Waterfowl, Raptors and Breeding Terrestrial Birds of the Suncor Lease in 1995

May, 1996

Prepared for:

Suncor Inc.

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This report is one of a series of reports prepared for Suncor Inc. Oil Sands Group for the Environmental Impact Assessment for the development and operation of the Steepbank Mine, north of Fort McMurray, Alberta. These reports provided information and analysis in support of Suncor's application to the Alberta Energy Utilities Board and Alberta Environmental Protection to develop and operate the Steepbank Mine, and associated reclamation of the current mine (Lease 86/17) with Consolidated Tailings technology.

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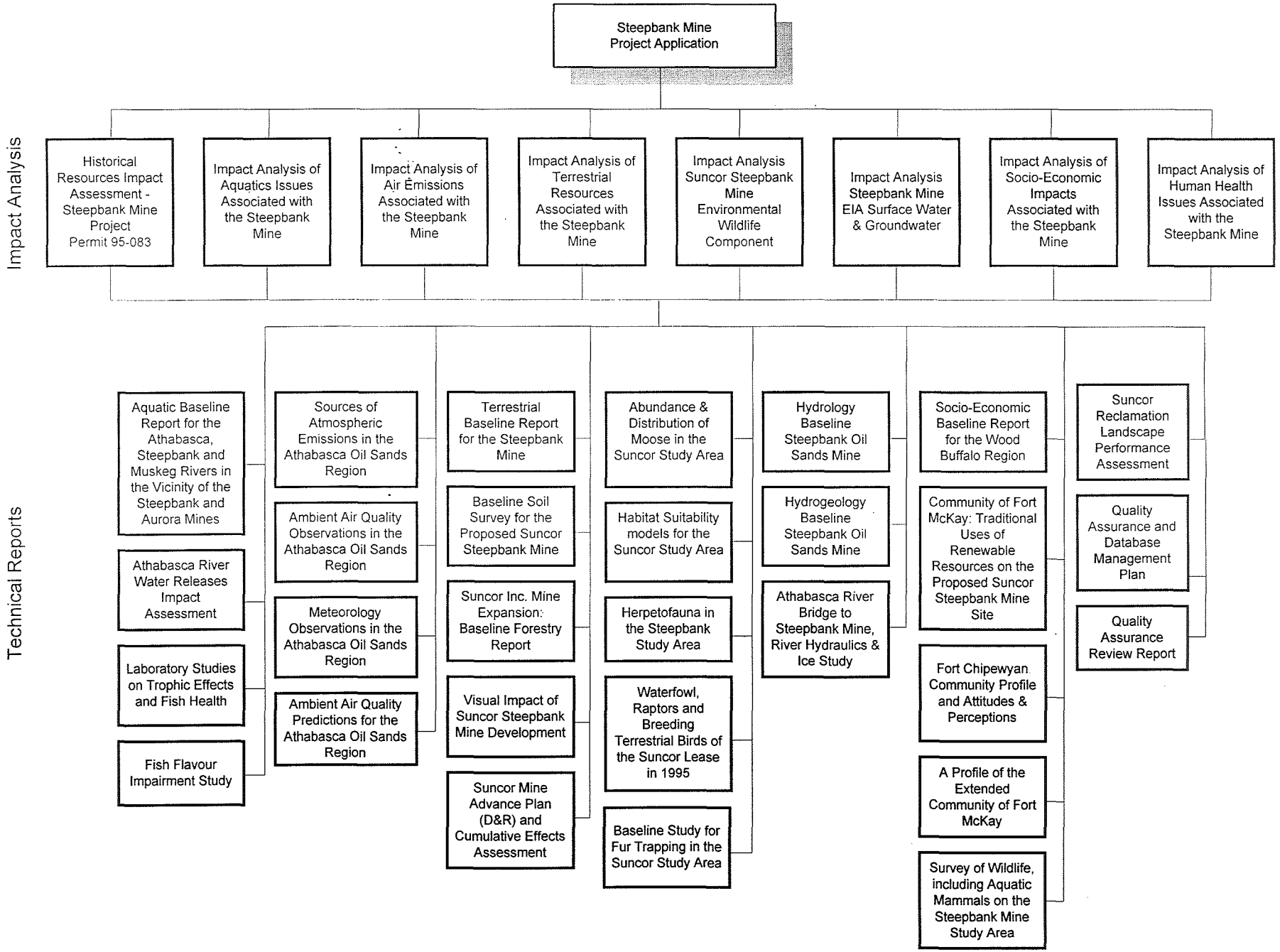

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WATERFOWL, RAPTORS AND BREEDING TERRESTRIAL BIRDS OF THE SUNCOR LEASE IN 1995

May 1996

Prepared for:

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Fort McMurray, Alberta

Prepared by:

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EXECUTIVE SUMMARY

An avifauna survey was completed in 1995 as part of an environmental impact assessment of a new mine development by Suncor Inc., Oil Sands Group, north of Fort McMurray, Alberta. Specific surveys included:

- an aerial survey of breeding waterfowl on major wetlands within the study area
- three aerial surveys for migrating/staging waterfowl during autumn
- an aerial survey for breeding raptors
- 95 point counts for breeding terrestrial birds in 11 major upland habitat types.

Thirteen species of waterfowl were recorded during breeding pair surveys, with an overall density of 3.42 pairs per kilometre of shoreline. Natural wetlands supported the highest breeding densities (12.64 pairs/km), and riverine habitats the lowest (0.76 pairs/km). Mallards were the most common species within the study area (0.86 pairs/km). A total of 748, 746 and 1160 waterfowl were reported during aerial surveys on 7 September, 20 September and 2 October, respectively. Dabblers accounted for 65% of individuals encountered on these surveys, the majority (90%) of which were Mallards. Scaup were the most common diving duck species (43%). Large lakes and reservoirs were the most important wetlands for migrating/staging waterfowl.

Sightings of raptors during the aerial survey included the Broad-winged Hawk, Northern Goshawk, Northern Harrier, and Bald Eagle (active nest east of Tar Island). Three additional species (American Kestrel, Northern Harrier, Sharp-shinned Hawk) were added during upland bird surveys and incidental observations.

Seventy-two avian species were encountered during point counts in specific habitat types, with six additional species being recorded during incidental observations. Tennessee Warblers were the most cosmopolitan species, occurring in 10 of 11 habitats, and in 58.9% of count circles. Twenty four species were found in only a single habitat type. Riparian Deciduous Forests and Closed Shrub Complexes rated highest in terms of number of unique species (six and nine, respectively), total number of species (28 in both), mean number of species/count (8.3 and 8.6), mean number of individuals/count (10.1 and 13.8), and Shannon-Weaver diversity index (1.31 and 1.25). Closed

White Spruce habitat supported the highest density of birds (7.0/ha). Closed Black Spruce was the most impoverished habitat in terms of mean number of species (4.5) and individuals (5.9) per count, and overall bird density (3.0/ha), whereas Disturbed/Herb, Grass Dominant habitats had the lowest species total (11) and species diversity (0.91).

Four recommendations to minimize the impact of the new mine development on local avifauna are proposed:

- Protect small wetlands wherever possible
- Minimize development in riparian forests
- Preserve examples of all existing habitat types, and aim to restore existing habitat types during future reclamation, and
- Minimize disturbance around the active Bald Eagle nest.

ACKNOWLEDGMENTS

This baseline report was prepared for Suncor Inc., Oil Sands Group (Suncor) by Westworth, Brusnyk & Associates Ltd. as part of the Suncor Steepbank Mine Environmental Impact Assessment (EIA). Mr. Don Klym was the Suncor project manager and Ms. Sue Lowell was the Suncor project coordinator. Mr. Steve Tuttle was Suncor's task leader for the wildlife resources component. Mr. Hal Hamilton of Golder was the EIA project manager.

The component leader for the wildlife resources impact assessment was Mr. Lawrence Brusnyk. Mr. Ernest Ewaschuk and Mr. David Prescott were the authors of this baseline report. The field work was also conducted by Mr. Ewaschuk and Mr. Skinner. Mr. John Gulley (Suncor) provided background data on avian use of Lease 86/17. Ms. Kari Donnelly and Ms. Carol Brittain were responsible for word processing and report formatting.

Mr. Lawrence Brusnyk, Mr. John Gulley (Suncor), and Ms. Bette Beswick reviewed the draft of the report.

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1.0 INTRODUCTION

Because of declining oil sands reserves at the site of their present mine, Suncor Inc., Oil Sands Group (Suncor) has put forward a proposal to expand their operation to include oil sands reserves in the vicinity of the Steepbank River on the east side of the Athabasca River. As part of an Environmental Impact Assessment for the Steepbank Mine Project, wildlife baseline studies were conducted during 1995 in areas that could be affected by the proposed development. This report details results of an inventory of avian resources conducted during 1995 by Westworth, Brusnyk & Associates Ltd. The study focussed on three groups of birds: raptors, waterfowl and breeding upland bird communities associated with particular habitat types.

2.0 METHODS

2.1 Waterfowl Surveys

Four waterfowl surveys were conducted on major waterbodies within the study area. A spring waterfowl survey was conducted on 22 May to determine the size and composition of local breeding populations. The timing of this survey closely corresponded to the Waterfowl Breeding Population Survey for northern Alberta conducted by the U. S. Fish and Wildlife Service (1995). Stratum 77, which covers the Suncor study area, which was initiated on 23 May. Autumn migration counts were conducted to determine peak numbers and species composition of transient waterfowl. Past research has shown great annual variation in the timing of waterfowl movements through the oil sands area (Collins et al. 1982, Gulley 1987, Hennan and Munson 1979, Schick and Ambrock 1974, Sharp et al. 1975, Ward et al. 1976), so three counts separated at 12 to 14 day intervals were completed (7 and 20 September, 2 October).

Spring surveys were conducted along the Athabasca and Steepbank Rivers, and on nine major wetlands within the study area (Figure 1). Due to time constraints, autumn surveys omitted the Steepbank River and Wetland #3. Counts were conducted from a Bell 206 Jet Ranger helicopter, flying approximately 100 m above ground level at an air speed of 80-100 km/h. The speed and altitude of flight were varied to obtain the best possible count, with autumn counts generally being conducted at higher speeds and altitudes than spring counts. Because of its width, each side of the Athabasca River was surveyed separately, with each survey focussing on waterfowl from the shoreline to the midpoint of the river.

Two observers, on opposite sides of the aircraft, participated in each survey. Continual communication between observers ensured that birds were counted without duplication. One observer recorded data on a tape recorder, while the other observer manually tallied data as a backup. In spring surveys, we recorded the species of all birds encountered, as well as their social status, for later calculation of indicated pair breeding (IBP) density on each wetlands area, as follows:

Dabbler IBP = P + LD + G + LH, and

Diver IBP = P + LD + G + LH,

where P = number of pairs, LD = number of lone drakes, G = number of grouped birds, and LH = number of lone hens. For dabblers, G = the number of grouped drakes in groups of 5 or less, whereas in divers, G = the number of birds in groups ≤ 5 that included a hen. Groups of >5 individuals were classed as non-breeding flocks, and were not included in calculations of breeding pairs (Dzubin 1969, Hennan and Munson 1979).

During autumn surveys, only numbers of individuals of each species were recorded. The eclipse plumage of most waterfowl at this time of year often precluded identification of ducks to the species level. Therefore observers focussed primarily on the number of individuals within the "dabbler" or "diver" guilds.

Other species of birds encountered during waterfowl surveys were also recorded.

2.2 Raptor Surveys

We conducted aerial inventories for breeding raptors during helicopter surveys of breeding waterfowl on 22 May, and during a 22 May fixed-wing aircraft survey that focused specifically on raptors. During the latter survey, eight parallel transects, approximately 3 km apart, were flown at an altitude of 100-300 m, and an air speed of approximately 100 km/h. All species of raptors were recorded, as well as the location of active nests. The occurrence of raptors were also recorded during terrestrial breeding bird surveys (see below) and during flights for migratory waterfowl conducted during the fall.

2.3 Terrestrial Breeding Bird Surveys

Surveys of upland breeding birds were conducted between 9 and 15 June 1995 in 14 pre-defined habitat types (based on preliminary vegetation classification by Golder Associates Ltd.) which encompassed the major vegetative communities present on the Suncor study area. Surveys were completed using unlimited-distance point counts, where the count radius was divided into two bands

(within and beyond 60 m) to permit calculation of density of individual species in a habitat (Bibby et al. 1992, see below). Morrison et al. (1981) calculated that between four and six counts are sufficient to quantify the breeding birds of homogeneous vegetation types. Therefore a minimum sample of six counts were made in each habitat. All birds seen or heard within a five-minute count interval were recorded, although birds flying over the habitat were excluded unless they appeared to be foraging over, or otherwise associated with, the focal area. Over 90% of counts were conducted between 0445 and 1000 h, MDT, with the remainder being conducted between 1930 and 2100 h. All counts were conducted during rainless conditions, with winds <15 km/h.

The 14 habitat types were later condensed into 11 classes (Table 1) to conform as closely as possible with the final vegetation classification produced by Golder Associates Ltd. This reclassification resulted in three habitats being merged into the Upland Mixed Wood, Aspen Dominant habitat type, and two being condensed into the Closed Black Spruce type. Accordingly, sample sizes for surveys in these habitats were larger (n = 14 and 19, respectively) than for other habitats surveyed. Two habitats that were included in Golder's final, but not initial, classification (Closed Black Spruce/Tamarack and Closed Mixed Coniferous, Black Spruce Dominant) did not match any of the habitats surveyed, and were omitted from the analysis. Riparian Deciduous Forest, which was dropped from the final classification, was retained for analysis because of the unique composition (i.e., dominance of balsam poplars) and restricted distribution (i.e., along major rivers) of this habitat type.

For each habitat, calculations were made on the percentage of circles in which each species was encountered and the mean number of individuals of each species/count. The density (number/ha) of each species in a habitat was also calculated by summing the total number of individuals recorded within and beyond 60 m of the observer, with density calculated as follows:

$$D = \log_e(n/n_1) \times n/m(\pi r^2)$$

(Bibby et al. 1992), where n = total number of birds counted, n_1 = number of individuals beyond 60 m, m = total number of point counts in a habitat, and r = the fixed radius (60 m). The resulting value was multiplied by 10,000 to give a density in units of individuals/ha. Densities could not be calculated for species which were only recorded within, or outside of, the 60-m fixed radius.

The overall bird communities of each habitat type were summarized by calculating:

(i) the total number of species observed during point counts

(ii) the mean (±SE) number of species/count

(iii) the mean (±SE) abundance of individuals/count

(iv) the Shannon-Weaver diversity index, $H' = -\Sigma p_i \ln p_i$ where p_i = the proportion of total number of individuals belonging to the i^{th} species (Shannon and Weaver 1949)

(v) the overall density of birds in each habitat (all species combined), and

(vi) the number of species that were unique to each habitat.

Species encountered during casual observations in each habitat type during the study period, but that were not detected during point counts are also reported herein.

3.0 RESULTS

3.1 Waterfowl Surveys

3.1.1 Breeding Survey

Thirteen species of waterfowl were identified during the survey for breeding waterfowl, with Mallards being the most abundant species (0.86 pairs/km of shoreline, Table 2). Overall, 436 indicated pairs of waterfowl were encountered on the study area, with the highest density of breeding waterfowl being observed on Wetlands #5 (16.85 pairs/km), and the lowest on the Steepbank River (0.53). For comparative purposes, the surveyed wetlands were grouped into five general types: natural wetlands (Wetlands #'s 1, 4, and 5), beaver impoundments (Wetlands #'s 2 and 3), reservoirs (Beaver Creek and Poplar Creek Reservoirs and Ruth Lake), channels (Poplar Creek/Ruth Lake channel), and rivers (Athabasca and Steepbank). Overall, natural wetlands supported the highest breeding pair densities (12.64 pairs/km), followed by beaver ponds (9.75), reservoirs (6.91), the channel (4.57) and rivers (0.76).

The most abundant breeding waterfowl species on the study area in 1995 were Mallard, Lesser Scaup, Ring-necked Duck, American Wigeon, Green-winged and Blue-winged Teal (Table 2). For comparison, the U. S. Fish and Wildlife Service survey for Stratum 77 lists Green-winged Teal, Mallard, Lesser Scaup, Bufflehead, American Wigeon and Blue-winged Teal as being most abundant species in northern Alberta.

3.1.2 Autumn Surveys

In total, 748, 736 and 1166 waterfowl were observed during the three autumn waterfowl surveys (Appendix 1, 2, and 3). Dabblers accounted for 65% of all ducks observed in the autumn of 1995. This total was relatively constant over the three surveys (range 58 to 76%). Forty-five percent of dabblers were identified to species, with Mallards comprising the majority (90%) of this total. Of the 21% of divers identified to species, 43% were scaup, 26% were Common Goldeneye and 30% were Bufflehead. Lakes and reservoirs were the most important waterbodies for staging/migrating waterfowl, with Ruth Lake attracting a larger percentage of divers than Beaver Creek and Poplar

Creek Reservoirs (Figure 2).

Thirteen species other than raptors and waterfowl were recorded during spring and autumn aerial surveys (Table 3).

3.2 Raptor Surveys

3.2.1 Aerial Survey

Six sightings with raptors or raptor nests were made during the fixed-wing survey on 22 May. Adults of four species were identified, including Broad-winged Hawk, Northern Goshawk, Northern Harrier and Bald Eagle. A single, empty nest with no adults nearby, was also noted as well as a single, unidentified large accipiter (Cooper's Hawk or Goshawk). The Bald Eagle nest remained active throughout the period when upland bird surveys were conducted (9 to 15 June). To minimize disturbance, the contents of the nest were not checked.

3.2.2 Other Raptor Sightings

Only one raptor, a Red-tailed Hawk, was observed during point counts for breeding upland birds. This was an observation of a single adult in an Open Black Spruce/Labrador Tea habitat on 10 June (Appendix 4). However, incidental observations of three additional species were made during breeding bird surveys on 10 June: a single Northern Harrier in Closed Shrub Complex habitat, and a pair of Sharp-shinned Hawks and a single American Kestrel along a power line right-of-way adjacent to an aspen cut block.

Four species of raptor were observed during autumn waterfowl surveys. Single adult Bald Eagles were seen on all three flights: on 7 September on the southwest shore of Poplar Creek Reservoir; on 20 September on the east side of the Athabasca river, approximately 1 km south of the nest site; and on 2 October, on the east side of the Athabasca River, about 2 km south of Wetland #1. It is unknown whether these sightings were of the same individual. Single Sharp-shinned Hawks were observed on 7 September along the Athabasca River 1 km north of Stony Island, and on 20 September approximately 1.5 km east of Wetland #2. We also encountered a single Broad-winged

Hawk on the east side of Ruth Lake on 20 September, and a single Northern Harrier at the north end of Poplar Creek Reservoir on 2 October.

The empty Bald Eagle nest was inspected from a helicopter on 7 September. The nest was flattened, suggesting prolonged use over the summer, but no evidence of breeding success or failure was evident.

Observations of raptors on the Suncor study area during 1995 are summarized in Table 4.

3.3 Terrestrial Breeding Bird Surveys

A total of 95 point counts were conducted during the study (Figure 1). The bird communities of each habitat are detailed in Table 5 and Appendix 4.

Seventy-two species of birds were encountered during point counts. An additional six species (Spruce Grouse, Northern Harrier, Broad-winged Hawk, Bald Eagle, Boreal Chickadee and White-winged Crossbill) were observed in specific habitat types during incidental observations, but not during point counts. The most common and widespread species observed during point count surveys was the Tennessee Warbler, which was found in 58.9% of all count circles, and in 10 of the 11 habitats (Table 5). The highest density of this species occurred in Open Tamarack, Bog Birch (2.11 individuals/ha, Appendix 4). Six other species were found in >25% of circles: White-throated Sparrow (42.1% of circles; 11 habitats), Red-eyed Vireo (37.9%, 8 habitats), Ruby-crowned Kinglet (33.7%, 8 habitats), American Robin (30.5%, 9 habitats), Ovenbird (29.5%, 6 habitats) and Swainson's Thrush (25.3%, 8 habitats). Chipping Sparrows were also widespread (10 habitats, Table 5), but were found in only 20.1% of count circles. Twenty-four species were detected in only a single habitat type (Table 5, Appendix 4), with the highest number of unique species being found in Closed Shrub Complexes (9) and Riparian Deciduous Forests (6, Table 6).

Riparian Deciduous Forests and Closed Shrub Complexes were exceptional not only on the basis of unique species, but in terms of total number of species observed (28 in both), mean number of species/count (8.3 and 8.6, respectively), mean number of individuals/count (10.1 and 13.8), and S-W diversity index (1.31 and 1.25, Table 6). These habitats were also second (Closed Shrub

Complexes = 6.6 birds/ha) and third (Riparian Deciduous Forests = 5.9 birds/ha) in terms of overall bird density, being exceeded only by Closed White Spruce habitats (7.0 birds/ha). Closed Black Spruce habitat was the lowest ranking in terms of mean number of species (4.5), individuals/count (5.9) and overall density of birds (3.0 birds/ha). The lowest species total (11) and species diversity (0.91) were recorded in Disturbed, Herb-Grass Dominant habitats (Table 6).

4.0 DISCUSSION

The Suncor study area encompasses a complex mosaic of upland and wetland habitat types, and consequently supports a rich and diverse avifauna. Overall, 108 species of birds were detected on the study area during 1995 (Appendix 5). With the exception of the unidentified species of swan (likely the Tundra Swan) which was only seen during autumn migration, all species detected probably breed in the immediate area (Godfrey 1986, Semenchuk 1992). This total is consistent with the number of potentially breeding species (113) found during the Alberta breeding bird atlas project in three 10-km^2 squares that occur within the study area (data from Semenchuk 1992), but lower than the 136 "resident" species reported on the Suncor study area between 1976 and 1988 by Gulley (1988), the 138 breeding species recorded on the adjacent Syncrude lease (Sharp et al. 1975), and the 166 species listed by Francis and Lumbis (1979) for the 128,000 km^2 Alberta Oil Sands Environmental Research Program (AOSERP) area of northeastern Alberta. However, these surveys were primarily designed to determine the relative value of upland and wetland habitats for birds within a single breeding season, and not to produce an exhaustive list of species for the study area. Nocturnal and secretive species that require specialized survey techniques such as tape playbacks (Marion et al. 1981) are especially likely to be under-represented in these data. Additionally landbird use of the area during the non-breeding season was not quantified. The addition of transient and wintering landbirds that breed north of the study area would render the overall diversity of birds supported by habitats on the Suncor lease to be substantially higher than we report. Gulley (1988) has recorded a total of 221 species in the Suncor area over a 13-year period, and Francis and Lumbis (1979) listed 238 species that are known to occur throughout the year within the AOSERP area.

Natural wetlands and beaver impoundments were relatively uncommon on the Suncor study area, but supported higher densities of breeding waterfowl than man-made reservoirs, lakes or major rivers. The attractiveness of these wetlands is at least partly due to the flat shoreline gradient that creates a high interspersion of water and vegetation. In contrast, man-made reservoirs generally had steeper, well-defined shorelines for much of their perimeters. This was especially true of Poplar Creek Reservoir, which had a lower waterfowl breeding density (4.40 pairs/km) than other man-made impoundments. The importance of natural wetlands relative to reservoirs and rivers was also noted by Hennan and Munson (1979), who, in 1976, conducted breeding waterfowl surveys on seven of the same water bodies surveyed in 1995 (Table 7). Also evident from comparison with data from

1976 is the substantially higher density of waterfowl observed in 1995. This trend is consistent with a 36% increase in waterfowl populations in northern Alberta and adjacent areas over this time period (U. S. Fish and Wildlife Service 1995). However, surveys for this study were conducted by helicopter, which are slower and more manoueverable than the fixed wing aircraft used by Hennan and Munson (1979). Accordingly, differences in survey methodology might partly explain the higher waterfowl densities observed in 1995.

In addition to the wetlands which were surveyed from the air, a number of minor wetland types encountered during terrestrial bird surveys on the Suncor study area were found to be important habitats for waterfowl and other bird species. For example, Blue-winged and Green-winged Teal and Bufflehead were frequently observed in ditches and borrow pits created by road construction activities. In addition, small streams and pools provided habitat for Bufflehead, as well as Killdeer, Spotted and Solitary Sandpipers. Bird use of such waterbodies further highlights the overall importance of natural wetlands to the avifauna of the Suncor study area.

Reservoirs were more important than natural wetlands or rivers on the Suncor study area for staging/migrating waterfowl during the autumn of 1995, with the highest numbers recorded on Ruth Lake. Hennan and Munson (1979) also noted the importance of this area, and Ruth Lake in particular, relative to other wetlands on the Suncor study area. However, these authors observed much higher densities of waterfowl on lakes to the north and east of the present study area (e.g., Gordon, Little McClelland, Ronald Saline and Audet Lakes) during autumn. Thus, the Suncor study area appears to be of relatively minor importance to migrating/staging waterfowl compared to other areas of northeastern Alberta. However the timing of this study's surveys may have underestimated the importance of the area to some waterfowl species. Hennan and Munson (1979) noted that the peak of White-fronted and Canada Goose movements through the oil sands area was on 7 September 1976. White-fronted Geese were not observed during surveys on the study area, and only 20 Canada Geese were observed over the three surveys. However, three flocks of White-fronted Geese were observed several kilometres north of Fort McMurray on 7 September. Thus these surveys may have been too late in the year to determine use of the study area by these species. Similarly, Hennan and Munson (1979) reported peak movements of Tundra Swans and Snow Geese through the area on 4 October 1976. We only recorded two swans during the last survey of the year (2 October), so most individuals of these species may not yet have moved through the region by the time our surveys

were completed. Finally, waterfowl surveys were not conducted during spring migration in 1995. Gulley (1987, 1988) noted that numbers of waterfowl migrating through the Suncor area are generally higher in spring than in autumn. The overall importance of the area to migrating waterfowl may therefore be higher than our data suggest.

Raptors were infrequently encountered on the Suncor study area, and most encounters with these species resulted from opportunistic sightings. Perhaps the most notable species we observed was the nesting Bald Eagles. The species is a reasonably common but sparsely-distributed breeder in extreme northeastern Alberta (Munson et al. 1980), and is frequently observed during migration along the Athabasca River in the Suncor lease area (Ward et al. 1976). However, the active nest east of Tar Island is the first known nesting attempt by the species in the area for at least 15 years (J. Gulley, pers. comm). We cannot confirm successful nesting of these individuals, but nests tend to be re-used for several years (Bent 1937). Therefore Bald Eagles would be expected to return to this area in the future if suitable habitat remains.

Upland habitats varied widely in terms of their importance to bird species. Black spruce forests supported the lowest richness and abundance of birds, which is consistent with other studies in the boreal forests of Canada (Gillespie 1960, Carbyn 1971, Erskine 1977, McLaren and McLaren 1981). The highest richness of birds on the Suncor study area is supported by shrub habitats and riparian forests. The attractiveness of deciduous shrub habitat to birds has previously been recognized in coniferous regions (Ward 1975, Wisely and Tull 1977, McLaren and McLaren 1981), while riparian forests have frequently been found to have higher species richness than adjacent uplands (Oakley et al. 1985, Knopf et al. 1988, Gates and Giffen 1991). Francis and Lumbis (1979) acknowledged the high species diversity of "overmature bottomland forests" along the Athabasca River, and considered these areas to be the most important habitat for terrestrial birds in the oil sands region. In Suncor's study area, shrub habitats typically occur in areas of standing water, and like riparian forests, contain vegetational elements from adjacent wetlands and upland sites. Such vegetative diversity, along with the presence of water to produce insects, apparently provides high-quality habitat for a wide range of bird (Oakley et al. 1985), and other vertebrate species (Brode and Bury 1984, Doyle 1990). The value of riparian forests to birds may be even greater during the spring and autumn migration, when these habitats can support over 10 times the number of individuals that use adjacent upland sites (Stevens et al. 1977, Hehnke and Stone 1979). The importance of riparian

corridors within the oil sands area might be particularly high, because the Athabasca River is the major north-south river system in northeastern Alberta. Ward et al. (1976) have documented substantial migratory movements of water and land birds through the Athabasca River valley in the vicinity of the Suncor study area.

We have quantified the relative importance of upland habitats on the Suncor study area based on bird use of discrete vegetation types. Because the habitat patches surveyed were larger than the breeding home range of many of the small-bodied species encountered, the relative importance assigned to various habitat classes is probably accurate. However, the home ranges of many larger species likely encompass a number of different habitat types, and selection of a breeding area probably occurs on a scale that is larger than could be addressed using point-count surveys (McGarigal and McComb 1995). For these species, landscape features such as patch size and shape, habitat interspersion, proximity to water, human disturbance and other factors might be important considerations.

Based on this study of bird distribution and abundance on the Suncor study area, we make the following major recommendations concerning impacts of the new mine development:

1. Small wetlands are relatively uncommon on the Suncor study area, and should be protected wherever possible. These wetlands support higher densities of waterfowl than rivers, reservoirs and lakes on the study area, and are typically found in association with closed shrub complexes that are amongst the most important upland habitats for breeding birds.

2. Development in riparian forests should be avoided wherever possible. There is evidence that riparian strips adjacent to forest clear cuts must be at least 60 m wide for bird populations to approximate those found in uncut riparian tracts (Darveau et al. 1995). Therefore, it is recommended that clearcutting on the new mine development not occur within 60 m of the Athabasca and Steepbank Rivers.

3. All upland habitats surveyed support distinctive assemblages of bird species. To minimize loss of biodiversity, mine development should therefore proceed in a manner that preserves examples of all habitat types, and future habitat efforts should aim to restore the range of habitat types that

presently occur in the study area.

4. The Bald Eagle nesting site should not be disturbed. Bald Eagles are presently recovering from severe population declines (Bednarz et al. 1990), and are a sparsely-distributed breeding species in northern Alberta. Knight and Knight (1984, 1986) have shown that the species is sensitive to human activity, so excessive disturbance around the nest site will undoubtedly cause abandonment of the breeding territory. Adequate protection of the riparian habitat (see above) where the nest is currently located may be sufficient to ensure future breeding of this species on the study area.

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TABLES

6.0 TABLES

Table 1. Eleven habitat types used in final analysis of breeding terrestrial bird communities on the Suncor study area in 1995.

HABITAT TYPE	DESCRIPTION
CLOSED BLACK SPRUCE	Mature lowland forests containing >90% black spruce with >70% canopy cover
CLOSED DECIDUOUS, ASPEN DOMINANT	Mature upland forests containing >70% trembling aspen
CLOSED JACK PINE	Mature upland forests with >50% jack pine, <50% trembling aspen and white birch
CLOSED MIXEDWOOD	Mature woodland containing equal proportions (40-60%) coniferous (white spruce) and deciduous (trembling aspen/white birch) species
CLOSED MIXEDWOOD, WHITE SPRUCE DOMINANT	Mature upland forests containing 60-80% white spruce, 20-40% trembling aspen/white birch
CLOSED SHRUB COMPLEX	Moist, lowland areas with willows, bog birch and sedges, and >80% canopy cover
CLOSED WHITE SPRUCE	Upland forests containing 70-90% mature white spruce with >90% canopy cover
DISTURBED, HERB-GRASS DOMINANT	Sites revegetated following clearcutting or mining operations. <20% canopy cover of white spuce, willow or jack pine <3 m tall, interspersed with grass and forbs
OPEN BLACK SPRUCE, LABRADOR TEA	Lowland areas containing >90% black spruce (often stunted) with <30% canopy cover and understory of labrador tea
OPEN TAMARACK , BOG BIRCH	Moist, lowland areas containing <20% black spruce/tamarack canopy, interspersed with willows and bog birch
RIPARIAN DECIDUOUS FOREST	Mature willow/balsam poplar forests interspersed with trembling aspen, white spruce and white birch adjacent to major watercourses

Table 2. Indicated breeding pair densities (IBP/ km of shoreline) of waterfowl species encountered on major waterbodies within the Suncor study area on 22 May, 1995.

Species	Wetland[a]											Overall
	AR	BC	PC	PC/RL	RL	SB	1	2	3	4	5	
Green-winged Teal	0.04	0.90	0.97	0.86	0.11		1.96	0.50	1.00	0.49	1.69	0.30
Mallard	0.22	3.20	0.54	0.86	1.81	0.26	1.96	3.50	3.00	1.13	3.37	0.86
Blue-winged Teal	0.18	0.08	0.22	0.86			1.57	2.50		0.97	1.69	0.26
N. Shoveler		0.33								0.16	0.56	0.05
Gadwall	0.06									0.16		0.03
American Wigeon	0.07	1.31	0.54	0.86	1.24	0.08	0.78	1.00		0.65	1.69	0.40
Ring-necked Duck		1.23	0.64	1.14	2.37		1.57	1.00		1.46	2.25	0.51
Lesser Scaup	0.15	1.64	0.86		1.92		3.53	0.50		1.13	2.81	0.58
Surf Scoter	0.04											0.02
Wh.-winged Scoter	0.06											0.02
Comm. Goldeneye	0.15	0.08	0.54					0.50		0.49	0.56	0.15
Bufflehead			0.11				2.75	2.00	4.00	0.32	2.25	0.17
Comm. Merganser	0.04	0.08				0.19						0.06
Total IBP	54	108	41	16	66	14	36	23	8	43	30	439
km surveyed	54.65	12.19	9.31	3.50	8.85	26.52	2.55	2.00	1.00	6.18	1.78	128.53
Density (IBP/km)	0.99	8.86	4.40	4.57	7.46	0.53	14.12	11.50	8.00	6.96	16.85	3.42

[a] AR=Athabasca River; BC=Beaver Creek Reservoir, PC=Poplar Creek Reservoir; PC/RL=Poplar Creek/Ruth Lake channel; RL=Ruth Lake; SB=Steepbank River. See Figure 1 for locations of named and numbered wetlands.

Table 3. Summary of bird species other than raptors and waterfowl encountered during aerial surveys on the Suncor study area during spring and autumn, 1995.

Species	Spring[a]	Fall[b]
Common Loon	11	3
Horned Grebe	1	
Red-necked Grebe	76	22
Double-crested Cormorant	1	2
American Bittern		3
Great Blue Heron	20	8
American Coot	6	166
Yellowlegs spp.	4	25
Unidentified shorebirds	8	16
Spotted Sandpiper	68	2
White-headed gull spp.		66
Belted Kingfisher		1
Common Raven	1	1

[a] spring survey on 22 May
[b] autumn surveys on 7 September, 20 September and 2 October

Table 4. Summary of raptor observations on the Suncor study area during 1995.

Species	Date	Observation
Bald Eagle	22 May	Single adult on nest, southeast of Tar Island on east bank of Athabasca River (56°58'N, 111°26'W)
	7 September	Single adult, southwest shore of Poplar Creek Reservoir (56°55'N, 111°30'W)
	20 September	Single adult, east side of Athabasca River, 1 km south of nest site (56°58'N, 111°27'W)
	2 October	Single adult, east side of Athabasca River, 2 km south of wetland #1 (56°57'N, 111°27'W)
Northern Harrier	22 May	Single bird flying, 2 km east of Athabasca River, 1 km north of Wood Creek (56°54'N, 111°23'W)
	10 June	Single bird, south end of Beaver Creek Reservoir in closed shrub complex (56°58'N, 111°35'W)
	2 October	Single bird, north end of Poplar Creek Reservoir (56°57'N, 111°30'W)
Sharp-shinned Hawk	10 June	Pair in clearcut along power line south of Beaver Creek Reservoir (56°57'N, 111°38'W)
	7 September	Single bird along Athabasca River 1 km north of Stony Island (56°54'N, 111°26'W)
	20 September	Single bird 1.5 km east of wetland #2 (56°53'N, 111°22'W)
Northern Goshawk	22 May	Single adult flying east over Athabasca River, 3 km south of Tar Island (56°57'N, 111°27'W)
Large Accipiter	22 May	Single bird, 16 km west of Athabasca River, 0.5 km north of Beaver River (56°53'N, 111°41'W)
Broad-winged Hawk	22 May	Single adult in riparian deciduous forest, north bank of Steepbank River, 3 km east of confluence with Athabasca River (56°59'N, 111°24'W)
	20 September	Single bird, east side of Ruth Lake (56°59'N, 111°33'W)
Red-tailed Hawk	10 June	Single bird during point count in open black spruce, labrador tea habitat, 1 km west of Suncor gate (56°58'N, 111°30'W)
American Kestrel	10 June	Single bird in clearcut along power line south of Beaver Creek Reservoir (56°57'N, 111°38'W)
Unknown, empty nest	22 May	In aspen grove, north side of Steepbank River, 1 km east of wetland #5 (57°02'N, 111°28'W)

Table 5. Summary of frequency of occurrence of avian species in point counts within 11 different habitat types on the Suncor study area in 1995. Small dots: ≤33.3 % of counts; medium dots: 33.4 to 66.7 % of counts; large dots: >66.7 % of counts.

Species	Habitat Type[1]										
	CLBS	CDAD	CLJP	CLMW	CMWS	CLSC	CLWS	DHGD	OBSL	OTBB	RIDE
Great Blue Heron						•					
Red-tailed Hawk									•		
Ruffed Grouse							•				
Sandhill Crane						•					
Lesser Yellowlegs						●			●		
Spotted Sandpiper						•					
Common Snipe						●		•			
Bonaparte's Gull	•										
Common Nighthawk			•						•		
Yellow-bellied Sapsucker							•				
Downy Woodpecker		•				•					
Hairy Woodpecker		•				•			•		
Northern Flicker		•	•					•			•
Pileated Woodpecker				•	•						
Western Wood-pewee		•	•								
Yellow-bellied Flycatcher	•										
Alder Flycatcher						●		•		●	•
Least Flycatcher		•									●
Eastern Kingbird						•					
Barn Swallow						•					
Gray Jay	●	•	•		•	•	●		●	•	
Blue Jay					•						•
American Crow		•									•
Common Raven	•						•				
Red-breasted Nuthatch	•			•			•				
Brown Creeper				•	•						
Winter Wren	•				•		•				
Marsh Wren						•					
Golden-crowned Kinglet							•				
Ruby-crowned Kinglet	●		•	•	●	•	●		●	●	
Swainson's Thrush	•	•		●	●		●		•	•	●
Hermit Thrush	●	•	●	●	•				●		
American Robin	•	●	•	•	•	•	•	●			●
Cedar Waxwing											•
Solitary Vireo	•		•	•	•		•				
Warbling Vireo											•
Red-eyed Vireo		●	●	•	•	•	•	●			●
Tennessee Warbler	●	●	•	●	●	●	●		●	●	●

Table 5, con't

Species	Habitat Type[1]										
	CLBS	CDAD	CLJP	CLMW	CMWS	CLSC	CLWS	DHGD	OBSL	OTBB	RIDE
Orange-crowned Warbler	•								•	•	
Yellow Warbler	•					●					●
Magnolia Warbler		•							•	•	•
Cape May Warbler				•			•				
Yellow-rumped Warbler	•	•		●			•		•		
Black-throated Green Warbler											•
Palm Warbler	•					•			•	•	
Bay-breasted Warbler	•						•				
Blackpoll Warbler							•				
Black-and-White Warbler	•	•					•				•
American Redstart											●
Ovenbird		●	•	●	●		•				•
Northern Waterthrush						•					•
Connecticut Warbler		•	•								
Mourning Warbler		•									●
Common Yellowthroat						●				●	•
Wilson's Warbler						●				•	
Canada Warbler		•									•
Western Tanager		•	•	•	•						
Rose-breasted Grosbeak		•									●
Chipping Sparrow	•	•	●	•	•		•	•	•	•	•
Clay-colored Sparrow						●		●			
Savannah Sparrow								●			
LeConte's Sparrow						●		●			
Song Sparrow											•
Lincoln's Sparrow						•		●			•
Swamp Sparrow						●					
White-throated Sparrow	•	●	•	●	•	●	•	●	●	●	●
Dark-eyed Junco	•	•	•		•				●	•	
Red-winged Blackbird						•					
Rusty Blackbird						•					
Brown-headed Cowbird											•
Northern Oriole		•									•
Pine Siskin			•								

[1]CLBS=Closed Black Spruce; CDAD=Closed Deciduous, Aspen Dominant; CLJP=Closed Jack Pine; CLMW=Closed Mixed Wood; CMWS= Closed Mixed Wood, White Spruce Dominant; CLSC=Closed Shrub Complex; CLWS=Closed White Spruce; DHGD=Disturbed, Herb-Grass Dominant; OBSL=Open Black Spruce, Labrador Tea; OTBB=Open Tamarack, Bog Birch; RIDE= Riparian Deciduous Forest.

Table 6. Summary of bird communities determined from point counts in 11 habitat types on the Suncor study area, 1995.

HABITAT TYPE[a]	Total # Species	Mean # Species/Count	Mean # Indiv/Count	Shannon-Weaver Diversity Index	# Unique Species	Bird Density (# Indiv/ha)
CLBS	21	4.5	5.9	1.14	2	3.0
CDAD	25	5.8	8.4	1.12	0	4.0
CLJP	17	5.3	6.5	1.17	1	3.3
CLMW	16	5.4	6.9	1.05	0	4.0
CMWS	17	5.5	7.5	1.11	0	4.3
CLSC	28	8.6	13.8	1.25	9	6.6
CLWS	21	5.7	7.4	1.18	4	7.0
DHGD	11	5.3	7.9	0.91	1	4.2
OBSL	16	5.9	6.7	1.10	1	3.5
OTBB	16	5.9	8.2	0.98	0	5.5
RIDE	28	8.3	10.1	1.31	6	5.9

[a] CLBS=Closed Black Spruce; CDAD=Closed Deciduous, Aspen Dominant; CLJP=Closed Jack Pine; CLMW=Closed Mixedwood; CMWS= Closed Mixedwood, White Spruce Dominant; CLSC=Closed Shrub Complex; CLWS=Closed White Spruce; DHGD= Disturbed, Herb-Grass Dominant; OBSL=Open Black Spruce, Labrador Tea; OTBB=Open Tamarack, Bog Birch; RIDE=Riparian Deciduous Forest.

Table 7. Comparison of waterfowl densities (IBP/km) on seven waterbodies on the Suncor study area surveyed during the present study (1995), and during 1976 by Hennan and Munson (1979). See Figure 1 for location of named and numbered waterbodies.

Water Body	1976	1995
Wetland #1	11.0	14.12
Wetland #4	2.3	6.96
Wetland #5	4.5	16.85
Ruth Lake	3.7	7.46
Beaver Creek Reservoir	1.3	8.86
Athabasca River	0.4	0.99
Steepbank River	0	0.53

FIGURES

7.0 FIGURES

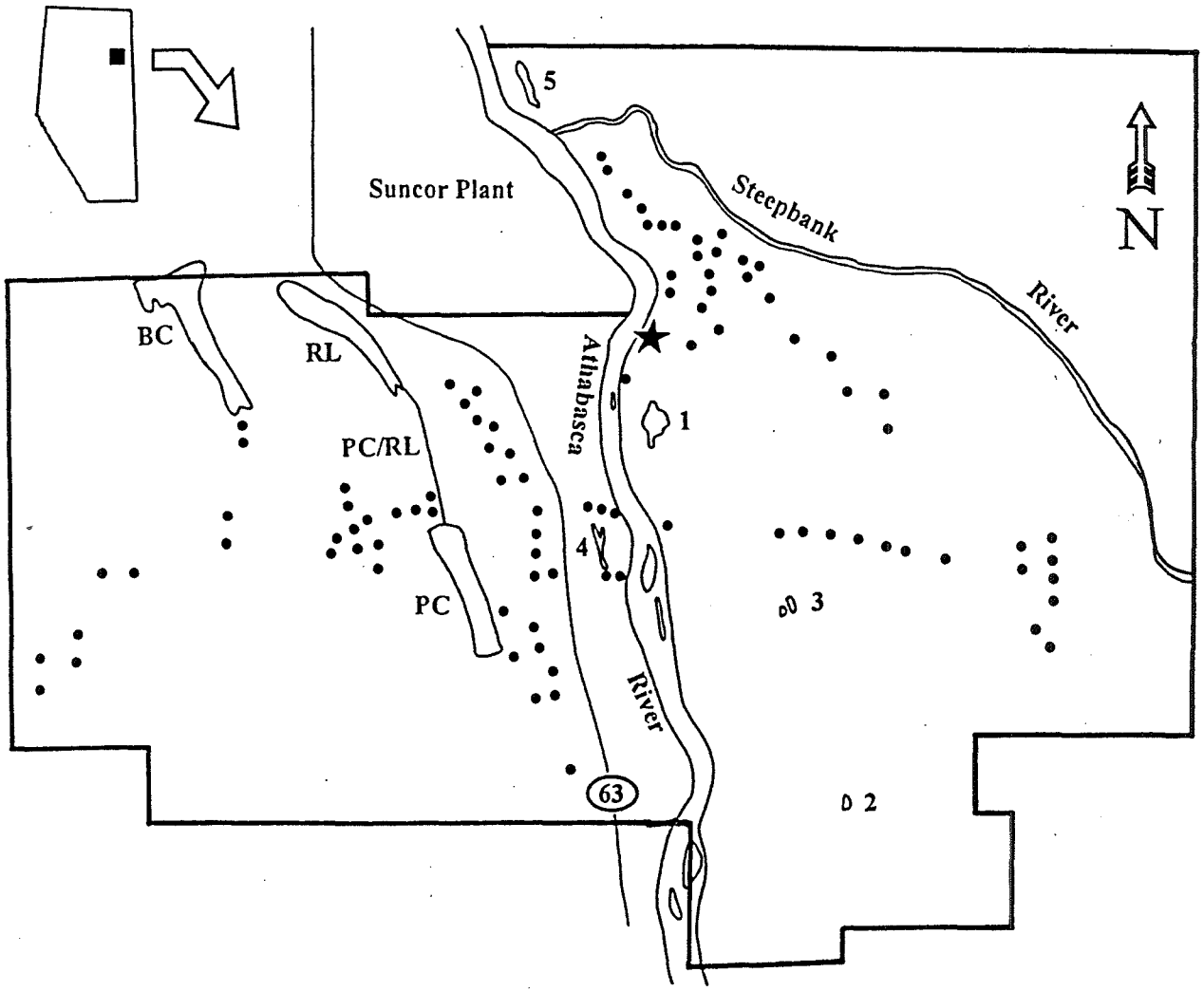

Figure 1. Map of the Suncor study area, showing water bodies surveyed for breeding and migrating waterfowl, location of point counts for terrestrial breeding birds (solid circles) and location of the Bald Eagle nest (star).

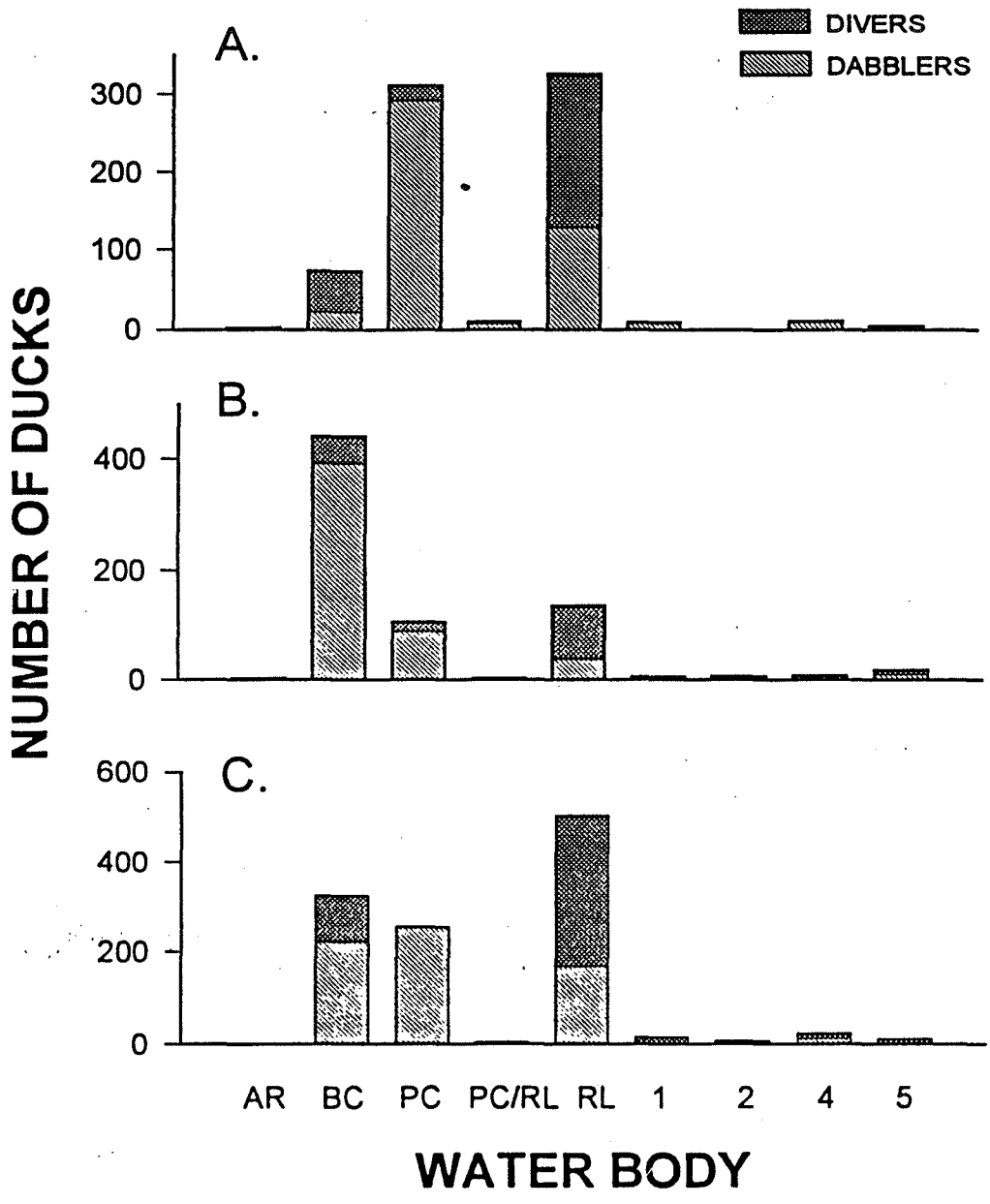

Figure 2. Numbers of dabbling and diving ducks observed during aerial surveys of nine water bodies on the Suncor study area on 7 September (A), 20 September (B), and 2 October (C) 1995. See Table 2 for definition of acronyms for water body names.

APPENDICES

8.0 APPENDICES

Appendix 1. Numbers of waterfowl observed on major wetlands within the Suncor study area during migration survey on 7 September, 1995.

Species	Wetlands[a]									
	AR	BC	PC	PC/RL	RL	1	2	4	5	
Unidentified Swans										
Canada Goose		2								
Dabblers										
Green-winged Teal			30							
Mallard		1			16	4			1	
Blue-winged Teal		3			4					
Northern Shoveler										
Gadwall									2	
American Wigeon		2		1		2			1	
Unidentified Dabblers	2	17	263	7	109	3		11		
Total Dabblers	2	23	293	8	129	9		11	4	
Divers										
Scaup spp.		9	12		28					
Common Goldeneye					22					
Bufflehead										
Merganser spp.										
Unidentified Divers		41	6	2	147					
Total Divers		50	18	2	197					
Total Waterfowl	2	75	311	10	326	9	0	11	4	Grand Total 748

[a] see Table 2 for definition of acronyms. Locations of named and numbered wetlands are shown in Figure 1.

Appendix 2. Numbers of waterfowl observed on major wetlands within the Suncor study area during migration survey on 20 September, 1995.

Species	Wetlands[a]									
	AR	BC	PC	PC/RL	RL	1	2	4	5	
Unidentified Swans										
Canada Goose	6									
Dabblers										
Green-winged Teal		5			2				1	
Mallard		170	5		8		2		11	
Blue-winged Teal										
Northern Shoveler		4								
Gadwall		1								
American Wigeon		7	1							
Unidentified Dabblers	2	207	86	2	30	2	5	3		
Total Dabblers	2	394	92	2	40	2	7	3	12	
Divers										
Scaup spp.		9	5		38	3				
Common Goldeneye					2					
Bufflehead										
Merganser spp.	1									
Unidentified Divers		39	7	1	55	1		5	6	
Total Divers	1	48	15	1	96	4		5	6	
Total Waterfowl	9	442	107	3	136	6	7	8	18	Grand Total 736

[a] see Table 2 for definition of acronyms. Locations of named and numbered wetlands are shown in Figure 1.

Appendix 3. Numbers of waterfowl observed on major wetlands within the Suncor study area during migration survey on 2 October, 1995.

Species	Wetlands[a]									
	AR	BC	PC	PC/RL	RL	1	2	4	5	
Unidentified Swans		2								
Canada Goose		12								
Dabblers										
Green-winged Teal										
Mallard		203			143		3	8		
Blue-winged Teal										
Northern Shoveler										
Gadwall										
American Wigeon										
Unidentified Dabblers		19			26			5	1	
Total Dabblers		222			169		3	13	1	
Divers										
Scaup spp.						4				
Common Goldeneye		9		5	20	6				
Bufflehead		1			64				8	
Merganser spp.										
Unidentified Divers		92	254		252	6	4	11	2	
Total Divers		102	254	5	336	16	4	11	10	
Total Waterfowl	0	338	254	5	505	16	7	24	11	Grand Total 1160

[a] see Table 2 for definition of acronyms. Locations of named and numbered wetlands are shown in Figure 1.

Appendix 4. Bird communities of 11 habitat types on the Suncor study area during 1995. See Table 1 for descriptions of habitat types.

Species	CLOSED BLACK SPRUCE N = 14 Percentage of Counts	Mean Individuals Per Count	Density (Individuals/ha)
Bonaparte's Gull[a]	7.1	0.14	-
Yellow-bellied Flycatcher[a]	7.1	0.07	-
Gray Jay	35.7	0.50	0.37
Common Raven	7.1	0.07	-
Red-breasted Nuthatch	21.4	0.21	0.08
Winter Wren	14.3	0.14	0.09
Ruby-crowned Kinglet	71.4	1.14	0.58
Swainson's Thrush	21.4	0.21	0.08
Hermit Thrush	42.9	0.50	0.07
American Robin	7.1	0.07	-
Solitary Vireo	7.1	0.07	-
Tennessee Warbler	57.1	0.79	0.42
Orange-crowned Warbler	14.3	0.21	0.21
Magnolia Warbler	7.1	0.07	-
Yellow-rumped Warbler	21.4	0.29	0.18
Palm Warbler	21.4	0.21	0.21
Bay-breasted Warbler	7.1	0.07	-
Black-and-White Warbler	7.1	0.07	-
Chipping Sparrow	21.4	0.21	-
White-throated Sparrow	7.1	0.07	-
Dark-eyed Junco	28.6	0.71	0.76

[a] Species are unique to the habitat.

Habitat Summary

Total # Species: 21	Mean # Individuals/Count: 5.9 ± 0.6
Mean # Species/Count: 4.5 ± 0.4	Species Diversity: 1.14
Number of Unique Species : 2	Bird Density (#/ha): 3.0

ALSO OBSERVED IN HABITAT: Spruce Grouse, Boreal Chickadee

... Continued Appendix 4.

CLOSED DECIDUOUS, ASPEN DOMINANT
N = 19

Species	Percentage of Counts	Mean Individuals Per Count	Density (Individuals/ha)	
Downy Woodpecker	5.3	0.05	-	
Hairy Woodpecker	10.5	0.11	-	
Northern Flicker	15.8	0.16	-	
Western Wood-pewee	15.8	0.16	0.06	
Least Flycatcher	31.6	0.47	0.34	
Gray Jay	10.5	0.11	-	
American Crow	5.3	0.05	-	
Swainson's Thrush	15.8	0.26	0.19	
Hermit Thrush	10.5	0.11	0.06	
American Robin	63.2	0.95	0.10	
Red-eyed Vireo	73.7	1.00	0.41	
Tennessee Warbler	78.9	1.74	1.43	
Magnolia Warbler	5.3	0.05	-	
Yellow-rumped Warbler	5.3	0.11	0.06	
Black-and-White Warbler	26.3	0.32	0.31	
Ovenbird	84.2	1.37	1.28	
Connecticut Warbler	5.3	0.11	0.06	
Mourning Warbler	5.3	0.05	-	
Canada Warbler	15.8	0.16	0.06	Western
Tanager	10.5	0.16	-	
Rose-breasted Grosbeak	10.5	0.11	-	
Chipping Sparrow	10.5	0.11	0.06	
White-throated Sparrow	52.6	0.63	0.05	
Dark-eyed Junco	5.3	0.05	-	
Northern Oriole	5.3	0.05	-	

Habitat Summary

Total # Species: 25	Mean # Individuals/Count: 8.4 ± 0.5
Mean # Species/Count: 5.8 ± 0.4	Species Diversity: 1.12
Number of Unique Species : 0	Bird Density (#/ha): 4.0

ALSO OBSERVED IN HABITAT: Broad-winged Hawk, Black-capped Chickadee

... Continued Appendix 4.

CLOSED JACK PINE
N = 6

Species	Percentage of Counts	Mean Individuals Per Count	Density (Individuals/ha)
Common Nighthawk	16.7	0.17	-
Northern Flicker	33.3	0.33	-
Western Wood-pewee	16.7	0.17	-
Gray Jay	16.7	0.17	-
Ruby-crowned Kinglet	16.7	0.17	-
Hermit Thrush	50.0	0.67	-
American Robin	33.3	0.33	0.20
Solitary Vireo	16.7	0.17	-
Red-eyed Vireo	50.0	0.67	0.41
Tennessee Warbler	33.3	0.67	0.82
Ovenbird	33.3	0.33	0.20
Connecticut Warbler	16.7	0.50	0.18
Western Tanager	16.7	0.17	-
Chipping Sparrow	83.3	0.83	0.68
White-throated Sparrow	33.3	0.33	-
Dark-eyed Junco	33.3	0.50	0.18
Pine Siskin[a]	33.3	0.33	-

[a] Species are unique to the habitat.

Habitat Summary

Total # Species: 17	Mean # Individuals/Count: 6.5 ± 1.0
Mean # Species/Count: 5.3 ± 0.8	Species Diversity: 1.17
Number of Unique Species : 1	Bird Density (#/ha): 3.3

ALSO OBSERVED IN HABITAT: Cedar Waxwing

... Continued Appendix 4.

Species	CLOSED MIXEDWOOD N = 7 Percentage of Counts	Mean Individuals Per Count	Density (Individuals/ha)
Pileated Woodpecker	14.3	0.14	-
Red-breasted Nuthatch	28.6	0.29	0.18
Brown Creeper	14.3	0.14	-
Ruby-crowned Kinglet	14.3	0.29	0.18
Swainson's Thrush	71.4	0.86	0.31
Hermit Thrush	42.9	0.57	0.15
American Robin	28.6	0.29	0.18
Solitary Vireo	14.3	0.14	-
Red-eyed Vireo	14.3	0.14	-
Tennessee Warbler	100.0	1.71	1.67
Cape May Warbler	14.3	0.14	-
Yellow-rumped Warbler	42.9	0.43	0.15
Ovenbird	71.4	0.86	0.31
Western Tanager	14.3	0.14	-
Chipping Sparrow	14.3	0.14	-
White-throated Sparrow	42.9	0.57	-

Habitat Summary

Total # Species: 16	Mean # Individuals/Count: 6.9 ± 0.8
Mean # Species/Count: 5.4 ± 0.6	Species Diversity: 1.05
Number of Unique Species : 0	Bird Density (#/ha): 4.0

... Continued Appendix 4.

CLOSED MIXEDWOOD, WHITE SPRUCE DOMINANT
N = 7

Species	Percentage of Counts	Mean Individuals Per Count	Density (Individuals/ha)
Pileated Woodpecker	14.3	0.14	-
Gray Jay	28.6	0.29	0.18
Blue Jay	14.3	0.14	-
Brown Creeper	28.6	0.43	0.42
Winter Wren	28.6	0.29	0.18
Ruby-crowned Kinglet	57.1	0.57	0.70
Swainson's Thrush	71.4	0.86	0.31
Hermit Thrush	14.3	0.29	0.18
American Robin	14.3	0.14	-
Solitary Vireo	14.3	0.14	-
Red-eyed Vireo	14.3	0.14	-
Tennessee Warbler	57.1	1.00	1.11
Ovenbird	42.9	1.14	0.47
Western Tanager	28.6	0.29	0.18
Chipping Sparrow	14.3	0.29	0.18
White-throated Sparrow	14.3	0.14	-
Dark-eyed Junco	14.3	0.14	-

Habitat Summary

Total # Species: 17	Mean # Individuals/Count: 7.5 ± 1.6
Mean # Species/Count: 5.5 ± 0.8	Species Diversity: 1.11
Number of Unique Species : 0	Bird Density (#/ha): 4.3

ALSO OBSERVED IN HABITAT: White-winged Crossbill

... Continued Appendix 4.

CLOSED SHRUB COMPLEX
N = 8

Species	Percentage of Counts	Mean Individuals Per Count	Density (Individuals/ha)
Great Blue Heron[a]	12.5	0.13	-
Sandhill Crane[a]	25.0	0.25	-
Lesser Yellowlegs	37.5	1.00	0.12
Spotted Sandpiper[a]	12.5	0.13	-
Common Snipe	50.0	0.50	0.61
Downy Woodpecker	12.5	0.13	-
Hairy Woodpecker	12.5	0.13	-
Alder Flycatcher	75.0	1.75	0.37
Eastern Kingbird[a]	12.5	0.25	-
Barn Swallow[a]	12.5	0.13	-
Gray Jay	12.5	0.13	-
Marsh Wren[a]	25.0	0.38	0.36
Ruby-crowned Kinglet	12.5	0.13	-
American Robin	12.5	0.13	-
Red-eyed Vireo	25.0	0.25	0.15
Tennessee Warbler	37.5	0.50	0.31
Yellow Warbler	37.5	0.63	0.12
Palm Warbler	25.0	0.25	0.15
Northern Waterthrush	12.5	0.13	-
Common Yellowthroat	100.0	2.13	1.20
Wilson's Warbler	50.0	0.63	0.51
Clay-colored Sparrow	50.0	0.88	0.66
LeConte's Sparrow	37.5	0.38	-
Lincoln's Sparrow	12.5	0.13	-
Swamp Sparrow[a]	75.0	1.63	1.11
White-throated Sparrow	37.5	0.63	0.12
Red-winged Blackbird[a]	25.0	0.38	-
Rusty Blackbird[a]	12.5	0.13	-

[a] Species are unique to the habitat.

Habitat Summary

Total # Species: 28	Mean # Individuals/Count: 13.8 ± 1.3
Mean # Species/Count: 8.6 ± 0.5	Species Diversity: 1.25
Number of Unique Species : 9	Bird Density (#/ha): 6.6

ALSO OBSERVED IN HABITAT: Northern Harrier

... Continued Appendix 4.

Species	CLOSED WHITE SPRUCE N = 6 Percentage of Counts	Mean Individuals Per Count	Density (Individuals/ha)
Ruffed Grouse[a]	16.7	0.18	-
Yellow-bellied Sapsucker[a]	16.7	0.18	-
Gray Jay	66.7	0.84	1.19
Common Raven	16.7	0.18	-
Red-breasted Nuthatch	33.3	0.50	0.49
Winter Wren	16.7	0.18	-
Golden-crowned Kinglet[a]	16.7	0.18	-
Ruby-crowned Kinglet	83.3	1.67	0.53
Swainson's Thrush	50.0	0.67	0.17
American Robin	16.7	0.18	-
Solitary Vireo	16.7	0.18	-
Red-eyed Vireo	33.3	0.33	0.20
Tennessee Warbler	83.3	1.17	1.29
Cape May Warbler	16.7	0.18	-
Yellow-rumped Warbler	33.3	0.50	0.49
Bay-breasted Warbler	16.7	0.18	-
Blackpoll Warbler[a]	33.3	0.33	-
Black-and-White Warbler	16.7	0.18	-
Ovenbird	16.7	0.18	-
Chipping Sparrow	33.3	0.50	-
White-throated Sparrow	33.3	0.33	-

[a] Species are unique to the habitat.

Habitat Summary

Total # Species: 21	Mean # Individuals/Count: 7.4 ± 0.6
Mean # Species/Count: 5.7 ± 0.6	Species Diversity: 1.18
Number of Unique Species : 4	Bird Density (#/ha): 7.0

ALSO OBSERVED IN HABITAT: White-winged Crossbill

... Continued Appendix 4.

DISTURBED, HERB-GRASS DOMINANT
N = 7

Species	Percentage of Counts	Mean Individuals Per Count	Density (Individuals/ha)
Common Snipe	14.3	0.14	-
Northern Flicker	14.3	0.14	-
Alder Flycatcher	28.6	0.43	0.15
American Robin	42.9	0.43	0.15
Red-eyed Vireo	57.1	0.57	-
Chipping Sparrow	28.6	0.29	-
Clay-colored Sparrow	71.4	1.29	0.67
Savannah Sparrow[a]	100.0	2.14	2.08
LeConte's Sparrow	57.1	1.14	1.40
Lincoln's Sparrow	71.4	0.86	0.14
White-throated Sparrow	42.9	0.43	0.15

[a] Species are unique to the habitat.

Habitat Summary

Total # Species: 11	Mean # Individuals/Count: 7.9 ± 0.6
Mean # Species/Count: 5.3 ± 1.0	Species Diversity: 0.91
Number of Unique Species : 1	Bird Density (#/ha): 4.2

... Continued Appendix 4.

OPEN BLACK SPRUCE/LABRADOR TEA
N = 7

Species	Percentage of Counts	Mean Individuals Per Count	Density (Individuals/ha)
Red-tailed Hawk[a]	14.3	0.14	-
Lesser Yellowlegs	42.9	0.43	0.15
Common Nighthawk	14.3	0.14	-
Hairy Woodpecker	14.3	0.14	-
Gray Jay	42.9	0.71	0.32
Ruby-crowned Kinglet	85.7	1.00	0.30
Swainson's Thrush	14.3	0.14	-
Hermit Thrush	42.9	0.43	-
Tennessee Warbler	57.1	0.86	0.53
Orange-crowned Warbler	28.6	0.29	-
Magnolia Warbler	14.3	0.14	-
Yellow-rumped Warbler	28.6	0.29	-
Palm Warbler	28.6	0.29	-
Chipping Sparrow	14.3	0.14	-
White-throated Sparrow	71.4	0.71	-
Dark-eyed Junco	71.4	0.86	0.83

[a] Species are unique to the habitat.

Habitat Summary

Total # Species: 16	Mean # Individuals/Count: 6.7 ± 0.5
Mean # Species/Count: 5.9 ± 0.6	Species Diversity: 1.10
Number of Unique Species : 1	Bird Density (#/ha): 3.5

ALSO OBSERVED IN HABITAT: Spruce Grouse

... Continued Appendix 4.

OPEN TAMARACK, BOG BIRCH
N = 6

Species	Percentage of Counts	Mean Individuals Per Count	Density (Individuals/ha)
Alder Flycatcher	66.7	0.83	0.68
Gray Jay	33.3	0.33	-
Ruby-crowned Kinglet	66.7	0.83	0.16
Swainson's Thrush	16.7	0.17	-
Tennessee Warbler	83.3	1.83	2.11
Orange-crowned Warbler	16.7	0.17	-
Magnolia Warbler	33.3	0.50	0.49
Palm Warbler	33.3	0.33	-
Common Yellowthroat	66.7	1.17	0.87
Wilson's Warbler	16.7	0.33	0.20
Chipping Sparrow	16.7	0.17	-
White-throated Sparrow	83.3	1.33	0.55
Dark-eyed Junco	16.7	0.17	-

Habitat Summary

Total # Species: 13	Mean # Individuals/Count: 8.2 ± 1.0
Mean # Species/Count: 5.5 ± 0.3	Species Diversity: 0.98
Number of Unique Species : 0	Bird Density (#/ha): 5.5

... Continued Appendix 4.

RIPARIAN DECIDUOUS FOREST
N = 8

Species	Percentage of Counts	Mean Individuals Per Count	Density (Individuals/ha)
Northern Flicker	12.5	0.13	-
Alder Flycatcher	25.0	0.38	0.13
Least Flycatcher	37.5	0.50	0.31
Blue Jay	12.5	0.13	-
American Crow	12.5	0.13	-
Swainson's Thrush	37.5	0.50	-
American Robin	75.0	0.88	0.12
Cedar Waxwing[a]	12.5	0.13	-
Warbling Vireo[a]	12.5	0.13	-
Red-eyed Vireo	100.0	1.38	2.07
Tennessee Warbler	37.5	0.38	0.36
Yellow Warbler	37.5	0.50	0.31
Magnolia Warbler	12.5	0.13	-
Black-thr. Green Warbler[a]	12.5	0.25	0.15
Black-and-White Warbler	12.5	0.13	-
American Redstart[a]	75.0	1.13	1.50
Ovenbird	12.5	0.13	-
Northern Waterthrush	12.5	0.13	-
Mourning Warbler	37.5	0.38	0.36
Common Yellowthroat	25.0	0.25	-
Canada Warbler	12.5	0.13	-
Rose-breasted Grosbeak	37.5	0.63	0.28
Chipping Sparrow	25.0	0.25	-
Song Sparrow[a]	25.0	0.25	-
Lincoln's Sparrow	12.5	0.13	-
White-throated Sparrow	62.5	0.75	0.46
Brown-headed Cowbird[a]	12.5	0.13	-
Northern Oriole	25.0	0.25	-

[a] Species are unique to the habitat.

Habitat Summary

Total # Species: 28	Mean # Individuals/Count: 10.1 ± 1.1
Mean # Species/Count: 8.3 ± 0.8	Species Diversity: 1.31
Number of Unique Species : 6	Bird Density (#/ha): 5.9

ALSO OBSERVED IN HABITAT: Bald Eagle

Appendix 5. List of bird species observed on the Suncor study area in 1995. The list includes observations made during formal waterfowl, raptor and terrestrial breeding bird surveys, as well as incidental observations.

Common Loon	*Gavia immer*	Blue Jay	*Cyanocitta cristata*
Horned Grebe	*Podiceps auritus*	American Crow	*Corvus brachyrhynchos*
Red-necked Grebe	*Podiceps grisegena*	Common Raven	*Corvus corax*
Double-crested Cormorant	*Phalacrocorax auritus*	Black-capped Chickadee	*Parus atricapillus*
American Bittern	*Botaurus lentiginosus*	Boreal Chickadee	*Parus hudsonicus*
Great Blue Heron	*Ardea herodias*	Red-breasted Nuthatch	*Sitta canadensis*
Unidentified Swan	*Cygnus sp.*	Brown Creeper	*Certhia americana*
Canada Goose	*Branta canadensis*	Winter Wren	*Troglodytes troglodytes*
Green-winged Teal	*Anas crecca*	Marsh Wren	*Cistothorus palustris*
Mallard	*Anas platyrhynchos*	Golden-crowned Kinglet	*Regulus satrapa*
Blue-winged Teal	*Anas discors*	Ruby-crowned Kinglet	*Regulus calendula*
Northern Shoveler	*Anas clypeata*	Swainson's Thrush	*Catharus ustulatus*
Gadwall	*Anas strepera*	Hermit Thrush	*Catharus guttatus*
American Wigeon	*Anas americana*	American Robin	*Turdus migratorius*
Ring-necked Duck	*Aythya collaris*	Cedar Waxwing	*Bombycilla cedrorum*
Lesser Scaup	*Aythya affinis*	Solitary Vireo	*Vireo solitarius*
Surf Scoter	*Melanitta perspicillata*	Warbling Vireo	*Vireo gilvus*
White-winged Scoter	*Melanitta fusca*	Red-eyed Vireo	*Vireo olivaceus*
Common Goldeneye	*Bucephala clangula*	Tennessee Warbler	*Vermivora peregrina*
Bufflehead	*Bucephala albeola*	Orange-crowned Warbler	*Vermivora celata*
Common Merganser	*Mergus merganser*	Yellow Warbler	*Dendroica petechia*
Red-breasted Merganser	*Mergus serrator*	Magnolia Warbler	*Dendroica magnolia*
Bald Eagle	*Haliaeetus leucocephalus*	Cape May Warbler	*Dendroica tigrina*
Northern Harrier	*Circus cyaneus*	Yellow-rumped Warbler	*Dendroica coronata*
Sharp-shinned Hawk	*Accipiter striatus*	Black-throated Green Warbler	*Dendroica virens*
Northern Goshawk	*Accipiter gentilis*	Palm Warbler	*Dendroica palmarum*
Broad-winged Hawk	*Buteo platypterus*	Bay-breasted Warbler	*Dendroica castanea*
Red-tailed Hawk	*Buteo jamaicensis*	Blackpoll Warbler	*Dendroica striata*
American Kestrel	*Falco sparverius*	Black-and-white Warbler	*Mniotilta varia*
Spruce Grouse	*Dendragapus canadensis*	American Redstart	*Setophaga ruticilla*
Ruffed Grouse	*Bonasa umbellus*	Ovenbird	*Seiurus aurocapillus*
American Coot	*Fulica americana*	Northern Waterthrush	*Seiurus noveboracensis*
Sandhill Crane	*Grus canadensis*	Connecticut Warbler	*Oporornis agilis*
Killdeer	*Charadrius vociferus*	Mourning Warbler	*Oporornis philadelphia*
Lesser Yellowlegs	*Tringa flavipes*	Common Yellowthroat	*Geothlypis trichas*
Solitary Sandpiper	*Tringa solitaria*	Wilson's Warbler	*Wilsonia pusilla*
Spotted Sandpiper	*Actitis macularia*	Canada Warbler	*Wilsonia canadensis*
Common Snipe	*Gallinago gallinago*	Western Tanager	*Piranga ludoviciana*
Bonaparte's Gull	*Larus philadelphia*	Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Herring Gull	*Larus argentatus*	Chipping Sparrow	*Spizella passerina*
Common Nighthawk	*Chordeiles minor*	Clay-colored Sparrow	*Spizella pallida*
Belted Kingfisher	*Ceryle alcyon*	Savannah Sparrow	*Passerculus sandwichensis*
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Le Conte's Sparrow	*Ammodramus leconteii*
Downy Woodpecker	*Picoides pubescens*	Song Sparrow	*Melospiza melodia*
Hairy Woodpecker	*Picoides villosus*	Lincoln's Sparrow	*Melospiza lincolnii*
Northern Flicker	*Colaptes auratus*	Swamp Sparrow	*Melospiza georgiana*
Pileated Woodpecker	*Dryocopus pileatus*	White-throated Sparrow	*Zonotrichia albicollis*
Western Wood-pewee	*Contopus sordidulus*	Dark-eyed Junco	*Junco hyemalis*
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Red-winged Blackbird	*Agelaius phoeniceus*
Alder Flycatcher	*Empidonax alnorum*	Rusty Blackbird	*Euphagus carolinus*
Least Flycatcher	*Empidonax minimus*	Brown-headed Cowbird	*Molothrus ater*
Eastern Kingbird	*Tyrannus tyrannus*	Northern Oriole	*Icterus galbula*
Barn Swallow	*Hirundo rustica*	White-winged Crossbill	*Loxia leucoptera*
Gray Jay	*Perisoreus canadensis*	Pine Siskin	*Carduelis pinus*