Foreshore Inventory and Mapping
MOYIE LAKE






Prepared For:
East Kootenay Integrated Lake Management Partnership

Prepared By:
Ecoscape Environmental Consultants Ltd.

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File No.: 09-371

FORESHORE INVENTORY AND MAPPING

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EXECUTIVE SUMMARY

This report has been prepared based upon the belief that it is possible to manage our watersheds and their natural surroundings in a sustainable manner. The intent of this document is to provide relevant stakeholders with information to facilitate future land use planning and foreshore development guidance for shoreline areas around Moyie Lake. This project involved the following general process:

1. Shoreline Inventories following the Foreshore Inventory and Mapping (FIM) protocol (Appendix A) and additional fisheries and wildlife inventories to identify other sensitive features of concern. Inventories were conducted using a variety of methods and data was utilized from numerous different sources;

2. An Aquatic Habitat Index (AHI) was generated using the FIM data to determine the relative habitat value of the shoreline. This index follows similar methods that were developed for Okanagan Lake and Windermere Lake and is similar to other ongoing assessments along Shuswap Lake, Tie and Rosen Lakes, and Columbia Lake.

3. Shoreline Management Guidelines have been prepared for the shorelines surveyed to facilitate making informed land use decisions for our watersheds. The Shoreline Management Guidelines are intended to provide background information to 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 data provided in this document can be incorporated into land policy documents, such as Official Community Plans or Bylaws. The information collected during this assessment will be used as a baseline and allow development of specific objectives to be prepared for shoreline protection. Finally, once objectives have been prepared, the methodology will allow managers to assess and measure whether the specific shoreline objectives have been met over time.

The shoreline of Moyie Lake provides residents and tourists with excellent opportunities to live and recreate in a rural setting. Moyie Lake consists of a North and South Basin, with a very biologically diverse (i.e., productive) narrows region in the middle. The lake contains many important wildlife features, including several significant wetlands and flood bench communities which were mapped as part of this project. Moyie Lake also has several important stream tributaries that provide important spawning habitat for kokanee and salmonid species. In close proximity to Moyie Lake is Monroe Lake. Monroe is a smaller lake, with one cluster of development. Monroe Lake also contains important wetland habitats, and is surrounded by coniferous forests of varying structural stages due to recent forest fire events. Fisheries and Wildlife reports have been prepared for both Moyie and Monroe Lakes (under separate cover).

Foreshore Inventory and Mapping results (FIM) for this project provides valuable information regarding features, habitats, and other information for the shorelines of these lakes. A summary of the data collected indicates the following:

- It is estimated that 48% of the shoreline has a high level of impact which accounts for 17.5 km of shoreline. Areas of moderate and low impact account for 8% or 3 km and 45% or 16.6 km of the shoreline respectively. Impacts along the shoreline include lakebed

substrate modification, riparian vegetation removal, construction of retaining walls, docks and other anthropogenic features;

- The most predominant land use around the lake was rural (30.7%), followed by transportation (28.4 %) shorelines. Single Family residential areas were the third most commonly observed land use type, accounting for 17.9% of the shoreline. Other common land uses include natural areas and parklands;

- Sand beaches were the most rare shore type around the lake, accounting for less than 3% of the shoreline length. The most predominant shore types around the lake are Gravel and Rocky shores, which account for about 30% and 39% respectively. Wetlands and stream confluences were found along 16% and 5% of the shoreline respectively; and,

- Aquatic vegetation occurs along 25% of the shoreline length and is an important habitat feature for juvenile salmonids. Of this, emergent vegetation was the most commonly observed (e.g., emergent grasses, willows, or other areas with vegetation inundated during high water). Native beds of submergent vegetation were only documented along about 1% of the shoreline, and areas of floating vegetation were only observed along 2%.

The following summarizes habitat modifications observed:

- Docks were the most common modification observed, with a total of 108 structures recorded.
- Retaining walls were the next most common modification, with a total of 105 separate structures stretching over an estimated 4.6 km of the shoreline. In many cases, retaining walls extended beyond the high water level of the lake, and construction practices were not compliant with Best Management Practices.
- Groynes were not commonly observed, with only 2 structures recorded.
- There were a total of 10 boat launches and 5 marinas on this small lake.
- Substrate modification was observed on 36% of the shore length and was most commonly associated with retaining walls, transportation land uses, and historic mining activities.

The findings of the FIM indicate that the foreshore areas of Moyie Lake have been impacted by our current land use practices. The surveys indicate that in developed areas, impacts are greatest. It was readily apparent that where intense development was present most habitat features had been impacted. Despite these impacts, many areas around the shoreline remain in a relatively natural condition. The lake supports diverse wetland communities and has several important wildlife and fisheries habitats around stream confluences. Many of these wetland and stream confluence communities retain a natural characteristic (i.e., not heavily developed) and are at risk of impairment if not carefully considered during shoreline development activities.

The Aquatic Habitat Index (AHI) for Moyie Lake provides valuable information regarding the estimated habitat values of different shoreline areas. The following summarizes the results of the AHI analysis:

- The AHI found that approximately 15% of the shoreline is ranked as Very Low or Low habitat value. These areas are mostly found along highly developed shorelines that show little resemblance to the natural shore types they would have been;

- The AHI found that approximately 22% of the shoreline is ranked Very High and 31% is ranked as High. Many of these areas occurred in known shoreline spawning areas, stream confluences, wetlands, and other important habitat areas around the lake;
- Approximately 30% of the shoreline was of Moderate relative habitat value;
- Some shoreline areas have been documented to contain important burbot spawning habitats adjacent to them. Future detailed surveys may document other important shoreline features that should be considered;
- The AHI highlights the importance of the connection between our diverse stream side, wetland, and lakeshore habitats. Stream confluences and their adjacent features (e.g., shore marshes, large woody debris, and diverse riparian vegetation communities) are areas that tend to contain the highest fish and wildlife diversity, are extremely important for maintaining viable populations, and most importantly are water quality buffers that are required to preserve source drinking waters;
- The AHI also includes a restoration analysis. This analysis indicates that there are opportunities to repair impacted habitats. Habitat restoration opportunities include removal of groynes, the use of bioengineering in shoreline protection measures, and riparian revegetation. These habitat benefits will work to restore impacted habitats and reverse the current trends of habitat degradation. Habitat restoration opportunities should be pursued as part of any development or redevelopment applications. It may be useful to identify the potential for restoration opportunities in the standard terms of reference

Shoreline Management Guidelines have been prepared to facilitate informed land use planning decisions across multiple agencies, with the intention of streamlining the permitting and regulatory processes at these different agencies. Agencies participating in this project include the Regional District East Kootenay, Fisheries and Oceans Canada, and the Ministry of Environment. Vulnerability Zones for the shoreline areas of Moyie Lake have been prepared based upon the Habitat Index Results. The identification of these Vulnerability Zones allows a risk-based approach to shoreline management based upon habitat sensitivity. Based on this there is a higher risk of ecological degradation from developments proposed in shoreline areas with High and Very High habitat index scores. The Vulnerability Zones have been colour-coded for easy reference purposes and range from Red (Very High Habitat Value) to Grey (Very Low and Low Habitat Value). An activity risk matrix, which contains many of the most common applications received by the different agencies, has been developed. The matrix provides a summary of the risk of different activities within each Vulnerability Zone. A stepwise process has been developed, which is intended to guide proponents through the permitting process.

REPORT DISCLAIMER

The results contained in this report are based upon data collected during a brief one year inventory. Biological systems respond differently both in space and time. For this reason, the assumptions contained within the text are based upon field results, previously published material on the subject, and airphoto interpretation. The material in this report attempts to account for some of the variability between years and in space by using safe assumptions and a conservative approach. Due to the inherent problems of brief inventories (e.g., property access, GPS/GIS accuracies, air-photo interpretation concerns, etc.), professionals should complete their own detailed assessments of shoreline areas and shore wetlands to understand, evaluate, classify, and reach their own conclusions. Data in this assessment was not analyzed statistically and no inferences about statistical significance are made if the word significant is used. Use of or reliance upon biological conclusions made in this report is the responsibility of the party using the information. Neither Ecoscape Environmental Consultants Ltd., nor the authors of this report, are liable for accidental mistakes, omissions, or errors made in preparation of this report because best attempts were made to verify the accuracy and completeness of data collected and presented.

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1.0 INTRODUCTION

The Kootenay Region of British Columbia is regarded as a destination area offering scenic beauty and year-round recreational opportunities. This reputation has resulted in increased development pressure on the various lake shorelines in the region. This increase in development pressure has subsequently resulted in the need for development of land use policies such as Official Community Plans (OCP), Zoning Bylaws, and other landuse planning tools. It is widely acknowledged that development pressure has the potential to or has already impacted fish, wildlife, and/or water quality in many of the lakes. As a result of this, key stakeholders including Fisheries and Oceans Canada (DFO), BC Ministry of Environment (MOE), and the Regional District East Kootenay (RDEK) have gathered and presented data to ensure that land use decision making processes are consistent between the different levels of government and based on sufficient inventory to monitor and track objectives and goals using spatially relevant data (i.e., GIS).

It is a complex relationship between development pressure, the natural environment, and social, economic and cultural values. To balance these various community values, a solid understanding of aquatic and riparian resource values, land use interests, concerns of local residents and the long-term planning objectives is required. Thus, by collecting detailed, spatially accurate information of existing shoreline habitats and their condition, more informed land use planning decisions can be made that better balance the different pressures that exist. Foreshore Inventory and Mapping (FIM) is a standard shoreline mapping methodology that was employed to map the shoreline of Moyie Lake. This methodology has been standardized for mapping the shorelines of lakes in the province and provides the basis for integration of environmental information into land use policy documents.

2.0 PROJECT OVERVIEW

Moyie Lake covers about 891 hectares and supports important fish and wildlife habitats along the shoreline (Figure 1). The lake is a source of drinking waters, has important fisheries, and other associated environmental features that could be impacted by development. The intent of this project was to inventory the shoreline of the lake to understand the current condition of the shoreline. Without important inventory information such as this, it will not be possible to monitor whether management objectives for the lake have been met over time.

The mapping protocol will allow stakeholders to understand what the current condition of the shoreline is, to set objectives for better shore management in Official Community Plans or other policy documents, and measure and monitor changes in the shoreline overtime. Data collected during this assessment will be incorporated into a variety of planning policies at multiple levels of government to provide consistency in shoreline management policies between agencies. The methodology employed for this assessment is discussed in detail below and is an accepted standard that is being used to map shorelines around the province.

INSERT PROJECT LOCATION FIGURE 1

2.1 Project Partners

Numerous different parties have contributed to the success of this project. Foreshore Inventory and Mapping (FIM) protocols have been developed over the last five (5) years and have become a standardized 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. These contributing partners are recognized in Appendix A (Detailed methods).

This project was funded either directly or in kind by the following different agencies:

1. Fisheries and Oceans Canada (DFO)
2. Regional District of East Kootenay (RDEK)
3. East Kootenay Integrated Lake Management Partnership
4. Ministry of Environment
5. Wildsight

In support of this initiative, Ecoscape Environmental Consultants Ltd. (Ecoscape) also provided in-kind time, to the completion of this document. This contribution was made as part of our ongoing commitment to better shoreline management in the province.

2.2 Objectives

The project objectives were as follows:

1. Compile existing map base resource information for the Moyie Lake watershed;
2. Foster collaboration between the RDEK, DFO and the Province and utilize available expertise when possible;
3. Provide an overview of foreshore habitat condition on the lake;
4. Inventory foreshore morphology, land use, riparian condition and anthropogenic alterations;
5. Obtain spatially accurate digital video of the shoreline of the lake;
6. Provide access to the video and GIS geo-database through the RDEK and other sources;

7. Collect information that will aid in prioritizing critical areas for conservation and or protection and lake shore development;

8. Make the information available to planners, politicians and other key referring agencies that review applications for land development approval; and,

9. Integrate information with upland development planning, to ensure protection of sensitive foreshore areas so that lake management planning is watershed based.

3.0 FORESHORE INVENTORY & MAPPING METHODOLOGY

The Foreshore Inventory and Field Mapping detailed methodology (FIM) is found in Appendix A. This inventory 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 mapping initiatives such as SHIM, FIM, and CSIM by the Community Mapping Network is an integral part of ecologically sensitive community planning. The following sections summarize specific information for the Moyie Lake FIM.

3.1 Field Surveys

FIM field surveys were conducted June 3, 4 and 5, 2008 on Moyie Lake. Fisheries and wildlife surveys around Moyie Lake were conducted on July 21, 23, and 24, 2008. A fall sampling program for fish and wildlife was also conducted on September 25 and 26, 2008. Pre field reviews were completed daily and mapping was conducted in an organized fashion. Field assessments were completed by the British Columbia Conservation Corps., MOE, DFO, and Wildsight staff. Field surveyors were each assigned data to collect during the surveys. Field data collection was completed using a Trimble GPS unit with SHIM Lake v. 2.4 (FIM Data dictionary name).

3.2 Methodology

All of the methods outlined in Appendix A for FIM projects were carried out for this assessment. Daily information collected was downloaded to a laptop as a backup. Once downloaded, the entire database was reviewed for accuracy and corrections were made as necessary. Ecoscape has reviewed the database provided and worked with data collectors to ensure accuracy of the database. However, due to the large size of the dataset, small errors may be encountered. These errors, if found, should be identified and actions initiated to resolve the error.

3.2.1 Aquatic Vegetation Mapping and Classification

Aquatic vegetation mapping was carried out for the entire shoreline and littoral zone. For the purposes of this assessment, aquatic vegetation included all plant forms and communities occurring below the lake highwater level. Although some of the plants are not truly aquatic, all are hydrophitic and contribute to fish habitat. Vegetation mapping was completed using air photos, shoreline videos, and site photographs. Aquatic Vegetation polygons are similar to Zones of Sensitivity identified by the Okanagan and Windermere projects. Vegetation communities were classified using the Wetlands of British Columbia – A guide to identification (Mackenzie and Moran, 2004) and were categorized as:

Marsh (Wm)

A marsh is a shallowly flooded mineral wetland dominated by emergent grass-like vegetation. A fluctuating watertable is typical in marshes, with early-season high watertables dropping through the growing season. Exposure of the substrates in late season or during dry years is common. The substrate is usually mineral, but may have a well-decomposed organic veneer derived primarily from marsh emergents. Nutrient availability is high (eutrophic to hyper-eutrophic) due to circum-neutral pH, water movement, and aeration of the substrate.

Low Bench Flood Ecosystems (Fl)

Low bench ecosystems occur on sites that are flooded for moderate periods (< 40 days) of the growing season, conditions that limit the canopy to tall shrubs, especially willows and alders. Annual erosion and deposition of sediment generally limit understorey and humus development.

Mid Bench Flood Ecosystems (Fm)

Middle bench ecosystems occur on sites briefly flooded (10-25 days) during freshet, allowing tree growth but limiting tree species to only flood-tolerant broadleaf species such as black cottonwood and red alder.

Sites not described by the current nomenclature developed by Mackenzie and Moran (2004) were stratified into the following biophysical groups:

1. Emergent Vegetation (EV) generally refers to grasses, *Equisetum* spp. (i.e., horsetails), sedges, or other plants tolerant of flooding. Coverage within polygons need to be consistent and well established to be classified as EV. These were generally not dominated by true aquatic macrophytes and tended to occur in steeper sloping areas that are intermittently flooded or are groundwater receiving sites.

2. Sparse Emergent Vegetation (SEV) refers to the same vegetation types as emergent vegetation, but in these areas coverage were generally not very dense or were very patchy.

3. Overhanging Vegetation (OV) was mapped where observed. Overhanging vegetation also occurred with Emergent Vegetation (EVOV) and with Sparse Emergent Vegetation (SVOV).

4. Submerged Vegetation (SUB) areas generally consisted of native pondweed (*Potamogeton*) species. These areas were uncommon and only occurred in a few shallow bay areas.

5. Floating Vegetation (FLO) areas generally consisted of species such as *native Potamogeton,* pond lilies, and other types of vegetation that floats.

3.2.2 GIS and FIM Database Management

Data management for this project followed methods provided in Appendix A and generally involved the following steps:

- Data and photos were backed up to a computer/laptop on a daily basis;
- Photos were taken and photo logs were used to facilitate data review and interpretation;
- Air photo interpretation was completed using high resolution air photos that were flown during the summer of 2008.
- During data analysis, numerous checks were completed to ensure that all data was analyzed and accounted for.
- The TRIM shoreline file was provided by the MoE. Ecoscape subsequently mapped the shoreline using air photo interpretation, attempting to map the shoreline within ±5 m horizontal accuracy. This shoreline is sufficiently accurate for planning purposes required within this document and is believed to be within 5 m of the mean annual high water level for at least 80% of the lake. Thus, caution should be taken when using this line to interpret the mean annual high water level of the lake using this GIS shoreline feature.

The following data fields were added to the FIM data dictionary

1. An Electoral Area field was added to identify the jurisdiction (e.g. Regional District) in which respective shoreline segments occur.

2. A Community Field was added to the database to allow future data analysis by community if desired.

3. The following fisheries fields were added.

a. Burbot spawning zones have been identified for Moyie Lake. There is currently a wealth of information regarding the fishery and this data has been incorporated into the FIM dataset (Prince, 2007; Neufeld, 2008; Prince and Cope, 2008). Burbot spawning areas along the shoreline have been identified and shore segments where they occur have been flagged. These fisheries fields are considered similar to the Zones of Sensitivity that were developed for the Okanagan and Windermere projects.
b. Juvenile Rearing areas were considered to be any wide littoral zones that juvenile fish would utilize to forage. Most of these areas occur in and around stream mouth areas or wetlands.
c. Staging / Migration – Juvenile and adult fish migration routes are important components of fish life cycles. Migration and staging areas generally occur in deeper water zones in close proximity to spawning streams.

4.0 AQUATIC HABITAT INDEX METHODOLOGY

An Aquatic Habitat Index (AHI) is a tool that is used to help assess the habitat value or environmental sensitivity of a shoreline. An index is a numerical or categorical scale used to compare variables with one another. Use of an index to assess shoreline sensitivity has been utilized on Okanagan Lake (Schleppe and Arsenault, 2006) and Windermere Lake (McPherson S, and D. Hlushak, 2008). Indices are also currently in preparation for Slocan, Shuswap, and others. The purpose of the AHI is to facilitate land use planning by identifying the relative sensitivity of a shoreline.

The AHI utilizes a number of different parameters collected during the FIM. The index uses a points based mathematical model to assign the relative habitat value to each parameter. Features that have impaired the habitat value (e.g., retaining walls) are assigned negative scores to better reflect the current condition of the shoreline. The intent of this analysis was to compare the shoreline to its natural state.

A subsequent analysis was conducted to determine the habitat potential of a segment. This analysis involved removing ALL negative habitat parameters to determine if shoreline restoration could achieve a measurable benefit. This Habitat Potential index can be used to help assess where restorative efforts should be directed. It should be noted that this habitat restoration analysis has not considered the habitat benefits of riparian restoration. Riparian restoration should occur whenever possible along shoreline areas and benefits of riparian restoration can be assessed in the future.

4.1 Parameters

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

1. Biophysical;
2. Fisheries;
3. Riparian; and,
4. Modifications.

The following table (Table 1) identifies the parameters and logic used in the Moyie Lake index.

Table 1. The parameters and logic for the Aquatic Habitat Index of Moyie Lake.

Category	Criteria	Maximum Point	Percent of the Category	Percent of the Total	Logic	Value Categories
Biophysical	Shore Type	20	33.9	18.9	(% of Segment) x (Shore Type Value)	Stream Mouth = Wetland (20) > Gravel Beach = Rocky Shore (15) > Sand Beach = Cliff /Bluff (10), Other (5)
	Substrate	10	16.9	9.5	(% Substrate) x (Substrate Value)	Cobble (10) > Gravel (8) > Boulder = Organic = Mud = Marl (6), Fines = Sands (4) > Bedrock (2)
	Percentage Natural	15	25.4	14.2	(% Natural) x (Natural Score)	
	Aquatic Vegetation	8	13.6	7.6	(% Aquatic Vegetation) x (Aquatic Vegetation Score)	
	Overhanging Vegetation	6	10.2	5.7	(% Overhanging Vegetation) x (Overhanging Vegetation Score)	
Fish	Burbot Confirmed Spawning	8	44.4	7.6	Present (8), Absent (0)	Present (8), Absent (0)
	Staging Area	5	27.8	4.7	Present (5), Absent (0)	Present (5), Absent (0)
	Rearing Area	5	27.8	4.7	Present (5), Absent (0)	Present (5), Absent (0)
Riparian	Band 1 (Riparian)	10	62.5	9.5	(Vegetation Bandwidth Category) x (Vegetation Quality x Vegetation Score)	**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 (Upland)	6	37.5	5.7	(Vegetation Bandwidth Category) x (Vegetation Quality) x (Vegetation score)	**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)
Modifications	Retaining Wall	-3.5	27.9	-3.3	(% Retaining Wall) x (-5)	(% Retaining Wall) x (-5)
	Docks	-4	30.3	-3.6	(# Docks) x (-0.1)	(# Docks) x (-0.1)
	Groynes	-0.25	2.0	-0.2	(# Groynes) x (-0.25 per groyne)	(# Groynes) x (-0.25 per groyne)
	Boat Launch	-3	23.9	-2.8	(# Launches) x (-1 per launch)	(# Launches) x (-1 per launch)
	Marina	-2	15.9	-1.9	(# Marina) x (-1 per marina)	(# Marina) x (-1 per marina)

The parameters selected for the index were similar to the other indices developed. A description of each is found below.

4.1.1 Biophysical Parameters Description

The following summarizes the biophysical parameters of the index:

1. Shoreline type – A shoreline type is related to many aspects of productivity. Previous habitat indices (e.g., Schleppe and Arsenault, 2006) have used a fish habitat specificity table 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 because these segments tended not to be valuable utilizing a fish habitat specificity approach. Difficulties arose mostly because wetlands tend to mostly affect aquatic habitats (e.g., water quality or nutrient input) or have high wildlife value (which is not apparent in a fish habitat specificity approach). Other aspects of the habitat specificity were fine. The general habitat specificity for Moyie Lake follows that of Windermere and Okanagan (i.e., values follow similar patterns for each different shoreline type), except that Wetlands were considered as valuable as Stream Mouths premised on biodiversity and productivity values as well as water quality benefits. Thus, for most shore types, the habitat specificities generated for other lakes with similar fish habitats in the province were used in this assessment.

2. Substrate – Substrates also relate directly to productivity. There are generally two types of productive substrates, those utilized for spawning, and those that produce more biomass. The substrate values and parameters used for Moyie Lake are similar to the Okanagan and Windermere Lakes. More information regarding the rational of this parameter, please refer to the indices developed for the Okanagan (Schleppe and Arsenault, 2006) and Windermere (McPherson S. and D. Hlushak. 2008) Lakes.

3. Percent Natural – This parameter is similar to the Okanagan and Windermere. However, the relative percentage of the parameter was modified accordingly during calibration of the index.

4. Aquatic Vegetation – In more recent versions of the FIM database, more detailed information regarding aquatic vegetation was collected. In the Moyie Lake system, all vegetation below the HWL is considered productive. Since the FIM now allows analysis of this parameter, it was added to the index. The benefits of aquatic vegetation are many and include substrate for food and growth, biomass production, and structural cover.

5. Overhanging Vegetation – In the more recent versions of the FIM database, more detailed information regarding overhanging vegetation was collected. In the Moyie Lake system, overhanging vegetation was not present in all areas. Since it provides nutrients (i.e., litter fall) and opportunities to forage (e.g., insect drop), it was added to the index.

4.1.2 Fisheries Parameters Description

The fisheries parameters used for the AHI were those described above in Section 3.2.2 – GIS and Data Management. The different parameters are considered important for fish production in the Moyie system and were prioritized in the AHI accordingly. These are similar to areas identified as Zones of Sensitivity in the Okanagan and Windermere projects. The following were the fisheries parameters added:

1. Burbot Spawning (Burb_Spawn) areas were provided by the Ministry of Environment and are based upon fish population surveys conducted during 2006 and 2007 (see Price, 2000; Price and Cope, 2008; Neufeld, 2000). This information was digitized and included into the FIM dataset. Shoreline spawning areas were given a high weighting in the index because they relate directly to the productive capacity of a given area within a lake. Further, these zones are often habitat limiting factors that fish have a high specificity for.

2. Juvenile rearing areas were identified and included in the index. These areas are extremely important for fish habitat and were given a moderate weighting in the AHI.

3. Staging areas are also important areas for migrating fish. Staging areas were digitized based upon liaison with DFO field staff through the course of field work and the assessment. Field staff indicated to Ecoscape where fish were known to stage or hold prior to migrations. This parameter was considered because staging fish can be impacted by adjacent land uses such as marinas.

4.1.3 Riparian Parameters Description

The riparian parameters added to the index were similar to those added in the Okanagan and on Windermere projects. However, the newer versions of the FIM provided a distinction between the lakeside vegetation (Band 1/Riparian) and the areas behind (Band 2/Upland). To address this new data available, the index was modified slightly. The index was modified to include a factor assessing vegetation quality (i.e., tall shrubs thickets or wetland areas have a higher quality than landscaped yards). As with the other indices, vegetation bandwidths were categorized and a relative value was assigned. The Band 1 vegetation, directly adjacent to the lake was weighted higher than the Band 2 vegetation, as this vegetation contributes more to productivity within the lake.

4.1.4 Habitat Modifications Parameters Description

Habitat modification descriptions prepared by Schleppe and Arsenault (2006) provided a good description of the rationale for inclusion of these different parameters. 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 typically constructed from shoreline substrate modification, therefore gets counted twice). The following is quoted directly (shown in italics) from Schleppe and Arsenault (2006) completed by EBA Engineering Consultants Ltd. Further information on these parameters can also be found in the Windermere Lake assessment (McPherson and Hlushak, 2008).

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.

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 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.*

Docks also provide hiding locations for predators, such as bass and northern pike minnows. It has been shown that predatory fish, such as bass, can alter habitat use by small bodied fish (e.g., cyprinids, juvenile salmonids) (MacRae and Jackson, 2001) and that development on lakes can reduce the abundance of refuge for these juvenile fish (Bryan and Scarnecchia, 1992). The above highlights how docks have the potential to alter habitats and fish assemblages. Docks are also associated with other foreshore developments (e.g., retaining walls, groynes, etc.), and therefore cumulative effects of these structures likely further impact fish assemblages in small lakes.

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).

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).

Marinas

Marinas are a concentration of boat slips, offering a place of safety to vessels. Marinas likely have a variety of effects, but there is very little literature investigating the positive or negative habitat consequences of marinas. Large marinas also tend to have breakwaters, which can further affect wave action, sediment scour and deposition, and circulation. In general, when marinas are constructed in the littoral zone there tends to be a large increase in shading, which reduces the potential for aquatic macrophyte growth and therefore reduces the productivity of a particular shoreline area. Also, marinas tend to have other activities associated with them, including extensive boat movements, which can reduce the use of an area by more timid species *(e.g., rainbow trout). Other activities in marinas include fuelling stations, boat cleaning, bilge water, and sanitary waste disposal stations. Each of these activities has the potential to alter benthic communities, possibility altering the fish assemblage (i.e., congregations of more tolerant species and displacement of less tolerant species) and potential resulting in a loss in biodiversity, which can ultimately affect fish and/or fish habitat. Marinas also tend to be associated with other high intensity land developments, which may have a variety of effects including reducing water quality through inputs of chemicals, etc., increases in water turbidity, reduction in oxygen concentration, etc.*

4.2 Index Ranking Methodology

The AHI was used to analyze the habitat value of individuals segments relative to other segments on the lake. The output of the index is a five class ranking system, ranging from Very Low to Very High. Two different runs of the index were completed as follows:

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

2. Potential Value (AHI_POT) – This is the habitat index value when the anthropogenic modifiers (e.g. retaining walls) are removed from the analysis; thereby scoring each segment based on the site potential / capability. This highlights segments where restoration is possible.

4.2.1 Calibration and Calculation of the Index

The output of the AHI is a five class ranking system, ranging from very low to very high. This ranking reflects the current value of the shoreline relative to other areas of the shoreline. Because of this, some areas are considered Very Low habitat value. Although these areas are considered of lower habitat value, they still provide intrinsic habitat that can be impacted by adjacent land use so care should be taken when assessing the actual wildlife or fisheries productivity of a particular shoreline area. To calculate the Current Value of the shoreline using the habitat index, the total number of points for each of the different parameter (e.g., Shore Type, Retaining Wall, etc.) among the various categories (e.g., Fisheries, Riparian, and Biophysical) was summated (see Table 1, Section 4.1.1). This provided a score for each shore segment mapped during the FIM.

To calibrate the index, numerous iterations (in excess of 50 iterations) were run. For each iteration, the value of the different parameters was altered and the minimum, maximum, median, and distribution of scores was reviewed. This data was then viewed spatially along the shoreline for each shore segment. After reviewing the distribution of the data from the iterations, logical breaks were used to determine the category for Very High, High, Moderate, Low, and Very Low.

Ultimately, the value of habitat is a continuum, and there is room for some interpretation of this information. This index calculates the relative value of a shore segment to other shore segments within this lake, factoring in current modifications. 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 index is to act as a flagging tool so that important habitats are identified and considered during a land use decision process.

5.0 DATA ANALYSIS

5.1 General

General data analysis and review was completed for the FIM database. Data collected was reviewed and analysis focused on shore segment length. Analyses for this project were generally completed as follows:

1. The shoreline length for the shore segment was determined using GIS and added to the FIM database;

2. For each category, the analysis used the percentage natural or disturbed field to determine the approximate shoreline 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 following sections provide specific details for the biophysical analyses.

5.2 Biophysical Characteristics and Modifications Analysis

Biophysical characteristics of the shoreline segments were analyzed. For definitions of the different categories discussed below, please refer to Appendix A (Detailed Methods) for a description / definition. The following summarizes the different analyses that were completed:

1. Percent distribution of natural and disturbed shoreline;
2. Total shoreline length that remains natural or has been disturbed for each land use identified along the shoreline;
3. Total shoreline length that remained natural or has been disturbed for each shore type that occur along the shoreline;
4. Total length of shoreline that contained aquatic vegetation, emergent vegetation, floating vegetation, or submergent vegetation;
5. Total number of modification features recorded along the shoreline. This data represents point counts taken during the survey and is reported for groynes, docks, retaining walls, marinas, marine rails, and boat launches; and,
6. Total shoreline length of different shoreline modifiers (roadways, substrate modification, and retaining walls) was determined

5.3 Fisheries and Wildlife Sampling

Fisheries and wildlife sampling events were conducted on July 21, 22, and 23, 2008. A fall sampling period also occurred on September 25 and 26, 2008. These sampling events were conducted to add further data to the FIM data set, facilitate calibration of the index, and add additional sighting information.

The fisheries surveys for this assessment consisted of beach seining, minnow trapping, and snorkel surveys. The surveys focused on identifying important fish habitats and data was used to better understand fish utilization within the different shore segments. Yellow perch and pumpkinseed sunfish were invasive species that were identified in Moyie Lake. Invasive fish species are a cause for concern because of potential impacts they can have on native fish species. Impacts of invasive species are well documented and can include competitive exclusion (for habitat), predation, or competition for food.

Wildlife inventories along the shoreline focused on identifying important habitat features that may not have been captured completing the boat surveys during the FIM. Inventories identified adjacent wetlands, predominant native forest cover species, shrub cover species and coverage and incidental sightings of wildlife fauna. Where possible, this qualitative information was incorporated into the FIM data.

5.4 Aquatic Habitat Index Analysis

A brief summary of the shoreline lengths, shore types, and percent of the shoreline that is ranked as Very High to Very Low is presented. The summary provides information regarding the AHI results (Very High to Very Low), shore type, percent of the shoreline and shore length. The results of the habitat index are best viewed graphically and are presented in the Moyie Lake Figure Binder 1 at the end of this document.

6.0 RESULTS

The following section provides an overview analysis of the Moyie Lake system. Data is presented graphically in the text for ease of interpretation. Data tables for the different analyses are presented in Appendix B.

6.1 Biophysical Characteristics of the Lakes

Foreshore Inventory and Mapping was completed on 37,585 m (37.6 km) of shoreline on Moyie Lake. The total length of disturbed shoreline was 18,641 m (18.6 km) and the total length of natural shoreline was 18,944 m. This level of disturbance represents nearly 50% of the total shoreline length (Figure 2).

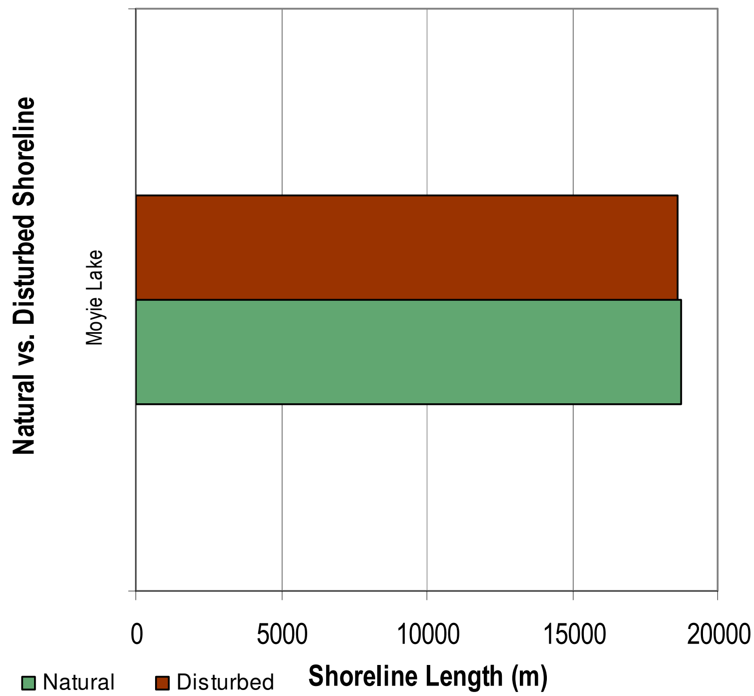


Figure 2 The total shoreline length that is either natural or disturbed on Moyie Lake.

Rural areas were the most prevalent land use along the Moyie Lake shoreline, representing approximately 30% of the shoreline or 11.4 km. Within these rural areas, the shoreline was generally 70% natural and 30% disturbed. Transportation (roads and rails) was the second most prevalent land use, occurring along 28% of the shoreline or 9.8 km. Single family residential areas represented approximately 8 km of shoreline, which accounted for about 18 % of the shoreline length. Within these residential areas, over 53% of the shoreline was disturbed.

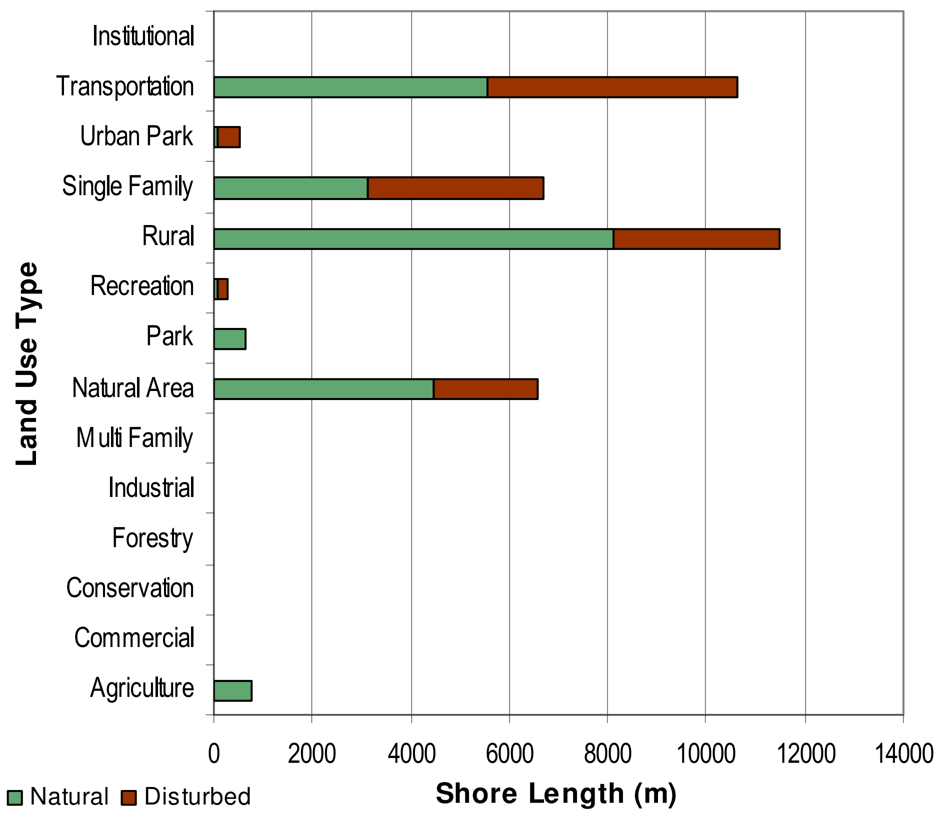


Figure 3 presents the natural and disturbed shoreline length by the different types of land us occurring around Moyie Lake.

The most predominant shore types observed were gravel beaches and rocky shores, which accounted for 30% (~11 km) and 39% (~15 km), respectively. Rocky shores and gravel beaches also tended to have a high level of disturbance, with approximately 42% and 48% of the shore length being disturbed respectively. Wetlands were the third most prominent shoreline type observed, accounting for about 16% of the shoreline, or approximately 5.8 km. Wetland shore types were also highly disturbed, with 30% of the shore length being impacted by some form of modification. Sand shore types were not very common and represented only 3% of the total shoreline length. Stream confluences accounted for 5.1% of the shore length (1.9 km), and these areas were disturbed along approximately 42% of their length.

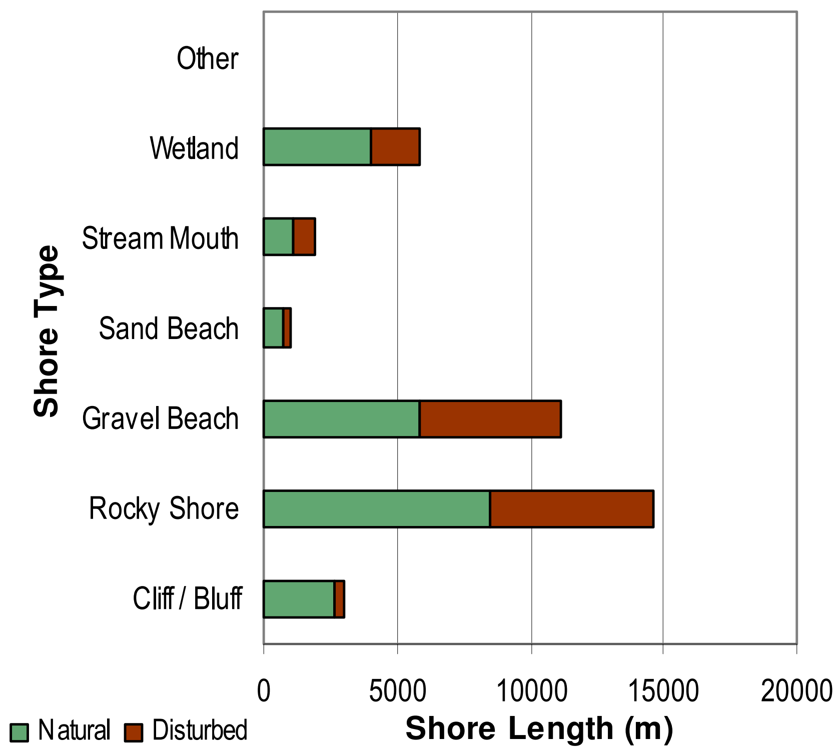


Figure 4 presents the length of natural and disturbed shoreline along each of the different shoreline types on Moyie Lake.

Aquatic vegetation is loosely defined as any type of emergent, submergent, or floating vegetation that occurred below the high water level. Thus, the aquatic vegetation field includes true aquatic macrophytes and those plants that are hydrophilic or tolerant of periods of inundation during high water level (e.g., willow species). Studies have shown that even terrestrial vegetation, during periods of inundation provides important food for juvenile salmonids and other aquatic life and this is why it has been included (Adams and Haycock, 1989). There is approximately 8.9 km of the shoreline that has aquatic vegetation, which represents approximately 24% of the total shoreline length. The total area of both dense and sparsely vegetated areas with aquatic vegetation (floating, emergent, or submergent) is 543,666 m^2. Most of the vegetation that was observed was either emergent shrubs or grass like vegetation and this emergent type of vegetation accounted for 24% of the Moyie shoreline or 8.3 km. The areas of native submergent and floating vegetation were rare on Moyie Lake, only accounting for close to 4% or 1.2 km.

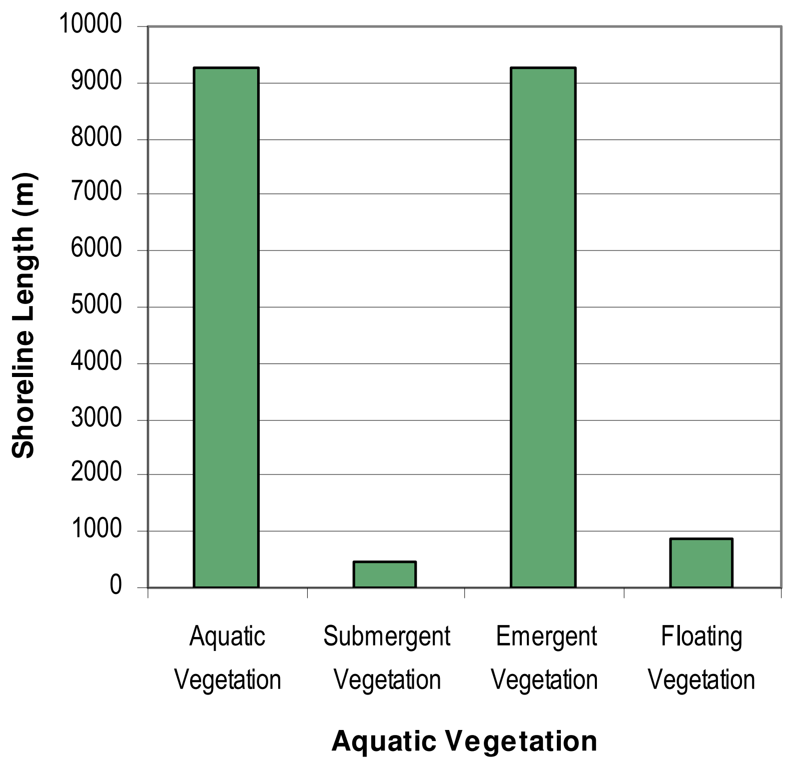


Figure 5 presents the total shoreline length that has aquatic, submergent, emergent, and floating vegetation along Moyie Lake.

Docks were the most commonly observed type of shoreline modification. There were a total of 106 docks on Moyie Lake. Retaining walls were the second most common modification observed, with 84 retaining walls being observed. Groynes were infrequent occurrences on the lake, with only 2 being observed. There are a total of 5 marinas with greater than 6 boat slips and 10 boat launches. There was a total of 3 marine rails observed on Moyie Lake. The above summarizes the current structures that occur on, over, and around Moyie Lake.

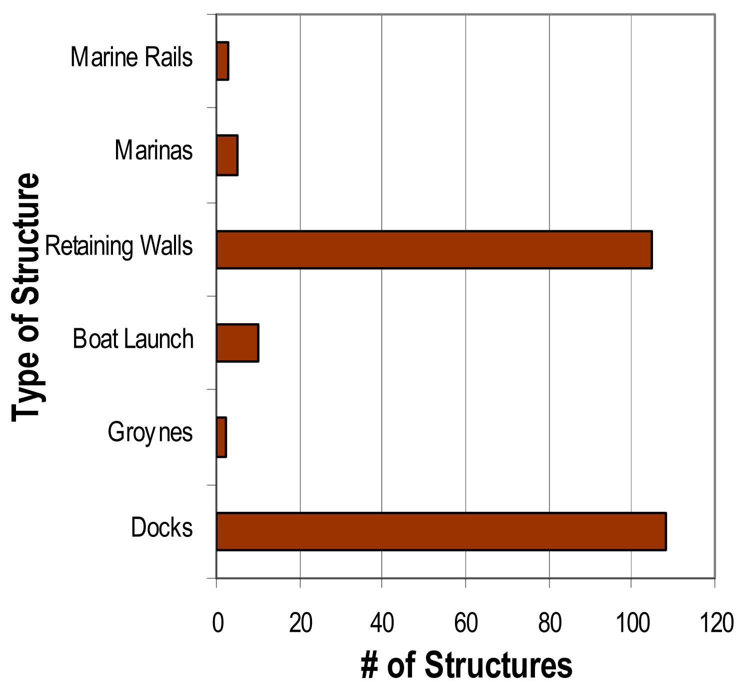


Figure 6 presents the total number of different shoreline modifications that occur around Moyie Lake.

The percentage of the shoreline that was impacted by transportation (roads, railways), retaining walls, and substrate modification was recorded to allow an estimation of the approximate shoreline length that has been affected by these different mechanisms (Figure 7). By far, substrate modification was the most substantial impact that was observed along the shoreline. In total, it is estimated that 36% or 13.2 km of shoreline has experienced some form of substrate modification. Substrate modification was variable and was most commonly associated with road or railways (i.e., structural fill material) or beach grooming activities. However, there are also mine tailings that occur in some locations around the lake. Retaining walls were the next most substantial impact to the shoreline and it is estimated that 13% or 4.6 km has been impacted by retaining walls. Retaining walls were observed both above and below the high water level (i.e., some walls had a visible water line indicating that they have encroached below the high water level). Finally, transportation related impacts (i.e., roadways and railways) accounted for 11% or 4 km and 12% or 4.3 km of the shoreline.

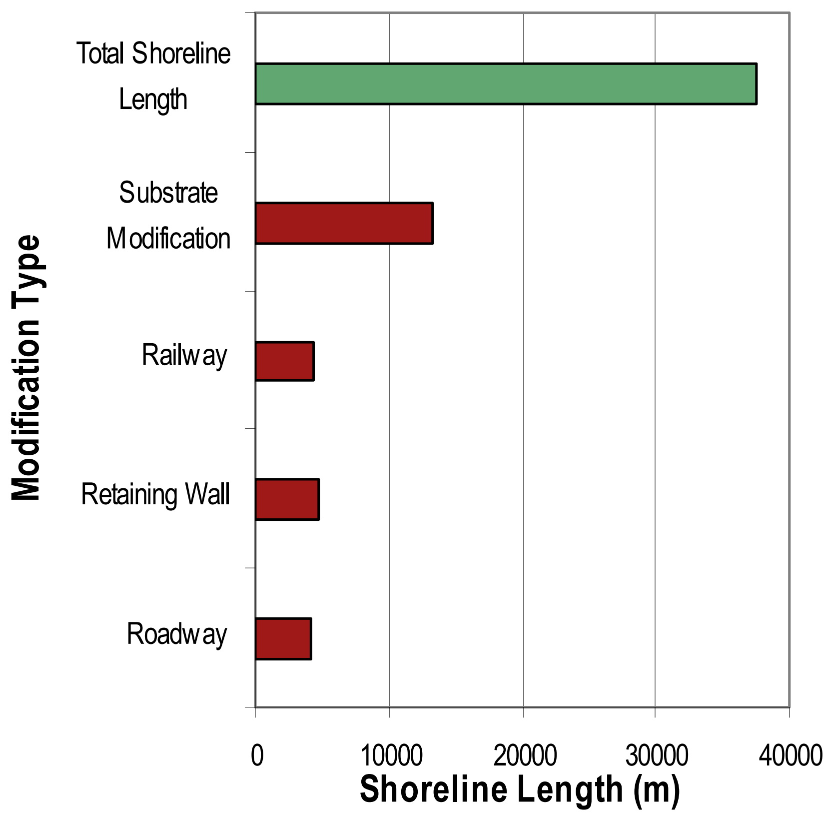


Figure 7 presents the total shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Moyie Lake.

The foreshore modifications by the different mechanisms described above have resulted in a high level of impact around approximately 47% or 17.8 km of the shoreline. Areas of moderate and low impact account for about 8% (2.0 km) and 44% (15.8 km) of the shoreline respectively.

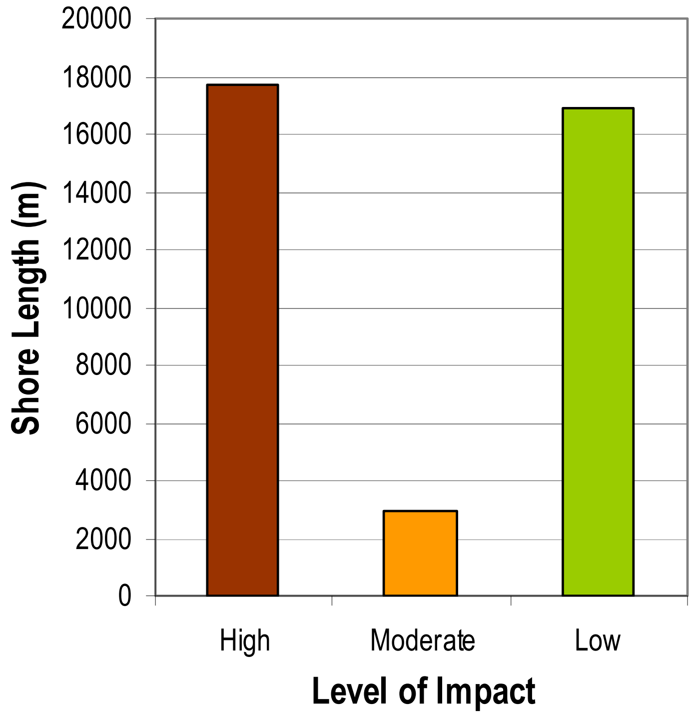


Figure 8 presents the level of impact (High, Moderate, Low, or None) observed along Moyie Lake.

6.2 Summary of Foreshore Modifications

The foreshore of Moyie Lake has experienced varying degrees of impacts. In general, steeper sloped areas (i.e., cliff bluff shorelines) tended to be more natural whereas lower gradient shorelines tended to have a higher level of impact. The following section is intended to summarize foreshore modifications that were observed during the field surveys in point form:

- Substrate modification and construction of retaining walls was the most significant impact observed adjacent or below the high water level of the shoreline. The construction of these features has likely resulted in the loss of aquatic vegetation (actual loss has not been determined), and a loss in productivity due to substrate modification. This impact is similar to other interior lakes that have been surveyed including Windermere, Okanagan, and Shuswap.

- In many areas it is apparent that emergent shrubby vegetation below the high water level (e.g., willows and cottonwoods), grasses and sedges, and other types of aquatic vegetation has been impacted. It is believed that most of this vegetation removal is the result of beach creation (i.e., beach grooming), substrate modification, or from road and railway fills. The losses of soil material that aquatic vegetation grows in will likely take years or decades to naturally regenerate, it at all. The continued losses of this vegetation will further impact juvenile salmonids during high water in the spring when they are known to feed upon organisms within the vegetation (Adams and Haycock, 1989).

- Riparian vegetation disturbance has changed the vegetation type from natural broadleaf or coniferous associations to landscaped, lawn, or un-vegetated associations. The significant losses of riparian vegetation have not been quantified as part of this assessment, but are considered significant. There are significant opportunities for riparian habitat enhancements along the shoreline of the lakes.

- Private boat launches have been constructed on Moyie Lake, resulting in a permanent loss of fish habitat in gravels that have been covered by concrete or significantly compacted / disturbed by boats and trailers. These boat launches were almost all associated with vehicular access, which has impacted riparian vegetation. It is conservatively estimated that these boat launches have resulted in the loss of at least 180 m^2 of lost foreshore habitat (i.e., below high water level) and 300 m^2 of riparian habitat (assuming the average boat launch is 3 m wide and 6 m long and has vehicular access through a 10 m wide riparian zone). It is likely that most of these boat launches were constructed without a provincial *Water Act* or federal *Fisheries Act* approval.

- Retaining walls were documented in nearly all developed areas. Retaining walls were constructed out of varying materials. In some instances, substrates from the lakebed were used to construct the walls. It is probable that some of the retaining walls constructed around the lake were not required to protect the shore from erosion and have been constructed purely for aesthetic purposes (i.e., landscaping). Thus, construction of some of these walls could have been avoided. In many cases, shoreline protection could have been achieved by utilizing bioengineering approaches to help mitigate impacts of the walls. Retaining walls constructed at or adjacent to the high water level should generally only occur to help reduce losses of land from shoreline erosion.

- Roadway and railway impacts were prevalent along many areas. In these areas, there was little evidence of bioengineering to soften constructed edges along the shoreline. However, in cases where the roadway was offset from the high water level, riparian conditions between the roadway/railway and the lakes tended to be better than those riparian areas observed in single family residential areas.

- Docks were the most prevalent of shoreline modifications. These overwater structures varied in size and were built using a variety of materials. Based on field inventory many of these structures may not be compliant with current Standard Best Practices.

6.3 Wildlife and Fisheries Summary

Moyie Lake has been documented to contain several different fish species including kokanee, rainbow trout, burbot, largescale suckers, longnose dace, mountain whitefish, westslope cutthroat trout, and bull trout (Dolly Varden[1]) (www.fishwizard.com). Native species that were documented during field surveys for this assessment included mountain whitefish, kokanee, redside shiners, largescale suckers, and lake chub (Appendix F). Non native species identified during this survey included the pumpkinseed sunfish. Yellow perch, although not sampled are also likely present (pers. comm., Bruce MacDonald, DFO). Similar to other studies like this, cyprinid species (minnows including redside shiners and lake chub) were the most common, representing nearly 82% of the relative abundance of species sampled. Cyprinids were documented in all shore segments / types surveyed, highlighting the general adaptive and tolerant nature of these species. Largescale suckers were also quite commonly observed, representing 8% of the relative abundance of fish species sampled. Like other interior lakes, it is not uncommon for the fish communities to be dominated by coarse fish such as minnows and suckers. Pumpkinseed sunfish were the most predominant non native fish observed, having a relative abundance of 9%. Salmonid species (rainbow trout, kokanee, and mountain whitefish) were not commonly observed, and only represented 1% of the fish species sampled during the brief survey.

The small sample sizes collected during these surveys do not provide sufficient data to accurately identify shoreline usage along the different shore segments or types by either fish or wildlife (i.e., it is not possible to determine significant differences in shoreline usage by different species). However, previous works in Windermere and Okanagan Lake, which had larger sampling efforts in lakes with similar fish assemblages, provide supporting evidence which can be used to make general conclusions. General conclusions can also be reached using published literature accounts. In general, sensitive fisheries areas include the narrows region between the north and south basins of Moyie Lake, all stream confluences and wetlands, and rocky or gravel shoreline areas that provide important spawning grounds (i.e., identified burbot spawning grounds). There are few productive littoral regions in Moyie Lake and therefore, any large littoral zone, stream confluence, island, or wetland area is important as a rearing zone for juvenile fish. Finally, fisheries sensitive zones also occur in deeper regions adjacent to stream mouths, where rainbow trout, kokanee, and bull trout likely stage prior to spawning migrations. Spatially, these different areas have been identified and the locations are identified in the Moyie Figure Binder.

[1] Dolly Varden and bull trout are very similar species and the species are often mistaken for each other (McPhail, 2007). Both species have been listed here, although it is unknown whether Moyie Lake contains one, both, or a hybrid species.

A variety of wildlife species were noted during the field assessment, including many different songbirds, waterfowl, birds of prey, reptiles, and mammals. A summary of the different wildlife species known to occur along the different shoreline segments can be found in Appendix F. Conclusions for wildlife can be made using a habitat suitability approach, which is typically preferable in cases where surveys are limited. Wildlife surveys generally indicated that wetland areas, such as the narrows region of the lake, had the greatest wildlife species diversity, whereas highly developed areas had very low diversity ratings. Well established riparian areas, such as low flood benches associated with stream confluences were also important habitat areas for different wildlife.

Key wildlife habitat features are present in many areas around the lake, and include important wetlands and shore marshes, riparian habitats, wildlife trees, and wildlife corridors. Baseline information collected during this survey provides an overview of some of the wildlife features present around the lake. However, detailed inventories should be completed for any significant changes in land (e.g., re-zoning or subdivision applications) to ensure that important wildlife habitat attributes are recorded, mapped, and protected during the development process.

6.4 Aquatic Habitat Index Results

The attached Figure Binders (Figure Binder 1) presents the spatial results of the assessment. The figure binder has been prepared to show a summary of all the information contained within this report. Appendix C provides the results of the AHI in tabular format.

Most of the Moyie Lake shoreline currently is high value habitat (33%), followed closely by Moderate Value Habitat (28%) (Table 2). Very High Value habitat accounts for (22%) and this is mostly attributed to important stream confluences and wetland areas in the narrows region of the lake. Low and Very Low habitats account for 18% of the shoreline length. The above analysis highlights the importance of shoreline areas adjacent to Moyie Lake including important wetland communities, in conjunction with many natural coniferous forest areas and spawning habitats for burbot.

The Potential Value summary presents what that habitat value would be if some of the modifications were removed from shoreline areas around Moyie Lake (Table 2). This analysis follows other lake habitat assessments, and may be somewhat misleading. It is important to note that this analysis does not consider riparian improvements and this is the most probable cause of the similar results (i.e., the analysis only considers removing constructed features such as groynes). In general, there was a shift from Very Low upwards. However, the results of the analysis indicate that there would be little transition in upwards movement of categories if modifications were removed. Subsequent analysis may help better interpret where restoration may be more feasible and result in the most improvement. It is our opinion that the results presented above are found because riparian improvements are not included in the analysis and the little weighting given to habitat modifications in the AHI.

Table 2. Summary of the Current Value and Potential Value shoreline lengths, segments, and percentage of the shoreline for the different habitat index categories for Moyie Lake (Very High to Very Low)

Categories	Current Value				Potential Value		
	# of Segments	Shoreline Length (m)	% of Shoreline		# of Segments	Shoreline Length (m)	% of Shoreline
Very High	7	8487.8	22.6		7	8487.8	22.6
High	5	12139.4	32.3		5	12139.4	32.3
Moderate	15	11350.9	30.2		15	11350.9	30.2
Low	2	2467.3	6.6		2	2467.3	6.6
Very Low	2	3139.8	8.4		2	3139.8	8.4
Total	31	37585.1	100.0		31	37585.1	100

The sensitivity of the shoreline was considered in terms of the different shore types that exist around the Moyie Lake (Table 3). The Very High value shorelines were prevalent on stream confluence areas and wetlands, which accounted for 78% and 15% of the total Very High shoreline length respectively. High Value shoreline segments were most prevalent on Rocky shores (67%) and Cliff (18%) shorelines. Moderate Value habitats were most common Gravel shorelines (49%), but were also quite prevalent on Stream confluence (23%) segments and Rocky (22%) shorelines.

Table 3. Summary of the Aquatic Habitat Index results for the different shore types for the Current Value of the Moyie Lake shoreline. All shore lengths are in meters.

Categories	Current Value			Cliff / Bluff		Rocky		Gravel		Sand2		Stream Mouth		Wetland		Other	
	# 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	Shoreline Length	% of Shoreline	Shoreline Length	% of Shoreline
Very High	7	8487.8	22.6	0.0	0.0	0.0	0.0	524.7	6.2	0.0	0.0	6474.9	76.3	1488.2	17.5	0.0	0.0
High	5	12139.4	32.3	2193.2	18.1	8330.0	68.6	600.3	4.9	0.0	0.0	1015.9	8.4	0.0	0.0	0.0	0.0
Moderate	15	11350.9	30.2	417.6	3.7	2327.6	20.5	5074.6	44.7	104.2	0.9	3426.9	30.2	0.0	0.0	0.0	0.0
Low	2	2467.3	6.6	0.0	0.0	493.5	20.0	1338.1	54.2	635.7	25.8	0.0	0.0	0.0	0.0	0.0	0.0
Very Low	2	3139.8	8.4	0.0	0.0	2296.2	73.1	843.6	26.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

7.0 STATE OF THE FORESHORE

The lakeshore of Moyie contains important habitats for fish and wildlife species. The lake systems are also source drinking waters for many different people. This combination of important fish, wildlife, and water quality considerations make it extremely important to identify, manage and protect these important economic resources. The following assessment provides overview information necessary to begin to manage these resources effectively. This work will allow a baseline upon which goals and objectives can be created and monitored.

Moyie Lake occurs in two basins (North and South), separated by a biologically productive narrows region with important stream confluences and wetlands. The North Basin is 583 ha in size, while the South Basin is 316 ha in size. Important tributaries to this moderate size interior lake include Lamb, Cotton, and Barkshanty Creeks. As with other shoreline studies, lower gradient areas tended to have higher disturbance. Lamb Creek was a notable exception, with the floodplain relatively intact. The most notable disturbances that were observed were foreshore modifications typically in the form of substrate alteration (e.g., boat launches or groynes) and riparian vegetation disturbance. Large scale industries, such as commercial moorages and forestry log yards, were not present. There are historic mine tailing piles that do occur in some locations around the lake. Finally important water quality observations were documented between the basins. The North Basin was found to have a higher water clarity (or lower turbidity) than the South Basin, possibly the result of historical fires in the Lamb Creek watershed.

The shoreline areas have been historically impacted by development practices. However, many regions around the lake are still relatively rural and natural and not highly developed. These natural areas include diverse wetland communities, important burbot spawning areas, and stream confluences. These areas are also associated with the greatest wildlife diversity. The important habitat features around the lake are prone to impacts from future development (if previous trends continue) and require careful planning if these areas are to continue to be of importance to fish and wildlife.

Biological systems are extremely difficult to predict and manage. Currently, these fish and wildlife ecosystems are experiencing rapid changes due to a variety of factors including but not limited to land development (e.g., water consumption may be exceeding the capacity of some streams, etc.) and climate change. At this point, it appears that the significant biological resources around the lake are maintaining viable populations. Determining the threshold upon which the cumulative effects of development will have measurable and noticeable impact on fish and wildlife species is very difficult and therefore a conservative approach is required. The Recreational Carrying Capacity of a lake is defined as the point where a lakes ability to accommodate recreational use (e.g., boating) and residential occupation can occur without compromising adjacent upland areas, biological resources, aesthetic values, safety, and other factors[2]. Determining carrying capacities in our interior

[2] Recreational carrying capacity differs from biological carrying capacity. Biological carrying capacity refers to the population size (i.e., # of individuals) a particular environment or system can sustain over the long term.

lake systems is currently one of the most significant challenges to lakeshore management because it impacts many cultural, social, and environmental values of residents.

7.1 Key Considerations

Environmental land use planning is difficult because of the inherent stochastic nature of biological systems (i.e., it is not easy to predict the responses of living animals to changes in their environment, particularly when the environment they live in is also changing). Given this key consideration, a conservative approach must occur. The following sections of this document have been prepared using precautionary principles to adjust for the inherent variability of living systems as part of a sustainable approach to land use planning and management. The data set that has been developed and utilized to prepare these guidelines can be updated as more information becomes available as part of a long term, adaptive management response which will better integrate our communities with their natural surroundings.

8.0 SHORELINE MANAGEMENT GUIDELINES FOR MOYIE LAKE

Shoreline Management Guidelines for Moyie Lake (Guidelines) are intended to streamline land use decision making processes between different agencies and stakeholders. Guidelines have been prepared by the East Kootenay Integrated Lake Management Partnership (EKILMP) for Windermere Lake, and this document was used as a template (EKILMP, 2009). This document will not be referenced at every instance to promote readability and similarities may exist between these documents because of the template developed for Windermere Lake. The original authors of the text should be credited for completion of this document.

The EKILMP partnership consists of a variety of different partners, including local, provincial, and federal governments, non-profit organizations, and local first nations. The EKILMP was formed in 2006 with the purpose of creating better policies for management of key lakes in the Kootenay region. The intent of the partnership is to better balance the environmental and developmental needs of residents.

8.1 Management Guidelines Overview

The Guidelines utilize a risk based approach to shoreline management. This approach determines the risk of a proposed activity in each of the identified Vulnerability Zones. Vulnerability Zones relate to the environmental sensitivity of the shoreline, as determined by the AHI. Vulnerability Zones have been color coded to help more easily understand the risk matrix.

The following is a “How To” Guide to Development Planning along the Moyie Lake Shoreline:

1. Determine the Shoreline Vulnerability Color Zone your application is situated in using Figure Binder 1. See Section 8.1.1 below.

2. Determine what the Risk is of your proposed activity using the risk matrix (see Section 8.1.2 below.) If the proposed activity has not been identified within the table, please assume the activity is High Risk and contact FrontCounter BC or the Regional District of East Kootenay for further advice and information. If your identified activity is considered High Risk, determine if you can move your activity to a different colour zone or select a lower risk activity.

    a. If a Species at Risk is present or identified by a Qualified Environmental Professional, the risk of proposed activities is greater. If identified, the Modified Column for Species at Risk should be used.

3. Use the flow chart contained in this document to determine your application review needs based upon the risk of your proposed activity.

8.1.1 Step 1 - Shoreline Vulnerability Color Zones

The Shoreline Vulnerability Color Zones are best viewed graphically, as they relate to specific shoreline areas. The Shoreline Vulnerability Color zones are based upon fisheries and wildlife information collected during field surveys and the Aquatic Habitat Index that was prepared for the shorelines. Figure Binder 1 contains the Shoreline Vulnerability Zones.

The following provides a brief summary of the different Vulnerability Color Zones.

Red Shoreline
Defined by: Very High by the Aquatic Habitat Index. **Background:** These areas have been identified as essential for the long term maintenance of fish and/or wildlife values through the Aquatic Habitat Index analysis process. This zone includes most creek mouths, wetland areas, and zones essential for fish and/or wildlife populations around the lake. Red Zones are considered very high habitat value because of their biophysical characteristics which create habitats of high diversity. These areas are considered integral to the maintenance of a healthy ecosystem. Wetlands, stream confluences, and other important identified habitats (e.g., spawning features) are all identified as Red Zones. Red Zones account for 22.6% of the total shoreline length of Moyie Lake and 18.6% of the Monroe Lake Shoreline. EKILMP recommends that these areas be designated for conservation use, and that no development that can impact these sensitive communities occur within them. Low impact water access recreation and traditional First Nation uses are permissible in these areas, but permanent structures or alteration of existing habitats is not considered to be acceptable. Habitat restoration may be appropriate in these areas where warranted. Invasive aquatic plant removal is acceptable, provided there is an approved aquatic plant removal program including trained persons. Please contact a plant specialist if uncertain of a plant species.

Orange Shoreline
Defined by: High Value Habitats identified by the Aquatic Habitat Index. **Background:** These shoreline segments have been identified as High Value Habitat Areas for fish and/or wildlife. These are made up of areas that are relatively natural; possibly have high value spawning habitats and/or other features that could be impacted by proposed land uses or activities. These areas are sensitive to development, continue to provide important habitat functions, but may be at risk from adjacent development pressures. Activity Risks in this zone will trigger the requirements to have an environmental assessment conducted by a Qualified Professional (QP). Restoration opportunities potentially exist in these areas. Proponents should consider moving high risk activities to other areas if possible, or pursuing activities that have lower risks associated with them. Orange shorelines account for 32.3% of Moyie Lake and 61.2% of Monroe Lake.

Yellow Shoreline

Defined by: Moderate Value Habitats identified by the Aquatic Habitat Index

Background:
These areas have generally experienced more intensive development disturbance and pressures. Generally, these areas do not contain critical habitat features required by fish and wildlife to maintain viable populations. However, these areas still maintain important general living habitats that are important to fish and wildlife that and they should be considered when changes to land uses are proposed. Yellow shorelines account for 30.2% of Moyie Lake and 20.2% of Monroe Lake.

Development is more appropriate on these shorelines, and should incorporate protection of habitat features that remain. Intensive development below the high water mark and/or within riparian areas could have unacceptable environmental impacts without proper planning. Restoration may be an option in some areas that have experienced some developments. Development may proceed for low risk activities provided a Best Management Practices (BMP) or Regional Operating Statement (ROS) is followed. High risk activities without a BMP or ROS will require a report from a Qualified Professional (QP).

Grey Shoreline

Defined by: Low and Very Low Habitats identified by the Aquatic Habitat Index

Background:
These are shorelines identified by the Aquatic Habitat Index analysis have a lower ecological value. However, they still may contain valuable habitats requiring some protection, such as in-lake wetlands, or gravel/cobble substrate areas. Grey shorelines account for 15.0% of Moyie Lake and 0% of Monroe Lake.

Residential development has been concentrated in these areas and has resulted in disturbances to the natural fish and wildlife habitat. In keeping with the objective of concentrating development in areas that are already disturbed or of low value, new developments may be considered in these areas. Redevelopment will also be considered. New developments or redevelopment proposals shall incorporate fish and wildlife habitat restoration or improvement features where feasible and practicable. For example, a retaining wall redevelopment may be moved back from the High Water Mark (HWM) and/or incorporate re-vegetation, bioengineering or other fish and wildlife features in the design.

8.1.2 Step 2 - Activity Risk Matrix and Analysis

Different shoreline activities have been assigned risk ratings based on the potential level of risk that they may have on fish and wildlife habitat values. Risks have been determined based upon the different habitat values present and typical requirement to complete the proposed activity. The table below provides the risks of different activities in each of the different shoreline Vulnerability Zones identified. Risks have been determined as Not Acceptable (NA), High (H) or Low (L). To account for the limited survey information, a species at risk modifier column has also been provided and should be used in cases where a species at risk has been identified in the project area.

Table 1: The following table displays the activity risk matrix for each different shoreline colour zone.

Activity	Shore Zone Colour and Activity Risk				Modifier
	Red	Orange	Yellow	Grey	Zone has Species at Risk
Over water piled structure (i.e. building, house, etc.)[1]	NA	NA	NA	NA	NA
Boat house (below HWM)[1]	NA	NA	NA	NA	NA
Dredging (new proposals)	NA	NA	NA	NA	NA
Beach creation above HWM	NA	NA	H	H	H
Beach creation below HWM	NA	NA	H	H	H
Aquatic vegetation removal	NA	NA	H	H	H
Upland vegetation removal	NA	NA	H	H	H
Marina[2]	NA	H	H	H	H
Breakwater	NA	H	H	H	H
Boat launch upgrade	NA	H	H	H	H
New boat launch	NA	H	H	H	H
Infill	NA	H	H	H	H
Groynes	NA	H	H	H	H
Fuel facility[3]	NA	H	H	H	H
Boat house (above HWM with vegetation removal)[1]	NA	H	H	H	H
Waterline trenched	NA	H	H	L	H
Erosion protection hard-joint planted	NA	H	H	L	H
Erosion protection vertical wall or retaining wall[4]	NA	H	H	L	H
Invasive weed removal	H	H	H	L	H
Boat house (above HWM without vegetation removal)[1]	NA	H	L	L	H
Permanent rail launch system	NA	H	L	L	H
Removable rail launch system	NA	H	L	L	H
Dock[1]	NA	H	L	L	H
Erosion protection (soft-bioengineered)	NA	H	L	L	H
Elevated boardwalk below HWM	NA	H	L	L	H
Mooring buoy	NA	H	L	L	H
Maintenance dredging (previously approved)	NA	H	L	L	H
Boat lift – temporary	NA	H	L	L	H
Geothermal loops – open[5]	NA	H	L	L	L
Geothermal loops – closed	NA	H	L	L	L
Habitat restoration[6]	H	H	L	L	H
Public beach maintenance	NA	L	L	L	H
Waterline drilled	NA	L	L	L	L

1. These Guidelines are to be used in the initial development planning stage and do not cover all legislative requirements. Docks and boathouses are an example of an activity that could require additional approval process through Transportation Canada or Ministry of Agriculture and Lands.
2. Marinas or marina expansions in orange zones may not be acceptable depending on the key habitat area attributes – upland or aquatic.
3. Fuel facilities are inherently high risk, and if approved will be subject to all other regulations.
4. Retaining wall redevelopment should be designed to restore fish and wildlife values where feasible and practical.
5. Geothermal loops open (water) versus closed (glycol) and associated risk must also be assessed and ranked for physical habitat and water quality aspects.
6. Habitat restoration proposals are listed as high risk in red and orange zones because individual objectives and proposals must be reviewed.

In cases where multiple activities with differing risk are proposed, the combined risk may increase. In these cases, proponents should default to the highest risk identified and retain a Qualified Professional (QP) to help determine if the overall risk has increased. If your activity is not listed, contact FrontCounter BC for advice. The Activity Risk Table also distinguishes between activities above the high water mark (HWM) and below the HWM. The HWM as opposed to the 'natural lake boundary' is the standard practice used by DFO when considering impacts to fish and wildlife values because the natural lake boundary often contains very important emergent vegetation communities that are important to fish and wildlife.

This following provides background, descriptions and examples of the Activity Risk Ratings. The risk ratings identify the potential risk activities pose to fish and wildlife. Activities identified as Not Acceptable (NA) or High (H) have the greatest potential whereas activities identified as Low (L) risk have a reduced potential to impact fish and wildlife populations. This process recognizes that there is a greater possibility that High Risk activities may not be approved by regulators due to the potential impacts of the activity. The process also identifies that important habitats do exist in degraded and developed areas and that minimal standards are required to protect fish and wildlife habitat in the grey zone areas.

Not Acceptable Activities

Several activities have been rated as Not Acceptable and they generally occur in Red or Orange zones or are activities that have a high potential to impact fish or wildlife populations even in lower value habitat areas. These activities listed have potential to negative impact fish and wildlife habitats and it is extremely difficult or impossible to mitigate or compensate for the activities. Applications for these types of development in the zones identified will not be considered.

High Risk Activities

Proposals within the High Risk category are known to have significant challenges related to providing adequate mitigation or compensation to address the loss of fish and/or wildlife habitat values. Acceptable mitigation measures would likely be very costly to implement. In addition, there is a high likelihood that a request for a Harmful Alteration, Disruption or Disturbance of Fish Habitat (HADD) authorization under the *Fisheries Act* would be triggered. Applicants are thus encouraged to avoid activities with a High Risk, consider activities that are a lower risk, or relocate the activity to an area where the environmental sensitivity is less. If the applicant wishes to proceed with a High Risk activity, a qualified professional should be retained to determine if there is a HADD &/or other environmental impacts which can be mitigated through design and relocation. The application will be reviewed by the applicable agencies. As identified in the Activity Risk Table, certain activities are rated High Risk for all shore colour zones and should be avoided if at all possible.

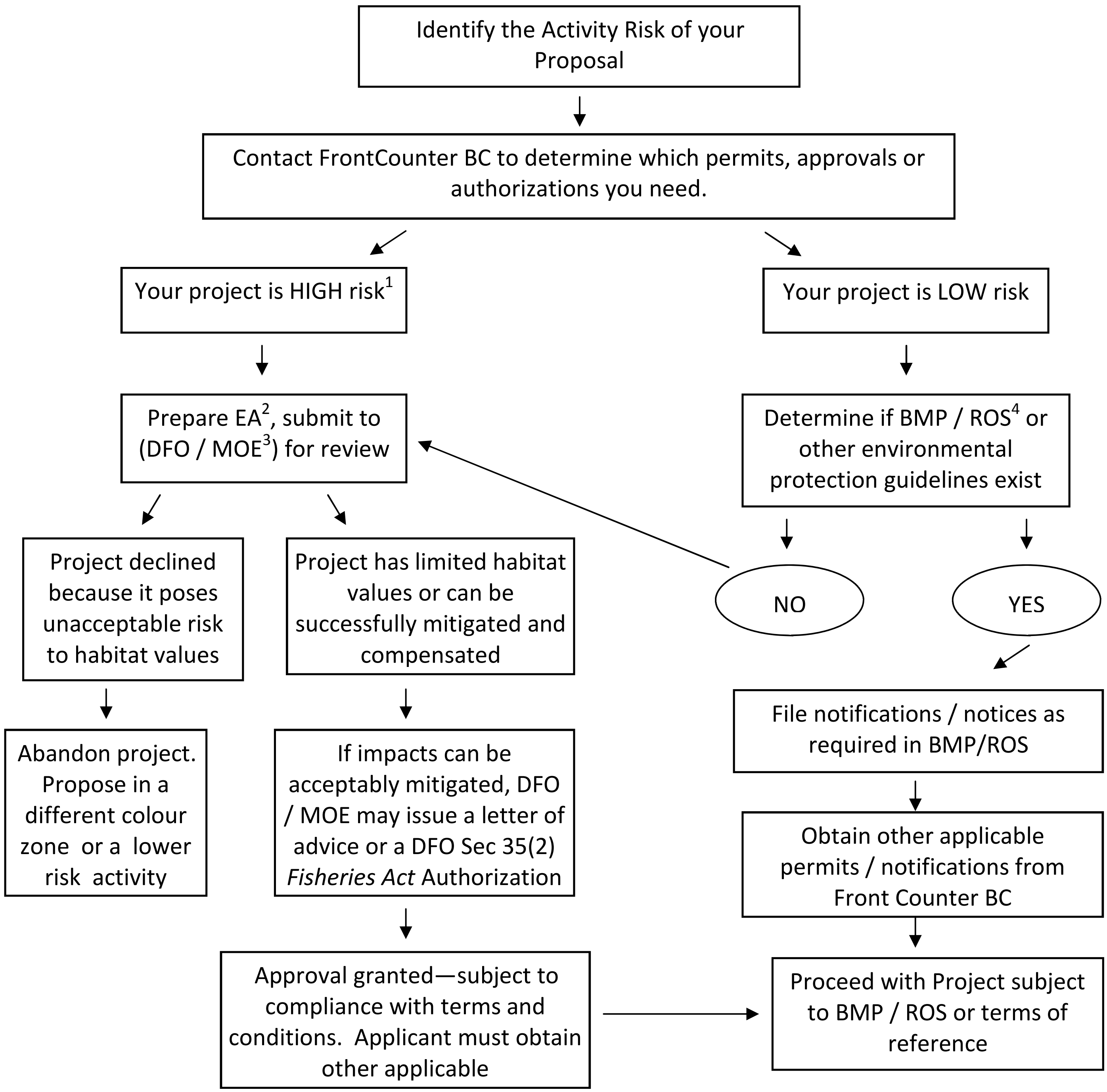
Low Risk Activities

With appropriate design and planning, Low Risk activities could be incorporated along the foreshore with minimal impacts on fish and wildlife habitat values. These activities are to follow BMP and/or ROS, where available. Where BMP/ROS are not available, or a deviation to the BMP/ROS is proposed, a QP is to be hired to determine if there is a HADD and design the project to minimize environmental impacts. The application will be reviewed by the applicable agencies. Examples of activities which have Low Risk along most/all of the shoreline are: maintenance dredging (previously approved) and erosion protection (soft-bioengineered).

8.1.3 Step 3 - Decision Process Flow Chart

The flow chart below provides an outline for the decision-making process for the High and Low Risk activities. The chart is a tool to help depict the Guideline requirements outlined in the previous sections. Note that this process provides Guidelines on only the initial planning stages of development. There are other legal requirements that are not covered through this process (such as approvals/notifications through Transport Canada, BC *Water Act*, BC *Lands Act*), which are the responsibility of the applicant. Additional potential legal requirement listings are provided in Appendix H. If these Guidelines are followed, the intent is that the subsequent permitting process(es) should be more streamlined for the applicant.

Flow Chart: Decision-making process for High and Low Risk Activities for Fish and/or Wildlife Habitat authorizations



[1] Activities within the High Risk category raise significant concerns. These activities have significant challenges related to providing adequate mitigation or compensation to address the loss of fish and/or wildlife habitat values and could be costly to implement acceptable mitigation measures. With High Risk activities, there is a high likelihood that a request for a Harmful Alteration Disruption or Destruction of fish habitat (HADD) authorization under Sec 35(2) of the *Fisheries Act* would be triggered. Proponents are encouraged to avoid activities with a High risk, revise activities to a lower risk option, or relocate the activity to a less sensitive colour zone.

[2] Environmental Assessment

[3] DFO- Fisheries and Oceans Canada; MOE- Ministry of Environment

[4] BMP – Best Management Practice; ROS – Fisheries and Oceans Canada Regional Operating Statement

8.2 Mitigation and Compensation Considerations

In order to assess impacts of a proposed project, it may be necessary to retain a QP who could assess habitat values and sensitivities in the area. Information contained in this report will help with this task; however, further studies will likely be necessary to address site specific issues and because of the limitations of information currently available. The DFO principle of "no net loss" within the Policy for the Management of Fish Habitat 1986 applies to all proposals where there is the potential for a HADD under Section 35(2) of the federal *Fisheries Act*. This involves following a sequence of mitigation alternatives. Mitigation is a process for achieving conservation through the application of a hierarchical progression of alternatives, which include: (1) avoidance of impacts; (2) minimization of unavoidable impacts; and (3) compensation for residual impacts that cannot be minimized. These alternatives are described as follows:

8.2.1 Avoidance of Impacts

The first step, avoidance, involves the prevention of impacts, either by choosing an alternate project, alternate design or alternate site for development. It is the first and best choice of mitigation alternatives. Because it involves prevention, the decision to avoid a high value area or to redesign a project so that it does not affect a high value area must be taken very early in the planning process. It may be the most efficient, cost effective way of conserving important habitats because it does not involve minimization, compensation or monitoring costs. Avoidance may include a decision of not to proceed with the project.

8.2.2 Minimization of Unavoidable Impacts

Minimization should only be considered once the decision has been made that a project must proceed, that there are no reasonable alternatives to the project, and that there are no reasonable alternatives to locating the project within key/high value habitat. Minimization involves the reduction of adverse effects of development on the functions and values of the habitat at all project stages (including planning, design, implementation and monitoring), to the smallest practicable degree. Considering any planning efforts, DFO must deem a HADD to be acceptable before work can commence.

8.2.3 Compensation

Compensation is the last resort in the mitigation process, an indication of failure in the two earlier steps. It should only be considered for residual effects that were impossible to minimize. Compensation refers to a variety of alternatives that attempt to "make up for" the unavoidable loss of or damage to habitat functions and values. Habitat compensation may be an option for achieving "no net loss" when residual impacts of projects on habitat productive capacity are deemed harmful after relocation, redesign or mitigation options have been implemented. After reviewing the project proposal and the potential impacts to fish habitat, DFO may determine that the impacts are not acceptable if the habitat to be affected is critical habitat or compensation is not feasible. In addition, compensation for deposit of a deleterious substance into water frequented by fish is not acceptable. Habitat compensation involves replacing the loss of fish habitat with newly created habitat or improving the productive capacity of some other natural habitat. Depending on the nature and scope of the compensatory works, habitat compensation may require, but not be limited to, several years of post-construction monitoring and evaluation. In the event that functional objective of the compensation are not achieved (i.e., due to failure or inadequate maintenance), additional remediation or redevelopment of the compensation works may be required to achieve the compensation objectives. There is no guarantee that projects in high value fish habitats that result in HADD will be authorized under Section 35(2) if application is submitted.

9.0 RECOMMENDATIONS FOR FUTURE CONSIDERATION

9.1 General

The following are other recommendations that could be incorporated into foreshore protection policies:

1. **Environmentally Sensitive Areas should be identified because they are extremely important**. For instance, The City of Kelowna has just recently completed a review of environmental development permit areas (EDP's) and has added over 400 properties to an EDP list for a variety of reasons. As the example above portrays, keeping environmental development permit areas up to date is important. EDP's are most accurately determined by appropriate inventory work such as the FIM, Sensitive Ecosystem Inventory (SEI, see below) and SHIM. It is recommended that areas that have been determined as environmentally sensitive be added to the Development Permit Areas within any policy documents applicable (e.g., OCP, Bylaws, etc.). It is important that addition of new inventory data be simple and easy to implement because the budgetary constraints for inventory often result in projects being completed over a series of years as data is collected. *All lakeside areas identified in this report should be designated as development permit areas.*

2. **Environmentally sensitive areas should be included in Official Community Plans, Bylaws, and policy documents within the different agencies.** The AHI provides a basis for identification of shoreline environmentally sensitive areas. It is possible to incorporate the AHI into OCP documents in a variety of ways. The Guidance Document provided outlines how referrals and development proposals should proceed. The following provides our recommendation for how Very High and High Habitats are considered:

    - Very High and High Value Areas –These areas are considered to be the most valuable areas of the shoreline and comprise approximately 55% of the shoreline. Intensive development along these areas is strongly discouraged because it is likely very difficult to mitigate for potential impacts and not likely possible to compensate for losses to these habitat areas. Explicit terms of reference (mentioned below) for proposed significant changes in land use (i.e., large subdivisions) should be developed collectively for all projects or on a case by case basis (dependant upon resources available). If possible, an interagency approach and terms of reference would streamline the referral and review process.

3. **Standard terms of reference for professional reports should be developed for environmental assessments of development applications.** This document will ensure consistency in environmental reporting across agencies and jurisdictions. The RDCO, City of Kelowna, and other Okanagan Valley municipalities have well developed terms of reference that could be used as templates. The Terms of Reference will outline professional requirements for assessments in the region and provide a list of considerations that environmental professionals must address as part of a development application. Site specific assessments are a critical component of a development permit process because every proposal is unique and the Terms of Reference will help address the uniqueness of different areas. The inventories and data within this document should be provided as part of the terms of reference (i.e., the GIS data, air photos, and other biological information contained in this report should be provided)

4. **Habitat restoration opportunities should be achieved wherever possible by identifying them during the development review processes.** In highly urbanized areas, examples include removal of retaining walls, placement of large woody debris, live staking and re-vegetating shoreline regions, riparian restoration, etc. It may be useful to identify the potential for restoration opportunities in the standard terms of reference discussed above. There is significant opportunity for partnerships (i.e., multi agency partnerships with stewardship groups) to be formed to help facilitate habitat restoration around the lake.

5. **Core habitat areas are extremely important to maintain and should be identified as early as possible in the development process.** Detailed assessments and identification of core habitat areas for conservation should be done as early in the development process as possible. Numerous different possibilities exist for areas identified as sensitive, including Section 219 No Build / No Disturb Covenants, creation of Natural Areas Zoning bylaws (i.e., split zoning on a property), or by other mechanisms (donation to trust, etc.).

6. **A Land Act Section 16 Map Reserve should be established on all areas identified as having very high value (Red Zones) wherever possible.**

7. **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 extremely important part of the environmental review process. This information should be available to the public, including all air photos, GIS files, and other electronic documents. One 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.

8. **An Environmental Advisory Commission or other suitable body should be created and be included in the development review process to involve local residents.** The RDCO has created an Environmental Advisory Commission, which functions similar to an Advisory Planning Commission. The commission was created based upon the belief that local residents should contribute to the stewardship of their natural resources. In the Columbia-Shuswap Regional District (CSRD), the Shuswap Lake Integrated Planning Process (SLIPP) process has incorporated both political and resident representatives. This may provide an avenue to address the environmental concerns of residents and act as an advising committee to relevant stakeholders and governmental agencies.

9. **Establish a Moyie Lake Stewardship Committee.** This committee could help be a liaison for local people to express their concerns to governmental agencies. Similar types of committees are being established elsewhere.

10. **Development and use of best practices for construction of bioengineered retaining walls is required.** Bioengineering has many different meanings. Concise guidelines and BMPs should be developed that are consistent with standard practices of bioengineering.

11. **A communication and outreach strategy should be developed to inform stakeholders and the public of the findings of this study and improve stewardship & compliance**. Initially, it is recommended that notice of the availability of this report and associated products are available on the Community Mapping Network. Ecoscape understands that this project has and will continue to have a communication and outreach strategy.

12. **Lake shore erosion hazard mapping should be conducted for private lands to identify areas at risk, which will stream line the review process and reverse the damaging trend of unnecessary hard armoring and construction of retaining walls along the shoreline of the lakes.** Also, this methodology would be helpful to identify areas that are sensitive to boat wake erosion. The province has formalized methodology for lakeshore hazard mapping and this methodology, or some adaptation of it, would be preferred (Guthrie and Law, 2005). This mapping should be integrated with the FIM data, and be completed for each segment. Flooding, terrain stability, alluvial fan hazard mapping should also be considered for developing areas along the lakeshore. Until lakeshore erosion hazard mapping is completed, it is advisable to only consider shoreline protection works on sites with demonstrated shoreline erosion. To accomplish this, an engineer or biologist report should accompany proposal for shoreline armoring to ensure that works are required, minimize impacts and use bioengineering techniques.

13. **Storm water management plans should be included in all development applications that alter the natural drainage patterns.** It appears that development along the lakeshore has been occurring without the benefit of comprehensive storm water management plans. Poor storm water management can alter small streams by diversion, changes in water quality, and/or changes in discharge locations to the lake. This can result in erosion of non condition foreshores and impacts to shore spawning areas. It is recommended that storm water management plans be required as part of development processes.

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

15. **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, if feasible.**

16. **Compensatory works resulting from projects or portions of projects that could not be avoided must follow the DFO Decision Framework for the Determination and Authorization of a HADD of Fish Habitat and be consistent with the ‘No Net Loss" guiding principle for the Management of Fish Habitat.**

17. **Habitat enhancements should not be considered in cases where incomplete or ineffective mitigation is proposed. Habitat enhancement should only be considered when effective mitigation efforts are feasible (e.g., avoidance) and a strong business case proving mitigation feasibility has been prepared.**

18. **Habitat mitigation and compensatory efforts of 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 efforts are constructed to an acceptable standard.

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

20. **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.

9.2 Future Data Management

Future data management is extremely important. This assessment has integrated much of the available information into one concise GIS dataset. However, future works will be conducted and they should be integrated into this data wherever possible. The following are recommendations for future use of the FIM dataset:

1. **One agency should take the lead role in data management and upkeep**. This agency should be responsible for holding 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.

2. **A summary column(s) should be added to FIM GIS dataset that flags new GIS datasets as they become available.** Examples of this include new location maps for rare species, fish, etc. Other examples include the addition of appropriate wildlife data. Where feasible, these new data sets should reference the shore segment number (see below).

3. **The Segment Number is the unique identifier. Any new shoreline information that is provided should reference and be linked to the shore segment number.**

9.3 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. **The Sensitive Habitat Inventory and Mapping (SHIM) is a GIS based stream mapping protocol that provides substantial information regarding streams and watercourses and should be conducted on all watercourses around the lake**. Mapping should focus on our significant salmonid rivers and streams first, and then one smaller tributaries containing resident fish habitat, followed by non fish bearing waters. 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.

2. **Wetlands are extremely productive and important components of our ecosystems and these features should be inventoried**. Numerous low flood and mid flood benches and shore marshes were mapped during this survey. Detailed Wetland Inventory and Mapping (WIM) of these features are recommended. Detailed mapping of terrestrial wetlands is also important to ensure that linkages between foreshore and upland areas are achieved.

3. **Sensitive Ecosystem and Inventory (SEI) and Terrestrial Ecosystem Mapping (TEM) are useful terrestrial mapping tools and these inventories should be completed**. These assessments help land managers identify sensitive terrestrial zones which can be integrated into the FIM, SHIM, and WIM GIS datasets.

4. **An inventory of high value habitat islands in urbanized areas should be conducted.** In many cases, small sections of higher habitat quality were observed in segments ranked Moderate to Low. These areas were typically areas that had well-established native vegetation or relatively natural shorelines. Development applications proposed in these "islands" of higher habitat quality should avoid disturbance to these "islands" as much as possible. A survey of these small "islands" would clarify which segments contain "islands" and would help aid planning objectives. This could form part of a riparian mapping exercise.

5. **A carrying capacity analysis of the lake should be completed.** Biological systems are extremely difficult to predict and manage. Currently, these fish and wildlife ecosystems are experiencing rapid changes due to a variety of factors including but not limited to land development (e.g., water consumption may be exceeding the capacity of some streams, etc.) and climate change. At this point, it appears that the significant biological resources around the lake are maintaining viable populations. Determining the threshold upon which cumulative effects will have measurable and noticeable impacts is very difficult and therefore a conservative approach is required. The Carrying Capacity of a lake is defined as the point where a lakes ability to accommodate recreational use (e.g., boating) and residential occupation without compromising adjacent upland areas, biological resources, aesthetic values, safety, and other factors. Determining carrying capacities on our large, interior lake systems is currently one of the most significant challenges to lakeshore management because it impacts many cultural, social, and environmental values of residents.

6. **A survey, on a home by home basis, should be conducted to help educate home owners.** A home owner report card could be prepared that would provide land owners with a review of the current condition of their properties. The assessment should provide them with sufficient information to help land owners work towards improving habitats on their property. This assessment is not intended to single out individual owners, but rather to help owners understand the important habitat values present on their properties.

7. **Native beds of submergent and floating vegetation should be mapped in detail.** Native beds of submergent and floating vegetation were rare on Moyie Lake. More detailed mapping, maybe as part of a Wetland Inventory and Mapping project, would help better classify and described these rare, sensitive features. A good example of these communities is located in Segments 5.

10.0 CONCLUSIONS

The following report has documented the current condition of the Moyie Lake shoreline. The assessment provides substantial background information summarizing the current condition of the upland and terrestrial zones and foreshores of the lake. An AHI was developed that used biophysical information collected during the survey to rank the relative environmental sensitivity of the shore zone areas around the lakes. Recommendations are presented to help integrate this information into local land use planning initiatives.

The Shoreline Management Guideline presented in this document will facilitate a risk based approach to land use management that uses conservative principles because of the inherent variability in living ecosystems. The risk of common shoreline activities has been prepared based upon Vulnerability Zones which were developed using the shoreline habitat sensitivity determined by the AHI. This approach will help proponents and government agencies better integrate proposed developments with their natural surroundings and provide consistency in the review process.

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GLOSSARY OF TERMS AND ACRONYMS

Alluvial Fan / Stream Mouth– Alluvial fans 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.

Allocthonous Inputs - Organic material (e.g., leaf litter) reaching an aquatic community from a terrestrial community

Anadromous – Anadromous fish as sea run fish, such as Coho, Chinook, and Sockeye salmon.

Aquatic Habitat Index (AHI)-The index is a ranking system based upon the biophysical attributes 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 have been recently creating documents containing 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 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.

Non Anadromous – Non anadromous fish are fish that do not return to the sea to mature. Examples include rainbow trout (excluding steelhead), bull trout, and whitefish.

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 / Alluvial Fan / Stream Confluence – 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 PLATE SUMMARY

MOYIE LAKE

FORESHORE INVENTORY AND MAPPING
FIGURE BINDER

APPENDIX A

Foreshore Inventory and Mapping Methodology

APPENDIX B
Moyie Lake Data Tables

Table 1: Natural versus Disturbed shoreline lengths and percentages in Moyie Lake.

	Moyie Lake	
	% of Shoreline	Shore Length (m)
Natural	50.40%	18944
Disturbed	49.60%	18641
	Total	37585.1

Table 2: The total length of natural and disturbed shorelines and their associated land uses around Moyie Lake.

	% of Shoreline Length	Shoreline Length	Natural Shore Length	Disturbed Shore Length (m)	% Natural	% Disturbed
Agriculture	2.1%	784	784	0	0.0%	0.0%
Commercial	0.0%	0	0	0	0.0%	0.0%
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	17.5%	6574	4477	2097	68.1%	31.9%
Park	1.7%	636	636	0	100.0%	0.0%
Recreation	0.8%	294	88	206	0.0%	0.0%
Rural	30.5%	11472	8117	3355	70.8%	29.2%
Single Family	17.8%	6679	3125	3554	46.8%	53.2%
Urban Park	1.4%	527	61	466	11.6%	88.4%
Transportation	28.3%	10619	5557	5061	52.3%	47.7%
Institutional	0.0%	0	0	0	0.0%	0.0%
Total	100.0%	37585.1				

Table 3: The total length of natural and disturbed shoreline and associated percentages within the different shore types that occur around Moyie Lake.

Shore Type	% of Total	Total Shoreline Length (m)	Natural Shore Length (m)	Disturbed Shore Length (m)	% Natural	% Disturbed
Cliff / Bluff	8.1%	3039	2626	413	86.4%	13.6%
Rocky Shore	38.8%	14591	8522	6069	58.4%	41.6%
Gravel Beach	29.7%	11152	5830	5322	52.3%	47.7%
Sand Beach	2.8%	1036	715	321	69.0%	31.0%
Stream Mouth	5.1%	1905	1095	809	57.5%	42.5%
Wetland	15.6%	5864	4057	1806	69.2%	30.8%
Other	0.0%	0	0	0	0.0%	0.0%
Total	100.00%	37585.1				

Table 4: The total shoreline length and percentage that has aquatic, submergent, emergent, and floating vegetation along Moyie Lake.

Type	% of Total Shoreline Length	Shoreline Length (m)
Aquatic Vegetation	24.7%	9282
Submergent Vegetation	1.2%	437
Emergent Vegetation	24.7%	9282
Floating Vegetation	2.3%	850

Table 5: The total number and density (# per km) of different shoreline modifications occurring around Moyie Lake.

Type	Total #	# Per km
Docks	108	2.87
Groynes	2	0.05
Boat Launch	10	0.27
Retaining Walls	105	2.79
Marinas	5	0.13
Marine Rails	3	0.08

Table 6: The approximate shoreline length that has been impacted by substrate modification, road and railways, and retaining walls along Moyie Lake.

Category	% of Shoreline	Shore Length (m)
Roadway	11%	4106
Retaining Wall	12%	4685
Railway	12%	4452
Substrate Modification	35%	13263
	Total Shoreline Length	37585

Table 7: The Level of Impact around Moyie Lake.

Category	Level of Impact (% of Shoreline)	Shore Length
High	47.23%	17750
Moderate	7.89%	2964
Low	44.89%	16871
Total		37585

APPENDIX C

Moyie Lake Aquatic Habitat Index

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APPENDIX D
Summary of Fisheries Data

Table 1: Summary of the total number of fish surveyed during spring and fall sampling seasons in Moyie Lake using beach seines and snorkel surveys.

<table>
<tr><th>Species</th><th>Common Family Name</th><th>Total Number Surveyed</th><th>Relative Abundance (%)</th></tr>
<tr><td>Redside Shiner</td><td>Cyprinid (Minnows)</td><td>106</td><td rowspan="4">82</td></tr>
<tr><td>Cyprinid (unidentified)</td><td>Cyprinid (Minnows)</td><td>1642</td></tr>
<tr><td>Lake Chubb</td><td>Cyprinid (Minnows)</td><td>25</td></tr>
<tr><td>Long Nose Dace</td><td>Cyprinid (Minnows)</td><td>23</td></tr>
<tr><td>Largescale sucker</td><td>Sucker</td><td>173</td><td>8</td></tr>
<tr><td>Kokanee</td><td>Salmonid</td><td>5</td><td rowspan="3">1</td></tr>
<tr><td>Rainbow Trout</td><td>Salmonid</td><td>2</td></tr>
<tr><td>Mountain Whitefish</td><td>Salmonid</td><td>18</td></tr>
<tr><td>Pumpkinseed Sunfish</td><td>Non Native</td><td>204</td><td>9</td></tr>
<tr><td></td><td>Total</td><td>2198</td><td>100</td></tr>
</table>

APPENDIX E

Summary of Wildlife and Vegetation Surveys

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APPENDIX F

Additional Legal Requirements

This Appendix was reproduced from the Windermere Lake Shoreline Management Guidelines entirely. 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, and Regional District. 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 Department of Fisheries and Oceans 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 G

Best Management Practices and Regional Operating Statements

This Appendix was reproduced from the Windermere Lake Shoreline Management Guidelines entirely. 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