighthawk	1	Auditory	23-Jul-07	12	452118	6220263
Common nighthawk	1	Auditory	23-Jul-07	12	451831	6219873
Common nighthawk	1	Auditory	23-Jul-07	12	451631	6219673
Common nighthawk	2	Auditory	23-Jul-07	12	452385	6221181
Common nighthawk	2	Auditory	23-Jul-07	12	452260	6220711
Common nighthawk	1	Auditory	23-Jul-07	12	452118	6220263
Common nighthawk	1	Auditory	23-Jul-07	12	451831	6219873
Gray jay	1	Unclassified	6-Dec-06	12	449029	6221388
Gray jay	1	Unclassified	7-Dec-06	12	455652	6218740
Great gray owl	1	Auditory	28-Apr-07	12	458110	6212004
Great horned owl	1	Auditory	22-Jul-07	12	449609	6219773
Greater yellowlegs	1	Auditory, Visual	23-May-07	12	460836	6213377
Greater yellowlegs	1	Auditory, Visual	24-May-07	12	451814	6218337
Merlin	1	Visual	24-May-07	12	451814	6218337
Northern hawk owl	1	Visual	17-Jun-07	12	455066	6220867
Northern Hawk owl	1	Visual	25-May-07	12	454192	6221776
Northern Hawk owl	1	Visual	29-Apr-07	12	452061	6222407
Northern Hawk owl	1	Visual	24-Feb-07	12	455349	6221742
Northern Hawk owl	1	Visual	26-Feb-07	12	455563	6218289
Red-tailed hawk	1	Visual	17-Jun-07	12	454200	6218492
Red-tailed hawk	1	Visual	24-May-07	12	455613	6219934
Sandhill crane	1	Auditory	23-May-07	12	460836	6213377
Solitary sandpiper	2	Visual	16-Jun-07	12	449254	6221502
Three-toed woodpecker	1	Auditory, Visual	27-Feb-07	12	449745	6216994
Wilson's snipe	1	Visual	16-Jun-07	12	447907	6222847
Wilson's snipe	1	Auditory	23-Jul-07	12	452879	6221905

3.4.12 Biodiversity

Most (74%) of the LSA was considered to have potential for moderate-low wildlife biodiversity (Table 3-25, Figure 3-18) because of the early seral stage of most of the LSA resulting from the 1996 Mariana Lake fire. Mature to old forests usually have higher avian species richness and diversity than young forests (Hobson and Bayne 2000), and therefore, biodiversity is expected to increase in the LSA over time. Waterbodies had the highest biodiversity ranking, with 112 species potentially occurring in or near them (i.e., riparian habitats). Other habitats with high biodiversity include old mixedwood forest with spruce, aspen and balsam poplar. These habitats support a range of listed species including black-throated green warbler and Canada warbler. Anthropogenic features were expected to have low biodiversity, although some of these disturbances, such as inactive well pads and the transmission line may have value to some wildlife.

Table 3-25
Biodiversity in the LSA at baseline

Biodiversity Categories	Area (ha)	% of LSA
High	73	0.5
Moderate-high	756	4.9
Moderate	2,729	17.8
Moderate-low	11,378	74.0
Low	435	2.8
Total	**15,370**	**100.0**

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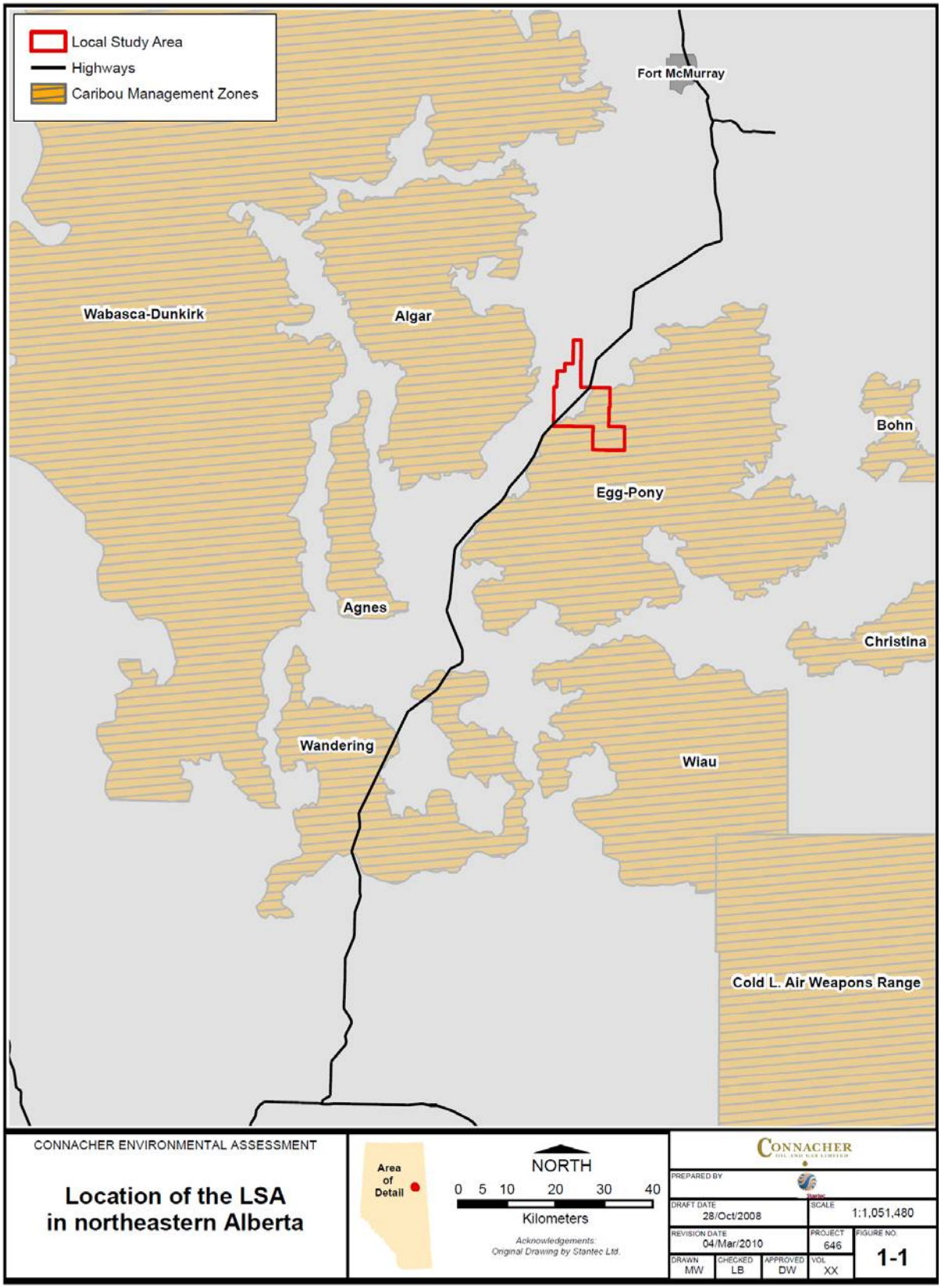
FIGURES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Highways
Caribou Management Zones
Fort McMurray
Wabasca-Dunkirk
Algar
Bohn
Egg-Pony
Agnes
Christina
Wandering
Wiau
Cold L. Air Weapons Range
CONNACHER ENVIRONMENTAL ASSESSMENT
Location of the LSA
in northeastern Alberta
Area of Detail
NORTH
0 5 10 20 30 40
Kilometers
Acknowledgements:
Original Drawing by Stantec Ltd.
CONNACHER
PREPARED BY
DRAFT DATE 28/Oct/2008
SCALE 1:1,051,480
REVISION DATE 04/Mar/2010
PROJECT 646
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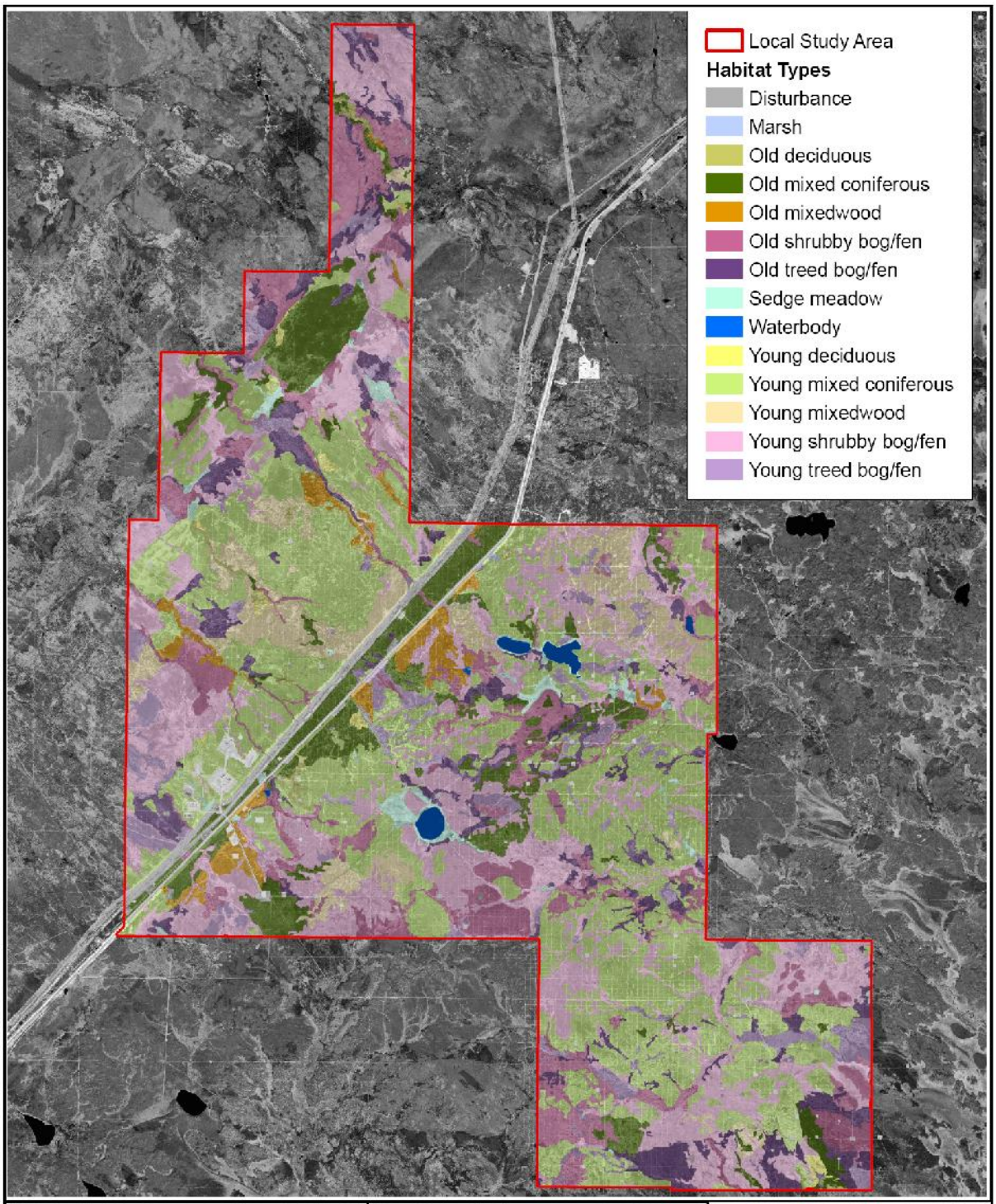
APPROVED DW
VOL XX



CONNACHER ENVIRONMENTAL ASSESSMENT

Wildlife Habitats in the LSA at Baseline

Area of Detail

NORTH

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Kilometers

Acknowledgements:
Original Drawing by Stantec Ltd.

CONNACHER

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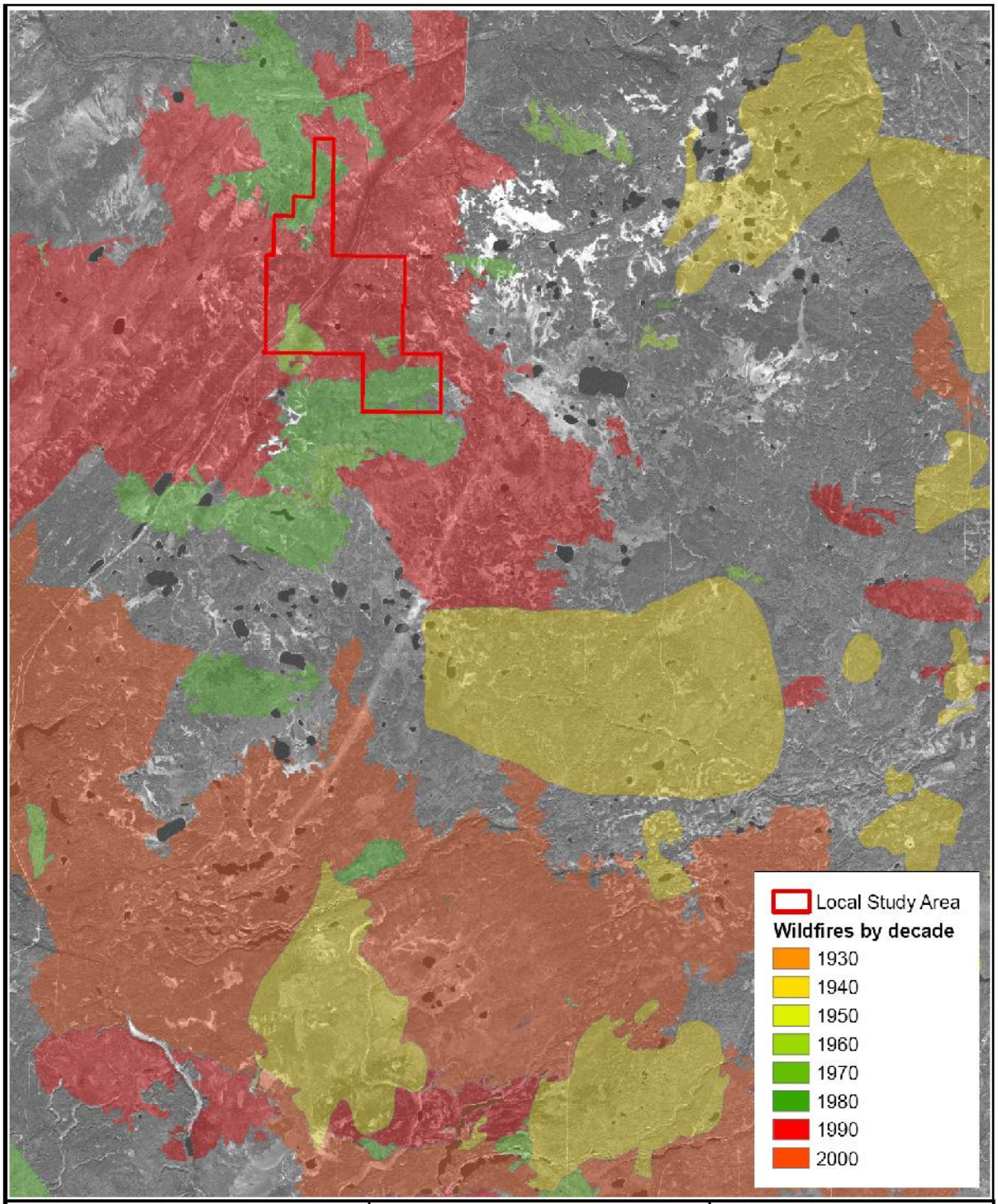

CONNACHER ENVIRONMENTAL ASSESSMENT

Wildfire History of the LSA and area

NORTH

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Kilometers

Acknowledgements:
Original Drawing by Stantec Ltd.

CONNACHER

PREPARED BY

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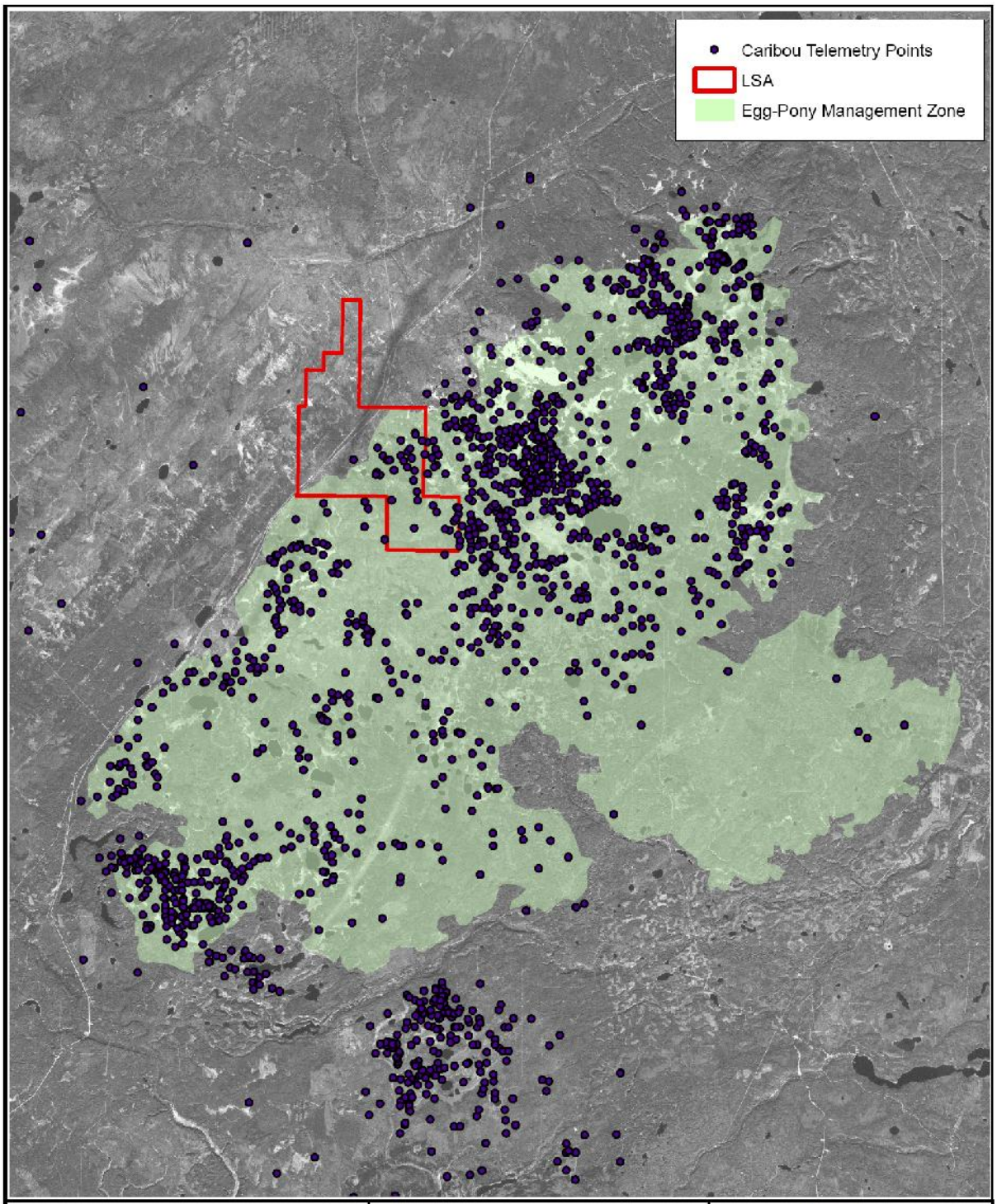

CONNACHER ENVIRONMENTAL ASSESSMENT

Caribou Telemetry Points for the Egg-Pony Management Zone
Source: Alberta Caribou Committee
Note: Locational accuracy 100 m - 5 km

Area of Detail

NORTH
0 2.5 5 10 15
Kilometers

Acknowledgements: Original Drawing by Stantec Ltd.

CONNACHER

PREPARED BY: Golder

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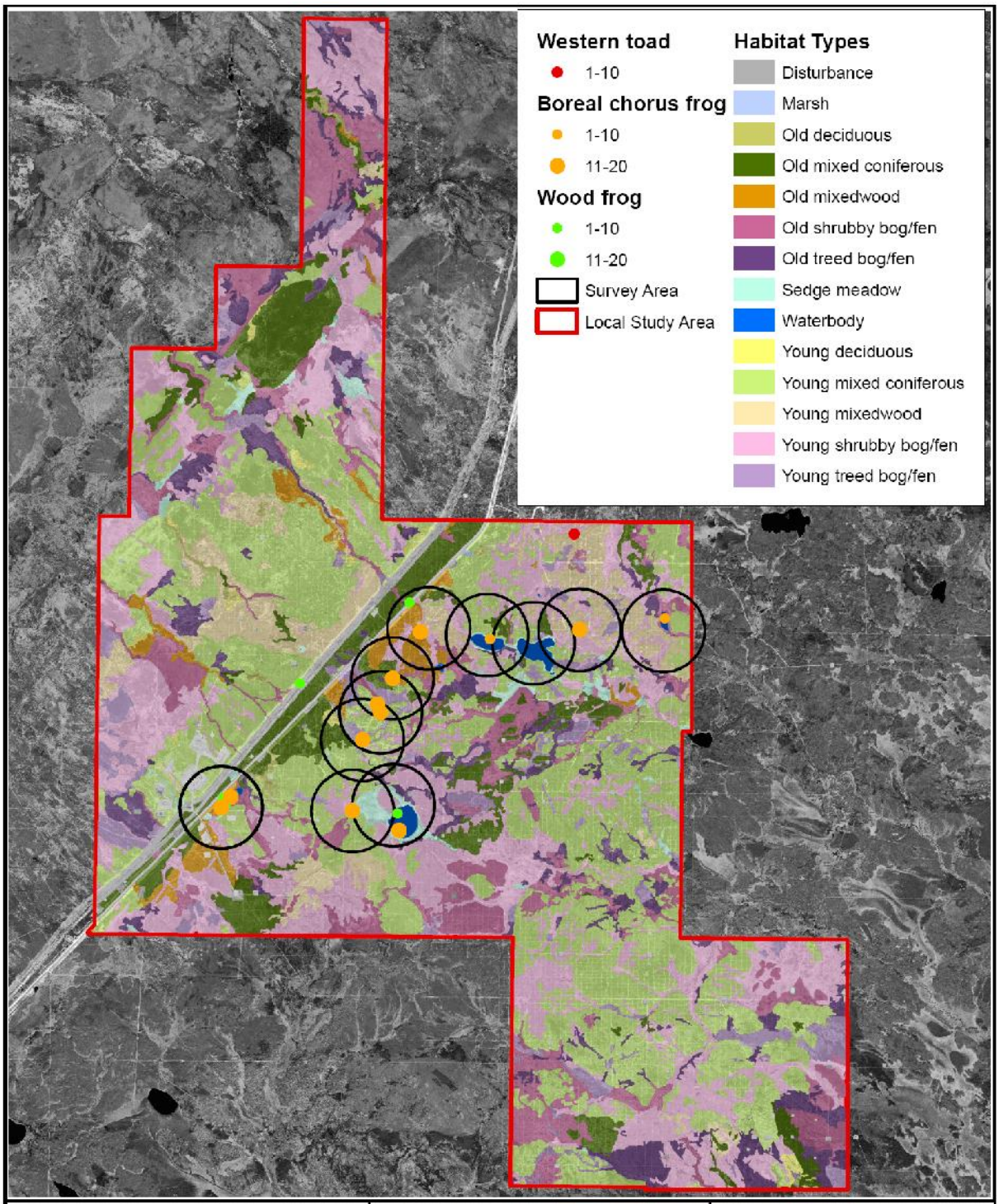

CONNACHER ENVIRONMENTAL ASSESSMENT

Amphibian Survey Stations and Observations in the LSA

Area of Detail

NORTH

0 0.5 1 2 3 4

Kilometers

Acknowledgements:
Original Drawing by Stantec Ltd.

CONNACHER

PREPARED BY: Stantec

DRAFT DATE: 20/Oct/2008	SCALE: 1:105,119
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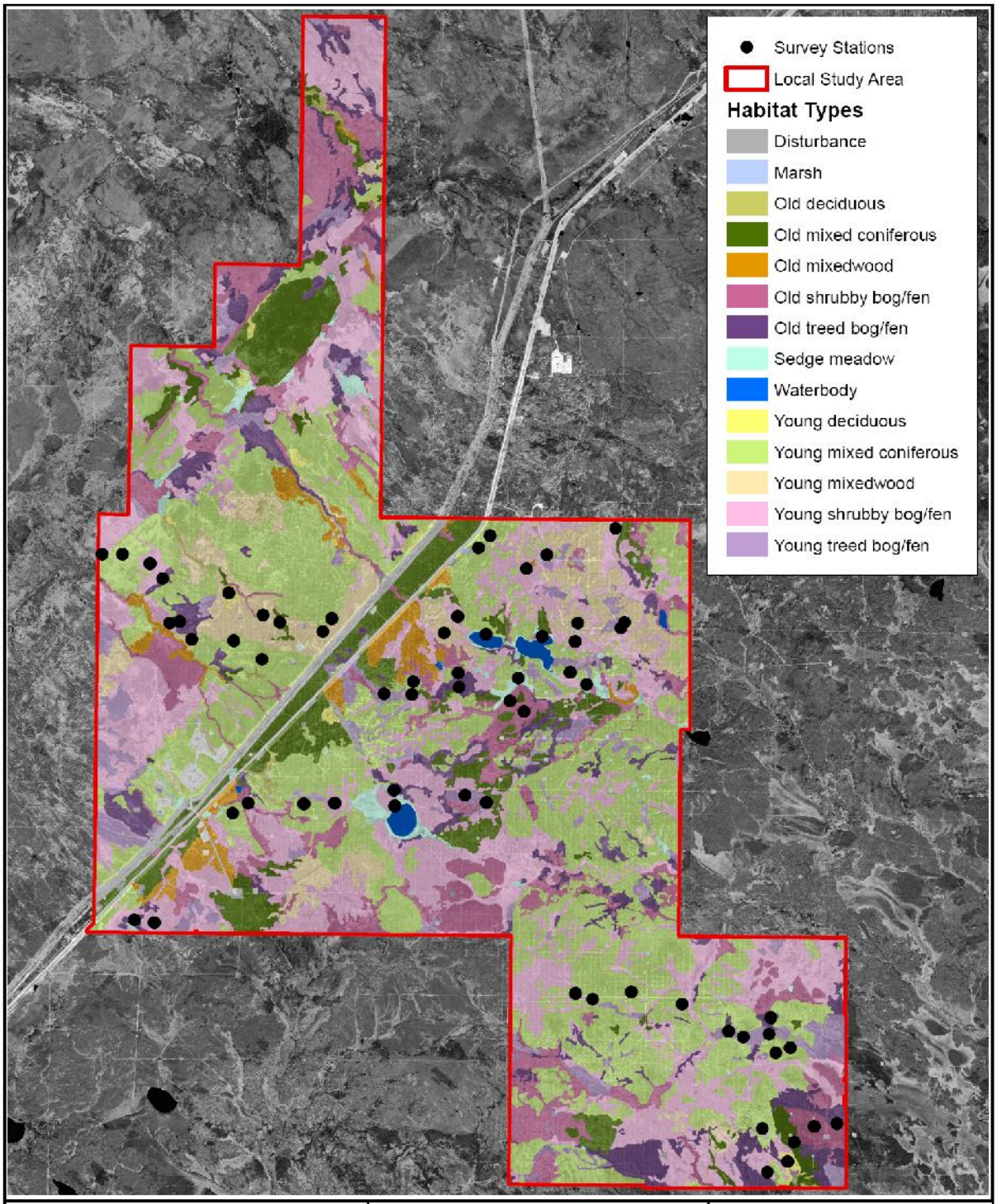

CONNACHER ENVIRONMENTAL ASSESSMENT

Breeding Bird Survey Stations in the LSA

Area of Detail

NORTH

0 0.5 1 2 3 4

Kilometers

Acknowledgements:
Original Drawing by Stantec Ltd.

CONNACHER

PREPARED BY	
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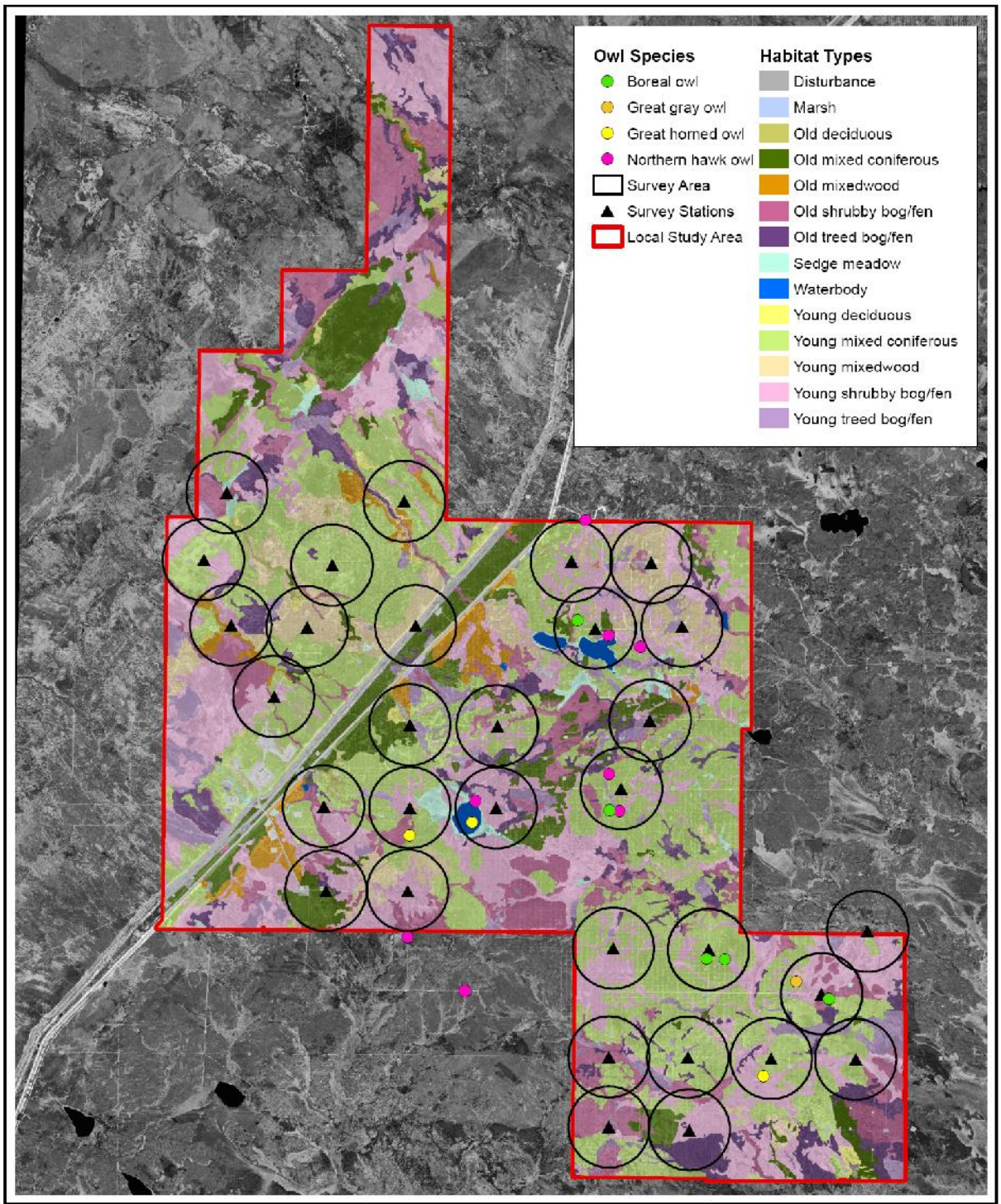

CONNACHER ENVIRONMENTAL ASSESSMENT

Owl Survey Stations and Observations, March 2007

Area of Detail

NORTH

0 0.5 1 2 3 4

Kilometers

Acknowledgements:
Original Drawing by Stantec Ltd.

CONNACHER

PREPARED BY	
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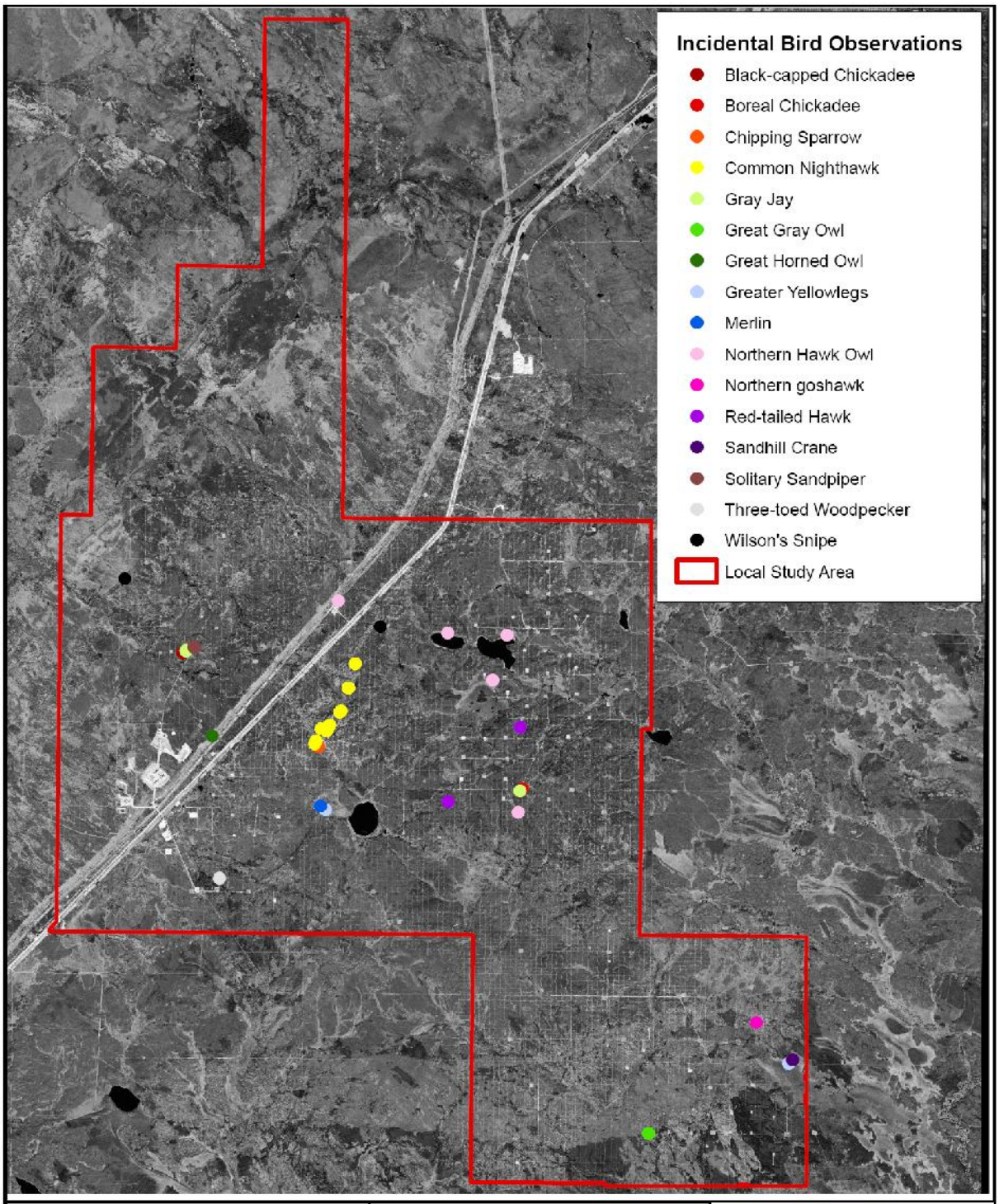

CONNACHER ENVIRONMENTAL ASSESSMENT

Incidental Bird Observations in the LSA

Area of Detail

NORTH

0 0.5 1 2 3 4

Kilometers

Original Drawing by Stantec Ltd.

CONNACHER

PREPARED BY				
DRAFT DATE 29/Oct/2008			SCALE 1:105,510	
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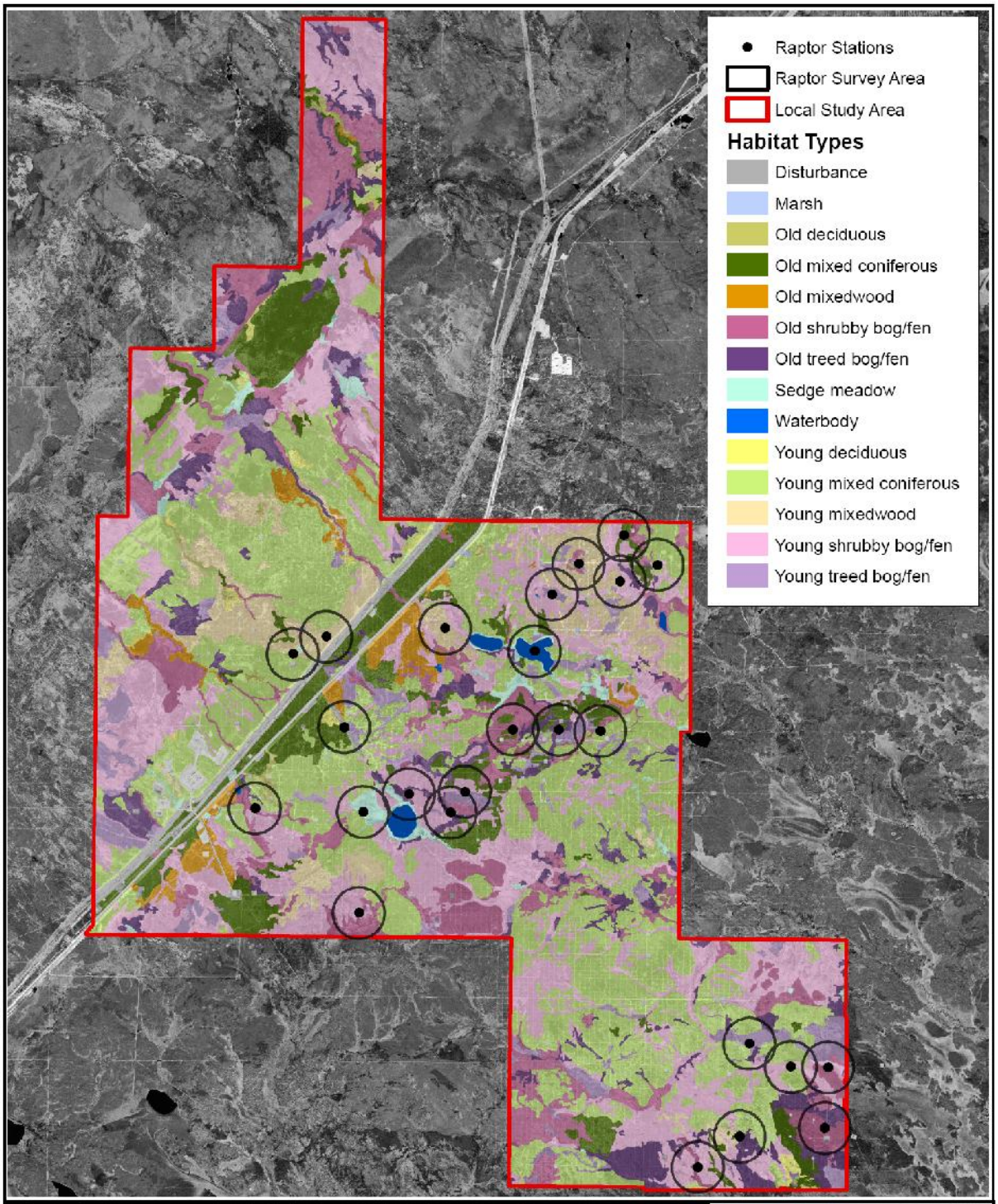

CONNACHER ENVIRONMENTAL ASSESSMENT

Raptor Survey Stations in the LSA

Area of Detail

NORTH

0 0.5 1 2 3 4

Kilometers

Acknowledgements: Original Drawing by Stantec Ltd.

CONNACHER

PREPARED BY: Stantec	
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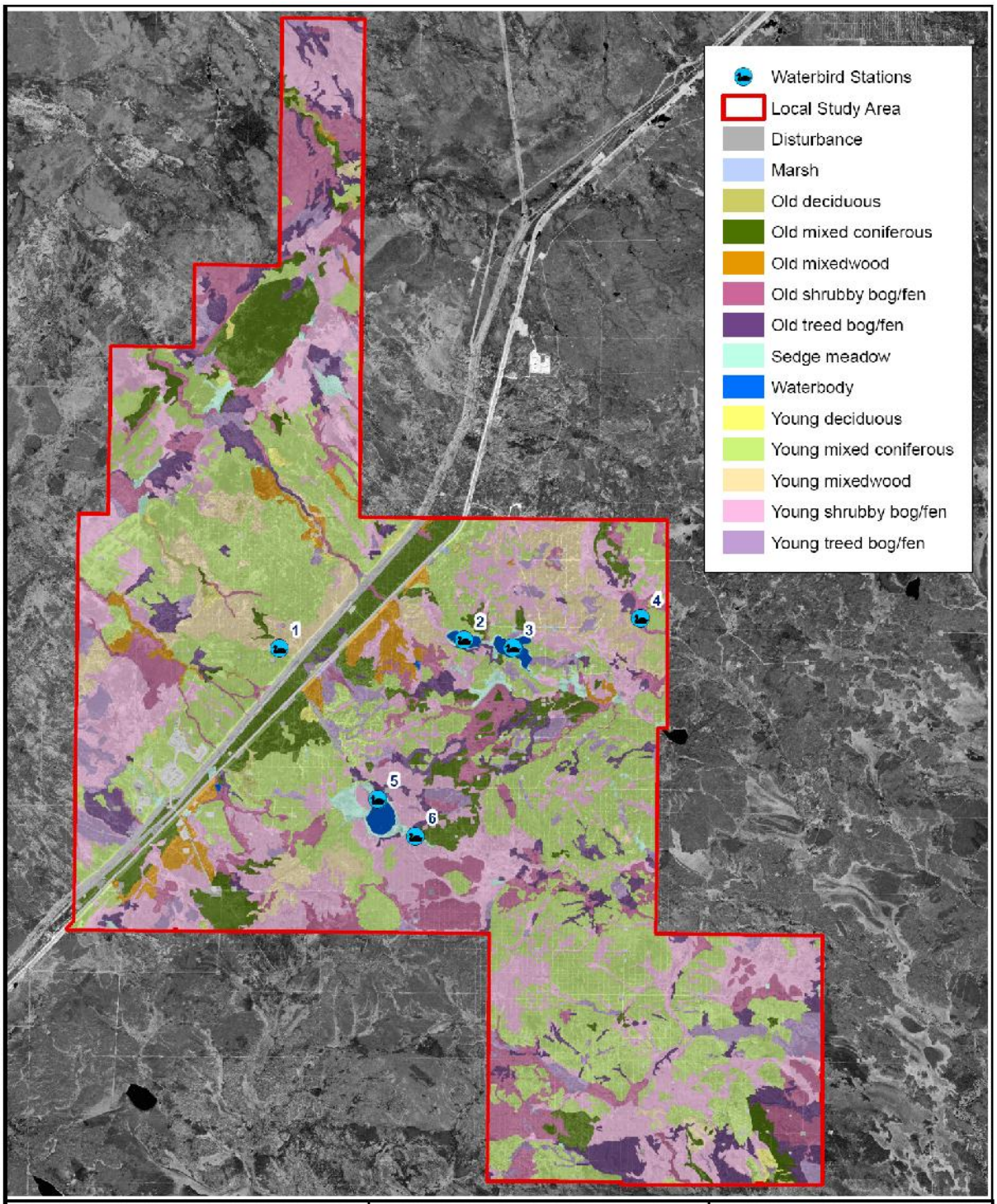
APPROVED: LB	VOL: XX

FIGURE NO. **3-8**



CONNACHER ENVIRONMENTAL ASSESSMENT

Waterbird Survey Stations in the LSA

Area of Detail

NORTH

0 0.5 1 2 3 4

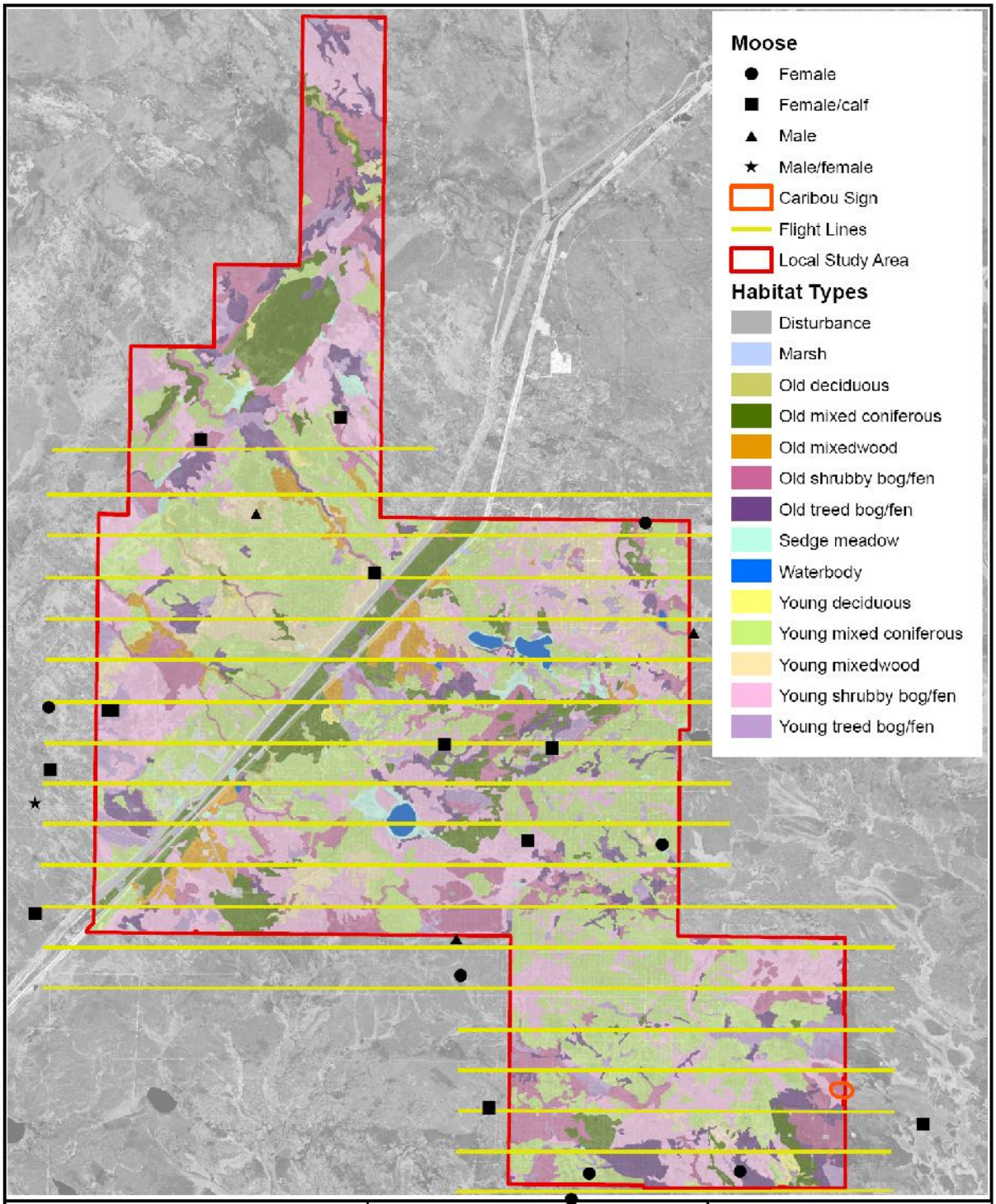
Kilometers

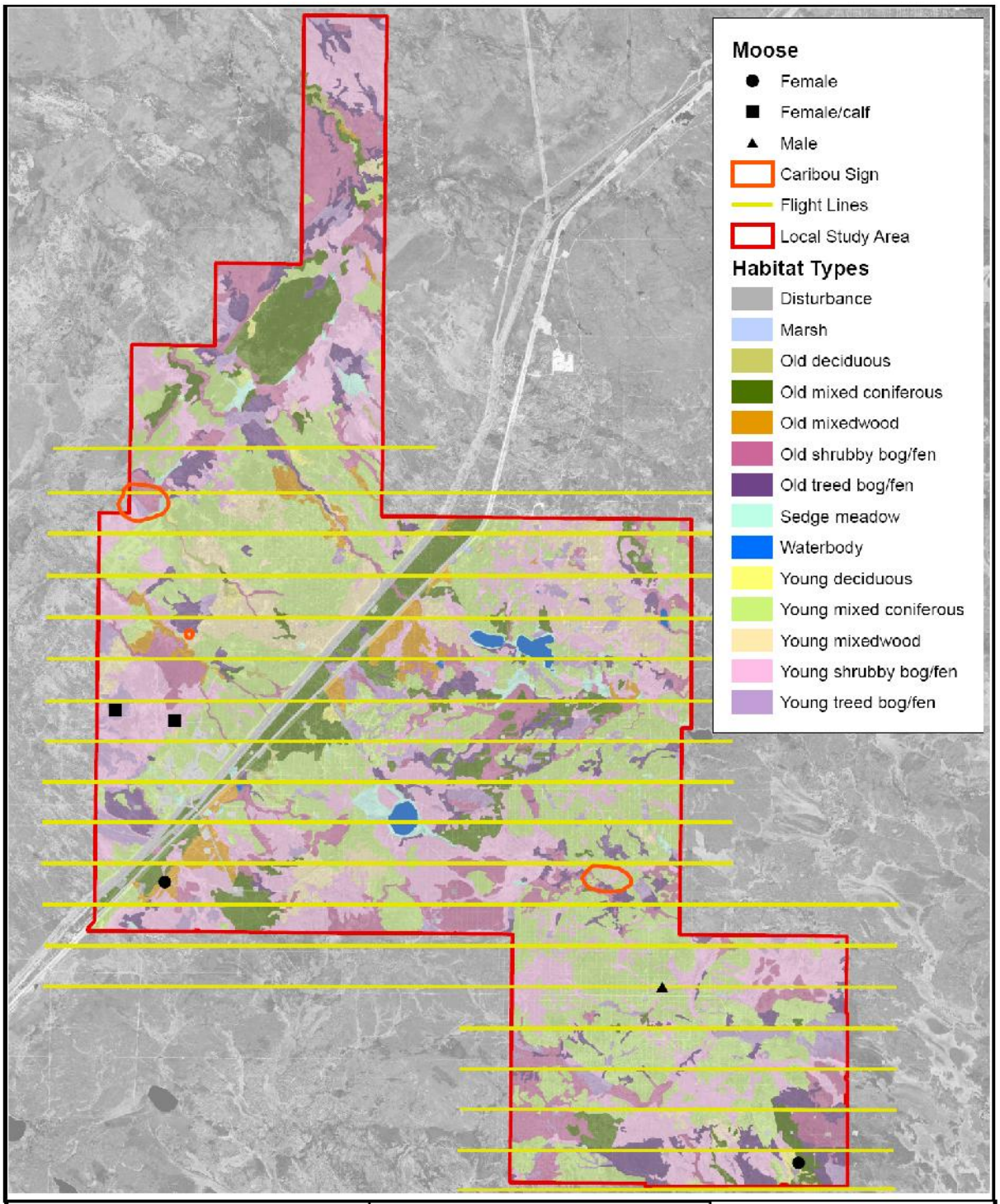
Acknowledgements:
Original Drawing by Stantec Ltd.

CONNACHER

PREPARED BY	
DRAFT DATE: 20/Oct/2008	SCALE: 1:105,432
REVISED DATE: 18/Jan/2010	PROJECT: 046
DRAWN: MW	CHECKED: DW
APPROVED: XX	MAP: XX

DRAWING NO: 3-9


Moose
Female
Female/calf
Male
Male/female
Caribou Sign
Flight Lines
Local Study Area
Habitat Types
Disturbance
Marsh
Old deciduous
Old mixed coniferous
Old mixedwood
Old shrubby bog/fen
Old treed bog/fen
Sedge meadow
Waterbody
Young deciduous
Young mixed coniferous
Young mixedwood
Young shrubby bog/fen
Young treed bog/fen
CONNACHER ENVIRONMENTAL ASSESSMENT
2006 - 2007 Early Winter Aerial Survey Observations in and around the LSA
Area of Detail
NORTH
0 0.5 1 2 3 4
Kilometers
Acknowledgements:
Original Drawing by Stantec Ltd.
CONNACHER
PREPARED BY
Stantec
DRAFT DATE 20/Oct/2008
SCALE 1:105,119
REVISION DATE 18/Jan/2010
PROJECT 646
DRAWING NO 3-10
DRAWN MW
CHECKED DW
APPROVED LB
VOI XX



CONNACHER ENVIRONMENTAL ASSESSMENT

2006 - 2007 Late Winter Aerial Survey Observations in and around the LSA

Area of Detail

NORTH

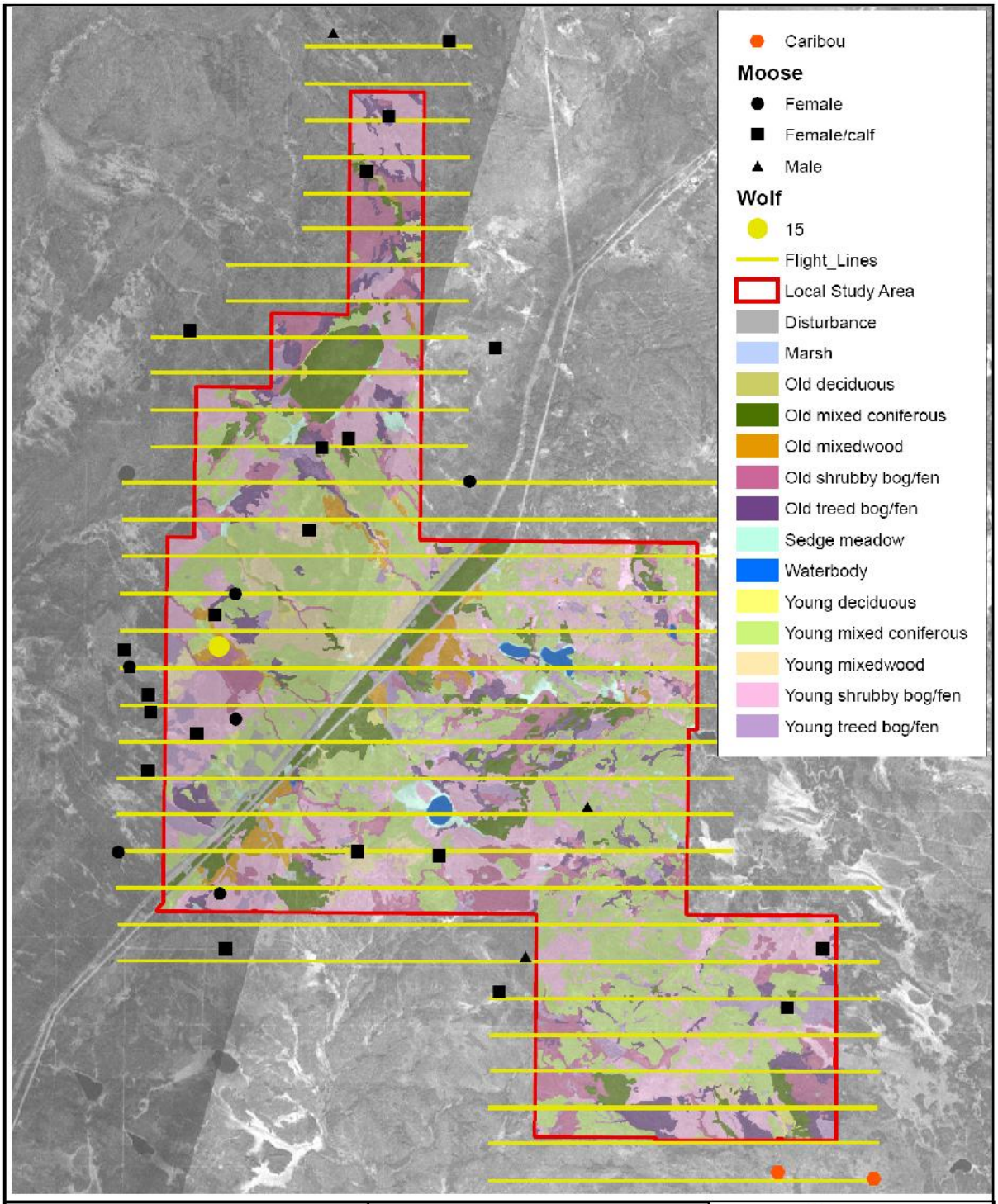
0 0.5 1 2 3 4

Kilometers

Original Drawing by Stantec Ltd.

CONNACHER

PREPARED BY: Stantec	
DRAFT DATE: 29/Oct/2008	SCALE: 1:105,119
REVISION DATE: 10/Jan/2010	PROJECT: 846
DRAWN: MW	CHECKED: DW
APPROVED: XX	VOL: XX
FIGURE NO.: 3-11	



CONNACHER ENVIRONMENTAL ASSESSMENT

2007 - 2008 Early Winter Aerial Survey Observations in and around the LSA

Area of Detail

NORTH

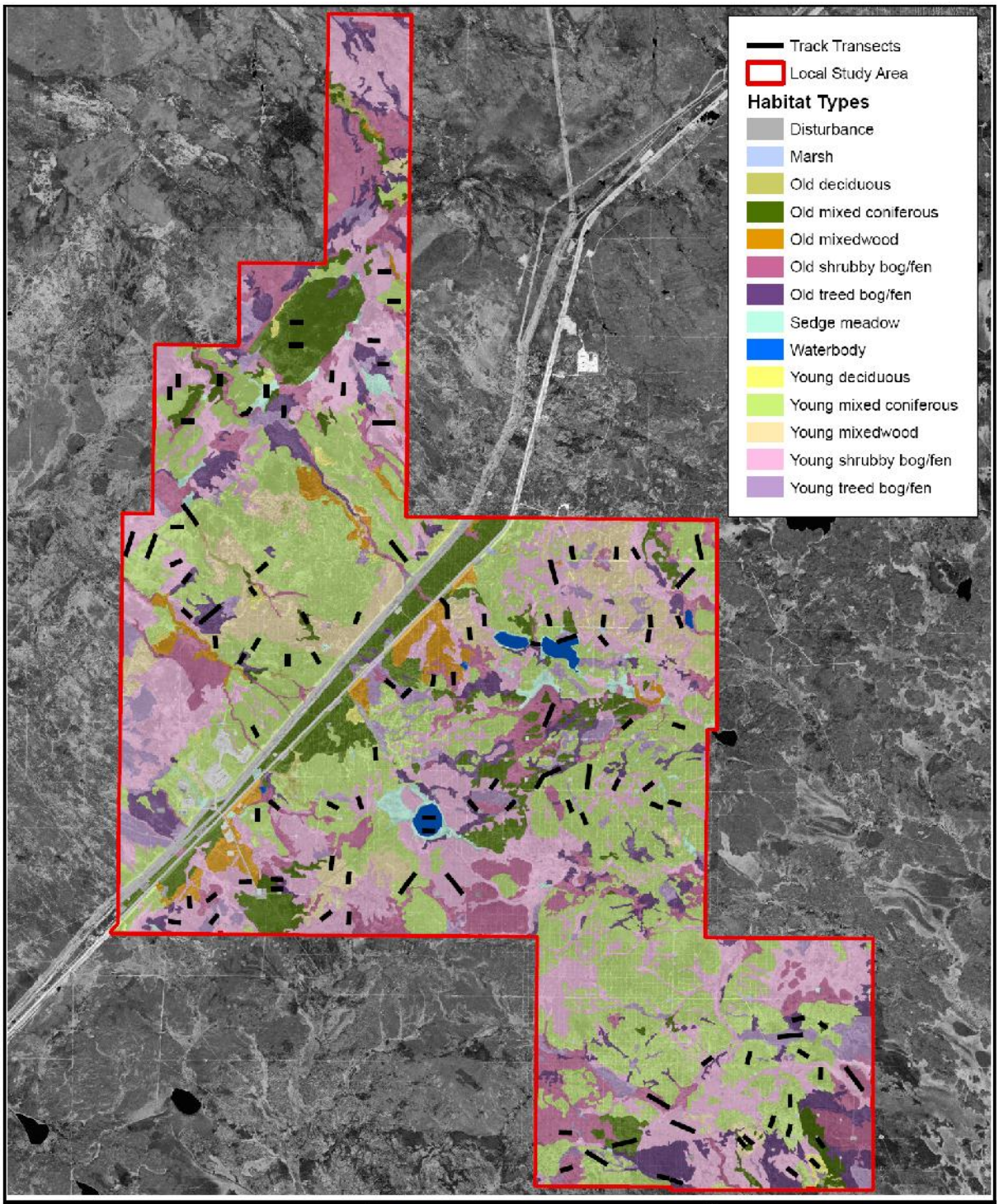
0 0.5 1 2 3 4

Kilometers

Acknowledgements: Original Drawing by Stantec Consulting Ltd.

CONNACHER

PREPARED BY				
DRAFT DATE: 29/Oct/2008			SCALE: 1:117,464	
REVISION DATE: 10/Jan/2010			PROJECT: 848	FIGURE NO: 3-12
DRAWN: MW	CHECKED: DW	APPROVED: LB	VOL: XX	



CONNACHER ENVIRONMENTAL ASSESSMENT

Winter Track Survey Transects in the LSA, 2006 - 2008

Area of Detail

NORTH

0 0.5 1 2 3 4

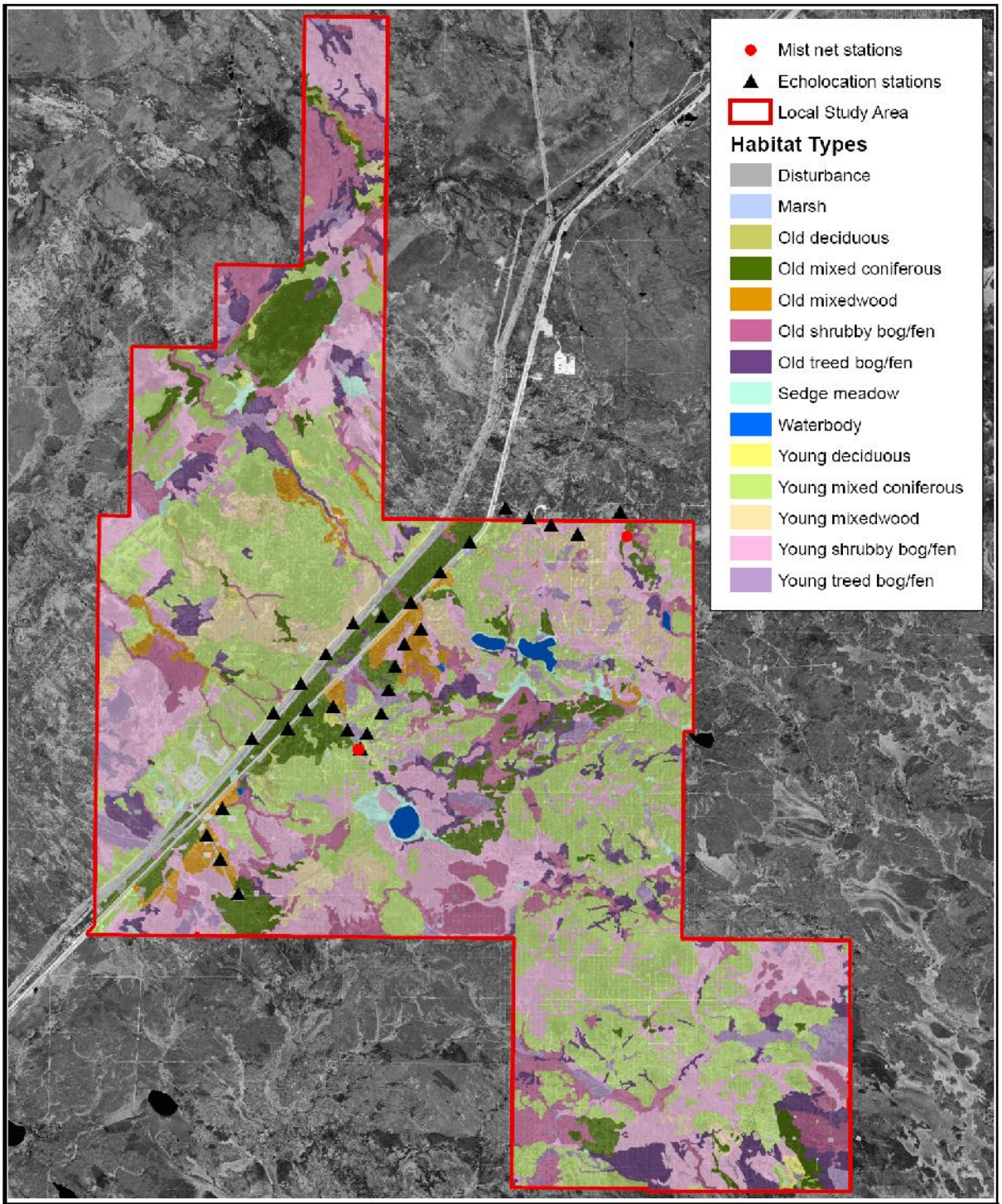
Kilometers

Acknowledgements: Original Drawing by Stantec Ltd.

CONNACHER

PREPARED BY	Stantec
DRAFT DATE 28/Oct/2008	SCALE 1:104,930
REVISION DATE 18/Jan/2010	PROJECT 646
DRAWN MW	CHECKED DW
APPROVED LB	VER XX

FIGURE NO. **3-13**



CONNACHER ENVIRONMENTAL ASSESSMENT

Bat Echolocation and Mist net Survey Stations in the LSA

Area of Detail

NORTH

0 0.5 1 2 3 4

Kilometers

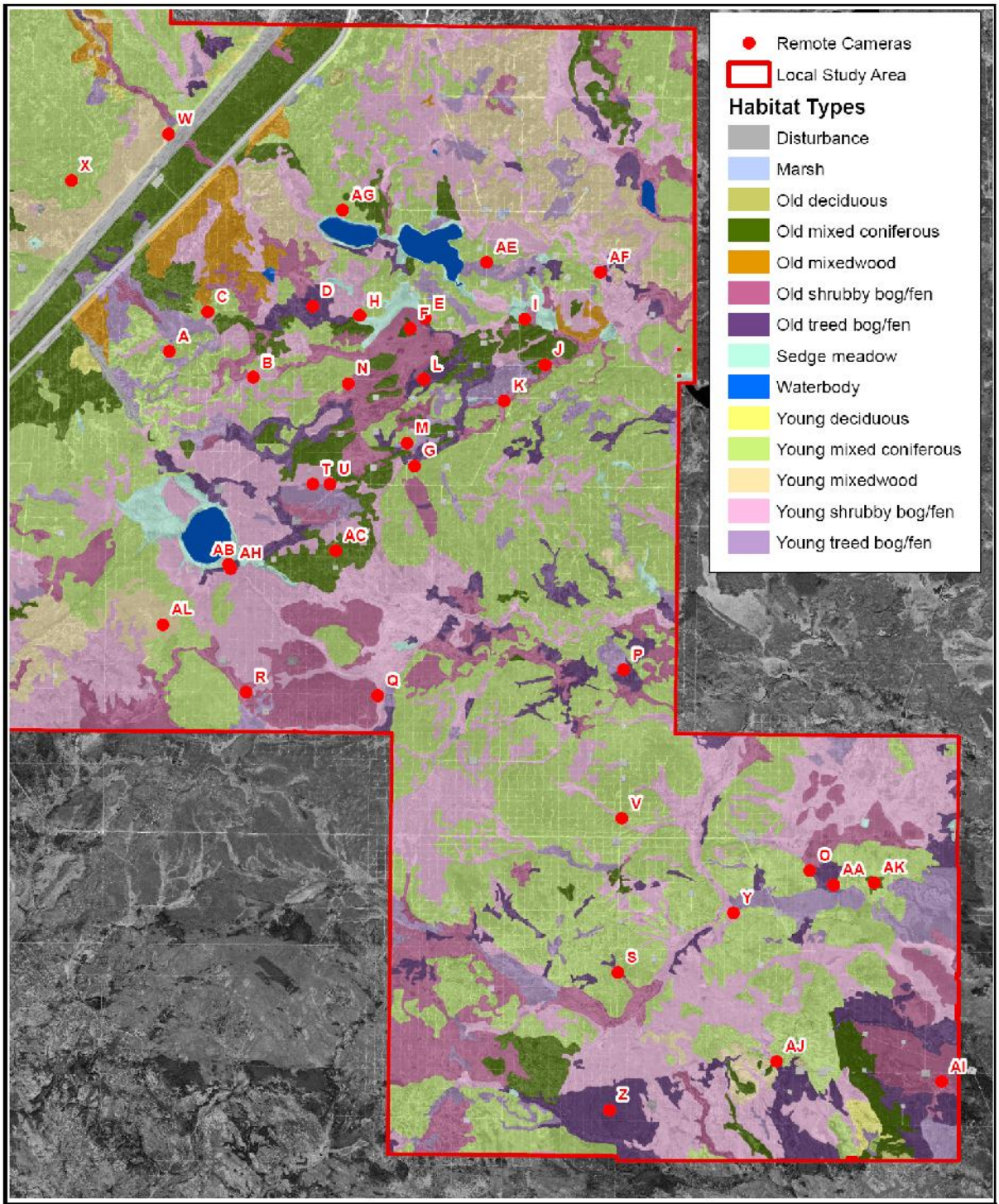
Acknowledgements:
Original Drawing by Stantec Ltd.

CONNACHER

PREPARED BY: Stantec

DRAFT DATE	SCALE
20/Oct/2008	1:105,119
REVISION DATE: 18/Jan/2010	PROJECT: 646
DRAWN: MW	CHECKED: DW
APPROVED: LB	VER: XX

DRAWING NO: 3-14



CONNACHER ENVIRONMENTAL ASSESSMENT

Location of Remote Cameras in the LSA: August 2008 - November 2009

Area of Detail

NORTH

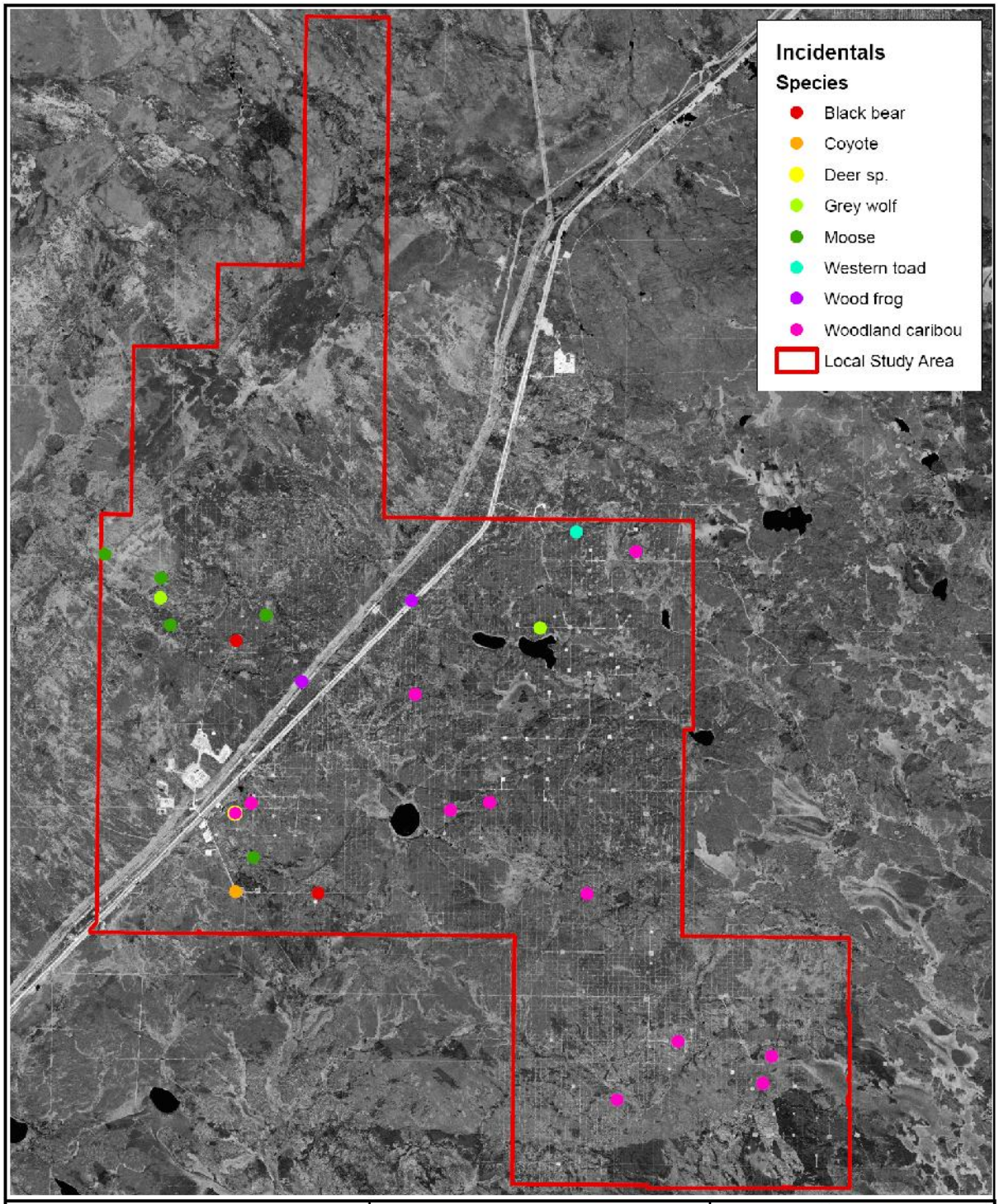
0 0.5 1 2

Kilometers

Acknowledgements:
Original Drawing by Stantec Ltd.

CONNACHER

PREPARED BY	
DRAFT DATE: 20/Oct/2008	SCALE: 1:62,181
REVISION DATE: 18/Jan/2010	PROJECT: 046
DRAWN: MW	CHECKED: DW
APPROVED: LB	VER: XX
DRWG. NO: 3-15	



CONNACHER ENVIRONMENTAL ASSESSMENT

Incidental Mammal and Amphibian Observations in the LSA

Area of Detail

NORTH

0 0.5 1 2 3 4

Kilometers

Acknowledgements: Original Drawing by Stantec Ltd.

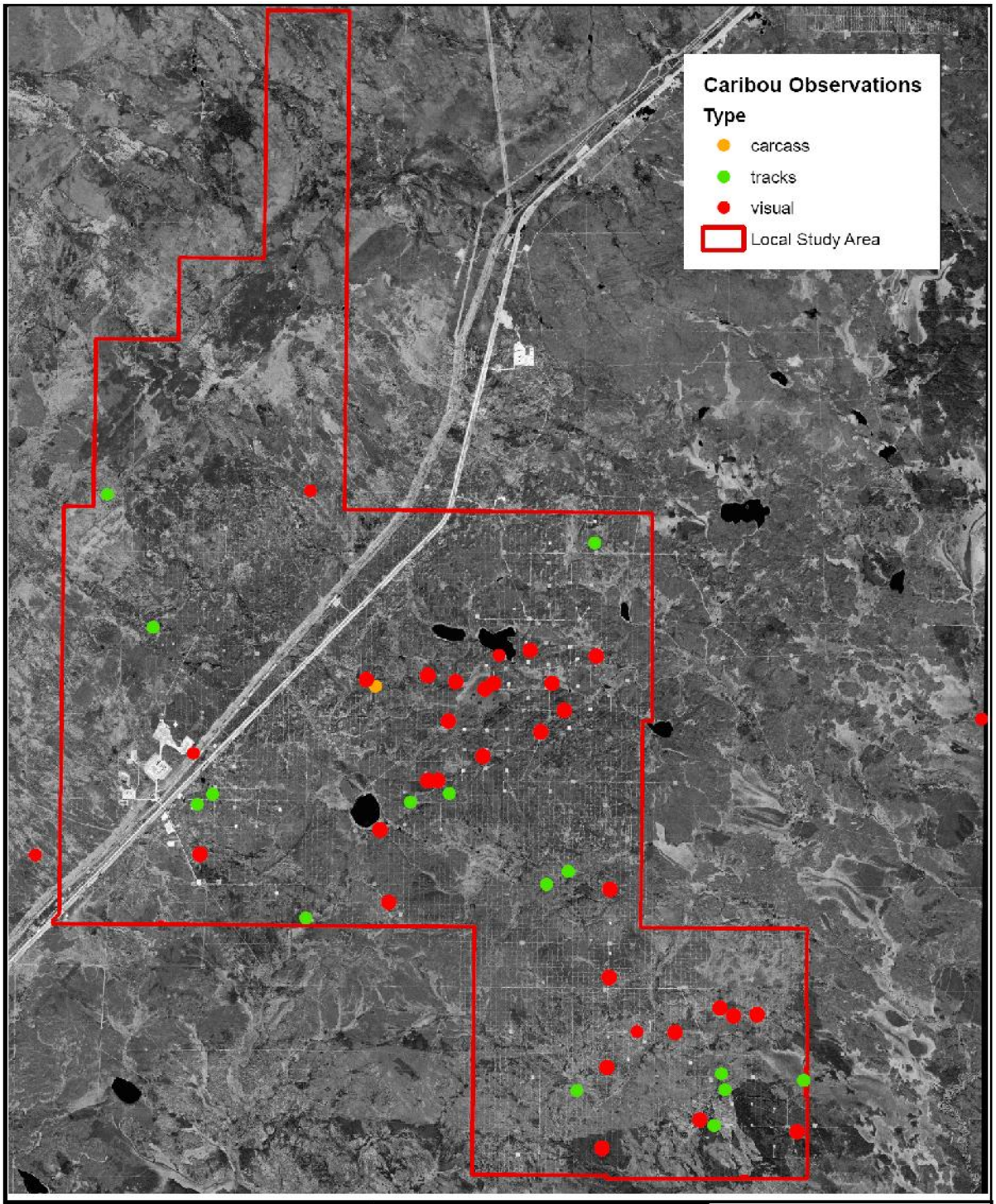
CONNACHER

PREPARED BY: Stantec

DRAFT DATE	SCALE
20/Oct/2008	1:105,119
REVISION DATE: 18/Jan/2010	PROJECT 646

DRAWN MW | CHECKED DW | APPROVED LB | VOL XX

3-16



CONNACHER ENVIRONMENTAL ASSESSMENT

Woodland Caribou Observations in and around the LSA

Area of Detail

NORTH

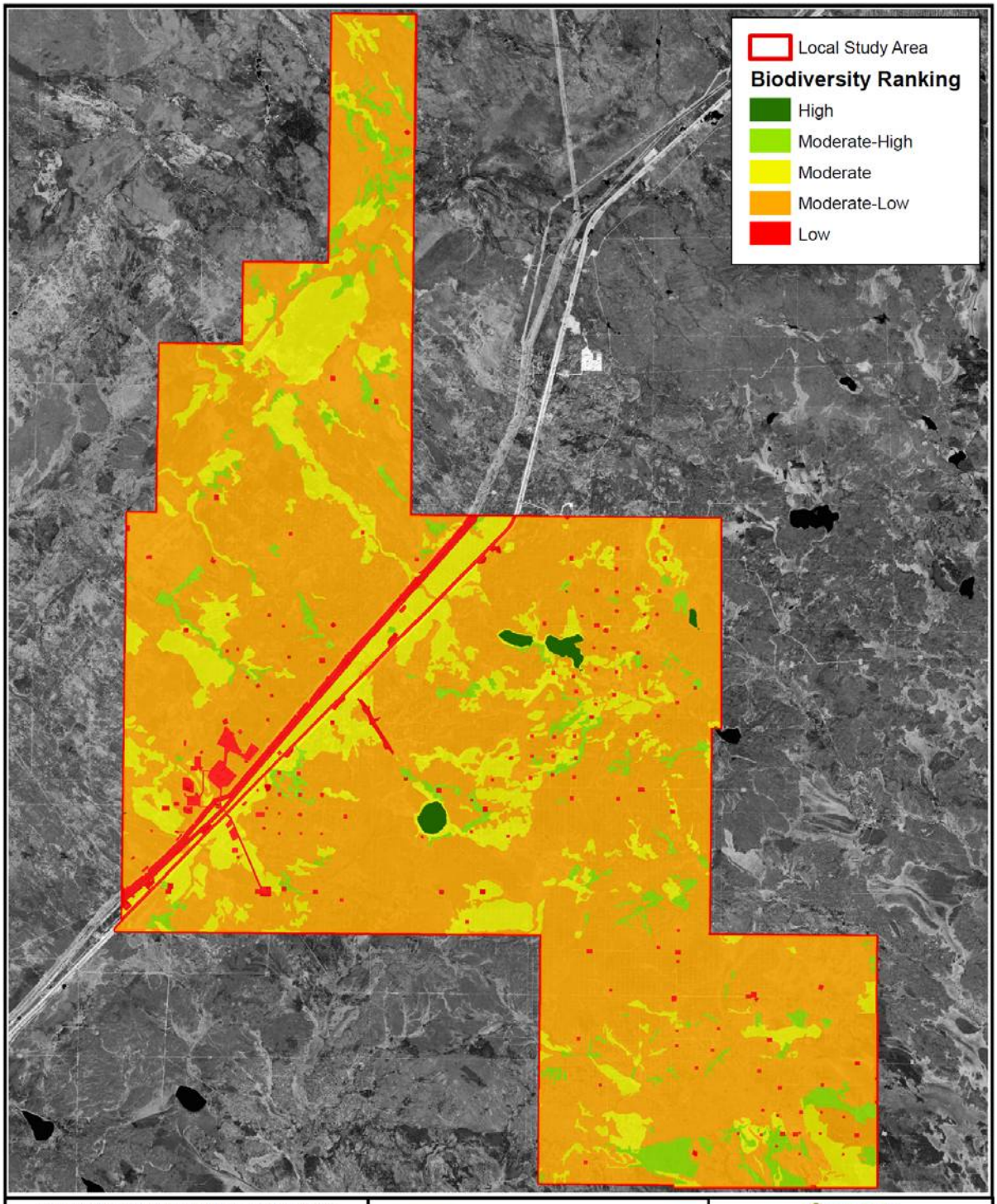
0 0.5 1 2 3 4

Kilometers

Acknowledgements:
Original Drawing by Stantec Ltd.

CONNACHER

PREPARED BY			
DRAFT DATE: 30/Oct/2008		SCALE: 1:105,517	
REVISION DATE: 18/Jan/2010		PROJECT: 046	FIGURE NO: 3-17
DRAWN: MW	CHECKED: DW	APPROVED: LB	VER: XX



CONNACHER ENVIRONMENTAL ASSESSMENT

Biodiversity in the LSA under Baseline Conditions

Area of Detail

NORTH

0 0.5 1 2 3 4

Kilometers

Acknowledgements:
Original Drawing by Stantec Ltd.

CONNACHER

PREPARED BY				
DRAFT DATE 05/Apr/2010			SCALE	1:104,879
REVISION DATE 05/Apr/2010			PROJECT 646	FIGURE NO. 3-18
DRAWN MW	CHECKED RW	APPROVED LB	VOL XX	

APPENDICES

Appendix 1. Common and scientific names of wildlife species recorded in the LSA.

Common Name	Scientific Name	Common Name	Scientific Name
Herptiles:		***Birds (continued):***	
Canadian toad	*Bufo hemiophrys*	Brown creeper	*Certhia americana*
Red-sided garter snake	*Thamnophis sirtalis*	Canada warbler	*Wilsonia canadensis*
Wood frog	*Rana sylvatica*	Cape May warbler	*Dendroica tigrina*
Western toad	*Bufo boreas*	Common loon	*Gavia immer*
Mammals:		Common nighthawk	*Chordeiles minor*
American beaver	*Castor canadensis*	Common yellowthroat	*Geothlypis tricha*
Black bear	*Ursus americanus*	Connecticut warbler	*Oporornis agilis*
Canada lynx	*Lynx canadensis*	Eastern phoebe	*Sayornis phoebe*
Fisher	*Martes pennanti*	Great blue heron	*Ardea herodias*
Wolverine	*Gulo gulo*	Great grey owl	*Strix nebulosa*
Gray wolf	*Canis lupus*	Green-winged teal	*Anas crecca*
Hoary bat	*Lasiurus borealis*	Horned grebe	*Podiceps auritus*
Moose	*Alces alces*	Least flycatcher	*Empidonax minimus*
Muskrat	*Ondatra zibethicus*	Northern goshawk	*Accipiter gentilis*
Northern long-eared bat	*Myotis septentrionalis*	Northern harrier	*Circus cyaneus*
Silver-haired bat	*Lasionycteris noctivagans*	Northern hawk owl	*Surnia ulula*
River otter	*Lutra canadensis*	Northern pintail	*Anas acuta*
Wolverine	*Gulo gulo*	Olive-sided flycatcher	*Contopus borealis*
Woodland caribou	*Rangifer tarandus*	Osprey	*Pandion haliaetus*
Birds:		Pied-billed grebe	*Podilymbus podiceps*
American bittern	*Botaurus lentiginosus*	Pileated woodpecker	*Dryocopus pileatus*
Bald eagle	*Haliaeetus luecocephalus*	Ruffed grouse	*Bonasa umbellus*
Barred owl	*Strix varia*	Rusty blackbird	*Euphagus carolinus*
Bay-breasted warbler	*Dendroica castanea*	Sandhill crane	*Grus canadensis*
Black tern	*Chilidonias niger*	Sharp-tailed grouse	*Tympanuchus phasianellus*
Black-backed woodpecker	*Picoides arcticus*	Short-eared owl	*Asio flammeus*
Blackburnian warbler	*Dendroica fusca*	Sora	*Porzana carolina*
Black-throated green warbler	*Dendroica virens*	Western tanager	*Piranga ludoviciana*
Boreal owl	*Aegolius funereus*	White-winged scoter	*Melanitta fusca*
Broad-winged hawk	*Buteo platypterus*	Yellow rail	*Coturnicops noveboracensis*

Appendix 2. Biodiversity (number of potential species) by ecosite phase, stand age or disturbance type.

Ecosite Phase	Age	Biodiversity (no. of species)		
		Birds	Mammals/ Herptiles	Totals
B1	Young	22	17	39
	Old	25	25	50
B2	Young	27	12	39
	Old	32	14	46
B3	Young	35	19	54
	Old	50	24	74
B4	Young	26	17	43
	Old	34	26	60
C1	Young	26	16	42
	Old	29	22	51
D1	Young	28	13	41
	Old	32	17	49
D2	Young	36	18	54
	Old	52	25	77
D3	Young	27	20	47
	Old	38	24	62
E1	Young	31	14	45
	Old	36	18	54
E2	Young	38	20	58
	Old	55	25	80
E3	Young	27	20	47
	Old	39	25	64
F1	Young	35	14	49
	Old	37	16	53
F2	Young	43	20	63
	Old	57	25	82
F3	Young	32	19	51
	Old	42	25	67
G1	Young	25	15	40
	Old	34	23	57
H1	Young	28	17	45
	Old	39	21	60
I1	Young	34	15	49
	Old	43	21	64
I2	Young	24	19	43
	Old	23	20	43
J1	Young	36	16	52
	Old	45	21	66
J2	Young	23	20	43
	Old	22	20	42
K1	Young	32	16	48
	Old	36	19	55
K2	Young	23	20	43
	Old	22	20	42
K3	n/a	24	25	49
L1	n/a	37	20	57
NWF	n/a	14	15	29
NWL	n/a	93	19	112

Disturbance Type	Biodiversity (no. of species)		
	Birds	Mammals/ Herptiles	Totals
Winter road	5	9	14
Permanent road	0	5	5
Airstrip	3	5	8
Borrow pit	0	5	5
Camp	3	6	9
Clearcut	20	8	28
Highway	0	5	5
Inactive well pad	7	10	17
Active well pad	2	7	9
Plant	2	6	8
Transmission line	16	9	25
Remote sump	2	5	7
Road/utility corridor	9	5	14
Lay down	0	5	5