Piping Plover

Habitat Classification

and Inventory for Selected Parkland Region Lakes

**PIPING PLOVER HABITAT CLASSIFICATION
AND INVENTORY FOR
SELECTED PARKLAND REGION LAKES**

One Of Two Reports

**Documenting Habitat Suitability
for
Selected Piping Plover Lakes
in
The Parkland and Grassland Natural Regions**

**Alberta Environment
Land and Forest Service
Resource Data Division
Ecosystem Data Section**

R. E. Wells and B. J. Cornish

June 1999

PIPING PLOVER HABITAT CLASSIFICATION
AND INVENTORY FOR
SELECTED PASTURELAND REGION LAKES

One of the primary
habitat management
goals for piping plovers
is to maintain and enhance
nesting habitat.

Project 10-10-10
Lake and Wetland
Inventory
Project 10-10-10

A. E. Voth and J. G. Smith

June 1997

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ANNEX 1

The following table provides a summary of the data collected during the fieldwork. The data is presented in a tabular format, with the first column representing the location, the second column representing the date, and the third column representing the number of observations.

The data was collected over a period of six months, from January to June 2018. The locations were selected based on their proximity to the study area.

The data was collected using a combination of direct observation and interviews with local residents. The data was then analyzed using statistical software.

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The results of the analysis show that there is a significant difference in the number of observations between the different locations. This difference is statistically significant at the 5% level.

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PIPING PLOVER HABITAT CLASSIFICATION AND INVENTORY FOR SELECTED PARKLAND REGION LAKES

1.0 INTRODUCTION

The piping plover (*Charadrius melodus*) is a small plump shorebird with sandy-coloured upperparts, a diagnostic bill shape and distinctive head and breast patterns. They were hunted close to extinction in the late 1800s and early 1900s. Although recovering somewhat under the Migratory Birds Convention Act, the species began to decline again in the 1940s (Haig and Oring 1985), and is now ranked as endangered (COSEWIC 1998).

This bird is found typically on sandy or gravelly beaches of saline lakes. Habitat requirements include a dry, sparsely vegetated backshore area above the high water line for nesting, and wet shoreline areas close to water's edge for feeding (Wershler and Wallis 1986). Because of the requirement for virtually non-vegetated gravelly nesting areas, only certain types of water bodies provide suitable habitat. Two factors, high salinity of the water and fluctuating water levels, prevent the establishment of vegetation and in the long-term ensure the maintenance of the barren sandy or gravelly areas along the shorelines for nesting (Wershler 1988)

In Alberta, the species breeds at lakes, ponds and rivers in the Parkland and Grassland Natural Regions, as far north as the North Saskatchewan River and south to the Oldman and South Saskatchewan rivers (Semenchuk 1992).

In response to a request from Alberta Fish and Wildlife Division, the Alberta Resource Data Division began a study to collect baseline plover habitat information at lakes that support nesting piping plover. These data would be useful in documenting on-going habitat changes and impacts on plover numbers. Specific objectives were to:

1. Map substrate distribution, reflecting presence of gravels at the surface and the rate at which vegetation is expected to become established.
2. Establish preliminary habitat suitability ratings for piping plover nesting.

Based on their significance to piping plovers in Alberta, ten key lakes were selected for baseline habitat mapping. In the Parkland Region these included West Reflex Lake (west of the 4th Meridian), Killarney Lake (along with a small adjacent pond), and Rockeling (or Rockland) Bay with 'Rider Lake' (adjacent to Buffalo Lake). In the Grassland Region, Little Fish, Handhills, Dowling, Chain Lake #4, Chappice and Sam lakes were selected for study.

This report presents the results of the habitat research carried out at Parkland Region waterbodies in 1995 (Table 1, Fig. 1). Habitat mapping results for Little Fish Lake (Wells and Lindberg 1991) and for other lakes in the Grassland Region (Wells and Cornish 1999) are presented under separate cover.

Table 1. Location of Parkland Region lakes selected for piping plover habitat mapping.

Site Name	Location	Map Sheet	Lat./Long.
West Reflex Lake	Twp 42, 43, Rge 1, W4M	73 D/9	53°40' 110°00'
Killarney Lake	Twp. 41,42, Rge 1, W4M	73 D/9	53°35' 110°05'
Rockeling Bay/ Rider Lake	Twp 41, Rge 20, W4M	83 A/10	52°33' 112°48'; 52°32' 112°46'

Figure 1 - Location of Parkland Region Lakes Selected for Plover Habitat Inventory

2.0 INVENTORY METHODOLOGY

2.1 Aerial Photography

Two sets of black and white aerial photography were flown at different scales in mid June, 1995, for each of the plover lakes described below. One set, at 1:10 000, was used for photo interpretation and field mapping. The second set, at 1:30 000 or 1:40 000 depending on the size of the lake, was used to prepare semi-controlled photo mosaics for enlargement to 1:10 000 and use as photo-transfer base maps. After the field mapping operation, polygon boundaries and designations were transferred from the 1:10 000 photos to the photo mosaic bases at the same scale. Final plover habitat maps were compiled on the photo mosaics for each lake. Line work from each of these maps was digitized and merged with their polygon attribute data to bring them into the Department's Arc/Info geographic information system.

Acquisition of new aerial photography was scheduled to avoid nest disturbance and to coincide with essentially full shoreline vegetation development (Wells and Lindberg 1991). Because field survey operations could not begin until mid July, after plover fledglings have left nesting sites, air photos had to show ground conditions at full vegetation for accurate location of soil observations. This also allowed enough lead time to obtain the new air photos for preliminary interpretation and field survey.

2.2 Field Survey

Field data were collected at soil observation pits located within the stratification provided by preliminary air photo interpretation boundaries. The observation pits were located along transects running from the current lakeshore boundary to the former high water mark. Additional observations were done in order to adequately inventory areas of high substrate material complexity.

Basic site and soil data was collected at each observation site. Site data collected included slope, aspect, surface expression, identification of surficial materials (lacustrine, till, residual, etc.) and contrasting layers if present. Soil profile data collected included: soil horizons, their color, texture, structure, estimated coarse fragment or gravel content, presence of lime and/or soluble salts, and presence of gley features. Kind and amount of surface coarse fragments (gravel, cobbles, stones or boulders) were estimated, and depth to water table was recorded if present within the soil control section (1.5m). No soil samples were collected for laboratory analysis.

The first objective of the field inventory was to identify and delineate non-vegetated map units with sufficient gravel content either within the mineral substrate or on the surface to provide plover nesting habitat. The second objective was to estimate the likely rate of revegetation of these map units as indicated by the presence and amount of surface soil salinity observed within the units. The field estimates are necessarily tentative because they are not corroborated by quantitative laboratory data to verify the degree of salinity and sodicity (sodium content) actually present.

Vegetation data collected at each site was essentially physiognomic in nature and is stratified to reflect the time since last major inundation and/or the frequency of inundation. Vegetation covers range from recently exposed, non-vegetated wetlands with shallow water tables adjacent the current lakeshore—to sparsely or partially vegetated wetlands with deeper water tables—to dryer, fully vegetated, upland grass communities—to still higher upland grass and shrub covers (with or without trees). Intermingled with these covers, generally at low to mid lakeshore positions, may be units with "weedy" (Canada thistle, sow thistle, sweet clover) vegetation cover reflecting somewhat dryer but still periodically inundated or saturated moisture conditions. The saturated moisture conditions usually result from a rise in the underlying ground water table. However, saturated conditions may also occur from lateral moisture seepage along a compact or clay textured layer at shallow depth (less than 1m) under a coarser-textured surface layer.

2.3 Mapping Legend

The mapping legend (Appendix C) is designed to show map unit components that reflect the interrelationships among soil parent origin and texture, soil profile development, salinity, drainage conditions, depth to and fluctuations of water table, and the kind and rate of vegetation growth. The mapping legend built for the habitat inventory of Little Fish Lake (Wells and Lindberg 1991) was extended and generalized for inventory of other plover lakes in both the Parkland and Grassland Natural Regions. As it stands, the current legend is not a full-fledged ecological mapping legend. Its emphasis is on identification and characterization of substrate materials with only general or physiognomic description of vegetation cover. With additional work to identify and integrate vegetation community types within map units, the legend should also reflect further differences between plover habitats between the two natural regions and possibly be more helpful in estimating rate of revegetation.

Even at a scale of 1:10 000, many polygons are made up of more than one map unit component and have to be shown as complexes of primary, secondary and possibly tertiary components. The relative amounts of each component are indicated in decreasing order of abundance in the polygon database (or on the hardcopy maps as indicated either by decreasing order or by /, // slashes) as follows:

Primary ($\geq 55\%$) / Secondary (20 - 45%) // Tertiary ($\leq 20\%$).

A primary component present by itself is understood as occupying greater than 90% of the polygon area. Primary and Secondary components present indicate proportions of 55 - 70% and 20 - 45%, respectively. Primary and Tertiary components present indicate 80 - 90% and 10 - 20% coverage, respectively.

Note that because the generalized legend in Appendix C also applies to shoreline areas mapped at lakes in the Grassland region, a few of the units do not occur in the inventoried Parkland plover lakes reported here.

2.4 Habitat Suitability and Rate of Revegetation

Plover habitat suitability and revegetation ratings discussed below are shown in the general legend in Appendix C, in the Figure 2 bar graph, and their distribution is displayed on the color diagram maps for each lake in Appendix B.

2.4.1 Suitability

The model used for application of suitability and revegetation ratings to polygon units found to have some habitat potential is listed in Table 2.

Table 2 - Application of suitability and revegetation ratings to polygon habitat units.

Primary		Secondary		Tertiary		Polygon Rating
HS	RV	HS	RV	HS	RV	
S	N	-	-	+S	+N,S	SN
S	S	-	-	+S	+N,S	SS
S	N	U	N,S	-	-	MN
S	S	U	N,S	-	-	MS
U	S	-	-	S	S	MS*
U	N	-	-	S	N	MN*
U	N	S	S	-	-	MS
U	N	S	S	S	S,N	MS
U	N	S	N	-	-	MN
U	N	S	N	S	N,S	MN

M	N	-	-	-	-	MN
M	S	-	-	-	-	MS
M	N	S	N	-	-	MN
M	S	S	S	-	-	MS

*Non-vegetated units

Ratings of Suitable are assigned to each map polygon based on the dominant presence (greater than 50% of the polygon area) of non-vegetated map unit components with fine (0.2-0.5cm) and medium (0.5-2cm) gravel in and/or on a surface soil layer. Units with fine lag surface gravel (LSg, LSgs units) are separated from those with a gravelly upper layer (LG, LGs units) because these surface gravels tend to be ephemeral and may not remain in place during any major future inundation.

Polygons with a Suitable primary component and an Unsuitable secondary component (e.g. LG/LSv) receive a Marginal rating. On the other hand, a non-vegetated polygon having an Unsuitable primary component and Suitable secondary or tertiary components (e.g. LSs/LGs or LSs//LGs) also receives a Marginal rating (See asterisked combinations in above list). This is because absence of vegetation allows plovers to make use of any suitable areas within the polygon, provided that distance to water is not too great.

Non-vegetated gravelly units (EG, EGs) also receive a marginal rating because active wind deposition during the nesting season may bury nesting sites with sand.

2.4.2 Revegetation

Rate of revegetation rating is based on the on-site, observed presence of surface and subsoil salinity and its assumed effect on vegetation growth. Because no soil samples were taken to get quantitative estimates of the amount and kind of soluble salts present, only two ratings were used, Slow and Normal, based on visual estimates of low or absent versus moderate to severe surface salt presence. Slowly vegetated unsuitable areas were also mapped separately from normally vegetated areas. This is because of their different potential, especially those with gravel, as possible future nesting sites, either after future inundation and exposure, or for treatment for habitat improvement.

2.5 Final Maps

Final habitat maps are supplied in digital format for presentation at 1:10 000 in cleaned and merged spatial polygon and attribute databases in Arc/Info .E00 file format. They are registered to the Alberta digital 1:20 000 base map files in UTM projection and NAD 27 datum referenced. These data are supplied on CD-ROM disk together with a digital copy of this report in Microsoft Word format. Black and white copies of the final working copy maps made from annotated photo mosaics of each of the three lakes are on file in the Regional Alberta Environment office, Fish and Wildlife Division at Red Deer, Alberta.

3.0 REFLEX LAKE

3.1 Location and General Description

West Reflex Lake, known locally as Salt Lake, is one of a series of saline lakes extending from eastern Alberta into Saskatchewan. This permanent, hypersaline lake straddles the Alberta-Saskatchewan boundary near Chauvin, 40 km northeast of Provost (Fig. 1). The Alberta portion occupies parts of Townships 42-43, Range 1, west of the 4th Meridian, and is included within the Central Parkland Natural Subregion (Achuff 1994).

Reflex Lake is classed as primary piping plover breeding habitat, since it appears to provide reliable nesting habitat regardless of climatic fluctuations (Wershler 1992). This is one of the most important piping plover nesting habitats in Alberta (Wallis 1990).

Adjacent to the lake basin there are both private and crown lands. Crown lands include the lakebed and the southeast quarter of Section 36 – Twp 42 – Rge 1, W4M. Primary utilization includes recreation, grazing, annual crops and hay crops. Off-road motor vehicles are occasionally a problem, and there is some recreational cottage development in the area (Nature Conservancy 1990).

3.2 Lake and Drainage Basin Characteristics

3.2.1 Climate

Long-term climate data are available from a station at Kinsella Ranch near Wainwright, about 55 km to the west at an elevation of 705 m above sea level (asl) (Table 3; Environ. Canada 1993). These data, collected from 1962 to 1990, are summarized below.

- The mean daily temperature varies from -15°C to +17°C.
- The annual mean temperature is 2.3° C.
- The wettest months are June and July, and the driest month is February. The mean total annual precipitation is 428 mm, of which an average of 319 mm (about 75%) falls as rain.

Table 3. Climate data collected at stations in the vicinity of piping plover lakes studied in the Parkland Region (Environ. Canada 1993).

Climate Station	Location (Lat./Long.); Elevation asl	Nearby Piping Plover Habitats	Total Precip. (mm)	% as rain	Mean Annual Temp. (°C)
Kinsella Ranch near Wainwright	5300N, 11131W; 705m	West Reflex Lake; Killamey Lake	428	75	2.3
Red Deer	5211N 11354W; 905 m	Rockeling Bay /Rider Lake	470	76	2.6

3.2.2 Bedrock Geology, Landforms and Surficial Materials

West Reflex Lake is part of the Eastern Alberta Plain (Pettapiece 1986). The lake is included within the Ribstone Plain Ecodistrict (Strong and Thompson 1995).

The bedrock underlying the lands surrounding the park consists of a sequence of sedimentary rocks of Upper Cretaceous age (Wyatt et al 1944, Carlson and Topp 1971). Closest to the surface around most of the perimeter of the lake is the Birch Lake Formation, consisting of buff to yellow-coloured sandstone and some interbedded shale. An older formation, the Grizzly Bear marine shale formation, underlies areas north of Reflex Lake (Wyatt et al 1944). A major preglacial valley runs west of Reflex Lake (Hackbarth 1975).

The uplands surrounding Reflex Lake are primarily rolling to hilly glacial deposits or reworked glacial deposits associated with the most recent Laurentide glaciation. Most common are sandy glaciofluvial deposits, primarily kame moraine, deposited by glacial meltwater near the ice front (Bayrock 1967, Wyatt et al 1944). An area of eolian deposits, formed on top of glacial till, occurs southeast of the lake (Thorpe and Godwin 1993).

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3.2.3 Hydrography

Reflex Lake is within the North Saskatchewan River drainage basin. The watershed area contributing runoff to the lake has been estimated at 69.2 km² (Deboer 1995). The lake has no apparent outflow.

Hydrologic measurements are unavailable, but area – capacity relationships were calculated and lake size simulated based on specific water level increments. The size of Reflex Lake, based on estimated month end water levels from 1972 to 1993, is predicted to range from about 450 ha to about 1000 ha (Deboer 1995).

Several permanent seepage springs can be found principally in backshore areas in the southwestern corner of the lake. These saline springs flow even during extended periods of drought (Nature Conservancy of Canada 1990).

3.2.4 Water Quality

This is a permanent hypersaline lake (Wallis 1990). No detailed water quality data are available, however.

3.2.5 Vegetation

No emergent or submergent aquatic vegetation grows in the lake (Nature Conservancy of Canada 1990). The vegetation types occurring around the lake include sparse alkali shoreline, saline springs, grassland / meadows, tall shrub communities, balsam poplar woods and aspen woods. These types can be found in a sequence extending outward from the abandoned lake shoreline to surrounding uplands (Wallis 1990).

Vegetation along the sandy or gravelly nearshore is sparse to non-existent. Plant species which can be found intermittently along the foreshore/nearshore areas include: on wetter areas - western sea-blite (*Suaeda calceoliformis*), Nevada bulrush (*Scirpus nevadensis*), three-square rush (*Scirpus pungens*), and seaside arrow-grass (*Triglochin maritimum*); and on somewhat drier nearshore sites - salt grass (*Distichlis stricta*), scratch grass (*Muhlenbergia asperifolia*), alkali cord grass (*Spartina gracilis*), western wheat grass (*Agropyron smithii*), foxtail barley (*Hordeum jubatum*) and wire rush (*Juncus balticus*) (Wallis 1990).

Vegetation near the saline springs is very diverse, including many of the halophytic (salt-tolerant) species mentioned above, and others such as rayless aster (*Aster brachyactis*), creeping spike-rush (*Eleocharis palustris*), and several rare plants (Nature Conserv. of Canada 1990).

Although the vegetation types along shoreline areas are floristically very different from the uplands, some species may overlap, and an understanding of adjacent upland community types may help explain relationships within the nearshore zones. A detailed description of typical native vegetation of aspen woodland is given in Moss (1932). Much of the native vegetation in the parkland has been converted to cultivated cropland, however (Wallis 1987).

A tall shrub community dominated by willows (*Salix spp.*), water birch (*Betula occidentalis*), and sometimes silverberry (*Elaeagnus commutata*) forms a band around the highest parts of the abandoned lakeshore (Nature Conservancy of Canada 1990). On somewhat higher ground than this shrub community, balsam poplar (*Populus balsamifera*) woods occur on the moderately well-drained areas. This in turn gives way to the mosaic of aspen poplar (*Populus tremuloides*) woods, shrubbery and grasslands occurring in the drier uplands.

Upland shrub communities on the kame moraine are dominated by saskatoon (*Amelanchier alnifolia*), pincherry (*Prunus pensylvanica*), chokecherry (*Prunus virginiana*), silverberry, rose (*Rosa spp.*), and buckbrush (*Symphoricarpos occidentalis*) (Nature Conservancy of Canada

1990). Grasslands consist primarily of northern wheat grass (*Agropyron dasystachyum*), june grass (*Koeleria macrantha*), western porcupine grass (*Stipa curtiseta*) and spear grass (*Stipa comata*) along with a variety of forbs.

3.3 Piping Plover Populations

The population of adult piping plovers observed at this lake ranges from 12 to 46+, based on data from 1986 to 1996 (Prescott 1997; Bjorge and Murphy 1997; Appendix A). (Data collection methods and survey coverage varied between years, however). In 1995, the year substrate data were collected at this lake, a total of 37 adults were observed during June surveys (Prescott 1997). That year, a total of 16 nests with eggs or young were also recorded (ANHIC 1998).

Table 4. Piping plovers observed at four parkland region water bodies in Alberta in 1995.

LAKE	Adults* ¹	Nests with eggs or young**
West Reflex Lake	37	16
Killarney Lk.	40	24
Rockeling Bay	13	1
Rider Lake	6	1

*Source: Prescott 1997

**Source: ANHIC 1998

¹ Breeding status unknown;

4.0 KILLARNEY LAKE

4.1 Location and General Description

Killarney Lake is a permanent, moderately saline lake located in the M.D. of Wainwright, south of Chauvin and about 25 km northeast of Provost (Fig. 1). The lake occupies parts of Townships 42 (primarily) and 41, Range 1, west of the 4th Meridian. It is included within the Central Parkland Natural Subregion (Achuff 1994).

This lake has been described as less productive for piping plovers than some other lakes because of more restricted nesting habitat or more temporary feeding habitat (Wershler 1990). An adjacent series of shallow waterbodies west of Killarney Lake (here called 'Arvid Project Pond') also provides potential for plover habitat (A. Murphy, pers. comm.; see memo May 31, 1996 to Russ).

Lands within the lake watershed include both private and crown lands, and are utilized for recreation, grazing, annual crops and hay crops. The south end of the lake is part of Dillberry Lake Provincial Park.

4.2 Lake and Drainage Basin Characteristics

4.2.1 Climate

Long-term climate data are available from Kinsella Ranch, near Wainwright, at an elevation of 705 m (Environ. Canada 1993). These are summarized above (Table 3; Section 3.2.1).

4.2.2 Bedrock Geology, Landforms and Surficial Materials

Bedrock formations underlying the area are of Upper Cretaceous age, consisting of thickbedded sandstone and shales (Green 1972) belonging to the Pale Beds Formation. The upper parts contain light-coloured bentonite, which if exposed makes soils very sticky when wet and very hard with many cracks when dry.

Killarney Lake covers parts of two ecodistricts – Ribstone Plain and Provost Plain (Strong and Thompson 1995). In the immediate vicinity of Killarney Lake, parent materials are primarily glaciofluvial, glaciolacustrine, morainal and recent lacustrine. Glaciofluvial deposits predominate, especially east and northwest of the lake. These are kame moraine deposits composed of sand to gravelly sand, with small pockets of gravel and scattered lenses of glacial till. The flat valley containing Killarney Lake is composed of glaciofluvial outwash sand. Some glaciolacustrine deposits, consisting of sands and some silt accumulated in proglacial lakes, are present northeast of the lake. Hummocky moraine occurs south of the lake, while recent lacustrine deposits are associated with Killarney Lake shoreline and lowlands to the west (Renewable Resources 1974, Meijer and Karpuk in prep).

The terrain surrounding Killarney Lake is characterized by slopes of 0 to 5%, except in the till deposits to the south where slopes are 5 to 10% (Renewable Resources 1974). The area can be described as fairly level to undulating with some local knob and kettle relief marked by pothole lakes. Elevation of Killarney Lake is about 646 m.

4.2.3 Hydrography

Like Reflex Lake, Killarney Lake lies within the North Saskatchewan River drainage basin. There is no surface outflow. Surface inflow is from the Arvid Project Pond to the west, which is artificially regulated by a control structure. The control structure was built in 1970 for the purpose of creating waterfowl habitat on the smaller waterbody and to prevent the formation of alkali flats (Renewable Resources 1994). Concerns have been expressed about the negative impact of this control structure on long-term maintenance of productive plover feeding and nesting habitat, especially within the small delta of the inlet (Wallis 1990).

At full surface level (FSL), the lake is estimated to be 5.7 km² in area, including the adjacent Arvid Project Pond, which is contiguous with Killarney Lake at flood levels (A. Murphy pers. comm.; see summary sheet for Killarney). The lake has a maximum depth of 5.0 m, and shoreline length of 13 km (Table 5). In 1974, the lake surface area was 483 ha (4.83 km²), with a maximum depth of 4.3 m and a shoreline length of 11.2 km (Renewable Resources 1974). A bathymetric map was produced in 1974 based on depth measurements taken that year (Alberta Environ., Techn. Services Div. data in Renewable Resources 1974). Lake levels then fell dramatically through the 1980s and into the early 1990s.

Table 5. Killarney Lake basin and watershed characteristics, in 1972 and in the early 1990s (Renewable Resources 1974; A. Murphy, pers. comm.).

PARAMETER	1972 ¹	1990s (estimate) ²
Lake surface area (ha)	483	
Lake basin size (km ²)		5.7 (at FSL*), including Arvid pond)
Shoreline length (km)	11.2	13
Modal annual water level decline		210 mm
Modal shoreline exposure (mid range)		20 m
Vertical substrate distribution (fr/FSL)*		1.0-4.0 m
Maximum depth (m)	4.3	5.0 (at FSL*)
Plover habitat life expectancy and return interval		7 years/20 years
Maximum plover habitat width		280 m
Total watershed drainage area		370 km ²

¹ Renewable Resources 1974

² A. Murphy, pers. comm.

*FSL – full supply level

4.2.4 Water Quality

Dillberry Lake is described as having moderately saline sodium bicarbonate-sulphate water (Renewable Resources 1974). Surface water chemistry values taken in 1972 and in 1974 for several parameters are given in Table 6. These data show that the chemistry of the lake is dynamic and varies between years, likely related to factors such as rates of evaporation and amount of precipitation. However, Govett (1958; in Renewable Resources 1974) concluded that the chemical composition of surrounding surficial deposits is a major control on the chemistry of saline lakes in east-central Alberta.

Table 6. Surface water chemistry data for Killarney Lake, 1972 and 1974 (Renewable Resources 1974)(Concentrations in parts per million).

Parameter	1972	1974
T. Dissolved Solids	3352	3096
Hardness	106	91
Calcium	12	10
Magnesium	18	16
Sulphate	735	580
Chloride	242	237
Alkalinity	1530	1264
Sodium	1194	970
pH	9.2	9.3

4.2.5 Vegetation

Vegetation types occurring in the offshore and nearshore areas include aquatic emergents and several halophytic communities. In contrast to Reflex Lake, which supported no aquatic emergent vegetation, several patches of emergents were recorded in 1974 in the northeast and the southwest parts of the lake (Renewable Resources 1974).

A small area of halophytic vegetation surrounds the lake in the abandoned nearshore zone close to the water's edge. Plant species in this saline area consist of several bands of vegetation found in a sequence from wettest to drier soils. These community types are dominated by foxtail barley (*Hordeum jubatum*), Nuttall's salt-meadow grass (*Puccinellia nuttalliana*), salt grass (*Distichlis stricta*), Nevada bulrush (*Scirpus nevadensis*) and western sea-blite (*Suaeda calceoliformis*) (Wallis 1990).

The upland vegetation of nearby Dillberry Lake Provincial Park is likely similar to that adjacent to Killarney Lake, and is described in detail in Meijer and Karpuk (in prep.). Balsam poplar woods occur on less well-drained areas associated with lacustrine deposits. The understory consists of water birch (*Betula occidentalis*) willows (*Salix spp.*) and red-osier dogwood (*Cornus stolonifera*). A very diverse forb layer is present in the balsam poplar woods. Mosaic of aspen poplar woods, shrubbery and grasslands occurring in the drier sandy upland glaciofluvial and eolian deposits, a mosaic of aspen woods, shrubbery and grasslands occurs.

Tall shrub communities on the upland glaciofluvial deposits (kame moraine) are dominated by saskatoon (*Amelanchier alnifolia*) and choke cherry (*Prunus virginiana*) along with low aspen regeneration. Low shrub communities, where silverberry (*Elaeagnus commutata*), rose (*Rosa spp.*), and buckbrush (*Symphoricarpos occidentalis*) predominate, occur on somewhat drier aspects or more well-drained soils. Silverberry communities are fairly common on the dry beach ridges surrounding Killarney Lake.

Grasslands are most common on southern aspects. Prominent grass species include western porcupine grass (*Stipa curtisetia*), slender wheat grass (*Agropyron trachycaulum*), june grass (*Koeleria macrantha*), and needle-and-thread (*Stipa comata*) along with a variety of forbs tolerant of dry conditions.

4.3 Piping Plover Populations

The number of piping plovers observed during surveys conducted in the past 10 years has varied from about 8 to 48 (Prescott 1997; Appendix A). In 1995 (the year this habitat study was conducted), 37 adults were observed during June surveys (in Prescott 1997). That year, 16 nests with eggs or young were also recorded (ANHIC 1998). Seven piping plover nests were recorded in 1997 (I. Richardson, pers. comm. in Meijer and Karpuk in prep.).

5.0 ROCKELING BAY/ RIDER LAKE

5.1 Location and General Description

Rockeling (or Rockland) Bay and Rider Lake are interconnected waterbodies just northeast of Buffalo Lake. They are located about 15 to 20 km eastsoutheast of Bashaw, or about 65 km east of Lacombe, and occupy parts of several sections in Township 41 Range 20 west of the 4th Meridian. These waterbodies are historical overflow basins which were infrequently filled from Buffalo Lake during flood events (A. Murphy, pers. comm. – memo). However, water levels at Buffalo Lake have been stabilized to enhance recreational opportunities there (Prescott 1997). Mitigative habitat management projects to protect piping plovers nesting at Rockeling Bay/Rider Lake have been proposed.

Historically, Rockeling Bay/Rider Lake have provided reliably productive piping plover nesting habitat, and are classed as primary habitat (Wershler 1992).

5.2 Lake and Drainage Basin Characteristics

5.2.1 Climate

Long-term climate data are available from a station at Red Deer, about 55 km to the southwest. The mean annual temperature at Red Deer is 2.6°C, and the area receives an average of 470 mm of annual precipitation, with 76% falling as rain (Table 5).

5.2.2 Bedrock Geology, Landforms and Surficial Materials

The uppermost bedrock layer underlying the area is the Horseshoe Canyon Formation. This formation is represented by grey sandstone, bentonitic mudstone and carbonaceous shale, with scattered bentonitic and limestone beds, all of Cretaceous age (Wells and Bentz 1993).

The area around the immediate perimeter of Rockeling Bay/Rider Lake is included in the Buffalo Lake Plain physiographic district of the Eastern Alberta Plains (Pettapiece 1986). The distribution of surficial materials is as a result of the Keewatin (late Wisconsin) glaciation. Surficial materials in and near the Buffalo Lake basin consist of undulating and occasionally rolling glaciolacustrine clay and sandy glaciofluvial sediments, deposited over till. Further to the southeast, with greater relief, is the Bashaw Upland (elev 750 to 950 m), where the primary landforms are hummocky till deposits, with some blanket till deposits over rolling bedrock (Wells and Bentz 1993, Bowser et al 1947). The approximate elevation close to the lakeshore is about 780 m above sea level.

According to Bowser et al (1947), the sandy loam soils along the north side of Buffalo Lake are quite variable, but generally contain coarse sand and usually some fine gravel. Soils are primarily black chernozems.

5.2.3 Hydrography

The basin and watershed characteristics of Rockeling Bay/Rider Lake are presented in Table 7. It is anticipated that the stabilization of water levels at Buffalo Lake will result in elimination of periodic natural flooding of adjacent Rockeling Bay/Rider Lake, and thus promote revegetation of beach nesting habitats (Prescott 1997). A proposed mitigation project would manage water levels to control shoreline vegetation around Rockeling Bay/ Rider Lake every 5 to 7 years, in order to rejuvenate piping plover nesting substrates. Specifically, the proposed piping plover habitat management project would allow for the filling of Rockeling Bay and Rider Lake to between 780.65 m and 780.85 m (A. Murphy memo, Dec. 20, 1995 to R. Wells).

Table 7. Rockeling Bay/Rider Lake basin and watershed characteristics (A. Murphy, pers. comm).

PARAMETER	VALUE
Lake basin size at FSL*	2.8 km ²
Shoreline length	12 km
Modal annual water level decline	220 mm
Modal shoreline exposure (mid range)	50 m
Vertical substrate distribution (fr/FSL)*??	0 -1.5 m
Maximum depth at FSL*	2.5 m
Habitat life expectancy and return interval	4 years / 5 yrs (managed)
Maximum habitat width	200 m
Total watershed drainage area	1440 km ²

*FSL – full supply level; Note: water levels are controlled in Buffalo Lake; FSL value taken from benchmark at control structure (A. Murphy, pers. comm., summary sheet)

5.2.4 Water Quality

Surface water chemistry data collected at a station on Rockeling Bay for 1980 and 1993 are given in Table 8. According to Wershler (1990), the freshening of Buffalo Lake may have an adverse effect on invertebrate populations which provide food for piping plover.

Table 8. Surface water chemistry data for Rockeling (Rockland) Bay, 1980 and 1993 (mg/l unless otherwise indicated) (NAQUADAT station, 27–41-20-W4; Alberta Environmental Prot., unpubl. data).

Parameter	1980 (Sept)	1993 (Sept)
Calcium	4.93	6
Magnesium	98.8	146
Sodium	1450	3160
Chloride	33	60.6
Alkalinity (total, CaCO ₃)	2204	3580
HCO ₃	n/a	2145
CO ₃	n/a	828
Sulphate	1550	3400
Residue filterable	4750	9982
Specific conductance (USIE/CM)	5967	11560
pH (units)	9.59	9.55

n/a – data not available

5.2.5 Vegetation

Rockeling Bay/Rider Lake are included within the Central Parkland Natural Subregion. Upland vegetation is characterized by scattered groves of aspen interspersed with grassland or shrublands.

The vegetation along the nearshore areas of these waterbodies varies with the moisture regime and the coarseness of the substrate. In some seepage areas and isolated sections of the water bodies, there are patches of aquatic emergents, consisting predominantly of bulrush (*Scirpus validus*). Much of the shoreline is completely non-vegetated. Sparsely vegetated clayey shoreline areas have low rushes (*Juncus spp.*) and foxtail barley (*Hordeum jubatum*), while gravelly or sandy beach ridges are often heavily vegetated by foxtail barley (*Hordeum jubatum*), sometimes with gumweed (*Grindelia squarrosa*), sow thistle (*Sonchus arvensis*) and sweet clover (*Melilotus sp.*) There are scattered narrow bands of willow (*Salix sp.*) along the damper edges of the upper beach portion (Russ' field notes and photos, 1995).

Farther from the shoreline towards the upland areas, the vegetation cover consists primarily of grasses with scattered shrubs, primarily silverberry (*Elaeagnus commutata*), Canada buffaloberry (*Shepherdia canadensis*), and sparse balsam poplar (*Populus balsamifera*) trees. On the upland glacial till are grassy meadows interspersed with stands of balsam poplar and aspen trees. The woodlands have dense understories of buckbrush (*Symphoricarpos occidentalis*), rose (*Rosa spp.*), and Canada buffaloberry, or red-osier dogwood (*Cornus stolonifera*) and willows in the damper areas. Silverberry is found often at the edges of aspen groves (Bird 1973, Russ' field notes and photos, 1995).

5.3 Piping Plover Populations

The number of adult piping plovers observed during surveys conducted in the past 10 years has varied from 41 in 1989 to 0 in 1996 (Prescott 1997; Appendix A). In 1995 (the year of this habitat study), 13 adults were observed at Rockeling Bay, and 6 at Rider Lake (Table 4; Prescott 1997). One nest with eggs or young was recorded at each location in 1995 (ANHIC 1998).

6.0 HABITAT INVENTORY RESULTS

6.1 Substrate Materials

Gravelly substrate materials generally occur on these lakes as parallel shore beach bars, or as low points or spits when finer materials are removed by lakeshore wave action and wave induced, near-shore (littoral) currents.

The kind and amount of gravelly substrate materials present in the shoreline areas all three lakes are summarized by dominant map unit components in Table 9. Gravelly lacustrine units, LG and LGs units, dominate approximately 18, 20 and 52 percent, respectively, of the Reflex Lake, Killarney Lake and Rockeling Bay-Rider Lake shoreline areas. Of these, non-vegetated or non-vegetated and saline areas (LG and LGs units) total around 6 percent of the shoreline area for Reflex and Killarney shoreline areas but only 1.4 percent for Rockeling-Rider shoreline. Smaller amounts of sandy materials with fine lag surface gravel (LSg and LSgs units), 1.5, 2.8 and 0.5 percent, respectively, add to the available plover habitat at the three lakes. Note that the amount of suitable habitat indicated by shading is approximate because only dominant polygon components are considered.

At Reflex Lake, sandy eolian materials most of which (ESv, ES units) are sparsely or non-vegetated occupy around 40ha (100acres), or 10.5 percent of the shoreline area. These sandy units, located on the lower to mid shoreline, are subject to continuing wind erosion with possible resulting deposition and burial of adjacent, more or less freshly exposed gravel bars (LG and LGs units) which are suitable plover nesting habitat.

Polygons with primary or secondary amounts of saline lacustrine sand with surface lag deposits of fine gravel (LSgs units) provide suitable nesting habitat at the eastern end of Reflex lake. Some of these units that have gravel-size particles of surface saline crust are also used as nesting habitat by the plovers.

Permanent seepage spring areas occupy nearly 3 percent of the Reflex shoreline area while a tiny amount of disturbed land is located on the upper shoreline along the northern side.

At Killarney Lake, gravelly surface materials comprise around 12 percent of the shoreline area. Of these, approximately 24ha (11 polygons) are non-vegetated (LG, LGs) and provide suitable plover nesting habitat. Sandy shoreline materials with lag surface gravel (LSg, LSgs) provide roughly 11ha (10 polygons) of suitable shoreline habitat.

At the Rockeling Bay/Rider Lake shoreline area, non-vegetated gravelly substrate materials (LG, LGs) occupy approximately 6ha in 14 polygons. These amount to less than 2 percent of the total shoreline area. Non-vegetated sandy materials with lag surface gravel cover just over 2ha in 4 polygons, or 0.5 percent of the shoreline area. The gravelly sites then are relatively small and scattered, and may be quite vulnerable to disturbance, such as trampling by watering cattle.

6.2 Shoreline Area Soils

Soil components of the shoreline habitat map units are classified according to the Canadian System of Soil Classification (Soil Classification Working Group 1998). The generalized soil sequence discussed here applies to shoreline areas of all three plover lakes.

Soil profile development and horizon differentiation increases with increasing distance away from the current lake edge. Rego Gleysols, with no surface mineral-organic (Ah) horizon, occur on recently exposed, non-vegetated areas immediately adjacent to the present lake edge. These soils are strongly gleyed and usually have a water table at or not far (30cm or less) from the surface.

At slightly higher, sparsely vegetated, less recently exposed levels, Rego Gleysols are replaced by Orthic Regosols and Rego Gleysols with thin, rudimentary Ah horizons. The depth to water table on these slightly dryer sites is generally greater than 30cm.

Again, at still slightly higher mid-shore sites with more or less continuous vegetation cover, Orthic Gleysols with thin Ah horizons occur as the dominant soils. Soils still exhibit strong gley features but depth to water table is generally greater than 50cm. At the same level, Rego Humic Gleysols (well-developed Ah horizons, 10cm or more in thickness) occur under fully vegetated sites, possibly as a result of lateral seepage of oxygen and nutrient enriched water.

At mid and upper shoreline positions Rego and Calcareous Chernozemic subgroups, transitional between the Dark Brown and Black great groups are dominant under fully vegetated, upland grass or grass and shrub communities. A water table is generally absent above 1 meter.

6.3 Habitat Suitability

Habitat suitability/revegetation polygon ratings are shown for Reflex and the other two Parkland lakes in Figure 2. The ratings given in the bar graph consider the presence of secondary and tertiary map unit components as well as dominant components. Polygons with a Suitable primary component alone or with a Suitable primary and Unsuitable tertiary component (e.g. Lg//LSv) receive a Suitable rating. The unsuitable tertiary component is judged not to be a significant detriment to the overall suitability of the unit. See Table 2, page 4 for an essentially complete listing used to rate habitat suitability and rate of revegetation.

The Figure 2 graph shows Reflex and Killarney Lakes to have the highest proportion of Suitable-Normal and Suitable-Slow rated shoreline area. Rockeling-Rider shoreline has the highest amount of marginally suitable habitat while small but significant areas of marginal habitat are also present at Reflex and Killarney Lakes.

Location and extent of suitable, marginal and unsuitable habitat and their rate of revegetation are displayed for each lake on the diagram maps in Appendix 3. These maps show Reflex and Killarney Lakes to have quite extensive sections of suitable habitat well distributed in close proximity to the current lake edge. At Rockeling Bay/Rider Lake, however, marginally suitable sites with a normal rate of revegetation are predominant while the few suitable sites (suitable - slow) are scattered and small in extent.

Table 9. Map Unit Summary of Substrate Materials for Parkland Plover Lakes
(By dominant components)

Lake	Ha	Map Unit	Area (ha)	# Polygons	% Shrin	Eolian(%)	Gravel(%)	Sand/Silt(%)
Reflex		ESst	12.2	5	3.2			
T. Shoreline	382.73	ESv	11.1	5	2.9			
T. Water	468.37	ES	16.8	3	4.4	40.2 (10.5)		
T. Area	851.10	LGs	16.9	6	4.4			
		LGt	27.9	3	7.3			
		LGu	8.9	2	2.3			
		LGv	11.2	4	2.9			
		LG	5.2	5	1.4		70.0 (18.3)	
		LSgs	5.9	1	1.5			
		LSs	36.5	5	9.5			
		LSt	91.6	10	23.9			
		LSu	43.0	7	11.2			
		LSv	29.7	9	7.8			
		LS	55.1	11	14.4			206.6 (68.4)
		DL	0.7	1	0.2			
		SP	10.2	4	2.7			
Killamey		EGs	1.2	1	0.3			
T. Shoreline	407.89	EGv	8.3	4	2.0			
T. Water	282.76	EG	4.3	1	1.0			
T. Area	691.48	ESs	4.5	3	1.1			
		ESv	26.1	11	6.4			
		ES	5.7	2	1.4	50.1 (12.3)		
		LGs	8.1	6	2.0			
		LGt	20.8	7	5.1			
		LGu	18.7	5	4.6			
		LGv	18.7	12	4.6			
		LG	15.8	5	3.9		82.1 (20.1)	
		LSgs	4.0	2	1.0			
		LSg	7.2	8	1.8			
		LSs	164.4	20	40.3			
		LSt	4.7	3	1.2			
		LSu	4.7	3	1.1			
		LSvs	0.3	1	0.1			
		LSv	34.3	18	8.4			
		LS	52.7	3	12.9			272.3 (66.8)
		AE	1.9	2	0.5			
		DL	0.7	2	0.2			
		SP	0.8	3	0.2			
		Z	0.8	1				
Rockeling-Rider		LGs	5.8	13	1.4			
T. Shoreline	421.23	LGt	5.1	2	1.2			
T. Water	376.82	LGu	101.5	22	24.1			
T. Area	798.05	LGv	102.7	42	24.4			
		LG	0.1	1	0.0			
		LSgs	2.3	4	0.5		217.4 (51.6)	
		LSs	39.9	18	9.5			
		LSt	28.4	15	6.7			
		LSu	42.8	8	10.2			
		LSv	72.3	39	17.2			
		LS	5.5	9	1.3			188.9 (44.8)
		AE	14.9	18	3.5			

AE - Aquatic emergents

DL - Disturbed land

SP - Seepage area

Z - Upland

Suitable habitat

Figure 2 - Shoreline Habitat Distribution

7.0 SUMMARY AND CONCLUSIONS

Inventory of plover habitat on these three lakes was done during the summer of 1995 and as a result, may not closely reflect shoreline area conditions present in 1999. Fluctuating water levels, vegetation encroachment, and wind erosion or deposition all interact dynamically to produce continually changing conditions in which the plovers may or may not thrive.

Land use activities by owners or lessees also play a significant role in this especially dynamic environment. Without enlightened management for example, the presence of grazing cattle during the active nesting period, May to July, can be deleterious to plover nesting success.

The results of the inventory suggest that Reflex Lake and Killarney Lake have the greatest potential to maintain suitable plover nesting habitat. High salinity at both these lakes should greatly reduce the rate of revegetation on suitable sites. Moreover, the presence of several permanent seepage springs serves to maintain a relatively constant water level at Reflex Lake. On the other hand, widely fluctuating water levels at Killarney Lake may mean that suitable sites are at times too distant to water to be utilized by nesting plovers.

Suitable nesting sites on the Rockeling Bay/Rider Lake shoreline area are of small extent and widely scattered. Quite a lot of trampling of these sites by watering cattle was observed during the field survey in the summer of 1995. Most of the non-vegetated, suitable gravelly habitat is present at slightly higher levels and is rated marginal because it is closely intermingled with more or less fully vegetated sites, cover that may increase access to nests by predators, such as foxes and coyotes. These marginal areas may have potential as habitat after future inundation and exposure. In addition, moderate to high salinity present at these sites should significantly slow their rate of revegetation.

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APPENDIX A

ADULT PIPING PLOVER AT FOUR PARKLAND LAKES, 1989 - 1996

APPENDIX A. Adult piping plovers at four parkland lakes in Alberta between 1989 and 1996
(summarized in Prescott 1997).

LAKE	YEAR										
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Killarney Lk.	n/a	n/a	n/a	8-10	n/a	22	n/a	29	48	40	25
West Reflex Lk.	46+	35+	n/a	20	21	12	11	16	28	37	19
Rockeling Bay	18	n/a	n/a	30	22	6	9	12	17	13	0
Rider Lake	15	n/a	n/a	11	17	7	16	7	12	6	0

n/a – data not available

APPENDIX B

DIAGRAM MAPS FOR PLOVER HABITAT SUITABILITY AND REVEGETATION RATE

Map 1 - Plover Habitat Suitability and Revegetation Rate for Reflex Lake (1995)

Map 2 - Plover Habitat Suitability and Revegetation Rate for Killarney Lake (1995)

Map 3 - Plover Habitat Suitability and Revegetation Rate for Rockeling Bay / Rider Lake (1995)

APPENDIX C

GENERALALIZED PIPING PLOVER HABITAT CLASSIFICATION MAP LEGEND

GENERALIZED PIPING PLOVER HABITAT CLASSIFICATION MAP LEGEND

Map Unit Symbol	Map Unit Description	Dominant Soils	Depth to Water Table	Reveg. Rate †	Nesting Habitat Suitability*
<i>Lacustrine-Sand, Silt</i>					
LS	Very moist to wet, non-vegetated, non-saline freshly exposed sand, silty sand or silty clay.	Gleyed Regosols	At or near surface, 0-20cm	N	U
LSs	Moist to very moist, non-vegetated, strongly saline (salt deposit or crust at soil surface) sand, silty sand, or slit loam. May have included small non-vegetated, sandy, saline areas (LSgs) with fine lag gravel at the surface.	Gleyed Regosols, saline	Variable, 20-40cm	S	U
LSg	Moist, non-vegetated, non-saline, recently exposed sand; fine lag gravel on surface.	Gleyed Regosols	Around 30cm	N	S
LSgs	Moist, non-vegetated, strongly saline(salt deposit or crust at soil surface) recently exposed sand; fine lag gravel on surface.	Gleyed Regosols, saline	Around 30-50cm	S	S
LSgv	Moist, sparsely to moderately vegetated (sedges, grasses) sand; fine lag gravel on surface.	Rego and Orthic Gleysols, Gleyed Regosols	Greater than 30cm	N	U
LSv	Moist to wet, non-saline, sand to silty sand or silty clay; generally underlain by clayey lacustrine, or occasionally, by till materials at depths less than 1 meter; sparsely to moderately vegetated (sedges, rushes and/or weed species, e.g. sow thistle, sweet clover).	Rego & Orthic Gleysols, Gleyed Regosols	Variable, 20-60cm	N	U
LSvs	Moist, saline, sand to silty sand or silty clay lacustrine materials; generally underlain by clayey lacustrine, or occasionally, by till materials at depths less than 1 meter; sparsely to moderately vegetated (rush, sedge). May occasionally have inclusions (<20%) of LSgs.	Orthic and Gleyed Cumulic Regosols, moderately well or imperfectly drained, + saline.	Absent above 1 meter	S	U

Map Unit Symbol	Map Unit Description	Dominant Soils	Depth to Water Table	Reveg. Rate †	Nesting Habitat Suitability*
LSu	Moist, sand or silty sand; fully vegetated with upland grass communities.	Gleyed Humic Regosols, Orthic +Humic Gleysols	Greater than 1 meter	N	U
LSt	Dry to moist, sandy, upper lake terraces or beaches; scattered surface stones and boulders where sands are underlain by coarse gravels or water-resorted, washed till at less than 1 meter depth. Shrubs (silver berry, buffalo berry, willow) and +open tree (aspen, poplar) cover	Rego Dark Brown to Black Chernozemics, Gleyed Humic Regosols	Absent above 1 meter	N	U
<i>Lacustrine-Gravelly Sand</i> LG	Moist, recently exposed, non-vegetated fine gravel or gravelly sand, usually with greater or lesser amounts of surface cobbles; may have inclusions of lower-lying sandy or silty areas (LS).	Gleyed Regosols, Rego Gleysols	Around 30cm	N	S
LGs	Moist, recently exposed, non-vegetated, strongly saline, fine gravel or gravelly sand, usually with greater or lesser amounts of surface cobbles.	Gleyed Regosols, Rego Gleysols, saline phases	Around 30 - 50 cm	S	S
LGv	Moist, sparsely to partially vegetated (sedges, rushes and/or weed species, e.g. sow thistle, sweet clover), fine gravel or gravelly sand, usually with greater or lesser amounts of surface cobbles. Often with small inclusions of LG.	Rego and Orthic Gleysols	Greater than 50cm	N	M
LGu	Moist, fully vegetated with upland grass communities, gravelly and cobbly sand. May have occasional small patchy inclusions of LGs.	Orthic Gleysols	Greater than 50cm	N	U
LGt	Dry, vegetated with sparse shrubs (silver berry, buffalo berry) and some trees (balsam poplar) cobbly and gravelly sand. Includes mostly upper beach segments. Minor inclusions of LG where adjacent to lower, more recently exposed shoreline units. Very occasional inclusions of sandy beach ridge, + eolianized.	Rego Black Chernozemics, Gleyed Humic Regosols	Absent above 1 metre	N	U

Map Unit Symbol	Map Unit Description	Dominant Soils	Depth to Water Table	Reveg. Rate †	Nesting Habitat Suitability*
<i>Eolian-Sand</i>					
ES	Dry to moist, non-vegetated fine sand; eolianized and/or duned, low to mid position beach ridges. May have minor inclusions of ESv.	Orthic Regosols	Usually > 80cm	N	U
ESs	Dry to moist, strongly saline, non-vegetated fine sand; eolianized and/or duned, low to mid position beach ridges. May have minor inclusions of ESv.	Orthic Regosols, saline	Usually > 80cm	S	U
ESv	Moist, fine sand; eolianized and/or low dunes; low to mid beach positions; partly stabilized by vegetation (sedges, rushes, and some grasses).	Gleyed Regosols, Orthic Gleysols, Orthic Regosols	Variable, often 50cm or less; greater than 100cm at higher beach positions.	N	U
ESvs	Moist, fine sand; saline patches; eolianized and/or low dunes; low to mid beach positions; partly stabilized by vegetation (sedges, rushes and some grasses).	Gleyed Regosols, Orthic Gleysols, Orthic Regosols, + saline phases.	Variable, often 50cm or less	S	U
ESu	Dry to moist, sand or silty sand; partially to fully vegetated with upland grass communities.	Cumulic, +Humic Regosols, Gleyed regosols, saline.	Usually > 80cm	N	U
ESus	Dry to moist, sand or silty sand; saline patches; partially to fully vegetated with upland grass communities.	Cumulic, +Humic Regosols, Gleyed Regosols, saline.	Usually > 80cm	S	U
<i>Eolian - Sand Over Gravel</i>					
EG	Moist to dry, eolian sand veneer or low dunes over fine gravel, ± cobbles; inclusions (up to 20% of area) of bare gravel patches (LG).	Gleyed Regosols, Orthic Regosols	Variable, often 50cm or more	N	M

Map Unit Symbol	Map Unit Description	Dominant Soils	Depth to Water Table	Reveg. Rate †	Nesting Habitat Suitability*
EGs	Moist to dry, eolian sand veneer or low dunes over gravel, + cobbles; inclusions (up to 20% of area) of bare gravel patches (LG); strongly saline, partly stabilized by sparse salt-tolerant vegetation.	Gleyed Regosols and Orthic Regosols, saline phases	Greater than 50cm or absent	S	M
EGv	Moist to dry, eolian sand veneer or low dunes over gravel, + cobbles; partially stabilized by sparse vegetation (rushes, sedges); inclusion (up to 20%) of gravelly patches (LG) between the dunes; on lower beach these patches may be inundated after heavy rains.	Gleyed Regosols, Orthic Regosols	Variable, 50cm or less	N	U
EGvs	Moist to dry, saline, eolian sand veneer or low dunes over gravel, + cobbles; partially stabilized by sparse vegetation (sedges, grasses); inclusions (up to 20%) of gravelly patches (LGs) between the dunes	Gleyed Regosols, Orthic Regosols	Variable, 50cm or more	S	U
<i>Miscellaneous Units</i>					
AE	Aquatic Emergent (bulrush, mostly).	-	+ Inundated	-	U
DL	Disturbed land. Excavated materials.	-	-	-	U
SP	Seepage area and/or lakeshore springs.	-	-	-	U
W	Shallow open water; often with emergent vegetation, and occasionally with submergent vegetation in deeper portions.	-	-	-	U
Z	Included upland area.	-	-	-	U

*Habitat Suitability:

S = Suitable
M = Marginal
U = Unsuitable

† Revegetation Rate:

N = Normal
S = Slow

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