Lake Winnipeg South Basin
Sensitive Habitat Inventory and Mapping
(SHIM) 2011-12

SECTION B:

SCIENCE REPORT

TABLE OF CONTENTS

A Foreshore Inventory Mapping Report

For the South Basin of Lake Winnipeg

for Lake Winnipeg Sensitive Habitat Inventory Mapping Project (SHIM) 2011-2012

Whelan Enns Associates Inc.
Winnipeg, MB

March 2012

Table of Contents

List of Figures and Tables

Observations

List of Tables

Modifications to the Shoreline

Lake Winnipeg – South Basin
Foreshore Inventory Mapping – Pilot Project 2012
Prepared for Lake Winnipeg Foundation Inc.
April 2012

Acknowledgments

The following individuals carried out fieldwork for this assessment:

Lisette Ross, M.Sc., Native Plant Solutions
Pauline Bloom, M.Sc., Native Plant Solutions
Phillip Rose, B.Sc., Cert. FWT, Native Plant Solutions
Bruce MacDonald, B.Sc., B.Ed., Terra Limnic Consulting
Desiree Stratton, University of Manitoba
Rosemary Ann (Annie) Eastwood, B.Sc. Washington State University

Linda Benson, Boat pilot
Jake Benson, Boat pilot

Lake Winnipeg Foundation Inc. would like to thank the following individuals for their technical contributions to the project:

Jared Whelan, B.Sc. Whelan Enns Associates Inc.
Darwin Monita, Aquatics Environmental Services
Todd Schwartz, Department of Fisheries and Oceans
Alex Salki, Lake Winnipeg Foundation Inc.
Greg McCullough, University of Manitoba
Darren R. Wanless, Principal, Cansel Manitoba Division
Jessica McCreary, B.Sc., Whelan Enns Associates Inc.

The FIM report was completed by the following people:

Jared Whelan, Whelan Enns Associates Inc.
Lisette Ross, Native Plant Solutions
Bruce MacDonald, Terra Limnic Consulting
Alex Salki, Lake Winnipeg Foundation Inc.
Gail Whelan Enns, Principal, Whelan Enns Associates Inc.

A special thank you to the Department of Conservation and Water Stewardship for providing access to air photo imagery. The 2011 Lake Winnipeg Flood 30cm Digital Ortho Imagery was completed by ATLIS Geomatics.

We would like to thank Alex Salki as the project coordinator for Lake Winnipeg Foundation Inc.

Disclaimer

The results contained in this report are primarily based upon data collected during 8 days of field survey in 2011, an unusual high water year, by parties other than Whelan Enns Associates Inc. (WEA) The field inventories were brief and limited in number and scope. WEA assumes that the data collected are accurate and reliable. This data was augmented by previously documented material. Data in this assessment was not analyzed statistically. Verification with air photos was not completed for the draft report dated April 2012. Use or reliance upon conclusions made in this report is the responsibility of the party using the information. Neither WEA Inc., Lake Winnipeg Foundation Inc., nor the authors of this report are liable for accidental mistakes, omissions or errors made in its preparation because best attempts were made to verify the accuracy and completeness of data collected and presented.

Acknowledgements of Funding

Organizations that provided funding or resources for the Lake Winnipeg South Basin FIM and SHIM work.

- Environment Canada – Lake Winnipeg Basin Stewardship Fund
- Thomas Sill Foundation
- Department of Fisheries and Oceans (Pacific and Manitoba)
- Lake Winnipeg Foundation Inc.
- Wildsight British Columbia

Executive Summary of FIM Results

- The study purpose was to collect baseline information on the current uses of Lake Winnipeg's south basin shoreline using foreshore inventory and mapping (FIM) criteria established for similar studies in British Colombia. The FIM uses maps and GIS tools to describe the shoreline in segments, 50 of which were defined along the 299 km stretch from Traverse Bay on the east shore to near Riverton on the west shore (Appendix 2) Information gathered includes; shore type, substrates, adjacent land uses and shoreline modifications. When possible this information has been combined with other mapping data from Manitoba government sources.
- Sample sites were established in 27 segments and surveys were conducted for fish, invertebrates, wildlife and vegetation. This information was then analyzed and a report written..
- For each segment, an Ecological Habitat Index (EHI) was calculated. Based on field observations of criteria such as: shore type, natural vs disturbed shoreline, substrate type, bird observations, biologically productive areas, shoreline vegetation quality, and shoreline modifications. Each criterion was weighted for segment rating derivation.
- The sum of the criteria calculations provided a segment index score that ranged from very high, 88.93, to very low, -444.42.
- The information collected and the analyses undertaken were used to develop guidelines to better manage the south basin foreshores of Lake Winnipeg.
- Overall, the study area shoreline had a high, 42%, level of impact.
- The two dominant shoreline uses were single-family dwellings and natural lands.

- The most common shore types were sand, gravel, wetlands, and modified shorelines.
- A detailed summary of the findings for vegetation and wildlife sampling can be found later in this report.
- Modifications to shorelines included retaining walls of various type, docks, boathouses, boat launches, and marinas.
- The FIM results show that portions of the south basin shoreline are heavily modified. The segments with the most modification include; 7, 10, 16, 19, 28, 29, 36, 37, 38, 39, 41, 42, 43, 44, 45, 46, 47.
- Approximately 60% of the study area exists in a predominantly natural state.
- The ecological habitat index (EHI) analyses reveal that approximately 70% of all segments have a very high, high, or moderate ecological value.
- Where higher ecological habitat index values were identified, fish habitat, wetlands, streams, intact natural shorelines, and adjacent natural habitat were key factors as well as an absence of man-made shoreline modifications such as retaining walls, docks, and roads.
- A second iteration of the EHI was run without any anthropogenic modifications to measure the influence of modifications on EHI scores.
- This was a pilot project to test the FIM methodology successfully used for several British Columbia lakes and adapt it to Lake Winnipeg and other Manitoba lakes. Within the constraints and resources available to this first project, good results were produced and the overall applicability of the BC methodology to Manitoba lakes, with minor modification, was confirmed.
- Please see Section C of this report for recommendations and guidelines.

Caveats

- This was a first year pilot project to determine if the methodology developed for BC lakes could be applied to Lake Winnipeg.
- The data dictionary (V2.6) used in British Columbia FIM projects can be utilized for Lake Winnipeg. The data dictionary was supplied along with a loaned GPS unit by DFO regional office in B.C.
- Lake Winnipeg, at the time of the FIM survey, was well above normal water levels, because of exceptional river inflows and precipitation.
- Only one mid-summer field survey with limited sampling in 27 locations was undertaken.
- The late spring in 2011may have influenced vegetation and bird species composition and abundance.
- Delayed availability of air photos required reliance on field observations for EHI index analysis.
- EHI calculations did not include Riparian zone 2 data due to unavailability of aerial photos at the time of analysis.

Study Area Description

- The surface area of Lake Winnipeg is 23,750 km2.
- The mean water depth of the lake is 12m. South Basin mean depth is 9m.
- The maximum length of the lake is 430 km.
- The length of the shoreline is 1,750 km.
- The volume of the lake is 284 km3.
- The mean lake level above sea level is 217.4 m.
    - Source - Restoring the Health of Lake Winnipeg, Report by Lake Winnipeg Implementation Committee.
    - Source - Manitoba Conservation and Water Stewardship.
    - Source - Brunskill et all 1980.
- The main inflow rivers to Lake Winnipeg are; Winnipeg River, Saskatchewan River, Red River and the Dauphin River.
- The only main outflow is the Nelson River.
- There are many small and large wetlands adjacent to the study area. The largest wetland is Netley Marsh. This marsh area has been studied in the past but was not included in this project.
- The study area is bounded by Provincial Highway 8 on the west side of the lake, Provincial Highway 9 and 59 in the South and Provincial Highway 59 on the East side.
- The study area began near Sandy Point near Riverton, travels south along the lake shore all the way around to the east side of the south basin past Elk Island Provincial Park to Jackfish Creek.
- There are many small towns and cottage areas adjacent to the study area. The west side of the study area started north of Balaton Beach, and further south included Silver Harbour, Gimli, Winnipeg Beach and Matlock. The study area continued along Netley Marsh past Scantebury, Beaconia, Grand Marais, Grand Beach, Hillside Beach, Victoria Beach, Sandy Bay to Jackfish Creek.
- There are three First Nations communities near or adjacent to the study area. They are Peguis First Nation, Brokenhead Ojibway Nation and Sagkeeng First Nation (Fort Alexander).
- There are several parks and protected areas adjacent to the study area. They included; Hnausa Beach Provincial Park, Camp Morton Provincial Park, Winnipeg Beach Provincial Park, Brokenhead Wetland Ecological Reserve, Grand Beach Provincial Park, and Elk Island Provincial Park.

For a more complete description of the geography, geology, morphology and hydrology please see reports by the Lake Winnipeg Implementation Committee, Manitoba Geological Survey – Status of the Lake Winnipeg Project, Manitoba Shoreline Management Handbook and the State of Lake Winnipeg: 1999-2007 report.

Sensitive Habitat Inventory Mapping (SHIM) Project Objectives

- Collect and inventory information from the shoreline of the South basin of Lake Winnipeg.
- Collect and analyze data for use in developing recommendations for south basin Lake Winnipeg shorelines, future FIM/SHIM projects, and shoreline management guidance …
- Share the data, analysis and report with local government and provincial departments with the goal of developing future working relationships to improve the health of the lakeshore and lake.
- Build a collection of data for Lake Winnipeg Foundation for future scientific and technical projects for the Lake Winnipeg.

Foreshore Inventory and Mapping (FIM) Methodology

The inventory and mapping of the south basin foreshores of Lake Winnipeg were undertaken according to standard procedures in Mason and Knight (2001). Methods were adapted in certain circumstances to address fundamental differences between Lake Winnipeg and British Columbia lakes where FIM studies have been conducted.

Foreshore Survey and Inventory

Field surveys were conducted along the south basin shorelines of Lake Winnipeg, Manitoba between Riverton and Traverse Bay from 30 July to 4 August 2011. Data were collected in a systematic and consistent manner to ensure high data quality. Field assessments were completed by Bruce MacDonald (Terra Limnic Consulting), Lisette Ross (Native Plant Solutions – Ducks Unlimited Canada), Pauline Bloom (Native Plant Solutions – Ducks Unlimited Canada), Annie Eastwood (Washington State University), and Desiree Stratton (University of Manitoba). Field observations for each segment were recorded in a hand held TRIMBLE Nomad GPS unit with the Sensitive Habitat Inventory and Mapping (SHIM) data dictionary (version 2.6).

Surveys were conducted from a 21-foot fishing boat operated within 30 m of shore by Bruce and Linda Benson, fishers with extensive experience on Lake Winnipeg. Occasionally, water depth, hidden underwater structures, and/or weather conditions required a wider offset from shore.

Secchi disc measurements for water transparency were not taken during this survey. Numerous previous studies have indicated that mid-summer south basin water transparencies generally range from 0.1 to 0.5m with lowest readings in the Red River inflow area (State of Lake Winnipeg, 2011).

Defining Segments

The shoreline of the south basin of Lake Winnipeg between Riverton and Traverse Bay was divided into multiple segments. The start of each new segment was based primarily on a change in shoreline type, but when necessary a significant change in land use, shore modification, or level of impact was also used. Maps were reviewed prior to starting the survey to help identify occurrences of possible segment breaks. However, final decisions on shoreline segment start and

end points were made in the field following team member discussions. Large, important shoreline features were designated as separate segments (e.g., Gimli harbor and the main inlet of the Red River) rather than being nested within a segment. (see *Nesting Data Points within Shoreline Segments*).

Nesting Data Points within Shoreline Segments

The Trimble data dictionary provides the option to nest particular features (e.g., marinas, modifications, important sites) within a segment. In the south basin Lake Winnipeg study, nested features included stream mouths, marinas, water treatment plants, dredged canals/channels in wetlands and other significant shoreline features. For nested sites, supplementary information was entered into field notebooks and photographs were taken.

Segment Characteristics

Field code definitions for the SHIM data dictionary are included in the online data repository (http://130.179.67.140/dataset/lwfshim/resource/b8de5e13-fa54-43e0-a3f8-7c57104bfa36) and are adapted from Schleppe (2009).

Weather conditions were recorded at the start of each segment. Air and water temperatures were recorded once each day. The comments section for each shoreline segment includes wind direction and speed.

The data dictionary information for each segment begins with a general summary of the segment classification where dominant features of the shore type, modifiers, littoral zone slope, land use, level of impact, livestock access, percent disturbed, and percent natural are first recorded. More detailed data for the shore type, land use, substrate, vegetation, modifiers, flora and fauna follow the initial classification of each segment.

Data collected for individual shoreline segments included shore type (e.g. cliff/bluff, rocky, gravel, sand, stream mouth, wetland, and other); land use (e.g., agriculture, commercial, conservation, forestry, industrial, institutional, multi-family, natural area, park, recreation, rural, single-family, and urban park); substrate (e.g., marl, mud, organic, fines, sand, gravel, cobble, boulder, and bedrock); vegetation characteristics; littoral zone; modifications (see below); and flora and fauna.

Shore type, land use, and substrate sub-categories were estimated as a percentage of the shoreline segment, with the total for each category adding to 100%. Field team members relied on visual observations to estimate percentages. A handheld GPS provided team members with the general length of each segment in the field. A minimum of three people were needed to estimate percentages and ensure accuracy (and if necessary to prevent a 'tie') for any percentage-based fields in the data dictionary. Typically all five team members were involved in arriving at percentages.

Individual team members were assigned to a particular segment for tracking and noting shoreline modifications that required an exact count (e.g., groynes, docks, retaining walls, boat houses, etc.). Each count was tallied and recorded into the Trimble GPS for each segment.

Vegetation data was also collected for each segment. Data was recorded for Vegetation Band 1 (predominant vegetation class present along foreshore). Because of, in most cases, the low sloping shorelines, observations of Vegetation Band 2, situated beyond the 30m landward boundary of Vegetation Band 1, were not possible. Band one vegetation (e.g., coniferous, broadleaf, mixed forest, shrubs, herbs/grasses, exposed soils, landscape, natural wetland, disturbed wetland, row crops, and unvegetated) details were observed and recorded. The structural age (stage) of the stand (i.e, sparse, grass herb, low shrub, tall shrub, pole/sapling, young forest, mature forest, and old forest), shrub coverage, tree coverage, distribution of the vegetation band (i.e., patchy versus continuous), band width, overhanging vegetation, and the presence of aquatic vegetation (e.g., submergent, emergent, and floating aquatic vegetation) was also recorded.

Incidental sightings of fauna (primarily birds) were recorded by all team members for each segment. In cases of a mismatch between observed counts, the mean between the counts was entered into the Trimble GPS.

Modifications

The modifications category was used to identify alterations made to the shoreline to prevent shoreline erosion as well as structures for boat and pleasure activities. Modifications included retaining walls, docks, boat houses, groynes, boat launches, railways, roads, marine rails, marinas, and substrate modifications. Rip-rap was a major shoreline modification in the south basin of Lake Winnipeg but the category was not included as a modification in the BC case-based data dictionary. To ensure that this important structural modification was documented, information regarding % of segment length and construction material used as rip-rap were included in the modifications comments field within the Trimble GPS.

The comments fields within the Trimble data dictionary were critical for capturing information about features not included within the dictionary. The dictionary can be altered to accommodate features of the Lake being surveyed, but these features are often unknown until the survey team is actually conducting the on lake survey. The bedrock field in the substrate section in Trimble GPS data dictionary was used to indicate when the presence of shoreline modifications such as rip-rap or retaining walls made it impossible to determine natural shoreline substrates.

Photographic Documentation

Photo images were taken along the entire shoreline survey to capture features characteristic of each segment. At the start of each new segment, a place card identifying the segment number and date was photographed. All subsequent photos were of that particular segment. This methodology ensured that photos were kept organized between segments. Photos were downloaded at the end of each day and organized by date and segment number. A field notebook was dedicated to recording photo numbers for each segment and any other photo-related notes.

Data Verification

All data were downloaded to a laptop for backup at the end of each day. After the shoreline survey was complete, the entire database was downloaded and proofed to ensure accuracy and consistency of the data with what was observed and counted in the field. Detailed field notes

written by each team member for each segment became an invaluable tool for proofing the data and ensuring the Trimble GPS data was correct.

Wildlife, Vegetation, and Fish Surveys for SHIM assessment

Fish, wildlife, and vegetation surveys were conducted between 4 August and 7 August 2011 at 27 points (sample locations) along the south basin shoreline of Lake Winnipeg. Survey sites were selected to represent the entire variety of shore types recorded during the FIM portion of the project. Each shore type was represented at least once and both natural and developed shoreline types were sampled. Shoreline types were mainly surveyed for fish, wildlife, and vegetation (n = 21). Some sites were surveyed only for fish (n = 4) or only for wildlife and vegetation (n = 2), depending on site characteristics. Photos were taken at each survey location to record site characteristics and the species found at each site. (see photo documentation methods above.)

Species presence (primarily birds, but also mammals and amphibians) was recorded at each sampling location. Bird presence was recorded via visual and/or auditory observation. Numbers of birds were recorded whenever possible. Tree and shrub species were recorded along with information regarding the amount of cover and the age of tree canopy. Invasive plant species were recorded. Invertebrate sampling using sweep nets was conducted at many sites; however conditions were not always appropriate for collecting adequate samples of invertebrates.

Littoral zone details, including gradient and substrate piece size, were also identified. Some wildlife species may have been present but not observed or taken flight because of the approaching boat, crew, and/or off-loading activities. Whenever possible, efforts were made to conduct surveys in the morning when birds are more active. Frequently, wildlife observers went on shore first to survey the segment before the rest of the crew unloaded.

Fish surveys were conducted using a 15 metre beach seine in the sand and gravel beach, rocky, and stream mouth shore types. Minnow traps were used to sample wetlands, natural large organic debris habitat features, and marina/dock and rip-rap/rock groyne modifications. Minnow traps were left to soak overnight (minimum 12 hours). The number of fish, species and life stages were recorded at each site. All fish were released unharmed except for vouchers of 2 species which were kept to confirm identification. Observations of substrate, aquatic macrophytes, water temperature and clarity and other habitat features were recorded at each sample site. Results are found in Appendix 10.

Literature Cited

Mason, B., and R. Knight. 2001. Sensitive Habitat Inventory and Mapping. Community Mapping Network, Vancouver, British Columbia. 315pp + viii. M. Johannes, Editor.

Schleppe, J., 2009. Moyie Lake Foreshore Inventory and Mapping. Ecoscape Environmental Consultants Ltd.. Project File: 09-371. July, 2009. Prepared for: East Kootenay Integrated Lake Management Partnership.

State of Lake Winnipeg: 1999 to 2007. Environment Canada and Manitoba Water Stewardship. June 2011. 209pp + viii.

Overview

List of Segments

- Please refer to the map in the Appendices for an overview of the study area.
- There were 50 segments in total covering 299 km.
- The GPS data collected and was corrected for error. However the margin of error for locations still ranges from 10 to 50 metres.
- There are 27 sample sites; a mixture of fish and wildlife/vegetation sites.

Field Assessment

- When - July 30 to August 4th for FIM. August 4 to August 7 for survey sites.
- Who – Field team members.
- GPS equipment used – Trimble Nomad.
- Segments 50 in total
- Sample sites 27 sample sites; mixture of fish and wildlife/vegetation sites.
- Data collected
- Input into spreadsheets

Data Dictionary

- Almost all fields of the data dictionary were used in the field study.
- See appendices for complete data dictionary
- This pilot project used version 2.6 of the data dictionary which was used in BC for several projects.
- Jim Smith Lake, Mabel Lake, Monroe Lake, Moyie Lake, Okanagan Lake 2011, St. Mary Lake all used version 2.6 of the FIM data dictionary on Trimble GPS units.

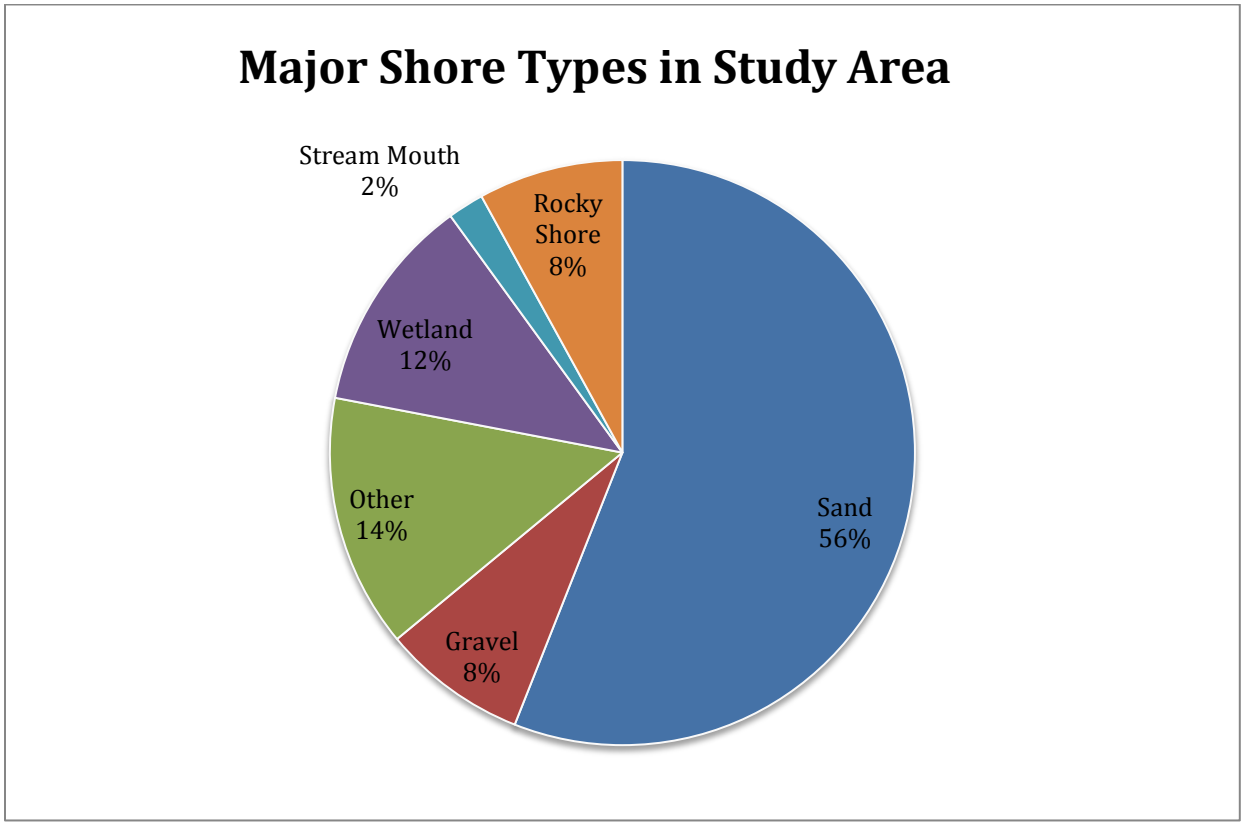
Report preparation

- The reports summarized data collected and described the results using tables and figures.

GIS Products

- Software and tools used for the GIS analysis and map creation were;
    - Arc GIS 9.X, Arc Catalog, Pathfinder, various computers and printers.
    - Importing GPS data from two different GPS units, one for FIM data and one for locations of sample sites and other anthropogenic sites.
    - Trimble Nomad GPS unit
    - Second hand held GIS unit used for fish, wildlife and vegetation sample sites.
- Data sources
    - Manitoba Government data from the Manitoba Lands Initiative, Geogratis, GPS data from field work conducted by Lake Winnipeg Foundation, USGS for Landsat 5 imagery.
    - 2011 Lake Winnipeg Flood 30cm Digital Ortho Imagery, ATLIS Geomatics, 1333 Dugald Road, Winnipeg.
- See appendices for all maps.

Figure 1. Major Shore Types in Study Area



Discussion

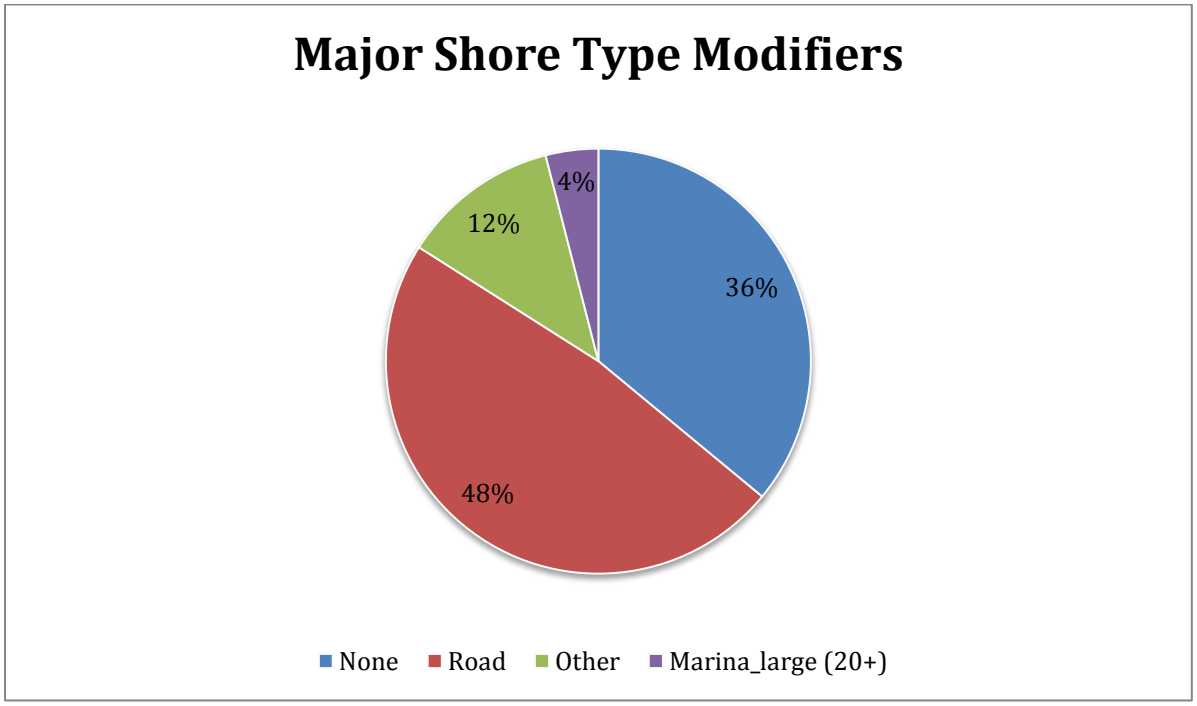
The major shore type in the study area were sand (56%), wetland (12%), gravel (8%) and rocky (8%). Segments categorized as "Other" (14%) included; segments that were mostly or highly developed with heavy shoreline modification, hardened shorelines, many single family dwellings, large marinas, man-made beaches, roads and dikes very close to shoreline or on the shoreline. (See segments; 7, 9, 10, 11, 16, 19, and 33.)

SHIM Data Dictionary v2.6 – Shore Types

Shore type is a categorical field that describes the predominant shore type that occurs along the length of the shore segment (i.e., the highest percentage of the linear shoreline length). Shore types include Cliff/Bluff, Rocky Shore, Gravel, Sand, Stream Mouth, Wetland, and Other. If other is selected, comments should be included to describe the shore type observed.

The majority of the study area was categorized as Sand shore type (56%), along with 12 percent wetland, 8 % for both gravel and rocky shore type. Given the low number of stream and river mouths along the south basin shoreline, the 2% of stream mouth shore type is not surprising.

Figure 2. Major Shore Type Modifiers



Discussion

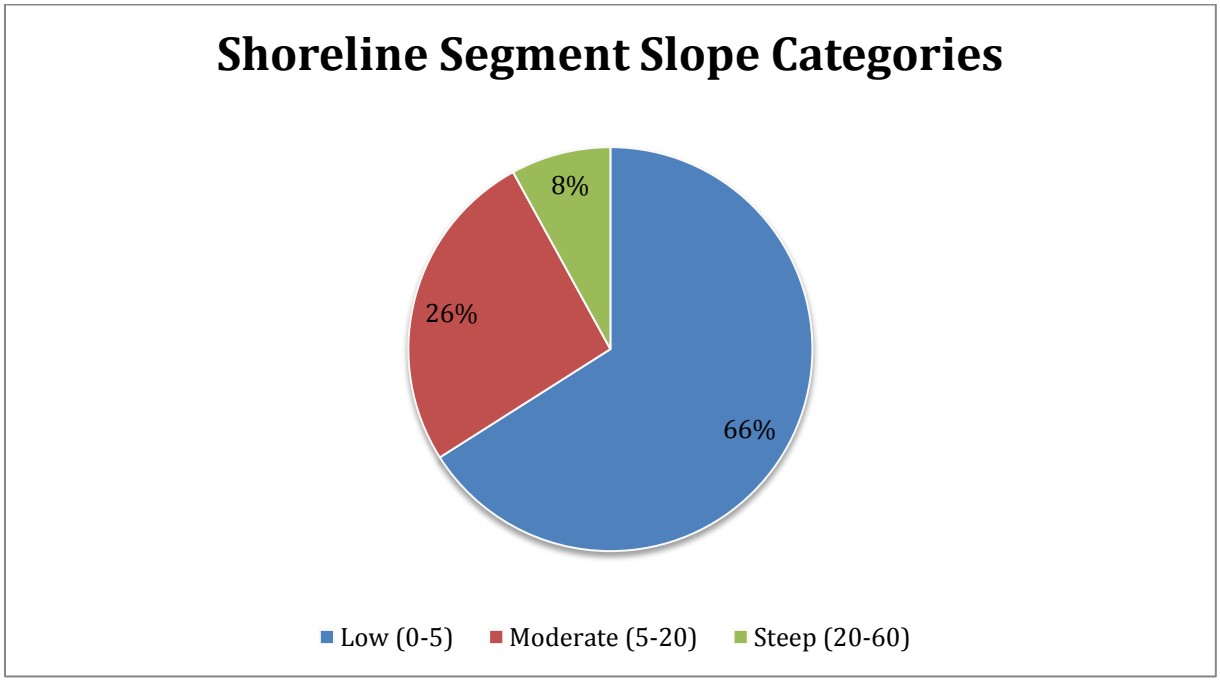
The largest modifier to shoreline segments in the study area was adjacent roads (48%). The next largest modifier grouping was none (natural state) (36%), along with other modifiers (12%) and large marinas (4%).

The other modifiers (12%) included; dwellings, cleared land, shoreline erosion protection, drainage, dredging, channels, infrastructure, pump houses etc.

SHIM Data Dictionary v2.6

The shore type modifier field is used to describe significant shoreline structures/activities that influence the shoreline. The field is categorical and choices include Log Yard, Small Marina (6-20 slips), Large Marina (greater than 20 slips), Railway, Roadway, None, and Other. If other is selected, the comments field should be used to identify the modifier. If the field is left blank, users should assume that there is no shoreline modifier.

Figure 3. Shoreline Segment Slopes Categories



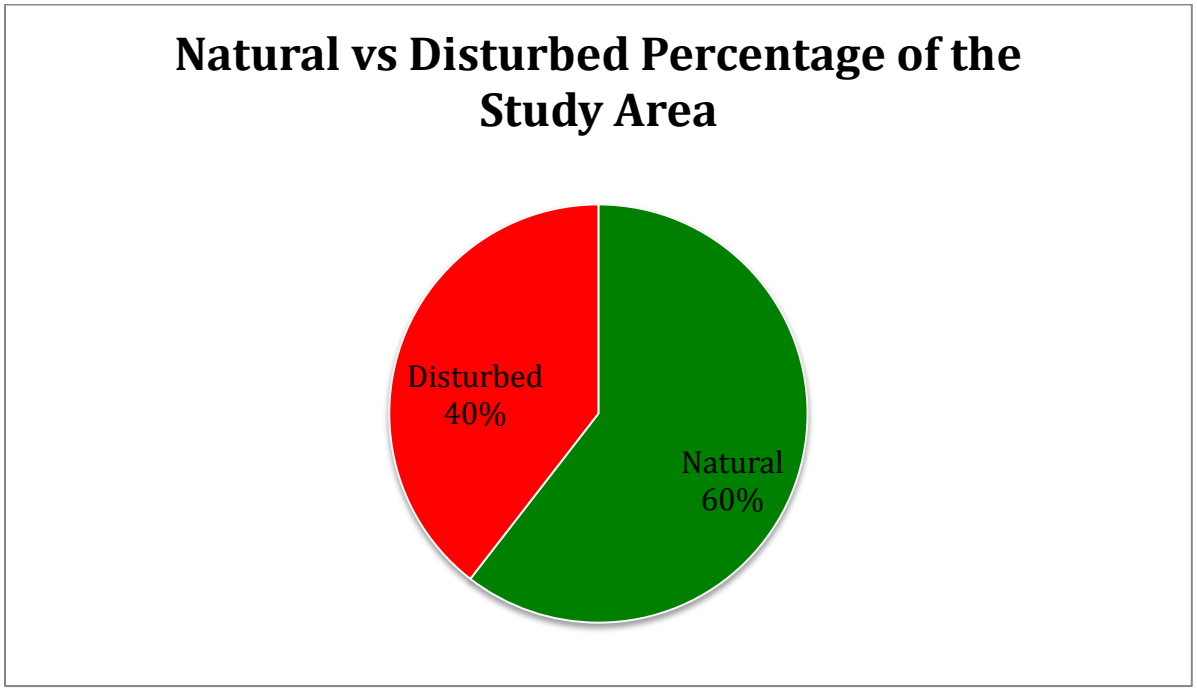
Discussion

The majority of the slope along the shoreline in the study area was low (66%), then moderate slope (26%) and steep slopes (8%).

SHIM Data Dictionary v2.6

Slope is a categorical determination of the slope or gradient of the shoreline. Categories include Low (less than 5%), Moderate (5-20%), Steep (20-60%), Very Steep (>60%), and Bench. A bench is a shoreline that rises, typically steeply or very steeply, has a flat area typically greater than 15 horizontal meters, and then becomes steep or very steep again. On bluff shore types where the shoreline rises sharply and then flattens, the categorical statement should describe the steep portion of the shoreline (i.e., do not use bench).

Figure 4. Land Use – Natural vs. Disturbed Percentage of the Study Area

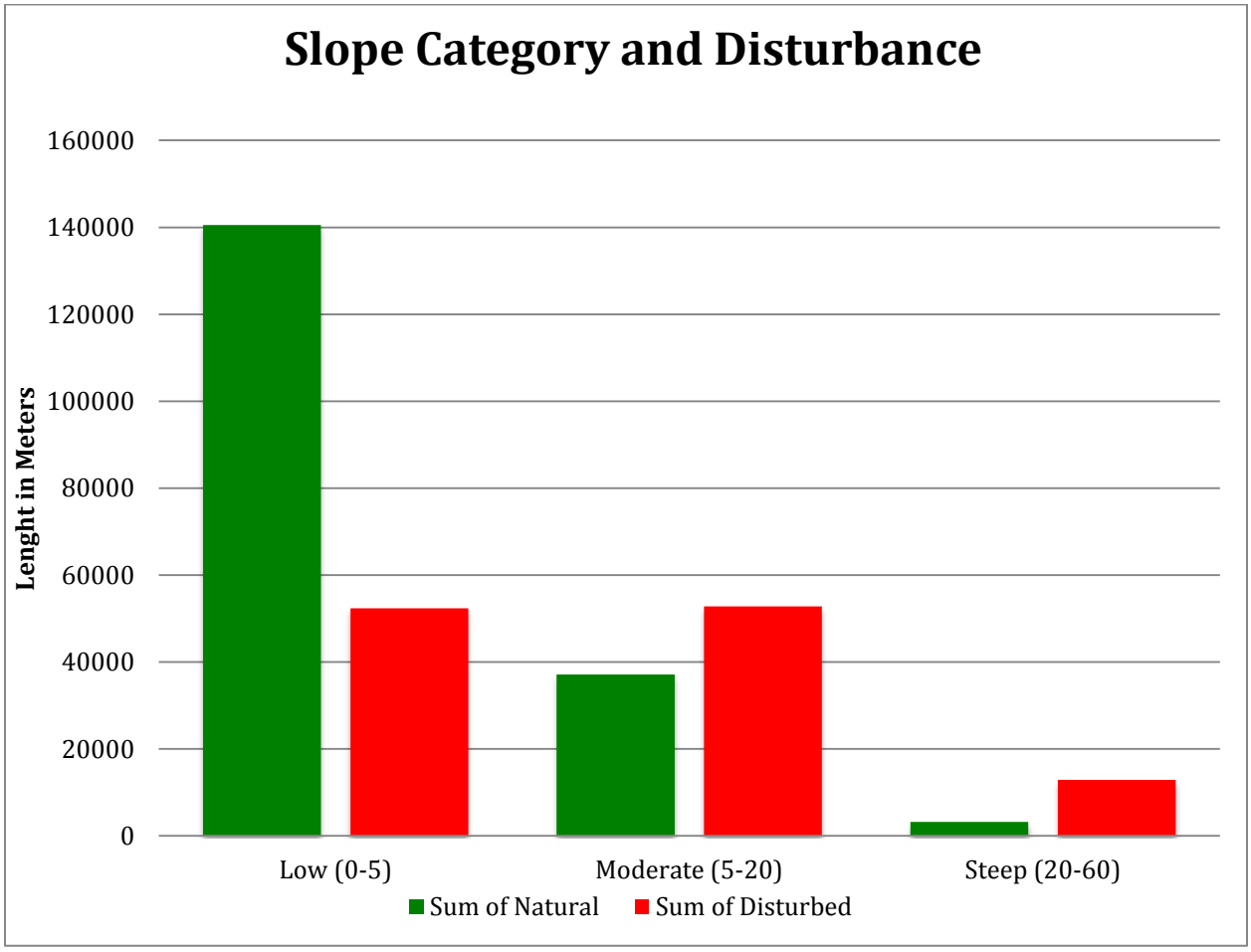


Discussion
The majority of the study area shoreline was categorized as natural (60%), with remaining shoreline disturbed (40%).

SHIM Data Dictionary v2.6
Percentage of the shoreline that is *disturbed* is a measurement of the approximate length and depth of the shore zone that has been disturbed. Assessors use a combination of field observations and air photo interpretation to determine the percentage disturbed. Generally, the percentage disturbed corresponds to the level of impact (i.e., a high percentage of disturbance should translate into a High level of impact). The summation of the Percentage Disturbed and the Percentage Natural should equal 100%.

Percentage of the shoreline that is *natural* is a measurement of the approximate length and depth of the shore zone that remains in a natural condition. Assessors use a combination of field observations and air photo interpretation to determine the percentage disturbed. Generally, the percentage natural should correspond to the level of impact. The summation of the Percentage Disturbed and the Percentage Natural should equal 100%.

Figure 5. Comparison of Major Slope Categories with Natural and Disturbed Segments

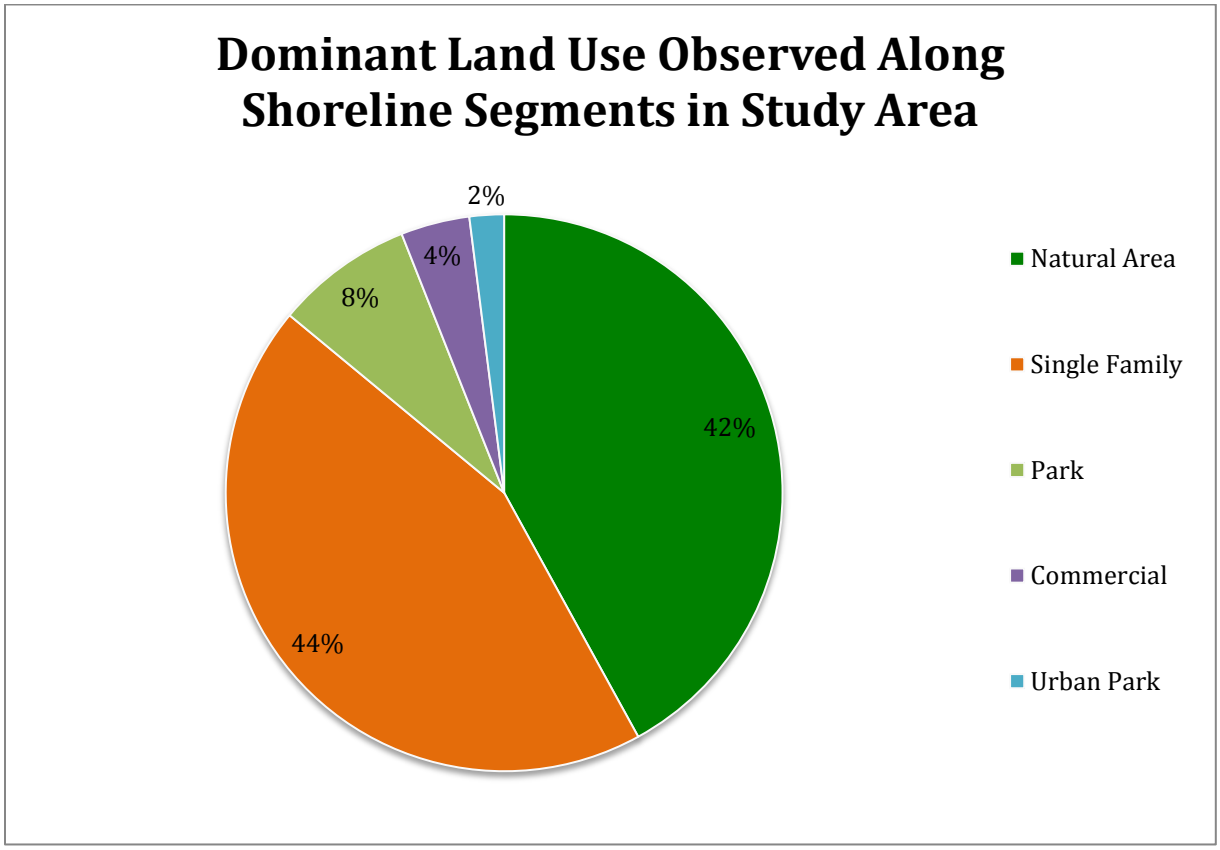


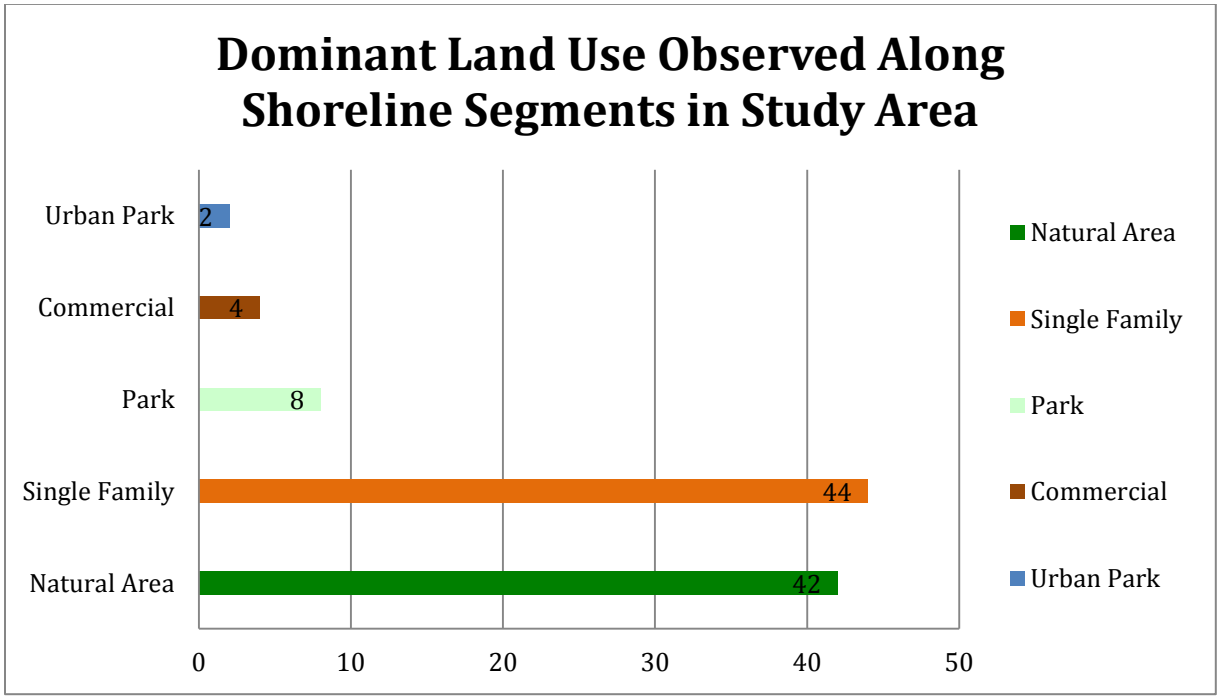
Discussion

See definition for slope categories and natural vs disturbed in the previous graphs.

The field assessment found that a majority of low slope shoreline is still in natural state along the south basin of Lake Winnipeg, compared to the moderate slopes and steep slopes, which are more disturbed. It is likely that moderate or steep slopes without natural vegetation are more susceptible to erosion.

Figure 6. Dominant Land Use Observed Along Shoreline Segment in Study Area



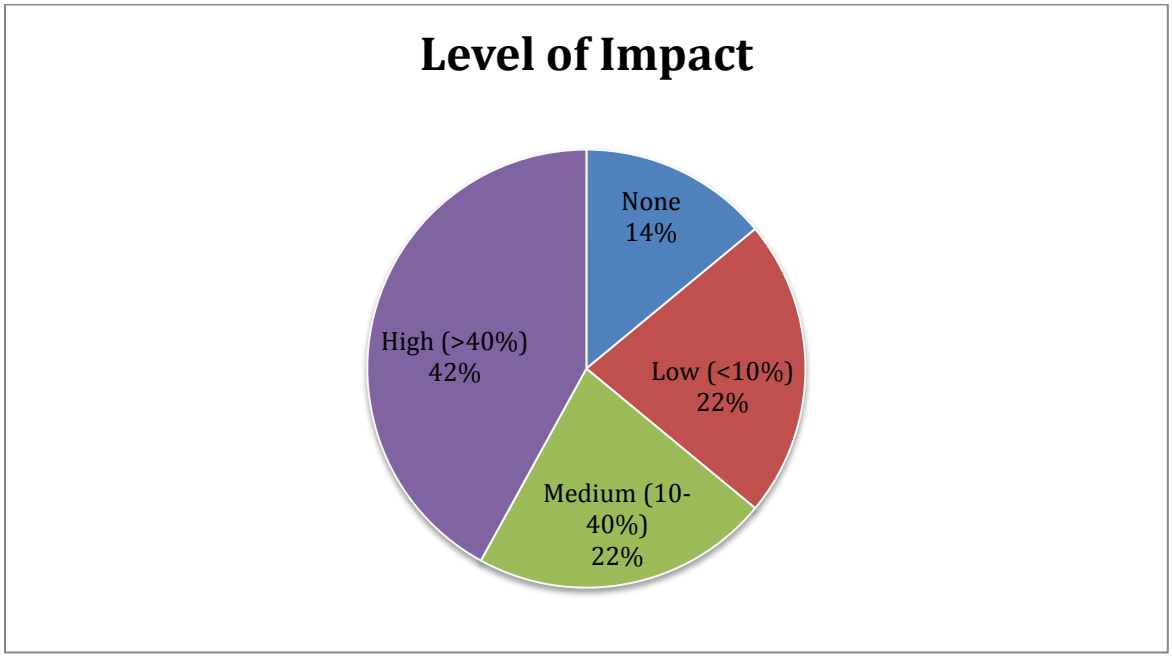


Discussion
The *dominant* land uses along the Lake Winnipeg south basin shoreline in the study area were single family dwelling at 44% and natural areas at 42%. The remaining use is split between natural parks at 8%, commercial property at 4% and urban parks at 2%.

Note: The data is shown in pie chart and bar graph for reader convenience. There is no difference in the data.

SHIM Data Dictionary v2.6
Land use is a categorical field that is used to describe the dominant land use observed along the segment. Categories include Agriculture, Commercial, Conservation, Forestry, Industrial, Institution, Multi-Family, Natural Area, Park, Recreation, Single Family, Rural, and Urban Park. Land use determination is based upon a combination of field observation, review of zoning and bylaw maps, and air photo interpretation. Please refer to detailed definitions of the different land use types to better understand the different categories.

Figure 7. Level of Impact along Shoreline in Study Area



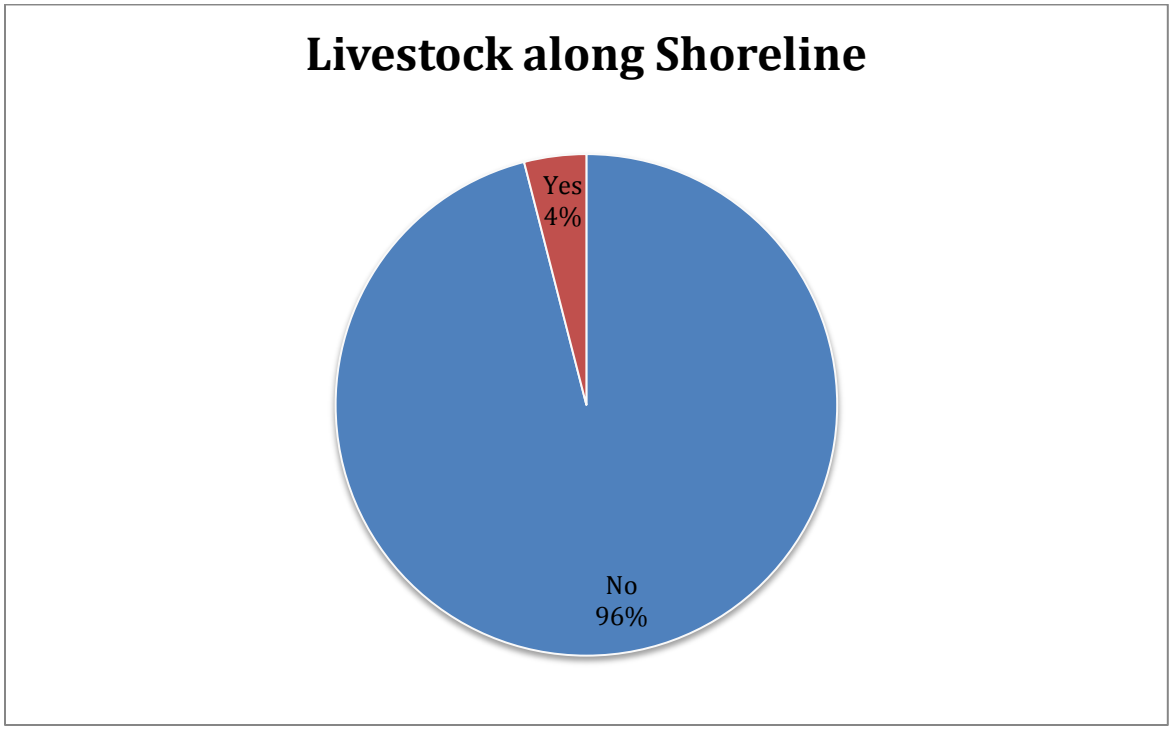
Discussion

42% of the shoreline is highly altered by anthropogenic activities, 22% moderately altered, and 22% falls into the low alteration category. 14% of the shoreline in the study area shows no visible impact based on observation at the time of the study.

SHIM Data Dictionary v2.6

Level of impact is a categorical field used to describe general disturbances observed along the shoreline. Disturbances are considered to be any anthropogenic influence that has altered shoreline features including the foreshore substrates, vegetation, or the shoreline (e.g., retaining walls, groynes, etc.). Level of impact is determined from the length of the shore line (i.e., along the segment) and the depth of the shore zone area to between 15 to 50 m back. In more rural settings, typically the assessment area is greater (i.e., 50 m) and in more developed shorelines, typically the assessment area is less (i.e., 15 m). In cases of roadways, highways or railways, one should generally assess the location of the rail or roadway along the segment. To facilitate interpretation of this category, air photo interpretation is recommended to better estimate disturbance. Disturbance categories include High (>40%), Medium (10-40%), Low (<10%), or None. Consistency of determination is very important and assessors should consistently use the same criteria to determine the level of impact.

Figure 8. Adjacent Livestock Operations



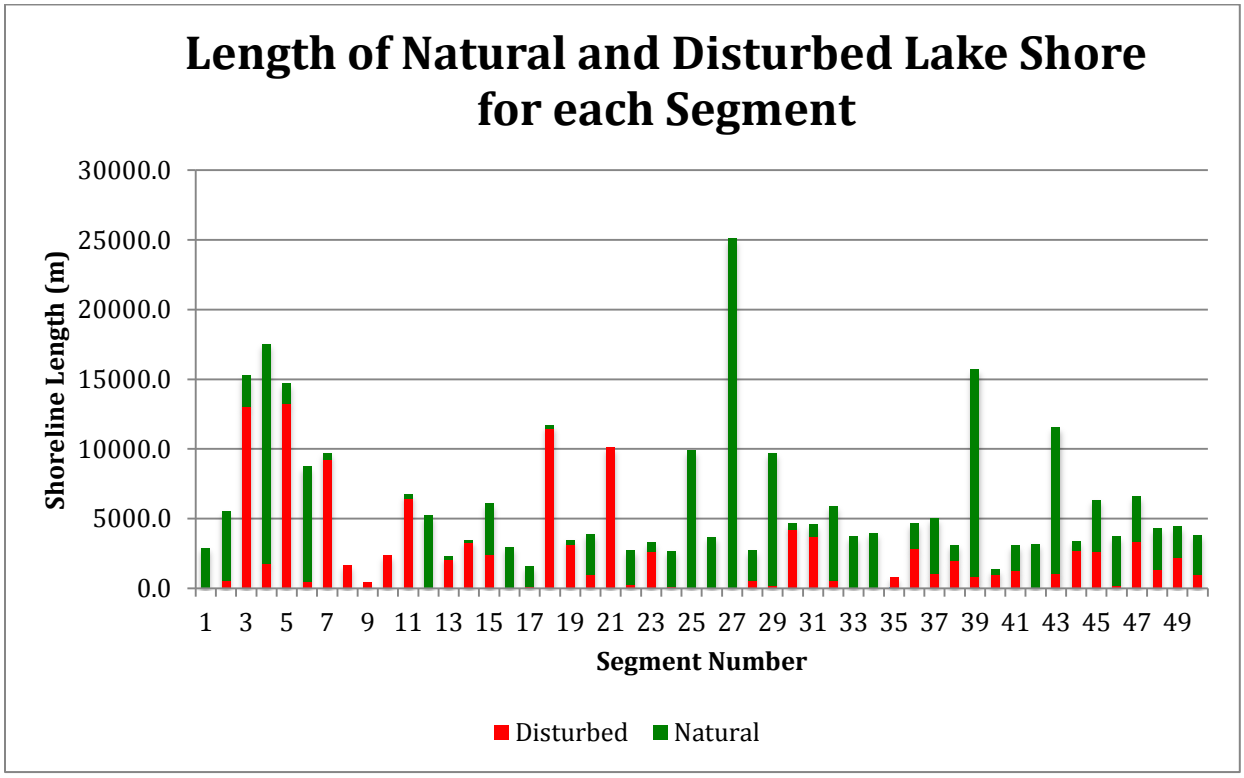
Discussion

Very little (4%) of the Lake Winnipeg south basin study area of 299 km shoreline is impacted by livestock having direct access to the shoreline.

SHIM Data Dictionary v2.6

Livestock access is a categorical field that is used to determine whether livestock, such as cattle, have access to the foreshore. Choices include Yes or No or blank. If the field is left blank, one should assume that cattle do not have access.

Figure 9. Length of Disturbed vs Natural Segment Length in Study Area



Discussion

This graph shows the proportional lengths (m) of natural and disturbed shoreline sections in each segment in the study area.

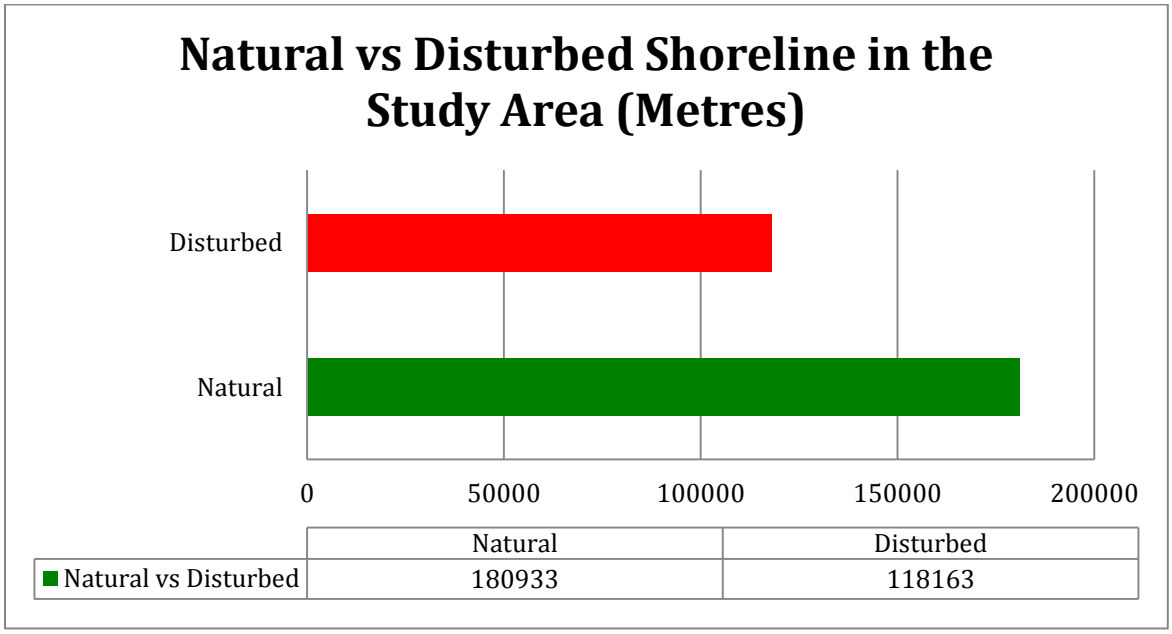
This graph shows the relative length of each segment that is disturbed and natural. The calculation is the percentages disturbed and natural multiplied by the length of the segment in meters.

SHIM Data Dictionary v2.6

The shoreline fraction that is *disturbed* is a measurement of the approximate length and depth of the shore zone that has been disturbed. Assessors should use a combination of field observations and air photo interpretation to determine the fraction disturbed. Generally, the percentage disturbed should correspond to the level of impact (i.e., a high percentage of disturbance should translate into a High level of impact). The summation of the Percentage Disturbed and the Percentage Natural should equal 100%.

Percentage of the shoreline that is *natural* is a measurement of the approximate length and depth of the shore zone that remains in a natural condition. Assessors should use a combination of field observations and air photo interpretation to determine the percentage disturbed. Generally, the percentage natural should correspond to the level of impact. The summation of the Percentage Disturbed and the Percentage Natural should equal 100%.

Figure 10. Natural vs Disturbed Shoreline in Study Area in Metres



Discussion

The shoreline length in the study area identified as disturbed is 118 163 meters or 118.163 kilometers out of a total of 299.096 kilometers.

Figure 4. Land Use – Natural vs. Disturbed Percentage of the Study Area

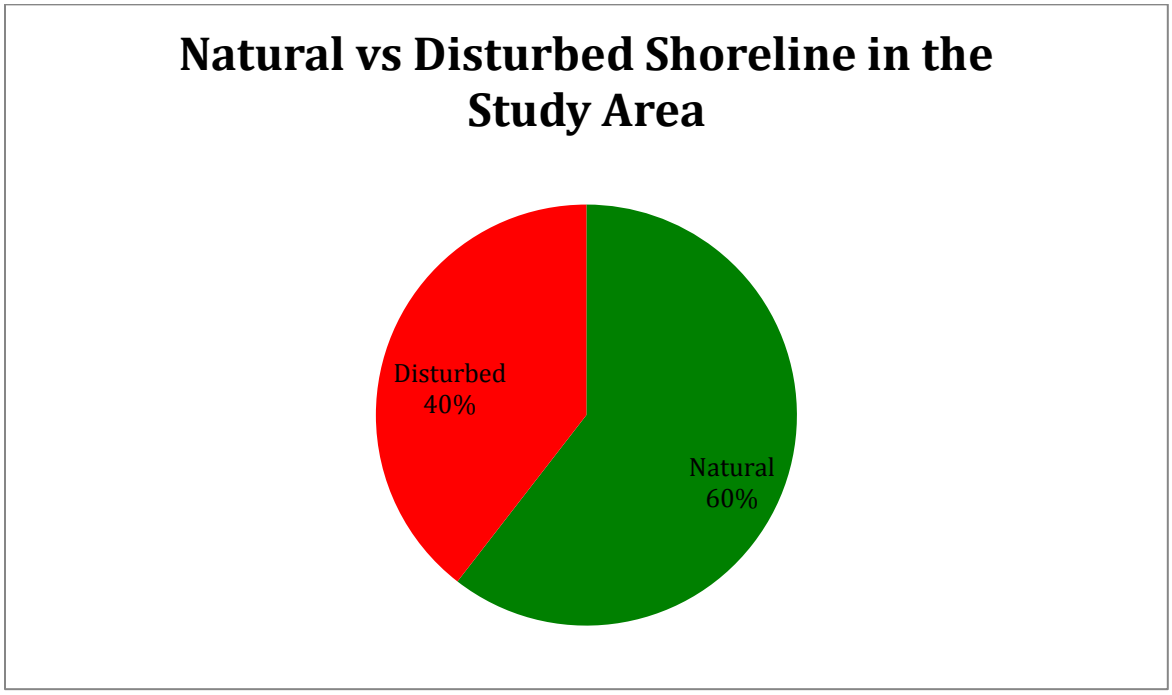


Figure 11. Dominant Land Use and Disturbed Shoreline

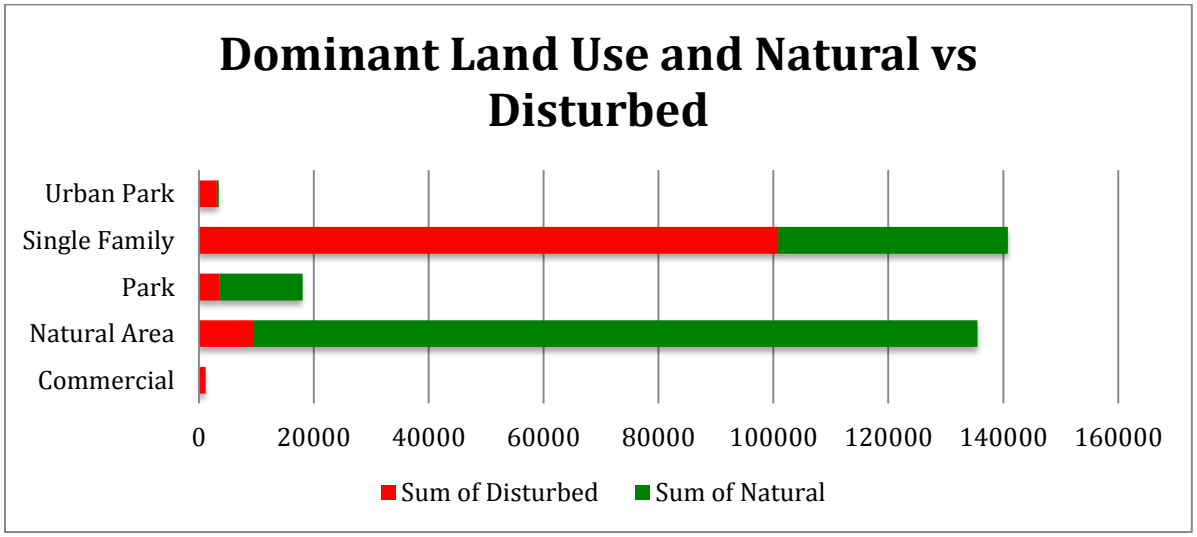


Table 1. Dominant Land Use and Natural vs Disturbed Shoreline

Land Use	Disturbed (m)	% Disturbed	Natural (m)	% Natural
Urban Park	3136.5	2.7	348.5	0.2
Single Family	100791.68	85.3	40037.32	22.1
Park	3632.45	3.1	14449.55	8.0
Natural Area	9424.39	8.0	126097.61	69.7
Commercial	1178	1.0	0	0.0
Grand Total	118163.02	100.0	180932.98	100.0

Discussion

The dominant land uses observed along all shoreline segments in the study area were single family dwellings and natural areas. The majority of singled family dwellings category is also associated with longer stretches of disturbed lakeshore. Almost all of the urban park areas are categorized as disturbed. Parks are mostly natural with some areas disturbed most likely from infrastructure. Natural land use category remains almost entirely undisturbed. Commercial areas are entirely disturbed.

SHIM Data Dictionary v2.6

Land use is a categorical field used to describe the ***dominant*** land use observed along the shoreline study area. Categories include Agriculture, Commercial, Conservation, Forestry, Industrial, Institution, Multi-Family, Natural Area, Park, Recreation, Single Family, Rural, and Urban Park. Land use can be determined based upon a combination of field observation, review of zoning and bylaw maps, and air photo interpretation. Please refer to detailed definitions of the different land use types to better understand the different categories. (Repeat of page 17)

Percentage (graph not expressed as %) of the shoreline that is *natural* is a measurement of the approximate length and depth of the shore zone that remains in a natural condition. Assessors should use a combination of field observations and air photo interpretation to determine the

percentage disturbed. Generally, the percentage natural should correspond to the level of impact. The summation of the Percentage Disturbed and the Percentage Natural should equal 100%. Repeat of Page 20

Percentage (graph not expressed as %) of the shoreline that is *disturbed* is a measurement of the approximate length and depth of the shore zone that has been disturbed. Assessors should use a combination of field observations and air photo interpretation to determine the percentage disturbed. Generally, the percentage disturbed should correspond to the level of impact (i.e., a high percentage of disturbance should translate into a High level of impact). The summation of the Percentage Disturbed and the Percentage Natural should equal 100%. (Repeat of Page 20)

Figure 12. Shore Type for Study Area

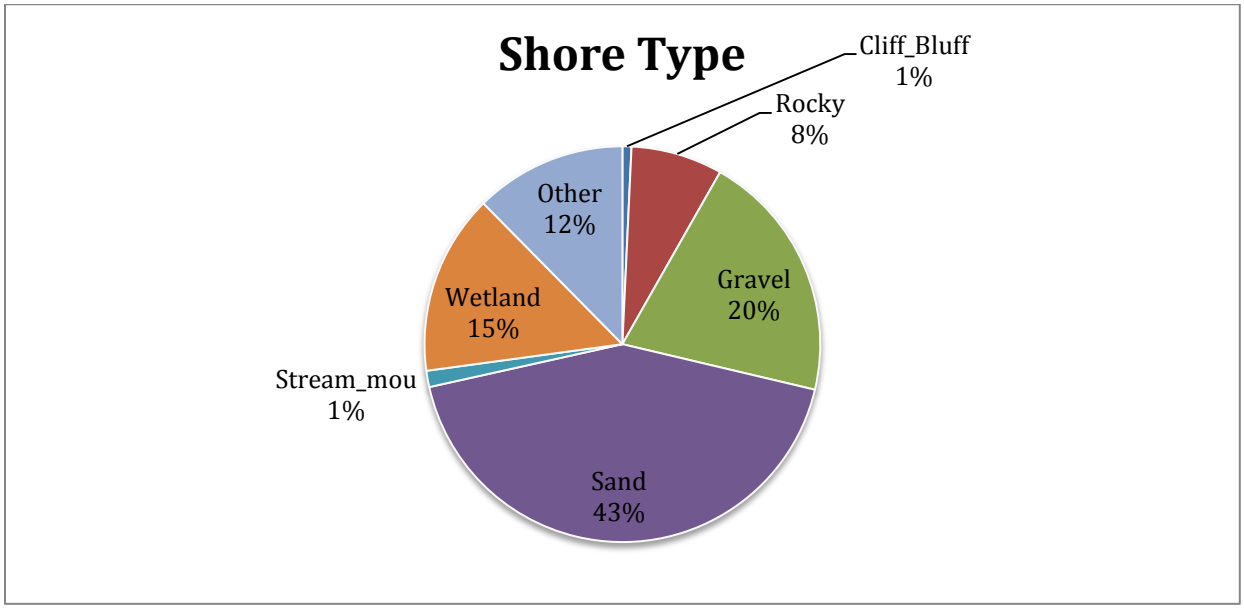
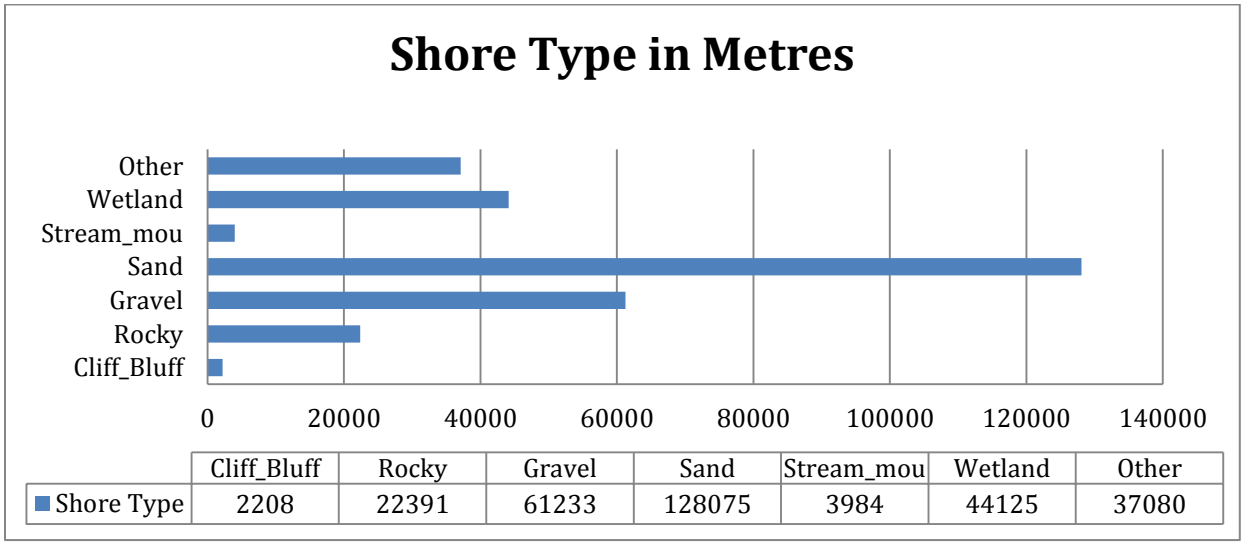


Table 2. Shore Type for Study Area in Metres



	Cliff_Bluff	Rocky	Gravel	Sand	Stream_mou	Wetland	Other
Shore Type	2208	22391	61233	128075	3984	44125	37080

Discussion

The largest shore type along the 299 km Lake Winnipeg south basin study area is sand (43%) then gravel (20%) followed by wetland (15%), other (12%) and rocky shore type (8%). A small percentage of the study area included cliff / bluffs (1%) which were in segment 28, 42 and 44.

Stream mouths are a small (1%) but vitally important shore type in the overall assessment of the study area. Segments that included stream mouths are: 3, 6, 7, 24. Note this is not the same as counting all the streams and rivers that feed into the lake. This shore type category reveals that a not insignificant percentage of the shore line is actually stream mouths.

Other shore types account for 12% of the shoreline and consists of disturbed land.

See definitions of the shore types below. Photos of different shore types as viewed summer 2011 are also included.

SHIM Data Dictionary v2.6

The *Cliff / Bluff* shoreline field contains the percentage of the segment, based upon the shore segment length, that is a cliff or bluff shore type. A cliff shore type is typically very steep with substantial vertical elements. A bluff shore type is typically steep or very steep, and then flat for a substantial distance, typically formed by the fast recession of water levels during glacial periods.

The *Rocky Shoreline* field contains the percentage of the segment, based upon the shore segment length, that is rocky. Rocky shores consist mostly of boulders and bedrock, with components of large cobble and some gravels. These shore types tend to occur on steeper shorelines. Previous versions of the data dictionary called these shorelines low rocky shorelines or possible (but less so) vegetated shorelines.

The *Gravel* shoreline type field contains the percentage of the segment, based upon the shore segment length, that is a gravel beach. Gravel beach shorelines tend to occur on Low or

Moderate slopes, and substrates are predominantly gravels and cobbles. These shore types may also contain small percentages of gravels and or bedrock. Often gravels beaches and rocky shores occur along one segment, with gravel shoreline types occurring in depositional areas (i.e., in bays) and rocky shores (i.e., at points) occurring in erosional areas.

The *Sand* shoreline type field contains the percentage of the shoreline , based upon the shore segment length, that is a sand beach. Sand beach shorelines tend to occur in low gradient shorelines and are predominated by sands and small gravels. These shore types may also contain some gravel shoreline areas in places that are more exposed to wind and wave action (e.g., points).

The *Stream Mouth* shoreline type field contains the percentage of the shoreline, based upon the shore segment length, that is a stream mouth. A stream mouth is defined as the space where there is a confluence between a lake and a stream or a river and the stream has direct influence on sediment movements and deposition or is part of the active floodplain. Typically, the stream mouth segment is larger for rivers and smaller for creeks. A separate segment should be created for significant fisheries streams, such as those known to contain spawning populations of fish.

The *Wetland* shoreline type field contains the percentage of the shoreline , based upon the shore segment length, that is a shore marsh or wetland. A wetland segment typically occurs on low gradient sites, the littoral zones is wide and shallow, substrates are predominantly silts, organics, or clays, and there is emergent vegetation present.

The *Other* shore type field allows assessors to enter shoreline types that do not fit into one of the general categories above. If the other shore type field is used, assessors add comments to describe the shore type and provide justification for use of the other field. Examples of other shore types may include constructed boat access canals.

Figure 13. Shore Types and Disturbed vs Natural

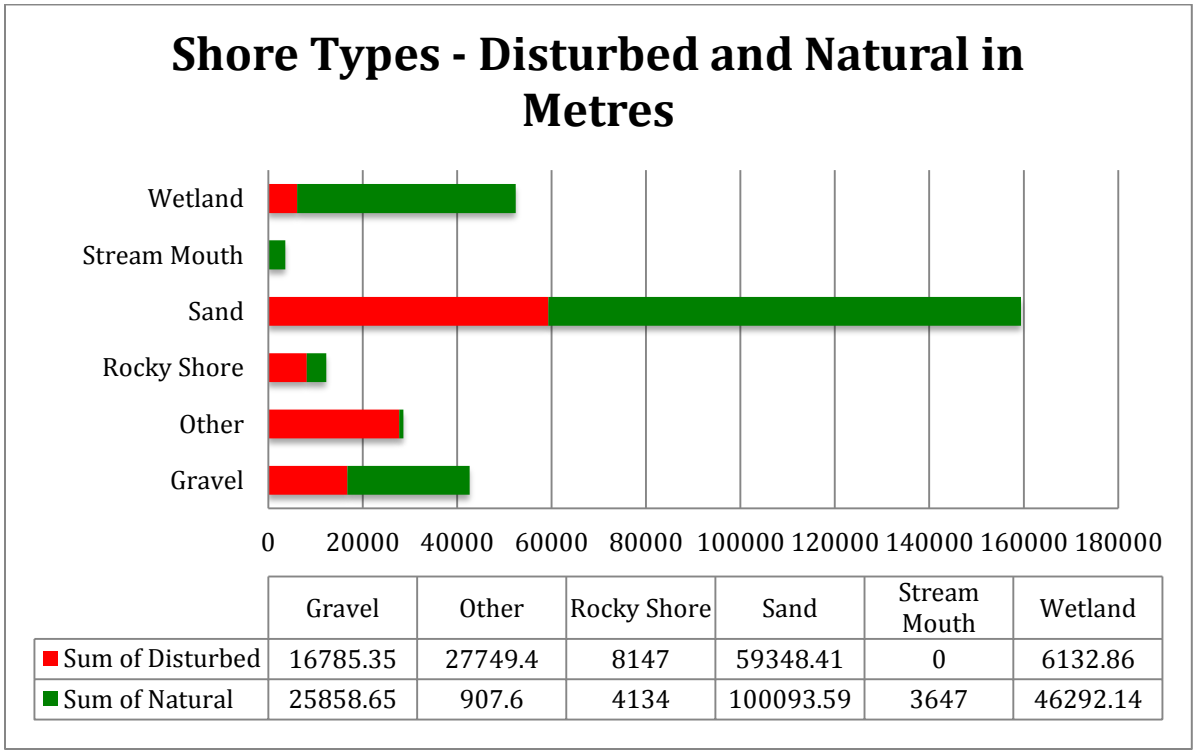


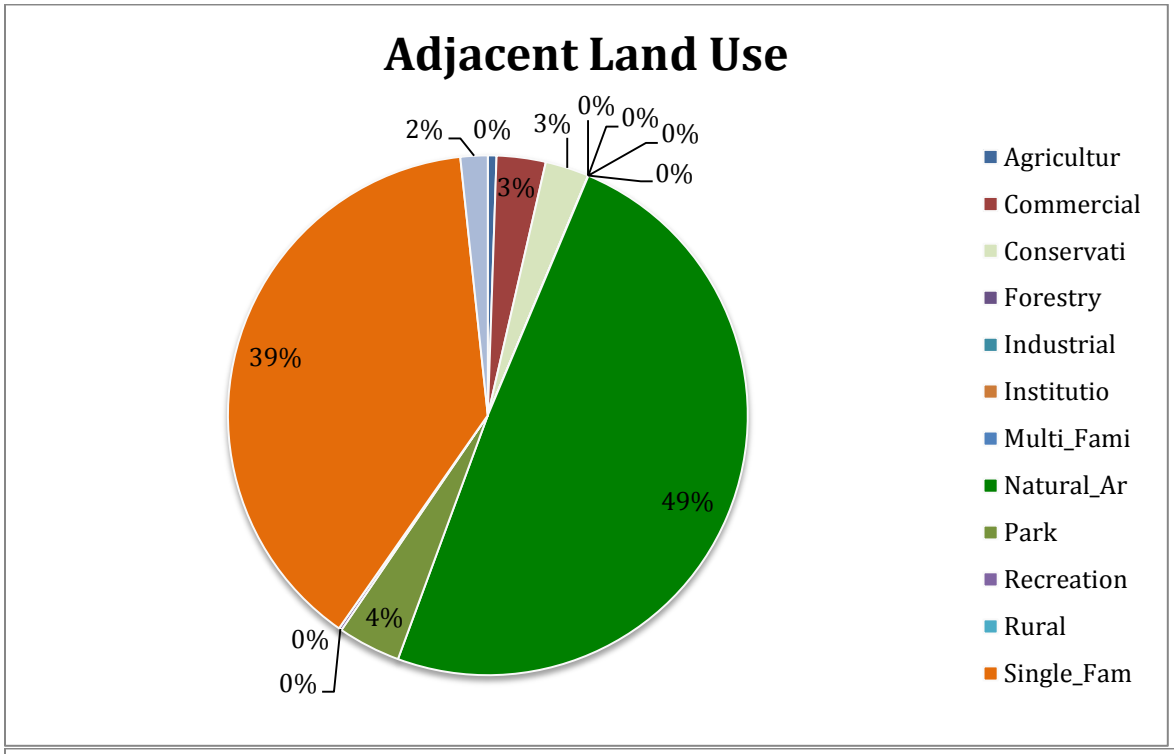
Table 3. Shore Types and Disturbed vs Natural

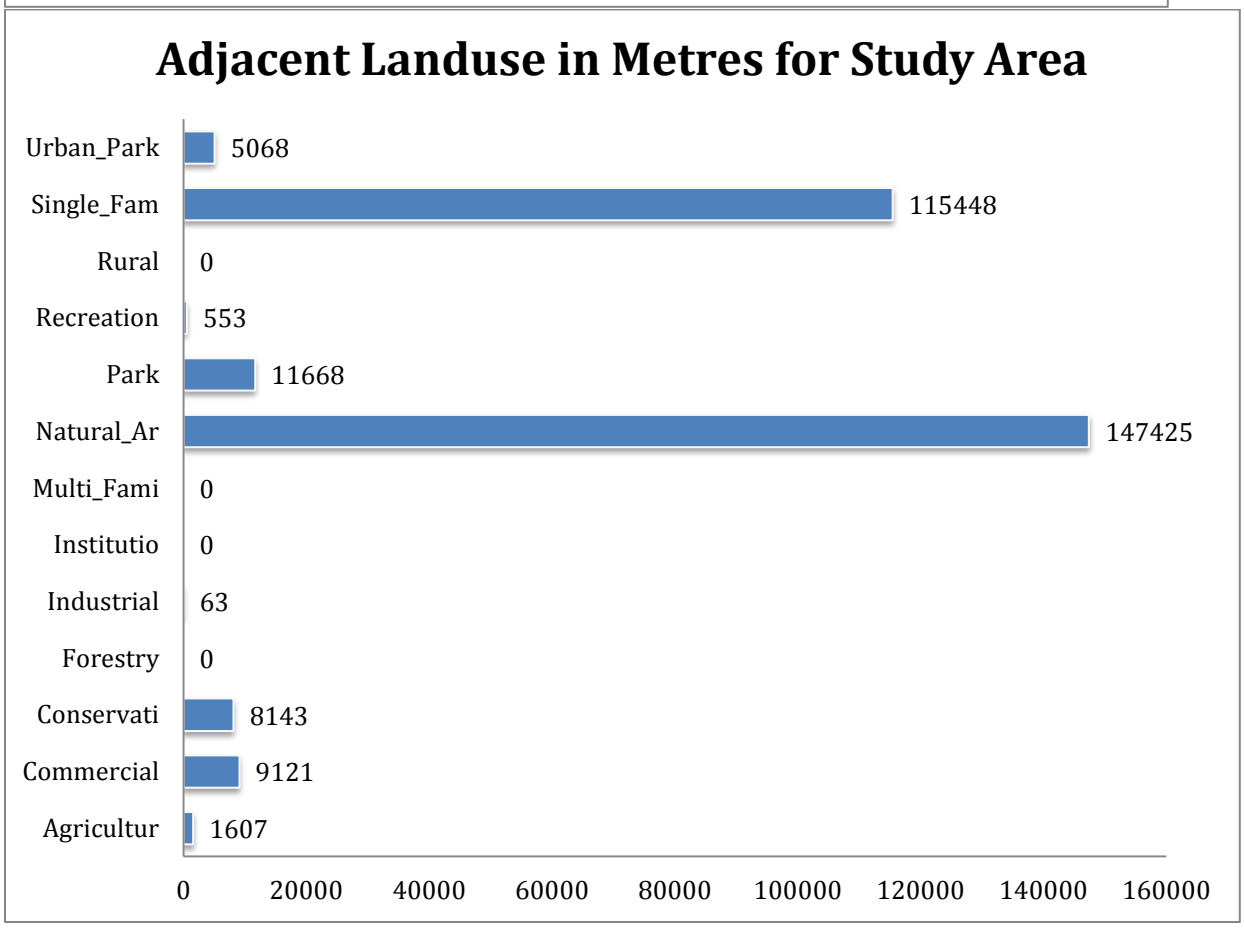
Shore Type	Disturbed (m)	Disturbed %	Natural (m)	Natural %
Wetland	6132.86	5.2	46292.14	25.6
Stream Mouth	0	0.0	3647	2.0
Sand	59348.41	50.2	100093.59	55.3
Rocky Shore	8147	6.9	4134	2.3
Other	27749.4	23.5	907.6	0.5
Gravel	16785.35	14.2	25858.65	14.3
Grand Total	118163.02	100.0	180932.98	100.0

Discussion

The majority of wetlands within the study area are still natural. Stream mouths also are natural. These stream mouths do not include man made drainage ditches and canals that fall into the Other category which is mostly disturbed. A large portion of the sand shoreline type in the Lake Winnipeg south basin has been disturbed. Most of the rocky shore has also been disturbed, as has the Other shore type. A large portion of gravel shore type has also been disturbed.

Figure 14. Adjacent Land Use





Discussion
The two charts above provide a breakdown of all identified shoreline land uses for the Lake Winnipeg south basin study area including all land uses listed in the data dictionary used for this project.

The previous graphs on land use showed only dominant land uses. The dominant land uses in the previous graph were selected from the highest percentage of a specific land use in each segment.

The two graphs above show all land uses along the shoreline in all segments without selecting a dominant land use per shoreline segment.

The difference between the dominant land use for a segment and the specific percentages per segment are due to ties in percentages. Also the 5% difference can be due rounding and estimates.

The two largest shoreline land uses in the study area are natural areas (49%) and single family dwellings, which includes cottages (39%). The next largest land use is park at 4%, commercial 3%, conservation at 2.7%. There is a small urban park percentage at 1.7% and even smaller agricultural land use at 0.5%.

SHIM Data Dictionary v2.6 – Shoreline Land Use
The agriculture land use field is the percentage of the shoreline, based upon the shore segments length, that is predominantly used for crop based agriculture or as active livestock range lands (i.e., extensive holding areas, large numbers of cattle). Livestock pastures that are not active rangelands (i.e., a few cows or horses) are not considered an agriculture land use (see rural).

The Commercial Land use field is the percentage of the shoreline, based upon the shore segments length, that is predominantly used for commercial purposes. Commercial purposes include retail, hotels, food establishments, marinas with fuel, stores, etc. Commercial areas tend to be evident along highly impacted shorelines.

The Conservation Land use field is the percentage of the shoreline, based upon the shore segments length, that is predominantly used for conservation of critical or important habitats. Examples of conservation shorelines include lands held by the Land Conservancy, biological reserves, protected parks, etc. Conservation lands do not occur on privately held shorelines, unless conservation covenants or other agreements are in place to protect areas in perpetuity.

The Forestry Land use field is the percentage of the shoreline, based upon the shore segments length, that is predominantly used for forestry. These areas are typically Crown Lands that are part of active cut blocks. Log Yards are not considered a Forestry Land use as they are Industrial.

The Industrial Land use field is the percentage of the shoreline, based upon the shore segments length that is predominantly used for industrial purposes. Examples of industrial purposes include log yards, processing facilities, lumber mills, etc. These shorelines are typically heavily impacted.

The Institutional Land Use field is the percentage of the shoreline, based upon the shore segments length ,that is predominantly used for institutional purposes. Examples of institutional land uses include schools, public libraries, etc.

The Multi-Family Land Use field is the percentage of the shoreline, based upon the shore segments length, that is predominantly used for multi-family residences. Multi-family developments are typically condominiums or town homes.

The Natural Areas Land use field is the percentage of the shoreline, based upon the shore segments length, that is predominantly natural crown lands. These areas do not occur in provincial parklands and cannot be privately held.

The Park Land Use field is the percentage of the shoreline, based upon the shore segments length, that is predominantly natural areas parklands. These parks areas can be provincial, federal, or municipal parks. These parks tend to be predominantly natural and are different from urban parks, which are used intensively for recreational purposes (e.g., public beaches).

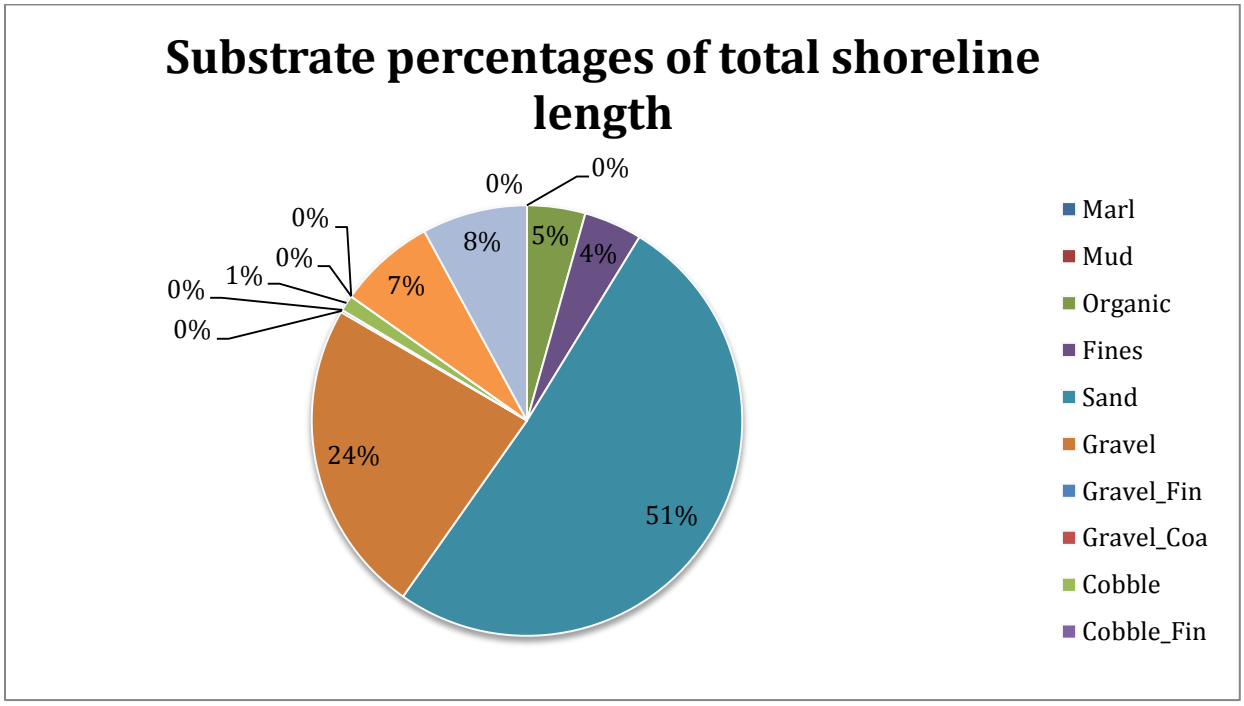
The Recreation Land Use field is the percentage of the shoreline, based upon the shore segments length, that is predominantly used for recreational purposes. Examples include public or private campgrounds, areas of known cabin rentals, etc. In some cases recreational shoreline may also be referred to as single family land uses, depending upon how much are known about them. Generally, if a shoreline contains privately held cabins that are rented out occasionally, these should be referred to as single family land uses rather than recreational.

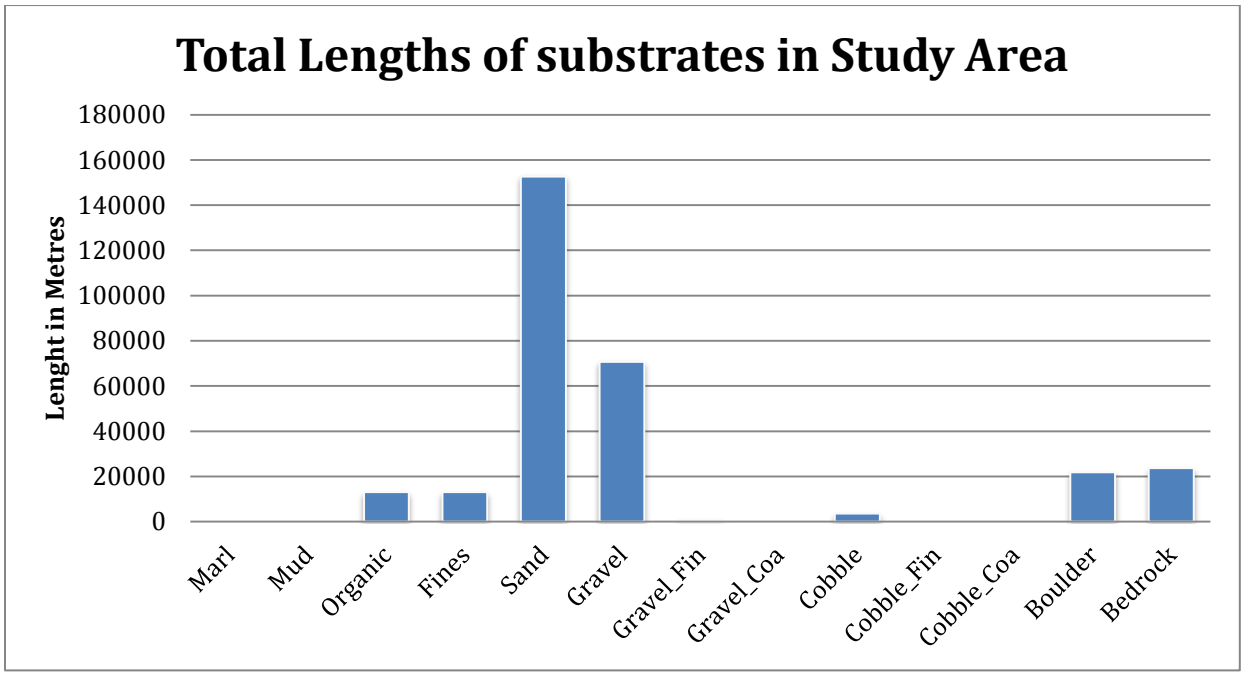
The Rural Land Use field is the percentage of the shoreline, based upon the shore segments length, that is predominantly used for rural purposes. These shorelines are typically large lots, private estates, or hobby farms. Differentiation between rural and single family land use can be difficult when lots are narrow but deep (i.e. appear dense on the shoreline but extend quite far back). When doubt exists between a rural designation and a single family land use, assessors should be consistent in their judgments and refer back to local government zoning or bylaws to help decide on the appropriate land use type.

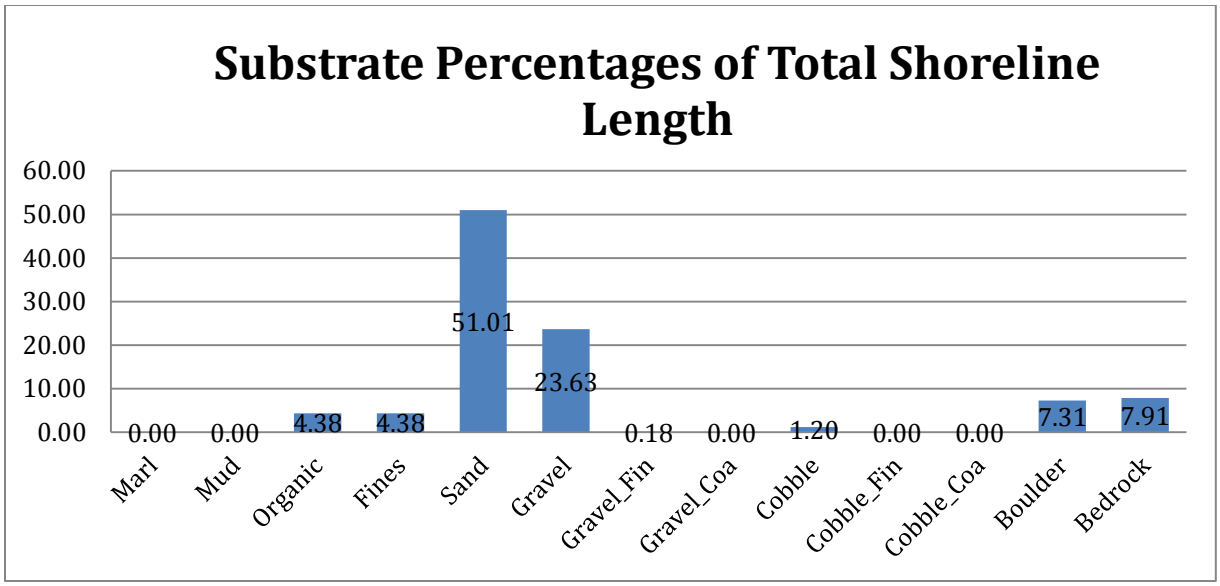
The Single Family Residential Land Use is the percentage of the shoreline, based upon the shore segments length, that is predominantly used for single family residential purposes. Typically, single family residential occurs in more densely developed areas. However, seasonal use cottages or cabins are considered single family residential areas if the dwellings have associated outbuildings, docks, and other features consistent with more densely developed areas. This approach has been taken for the Lake Winnipeg south basin summer 2011 project

The Urban Park Land Use is the percentage of the shoreline, based upon the shore segments length that is predominantly used as an urban park. Examples of this land use include public beaches, picnic areas, etc. Shorelines dominated by this land use tend to have limited riparian vegetation and contain extensive areas of turf in the under story.

Figure 15. Shoreline Substrates (Percentage and Lengths)







Discussion
The majority of the substrate in the study area is sand (51%), followed by gravel (24%), boulders (7.3%), bedrock (7.9%), organic (4.38%, and fine sand (4.38%).

SHIM Data Dictionary – Substrates
The *Marl* substrate field allows assessors to enter the relative percentage of marl occurring along the shoreline. Marl is a substrate that is typically white in color associated with clear lakes and consists of loose clay, precipitated calcium carbonate, mollusk/invertebrate shells, and other impurities.

The *Mud* substrate field allows assessors to enter the relative percentage of mud occurring along the segment. Mud is a substrate that is typically dark in color and consists of a mixture of silts, clays, and finely decayed organic material that is not typically discernible.

The *Organic* substrate field allows assessors to enter the relative percentage of organic materials that occur along the shoreline. Organic substrates are typically associated with wetland sites and consist of detritus material that is identifiable to some extent (e.g., sticks, leaves, etc.).

The *Fines* substrate field allows assessors to enter the relative percentage of fines that occur along the shoreline. Fines consist of silts and clays and these substrates are typically less than 1 mm in size. Fines are differentiated from mud because there is little to no organic content.

The *Sand* substrates field allows assessors to enter the relative percentage of sands that occur along the shoreline. Sands are any particle that contains granular particles visible to the naked eye. These particles are typically .06 to 2 mm in size.

The *Gravel* substrates field allows assessors to enter the relative percentage of gravels that occur along the shoreline. Gravels are particles that range from 2 mm to approximately 64 mm. Thus, they are the size of a lady bug to the size of a tennis ball or orange. This field should only be

used when substrates are difficult to identify and assessors cannot determine whether fine or course gravels.

The *Fine Gravel* substrates field allows assessors to enter the relative percentage of fine gravels that occur along the shoreline. Fine gravels are particles that are 2 mm to approximately 16 mm or the size of a ladybug to the size of a grape. This field should only be used when assessors have good visibility and can confidently identify fine gravels. If this field is used, the generally gravel category should not be used.

The *Coarse Gravel* substrates field allows assessors to enter the relative percentage of course gravels that occur along the shoreline. Coarse gravels are particles that are 16 mm to approximately 64 mm or the size of a grape to the size of a tennis ball or orange. This field should only be used when assessors have good visibility and can confidently identify coarse gravels. If this field is used, the generally gravel category should not be used.

The Cobble substrates field allows assessors to enter the relative percentage of cobbles that occur along the shoreline. Cobbles are particles that are 64 to 256 mm in size (Tennis ball to basketball).

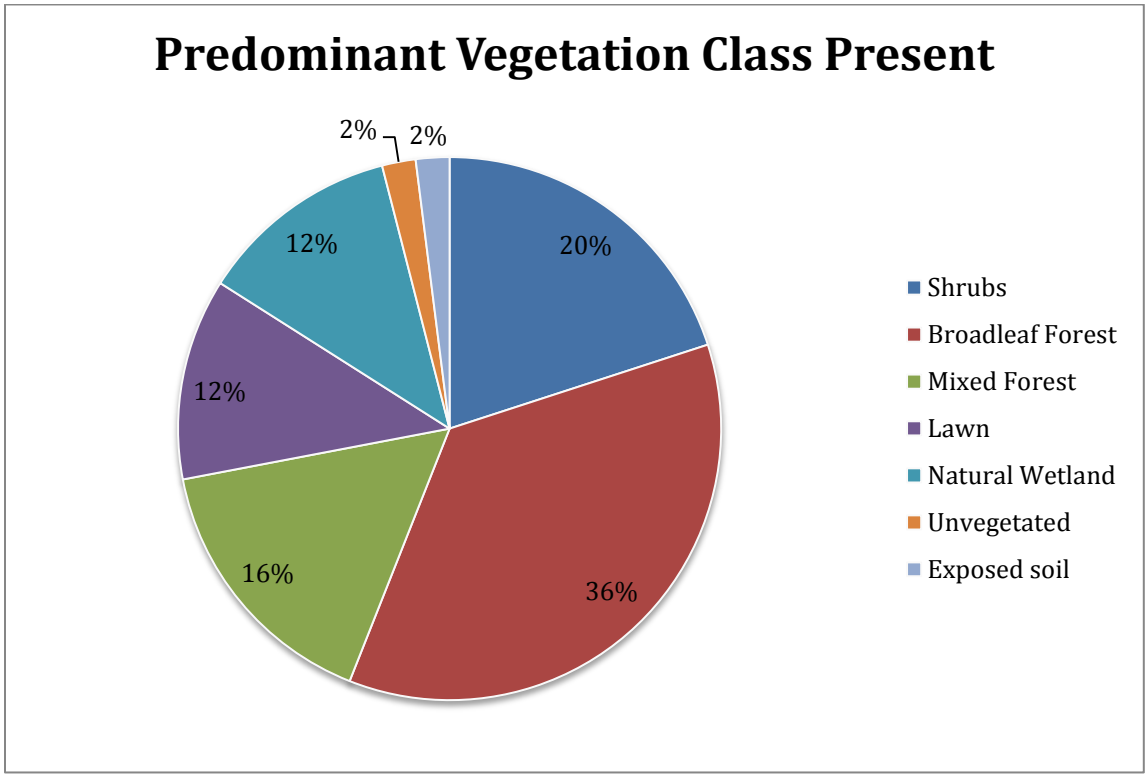
The *Fine Cobble* substrates field allows assessors to enter the relative percentage of fine cobbles that occur along the shoreline. Fine cobbles are particles that are 64 to 128 mm in size (tennis ball to coconut). This field should only be used when assessors have good visibility and can confidently identify fine cobbles. If this field is used, the general cobble category should not be used.

The *Coarse Cobble* substrates field allows assessors to enter the relative percentage of course cobbles that occur along the shoreline. Coarse cobbles are particles that are 128 to 256 mm in size (coconut to basketball). This field should only be used when assessors have good visibility and can confidently identify coarse cobbles. If this field is used, the general cobble category should not be used.

The *Boulder* substrates field allows assessors to enter the relative percentage of boulders that occur along the shoreline. Boulders are particles that are greater than 256 mm in size (bigger than a basketball). These substrates cannot typically be lifted by one person as they are too heavy.

The *Bedrock* substrates field allows assessors to enter the relative percentage of bedrock that occurs along the shoreline. Bedrock is consider any rock where blocks are larger than 4 m or is solid, un-weathered underlying rock.

Figure 16. Predominant Riparian Vegetation



Discussion

The predominant vegetation classes present along the south basin shoreline were; broadleaf forest (36%), shrubs (20%), mixed forest (16%), lawn (12%), natural wetland (12%), unvegetated (2%) and exposed soil (2%).

SHIM Data Dictionary 2.6 – Vegetation Band One

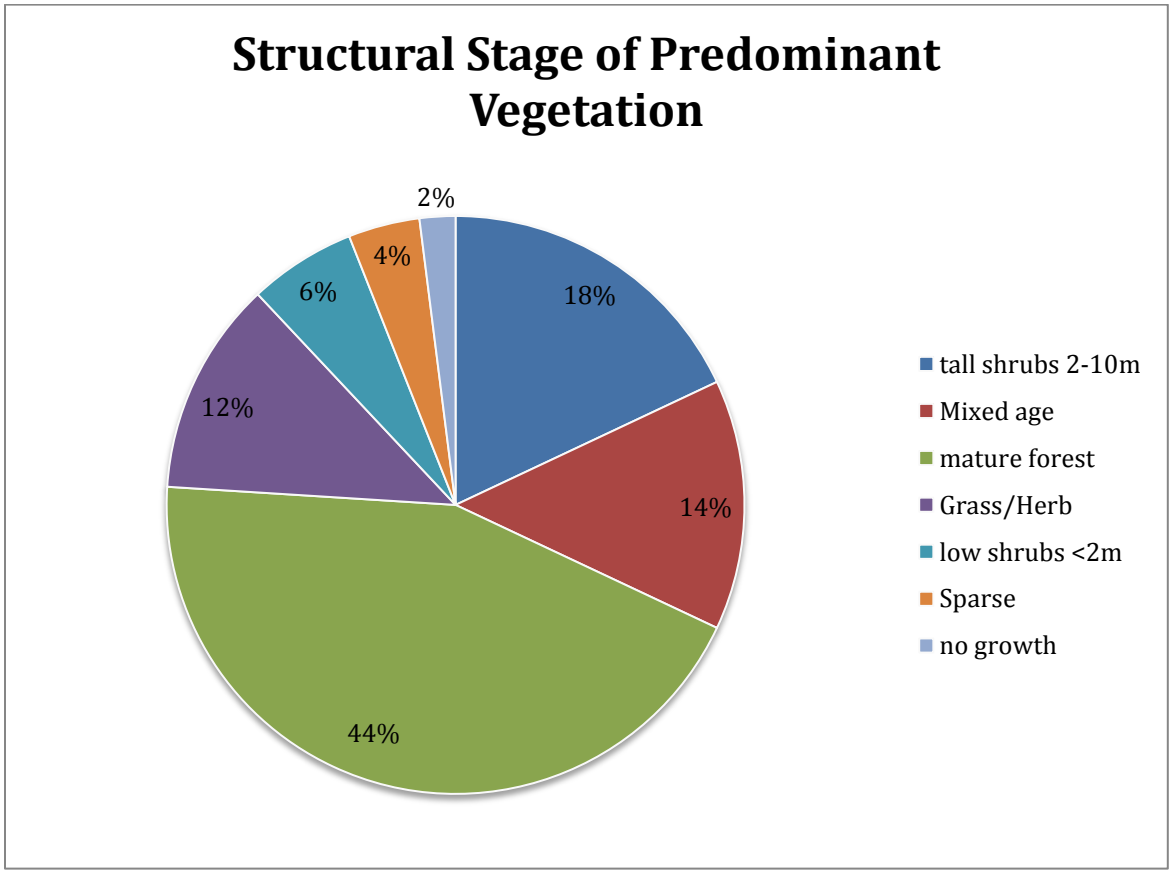
The Vegetation Band One Land Cover Class is a description of the predominant vegetation class present. Categories are largely derived from the Sensitive Habitat Inventory and Mapping Module 4. The Coniferous Class occurs where tree cover is at least 20% of the shore zone area and at least 80% of the trees are coniferous. The Broadleaf Class occurs where the tree cover is at least 20% and at least 65% of the trees are broadleaf or deciduous. The Mixed Forest Class occurs where tree cover is at least 20% and there are no more than 80% coniferous trees and no more than 65% broadleaf trees. The Shrubs Class occurs where tree coverage is less than 10% and there shrubs cover at least of 20%. Shrubs are defined as multi-stemmed woody perennial plants. The Herbs / Grasses Class occur where there is at less than 10% tree coverage and less than 20% of shrubs. The Exposes Soil Class occurs where recent disturbance, either anthropogenic or natural, has occurred and mineral soils are exposes.

The Landscape Class refers to urbanized areas where most natural vegetation has been replaced by at least 30% coverage of ornamental trees, shrubs, and other vegetation. The Lawn Class occurs in urbanized areas where turf grasses cover at least 30% of the shore zone area

and landscaping with ornamental shrubs or trees is less than 30% coverage. The Natural Wetland Class occurs where shore marshes dominate the shore zone area and they have not been significantly influenced by human disturbance. The Disturbed Wetland Class occurs where shore marshes predominate the shore zone area and they have experienced significant disturbance (i.e., greater than 30%).

The Row Crops Class occurs in agricultural areas where crops are growing. If sites are agricultural, but are not used for row crops (e.g., pasture lands), they should be described as Herbs/Grasses and comments should be used to indicate the agricultural nature of the shore segment. Un-vegetated Sites occur where there is less than 5% vegetation cover and at least 50% of the vegetation cover is mosses or lichens. Un-vegetated sites tend to occur on rocky, exposed shorelines.

Figure 17. Structural Stage of the Dominant Vegetation Along the Shoreline



Discussion

The predominant structure of vegetation observed along the south basin shoreline segments was; mature forest (44%), tall shrubs (18%), mixed age (14%), grass/herb (12%), low shrubs (6%), sparse (4%) and no growth (2%).

SHIM Data Dictionary 2.6 – Vegetation Band One Stage

The Vegetation Band One Stage is a description of the structural stage of the dominant vegetation in the shoreline segment. Categories are largely derived from the Sensitive Habitat Inventory and Mapping Module 3 and the Field Manual for Describing Terrestrial Ecosystems.

The Sparse Stage describes sites that are in the primary or secondary stages of succession, with vegetation consisting mostly of lichens and mosses, and the total shrub coverage is less than 20% and tree coverage is less than 10%.

The Grass Herb Stage describes sites where shore zones are dominated by grasses and herbs, as a result of persistent disturbance of natural conditions (e.g., grasslands).

The Low Shrubs stage describes sites that are dominated by shrubby vegetation less than 2 m in height.

The Tall Shrubs Stage is dominated by vegetation that is 2 to 10 m in height and seedlings and advance regeneration may be present.

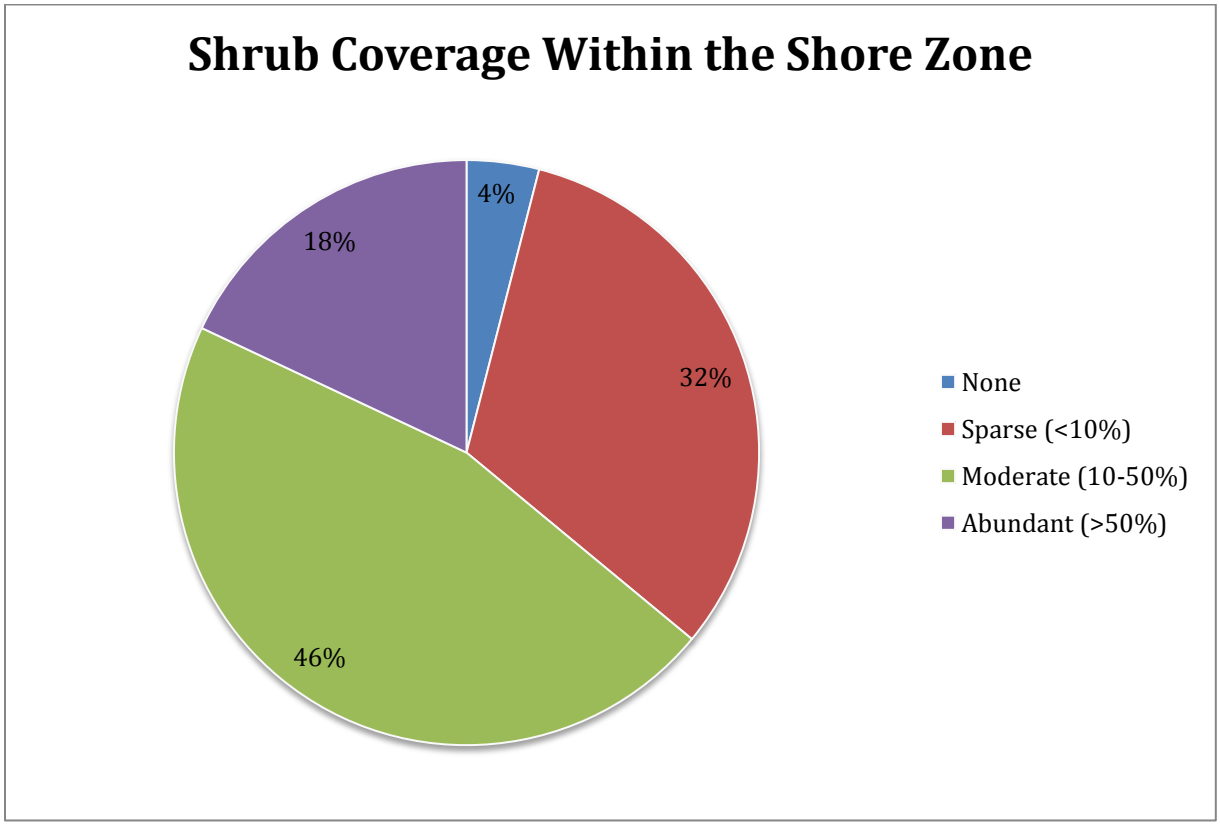
The Pole / Sapling Stage describes sites that contain trees greater than 10 m in height, typically densely stocked, and there is little evidence of self-thinning or vertical structure.

The Young Forest Stage describes sites that are typically less than 40 years old (but could be as great as 50 to 80 years depending upon the forest community), self-thinning is evident, and the forest canopy has begun to differentiate into distinct layers.

The Mature Forest Stage describes sites that are typically 40 to 80 years old (but could be as high as 140 years), and the under story is well developed with a second cycle of shade trees.

The Old Forest Stage describes sites that are typically greater than 80 years old with stands that are structurally complex. Old Forests contain abundant coarse woody debris at varying stages of decay. Old Forests are at least 80 years in age, but may be as old as 250 years and should be considered relative to the forest community and shoreline ecosystems being assessed.

Figure 18. Shrub Coverage Within the Shore Zone



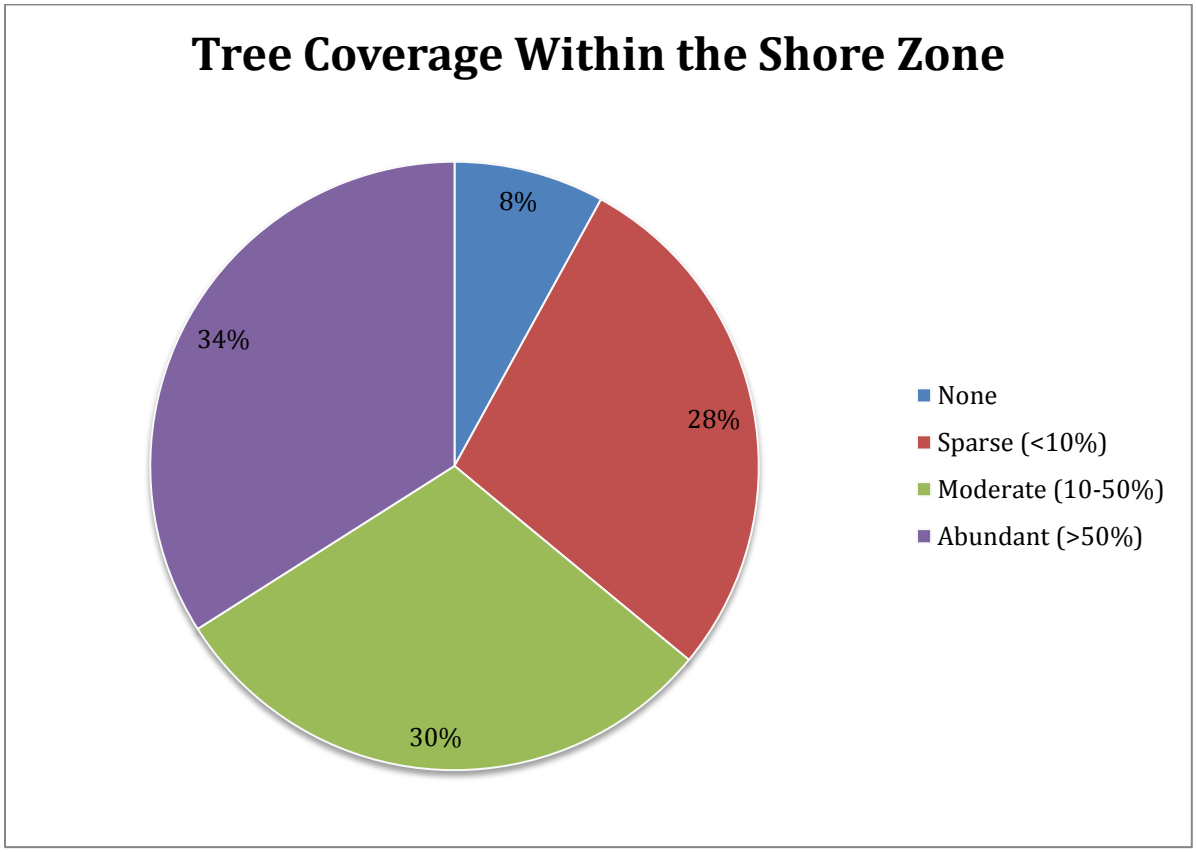
Discussion

The shrub coverage observed was; moderate (46%), sparse (32%), abundant (18%) and none (4%).

SHIM Data Dictionary 2.6 – Shrub Coverage

The Shrub Coverage categorically describes shrub coverage within the shore zone. Sparse sites have less than 10% shrub coverage. Moderate shrub coverage occurs on sites that have between 10 to 50% coverage. Abundant shrub coverage occurs on sites that have greater than 50% shrub coverage.

Figure 19. Tree Coverage Within the Shore Zone



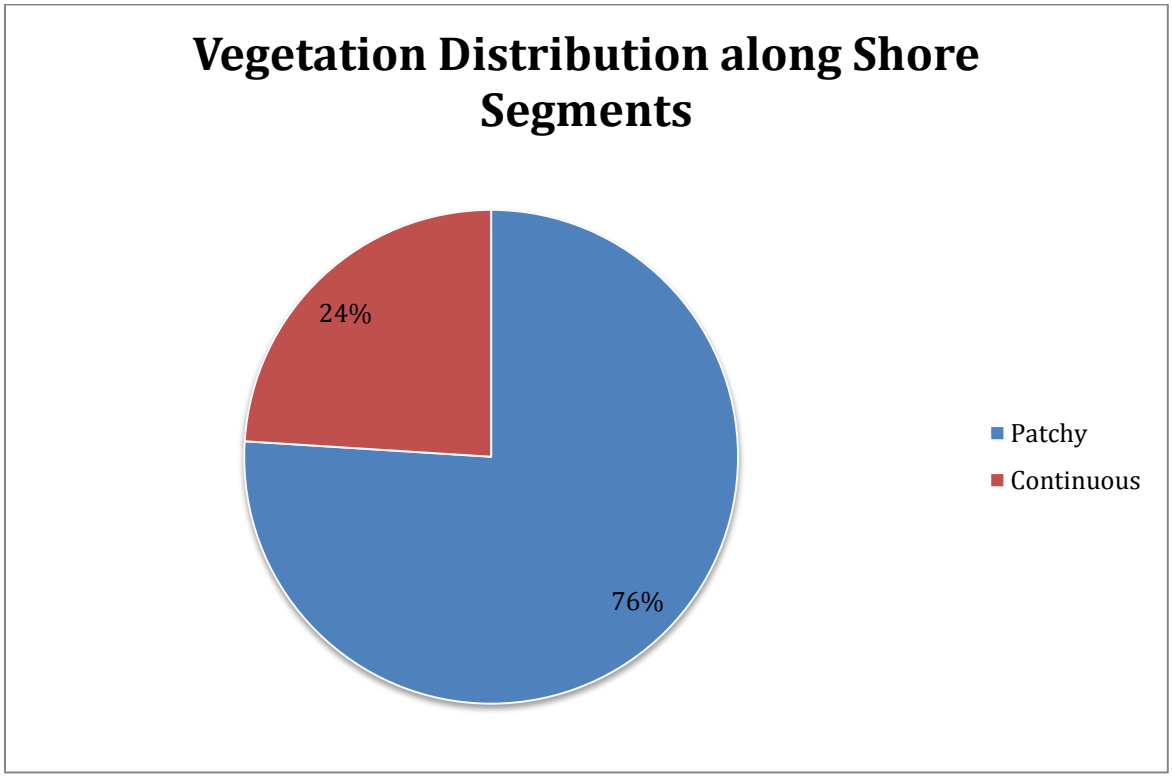
Discussion

The tree cover observed was; abundant (34%), moderate (30%), sparse (28%) and none (8%).

SHIM Data Dictionary 2.6 – Tree Coverage

The Tree Coverage categorically describes Tree coverage within the shore zone. Sparse sites have less than 10% Tree coverage. Moderate Tree coverage occurs on sites that have between 10 to 50% coverage. Abundant Tree coverage occurs on sites that have greater than 50% Tree coverage.

Figure 20. Vegetation Distribution along Shore Segments



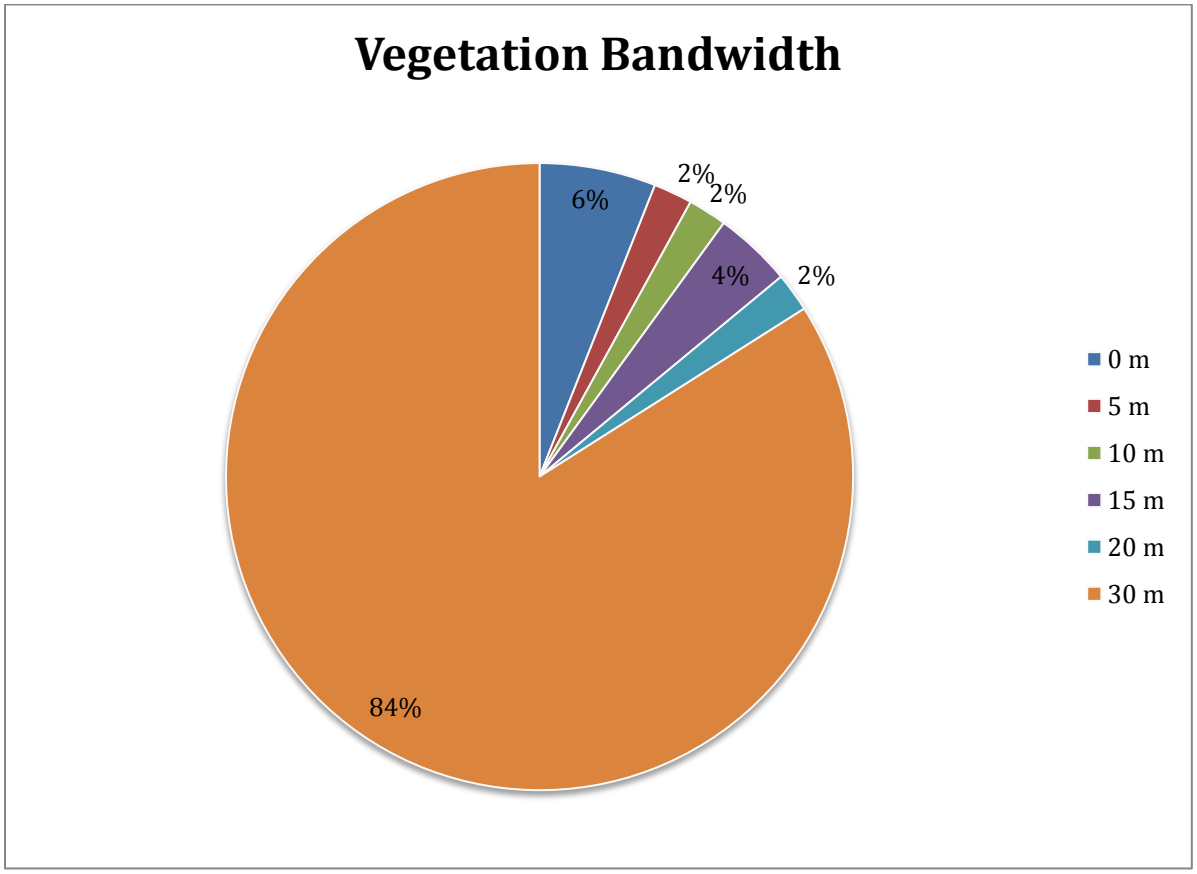
Discussion

The vegetation distribution observed in the study area was patchy (76%) and continuous (24%) over the entire length of shoreline.

SHIM Data Dictionary 2.6 – Vegetation Band Distribution

The Distribution field is used to describe whether the vegetation band described is continuous along the entire shore segment. Categories include Continuous and Patchy (for sites where the dominant vegetation band occurs in patches along the segment). An example of a patchy distribution is a shore segment where most areas are extensively landscape, with the exception of a few shore lots which remain relatively natural. In this case, the dominant landscaped area would be described and comments would be used to identify residual natural areas.

Figure 21. Vegetation Bandwidth



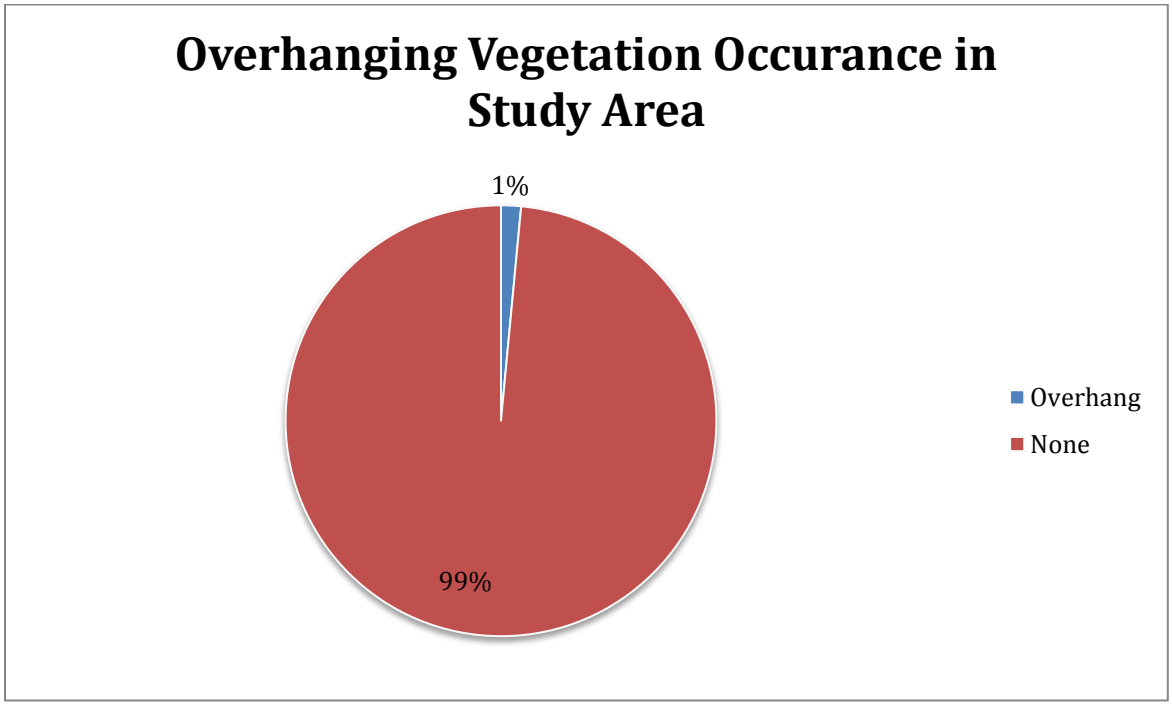
Discussion

The width of the vegetation observed in the study area was; 30m (84%), 0 m (6%), 15 m (4%), 10 m (2%), 5 m (2%) and 20 m (2%).

SHIM Data Dictionary 2.6 – Vegetation Bandwidth

The Vegetation Band One Bandwidth field is used to provide an estimate of the approximate width of the band being described. In cases where bandwidth varies along the segment, a representative width should be used to describe the shore segment. The intent of this field is to provide a general description of the width of the vegetation band that is being described and users of the database need to consider this when assessing data within the database.

Figure 22. Vegetation Overhanging

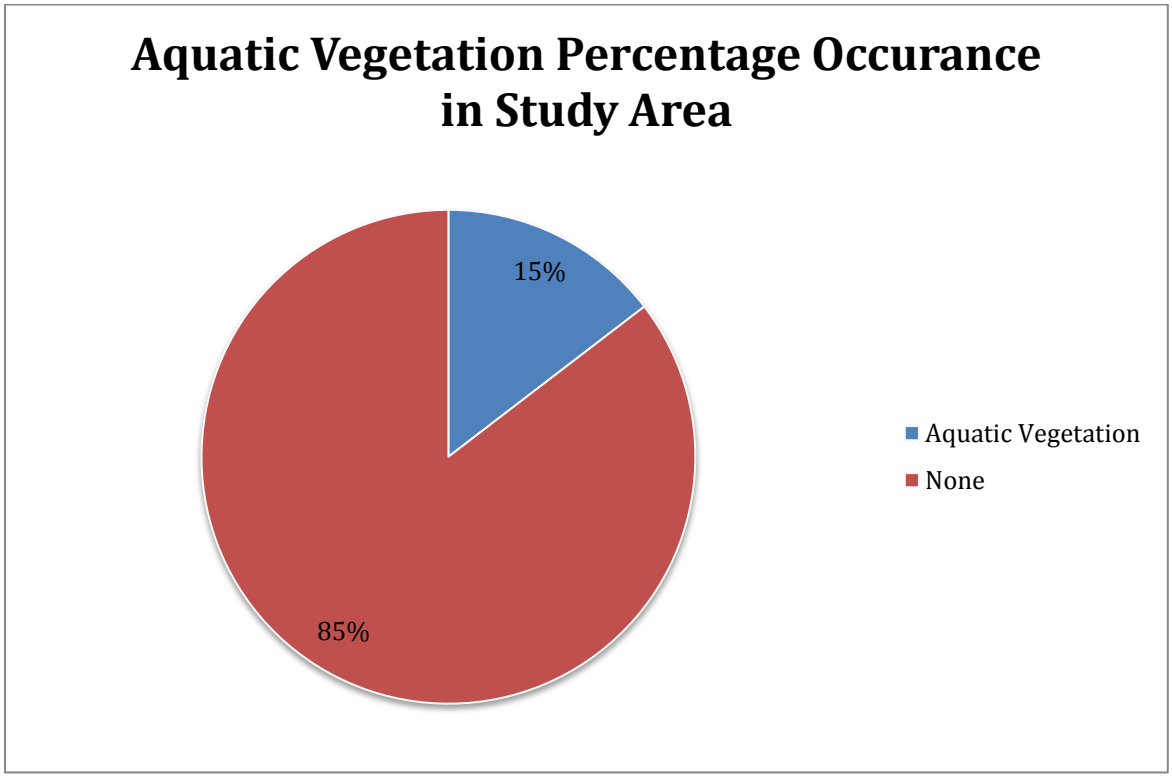


Discussion
Overhanging vegetation was not observed in the study area except for a small portion of the total (1%).

SHIM Data Dictionary 2.6 – Overhanging Vegetation

The Overhanging Vegetation field is used to describe the percentage of the shore segment length that contains significant overhanging vegetation. Overhanging vegetation should be considered as if the lake was at full pool or the mean annual high water level.

Figure 23. Aquatic Vegetation Presence in Study Area



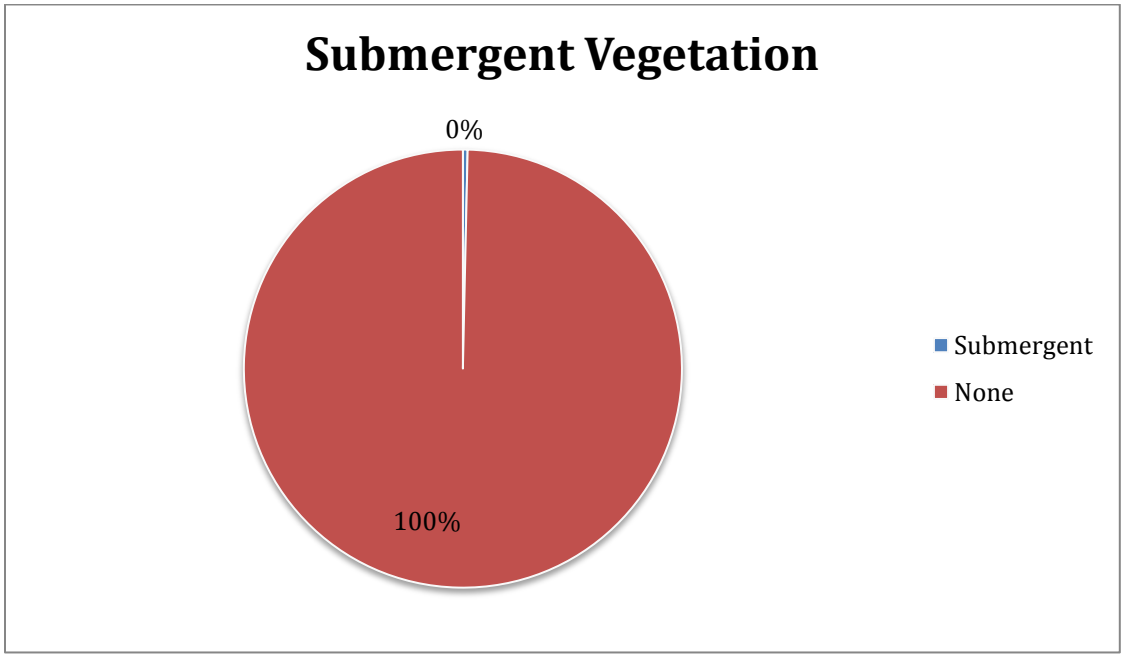
Discussion

Aquatic vegetation was observed in 15% of the study area.
Aquatic vegetation was observed in segments; 1, 2, 4, 10, 13A, 13B, 13C, 14, 15, 25, 27, 30, 32, 36, 40 and 40A.

SHIM Data Dictionary 2.6 – Aquatic Vegetation

The Aquatic Vegetation field is used to describe the percentage of the shoreline that contains emergent, submergent, and floating aquatic vegetation.

Figure 24. Submergent Vegetation Presence in Study Area



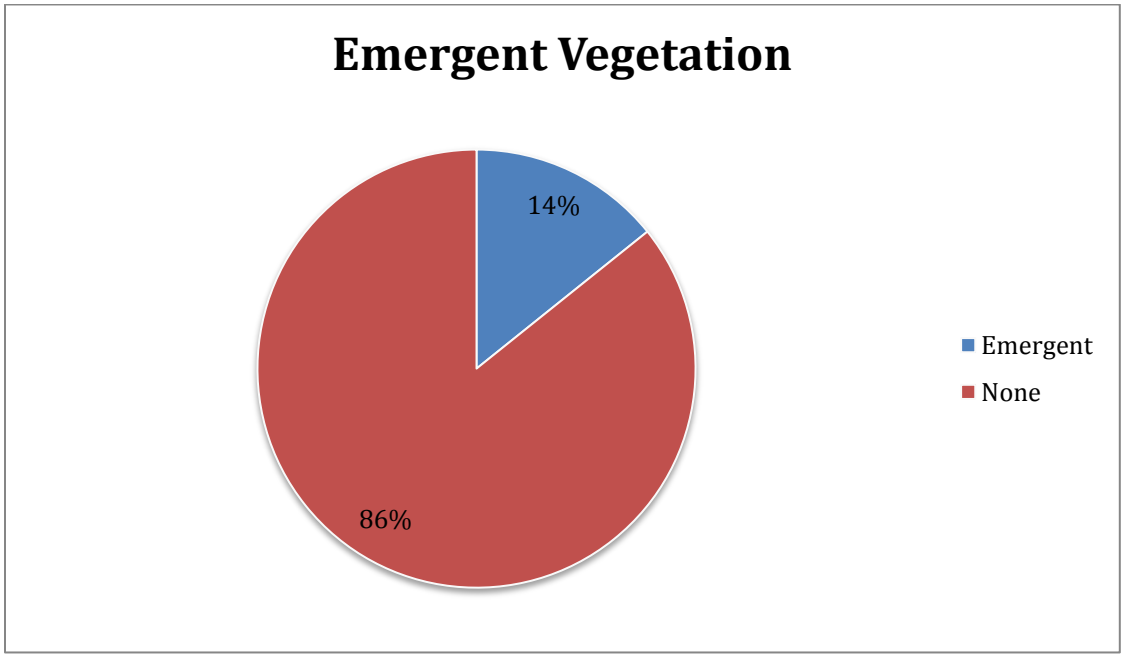
Discussion

There is only an estimated 1034 metres of submergent vegetation in the Lake Winnipeg south basin study area of 299 066 metres. This comes to less than 1% of the total study area shoreline. Submergent vegetation occurred in segments 13A, 13C, 14, 15, 23, 25, and 43.

SHIM Data Dictionary 2.6 – Submergent Vegetation

The Submergent Vegetation field is used to describe the percentage of the shoreline that contains submergent vegetation. Submergent vegetation includes species such as milfoil, Potamogeton spp., etc.

Figure 25. Emergent Vegetation Presence in Study Area



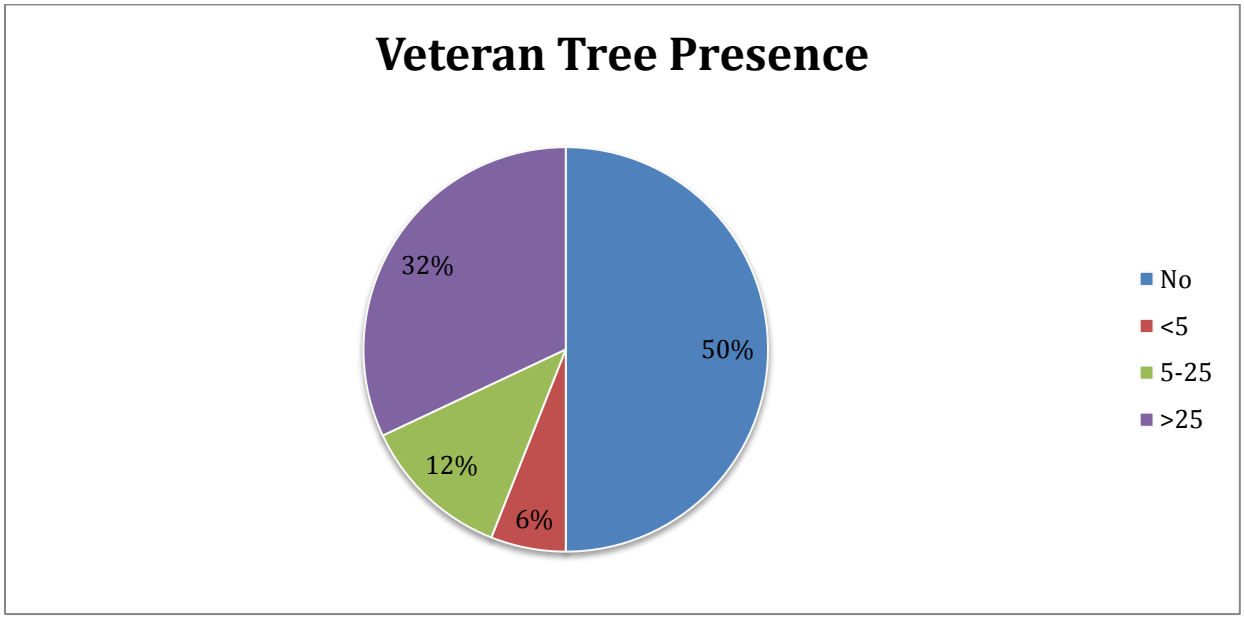
Discussion

Emergent vegetation was observed along 14% of the study area.
Emergent vegetation occurred in segments; 1, 2, 4, 10, 13A, 13C, 14, 15, 23, 25, 27, 30, 32, 36, 40 and40A.

SHIM Data Dictionary 2.6 – Emergent Vegetation

The Emergent Vegetation field is used to describe the percentage of the shoreline segment that contains emergent vegetation. Emergent vegetation includes species such as cattails, bulrushes, varies sedges, etc.

Figure 26. Veteran Trees Presence in Study Area



Discussion

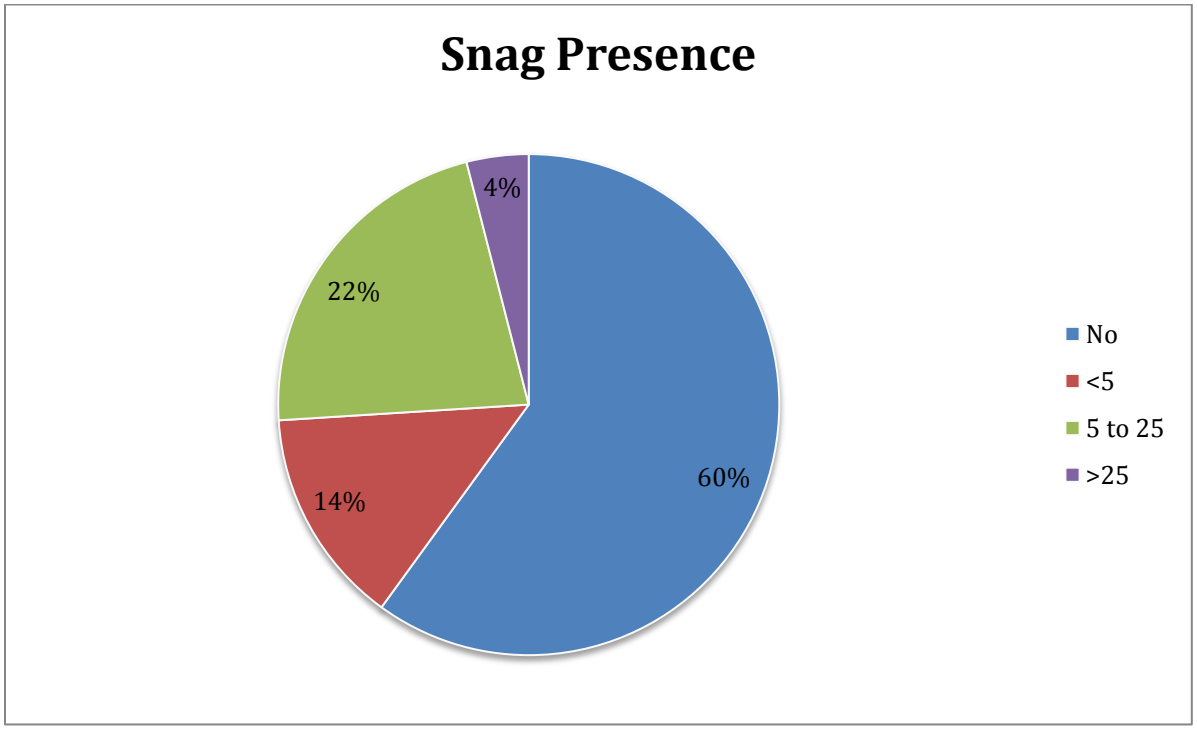
Veteran trees were not present in 50% of the study area , however 32% of the study area segments had more than 25 veteran trees, 12% had between 5 and 25 veteran trees, 6% had fewer than 5 veteran trees.

The highest number of veteran trees observed occurred in segments; 3, 4, 5, 6, 7, 18, 23, 25, 28, 36, 37, 39, 44, 45, 46 and 47.

SHIM Data Dictionary 2.6 – Veteran Trees

The Veteran Tree field is a categorical field to describe the number of veteran trees that occur along the shore segment. Veteran trees are defined as a tree that is significantly older than the dominant forest cover and provides increased structural diversity. Categories include No, Less than 5 Trees, 5 to 25 Trees, and Greater than 25 trees.

Figure 27. Snag Presence in Study Area



Discussion

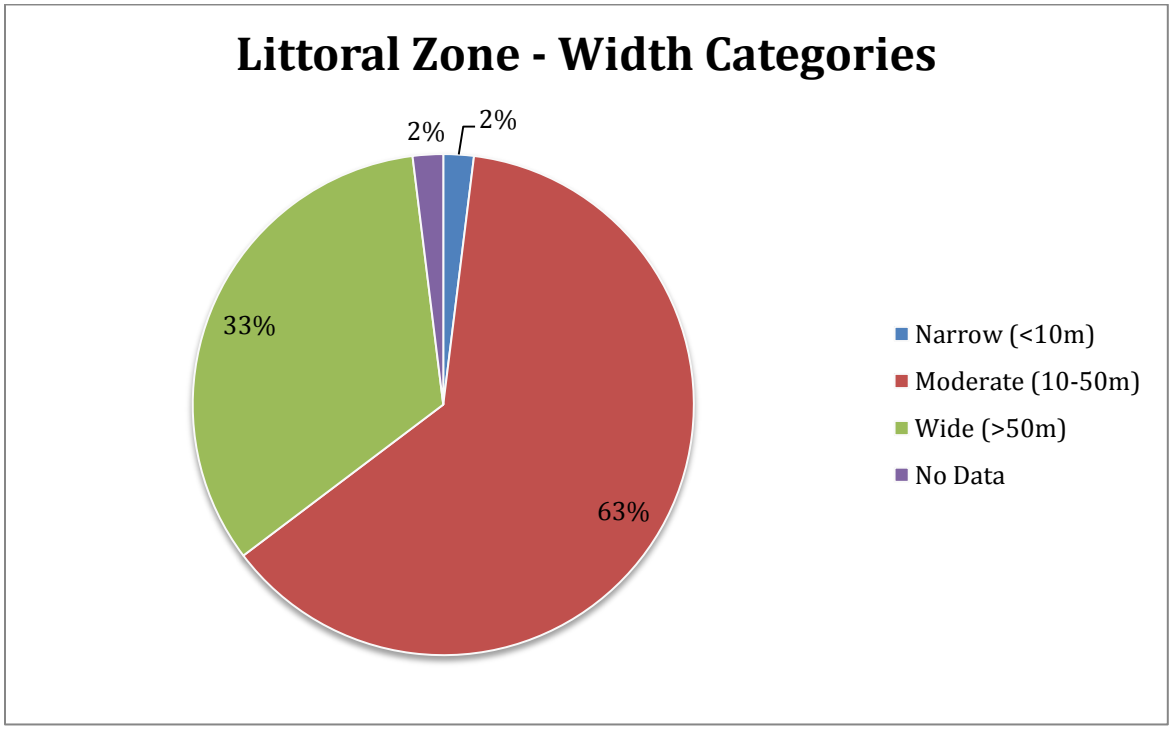
Snags were not observed in 60% of the study area segments. However 22% of the study area had between 5 and 25 snags per segment, 14% had less than 5 snags and 4% had more than 25 snags.

Highest number of snags occurred in segments; 18, 20, 21, 22, 23, 25, 28, 37, 42, 44, 45,46 and 47.

SHIM Data Dictionary 2.6 – Snags

The Snags field is a categorical field to describe the number of dead standing snags that occur along the shore segment. Snags are defined as dead standing trees that provide increased structural diversity. Categories include No, Less than 5 Trees, 5 to 25 Trees, and Greater than 25 trees.

Figure 28. Littoral Zone Width Categories



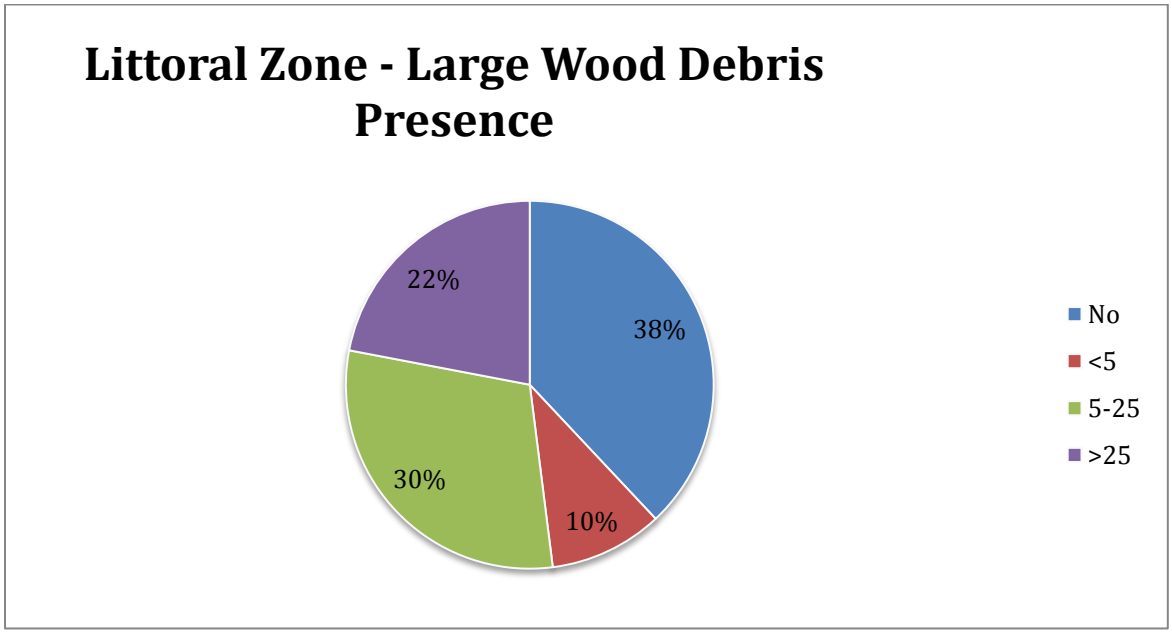
Discussion
The width of the littoral zones found in the study area ranged from; narrow (2%), moderate (63%), wide (33%) and a few locations with no data (2%).

SHIM Data Dictionary 2.6 – Littoral Zone Width

The Littoral Zone Width Category provides a general classification of the littoral zone. Wide littoral zones are greater than 50 m. Moderate littoral zones are 10 to 50 m in width, and Narrow littoral zones are less than 10 m wide.

The littoral zone is considered the near shore area where sunlight penetrates all the way to the sediment and allows aquatic plants (macrophytes) to grow.

Figure 29. Littoral Zone Large Woody Debris Presence



Discussion

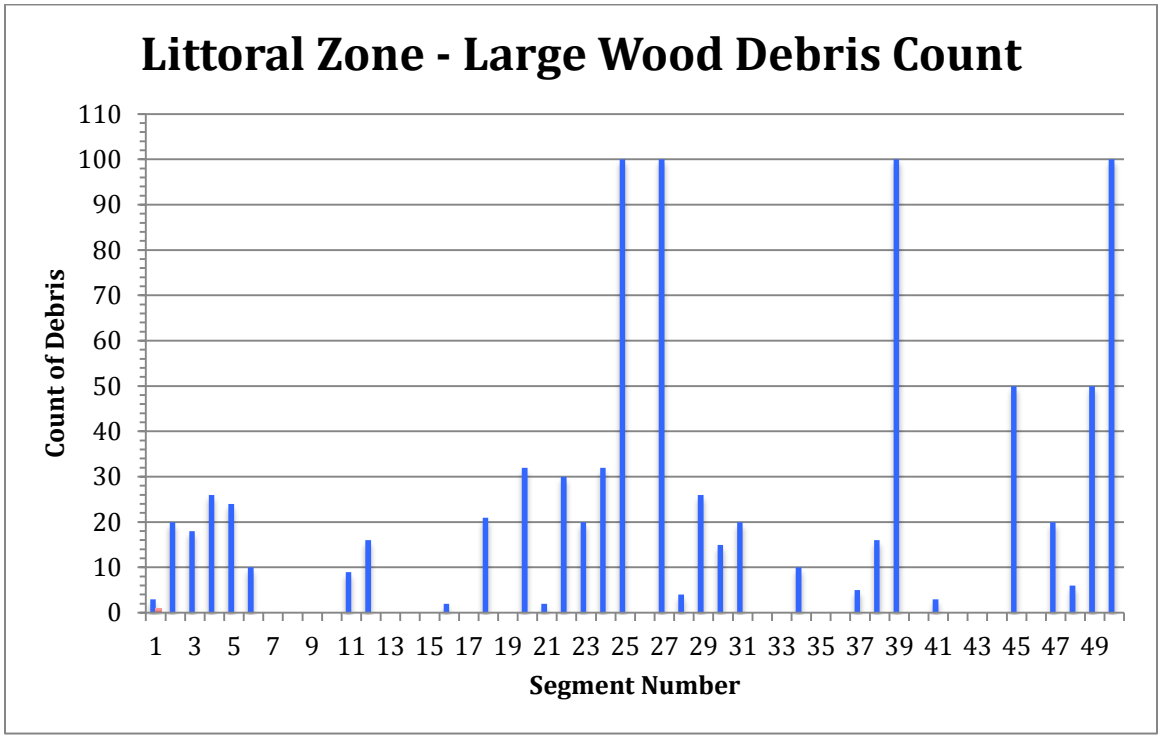
The presence of large woody debris was observed along the study area segments. There were no large wood debris observed in 38% of the segments, less than 5 observed in 10% of the segments, between 5 and 25 observed in 30% of segments, and more than 25 observed in 22% of segments.

The segments with the largest volume of woody debris observed were; 4, 18, 20, 22, 23, 25, 27, 37, 42, 46 and 47.

SHIM Data Dictionary 2.6 – Littoral Zone Large Woody Debris Presence

The Large Woody Debris (LWD) presence field allows assessors to indicate whether LWD is present along the segment. Categories include <5 Pieces, 5 to 25 Pieces, and >25 Pieces.

Figure 30. Littoral Zone – Large Woody Debris Count



Discussion

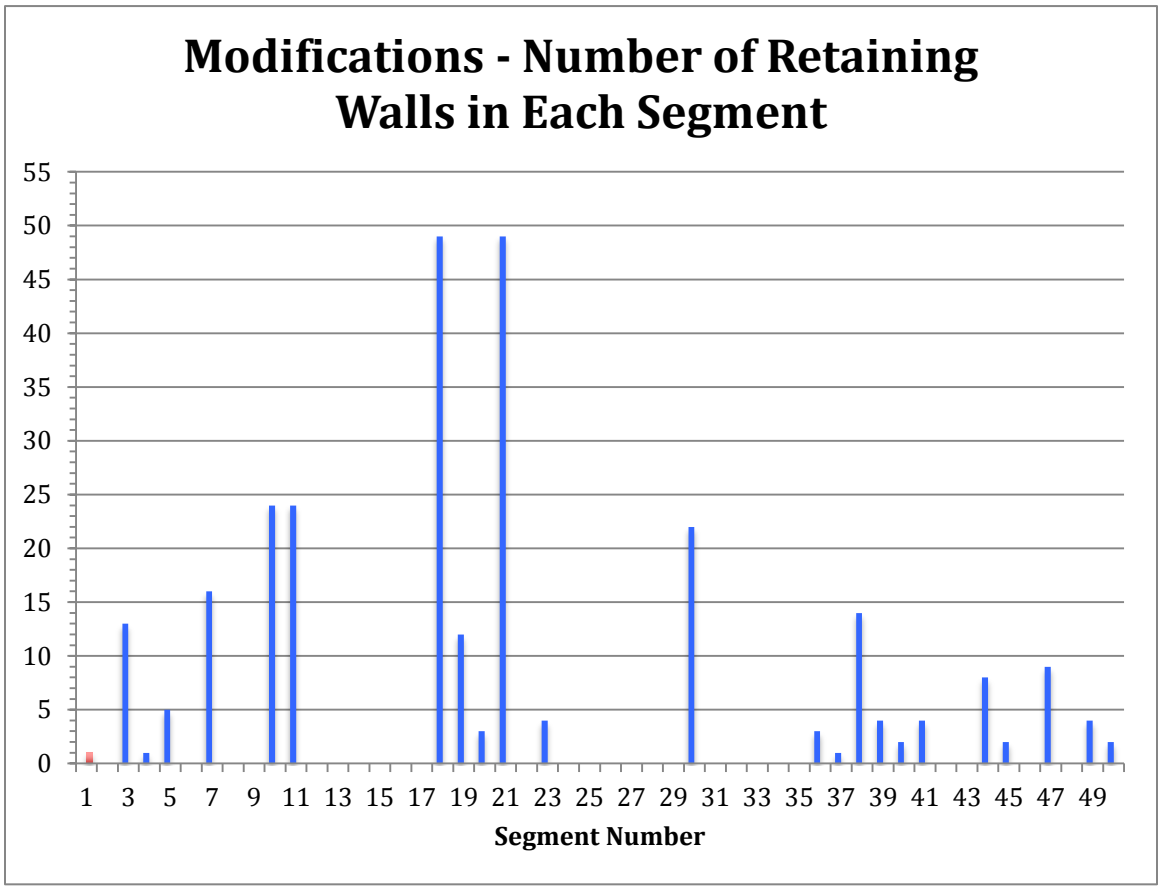
The segments with the highest observed count of woody debris were; 23, 25, 37, 42, 46 and 47.

SHIM Data Dictionary 2.6 – Littoral Zone Large Woody Debris Count

The Large Woody Debris count field allows assessors to enter the total number of large woody debris pieces counted along the shore segment. Only significant pieces of large woody debris, which are contributing to fish habitat, should be counted. The chart lists those Lake Winnipeg south basin shoreline segments where LWD was visible, or counted.

Modifications to Shoreline

Figure 31. Retaining Wall Count



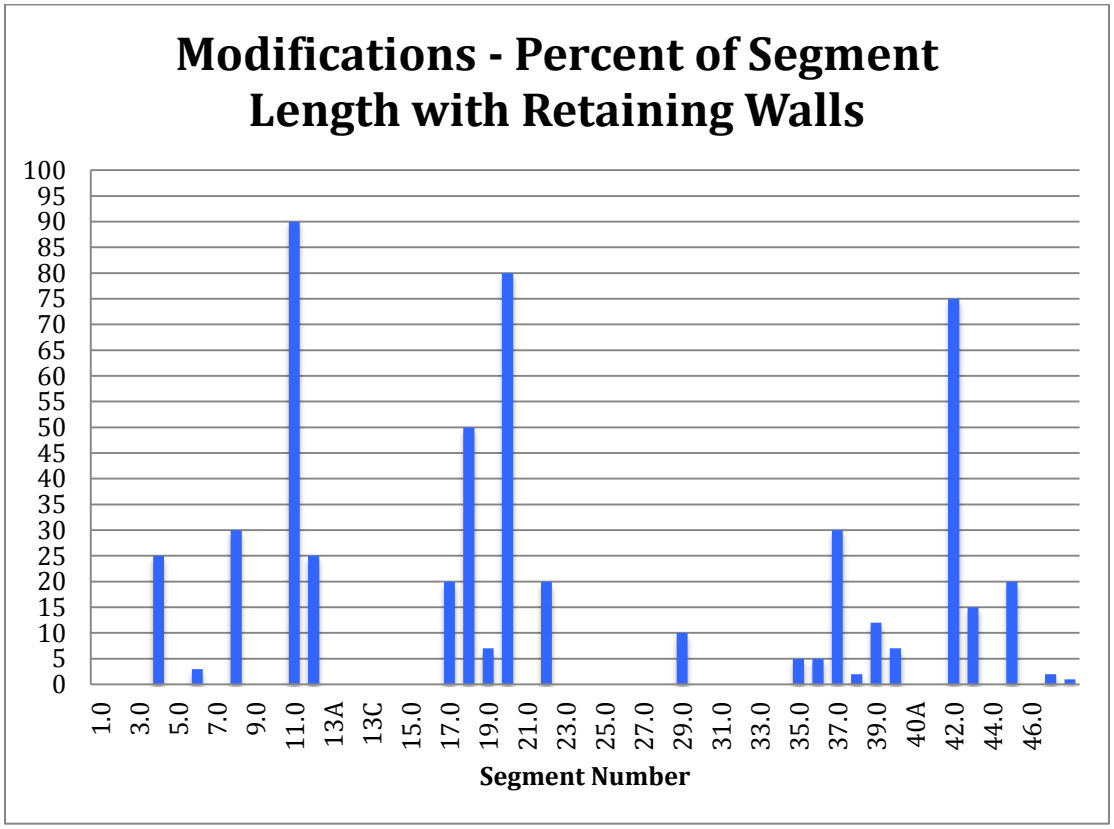
Discussion

The segments with the highest number of retaining walls observed were; 3, 7, 10, 11, 16, 17, 19, 28 and 36.

SHIM Data Dictionary 2.6 – Retaining Wall Count

The Retaining Wall count field is the total number of retaining walls occurring along the shoreline segment. Retaining walls should only be counted if they are within 5 to 10 m of the high water level. Retaining walls must have a vertical element that is greater than 30 cm and must be retaining earth to some degree. On steep sloping sites, more than one retaining wall may be present (i.e., the property is tiered). In these cases each retaining wall is counted.

Figure 32. Retaining Wall Modification as a Percent of Segment Length



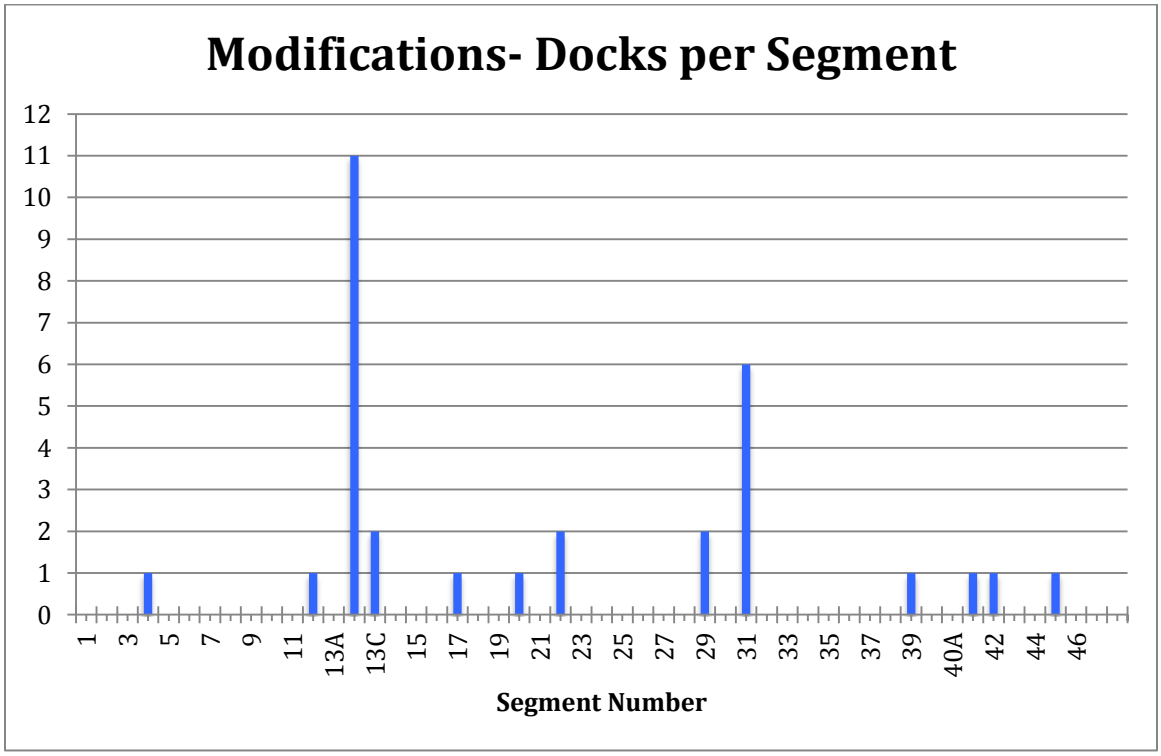
Discussion

The segments with 20% or greater of their length behind retaining walls are; 3, 7, 10, 11, 16, 17, 19, 21, 36, 41 and 44.

SHIM Data Dictionary 2.6 – Percent Retaining Wall

The Percent Retaining Wall field indicates that approximate percentage of the shore segment length where retaining walls occur.

Figure 33. Modification of Shoreline in the form of Docks

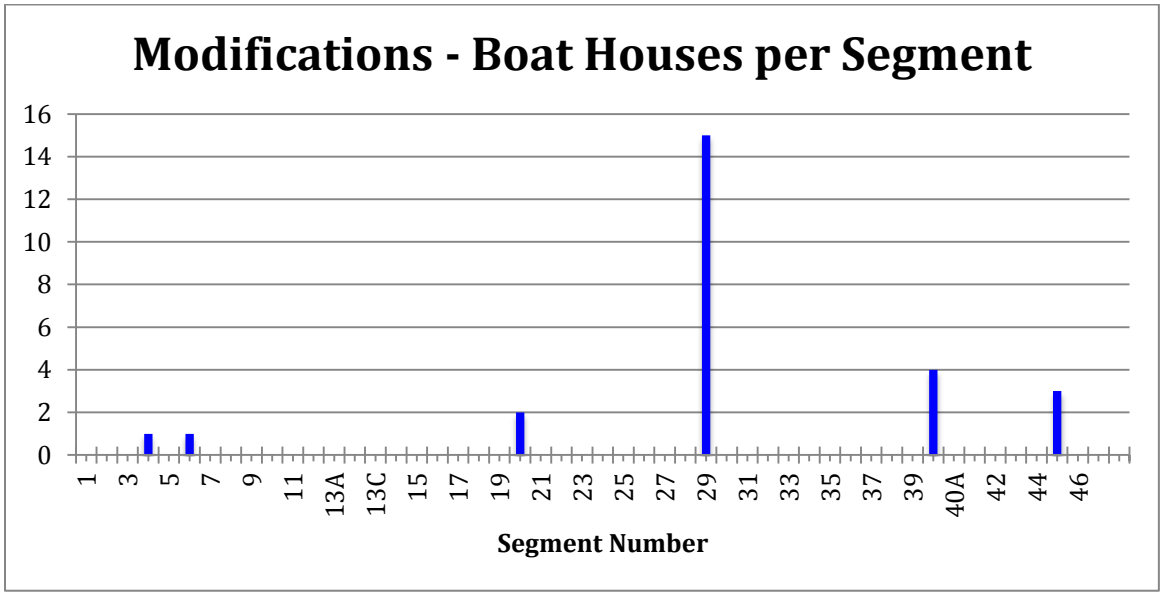


Discussion
The segments with the highest count of docks are; 13A, and 30.

SHIM Data Dictionary 2.6 – Docks Count

The Docks count field is the total number of pile supported or floating docks or swimming platforms that occur along the segment. Properties may have more than one dock present and each different structure is considered a separate dock. For instance, a property could have one swimming float and one dock. The chart shows shoreline segments in Lake Winnipeg south basin that include docks.

Figure 34. Modifications – Count of Boat Houses



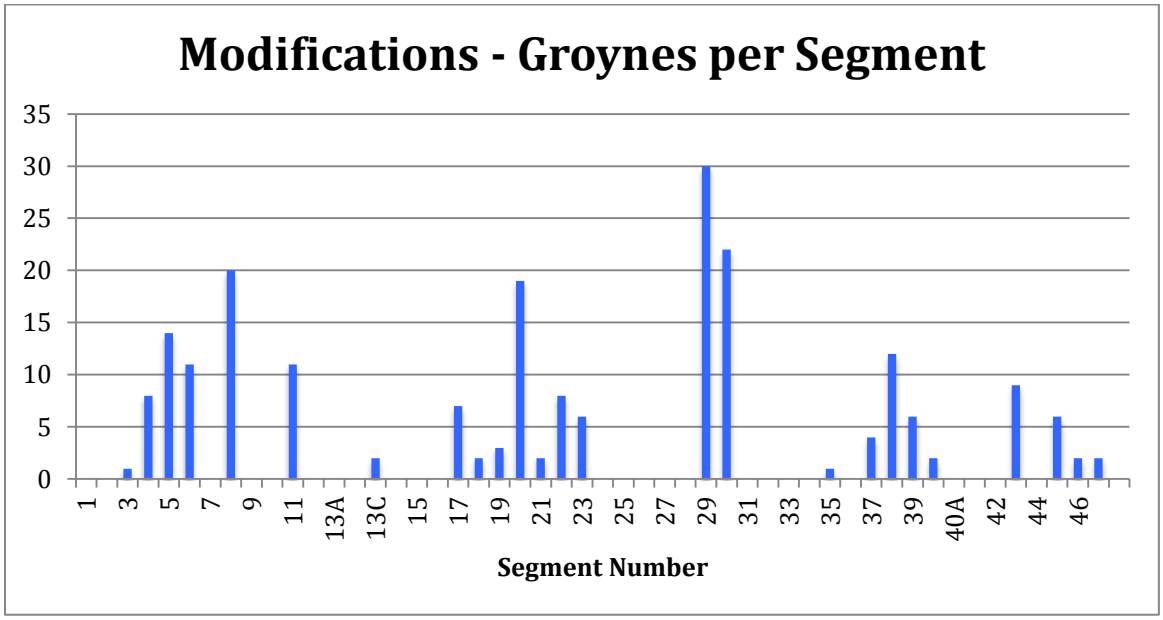
Discussion

Segment number 28 had the most counted boathouses in the study area.

SHIM Data Dictionary 2.6 – Count Boat Houses

The Boat House count field is used to count boat houses that occur along the segment. Boat Houses are structures that are specifically designed to house boats or watercraft. Boat Houses can either be located on land or as structures over the water. If only structures over the water are counted, assessors should be consistent and make note of this so end users are aware of what definition was used for a boat house. If structures on land are considered as boat houses, a rail or boat launch should be present that land owners use to launch the boat to the lake. Garages that house boats should not be counted as boat houses because there is not an associated launch structure.

Figure 35. Modifications – Count of Groynes



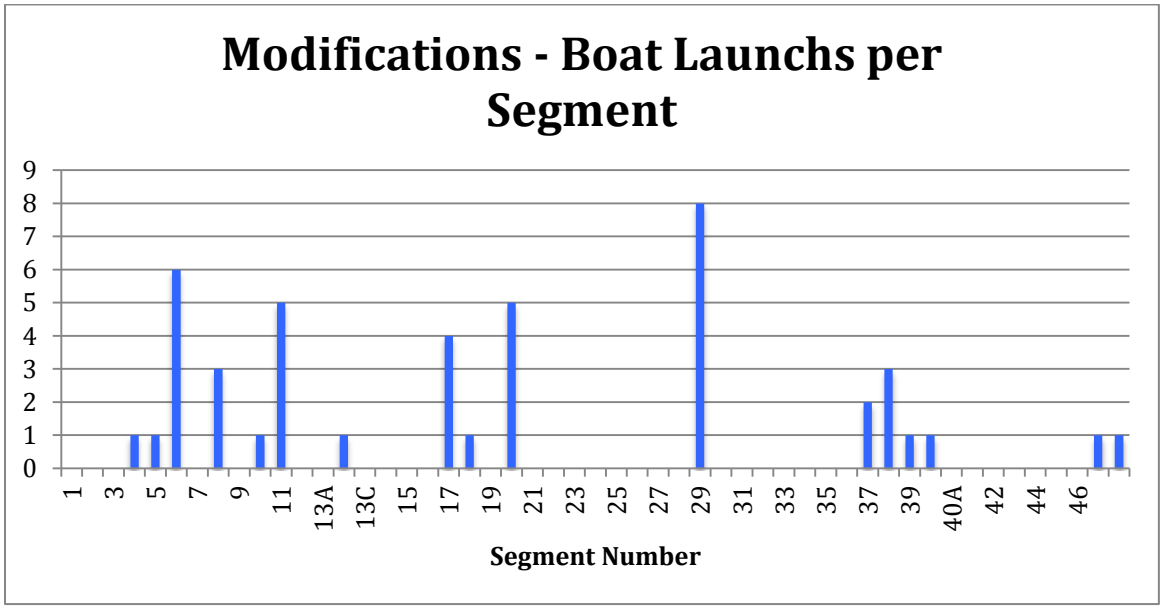
Discussion

The segments in the study area with the most groynes were; 4, 5, 7, 10, 19, 28, 29 and 37.

SHIM Data Dictionary 2.6 – Count Groynes

The Groyne count field is used to count any structure that is perpendicular to the shoreline that is impacting regular sediment drift along the shoreline. Groynes can be constructed out of concrete, rock, piles, wood, or other materials. Docks or other structures that are acting as groynes and affecting sediment movement should be included in the groyne count. Rock lines that are too small to significantly impact sediment movement should not be counted as a groyne.

Figure 36. Modifications – Count of Boat Launches



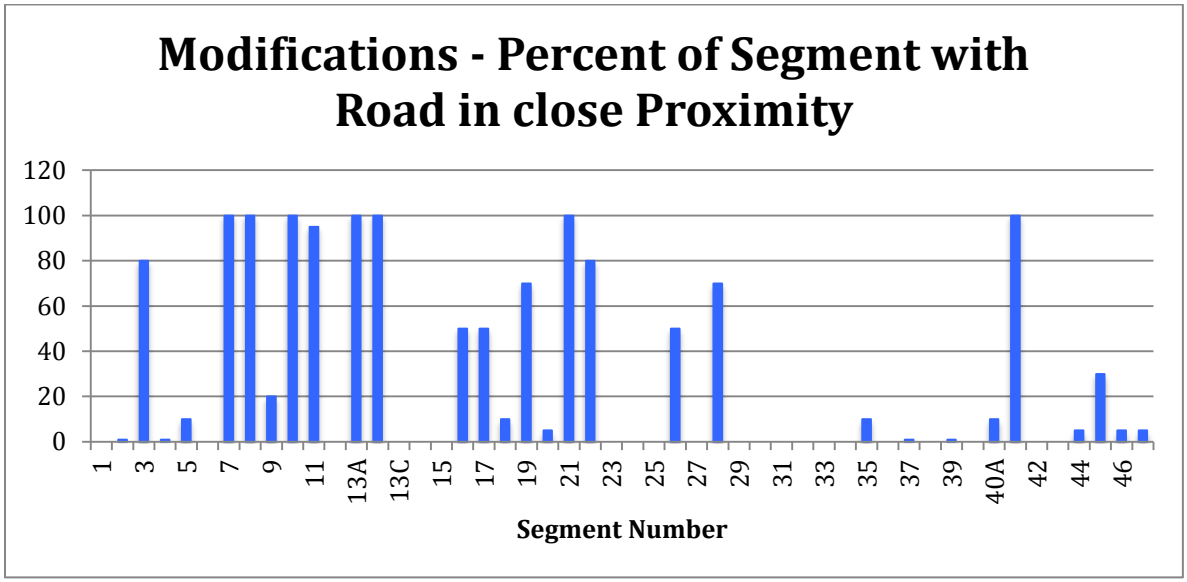
Discussion

Boat launches were either gravel or concrete launches. The segments with the highest count of boat launches were; 5, 10, 19 and 28. Both concrete and gravel boat launches were counted.

SHIM Data Dictionary 2.6 – Boat Launch Count

The Boat Launch count field is the total number of boat launches that were observed along the shoreline. Generally, only permanent boat launches are counted (e.g., made of concrete). However, on small systems assessors may choose to count gravel boat launches as these may be the only type present. Assessors should document criteria used to determine what constitutes a boat launch during the assessment.

Figure 37. Modifications – Percent of Segment in close Proximity to a Road



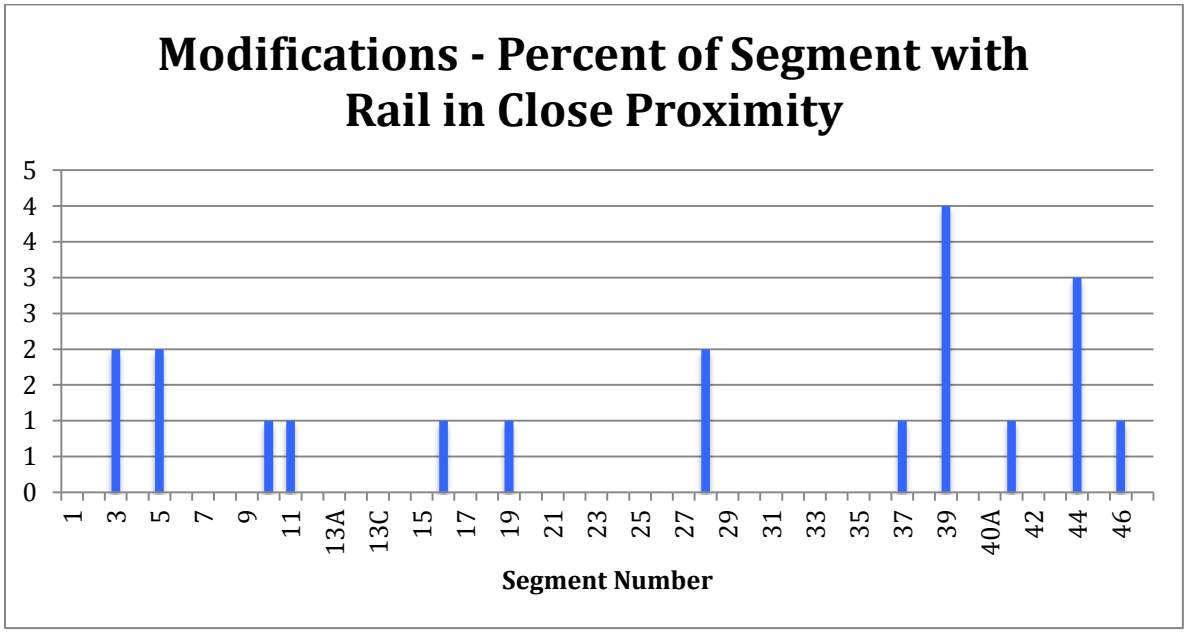
Discussion

The segments with highest percentage of the segment in close proximity to road were; 3, 7, 8, 10, 11, 13A, 13B, 16, 17, 21, 22, 26, 28 and 41. The observations were limited to those from the boat along the shoreline. These observations have not been verified or revised based on air photos at the time of this draft report.

SHIM Data Dictionary 2.6 – Percent Road Modifier

The Percent Road Modifier field is used to describe the percentage of the linear shore segment length that contains a roadway in close proximity to the shoreline.

Figure 38. Modifications – Percent of Segment in Close Proximity to Rail



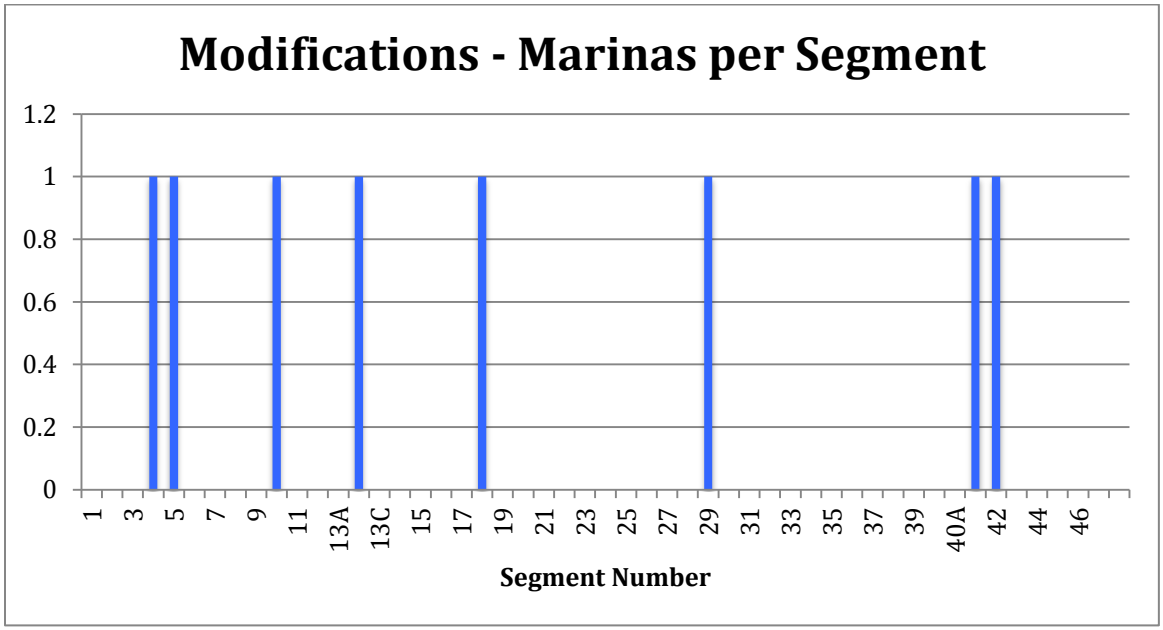
Discussion

Most segments were not in close proximity to rail. The observations were limited to those from the boat along the shoreline. These observations have not been verified or revised based on air photos at the time of this draft report.

SHIM Data Dictionary 2.6 – Percent Rail Modifier

The Percent Rail Modifier field is used to describe the percentage of the linear shore segment length that contains railways in close proximity to the shoreline. The chart identifies those Lake Winnipeg south basin shoreline segments with railway in close proximity.

Figure 39. Modifications – Count of Marinas per Segment



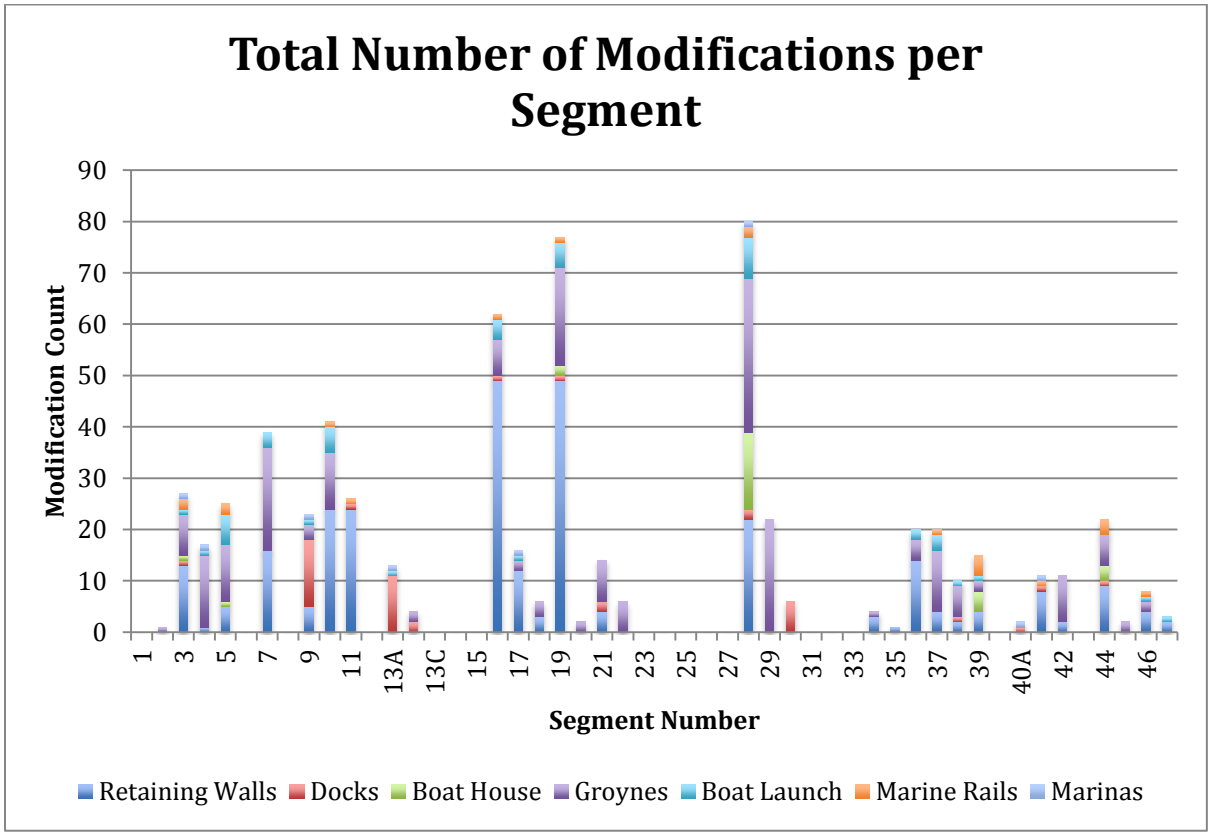
Discussion

No single segment had more than a single marina. However a marina has a large localized impact in a segment of the lakeshore.

SHIM Data Dictionary 2.6 – Marina Count

The Marinas Field is the total number of large and small marinas that were documented along the shoreline. A marina is considered to be any pile supported or floating structure that has slips for 6 or more boats.

Figure 40. Total Count of all Modifications for each Segment in the Study Area

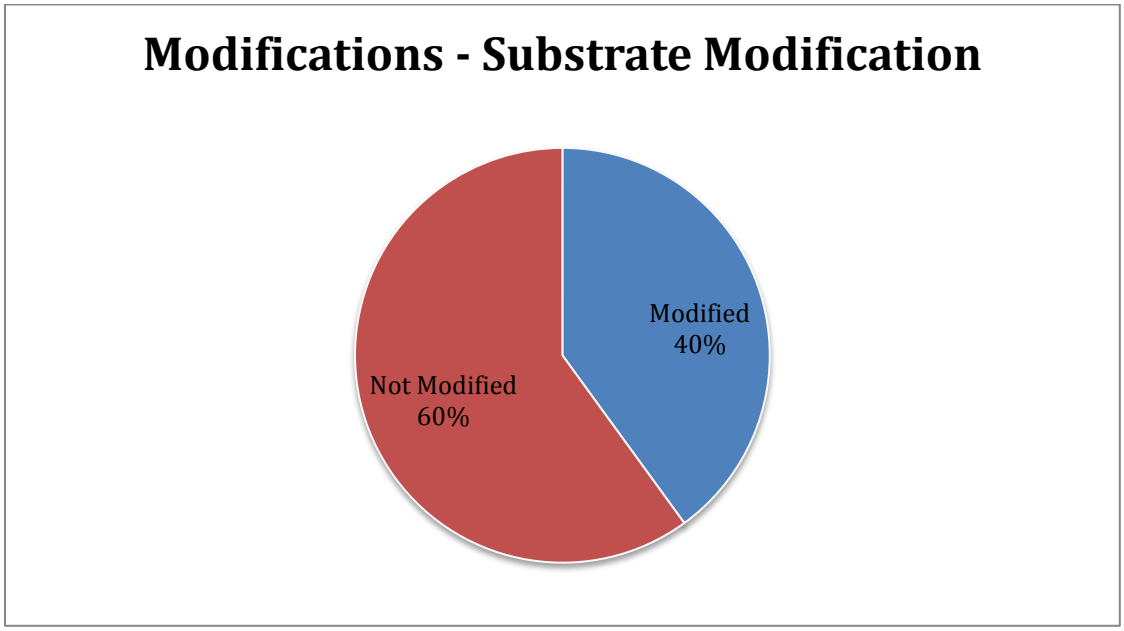


Discussion

This graph shows the combined counts for all observed modifications for each shoreline segment in the study area. Those segments with 20 or more shoreline modifications in the segments are; 3, 5, 7, 9, 10, 11, 16, 19, 28, 29, 36, 37 and 44.

Those segments with 40 or more observed shoreline modifications are; 10, 16, 19 and 28.

Figure 41. Modifications – Substrate of Segments in Study Area Modified



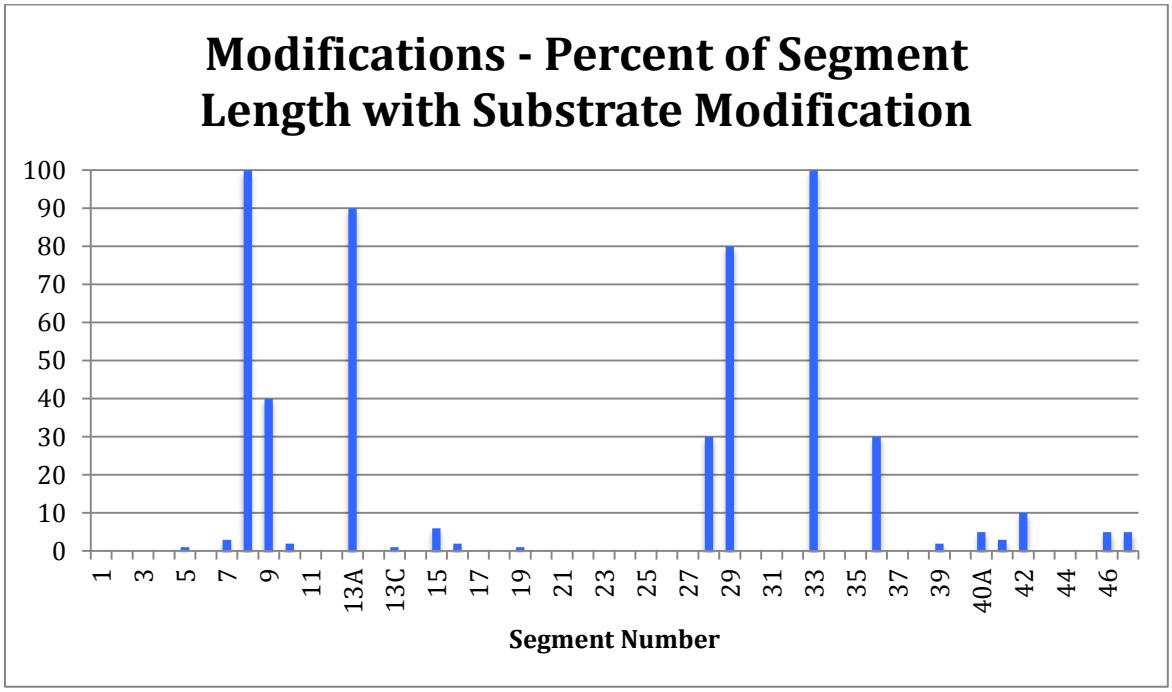
Discussion

The Lake Winnipeg south basin was found to have 40 % of its shoreline substrate modified. See previous charts as well.

SHIM Data Dictionary 2.6 – Substrate Modification Presence

The Substrate Modification Presence field is used to document whether substrate modification is occurring along the shore segment. Substrate modification includes any type of importation of sands, significant movement of natural substrates (e.g., to construct groynes), or earthworks.

Figure 42. Substrate Modification of Segments as a Percentage of the Segment Length



Discussion

Several segments have heavily modified substrates. They are; 8, 9, 13A, 28, 29, 33 and 36.

SHIM Data Dictionary 2.6 – Percent of Substrate Modification

The Percent Substrate Modification field is the estimated percentage of the shore segment where substrate modification has occurred.

Part 1

A Sensitive Habitat Inventory and Mapping (SHIM) Report

For the South Basin of Lake Winnipeg

for Lake Winnipeg Sensitive Habitat Inventory Mapping Project (SHIM) 2011-2012

Whelan Enns Associates Inc.
Winnipeg, MB

March 2012

Table of Contents

Part 1 Ecological Habitat Index (EHI)

List of Tables

List of Figures

Ecological Habitat Index parameters, Calculations, Methods and Values for the Lake Winnipeg South Basin 2011

Lake Winnipeg – South Basin
Sensitive Habitat Inventory and Mapping – Pilot Project 2011 - 2012
Prepared for Lake Winnipeg Foundation Inc.
April 2012

South Basin of Lake Winnipeg Sensitive Habitat Inventory and Mapping Project

Part 1 – Ecological Habitat Index (EHI) Ranking for Lake Winnipeg South Basin Shoreline Segments from 2011Sensitive Habitat Inventory and Mapping (SHIM) Project

Part 2 - An Overview of Fish and Fish Habitat in the Littoral Zone of the Lake Winnipeg South Basin for the 2011 Lake Winnipeg Sensitive Habitat Inventory and Mapping Project (SHIM)

Part 3 – Survey of Avian and Vegetation Communities in the Littoral and Riparian Zones of the Lake Winnipeg South Basin 2011.

Appendices - Overview Maps of the Lake Winnipeg South Basin Sensitive Habitat Inventory and Mapping (SHIM) Project

- Overview Map
- Sample Sites Map
- Nested Sites Map
- Composite Map

Appendices – Shoreline Section Maps of Lake Winnipeg South Basin Sensitive Habitat Inventory and Mapping Project (SHIM)

- Section 1 – Segments 1 - 5
- Section 2 – Segments 5 - 16
- Section 3 – Segments 16 - 25
- Section 4 – Segments 25 - 36
- Section 5 – Segments 35 - 47

Acknowledgements

The following individuals carried out fieldwork for this assessment:

Lisette Ross, M.Sc., Native Plant Solutions
Pauline Bloom, M.Sc., Native Plant Solutions
Phillip Rose, B.Sc., Cert. FWT, Native Plant Solutions
Bruce MacDonald, B.Sc., B. Ed. Terra Limnic Consulting
Desiree Stratton, University of Manitoba
Rosemarry Ann (Annie) Eastwood, B.Sc. Washington State University

Linda Benson, Boat pilot
Jake Benson, Boat pilot

Lake Winnipeg Foundation would like to thank the following individuals for their technical contributions to the project:

Jared Whelan, B.Sc. Whelan Enns Associates Inc.
Darwin Monita, Aquatics Environmental Services
Todd Schwartz, Department of Fisheries and Oceans
Alex Salki, Lake Winnipeg Foundation board member
Greg McCullough, University of Manitoba
Darren R. Wanless, Principal Cansel Manitoba Division
Jessica McCreary, B.Sc., Whelan Enns Associates Inc.

The report was completed by the following people:

Jared Whelan, B.Sc. Whelan Enns Associates Inc.
Lisette Ross, M.Sc., Native Plant Solutions
Bruce Mac Donald, Terra Limnic Consulting
Alex Salki, M.Sc. Lake Winnipeg Foundation board member
Gaile Whelan Enns, Principal, Whelan Enns Associates Inc.

A special thank you to the Department of Conservation and Water Stewardship for providing access to air photo imagery. The 2011 Lake Winnipeg Flood 30cm Digital Ortho Imagery was completed by ATLIS Geomatics.

We would like to thank Alex Salki as the project coordinator for Lake Winnipeg Foundation Inc.

Disclaimer

The results contained in this report are primarily based upon data collected during 8 days of field survey by parties other than Whelan Enns Associates Inc. (WEA) This data was augmented by previous documentation material. WEA assumes that the data collected are accurate and reliable. The field inventories were brief and limited in number and scope. Also 2011 was an unusual, high water year. Data in this assessment was not analyzed statistically. Verification with air photos was not completed for the draft report dated March 2012. Use or reliance upon conclusions made in this report is the responsibility of the party using the information. Neither WEA Inc., Lake Winnipeg Foundation, nor the authors of this report are liable for accidental mistakes, omissions or errors made in its preparation because best attempts were made to verify the accuracy and completeness of data collected and presented.

Overview

An Ecological Habitat Index was calculated using the results of the Foreshore Inventory and Mapping field data. This was used to determine a relative ecological habitat inventory rank for each segment in the Lake Winnipeg South Basin study area. The index follows similar methods used in various BC SHIM lake studies.

Table 1. EHI Parameters, Calculation Methods, and Values for Lake Winnipeg South Basin Shoreline Segments

Ecological Habitat Index Parameters, Calculations Methods and Values for the South Basin of Lake Winnipeg

Category	Criteria	Maximum Point	Percent of the Category	Percent of the Total	Calculation	Value Categories
Biophysical	Shore Type	20	33.898	17.021	% Segment x Shore Type Value (20)	Stream Mouth = Wetland (20) > Gravel Beach = Rocky Shore = Vegetated Shore (15) > Sand Beach = Cliff/Bluff (10) > Other (5)
	Percent Natural	15	25.424	12.766	% Natural x Natural Score (15)	% Natural x Natural Score (15)
	Substrate	10	16.949	8.511	% Substate x Substrate Value (10)	Organic = Cobble (10) > Gravel = Sand (8) > Boulder = Silt = Mud (6) > Marl (4) > Bedrock (2)
	Aquatic Vegetation	8	13.559	6.809	% Aquatic Vegetation x Aquatic Vegetation Score (8)	% Aquatic Vegetation x Aquatic Vegetation Score (8)
	Overhanging Vegetation	6	10.169	5.106	% Overhanging Vegetation x Overhanging Score (6)	% Overhanging Vegetation x Overhanging Score (6)
Zones of Sensitivty	Birds	10	50.000	4.255	High (10), Moderate (6), Few (3), None (0)	High (10), Moderate (6), Few (3), None (0)
	Biologically Productive Areas	10	50.000	4.255	High (10), Moderate (6), Few (3), None (0)	High (10), Moderate (6), Few (3), None (0)
Shoreline Vegetation	Band 1 (Riparian)	10	50.000	8.511	Vegetation Bandwidth Value x Vegetation Quality Value x Band 1 Score (10)	**Vegetation Bandwidth Value** 0 to 4.9 m (0.2) < 5 to 9.9 (0.4) < 10 to 14.9 m (0.6) < 15 to 19.9 (0.8) < 20 m (1) **Vegetation Quality Value** Natural wetland = Disturbed wetland = Broadleaf = Shrubs (1) > Coniferous Forest = mixed Forest (0.8) > Herbs/Grasses = Unvegetated (0.6) > Lawn = Landscaped = Row Crops (0.3) > Exposed Soil (0.05)
	Veteran Trees	5	25.000	4.255	>25 (5), 5-25 (3), <5 (1)	>25 (5), 5-25 (3), <5 (1), 0 (0)
	Snags	5	25.000	4.255	>25 (5), 5-25 (3), <5 (1)	>25 (5), 5-25 (3), <5 (1), 0 (0)
Modifications	Retaining Wall	-3.5	18.919	2.979	% Retaining wall x (-5)	
	Docks	-3	16.216	2.553	# Docks x (-0.1 per dock)	
	Groynes	-3	16.216	2.553	# Groynes x (-0.5 per groyne)	
	Boat Launch	-3	16.216	2.553	# Launches x (-3 per launch)	
	Marinas	-6	27.027	4.255	Small Marinas (< 20 slips), Medium Marina (20 - 50 slips), Large marina (>50 slips)	Small Marina (-2), Medium Marina (-4), Large Marina (-6) per marina

Ecological Habitat Index Methods

Categories

This project used four main categories of data for the calculations of the ecological habitat index (EHI). The categories are; biophysical, zones of sensitivity, shoreline vegetation and modifications. The categories used for the ecological habitat index are similar to those used in SHIM studies in British Columbia (BC). Due to the lack of fish sampling for each segment, fish criteria were not used for the index.

Criteria

The criteria used for biophysical data are; shore type, percent natural, substrate type, aquatic vegetation presence and overhanging vegetation presence.

The criteria for the zones of sensitivity data are; bird observation and diversity (the number of bird guilds present in a segment) and the presence of biologically important areas such as streams, wetlands, marshes, important bird areas, breeding areas, sand spits, and adjacent natural areas.

The criteria used for shoreline vegetation data include the quantity (width) of the riparian zone and the quality of the vegetation. The criteria also included the presence and quantity of veteran trees and snags.

The criteria used for modification data included; percentage of the segment impacted by retaining walls, the number of docks in a segment, the number of groynes in a segment, the number of boat launches (both gravel and cement) in a segment and the number and size of marinas in a segment.

The criteria are also similar to BC studies with an emphasis on bird observations and biologically productive areas. Due to the lack of air photo analysis at the time of the writing for the draft report only riparian band 1 data was used. A partial replacement for riparian band 2 data is the use of data collected on veteran trees and snags. The modification criteria are also those used in BC studies.

Weighting (Maximum Points)
The weighting or maximum points for each criteria is close to values used in BC studies. Some criteria are lower and some higher. There is an emphasis on desirable shore type for fish habitat, natural areas and the intact vegetation along the shoreline segments. Due to the positive effect that intact shorelines with trees have on retaining shoreline integrity, the weighting is a little higher than in some BC studies. The weightings for modifications criteria retaining walls, docks, groynes, boat launches and marinas are similar to those in BC studies.

However the sheer number of modifications to the Lake Winnipeg South Basin shoreline segments in the study area is significant. This high number of shoreline modifications has a significant effect on the ecological habitat index values calculated.

Percent of Category
For each of the five categories, the combined percentages of the criteria comprising the category total 100%.

Percent of Total
Due to rounding, total percentages of the Category and Total columns do not add to 100% .

Calculations
The formulae used to calculate ecological habitat index ranking for the Lake Winnipeg south basin shoreline segments are the same as used in the BC SHIM studies.

Value Categories
The value categories used in Table 1 are similar to those used in BC SHIM studies but with updated weighting for criteria for the Lake Winnipeg south basin shoreline.

Lake Winnipeg South Basin – Ecological Habitat Index Calculation Results

Figure 1. Number of Segments in each Ecological Habitat Index Ranking

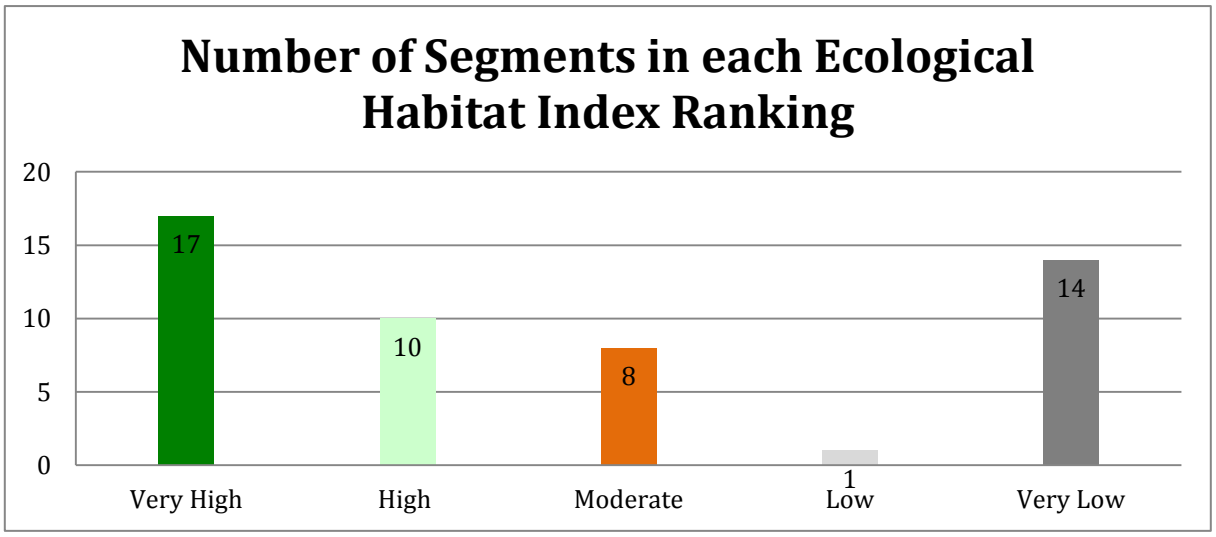
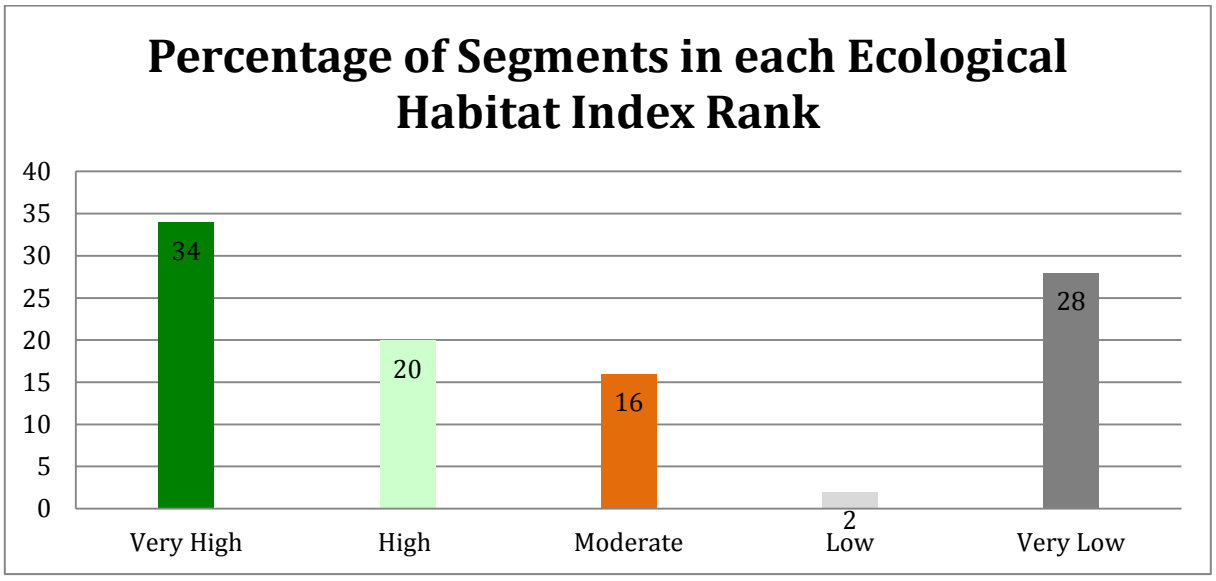


Table 2. . Numbers and percentages of segments in each EHI rank

Ranking	Colour	Value Range	Count	% of Count
Very High	Dark Green	88.93 to 61.43	17	34
High	Light Green	61.42 to 33.92	10	20
Moderate	Brown	33.91 to 6.41	8	16
Low	Grey	6.4 to -21.1	1	2
Very Low	Dark Grey	(-21 to -444.42)	14	28
Total			50	100

Figure 2. Percentage of Segments in each Ecological Habitat Index Rank



Discussion

Very High EHI indicates generally that a segment has high scores in the biophysical, zones of sensitivity and shoreline vegetation categories with few shoreline modifications.

High EHI indicates generally that a segment has high to moderate biophysical, zones of sensitivity and shoreline vegetation scores with few shoreline modifications.

Moderate EHI indicates generally that a segment has high to moderate biophysical, zones of sensitivity and shoreline vegetation scores with more shoreline modifications.

Low EHI indicates generally that a segment has lower biophysical, zones of sensitivity and shoreline vegetation scores with more shoreline modifications.

Very Low EHI indicates generally that a segment has lower biophysical, zones of sensitivity and shoreline vegetation scores with many shoreline modifications.

The majority of segments have EHI scores of Very High or High. However a significant number of segments score Low or Very Low

Figure 3. Shoreline Length for Each Ecological Habitat Index Rank

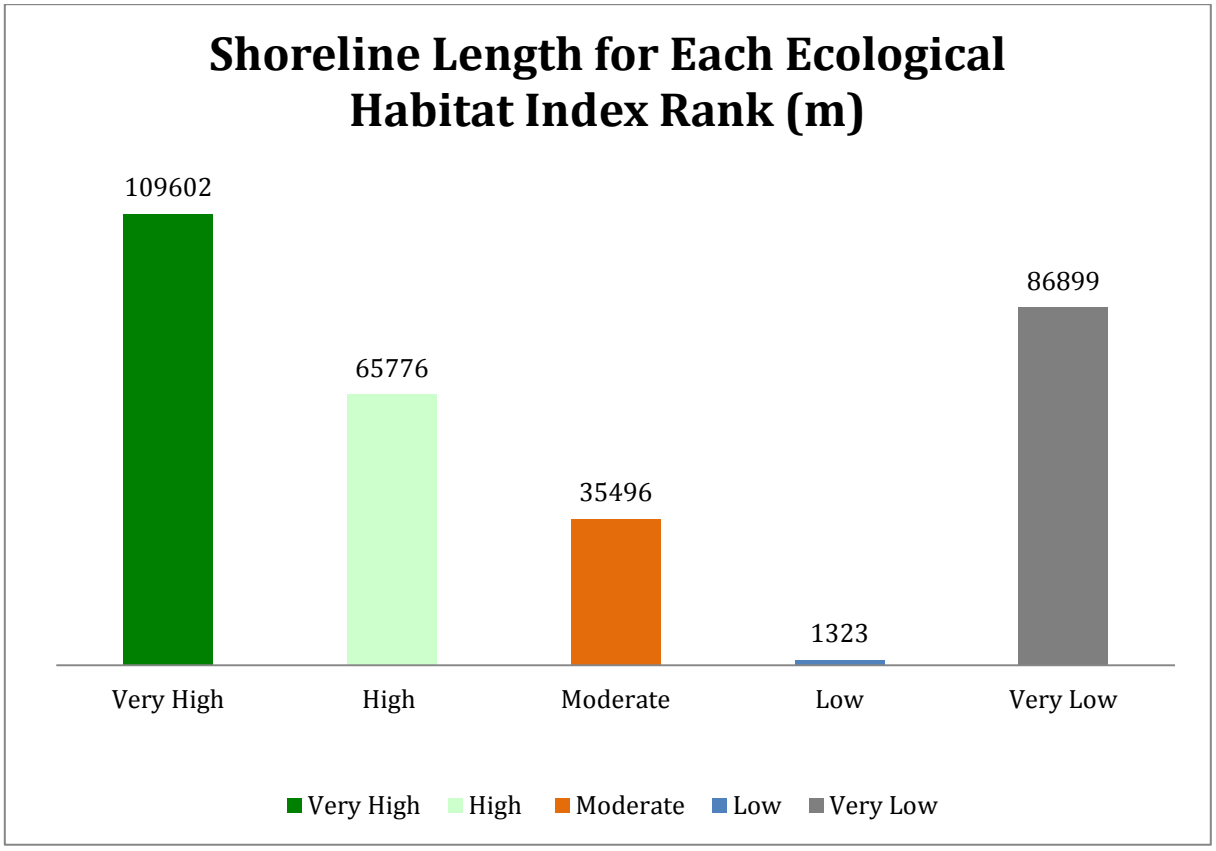
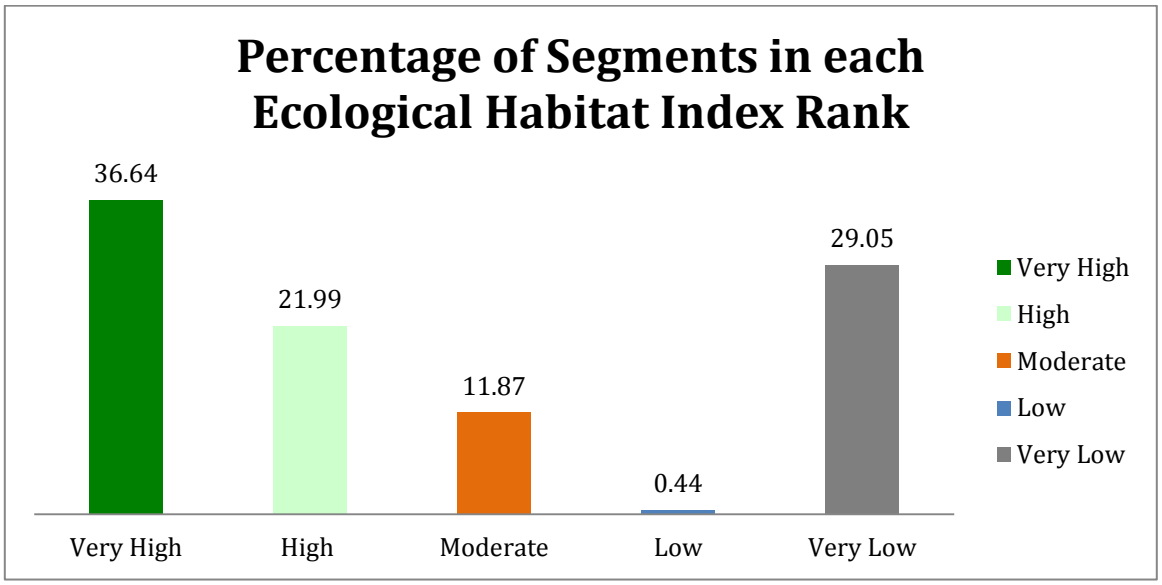


Table 3. Length (m) and percentage of total shoreline length in each EHI rank

Ranking	Colour	Shoreline Length (m)	% of Length
Very High	Dark Green	109602	36.64
High	Light Green	65776	21.99
Moderate	Brown	35496	11.87
Low	Grey	1323	0.44
Very Low	Dark Grey	86899	29.05
Total		299096	

Figure 4. Percentage of Segments in each Ecological Habitat Index Rank



Discussion

The total shoreline length as well as the proportion of total shoreline length within each EHI rank mirrors the number of segments in each EHI rank.

Figure 5. Ecological Habitat Index of Shore Types

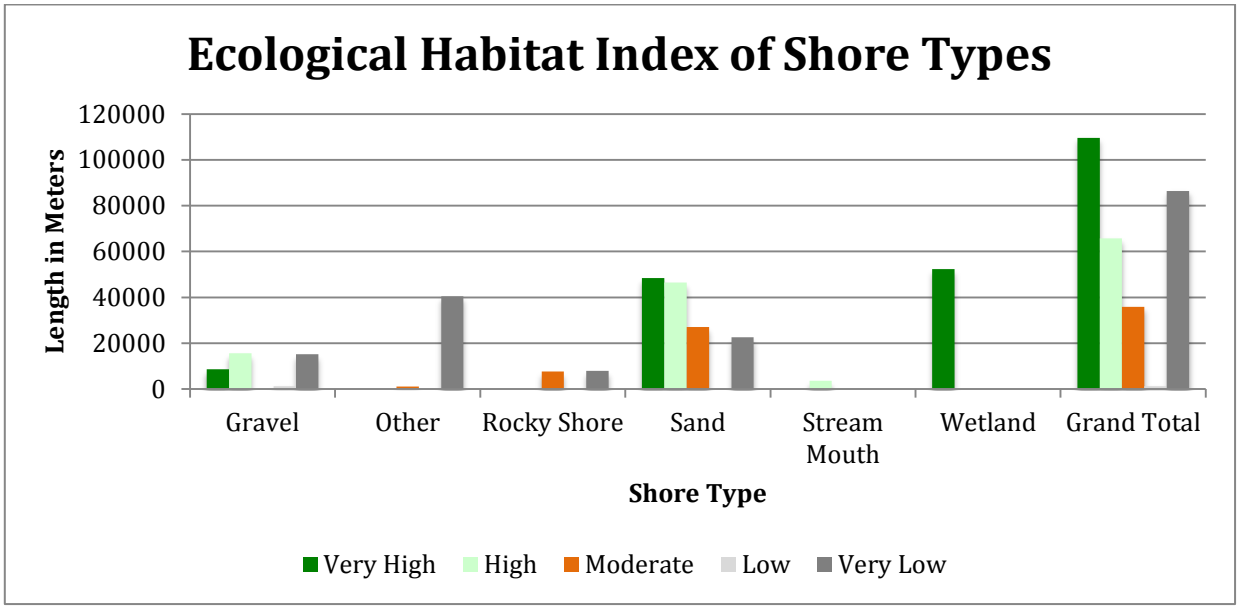


Table 4. Lengths of Shore Types in EHI ranks

Sum of Segment Length (m)	Column Labels						
Row Labels	Gravel	Other	Rocky Shore	Sand	Stream Mouth	Wetland	Grand Total
Very High	8725			48452		52425	109602
High	15665			46464	3647		65776
Moderate		1178	7669	27070			35917
Low	1323						1323
Very Low	15275	40564	7984	22655			86478
Grand Total	**40988**	**41742**	**15653**	**144641**	**3647**	**52425**	**299096**

Table 5. Percentages of Shore Types in EHI Ranks

Sum of Segment Length (m)	Column Labels						
Row Labels	Gravel %	Other %	Rocky Shore %	Sand %	Stream Mouth %	Wetland %	Grand Total %
Very High	2.9			16.2		17.5	36.6
High	5.2			15.5	1.2		22.0
Moderate		0.4	2.6	9.1			12.0
Low	0.4						0.4
Very Low	5.1	13.6	2.7	7.6			28.9
Grand Total	**13.7**	**14.0**	**5.2**	**48.4**	**1.2**	**17.5**	**100.0**

The Gravel shoreline type (13.7% of total shoreline length) has a mix of very high, high, low very low EHI ranking.

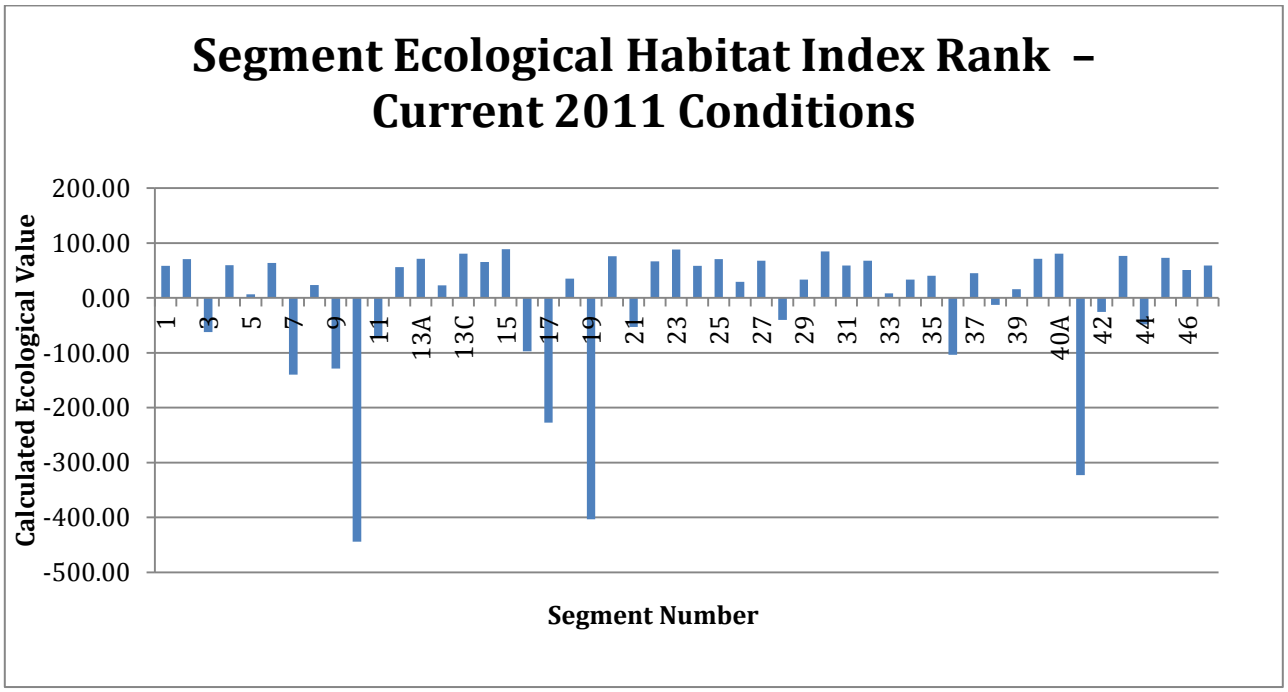
The Other shoreline type (14%) includes extensively rip-rapped shorelines, entirely developed, manicured, heavily protected from shoreline erosion, altered uplands and substrate. The EHI ranking is almost entirely very low.

The Rocky shoreline (5.2%) has some moderate EHI and some very low EHI ranking.
The Sand shoreline type is the most common in the study area (48.4%) with segments in all except the low EHI rank.

Stream mouths are a small percentage of the total study area length (1.2%) but of high EHI rank. Stream mouths score lower than might be expected because of lower bird scores, and low vegetation scores. (There is no shoreline vegetation in the stream mouth.)

Intact wetlands in the study area (17.5% of total shoreline length) have a very high EHI rank.

Figure 6. Segment Ecological Habitat Index Rank – Current 2011 Conditions



Discussion

The majority of segments in the study area have a positive ecological habitat index ranking based on the collected data and calculations. However there are a significant number of segments that have very low EHI rankings.

Very high EHI rankings are found for segments 2, 6, 13A, 13C, 14, 15, 20, 23, 25, 27, 30, 32, 30, 40A, 43, and 45

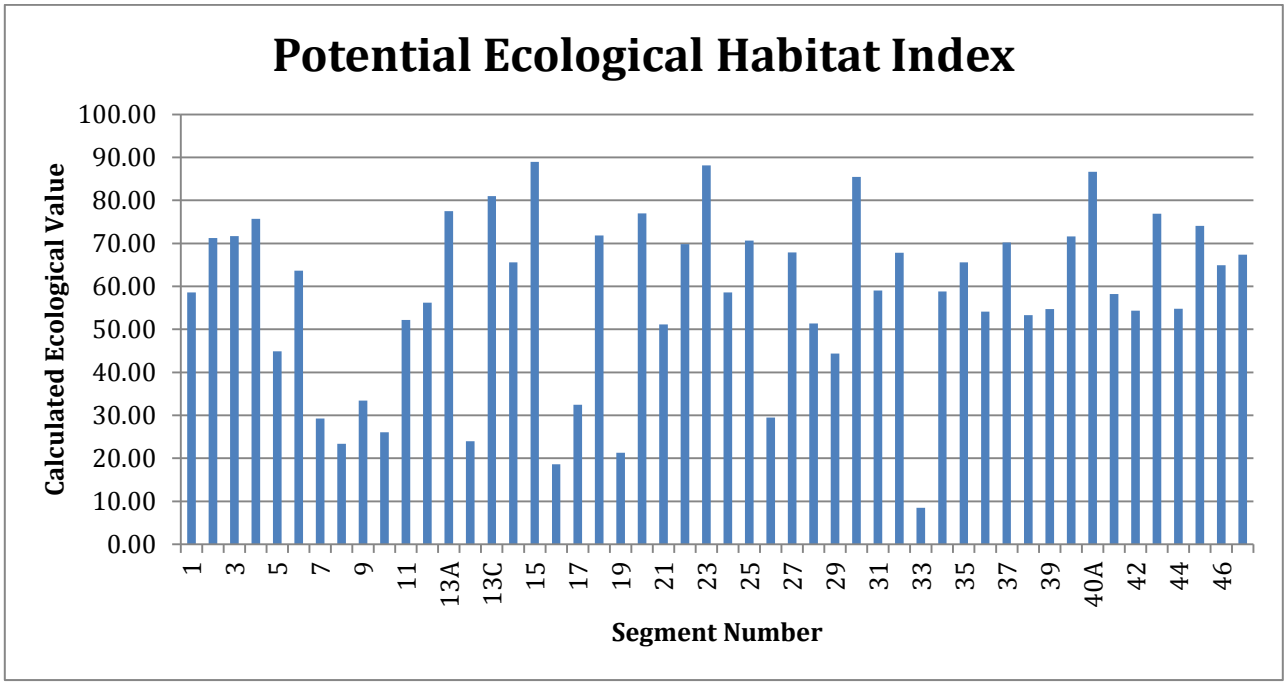
High EHI rankings were noted for segments ; 1, 4, 12, 18, 24, 31, 35, 37, 46 and 47.

Segments 5, 8, 13B, 26, 29, 33, 34 and 39 have moderate EHI rankings.

Segment 38 has a low EHI ranking..

Very low EHI ranking segments are; 3, 7, 9, 10, 11, 16, 17, 19, 21, 28, 36, 41, 42, and 44.

Figure 7. Segment Ecological Habitat Index Ranking with Shoreline Modifications Removed from Calculations



Discussion

Figure 7 shows the EHI values for all segments in the study area with the shoreline modifications removed from the calculation of the EHI.

All segments are now rated with very high, high or moderate EHI rankings. There are no longer any low or very low EHI ranked segments.

Shoreline modifications have a significant impact on the calculations of the ecological habitat index for the segments in the study area.

Table 6. Segment Ecological Habitat Index Summary

Table: Ecological Habitat Index Calcualtions Summary Table

Segment #	Segment Length (m)	Segment Length (km)	Biophysical Total	Zones of Sensitivity Total	Shoreline Vegetation Total	Modifications Total	Current Value	Current Rank	Potential Value	Potential Rank
1	2924	2.924	32.58	20.00	6.00	0.00	58.58	High	58.58	High
2	5547	5.547	29.24	9.00	33.00	-0.50	70.74	Very High	71.24	Very High
3	15275	15.275	20.65	16.00	35.00	-134.10	-62.45	Very Low	71.65	Very high
4	17539	17.539	26.68	13.00	36.00	-16.00	59.68	High	75.68	Very High
5	14686	14.686	11.90	3.00	30.00	-38.50	6.40	Moderate	44.90	High
6	8725	8.725	28.66	6.00	29.00	0.00	63.66	Very High	63.66	Very High
7	9716	9.716	9.30	6.00	14.00	-169.00	-139.70	Very Low	29.30	Moderate
8	1656	1.656	14.40	0.00	9.00	0.00	23.40	Moderate	23.40	Moderate
9	421	0.421	11.40	10.00	12.00	-161.80	-128.40	Very Low	33.40	Moderate
10	2337	2.337	7.08	10.00	9.00	-470.50	-444.42	Very Low	26.08	Moderate
11	6741	6.741	11.15	10.00	31.00	-125.10	-72.95	Very Low	52.15	High
12	5209	5.209	32.20	12.00	12.00	0.00	56.20	High	56.20	High
13A	2271	2.271	34.50	13.00	30.00	-6.10	71.40	Very High	77.50	Very High
13B	3444	3.444	18.95	3.00	2.00	-1.20	22.75	Moderate	23.95	Moderate
13C	6106	6.106	42.00	9.00	30.00	0.00	81.00	Very High	81.00	Very High
14	2943	2.943	29.56	6.00	30.00	0.00	65.56	Very High	65.56	Very High
15	1541	1.541	46.93	12.00	30.00	0.00	88.93	Very High	88.93	Very High
16	11660	11.66	6.60	3.00	9.00	-115.60	-97.00	Very Low	18.60	Moderate
17	3485	3.485	17.50	6.00	9.00	-260.00	-227.50	Very Low	32.50	Moderate
18	3882	3.882	23.85	10.00	38.00	-36.50	35.35	High	71.85	Very High
19	10110	10.11	6.30	6.00	9.00	-424.60	-403.30	Very Low	21.30	Moderate
20	2717	2.717	27.95	16.00	33.00	-1.00	75.95	Very High	76.95	Very High
21	3239	3.239	12.12	6.00	33.00	-104.20	-53.08	Very Low	51.12	High
22	2664	2.664	27.85	9.00	33.00	-3.00	66.85	Very High	69.85	Very High
23	9847	9.847	32.12	16.00	40.00	0.00	88.12	Very High	88.12	Very High
24	3647	3.647	42.60	16.00	0.00	0.00	58.60	High	58.60	High
25	25068	25.068	40.62	20.00	10.00	0.00	70.62	Very High	70.62	Very High
26	2721	2.721	26.46	3.00	0.00	0.00	29.46	Moderate	29.46	Moderate
27	9691	9.691	28.90	6.00	33.00	0.00	67.90	Very High	67.90	Very High
28	4612	4.612	16.36	3.00	32.00	-91.20	-39.84	Very Low	51.36	High
29	4563	4.563	8.40	3.00	33.00	-11.00	33.40	Moderate	44.40	High
30	5874	5.874	43.45	12.00	30.00	-0.60	84.85	Very High	85.45	Very High
31	3715	3.715	29.00	9.00	21.00	0.00	59.00	High	59.00	High
32	3947	3.947	28.80	9.00	30.00	0.00	67.80	Very High	67.80	Very High
33	757	0.757	7.00	0.00	1.50	0.00	8.50	Moderate	8.50	Moderate
34	4643	4.643	22.80	3.00	33.00	-25.50	33.30	Moderate	58.80	High
35	4980	4.98	29.60	6.00	30.00	-25.00	40.60	High	65.60	Very High
36	3078	3.078	16.13	3.00	35.00	-158.00	-103.87	Very Low	54.13	High
37	15665	15.665	28.17	10.00	32.00	-25.00	45.17	High	70.17	Very High
38	1323	1.323	18.30	3.00	32.00	-66.10	-12.80	Low	53.30	High
39	3026	3.026	21.72	3.00	30.00	-39.00	15.72	Moderate	54.72	High
40	3163	3.163	32.59	9.00	30.00	0.00	71.59	Very High	71.59	Very High
40A	11565	11.565	46.65	10.00	30.00	-6.10	80.55	Very High	86.65	Very High
41	3372	3.372	18.18	6.00	34.00	-381.10	-322.92	Very Low	58.18	High
42	6298	6.298	14.31	10.00	30.00	-79.50	-25.19	Very Low	54.31	High
43	3707	3.707	31.89	13.00	32.00	0.00	76.89	Very High	76.89	Very High
44	6555	6.555	16.80	6.00	32.00	-103.10	-48.30	Very Low	54.80	High
45	4226	4.226	23.10	13.00	38.00	-1.00	73.10	Very High	74.10	Very High
46	4405	4.405	16.95	10.00	38.00	-14.00	50.95	High	64.95	Very High
47	3810	3.81	22.35	13.00	32.00	-8.00	59.35	High	67.35	Very High

Table 6 shows the results of the calculations of the ecological habitat index for all segments in the study area. As well, the results of removing shoreline modifications from the calculations are present in the column titled “Potential Rank”.

Part 2

An Overview Survey of Fish and Fish Habitat in Littoral Zone of the South Basin of Lake Winnipeg

for Lake Winnipeg Sensitive Habitat Inventory Mapping Project (SHIM) 2011-2012

L.B. Mac Donald and D.C. Garry

Terra Limnic Consulting

G 12 C 19 RR # 1

Winlaw, B.C. V0G 2J0

March 2012

TABLE OF CONTENTS

LIST OF TABLES

LIST OF PHOTOGRAPHS

1.0. Fish Community of Lake Winnipeg Basin

1.1. Overview

Canada is rich in supplies of freshwater with 20% of the world's freshwater and 15% of the world's lakes surface area. Lake Winnipeg is the 10th largest body of freshwater in the world covering 24,000 square kilometres. Canada is relatively poor in the number of freshwater fish species with only 1% of the world total (13,975 species) due in part to the recent retreat of the Pleistocene ice cover. The total number of species in Canada is reported as 181 (Scott and Crossman, 1973). The Atlantic drainage has the most species at 142 with the Hudson Bay drainage next at 94 (Scott and Crossman, 1973). The Lake Winnipeg watershed could therefore be considered to contain a relatively diverse fish community for Canada with 79 species or 44% of the total number of identified species. (Scott and Crossman, 1973 and Stewart and Watkinson, 2007).

A closer look at the Lake Winnipeg fish community reveals 60 fish species (76% of total Lake Winnipeg watershed species) that utilise lacustrine littoral zone habitats for spawning, rearing or migration.

Table 1. Number of Freshwater Fish Species in Canada and Lake Winnipeg

Number of Species within Drainage		
Drainage	**Number of Species**	**Percent of Canada Total**
Canada	181	
Atlantic	142	78
Hudson Bay	94	52
Pacific	67	37
Arctic	56	31
Gulf of Mexico	27	15
Lake Winnipeg Watershed	79	44
Lake Winnipeg Littoral	60	33

1.2. Fish Survey Results

A fish and fish habitat survey of the Lake Winnipeg (south basin) riparian and littoral habitat (eulittoral and infralittoral zones) from Riverton to Jackfish Creek was conducted August 4 -7, 2011. The littoral zone (sand and gravel beaches and rocky shorelines), stream mouths or tributary inlets (i.e. Red River, Brokenhead River, Meleb drain) and wetland areas were sampled. A total of 1966 fish were captured or observed comprising 13 species (Table 2). Most captures were from the sand beach habitat type (85%) with the gravel beach type second (9%) and stream mouth third (6%). The use of beach

seines in wetlands and along rocky shores proved difficult, limiting fish captures in these habitat types. Minnow traps were utilised in the wetland and rocky shore habitat types and modifications (e.g. rock groynes) but only 5 fish were captured. However, fish were captured in all habitat types except wetlands. The highest species diversity was found at sand beach and stream mouth habitats (6 species each) with gravel beach second (3 species) (Table 3).

Beach seining the littoral zone Segment 3 Site 1 *photo B. MacDonald*

Catches in the sand beach habitat type were highest at four sample sites: Segment 5, Site 1 (Spruce Sands), Segment 26, Site 1(adjacent Netley-Libau marsh), Segment 37, Site 1 (Grand Beach) and Segment 42, Site 1, (Victoria Beach) (Table 2).

A sand beach at Segment 26, Site 1 (adjacent Netley-Libau marsh) and a stream mouth at Segment 6, Site 1 (Meleb drain) had the highest number of species captured at 6 (Table 3).

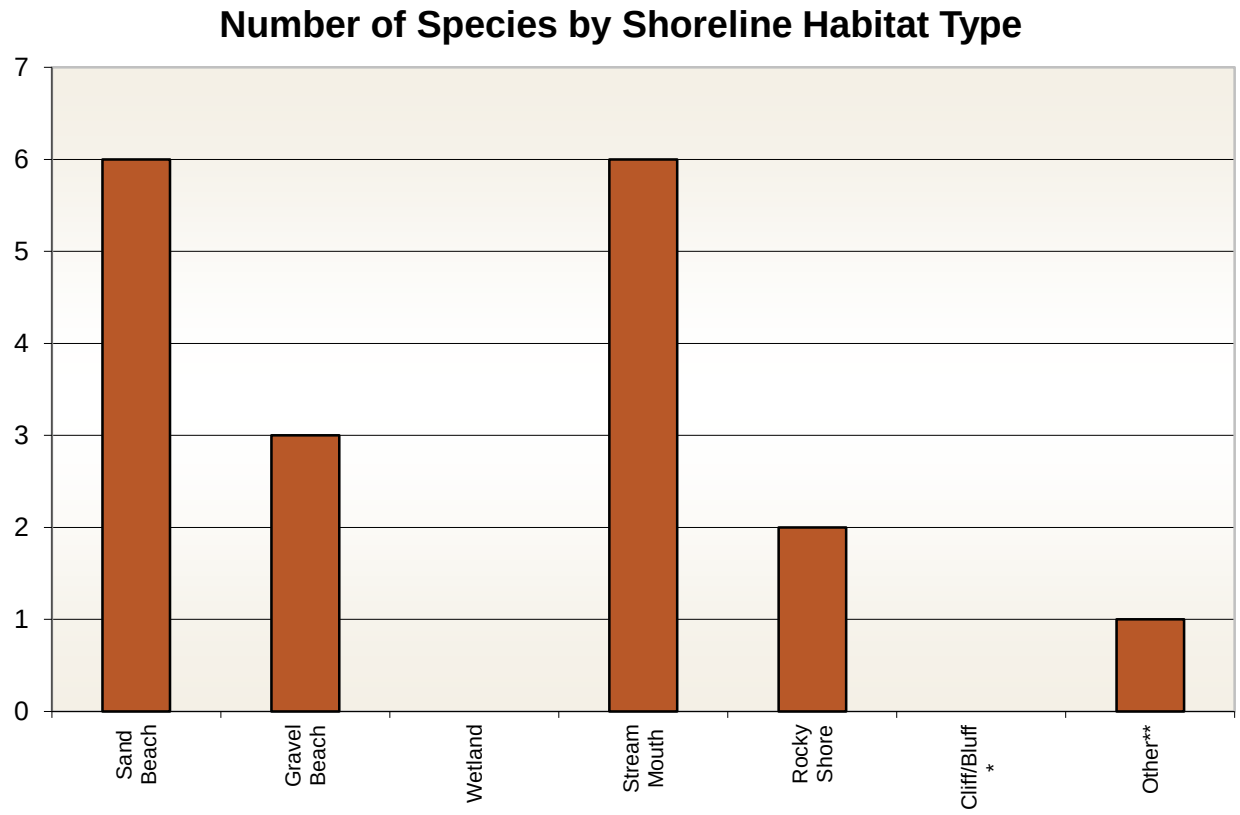
Table 2. Fish Survey Results

Species Abundance by Habitat								
	Habitat Type							
Species	Sand Beach	Gravel Beach	Stream Mouth	Rocky Shore	Cliff/Bluff	Wetland	Other	Total Sample
Shiner*	420	6	0	0	0	0	0	426
Goldeye	2	0	0	0	0	0	0	2
Walleye	18	8	0	0	0	0	0	26
White Bass	364	104	7	2	0	0	0	477
Sauger	13	0	6	1	0	0	0	20
Yellow Perch	12	3	21	0	0	0	2	38
Emerald Shiner	582	44	8	0	0	0	0	0
Quillback	3	6	75	0	0	0	0	84
Black Bullhead	248	0	0	0	0	0	0	248
Brown Bullhead**	10	0	0	0	0	0	0	10
Weed Shiner	0	0	1	0	0	0	0	1
Total	1672	171	118	3	0	0	2	1966
Percent Catch	85	9	6	<1	0	0	<1	

*** Not identified to Species**
**** Field identification not confirmed**

In addition to fish sampled directly, adult carp carcasses were observed in Segment 26 and 38 respectively (total 2) and an adult channel catfish carcass was observed in Segment 27. Large schools (100+) of young-of-year bullhead species were observed in shallow natural emergent vegetation and planted grasses at Hillside Lagoon marina and Winnipeg Beach marina.

Table 3. Number of Species by Habitat Type



* Cliff/Bluff was not sampled
** Habitat type "Other" is highly modified shoreline

The species mix was typical of the nearshore and tributary inlet fish communities and included both native and introduced species (e.g. white bass), young-of-year, juvenile and adult life stages and invertivore, omnivore and piscivore species (Appendix 1 – List of Species). Although no sampling was conducted in the tributaries, the presence of riverine species in catches demonstrates the importance of tributary inlets as migration/dispersal corridors (Hanke, 1996) and rearing areas for riverine species (e.g. weed shiner). In addition, adult piscivores (e.g. walleye) commonly use littoral areas, moving inshore to capture prey. The 2011 sampling program and a review of other sources such as Lysack, 1984, Hanke, 1996, Franzin, et. al., 2003 and Stewart and Watkinson, 2007 suggest the littoral zone, including wetlands and tributary inlets, of the south basin of Lake Winnipeg are important habitats for a diverse number of fish species. The high number of juvenile fish utilizing these areas further indicates that these areas are important summer rearing habitats.

It should be recognised that the August 4-7, 2011 survey was intended to be an overview survey in support of the development of the SHIM foreshore assessment and classification maps and not an intensive study of the fish community in Lake Winnipeg.

1.3. Species at Risk:

1.3.1. Fish:

Appendix 1 lists the current (Species at Risk Act (SARA) public registry) fish species formally listed, under consideration for SARA listing, assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or being considered by COSEWIC for assessment. While there are several species of concern none are currently SARA Schedule 1 listed as Endangered which requires an action plan for the recovery of the species. One species, the lake sturgeon is currently being considered for SARA Schedule 1 listing as Endangered. Four species: northern brook lamprey, silver chub, bigmouth buffalo and deepwater sculpin are all listed as SARA Schedule 1 Special Concern which requires a management plan for the species. None of the 5 species SARA listed or under consideration appear to be lacustrine-littoral dependant (Appendix 1).

COSEWIC has assessed 8 species and recommends SARA listing of threatened for rosyface shiner and shortjaw cisco, special concern for silver lamprey and the Newfoundland population only of banded killifish and not at risk for horneyhead chub, weed shiner, spoonhead sculpin and bluntnose minnow.

COSEWIC recommends assessments for 14 fish species. Six species use both lake and river habitats (Appendix 1) and are either high or medium priority: river darter (high priority), river shiner (medium priority), quillback (medium priority), silver redhorse (medium priority), lake cisco (medium priority) and slimy sculpin (medium priority). Low priority species include: lake trout, blackside darter and western blacknose dace.

1.3.2. Commercial and Recreation Fisheries:

Lake Winnipeg supports significant aboriginal commercial and subsistence fisheries, other commercial and recreational fisheries. The catch is mainly comprised of the following species: lake whitefish, walleye, sauger, cisco, northern pike, yellow perch, goldeye, channel catfish, freshwater drum, carp, burbot, black crappie, white bass, redhorse spp. (minor importance) and lake sturgeon (Franzin, et al, 2003).

There is also a bait fishery (commercial and recreational) that targets cyprinids (i.e. shiner, dace and chub spp.), sculpins, sticklebacks, suckers, trout perch, mudminnows, cisco, goldeye, mooneye and yellow perch (Government of Manitoba).

1.3.3. Introduced and Invasive Species

Several fish species have been either intentionally introduced to provide recreational fisheries or illegally introduced to the Lake Winnipeg watershed. They include currently recreationally exploited common carp, white bass, smallmouth bass and largemouth bass and non-fishery fish such as rainbow smelt and goldfish. The most notable is the rainbow smelt which first appeared in Lake Winnipeg in 1991 (Stewart and Watkinson, 2007) and occupies the same ecological niche as native species. The Lake Winnipeg ecosystem is probably still adjusting to this relatively recent and significant introduction (State of Lake Winnipeg 1997 – 2007, Government of Manitoba).

Other potential exotic aquatic species threats include the zebra mussel (Dreissena polymorpha) which was recently reported in the Red River drainage in Minnesota, quagga mussel (Dreissena rostriformis), spiny water flea (Bythothephes longimanus) rusty crayfish (Orconectes rusticus) and other invertebrate, viral and plant organisms.

The State of the Lake Winnipeg Basin 1999-2007 Report (June 2011) suggests that work is required to better understand the ecosystem dynamics of invasive species, native fish communities and water quality changes currently underway or anticipated.

1.4. Recommendations:

1.4.1 Sampling

Beach seining did not prove effective for sampling rocky shore habitats. Minnow traps did not catch fish at most rocky shore habitats, large organic debris (LOD) habitat, wetlands (cattail marsh) or modification (e.g. rock groynes) sample sites. In addition, sampling was conducted in summer only (August 4-7, 2011) in a particularly wet year with very high lake levels (July 8 maximum level 716.9 feet, October 15, 714.7 feet).

Additional sampling should be conducted by electrofisher in the rocky shore, LOD, wetland habitats and modifications. In addition, trap netting and/or gill netting should be considered to provide additional fish distribution information for adult life stages. Sampling in spring and fall is also recommended to allow observation of the shoreline and sampling of beach habitat at lower water levels.

2.0. Fish Habitat – Lake Winnipeg South Basin
2.1. Overview

A total of 299.096 kilometres of the south basin of Lake Winnipeg shoreline from Riverton Harbour entrance to Traverse Bay was surveyed from July 30 – August 7, 2011. Six shoreline habitat types were documented: sand beach, gravel beach, rocky shore, stream mouth, wetland and other (highly modified shoreline such as Gimli Harbour). Sixty percent (60%) of the shoreline was in a natural state while 40% had some level of development. The most common habitat type was sand beach (42.82%) followed by wetlands (14.75%), gravel beach (20.47%), other/modified shore (12.40%) and rocky shore (7.49%). The outlet of the Red River was the only identified stream mouth habitat type (1.33%). All other tributaries/stream mouths were incorporated into the other shore types as “nested sites”.

Sand and gravel beaches combined represented 63.29% of the shoreline and yielded the largest fish catches and the highest number of species. Although stream mouth was the least common habitat type sampling yielded high species diversity (6 species) and the third highest catches (Table 2, Table 3). Wetland habitats were the third most common (14.75%) and were mainly concentrated in a few areas such as the Netley-Libau complex, Willow Creek/island area, Beaconia and Hillside lagoons. Fish use of these areas was not well documented due to sampling difficulty. The biological productivity of wetlands is, however, well documented in the scientific literature. Rocky shore habitat (7.49%) was concentrated on the eastern shore, from Balsam Bay to Victoria Beach. Fish use of rocky shore areas was not well documented due to sampling difficulty but the habitat type was remarkable and uncommon in the south basin. Rocky shore also had generally less shoreline erosion than low bank sand and gravel beach areas. The other (highly modified) habitat type (12.40%) consisted of highly developed areas including roadways, harbours or large marinas and engineered shorelines adjacent private property and was scattered around the basin with concentrations in the communities of Gimli, Winnipeg Beach, Matlock, Grand Marais and Victoria Beach.

Foreshore substrate composition was estimated at 51% sand (particle sizes <2 mm), 24% gravel (2 – 64 mm), 8.75 silt, clay and organics, 1% cobble (64 -256 mm), 7.31% boulder (>256 mm), bedrock 7.91%.

Fish sampling was conducted in all habitat types: 15 sand and gravel beach sites, 4 rocky shore, 3 other/modified, 3 stream mouth and 1 wetland. Both developed and natural shorelines were sampled including 1 large organic debris (LOD) complex, 2 marinas, 1 wooden pier and 1 rock groyne.

Shoreline development was noted in all habitat types with concentrations at communities, commercial infrastructure (e.g. harbours) and private land. Shoreline

erosion was widespread although shorelines with intact vegetation generally had less. Many recent or active shoreline stabilisation projects were observed throughout the entire survey area. Beach ridges with adjacent wetlands were generally in a natural and stable condition although some erosion was observed along beach ridges in shoreline segment 27.

Table 4. Sediment particle sizes

Sizes of Sediment Particles (Walters, T. F. 1995)		
Category	**Size range**	**Phi scale**
Boulder	$>256\ mm$	– 8
Cobble	$64-256\ mm$	– 6, – 7
Pebble	$16-64\ mm$	– 4, – 5
Gravel	$2-16\ mm$	– 1, – 2, – 3
Very coarse sand	$1-2\ mm$	0
Coarse sand	$0.5-1\ mm$	1
Medium sand	$0.25-0.5\ mm$	2
Fine sand	$0.125-0.25\ mm$	3
Very fine sand	$0.0625-0.125\ mm$	4
Silt	$4-62\ \mu m$	5, 6, 7, 8
Clay	$<4\ \mu m$	9

2.2. Habitat Assessments

2.2.1. Sand and Gravel Beach

The sand and gravel beach shoreline habitat types were the most common at 63.29% of the total length of the shoreline (189.308 kilometres). Condition of the habitat, adjacent land use and fish community sampled were similar in the two habitat types and were combined for purpose of this discussion. Sand and gravel beaches were distributed throughout the study area. Of 28 segments 15 were in a mostly natural condition and 13 had a low to high level of development. Many of the natural beaches had some level of disturbance (low – moderate). The main land use was single family (14 of 28). Sand beaches included “beach ridges” (e.g. Segment 2) which separated wetlands from the main lake. The “beach ridges” had high biodiversity for fish and wildlife due to the proximity of both beach and wetland habitat types. Although there were moderate to wide (>50 meters) littoral zones throughout the survey area aquatic macrophytes were almost completely absent from sand and gravel beach shoreline habitats.

Historic and recent shoreline erosion was widely distributed in both natural and developed segments. Shoreline modifications were common with various types of angular and round rip-rap, rock filled gabion walls, wood and steel retaining walls, rock groynes and sand bags used as erosion protection or for land stabilisation. There did not appear to be any common standard and many materials were used in the erosion protection projects. Failures of round rock, rock filled gabions and wood wall erosion protection structures were common. Erosion was generally worse along unvegetated foreshore although some natural vegetated shorelines were also eroding.

Fifteen sand and gravel beaches were sampled. The sample results and a review of other studies (Hanke, 1996, Franzin, et. al., 2003) indicate that the sand and gravel beaches support a diverse and abundant fish community and are a common, valuable and productive foreshore habitat even with the significant amount of shoreline modification.

Although the lake level was higher than normal during the survey (July 8 level 716.9 feet, October 15 level 714.7 feet) and above the 713.6 foot impact level allowed by DFO, some of the erosion works observed during the July 30 – August 7, 2011 survey appeared to have in-filled sand and gravel beach habitats. Extensive riparian vegetation removal was common. While the amount of site specific, direct infilling of sand and gravel beach fish habitat could be considered low risk to overall Lake Winnipeg fish habitat productivity, retaining walls and other shoreline protection works covered approximately 37.17 kilometres or 12% of the surveyed shoreline.

While the Red River is a major sediment source for the south basin, sediment from the erosion of shoreline cliffs and banks is likely also significant. The shoreline movement of sediments and the creation of beaches, littoral shoals, bars and islands is a complex geomorphic process (Chorley et al, 1984). Shoreline hardening, with ongoing and widespread shoreline erosion protection works, that reduces this supply of sediment, or affects the shoreline movement of sediment, may present a long term ecosystem level threat to sand and gravel beaches, islands, shoals and spits. The long term basin wide effects of existing and new shoreline hardening on littoral shoal, island, sand spit and beach development and stability should be reviewed to determine the risk of long term detrimental changes to fish habitats.

Modification: rock gabion retaining wall/sand beach Segment 38 *photo B. MacDonald*

Modification: steel shoreline groyne Segment 30 *photo P. Bloom*

2.2.1.1 Recommendations: Sand and Gravel Beaches

1. Consider implementing a study of south basin shoreline physical processes including sediment supply and current and projected impacts of long term shoreline development (e.g. full build out) of private and crown lands and potential impacts to fish habitats.
2. Design and implement a shoreline erosion project compliance monitoring program to determine if the current advice and recommendations of DFO and the Shoreline Erosion Technical Committee are being observed.
3. Review current shoreline erosion protection techniques and develop as required shoreline erosion project standards and guidelines for the protection of fish and wildlife habitats for use by private land owners.
4. Establish sand and gravel beach fish habitat condition indicator sites and design and implement a long-term fish and wildlife trend monitoring program.
5. Review the current land development setbacks from watercourses, lakeshores and wetlands and increase the development setback from the high water mark and increase the retention of riparian vegetation.
6. Sand/gravel beach ridges and adjacent wetlands should be considered high biodiversity zones and be designated as conservation zones.
7. Develop and implement a lake foreshore stewardship/best management practise guide for lake shore land owners.

2.3. Stream Mouth

The stream mouth habitat type was the least common of all habitat types. The Red River main channel (segment 24) entering the lake was the only designated stream mouth segment. Five other Red River channels were nested in segments 24 - 27. The Brokenhead River (segment 27), Willow Creek (segment 17), Arnason-Siglavik-Miklavik-Husavik complex (segments 15 - 17), Grand Beach Lagoon (segment 37), Hillside Lagoon (segment 43), Beaconia East and West channels (segment 29) were nested as outlets from wetland lagoons. Meleb drain (segment 6), a small stream and the Drunken River (segment 4), a developed harbour/marina, were also nested. There were several small agricultural or municipal drains that entered the foreshore at various locations. All the drains were channelized, blocked, or exited drainage pipes and consequently were permanently or temporally not accessible to fish. The drain pipe locations were geo-referenced.

In general the impacts to stream mouths were minor and confined to the adjacent wetlands with the exception of the heavily modified Drunken River and possibly the Winnipeg Beach marina. The Winnipeg Beach marina was not identified as a stream mouth in the field but a further review indicated this marina may have been constructed in a stream mouth/wetland. Pleasure boat traffic, sometimes at high speed with large

wake, was observed at the entrance to many of the stream channels and adjacent wetlands (i.e. Arnason, Siglavik, Miklavik, Hillside Lagoon).

Stream mouth: boat channel to Arnason Segment 15 *photo P.Bloom*

Stream mouths had the highest number of species captured and the 3rd highest catches of fish. Surface feeding behaviour and several bird species were frequently observed in this habitat type. The small number of tributaries to the south basin and the significant number of species that utilise both lake and river habitats (60) indicate the importance of this habitat type. Stream mouths are well documented as being important upstream and downstream migration corridors, productive rearing areas and dispersal routes between streams, lake and adjacent wetlands. The high biodiversity and habitat value of stream mouths warrant their designation as an important habitat type.

2.3.1. Recommendations: Stream Mouth

1. Stream mouths should be delineated, mapped and designated as conservation zones. Future development should be restricted for a minimum of 250 meters on either side of the channel or to a natural feature (i.e. wetland, topographic break, existing development or vegetation change).
2. Boating speed restrictions should be considered and any current restrictions should be enforced to prevent wake damage to adjacent wetlands and fish and wildlife habitats.

2.4. Wetlands

The wetland habitat type was the third most common habitat type surveyed in the study area. Six segments or 14.75% of the total length of shoreline (3.984 kilometres) were identified. The wetlands classified included those contiguous with the main lake and large wetlands separated from the main lake in places, but not completely, by a narrow beach ridge (i.e. Netley-Libau and segment 2).

No fish were captured in the wetland segments due to sampling difficulties but observations of surface fish activity adjacent to wetlands (open water/lagoon) in segments 13, 27 and 43 and a review of fish species that utilise shallow wetland lagoons and aquatic macrophytes (i.e. carp, pike, emerald shiner, weed shiner, spottail shiner, golden shiner, yellow perch, bullhead spp.) indicates the value of wetlands as important fish habitat. In addition to direct fish habitat value, wetlands are known for maintaining and improving water quality, hydrologic buffering of watersheds, protecting shorelines from wave erosion and storm damage, sequestering carbon and high biodiversity.

Several of the wetland complexes surveyed have been partially developed for commercial marinas or private moorage and recreational boat access to the lake. The impacts include dredging, in-filling replacing wetland vegetation (e.g. cattails) with landscaping, boat launches, docks, roads and buildings. Major development impacts were noted in the Hillside Lagoon and Husavik- Miklavik-Siglavik - Arnason wetland complex with smaller impacts at Chalet beach, Willow Island and Grand Beach and East Beaconia lagoons.

Wetland channels do occur naturally in wetland lagoons and developing additional channels may add open water fish habitat. While DFO may not be able to address all environmental issues with the Fisheries Act of Canada (FA) due to its limited scope, basin wide wetland ecosystem impacts, including biodiversity impacts (i.e. wildlife, plants, amphibians, plants), boat wake impacts, water quality impacts (e.g. oil and gas spills), loss of hydrologic buffering and reduced water quality filtering benefits, from extensive wetland development, can occur if they are not considered and adequately mitigated in development project approvals.

The high biodiversity and ecosystem values of wetlands, and the potential threat from continuing development for recreation and private use of the wetlands in the SHIM south basin survey area warrant consideration of these areas as conservation zones.

2.4.1. Recommendations: Wetlands

1. Wetlands in the Lake Winnipeg south basin should be delineated, mapped and designated as conservation zones.
2. Agencies responsible for reviewing and approving wetland development proposals (federal, provincial and municipal) should review their approval process and ensure all environmental values (site specific and basin wide) are addressed in the approval process.

Wetland development (recent) Segment 15 *photo B. MacDonald*

Wetland development (older) Segment 13 *photo P. Bloom*

2.5. Rocky shore

The rocky shore habitat type represented only 7.49% of the total length of shoreline (22.391 kilometres). Rocky shore was the dominant shore type on the east shore in segments 28, 34, 39, and 41.

Only 3 fish, 2 white bass and 1 sauger, were captured at 4 sample sites. This habitat type was not able to be effectively sampled. The typical fish community that should be expected in the gravel/cobble/boulder substrates include: sauger, rock bass, trout perch, mimic shiner, walleye, sculpin ssp. and channel catfish. The paucity of this habitat type and the value of the fish community (recreational and commercial spp.) support recognition of this habitat type as important.

The rocky shoreline type was generally more stable with more vegetation cover. There was evidence of historic and recent erosion although not as prevalent as the western and southern south basin sand beach segments. There were many historic private land erosion protection works including 22 retaining walls (5th highest by segment), 30 groynes and 15 boat houses (highest segment numbers) in segment 30. There was one large marina/harbour at Balsam Bay. Coarser substrate and bank material (gravel, cobble, boulder), more vegetation cover and lower development densities appeared to mitigate shoreline erosion and reduced the number of erosion protection projects.

Rocky shore: stable natural shoreline Segment 30 *photo P. Bloom*

2.5.1. Recommendations: Rocky Shore

1. Design and implement a shoreline erosion project compliance monitoring program to determine if the current advice and recommendations of DFO and the Shoreline Erosion Technical Committee are being observed.
2. Review current shoreline erosion protection techniques and develop as required shoreline erosion project standards and guidelines for the protection of fish and wildlife habitats for private land owners.
3. Review the current land development setbacks from watercourses, lakeshores and wetlands and increase the development setback from the high water mark and increase the retention of riparian vegetation.
4. Develop and implement a lake foreshore stewardship/best management practise guide for lake shore land owners.

2.6. Other/Modifications

The other habitat type includes foreshore that is heavily developed or influenced by development so that the original habitat value may no longer apply. While some of these shoreline segments still had sand or gravel beaches the foreshore and riparian were almost completely changed from the natural condition. 12.40% of the total length of shoreline (37.080 kilometres) were designated as other. The modification of the shoreline included mixed material retaining walls (rock, concrete, steel, wood, etc.),

roadways with extensive shoreline rip-rap and marinas and harbours (e.g. Gimli) on private, public or commercial land, with much of it below the lake level observed during the survey. Highly modified segments and sites include:

- 6 large marinas at Hnausa, Silver Harbour, Gimli, Winnipeg Beach, Balsam Harbour and Victoria Beach,
- Segments 9,10,18,21,35 and 44.

Gimli Harbour Segment 9 *photo P. Bloom*

Sampling at these shoreline segments was conducted by minnow trap at 1 marina and 2 rock groynes. Two yellow perch juveniles were captured at the marina site (under the dock) and no fish were captured at the rock groynes. Two schools (100+) of juvenile bullhead were observed at Hillside Lagoon marina and Winnipeg Beach marina.

Some fish species commonly use artificial structure for cover. Yellow perch for example are commonly found near docks. Juvenile fish use of voids in rip-rap has also been documented. In addition shallow areas or open water created by infilling and dredging respectively can create habitat for some species. There are however many negative effects of modifying shorelines with vertical walls, dredging littoral areas, removing littoral vegetation (aquatic macrophytes) and sources of large organic debris (shoreline trees). These negative effects of modifying shoreline include: direct loss of living space, reduced benthic invertebrate production, obstruction of shoreline migration, habitat simplification and changes to species interaction dynamics.

In general natural shorelines have higher biodiversity and productivity. Modifications therefore are included as negative factors in the SHIM analysis and classification of lake shoreline.

2.6.1. Recommendations: Other/Modifications

1. Conduct a monitoring program to review the use of shoreline modifications by fish and implement any design changes necessary to address any currently unmitigated impacts.

2.7. Biologically Significant Areas

Important and critical habitats for Lake Winnipeg fish species have been discussed with natural stream mouth and wetlands and wetland/beach ridge habitats noted for biological productivity. At sample sites 26-1 (Red River channel) and 27-1 (adjacent Netley-Libau marsh) small unidentified mollusc shells (<100 mm.) were abundant. Unidentified molluscs were also noted at sample site 33-1(Grand Marais).

2.7.1. Recommendations: Biologically Significant Areas

1. Identify and map all biologically significant areas.

2. See recommendations for all shore types.

2.8. Water Regulation

Lake Winnipeg has been operated as a reservoir since 1976 when hydroelectric facilities were constructed by Manitoba Hydro (MH) on the Nelson River The first generation station to affect the Lake was constructed between 1966 and 1968 at Grand Rapids, using the flow of the South Saskatchewan River to generate hydro power.

On July 8, 2011 the level of Lake Winnipeg rose to 716.9 feet the highest since regulation began in 1976.

Lake shoreline erosion is a serious concern for property owners. In 2010 a severe fall storm caused significant erosion throughout the south basin. Wind can raise the water level particularly in fall and winter by 1.97 ft. – 3.94 ft. (0.6 m – 1.2 m.) (Baird and Stantec, 2000) exacerbating wave erosion. Many recent and active retaining wall and erosion protection works likely targeting 2010 storm erosion sites were observed throughout the south basin during the SHIM survey. The potential impact on fish and fish habitat, of these works, has been discussed (Section 2.7.).

The cause of shoreline erosion in the south basin of Lake Winnipeg is beyond the scope of the SHIM 2011 survey. However ongoing shoreline hardening to prevent erosion may have unanticipated effects on shoreline processes and consequently littoral fish and fish

habitats. Investigation of the links between lake levels, erosion protection works and fish littoral fish habitat impacts should be considered.

2.8.1. Recommendations: Water Regulation

1. Consideration should be given to studying the link between regulation of Lake Winnipeg levels, current and historic (pre-regulation) shoreline erosion,, frequency and causes, severe weather events and potential climate change impacts on future lake levels and the potential links to littoral fish habitat productivity.

3.0. Climate Change

The Lake Winnipeg drainage basin is in an area of North America which is expected, under current climate models (e.g. doubling of CO2 levels), to experience summer surface air temperature increases of more than 6 degrees Celsius and as much as 9 degrees Celsius near southern Lake Winnipeg. Resultant summer soil moisture decreases of more than 30% and up to 50% as well as lower winter precipitation will result in the overall reduction in water supply to Lake Winnipeg which could lead to lower water levels in the lake and tributaries (Franzin, et al 2003).

Lower water levels and increased surface water temperatures will have effects on the fish community and fish use of the littoral areas of the south basin including important tributaries and wetland areas. While consideration of the effects of climate change on the Lake Winnipeg south basin foreshore fish and fish habitat is beyond the scope of the SHIM survey, consideration of potential climate change impacts should be incorporated into present and future land use, water use, and fish and wildlife management plans for the south basin of Lake Winnipeg.

4.0. Summary

The Lake Winnipeg south basin littoral zone contains a diverse and abundant fish community. Sand and gravel beaches although heavily developed above the normal high water level, are important fish habitats. Long term impacts on shoreline process from foreshore hardening should be investigated. Rocky shore while not a common habitat type in the study area, appeared more stable and resilient to wave erosion than gravel and fine textured banks. Naturally vegetated banks and shorelines exhibited less erosion although historic and recent erosion and instability was widespread in sand beach, gravel beach and rocky shore types. Stream mouth and wetland habitats are important areas for biodiversity. Recent developments in these habitats present potentially serious ecosystem threats. Littoral fish and wildlife production is significant in the south basin and immediate consideration should be given to the type, concentration and distribution of development and the potential effects of that development on

ecosystem biodiversity values including fish habitat. Consideration should be given to the establishment of conservation zones in high biodiversity areas.

4.1. Summary of Recommendations:

General:

1. Develop and implement a landowner shoreline habitat restoration guide and hold workshops for interested landowners to help restore degraded fish and wildlife habitats.
2. Develop a citizen science monitoring program to track long term trends in habitat quality and fish and wildlife populations.
3. Establish a requirement for a site specific Environmental Assessment for medium and large projects in sensitive habitats.
4. Review the SHIM data dictionary and consider amending fields to better describe Manitoba Lakes including foreshore topography before initiating new SHIM projects. Changes such as replacing cliff/bluff shore type with low bank/high bank shore type and adding shoreline erosion as a shore modifier (% erosion) rather than a nested site among others should be considered by qualified fish and wildlife professionals.
5. Review the value of shore types such as gravel and sand beach shore types to calibrate the relative habitat value for Manitoba fish species.
6. Designate wetlands, wetland/beach ridges, stream mouths and sand spits and islands as conservation zones.
7. Prepare a development guideline document that identifies the acceptable activities in the various foreshore segments including where detailed environmental assessments are required and where current development guidelines are adequate.
8. Conduct detailed assessments of biologically productive areas so they may be more accurately delineated.

Sampling

1. Beach seining did not prove effective for sampling rocky shore habitats. Minnow traps did not catch fish in most sampling rocky shore habitat, large organic debris (LOD) habitat, wetlands (cattail marsh) or modification (e.g. rock groynes) sample sites. In addition, sampling was conducted in summer only (August 4-7, 2011) in a particularly wet year with very high lake levels (July 8 maximum level 716.9 feet, October 15, 714.7 feet).

   Additional sampling should be conducted by electrofisher in the rocky shore, LOD, wetland habitats and modifications. In addition, trap netting and/or gill netting should be considered to provide additional fish distribution information for

adult life stages. Sampling in spring and fall is also recommended to allow observation of the shoreline and sampling of beach habitat at lower water levels.

Sand and Gravel Beaches

1. Consider implementing a study of south basin physical shoreline processes including sediment supply and current and the projected impacts of long term shoreline development (e.g. full build out) of private and crown lands.
2. Design and implement a shoreline erosion project compliance monitoring program to determine if current advice and recommendations of DFO and the Shoreline Erosion Technical Committee are being observed.
3. Review current shoreline erosion protection techniques and develop shoreline erosion project standards and guidelines for the protection of fish and wildlife habitats for private land owners.
4. Establish sand and gravel beach fish habitat indicator sites and design and implement a long term fish and wildlife trend monitoring program.
5. Review the current land development setbacks from watercourses, lakeshores and wetlands and increase the development setback from the high water mark and increase the retention of riparian vegetation.
6. Sand/gravel beach ridges and adjacent wetlands should be considered high biodiversity zones and be designated as conservation zones.
7. Develop and implement a lake foreshore stewardship/best management practise guide for lake shore land owners.

Stream Mouth

1. Stream mouths should be delineated, mapped and designated as conservation zones. Development should be restricted for a minimum of 250 meters on either side of the channel or to a natural feature (i.e. wetland, topographic break, existing development or vegetation change).
2. Boating speed restrictions should be considered and any current restrictions should be enforced to prevent wake damage to adjacent wetlands and fish and wildlife habitats

Wetlands

1. Wetlands should be delineated, mapped and designated as conservation zones.
2. Design and implement a wetland development fish and wildlife monitoring program to determine if current development standards have achieved habitat protection goals and standards.

Rocky Shore

1. Design and implement a shoreline erosion project compliance monitoring program to determine if the current advice and recommendations of DFO and the Shoreline Erosion Technical Committee are being observed.
2. Review current shoreline erosion protection techniques and develop as required shoreline erosion project standards and guidelines for the protection of fish and wildlife habitats for private land owners.
3. Review the current land development setbacks from watercourses, lakeshores and wetlands and increase the development setback from the high water mark and increase the retention of riparian vegetation.
4. Develop and implement a lake foreshore stewardship/best management practise guide for lake shore land owners.

Biologically Significant Areas

1. Identify and map all biologically significant areas.
2. See recommendations for all shore types.

Lake Regulation:

1. Consideration should be given to studying the link between regulation of lake levels, current and historic (pre-regulation) shoreline erosion severity, frequency and causes, potential climate change impacts on future lake levels and the potential links to littoral fish habitat productivity.

References

Literature Cited

Baird and Stantec. 2000. A report prepared by W.F. Baird & Associates Coastal Engineers Ltd. and Stantec Consulting Ltd. 2000. Lake Winnipeg shoreline erosion study. W.F. Baird & Associates Coastal Engineers Ltd., Oakville, Ontario.

Brunskill, G. J., S. E. M. Eliott and P. Campbell. 1980 Morphometry, hydrology and watershed data pertinent to the limnology of Lake Winnipeg. Canadian Manuscript Report of Fisheries and Aquatic Sciences, 1556: 23p.

Chorley, R. J., S. A. Schumm, and D. E. Sugden. 1984. Geomorphology. Methuen & Co. Ltd., New York, NY

Franzin, W. G., K. W. Stewart, G. F. Hanke, and L. Heuring. The Fish and Fisheries of Lake Winnipeg: The First 100 Years. 2003 Central and Arctic Region, Department of Fisheries and Oceans

Hanke, G. F., 1996. A Survey of the Fishes of Lake Winnipeg and Interactions of the Introduced White Bass with the Native Ichythofauna of the Hudson Bay Drainage: with emphasis of young-of-the-year fishes in nearshore environments.

Lysack, W. The Bait Fishery of The Lower Red River, 1983-84. Manitoba Department of Natural Resources, Fisheries Branch. 256 pages.

McPherson, S., D. Hlushak, I. Adams and M. Polzin. 2010. Columbia Lake Sensitive Habitat Inventory and Mapping. Consultant report prepared for the East Kootenay Integrated Lake Management Partnership. Prepared by Interior Reforestation Co. Ltd., Cranbrook, BC

McPherson, S., D. Hlushak, I. Adams and M. Polzin. 2010. Wasa Lake Sensitive Habitat Inventory and Mapping. Consultant report prepared for the Wasa Lake Land Improvement District. Prepared by Interior Reforestation Co. Ltd., Cranbrook, BC

Nielsen, L. A. and D. L. Johnson, editors. 1983. Fisheries Techniques. American Fisheries Society, Bethesda, Maryland.

Schreck, C. B., and P. B Moyle, editors. 1990. Methods for fish biology. American Fisheries Society, Bethesda, Maryland.

Scott, W. B., and E. J. Crossman. 1973. Freshwater Fishes of Canada. Bulletin 184 Fisheries Research Board of Canada, Ottawa, ON

Stewart, K., and D. Watkinson. 2004. The Freshwater Fishes of Manitoba. University of Manitoba Press, Winnipeg, MB

Waters, T. F. 1995. Sediment in Streams: Sources, Biological Effects, and Control. American Fisheries Society Monograph 7. American Fisheries Society, Bethesda, Maryland

Wetzel, R. G. 1975. Limnology. W. B. Saunders Company, Philadelphia, PA

Freshwater Fish of the World – A Status Report
http://ecolocalizer.com/2009/10/14/freshwater-fish-of-the-world-a-status-report/

Government of Canada: COSEWIC Committee on the Status of Endangered Wildlife in Canada
www.cosewic.gc.ca/

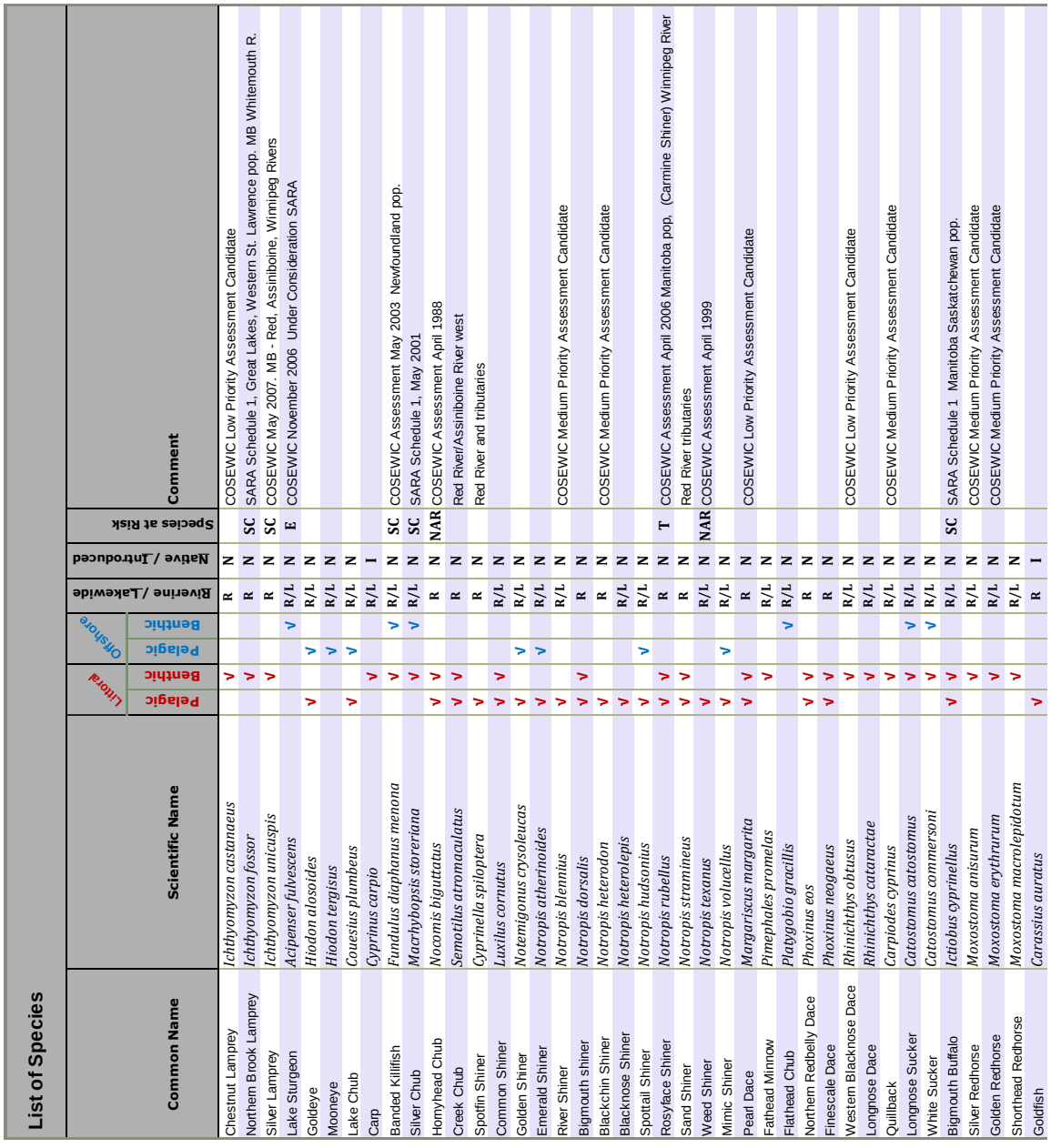
Government of Canada: Species at Risk Public Registry
www.sararegistry.gc.ca

Government of Manitoba: A Field Guild to Common Bait Fish Species in Manitoba.
www.gov.mb.ca/waterstewardship/fisheries/commercial/baitguide.pdf

Government of Manitoba: State of Lake Winnipeg: 1997-2007
http://www.gov.mb.ca/waterstewardship/water_quality/state_lk_winnipeg_report/pdf/state_of_lake_winnipeg_rpt_technical_low_resolution.pdf

Natural Resources Canada: The Atlas of Canada: Freshwater
http://atlas.nrcan.gc.ca/auth/english/maps/freshwater

Appendix 1: Fishes of Lake Winnipeg



List of Species

Common Name	Scientific Name	Littoral: Pelagic	Littoral: Benthic	Offshore: Pelagic	Offshore: Benthic	Riverine /Lakewide	Native /Introduced	Species at Risk	Comment
Chestnut Lamprey	*Ichthyomyzon castaneus*		v			R	N		COSEWIC Low Priority Assessment Candidate
Northern Brook Lamprey	*Ichthyomyzon fossor*		v			R	N	SC	SARA Schedule 1, Great Lakes, Western St. Lawrence pop. MB Whitemouth R.
Silver Lamprey	*Ichthyomyzon unicuspis*		v			R	N	SC	COSEWIC May 2007. MB - Red, Assiniboine, Winnipeg Rivers
Lake Sturgeon	*Acipenser fulvescens*				v	R/L	N	E	COSEWIC November 2006 Under Consideration SARA
Goldeye	*Hiodon alosoides*	v		v		R/L	N		
Mooneye	*Hiodon tergisus*			v	v	R/L	N		
Lake Chub	*Couesius plumbeus*	v		v		R/L	N		
Carp	*Cyprinus carpio*		v			R/L	I		
Banded Killifish	*Fundulus diaphanus menona*		v		v	R/L	N	SC	COSEWIC Assessment May 2003 Newfoundland pop.
Silver Chub	*Macrhybopsis storeriana*		v		v	R/L	N	SC	SARA Schedule 1, May 2001
Hornyhead Chub	*Nocomis biguttatus*	v	v			R	N	NAR	COSEWIC Assessment April 1988
Creek Chub	*Semotilus atromaculatus*	v	v			R	N		Red River/Assiniboine River west
Spotfin Shiner	*Cyprinella spiloptera*	v				R	N		Red River and tributaries
Common Shiner	*Luxilus cornutus*	v	v			R/L	N		
Golden Shiner	*Notemigonus crysoleucas*	v		v		R/L	N		
Emerald Shiner	*Notropis atherinoides*	v		v		R/L	N		
River Shiner	*Notropis blennius*	v				R/L	N		COSEWIC Medium Priority Assessment Candidate
Bigmouth shiner	*Notropis dorsalis*	v	v			R	N		
Blackchin Shiner	*Notropis heterodon*	v				R	N		COSEWIC Medium Priority Assessment Candidate
Blacknose Shiner	*Notropis heterolepis*	v				R/L	N		
Spottail Shiner	*Notropis hudsonius*	v		v		R/L	N		
Rosyface Shiner	*Notropis rubellus*	v	v			R	N	T	COSEWIC Assessment April 2006 Manitoba pop, (Carmine Shiner) Winnipeg River
Sand Shiner	*Notropis stramineus*	v	v			R	N		Red River tributaries
Weed Shiner	*Notropis texanus*	v				R/L	N	NAR	COSEWIC Assessment April 1999
Mimic Shiner	*Notropis volucellus*	v		v		R/L	N		
Pearl Dace	*Margariscus margarita*	v	v			R	N		COSEWIC Low Priority Assessment Candidate
Fathead Minnow	*Pimephales promelas*		v			R/L	N		
Flathead Chub	*Platygobio gracilis*				v	R/L	N		
Northern Redbelly Dace	*Phoxinus eos*	v	v			R	N		
Finescale Dace	*Phoxinus neogaeus*	v	v			R	N		
Western Blacknose Dace	*Rhinichthys obtusus*		v			R/L	N		COSEWIC Low Priority Assessment Candidate
Longnose Dace	*Rhinichthys cataractae*		v			R/L	N		
Quillback	*Carpiodes cyprinus*		v			R/L	N		COSEWIC Medium Priority Assessment Candidate
Longnose Sucker	*Catostomus catostomus*		v		v	R/L	N		
White Sucker	*Catostomus commersoni*		v		v	R/L	N		
Bigmouth Buffalo	*Ictiobus cyprinellus*	v	v			R/L	N	SC	SARA Schedule 1 Manitoba Saskatchewan pop.
Silver Redhorse	*Moxostoma anisurum*		v			R/L	N		COSEWIC Medium Priority Assessment Candidate
Golden Redhorse	*Moxostoma erythrurum*		v			R/L	N		COSEWIC Medium Priority Assessment Candidate
Shorthead Redhorse	*Moxostoma macrolepidotum*		v			R/L	N		
Goldfish	*Carassius auratus*	v				R	I		

List of Species – Page 1 – Chestnut Lamprey to Goldfish

List of Species

Common Name	Scientific Name	Littoral Pelagic	Littoral Benthic	Offshore Pelagic	Offshore Benthic	Riverine / Lakewide	Native / Introduced	Species at Risk	Comment
Black Bullhead	*Ameiurus melas*		√			R/L	N		
Brown Bullhead	*Ameiurus nebulosus*		√			R/L	N		
Channel Catfish	*Ictalurus punctatus*		√			R/L	N		
Stonecat	*Noturus flavus*					R	N		
Tadpole Madtom	*Noturus gyrinus*		√			R	N		
Northern Pike	*Esox lucius*	√				R/L	N		
Central Mudminnow	*Umbra limi*		√			R	N		
Rainbow Smelt	*Osmerus mordax*			√		L	I		Introduced, since 1990
Cisco (Lake)	*Coregonus artedi*	√		√		R/L	N		COSEWIC Medium Priority Assessment Candidate
Lake Whitefish	*Coregonus clupeaformis*			√	√	R/L	N		COSEWIC Medium Priority Assessment Candidate
Blackfin Cisco	*Coregonus nigripinnis*			√	√	L	N		Occurance Uncertain -- Listed in Scott and Crossman
Shortjaw Cisco	*Coregonus zenithicus*				√	L	N	T	COSEWIC Assessment May 2003
Lake Trout	*Salvelinus namaycush*			√		L	N		COSEWIC Low Priority Assessment Candidate
Trout-perch	*Percopsis omiscomaycus*	√	√			R/L	N		
Burbot	*Lota lota*		√		√	R/L	N		
Brook Stickleback	*Culaea inconstans*		√			R/L	N		
Ninespine Stickleback	*Pungitius pungitius*	√		√		L	N		
Mottled Sculpin	*Cottus bairdi*		√			R/L	N		
Slimy Sculpin	*Cottus cognatus*		√			R/L	N		COSEWIC Medium Priority Assessment Candidate
Spoonhead Sculpin	*Cottus ricei*		√			L	N	NAR	COSEWIC Assessment April 1989
Deepwater Sculpin	*Myoxocephalus quadricornis*				√	L	N	SC	SARA Schedule 1 Great Lakes, Western St. Lawrence pop., Whiteshell
White Bass	*Morone chrysops*	√		√		R/L	I		Introduced, since 1962
Rock Bass	*Ambloplites rupestris*	√	√			R/L	N		
Smallmouth Bass	*Micropterus dolomieui*	√				R/L	I		Introduced, since 1900. Mostly lakes
Largemouth Bass	*Micropterus salmoides*	√				L	I		
Pumpkinseed	*Lepomis gibbosus*	√				R/L	N		
Bluegill	*Lepomis macrochirus*	√				R/L	N		
White Crappie	*Pomoxis annularis*	√				R	N		
Black Crappie	*Pomoxis nigromaculatus*	√				R/L	N		
Iowa Darter	*Etheostoma exile*		√			R/L	N		
Johnny Darter	*Etheostoma nigrum*		√			R/L	N		
Yellow Perch	*Perca flavescens*	√		√		R/L	N		
Logperch	*Percin caprodes*		√			R/L	N		
Blackside Darter	*Percina maculata*	√	√			R/L	N		COSEWIC Low Priority Assessment Candidate
River Darter	*Percina shumardi*		√			R/L	N		COSEWIC High Priority Assessment Canidate Manitoba pop.
Sauger	*Sander canadensis*		√		√	R/L	N		
Walleye	*Sander vitreum*		√		√	R/L	N		
Freshwater Drum	*Aplodinotus grunniens*		√		√	R/L	N		
Bluntnose Minnow	*Pimephales notatus*	√	√			R	N	NAR	COSEWIC Assessment April 1998 Red River, Winnipeg River

List of Species – Page 2 – Black Bullhead to Bluntnose Minnow

Appendix 2: Fish Photographs

Juvenile white bass *photo B. MacDonald*

Juvenile quillback *photo B. MacDonald*

Juvenile sauger *photo B. MacDonald*

Goldeye *photo B. MacDonald*

Appendix 3: Shore/Habitat Types

Sand beach Segment 5 *photo B. MacDonald*

Gravel beach Segment 39 *photo B. MacDonald*

Rocky shore Segment 30 *photo B. MacDonald*

Stream mouth (Meleb drain) Segment 6 *photo B. MacDonald*

Wetland Segment 43 *photo B. MacDonald*

Other - marina at Hillside lagoon Segment 43 *photo B. MacDonald*

Appendix 4: Habitat Features/Sample Sites

Large organic debris Segment 27 *photo B. MacDonald*

Large organic debris – minnow trap sample site Segment 30 *photo B. MacDonald*

Modification – recent rip-rap erosion Segment 5 *photo P. Bloom*

Modification –wood/rock retaining wall Segment 5 *photo P. Bloom*

Small gravel substrate Segment 3 *photo B. MacDonald*

Stable and unstable shorelines Segment 36 *photo P. Bloom*

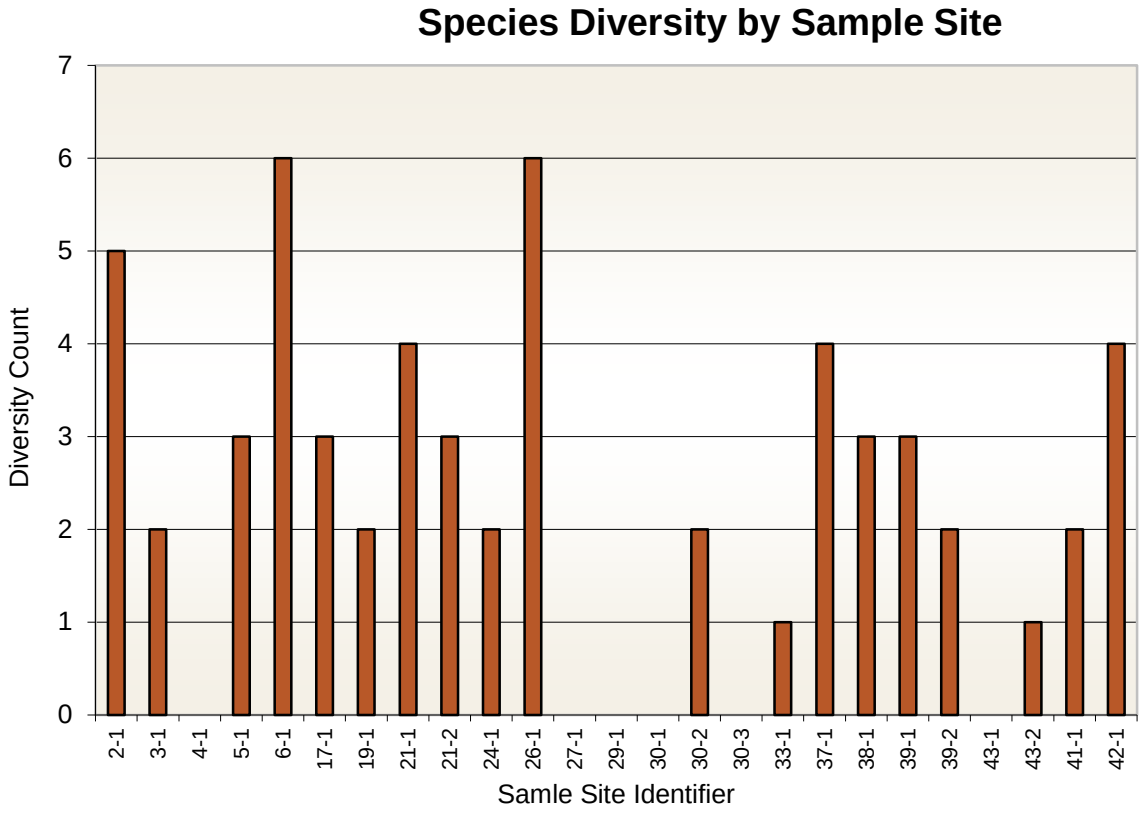
Vegetated shoreline Segment 6 *Photo P. Bloom*

Meleb drain – recreational fishers Segment 6 *photo P. Bloom*

Appendix 5: Relative Abundance by Sample Site

Sample Site	Species Abundance
2-1	48
3-1	4
4-1	0
5-1	572
6-1	43
17-1	83
19-1	48
21-1	17
21-2	17
24-1	8
26-1	266
27-1	0
29-1	0
30-1	0
30-2	11
30-3	0
33-1	6
37-1	264
38-1	12
39-1	96
39-2	5
43-1	0
43-2	2
41-1	3
42-1	458

Appendix 6: Species diversity by sample site



Appendix 7: Letter of Advice

Fisheries and Oceans Canada
Pêches et Océans Canada

Freshwater Institute
Prairies Area, Manitoba District
501 University Crescent
Winnipeg, Manitoba
R3T 2N6
(204) 983-5183

Institut des eaux douces
Secteur des Prairies, District du Manitoba
501 University Crescent
Winnipeg, (Manitoba)
R3T 2N6
(204) 983-5183

Effective until December 31, 2011

Dear Sir or Madam,

Re: Letter of advice for shoreline erosion protection works on Lake Winnipeg in 2010 and 2011

Fisheries and Oceans Canada (DFO) is responsible for protecting fish and fish habitat across Canada. Under the ***Fisheries Act*** no one may carry out a work or undertaking that will cause the harmful alteration, disruption or destruction (HADD) of fish habitat unless it has been authorized by DFO.

DFO – Manitoba District recommends the following mitigation measures be implemented in order to minimize the potential impacts that any shoreline protection works may have on the fish and fish habitat of Lake Winnipeg. If you are unable to meet these measures or if you have questions regarding them, please contact the DFO – Winnipeg Office.

- Shoreline erosion protection works should follow the designs, specifications, and recommendations of an engineer, an expert authority (e.g. the Shoreline Erosion Technical Committee) or a shoreline erosion protection specialist to avoid premature failure and unnecessary impact to the shoreline and the environment.
- Prevent any infilling of Lake Winnipeg by placing all rock riprap above the average annual high water level contour (elevation 217.51 m or 713.5 ft above sea level). While the lakebed above the average annual high water level is normally dry, when water levels are high or during wind setup this area of lakebed may be under water. (Note: Placing rock out into the lake below the average annual high water level contour will typically result in infilling and the destruction of fish habitat which is prohibited under the ***Fisheries Act***. Embedding the toe of the riprap below the lakebed is acceptable).
- Where possible back-slope the bank and install riprap or vegetation plantings (bioengineering) at a slope of 4:1 (horizontal:vertical) or less to improve bank stability.
- Construction should occur when water levels are low and the area to be protected is dry, or during the winter when the area is frozen to the bottom. At all times during construction, ensure that effective measures are taken to prevent sediment from construction activities from entering the lake.
- Use only clean rock for armouring the shoreline and haul it in from an appropriate land-based source. Do not take any rocks from the banks or bed of the lake or any other water body. Avoid using poor quality limestone that breaks down quickly when exposed to the elements. All rock should be clean and free of fine materials that could be washed away by wave action.
- The deposit of deleterious substances into water frequented by fish is prohibited under the ***Fisheries Act***. Appropriate precautions must therefore be taken to ensure that potentially deleterious substances (such as fuel, hydraulic fluids, oil, sediment etc.) do not enter any water body.
- Ensure that equipment operating near any water body is free of external fluid leaks, grease, oil and mud and that any cleaning, fuelling and servicing of equipment is conducted in a manner to prevent the entry of deleterious substances into any water body and an emergency spill kit for in water use is on site during construction.
- Shoreline vegetation is retained to the greatest extent possible to maximize the stability of the bank. Aquatic vegetation should not be removed.
- Install effective temporary and long-term erosion and sediment control measures and re-vegetate any exposed soils in order to prevent the entry of sediment into the lake. Inspect these measures regularly and ensure that they are functioning properly until vegetation is re-established. Make all necessary repairs and adjustments if any damage is discovered or if these measures are not effective in controlling erosion and discharge of sediment.

Canada

- Planting native vegetation (e.g. willows, sedges, deep rooted grasses, etc.) within and behind the riprap, or using bioengineering / biotechnical stabilization treatments is encouraged as shoreline vegetation is a valuable component of fish habitat and deep rooted native plants can improve the ability of the shoreline to resist erosion. Consult a riparian (shoreline) plant specialist to determine the appropriate plant species and maintenance activities that are required to re-establish this vegetation.

By implementing these additional measures, it is our opinion that the proposed works and undertakings will not likely result in the harmful alteration, disruption or destruction (HADD) of fish habitat, and therefore a subsection 35(2) Authorization is not necessary.

You could contravene subsection 35(1) of the ***Fisheries Act*** if a HADD of fish habitat results from any change in your proposed plan or from failure to properly implement these additional measures. Subsection 35(1) states, ***"no person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat."***

This letter of advice does not permit the deposit of a deleterious substance (section 36 of the ***Fisheries Act***) into waters frequented by fish nor does it release you from the responsibility to obtain any other Federal (for example, the *Navigable Waters Protection Act*), Provincial or Municipal approvals. You are solely responsible for the engineering and construction of the shoreline protection works at your property, and any resulting damage to the bank or to adjacent shorelines that may result.

It is recommended that a copy of this letter is kept at the work site during construction and is provided to the contractor(s) prior to commencing any work.

Please contact Fisheries and Oceans Canada – Winnipeg Office at (204) 983-5163 should you have any questions regarding the content of this letter.

Sincerely,

Darryl Chudobiak
Habitat Management Team Leader
Manitoba District, Prairies Area

Canada

Part 3

A Survey of Avian and Vegetation Communities in Littoral and Riparian Zones of South Basin of Lake Winnipeg

for Lake Winnipeg Sensitive Habitat Inventory Mapping Project (SHIM) 2011-2012

L.C.M. Ross and P.K. Rose

Native Plant Solutions – Ducks Unlimited Canada

Winnipeg, MB

March 2012

TABLE OF CONTENTS

1.0. Wildlife and Vegetation Communities of Lake Winnipeg South Basin

1.1. Overview of sampling strategies for wildlife and shoreline vegetation

Two different surveying strategies provided insight into the wildlife and vegetation communities within the south basin of Lake Winnipeg. Incidental wildlife observations were conducted along the entire shoreline between Riverton and Traverse Bay from July 30th to August 4th, 2011 (see shoreline segment numbers in Appendix 4). Surveys were conducted from a boat operated approximately 30m offshore. All wildlife observed between the boat and the shoreline (littoral zone), or within a 30m buffer upslope of the high water mark (riparian zone), are included in the data. These sightings provided valuable insight into habitat use and preference of avian communities within the south basin. A second round of more intensive wildlife and vegetation sampling occurred in the south basin between August 4th and 7th, 2011. Wildlife and vegetation surveys were conducted both off and on-shore at 23 locations in the south basin (refer to main SHIM report for sampling locations).

Survey sites were selected to represent the variety of shoreline types recorded during the Foreshore Inventory and Mapping (FIM) portion of the project (Figure 1). Each shoreline type was sampled at least once and both natural and developed shorelines of each type were sampled during the more intensive sampling survey. *Note in upper part Fig 1. Y axis should read No. segments of observed shore types. Note: total number of segments shown by graph = 48 (2 missing)*

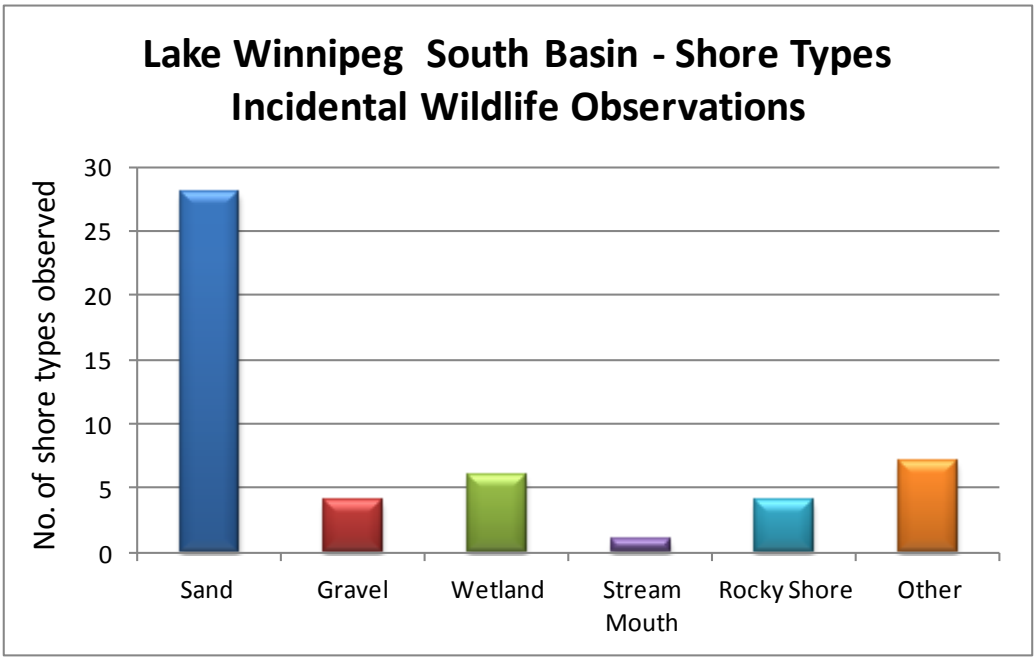


Figure 1a. Shows the variety of shoreline types and number of shoreline types sampled for wildlife and vegetation through incidental and intensive observations in the Lake Winnipeg south basin. (Note: habitat type "Other" are highly modified shorelines).

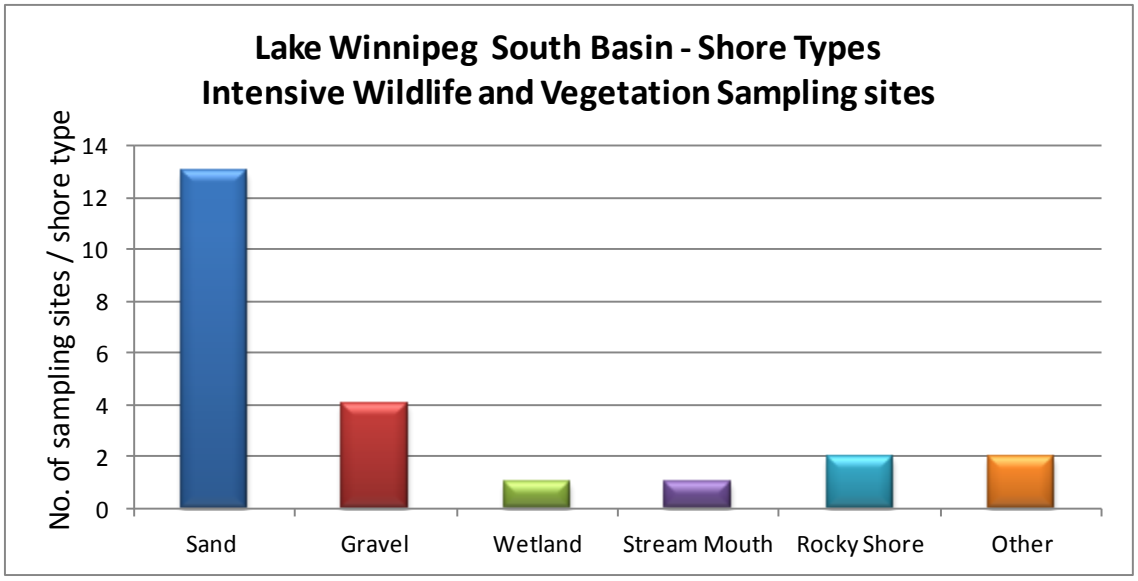


Figure 1b. Shows the variety of shoreline types and number of shoreline types sampled for wildlife and vegetation through incidental and intensive observations in the Lake Winnipeg south basin. (Note: habitat type "Other" are highly modified shorelines).

1.2. Wildlife Survey Results

1.2.a. Incidental wildlife observation in the South Basin

Twenty-five bird species, representing nine avian guilds, were observed through incidental observations in the Lake Winnipeg south basin (Table 1). Incidental observations were critical for collecting data on many overwater or on-the-water bird species. Observations from the boat, moving at a slow speed, meant we were able to observe many species without disturbing them. It is important to note that not all species observed during the incidental sightings were also observed during the onshore wildlife surveys, and visa versa. Birds were the most common wildlife observed, with one observation of a muskrat (*Ondatra zibethicus*) in Willow Bay.

Table 1. Incidental wildlife observations in the Lake Winnipeg south basin SHIM 2011

Guild	Common Name	Scientific Name	Species Code
Raptors:	Bald Eagle*	*Haliaeetus leucocephalus*	BAEA
	Golden Eagle	*Aquila chrysaetos*	GOEA
	Osprey	*Pandion haliaetus*	OSPR
	Swainson's Hawk	*Buteo swainsoni*	SWHA
	Turkey Vulture*	*Cathartes aura*	TUVU
Fish Eaters:	Double Crested Cormorant*	*Phalocrocorax auritus*	DCCO
	Common Loon	*Gavia immer*	COLO
	Common Merganser	*Mergus merganser*	MERG
	Western Grebe	*Aechmophorus occidentalis*	WEGR
	American White Pelican*	*Pelecanus erythrorhynchos*	AMWP
Insectivores:	Bank Swallow*	*Riparia riparia*	BASW
	Tree Swallow*	*Tachycineta bicolor*	TRSW
	Western Kingbird	*Tyrannus verticalis*	WEKI
Shorebirds:	Spotted Sandpiper*	Actitis macularius	SAPI
	Wilson's Phalerope	*Phalaropus tricolor*	PHAL
Gulls and Terns:	Common Tern*	*Sterna hirundo*	COTE
	Black Tern	*Chlidonias niger*	BLTE
	Herring Gulls*	*Larus smithsonianus*	GULL
	Ring-billed Gulls*	*Larus delawarensis*	GULL
Waterfowl:	Canada Goose*	*Branta canadensis*	CAGO
	Mallard*	*Anas platyrhynchos*	MALL/DUCK
	Blue-winged Teal	*Anas discors*	BWTE/DUCK
Corvids:	American Crow*	*Corvus brachyrhynchos*	AMCR
Blackbirds:	Red-winged Blackbird*	*Agelaius phoeniceus*	RWBB
Heron:	Great Blue Heron*	*Ardea herodias*	GBHE

* Indicates those species observed during both incidental and onshore surveys.

Approximately 2221 birds were observed and counted across all 50 south basin shoreline segments during the 5 days of observations from the boat. Incidental observations were highest in segments 31 and 32, followed by segments 12, 23, 25, 37, and 1 (Figure 2). Segments 1, 12, and 32 were sand spits. Segment 31 was a marsh area on the east shore, while segment 23 was a beach ridge separating Lake Winnipeg from Netley Marsh. Segment 25 contained wetland areas interspersed with small cut channels. Segment 37 was unique in that it possessed a fairly intact mature mixed forest shoreline for most of its length.

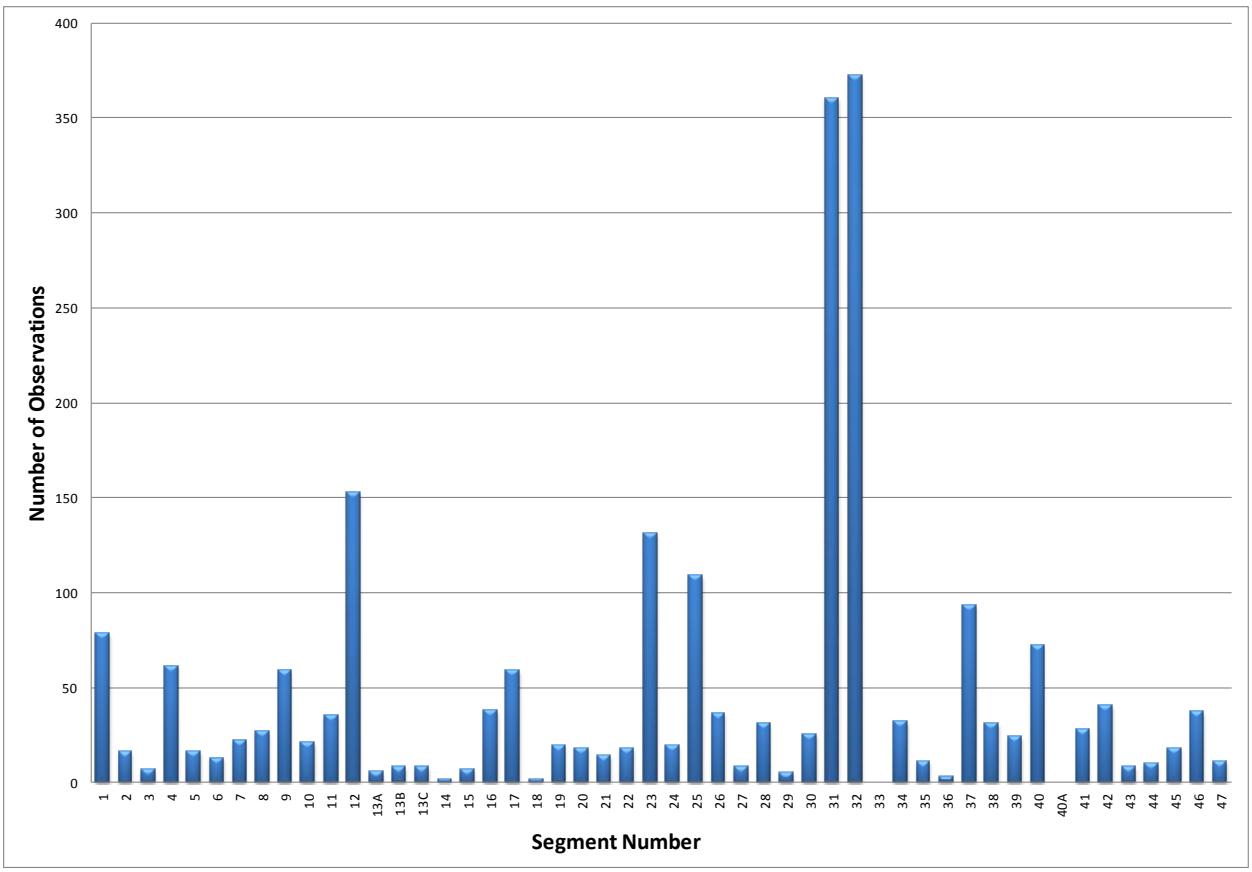


Figure 2. Incidental bird sightings observed by segment number in Lake Winnipeg south SHIM 2011

Ring-billed and herring gulls were the most prevalent birds observed in the south basin, followed by American white pelicans, common terns, Canada geese, various waterfowl species and the American bald eagle (Figure 3). Gulls and Terns, Fish Eaters, and Waterfowl were the most prevalent guilds in the south basin (Figure 4).

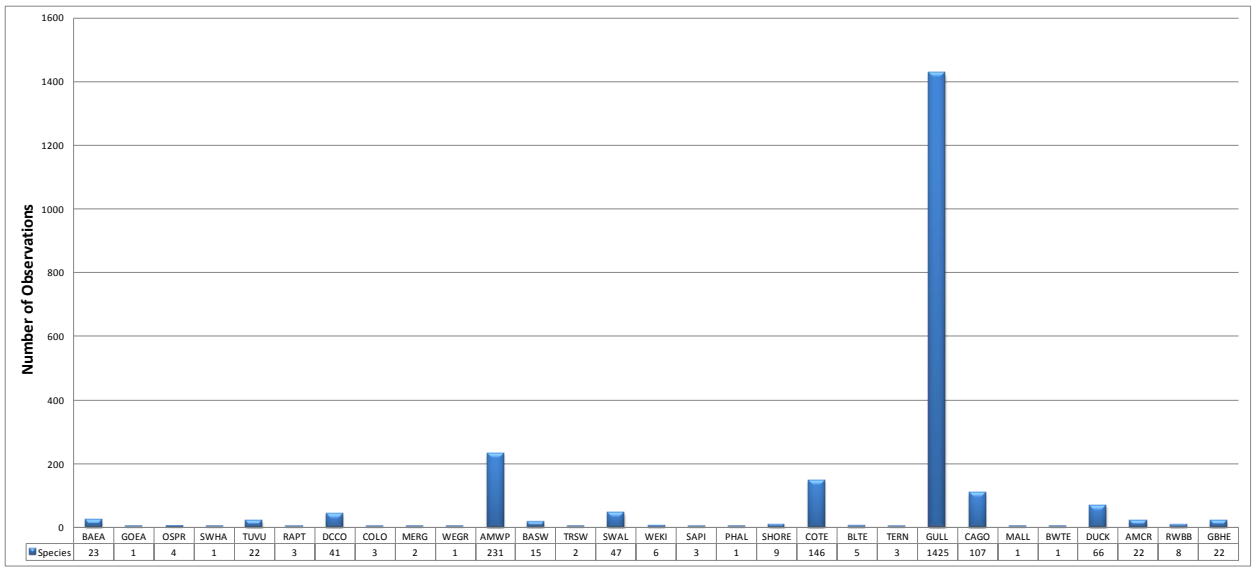


Figure 3. Total count of each bird species observed in the Lake Winnipeg south basin through incidental observations.

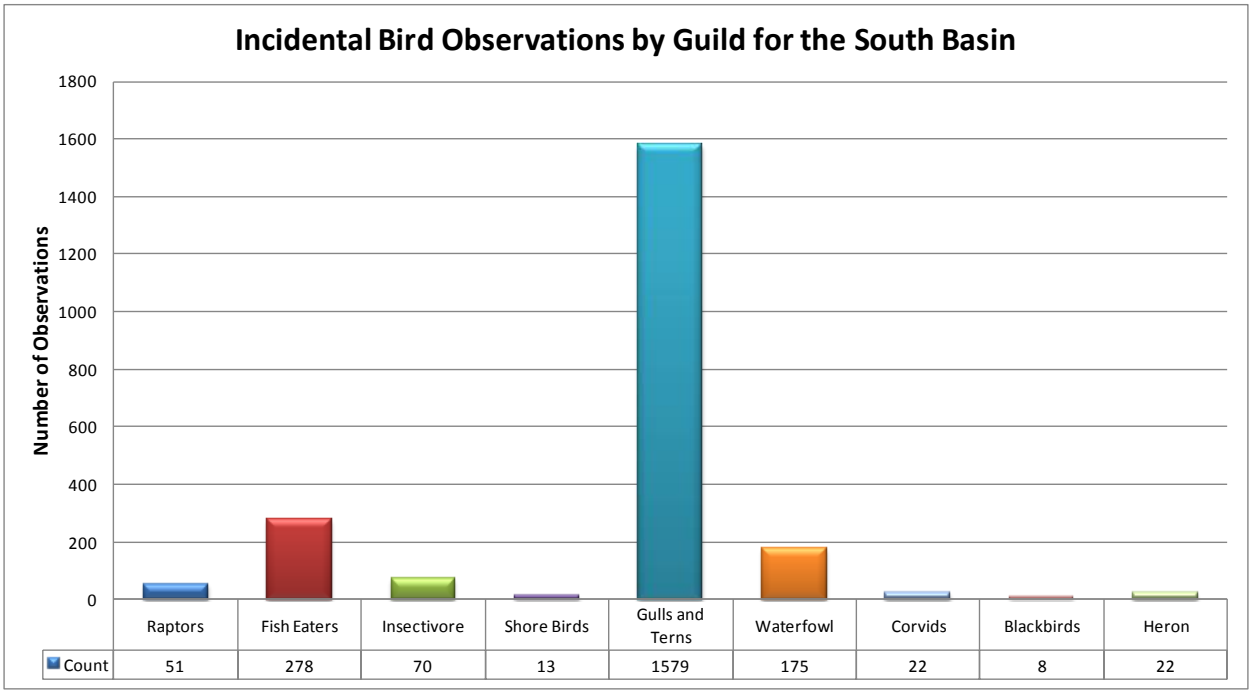


Figure 4. Incidental birds observations by guild in the Lake Winnipeg south basin.

Once the field portion of the Lake Winnipeg south basin SHIM study was complete, each habitat segment was designated a specific shore type based on the most dominant shore type present within that segment. Incidental observations by segment number were then rolled up to a shore type designation to better understand which shore types supported the greatest avian populations. Figure 5 presents the number of

avian observations by shoreline type. The sandy shore type was the most preferred habitat by avian communities in the Lake Winnipeg south basin.

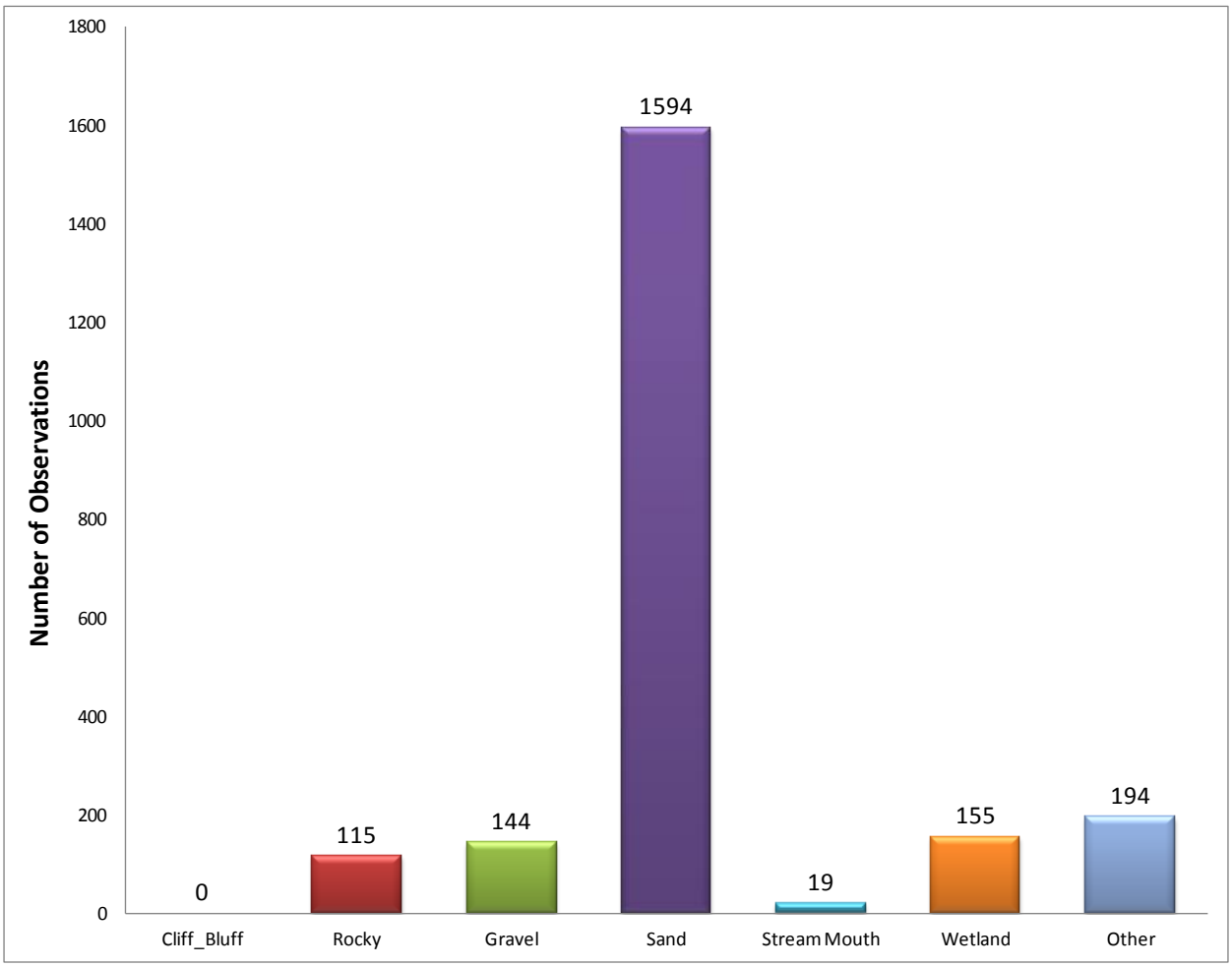


Figure 5. Number of birds observed in Lake Winnipeg south basin by shoreline type (Note: No bird observations were made in segments dominated by cliff bluff habitat)

1.2.b. Onshore species observed in the Lake Winnipeg south basin

While incidental wildlife observations provided good information on overwater and on-the-water species in the south basin, onshore wildlife observations were crucial for identifying many smaller riparian species, such as songbirds. Thirty-eight bird species, two amphibian species, 1 mammal species, and 6 invertebrate species were identified during the 4 days of onshore sampling in early August (Table 2, Table 3). For vegetation, 13 species of trees and shrubs were observed, in addition to 9 grass and submergent plant species (Table 3).

Table 2. Onshore avian observations in Lake Winnipeg south basin.

Guild	Common Name	Scientific Name
Raptors:	Bald Eagle	*Haliaeetus leucocephalus*
	Cooper's Hawk	*Accipiter cooperii*
	Turkey Vulture	*Cathartes aura*
Fish Eaters:	Double Crested Cormorant	*Phalocrocorax auritus*
	American White Pelican*	*Pelecanus erythrorhynchos*
Songbirds:		
Insectivore:	Bank Swallow	*Riparia riparia*
	Tree Swallow	*Tachycineta bicolor*
	Eastern Kingbird	*Tyrannus tyrannus*
	Yellow Warbler	*Setophaga petechia*
	Baltimore Oriole	*Icterus galbula*
	Marsh Wren	*Cistothorus palustris*
	Palm Warbler	*Setophaga palmarum*
	House Wren	*Troglodytes aedon*
	Northern Flicker	*Colaptes auratus*
	Red-eyed Vireo	*Vireo olivaceus*
	Yellow-bellied Flycatcher	*Empidonax flaviventris*
	Olive-sided Flycatcher*	*Contopus cooperi*
	Ruby Throated Hummingbird**	*Archilochus colubris*
Granivore:	American Goldfinch	*Spinus tristis*
	Song Sparrow**	*Melospiza melodia*
	White-crowned Sparrow**	*Zonotrichia leucophrys*
Frugivore:	Cedar Waxwing**	*Bombycilla cedrorum*
Shorebirds:	Spotted Sandpiper	*Actitis macularius*
	Solitary Sandpiper	*Tringa flavipes*
	Semipalmated Plover	*Charadrius semipalmatus*
	Lesser Yellow Legs	*Tringa flavipes*
Gulls and Terns:	Common Tern*	*Sterna hirundo*
	Herring Gulls	*Larus smithsonianus*
	Ring-billed Gulls	*Larus delawarensis*
Waterbirds:	Canada Goose	*Branta canadensis*
	Mallard	*Anas platyrhynchos*
	Sora	Porzana carolina
Corvids:	American Crow	*Corvus brachyrhynchos*
	Common Raven	*Corvus corax*
	Common Grackle	*Quiscalus quiscula*
	Black-billed Magpie	*Pica hudsonia*
Blackbirds:	Red-winged Blackbird	*Agelaius phoeniceus*
Heron:	Great Blue Heron	*Ardea herodias*

***** SARA Schedule 1; COSEWIC Threatened in November 2007

****** Opportunistic feeder

Table 3. Onshore wildlife and vegetation observations in Lake Winnipeg south basin.

Guild	Common Name	Scientific Name
Amphibians:	American Toad	*Bufo americanus*
	Northern Leopard Frog	*Rana pipiens*
Mammal:	Franklin's Ground Squirrel	*Spermophilus franklinii*
Invertebrates:	Cicadas	Order Hemiptera
	Monarch butterfly	*Danaus plexippus*
	Damselfly	Suborder Zygoptera
	Dragonfly	Suborder Anisoptera
	Caterpillar	Order Lipidoptera
Trees:	Balsam Poplar	*Populus balsamifera*
	Jack Pine	*Pinus banksiana*
	White Spruce	*Picea glauca*
	Trembling Aspen	*Populus tremuloides*
	Crab Apple	*Malus sp.*
	Eastern Cottonwood	*Populus deltoides*
	Green Ash	*Fraxinus pennsylvanica*
	American Elm	*Ulmus americana*
	Bur Oak	*Quercus macrocarpa*
	Black Spruce	*Picea mariana*
	White Pine	*Pinus strobus*
	Manitoba Maple	*Acer negundo*
	White Birch	*Betula papyrifera*
Shrubs:	Willow	*Salix* sp.
	Rose	*Rosa* sp.
	Wild Plum	*Prunus americana*
	Chokecherry	*Prunus virginiana*
	Redosier Dogwood	*Cornus sericea*
	River Alder	*Alnus incana*
	Wild Raspberry	*Rubus idaeus*
	Virginia Creeper	*Parthenocissus quinquefolia*
	Caragana	*Caragana sp.*
	Purple Milkvetch	*Astragalus agrestis*
	Low Bush Cranberry	*Vaccinium oxycoccos*
	Beaked Hazelnut	*Corylus cornuta*
	Saskatoon	*Amelanchier alnifolia*
Grass/submergents:	Cattail	*Typha* sp.
	Smartweed	*Polygonum* sp.
	Duckweed (floating?)	*Lemna* sp.
	Common Reed Grass	*Phragmites australis*
	Water Milfoil	*Myriophyllum* sp.
	Reed Canary Grass[A]	*Phalaris arundinacea*
	Giant Burreed	*Sparganium eurycarpum*
	River Bulrush	*Schoenoplectus fluviatilis*
	Purple Loosestrife[A]	*Lythrum salicaria*

[A] Classified as invasive.

1.2.c. Diversity and abundance of onshore species observed in Lake Winnipeg south basin by shoreline type

Sand beach shorelines supported the greatest diversity of both wildlife and tree species, while gravel shorelines supported the greatest diversity of shrub species (Figure 6). Due to the physical nature of wetlands, very few tree or shrub species were observed in these locations during onshore observations. The "*other*" category for shoreline habitat included shores which were highly modified by either rip-rap and/or retaining walls. This category also included all marinas and harbours in the south basin, such as Gimli Harbour. Marinas, harbours, rip-rap infrastructure and retaining walls provide good perching habitat for many avian species. This may be why we observed more diversity for wildlife in this category than we observed for either tree or shrub species.

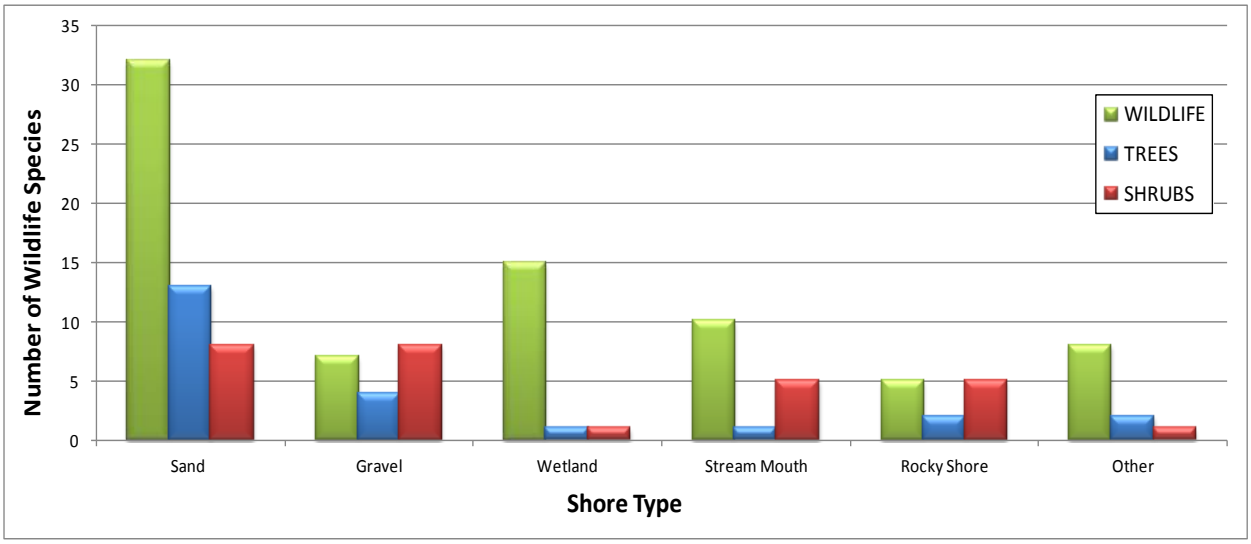


Figure 6. Number of onshore species observed by shore habitat type in the Lake Winnipeg south basin for wildlife, trees and shrubs.

The most common tree species observed in the Lake Winnipeg SHIM onshore survey were green ash, trembling aspen, Manitoba maple, white birch, and balsam poplar. Willow and red osier dogwood were the two most common shrub species observed. For wildlife species, gulls, terns, Canada geese, and pelicans were the most common species observed for onshore surveys. Most species of plant and wildlife found in the "*other*" shore type were relatively common and abundant in one or many of the other shoreline types as well. This includes species such as green ash, willow, gulls, terns,

kingbirds and yellow warblers. We found very few species that were specific to just the "other" shore type.

It is apparent that sand beach shoreline types play an integral role in supporting not only the number of species occurring in the south basin of the Lake, but their abundance as well. Sand beach shorelines dominated observation counts for wildlife, trees and shrubs in the south basin (Figure 7, Figure 8). Wildlife counts were also relatively high on the "other" shoreline habitat type as well. This is likely for the reasons mentioned in the preceding paragraph. Not surprisingly, gravel and rocky shorelines were also important for tree and shrub abundance.

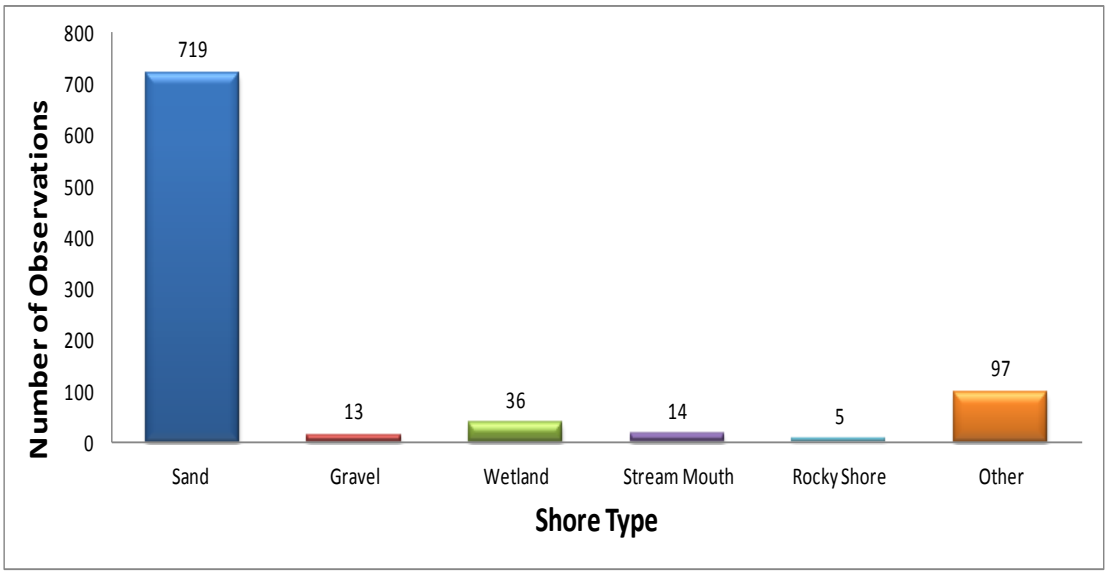


Figure 7. Total number of onshore wildlife observations by shoreline habitat type in Lake Winnipeg south basin.

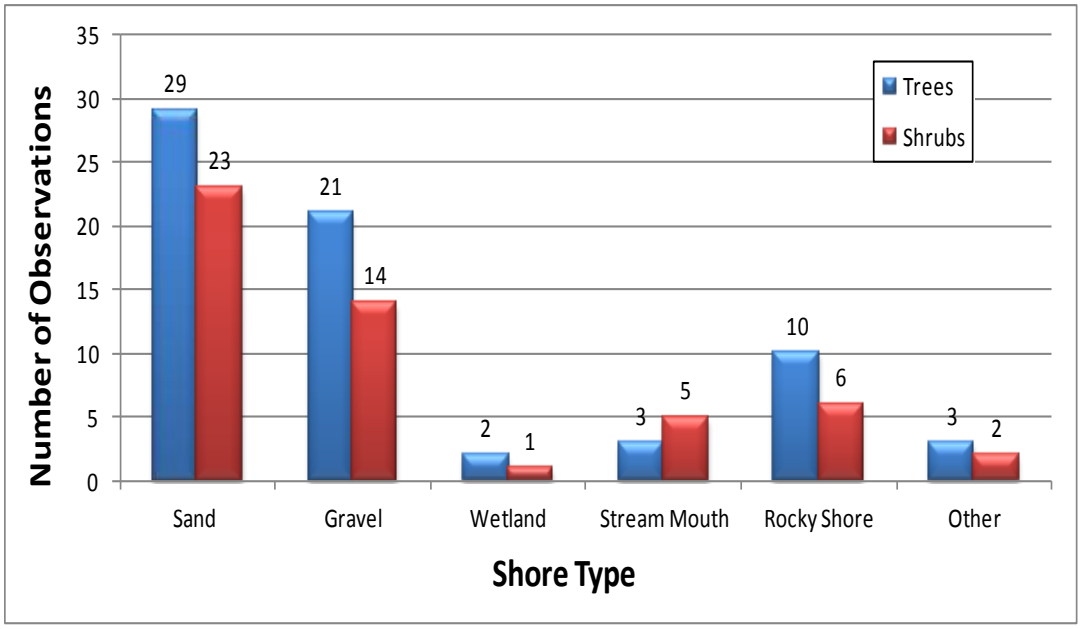


Figure 8. Total number of tree and shrubs observed in different shoreline habitat types in Lake Winnipeg south basin.

We suspected during our field observations that a majority of the wildlife we observed occurred on sand spits. Of the 719 wildlife observations made on sand beach shore types, 88% or 638 of our wildlife observations occurred on sand spits. This demonstrates the importance of sand spits for supporting wildlife, particularly avian species, in the south basin of Lake Winnipeg.

1.2.d. Diversity and abundance of onshore species observations by habitat sensitivity rating

One very important objective of the Lake Winnipeg south basin SHIM project was to rate shoreline habitat based on a number of parameters collected in the field. This rating system led to the identification of five categories, including very sensitive and sensitive shoreline habitats in the south basin of Lake Winnipeg (see main report for south basin shoreline ecological habitat index rankings). The rating system can provide guidance to landowners, local governments, and area planners on future development and habitat protection. Consequently, it was important to determine how wildlife and vegetation observations were reflected within the habitat rating system. Two calculations were conducted. One calculation looked at the number of species that occurred in each of the five sensitivity ratings. The second calculation looked at the number of observations that occurred for each group within the rating system.

Our results indicate that shorelines rated as very sensitive and sensitive habitats under the SHIM rating system are very important for supporting species diversity in the Lake

Winnipeg south basin. The greatest diversity of wildlife and grass/emergent plants occurred in very sensitive shoreline areas of Lake Winnipeg (Figure 9), while sensitive shorelines were important for supporting a high diversity of tree and shrub species. Those shorelines rated as moderate showed the poorest overall diversity for most species.

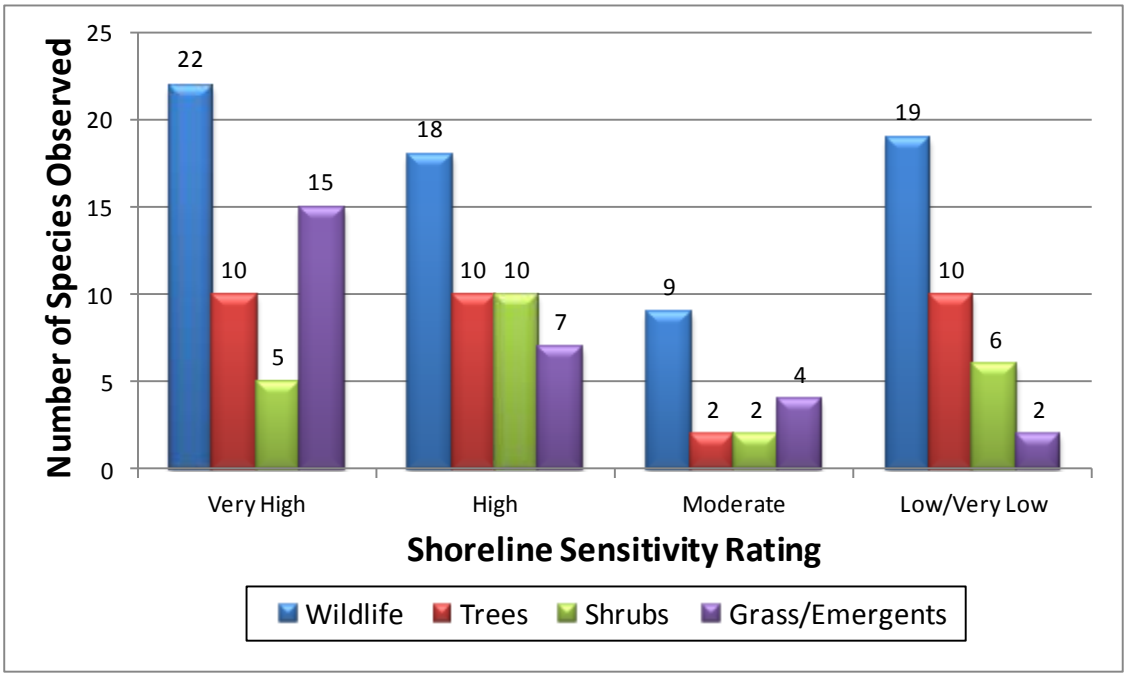


Figure 9. Number of species observed by shoreline sensitivity rating in of Lake Winnipeg south basin shoreline segments.

Not all variables carry the same weight within the shoreline ranking system of SHIM. Wildlife and plants are only a few of the many variables taken into consideration when shorelines are rated as very high, high, moderate, low and very low using SHIM. Therefore, it was not unusual that more wildlife, trees and shrubs were found on sensitive shorelines than on shorelines rated as very sensitive (Figures 10 and 11). This result speaks to the importance of locations such as sand spits for supporting wildlife in Lake Winnipeg. For a variety of reasons, sand spits do not result in a rating of "*very sensitive*" in the SHIM system. Instead, sand spits, because of a lack of dense vegetation and other factors, are ranked as *sensitive habitats*. Therefore it is important to note that shorelines types with lower ratings still play a vital role in supporting biological diversity in and around the Lake.

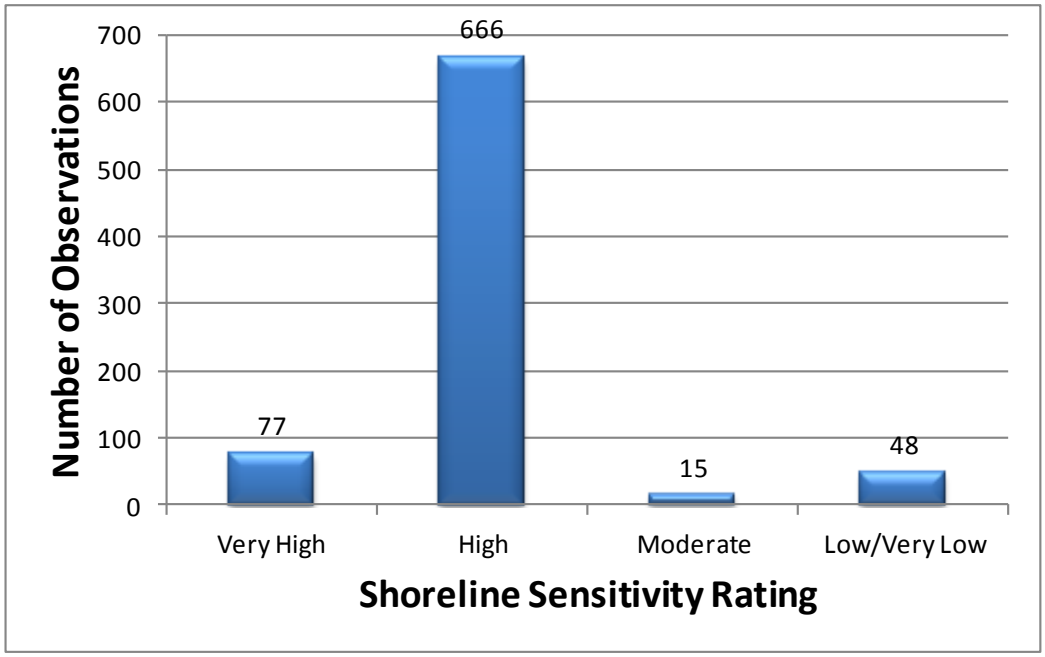


Figure 10. Number of wildlife observed by shoreline sensitivity rating in Lake Winnipeg south basin.

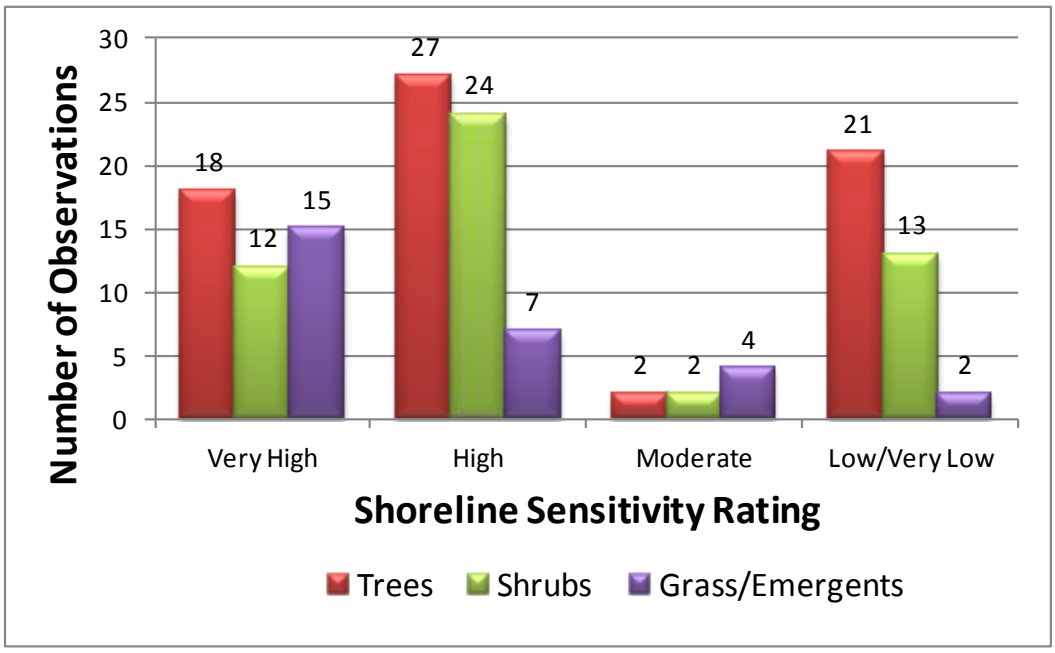


Figure 11. Number of trees, shrubs and grass/emergent plants observed by shoreline sensitivity rating in the Lake Winnipeg south basin.

2.0. Species at risk
2.1a. Birds

A list of bird species that are formally listed under the federal Species at Risk Act (SARA), are under consideration for SARA listing, have been assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or are being considered by COSEWIC for assessment and inhabit the Lake Winnipeg south basin or surrounding area is provided in Appendix 1 (Table 1). Not all of these species rely directly on Lake Winnipeg and its immediate shoreline, but all exist within a short proximity of it and therefore could be affected by management decisions.

There are 5 species currently listed as SARA Schedule 1 *Endangered in Manitoba*, but only one is applicable to the Lake Winnipeg basin, which is the piping plover. Twelve species are listed as SARA Schedule 1 *Threatened in Manitoba* and three other species are listed as *Threatened* by COSEWIC, but have no SARA status. Nine of these species can be found in or around the Lake Winnipeg south basin.

In Manitoba there are two species labeled as SARA Schedule 1 *Special Concern*, a single species labeled as SARA Schedule 3 *Threatened*, and two others designated by COSEWIC as *Threatened*, but have not yet been given a SARA Status. The species found in close proximity to Lake Winnipeg include the horned grebe, rusty blackbird, short-eared owl, and yellow rail.

Twenty-eight other species have been assessed by COSEWIC and deemed *Not at Ris*k and 25 of these are found near the South Basin of Lake Winnipeg. The American white pelican, Cooper's hawk, eastern bluebird, and great grey owl were formerly classified as either *Threatened* or *Special Concern*, but are now considered *Not at Risk*.

Ten species from the Lake Winnipeg south basin region have been listed as candidate species in 2012. Candidate species are defined by COSEWIC as species that have not been assessed yet but are suspected of being at risk of extinction or extirpation, or species that were previously listed as *Not at Risk* or *Data Deficient* and now believed to be at risk. Of these ten species, three are listed as high priority, two are listed as mid priority, and five are listed as low priority.

During the foreshore mapping and wildlife surveys conducted in the summer of 2011 one *At Risk* species, two formerly *At Ris*k species, six other *Not at Risk* species, and two candidate bird species were observed. This consisted of a single Olive-sided flycatcher which is a threatened species, 33 American white pelicans which were designated as *Threatened* until 1987, one Cooper's hawk which was considered a *Special Concern* species until 1996, six eastern kingbirds which are a low priority

candidate species, and an unidentified phalarope which would either be a high or low priority candidate species.

2.1b. Reptiles and amphibians

A list of amphibian and reptile species that are formally listed under SARA, are under consideration for SARA listing, have been assessed by COSEWIC, or are being considered by COSEWIC for assessment and inhabit the Lake Winnipeg South Basin or surrounding area is provided in Appendix (Table 2). In Manitoba there are no species of amphibians listed as *Endangered* or *Threatened* and a single reptile species listed as *Endangered;* however this species is not relevant to the Lake Winnipeg south basin.

Two species of amphibians and one species of reptile are listed as Schedule 1 *Special Concern* and found in Manitoba, but only the northern leopard frog and snapping turtle are found around Lake Winnipeg. Six species of amphibian in Manitoba, 4 of which exist in the Lake Winnipeg south basin have also been assessed by COSEWIC and listed as *Not at Risk*. The painted turtle was also assessed and designated *Not at Risk* and can be found in the Lake Winnipeg south basin.

Two of the *Not at Risk* species found in the study area are flagged for re-examination by COSEWIC and are included in the 2012 candidate species list and these are the mudpuppy and Canadian toad. There are also five new species of amphibian and four species of reptile listed by COSEWIC as candidate species in 2012, which are found in and around the south basin of Lake Winnipeg.

During wildlife surveys conducted in 2011 ten northern leopard frogs, which are a *Special Concern* species and three American toads, which are a *Low Priority* candidate species were detected. Northern leopard frogs are of some significance because COSEWIC divides them into two groups, each with their own designation, and Manitoba is the only province where both groups are present. All western boreal and prairie populations make up one group and are classified as SARA Schedule 1 *Special Concern* and all eastern populations make up the other group and are classified as Not at Risk. The northern leopard frog population around Lake Winnipeg exists along the boundary of both groups and therefore likely to have some influence on each one.

2.1c. Mammals

A list of mammal species that are formally listed under SARA, are under consideration for SARA listing, have been assessed by COSEWIC, or are being considered by COSEWIC for assessment and inhabit the Lake Winnipeg South Basin or surrounding area is provided in Appendix 1 (Table 3). Two mammal species in Manitoba are currently listed by COSEWIC as *Endangered* and are awaiting SARA designation.

There are three mammal species that are classified as *Threatened* by COSEWIC and two of these are SARA Schedule 1 *Threatened*. Two other mammal species in Manitoba are classified as *Special Concern*, but only one is given a SARA status. Two of these *Species at Risk* in Manitoba are found in the vicinity of the Lake Winnipeg South Basin and these include the little brown myotis and northern myotis, which are both classified as *Endangered*. Four mammals whose ranges include the south basin of Lake Winnipeg have also been assessed by COSEWIC but are deemed to be *Not at Risk*. These include the American badger, American bear, Canada lynx, and northern grey wolf. During wildlife surveys conducted in 2011 no mammal *Species at Risk* were observed.

2.1d. Vascular plants

There are currently ten species listed as *At Risk* under SARA, but none of these are found in and around the south Basin of Lake Winnipeg. The Manitoba Conservation Data Centre also recognizes an additional 54 species as being provincially rare or uncommon.

3.0. Introduced and invasive species

The Invasive Species Council of Manitoba has identified a number of invasive species that could significantly impact Manitoba's native flora and fauna. Thirty of these species are known to exist in municipalities within and around the south basin of Lake Winnipeg and these are listed in Appendix 2. During wildlife and vegetation surveys conducted in 2011 purple loosestrife was detected in segments 6, 24, and 25. Reed canary grass was observed in segments 4 and 25. *Caragana* was recorded at segments 6 and 28 and a crabapple tree was recorded on segment 40. Both are introduced, but not considered to be highly invasive. During the same time period cattail, watermilfoil, *Phragmites australis*, and smartweed were also observed at various points along the shoreline. Invasive species of cattail, smartweed, and *Phragmites* are known to exist along with their native counterparts in Manitoba. Manitoba has a number of native species of watermilfoil, but there is growing concern about the spread of Eurasian watermilfoil. Eurasian watermilfoil has been reported, but not confirmed, in southwestern Manitoba within a small portion of the Souris River. It also has established populations in neighboring states and has been confirmed in the Red River Watershed in North Dakota.

4.0 Recommendations

- Conduct surveys during important times of the year (i.e., breeding, migration, spring, summer, fall, etc.)

- Conduct wildlife surveys during the time of day when they are most active (i.e., early morning, sunset)
- Sample each shore type in a way that accurately reflects the presence of that shore type within the south basin (i.e., if 60% of segments are sandy beach then make 60% of sample points on sandy beach)
- Conduct more detailed vegetation surveys that will includes all plant types so that rare and uncommon plants as well as introduced and invasive plants are better accounted for during the onshore survey
- Review weighting standards for the wildlife and vegetation sections in the SHIM sensitivity rating system so that important wildlife and vegetation areas are better reflected in the final results
- Recognize and utilize the survey strengths of both incidental and onshore observations in interpreting future SHIM shoreline surveys
- What was noted through the writing of this document was how little information is available on the wildlife and plant communities in and around Lake Winnipeg. This is surprising considering what a large portion of the province this Lake covers. Most research over the last number of decades has focused on the fish and invertebrate communities, and on water quality.

5.0 References

Government of Canada. 2012. COSEWIC Species Database. Committee on the Status of Endangered Wildlife in Canada. [Online available at: http://www.cosewic.gc.ca/eng/sct1/searchform_e.cfm.]

Government of Canada. 2012. The Prioritized candidate species list. Committee on the Status of Endangered Wildlife in Canada. Retrieved March 12, 2012. [Online available at: http://www.cosewic.gc.ca/eng/sct3/index_e.cfm.]

Government of Canada. 2010. A-Z Species index. Species at risk public registry. [Online available at: http://www.sararegistry.gc.ca/sar/index/default_e.cfm.]

International Union for Conservation of Nature and Natural Resources. 2011. IUCN Red list of threatened species. Version 2011.2. [Online available at: http://www.iucnredlist.org/apps/redlist/search.]

Invasive Species Council of Manitoba. 2012. Invasive species list. Invasive Species Council of Manitoba: Invasive Plants & Animals in Manitoba. [Online available at: http://invasivespeciesmanitoba.com/site/.]

United States Department of Agriculture. 2012. PLANTS database. Natural Resources Conservation Service. [Online available at: http://plants.usda.gov/java/.]

Friesen, C. and Murray, C. 2011. Rare species surveys and stewardship activities by the Manitoba Conservation Data Centre, 2010. Report No. 2010-01. Manitoba Conservation Data Centre, Winnipeg, Manitoba. 24 pp.

Peterson, R. T. 2002. Birds of eastern and central North America (5th ed.). New York, NY: Houghton Mifflin Company.

Appendix 1:

Table 1. Bird species assessed or set to undergo assessment by COSEWIC in the Lake Winnipeg South Basin.

Common Name	Scientific Name	Species at Risk	Comment
Piping Plover *circumcintus* subspecies	*Charadrius melodus circumcinctus*	E	SARA Schedule 1; COSEWIC Threatened in April 1978, Endangered in April 1985, split into subspecies in May 2001, circumcintus designated Endangered in May 2001
Barn Swallow	*Hirundo rustica*	T	SARA No Status; COSEWIC Threatened in May 2011
Bobolink	*Dolichonyx oryzivorus*	T	SARA No Status; COSEWIC Threatened in April 2010
Canada Warbler	*Wilsonia canadensis*	T	SARA Schedule 1; COSEWIC Threatened in April 2008
Chimney Swift	*Chaetura pelagica*	T	SARA Schedule 1; COSEWIC Threatened in April 2007
Common Nighthawk	*Chordeiles minor*	T	SARA Schedule 1; COSEWIC Threatened in April 2007
Golden-winged Warbler	*Vermivora chrysoptera*	T	SARA Schedule 1; COSEWIC Threatened in April 2006
Olive-sided Flycatcher*	*Contopus cooperi*	T	SARA Schedule 1; COSEWIC Threatened in November 2007
Red-headed Woodpecker	*Melanerpes erythrocephalus*	T	SARA Schedule 1; COSEWIC Special Concern in April 1996, Threatened in April 2007
Whip-poor-will	*Caprimulgus vociferus*	T	SARA Schedule 1; COSEWIC Threatened in April 2009
Horned Grebe	*Podiceps auritus*	SC	SARA No Status; COSEWIC Special Concern in April 2009
Rusty Blackbird	*Euphagus carolinus*	SC	SARA Schedule 1; COSEWIC Special Concern in April 2006
Short-eared Owl	*Asio flammeus*	SC	SARA Schedule 3; COSEWIC Special Concern in April 1994
Yellow Rail	*Coturnicops noveboracensis*	SC	SARA Schedule 1; COSEWIC Special Concern in April 1999
American Coot	*Fulica americana*	NAR	
American White Pelican*	*Pelecanus erythrorhynchos*	NAR	COSEWIC Threatened in April 1978, Not at Risk in April 1987
Bald Eagle*	*Haliaeetus leucocephalus*	NAR	
Black Tern*	*Chlidonias niger*	NAR	
Boreal Owl	*Aegolius funereus*	NAR	
Caspian Tern	*Sterna caspia*	NAR	COSEWIC Special Concern in April 1978, Not at Risk in April 1999
Common Loon*	*Gavia immer*	NAR	
Common Tern*	*Sterna hirundo*	NAR	
Cooper's Hawk*	*Accipiter cooperii*	NAR	COSEWIC Special Concern in April 1983, Not at Risk in April 1996
Double-crested Cormorant*	*Phalocrocorax auritus*	NAR	
Eastern Bluebird	*Sialia sialis*	NAR	COSEWIC Special Concern in April 1984, Not at Risk in April 1996
Eastern Screech-Owl	*Megascops asio*	NAR	
Golden Eagle*	*Aquila chrysaetos*	NAR	
Great Grey Owl	*Strix nebulosa*	NAR	COSEWIC Special Concern in April 1979, Not at Risk in April 1996
Merlin	*Falco columbarius*	NAR	
Nelson's Sharp-tailed Sparrow	*Ammodramus nelsoni*	NAR	
Northern Goshawk *atricapillus* subspecies	*Accipiter gentilis atricapillus*	NAR	
Northern Harrier	*Circus cyaneus*	NAR	
Northern Hawk Owl	*Surnia ulula*	NAR	
Red-necked Grebe	*Podiceps grisegena*	NAR	
Red-tailed Hawk	*Buteo jamaicensis*	NAR	
Sandhill Crane *tabida* subspecies	*Grus canadensis tabida*	NAR	
Sedge Wren	*Cistothorus platensis*	NAR	
Sharp-shinned Hawk	*Accipiter striatus*	NAR	
Snowy Owl	*Bubo scandiaca*	NAR	
Evening Grosbeak	*Coccothraustes vespertinus*		COSEWIC High Priority Assessment Candidate
Belted Kingfisher	*Megaceryle alcyon*		COSEWIC High Priority Assessment Candidate
Red-necked Phalarope*	*Phalaropus lobatus*		COSEWIC High Priority Assessment Candidate
Grasshopper Sparrow	*Ammodramus savannarum*		COSEWIC Mid Priority Assessment Candidate
American Kestrel	*Falco sparverius*		COSEWIC Mid Priority Assessment Candidate
Lesser Scaup	*Aythya affinis*		COSEWIC Low Priority Assessment Candidate
Killdeer	*Charadrius vociferus*		COSEWIC Low Priority Assessment Candidate
Conniticut Warbler	*Oporornis agilis*		COSEWIC Low Priority Assessment Candidate
Red Phalarope*	*Phalaropus fulicarius*		COSEWIC Low Priority Assessment Candidate
Eastern Kingbird*	*Tyrannus tyrannus*		COSEWIC Low Priority Assessment Candidate

* Species observed during the Lake Winnipeg shoreline survey.
E = endangered; T = Threatened, SC = Special Concern, NAR = Not at Risk

Table 2. Reptile and amphibian species assessed or set to undergo assessment by COSEWIC in the Lake Winnipeg South Basin.

Common Name	Scientific Name	Species at Risk	Comment
Northern Leopard Frog Western Boreal/Prairie Populations*	*Lithobates pipiens*	SC	SARA Schedule 1; COSEWIC Special Concern in April 1998
Canadian Toad	*Bufo hemiophrys*	NAR	COSEWIC Mid Priority Assessment Candidate Species
Cope's Grey Treefrog	*Hyla chrysoscelis*	NAR	
Mudpuppy	*Necturus maculosus*	NAR	COSEWIC Mid Priority Assessment Candidate Species
Northern Leopard Frog Eastern Populations*	*Lithobates pipiens*	NAR	
Gray Treefrog	*Hyla versicolor*		COSEWIC Mid Priority Assessment Candidate Species
American Toad*	*Anaxyrus americanus*		COSEWIC Low Priority Assessment Candidate Species
Wood Frog	*Lithobates sylvaticus*		COSEWIC Low Priority Assessment Candidate Species
Spring Peeper	*Pseudacris crucifer*		COSEWIC Low Priority Assessment Candidate Species
Boreal Chorus Frog	*Pseudacris maculata*		COSEWIC Low Priority Assessment Candidate Species
Snapping Turtle	*Chelydra serpentina*	SC	SARA Schedule 1; COSEWIC Special Concern in November 2008
Western Painted Turtle	*Chrysemys picta bellii*	NAR	
Smooth Greensnake	*Opheodrys vernalis*		COSEWIC Mid Priority Assessment Candidate Species
Plains Gartersnake	*Thamnophis radix*		COSEWIC Mid Priority Assessment Candidate Species
Red-bellied Snake	*Storeria occipitomaculata*		COSEWIC Low Priority Assessment Candidate Species
Common Gartersnake	*Thamnophis sirtalis*		COSEWIC Low Priority Assessment Candidate Species

* Species observed during the Lake Winnipeg shoreline survey.
E = endangered; T = Threatened, SC = Special Concern, NAR = Not at Risk

Table 3. Mammals assessed or set to undergo assessment by COSEWIC in Lake Winnipeg South Basin.

Common Name	Scientific Name	Species at Risk	Comment
Little Brown Myotis	*Myotis lucifugus*	E	No SARA Status; COSEWIC Endangered in Emergency Assessment in February 2012
Northern Myotis	*Myotis septentrionalis*	E	No SARA Status; COSEWIC Endangered in Emergency Assessment in February 2012
American Badger *taxus* subspecies	*Taxidea taxus taxus*	NAR	
American Black Bear	*Ursus americanus*	NAR	
Canada Lynx	*Lynx canadensis*	NAR	
Northern Grey Wolf	*Canis lupus occidentalis*	NAR	

* Species observed during the Lake Winnipeg shoreline survey.
E = endangered; T = Threatened, SC = Special Concern, NAR = Not at Risk

Appendix 2:

Table 1. Introduced and invasive species known to exist in municipalities within and around the south Basin of Lake Winnipeg.

Common Name	Scientific Name	Category*	Comment
Spotted Knapweed	*Centaurea maculosa*	1	Present in low amounts in nearby municipalities
Blueweed	*Echium vulgare*	2	Present in low amounts in nearby municipalities
Common Tansy	*Tanacetum vulgare*	2	Present in South Basin Municipalities in low and medium amounts
Dalmatian Toadflax	*Linaria dalmatica*	2	Present in South Basin Municipalities in low and medium amounts
Downy Brome	*Bromus tectorum*	2	Present in South Basin Municipalities in medium amounts
European Buckthorn	*Rhamnus cathartica*	2	Present in South Basin Municipalities in low and medium amounts
Flowering Rush	*Butomus umbellatus*	2	Present in low amounts in the city of Winnipeg
Himalayan Balsam	*Impatiens glandulifera*	2	Present in South Basin Municipalities in low amounts
Invasive Phragmites	*Phragmites australis*	2	Present in low amounts in nearby municipalities
Japanese Brome	*Bromus japonicus*	2	Present in South Basin Municipalities in low and medium amounts
Leafy Spurge	*Euphorbia esula*	2	Present in South Basin Municipalities in low and medium amounts
Oxeye Daisy	*Leucanthemum vulgare*	2	Present in South Basin Municipalities in medium and high amounts
Purple Loosestrife	*Lythrum salicaria*	2	Present in South Basin Municipalities in low medium and high amounts
Red Bartsia	*Odontites serotina*	2	Present in South Basin Municipalities in medium and high amounts
Scentless Chamomile	*Matricaria perforata*	2	Present in South Basin Municipalities in medium and high amounts
St. John's Wort	*Hypericum perforatum*	2	Present in low amounts in nearby municipalities
Yellow Toadflax	*Linaria vulgaris*	2	Present in South Basin Municipalities in low and medium amounts
Baby's Breath	*Gypsophila paniculata*	Other	Present in South Basin Municipalities in low and medium amounts
Bull Thistle	*Cirsium vulgare*	Other	Present in South Basin Municipalities in low amounts
Canada Thistle	*Cirsium arvense*	Other	Widespread in Manitoba
Common Burdock	*Arctium minus*	Other	Present in South Basin Municipalities in medium and high amounts
Cow Cockle	*Saponaria vaccaria*	Other	Present in South Basin Municipalities in low and medium amounts
Field Bindweed	*Convolvulus arvensis*	Other	Present in low and medium amounts in nearby municipalities
Orange Hawkweed	*Hieracium aurantiacum*	Other	Present in low amounts in nearby municipalities
Perrenial Sowthistle	*Sonchus arvensis*	Other	Present in South Basin Municipalities in medium and high amounts
Scotch Thistle	*Onopordum acanthium*	Other	Present in low amounts in nearby municipalities
Tall Buttercup	*Ranunculus acris*	Other	Present in low amounts in nearby municipalities
White Cockle	*Lychnis alba*	Other	Present in South Basin municipalities in medium amounts
Narrow-leaved and Hybrid Cattail	*Typha angustifolia and T. angustifolia x T. glauca*	Other	Widespread in Manitoba
Reed Canary Grass	*Phalaris arundinacea*	Other	Present in South Basin municipalities in high amounts

* The classification given to an invasive species by the Invasive Species Council of Manitoba.
Category 1 - Priority Early Detection and Rapid Response species that are not yet found in Manitoba or have recently arrived.
Category 2 - Early Detection and Rapid Response species that have established themselves in Manitoba but to a degree that can still be contained or eradicated
Other - Invasive species that have lower priority and are not included on the Early Detection and Rapid Response list.