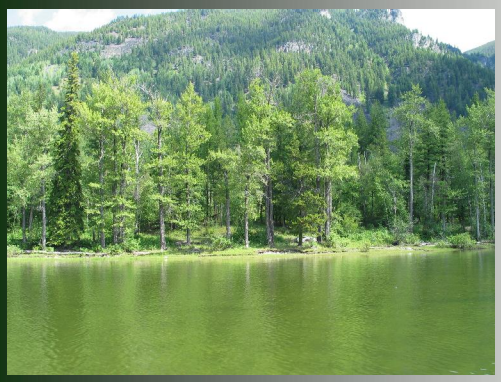
Foreshore Inventory and Mapping and Aquatic Habitat Index

St. Mary Lake



Prepared For:
East Kootenay Integrated Lake Management Partnership

Prepared By:
ECOSCAPE ENVIRONMENTAL CONSULTANTS LTD.

April, 2011
File No. 10-682

FORESHORE INVENTORY AND MAPPING AND AQUATIC HABITAT INDEX

East Kootenay Integrated Lake Management Partnership

St. Mary Lake

Prepared For:

EAST KOOTENAY INTEGRATED
LAKE MANAGEMENT PARTNERSHIP

Prepared By:

ECOSCAPE ENVIRONMENTAL CONSULTANTS LTD.
#102 – 450 Neave Court
Kelowna, B.C.
V1W 3A1

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EXECUTIVE SUMMARY

The East Kootenay region of BC has been increasing in population over the years, raising concerns related to recreational and development pressures on local resource values. As the population within the Columbia watershed has grown, development and recreation pressures have spread to more rural areas, such as St. Mary Lake near Kimberley, BC. It has become apparent that the increased development pressure has the potential to degrade the inherent natural beauty and high recreational values within the watershed and cause negative impacts to fish, wildlife, and water quality. The spread of development to remote areas is the result of an increasing demand for lakeside vacation homes and year-round residences with better overall servicing and access. The increasing development pressures present an opportunity to assess and address foreshore conditions and lakeside development concerns to produce sustainable management plans for future proposed development.

In response to the need for better lake planning and management, the East Kootenay Integrated Lake Management Partnership (EKILMP) undertook an environmental assessment and biophysical inventory of St. Mary Lake to document the current condition of the foreshore and to facilitate the development of an integrated approach to the watershed management. This report has been prepared based upon the belief that it is possible to manage this shoreline and the natural surrounding area in a responsible, sustainable manner.

St. Mary Lake and the associated watershed contribute fresh water and nutrients to the Columbia basin within the Rocky Mountain trench. The lake and its tributaries support resident populations of burbot, kokanee, mountain whitefish, rainbow trout, and westslope cutthroat trout. Bull trout and Dolly Varden are also known to occur. Coarse species such as longnose sucker provide forage for other fish. The shoreline and associated riparian areas also provide important habitat for a wide variety of wildlife species, including raptors (e.g., osprey, bald eagles), song birds, large game (e.g., deer and moose), and numerous other species of birds and small mammals. The federally endangered caribou occurs within the St. Mary watershed.

Similar lake management projects within BC follow a three-step process described below.

1. Foreshore Inventory and Mapping (FIM) is a protocol that is used to collect baseline information regarding the current condition of a shoreline. The FIM uses a mapping based (GIS) approach to describe shorelines. These inventories provide information on shore types, substrates, land use, and habitat modifications. This new information has been combined where possible, with other mapping information such as previous fisheries inventories, recent orthophotos, and other information.

2. An Aquatic Habitat Index (AHI) is generated using the FIM data to determine the relative habitat value of the shoreline. This index follows similar methods that were developed for Shuswap Lake and is similar to other ongoing assessments along lakes in the Kootenay region. The AHI uses factors such as biophysical criteria (e.g., shore type, substrate information, etc.), fisheries information (e.g., juvenile rearing suitability, migration and staging areas), riparian conditions (e.g., width and type of riparian community), terrestrial conditions (e.g., veteran trees, snags), and modifications (e.g., docks, retaining walls, etc.) to estimate the relative habitat value of each discrete shoreline segment. The AHI classifies this information in a 5-category system from Very High to Very Low and describes the relative value of the shoreline segments to one another (i.e., compares shoreline segments along St. Mary Lake to each other and not to other lakes).

3. Shoreline Management Guidelines are prepared to identify shoreline vulnerability zones or sensitivity to changes in land use or habitat modification. Shoreline vulnerability zones are based upon the AHI described above. The shoreline vulnerability zones are identified using a risk-based approach to shoreline management, assessing the potential risks of different activities (e.g., construction of docks, groynes, marinas, etc.) within the shoreline segments. The Shoreline Management Guidelines document is intended to provide background information for stakeholders, proponents, and governmental agencies when land use changes or activities are proposed that could alter the shoreline, thereby affecting fish or wildlife habitat.

The FIM results provide valuable information regarding environmental features, habitats, and other information for the shorelines of St. Mary Lake. A summary of the results of the data analysis includes the following:

- The level of impact along the St. Mary Lake shoreline was determined based upon categorical descriptions of the level of disturbance observed along the lake. It is estimated that 12.0% of the shoreline has a high level of impact (greater than 40% disturbance) which accounts for 1249 m of shoreline. Areas of moderate impact (between 10 to 40% disturbance) account for 20.9% or 2188 m while areas of low impact (less than 10% disturbance) account for 67.19% or 7012 m of the shoreline. There is 0% shoreline that is believed to have no impact. Impacts along the shoreline include lakebed substrate modification, riparian vegetation removal, retaining walls, docks, and beach grooming. Overall, it is estimated that 22% (i.e., 2346 m) of the shore length is disturbed and 78% (i.e., 8104) is natural;

- The most predominant land use around the lake is natural area (74.8%) followed by single family (10.6%) and transportation (8.0%). Other land uses include recreation (5.0%) and commercial (1.6%) areas;

- Stream mouth is the most common shore type along the lake, representing 32.5% of the entire shore length. Other shore types around the lake include Rocky shore (29.4%), Wetland (24.6%), Gravel beach (10.2%), and Sand beach (3.2%);

- Aquatic vegetation occurs along 58.2% of the shoreline length. Of this, emergent vegetation (e.g., cattail and bulrush) was the most commonly observed making up 49.2% of the shoreline. Native beds of submergent vegetation were documented along 38.4% of the shoreline. Floating vegetation was not observed.

- Habitat modifications observed along the St. Mary shoreline include the following:
    - Docks were the most common modification observed, with a total of 7;
    - Retaining walls were the next most predominant modification, with a total of 5;
    - Three (3) groynes were observed. Groynes along the shoreline are typically constructed to improve access and create gravel/sand beaches.
    - Two (2) boat launches were observed;
    - Roadway modification was observed on 1% (76.0 m) of the total shoreline.

The FIM results indicate that the St. Mary Lake shoreline has been moderately impacted by land use practices. Reliance on provincial Best Management Practices and voluntary compliance with regulations and guidance documents are not resulting in the required protection of important fish and wildlife habitats along the shoreline. Shoreline modifications that encroached onto Crown Land (i.e., below the lake high water level) were observed. All relevant agencies and stakeholders need to work with the public to improve communication and education to ensure that everyone is aware of the habitats present, their

values, and the potential influences development activities may have upon them. Recommendations for public awareness and stewardship are presented to facilitate public involvement and compliance in the protection of foreshore. The combination of education and cooperative enforcement will help reduce mitigate future impacts on habitat along the shoreline and help promote the sustainable management of the foreshore.

The AHI for St. Mary Lake provides valuable information regarding the estimated habitat values of different shoreline areas. The AHI is a categorical scale of relative habitat value that ranks shoreline segments from Very High to Very Low. The following summarizes the results of the AHI analysis:

- Approximately 56% of the total shoreline is ranked as High or Very High. These areas are characterized by wetlands, spawning streams, aquatic vegetation, and terrestrial features such as veteran trees and snags.

- Approximately 25% of the total shoreline is ranked as Moderate. Moderate value areas generally occur along shoreline segments impacted by modifications and habitat alteration. These areas provide suitable fish rearing and riparian habitat but have been impacted by modifications related to residential and recreational development.

- Approximately 11% of the shoreline is ranked as Low. These areas occur along the segments characterized by residential development and shoreline modifications. These areas have lower terrestrial and fish habitat values.

- Approximately 8% of the total shoreline is ranked as Very Low. These areas are the most highly developed shorelines and provide the least habitat value for wildlife.

- All areas of the shoreline are considered suitable salmonid rearing habitat. Greater value was placed on shorelines with higher quality rearing habitat (i.e., intact wetland community, aquatic vegetation) and migration and staging habitat for spawning salmonids (e.g., stream mouths). Areas with relatively low juvenile habitat suitability still contribute to overall salmonid production within the lake.

- Greater value was placed on shorelines that provide connectivity between terrestrial and riparian habitats or between different aquatic ecosystems (e.g., St. Mary River corridor). Stream confluences and adjacent features (e.g., wetlands, large woody debris, and diverse riparian vegetation communities) are areas that tend to sustain the highest biodiversity and productivity.

- A restoration analysis for instream features was conducted by hypothetically removing shoreline modifications from the AHI and re-evaluating the segments. The restoration analysis did not include an assessment of how changes in riparian condition would improve relative habitat value. In two cases, the relative value of the segment moved up a category after removing the effects of the modifications. Habitat restoration opportunities include removal of docks, groynes, and retaining walls and restoration of native shoreline substrates. Habitat restoration opportunities should be considered with all proposed development or re-development applications.

Shoreline Management Guidelines are the final step in the three step shoreline management process and will ultimately be used to guide the development of shoreline policies, bylaws, and Official Community Plans. The guidelines will help decision makers to make informed land use decisions across multiple agencies and will help streamline the permitting and regulatory processes at the various governmental levels by focusing resources on areas or activities with the greatest risks.

The inventories and analysis completed during this study are meant to identify important shoreline habitats, biophysical resources, and modifications along St. Mary Lake. As a result, important shoreline areas have been delineated into distinct segments (FIM) and the relative value of each has been categorized (AHI). Although impacts from shoreline modification were observed along the lake, there are important habitats present that require sustainable management to prevent further degradation and to protect the valuable natural resources provided by the lake ecosystem. The sensitive and modified shoreline areas that have been identified should be considered during future shoreline land use decisions and development proposals.

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Jason Schleppe, R.P.Bio., Ecoscape Environmental Consultants Ltd (Ecoscape)
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Jeff Guerin, R.P.F., Fisheries and Oceans Canada

The report was written by:
Adam Patterson, B.Sc. (Ecoscape) and
Jason Schleppe, M.Sc., R.P.Bio. (Ecoscape)

The report was reviewed by:
Jason Schleppe, M.Sc., R.P.Bio. (Ecoscape)

Geographical Information System (GIS) mapping and analysis was completed by:
Robert Wagner, B.Sc. (Ecoscape)

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DISCLAIMER

The results described in this report are based upon data collected during surveys occurring over a one week period. Aquatic and riparian ecosystems are inherently complex and exhibit extreme variability in both space and time. For this reason, conservative estimates and assumptions have been used, based upon field results, previously published material, and aerial photo interpretation. Due to the intrinsic limitations of relatively brief field inventories (e.g., property access, GPS/GIS accuracies, aerial photo interpretation concerns, etc.), professionals are encouraged to complete their own detailed assessments to further evaluate and classify shoreline habitats and draw independent conclusions. Data in this assessment were not analyzed statistically and use of the word 'significance' does not imply statistical significance. Use of or reliance upon conclusions made in this report is the responsibility of the party using the information. Ecoscape Environmental Consultants Ltd., East Kootenay Integrated Lake Management Partnership, Fisheries and Oceans Canada, project partners, and the authors of this report are not liable for data mistakes, omissions, or errors made in gathering data and in preparation of this report. Best attempts were made to verify the accuracy and completeness of the data collected.

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1.0 INTRODUCTION

The East Kootenay region of BC has faced increasing recreational and development pressures on local resource over the last several years, related to population growth and a growing demand for lakefront development. Development pressures have spread to remote corners of the Columbia watershed including outlying areas such as St. Mary Lake near Kimberley, BC. It has become apparent that shoreline development has the potential to degrade the ecological and recreational values inherent within lake systems and result in negative impacts to riparian and aquatic ecosystems. The demand for shoreline development has led to a need to assess and address foreshore conditions and environmental concerns to create sustainable management plans for future proposed development.

The relationship between development pressure, the natural environment, and social, economic, and cultural values is complex and fluctuating. To balance the various community and stakeholder values, a comprehensive understanding of aquatic and riparian resource values, land use interests, and concerns of local residents is required to develop appropriate long-term planning and policy objectives. Development of long term planning objectives at the local, provincial and federal agencies is also required so aquatic resources are effectively managed. Detailed shoreline inventories provide a broad foundation of environmental information which allows stakeholders to better understand the implications of proposed development on identified sensitive shoreline habitats. The intended result of the AHI is to facilitate informed land use planning decisions that balance the various public concerns while protecting important natural resources.

In response to the need for better lake planning and management, the East Kootenay Integrated Lake Management Partnership (EKILMP) undertook an environmental assessment and biophysical inventory of St. Mary Lake to document the current condition of the foreshore and to facilitate the development of an integrated approach to the watershed management. This report has been prepared based upon the belief that it is possible to manage the shoreline and the natural surrounding area in a responsible, sustainable manner. Current management practices being implemented throughout British Columbia in the Shuswap, Okanagan and Kootenay regions are utilizing a three step process to help integrate environmental data with land use planning information to facilitate development review and decision making processes. For this project, steps 1 and 2 below were completed. The three step process involves the following steps:

1. Foreshore Inventory and Mapping (FIM) – FIM is a broad scale inventory process that attempts to define and describe the shoreline of lake systems. The inventory provides baseline information regarding the current condition, and natural features of the shoreline, and characterizes the level of development (e.g., retaining walls, docks, groynes, etc.). The data collected allows managers and the public to monitor shoreline changes over time and to measure whether proposed

land use decisions are meeting their intended objectives. This baseline inventory provides sufficient information to facilitate identification of sensitive shoreline segments as part of step 2 below.

2. Aquatic Habitat Index or Ecological Sensitivity Index (AHI) – The AHI utilizes data collected during the FIM, field reviews, and other data sources (e.g., Land and Data Warehouse, previously published works, etc.) to develop and rank the sensitivity of the shoreline using an index. An index is defined as a numerical or categorical scale used to compare variables with one another or with some reference point. In this case, the index is used to compare the sensitivity of the different shoreline areas around the lake to other shoreline areas within the lake (i.e., the index compares the ecological or aquatic sensitivity of different shoreline areas within the lake system to each other rather than to other lake shorelines). The index provides an indication of the relative value of one shoreline area to another.

3. Shoreline Management Guidelines (Guidelines) - The Guidelines are the final step in the process and are intended to help land managers at all levels of government quickly assess applications and to provide the first step for review, planning, and prescribing shoreline alterations (i.e., land development) by applicants and review agencies. The assessments consider numerous other biological criteria (e.g., wetlands and shore marshes, aquatic vegetation, adjacency to sensitive terrestrial features, migration and staging areas, etc.) making it more inclusive of sensitive shoreline areas.

2.0 PROJECT OVERVIEW

Fish populations within St. Mary Lake have been modified by stocking practices and population management over the years. The current fish community is comprised of an assemblage of native sport fish including bull trout, and westslope cutthroat trout. Rainbow trout and kokanee also occur within the lake but are stocked. Hybridization between cutthroat and rainbow trout has been documented, but generally occurs downstream of the lake, which provides a natural separation between the upper and lower reaches of the St. Mary River (Bisset, pers. comm.). Other resident fish include burbot, longnose sucker, and mountain whitefish. The diverse assemblage of sport fish provides high recreational value within the lake. The lake also provides a recreational destination for boaters, swimmers, and naturalists. Protection of the various environmental values is extremely important because these features are integral to functional lake systems and watershed integrity.

Community members have raised a number of concerns with regard to the impacts adjacent land use and recreational demands are having on the lake. The St. Mary Lake FIM project provides an opportunity for the project partners to support an initiative that will

inform future policy development and allow for improved future management of these resources. The information generated from this project and future steps, including the development of shoreline management guidelines will improve development of policy and management plans. From a local government perspective the project will provide a valuable resource that can be used to make informed decisions regarding land use applications. The mapping protocol will help stakeholders understand the current condition of the shoreline, set objectives for better shoreline management in Official Community Plans or other policy documents, and measure and monitor changes in the shoreline over time.

2.1 Project Partners

FIM protocols have been developed over the last seven years and have formed a standard approach to shoreline inventory. Numerous local governments, non-profit organizations, biological professionals, and provincial and federal agencies have contributed to the development of the FIM protocol. The detailed methods (available as a separate document) provide a complete list of contributing parties. This project was funded by the following agencies and organizations:

1. East Kootenay Integrated Lakes Management Partnership
2. Columbia Basin Trust
3. Canadian Columbia River Inter-Tribal Fishery Commission
4. Wildsight
5. Regional District East Kootenay
6. Fisheries and Oceans Canada
7. Community Mapping Network
8. Ministry of Environment

2.2 Objectives

The general objectives of the St. Mary Lake FIM project include the following:

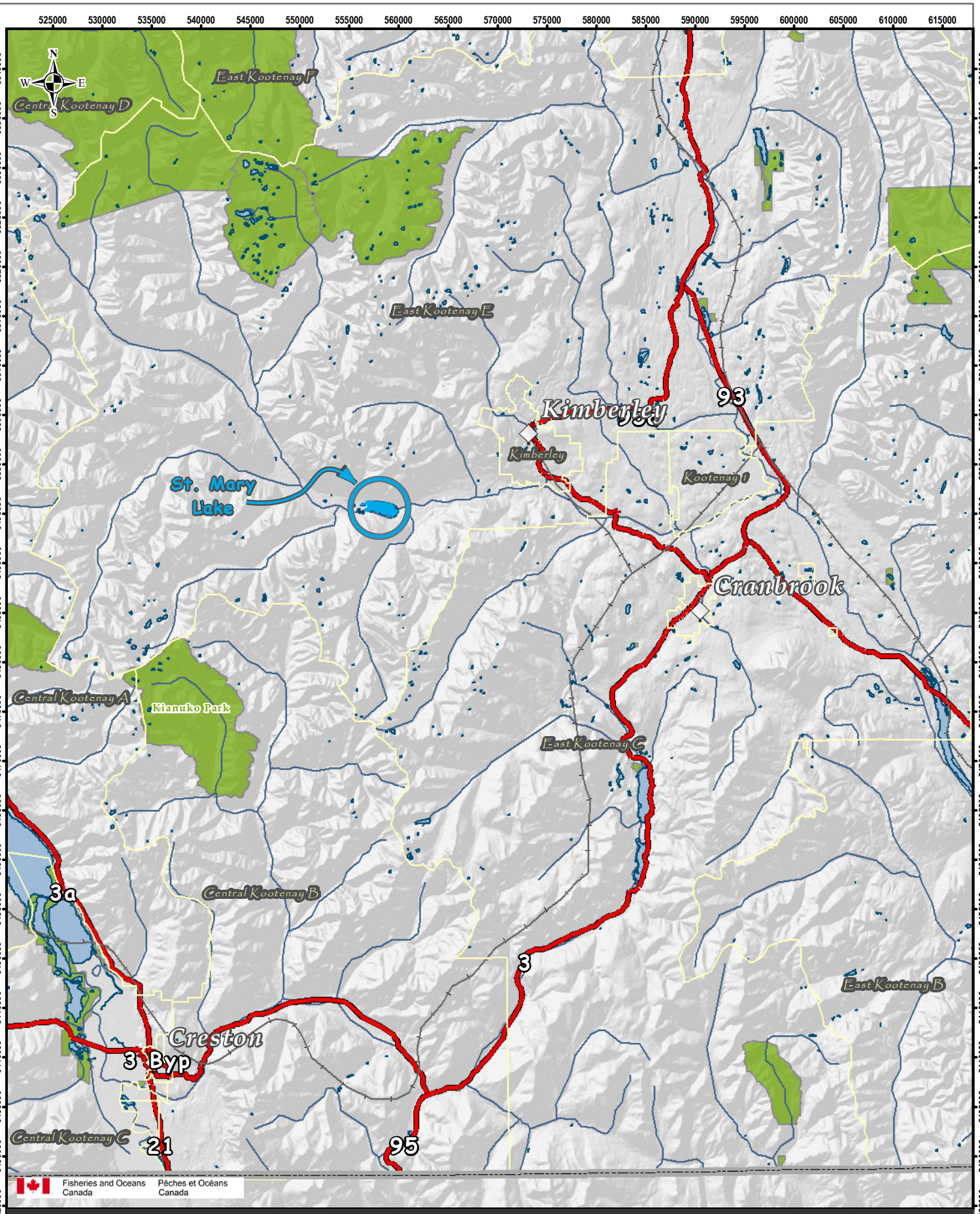
1. Foster collaboration between local government (RDEK), DFO, Ministry of Environment, First Nations, EKILMP, and the local communities;
2. Compile existing map base resource information for St. Mary Lake;
3. Provide an overview of foreshore habitat condition along St. Mary Lake;
4. Inventory and characterize foreshore condition, current land use, riparian and aquatic ecosystem quality, fisheries values, and anthropogenic modifications;
5. Obtain spatially accurate digital video of the lake shoreline taken from a boat survey;
6. Prepare the video and GIS geo-database for loading onto the Community Mapping Network at www.cmnbc.ca.
7. Collect and analyze data that will aid in prioritizing critical areas for conservation and guide sustainable shoreline development;

8. Make information available to planners, politicians, and other key referring agencies that review applications for proposed land development; and
9. Integrate information with upland development planning to ensure protection of sensitive foreshore areas that lake management planning is watershed based.

The FIM and AHI completed as part of this assessment form a basis to address these objectives. The Guidelines address the more detailed planning aspects required to meet long-term objectives.

2.3 Study Location

St. Mary Lake is located in the East Kootenay region of BC, approximately 16 km west of the City of Kimberley. The forest community surrounding the lake is comprised of a diverse assemblage of spruce (*Picea* sp.), interior Douglas-fir (*Pseudotsuga menziesii* var. *glauca*), and western larch (*Larix occidentalis*) mixed with black cottonwood (*Populus baslsamifera* ssp. *trichocarpa*), and paper birch (*Betula papyrifera*). The riparian community along the lake shoreline has a diverse structural and species composition and includes Douglas maple (*Acer glabrum*), red-osier dogwood (*Cornus stolonifera*), alder (*Alnus* sp.), rose (*Rosa* sp.), and willow (*Salix* sp.). Emergent vegetation along the foreshore includes cattail (*Typha latifolia*), bulrush (*Scirpus* sp.), and sedge (*Carex* sp.). The location of the study area is shown in Figure 1.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ECOSCAPE
Environmental Consultants Ltd.
St. Mary Lake
Foreshore Inventory and Mapping
Figure 1 - Project Location
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2.4 Important Fisheries and Wildlife Resource Information

According to the BC Fisheries Information Summary System (FISS), fish present in St. Mary Lake include bull trout (*Salvelinus fontinalis*), burbot (*Lota lota*), kokanee (*Oncorhynchus nerka*), rainbow trout (*O. mykiss*), westslope cutthroat trout (*O. clarkii lewisi*), longnose sucker (*Catostomus catostomus*), and mountain whitefish (*Prosopium williamsoni*) (FISS 2011). Hybridization occurs between cutthroat and rainbow trout. Recorded stocking of trout and kokanee has been occurring in St. Mary Lake since 1918 (FISS 2011).

The focus of fisheries management is to restore or maintain healthy populations of salmonids and other fish species within the lake and tributaries while preventing the introduction of non-native fish. Facilitating this general objective requires detailed understanding of the complex competitive interactions within the system, in addition to understanding the condition of the foreshore. Some of the key fisheries issues relevant to the management of St. Mary Lake include identifying and addressing foreshore development, identifying impacts to lakeside riparian habitats, and identifying important spawning and migrating habitats. Long-term management objectives may include the restoration of native fishery stocks and conservation of species of concern such as westslope cutthroat. Rainbow trout are known to hybridize with cutthroat trout and "pure" genetic strains of westslope cutthroat are becoming increasingly rare within interior freshwater systems (Corbett et al. 2001).

St. Mary Lake and the surrounding riparian and upland ecosystems provide important habitats for a variety of wildlife species besides fish. Waterfowl such as common loon (*Gavia immer*), common merganser (*Mergus merganser*), and goldeneye (*Bucephala* sp.) and raptors such as osprey (*Pandion haliaetus*) and bald eagle (*Haliaeetus leucocephalus*) utilize the lake and foreshore for foraging and nesting habitat. Shorebirds and gulls are also commonly observed around the lake. Many other songbird species such as nuthatches, kinglets, thrushes, sparrows, swallows, and waxwings commonly nest and forage along the lake foreshore. Moose (*Alces alces*) and other ungulates frequent the St. Mary River corridor and wetland areas and river otters (*Lontra canadensis*) have been observed within the lake.

2.5 Foreshore Management Overview

The importance of fisheries and wildlife resources along St. Mary Lake and the sensitive ecosystems associated with the lake and foreshore, provide a clear rationale for completion of a detailed shoreline inventory and mapping project. A three step process is currently being used as a shoreline management template in BC. This process is described in previous sections of this document, but generally involves the following components: inventory using the FIM standards, analysis of relative habitat value using the AHI, and development of shoreline management guidelines.

3.0 FORESHORE INVENTORY & MAPPING METHODOLOGY

The Foreshore Inventory and Mapping detailed methodology is based upon mapping standards developed for Sensitive Habitat Inventory and Mapping (SHIM) (Mason and Knight, 2001) and Coastal Shoreline Inventory and Mapping (CSIM) (Mason and Booth, 2004). The development of these mapping initiatives is an integral part of ecologically sensitive community planning. The following sections summarize specific information related to the St. Mary FIM project.

3.1 Field Surveys

Field surveys were conducted on July 19, 2010. Surveys were completed by crews of various sizes. Each crew member was assigned data to collect during the surveys. Field assessors used air photos with cadastre and topographic information to assist with field data collection. Two TRIMBLE GPS units with SHIM Lake v. 2.6 (FIM Data dictionary name) were carried and a hurricane antennae was also used. Finally, digital photographs, with a GPS stamp, were collected. Other field surveys conducted included the GPS digital video, completed by DFO. The specifics of the GPS digital video are discussed in the FIM methodology. The principle objectives of the video and photographic surveys were to:

- Provide a photographic documentation of the St. Mary Lake shoreline;
- To record data relating to the presence or absence of shoreline modifications such as docks, retaining walls, and boat launches.

Weather is an important consideration, particularly during the photo and video documentation portions of the assessment. Good photo documentation is vital because data analysis following data collection can be hindered by poor photography. Weather during the surveys was generally clear and no significant storm events occurred.

3.2 Methodology

Standard methods for FIM projects were used for this assessment. Data collected was downloaded daily to a laptop for backup. Once downloaded, the entire database was reviewed for accuracy and corrections were made as required. Ecoscape has attempted to ensure the data is as accurate and error-free as possible. However, due to the large size of the dataset, small errors may have occurred. These errors, if found, should be identified and actions initiated to resolve the error. The following information was collected during field surveys:

1. The spatial extent of wetlands and areas of emergent, submergent and floating vegetation were mapped and photographed to delineate the approximate area where aquatic vegetation occurs. Aquatic vegetation includes any plants growing

below the high water level of the lake. Areas of overhanging vegetation were also mapped.
2. Stream confluences (i.e., lake inlets and outlet), seepage areas, and other features were mapped.
3. The locations of shoreline modifications, including boat launches, docks, and groynes, were mapped.

3.2.1 Aquatic Vegetation Mapping and Classification

Aquatic vegetation mapping was conducted along the shoreline. For the purposes of this assessment, aquatic vegetation includes plants occurring below the high water level of the lake (including flood benches). Although some of the plants are not truly aquatic, all are hydrophilic (i.e., water loving) and contribute to water quality and fish habitat. Vegetation mapping was completed by digitizing vegetation polygons from field observations recorded on aerial photographs. Vegetation communities were classified using the Wetlands of British Columbia – A guide to identification (Mackenzie and Moran, 2004):

Aquatic vegetation sites not described by the current nomenclature developed by Mackenzie and Moran (2004) were stratified using the following biophysical groups:

1. Emergent Vegetation (EV) generally refers to grasses, horsetail (*Equisetum* sp.), sedge, or other plants tolerant of flooding. Vegetation coverage within each polygon needed to be consistent and well established to be classified as EV. These areas were generally not dominated by true aquatic macrophytes and tended to occur in moderate to steep sloping areas.
2. Sparse Emergent Vegetation (SEV) refers to the same vegetation types as Emergent Vegetation, but coverage within these areas was generally not sparse or patchy. The vegetation patchiness was generally due to the association with beach grooming or other modifications.
3. Overhanging Vegetation (OV) consists of broadleaf vegetation that is growing over the lake, shading the shoreline littoral zone. Overhanging vegetation was mapped where it was observed. Overhanging vegetation also occurred with Emergent Vegetation (EVOV) and Sparse Emergent Vegetation (SVOV).
4. Submergent Vegetation (SUB) generally consists of native *Potamogeton* spp. and is considered aquatic vegetation that remains below the water surface for most of the growing season. These areas were uncommon and only occurred in a few shallow areas.
5. Floating Vegetation (FLO) generally consists of species such as native *Potamogeton* spp., pond lilies, and other types of vegetation that floats upon the water surface.

3.2.2 GIS and FIM Database Management

Data management for this project followed standard FIM methods and generally include the following steps:

- Data and photos were backed up to a computer/laptop on a daily basis.
- During data analysis, numerous checks were completed to ensure that all data was analyzed and accounted for.

The following data fields were added to the FIM data dictionary:

1. An Electoral Area field was added to define the electoral area within the Regional District that shoreline segments were part of.
2. Fisheries fields were added. These fisheries fields are similar to the Zones of Sensitivity that were developed for the Okanagan and Windermere projects. The following describes fisheries fields added and the original data source for the fields:
    a. Juvenile Rearing;
    b. Migration; and
    c. Staging.
3. Terrestrial - SEI data is not available for the St. Mary Lake shoreline. Instead, sensitive terrestrial information was determined by identifying the presence of wildlife movement corridors and other important terrestrial wildlife features such as veteran trees and snags. The terrestrial resources selected for this analysis are described in Section 4.1.4 below. The terrestrial parameters chosen include:
    a. Veteran Trees;
    b. Snags; and
    c. Wildlife Corridors.
4. An AHI results field was added (AHI_CUR). This field reflects the current conditions of the shoreline from the results of the AHI, discussed below.
5. An AHI potential analysis (AHI_POT) was completed by removing instream features from the AHI results. This analysis provides a summary of potential locations where habitat improvements are possible along the shoreline. This analysis does not consider improvements to riparian vegetation.

4.0 AQUATIC HABITAT INDEX METHODOLOGY

The AHI is a tool that is used to assess the relative habitat value of a shoreline relative to other shoreline areas within the lake. By definition, an index is a numerical or categorical scale used to compare variables with one another. Use of such an index to assess shoreline sensitivity has been utilized on Moyie and Monroe Lakes (Schleppe, 2009) and Windermere Lake (McPherson and Hlushak, 2008). Indices are currently being completed

for numerous lakes in the Okanagan and Kootenay regions. The purpose of the AHI is to facilitate land use planning around shorelines by identifying the relative value of shoreline areas within a lake system. The relative habitat value of an area can then be used to infer the environmental sensitivity of the shoreline (i.e., areas of higher relative value have greater environmental sensitivity).

The AHI utilizes a number of parameters collected during the FIM. The index uses a points based mathematical index to assign the relative habitat value to each parameter. Thus, features of more estimated significance are assigned higher relative values. Features that have impaired the habitat value (e.g., shoreline modifications such as groynes and docks) are assigned negative scores to reflect the impacted condition of the shoreline.

A subsequent analysis was conducted to determine the habitat *potential* of each shoreline segment. This analysis involved removing the negative scores associated with ALL modifications to determine if predicted shoreline restoration will achieve a measurable benefit. The Habitat Potential Index (HPI) can be used to help assess where restorative efforts should be directed. The HPI analysis did *not include effects of riparian restoration* due to the extent of database and predictive mapping that would be required to facilitate such an analysis. To complete this, more detailed habitat restoration analyses are required.

The index generated has only utilized information that is currently available or that can be reasonably inferred based upon previous works. In many instances, data gaps have been identified and assumptions have been made. As more information is collected regarding shoreline areas of St. Mary Lake, the AHI may be updated.

4.1 Parameters

The parameters of the AHI reflect a certain type of habitat found along the shoreline. The parameters were broken down into four general categories as follows:

1. Biophysical;
2. Fisheries;
3. Shoreline Vegetation;
4. Terrestrial; and
5. Modifications.

Table 1 summarizes the parameters and logic used in the St. Mary Lake AHI. The parameters selected for the index are similar to the previous AHI analyses (e.g., Moyie and Monroe Lakes). A detailed description of each parameter category is provided below.

Table 1: The parameters and logic for the Aquatic Habitat Index of St. Mary Lake.

Category	Criteria	Maximum Point	Percent of the Category[1]	Percent of the Total[1]	Logic	Uses Weighted FIM Data	Value Categories
Biophysical	Shore Type	15	31.3	14.6	% of Segment * Maximum Point	Yes	Stream Mouth = Wetland (15) > Gravel Beach = Rocky Shore (12) > Sand Beach (8) = Cliff /Bluff (8), Other (5)
	Substrate	12	25.0	11.6	% Substrate * Maximum Point	Yes	Organic = Mud = Marl (12) = Fines (12), Cobble (10) > Gravel (10) > Boulder = Sands (4) > Bedrock (2)
	Percentage Natural	5	10.4	4.9	% Natural * Maximum Point	No	% Natural * Maximum Point
	Aquatic Vegetation	8	16.7	7.8	% Aquatic Vegetation * Maximum Point	No	% Aquatic Vegetation * Maximum Point
	Overhanging Vegetation	4	8.3	3.9	% Overhanging Vegetation * Maximum Point	No	% Overhanging Vegetation * Maximum Point
	Large Woody Debris	4	8.3	3.9	# of Large Woody Debris/km * Relative Value * Maximum Point	No	**Relative Value** >15 LWD (1) > 10 to 15 LWD (0.8) > 5 - 10 LWD (0.6) > 0 - 5 LWD (0.4) > 0
Fisheries	Juvenile Rearing	10	55.6	9.7	High (10), Moderate (4), Low (2)	Yes	High (10), Moderate (4), Low (2)
	Migration Corridor	4	22.2	3.9	Present (4), Absent (0)	No	Present (4), Absent (0)
	Staging Area	4	22.2	3.9	Present (4), Absent (0)	No	Present (4), Absent (0)
Shoreline Vegetation[2]	Band 1	8	66.7	7.8	Vegetation Bandwidth Category * Vegetation Quality * Maximum Point	Yes	**Vegetation Bandwidth Category** 0 to 5 m (0.2) < 5 to 10 m (0.4) < 10 to 15 m (0.6) < 15 to 20 m (0.8) < 20 m (1)
	Band 2	4	33.3	3.9	Vegetation Bandwidth Category * Vegetation Quality * Maximum Point	Yes	**Vegetation Quality Category** 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)
Terrestrial	Veteran Trees	5	38.5	4.9	>25 (5), 5-25 (3), <5 (1)	Yes	>25 (5), 5-25 (3), <5 (1)
	Snags	5	38.5	4.9	>25 (5), 5-25 (3), <5 (1)	Yes	>25 (5), 5-25 (3), <5 (1)
	Wildlife Corridor	3	23.1	2.9	Present (3), Absent (0)	Yes	Present (3), Absent (0)
Modifications	Retaining Wall	-0.06	0.5	-0.1	% Retaining Wall * (-2)	No	% Retaining Wall * (-2)
	Docks	-10.00	82.8	-9.7	# Docks/km * (-10)	No	# Docks/km * (-10)
	Groynes	-0.01	0.1	0.0	# Groynes/km * (-2 per groyne)	No	# Groynes/km * (-2 per groyne)
	Boat Launch	-2.00	16.6	-1.9	# Launches * (-2 per launch)	No	# Launches * (-2 per launch)

1. Numbers have been rounded to the nearest whole number. All calculations were completed without rounding.

2. The Shoreline vegetation category has been calculated to include an estimate of quantity (i.e., bandwidth) and quality (i.e., relative value). In cases where two bands are present, there is a higher diversity which is more productive, resulting in a higher score.

4.1.1 Biophysical Parameters

The following summarizes the biophysical parameters of the index:

1. Shore Type – Shore type was given a maximum value of 15. Shore types are related to many aspects of productivity. Previous habitat indices (e.g., Schleppe and Arsenault, 2006) used habitat specificity tables to determine the value of a shoreline. A similar approach was used for Windermere Lake (McPherson and Hlushak, 2008). However, in these previous versions, wetlands were difficult to account for utilizing the fish habitat specificity approach originally developed for Okanagan Lake (Schleppe and Arsenault, 2007). Wetlands are considered to be highly valuable shoreline areas for several reasons, including their contributions to biodiversity, biomass, and water quality. The general habitat specificity for St. Mary Lake follows that of the original assessment for the Okanagan, except that wetlands have been defaulted to the highest value possible shoreline value (i.e., equivalent to a stream confluence).
2. Substrate – Substrate types were given a maximum value of 12. Substrates relate directly to lake productivity. There are generally two types of productive substrates, those utilized for spawning and those that produce more biomass. Substrates within St. Mary Lake have value in production of biomass such as aquatic invertebrates and other organisms that occur within organic substrates. As such, greater value was placed on soft, organic substrates based on the productive forage habitat they provide for the fish species of management concern within St. Mary Lake.
3. Percent Natural – Areas of natural shoreline have a relative habitat value that is greater than disturbed shoreline areas and were given a maximum value of 5. Natural shorelines tend to have better functioning ecological systems and provide better overall habitat value than disturbed shorelines.
4. Aquatic Vegetation – Aquatic vegetation was given a maximum value of 8. The percent cover of aquatic vegetation was determined along the St. Mary Lake shoreline. The benefits of aquatic vegetation include forage, biomass production, and cover.
5. Overhanging Vegetation – Overhanging vegetation was given a maximum value of 4. Although not frequently observed along the St. Mary Lake shoreline, it provides allochthonous inputs (i.e., nutrients), shade, cover, and forage.
6. Large Woody Debris – Woody debris was given a maximum value of 4. Woody debris provides nutrients, cover, forage, and complexity to aquatic habitats.

4.1.2 Fisheries Parameters

The fisheries parameters used for the AHI were based upon those described above in Section 3.2.2. These parameters are considered important for fish production in the St. Mary Lake system and were prioritized in the AHI accordingly. Parameters were

considered in terms of salmonid habitat and productivity. The fisheries parameters added to the AHI include the following:

1. Juvenile Rearing - Juvenile rearing was given a maximum value of 10. Relative shoreline habitat value (High, Moderate, and Low) was determined for this parameter. Details of the parameters used to categorize the rearing suitability values are provided in Table 2. Since shoreline utilization data is unavailable, the juvenile rearing was based upon known rearing habitat requirements for the species known to reside within the lake (e.g., proximity to spawning streams, littoral area, substrates, etc.).
2. Migration Corridor – Migration corridors were given a maximum value of 4. Juvenile fish migration areas were determined based upon known spawning areas in streams. The areas generally encompass shoreline areas where fish migrate out from or into a stream system. The areas near the lake inlet/outlet are significant during out migration of juvenile fish because they are more susceptible to predation at this time.

   Probable juvenile and adult fish migration routes (Yes or No) used by resident fish at some point in their life cycle were prepared using professional judgment and are limited to areas near the inlet and outlet of spawning streams. These routes are based upon areas where fish will likely concentrate during significant spawning, immigration, or emigration from streams. To develop these migration areas, key habitat characteristics were used and included adjacency to spawning rivers, outmigration considerations, and review of fish life history characteristics were all considered. Due to the small size of the lake, migration considerations are considered to be relatively small in relation to other aspects of fish productivity (e.g., substrates) and were assigned a lower relative score for this reason.
3. Staging Area – The presence of Staging areas (Yes or No) were given a maximum value of 4. Staging areas occur where fish congregate prior to migration. In general, these areas are loosely defined and vary over space and time. The information presented is limited to the confluences of known salmon spawning streams, where fish are known to congregate before migrations. It may not entirely reflect all locations or spatial extents of staging areas. Future surveys will provide a better understanding of where mature adults stage prior to migrations.

Table 2: The parameters and logic for the Juvenile Rearing Habitat Suitability of St. Mary Lake.

Category	Criteria	Maximum Point	Percent of the Category[1]	Logic	Uses Weighted FIM Data	Value Categories
Criteria	Shore Type	12	22.6	% of Segment * Maximum Point	Yes	Stream Mouth (12) > Wetland (8) = Sand Beach (8)> Gravel Beach = Rocky Shore (6) = Cliff /Bluff (4), Other (1)
	Substrate	9	17.0	% Substrate * Maximum Point	Yes	Organic(9) = Mud (9) = Marl (9) = Fines (9) > Boulder (8) > Cobble (7) > Gravel (7) > Sands (6) > Bedrock (4)
	Aquatic Vegetation	5	9.4	Aquatic Vegetation Category Score	No	**Aquatic Vegetation Category Score** Aq. Veg > 80% = 5, Aq. Veg 50% to 80% = 3. Aq. Veg < 50% = 1
	Littoral Width	12	22.6	Littoral Width Category Score	No	**Littoral Width Category** Wide (>50m) = 12, Moderate (10 to 50 m) = 8, Narrow (<10m) = 3
	Overhanging Vegetation	1	1.9	% Overhanging Vegetation * Maximum Point	No	
	Large Woody Debris	4	7.5	Large Woody Debris Category Score * Maximum Point	No	**Large Woody Debris Category Score** >15 LWD (1) > 10 to 15 LWD (0.8) > 5 - 10 LWD (0.6) > 0 - 5 LWD (0.4) > 0
	Migration Corridor	5	9.4	Present / Absent	No	Present (5), Minor (0)
	Salmonid Spawning Stream Present	5	9.4	Present / Absent	No	Present (5), Minor (0)

1. Numbers have been rounded to the nearest whole number. All calculations were completed without rounding.
2. The Shoreline vegetation category has been calculated to include an estimate of quantity (i.e., bandwidth) and quality (i.e., relative value). In cases where two bands are present, there is a higher diversity which is more productive, resulting in a h

4.1.3 Shoreline Vegetation Parameters

The riparian parameters added to the index were similar to those added in the Moyie and Monroe Lakes FIM. The FIM provides a distinction between the lakeside vegetation (Band 1/Riparian) and the areas beyond (Band 2/Upland). To address this new data available, the index was modified to include a factor assessing vegetation quality (i.e., tall shrub thickets or wetland areas have a higher quality than landscaped *yards*). As with the other indices, vegetation bandwidths were categorized and points were assigned. Vegetation bandwidth categories included 0-5 m, 5-10 m, 10-15 m, 15-20 m, and greater than 20 m. The Band 1 vegetation was assigned greater value (i.e. maximum value of 8) than Band 2 vegetation (i.e., maximum value of 4) because of direct proximity to aquatic habitats.

4.1.4 Terrestrial Parameters

The terrestrial parameters identified and used for the St. Mary AHI analysis are described below. These parameters are considered important to maintain healthy riparian and shoreline ecosystems as well as enhancing fish productivity within the St. Mary Lake system.

1. Veteran Trees - Veteran tree presence was categorized (i.e., 0, <5, 5-25, >25) and given a maximum value of 5. Veteran trees are trees that have survived historical disturbance (e.g., fire, flooding, logging) and are the oldest trees within a generally younger stand. Due to their age, veteran trees are often irregular in shape with deformities, split tops, and cracks, which provide unique habitat features for wildlife. These trees also provide recruitment for snags (i.e., standing dead trees) which makes them extremely valuable wildlife trees and they require conservation to protect that resource. Safety is often the cause for the removal of veteran trees as risk to the general public supersedes the ecological value the trees provide.
2. Snags - Snag presence was categorized (i.e., 0, <5, 5-25, >25) and given a maximum value of 5. A snag is a standing dead, damaged, or broken tree. These trees provide important habitat for primary and secondary cavity nesting species, perching habitat for birds of prey, and denning habitat for a variety of mammals. These trees provide recruitment for large woody debris along the forest floor or adjacent shoreline. It is important to retain snags where possible for the important contribution to habitat and overall biodiversity they provide. However, as with veteran trees, safety concerns often preclude the conservation of the trees and removal becomes necessary to protect infrastructure or the general public.
3. Wildlife Corridors - Wildlife corridors were given a maximum value of 3 because they provide connectivity between patches of habitat. Corridors prevent the isolation of habitat patches that have been fragmented within the landscape. Wildlife use the cover provided by corridors to safely migrate between habitats. These movements provide a transfer of genetic material between populations, prevent inbreeding, and maintain healthy populations of wildlife. Corridors often follow natural features such as streams and associated riparian communities or other contiguous habitats. Development and disturbance should avoid these areas and comprehensive mitigation planning is required where proposed development transects or abuts wildlife corridors. The St. Mary River forms a suitable wildlife corridor through the steep-sided valley. This corridor provides connectivity between the sub-alpine headwaters of the stream with lower elevation montane habitats downstream.

4.1.5 Habitat Modifications

Habitat modification parameters are described by Schleppe and Arsenault (2006). The descriptions provided a rationale for inclusion of these parameters in the AHI. Other

habitat modifications parameters, such as Percent Substrate Modification or Percent Roadway were not included in the analysis because they may compound (i.e., groynes constructed from shoreline substrate modification gets counted twice). The following is quoted directly (shown in italics) from the EBA Engineering Consultants Ltd. report *The Kelowna Shore Zone Fisheries and Wildlife Habitat Assessment* (Schleppe and Arsenault, 2006). The City of Kelowna provided permission to utilize data from the assessment. Further information on these parameters can also be found in the Windermere Lake assessment report (McPherson and Hlushak, 2008). Text below that is not in italics has been added in regards to the application of the modifications to the St. Mary Lake AHI.

1. *Retaining Walls - Retaining walls are considered to be negative habitat features for a variety of reasons. These structures are generally constructed to armour or protect shorelines from erosion. Kahler et al (2000) summarized the effects of piers, docks, and bulkheads (retaining walls) and suggested that these structures may reduce the diversity and abundance of near shore fish assemblages because they eliminate complex habitat features that function as critical prey refuge areas. Kahler et al. (2000) found evidence of positive effects for armouring structures along a shoreline in the published literature. Carrasquero (2001) indicated in his review of overwater structures that retaining walls might also reduce the diversity of benthic macroinvertebrate communities more than other structures such as riprap shoreline armouring because they reduce the habitat complexity.*

   Natural erosion along a shoreline can be the result of removal of riparian or lakeside vegetation, which may have been the cause of the erosion in the first place. In other cases, retaining walls have been constructed to hold up soil material, possibly reclaiming land, so that lawns can be planted or for other landscaping purposes. As indicated in the FIM report by the RDCO, the construction of structures by residents, may lead to neighbours imitating their neighbours. Also, construction of one retaining wall may lead to energy transfer via waves resulting in erosion somewhere else. The above arguments highlight the consequences of retaining wall construction and the potential negative habitat effects that they have.

   Five (5) retaining walls occur along the shoreline of St. Mary Lake and their effects have been incorporated into the AHI.

2. *Docks - The negative effects of docks on fish habitat are controversial. On one hand docks may provide areas of hiding from ambush predators, reductions in large woody debris inputs, and these structures are often associated with other anthropogenic disturbances such as retaining walls (Kahler et al. 2000; Carrasquero 2001). On the other hand, docks also provide shaded areas that can attract fish and provide prey refuge, and pilings can provide good structure for periphyton growth (Carrasquero 2001). Numerous factors, such as the scale of*

study and the cumulative effects of these structures, are also important and should be considered when discussing overwater structures (Carrasquero 2001).

Docks have also been documented to increase fish density due to fish's general congregation around structure, but decrease fish diversity in these same areas (Lange 1999). Coupled with this result, Lange also found that fish diversity and density were negatively correlated with increased density and diversity of shoreline development, meaning that increases in dock density may reduce fish abundance and diversity. Chinook salmon have been documented to avoid areas of with increased overwater structures (e.g., docks) and riprap shorelines, and therefore, construction of these structures may affect juvenile migrating salmonids (Piaskowski and Tabor, 2000).

Regardless of the controversy, it is apparent that docks do affect fish communities and the degree of effects are most likely related to the intensity of the development, the scale of the assessment, and fish assemblage life history requirements. Different fish assemblages may respond differently to increased development intensity, and fish assemblages containing salmonids may be more sensitive than southern or eastern fish assemblages (e.g., bass, perch, and sunfish, etc.). It is for these reasons that dock density was included in the index, and that docks were treated as a negative parameter, with increasing dock density considered as having more negative effects than lower dock densities.

One (1) dock was observed within Segment 4 and another six (6) were observed within Segment 7. The impact of the docks on the resident fish of St. Mary Lake may not be readily apparent because of the low density.

3. *Groynes - Groynes are structures that are constructed to reduce or confine sediment drift along a shoreline. These structures are typically constructed using large boulders, concrete, or some other hard, long lasting material. Reducing the movement of sediment materials along the shoreline can have a variety of effects on fish habitat, including increasing the embeddedness of gravels. Published literature regarding the specific effects of groynes on fish habitat are few, but because these structures are often considered Harmful Alterations, and Disruptions of Fish Habitat (HADD) as defined under the federal Fisheries Act, they are believed to have negative effects, mostly associated with the loss of area available for fish (e.g., Murphy 2001).*

   Three (3) groynes were observed along the St. Mary Lake shoreline within Segment 7. Removal of substrates for groynes typically results in significant degradation of habitat including loss of emergent vegetation zones, sediment deposition, and destabilization of shoreline substrates. Migration and rearing habitats for juvenile fish may also be negatively impacted by groynes. It is also

possible that groynes force migrating juveniles to deeper water zones where they are more susceptible to predation.

4. *Boat Launches - Boat launches were considered to be a negative parameter within the AHI. Boat launches are typically constructed of concrete that extends below the high water level. The imperviousness of this material results in a permanent loss of habitat, which ultimately reduces habitat quality and quantity for fish. Concrete does not allow growth of aquatic macrophytes, and reduces foraging and/or refuge areas for small fish and macroinvertebrates. The extent of the potential effects of boat launches relates to their size. Thus, multiple lane boat launches tend to have a large effect on fish habitat than smaller launches with fewer lanes because there is more surface area affected. The AHI treated each different boat launch lane as one unit, and therefore one launch could have multiple boat ramps. The intent of using the data in this fashion was to incorporate the size of the structure (i.e., more ramps, decrease in available habitat).*

   Two (2) boat launches were observed along the St. Mary Lake shoreline within Segment 9. Boat access was recently restricted by lakeshore development which has led to a greater demand for public boat access to the lakeshore. The presence of boat launches, while negative for fish habitat, may provide a benefit in focusing lake access in a specific area and preventing unsanctioned or illegal access.

These modifications were selected because they are easily observed, quantified, and incorporated to the AHI. The negative effect of modifications within St. Mary Lake was reduced from the previous AHI analyses (e.g., Moyie and Monroe Lakes) because the extent and magnitude of impacts observed were substantially lower and otherwise the criteria would have resulted in excessive devaluing of shoreline segment habitat value. Road modification was observed along the shoreline which represents approximately 1% (76 m) of the total shoreline.

4.2 Index Ranking Methodology

The AHI was used to analyze the relative habitat value of a segment to those compared around the different lakes assessed. The output of the index is a five class ranking system, ranging from Very Low to Very High. The index was used to output two shoreline segment values described below:

1. Current Value (AHI_CUR) – This is the current index value for each shore segment based upon the existing biophysical, riparian, fisheries, and terrestrial resources and modifications observed.

2. Potential Value (AHI_POT) – This is the potential index value for each shore segment after the hypothetical removal of modifications. It is the total index value based upon the biophysical, riparian, fisheries, and terrestrial resource parameters only. This value is used to highlight segments where restoration would likely have the most measurable benefit. This category does not consider riparian restoration impacts.

4.2.1 Calculating the Aquatic Habitat Index

The AHI consists of a variety of parameters and each has a range in potential scores based upon the physical properties of each shoreline segment. Table 1 summarizes the logic and the maximum possible score for each parameter. To determine the AHI ranking for each segment, the score for a shoreline segment determined using the physical characteristics in the FIM database. Weighted averages were used where possible to most accurately evaluate the score. Once the scores had been assigned to all parameters, the total scores for each category: Biophysical, Fisheries, Shoreline vegetation, Terrestrial and, Modifications were summated for each segment. The total habitat value for each shoreline segment included all positive and all negative index parameters.

The output of the AHI is a five class ranking system, ranging from Very Low to Very High. The rank assigned to each shoreline segment reflects the relative value of the segment in its current condition. To calibrate the index, the Mabel Lake index was used as a baseline because of similarities between the two systems. From this baseline, numerous iterations were run (i.e., the index was run at least 50 times) and changes were made as necessary to reflect current conditions. During each run of the index, the minimum, maximum, median, and distribution of scores was reviewed. After reviewing the distribution of the data from the iterations, logical score breaks were used to determine the limits of each of the five classes. These breaks were made because of the clustering of scores based upon the output of the results.

Ultimately, the value of habitat is a continuum, and there is room for some interpretation of this information. Further review, addition, and improvements to the index are encouraged and this database has been designed to allow inclusion and update of information. The ultimate purpose of the AHI is to accurately represent the current relative condition of the shoreline segments and identify areas of particular sensitivity based upon the information available. The following provides a description of each of the AHI value categories:

1. Very High - Areas classified as Very High are considered critical to the maintenance of fish and wildlife populations. Most areas identified as Very High occur in extremely sensitive floodplain areas, spawning stream mouths, wetland habitats, or provide productive rearing and spawning

habitat for important native species such as salmonids. These areas are generally undisturbed and considered highest priority for conservation.

2. High - Areas classified as High are considered to be important to the maintenance of healthy fish and wildlife populations. These areas typically provide high quality rearing habitat, extensive aquatic vegetation communities, or sensitive stream confluence. These areas are important to maintain high quality and diversity of habitat. Goals and objectives should include maintenance of existing values and habitat restoration or enhancement where feasible.

3. Moderate - Areas classified as Moderate are typically common around the lake and have generally been affected by shoreline modifications. These areas may contain important habitat areas, such as migrating or rearing habitats, and these characteristics should be considered independently of the overall segment value. Development within these areas should be planned between nodes of existing development. All proposed development should include some form of habitat restoration or compensation, with the goal of restoring the shoreline to a more natural state (e.g., from landscaped to vegetated) and removal of negative modification (e.g., retaining walls, non-native substrates, etc.)

4. Low - Low value areas are generally highly modified. These areas have been negatively impacted through land development activities and habitat alteration. Development within these areas should be planned in a similar manner as Moderate value areas. However, restoration objectives should be set higher in these areas during redevelopment.

5. Very Low - Very Low areas are highly modified segments that are not adjacent to any known important habitat characteristics. These areas require significant remediation effort to restore habitat values.

Criteria within the St. Mary Lake AHI are generally similar to those used for previous assessments of interior lakes (e.g., Jim Smith Lake). Changes that have been made are described throughout the document.

5.0 DATA ANALYSIS

General data analysis and review was completed for the FIM database. Field data collected was reviewed, refined, and corrections and additions were made as required. Analysis of the refined data focused on each shoreline segment. Analyses for this project were completed as follows:

1. The length for each discrete shoreline segment was determined using GIS and added to the FIM database;
2. For each category, the analysis used the percentage natural/disturbed field to determine the segment length that was either natural or disturbed. This was done on a segment by segment basis. In some cases, the percentage natural or disturbed was reported because it made comparison easier than comparing shoreline lengths.

The above summarizes the general data review and analysis approach. The following sections provide specific details for the biophysical and AHI analyses.

5.1 Biophysical Characteristics and Modifications Analysis

Biophysical characteristics of each shoreline segment were analyzed based on field data, photos, and aerial imagery. Definitions of the categories discussed below are provided in the FIM Detailed Methodology. The following summarizes the analyses that were completed:

1. Percent natural and disturbed for each shoreline segment;
2. Total shoreline length of natural or disturbed for each slope category that occurs along each shoreline segment;
3. Total shoreline length that remained natural or disturbed for each land use identified along each shoreline segment;
4. Total shoreline length of natural or disturbed for each shore type that occurs along each shoreline segment;
5. Total shoreline length that contained aquatic vegetation (i.e., emergent, floating, or submergent) along each shoreline segment;
6. Total number of modification features recorded along each shoreline segment. This data represents point counts taken during the survey for groynes, docks, retaining walls, marinas, marine rails, and boat launches; and
7. Total shoreline length of other shoreline modifications (i.e., roadways, substrate modification, retaining walls) along each shoreline segment.

5.2 Aquatic Habitat Index Analysis

A summary of the shoreline lengths and shore types is presented in the Results Section 6.0. The summary provides information regarding the AHI results (Very High to Very Low) analyzed by shore type, including the percent of the shoreline that is within each of the AHI categories.

6.0 RESULTS

The following section provides an overview of the AHI analysis of St. Mary Lake. Data is presented graphically and summarized in the text for ease of interpretation. Data tables for each analysis are presented in Appendix A.

6.1 Biophysical Characteristics of St. Mary Lake

The FIM survey was completed on 10450 m (10.5 km) of shoreline along St. Mary Lake. The total length of disturbed shoreline is 2346 m, which represents approximately 22.4% of the total shoreline (Figure 2). The total length of natural shoreline is 8104 m, which represents approximately 77.6% of the total shoreline.

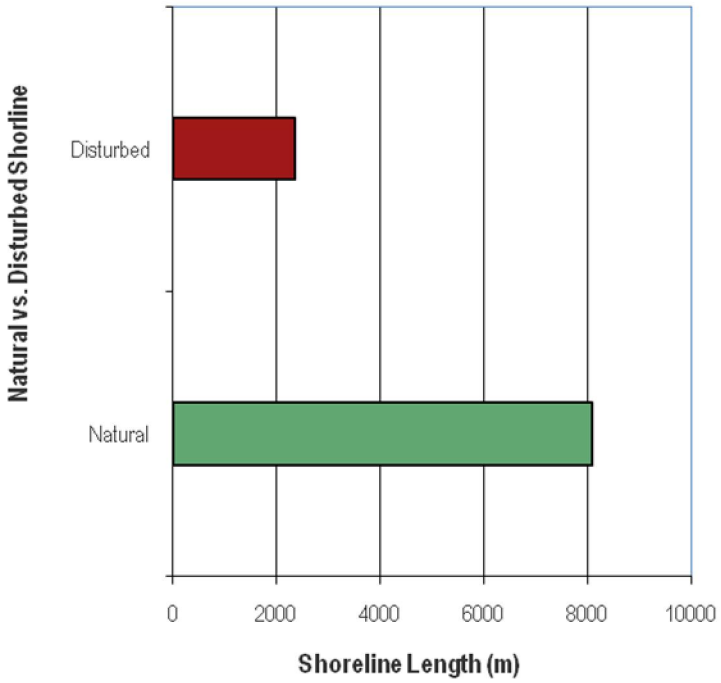

Figure 2. Natural and disturbed shore lengths along St. Mary Lake.

The slope analysis is a summary of slope categories (% slope) that occur in upland areas above the high water level of the lake. Areas of a lower gradient tend to have the highest level of disturbance due to the suitability for development. St. Mary Lake is generally characterized by low to moderate sloping shorelines. There are 6862 m of low gradient slopes (0-5%), which are approximately 11.3% disturbed. There are 3588 m of moderate gradient slopes (5-20%), and these slopes are approximately 43.8% disturbed. Benches and Steep to Very Steep slopes do not occur along the shoreline of St. Mary Lake.

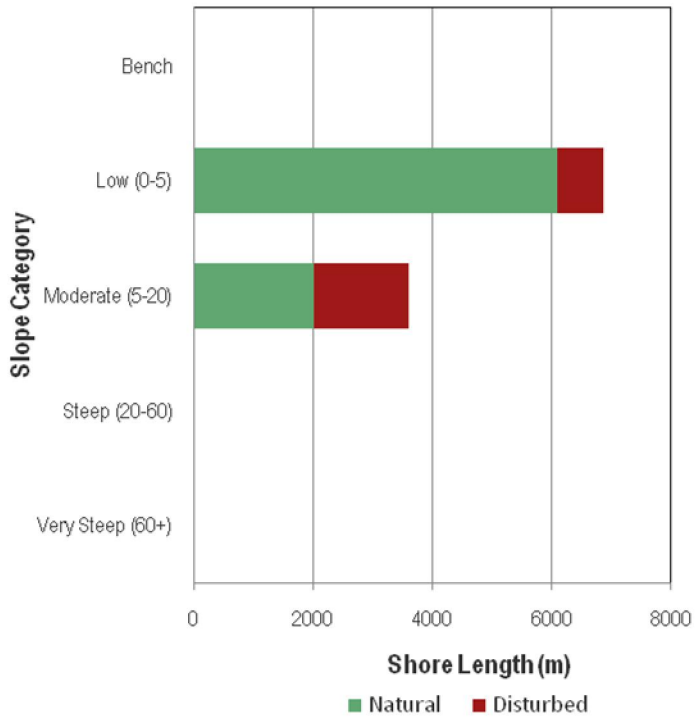

Figure 3. Natural and disturbed shore lengths within slope categories along St. Mary Lake.

Land use around St. Mary Lake is dominated by Natural Area which accounted for 7814 m (74.8%) of the total shoreline. Within the Natural Area shoreline, approximately 88.4% is undisturbed. Single Family and Transportation land use represent the next greatest land use at 1113 m (10.6%) and 831 m (8.0%), respectively. Recreation and Commercial represent relatively minor land use at 525 m (5.0%) and 167 m (1.6%), respectively.

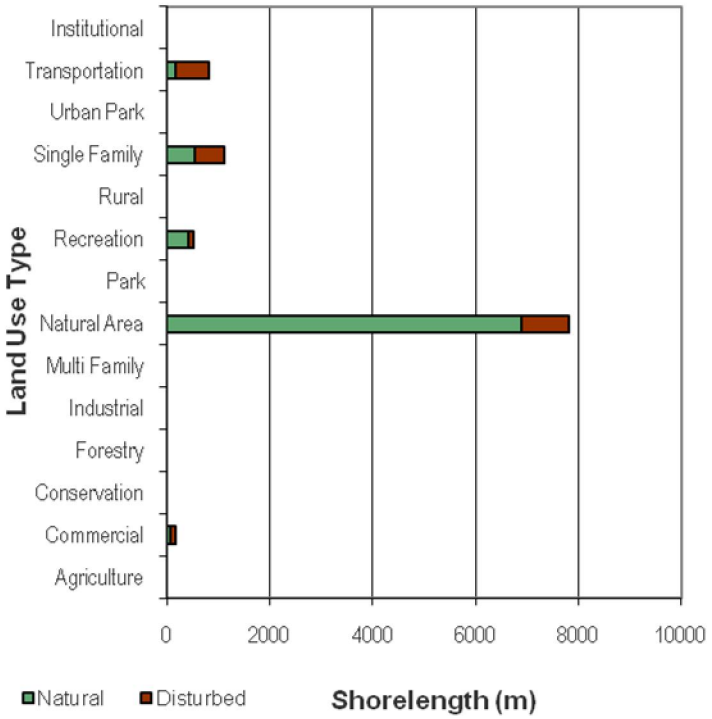

Figure 4. Natural and disturbed shore lengths within land use categories along St. Mary Lake.

The dominant shore type along St. Mary Lake is Stream mouth, which represents 3396 m (32.5%) of the total shoreline and includes tributary inlets and the lake outlet. The stream mouth shore type is approximately 91.6% natural. Rocky shore is the next greatest shore type, representing 3072 m (29.4%) of the total shoreline which is 55.6% natural. Approximately 2574 m (24.6%) of the shoreline is Wetland which is approximately 98.1% natural. The remainder of the shoreline is represented by Gravel (10.2%) and Sand (3.2%) beach shore types, which are 54.4% and 52.6% natural, respectively.

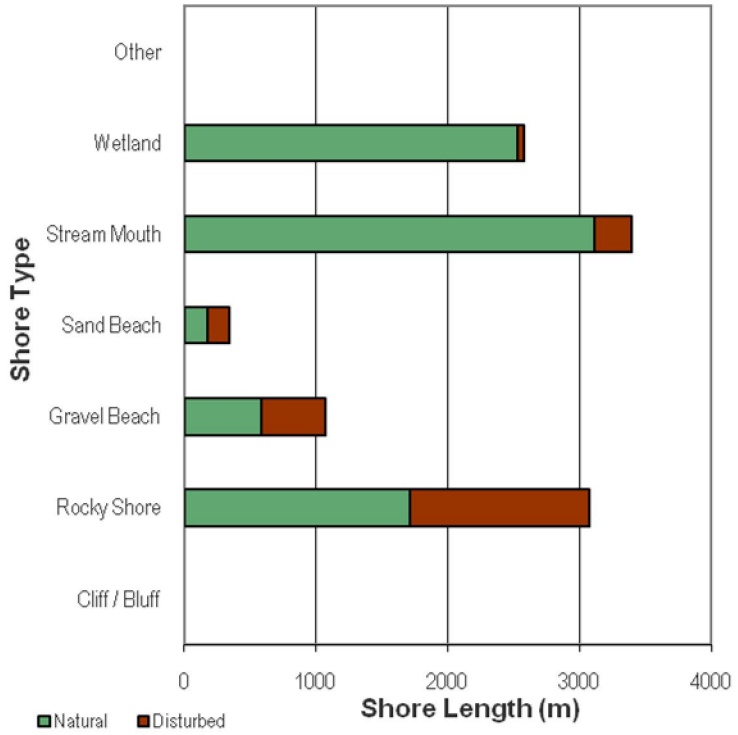

Figure 5. Natural and disturbed shore lengths within shore types along St. Mary Lake.

Aquatic vegetation is generally defined as any type of emergent, submergent, or floating vegetation that occurs below the high water level of an aquatic ecosystem. The aquatic vegetation category includes true aquatic macrophytes as well as plants that are hydrophilic or tolerant of periods of inundation during periods of high water. Research indicates that terrestrial vegetation during periods of inundation provides allochthonous input for juvenile fish and other aquatic organisms so it has been included (Adams and Haycock, 1989).

Approximately 6085 m (58.2%) of the total shoreline is characterized by some form of aquatic vegetation. The majority of the aquatic vegetation is represented by emergent vegetation which comprised 5147 m (49.2%) of the shoreline. Emergent vegetation includes cattail (*Typha latifolia*) and bulrush (*Scirpus* sp.) communities which are associated with the extensive wetland communities along the shoreline. Submergent vegetation is less common along the lake, representing 4008 m (38.4%). Floating vegetation does not occur along the shoreline.

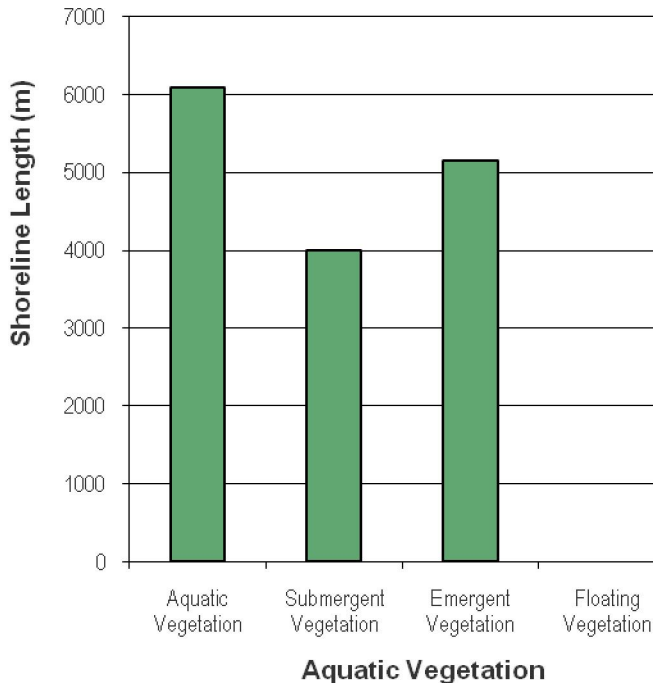

Figure 6. Shore lengths of aquatic vegetation types along St. Mary Lake.

Docks are the most common form of shoreline modification with a total of 7. Retaining walls are the next most common modification with 5 structures. Three (3) groynes and two boat launches also occur along the lake shoreline. There are no marinas or marine rails along the lake shoreline.

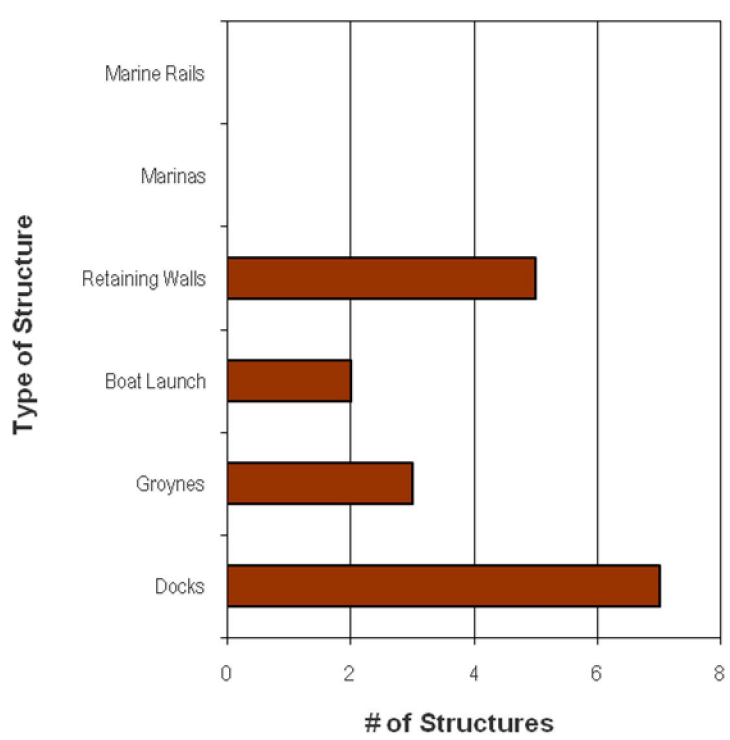

Figure 7. Number and type of modification structures observed along St. Mary Lake.

Shoreline substrate modification includes impacts from roads, railways, retaining walls, and other substrate modification. Substrate modification observed along the St. Mary Lake shoreline includes road modification which represents approximately 76.0 m (1.0%) of the total shoreline.

The relative level of impact along the St. Mary Lake shoreline is shown in Figure 8. It is estimated that 1249 m (12.0%) of the shoreline is characterized by a High level of impact (i.e., >40% disturbed). Approximately 2188 m (20.9%) of the shoreline is characterized by Moderate impact (i.e., 10-40% disturbed). Approximately 7012 m (67.1%) of the shoreline is characterized by Low impact (i.e., <10% disturbed). There were no areas observed with no disturbance.

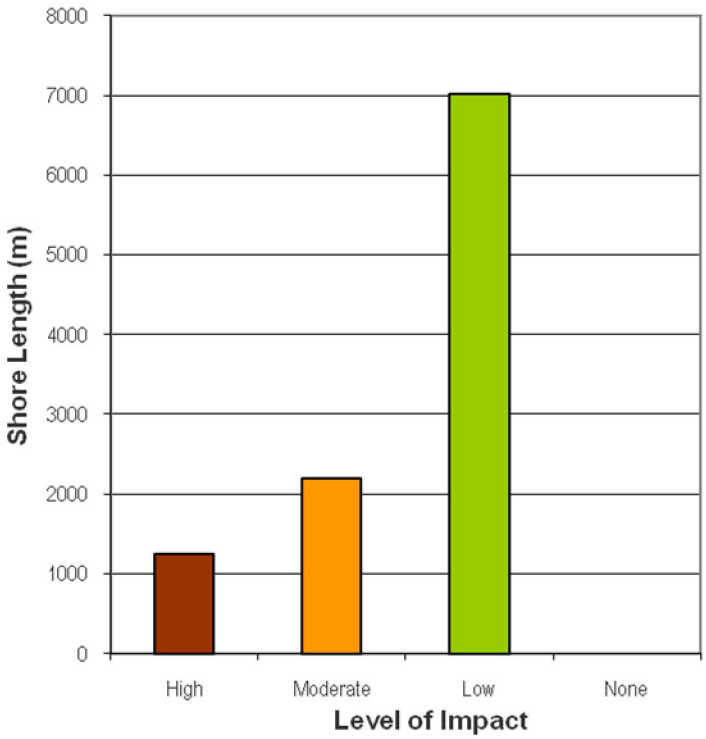

Figure 8. Shore length levels of impact along St. Mary Lake.

The juvenile fish rearing categories for the St. Mary Lake shoreline are shown in Figure 9. Areas classified as having High juvenile rearing values represent 5189 m of the total shoreline, 4911 m of which are undisturbed (94.6% natural). Areas of moderate rearing value occur along 3514 m of shoreline and are 53.1% disturbed. Areas of low rearing value occur along 1745 m of shoreline and are 76.0% natural.

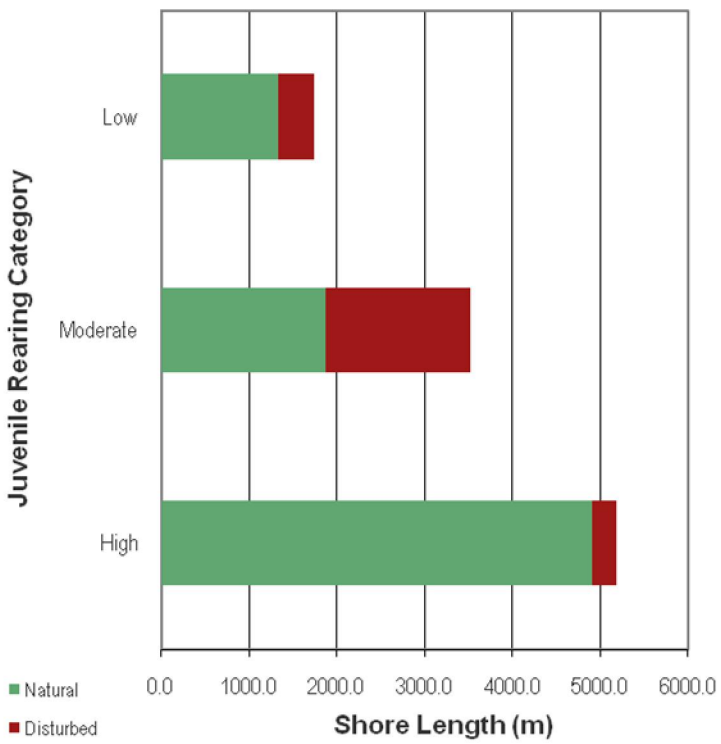

Figure 9. Natural and disturbed shore lengths within juvenile rearing areas along St. Mary Lake.

6.2 Summary of Foreshore Modifications

St. Mary Lake provides important wildlife habitat for both fish (e.g., salmonids) and birds (e.g., waterfowl) and a variety of other terrestrial species (e.g., ungulates). The extensive shoreline wetlands, sand and gravel bars, and wide littoral areas represent sensitive ecosystems with important values for water quality, fish rearing, and biomass productivity. The corridor formed by the St. Mary River provides connectivity between St. Mary Lake and habitats both upstream and downstream.

The lake also provides unique local recreational opportunities for boating, swimming, and fishing. The proximity of the lake to a city centre (i.e., Kimberley) makes the area a convenient destination for visitors. The natural beauty of the lake also draws residents who want to build homes along the natural shoreline with views of the lake. This combination of important fish and wildlife habitat and development pressure present a vital need to identify and characterize shoreline features and manage the resource in a sustainable way. The data collected during this assessment provides the baseline information necessary to guide the development of a long-term plan to manage the resource effectively for both environmental and socio-economic concerns.

Currently, the shoreline of the lake is approximately 78% natural, based upon the results of the FIM survey. Most of the undisturbed shoreline occurs within natural areas of the shoreline (e.g., Crown Land) which may face development pressures in the future. Areas of particular significance (i.e., wetlands and stream mouths associated with the St. Mary River inlet and) occur within areas that have been disturbed by beach grooming, riparian vegetation removal, and house construction. The FIM analysis indicates there is a need to develop long-term sustainable development objectives to protect the existing natural features and restore areas that have been disturbed by development.

In general, impacts to the foreshore from development along the lake are relatively minor and localized. Contiguous areas of undisturbed habitat are prevalent. During the FIM field surveys, observations regarding the state of the foreshore were made and are summarized below:

- Seven (7) docks were observed along the shoreline. It is possible that many of the docks were not constructed following best management practices which require elevated walkways on piles to deeper water zones at low water level. The impact of non-compliance is small on an individual scale, but cumulatively the extent of habitat related degradations will have significant effects on fish habitat.

- Five (5) retaining walls were observed along the shoreline, which were constructed out of mixed materials. It is probable that the retaining walls observed have been constructed without using provincial Best Management Practices or with *Water Act* or *Fisheries Act* approval.

- Three (3) groynes have been constructed along the shoreline within Segment 7. Two (2) boat launches have been constructed along the shoreline within Segment 9. It is unknown whether the boat launches were constructed using provincial Best Management Practices or with *Water Act* or *Fisheries Act* approval.

6.3 Aquatic Habitat Index Results

The results of the AHI are most easily reviewed graphically. The attached Figure Binder presents the spatial results of the FIM assessment. The Figure Binder has been prepared to summarize the information contained within this report. The results of the AHI are also provided in Appendix B.

The AHI incorporates biophysical information to categorize the relative value of each discrete shoreline segment. The overall results of the AHI indicate that approximately 56.2% of the entire shoreline is ranked as Very High and High. Approximately 24.4% of the shoreline length is ranked as Moderate, and the remaining 19.4% is ranked as Low and Very Low. Areas of high and very high habitat value were typically represented by stream mouths (lake inlets and outlet), wetland areas, and high value fish staging, rearing or migrating areas. The majority of the low value segments are characterized by shoreline modifications such as substrate modification, docks, and landuse such as single-family development.

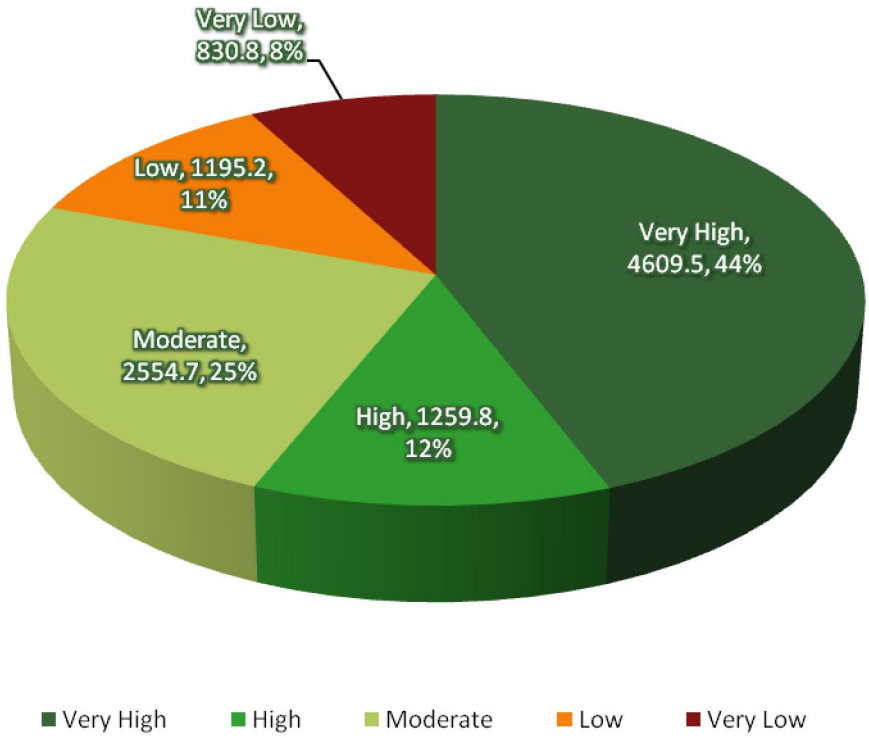

Figure 10. Proportional Aquatic Habitat Index rankings for shore lengths along St. Mary Lake.

Table 3 provides further detail on the current and potential value of the shoreline segments along St. Mary Lake.

Table 3: Current and Potential AHI Value for each shore length along St. Mary Lake.

Categories	Current Value			Potential Value		
	# of Segments	Shoreline Length (m)	% of Shoreline	# of Segments	Shoreline Length (m)	% of Shoreline
Very High	1	4609.5	44.1	1	4609.5	44.1
High	2	1259.8	12.1	2	1259.8	12.1
Moderate	3	2554.7	24.4	4	3148.0	30.1
Low	2	1195.2	11.4	1	601.9	5.8
Very Low	1	830.8	8.0	1	830.8	8.0

The AHI results were analyzed to determine the distribution of habitat values by shore type (Figure 11). The analysis indicated that Very High Value shorelines occurred mostly adjacent to Stream Mouth and Wetland areas. Most of the Very Low value habitat was found on Sand or Other areas.

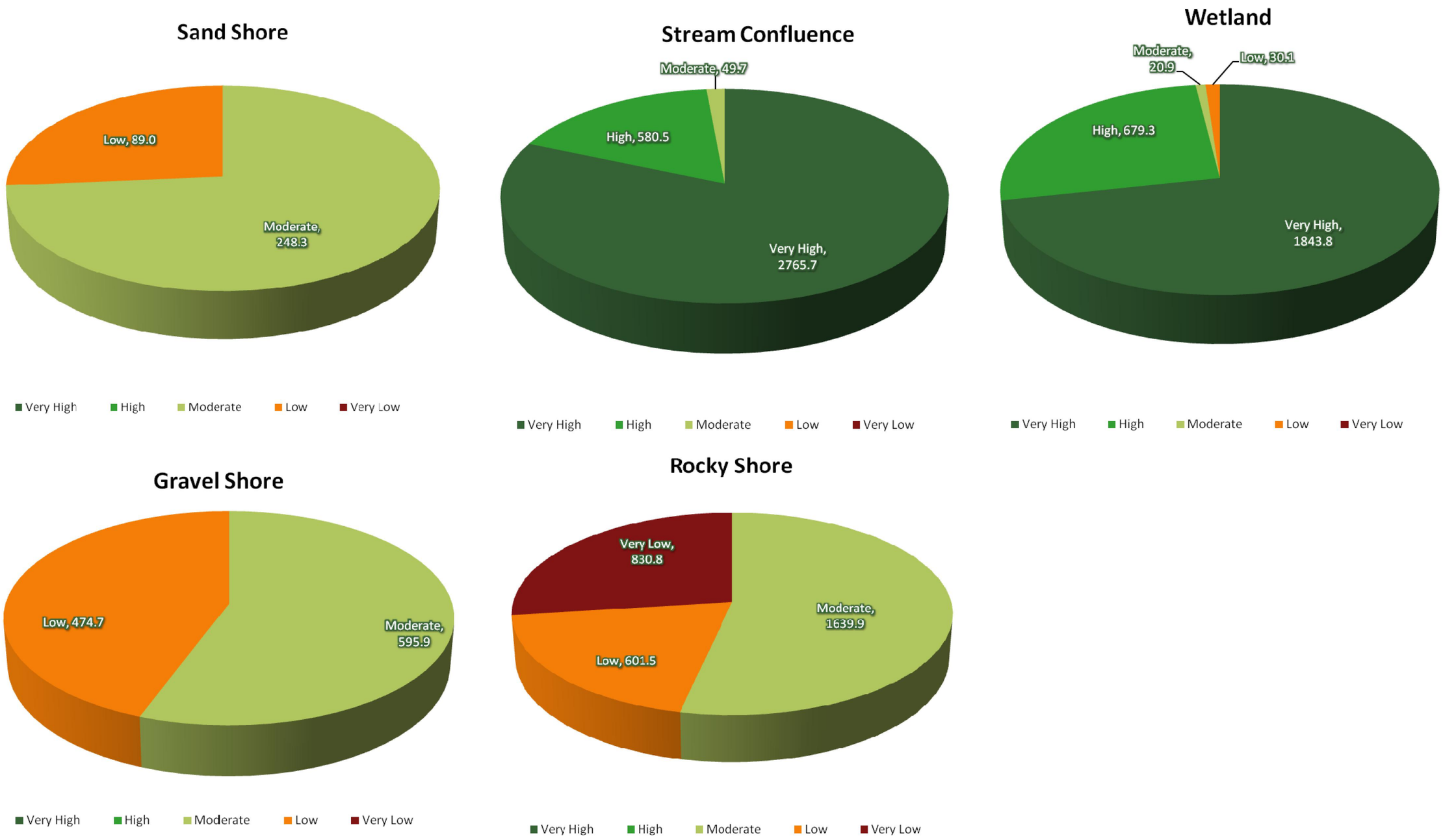

Figure 11. Proportional Aquatic Habitat Index rankings for each shore type along St. Mary Lake.

The AHI Potential Value summary indicates what the habitat value would be if the existing modifications were removed (Table 5). This analysis highlights areas where restoration will most likely result in a measurable improvement to shoreline habitat. It is important to note that this analysis does not consider riparian improvements which would likely result in additional habitat improvements. In general, there was a shift from low to moderate in areas characterized by sand substrates. Another shift occurred from moderate to high in areas characterized by stream mouth. There was no change observed in the Very High or Very Low categories. More detailed analysis will help to better interpret where restoration efforts may be more realistic, feasible, and cost effective.

Table 4: Current value AHI results for shore types along St. Mary Lake.

Categories	Current Value			Rocky		Gravel		Sand		Stream mouth		Wetland	
	# of Segments	Shoreline Length	% of Shoreline	Shoreline Length	% of Shoreline	Shoreline Length	% of Shoreline	Shoreline Length	% of Shoreline	Shoreline Length	% of Shoreline	Shoreline Length	% of Shoreline
Very High	1	4609.5	44.1	0.0	0.0	0.0	0.0	0.0	0.0	2765.7	60.0	1843.8	40.0
High	2	1259.8	12.1	0.0	0.0	0.0	0.0	0.0	0.0	580.5	46.1	679.3	53.9
Moderate	3	2554.7	24.4	1639.9	64.2	595.9	23.3	248.3	9.7	49.7	1.9	20.9	0.8
Low	2	1195.2	11.4	601.5	50.3	474.7	39.7	89.0	7.4	0.0	0.0	30.1	2.5
Very Low	1	830.8	8.0	830.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5: Potential value AHI results for shore types along St. Mary Lake.

Categories	Potential Value			Rocky		Gravel		Sand		Stream_mou		Wetland	
	# of Segments	Shoreline Length	% of Shoreline	Shoreline Length	% of Shoreline	Shoreline Length	% of Shoreline	Shoreline Length	% of Shoreline	Shoreline Length	% of Shoreline	Shoreline Length	% of Shoreline
Very High	1	4609.5	44.1	0.0	0.0	0.0	0.0	0.0	0.0	2765.7	60.0	1843.8	40.0
High	2	1259.8	12.1	0.0	0.0	0.0	0.0	0.0	0.0	580.5	46.1	679.3	53.9
Moderate	4	3148.0	30.1	1669.6	53.0	1070.5	34.0	337.3	10.7	49.7	1.6	20.9	0.7
Low	1	601.9	5.8	571.8	95.0	0.0	0.0	0.0	0.0	0.0	0.0	30.1	5.0
Very Low	1	830.8	8.0	830.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 12 summarizes the relative amount of natural and disturbed shoreline areas within each of the AHI Ranking categories. Within areas ranked as Very High, the shoreline is 99% natural. In High value areas, the shoreline is 100% natural and within Moderate value areas the shoreline was 68.5% natural. Areas of Low and Very Low value are characterized by 40% and 20% natural shoreline, respectively.

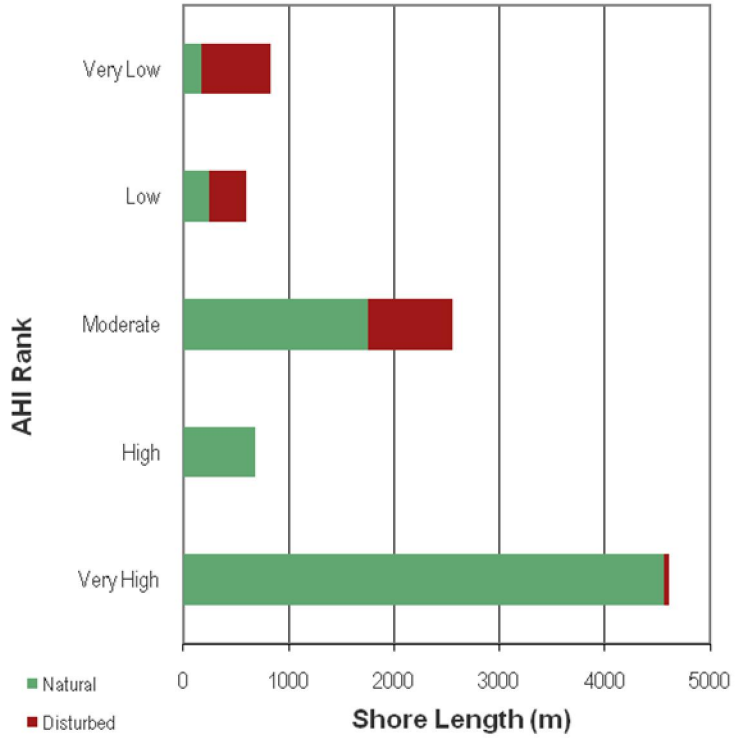

Figure 12. Natural and disturbed shore lengths in each AHI Rank category observed along St. Mary Lake.

7.0 RECOMMENDATIONS

The following sections provide general recommendations for protection of the existing shoreline values, and future data management and inventory considerations.

7.1 Foreshore Protection

The following section provides a summary of recommendations for foreshore protection along St. Mary Lake. Some of the recommendations below are similar to previous FIM reports that were completed within the Okanagan and Kootenay regions. In cases of similarity, credit to the work should be given to the original authors. The following are recommendations for development of foreshore protection policies:

1. **Key shoreline linkages to sensitive terrestrial habitat have been identified by this assessment. These habitat linkage areas are extremely important to maintain and should be identified as early as possible in the development process.**
   Maintaining connectivity between riparian and terrestrial habitats or along corridors connecting aquatic ecosystems should be a major consideration during future management. The St. Mary River corridor, for example, provides a critical movement corridor for wildlife and represents important migration and spawning habitat for native sport fish. Maintaining intact corridors between habitats mitigates the effects of fragmentation and isolation and helps maintain healthy wildlife populations. Riparian communities make obvious corridors as they are associated with the streams that connect lakes and other aquatic habitats. These areas are also typically associated with red listed ecosystems and provide habitat for species at risk.

   This information should be incorporated into future policy to reduce potential impacts from land use decisions (e.g., zoning a property for commercial purposes may result in impacts that are difficult to mitigate). Numerous options exist to protect sensitive, habitats including No Build/No Disturb Covenants, creation of Natural Area Zoning bylaws (i.e., split zoning on a property), or other mechanisms (donation to trust, etc.). The Very High and High shoreline areas are considered the most important areas around the lake and protection of these key habitats is necessary.

2. **Restoration of shoreline ecosystem communities, including riparian and aquatic vegetation**
   Healthy communities provide important and measurable effects on water quality and fish habitat. Increased density and diversity and structural complexity of emergent and submergent vegetation will benefit juvenile trout as it provides increased productivity and food resources and cover from predators (Brown et al. 2009b).

3. **Environmental information collected during this survey should be available to all stakeholders, relevant agencies, and the general public.**
   Environmental information, including GIS information and air photos, are an important part of the environmental review process because they provide detailed technical information regarding the current ecological condition of the shoreline and associated habitats. This information should be readily available to the public to provide a transparent review process and include public input during land development decision making. A single agency should take the lead role in data management and any significant studies that add to this data set should be incorporated and updated accordingly.

4. **Compliance monitoring and policy enforcement during approved works is required, with negative consequences for failure to follow standard best management practices or to apply for relevant permits.**
   Unsanctioned and illegal modifications of shorelines are disappointingly common along many interior lakes. Retaining walls, docks, boat launches, and other shoreline access points are created without an appropriate permit or following provincial standards or best management practices. Improved compliance monitoring and policy enforcement at all levels of government will help ensure best practices are maintained.

5. **A communication and outreach strategy should be developed to inform stakeholders and the public of the findings of this study and improve stewardship and compliance**.
   Initially, it is recommended that notice of the availability of this report and associated products are available on the Community Mapping Network. Education and involvement of the public will help facilitate the development of the Shoreline Guidance Document.

6. **Local, provincial, and federal governments should only approve proposed developments with net neutral or net positive effects for biophysical resources.**

7. **Developments that have "significant" adverse effects to any biophysical resource (e.g., spawning areas) should not be approved on the basis that compensatory habitat works may offset such effects unless suitable rationale and arguments are presented (e.g., it benefits the general public versus an individual).**

8. **Compensatory works resulting from projects or portions of projects that could result in harmful alterations, destruction, or disruption of fish habitat must follow the DFO Decision Framework for the Determination and Authorization of Harmful Alteration, Disruption or Destruction of Fish Habitat[1]. The works must be consistent with the "No Net Loss" guiding principle of The Department of Fisheries and Oceans Policy for the Management of Fish Habitat.**

9. **Habitat mitigation and compensation plans for biophysical resources should occur prior to, or as a condition of, any approval of shoreline-altering projects.** To ensure that works are completed, estimates to complete the works and bonding amounts should be collected. These bonds will ensure performance objectives for the proposed works are met and that construction meets an acceptable standard.

[1] Note that the Riparian Areas Regulation does not address habitat compensation requirements because they fall under the jurisdiction of Fisheries and Oceans Canada.

10. **Development of land use alteration proposals should only be approved if the compromises or trade-offs will result in substantial, long-term net positive production benefits for biophysical resources.**

11. **Low impact recreational pursuits (biking, non motorized boating, etc.), pedestrian traffic, and interpretive opportunities should be encouraged**.
    These activities should be directed to less sensitive areas and risks to biophysical resources should be considered. Only activities that will not diminish the productive capacity of biophysical resources should be considered.

7.2 Future Data Management

Ongoing appropriate management of the data is important to ensure that data collected during this survey is kept available, accurate, and up to date. Future data collection should be integrated into the current AHI and additions and edits made as required. The following are recommendations for future management of the dataset:

1. **A single agency should take the lead role in data management and maintenance**.
   The responsible agency should manage and maintain the "master data set". Although the data may be available for download from numerous locations, one agency should be tasked with keeping the master copy for reference purposes. The Community Mapping Network (CMN) is currently publishing many of the data sets that have been collected. Sufficient funding must be allocated to CMN to keep up with management of the data because typically increasing datasets result in increasing costs.

2. **The shoreline segment numbers used in this report are the unique identifiers. Any new shoreline information that is collected should reference and become linked to the existing shoreline segment number.**
   This will help maintain consistency and connectivity between current and future data collection and integration. The responsibility of maintaining this consistency will be that of the single agency described above.

3. **A summary column(s) should be added to the FIM dataset that flags new GIS datasets as they become available.**
   Examples of this include new location maps for rare species occurrences and fish distributions. Other examples include the addition of appropriate wildlife habitat use data. Where feasible, these new data sets should reference the shoreline segment numbers identified in this report.

4. **Review and update of the FIM/AHI data and mapping should occur on a 5 to 10 ten year cycle.**
   Review and update of the FIM will be required to determine if shoreline goals and objectives are being achieved. Ideally, updates to the FIM dataset would be done

as projects are approved and completed (i.e., real time). However, at this time, it is unlikely that the multiple government agencies responsible have the capability to establish such a system.

7.3 Future Inventory and Data Collection

The following are recommendations for future biophysical inventory that will help facilitate environmental considerations in land use planning decisions:

1. **Data regarding stream and shore spawning locations for resident fish species is limited.**
   Sport fish species such as bull trout, burbot, westslope cutthroat trout, and stocked rainbow trout have been identified within the lake system. During the FIM review, it was noted that there is limited data regarding shore or stream spawning locations for these fish species. Future inventory of important spawning areas should be conducted to allow improved management of critical habitats.

2. **The Juvenile Rearing Suitability Index should be field confirmed.** The rearing index that was developed for this project is based upon the rearing index developed for Okanagan Lake. The index should be adjusted according to the results of a field program that samples different shoreline areas and types during different seasons. The differences between the two systems should be adjusted. This type of analysis could also be replicated across different lake types to better assess the relative value of different shoreline areas to juvenile salmonids. Similar investigations into utilization and importance of the different shore types by resident fish stocks may also yield information regarding the relationships between juvenile rearing suitability, fish stocks, and shore type.

3. **A field sampling program of the different shoreline areas should be developed to confirm the results of the AHI**. The AHI has been developed based upon information that is currently available for Okanagan Lake, upon review of other studies, and air / GPS stamped still photo / GPS Video. However, numerous assumptions have been built into the index and a field sampling program should be developed to confirm the results of the assessment and to test assumptions of the index.

4. **Complete Sensitive Habitat Inventory and Mapping (SHIM) for all watercourses around the lake**.
   SHIM is a GIS-based stream mapping protocol that provides substantial information regarding streams and watercourses. This mapping protocol provides useful information for fisheries and wildlife managers, municipal engineering departments (e.g., engineering staff responsible for drainage), and others. This information is also extremely useful for Source Water Protection initiatives because it identifies potential contaminant sources in an inventory.

5. **Complete Wetland Inventory and Mapping (WIM) for all wetlands along the shoreline of the lake and associated tributaries.**
   WIM is another GIS-based mapping protocol that provides information regarding wetland communities. WIM mapping along the St. Mary Lake shoreline and associated tributaries is recommended. Mapping of wetlands is also important to ensure that corridors between aquatic and terrestrial habitats are identified. Wetlands are sensitive and productive components of natural ecosystems and these features should be inventoried and mapped.

6. **A carrying capacity analysis of the lake should be completed.**
   The carrying capacity of a lake is defined as a lakes capacity to accommodate recreational use (e.g., boating) and shoreline residential development without compromising adjacent aquatic and terrestrial habitats, biological resources, aesthetic values, safety, and water quality. Biological systems are extremely complex and difficult to predict and manage. Shoreline ecosystems throughout the province are experiencing rapid changes due to a variety of factors including land development and climate change. Determining the threshold upon which cumulative effects will have measurable and noticeable impacts is difficult and controversial; therefore a conservative approach is required. Accurately determining sustainable carrying capacities on lake systems is currently one of the most challenging obstacles to lakeshore management because it affects cultural, social, and environmental resources and values.

7. **A survey of individual properties should be conducted and the results provided to home owners to provide educational and stewardship opportunities.**
   A property 'report card' could be prepared that would provide shoreline home owners with a review of the current condition of their properties. The assessment should provide them with sufficient information to help home owners work towards restoring and enhancing shoreline habitats on their property. An assessment like this is not intended to single out individual property owners, but rather to provide educational opportunities regarding the importance of shoreline habitats present along the lake.

8. **Native beds of submergent and floating vegetation should be mapped in detail.**
   Native beds of submergent and floating vegetation require more detailed mapping. Conducting a Wetland Inventory and Mapping project would help better identify, classify, and describe these important, sensitive features.

8.0 CONCLUSION

This report documents the current condition of 10.5 km of shoreline along St. Mary Lake in the East Kootenay region of BC. The Foreshore Inventory and Mapping (FIM) assessment provides a summary of current and background information characterizing the condition of the shoreline and riparian communities that comprise the foreshore of St. Mary Lake. An Aquatic Habitat Index (AHI) was developed that incorporates the biophysical information collected during the surveys to rank the relative environmental sensitivity and level of disturbance of each of the discrete shoreline segments around the lake. Recommendations are provided to help integrate this information into local land use planning initiatives and guide the future development of Shoreline Management Guideline.

Approximately 78% of the St. Mary Lake shoreline is in a natural (i.e., undisturbed) condition, representing approximately 8104 m of shoreline. Overall, approximately 56.2% of the shoreline is ranked as High or Very High value. The High value habitats tend to occur within stream mouth and wetland communities that provide suitable fish and wildlife habitat. Approximately 8.0% of the shoreline is ranked Very Low value and these areas tend to occur within areas that have been impacted by shoreline development and substrate modification.

Docks represented the most common form of shoreline modification. Of the approximately 22% of disturbed shoreline, approximately 33% is characterized by Moderate to High levels of impact resulting from docks, groynes, retaining walls, boat launches, and roadway modification. These impacts, along with riparian vegetation removal, are considered the most significant form of shoreline degradation observed around St. Mary Lake.

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GLOSSARY OF TERMS AND ACRONYMS

Alluvial Fan / Stream Mouth – Alluvial fans are areas where a stream outlet has a direct active influence (e.g., sediment deposition or channel alignment changes) on the lake.

Allochthonous Inputs - Organic material (e.g., leaf litter) that is contributed to an aquatic community from a terrestrial community.

Aquatic Habitat Index (AHI) -The index is a ranking system based upon the biophysical attributes and shoreline modifications of different shoreline types. The index consists of parameters such as shore type, substrate type, presence of retaining walls, marinas, etc. to determine the relative habitat value based upon a mathematical relationship between the parameters.

Aquatic Vegetation – Aquatic vegetation consists of any type of plant life that occurs below the high water level. In some instances, aquatic vegetation can refer to grasses and sedges that are only submerged for short periods of time.

Biophysical – Refers to the living and non-living components and processes of the ecosphere. Biophysical attributes are the biological and physical components of an ecosystem such as substrate type, water depth, presence of aquatic vegetation, etc.

Best Management Practice (BMP) - Is a method or means by which natural resources are protected during development or construction. For example, the Ministry of Environment has developed documents containing standards and guidelines for work in and around water.

Emergent Vegetation - Emergent vegetation includes species such as cattails, bulrushes, varies sedges, willow and cottonwood on floodplains, grasses, etc. Emergent vegetation is most commonly associated with wetlands, but is also occurs on rocky or gravel shorelines.

Fisheries and Oceans Canada (DFO) – Federal agency responsible for management of fish habitats

Fisheries Productivity - The maximum natural capability of habitats to produce healthy fish, safe for human consumption, or to support or produce aquatic organisms upon which fish depend.

Floating Vegetation - Floating vegetation includes species such as pond lilies and native pondweeds with a floating component.

Foreshore – The foreshore is the area that occurs between the high and low water marks on a lake.

Foreshore Inventory Mapping (FIM) -FIM is the methodology used to collect and document fish and riparian habitats lake corridors and was performed by the Regional District of Central Okanagan and partners. A full discussion of this mapping can be found in Regional District of Central Okanagan (2005)

Georeferencing - Georeferencing establishes the relationship between page coordinates on a planar map (i.e., paper space) and known real-world coordinates (i.e., real world location)

Groyne – A protective structure constructed of wood, rock, concrete or other materials that is used to stop sediments from shifting along a beach. Groynes are generally constructed perpendicular to the shoreline

Instream Features – Instream features are considered to be construction of something below the high water mark. Instream features may include docks, groynes, marinas, etc.

Lacustrine – Produced by, pertaining to, or inhabiting a lake

Lentic - In hydrologic terms, a non-flowing or standing body of fresh water, such as a lake or pond.

Life History – Life history generally means how an organism carries out its life. Activities such as mating and resource acquisition (i.e., foraging) are an inherited set of rules that determine where, when and how an organism will obtain the energy (resource allocations) necessary for survival and reproduction. The allocation of resources within the organism affects many factors such as timing of reproduction, number of young, age at maturity, etc. The combined characteristics, or way an organism carries out its life, is a particular species' life history traits.

Lotic – In hydrologic terms, a flowing or moving body of freshwater, such as a creek or river.

Retaining Wall – A retaining wall is any structure that is used to retain fill material. Retaining walls are commonly used along shorelines for erosion protection and are constructed using a variety of materials. Bioengineered retaining walls consist of plantings and armouring materials and are strongly preferred over vertical, concrete walls. Retaining walls that occur below the Mean Annual High Water Level pose a significant challenge, as fill has been placed into the aquatic environment to construct these walls.

Sensitive Habitat Inventory Mapping (SHIM) - The SHIM methodology is used to map fish habitat in streams.

Shore zone - The shore zone is considered to be all the upland properties that front a lake, the foreshore, and all the area below high water mark.

Streamside Protection and Enhancement Area (SPEA) - The SPEA means an area adjacent to a stream that links aquatic to terrestrial ecosystems and includes both the existing and potential riparian vegetation and existing and potential adjunct upland vegetation that exerts influence on the stream. The size of the SPEA is determined by the methods adopted for the Provincial Riparian Areas Regulation.

Stream Mouth / Stream Confluence / Alluvial Fan – Stream mouths are considered to be areas where a stream has the potential to have a direct active influence (e.g., sediment deposition or channel alignment changes) on the lake.

Submergent Vegetation – Submergent vegetation consists of all native vegetation that only occurs within the water column. This vegetation is typically found in the littoral zone, where light penetration occurs to the bottom of the lake. Eurasian milfoil is not typically considered submergent vegetation as it is non-native and invasive.

SEGMENT PHOTO PLATES

St Mary Lake **Segment No.** 1

Shore Type: Wetland

Cliff / Bluff	Rocky	Gravel	Sand	Stream Confluence	Wetland	Other
0%	0%	0%	0%	0%	100%	0%
Comments	emergent veg /shrubs					

AHI and Fisheries Information

AHI Rating	AHI Potential	Juvenile Rearing	Migration	Staging	Spawn Stream
High	High	Moderate	No	No	No

Land Use

Agriulture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi Family	Natural Area	Park	Recreation	Rural	Single Family	Urban Park	Transportation
0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
Comments													

Substrates

Marl	Mud	Organic	Fines	Sand	Gravel 2	Gravel Fin	Gravel Coa	Cobble	Cobble Fin	Cobble Coa	Boulder	Bedrock
0%	10%	10%	0%	80%	0%	0%	0%	0%	0%	0%	0%	0%
Comments												

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith
Mixed forest	mature forest	Abundant (>50%)	Abundant (>50%)	Continuous	30
Comments					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith (m)
0	0	0.00	0	0	0
Comments					

Aquatic Vegetation

Aquatic Veg	Submergent	Emergent	Floating	Comment
100%	0%	100%	100%	sedges/rushes

Modifications

Retaining Walls	% Ret. Wall	Docks	Docks per km	Boat Houses	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Marine Railways	Marinas	Substrate Mod.	% Substrate Mod
0	0	0	0.00	0	0	0.00	0	0	0	0	0	0	0
Comments	10 pilings												

*N/A = Not Available

St Mary Lake **Segment No.** 2

Shore Type: Rocky Shore

Cliff / Bluff	Rocky	Gravel	Sand	Stream Confluence	Wetland	Other
0%	100%	0%	0%	0%	0%	0%
Comments						

AHI and Fisheries Information

AHI Rating	AHI Potential	Juvenile Rearing	Migration	Staging	Spawn Stream
Moderate	Moderate	Low	No	No	No

Land Use

Agriulture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi Family	Natural Area	Park	Recreation	Rural	Single Family	Urban Park	Transportation
0%	0%	0%	0%	0%	0%	0%	95%	0%	5%	0%	0%	0%	0%
Comments													

Substrates

Marl	Mud	Organic	Fines	Sand	Gravel 2	Gravel Fin	Gravel Coa	Cobble	Cobble Fin	Cobble Coa	Boulder	Bedrock
5%	5%	10%	0%	20%	0%	10%	0%	0%	0%	0%	50%	0%
Comments												

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith
Mixed forest	mature forest	Abundant (>50%)	Abundant (>50%)	Continuous	30
Comments					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith (m)
0	0	0.00	0	0	0
Comments					

Aquatic Vegetation

Aquatic Veg	Submergent	Emergent	Floating	Comment
10%	100%	0%	0%	

Modifications

Retaining Walls	% Ret. Wall	Docks	Docks per km	Boat Houses	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Marine Railways	Marinas	Substrate Mod.	% Substrate Mod
0	0	0	0.00	0	0	0.00	0	0	1	0	0	0	0
Comments	old trail												

*N/A = Not Available

St Mary Lake **Segment No.** 3

Shore Type: Wetland

Cliff / Bluff	Rocky	Gravel	Sand	Stream Confluence	Wetland	Other
0%	0%	0%	0%	60%	40%	0%
Comments	lake inlet; cottonwoods /willow /birch					

AHI and Fisheries Information

AHI Rating	AHI Potential	Juvenile Rearing	Migration	Staging	Spawn Stream
Very High	Very High	High	Yes	Yes	Yes

Land Use

Agriulture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi Family	Natural Area	Park	Recreation	Rural	Single Family	Urban Park	Transportation
0%	0%	0%	0%	0%	0%	0%	94%	0%	5%	0%	1%	0%	0%
Comments	1 house												

Substrates

Marl	Mud	Organic	Fines	Sand	Gravel 2	Gravel Fin	Gravel Coa	Cobble	Cobble Fin	Cobble Coa	Boulder	Bedrock
20%	0%	20%	0%	80%	0%	0%	0%	0%	0%	0%	0%	0%
Comments	delta of river											

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith
Natural wetland	mature forest	Abundant (>50%)	Sparse (<10%)	Patchy	50
Comments					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith (m)
0	0	0.00	0	0	0
Comments					

Aquatic Vegetation

Aquatic Veg	Submergent	Emergent	Floating	Comment
95%	10%	90%	90%	rushes/sedges

Modifications

Retaining Walls	% Ret. Wall	Docks	Docks per km	Boat Houses	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Marine Railways	Marinas	Substrate Mod.	% Substrate Mod
0	0	0	0.00	0	0	0.00	0	0	1	0	0	0	0
Comments	1 house												

*N/A = Not Available

St Mary Lake **Segment No.** 4

Shore Type: Rocky Shore

Cliff / Bluff	Rocky	Gravel	Sand	Stream Confluence	Wetland	Other
0%	95%	0%	0%	0%	5%	0%
Comments	road, steep talus slope ,1 small wetland					

AHI and Fisheries Information

AHI Rating	AHI Potential	Juvenile Rearing	Migration	Staging	Spawn Stream
Moderate	Moderate	Moderate	No	No	No

Land Use

Agriulture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi Family	Natural Area	Park	Recreation	Rural	Single Family	Urban Park	Transportation
0%	40%	0%	0%	0%	0%	0%	0%	0%	0%	0%	60%	0%	0%
Comments													

Substrates

Marl	Mud	Organic	Fines	Sand	Gravel 2	Gravel Fin	Gravel Coa	Cobble	Cobble Fin	Cobble Coa	Boulder	Bedrock
10%	0%	10%	0%	20%	8%	0%	0%	0%	0%	40%	10%	2%
Comments												

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith
Mixed forest	mature forest	Moderate (10-50%)	Moderate (10-50%)	Continuous	15
Comments					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith (m)
0	0	0.00	0	0	0
Comments					

Aquatic Vegetation

Aquatic Veg	Submergent	Emergent	Floating	Comment
30%	90%	10%	10%	

Modifications

Retaining Walls	% Ret. Wall	Docks	Docks per km	Boat Houses	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Marine Railways	Marinas	Substrate Mod.	% Substrate Mod
1	0	1	0.00	1	0	0.00	0	0	1	0	0	0	0
Comments													

*N/A = Not Available

St Mary Lake **Segment No.** 5

Shore Type: Rocky Shore

Cliff / Bluff	Rocky	Gravel	Sand	Stream Confluence	Wetland	Other
0%	95%	0%	0%	0%	5%	0%
Comments						

AHI and Fisheries Information

AHI Rating	AHI Potential	Juvenile Rearing	Migration	Staging	Spawn Stream
Low	Low	Low	No	No	No

Land Use

Agriulture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi Family	Natural Area	Park	Recreation	Rural	Single Family	Urban Park	Transportation
0%	0%	0%	0%	0%	0%	0%	80%	0%	0%	0%	20%	0%	0%
Comments													

Substrates

Marl	Mud	Organic	Fines	Sand	Gravel 2	Gravel Fin	Gravel Coa	Cobble	Cobble Fin	Cobble Coa	Boulder	Bedrock
10%	0%	10%	0%	20%	10%	0%	0%	0%	0%	40%	10%	0%
Comments												

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith
Mixed forest	mature forest	Moderate (10-50%)	Moderate (10-50%)	Patchy	15
Comments					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith (m)
0	0	0.00	0	0	0
Comments					

Aquatic Vegetation

Aquatic Veg	Submergent	Emergent	Floating	Comment
30%	90%	10%	10%	

Modifications

Retaining Walls	% Ret. Wall	Docks	Docks per km	Boat Houses	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Marine Railways	Marinas	Substrate Mod.	% Substrate Mod
0	0	0	0.00	0	0	0.00	0	0	1	0	0	0	0
Comments													

*N/A = Not Available

St Mary Lake **Segment No.** 6

Shore Type: Rocky Shore

Cliff / Bluff	Rocky	Gravel	Sand	Stream Confluence	Wetland	Other
0%	100%	0%	0%	0%	0%	0%
Comments						

AHI and Fisheries Information

AHI Rating	AHI Potential	Juvenile Rearing	Migration	Staging	Spawn Stream
Very Low	Very Low	Moderate	No	No	No

Land Use

Agriulture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi Family	Natural Area	Park	Recreation	Rural	Single Family	Urban Park	Transportation
0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
Comments													

Substrates

Marl	Mud	Organic	Fines	Sand	Gravel 2	Gravel Fin	Gravel Coa	Cobble	Cobble Fin	Cobble Coa	Boulder	Bedrock
0%	0%	0%	0%	10%	40%	0%	0%	0%	0%	40%	10%	0%
Comments												

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith
Mixed forest	mature forest	Sparse (<10%)	Sparse (<10%)	Patchy	5
Comments					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith (m)
0	0	0.00	0	0	0
Comments					

Aquatic Vegetation

Aquatic Veg	Submergent	Emergent	Floating	Comment
30%	0%	0%	0%	

Modifications

Retaining Walls	% Ret. Wall	Docks	Docks per km	Boat Houses	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Marine Railways	Marinas	Substrate Mod.	% Substrate Mod
0	0	0	0.00	0	0	0.00	0	0	1	0	0	0	0
Comments													

*N/A = Not Available

St Mary Lake **Segment No.** 7

Shore Type: Gravel

Cliff / Bluff	Rocky	Gravel	Sand	Stream Confluence	Wetland	Other
0%	10%	60%	25%	5%	0%	0%
Comments	some imported sand , dredging					

AHI and Fisheries Information

AHI Rating	AHI Potential	Juvenile Rearing	Migration	Staging	Spawn Stream
Moderate	Moderate	Moderate	No	Yes	No

Land Use

Agriulture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi Family	Natural Area	Park	Recreation	Rural	Single Family	Urban Park	Transportation
0%	0%	0%	0%	0%	0%	0%	30%	0%	0%	0%	70%	0%	0%
Comments	some new development												

Substrates

Marl	Mud	Organic	Fines	Sand	Gravel 2	Gravel Fin	Gravel Coa	Cobble	Cobble Fin	Cobble Coa	Boulder	Bedrock
10%	0%	0%	0%	25%	55%	0%	0%	5%	0%	0%	5%	0%
Comments												

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith
Mixed forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Patchy	5
Comments					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith (m)
0	0	0.00	0	0	0
Comments					

Aquatic Vegetation

Aquatic Veg	Submergent	Emergent	Floating	Comment
30%	90%	10%	10%	

Modifications

Retaining Walls	% Ret. Wall	Docks	Docks per km	Boat Houses	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Marine Railways	Marinas	Substrate Mod.	% Substrate Mod
4	0	6	0.01	0	3	0.00	0	0	0	0	0	0	0
Comments													

*N/A = Not Available

St Mary Lake **Segment No.** 8

Shore Type: Gravel

Cliff / Bluff	Rocky	Gravel	Sand	Stream Confluence	Wetland	Other
0%	0%	0%	0%	100%	0%	0%
Comments	lake outlet					

AHI and Fisheries Information

AHI Rating	AHI Potential	Juvenile Rearing	Migration	Staging	Spawn Stream
High	High	High	Yes	Yes	Yes

Land Use

Agriulture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi Family	Natural Area	Park	Recreation	Rural	Single Family	Urban Park	Transportation
0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%
Comments													

Substrates

Marl	Mud	Organic	Fines	Sand	Gravel 2	Gravel Fin	Gravel Coa	Cobble	Cobble Fin	Cobble Coa	Boulder	Bedrock
10%	0%	0%	0%	80%	0%	10%	0%	0%	0%	0%	0%	0%
Comments												

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith
Mixed forest	mature forest	Moderate (10-50%)	Moderate (10-50%)	Continuous	20
Comments					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith (m)
0	0	0.00	0	0	0
Comments					

Aquatic Vegetation

Aquatic Veg	Submergent	Emergent	Floating	Comment
5%	10%	10%	10%	

Modifications

Retaining Walls	% Ret. Wall	Docks	Docks per km	Boat Houses	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Marine Railways	Marinas	Substrate Mod.	% Substrate Mod
0	0	0	0.00	0	0	0.00	0	0	0	0	0	0	0
Comments													

*N/A = Not Available

St Mary Lake **Segment No.** 9

Shore Type: Gravel

Cliff / Bluff	Rocky	Gravel	Sand	Stream Confluence	Wetland	Other
0%	5%	80%	15%	0%	0%	0%
Comments						

AHI and Fisheries Information

AHI Rating	AHI Potential	Juvenile Rearing	Migration	Staging	Spawn Stream
Low	Moderate	Moderate	No	Yes	No

Land Use

Agriulture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi Family	Natural Area	Park	Recreation	Rural	Single Family	Urban Park	Transportation
0%	0%	0%	0%	0%	0%	0%	60%	0%	40%	0%	0%	0%	0%
Comments	traditional unimproved rec site/former sawmill site												

Substrates

Marl	Mud	Organic	Fines	Sand	Gravel 2	Gravel Fin	Gravel Coa	Cobble	Cobble Fin	Cobble Coa	Boulder	Bedrock
0%	0%	0%	5%	25%	50%	0%	10%	10%	0%	0%	0%	0%
Comments												

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith
Broadleaf forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Patchy	20
Comments					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwith (m)
0	0	0.00	0	0	0
Comments					

Aquatic Vegetation

Aquatic Veg	Submergent	Emergent	Floating	Comment
5%	90%	10%	10%	

Modifications

Retaining Walls	% Ret. Wall	Docks	Docks per km	Boat Houses	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Marine Railways	Marinas	Substrate Mod.	% Substrate Mod
0	0	0	0.00	0	0	0.00	2	0	0	0	0	0	0
Comments	30 pilings , abundant deadheads/debris												

*N/A = Not Available

Foreshore Inventory and Mapping
FIGURE BINDER

St. Mary Lake

Foreshore Inventory and Mapping

Legend

- 999 Foreshore Inventory and Mapping (FIM) Segment Number
- Segment Break
- Foreshore Inventory and Mapping (FIM) Segment
- Streams
- Electoral Area / Municipal Boundary
- Cadastre
- Contours

Aquatic Habitat Index Rating

- Very High
- High
- Moderate
- Low
- Very Low

Segment Number: 1
Habitat Index Rating: High
Juvenile Rearing: Moderate

Segment Number: 2
Habitat Index Rating: Moderate
Juvenile Rearing: Low

Segment Number: 3
Habitat Index Rating: Very High
Juvenile Rearing: High

Segment Number: 4
Habitat Index Rating: Moderate
Juvenile Rearing: Moderate

Segment Number: 5
Habitat Index Rating: Low
Juvenile Rearing: Low

Segment Number: 6
Habitat Index Rating: Very Low
Juvenile Rearing: Moderate

Segment Number: 7
Habitat Index Rating: Moderate
Juvenile Rearing: Moderate

Segment Number: 8
Habitat Index Rating: High
Juvenile Rearing: High

Segment Number: 9
Habitat Index Rating: Low
Juvenile Rearing: Moderate

St. Mary Lake

St. Mary River

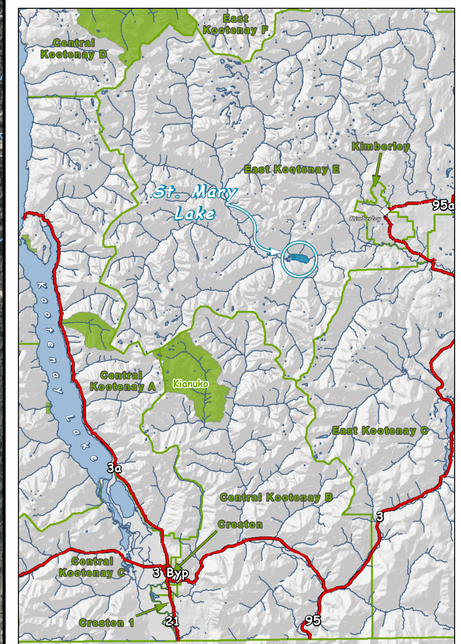
Allie Creek

Argyle Creek

Report Creek

St. Mary Forest Service Road

Lakeside Road



ECOSCAPE
Environmental Consultants Ltd.

200 100 0 200 400 600
Meters

1 : 6,000

APPENDIX A
Data Tables

Table 1: The percentage of natural and disturbed shoreline along St. Mary Lake

	% of Shoreline	Shore Length (m)
Natural	77.55%	8104
Disturbed	22.45%	2346

Table 2: The percentage of natural and disturbed shore lengths within each of the different slope categories.

Slope	% of Total Shore Length	Total Shore Length (m)	Shore Length Natural (m)	Shore Length Disturbed (m)	% Natural	% Disturbed
Very Steep (60+)	0.0	0	0	0	0.0	0.0
Steep (20-60)	0.0	0	0	0	0.0	0.0
Moderate (5-20)	34.3	3588	2016	1571	56.2	43.8
Low (0-5)	65.7	6862	6088	775	88.7	11.3
Bench	0.0	0	0	0	0.0	0.0

Table 3: The total length of natural and disturbed shorelines and their associated land uses around St. Mary Lake

	% of Shoreline Length	Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	0.0%	0	0	0	0.0%	0.0%
Commercial	1.6%	167	67	100	40.0%	60.0%
Conservation	0.0%	0	0	0	0.0%	0.0%
Forestry	0.0%	0	0	0	0.0%	0.0%
Industrial	0.0%	0	0	0	0.0%	0.0%
Multi Family	0.0%	0	0	0	0.0%	0.0%
Natural Area	74.8%	7814	6904	910	88.4%	11.6%
Park	0.0%	0	0	0	0.0%	0.0%
Recreation	5.0%	525	425	100	80.9%	19.1%
Rural	0.0%	0	0	0	0.0%	0.0%
Single Family	10.6%	1113	542	571	48.7%	51.3%
Urban Park	0.0%	0	0	0	0.0%	0.0%
Transportation	8.0%	831	166	665	20.0%	80.0%
Institutional	0.0%	0	0	0	0.0%	0.0%

Table 4: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around St. Mary Lake

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	0.0%	0	0	0.0	0.0%	0.0%
Rocky Shore	29.4%	3072	1707	1364.9	55.6%	44.4%
Gravel Beach	10.2%	1071	583	487.8	54.4%	45.6%
Sand Beach	3.2%	337	178	159.7	52.6%	47.4%
Stream Mouth	32.5%	3396	3111	284.7	91.6%	8.4%
Wetland	24.6%	2574	2525	49.0	98.1%	1.9%
Other	0.0%	0	0	0.0	0.0%	0.0%

Table 5: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along St. Mary Lake

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	58.2%	6085
Submergent Vegetation	38.4%	4008
Emergent Vegetation	49.2%	5147
Floating Vegetation	0.0%	0

Table 6: The total number and density (# per km) of different shoreline modifications occurring around St. Mary Lake

Type	Total #	# Per km
Docks	7	0.67
Groynes	3	0.29
Boat Launch	2	0.19
Retaining Walls	5	0.48
Marinas	0	0.00
Marine Rails	0	0.00

Table 7: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along St. Mary Lake

Category	% of Shoreline	Shore Length (m)
Roadway	1%	76.0
Retaining Wall	0%	0.1
Railway	0%	0.0
Substrate Modification	0%	0.0

Table 8: The Level of Impact around St. Mary Lake (High (> 40%), Moderate (10-40%), Low (<10%), None (0%))

Level of Impact	% of Shoreline	Shore Length (m)
High	11.95%	1249
Moderate	20.94%	2188
Low	67.10%	7012
None	0.00%	0

Table 9: The shore length and percentage of shoreline areas classified as having High, Moderate, or Low Juvenile Rearing Value on St. Mary Lake.

Juvenile Rearing Category	# of Segments	Shore Length				
		Natural (m)	Natural (%)	Disturbed (m)	Disturbed (%)	Total
High	2	4911.7	94.6%	278.3	5.4%	5189.9
Moderate	5	1865.4	53.1%	1649.5	46.9%	3514.9
Low	2	1326.8	76.0%	418.3	24.0%	1745.1

APPENDIX B

AQUATIC HABITAT INDEX RESULTS

Denotes the Lowest Score Possible in the Category					
Very High	60	Moderate	40	Very Low	0.0
High	50	Low	38		

	Biophysical						Fisheries			Riparian		Terrestrial			Modifications				
Segment	Shore Type	Substrate	% Natural	Aquatic Vegetation	Overhanging Vegetation	Large Woody Debris	Juvenile Rearing	Migration Corridor	Staging Area	Band 1 (Riparian)	Band 2 (Upland)	Veteran Trees	Snags	Wildlife Corridor	Retaining Wa	Docks	Groynes	Boat Launch	Marina
1	15	4.8	5	8	0	4	4	0	0	6.4	0	3	3	0	0	0.00	0.00	0	0
2	12	7.4	4.75	0.8	0.04	4	2	0	0	6.4	0	3	5	0	0	0.00	0.00	0	0
3	15	6.4	4.95	7.6	0	0.8	10	4	4	8	0	5	1	3	0	0.00	0.00	0	0
4	12.15	8.84	2	2.4	0.04	4	4	0	0	3.84	0	3	3	0	-0.00024	-1.00	0.00	0	0
5	12.15	9	2	2.4	0.04	4	2	0	0	3.84	0	1	3	0	0	0.00	0.00	0	0
6	12	10	1	2.4	0.04	3.2	4	0	0	1.28	0	1	3	0	0	0.00	0.00	0	0
7	11.15	8.3	2.5	2.4	0.04	4	4	0	4	1.28	0	3	1	0	-0.0004	-0.01	-0.01	0	0
8	15	5	3	0.4	0	4	10	4	4	5.12	0	1	3	3	0	0.00	0.00	0	0
9	11.4	8.6	3	0.4	0	4	4	0	4	6.4	0	1	1	0	0	0.00	0.00	-4	0

Score Possible	Total Score Possible				
	48	18	12	5.0	

Segment	Biophysical	Fisheries	Riparian	Terrestrial	Modification (All)
1	36.8	4	6.4	6	0.0
2	28.99	2	6.4	8	0.0
3	34.75	18	8	9	0.0
4	29.43	4	3.84	6	-1.0
5	29.59	2	3.84	4	0.0
6	28.64	4	1.28	4	0.0
7	28.39	8	1.28	4	0.0
8	27.4	18	5.12	7	0.0
9	27.4	8	6.4	2	-4.0

Summary								
Max	69.8	84.0	Max	69.8	84.0	Max		
Min	37.9	45.7	Min	37.9	45.7	Min		

Segment	Shore Length	Current Value	Current Value Total Percent	AHI Ranking	Potential Value	Potential Value Percentage	Potential Value AHI Ranking
1	679.3	53.2	64.1	High	53.2	64.1	High
2	1143.2	45.4	54.7	Moderate	45.4	54.7	Moderate
3	4609.5	69.8	84.0	Very High	69.8	84.0	Very High
4	418.3	42.3	50.9	Moderate	43.3	52.1	Moderate
5	601.9	39.4	47.5	Low	39.4	47.5	Low
6	830.8	37.9	45.7	Very Low	37.9	45.7	Very Low
7	993.1	41.7	50.2	Moderate	41.7	50.2	Moderate
8	580.5	57.5	69.3	High	57.5	69.3	High
9	593.3	39.8	47.9	Low	43.8	52.8	Moderate

APPENDIX C

Additional Legal Requirements

This Appendix was reproduced entirely from the Windermere Lake Shoreline Management Guidelines. All credit should be given to the original authors of that document.

Laws and regulations provide the regulatory 'teeth' to uphold environmental protection and management. Applicable legislative requirements must be met for a project to be in compliance with the law. Legal requirements have been presented here in the following categories: Federal, Provincial, Regional District and District of Invermere. For each of these jurisdictions, a list of pertinent legislation bylaws and/or plans; and contact information (web site links) has been provided. The reader is cautioned that other legislation (not listed) may apply to their development, and they are encouraged to consult with the appropriate agency prior to proceeding with any proposed works.

1. Federal Legislation

All federal legislation is administered by the parliament of Canada (federal government).

Canada Migratory Birds Convention Act

This Act implements an internationally recognized Convention between Canada and the United States to protect various species of migratory game birds, migratory insectivorous birds and migratory non-game birds including herons. The taking of nests or eggs of these birds is prohibited, except for permitted scientific or propagating purposes.

Fisheries Act

The *Fisheries Act* is administered by the federal DFO and is one of the most important pieces of legislation for managing aquatic resources in Canada. The fish habitat provisions of this Act enable the federal government to protect marine and freshwater habitats supporting those species that sustain fisheries, namely fish, shellfish, crustaceans and marine mammals.

Navigable Waters Protection Act

This act is administered by Transport Canada and is primarily applicable to protecting, maintaining, and developing opportunities for the public to access and use waterbodies for navigation and recreation. Any activities that may affect movement of people or goods, near or on water are affected (i.e. dock/marina construction, dredging, shoreline development).

Pesticides Act

The *Pesticides Act* is intended to 1) prevent and mitigate harmful effects to the environment and human health, and 2) rationalize and reduce the use of pesticides. The Act promotes the analysis, assessment and control of the effects of the use of pesticides through specific activities intended to widen knowledge about these products (environmental monitoring, for example).

Species at Risk Act

This act prevents Canadian indigenous species, subspecies and distinct populations from becoming extirpated or extinct, provides for the recovery of endangered or threatened species and encourages the management of other species to prevent them from becoming at risk.

Canadian Environmental Assessment Act (CEAA)

The CEAA requires federal departments to conduct environmental assessments (EA) for prescribed projects and activities before providing federal approval or financial support. The EA is a planning tool used to identify potential effects of projects or activities on the environment. This includes the air, water, land and living organisms, including humans.

Indian Act

The *Indian Act* provides legislation relating to Indians and Lands Reserved for Indians. The Indian Act is administered by the Minister of Indian Affairs and Northern Development.

2. Provincial Legislation

All provincial government legislation within BC is administered by the legislative assembly of British Columbia (provincial government).

Land Act

The *Land Act* is the main legislation governing the disposition of provincial Crown (i.e. public) land in British Columbia. Crown land is any land owned by the Province, including land that is covered by water, such as the foreshore and the beds of lakes, rivers and streams. The *Land Act* is administered by the Ministry of Sustainable Resource Management.

Wildlife Act

The provincial Ministry of Environment administers the *Wildlife Act*, which includes legislation relating to the conservation and management of wildlife populations and habitat, issuing licenses and permits for fishing, game hunting, and trapping. A provision of the *Wildlife Act*, which may be pertinent to shoreline development is the prohibition, to take, injure, molest, or destroy a) a bird or its egg; b) the nest of an eagle, peregrine falcon, gyrafalcon, osprey, heron, or burrowing owl; c) or the nest of any other bird species when the nest is occupied by a bird or its egg.

Water Act

The *Water Act* is the primary provincial statute regulating water resources. Under the *Water Act*, a stream is defined as "*a natural watercourse or source of water supply, whether usually containing water or not, and a lake, river, creek, spring, ravine, swamp and gulch*." Section 9 of the *Water Act* requires that a person may only make "changes in and about a stream" under an Approval or Notification where required; or under a Water License or Order.

Weed Control Act

The B.C. *Weed Control Act* imposes a duty on all land occupiers to control designated noxious plants. The purpose of the Act is to protect our natural resources and industry from the negative impacts of foreign weeds.

3. Regional District of East Kootenay

The Regional District of East Kootenay (RDEK) provides local government services to rural areas outside municipal boundaries. The RDEK functions as a partnership of the municipalities and electoral areas (unincorporated areas) within its boundaries. These local governments work together through the RDEK to provide and coordinate services in both urban and rural areas. Regional districts are governed by the *Local Government Act* and other provincial legislation.

APPENDIX D

Best Management Practices and Regional Operating Statements

This Appendix was reproduced entirely from the Windermere Lake Shoreline Management Guidelines. All credit should be given to the original authors of that document.

Many provincial and federal agencies have developed Best Management Practices (BMP) in order to provide consistent direction to the public on acceptable development methods. The BMPs provide information to help ensure that proposed development activities are planned and carried out in compliance with the various applicable legislation, regulations, and policies. The range of activities that associate BMPs is broad.

The province of BC has, over a period of many years, developed a series of BMPs. These have evolved into "Develop with Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia." The Develop with Care Guidelines have links to several provincial BMPs related to shoreline development activities. Examples are as follows:

- Standards and Best Management Practices for Instream Works;
- Best Management Practices for Small Boat moorage on Lakes
- Timing and Terms and Conditions for Changes In and About a Stream Specified by MOE Habitat Officers, Kootenay Region
- Small Boat Moorage
- Boat Launch Construction and Maintenance on Lakes
- Lakeshore Stabilization
- Installation and Maintenance of Water Line Intakes
- Best Management Practices for Raptor Conservation during Urban and Rural Land Development in British Columbia
- Best Management Practices for Amphibians and Reptiles in Urban and rural Environments in BC
- Best Management Practices for Recreational Activities on Grasslands in the Thompson and Okanagan Basins

The Regional Operating Statements (ROS) developed by DFO, provide information regarding several low risk activities associated with shoreline development, including but not limited to:

- Aquatic Vegetation Removal in Lakes
- Bridge & Culvert Maintenance
- Dock and Boathouse Construction in Freshwater Systems
- Routine Maintenance Dredging for Navigation
- Public Beach Maintenance
- Clear Span Bridges
- Culvert Maintenance
- Directional Drilling
- Small Moorings
- Underwater Cables in Freshwater Systems
- Overhead Line Construction
- Maintenance of Riparian Vegetation in Existing Rights of Ways
- Dry Open Cut Stream Crossing
- Isolated Ponds