East Kootenay Integrated Lake Management Partnership

Koocanusa Reservoir Sensitive Habitat Inventory Mapping – Phase 2
Final Report

Project Number

UKE-F17-F-1403

Prepared For

Fish and Wildlife Compensation Program

Prepared By

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Date

December 15, 2017

Prepared with financial support of the Columbia Basin Trust and the Fish and Wildlife Compensation Program on behalf of its program partners BC Hydro, the Province of BC, Fisheries and Oceans Canada, First Nations and public stakeholders.

Executive Summary

The East Kootenay Integrated Lake Management Partnership (EKILMP) has worked together since 2006 to address the intensification of shoreline development pressures on lakes in the Kootenay Region.

The Partnership is made up of federal, provincial, regional, municipal and First Nations governments, community representatives as well as non-government organizations. This collaborative adopted Fisheries and Oceans Canada's methodology for Sensitive Habitat Inventory Mapping (SHIM). SHIM helps to develop and implement guidelines for shoreline development that protects existing fish and wildlife values and conserves ecosystems and species of conservation concern.

To date, EKILMP has completed projects for Windermere Lake, Columbia Lake, Wasa Lake, Moyie Lake, Monroe Lake, Tie Lake, Rosen Lake, St. Mary's Lake, and Jimsmith Lake. The reports can be viewed at ekilmp.com.

In 2015, EKILMP initiated Sensitive Habitat Inventory Mapping projects for the Canadian portion of Lake Koocanusa. The Foreshore Inventory and Mapping, and Fish and Wildlife Habitat Assessment were completed during Phase One of the project.

The Foreshore Inventory and Mapping (FIM) identified the land use, shore type, existing riparian condition, and anthropogenic alterations along the foreshore of Lake Koocanusa. The field team used a Trimble GPS unit to map approximately 160km of shoreline and document modifications. Based on this data, the shoreline was broken into 58 segments. The FIM serves as a benchmark for regulatory agencies by documenting current foreshore condition and structures such as docks and mooring buoys.

The Fish and Wildlife Habitat Assessment identified 18 sampling sites spanning a variety of shore types, including low rocky shore, sandy beach, cliff/bluff, and creek mouth. Fish, bird and wildlife habitat and occurrence and aquatic invertebrate presence/absence data was collected in July and September to capture fish and wildlife various breeding, rearing and migration timeframes.

The drawdown zone (DDZ) of the reservoir fluctuates upwards of 2,359 ft and 2,459 ft depending on snowpack, time of year, flood control targets, and minimum flow requirements identified for White Sturgeon, Bull Trout and salmon. In April 2016, the field team conducted a low pool aerial survey the reservoir using a helicopter. They documented slope, substrate, vegetation, modifications and fish and wildlife observations. They also recorded the shoreline using a GPS referenced video camera and still photographs with GPS reference.

Some observations of note included: the presence of juvenile yellow perch in the reservoir; the high value habitat and cold source water provided by the limited number of tributaries; and, the extensive Off Road Vehicle use in the drawdown zone.

Critical nesting habitat for the long-billed curlew was also identified. While provincial government agencies have previously identified long-billed curlew habitat, and implemented protection mechanisms by designating the lands as Wildlife Habitat Areas, new nesting locations were recently identified by the East Kootenay Integrated Lake Management Partnership.

Phase Two included the completion of an Aquatic Habitat Index and final Foreshore Inventory and Mapping and Shoreline Guidance Document reports.

The Aquatic Habitat Index (AHI) was used to score and rank each shoreline segment based on its ecological value. The AHI used numerical data collected by the EKILMP field team from four categories of parameters: 1) biophysical, 2) zones of sensitivity, 3) vegetation and 4) modifications. Parameter values were based on their positive or negative contributions to environmental health.

The information collected, summarized and presented in the reports will aid government and organizations overseeing foreshore and upland development. It serves as a benchmark by documenting land use and habitat changes necessary for the development of regulations, standards, policies and educational materials.

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1. Introduction

Koocanusa Lake is a reservoir formed by the creation of the Libby Dam in Montana in 1973 (Figure 1). Since then, land use pressures have escalated including off-road vehicle use, informal camping, shoreline disturbance, and water quality concerns resulting from upstream mining activity.

Sensitive Habitat Inventory Mapping (SHIM) is a protocol developed by Fisheries and Ocean Canada. It provides decision-makers, planners, developers, landowners and government agencies with the tools required to make sustainable foreshore land use decisions that take into account cumulative impacts to fish and wildlife habitats. The resulting Shoreline Management Guidelines are used as an initial step when reviewing, planning for, or prescribing alterations along the shoreline. This approach provides a science-based assessment of areas of highest natural value requiring the highest level of ongoing protection. Shoreline Management Guidelines can also be used when assessing shoreline property values through BC Assessment. Projects have been completed for nine lakes across the East Kootenay, and two additional lakes in the West Kootenay. Guidelines have been implemented into local planning policies for three lakes, and partnership continues to support the implementation of the remaining guidelines into policy.

The Sensitive Habitat Inventory Mapping program has three stages:

1. Foreshore Inventory Mapping (FIM)
2. Fish and Wildlife Habitat Assessment and Aquatic Habitat Index
3. Shoreline Management Guidelines

FIM assists in identifying the land use, shore type, existing riparian condition, and anthropogenic alterations along the foreshore. Based on this data, the shoreline is broken into a number of segments. The FIM serves as a benchmark for regulatory agencies by documenting current foreshore condition, and provides evidence for regulatory investigations and will assess objectives set out in foreshore protection initiatives.

The Fish and Wildlife Habitat Assessment uses scientific analysis to identify zones of sensitivity and key habitat features, and rank shoreline segments using the Aquatic Habitat Index (AHI). Fish, bird and wildlife habitat and occurrence and aquatic invertebrate presence/absence data is collected during the summer and fall over a one-year period. The AHI quantifies the Ecological Value for each shoreline segment and identifies the potential if anthropogenic alterations were to be removed.

The information analysis and resulting Shoreline Management Guidelines are used as an initial step when reviewing, planning for, or prescribing alterations along the shoreline. This approach provides a science-based assessment of areas of highest natural value

requiring the highest level of on-going protection. EKILMP believes the Guidelines will help focus where new development could be located on the lake while sustaining priceless natural public assets and maintaining the economic viability of the area.

SHIM helps build local expertise and allows communities to take a more active role in planning and management.

Due to overwhelming interest from lake stewardship groups across the East Kootenay to have the SHIM process completed for their lakes, EKILMP developed a list of criteria to be considered a priority for SHIM. This includes: heavy development pressures; land use planning in place or underway; presence of a motivated local group; cooperative partners present; source water issues; and, high fish, wildlife and archaeological values. Koocanusa has been identified as the next priority lake by the partnership (see table 1).

Lakes completed:

- Lake Windermere
- Columbia Lake
- Wasa Lake
- Moyie Lake
- Monroe Lake
- Jimsmith Lake
- St. Mary Lake
- Rosen Lake
- Tie Lake

In recognition of the success of the East Kootenay Integrated Lake Management Partnership, a similar initiative was created in the West Kootenay in 2011, to focus on inventory and mapping projects for West Kootenay lakes. This initiative is called the Kootenay Lake Partnership and has completed two additional lakes.

Lakes completed:

- Kootenay Lake
- Slocan Lake

Table 1: Lake Koocanusa Priority Criteria

Criteria	Lake Koocanusa
Heavy development pressure	High number of seasonal visitors and day-users including off-road vehicle use and informal camping on Crown Land.
Land use planning in place or underway.	Baynes Lake Official Community Plan 2011.
	South Country Zoning and Floodplain Management Bylaw.
	Lake Koocanusa Official Community Plan 2013.
	Watershed Action Plan underway.
	Lake Koocanusa Land-Use Area Analysis underway.
	Koocanusa Recreation Strategy underway.
Presence of a motivated local group.	The Lake Koocanusa Community Council has identified stewardship of the lake as a priority.
Cooperative partners present.	The Regional District of East Kootenay and provincial government are represented and involved in EKILMP.
Source water issues.	Erosion potential of foreshore can result in increased sediment load.
	Individual drinking water systems are located on the lake.
High fish and wildlife values.	Encompasses trans-boundary migratory routes and part of the Pacific Flyway.
	Surrounding lands provide winter range for ungulates, habitat for wildlife and endangered plant species and provincially listed red and blue mammals and birds.
	Lake and tributaries support an abundance of sport fish and provide spawning/rearing habitats for a variety of species.

Fish Values

Koocanusa contains a productive fishery for a variety of species, though a primarily pelagic food web. While populations of adfluvial salmonids (bull trout and kokanee) are relatively well studied in spawning and rearing streams, the habitat use and shoreline associations of these and other species is poorly characterized in Koocanusa relative to other large lakes and reservoirs in the Kootenay region. Focal species that are of conservation concern, are highly exploited by recreational fisheries and significant for traditional use by First Nations include kokanee, rainbow trout, cutthroat trout, bull trout and burbot. Burbot may be particularly sensitive to shoreline habitat disruption in Koocanusa due to reservoir operations due to spawning habitat requirements and migratory behaviour. Spawning and associated migrations occur during the reservoir drawdown period in late winter. It is possible that operations may cause dewatering of burbot spawning areas or reduction in suitability of spawning habitat for fish that spawn in shallow habitats. For fish that ascend streams to spawn or spawn in stream confluence areas, operations may restrict access or spawning site suitability.

While some data has been compiled on fish occurrence and abundance on shoreline areas in Koocanusa and in tributaries, the area is largely data deficient and will require field sampling to determine species occurrence and abundance. In addition, shoreline habitat use may change depending on reservoir elevation at different periods of the year, and be dynamically responsive to changing habitat conditions as a result of sediment transport and shoreline erosion. Fisheries values will have to accommodate the dynamic nature of such changing habitat conditions in the reservoir.

Wildlife Values

An abundance of important wildlife habitat surrounds the reservoir and many species utilize the foreshore for some of their life requisites. Five ungulate species inhabit the area and several threatened and endangered species occur in the upland habitats. One species of concern, the long-billed curlew, nests along the shoreline of Koocanusa. Unfortunately, one colony nests within the draw down zone and their nests are inundated each spring when the reservoir level increases. Many other species such as cavity nesting ducks and raptors, and mammals such as grizzly bear are dependent on shoreline attributes found along the shores of the reservoir.

Recreational Use

Significant recreational land-use pressures have recently escalated with unmanaged off-road vehicle use and uncontrolled camping. More than 100,000 people visit the lake and area each year to recreate on the land and water. These activities result in direct impacts on the landscape and shoreline of the reservoir.

The Koocanusa Recreation Steering Committee, a multi-agency steering committee, was

brought together to support Crown Land recreation that maintains the ecological integrity, cultural values, aesthetic appeal and economic values of the Koocanusa area, and identify and implement recreation management solutions for current and future users.

The Koocanusa Shoreline Management Guidelines have the potential to help inform recreational activity and management along the foreshore, and in the drawdown zone through the identification of Zones of Sensitivity.

2. Goals and Objectives

The goal of the Lake Koocanusa Sensitive Habitat Inventory Mapping project is to complete a comprehensive aquatic monitoring strategy that will guide foreshore development in a manner that protects the ecological health of the lake.

The objectives of the project are to:

- Greatly improve information about the fish, wildlife and archaeological values of Lake Koocanusa;
- Develop science-based coordinated management guidance for land and water uses associated with Lake Koocanusa, and promote the application of this guidance in decision-making by all levels of government including First Nations, developers, planners, and all other interests;
- Liaise with related initiatives to enable aquatic and terrestrial ecosystem monitoring to effectively contribute to a cumulative effects assessment and an improved understanding of the overall health of the lake ecosystem; and,
- Facilitate information sharing and encourages collaboration amongst the community to efficiently and effectively coordinate and integrate land use decision-making.

3. Study Area

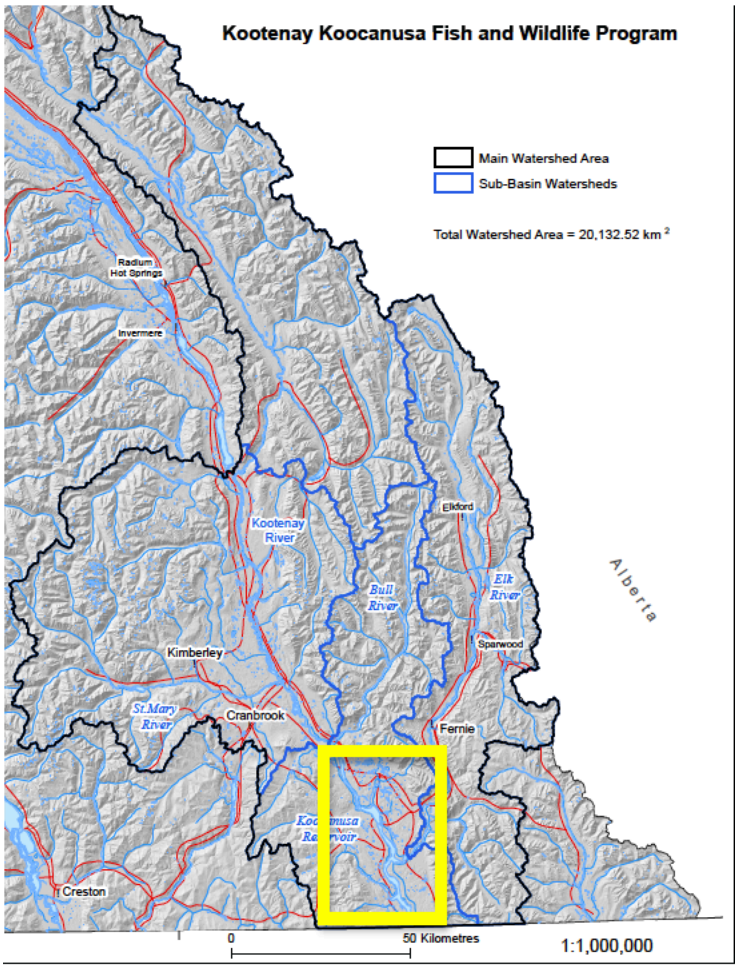

Figure 1: Map of study area outlined

4. Methods

The methodology is based upon mapping standards developed for Sensitive Habitat Inventory Mapping (SHIM) (Mason and Knight, 2001), and modified to account for the project being applied to a reservoir.

Fieldwork was conducted during July, 2015 (at reservoir elevation level 2,444 ft), and September, 2015 (at reservoir elevation level 2,459 ft).

The Foreshore Inventory and Mapping (FIM) identified the land use, shore type, substrate, existing riparian condition, and anthropogenic alterations along the foreshore of Lake Koocanusa. The field team travelled the length of the shoreline via houseboat, and used a Trimble GPS unit to map approximately 160 km of shoreline and document

modifications. Based on this data, the shoreline was broken into 57 segments (see Figure 2). The FIM serves as a benchmark for regulatory agencies by documenting current foreshore condition, and provides evidence for regulatory investigations and will assess objectives set out in foreshore protection initiatives.

The Fish and Wildlife Habitat Assessment identified 17 sampling sites (see Figure 2) spanning a variety of shore types, including low rocky shore, sandy beach, cliff/bluff, and creek mouth. Fish, bird and wildlife habitat and occurrence and aquatic invertebrate presence/absence data was collected in July and September to capture fish and wildlife various breeding, rearing and migration timeframes. Fish sampling was conducted using snorkel, beach seine, and gee-trap protocols, macro-invertebrates were sampled using Pacific Streamkeepers Federation protocols, and wildlife sampling was conducted using observation techniques.

The following additional information was collected during field surveys:

- Biophysical
  - Shore type
  - Substrate
  - Percentage natural
  - Aquatic vegetation
  - Overhanging vegetation
  - Large woody debris
  - Pocket beach
- Fisheries
  - Juvenile rearing
  - Migration corridor
  - Staging area
- Terrestrial
  - Veteran trees
  - Snags
  - Wildlife corridor
- Modifications
  - Retaining walls
  - Docks
  - Groynes
  - Boat launches
  - Staircases
  - Marinas
  - Mooring buoys
  - Swimming platforms
  - Breakwaters
  - Pillings
  - Unorganized camping
  - Cattle access
  - Livestock fencing
  - Evidence of ORV use

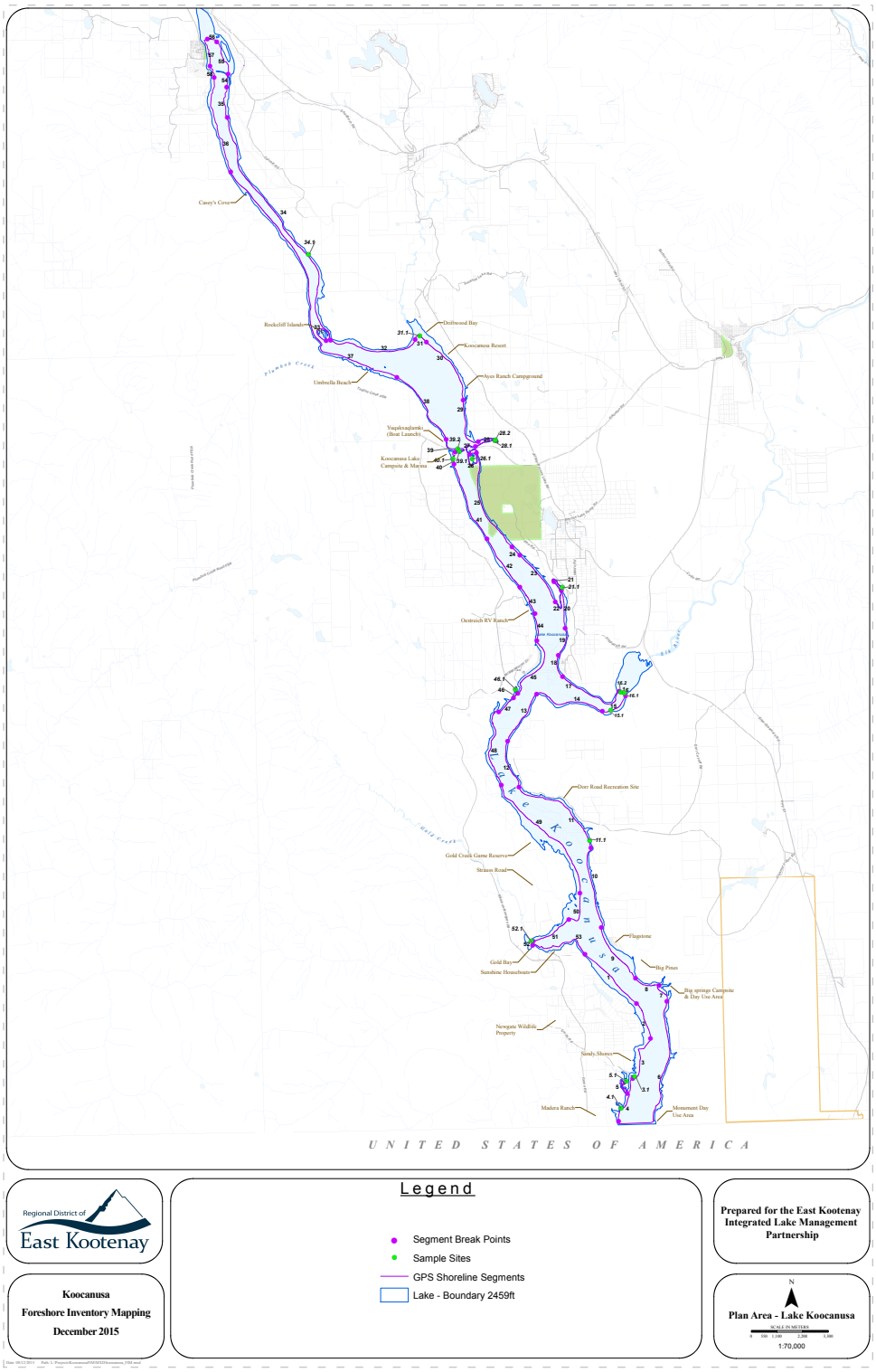

Figure 2: Koocanusa Foreshore Inventory Mapping map

The Shoreline Management Guidelines were prepared based on findings from the Sensitive Habitat Inventory Mapping (SHIM) study, which included the following exercises:

1. Foreshore Inventory and Mapping (FIM) was conducted to identify and inventory important habitat features across the reservoir. Data sources included fish and wildlife surveys completed by the EKILMP team, as well as information from various provincial databases: and
2. And Aquatic Habitat Index (AHI) was generated using the FIM data to determine the relative habitat value of each shoreline segment. This index follows similar methods that were developed for other lakes in the East Kootenay Region, including Windermere Lake, Tie Lake, Rosen Lake and Columbia Lake.

In an effort to standardize shoreline management guidelines between lakes across the region, large sections of the Shoreline Guidance Document were adapted from the previous reports.

The original guidelines and activity risk table developed for natural lakes was modified to take into consideration the significant variations in water levels occurring in active hydroelectric reservoirs, such as Lake Koocanusa. A risk table was developed to differentiate varying levels of risks associated with projects/activities proposed along the shoreline at full-pool and low-pool. The full-pool shoreline is defined as the elevation band between 744.9 to 749.5m and the 30m zone of adjacent upland. The drawdown zone is identified as the elevation between 730.9 and 744.9m.

A colour scheme was then developed to rank shoreline segments based on fish and wildlife habitat values, determined through the AHI analysis. The colour scheme (red, orange, yellow or grey) represents the level of sensitivity to development for each shoreline segment.

Shoreline developments/activities were then assigned risk ratings based on the level of potential risk they may pose to fish and wildlife habitat values. Recognizing that the different shoreline zones have different habitat values and levels of sensitivity, the risk of each activity was identified for each shoreline colour zone. A species at risk modifier column was added, in the event that species at risk have been identified in the project area.

A flow chart outlining the decision-making process for the High and Low risk activities was also presented. The chart provides guidance for the initial planning stages of a development project to help the applicant understand what might be required to proceed with their project. The guidelines are intended to help land managers review, plan and prescribe shoreline development and management proposals. The objective is to help plan future developments and recreational activities on Koocanusa, while conserving and restoring natural habitat that local fish and wildlife species rely on.

5. Results and Outcomes

The East Kootenay Integrated Lake Management Partnership has achieved significant successes with Phase Two of the Koocanusa Reservoir Sensitive Habitat Inventory Mapping Project.

The Aquatic Habitat Index (AHI) results show that the majority of the shoreline has High (41%) or Very High (23%) ecological value. These areas include segments that have little disturbance and are important habitat areas for fish and wildlife. These areas include most tributary inlets, shallow vegetated areas, and zones essential for fish and/or wildlife populations to complete their life cycle. The Moderate (24%), Low (6%) and Very Low (6%) ranked segments are generally disturbed, therefore have lower values for fish and wildlife.

Very High habitat areas were identified as essential for the long-term maintenance of fish and/or wildlife values through the AHI analysis process. These areas are located along the shoreline and include most tributary inlets, shallow vegetated areas, and zones essential for fish and/or wildlife populations to complete their life cycle. Proponents should consider moving high risk activities to other areas if possible, or pursuing lower risk activities. EKILMP recommends that these areas be designated for conservation use, and that no development or activities that can impact these sensitive communities occur within them. Low impact alter access recreation and traditional First Nation uses are permissible in these areas, but permanent structures or alteration of existing habitats are prohibited. Habitat restoration and enhancement projects are encouraged in these areas where warranted.

High Value habitat areas are sensitive to development, provide important ecological functions, but may be at risk from adjacent development pressures. Restoration opportunities potential exist in these areas. Proponents should consider moving high risk activities to other areas if possible, or pursuing activities that have lower associated risks.

Moderate Value areas have generally experienced more intensive development disturbance and pressures. These areas generally do not contain critical habitat features required by fish and wildlife to maintain viable populations, however, these areas still provide important connectivity between high value habitat areas. Development is more appropriate on these shorelines, and should incorporate protection of habitat features that remain. Intensive development within riparian areas could have unacceptable environmental impacts without proper planning. Restoration may be an option in some areas that have experienced development pressures. Development may proceed for low risk activities provided a Best Management Practice (BMP) or Regional Operating Statement is followed.

Low and Very Low Value habitats are generally disturbed areas, however, may still contain values requiring protection. Human development has been concentrated in these areas

and has resulted in disturbances to the natural fish and/or wildlife habitat. In keeping with the objective of concentrating development in areas that are already disturbed, or of low value, new development may be considered in these areas. Re-development will also be considered, and should incorporate fish and wildlife habitat restoration or improvement features where feasible.

Zones of Sensitivity (ZOS) were identified for the shoreline and drawdown zone. ZOS includes aquatics, birds and unique features such as scenic values. ZOS were identified for tributary mouths, existing Wildlife Habitat Areas (WHA) for lewis's woodpecker and long-billed curlew, as well as new curlew sites identified, bank swallow nesting areas, and juvenile rearing habitat. There were 25 ZOS identified on the reservoir.

Identified ZOS mostly consist of shallow vegetated areas such as tributary inlets and vegetated flats on the margin of the lake. As water levels rise in spring and summer, mud flat areas with established terrestrial vegetation become inundated providing a suitable combination of shallow depth and abundant cover for rearing of fry and juvenile fish. Similar conditions are found in tributary inlets where stream water inflow also create a temperature refuge for cold-water species in summer. Tributary inlets are important migration corridors providing connectivity with critical tributary spawning habitat. These areas are particularly sensitive to disturbances from anthropogenic activities such as off-road vehicle use, construction activities below the high water mark, and artificial fluctuations in water levels. Aquatics ZOS also provide foraging opportunities for birds and other wildlife. Lake Koocanusa is an important staging area for migrating birds including waterfowl, waders, shorebirds and others. These ZOS can be used to guide the Recreation Management Strategy currently underway.

6. Discussion

Over 45 years after the construction of the Libby Dam and the impoundment of the Kootenay River below Wardner, the shoreline of Lake Koocanusa now supports a diverse and abundant fish and wildlife community, relying on the reservoir's habitat to complete its life cycle. Habitat conditions along the foreshore of the reservoir are highly dependent on annual and inter-annual fluctuations in water levels, resulting from the operation of the Libby Dam. Consequently, additional impacts from anthropogenic activities in the area can pose a significant threat to the long-term survival of local fish and wildlife populations. Conservation of ecosystem functions along the Lake Koocanusa foreshore is critical to maintain the environmental, social, aboriginal, and economic values of the area.

Results of the FIM study show that approximately 72% (130 km) of the shoreline of Lake Koocanusa is in natural condition and 28% (50 km) is disturbed. AHI results show that the majority of the shoreline has High (41%) or Very High (23%) ecological value. Shoreline segments with Very High and High ecological value generally included a Zone of Sensitivity

for aquatic or wildlife value.

The Lake Koocanusa Shoreline Management Guidelines provide a decision-making framework for regulatory agencies and proponents of future development projects, as well as the Koocanusa Recreation Steering Committee, to ensure responsible development and guaranty the long-term sustainability of the Lake Koocanusa shoreline ecosystem.

7. Recommendations

The shortfalls of the SHIM standards, originally developed for natural lakes, to assess shoreline and drawdown conditions in a reservoir presented significant challenges for the completion of this study. However, lessons learned through this project also pose an opportunity. This type of approach can be applied to other reservoirs such as Arrow Lakes and Duncan. And, with the ongoing Columbia River Treaty renegotiations, improved knowledge and understanding of the ecology of Koocanusa Reservoir will potentially benefit the people of the area.

The following section provides recommendations to help improve upon the results of the present study. A modified SHIM standard specific to reservoirs would help to further understand and protect the natural integrity of Lake Koocanusa.

Several recommended actions are proposed, including:

- Creation of a Standard Methods for Completion of Foreshore Inventory and Mapping Projects for reservoirs along with a separate data dictionary;
- Acquiring orthophotos of the reservoir at low and full pool;
- Acquiring LiDAR data for the entire reservoir;
- Revise field assessments at Wardner and make upgrades to the SHIM;
- Conduct detailed inventories to determine the current status of sensitive species and habitats associated with the broadly mapping zones of sensitivity;
- Complete SHIM for the major tributaries that feed into Lake Koocanusa;
- Develop a Lake Management Plan and incorporate Shoreline Management Guidelines into existing OCPs and future zoning bylaws;
- Further educate the community on the importance of foreshore management;
- Identify significant erosion areas in the drawdown zone;
- Conduct a detailed assessment of the impacts of off-road vehicle use in the drawdown zone; and,
- Conduct further study on the ecology of the reservoir and wildlife habitat enhancement opportunities.

8. Acknowledgements

The following individuals provided technical contributions to the project
Bruce MacDonald, Fish Habitat Biologist, Fisheries and Oceans Canada (retired), Terra Limnic Consulting
Peter Holmes, Ministry of Forests, Lands and Natural Resource Operations
Heather Leschied, East Kootenay Integrated Lake Management Partnership Coordinator

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- Presentation entitled, "Lake Management Planning Using the Sensitive Habitat Inventory Mapping Approach in the East Kootenay Region of British Columbia". North American Lake Management Society Annual Conference, Banff, Alberta, November 2016
- Presentation entitled, "Sensitive Habitat Inventory Mapping and Community-Based Monitoring", Alberta EcoTrust Environmental Gathering: "Breaking Through", Edmonton, Alberta, February 2017
- VAST Resource Solutions Inc. 2017. Lake Koocanusa Foreshore Inventory and Mapping and Aquatic Habitat Index. Report prepared for the East Kootenay Integrated Lake Management Partnership. Prepared by J. Romeo, D. Hlushak, I. Adams and B. Meunier.
- VAST Resource Solutions Inc. 2017. Lake Koocanusa Shoreline Management Guidelines. Report prepared for the East Kootenay Integrated Lake Management Partnership. Prepared by J. Romeo, D. Hlushak, I. Adams and B. Meunier.
- www.ekilmp.com

9. References

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

VAST Resource Solutions Inc. 2017. Lake Koocanusa Foreshore Inventory and Mapping and Aquatic Habitat Index. Report prepared for the East Kootenay Integrated Lake Management Partnership. Prepared by J. Romeo, D. Hlushak, I. Adams and B. Meunier.

VAST Resource Solutions Inc. 2017. Lake Koocanusa Shoreline Management Guidelines. Report prepared for the East Kootenay Integrated Lake Management Partnership. Prepared by J. Romeo, D. Hlushak, I. Adams and B. Meunier.

Attachments

The following documents are attached to this report:

- VAST Resource Solutions Inc. 2017. Lake Koocanusa Foreshore Inventory and Mapping and Aquatic Habitat Index. Report prepared for the East Kootenay Integrated Lake Management Partnership. Prepared by J. Romeo, D. Hlushak, I. Adams and B. Meunier.
- VAST Resource Solutions Inc. 2017. Lake Koocanusa Shoreline Management Guidelines. Report prepared for the East Kootenay Integrated Lake Management Partnership. Prepared by J. Romeo, D. Hlushak, I. Adams and B. Meunier.

LAKE KOOCANUSA
FORESHORE INVENTORY AND MAPPING AND AQUATIC HABITAT INDEX

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Peter Holmes, Ministry of Forests, Lands and Natural Resource Operations (FLNRO)
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Cover Photos:

Top: Ben Meunier; Left Top and Bottom: Heather Leschied

DISCLAIMER

The results contained in this report are primarily based upon data collected from field surveys completed by parties other than VAST Resource Solutions Inc. (VAST). VAST and the authors assume that data collected are accurate and reliable. Data in this assessment was not analysed statistically. Use or reliance upon conclusions made in this report is the responsibility of the party using the information. Neither VAST, nor the authors of this report are liable for accidental mistakes, omissions or errors made in its preparation as best attempts were made to verify the accuracy and completeness of data collected and presented.

EXECUTIVE SUMMARY

Lake Koocanusa is a reservoir formed by the completion of the Libby Dam in Montana in 1973. This transboundary reservoir extends 140 km between Wardner, BC and Libby, Montana. This study focuses on the Canadian portion of the lake. The East Kootenay Integrated Lake Management Partnership (EKILMP) commissioned VAST Resource Solutions Inc. (VAST) to complete this project which includes:

1) Foreshore Inventory and Mapping study (FIM);
2) Aquatic Habitat Index (AHI); and
3) Shoreline Management Guidelines.

The purpose of this Sensitive Habitat Inventory and Mapping (SHIM) project for Lake Koocanusa is to provide baseline information on foreshore condition and environmental values to aid in future decision-making. At this time, there are no standards in place to adequately address reservoirs. Therefore, the current FIM standards has been used. Although there may be shortfalls with this approach, it is currently the best available science.

The foreshore of Lake Koocanusa was determined to be 179.6 km, which was delineated into 57 segments based on contiguous characteristics. The physical analysis of the foreshore revealed the most prevalent shore type to be gravel beach (36%). Cliff/bluff and sand beach shore types also extended along substantial lengths (22% and 16%, respectively); while the stream mouth shore type was minimal (1%). Aquatic vegetation only extended along 4% of the shoreline. The study area falls within the Interior Douglas-Fir dry mild, biogeoclimatic zone (IDFdm2) and the Ponderosa Pine dry hot, biogeoclimatic zone (PPdh2). The vegetation along the natural shoreline areas was mainly composed of mature species providing abundant coverage. Overall, 72% of the foreshore was found to be in a natural condition and 28% was found to be disturbed.

The EKILMP team conducted fish and wildlife field assessments during summer (July 10 –16, 2015) and fall (September 22- 24, 2015) field visits. Twenty-eight sites throughout Lake Koocanusa were selected for fish assessments and thirteen sites were selected for wildlife assessments. This data as well as literature review information on species and habitats was used to document the ecological status of the shoreline. Overall, the foreshore of Lake Koocanusa was found to be biologically diverse and important to numerous plant, fish and wildlife species. Several sensitive plant, wildlife and fish species inhabit or potentially inhabit the area.

An Aquatic Habitat Index (AHI) was used to score and rank each shoreline segment based on its ecological value. The AHI used numerical data collected by the EKILMP field team from four categories of parameters: 1) biophysical, 2) zones of sensitivity, 3) vegetation and 4) modifications. Parameter values were based on their positive or negative contributions to environmental health. The AHI was originally developed for a lake environment, and therefore may not fully represent the ecological values of a reservoir full-pool shoreline. The following Existing Ecological Shore Rankings were determined from the AHI: Very High - 23% of shoreline, High – 41%, Moderate – 24%, Low – 6% and Very Low - 6%.

The information collected, summarized, and presented in this report will aid government and organizations overseeing foreshore and upland developments. This report serves as a benchmark by documenting land use and habitat changes necessary for the development of regulations, standards, policies and education materials.

Several recommended actions are proposed, including: creating a *Standard Methods for Completion of Foreshore Inventory and Mapping Projects* for reservoirs along with a separate data dictionary, acquiring orthophotos of the reservoir at low and full pool, acquiring LiDAR data for the entire reservoir, conducting species and habitats inventories and further educating the community on the importance of foreshore management.

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1.0 INTRODUCTION

The gazetted name of Koocanusa reservoir is Lake Koocanusa. It is a reservoir formed by the completion of the Libby Dam in Montana in 1973. This transboundary reservoir extends 140 km between Libby, Montana and Wardner, BC. It is the fourth dam constructed under the Columbia River Treaty. The dam is operated by the US Army Corps of Engineers, and provides flood control and hydroelectric power for Montana, Idaho, Washington, Wyoming, California, Utah, Oregon and Nevada. Since the dam was built, land use pressures around the reservoir have escalated including off-road vehicle use, informal camping, shoreline disturbance, and water quality concerns resulting from upstream mining activity (www.ekilmp.com).

Lake Koocanusa operates on a flood management strategy referred to as the VarQ. It was implemented to improve the reservoir and river operations at the Libby Dam (Wade and Weatherly, 2012). Similar to standard flood management, VarQ uses forecasted inflow, except in years that have a lower risk of flooding, it allows for greater flexibility to regulate the amount of water and the time at which water needs to be released from the reservoir (Wade and Weatherly, 2012). The maximum and minimum operating levels for Lake Koocanusa are 749.5 metres (2,459 feet) and 697.1 metres (2,287 feet), respectively as shown in Figure 1. For the purpose of this study, EKILMP defines full-pool as 744.9 to 749.5 m (2444 - 2459 feet) and the 30 meter zone of adjacent upland, while low-pool is when reservoir elevations are between 730.9 and 744.9 m (2398 - 2444 feet). In general, full-pool occurs from July through September, while low-pool occurs from January through April. It is the full-pool shoreline and associated foreshore that is the focus of this study.

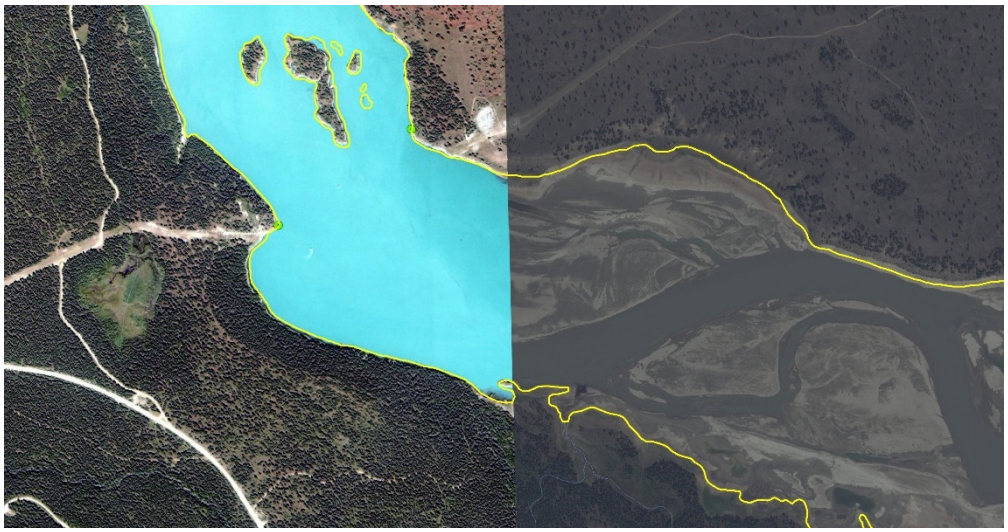


Figure 1. Orthophoto view of Lake Koocanusa, showing full-pool (left) and low-pool (right). The BC Freshwater Atlas shoreline is shown in yellow.

Due to its sheer size, Lake Koocanusa has a unique set of aquatic, foreshore, and shoreline habitats which need to be considered in current and future development. Since the lake's inception, these important habitats have been subject to cumulative industrial, residential and recreational land use pressures; therefore, a thorough understanding of Lake Koocanusa's rich shoreline characteristics and habitats is pertinent for sustainable future planning initiatives. Lake Koocanusa supports an important regional fish community, especially from a sport fishery standpoint. Ecologically, Lake Koocanusa has seen significant changes from historical conditions between the effects of impoundment and species introductions. Additionally, the British Columbia government has protected a few areas of Long-billed Curlew habitat, by designating the lands as Wildlife Habitat Areas (WHAs). There are two approved Long-billed Curlew WHAs in the study area: at the north end of the lake near Wardner and near Baynes Lake in the Kerr Road area.

Furthermore, the Koocanusa area has been a region of great importance to First Nations for many centuries, as it is located within the traditional territory of the Ktunaxa Nation, and it contains recorded archaeological sites that represent a significant connection for the Ktunaxa Nation (RDEK 2014a).

As with many lakes across British Columbia, Lake Koocanusa has seen a rise in recreational use resulting in an increase in foreshore disturbances. The Koocanusa area is a popular tourism and recreational region, appealing to residents and visitors for a range of activities which include fishing, camping, boating and off-road vehicle use. With an increase of these activities in the Koocanusa area, there has been an increase in negative impacts on Crown land resources in the area such as degradation of sensitive grasslands and wildlife habitat (Zukiwsky, Liepa, Hlushak, Volp & Cooper, 2015). Increased information about critical habitats will more accurately guide key regional stakeholders with the proper understanding of how anthropogenic development may impact important natural habitat features, and furthermore, will assist local governments in their long-term planning objectives, resulting in a better balance between development and conservation goals. Within the Canadian portion, Official Community Plans (OCPs) exist for the broader Lake Koocanusa region (RDEK 2014a) and for the Baynes Lake area (RDEK 2014b). Both plans recognize the value of protecting Lake Koocanusa waters. During development, the shoreline is often modified in order to improve recreational access (e.g., docks, vegetation removal, boat launches), and to protect land from erosion forces (e.g., groynes and retaining walls). The alterations and their potential negative impacts on the foreshore environment have become a concern with local citizens and regulatory agencies.

Recognizing the need for better lake management, a biophysical inventory of Lake Koocanusa is required. Steps 1 and 2 were completed in this report, and Step 3 will be included in a separate document. The definitions and details relating to each step are outlined below (Schleppe and Patterson, 2011).

1. *Foreshore Inventory and Mapping (FIM) – FIM is a broad scale inventory process that attempts to define and describe the shoreline of lake systems. The inventory provides baseline information regarding the current condition, and natural features of the shoreline, and characterizes the level of development (e.g., retaining walls, docks, groynes, etc.). The data collected allows managers and the public to monitor shoreline changes over time and to measure whether proposed land use decisions are meeting their intended objectives. This baseline inventory provides sufficient information to facilitate identification of sensitive shoreline segments as part of step 2 below.*

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

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

2.0 PROJECT OVERVIEW

2.1 Objectives

The objectives of this study are to provide an overview of foreshore habitat condition, rank contiguous shoreline segments based on their fish and wildlife habitat values, and prepare management guidelines for the ranked segments, specifying development risks of various activities. SHIM methodology was not designed for reservoirs. Therefore, most of the data collected in the field applies to the full-pool mark of the reservoir. The shoreline of Lake Koocanusa is to be considered the full-pool mark, at 749.5 m (2459 feet).

The objectives of the SHIM will be achieved through completion of the following activities:

1. **Foreshore Inventory and Mapping (FIM)**
   - Delineate the shoreline into segments, based on contiguous physical features using field findings and geographic data; and,
   - Inventory foreshore morphology, land use, shoreline condition and anthropogenic alterations within each of the segments.
2. **Aquatic Habitat Index (AHI)**
   - Report on fish and wildlife habitat values using field and literature findings;
   - Identify sensitive shoreline features and habitats;
   - Prepare an index that ranks habitats along the foreshore based on biophysical attributes;
   - Develop a GIS database on the ecological integrity of the lake's foreshore;
   - Utilize physical (FIM data) and biological variables to mathematically score each segment;
   - Scores will allow segments to be compared to one another to determine their importance to fish or wildlife habitat.
3. **Shoreline Guidance Document**
   - Colour code segments, based on their habitat index values; and
   - Identify risk for development activities in each colour zone.

Foreshore Inventory and Mapping (FIM) and the Aquatic Habitat Index (AHI) completed in this report will be used to develop science-based coordinated shoreline management guidelines for land and water uses. The shoreline guidelines are used to provide consistent policy information and aid in decision-making by all levels of government, developers, planners and other interests (EKILMP 2006).

2.2 Project Partners

The East Kootenay Integrated Lake Management Partnership (EKILMP) formed in 2006 in response to concerns over the fast pace of foreshore development in the East Kootenay (EKILMP 2006). Their aim is to protect lakes in the East Kootenay by encouraging integrated and coordinated approaches and providing guidance on best practices and restrictions of use where necessary (EKILMP 2006). EKILMP have recorded the baseline ecosystem values of nine East Kootenay lakes: Windermere, Columbia, Moyie, Monroe, Tie, Rosen, St. Mary, Jim Smith and Wasa. EKILMP (www.ekilmp.com) provides a list of their partnerships and goals, and have been directly quoted here (as shown in italics).

The East Kootenay Integrated Lake Management Partnership (EKILMP) is a coalition of various agencies, local governments, First Nations and non-government organizations with joint responsibilities to protect lake ecosystems. The mandate of the partnership is to maintain the integrity of lake ecosystems for fish, wildlife, drinking water, heritage, recreation and aesthetic values. EKILMP develops science-based, coordinated management guidance for land and water uses associated with East Kootenay lakes, in southeastern British Columbia.

Through partnership, information sharing and optimizing available resources, the EKILMP wishes to develop integrated, collaborative approaches to lake management, in order to address the current and future activities in the watershed in ways that sustain the ecological health, social and economic values of lakes in the East Kootenay.

2.3 Current Foreshore Management

Land use activities at Lake Koocanusa are governed by several bylaws and policies, including the Lake Koocanusa Area Official Community Plan (OCP – Bylaw 2432; RDEK 2014a), and the Baynes Lake area Official Community Plan (OCP – Bylaw 2319; RDEK 2014b). Details relating to the protection of foreshore or other associated environmental features in these documents are noted below:

Lake Koocanusa Area OCP (RDEK 2014a)

The Lake Koocanusa plan area is located in southeastern British Columbia between Jaffray and the US border, also known as "South Country". The OCP aims to provide direction on land use and developmental issues within the plan area. During the public consultation for the OCP, natural and environmental attributes were among the most highly valued characteristics of the area. Residents also supported the protection and preservation of wildlife and their habitats located within the plan area. Broad environmental goals identified in the Lake Koocanusa OCP include: maintaining its rural and agricultural character by minimizing the impacts of land development on the natural environment, and preserving unique ecosystem features in the area such as riparian areas, dry grasslands, ungulate winter range, wildlife corridors, and wildlife habitat areas in order to sustain the biodiversity of the area. The plan area provides important habitat to red-listed species such as the American Badger and Lewis's Woodpecker and blue-listed species such as the Long-billed Curlew and Flammulated owl, and also provides habitat and winter forage for a range of wildlife such as elk and deer.

The Lake Koocanusa OCP area is situated within the traditional territory of the Ktunaxa Nation, and surrounds the Tobacco Plains Indian Reserve. The Ktunaxa Nation Council was a part of the steering committee for this planning process, expressing their rights for future land use in the area. The plan area contains recorded archaeological sites that identify a significant historical connection for the Ktunaxa Nation.

Baynes Lake Area OCP (RDEK 2014b)

The Baynes Lake OCP area is situated in southeastern British Columbia, adjacent to Lake Koocanusa. This area is often referred to as "South Country". The OCP serves as a guidance tool for future land use and development in the Baynes Lake area. The first goal of the Baynes Lake OCP is to "Protect the integrity of Baynes Lake, Lake Koocanusa and all other surface and ground water resources" (Section 3). Additional environmental issues identified in the OCP include the protection of endangered and threatened plant and animal species and the preservation of grassland and riparian ecosystems.

The OCP (Section 10.1) recognizes Lake Koocanusa as a unique physical landscape feature, as it, along with other seasonal water bodies, is a significant water resource in the area, providing essential habitat for a variety of fish and wildlife species and also meeting the potable water, irrigation and recreational needs of residents within the OCP area.

3.0 METHODS

3.1 Field Assessment

The initial field assessment for the FIM was conducted in July, 2015 from a boat, by EKILMP partners and/or consultants Bruce MacDonald (Terra Limnic Consulting), Heather Leschied (Living Lakes Canada), Peter Holmes (FLNRO), and Walter Kehler (Lake Koocanusa Community Council). Field assessors used a Trimble Pathfinder GPS unit loaded with the FIM Data Dictionary SHIM Lake v. 2.6 to record the GPS track and input field data. They carried orthophoto based maps for reference to aid in data collection, and captured digital images of shoreline features.

EKILMP members conducted fish and wildlife surveys in the summer (July 10-16) and fall (September 22-24) of 2015, which included sampling fish and documenting wildlife observations. In April 2016, GPS video, photographs, substrate, gradient, wildlife and land use observations were taken of the study area via a helicopter.

3.2 Foreshore Inventory and Mapping (FIM)

FIM report development includes:

1. Summarizing available information on environmental values;
2. Preparing detailed descriptions for each segment;
3. Analyzing and summarizing biological and physical data for the lake using the FIM database; and,
4. Using GIS to map segment locations, emergent vegetation polygons, and other pertinent segment data.

During the field assessment, the shoreline was delineated in contiguous segments based on biophysical features. Standard FIM data for each segment was collected to provide an understanding of features and condition. This data was summarized in the FIM database and includes parameters such as: segment length, land use, shore type, substrates, shoreline cover, aquatic vegetation, shoreline modifications and flora and fauna details.

3.3 GIS and FIM Database Management

The GeoBC Freshwater Atlas GIS dataset was used to define the boundary of Lake Koocanusa. The shoreline segment line-work was modified in Segments 3, 41, 42 and 43 to more accurately follow the full-pool mark. There were no orthophotos provided, therefore the best available information including field notes, field photos, GPS video and imagery from ArcGIS Web Mapping Services was used to complete the edits. The shoreline should therefore not be considered exact, but rather a representative line used to display the full-pool mark.

Where information was absent, the database was updated using available office tools including Google Earth and other GIS applications. Adhering to the FIM Standards, the following parameters were calculated for each segment:

- Natural vs. disturbed shoreline;
- Land use;
- Shore type;
- Substrate type;
- Aquatic vegetation;
- Full-Pool and Drawdown Zone Vegetation;
- Shoreline modifications; and
- Level of impact

The legal boundaries of properties (parcel fabric) around the lake were provided by the RDEK. The RDEK parcel fabric metadata states horizontal accuracy of approximately +/- 10 m. The RDEK makes no warranties or representations concerning the validity or accuracy of the data.

The Sensitive Habitat Inventory and Mapping Methods (Mason and Knight 2001) and the Foreshore Inventory and Mapping Standards (Schleppe and Mason 2009) provide additional technical procedures including GPS, data management, database development and quality control.

3.4 Fish and Wildlife Assessment

3.4.1 Fish Sampling and Analysis

Fish assessments were completed at 28 sites around the lake between July 10-16 and September 22-24, 2015 (Appendix B). A variety of sampling techniques were utilized to obtain information on species presence and relative abundance, including snorkel, seine, Gee traps, and observations from the boat. The most appropriate technique considering the site conditions was used. The following details were recorded for each site sampled: a description of substrate type, general aquatic vegetation details, air temperature, water temperature, method used, numbers of each fish species, life stage for fish, as well as site observations. Any fish captured were released in the area where they were found once sampling data was recorded.

Fish data was generally not analyzed using statistical methods since the sampling program was designed only to determine presence/absence and relative abundance. To provide a general understanding of fish use at each sample site, relative abundance was calculated for each species. Data from all sampling techniques was pooled in the relative abundance calculations. Summer and fall data were analysed separately in order to identify any seasonal distinctions in habitat use. Where raw data provided numbers that were not absolute (e.g., >200 or 100+), only the whole number (e.g., 200 or 100) was considered for mathematical and graphical purposes.

Using the 2015 field data and historical accounts, a fish summary was prepared that discussed Lake Koocanusa specific data and identified important habitats and interactions, particularly for sensitive or regionally significant species. Any confirmed habitat for sensitive species along the shoreline was included in the aquatic Habitat Index as an area of biological significance or Zone of Sensitivity (ZOS).

3.4.2 Wildlife Observations and Analysis

Wildlife assessments were completed at 13 sites during the July 10-16 and September 22-24, 2015 field visits (Appendix C). The assessment involved visual and acoustic identification of wildlife present, or signs of their presence, in the upland area, flying or on the water surface at each sample site. A general habitat assessment was also completed to document important habitat attributes, and comments were noted regarding anthropogenic impacts or relevant issues related to wildlife habitat.

A review of the BC Conservation Data Centre (BC CDC 2016) records was conducted to identify sensitive vegetation and wildlife species potentially in the area. Additional accounts for wildlife species closely associated with foreshore ecosystems are also provided. Any confirmed habitat for sensitive species along the shoreline was included in the Aquatic Habitat Index (AHI) as an area of biological significance or ZOS.

3.5 Aquatic Habitat Index (AHI)

The AHI estimates the environmental sensitivity or biological value of one shoreline segment relative to other shoreline segments on a waterbody. The index incorporates physical and biological data into a model which analyses and ranks each segment. For consistency and comparison between lake systems, the AHI methods and calculations used for Lake Koocanusa closely followed those used for Columbia Lake (McPherson, 2010) and those used for Windermere Lake (McPherson and Hlushak, 2008). Schleppe and Arsenault (2006) deserve special recognition for initially developing this complex matrix for Okanagan Lake. The AHI methods and calculations were originally developed for a lake foreshore environment, and although they may not fully represent the ecological values of a reservoir full pool shoreline, there is not currently enough scientific information to warrant changes to the AHI.

The AHI uses physical (FIM data) and biological variables to mathematically score each segment. The scores allow segments to be compared to one another, to determine their importance to fish or wildlife habitat. The index incorporates both positive habitat features such as natural areas that add to the habitat value of a segment, and negative habitat features such as marinas which decrease the habitat value. Parameter values were based upon their positive or negative contribution to aquatic habitat.

The index includes four categories of parameters:

1. Biophysical;
2. Zones of Sensitivity;
3. Vegetation; and
4. Modifications.

Table 1 summarizes the categories and parameters that were incorporated into the index and provides a summary of calculations and associated parameter values.

Table 1. Aquatic Habitat Index - Parameters, Weightings and Calculation Methods for Lake Koocanusa.

Category	Parameter	Maximum Point	Percent of the Category	Percent of the Total	Calculation	Value Categories
Biophysical	Shore Type	20	*33.9%*	*20.2%*	% of Segment x Shore Type Value	Stream Mouth = Wetland (20) > Gravel Beach = Rocky Shore (15) > Sand Beach = Cliff /Bluff (10), Other (5)
	Percentage Natural	15	*25.4%*	*15.2%*	% Natural x Natural Score	Natural Score (15)
	Substrate	10	*16.9%*	*10.1%*	% Substrate x Substrate Value	Cobble (10) > Gravel (8) > Boulder = Organic = Mud = Marl (6), Fines = Sands (4) > Bedrock (2)
	Aquatic Vegetation	8	*13.6%*	*8.1%*	% Aquatic Vegetation x Aquatic Vegetation Score	Aquatic Vegetation Score (8)
	Overhanging Vegetation	6	*10.2%*	*6.1%*	% Overhanging Vegetation x Overhanging Vegetation Score	Overhanging Vegetation Score (6)
Zones of Sensitivity	Aquatics	5	*33.3%*	*5.1%*	Present (5), Absent (0)	Present (5), Absent (0)
	Birds	5	*33.3%*	*5.1%*	Present (5), Absent (0)	Present (5), Absent (0)
	Unique Features	5	*33.3%*	*5.1%*	Present (5), Absent (0)	Present (5), Absent (0)
Vegetation	Band 1 - Full-Pool Vegetation	10	*40.0%*	*10.1%*	Vegetation Bandwidth Category x Vegetation Quality Category x Band 1 Score (10)	**Vegetation Bandwidth Category** 0 to 4.9 m (0.2) < 5 to 9.9 m (0.4) < 10 to 14.9 m (0.6) < 15 to 19.9 m (0.8) < 20 m (1)
	Band 2 - Drawdown Zone Vegetation	5	*20.0%*	*5.1%*	Present (5), Absent (0)	**Vegetation Quality Category** Wetland = Broadleaf = Shrubs (1) > Coniferous forest = Mixed forest (0.8) > Herbs/Grasses = Unvegetated (0.6) > Lawn = Landscaped = Row crops (0.3) > Exposed soil
	Veteran Trees	5	*20.0%*	*5.1%*	>25(5), 5-25 (3), <5(1), 0 (0)	>25(5), 5-25 (3), <5(1), 0 (0)
	Snags	5	*20.0%*	*5.1%*	>25(5), 5-25 (3), <5(1), 0 (0)	>25(5), 5-25 (3), <5(1), 0 (0)
Modifications	Retaining Wall	-3.5	*22.6%*	*-3.5%*	% Retaining Wall x (-5)	% Retaining Wall x (-5)
	Docks	-3	*19.4%*	*-3.0%*	# Docks x (-0.1)	# Docks x (-0.1)
	Boat Launch	-3	*19.4%*	*-3.0%*	# Launches x (-3)	# Launches x (-3)
	Marina	-6	*38.7%*	*-6.1%*	# of Marinas * (-2)	# of Marinas * (-2)

3.5.1 Biophysical Parameters

The determination of extent for each of the biophysical parameters is described in full in *Standard Methods for Completion of Foreshore Inventory and Mapping Projects* (Schleppe and Mason, 2009). The following section briefly describes the parameters in terms of how they contribute or detract from the habitat value of a shore segment.

Shore Type
Shore Type breaks the shore zone into distinct segments that correspond to the physical features of the land/water juncture. This parameter assumes that all shore types have similar physical features in their natural state and that habitat utilization by the different species is similar in identical shore types (e.g., the use of one sand beach by fish is similar to the use of a different sand beach in another area) (Schleppe and Arsenault 2006).

The Shore Type values were established in the earlier lake studies through detailed habitat specificity analyses using local data and literature reviews. The Okanagan Lake Shore Type scored each Shore Type according to fish usage. In the Windermere Lake analysis, although Shore Type scores were still based on fish values, the value of wetland habitat for values other than direct fish usage (e.g., primary productivity, wildlife and aquatic health) was identified as a unique parameter. The Moyie Lake study refined this step by incorporating the full spectrum of wetland values into the Shore Type score. Although the Shore Type Scoring has gone through an iterative development process from each lake study, the importance of each Shore Type has remained relatively constant.

For this study, the Shore Type Scores from Columbia Lake were used as a standard. This standard is considered applicable to Lake Koocanusa as it represents the most widely used categories for shore type. Stream mouths and wetlands were rated as having the highest values for fish and wildlife, followed by gravel beach and rocky shore. Sand beach, cliff/bluff and other (mainly grass/herb) habitats were valued the lowest.

Substrate Type
Lake bed substrates relate directly to lake productivity (Schleppe 2009). Many fish species depend on coarse substrate compositions for egg deposition (spawning) and for seeking cover from predators (rearing). Substrates also provide rooting areas for aquatic vegetation, foraging opportunities for benthic macro-invertebrate, and three-dimensional structure (Randall *et al.* 1996). Schleppe and Arsenault (2006) ranked substrate types based on life history requirements for different fish species. Their attributed substrate values have subsequently been accepted as standards for this and other lake assessments (Windermere and Moyie Lakes).

Percentage Natural
Natural shorelines have a high fisheries, wildlife and ecological value because they have few anthropogenic disturbances that can degrade habitat integrity (e.g., docks, transport infrastructure). This parameter is based on the assumption that natural areas typically function better and are more similar to historical ecosystems than highly disturbed shorelines. In an active hydroelectric reservoir such as Lake Koocanusa, the concept of natural shoreline is highly subjective as the shoreline has been significantly modified from its original state during the creation of the reservoir and is continuously remodelled through erosion resulting from artificial fluctuations in water levels. In the absence of science-based information to support a change in weighting for this parameter, the value used in this assessment follows the standard established at Moyie Lake, which was based on the Windermere and Okanagan Lake studies.

Aquatic Vegetation
All vegetation below the high water level is considered productive (Schleppe 2009). Aquatic plants provide fish and wildlife with food, spawning or nesting habitat, foraging substrates, and cover from sun and predators (Engel 1990). Schleppe and Patterson (2011) provided descriptions for the types of aquatic vegetation often observed along shorelines and have been directly quoted here (as shown in italics).

Emergent Vegetation generally refers to grasses, horsetail (Equisetum sp.), sedge, or other plants tolerant of flooding. Submergent Vegetation generally consists of native Potamogeton spp. and is considered aquatic vegetation that remains below the water surface for most of the growing season. Floating Vegetation generally consists of species such as native Potamogeton spp., pond lilies, and other types of vegetation that floats upon the water surface.

Overhanging Vegetation
Overhanging vegetation is a valuable component of the shoreline. Leaf litter, fallen branches/trees and associated insect drop provide food and habitat for aquatic organisms (Holmes pers comm.). Overhanging vegetation extent was calculated during the FIM field assessment and the AHI.

3.5.2 Zones of Sensitivity

Zones of sensitivity (ZOS) are areas of biological importance specific to Lake Koocanusa. ZOS are defined as being productive fish or wildlife areas. Supporting information for each of the ZOS is provided in the Results Section of this document (Section 4.1.5) and has also been summarized in Appendix A.

Aquatics
For this study, the Aquatics ZOS are areas below the high-water mark providing critical habitat for fish species to complete their life cycle. These ZOS mostly consist of shallow vegetated areas such as tributary inlets and vegetated flats on the margin of the lake. As water levels rise in spring and summer, mud flat areas with established terrestrial vegetation become inundated providing a suitable combination of shallow depth and abundant cover for rearing of fry and juvenile fish. Similar conditions are found in tributary inlets where stream water inflow also create a temperature refugia for cold-water species in summer. Tributary inlet are important migration corridors providing connectivity with critical tributary spawning habitat. These areas are particularly sensitive to disturbances from anthropogenic activities such as off-road vehicle use, construction activities below the high water mark, and artificial fluctuations in water levels. Aquatics ZOS also provide foraging opportunities for birds and other wildlife.

The Aquatics ZOS in Lake Koocanusa were broadly mapped, and based on findings from the fish and wildlife field assessments, literature review, and/or on professional opinion.

Birds
This ZOS is made up of existing approved WHAs for Long-billed Curlew (*Numenius americanus*) and Lewis's Woodpecker (*Melanerpes lewis*) that occur adjacent to the shoreline of Lake Koocanusa, along with identified Bank Swallow (*Riparia riparia*) nesting areas (Table 2).

Table 2. Nest site characteristics for bird species with identified Zone(s) of Sensitivity.

Species	Nesting Habitat Features	Koocanusa use	Reference
Long-billed Curlew	• Dry, short-grass grassland and pasture areas. • Often over-grazed pasture.	• May nest close to reservoir in suitable habitat. • May forage along shoreline	Ohanjanian 2001; Dugger and Dugger 2002
Lewis's Woodpecker	• Cavity nester in large diameter Ponderosa Pine or Trembling Aspen • Often in recent burns	• May nest close to reservoir, but not an obligate riparian species	Environment Canada 2014; Vierling et al. 2013.
Bank Swallow	• Colonial nester using "eroding, vertical banks composed of unconsolidated substrates (e.g., silty fine sands)" (COSEWIC 2013)	• Several known colonies in the study area as well as nearby (e.g. northeast of Wardner along Ft Steele – Wardner road.	COSEWIC 2013; Garrison 1999.

Lake Koocanusa is an important staging area for migrating birds including waterfowl, waders, shorebirds and others. Key areas are likely to be locations where birds can find shelter from winds and waves, in the lee of inlets or islands. Most, if not all, of these areas are recognized here as Aquatic ZOS.

Unique Features
Areas that have significant recreational and scenic value.

3.5.3 Vegetation Parameters

Band 1 (Full-Pool Vegetation) and Band 2 (Drawdown Zone Vegetation)
Vegetation adjacent to lakes is important for fish and wildlife habitat as described above for the Overhanging Vegetation parameter. It is also important for terrestrial wildlife species since it can incorporate important habitats such as grasslands and migration corridors. Vegetated shorelines help to reduce erosion through both soil stabilization and reducing the erosional energy of rainfall and wave action (Holmes pers. comm.).

The AHI considered the extent, score and quality of Band 1 and Band 2 individually for each segment. Following previous AHI calculations, Band 1 vegetation was weighted higher than Band 2 vegetation due to Band 1 being the primary shoreline vegetation.

Veteran Trees
Veteran Trees are trees that are considerably older than the rest of the forest they occur in (Schleppe, 2009). As a veteran tree deteriorates, it can support a variety of wildlife species, including birds, mammals and amphibians (BC Wildlife Tree Committee 2009). Wildlife trees provide several types of critical habitats including nest cavities and platforms, nurseries, dens, roosts, hunting perches, foraging sites and display stations (Backhouse 1993). Loss of this habitat is a concern for many dependant wildlife species and the most effective wildlife management practices is to retain wildlife trees (BC Wildlife Tree Committee 2009). High value wildlife trees take a long time to generate so maintaining those present is the preferred management option. Wide diameter trees are best and these are often centuries old. Dead trees are often removed for either aesthetic or safety reasons, as well as firewood collection.

Snags
A snag is a dead or damaged standing tree (Schleppe & Anderson, 2011). Snags provide increased structural diversity to an area (Schleppe, 2009). Similar to veteran trees, snags can also pose safety concerns, and are often removed as a result.

3.5.4 Habitat Modification Parameters

Schleppe and Arsenault (2006) provided detailed descriptions of the influences of habitat modification parameters on the shoreline habitats and have been directly quoted here (as shown in italics).

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 nearshore fish assemblages because they eliminate complex habitat features that function as critical prey refuge areas. 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. 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 for 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 over-water 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, 2001). Further, docks are known to create islands or bottlenecks in lake habitats, since they can modify predator/prey interactions which can cause fundamental shifts in the trophic structure of an ecosystem (J. Bisset pers. comm.).

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.

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. G*roynes are known to have significant impacts as docks on shoreline processes and fish. They concentrate fish, disrupt shoreline migration, and force juveniles into deeper waters away from refuge where they are easily predated upon (Mac Donald pers. comm.). Groynes are also built to provide protection from waves/prevailing winds, mooring boats or as erosion protection (Mac Donald pers. comm.). *Groynes also reduce the natural movement of substrates along the shoreline, which can increase the embeddedness of gravels. These structures are often considered a Harmful Alteration and Disruption of Fish Habitat (HADD) as defined under the federal Fisheries Act.*

Boat Launches

Boat launches were considered to be a negative parameter within the index. 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.

Marinas

Marinas are a concentration of boat slips, offering a place of safety to vessels. 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 associated activities, 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. Large marinas tend to have breakwaters, which affect lake processes and fish in a similar manner to groynes (B. MacDonald pers. comm.). Breakwaters impede shoreline migration and force juvenile fish to venture into deeper water making them subject to predation (B. MacDonald pers. comm.). The breakwaters further affect wave action, sediment scour, deposition and circulation. Dredging to maintain depth and access for boats is an additional significant impact on the foreshore (B. MacDonald pers. comm.). Other effects of marinas on the natural environment are that they tend to: have homogeneous substrates; concentrated hydrocarbon levels, alter water quality; provide a continuous disturbance to aquatic vegetation; and re-suspend sediments (J. Bisset pers. comm.). Each of these activities has the potential to alter benthic communities, possibly 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., increasing water turbidity, and reducing oxygen concentration, etc.

3.5.5 Index Ranking

Once the biophysical, ZOS, vegetation and modification scores were assigned for all parameters, the values were summated for each segment. The range of AHI lake values were divided into five equal categories - Very Low, Low, Moderate, High, and Very High. These categories are considered the **Current Ecological Value** of a shore Segment.

To investigate the potential for restoration, negative instream parameters were removed from the index and the index was re-run to determine the **Ecological Potential** of each segment.

4.0 RESULTS

4.1 Biophysical FIM Summary

In total, 179.6 km of foreshore was surveyed and divided into 57 contiguous segments. The segments ranged in length from 0.7 km to 11.5 km. Detailed descriptions of segments are located in Appendix A. Natural vs. disturbed areas, land use, foreshore type, substrate type, aquatic vegetation, ZOS, full-pool vegetation (Band 1), modifications along the foreshore and level of impact have been reviewed in detail in order to provide an inventory of the foreshore condition.

4.1.1 Land Use

Overall, results indicate that 72% of the foreshore is in a natural condition and that 28% has been disturbed (Table 3). Lake Koocanusa is an altered ecosystem; it was a riverine ecosystem and is now a reservoir ecosystem. The shoreline is considered to have stabilized over the past 43 years; therefore, it is considered natural at full-pool for the purposes of the FIM analysis (Mac Donald pers. Comm.). The land use types and their extent along the shoreline are depicted in Figure 2. The extent of disturbed and natural foreshore areas for the entire shoreline are provided in Figure 3. Figure 4 provides an example of a natural and disturbed shoreline found along Lake Koocanusa.

Table 3. Lake Koocanusa shoreline condition (natural vs. disturbed) and land use summary.

Foreshore		Length (km)	Total (%)
Total Shoreline	Natural	130	72
	Disturbed	50	28
Land Use Summary	Agriculture	11	6
	Commercial	7	4
	Conservation	0	0
	Forestry	107	60
	Industrial	3	2
	Institutional	0	0
	Multi Family	0	0
	Natural Area	16	9
	Park	6	3
	Recreation	13	7
	Rural	5	3
	Single Family	11	6
	Urban Park	0	0
Total Foreshore		180	100

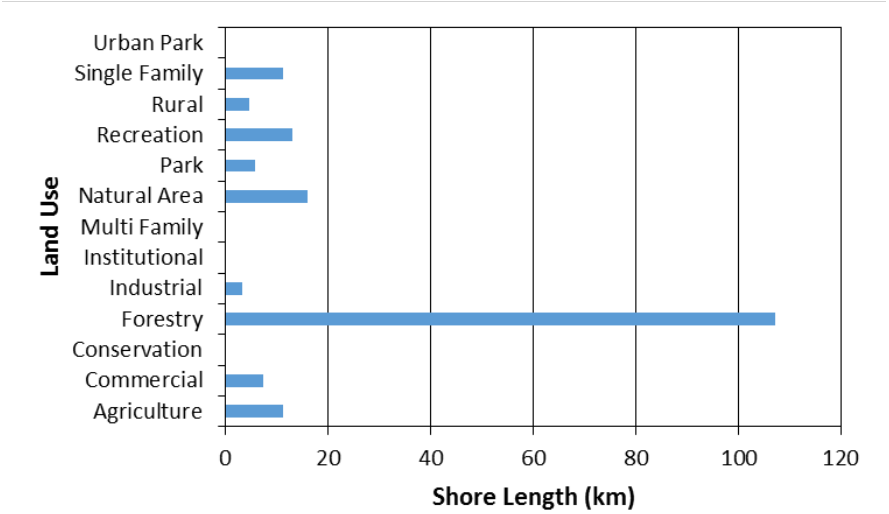


Figure 2. Land Use designation along the shoreline of Lake Koocanusa.

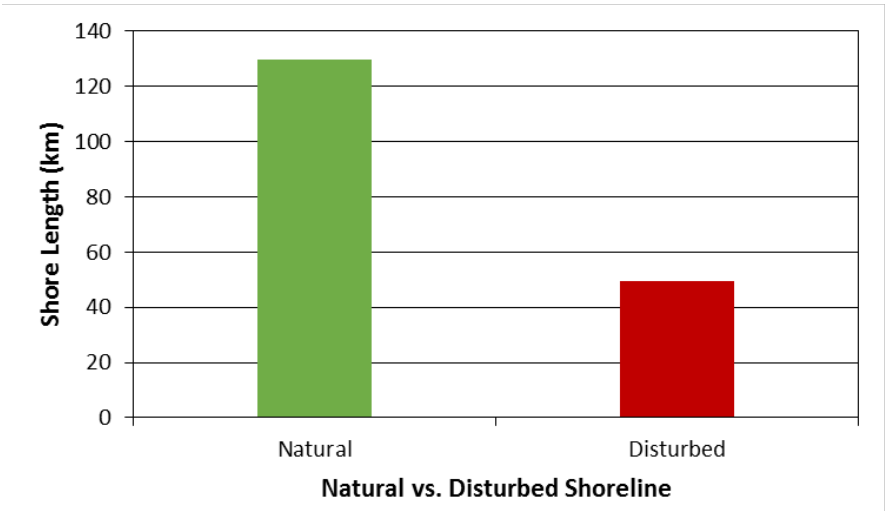


Figure 3. Extent of Natural and Disturbed shoreline along Lake Koocanusa.

Figure 4. An example of a natural shoreline (left photo) and disturbed shoreline (right photo). Photos by Heather Leschied (EKILMP), July 2015.

4.1.2 Shore Type

The foreshore of Lake Koocanusa is diverse consisting of cliff/bluff, rocky, gravel, sand, stream mouth, and other shore types. A breakdown of the lengths of each of these foreshore types along the perimeter of the lake is provided in Figure 5. The foreshore is primarily Gravel Beach Shore Type (64 km or 36% of the shoreline). Cliff/bluff and Sand Shore Types also make up substantial lengths of the shore (22% and 16% respectively), while Stream Mouth Shore Type makes up the smallest extent of foreshore (1%). Wetlands are not present along the foreshore. Figure 6 depicts the two dominant shorelines along Lake Koocanusa.

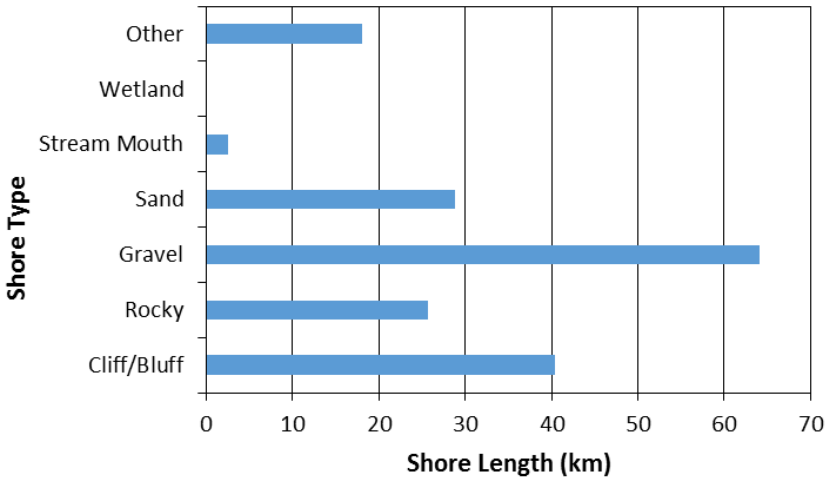


Figure 5. Total length of each Shore Type along Lake Koocanusa.

Figure 6. Gravel beach shore type (left photo) and Cliff/Bluff shore type (right photo). Photos taken by Heather Leschied (EKILMP), July 2015.

4.1.3 Substrate Type

The dominant lake substrate is gravel, which comprises 66 km (37%) of the shoreline, followed by sand (24%) and fines (16%). Fines including silt, mud and organic substrates were rare at full-pool, 749.5 m (2459 feet), but they were much more common at low-pool, and very productive (Mac Donald pers. comm.). Mud and organic substrates are least abundant along the shoreline (each making up 2% of the shoreline). A breakdown of the lengths of each of the substrate types along the perimeter of the lake is provided in Figure 7.

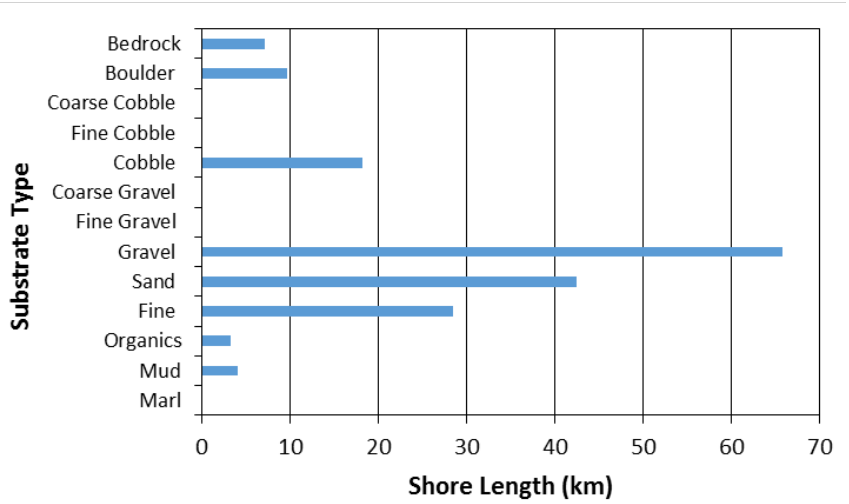


Figure 7. Substrate types observed along the foreshore of Lake Koocanusa.

4.1.4 Aquatic Vegetation

Aquatic vegetation describes the portion of the shoreline that comprises emergent, submergent, or floating vegetation (Schleppe and Mason, 2009). The dominant type of aquatic vegetation observed along the lake is emergent vegetation, comprising about 4.0% of the total shoreline (Figure 8). Submergent vegetation is less abundant representing only 0.2% of the shoreline. Floating vegetation was not observed along the shoreline. Figure 9 is an example of a segment that has emergent vegetation.

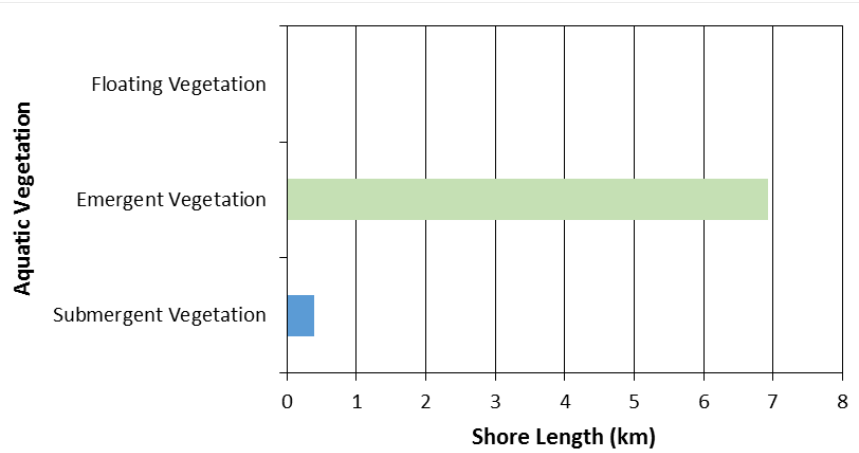


Figure 8. Aquatic Vegetation types along Lake Koocanusa.

Figure 9. Emergent vegetation along the shoreline of Segment 47. Photo by Heather Leschied (EKILMP), July 2015.

4.1.5 Zones of Sensitivity

The Zones of Sensitivity identified along Lake Koocanusa are listed in Table 4. The Zones of Sensitivity include Aquatics, Birds and Unique Features. Refer to the Shoreline Management Guidelines document (Appendix A – Map Series) for the locations of each ZOS.

Table 4. Zones of Sensitivity along Lake Koocanusa.

ZOS_ID	TYPE	COLOUR	RATIONALE
ZOS_02A	Aquatics	RED	Tributary mouth
ZOS_04A	Aquatics	RED	Shallow summer rearing habitat with submerged vegetation
ZOS_06B	Birds	RED	WHA (Lewis's Woodpecker)
ZOS_08B	Birds	RED	Bank Swallow nesting area
ZOS_09A	Aquatics	RED	Tributary mouth
ZOS_10A	Aquatics	RED	Shallow spring/summer rearing habitat with submerged vegetation
ZOS_10B	Birds	RED	WHA (Lewis's Woodpecker)
ZOS_12A	Aquatics	RED	Tributary mouth
ZOS_13A	Aquatics	RED	Shallow summer rearing habitat with submerged vegetation
ZOS_22A	Aquatics	RED	Tributary mouth and shallow vegetated bays providing summer rearing habitat
ZOS_25A	Aquatics	RED	Backwater channel providing juvenile rearing habitat
ZOS_27B	Birds	RED	WHA (Long-billed Curlew)
ZOS_30U	Unique Features	RED	Significant recreational and scenic value
ZOS_31B	Birds	RED	Bank Swallow nesting area
ZOS_32A	Aquatics	RED	Tributary mouth
ZOS_35A	Aquatics	RED	Tributary mouth
ZOS_37B	Birds	RED	Documented presence of nesting Long-billed Curlews
ZOS_43B	Birds	RED	WHA (Long-billed Curlew)
ZOS_47B	Birds	RED	Bank Swallow nesting area
ZOS_49A	Aquatics	RED	Tributary mouth
ZOS_52A	Aquatics	RED	Tributary mouth
ZOS_54A	Aquatics	RED	Shallow rocky beach providing summer rearing habitat
ZOS_54B	Birds	RED	WHA (Lewis's Woodpecker)
ZOS_56A	Aquatics	RED	Tributary mouth
ZOS_56B	Birds	RED	WHA (Lewis's Woodpecker)

4.1.6 Band 1 (Full-Pool Vegetation)

The dominant full-pool vegetation is coniferous forest (147 km; 82%), while unvegetated areas (0.9%) and broadleaf forests (0.6%) are less abundant (Figure 10). An example of coniferous forest vegetation is shown in Figure 11. Mature forest is the predominant full-pool vegetation stage of the lake, encompassing 127 km (71%) of the shoreline. Overhanging vegetation occurs in only about 2% (3 km) of the shoreline (Figure 12). Most of the shoreline has sparse shrub cover (114 km; 63%) and moderate tree cover (78 km; 43%).

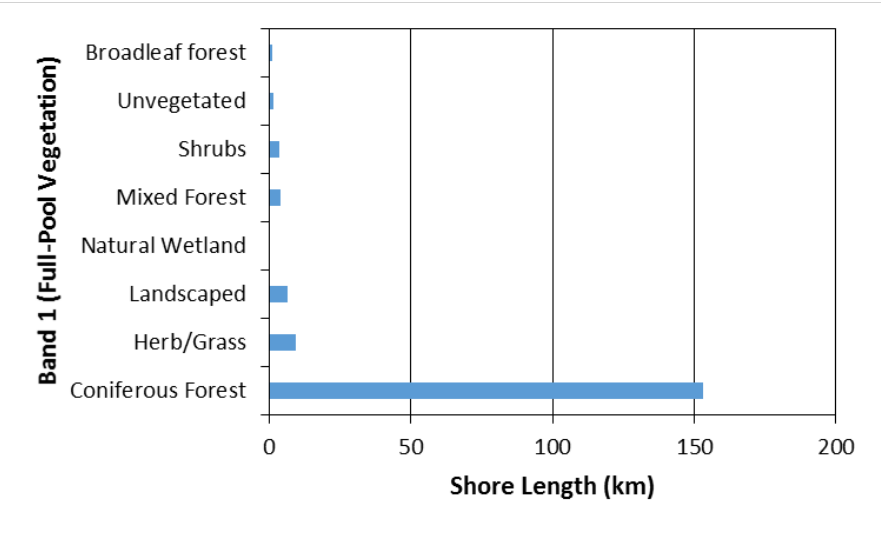


Figure 10. Full-Pool vegetation along the shoreline of Lake Koocanusa.

Figure 11. Coniferous forest vegetation along Segment 5. Photo by Heather Leschied (EKILMP), July 2015.

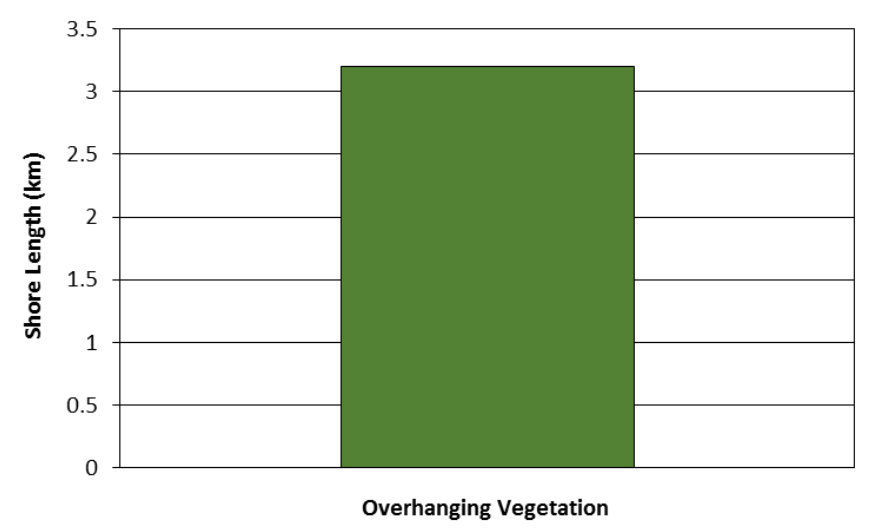


Figure 12. Total overhanging vegetation along Lake Koocanusa.

4.1.7 Shoreline Modifications

Lake Koocanusa shoreline modifications include retaining walls, docks, boat launches, and marinas (Figure 13). The most common form of shoreline modification are docks, with a total of 83 observed. Boat launches are the next most common type of modification with 36 recorded. Retaining walls and marinas also occur along the lake shoreline (22 and 9, respectively). There are no boat houses, groynes or marine railways along the lake shoreline. Figure 14 provides examples of shoreline modifications observed along Lake Koocanusa.

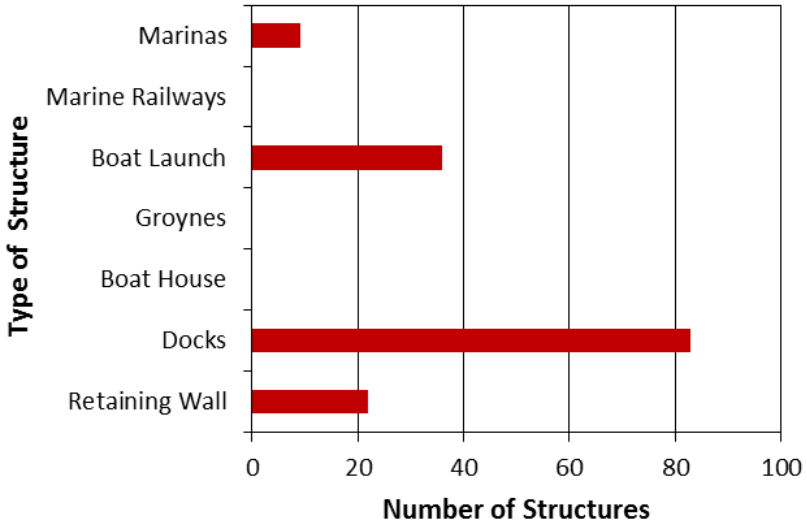


Figure 13. Number and type of modification structures along Lake Koocanusa.

Figure 14. Shoreline Modifications: a dock along Segment 44 (left photo) and a boat launch along Segment 38 (right photo). Photos by Heather Leschied (EKILMP), July 2015.

4.1.8 Level of Impact

Level of Impact (LoI) provides a qualitative indication of the overall health of the foreshore and considers the land use, level of disturbance, and modification information provided. Generally a High LoI refers to a segment with >40% alteration along its shoreline, a Moderate LoI is between 10 and 40% alteration, and a Low LoI segment is mainly natural with <10% alteration. Figure 15 provides a summary of the LoI ratings for Lake Koocanusa, and reveals that 28% (51 km) of the foreshore has a High LoI, 14% (25 km) has a Moderate LoI, 54% (97 km) has a Low LoI and 4% (7 km) has no level of disturbance.

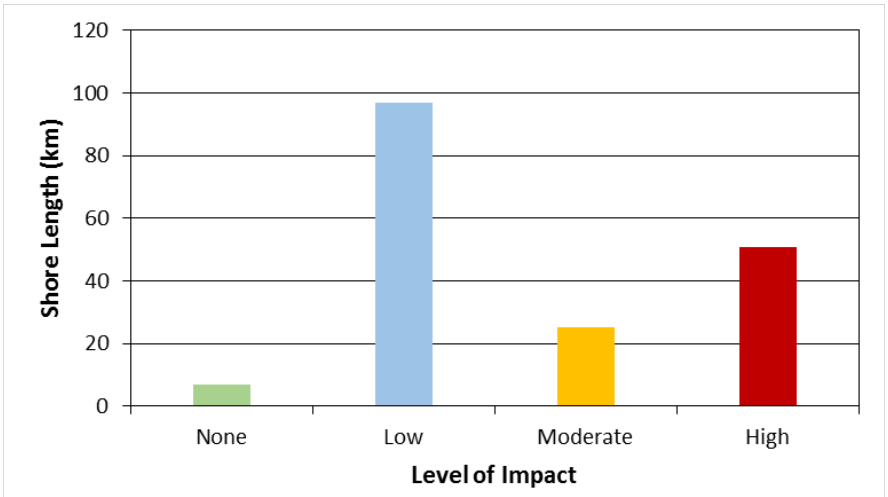


Figure 15. Level of impact along Lake Koocanusa.

4.2 Important Fish, Wildlife and Vegetation Resources

4.2.1 Fisheries

Lake Koocanusa provides a wide range of aquatic habitat. At full-pool, the Canadian portion of the lake is 65 km long and varies in width from 1,500 m near the US/Canada border to 700 m near the Kootenay River inlet. Maximum depth ranges from approximately 4 m near Wardner down to 35 m at the border. The lake's bathymetric profile is characterized by a flat bottom incised by deep trenches corresponding to the old river channel and side-channels. The bed material is dominated by sand, silt, and clay with occasional boulder and large woody debris. Water levels fluctuate over a range of 52.4 m in response to the Libby Dam operations resulting in significant seasonal changes in aquatic habitat. During the low water season (January through April) extensive drawdown areas appear along the shoreline and riverine conditions are restored between the Kootenay River near Wardner and the Kikomun Creek inlets. In extreme low water conditions, riverine conditions can extend south below the Gold Creek inlet. In the spring, rising water levels inundate drawdown areas creating shallow flats with submerged terrestrial vegetation, suitable for juvenile rearing and foraging of small-bodied fish. Bedrock and conglomerate cliffs are also present throughout the lake, along which steep slopes and deep-water habitat are more suitable for foraging of pelagic and large-bodied species. Tributary inlets provide significant habitat value, including temperature refugia, added cover from large woody debris and aquatic vegetation, and connection to tributary spawning habitat, attracting a wide variety of fish species and life stages. Important tributary inlets include the Kootenay River inlet to the North, the Kikomun Creek, Sand Creek and Elk River inlets to the East, and Gold, Plumbob and Linklater creek inlets on the West side of the lake.

The creation of Lake Koocanusa in 1972 resulted in a shift from fluvial to lacustrine conditions in the impounded section of the Upper Kootenay River. This shift had a significant impact on fish species relying on stream environments to complete their life cycle. Specifically, species assemblage was modified due to the loss of critical spawning, rearing, and foraging habitat originally found in the Kootenay River mainstem and its tributaries. A shift from riverine to lacustrine habitat was similarly responsible for a shift in food resources from aquatic macro-invertebrates to zooplankton. Slower stream flows, deep–water (pelagic) habitat, and increased water temperature created suitable conditions for some uncommon species to thrive (e.g., Peamouth Chub and Northern Pikeminnow) and for non-native species to establish (e.g., Kokanee, Rainbow Trout, and to a lesser extent Yellow Perch). Today, Lake Koocanusa supports a diverse fish community, including 11 native species and 6 introduced species (Table 5).

Table 5. Summary table of fish species occurring in Lake Koocanusa.

Common Name	Latin Name	Comment
Native Species		
Bull Trout	Salvelinus confluentus	Blue Listed species in BC
Burbot	Lota lota	Species of regional interest. Population severely depleted in Koocanusa
Largescale Sucker	Catostomus macrocheilus	
Longnose Dace	Rhinichtys falcatus	
Longnose Sucker	Catostomus catostomus	
Mountain Whitefish	Prosopium williamsoni	
Northern Pikeminnow	Ptychocheilus oregonensis	
Peamouth Chub	Mylocheilus caurinus	
Redside Shiner	Richardsonius balteatus	
Slimy Sculpin	Cottus cognatus	
Westslope Cutthroat Trout	Onchorhynchus clarki lewisi	Blue listed species in BC; Special Concern species under SARA.

Introduced species		
Brook Trout	Salvelinus fontinalis	Issue of hybridization with native Bull Trout
Kokanee	Oncorhynchus nerka	Most abundant sport fish in Koocanusa. Non-native species but high ecological and recreational value in the region.
Largemouth Bass	Micropterus salmoides	Invasive species causing increased predation on native species
Pumpkinseed	Lepomis gibbosus	Invasive species causing increased predation on native species
Rainbow Trout	Onchorhynchus mykiss	Issue of hybridization with native cutthroat
Yellow Perch	Perca flavenscens	Invasive species causing increased predation on native species

The lake supports an abundant Bull Trout (BT) population, a blue-listed species in BC. The population follows a lacustrine-adfluvial life history strategy in which adult fish spawn and juvenile fish subsequently rear, in tributary habitat before migrating downstream to the lake for rearing and feeding as sub-adult and adult fish. A total of 3 BT were observed at the Gold Creek inlet (site 52-1) as part of the SHIM fish sampling survey, but provincial records indicate that the species utilizes most tributary inlets across the lake including Kootenay River, Sand Creek, Plumbob Creek, Kikomun Creek, Elk River, and Gold Creek. Following a significant decline during the 1970's, the Koocanusa BT population abundance has been on an upward trend since the 1990's, likely in response to more restrictive angling regulations and the establishment of Kokanee in the lake which provides an additional food source for the population. Due to its migratory behaviour, the species is highly dependent on connectivity between lake and tributary habitats. As such, anthropogenic disturbances at or near tributary inlets on the lake can result in adverse effects to fish passage. Most significantly, the Elk River inlet provides a migratory corridor to the Wigwam River where the vast majority of Koocanusa BT congregate for spawning. An estimated 2,000 to 4,000 spawners follow this migration route each year to seek native spawning areas (Westover and Heidt, 2004). Subsequently, side-channel habitats in the inlet at low water likely provides shelter and foraging habitat to juvenile and sub-adult BT on their downstream migration to the lake. Koocanusa BT are also known to spawn in Gold, Plumbob and Linklater creeks, although in smaller numbers.

Westslope Cutthroat Trout (WCT) are present in a relatively low density in Lake Koocanusa, likely due to a low competitive advantage for the available food resource. No Cutthroat were captured during the 2015 field sampling program; the provincial fisheries database indicates that cutthroat distribution is restricted to forebay areas of most tributary inlets. Westslope Cutthroat Trout are blue-listed species in BC. The BC WCT population is also listed as Special Concern under the federal Species at Risk Act (SARA) indicating that the population may become threatened or endangered because of a combination of biological characteristics and identified threats. A management plan was developed by Department of Fisheries and Oceans Canada for the preservation of the BC population. Hybridization with non-native Rainbow Trout (RB) poses a significant threat to the species in the Upper Kootenay River drainage. Recent genetic surveys identified Koocanusa as a major source of hybridization for the St. Mary River and Lower Elk River WCT populations, likely as a result of extensive stocking of diploid RB in the lake in the 1980's (Lamson, 2016). From a habitat perspective, vegetation clearing of tributary inlets, cattle grazing, and large woody debris removal likely contribute to a loss of cover within the lake drawdown zone.

Originally introduced in the early 1980's, Kokanee have rapidly established and become a significant food source for other fish species such as BT. Kokanee are now the most abundant sportfish in Lake Koocanusa and are highly sought after by anglers during the summer months. Similarly to BT, Kokanee spawn in tributaries in the fall and rely on connectivity between lake and tributary habitats to complete their life cycle. Major spawning sites for Koocanusa

Kokanee include the Kootenay River mainstem (and tributaries upstream of the lake) and Sand Creek. An average spawning escapement of over 200,000 spawners has been reported in recent enumeration studies (Meunier, 2016). While some Kokanee populations in BC rely on shoreline habitat for spawning (e.g., Okanagan Lake), there is no evidence of such behaviour occurring in the Koocanusa population. Nevertheless, shoreline disturbances may be detrimental to newly hatched Kokanee fry, which likely depend on shallow habitat along the lake margins for concealment against predators during their early spring migration. Sub-adult and adult Kokanee occur in large schools in the limnetic zone, feeding mainly on zooplankton and small invertebrates and are likely less sensitive to shoreline disturbances than fry and juveniles. Despite their abundance, no Kokanee were captured as part of the SHIM field investigations.

Burbot is a species of special concern in the region, due to a significant decline in the population across the Kootenay River drainage as a result of over harvesting and hydroelectric development. Although the species is rarely found in rivers or lakes where water temperature exceed 18°C (McPhail, 2007), a self-sustaining Burbot population occurs in Lake Koocanusa, albeit in a relatively low density. The biology of the population is relatively unknown and spawning locations remain to be identified. In lakes, spawning typically occurs near shore in winter or early spring on substrate ranging from cobble to sand and silt. As a result, Burbot may be sensitive to shoreline and drawdown zone disturbances occurring on the lake, such as shoreline construction and mud bogging. Recent observations suggest that Burbot are present in the winter near the Elk River inlet; however, spawning was not confirmed (Robinson, 2013). No Burbot were captured as part of the SHIM fish sampling program.

Mountain Whitefish (MW) were recorded at most SHIM sampling locations and historical sampling sites across the lake. The species, typically found in fast flowing water, also occurs in BC lakes, but usually migrate to mainstem Kootenay River and its tributaries for spawning in early winter. Although there are no accounts of the Koocanusa MW population reproductive strategy, spawning likely occurs in most large tributaries across the lake (Ringstad and Oliver, 1979). Eggs typically incubate over winter and fry emerge in the spring or early summer. Consequently, MW fry may be susceptible to drawdown zone disturbances from anthropogenic activities occurring on the lake, such as mud bogging.

Cyprinid species occurring in Lake Koocanusa include Northern Pike Minnow, Peamouth, and Redside Shiner. They are ubiquitous in the lake and represent a significant food source for larger piscivorous fish. These three species share a number of similar life history traits: spawning typically occurs in the spring in tributary habitat or along shallow lake margins; Young-of-the-year, and juveniles are particularly dependent on vegetated shoreline habitat for cover against predators as well as foraging. Consequently, these species can be sensitive to disturbances along the shoreline such as vegetation clearing, bank erosion, and off-road vehicle use. Cyprinid species were the most abundant species captured as part of the SHIM field program and were found in nearly all sampling locations.

Suckers were the second most abundant species caught during the SHIM field investigations. Both Longnose Sucker and Largescale Sucker are found in the lake. Both species typically spawn in shallow habitat along shoreline margins over coarse substrate. Similarly to cyprinids, young-of-the-year suckers dependent on shallow, vegetated areas for rearing, and consequently are sensitive to anthropogenic disturbances along the lake shoreline.

Yellow Perch (YP), a non-native species to the Kootenay River drainage was found at four sampling locations across Lake Koocanusa during the SHIM field program. Records from the provincial fisheries database indicate that the species is widespread in the lake, particularly at tributary inlets and along shoreline margins. YP pose a conservation concern for native species due to its fast breeding rate, resulting in increased predation on native fish eggs and fry and increased competition for resources.

Although Eastern Brook Trout (EB) were not recorded as part of the SHIM field survey, the species is found in Lake Koocanusa particularly near tributary inlets. EB were introduced in the region at the beginning of the century and

are now widespread. The species presents a significant threat to native trout, particularly BT with which it hybridizes.

4.2.2 Wildlife

Lake Koocanusa and its adjacent shoreline vegetation support a wide variety of wildlife. Southern portions of the lake's Canadian reach occurs in the Kootenay variant dry, hot Ponderosa Pine Biogeoclimatic subzone (PPdh2), while north of approximately the Kikomun bridge, surrounding uplands transition to the Kootenay dry, mild Interior Douglas Fir subzone variant (IDFdm2). The southern PPdh2 lands are typical grasslands and open forests of mature ponderosa pine with interior Douglas-fir, western larch and lodgepole pine. Shrub and grassland communities are common. Northern reaches in the IDFdm2 are typically more closed forest stands of Douglas-fir as well as ponderosa pine, western larch and lodgepole pine. In both subzones, copses of trembling aspen may occur in wetter areas.

Key habitat features for wildlife associated with Lake Koocanusa include silt bluffs, emergent vegetation beds and rock islands (Table 6). These features provide a wide variety of ecological services including foraging habitats, nesting / breeding grounds and shelter.

Table 6. Important wildlife habitat features at Lake Koocanusa.

Habitat Feature	Importance
Silt bluffs	Nesting sites for Bank Swallow, Kingfisher and other species
Emergent vegetation beds	Biologically productive areas for aquatic invertebrates, provide foraging sites for waterbirds (e.g. heron, dabbling ducks, shorebirds); refugia from waves for many species; nesting sites for some birds (e.g. Red-winged Blackbird)
Bays and inlets	Important for waterfowl. Staging areas for migrating water birds (waterfowl, shorebirds, waders, etc.). Koocanusa's mostly exposed shorelines offer little refuge to birds from wind and waves. Bays (e.g. Gold Bay, Kragmont) are therefore important. Many of these are associated with contributing river/creek mouths which offer increased biological production and foraging opportunities for aquatic birds and mammals (e.g. river otter).
Fish populations	Food for picsivorous species including Osprey, mergansers, Common Loon, grebes,
Rock Islands	Nesting sites for gulls, geese and some other species
Wildlife trees	Dead or dying trees close to shoreline that provide structure for nesting habitat (e.g. cavities, stick nests)
Forest Cover	Particularly in areas south of the Kikomun bridge where there is minimal mature forest cover, cover to foreshore areas is limiting to many species seeking shade, protection, thermal cover in winter and other aspects of mature forest cover.

During field assessments of the Lake Koocanusa shoreline, wildlife observations were recorded by the field crew. Approximately 369 recordings were made of at least 11 species. Many waterfowl species (ducks and grebes) were not classified to species. "Gulls" recorded may have been Ring-billed Gulls (*Larus delawarensis*) which is the most frequently recorded gull on Koocanusa or some of the other gulls known to occur on Koocanusa, including Herring (*L. argentus*), California (*L. californicus*) and Bonaparte's (*Chroicocephalus philadelphia*) (eBird 2016). Ring-billed Gulls are the only species documented to possibly breed in the Koocanusa region (Davidson et al. 2015). Most likely breeding sites based on suitable habitat is the Kikomun bridge and islands in Segment 30.

Anecdotal information on wildlife observations and habitat features is presented for 13 of the 57 shoreline segments (Appendix C). These data were collected during July and September surveys of the reservoir. Findings of interest include a large number of ducks and geese at Waldo Cove / Kragmont (Segment 42). These were likely

southbound migrating birds, indicating the value of Koocanusa as staging habitat and the importance of bays and inlets for sheltering these water birds and/or providing nutrient / forage rich feeding sites.

Numerous waterfowl species use Lake Koocanusa, including ducks, geese, grebes, loons and others. Most use is likely to be foraging as the general lack of emergent vegetation and other cover restricts breeding opportunities. Some species may nest in nearby smaller lakes, ponds and wetlands. Their use of the lake is likely for foraging, particularly piscivorous species such as grebes, mergansers and Common Loon (*Gavia immer*). Many species occur at Koocanusa only in migration (both spring and fall), using the lake for staging. Cavity-nesting waterfowl (e.g. Goldeneyes [*Bucephala* spp.], Wood Duck [*Aix sponsa*] and Hooded Merganser [*Lophodytes cucullatus*]) may nest in wildlife trees in riparian areas adjacent to the lake, though these are likely only in deeper bays and similar areas, not along the main, exposed shoreline. Example segments may include: 12, 35 and 57.

Lake Koocanusa provides important staging habitat for many migrating water birds and shorebirds. Northbound migration occurs from mid-April through mid-May for most of these species. Southbound migration begins by mid-August for many shorebirds (sandpipers, plovers, dowitchers, etc.) and extends well into the fall for grebes and others. The resources and habitats available on the lake make the lake and important stop-over for these species. Few shorebirds likely nest close to Koocanusa. Species that may breed close to its shores include Spotted Sandpiper (*Actitis macularia*), Killdeer (*Charandrius vociferous*) and Long-billed Curlew (*Numenius americanus*). Only Spotted Sandpiper restricts its nesting to within a few metres of water, the other two shorebirds frequently nest well removed from shorelines. Western Grebes (*Aechmophorus occidentalis*) use Koocanusa most years as a staging area during migration for rest and foraging. Other regionally rare species, including American White Pelican (*Pelecanus erythrorhynchos*), Double-crested Cormorant (*Phalacrocorax auritus*) and American Avocet (*Recurvirostra americana*), are known from the lake as well.

Raptors utilizing Koocanusa include Bald Eagle (*Haliaeetus leucocephalus*) and Osprey (*Pandion haliaetus*). Both are primarily piscivorus, feeding on the fish resources of the lake. Both are also known to nest in the area, repeatedly utilizing the stick nests year-over-year in large wildlife trees close to the water. Eagle and osprey nests are protected year-round (regardless of whether they are active) by the *Wildlife Act* (s.34b). Numerous other raptors may occur at Koocanusa, but they are primarily terrestrial birds. A list of bird species recorded at Koocanusa from eBird (2016) is provided in Appendix D.

Upland wildlife that utilize the foreshore include elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*) and white-tailed deer (*O. virginianus*), a large number of songbirds (warblers, sparrows, flycatchers, etc.), small mammals (mice, voles, shrews) and several invertebrates including butterflies, moths, dragonflies and damselflies. For most of these species, a well-established riparian area is essential to provide cover and food opportunities. The extensive draw-down zone that characterizes the lake greatly reduces the ecological value of the lake's shoreline area as wildlife habitat. Therefore, in areas where this cover does occur it is especially important.

The extent to which aquatic mammals utilize Lake Koocanusa is unknown. Species may include: beaver (*Castor canadensis*), river otter (*Lontra canadensis*), mink (*Neovison vison*) and muskrat (*Ondontra zibethica*). Most of these species are more associated with wetland / pond habitats (beaver, muskrat) or riverine habitats (mink). River otters travel more widely and may be expected to make use of estuary type habitats in the vicinity of river mouths (e.g. Englishman and Sand Creeks) or wherever suitable small fish communities occur. The fluctuating lake levels likely rule out the reservoir as preferred or even suitable habitat for beavers.

Many of the larger species are known to cross the lake regardless of season. Mule deer readily cross the lake (I. Adams unpubl. data) and species such as American badger (*Taxidea taxus*) and bears (*Ursus* spp.) can be expected to readily swim across the lake. However, most large mammal movements are likely north-south on one side of the lake or the other.

Species at Risk

A search for listed species occurring in the Koocanusa area was conducted using the BC Conservation Data Centre's online Species and Ecosystem Explorer tool (BC CDC 2016). The search parameters were for all vertebrate and invertebrate species in the Rocky Mountain Forest District occurring in the PP and IDF Biogeoclimatic zones. This search returned approximately 100 species listed by the Conservation Data Centre (CDC) and/or federal Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Listed species known to occur at Koocanusa but not captured by the data search (e.g. Bank Swallow [*Riparia riparia*] and American White Pelican [*Pelecanus erythrorhynchos*]) were added. This list was reduced to 22 species based on expert knowledge of species using the area and available data from sources including eBird (2016), BC Breeding Bird Atlas (Davidson et al. 2015) and other records available from the CDC (Table 7).

The majority of these species are not obligate riparian or water species, but utilize the upland areas around the lake. Their regular movements and habitat use may bring them in contact with the Koocanusa foreshore and activities or developments around the lake will affect their habitat availability and quality.

Numerous listed bird species are particularly of interest at Koocanusa.

1. There are numerous Bank Swallow colonies in the silt cliffs that occur in several locations. This species has suffered significant declines, though in BC it is still considered not at risk provincially. Protection of the cliffs themselves and low disturbance during breeding season (May through July) is important where they occur.

2. Lewis's Woodpecker (*Melanerpes lewis*) is known to nest close to Lake Koocanusa in many areas (Environment Canada 2014). Both proposed Critical Habitat (under federal *Species at Risk Act*) and approved Wildlife Habitat Areas (under provincial *Forest and Range Protection Act*) occur along the Lake Koocanusa shoreline, particularly in the southern reaches. Although Lewis's Woodpecker is not considered strictly a riparian species, they do frequently nest close to water (Environment Canada 2014). Maintaining veteran and wildlife trees, particularly ponderosa pine and trembling aspen, is important to maintain nesting options for this species.

3. Long-billed Curlews are the largest shorebird in North America. Despite being a "shorebird" they nest in upland grassland areas, frequently well removed from water sources (Environment Canada 2013). If curlews nest below full-pool water level, their nest is at risk of being inundated prior to fledging. Two approved Wildlife Habitat Areas (WHA) designated for Long-billed Curlews occur along the Lake Koocanusa shoreline. One at the north end of the lake across from Wardner (Segment 26), the other at Kragmont (Segments 40-43). Curlews were also observed at Segment 37 which will be proposed as a WHA (P. Holmes pers. comm.). Though most feeding during the breeding season occurs near the nest in upland areas (Dugger and Dugger 2002), curlews will readily use foreshore mudflat areas when nearby.

Table 7. Provincial and/or Federally listed species at risk that are known to occur, or may occur, at Lake Koocanusa. Species include only those that regularly occur on/in the water or in adjacent shoreline vegetation areas. Occurrence documents probability of species occurring on/in Lake Koocanusa or its foreshore ecosystems.

English Name	Scientific Name	Occurrence	COSEWIC[1]	BC List	SARA[3]	MBCA[2]	Identified Wildlife	Notes
Western Toad	*Anaxyrus boreas*	Confirmed	SC (Nov 2012)	Blue	1-SC (Jan 2005)	na		Unlikely to breed in Koocanusa, probable riparian occurrences
Great Blue Heron, *herodias* subspecies	*Ardea herodias herodias*	Confirmed		Blue		Y	Y (Jun 2006)	Forages along shoreline
Long-billed Curlew	*Numenius americanus*	Confirmed	SC (May 2011)	Blue	1-SC (Jan 2005)	Y	Y (May 2004)	WHA and other known areas; use of foreshore unclear.
Bank Swallow	*Riparia riparia*	Confirmed	T (Apr 2013)	Yellow		Y		Known nesting at Koocanusa; forages over water
Lewis's Woodpecker	*Melanerpes lewis*	Confirmed	T (Apr 2010)	Blue	1-T (Jul 2012)	Y	Y (May 2004)	Not riparian obligate but may occur close to lake
American Badger	*Taxida taxus*	Confirmed	E (Nov 2012)	Red	1-E (Jun 2003)	na	Y (May 2004)	Known from area but not riparian obligate; capable of swimming across lake
Common Nighthawk	*Chordeiles minor*	Confirmed	T (Apr 2007)	Yellow	1-T (Feb 2010)	Y		Known from area, but more upland associated; may forage over water
Little Brown Myotis	*Myotis lucifugus*	Probable	E (Nov 2013)	Yellow	1-E (Dec 2014)	na		Riparian associated but not obligate
Barn Swallow	*Hirundo rustica*	Probable	T (May 2011)	Blue		Y		Known from area, but more upland associated; may forage over water
Townsend's Big-eared Bat	*Corynorhinus townsendii*	Possible		Blue		na		Possible in riparian
Northern Rubber Boa	*Charina bottae*	Possible	SC (Apr 2016)	Yellow	1-SC (Jan 2005)	na		Possible in riparian
Aphrodite Fritillary, *whitehousei* subspecies	*Speyeria aphrodite whitehousei*	Possible		Blue		na		Higher elevations
Tawny-edged Skipper, *themistocles* subspecies	*Polites themistocles themistocles*	Possible		Blue		na		
Checkered Skipper	*Pyrgus communis*	Possible		Blue		na		
Eastern Tailed Blue	*Cupido comyntas*	Possible		Blue		na		
Pronghorn Clubtail	*Gomphus graslinellus*	Possible		Blue		na		Lays eggs in wave-washed sand beaches. Known from Wasa Lake

Western Grebe	*Aechmophorus occidentalis*	Confirmed in Migration	SC (May 2014)	Red		Y		Stages on Koocanusa most years
Horned Grebe	*Podiceps auritus*	Confirmed in Migration	SC (Apr 2009)	Yellow		Y		
Eared Grebe	*Plethodon idahoensis*	Possible in Migration	SC (Nov 2007)	Yellow		Y	Y (May 2004)	
Sandhill Crane	*Antigone canadensis*	Confirmed in Migration	NAR (May 1979)	Yellow		Y	Y (Jun 2006)	
American Avocet	*Recurvirostra americana*	Confirmed in Migration		Blue		Y		
American White Pelican	*Pelecanus erythrorhynchos*	Confirmed in Migration		Red		N	Y (Jun 2006)	Rare migrant

[1] Committee on the Status of Endangered Wildlife in Canada, E = Endangered, T = Threatened, SC = Special Concern, date in parentheses is when most recent assessment occurred.

[2] Bird species protected by federal *Migratory Birds Convention Act 1994.*

[3] Species listed on Schedule 1 of Federal *Species at Risk Act*, E = Endangered, T = Threatened, SC = Special Concern, date in parentheses is when species was added to Schedule 1.

4.2.3 Plants

The BC CDC plant species list (Table 8) for the Interior Douglas Fir – dry mild (IDFdm2) and Ponderosa Pine – dry hot (PPdh2) biogeoclimatic zones indicates that there are 15 plant species that potentially occur in the Lake Koocanusa area. All of these species are provincially red-listed meaning they are considered extirpated, endangered or threatened in BC (BC CDC 2016).

Table 8. Red-listed plant species at risk that are known to occur, or may occur, at Lake Koocanusa.

English Name	Scientific Name	Probability	COSEWIC	BC List	SARA	Habitat Subtype	Reported Occurrence
Spalding's campion	*Silene spaldingii*	High	E (May 2005)	Red	1-E (Aug 2006)	Grassland	Rooseville in open PP
hairstem groundsmoke	*Gayophytum ramosissimum*	High		Red		Sagebrush Steppe; Conifer Forest - Dry	
mock-pennyroyal	*Hedeoma hispida*	High		Red		Meadow; Grassland; Conifer Forest - Dry	Kikomun Cr. Provincial Park, 9 km S of Elko in open PP habitat
little bluestem	*Schizachyrium scoparium*	High		Red		Grassland	Kikomun Cr. Provincial Park, North of Park along Kikomun Cr.
racemed groundsmoke	*Gayophytum racemosum*	Medium		Red		Vernal Pools/Seasonal Seeps; Grassland; Conifer Forest - Dry	
prairie gentian	*Gentiana affinis*	Medium		Red		Meadow; Grassland; Conifer Forest - Dry	
pinewood peavine	*Lathyrus lanszwertii* var. *sandbergii*	Medium		Red		Conifer Forest - Mesic (average);Conifer Forest - Dry	17.6 km S of Elko in open lodge pole pine
smooth goosefoot	*Chenopodium subglabrum*	Low	T (Apr 2006)	Red		Grassland; Sagebrush Steppe; Sand Dune	
scarlet gaura	*Gaura coccinea*	Low		Red		Grassland; Sagebrush Steppe	
Nuttall's sunflower	*Helianthus nuttallii* ssp. *rydbergii*	Low		Red		Marsh; Meadow; Grassland; Urban/Suburban	
spurred lupine	*Lupinus arbustus* ssp. *neolaxiflorus*	Low		Red		Meadow; Sagebrush Steppe; Conifer Forest - Dry	

Montana lupine	*Lupinus arbustus* ssp. *pseudoparviflorus*	Low		Red		Grassland; Sagebrush Steppe; Conifer Forest - Dry	
pale bulrush	*Scirpus pallidus*	Low		Red		Marsh; Riparian Herbaceous	
long-leaved aster	*Symphyotrichum ascendens*	Low		Red		Meadow; Grassland; Sagebrush Steppe	
Hooker's townsendia	*Townsendia hookeri*	Low		Red		Grassland	

4.3 Aquatic Habitat Index Results

The Current Ecological Value determined through the AHI for each segment are depicted in the Shoreline Management Guidelines document (Appendix A – Map Series). Table 9 summarizes the results by breaking down the Current Ecological Value for the shoreline based on the segments. Figure 16 portrays the Current Ecological Value rankings for the shoreline. The rankings for each segment can be found in Appendix E.

The AHI results for Lake Koocanusa reveal that the majority of the shoreline has a High (41%; 73.0 km), Very High (23%; 40.9 km) or Moderate (24%; 43.3 km) Current Ecological Value. Areas that are ranked as High or Very High typically include segments that have little disturbance and are important habitat areas for fish and wildlife. The Low and Very Low ranked segments are disturbed, therefore generally have lower values for fish and wildlife.

Table 9. AHI analysis results for the Current Ecological Values of the shoreline.

Ecological Value	Current Ecological Value		
	Total Segments	Total Shoreline Length	
		(%)	(km)
Very High	10	23	40.9
High	21	41	73.0
Moderate	17	24	43.3
Low	4	6	11.4
Very Low	5	6	11.0
			179.6

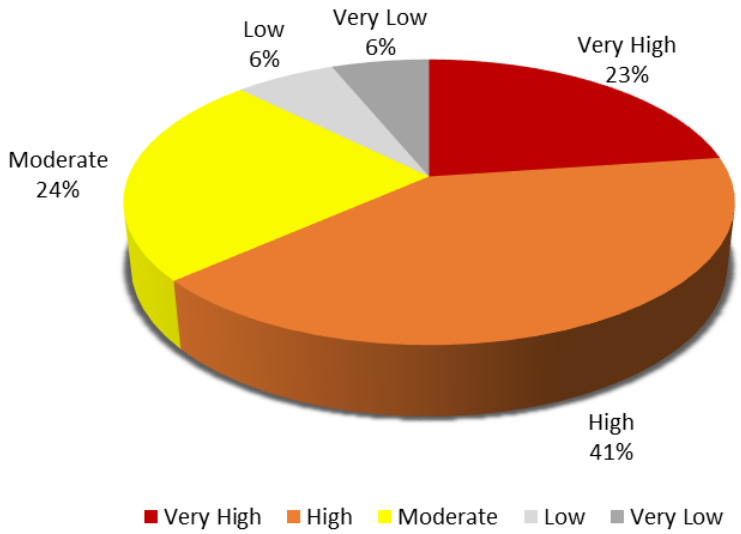


Figure 16. Current Ecological Value rankings and associated percentage (%) of shoreline.

5.0 CONCLUSION

Over 45 years after the construction of the Libby Dam and the impoundment of the Kootenay River below Wardner, BC, the shoreline of Lake Koocanusa now supports a diverse and abundant fish and wildlife community, relying on the reservoir's habitat to complete its life cycle. Habitat conditions along the foreshore of the reservoir are highly dependent on annual and inter-annual fluctuations in water levels, resulting from the operation of the Libby Dam. Consequently, additional impacts from anthropogenic activities in the area can pose a significant threat to the long-term survival of local fish and wildlife populations. Conservation of ecosystem functions along the Lake Koocanusa foreshore is critical to maintain the environmental, social, aboriginal, and economic values of the area.

Results of the FIM study showed that approximately 72% (130 km) of Lake Koocanusa's foreshore is in natural condition and 28% (50 km) is disturbed. AHI results reveal that of the 57 shoreline segments, 64% have high to very high ecological value while 36% have moderate to very low value. Shoreline segments with very high ecological value generally included an aquatics and/or birds ZOS.

These results were used to develop the Lake Koocanusa Shoreline Management Guidelines document. These Guidelines provide a decision-making framework for regulatory agencies and proponents of future development projects, to ensure responsible development and guaranty the long-term sustainability of the Lake Koocanusa foreshore ecosystem.

6.0 RECOMMENDATIONS

The shortfalls of the FIM standards, originally developed for natural lakes, to assess shoreline and drawdown conditions in a reservoir presented significant challenges for the completion of this study. The following section provides recommendations to help improve upon the results of the present study. A modified FIM standards specific to reservoirs would help to further understand and protect the natural integrity of Lake Koocanusa. Some of the recommendations below are similar to those recommended in previous FIM reports, and credit should be given to the original authors.

1. **Creation of Data Dictionary and Standard Methods for Completion of Foreshore Inventory and Mapping Projects for reservoirs.**
    - A new data dictionary specific to reservoirs should also be considered.
2. **Acquire orthophotos and LiDAR data for the entire lake at full and low-pool.**
    - There is currently no single orthomosaic of one lineage that covers the spatial extent of Lake Koocanusa in Canada.
    - This data can be used to more accurately delineate the Biologically Productive Areas that occur within the Drawdown Zone.
    - This data can be used to generate a precise elevation model from which contours can be derived (including full-pool) which could provide a more accurate shoreline.
    - This data can be used to produce a bathymetric map of Lake Koocanusa, which currently does not exist.
3. **Revise field assessments at Wardner (S 24 -27) and make upgrades to the SHIM.**
    - The assessments of these 4 segments were not done in detail due to accessibility/equipment problems.
4. **Conduct inventories to determine the current status of sensitive species and habitats associated with the foreshore.**
    - Conduct field verification of the broadly mapped ZOS.
    - Conduct additional species and habitat inventories (e.g., fish, reptiles, amphibians, birds, mammals and plants) in identified ZOS, to identify whether listed "at risk" or "sensitive" species or ecosystems are present.

- Complete a Wildlife Tree Assessment for the foreshore and protect wildlife trees during development, where safely possible.

5. **Complete sensitive habitat inventory and mapping (SHIM) for the major tributaries that feed into Lake Koocanusa.**
6. **Develop a Lake Management Plan and Incorporate Shoreline Management Guidelines into existing OCPs and future zoning bylaws.**
    - An outline of joint community/agency objectives, established through open houses and surveys;
    - Environmental protection regulations and guidelines for new development, re-development and management of existing developments; and
    - Determination of carrying capacity of foreshore modifications and activities.
7. **Educate developers and property owners on the foreshore values.**
    - Prepare an educational program for developers and existing lakeshore owners and users. This will assist stakeholders to: 1) understand the value of retaining natural foreshore features, 2) ensure existing sewage systems are properly operated and maintained, 3) develop lots in a way that minimizes impact on the environment and 4) understand the economic value inherent in protecting the ecological integrity of the lake.
    - Establish education panels at all boat launches.
    - Marina to establish a code of practice to reduce potential for pollutant and invasive species introduction.
    - Monitor and enforce boating regulations
8. **Identify significant erosion areas in the DDZ**.
    - Develop a plan to address or alleviate erosion where feasible.
9. **ROV and Recreational Use.**
    - Conduct a detailed assessment of the impacts of mud bogging and ORV use on the drawdown zone on fish and wildlife habitats to inform the Koocanusa Recreation Management Strategy (http://www.koocanusarecreation.ca./images/documents/Koocanusa-Recreation-Strategy-2017.pdf). ORV use should not be permitted in tributary mouths**.** Sections of Segment 21 and 22 (mud bog areas) should be inspected by ground to determine the level of impact particularly in vegetated, wetted areas and tributaries.
10. **Fisheries enhancements.**
    - Funds should be acquired to study the ecology of the reservoir, investigate potential fisheries enhancement opportunities and develop or restore habitats. Examples may include wetland development in tributary inlets or shallow bays; spawning habitat improvement in Linklater, Sand, Kikomun, Elk or other tributaries; reservoir fertilization.
11. **Wildlife habitat enhancements.**
    - Investigate habitat restoration opportunities particularly in degraded habitats, tributaries (spawning habitat, revegetation) and ZOS. Consider wetland developments in appropriate areas (shallow bays, lower tributaries) to increase breeding and forage area for wildlife. One example could be the outlet of Gold Creek where a perched wetland (for high-pool) could be engineered in the bay with a partial diversion of Gold Creek. Funding could be acquired from compensation from industrial activities in the area (Teck Coal, Army Corps of Engineers, etc.).

7.0 REFERENCES

Backhouse, F. 1993. Wildlife Tree Management in British Columbia. An initiative of the Wildlife Tree Committee of BC. Government of Canada and Province of BC.

BC Conservation Data Centre. 2016. BC Species and Ecosystems Explorer. B.C. Ministry of Environment. Retrieved: http://a100.gov.bc.ca/pub/eswp/

BC Wildlife Tree Committee. 2009. BC Ministry of Forests and Range. Retrieved: http://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-habitat-management/wildlife-tree-committee

Carrasquero, J. 2001. Overwater Structures: Freshwater Issues. Prepared by Herrera Environmental Consultants. Prepared for Washington Department of Fish and Wildlife.

COSEWIC. 2013. COSEWIC assessment and status report on the Bank Swallow *Riparia riparia* in Canada.

Committee on the Status of Endangered Wildlife in Canada. Ottawa.

Davidson, P.J.A., R.J. Cannings, A.R. Couturier, D. Lepage, and C.M. Di Corrado (eds.). 2015. The Atlas of the Breeding Birds of British Columbia, 2008-2012. Bird Studies Canada, Delta, B.C. Available: http://www.birdatlas.bc.ca/e

Dugger, B. D. and K. M. Dugger. 2002. Long-billed Curlew (*Numenius americanus*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/lobcur (subscription required)

East Kootenay Integrated Lake Management Partnership (EKILPM). 2006. Terms of Reference to the East Kootenay Integrated Lake Management Partnership. Draft Version 1.2.

East Kootenay Integrated Lake Management Partnership (EKILPM). n.d. Retrieved: http://www.ekilmp.com/about-us.html

eBird. 2016. eBird: An online database of bird distribution and abundance [web application]. eBird, Ithaca, New York. Available: http://www.ebird.org

Engel, S. 1990. Ecosystem Responses to Growth and Control of Submerged Macrophytes: a Literature Review. Wisconsin Department of Natural Resources, Technical Bulletin 170, Madison.

Environment Canada. 2013. Management Plan for the Long-billed Curlew (*Numenius americanus*) in Canada. *Species at Risk Act* Management Plan Series. Environment Canada, Ottawa.

Environment Canada. 2014. Management Plan for the Lewis's Woodpecker (*Melanerpes lewis*) in Canada. Species at Risk Act Management Plan Series. Environment Canada, Ottawa.

Garrison, B.A. (1999). Bank Swallow (*Riparia riparia*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/banswa

Jennings, M.J., E.E. Emmons, G.R. Hatzenbeler, C. Edwards and M.A. Bozek. 2003. Is Littoral Habitat Affected by Resdidential Development and Land Use in Watershed of Wisconsin Lakes? Lake and Reservoir Management 19(3):272-279.

Kahler, T.M., D. Grassley and Beauchamp. 2000. A Summary of the Effects of Bulkheads, Piers, and Other Artificial Structures and Shore Zone Development on ESA-listed Salmonids in Lakes. Prepared for: City of Bellevue, WA. Prepared by: Tom Kahler, the Watershed Company Kirkland, WA.

Lamson, H. 2016. Evaluation of Current Westslope Cutthroat Trout Hybridization Levels in the Upper Kootenay Drainage. UF-F16-105. Prepared for: Fish and Wildlife Compensation Program. 24pp.

Lange, M. 1999. Abundance and Diversity of Fish in Relation to Littoral and Shoreline Features. MSc. Thesis. University of Guelph, Ont. September 1999.

McPherson S., D. Hlushak, I. Adams and M. Polzin. 2010. Columbia Lake Sensitive Habitat

Inventory and Mapping. Consultant report prepared for the East Kootenay Integrated Lake

Management Partnership. Prepared by Interior Reforestation Co. Ltd., Cranbrook, BC.

McPherson, S., D. Hlushak and I. Adams. 2009. Wasa Lake Foreshore Inventory and Mapping. Consultant report prepared for the Wasa Lake Land Improvement District. Prepared by Interior Reforestation Co. Ltd., Cranbrook, BC.

McPherson, S. and D. Hlushak. 2008. Windermere Lake Fish and Wildlife Habitat Assessment. Consultant report prepared for the East Kootenay Integrated Lake Management Partnership. Prepared by Interior Reforestation Co. Ltd., Cranbrook, BC.

Meunier, B. 2016. 2016 Koocanusa Kokanee Enumeration Study. Prepared for Fish and Wildlife Compensation Plan. 14pp.

Ohanjanian, I.A. 2001. The Long-billed Curlew in the East Kootenay. Report to BC Ministry of Water, Land and Natural Resource Operations and BC Habitat Conservation Trust. Kimberley, BC.

Piaskoski, R.M. and R.A. Tabor. 2001. Nocturnal Habitat Use by Juvenile Chinook Salmon in Nearshore Areas of Southern Lake Washington. U.S. Fish and Wildlife Service. Lacey, Washington.

Radomski, P. and T.J. Goeman. 2001. Consequences of Himan Lakeshore Development on Emergent and Floating-Leaf Vegetation Abundance. North America Journal of Fisheries Management. Vol 21:46-61.

Randall, R.G., C.K. Minns, V.W. Cairns and J.E. Moore. 1996. The Relationship Between an Index of Fish Production and Submerged Aquatic Macrophytes and Other Habitat Features at Three Littoral Areas in the Great Lakes. Can. J. Fish. Aquat. Sci. 53 (Supl.1): 35-44.

RDEK 2014a. Lake Koocanusa Official Community Plan. Bylaw No. 2432, 2013. October 3, 2014 Consolidation. Regional District of East Kootenay. Cranbrook, BC.

RDEK 2014b. Baynes Lake Official Community Plan. Bylaw No. 2319, 2011. October 3, 2014 Consolidation. Regional District of East Kootenay. Cranbrook, BC.

Ringstad and Oliver. 1979. Preliminary Stream Biophysical Assessment and Inventory of Sportfish Utilization of Gold Creek, Tributary to Lake Koocanusa

Robinson, MD. 2013. Koocanusa Burbot Abundance and Distribution – Year 1 Data report. Lotic Environmental Ltd. Prepared for the Columbia Basin Trust. 14 p.

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

Schleppe, J. and D. Arsenault. 2006. The Kelowna Shore Zone Fisheries and Wildlife Habitat Assessment. EBA Consulting Engineers and Scientists. Project File: 0808-8840209. March 2006. Prepared for the City of Kelowna.

Schleppe, J. and B. Mason. 2009. Standard Methods for Completion of Foreshore Inventory and Mapping Projects. Prepared by Ecoscape Environmental Consultants Ltd. and the Community Mapping Network.

Schleppe, J. and A. Patterson. 2011. St. Mary Lake Foreshore Inventory and Mapping and Aquatic Habitat Index. Ecoscape Environmental Consultants Ltd. Project File: 10-682. Prepared for: East Kootenay Integrated Lake Management Partnership.

Vierling, K.T., V.A. Saab and B.W. Tobalske. 2013. Lewis's Woodpecker (*Melanerpes lewis*), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/lewwoo

Wade, W. and H. Weatherly. 2012. Libby VARQ Flood Control Impacts on Kootenay River Dikes. BGC Engineering Inc. Prepared for: Ministry of Energy, Mines and Natural Gas.

Westover, W.T. and K.D. Heidt. 2004. Upper Kootenay River bull trout radio telemetry project (2000-2003). British Columbia Ministry of Water, land and Air Protection, Environmental

Stewardship Division, Fish and Wildlife, Kootenay Region. 35 p.

Woodford, J.E. and M.W. Meyer. 2003. Impacts of Lakeshore Development on Green Frog Abundance. Biological Conservation, 110:227-284.

Zukiwsky, J., I. Liepa, D. Hlushak, J. Volp and L. Cooper. 2015. Koocanusa Area Situational Analysis and Recommendations for Crown Land Recreation. Prepared for: Koocanusa Recreation Steering Committee.

PERSONAL COMMUNICATIONS

Bisset, J. Aquatic Biologist. Canadian Columbia River Inter-Tribal Fishery Commission.

Holmes, P. Ministry of Forests, Lands and Natural Resource Operations (FLNRO).

Mac Donald, L.B. Terra Limnic Consulting.

Appendix A.
Segment Photo Plates

Lake Koocanusa Segment No. 1



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
2.8	Cliff/Bluff	None	Very Steep (60+)	Forestry	Low (<10%)	Yes	10	90
Comments:								

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
65	10	5	10	0	0	10
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	90	0	0	0	10	0	0
Comments:	many boats overnight/twin bays							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	30	40	10	10	0
Comments:	frequent clay banks						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	young forest	Sparse (<10%)	Moderate (10-50%)	Patchy	30	0
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Patchy	5
Comments:	no b2 data				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	10	>25
Comments:	narrow	

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	cactus point
Fauna Comments:	2 osprey

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	2	0	1	0	No	0
Comments:	23 mooring buoys, 14 boats									

Lake Koocanusa Segment No. 2



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
3	Stream Mouth	Other	Steep (20-60)	Forestry	Low (<10%)	Yes	5	95
Comments:	some low gradient areas, grassy, 1 private home, fields at top of bank							

AHI Data

Ecological Value
Very High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
25	26	20	17	2	0	10
Comments:	other is grassy area					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	80	0	10	0	0	0	10
Comments:								

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
10	0	10	25	25	20	10	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Patchy	30	5
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Grass/Herb	None	None	Continuous	10
Comments:	dominant exposed gravel and grassy /mud at head of inlet				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:	grass in the b2		

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	1	>25
Comments:	head of inlet littoral is wider 20 m	

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	
Fauna Comments:	biologically productive at 2444 fishy

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:	1 moored boat									

Lake Koocanusa Segment No. 3



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
4.2	Sand	None	Low (0-5)	Recreation	High (>40%)	Yes	80	20
Comments:	sandy shores campground							

AHI Data

Ecological Value
Low

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	10	90	0	0	0
Comments:	many boats					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	90	0	0	0	0	10	0	0
Comments:								

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	5	80	13	0	2	0
Comments:	sandy shores						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Moderate (10-50%)	Moderate (10-50%)	Patchy	30	0
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Patchy	15
Comments:	0				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:	some grassy area below hwm		

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	50	>25
Comments:		

Riparian Habitat

Veteran Trees	Snags
>25	<5
Flora Comments:	altered riparian
Fauna Comments:	8 gulls,3 grebes

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	2	0	10	0	No	0
Comments:	gravel boat launches									

Lake Koocanusa Segment No. 4

General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
1.6	Gravel	None	Low (0-5)	Natural Area	Low (<10%)	Yes	1	99
Comments:	camping, boat access							

AHI Data

Ecological Value
Very High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	70	30	0	0	0
Comments:	grassy /gravel beach					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	90	0	10	0	0	0	0
Comments:	unorganized camping							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	20	70	0	0	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Abundant (>50%)	Continuous	30	0
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Herbs/grasses	Grass/Herb	None	None	Patchy	50
Comments:					

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:	grassy area 30-100 m		

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	50	5-25
Comments:	grassy flats at 2444	

Riparian Habitat

Veteran Trees	Snags
>25	5-25
Flora Comments:	
Fauna Comments:	2 gulls ,2 wt deer, 2crows

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:										

Lake Koocanusa Segment No. 5



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
2.5	Rocky Shore	Other	Steep (20-60)	Forestry	Low (<10%)	Yes	5	95
Comments:	camping, boat access							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	60	20	10	0	0	10
Comments:	silt seam top of bank					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:	unorganized camping							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	10	20	40	20	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Abundant (>50%)	Continuous	30	2
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	0	None	None	Continuous	3
Comments:	sand/gravel/cobble/boulder matrix w small patches of herbs/grasses/LOD				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	1	>25
Comments:		

Riparian Habitat

Veteran Trees	Snags
>25	5-25
Flora Comments:	
Fauna Comments:	

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:										

Lake Koocanusa Segment No. 6



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
3.7	Cliff/Bluff	Marina large (20+)	Very Steep (60+)	Single Family	High (>40%)	Yes	40	60
Comments:	private/commercial/recreation							

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
90	2	5	3	0	0	0
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	20	0	0	30	0	20	0	30
Comments:	sunshine marina							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	70	10	10	5	5	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	Sparse	Moderate (10-50%)	Moderate (10-50%)	Patchy	30	1
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	2
Comments:	short gravel b2 at toe of cliffs				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	1	5-25
Comments:	very narrow	

Riparian Habitat

Veteran Trees	Snags
5-25	<5
Flora Comments:	
Fauna Comments:	1 tv,1 raven, swallow nests ,swallows , 1 Lewis woodpecker

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
2	1	Concrete	1	0	0	0	10	1	No	0
Comments:	250 m floating breakwater , cattle fence									

Lake Koocanusa Segment No. 7



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
1.4	Stream Mouth	Road	Low (0-5)	Natural Area	Low (<10%)	Yes	10	90
Comments:	gold cr fan /outlet shallow bay							

AHI Data

Ecological Value
Very High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
60	0	20	10	10	0	0
Comments:	stream outlet c/b and gravel/sand at full pool level					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:	orv use, road access, cattle							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	20	10	60	5	5	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Mixed forest	mature forest	Abundant (>50%)	Sparse (<10%)	Patchy	30	40
Comments:	grassy areas on s side in b2					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Herbs/grasses	Grass/Herb	None	None	Patchy	100
Comments:	b2 gravel 50 percent grassy 50 percent				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	100	<5
Comments:	shallow bay/fan	

Riparian Habitat

Veteran Trees	Snags
No	<5
Flora Comments:	
Fauna Comments:	10 mergs -4 juv, 1 juv eagle , 1 eagle ,swallows , 1 heron, 1 kingfisher

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	1	1	1	0	35	0	No	0
Comments:	orv access/truck access									

Lake Koocanusa Segment No. 8



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
2.1	Cliff/Bluff	None	Very Steep (60+)	Natural Area	Low (<10%)	Yes	10	90
Comments:	hoodoos							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
90	0	5	5	0	0	0
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:	grazing							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	60	15	15	8	2	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Shrubs	Sparse	Moderate (10-50%)	None	Patchy	30	0
Comments:	0					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	3
Comments:	short gravel b2 at toe of cliffs				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	5	5-25
Comments:		

Riparian Habitat

Veteran Trees	Snags
No	No
Flora Comments:	
Fauna Comments:	swallows , swallow nests , 1 heron, 1 gull

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	Other	0	0	0	0	0	0	No	0
Comments:	2 sailboats, cattle fence									

Lake Koocanusa Segment No. 9



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
2	Sand	Road	Moderate (5-20)	Natural Area	High (>40%)	Yes	80	20
Comments:	sandy beach							

AHI Data

Ecological Value
Low

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	10	90	0	0	0
Comments:	hi intensity rec, cattle, rvs, boats, truck stuck in water, orv					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	0	0	100	0	0	0	0
Comments:	unorganized camping / recreation/orv use							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	80	10	0	0	0
Comments:	sandy beach						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	Sparse	Sparse (<10%)	Sparse (<10%)	Patchy	30	0
Comments:	grass/bitterbrush/conifers					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	100
Comments:	small island of sand/grass at full pool ,balance sand b2				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	100	No
Comments:	wide and variable	

Riparian Habitat

Veteran Trees	Snags
No	No
Flora Comments:	
Fauna Comments:	1 osprey 1 crow, 40 gulls, dogs out of control

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	Other	0	0	0	0	10	0	No	0
Comments:	25 cattle, 3 trailers, 8 boats, 2 house boats , 1 tent, dogs									

Lake Koocanusa Segment No. 10



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
7.4	Rocky Shore	Road	Very Steep (60+)	Forestry	Medium (10-40%)	Yes	25	75
Comments:								

AHI Data

Ecological Value
Very High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	40	20	20	0	0	20
Comments:	bedrock outcrops , boulders scattered, gravel/sand fines matrix					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:	unorganized camping / recreation/orv use							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	15	15	30	10	10	20
Comments:	variable						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Continuous	30	1
Comments:	old burn 10 yrs at s end of segment					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Herbs/grasses	Grass/Herb	None	None	Continuous	75
Comments:	b2 variable width 30-500 m/grassy				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	30	>25
Comments:	wide and variable	

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	abundant high value snags, burn area
Fauna Comments:	5 loons, swallows, 100 can geese, 25 gulls, 1 sandpiper, 6 killdeer,1 mallard pot lewo

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	Other	0	0	2	0	0	0	No	0
Comments:	1 cattle fence,4 docks, camping. roads/trails, 2 pocket beaches, swim platform									

Lake Koocanusa Segment No. 11



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
3.7	Cliff/Bluff	None	Very Steep (60+)	Forestry	Low (<10%)	Yes	0	100
Comments:	wisa - wha							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
50	30	10	10	0	0	0
Comments:	some bedrock cliffs/silt bluffs					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:	old logging							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	20	10	20	20	20	10
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	Mixed age	Abundant (>50%)	Moderate (10-50%)	Continuous	30	0
Comments:	young forest in logged area/ old growth and mature above					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	2
Comments:	steep				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	1	>25
Comments:	no littoral	

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	abundant high value snags
Fauna Comments:	swallows , swallow nests , 2 osprey , 2 mergs, abundant song birds

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	Other	0	0	0	0	0	0	No	0
Comments:	1 cattle fence, old skid road/fory road									

Lake Koocanusa Segment No. 12



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
2	Rocky Shore	Other	Steep (20-60)	Recreation	Medium (10-40%)	No	40	60
Comments:	steep gravel/boulder banks							

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	60	30	10	0	0	0
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	0	0	0	0	100	0	0
Comments:	fs rec camping/boat launch gravel							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	5	10	40	35	10	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Continuous	30	0
Comments:	rec site					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	3
Comments:	gravel steep banks				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	2	5-25
Comments:	bay with boat launch and Englishman creek at head of inlet	

Riparian Habitat

Veteran Trees	Snags
<5	<5
Flora Comments:	
Fauna Comments:	swallows ,1 gull , 1 killdeer

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	Other	1	1	1	0	30	0	No	0
Comments:	gravel launch, 3 boats on shoreline									

Lake Koocanusa Segment No. 13



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
1	Rocky Shore	Other	Moderate (5-20)	Industrial	Medium (10-40%)	Yes	50	50
Comments:	shallow mud/grass bay adjacent Sweetwater s breakwater							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	50	0	0	0	0	50
Comments:	some rip rap some gravel breakwater n side and low gradient grasses					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	0	50	50	0	0	0	0
Comments:	hydro tugs moorage							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	30	0	20	30	20	0
Comments:	mixed substrate						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Broadleaf forest	young forest	Sparse (<10%)	Sparse (<10%)	Patchy	30	0
Comments:	grasses in shallow bay					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Herbs/grasses	Sparse	None	None	Patchy	30
Comments:	0				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	30	5-25
Comments:	shallow bay	

Riparian Habitat

Veteran Trees	Snags
No	<5
Flora Comments:	
Fauna Comments:	sandpipers ,meadow lark, west tan,killdeer,swallows,1 merg pot curlew hab

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	Other	1	1	0	0	30	0	No	0
Comments:	5 marker buoys , 2 log breakwater, 1 propane tank, 2 tugs									

Lake Koocanusa Segment No. 14



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
2.7	Gravel	Marina large (20+)	Bench	Single Family	High (>40%)	No	100	0
Comments:	Sweetwater							

AHI Data

Ecological Value
Very Low

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	100	0	0	0	0
Comments:	landscaping/houses					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	0	0	0	0	0	0	100
Comments:	new development							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	0	20	70	10	0	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Landscaped	Grass/Herb	None	None	Continuous	30	0
Comments:	extensive development /modified new					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	3
Comments:	steep gravel bank				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	1	No
Comments:	100 x 100 shallow gravel littoral area with patches exposed	

Riparian Habitat

Veteran Trees	Snags
No	No
Flora Comments:	landscaped/exposed soil - construction
Fauna Comments:	1 swallow

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
3	1	Mixed	20	10	1	0	100	1	Yes	1
Comments:	30 mooring buoys , 9 stairs , 4 swimming platforms, 4 log booms - 800 m, 1 boat basin n end									

Lake Koocanusa Segment No. 15



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
1.3	Cliff/Bluff	Road	Very Steep (60+)	Forestry	Low (<10%)	Yes	5	95
Comments:	1 private home with landscaping, active bank erosion							

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
80	0	20	0	0	0	0
Comments:	landscaping					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	62	0	0	0	0	0	38
Comments:	1 large home and outbuildings							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	50	20	25	5	0	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Patchy	30	1
Comments:	modified in private land					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	5
Comments:	3 percent grassy area at s end				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	3	5-25
Comments:		

Riparian Habitat

Veteran Trees	Snags
5-25	No
Flora Comments:	open grass slopes
Fauna Comments:	swallows , 2 merlin, 1 merg

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
1	1	Stonework	1	1	0	0	10	0	No	0
Comments:	4 pilings , 1 mooring buoy									

Lake Koocanusa Segment No. 16

General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
1.8	Cliff/Bluff	Marina large (20+)	Very Steep (60+)	Commercial	High (>40%)	No	100	0
Comments:	extensive development on steep banks/bluffs							

AHI Data

Ecological Value
Very Low

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
75	0	25	0	0	0	0
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	100	0	0	0	0	0	0	0
Comments:	rv park, 3 marinas							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	30	20	45	5	0	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Patchy	30	1
Comments:	highly modified					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	Sparse (<10%)	None	Patchy	5
Comments:	south end wet seep grasses wetland plants (at marina 3)				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	3	<5
Comments:		

Riparian Habitat

Veteran Trees	Snags
No	No
Flora Comments:	
Fauna Comments:	1 gull, swallows, owner shooting ground squirrels

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	2	2	1	0	100	3	Yes	5
Comments:	1 concrete boat launch, 8 stairs, 2 trails, 4 swimming platform platforms, 2 mooring buoys, fences									

Lake Koocanusa Segment No. 17



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
2.4	Cliff/Bluff	None	Very Steep (60+)	Forestry	Low (<10%)	Yes	5	95
Comments:	significant steep eroding clay/sand bluffs							

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
90	0	5	5	0	0	0
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:	extensive mostly historic trail network, 1 road access							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	60	30	9	0	0	1
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Patchy	30	1
Comments:	grassland open forest					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	3
Comments:	some bedrock, 50m patch red rock deposit				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	1	<5
Comments:	sparse lwd	

Riparian Habitat

Veteran Trees	Snags
<5	No
Flora Comments:	
Fauna Comments:	1 red tailed hawk, extensive swallow nests, 2 eagles, 1 jv eagle

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:										

Lake Koocanusa Segment No. 18



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
3.7	Gravel	None	Steep (20-60)	Forestry	Low (<10%)	Yes	0	100
Comments:								

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	75	25	0	0	0
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:	cattle access							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	10	65	10	5	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Moderate (10-50%)	Abundant (>50%)	Continuous	30	2
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Patchy	15
Comments:	80 percent exposed, grassy at northern 20 percent				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	5	>25
Comments:		

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	
Fauna Comments:	swallows, 1 jv eagle, 6 osprey, 4 crows, 3 geese, 1 gull, 1 squirrel

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:	1 mooring buoy, 500m log boom/breakwater at north end, 1 rope swing									

Lake Koocanusa Segment No. 19



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
0.9	Sand	Marina large (20+)	Moderate (5-20)	Commercial	High (>40%)	No	100	0
Comments:	Cutts marinas and rv park							

AHI Data

Ecological Value
Very Low

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	25	25	49	1	0	0
Comments:	2 rip rap breakwaters					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	100	0	0	0	0	0	0	0
Comments:	rv park, beach, marina, boat launch							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	45	25	5	15	0
Comments:	beach grooming						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Continuous	30	0
Comments:	heavily developed					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	20
Comments:	moderate to steep				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	5	No
Comments:	docks and boats	

Riparian Habitat

Veteran Trees	Snags
<5	No
Flora Comments:	
Fauna Comments:	1 osprey

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
6	6	Wood	10	10	1	0	100	2	Yes	100
Comments:	beach grooming, 4 breakwater 500m total, 8 mooring buoys, 6 pilings, 10 stairs, 1 swimming platform									

Lake Koocanusa Segment No. 20



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
1.6	Other	Road	Steep (20-60)	Industrial	High (>40%)	No	98	2
Comments:	large boat launch/riprap causeway /highway							

AHI Data

Ecological Value
Very Low

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	2	0	0	0	98
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	0	98	2	0	0	0	0
Comments:	orv use, camping, pocket beaches, road access							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	0	1	1	0	98	0
Comments:	rip rap/concrete boat launch /gravel beach 50 m long						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Unvegetated	Sparse	Sparse (<10%)	None	Patchy	15	0
Comments:	roadway/some shrubs in fill along road					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	2
Comments:	rip rap steep drop				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	2	No
Comments:		

Riparian Habitat

Veteran Trees	Snags
No	No
Flora Comments:	a few shrubs in road fill
Fauna Comments:	nil

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	5	0	No	0
Comments:	orphan dock and breakwater									

Lake Koocanusa Segment No. 21



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
3.5	Gravel	Road	Low (0-5)	Forestry	Low (<10%)	Yes	2	98
Comments:	In end gravel/rocky s end eroding sandy cliffs							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
30	15	40	15	0	0	0
Comments:	eroding sand banks s end					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:	orv use, camping, pocket beaches, road access							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	25	50	10	5	0
Comments:	eroding sand banks/bluffs						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Abundant (>50%)	Continuous	30	2
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	15
Comments:					

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	10	>25
Comments:		

Riparian Habitat

Veteran Trees	Snags
>25	5-25
Flora Comments:	
Fauna Comments:	2 eagles ,swallows

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	5	0	No	0
Comments:	orv use/camping									

Lake Koocanusa Segment No. 22



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
5	Rocky Shore	Road	Moderate (5-20)	Forestry	High (>40%)	Yes	50	50
Comments:	bedrock/rubble/boulder/sand-gravel, steep at start 600 m then low bench							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
2	60	28	10	0	0	0
Comments:	bedrock, boulders, low grassy benches, small bays					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:	cattle, extensive orv use, road network, camping							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	5	10	20	5	20	40
Comments:	broken bedrock common						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Abundant (>50%)	Continuous	30	0
Comments:	open grassy patches					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Herbs/grasses	Grass/Herb	None	None	Patchy	30
Comments:	50 percent exposed, 50 percent grassy				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	100	>25
Comments:		

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	
Fauna Comments:	1 jv eagle, 3 eagles ,3 tv,swallows ,sandpipers -pot curlew habitat degraded by cows

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	50	0	No	0
Comments:	unorganized camping, orv access, 4 pocket beaches, improvised boat launches									

Lake Koocanusa Segment No. 23

General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
11.5	Rocky Shore	Road	Steep (20-60)	Forestry	Low (<10%)	Yes	5	95
Comments:	bedrock much more prevalent than east shore							

AHI Data

Ecological Value
Very High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
10	30	40	9	1	0	10
Comments:	other is bedrock, 3 tiny springs/tributaries no fish access					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:	grazing, cattle fence, 100m eroded gravel scarp at north end of segment, check segment private land							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	15	15	50	8	2	10
Comments:	some stumps in B2						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Moderate (10-50%)	Abundant (>50%)	Continuous	30	0
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Herbs/grasses	Grass/Herb	None	None	Patchy	10
Comments:	50 percent exposed, 50 percent grassy				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:	wet draws hold emergent aquatics		

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	100	>25
Comments:	old river channel	

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	
Fauna Comments:	ht hawk, swallows/nests, 3 jv eagles, 2 eagles, 3 tv, crow, squirrel, chip, sandpipers,

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:	3 unorganized camping, 5 orv access									

Lake Koocanusa Segment No. 24

General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
2.5	Cliff/Bluff	Road	Very Steep (60+)	Natural Area	Low (<10%)	No	1	99
Comments:	south of wardner town site-osprey landing							

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
70	10	20	0	0	0	0
Comments:	bedrock and silt cliffs/ some sand/gravel banks minor components					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	0	0	0	0	0	0	100
Comments:	osprey landing , orv access							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	40	10	20	10	0	20
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Patchy	30	1
Comments:	private land - cliffs 2 road access points to shore					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Patchy	10
Comments:	patches of grassy foreshore				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	10	<5
Comments:	littoral is old channel/gravel bars	

Riparian Habitat

Veteran Trees	Snags
5-25	5-25
Flora Comments:	0
Fauna Comments:	1 tv, swallows

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	1	0	1	0	No	0
Comments:	2 road access points									

Lake Koocanusa Segment No. 25

General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
3.7	Gravel	Road	Moderate (5-20)	Single Family	High (>40%)	No	90	10
Comments:	wardner town site							

AHI Data

Ecological Value
Low

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	50	10	0	0	40
Comments:	steep gravel bank to private land-town site					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	0	0	0	5	0	0	95
Comments:	town site/municipal park							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
10	5	10	10	55	10	0	0
Comments:	grassy banks						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Landscaped	Grass/Herb	Sparse (<10%)	Sparse (<10%)	Patchy	30	1
Comments:	private lots					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Herbs/grasses	Grass/Herb	None	None	Continuous	40
Comments:	grassy foreshore				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	30	0
Comments:	grass		

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	10	<5
Comments:	littoral is old channel/gravel bars	

Riparian Habitat

Veteran Trees	Snags
No	No
Flora Comments:	
Fauna Comments:	

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	1	0	100	0	No	0
Comments:	road parallel									

Lake Koocanusa Segment No. 26



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
6.5	Other	Road	Low (0-5)	Agriculture	High (>40%)	Yes	50	50
Comments:	grazing fields							

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	0	0	0	0	100
Comments:	flat to edge of conifers					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
100	0	0	0	0	0	0	0	0
Comments:	200 plus cattle							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	70	10	20	0	0	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	Mixed age	Sparse (<10%)	Moderate (10-50%)	Patchy	30	0
Comments:	fields up to edge of conifers					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Herbs/grasses	Grass/Herb	None	None	Continuous	500
Comments:	variable width old flood plain				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	100	<5
Comments:	littoral is old channel/gravel bars	

Riparian Habitat

Veteran Trees	Snags
<5	No
Flora Comments:	
Fauna Comments:	500 geese, long bill curlew wha

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	5	0	No	0
Comments:	road access									

Lake Koocanusa Segment No. 27



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
3.4	Gravel	Road	Moderate (5-20)	Rural	None	Yes	20	80
Comments:	frontage old rail line							

AHI Data

Ecological Value
Very High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	50	50	0	0	0	0
Comments:	mix of gravel/cobble/boulders					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	0	0	0	0	0	100	0
Comments:								

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	10	50	20	10	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	Mixed age	Sparse (<10%)	Abundant (>50%)	Continuous	30	1
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Herbs/grasses	Grass/Herb	None	None	Patchy	30
Comments:	steep banks then lower gradient				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	100	<5
Comments:	river channel / old fields	

Riparian Habitat

Veteran Trees	Snags
5-25	<5
Flora Comments:	
Fauna Comments:	1 juvenile eagle , swallows

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	70	10	0	No	0
Comments:										

Lake Koocanusa Segment No. 28



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
1.2	Gravel	Railway	Moderate (5-20)	Agriculture	Medium (10-40%)	Yes	50	50
Comments:	90 percent low grassy bench, stopped short 200m of end of segment water too shallow							

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	100	0	0	0	0
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
90	0	0	0	10	0	0	0	0
Comments:	grazing, cattle fence, 100m eroded gravel scarp at north end of segment							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	9	30	50	10	1	0
Comments:	stumps						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Herbs/grasses	Grass/Herb	Moderate (10-50%)	Sparse (<10%)	Patchy	30	0
Comments:	0					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	10
Comments:	0				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	100	No
Comments:	old river channel	

Riparian Habitat

Veteran Trees	Snags
<5	No
Flora Comments:	conifers at edge of field
Fauna Comments:	2 bald eagles, 1 tv, 1 mule deer

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:	1 cattle fence									

Lake Koocanusa Segment No. 29



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
11	Gravel	Road	Very Steep (60+)	Forestry	Low (<10%)	Yes	5	95
Comments:	predominantly steep, 1 short section 800-1,000m of low and moderate gradient,							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
30	2	68	0	0	0	0
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	99	0	0	0	0	1	0
Comments:	cattle grazing, orv use, 9 unorganized camping with more upland							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	28	50	10	1	1
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Moderate (10-50%)	Abundant (>50%)	Continuous	30	1
Comments:	evidence of past logging					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	10
Comments:	a few grassy benches				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	5	>25
Comments:	less lwd than in reservoir proper	

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	some mid seral, some mature, relatively few snags
Fauna Comments:	2 mule,1 hum b,4 bld eagles,4 juv eagles,3 mergs,1 osprey,3 geese,kill d,g sq, swalls, squir, 2 gul

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	1	0	10	0	No	0
Comments:	2 mooring buoys, 2 boats, 1 cattle fence									

Lake Koocanusa Segment No. 30



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
2	Cliff/Bluff	None	Very Steep (60+)	Forestry	Low (<10%)	No	1	99
Comments:	bedrock/broken bedrock /rubble piles- islands 3 large, several small							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
70	30	0	0	0	0	0
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:	orv access at low pool and camping							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	0	10	0	20	60
Comments:	angular broken rock						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Patchy	30	2
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	2
Comments:	patchy grass areas below full pool				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:	mid seral		

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	1	No
Comments:	steep cliffs	

Riparian Habitat

Veteran Trees	Snags
<5	<5
Flora Comments:	mid seral
Fauna Comments:	1 osprey ,sandpipers ,3 mergs ,northern flicker, swallows , unk songbird

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:										

Lake Koocanusa Segment No. 31



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
4.1	Gravel	None	Very Steep (60+)	Forestry	Low (<10%)	Yes	5	95
Comments:	cliff bluffs							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
30	1	44	25	0	0	0
Comments:	1 pocket beach 100 meters					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	99	1	0	0	0	0	0
Comments:	southern crossing pipeline, game trails							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	0	25	65	8	1	1
Comments:	1 bedrock outcrop						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Patchy	30	0
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	0	None	None	Continuous	10
Comments:	1 bay 350m with shallow grassy bench below full pool				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	5	5-25
Comments:	steep drop	

Riparian Habitat

Veteran Trees	Snags
>25	<5
Flora Comments:	ecosystem restoration completed
Fauna Comments:	2 eagles bathing, 2 crows, swallows

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:	Orv use, localized									

Lake Koocanusa Segment No. 32



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
1.8	Stream Mouth	None	Low (0-5)	Natural Area	Low (<10%)	Yes	10	90
Comments:	sand creek outlet fan/braided channels							

AHI Data

Ecological Value
Very High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	80	0	20	0	0
Comments:	braided stream channel					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	0	0	100	0	0	0	0
Comments:	orv use							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
20	0	0	20	50	10	0	0
Comments:	silts deposits at full pool						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Shrubs	low shrubs <2m	Moderate (10-50%)	Sparse (<10%)	Patchy	30	0
Comments:	deciduous at head of inlet/sides					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Herbs/grasses	Sparse	None	None	Continuous	100
Comments:	flooded at full pool ,extensive gravel exposed at 2444 elevation				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	20	0
Comments:	emergent at head of inlet		

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	100	>25
Comments:	wide/long shallow bay	

Riparian Habitat

Veteran Trees	Snags
No	No

Flora Comments:	wetland veg at hwm
Fauna Comments:	37 Canada geese , 4 mergs, 2 loons, swallows ,fish sample site

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:	orv use									

Lake Koocanusa Segment No. 33



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
3.9	Gravel	Road	Steep (20-60)	Recreation	High (>40%)	No	80	20
Comments:	gravel, some sand banks							

AHI Data

Ecological Value
Very Low

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
29	0	50	20	0	0	1
Comments:	sand dunes, modifications					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	5	0	0	0	90	0	5
Comments:	extensive rv development							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	30	55	5	0	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Abundant (>50%)	Continuous	30	1
Comments:	mid seral forest					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	20
Comments:	patchy grass areas 10 percent				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	10	<5
Comments:	variable width	

Riparian Habitat

Veteran Trees	Snags
No	<5
Flora Comments:	heavily modified, landscaping, housing, camping
Fauna Comments:	swallows , Columbia ground squirrel, 1 eagle ,1 osprey

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
9	8	Mixed	36	8	7	0	90	0	No	0
Comments:	61 mooring buoys , 22 swimming platform ,29 stairs, 20 pilings,5 floating breakwater ,1 fence, boats									

Lake Koocanusa Segment No. 34



General Segment Classification

Segment Length (km)	*Shore Type*	*Shore Type Mod.*	*Slope*	*Land Use*	*Level of Impact*	*Livestock Access*	*Disturbed*	*Natural*
3.1	Gravel	Road	Steep (20-60)	Forestry	High (>40%)	Yes	50	50
Comments:	gravel shoreline with variable width 20 - 100 m grassy benches below full pool							

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	*Rocky*	*Gravel*	*Sand*	*Stream Mouth*	*Wetland*	*Other*
0	0	80	20	0	0	0
Comments:	grassy benches					

Land Use

Agriculture	*Commercial*	*Forestry*	*Industrial*	*Natural Area*	*Park*	*Recreation*	*Rural*	*Single Family*
0	0	100	0	0	0	0	0	0
Comments:	orv use, public roadway n half of segment							

Substrates

Mud	*Organics*	*Fine*	*Sand*	*Gravel*	*Cobble*	*Boulder*	*Bedrock*
0	0	5	20	60	15	0	0
Comments:	minor sloughing						

Vegetation Band 1

Class	*Stage*	*Shrub Cover*	*Tree Cover*	*Distribution*	*Bandwidth (m)*	*Overhanging Veg.*
Coniferous forest	mature forest	Sparse (<10%)	Abundant (>50%)	Continuous	30	1
Comments:	patchy conifers at s end					

Vegetation Band 2

Class	*Stage*	*Shrub Cover*	*Tree Cover*	*Distribution*	*Bandwidth (m)*
Herbs/grasses	Grass/Herb	None	None	Continuous	100
Comments:	grasses/terrestrial benches				

Aquatic Vegetation

Aquatic	*Submergent*	*Emergent*	*Floating*
0	0	0	0
Comments:	grassy benches		

Littoral Zone

Littoral Zone	*Littoral Width (m)*	*Large Woody Debris*
Wide (>50m)	20	5-25
Comments:	variable width	

Riparian Habitat

Veteran Trees	*Snags*
5-25	No
Flora Comments:	alfalfa
Fauna Comments:	1 bald eagle, swallows , 1 sand piper

Modifications

Retain Walls	*% Ret. Wall*	*Ret. Wall Material*	*Docks*	*Docks per km*	*Boat Launch*	*% Rail Modifier*	*% Road Modifier*	*Marinas*	*Substrate Mod.*	*% Substrate Mod.*
0	0	0	0	0	0	0	50	0	No	0
Comments:	orv trails to water									

Lake Koocanusa Segment No. 35



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
2.2	Gravel	Road	Steep (20-60)	Forestry	Low (<10%)	Yes	2	98
Comments:	Kikomun inlet road at western entrance							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
5	0	68	20	2	0	5
Comments:	other is grassy area					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	98	0	2	0	0	0	0
Comments:	orv use and mooring house boats, 2 percent stream mouth							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	5	20	60	15	0	0
Comments:	3 clay cliff / bluffs						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Abundant (>50%)	Patchy	30	1
Comments:	s side mid seral, n side mature					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Patchy	10
Comments:	some patchy grasses/terrestrial plan				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:	head of inlet grassy wetland		

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	5	5-25
Comments:	larger littoral at head of inlet	

Riparian Habitat

Veteran Trees	Snags
5-25	No
Flora Comments:	open forest n side
Fauna Comments:	1 osprey , 1 robin , 1 mule deer , merg family, 2 herons, swallows , swallow nests , fish jumping

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:	2 orv trails to water									

Lake Koocanusa Segment No. 36

General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
1.4	Other	Road	Steep (20-60)	Industrial	High (>40%)	No	70	30
Comments:	east side Kikomun crossing causeway							

AHI Data

Ecological Value
Low

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	70	30	0	0	0	0
Comments:	rip rap					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	0	70	30	0	0	0	0
Comments:	causeway overlaying natural gravel deposit							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	0	10	28	2	60	0
Comments:	highway						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Herbs/grasses	Grass/Herb	Sparse (<10%)	Sparse (<10%)	Patchy	10	1
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Patchy	10
Comments:	grasses/shrub/trees on gravel deposit under causeway and spreading out both sides n and s at bridge				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:	grasses on gravel deposit		

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	5	5-25
Comments:		

Riparian Habitat

Veteran Trees	Snags
No	No
Flora Comments:	deciduous on gravel deposit
Fauna Comments:	1 osprey nest with family, 2 squirrels

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	1	0	0	0	No	0
Comments:	1 orphan dock, low water boat launch									

Lake Koocanusa Segment No. 37



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
1.9	Gravel	None	Moderate (5-20)	Natural Area	Low (<10%)	No	5	95
Comments:	island at south Kikomun crossing							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	90	10	0	0	0
Comments:	grasses on island flat					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	0	0	100	0	0	0	0
Comments:	orv use and gravel boat launching							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	0	20	60	19	1	0
Comments:	4 concrete blocks / highway divide						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Herbs/grasses	Grass/Herb	None	None	Patchy	30	0
Comments:	review b1 band width					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Herbs/grasses	Grass/Herb	None	None	Patchy	100
Comments:	all to most of island underwater at full pool				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:	terrestrial grasses/plants on top of island		

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	100	<5
Comments:	littoral extends from island to shoreline at segment 25	

Riparian Habitat

Veteran Trees	Snags
No	No
Flora Comments:	
Fauna Comments:	2 curlew , 3 sandpipers , 1 crow, 1 eagle, 4 mallards, fish surfacing between island and shoreline s

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	1	0	0	0	No	0
Comments:	numerous gravel boat launches depending on water level									

Lake Koocanusa Segment No. 38

General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
5.9	Gravel	Other	Moderate (5-20)	Park	Medium (10-40%)	No	40	60
Comments:	Kikomun park							

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	70	30	0	0	0
Comments:	shore altered along portion of park, boat basins					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	5	0	0	95	0	0	0
Comments:	orv n of park							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	5	20	60	15	0	0
Comments:	some steep some low gradient						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Abundant (>50%)	Patchy	30	3
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	50
Comments:					

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:	some grass along segment in b2		

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	5	5-25
Comments:	steep drop off in places	

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	modified by parks
Fauna Comments:	3 sandpipers , 1 kestrel, 1 crow,1 osprey ,2 osprey nests

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	3	0	15	0	No	0
Comments:	foreshore was groomed by parks boat basins, 1 double concrete, 2 gravel									

Lake Koocanusa Segment No. 39

General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
0.7	Gravel	Road	Steep (20-60)	Single Family	High (>40%)	Yes	60	40
Comments:								

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
30	0	50	20	0	0	0
Comments:	steep banks some erosion					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
50	0	0	0	20	0	0	0	30
Comments:								

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	30	50	10	0	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Sparse (<10%)	Patchy	30	1
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	0	None	None	Continuous	5
Comments:	steep gravel bank				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	3	5-25
Comments:	steep drop off	

Riparian Habitat

Veteran Trees	Snags
No	>25
Flora Comments:	
Fauna Comments:	sand piper, crows

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	1	0	0	0	0	0	No	0
Comments:	2 swimming platforms									

Lake Koocanusa Segment No. 40



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
3.2	Other	Road	Low (0-5)	Agriculture	High (>40%)	Yes	75	25
Comments:	north end agriculture, south end natural with road							

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	15	15	0	0	70
Comments:	agriculture					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
100	0	0	0	0	0	0	0	0
Comments:	cattle fencing, road access, orv access							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	50	10	20	20	0	0	0
Comments:	grass herb						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Herbs/grasses	Grass/Herb	Sparse (<10%)	None	Continuous	30	1
Comments:	low growing vegetation					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Herbs/grasses	Grass/Herb	None	None	Continuous	100
Comments:	inundated at mid to full pool				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	30	0
Comments:	unknown species mix/terrestrial/aquatic		

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	5	5-25
Comments:	inundated area at mid pool, steep gravel bank/bench north half	

Riparian Habitat

Veteran Trees	Snags
<5	No
Flora Comments:	
Fauna Comments:	2 loons, many geese, gulls, 1 osprey

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:	temporary electric fence									

Lake Koocanusa Segment No. 41



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
1.9	Sand	None	Low (0-5)	Natural Area	Medium (10-40%)	Yes	10	90
Comments:	area mostly inundated at full pool except sand beach island at s end							

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	0	40	0	0	60
Comments:	wha curlew, sand dunes , sand island at full pool , 1 tree, low areas grass/herbs					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	0	0	100	0	0	0	0
Comments:	wha curlew							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
35	20	10	30	5	0	0	0
Comments:	muddy low growing vegetation						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Herbs/grasses	Grass/Herb	None	None	Continuous	30	0
Comments:	low growing vegetation					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Herbs/grasses	Sparse	None	None	Continuous	100
Comments:	inundated at mid to full pool				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	30	0
Comments:	unknown species mix/terrestrial/aquatic		

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	100	5-25
Comments:	inundated area at mid pool	

Riparian Habitat

Veteran Trees	Snags
No	No
Flora Comments:	
Fauna Comments:	very windy, 100 plus gulls, 1 osprey

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:	extensive orv, house boats, motor boats, pets, human use									

Lake Koocanusa Segment No. 42



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
0.9	Gravel	Road	Moderate (5-20)	Natural Area	High (>40%)	Yes	60	40
Comments:	natural area with road through 95 percent of segment							

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	30	30	0	0	40
Comments:	other is grassy area					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	0	0	55	0	40	0	5
Comments:								

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	20	30	30	20	0	0	0
Comments:	alfalfa						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Mixed forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Patchy	30	20
Comments:	public road					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Herbs/grasses	Sparse	Moderate (10-50%)	None	Patchy	100
Comments:	15 percent is terrestrial and aquatic plants below full pool				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	30	0
Comments:	unknown species mix/terrestrial/aquatic		

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	100	5-25
Comments:	inundated area at mid pool	

Riparian Habitat

Veteran Trees	Snags
<5	<5
Flora Comments:	alfalfa
Fauna Comments:	none, very windy

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	3	3	1	0	90	0	No	0
Comments:	1 concrete boat launch									

Lake Koocanusa Segment No. 43



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
1.9	Gravel	Road	Moderate (5-20)	Recreation	Medium (10-40%)	No	40	60
Comments:	F.O.L.K.S campground, mooring, boat launch, pocket beach							

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	50	20	0	0	30
Comments:	other is grassy area					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	0	0	30	0	70	0	0
Comments:	F.O.L.K.S Campground, houseboat use							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	20	10	25	43	1	1	0
Comments:	1 concrete boat launch						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Mixed forest	mature forest	Moderate (10-50%)	Moderate (10-50%)	Patchy	30	5
Comments:	campground, road access to lake, fence, 3 breakwater on land					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	25
Comments:	15 percent is terrestrial and aquatic plants below full pool				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	5	5	0
Comments:	unknown species mix		

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Moderate (10-50m)	20	5-25
Comments:	narrower at beginning, wide at end of segment	

Riparian Habitat

Veteran Trees	Snags
5-25	<5
Flora Comments:	deciduous encroachment at hwm
Fauna Comments:	none, very windy

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	1	1	1	0	35	0	Yes	8
Comments:	1 concrete launch, 29 mooring buoys, 51 boats, 2 platforms, 4 houseboats, 3 log booms1 pocket beach									

Lake Koocanusa Segment No. 44

General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
1.2	Cliff/Bluff	None	Steep (20-60)	Natural Area	Low (<10%)	No	2	98
Comments:	30 percent crown, 70 percent natural, 2 obvious developments							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
70	10	10	10	0	0	0
Comments:	some calcium conglomerate at start					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	30	0	65	0	0	0	5
Comments:	2 foreshore developments; steps and trail							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	30	30	30	8	0	2
Comments:	bedrock is calcium conglomerate						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Abundant (>50%)	Continuous	30	2
Comments:	obvious development is foreshore access					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	5
Comments:	steep gravel/cobble drop off				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	5	>25
Comments:		

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	low impact
Fauna Comments:	eagle, swallows

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
1	1	Stonework	1	1	0	0	1	0	Yes	1
Comments:	1 swimming platform, 2 mooring buoys, 2 stair access, 1 log boom 150 m, atv trail to gabions									

Lake Koocanusa Segment No. 45



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
0.7	Cliff/Bluff	Road	Steep (20-60)	Single Family	Medium (10-40%)	No	20	80
Comments:	developed on flat at top of cliff, access to foreshore by steep trails, roads							

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
80	10	10	0	0	0	0
Comments:	calcium conglomerate abundant					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	0	0	80	0	0	0	20
Comments:	mooring buoys, docks, boat launch							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	15	35	15	5	20
Comments:	bedrock is calcium conglomerate						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Patchy	30	1
Comments:	development on top of bank					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	1
Comments:	steep gravel drop off/bedrock drop off				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	1	5-25
Comments:		

Riparian Habitat

Veteran Trees	Snags
<5	5-25
Flora Comments:	
Fauna Comments:	swallows , 3 osprey , swallow nests

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	2	2	1	0	2	0	No	0
Comments:	19 mooring buoys, 4 stairs, 4 swim platforms, 1 log breakwater - 100 m, 6 boats									

Lake Koocanusa Segment No. 46



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
3.3	Cliff/Bluff	None	Steep (20-60)	Forestry	None	Yes	0	100
Comments:	some eroding clay banks/some gravel/sand slopes							

AHI Data

Ecological Value
Very High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
30	10	30	30	0	0	0
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:	log boom along shore 150 m long							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	20	30	30	15	5	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Patchy	30	1
Comments:	0					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	3
Comments:	steep gravel drop off				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	5	>25
Comments:	floating debris raft near start of segment	

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	arrow leaf balsam root, abundant rocky mtn juniper, good snags
Fauna Comments:	2 mergs, 1 loon, swallows , 2 juvenile eagles, 3 osprey, 1 turkey vulture

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:										

Lake Koocanusa Segment No. 47



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
5.9	Stream Mouth	None	Steep (20-60)	Natural Area	Low (<10%)	Yes	1	99
Comments:	elk river wetland/outlet							

AHI Data

Ecological Value
Very High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
35	0	35	0	30	0	0
Comments:	2 stream channels , balance submergent/emergent and deciduous, shrubs					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	50	0	50	0	0	0	0
Comments:	road access on both sides							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
40	10	0	40	10	0	0	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Moderate (10-50%)	Abundant (>50%)	Patchy	30	20
Comments:	at full pool band 1 includes mature deciduous, shrubs, emergent and some submergent plants and conifers					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Herbs/grasses	Grass/Herb	Moderate (10-50%)	None	Patchy	100
Comments:	wetland/emergent at mid pool elevation				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	5	60	0
Comments:	check emergent spp		

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	100	5-25
Comments:	upland river fan/wetland emergent/littoral	

Riparian Habitat

Veteran Trees	Snags
No	No
Flora Comments:	check spp
Fauna Comments:	7 mergs, swallows , 1 mallard

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:										

Lake Koocanusa Segment No. 48

General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
1.5	Rocky Shore	None	Steep (20-60)	Forestry	Low (<10%)	No	1	99
Comments:								

AHI Data

Ecological Value
Very High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
5	60	30	5	0	0	0
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:								

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	20	40	25	5	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Abundant (>50%)	Continuous	30	0
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Grass/Herb	None	None	Continuous	2
Comments:	narrow steep gradient foreshore				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	10	>25
Comments:		

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	
Fauna Comments:	1 sand piper ,1 eagle, 2 robins

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:										

Lake Koocanusa Segment No. 49



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
3.3	Cliff/Bluff	None	Very Steep (60+)	Forestry	Low (<10%)	No	1	99
Comments:	steep unstable cliffs							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
95	0	5	0	0	0	0
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:								

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	45	30	20	5	0	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Abundant (>50%)	Continuous	30	0
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Grass/Herb	None	None	Continuous	1
Comments:	narrow steep gradient foreshore				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	1	5-25
Comments:	no real littoral	

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	some larch/deciduous scattered
Fauna Comments:	1 robin, swallows

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:										

Lake Koocanusa Segment No. 50



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
2.5	Gravel	Road	Steep (20-60)	Forestry	Low (<10%)	Yes	1	99
Comments:	10 m steep gravel banks							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	10	60	30	0	0	0
Comments:	1 bedrock outcrop					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:								

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	20	40	25	4	1
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Abundant (>50%)	Continuous	30	0
Comments:	old road in 1 place at n end					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Grass/Herb	None	None	Continuous	5
Comments:	narrow steep gradient foreshore				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	5	>25
Comments:	narrow	

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	
Fauna Comments:	1 sand piper, 1 loon, swallows , 1 merg

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	1	0	No	0
Comments:										

Lake Koocanusa Segment No. 51



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
2.4	Gravel	Road	Bench	Forestry	Low (<10%)	Yes	30	70
Comments:	sand beach, organized camping, Dorr, grassy fields							

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	10	60	30	0	0	0
Comments:	1 sand beach 350 m long					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	50	0	0	0	50	0	0
Comments:	check land use/ownership							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	30	40	15	5	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	Grass/Herb	Moderate (10-50%)	Sparse (<10%)	Patchy	30	0
Comments:	recreation					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Grass/Herb	None	None	Continuous	10
Comments:	narrow steep gradient foreshore				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	5	>25
Comments:	narrow	

Riparian Habitat

Veteran Trees	Snags
<5	<5
Flora Comments:	
Fauna Comments:	humans

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	1	0	50	0	No	0
Comments:	check roads, Dorr official boat launch									

Lake Koocanusa Segment No. 52



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
5.2	Gravel	Road	Moderate (5-20)	Forestry	High (>40%)	Yes	50	50
Comments:	good public access, 3 sand beaches							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	10	60	30	0	0	0
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	95	0	0	0	5	0	0
Comments:	extensive upland and foreshore use, 5 unorganized campsites, heavy orv use with serious damage							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	24	25	35	10	5	1
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Moderate (10-50%)	Moderate (10-50%)	Patchy	30	0
Comments:	heavy use, roads, trails					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Grass/Herb	None	None	Patchy	30
Comments:	Dorr bay heavy orv use at low water				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Moderate (10-50m)	30	>25
Comments:		

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	
Fauna Comments:	1 mule deer , 1 crow, 1 eagle, 1 juv eagle, 2 loons, 2 gulls

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat House	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	1	0	0	0	95	0	No	0
Comments:	informal boat launches, 2 mooring buoys, 10 boats									

Lake Koocanusa Segment No. 53



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
4.4	Cliff/Bluff	None	Very Steep (60+)	Forestry	Low (<10%)	Yes	0	100
Comments:	a few calcium formations, a few shale outcrops/ledges							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
90	5	5	0	0	0	0
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:	some orv at beginning s end							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	5	25	50	15	3	2
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Patchy	30	0
Comments:	steep, little orv use					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Grass/Herb	None	None	Continuous	1
Comments:	steep drop off				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	1	5-25
Comments:		

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	
Fauna Comments:	1 osprey , swallows , raven, sparrow

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	40	1	No	0
Comments:										

Lake Koocanusa Segment No. 54



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
3.1	Rocky Shore	Road	Low (0-5)	Forestry	Medium (10-40%)	Yes	40	60
Comments:	unorganized recreation/marina							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	50	40	10	0	0	0
Comments:	mainly low gradient , extensive grassy benches					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	5	95	0	0	0	0	0	0
Comments:	orv use/camping							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	5	25	50	18	2	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Herbs/grasses	Grass/Herb	Sparse (<10%)	Sparse (<10%)	Continuous	50	0
Comments:	grassy benches/gravel sand banks					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Herbs/grasses	Grass/Herb	None	None	Patchy	50
Comments:	wider than 50 in some places/narrower in a few				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	50	>25
Comments:	benches	

Riparian Habitat

Veteran Trees	Snags
5-25	<5
Flora Comments:	
Fauna Comments:	3 sandpipers, 2 kingfishers, 2 eagles, 1 heron, 3 gulls, 1 crow, Columbia ground squirrels

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	1	0	0	0	40	1	No	0
Comments:	1 large marina, unorganized road network									

Lake Koocanusa Segment No. 55



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
1.1	Cliff/Bluff	None	Very Steep (60+)	Rural	Low (<10%)	Yes	5	95
Comments:	private no buildings /check ownership							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
69	0	10	20	1	0	0
Comments:	big springs clay/sand banks					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	0	0	0	0	0	100	0
Comments:	check land use/some orv use							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	20	50	20	10	0	0
Comments:	some clay at big springs						

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Continuous	30	0
Comments:	open continuous forest/ overhanging root balls					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	10
Comments:	steep drop sand/gravel				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	5	>25
Comments:	steep drop	

Riparian Habitat

Veteran Trees	Snags
5-25	5-25
Flora Comments:	early arrow leaf balsam root,mullen
Fauna Comments:	10 mergs, bald eagle, swallow nests , swallows , 2 Lewis woodpecker

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	0	0	0	0	No	0
Comments:										

Lake Koocanusa Segment No. 56



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
3	Sand	Other	Low (0-5)	Recreation	Low (<10%)	Yes	70	30
Comments:	big springs campground							

AHI Data

Ecological Value
Moderate

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0	0	10	90	0	0	0
Comments:						

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	5	0	0	0	95	0	0
Comments:	beach							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	0	95	5	0	0	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Moderate (10-50%)	Continuous	30	0
Comments:						

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	30
Comments:	sand bay low gradient				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Wide (>50m)	100	5-25
Comments:	shallow sand bay	

Riparian Habitat

Veteran Trees	Snags
5-25	<5
Flora Comments:	
Fauna Comments:	1 osprey/people

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	2	0	0	0	No	0
Comments:	log swim breakwater									

Lake Koocanusa Segment No. 57



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Mod.	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
6.8	Rocky Shore	None	Steep (20-60)	Forestry	Low (<10%)	Yes	5	95
Comments:	orv use, camping, grazing							

AHI Data

Ecological Value
High

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
25	30	30	15	0	0	0
Comments:	4 pocket sand beaches					

Land Use

Agriculture	Commercial	Forestry	Industrial	Natural Area	Park	Recreation	Rural	Single Family
0	0	100	0	0	0	0	0	0
Comments:	extensive orv use/grazing/mtn bike trail							

Substrates

Mud	Organics	Fine	Sand	Gravel	Cobble	Boulder	Bedrock
0	0	10	25	35	25	5	0
Comments:							

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Veg.
Coniferous forest	mature forest	Sparse (<10%)	Abundant (>50%)	Continuous	30	0
Comments:	productive					

Vegetation Band 2

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Exposed soil	Sparse	None	None	Continuous	10
Comments:	sand /gravel slope				

Aquatic Vegetation

Aquatic	Submergent	Emergent	Floating
0	0	0	0
Comments:			

Littoral Zone

Littoral Zone	Littoral Width (m)	Large Woody Debris
Narrow (<10m)	5	>25
Comments:	mostly steep drops with pocket beaches and 1 small bay with clay/silt cliffs	

Riparian Habitat

Veteran Trees	Snags
>25	>25
Flora Comments:	pine/fir/knapweed
Fauna Comments:	1 osprey / 1 wt deer/ 25 canada geese/1 den wildlife/swallow nests/crow/raven

Modifications

Retain Walls	% Ret. Wall	Ret. Wall Material	Docks	Docks per km	Boat Launch	% Rail Modifier	% Road Modifier	Marinas	Substrate Mod.	% Substrate Mod.
0	0	0	0	0	2	0	0	0	No	0
Comments:	informal									

Appendix B.
Fish Field Sampling Data

Lake Koocanusa SHIM FISH Sample Sites July 10 – 16, 2015 Note: Reservoir Elevation 2444 ft.							
Date	Segment	Site	Method	Water Temp	Species	Habitat Type	Comments
11/7	1	1	seine	22.3	147 cyp - rs	sand beach	Madera Ranch
11/7	2	1	seine	16.5	5 mwf juv 9 rb – 1-3 year olds	tributary outlet, mud/ gravel/ boulders	Linklater Cr, at 2444 pool level, cattle access
11/7	3	1	seine	23.0	16 cyp yoy	sand beach	Sandy Shores
16/7	7	1	seine	20.0	6 cyp yoy observed 3 adult sk	silt/ gravel/ boulder	Gold Cr fan, cattle access
15/7	13	1	seine	23.0	42 cyp rs mixed age classes	org/silt/ sand	small bay s of sweetwater, tug boat moorage, berm on n side
13/7	19	1	snorkel	23.0	nil	silt	Cutt's marina, poor visibility – 1.5 m
13/7	20	1	snorkel	22.0	1 npm juv	rip-rap	rip-rap at Kikomun causeway, poor visibility – 1.5 m
14/7	32	1	seine	25.7	105 cyp juv – npm/rs/pmc 50 juv sk	silt over gravel	Sand Cr fan
13/7	35	1	seine	21.5	3 cyp juv	org/silt/ gravel side-channel	Kikomun Cr fan, observed 30 mwf juv, observed 1 dead adult sucker
13/7	35	2	seine	11.4	1 lnd	gravel riffle/LOD	Kikomun Creek riffle
13/7	37	1	seine	23.5	1 mwf juv 12 cyp yoy 1 yp juv	silt over gravel	gravel island s of Kikomun causeway
12/7	42	1	seine	24.5	50+ sk yoy 300+ cyp yoy/juv -rs, npm, pmc 9 yp juv	silt/sand	Waldo Cove, vegetated backwater
12/7	47	1	seine	17.0	12 cyp	silt	Elk R fan/side - channel
12/7	48	1	2 minnow traps	23.0	nil	silt	Elk R inlet foreshore, 2.0 m depth
11/7	54	1	seine	24.0	8 rs	silt/sand beach	N of Husman Campground/marina

Lake Koocanusa SHIM FISH Sample Sites September 22 - 24, 2015 Note: Reservoir Elevation 2400 ft.							
Date	Segment	Site	Method	Water Temp	Species	Habitat Type	Comments
21/9	1	1				sand beach	not sampled due to access
21/9	2	1	seine	14.0	12 k adults 10 sk adults 500+ cyp- yoy 7 rs juv	tributary outlet, mud/ gravel/ boulders	Linklater Cr, at 2440 pool level, evidence of kokanee spawning in stream, cattle access, periphyton
21/9	3	1	seine	19.0	101 cyp spp - rs/pmc/npm mix - 12 adults, 89 yoy, 30 juv	sand beach	Sandy Shores
21/9	7	1	seine	14.0	1 rs juv Observed-30+ cyprinid juveniles, 4 sk adults, 3 bt adults	silt/sand gravel/ cobble	Gold Cr fan cattle access bt observed off creek mouth (staging/ spawning migration)
22/9	13	1	seine	21.0	12 rs yoy 1 crayfish (60 mm)	org/silt/ gravel	bay s of sweetwater, tug boat moorage, berm on n side
22/9	19	1	snorkel	17.0	2 sk adults	silt over gravel, LOD	Cutt's marina, 2 m visibility, small flowing trib at head of inlet, cattle access
22/9	20	1	snorkel	17.0	1 mwf juv	rip-rap	rip-rap at Kikomun causeway, 2 m visibility, periphyton on substrate
22/9	20	2	snorkel	17.0	observed large schools of cyp/cat along shoreline	rip-rap/ gravel	Yaqakxaq= amki boat launch (Kikomun)
24/9	29	1	seine	14.5	3 longnose dace juv 3 cyp juv	silt over boulders/ cobble	Covalli area poor water visibility, steep slope to old stream channel, cattle access

22/9	32	1	seine	13.0	36 cyp - rs/pmc yoy 2 rs adults 42 sk yoy 1 longnose dace	silt over gravel	Sand Cr fan patches of submergent aquatic veg (Najas genus) severe slumping stream banks, ORV use
22/9	35	1				gravel/org/silt side-channel	not sampled
22/9	35	2	seine	9.0	observed several adult kokanee carcasses, 2 sk adults	gravel riffle/ LOD	Kikomun Creek riffle, evidence of kokanee spawning, grizzly predation
22/9	37	1	seine	16.6	Observed 8 adult kokanee crarcasses, observed large school of cyp/cat juv	silt over gravel	gravel island s of Kikomun causeway
24/9	42	1	seine	17.5	5 yp - 4 juv, 1 adult 300+ sk yoy 50 npm yoy/juv	silt	Waldo Cove vegetated backwater, ORV use
24/9	47	1					not sampled due to access
24/9	47	2	observe			Elk R fan/side - channel	woody debris management site, cattle access on floodplain, ORV use, heavily modified site
24/9	48	1					not sampled due to access
24/9	52	1	seine	18.0	3 yp juv 500+ cyp spp-Rs/pmc/npm observed 1 adult sk observed large schools of cyp juv along shoreline	silt/sand/ gravel	Dorr Bay s of Dorr rec site, widespread submergent macrophytes (Najas genus) 2 chub infested with cestodes

Abbreviations:	
cyp	cyprinids spp
cat	catostomid spp
pmc	peamouth chub
rs	redside shiner
mwf	mountain whitefish
rb	rainbow trout
npm	northern pike minnow
yp	yellow perch
sk	sucker spp
lnd	long nose dace
yoy	young of year class
k	kokanee
bt	bull trout
juv	juveniles
s	south
n	north
LOD	large organic debris
org	organics

July 10-16, 2015	***Reservoir Elevation: 2444 ft.***							
Site	**1-1**	**2-1**	**3-1**	**7-1**	**13-1**	**19-1**	**20-1**	**32-1**
Technique	*seine*	*seine*	*seine*	*seine & boat obs.*	*seine*	*snorkel*	*snorkel*	*seine*
Survey Length	1x15m	1x15m	1x15m	3x15m	1x15m	1x15min.	1x15min.	1x15m
cyprinids spp			16	6				
long nose dace								
mountain whitefish		5						
northern pikeminnow							1	75
rainbow trout		9						
redside shiner	147				42			30
sucker spp				3				50
yellow perch								
Totals	**147**	**14**	**16**	**9**	**42**	**0**	**1**	**155**
Relative Abundance (%)	**18.1**	**1.7**	**2.0**	**1.1**	**5.2**	**0.0**	**0.1**	**19.1**

July 10-16, 2015	***Reservoir Elevation: 2444 ft.***							
Site	**35-1**	**35-2**	**37-1**	**42-1**	**47-1**	**48-1**	**54-1**	**Total**
Technique	*seine & boat obs.*	*seine*	*seine*	*seine*	*seine*	*Gee traps x 2*	*seine*	
Survey Length	1x15m	1x15 m	1x30m	2x15m	1x15m	12hrs.	1x15m	
cyprinids spp			12		12			**46**
long nose dace		1						**1**
mountain whitefish	30	1	1					**37**
northern pikeminnow				200				**276**
rainbow trout								**9**
redside shiner				100			8	**327**
sucker spp	3			50				**106**
yellow perch			1	9				**10**
Totals	**33**	**2**	**14**	**359**	**12**	**0**	**8**	**812**
Relative Abundance (%)	**4.1**	**0.2**	**1.7**	**44.2**	**1.5**	**0.0**	**1.0**	

September 22-24, 2015	***Reservoir Elevation: 2400 ft.***						
Site	**2-1**	**3-1**	**7-1**	**13-1**	**19-1**	**20-1**	**20-2**
Technique	*seine*	*seine*	*seine & obs.*	*seine*	*snorkel*	*snorkel*	*snorkel*
Survey Length	1x15m	1x15m	1x15m	1x15m	1x15min.	1x15min.	1x15min.
bull trout			3				
cyprinids spp	500	100	30				100*
crayfish				1			
kokanee	12						
long nose dace							
mountain whitefish						1	
northern pikeminnow							
redside shiner	7		1	12			
sucker spp	10		4		2		
yellow perch							
Totals	**529**	**100**	**38**	**13**	**2**	**1**	**100**
Relative Abundance (%)	**32.4**	**6.1**	**2.3**	**0.8**	**0.1**	**0.1**	**6.1**

September 22-24, 2015	***Reservoir Elevation: 2400 ft.***						
Site *Technique* Survey Length	**29-1** *seine* 1x15m	**32-1** *seine* 1x15m	**35-2** *seine & obs.* 1x15m	**37-1** *seine & obs.* 1x15m	**42-1** *seine* 1x15m	**52-1** *seine & obs.* 1x15m	**Total**
bull trout							**3**
cyprinids spp	3	36		100*		500	**1369**
crayfish							**1**
kokanee							**12**
long nose dace	3	1					**4**
mountain whitefish							**1**
northern pikeminnow					50		**50**
redside shiner		2					**22**
sucker spp		42	2		300	1	**361**
yellow perch					5	3	**8**
Totals	**6**	**81**	**2**	**100**	**355**	**504**	**1831**
Relative Abundance (%)	**0.4**	**5.0**	**0.1**	**6.1**	**21.8**	**30.9**	

*Note: data includes both juvenile and adult fish of the same species. Data that included '+' signs were rounded to a whole number so that relative abundance calculations could be completed (i.e., 100+ fish was recorded as 100 fish).

*Large schools of cyp juveniles observed at sites 26-1 and 39-2, given a value of 100

Species	**Relative Abundance**
bull trout	0.1%
cyprinids spp	49.7%
crayfish	0.0%
kokanee	0.5%
long nose dace	0.2%
mountain whitefish	1.6%
northern pikeminnow	13.3%
rainbow trout	0.4%
redside shiner	14.3%
sucker spp	19.1%
yellow perch	0.7%

Appendix C.
Wildlife Field Sampling Data

	Lake Koocanusa Sample Sites – Wildlife Observations for July and September, 2015			
Habitat Type\Site #	**1-1**	**2-1**	**3-1**	**7-1**
Forest Canopy - Age/Canopy - Species	Mature/open Py (Fd)	Open/clumps Py, Fd	None (sand dunes)	Mature/sparse Mixed spp.
Wildlife Trees	Few	Few – moderate	N	N
CWD	Few-none	Very little	Very little	N
LOD	Abundant	Moderate		N
Shrub Cover – Amount - Species	Moderate – abundant Bitterbrush, Oregon grape, native grasses	Sparse – moderate Rose, Bitterbrush	Low Bitterbrush on knobs	Moderate – abundant
Clay Banks	Y	Y	N	Y
Adjacent Wetlands	Y	Y	N	N
Littoral Zone – Gradient - Piece			Moderate – steep Sand	
Emergent/Submergent	N	N	N	
Wildlife – July	Heron, Swallows, deer, elk	Western toad, mule deer, skunk	Heron	13 adult + 2 imm. Mergansers, 1 adult + 1 juv. Bald Eagles, Swallows, Heron, 2 Kingfisher, 3 Killdeer, Sandpiper, bear scat, deer tracks
Wildlife – September		Bald eagle, B.C. Chickadee, mule deer, Pileated Woodpecker		1 adult + 2 W.T. deer fawns, heavy geese use, Ravens, Kingfisher
Notes	Well defined ungulate trails, cattle impacts, mullein	Significant cattle impacts	Day use beach	Cattle impacts

Habitat Type\Site #		**13-1**	**19-1**	**20-1**
Forest Canopy - Age/Canopy - Species		Open/sparse Deciduous (Fd)	Young (south side) Fd, Lw	A few scattered deciduous
Wildlife Trees			Few –small diameter Lw	N
CWD		Y (south side)(High value)	Y	N
LOD		Y (south side)	Y	N
Shrub Cover – Amount - Species		Y (sparse)	Sparse Willow	N
Clay Banks		Y (sparse south side/absent north)	N	N
Adjacent Wetlands		N	N	N
Littoral Zone – Gradient - Piece		N		Steep
Emergent/Submergent		Low	N	N
Wildlife	July	Sandpiper, Meadowlark, 2 American Robins, Western Tanager, Killdeer, Swallows, Merganser		
	September	Sparrows, Chickadee, deer, elk, heron tracks	1 kokanee	2 Grebes
Notes		Cattle impacts	Significant cattle impacts to stream	Rip Rap

Habitat Type\Site #		**32-1**	**35-1**	**37-1**
Forest Canopy - Age/Canopy - Species		None	None	None
Wildlife Trees		N	N	N
CWD		N	Y	Y
LOD		Y	Sparse	Y
Shrub Cover – Amount - Species		N	N Grass, herb, sedge	None Grassland/herb
Clay Banks		Y	N	N
Adjacent Wetlands		Y	Y	N
Littoral Zone – Gradient - Piece		Low	Low	Low Sand/gravel
Emergent/Submergent		N		No
Wildlife	July	Swallows, 2 mature + 3 imm. Mergansers, 2 Loons, 30 Canada Geese	Herons, 2 Kingfisher, Robin, Sparrows, western toad, deer	Long billed Curlew, Sandpiper, Osprey
	September	Canada Geese, Mallards, Grebes, Mergansers, Gulls, 2 mature + 1 juv. Bald Eagles, Sharp-shinned Hawk, 4 Loons, deer	Grebe (juv.), Mergansers, 6 Bald Eagles (juv.+ mat.), Mallards, Teal, 4 Loons, Crows, Sandpipers, Bufflehead, Heron tracks and grizzly, elk and deer tracks	Heron, gulls, deer beds, sparrows, heavy geese use
Notes		Garbage, ORV impacts	ORV/Cattle impacts, buttercup (?) establishment below HWM, three orphaned decks	Significant ORV use, Curlew nesting area and potential WHA

Habitat Type\Site #		42-1	47-1	54-1
Forest Canopy - Age/Canopy - Species		Mid – mature/Open - closed Py(Fd)(At)	Mature/closed Conifer/deciduous	Mature – OR/OF Py(Fd)
Wildlife Trees		N	N	N
CWD		N	Few	N
LOD		Abundant	Sparse	N
Shrub Cover – Amount - Species		Sparse – moderate Bitterbrush, Saskatoon	Sparse Willow spp.	Very sparse Wild rose, grassland,
Clay Banks		N	N	N
Adjacent Wetlands		N	Y	N
Littoral Zone – Gradient - Piece		Low Sand	Low	Moderate
Emergent/Submergent			Y	N
Wildlife	July		50 Canada geese, 7 Mergansers, Heron	Sparrow
	September	200 Canada Geese, 100+ ducks (Scaup, Mallard, Teal, Pintail), 1 gull 2 mule deer 1 Pileated Woodpecker	2 Mergansers, 50 gulls 1 white-tailed deer 1 Bald Eagle - juvenile	5 Mallards, 1 Merganser, 3 Grebes 1 Raven
Notes		Mid-afternoon/windy/hot (July), Alfalfa, clover, Road access open, ORV and cattle use impacts in WHA/AMA, Significant waterfowl staging area	BCH debris management area highly disturbed, log boom on dry flood plain, burn piles, ORV access and use, cattle tracks across entire flood plain	Excavator work on road, ORV damage, cattle impacts

Low-Pool Flight – April 12, 2016	
Segment Number	**Species Observed**
4	Ungulate tracks
8	Abundant ungulate tracks
17	Abundant ungulate tracks
27	Canada Geese
29	Mallards, Canada Geese
31	Canada Geese
32	Bald Eagle
34	5 Snow Geese
39	Ungulate tracks, 3 deer
40	Ungulate tracks
46	Bufflehead

Appendix D.
Lake Koocanusa Bird Records

Bird species (N = 133) recorded in eBird (2016) at 7 "hotspots" on Lake Koocanusa. Coarse habitat association for each species was added by I. Adams. The "US" location covers birds noted from the US reach of the reservoir; "Libby Dam" are birds observed in the vicinity of the dam. Note this is not an exhaustive list of birds that occur at or near Lake Koocanusa. It is a record of species that have been entered by "birders" using the eBird website. * denotes a listed species (federal and/or provincial)

Species	Habitat	Wardner	Kikomun Bridge	Elk Mouth	Gold Bay	Kragmont	US	Libby Dam	N sites
American Avocet	wader							1	1
American Coot	water bird	1	1						2
American Crow	land bird	1	1	1			1	1	5
American Dipper	riverine	1							1
American Goldfinch	land bird	1							1
American Kestrel	land bird	1		1	1	1			4
American Robin	land bird	1	1	1			1	1	5
American White Pelican*	water bird	1							1
American Wigeon	water bird	1	1	1					3
Bald Eagle	riparian	1	1	1	1	1	1	1	7
Bank Swallow*	riparian			1	1				2
Barn Swallow*	land bird							1	1
Belted Kingfisher	riparian		1	1		1		1	4
Black-billed Magpie	land bird		1	1					2
Black-capped Chickadee	land bird	1		1	1		1	1	5
Black-chinned Hummingbird	land bird							1	1
Black-headed Grosbeak	riparian			1					1
Blue Jay	land bird	1							1
Blue-winged Teal	water bird		1						1
Bonaparte's Gull	water bird			1					1
Brewer's Blackbird	wetland	1		1					2
Brown-headed Cowbird	land bird			1					1
Bufflehead	water bird	1	1					1	3
Bullock's Oriole	riparian	1							1
California Gull	water bird	1	1				1	1	4

Species	Habitat	Wardner	Kikomun Bridge	Elk Mouth	Gold Bay	Kragmont	US	Libby Dam	N sites
Calliope Hummingbird	land bird			1					1
Canada Goose	water bird	1	1	1	1		1	1	6
Canvasback	water bird	1							1
Caspian Tern	water bird					1			1
Cassin's Finch	land bird							1	1
Cassin's Vireo	land bird			1	1			1	3
Cedar Waxwing	land bird	1	1	1	1		1	1	6
Chipping Sparrow	land bird	1	1				1	1	4
Cinnamon Teal	water bird		1						1
Clark's Grebe	water bird		1						1
Clark's Nutcracker	land bird	1							1
Clay-colored Sparrow	grassland			1					1
Cliff Swallow	riparian			1			1	1	3
Common Goldeneye	water bird	1	1					1	3
Common Loon	water bird	1	1	1	1	1	1		6
Common Merganser	water bird	1	1	1	1		1	1	6
Common Nighthawk*	land bird			1				1	2
Common Raven	land bird	1	1	1			1	1	5
Common Redpoll	land bird	1							1
Common Yellowthroat	riparian			1					1
Cooper's Hawk	land bird	1		1					2
Dark-eyed Junco	land bird	1	1	1	1		1	1	6
Downy Woodpecker	land bird	1							1
Eastern Kingbird	land bird	1		1			1	1	4
Eurasian Collared-Dove	land bird	1							1
European Starling	land bird	1	1	1				1	4
Evening Grosbeak*	land bird	1						1	2
Golden Eagle	land bird		1	1					2
Gray Catbird	land bird	1							1

Species	Habitat	Wardner	Kikomun Bridge	Elk Mouth	Gold Bay	Kragmont	US	Libby Dam	N sites
Gray Jay	land bird		1	1			1		3
Great Blue Heron*	wader	1			1		1	1	4
Green-winged Teal	water bird	1							1
Hairy Woodpecker	land bird	1							1
Hermit Thrush	land bird							1	1
Herring Gull	water bird		1					1	2
Hooded Merganser	water bird		1						1
Horned Grebe*	water bird		1						1
House Finch	land bird	1						1	2
House Sparrow	land bird	1							1
Killdeer	shorebird	1	1				1		3
Lazuli Bunting	land bird	1		1					2
Lesser Scaup	water bird		1						1
Lewis Woodpecker*	land bird				1				1
Long-billed Curlew*	shorebird	1		1					2
MacGillivray's Warbler	land bird						1		1
Mallard	water bird	1	1	1		1	1		5
Merlin	land bird	1							1
Mountain Bluebird	land bird	1	1	1				1	4
Mountain Chickadee	land bird	1	1				1		3
Mourning Dove	land bird	1		1	1		1	1	5
Nashville Warbler	land bird							1	1
Northern Flicker	land bird	1	1	1	1		1	1	6
Northern Harrier	wetland	1	1						2
Northern Pintail	water bird		1						1
Northern Rough-winged Swallow	riparian	1	1		1			1	4
Northern Shoveler	water bird		1						1
Osprey	water bird	1	1		1		1	1	5
Pied-billed Grebe	wetland	1							1

Species	Habitat	Wardner	Kikomun Bridge	Elk Mouth	Gold Bay	Kragmont	US	Libby Dam	N sites
Pileated Woodpecker	land bird	1							1
Pine Siskin	land bird	1	1	1			1	1	5
Red Crossbill	land bird	1	1				1	1	4
Red-breasted Nuthatch	land bird	1	1		1		1	1	5
Redhead	water bird	1							1
Red-naped Sapsucker	land bird	1							1
Red-necked Grebe	water bird		1						1
Red-tailed Hawk	land bird	1	1	1		1	1	1	6
Red-winged Blackbird	wetland	1	1	1			1		4
Ring-billed Gull	water bird	1	1			1	1	1	5
Ring-necked Duck	water bird	1	1						2
Ring-necked Pheasant	land bird		1						1
Rock Pigeon	land bird	1							1
Rock Wren	land bird		1	1				1	3
Ruby-crowned Kinglet	land bird	1	1						2
Ruffed Grouse	land bird		1	1					2
Rufous Hummingbird	land bird	1							1
Savannah Sparrow	land bird	1							1
Sharp-shinned Hawk	land bird	1	1						2
Solitary Sandpiper	shorebird				1				1
Snow Bunting	land bird		1						1
Snow Goose	water bird	1							1
Song Sparrow	riparian	1		1			1	1	4
Spotted Sandpiper	shorebird	1	1	1	1		1	1	6
Spotted Towhee	land bird	1							1
Steller's Jay	land bird	1							1
Swainson's Thrush	land bird						1	1	2
Townsend's Solitaire	land bird	1	1				1	1	4
Tree Swallow	land bird	1	1				1		3

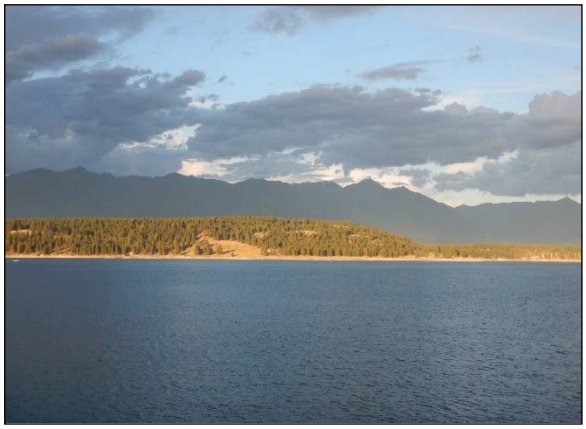
Species	Habitat	Wardner	Kikomun Bridge	Elk Mouth	Gold Bay	Kragmont	US	Libby Dam	N sites
Trumpeter Swan	water bird	1							1
Tundra Swan	water bird		1						1
Turkey Vulture	land bird	1		1				1	3
Varied Thrush	land bird	1							1
Vesper Sparrow	grassland	1	1						2
Violet-green Swallow	land bird	1	1	1			1	1	5
Warbling Vireo	land bird	1		1					2
Western Bluebird	land bird	1	1	1					3
Western Grebe*	water bird	1	1				1		3
Western Kingbird	land bird	1						1	2
Western Meadowlark	grassland	1	1						2
Western Tanager	land bird		1		1		1	1	4
Western Wood-Pewee	land bird	1					1	1	3
White-crowned Sparrow	land bird	1							1
Wild Turkey	land bird	1					1	1	3
Willow Flycatcher	wetland			1					1
Wood Duck	water bird							1	1
Yellow Warbler	riparian	1		1			1		3
Yellow-rumped Warbler	land bird	1	1	1			1	1	5
Totals		**88**	**62**	**50**	**20**	**8**	**41**	**52**	

Appendix E.
Aquatic Habitat Index Results

		Biophysical					Zones of Sensitivity		Vegetation				Modifications							
Segment Number	***Segment Length (km)***	**Shore Type**	**Percentage Natural**	**Substrate**	**Overhanging Vegetation**	**Aquatic Vegetation**	**Aquatic or Unique***	**Birds**	**Band 1 – Full Pool**	**Band 2 - DDZ**	**Veteran Trees**	**Snags**	**Retaining Walls**	**Dock Density**	**Boat Launch**	**Marina**	**AHI Score**	***Ecological Value***	**AHI Potential**	***Ecological Potential***
1	*2.78*	10.3	13.5	6.4	0.0	0.0	0.0	0.0	8.0	0.0	5.0	5.0	0.0	0	-3	0	**45.2**	***High***	48.2	*High*
2	*3.01*	12.0	14.3	6.6	0.3	0.0	5.0	0.0	8.0	0.0	5.0	5.0	0.0	0	0	0	**56.2**	***Very High***	56.2	*Very High*
3	*4.22*	10.5	3.0	4.6	0.0	0.0	0.0	0.0	8.0	0.0	5.0	1.0	0.0	0	-3	0	**29.1**	***Low***	32.1	*Low*
4	*1.65*	13.5	14.9	6.8	0.0	0.0	5.0	0.0	8.0	5.0	5.0	3.0	0.0	0	0	0	**61.2**	***Very High***	61.2	*Very High*
5	*2.49*	13.5	9.5	7.6	0.1	0.0	0.0	0.0	8.0	0.0	5.0	3.0	0.0	0	0	0	**46.7**	***High***	46.7	*High*
6	*3.65*	10.4	9.0	4.8	0.1	0.0	5.0	5.0	8.0	0.0	3.0	1.0	-0.1	-0.1	0	-2	**44.1**	***Moderate***	46.2	*High*
7	*1.41*	12.0	13.5	6.8	2.4	0.0	5.0	5.0	8.0	5.0	0.0	1.0	0.0	-0.1	-3	0	**55.6**	***Very High***	58.7	*Very High*
8	*2.08*	10.3	13.5	5.1	0.0	0.0	5.0	5.0	10.0	0.0	0.0	0.0	0.0	0	0	0	**48.9**	***High***	48.9	*High*
9	*2.04*	10.5	3.0	4.4	0.0	0.0	5.0	0.0	8.0	0.0	0.0	0.0	0.0	0	0	0	**30.9**	***Low***	30.9	*Low*
10	*7.42*	12.0	11.3	5.6	0.1	0.0	5.0	5.0	8.0	5.0	5.0	5.0	0.0	0	-3	0	**58.9**	***Very High***	61.9	*Very High*
11	*3.68*	12.0	15.0	6.2	0.0	0.0	0.0	0.0	8.0	0.0	5.0	5.0	0.0	0	0	0	**51.2**	***High***	51.2	*High*
12	*2.04*	14.5	9.0	7.9	0.0	0.0	5.0	0.0	8.0	0.0	1.0	1.0	0.0	-0.1	-3	0	**43.3**	***Moderate***	46.4	*High*
13	*1.04*	10.0	7.5	7.0	0.0	0.0	5.0	0.0	10.0	5.0	0.0	1.0	0.0	-0.1	0	0	**45.4**	***High***	45.5	*High*
14	*2.72*	15.0	0.0	7.4	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	-0.1	-2	-3	-2	**18.4**	***Very Low***	25.4	*Very Low*
15	*1.26*	11.0	14.3	5.3	0.1	0.0	0.0	0.0	8.0	0.0	3.0	0.0	-0.1	-0.1	0	0	**41.5**	***Moderate***	41.6	*Moderate*
16	*1.81*	11.3	0.0	6.1	0.1	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	-0.2	-3	-6	**16.2**	***Very Low***	25.4	*Very Low*
17	*2.37*	10.3	14.3	4.3	0.1	0.0	0.0	0.0	8.0	0.0	1.0	0.0	0.0	0	0	0	**37.9**	***Moderate***	37.9	*Moderate*
18	*3.67*	13.8	15.0	7.3	0.1	0.0	0.0	0.0	8.0	0.0	5.0	5.0	0.0	0	0	0	**54.2**	***High***	54.2	*High*
19	*0.94*	12.6	0.0	5.6	0.0	0.0	0.0	0.0	8.0	0.0	1.0	0.0	-0.3	-1	-3	-4	**18.9**	***Very Low***	27.2	*Low*
20	*1.65*	5.2	0.3	6.0	0.0	0.0	0.0	0.0	4.8	0.0	0.0	0.0	0.0	0	0	0	**16.3**	***Very Low***	16.3	*Very Low*
21	*3.48*	12.8	14.7	6.7	0.1	0.0	0.0	0.0	8.0	0.0	5.0	3.0	0.0	0	0	0	**50.3**	***High***	50.3	*High*
22	*5.00*	14.4	7.5	4.7	0.0	0.0	5.0	0.0	8.0	5.0	5.0	5.0	0.0	0	0	0	**54.6**	***High***	54.6	*High*
23	*11.51*	13.1	14.3	6.3	0.0	0.0	0.0	0.0	8.0	5.0	5.0	5.0	0.0	0	0	0	**56.7**	***Very High***	56.7	*Very High*
24	*2.51*	11.5	14.9	5.0	0.1	0.0	0.0	0.0	8.0	0.0	3.0	3.0	0.0	0	-3	0	**42.4**	***Moderate***	45.4	*High*
25	*3.72*	10.5	1.5	7.1	0.1	2.4	5.0	0.0	3.0	5.0	0.0	0.0	0.0	0	-3	0	**31.6**	***Low***	34.6	*Low*
26	*6.53*	5.0	7.5	4.8	0.0	0.0	0.0	5.0	8.0	5.0	1.0	0.0	0.0	0	0	0	**36.3**	***Moderate***	36.3	*Moderate*
27	*3.42*	15.0	12.0	7.4	0.1	0.0	0.0	5.0	8.0	5.0	3.0	1.0	0.0	0	0	0	**56.5**	***Very High***	56.5	*Very High*
28	*1.18*	15.0	7.5	6.6	0.0	0.0	0.0	0.0	6.0	0.0	1.0	0.0	0.0	0	0	0	**36.1**	***Moderate***	36.1	*Moderate*
29	*11.04*	13.5	14.3	6.6	0.1	0.0	0.0	0.0	8.0	0.0	5.0	5.0	0.0	0	-3	0	**49.4**	***High***	52.4	*High*
30	*1.98*	11.5	14.9	3.6	0.2	0.0	5.0*	0.0	8.0	0.0	1.0	1.0	0.0	0	0	0	**45.1**	***High***	45.1	*High*
31	*4.14*	12.3	14.3	7.1	0.0	0.0	0.0	5.0	8.0	0.0	5.0	1.0	0.0	0	0	0	**52.6**	***High***	52.6	*High*
32	*1.75*	16.0	13.5	7.0	0.0	1.6	5.0	0.0	10.0	5.0	0.0	0.0	0.0	0	0	0	**58.1**	***Very High***	58.1	*Very High*
33	*3.93*	12.5	3.0	6.5	0.1	0.0	0.0	0.0	8.0	0.0	0.0	1.0	-0.4	-3	-3	0	**24.6**	***Very Low***	31.0	*Low*
34	*3.15*	14.0	7.5	7.3	0.1	0.0	0.0	0.0	8.0	5.0	3.0	0.0	0.0	0	0	0	**44.9**	***Moderate***	44.9	*Moderate*
35	*2.16*	13.4	14.7	7.3	0.1	0.0	5.0	0.0	8.0	0.0	3.0	0.0	0.0	0	0	0	**51.4**	***High***	51.4	*High*
36	*1.45*	15.0	4.5	6.4	0.1	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0	-3	0	**26.6**	***Low***	29.6	*Low*
37	*1.94*	14.5	14.3	7.6	0.0	0.0	0.0	5.0	6.0	5.0	0.0	0.0	0.0	0	-3	0	**49.3**	***High***	52.3	*High*
38	*5.87*	13.5	9.0	7.3	0.2	0.0	0.0	0.0	8.0	0.0	5.0	5.0	0.0	0	-3	0	**45.0**	***Moderate***	48.0	*High*
39	*0.72*	12.5	6.0	6.6	0.1	0.0	0.0	0.0	8.0	0.0	0.0	5.0	0.0	-0.1	0	0	**38.1**	***Moderate***	38.2	*Moderate*
40	*3.21*	7.3	3.8	5.8	0.1	2.4	0.0	5.0	6.0	5.0	1.0	0.0	0.0	0	0	0	**36.3**	***Moderate***	36.3	*Moderate*
41	*1.95*	7.0	13.5	5.3	0.0	2.4	0.0	5.0	6.0	5.0	0.0	0.0	0.0	0	0	0	**44.2**	***Moderate***	44.2	*Moderate*
42	*0.91*	9.5	6.0	5.2	1.2	2.4	0.0	5.0	8.0	5.0	1.0	1.0	0.0	-0.3	-3	0	**41.0**	***Moderate***	44.3	*Moderate*
43	*1.86*	11.0	9.0	6.2	0.3	0.8	0.0	5.0	8.0	0.0	3.0	1.0	0.0	-0.1	-3	0	**41.2**	***Moderate***	44.3	*Moderate*
44	*1.18*	11.0	14.7	5.6	0.1	0.0	0.0	0.0	8.0	0.0	5.0	5.0	-0.1	-0.1	0	0	**49.3**	***High***	49.5	*High*
45	*0.71*	11.0	12.0	6.0	0.1	0.0	0.0	0.0	8.0	0.0	1.0	3.0	0.0	-0.2	-3	0	**37.9**	***Moderate***	41.1	*Moderate*
46	*3.34*	12.0	15.0	6.2	0.1	0.0	5.0	0.0	8.0	0.0	5.0	5.0	0.0	0	0	0	**56.3**	***Very High***	56.3	*Very High*
47	*5.90*	14.8	14.9	5.4	1.2	5.2	5.0	5.0	8.0	5.0	0.0	0.0	0.0	0	0	0	**64.4**	***Very High***	64.4	*Very High*
48	*1.52*	14.5	14.9	7.2	0.0	0.0	5.0	0.0	8.0	0.0	5.0	5.0	0.0	0	0	0	**59.6**	***Very High***	59.6	*Very High*
49	*3.26*	10.3	14.9	5.1	0.0	0.0	5.0	0.0	8.0	0.0	5.0	5.0	0.0	0	0	0	**53.2**	***High***	53.2	*High*
50	*2.48*	13.5	14.9	7.2	0.0	0.0	0.0	0.0	8.0	0.0	5.0	5.0	0.0	0	0	0	**53.5**	***High***	53.5	*High*
51	*2.35*	13.5	10.5	6.6	0.0	0.0	0.0	0.0	8.0	0.0	1.0	1.0	0.0	0	-3	0	**37.6**	***Moderate***	40.6	*Moderate*
52	*5.20*	13.5	7.5	6.1	0.0	0.0	5.0	0.0	8.0	0.0	5.0	5.0	0.0	-0.1	-3	0	**47.0**	***High***	50.1	*High*
53	*4.35*	10.5	15.0	6.9	0.0	0.0	0.0	0.0	8.0	0.0	5.0	5.0	0.0	0	0	-2	**48.4**	***High***	50.4	*High*
54	*3.06*	14.5	9.0	7.1	0.0	0.0	5.0	5.0	6.0	5.0	3.0	1.0	0.0	-0.1	0	-2	**53.5**	***High***	55.6	*Very High*
55	*1.14*	10.6	14.3	5.4	0.0	0.0	0.0	5.0	8.0	0.0	3.0	3.0	0.0	0	0	0	**49.3**	***High***	49.3	*High*
56	*2.97*	10.5	4.5	4.2	0.0	0.0	5.0	5.0	8.0	0.0	3.0	1.0	0.0	0	-3	0	**38.2**	***Moderate***	41.2	*Moderate*
57	*6.83*	13.0	14.3	7.0	0.0	0.0	0.0	0.0	8.0	0.0	5.0	5.0	0.0	0	-3	0	**49.3**	***High***	52.3	*High*
Max Value	*11.5*	*16.0*	*15.0*	*7.9*	*2.4*	*5.2*	*5.0*	*5.0*	*10.0*	*5.0*	*5.0*	*5.0*	*0.0*	*0.0*	*0.0*	*0.0*	***64.4***		*64.4*	
Min Value	*0.7*	*5.0*	*0.0*	*3.6*	*0.0*	*0.0*	*0.0*	*0.0*	*3.0*	*0.0*	*0.0*	*0.0*	*-0.4*	*-3.0*	*-3.0*	*-6.0*	***16.2***		*16.3*	

Maximum	***Minimum***	***Range***	***Class Size***	***Break(VH)***	***Break(H)***	***Break(M)***	***Break(L)***	***Break(VL)***
64.4	*16.2*	*48.2*	*9.6*	*54.8*	*45.1*	*35.5*	*25.8*	*0*

LAKE KOOCANUSA
SHORELINE MANAGEMENT GUIDELINES



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PREFACE

This report provides Shoreline Management Guidelines (the Guidelines) for the Canadian portion of Lake Koocanusa, which extends between Wardner, BC and the US/Canada border.

A recent increase in development proposals and recreational activities along the foreshore of Lake Koocanusa, including vegetation clearing, construction, off-road vehicle use, and cattle grazing, have rapidly degraded natural habitat and present a threat to the long-term sustainability of local fish and wildlife populations.

The Guidelines in this document provide a science-based assessment of habitat value and required level of protection for individual segments of the lake's foreshore. They were prepared based on the technical results from the Foreshore Inventory and Mapping exercise (FIM) and the Aquatic Habitat Index analysis (AHI).

The objective of the Guidelines is to help plan future developments and recreational activities on Lake Koocanusa, while conserving and restoring natural habitat that local fish and wildlife species rely on to complete their life cycle.

It is noted here that certain applications may require other agency approvals such as Interior Health or the Archaeology Branch for pre-contact archaeology sites, or pos-contact heritage wreck sites, and it is the responsibility of the proponent to ensure that all applicable permits or applications have been submitted and approved prior to prceeding with any works.

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1.0 INTRODUCTION

The Shoreline Management Guidelines (Guidelines) are intended to conserve fish and wildlife habitat and are a tool to assist landowners and recreational users proposing new developments and/or recreational activities along the shoreline. The Lake Koocanusa shoreline has a diversity of important fish and wildlife habitats and species. Future developments and activities should incorporate measures to guaranty the protection and long-term sustainability of fish and wildlife populations in the area, and whenever possible, help restore physical and ecological functions where they have been impacted. This is particularly important in ecologically sensitive areas. Clearly defined policies and associated strategies will help guide future decisions and promote a coordinated approach to foreshore management among regulatory agencies.

The Guidelines in this document were prepared based on findings from the Sensitive Habitat Inventory Mapping study (SHIM), which included the following exercises:

1. **Foreshore Inventory and Mapping** (FIM) was conducted to identify and inventory important habitat features across the reservoir. Data sources included fish and wildlife surveys completed by the EKILMP team, as well as information from various provincial databases; and

2. **An Aquatic Habitat Index** (AHI) was generated using the FIM data to determine the relative habitat value of each shoreline segment. This index follows similar methods that were developed for other lakes in the East Kootenay Region, including Windermere Lake, Tie Lake, Rosen Lakes and Columbia Lake.

In an effort to standardize shoreline management guidelines between lakes across the region, large sections of the following document were adapted from the Lake Windermere guideline document developed by the East Kootenay Integrated Lake Management Partnership in 2008, and this document is used as a template. The original authors are given full credit for any portion of this document that are similar to the original document.

The original guidelines and activity risk table developed for natural lakes was modified to take into consideration the significant variations in water levels occurring in active hydroelectric reservoirs, such as Lake Koocanusa. A risk table was developed to differentiate varying levels of risks associated with projects/activities proposed along the shoreline at full-pool. The full-pool shoreline is defined as the elevation band between 744.9 to 749.5 m (2444 - 2459 feet) and the 30 meter zone of adjacent upland. The drawdown zone is identified as the elevation between 730.9 and 744.9 m (2398 - 2444 feet).

2.0 SHORELINE MANAGEMENT GUIDELINES FOR LAKE KOOCANUSA

A colour scheme was developed to rank shoreline segments based on fish and wildlife habitat values, determined through the AHI analysis. The colour scheme (red, orange, yellow or grey) represents a shoreline segment's level of sensitivity to development. The delineation of each shoreline segment can be found on the SHIM maps in Appendix A. The SHIM maps, the activity risk table, and the process flow chart form the basis of the Guidelines.

The following is a How-to Guide for development planning along the Lake Koocanusa shoreline:

1. Determine the colour zone that your development project/activity is situated in using the maps in Appendix A. Note that Red Zones are designated Conservation Areas. No development should be considered or approved in these zones.

2. Determine the risk level associated with your specific activity using the Shoreline Activity Risk Table (Table 1). If your activity is not listed, assume high risk, and contact FrontCounter BC for advice.

a. If a species at risk has been identified in the area, the risk increases as identified in the Modifier Column of the Activity Risk Table.
b. If your activity is identified as High Risk, consider relocating your project to a colour zone with less sensitive habitat (e.g., move to a yellow or grey zone) or select a lower risk activity.

3. Use the Flow Chart to determine your projects regulatory review requirements based on the risk of the proposed development/activity.

2.1 Step 1 – Shoreline Sensitivity Colour Zones

Use the SHIM maps in Appendix A to determine the shoreline colour classification for the area of the proposed development/activity. The definitions and guidelines for each colour category are provided below.

Red Shoreline

Defined by: Very High Value Habitats

Recommendation:
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. These areas are located along the shoreline and include most tributary inlets, shallow vegetated areas, and zones essential for fish and/or wildlife populations to complete their life cycle. Proponents should consider moving high risk activities to other areas if possible, or pursuing lower risk activities.
EKILMP recommends that these areas be designated for conservation use, and that no development or activities 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 are prohibited. Habitat restoration and enhancement projects are encouraged in these areas where warranted.

Orange Shoreline

Defined by: High Value Habitats

Background:
These shoreline segments have been identified as High Value Habitat Areas for fish and/or wildlife through the AHI Analysis. These areas are sensitive to development, provide important ecological functions, but may be at risk from adjacent development pressures. 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 associated risks.

Yellow Shoreline

Defined by: Moderate Current Ecological Values in 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 provide important connectivity between high value habitat areas important for fish and wildlife to complete their life cycles. 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 Practice (BMP) or Regional Operating Statement (ROS) is followed. High risk activities without a BMP or ROS will require a report from a Qualified Environmental Professional (QEP).

Grey Shoreline

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

Background:
These are shorelines identified during the Habitat Index Analysis as having lower ecological value. However, they still may contain valuable habitats requiring some protection, such as in-lake wetlands, or gravel/cobble substrate areas.

Human 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 practical. Obtain advice from a QEP for habitat restoration techniques. For example, a retaining wall redevelopment may be moved back from the HWM and/or incorporate re-vegetation or other fish and wildlife features in the design.

2.2 Step 2 - Activity Risk Matrix and Analysis

Shoreline developments/activities have been assigned risk ratings based on the level of potential risk they may pose to fish and wildlife habitat values. Recognizing that the different shoreline zones have different habitat values and levels of sensitivity, the risk of each activity has been identified for each shoreline colour zone (Table 1). In the table, each colour zone and activity combination has been rated as either: Very High (VH), High (H) or Low (L). A species at risk modifier column has also been provided, which should be used if a species at risk has been identified in the project area.

It should be noted that when several activities with varying risk factors are proposed for the same location, the cumulative risk may increase and move the proposed project into a higher risk category. A Qualified Environmental Professional (QEP) may be required to determine if the overall risk has increased. If your activity is not listed, contact FrontCounter BC for advice. The Activity Risk Table often 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.

RISK RATING DESCRIPTORS

Very High Risk Activities

Several activities are rated as Very High Risk. These activities occur primarily in Red and Orange zones that have very high or high ecological ratings. The activities listed are known to have significant negative effects on fish and wildlife habitats and there are no options available to effectively mitigate their impact. Applications for these types of development in the zones identified will not be considered.

High Risk Activities

Proposals within the High Risk category pose a significant threat to fish and/or wildlife habitat values and often will require a Harmful Alteration, Disruption or Disturbance of Fish Habitat (HADD) authorization under the *Fisheries Act*. While some mitigation measures may be available, they are often too costly to implement. Proponents are encouraged to avoid activities with a High Risk, consider activities that are a lower risk, or relocate the proposed activity to a less sensitive area. If the proponent wishes to proceed with a High Risk activity, a QEP must be retained to complete an Environmental Assessment (EA) and develop a mitigation strategy to effectively address all negative effects of the project on the environment. The results of the EA should be submitted for review by regulatory agencies.

Low Risk Activities

With appropriate design and planning, Low Risk activities can be incorporated along the foreshore with minimal impacts on fish and wildlife habitat values. These activities must follow Best Management Practices (BMPs) and Department of Fisheries and Ocean Regional Operating Statements (ROS) where available. Where BMP/ROS are not available, or a deviation to the BMP/ROS is proposed, a QEP must be retained to determine the potential impact of the project on aquatic habitat, design mitigation measures to minimize environmental impacts, and apply for appropriate permits from regulatory agencies. Examples of activities that have low risk along most/all of the shoreline are: maintenance dredging (previously approved) and erosion protection (soft-bioengineered).

Table 1: Shoreline Activity Risk Table (VH = Very High, H = High, L = Low).

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

[1] These Guidelines are to be used in the initial development planning stage and do not cover all regulatory 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 habitat attributes.

[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

2.3 Step 3 - Decision Process Flow Chart

A flow chart outlining the decision-making process for the High and Low risk activities is presented in Figure 1. The chart is a tool to help identify the Guideline requirements outlined in the previous sections. Note that the flow chart provides guidelines only for the initial planning stages of a development project. Other regulatory requirements are not addressed through this process (such as approvals/notifications through RDEK, Transport Canada, BC *Water Act*, BC *Lands Act*), which are the responsibility of the proponent (Appendix B). The intent of the Guidelines is to streamline the subsequent permitting process. Contact FrontCounter BC to determine which permits, approvals or authorizations you need, in addition to fish and wildlife habitat authorizations.

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 are costly to implement. High Risk activities often require a Harmful Alteration, Disruption or Destruction of fish habitat (HADD) authorization under Sec 35(2) of the Fisheries Act. Proponents are encouraged to avoid High Risk activities, revise activities to a lower risk option, or relocate the activity to a less sensitive area.

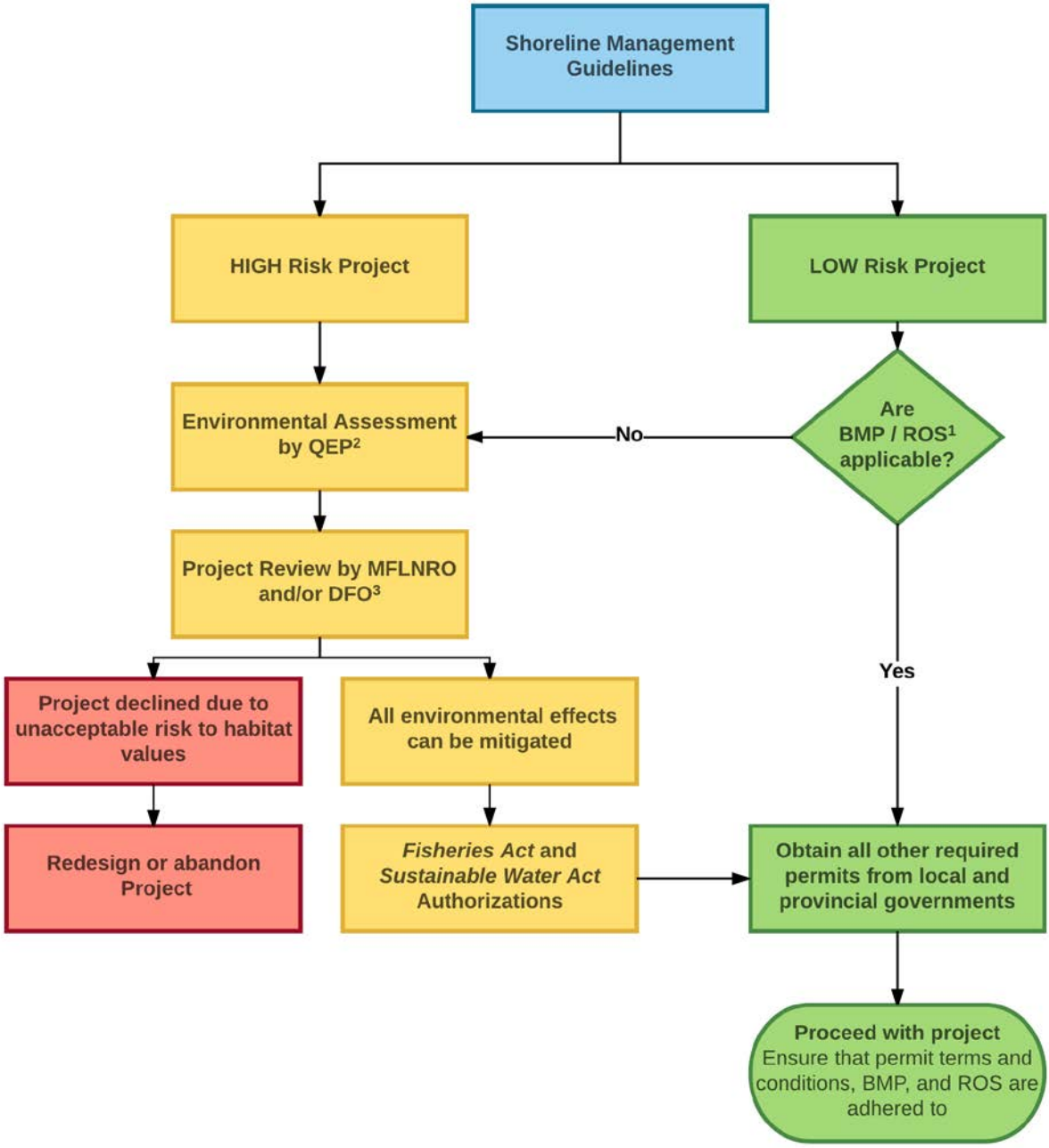

Figure 1: Decision-making process for regulatory approval of High and Low Risk Projects

[1]MP – Best Management Practice (Appendix C); ROS – Fisheries and Oceans Canada Regional Operating Statement
[2] QEP: Qualified Environmental Professional
[3]DFO- Fisheries and Oceans Canada; MFLNRO: Ministry of Forest, Land, and Natural Resource Operations

3.0 MITIGATION AND COMPENSATION CONSIDERATIONS

A QEP should be retained to assess the potential impacts of a project and develop a mitigation strategy. Results of this assessment are typically included in an Environmental Management Plan (EMP) submitted to regulatory agencies for review. The Lake Koocanusa Fish and Wildlife Habitat Assessment is a tool available to help with this task; however, further studies may be necessary, due to limitations of currently available information. The DFO principle of "no net loss" within the Policy for the Management of Fish Habitat (1986) applies to all proposals where the risk for a Harmful Alteration, Disruption or Destruction of fish habitat (HADD) exists. 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:

3.1 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 proceeding with the project.

3.2 Mitigation of Impacts

Mitigation 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 high value habitats. Mitigation 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 authorize a HADD before work can commence.

3.3 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 replace the 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 remediation, or redevelopment of the compensation works in the event the habitat is not meeting 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.

4.0 REFERENCES

McPherson, S. and D. Hlushak. 2008. Windermere Lake Fish and Wildlife Habitat Assessment. Consult report prepared for the East Kootenay Integrated Lake Management Partnership. Prepared by Interior Reforestation Co. Ltd., Cranbrook, BC.

Schleppe, J. and A. Patterson. 2011. St. Mary Lake Shoreline Management Guidelines. Ecoscape Environmental Consultants Ltd. Project File: 10-682. Prepared for: East Kootenay Integrated Lake Management Partnership.

APPENDIX A: MAP SERIES

Location Map

Lake Koocanusa

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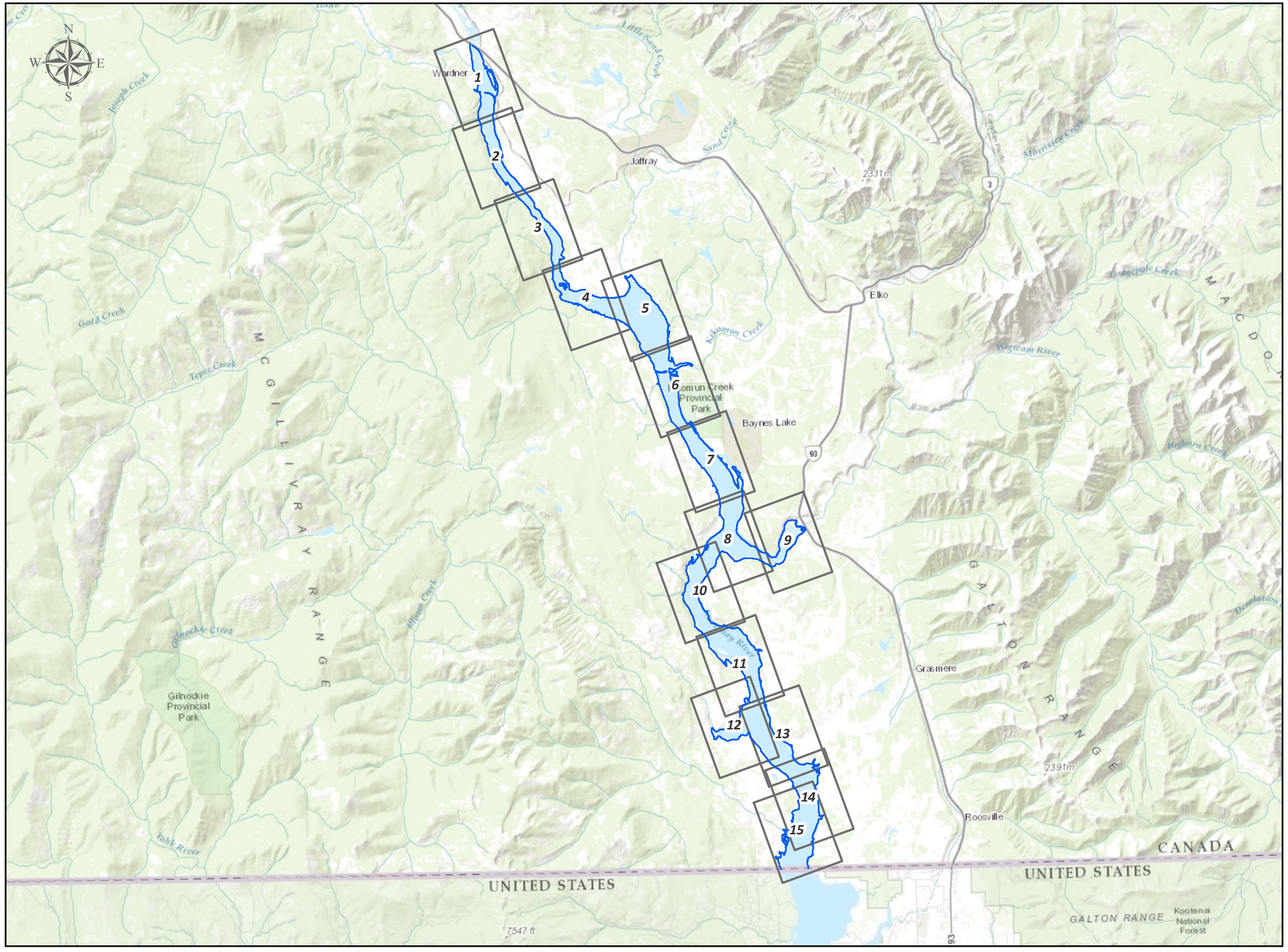
LAKE KOOCANUSA
Shoreline Colour Map Series

MAP KEY



MAP INFORMATION

1. MAP DATUM/PROJECTION: NAD 1983 UTM ZONE 11N.
2. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:20,000,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

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REVIEW	*EKILMP*	**DATE**	*2017-Jul-28*
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Kilometers

DATA SOURCES

- Topographic Base Maps provided by ArcGIS License
- Shoreline data based on TRIM and modified to more accurately represent full pool extent at time of study

OVERVIEW MAP

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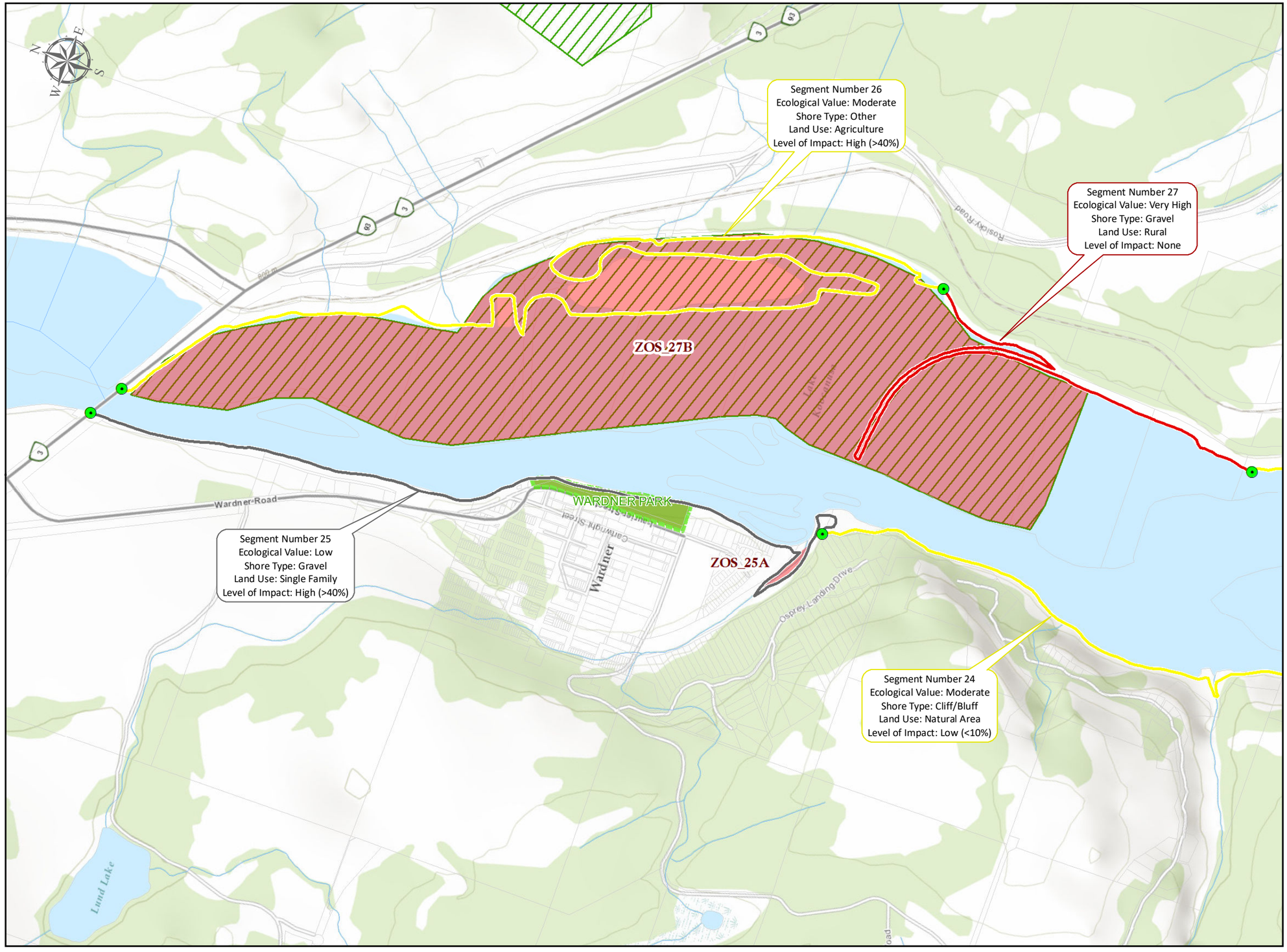

LAKE KOOCANUSA
Shoreline Colour Map Series

MAP NUMBER: 1

LEGEND

- Segment Break
- Sample Sites
- Provincial Park
- Wildlife Habitat Area (WHA)

SHORELINE COLOUR (Ecological Value)

- RED (Very High)
- ORANGE (High)
- YELLOW (Moderate)
- GREY (Low, Very Low)
- ZONES OF SENSITIVITY

MAP INFORMATION

1. MAP DATUM/PROJECTION: NAD 1983 UTM ZONE 11N.
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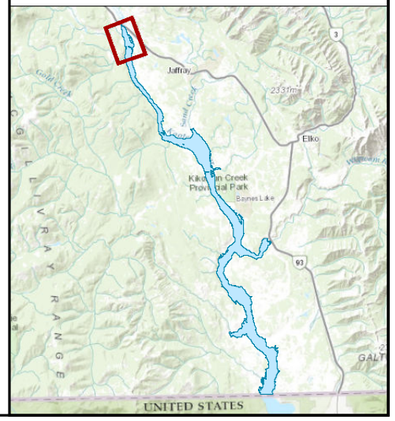
- Property boundary data provided by RDEK
- Parks/Protected Areas/WHA - GeoBC

OVERVIEW MAP



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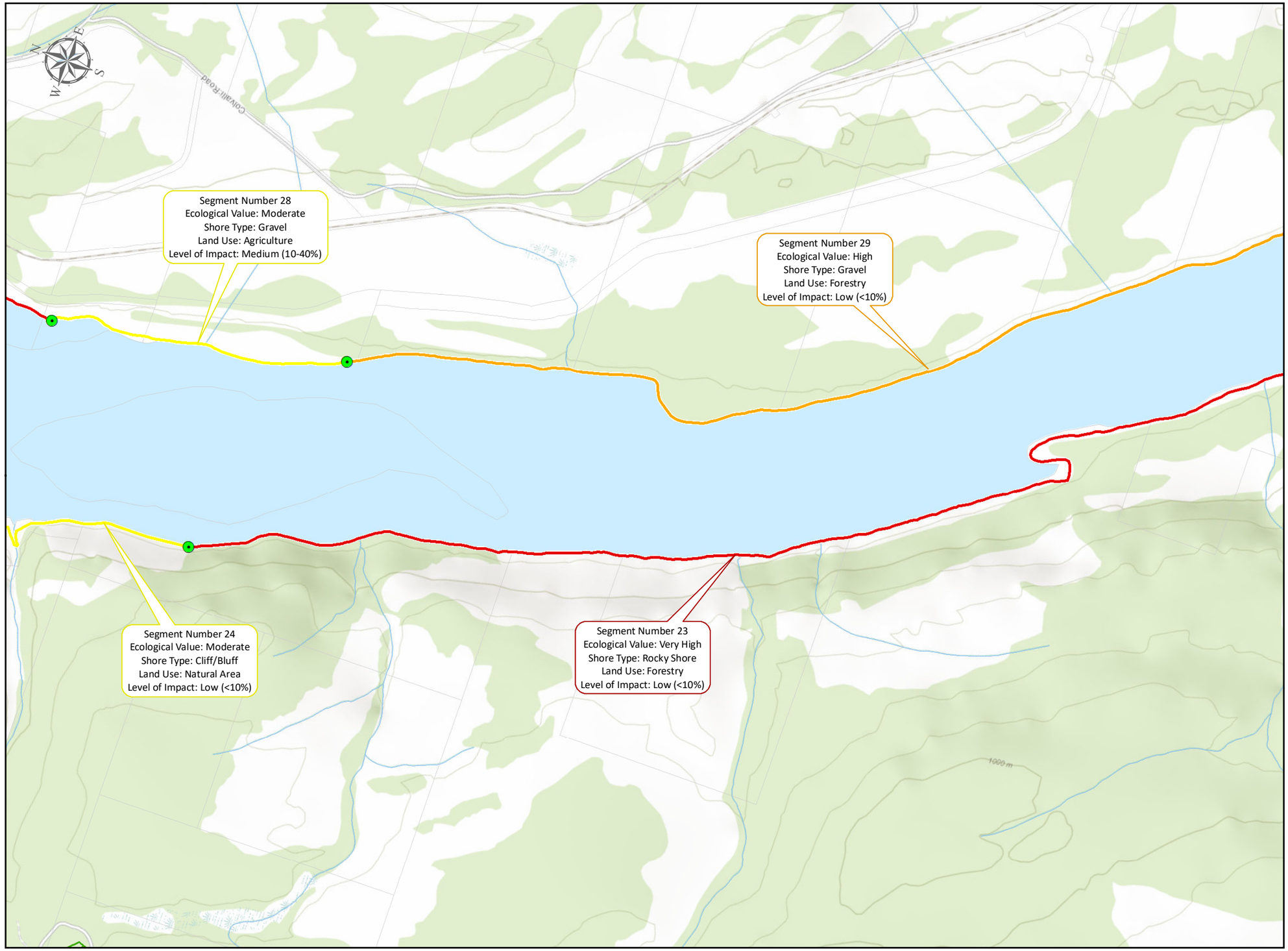

LAKE KOOCANUSA
Shoreline Colour Map Series

MAP NUMBER: 2

LEGEND

- Segment Break
- Sample Sites
- Provincial Park
- Wildlife Habitat Area (WHA)

SHORELINE COLOUR (Ecological Value)

- RED (Very High)
- ORANGE (High)
- YELLOW (Moderate)
- GREY (Low, Very Low)
- ZONES OF SENSITIVITY

MAP INFORMATION

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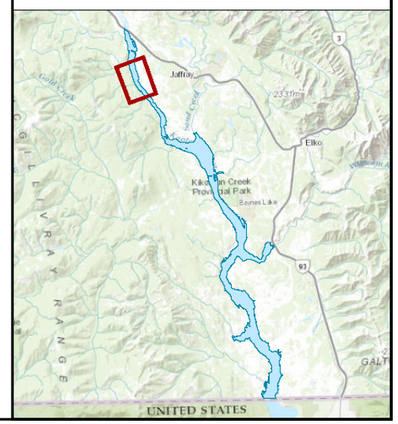
OVERVIEW MAP



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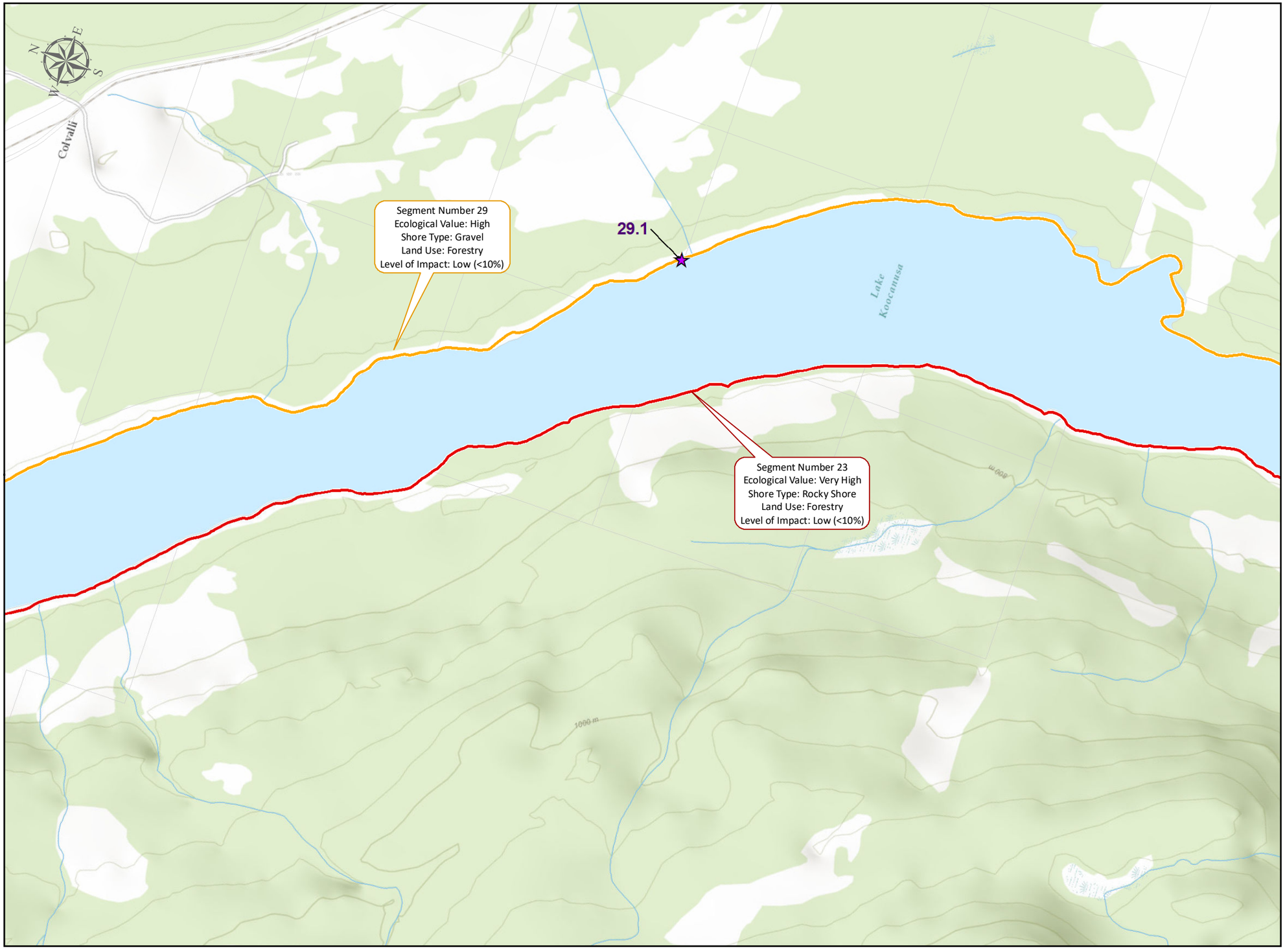

LAKE KOOCANUSA
Shoreline Colour Map Series

MAP NUMBER: 3

LEGEND

- Segment Break
- Sample Sites
- Provincial Park
- Wildlife Habitat Area (WHA)

SHORELINE COLOUR (Ecological Value)

- RED (Very High)
- ORANGE (High)
- YELLOW (Moderate)
- GREY (Low, Very Low)
- ZONES OF SENSITIVITY

MAP INFORMATION

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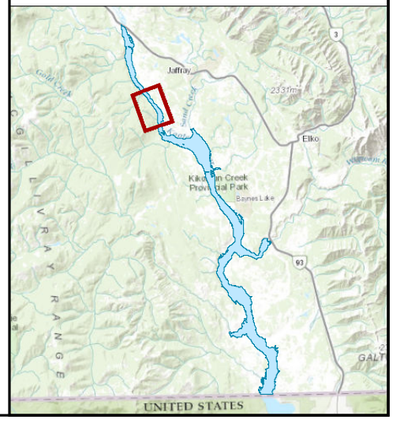
OVERVIEW MAP



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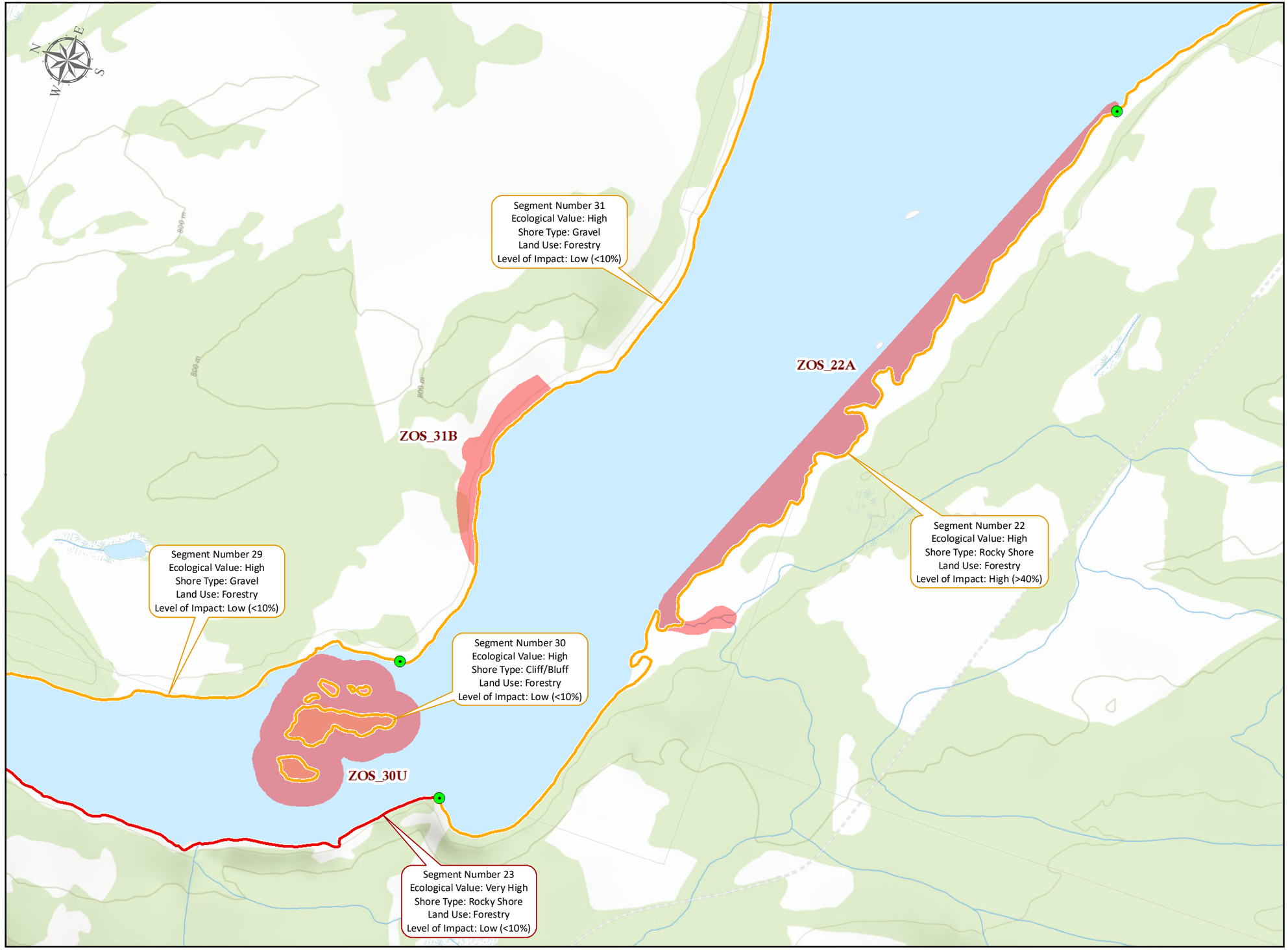

LAKE KOOCANUSA
Shoreline Colour Map Series

MAP NUMBER: 4

LEGEND

- Segment Break
- Sample Sites
- Provincial Park
- Wildlife Habitat Area (WHA)

SHORELINE COLOUR (Ecological Value)

- RED (Very High)
- ORANGE (High)
- YELLOW (Moderate)
- GREY (Low, Very Low)
- ZONES OF SENSITIVITY

MAP INFORMATION

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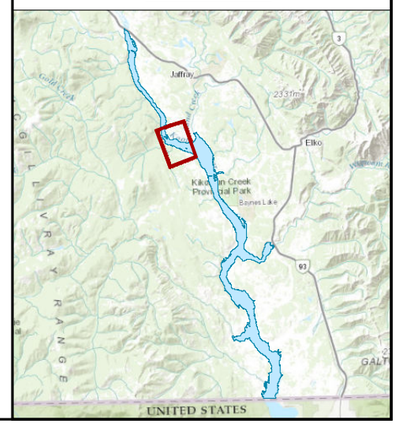

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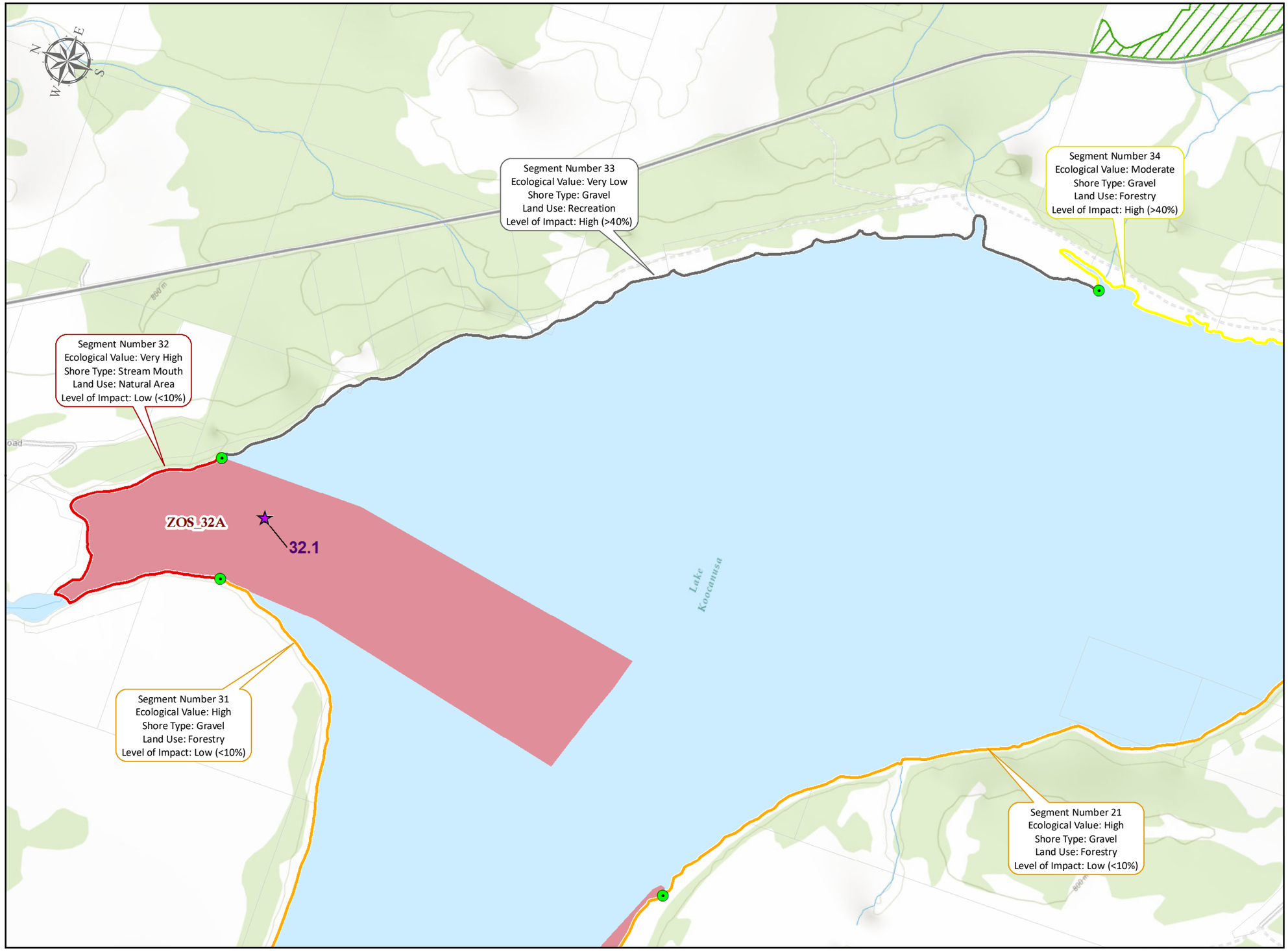

LAKE KOOCANUSA
Shoreline Colour Map Series

MAP NUMBER: 5

LEGEND

- Segment Break
- Sample Sites
- Provincial Park
- Wildlife Habitat Area (WHA)

SHORELINE COLOUR (Ecological Value)

- RED (Very High)
- ORANGE (High)
- YELLOW (Moderate)
- GREY (Low, Very Low)
- ZONES OF SENSITIVITY

MAP INFORMATION

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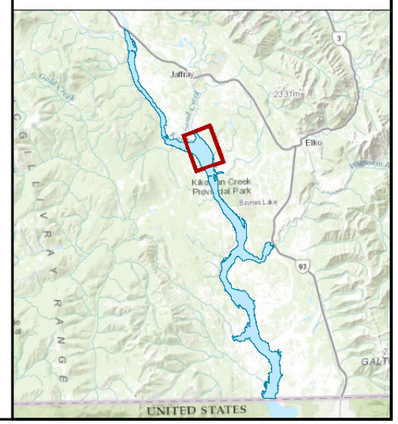

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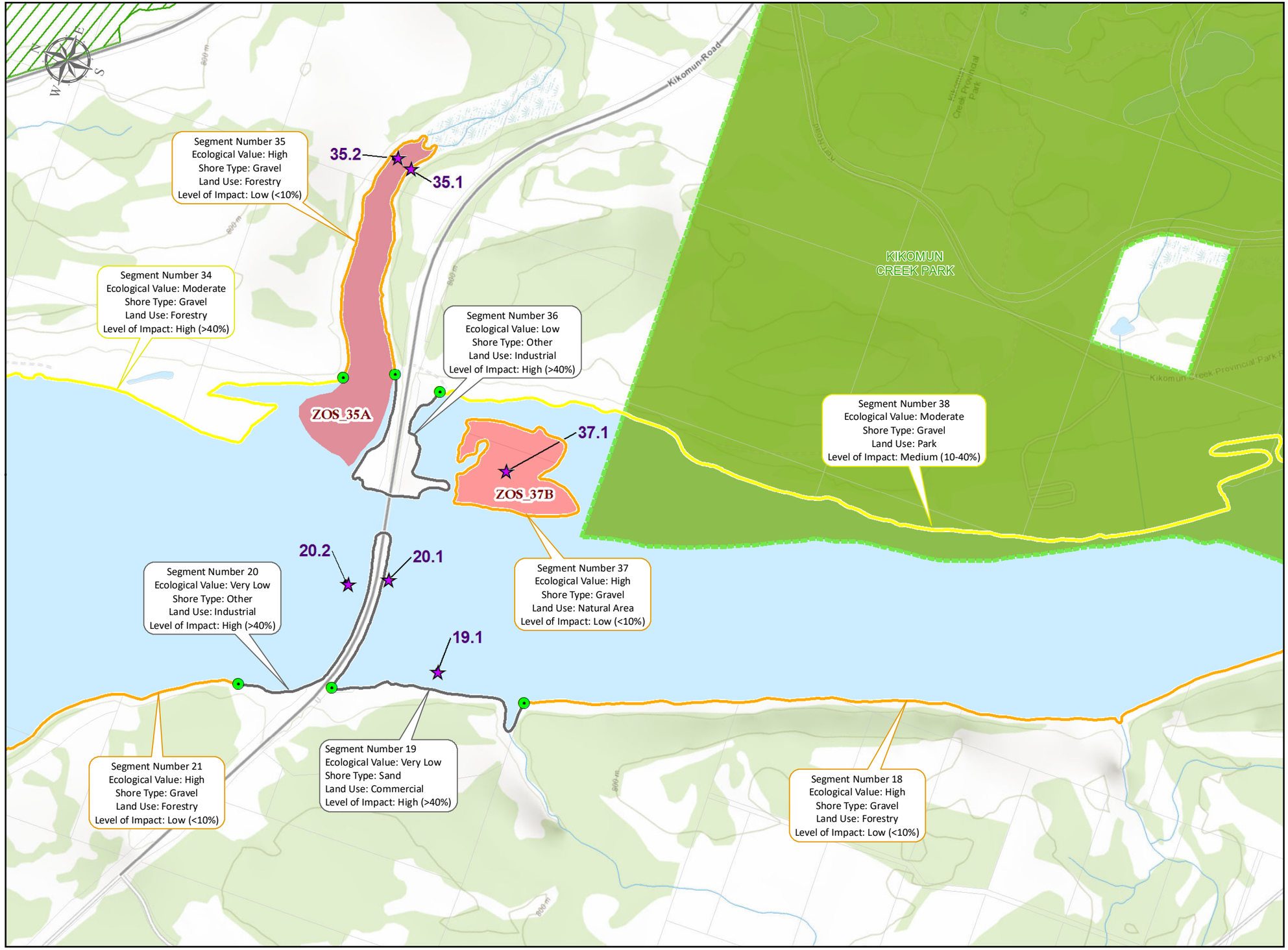

LAKE KOOCANUSA
Shoreline Colour Map Series

MAP NUMBER: 6

LEGEND

- Segment Break
- Sample Sites
- Provincial Park
- Wildlife Habitat Area (WHA)

SHORELINE COLOUR (Ecological Value)

- RED (Very High)
- ORANGE (High)
- YELLOW (Moderate)
- GREY (Low, Very Low)
- ZONES OF SENSITIVITY

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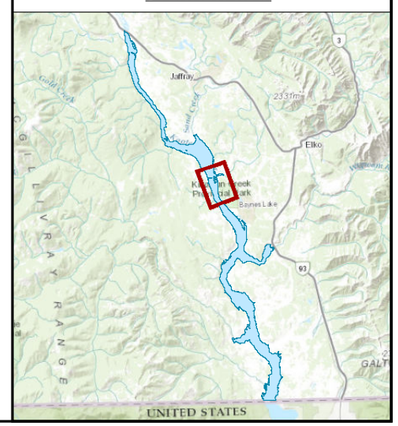

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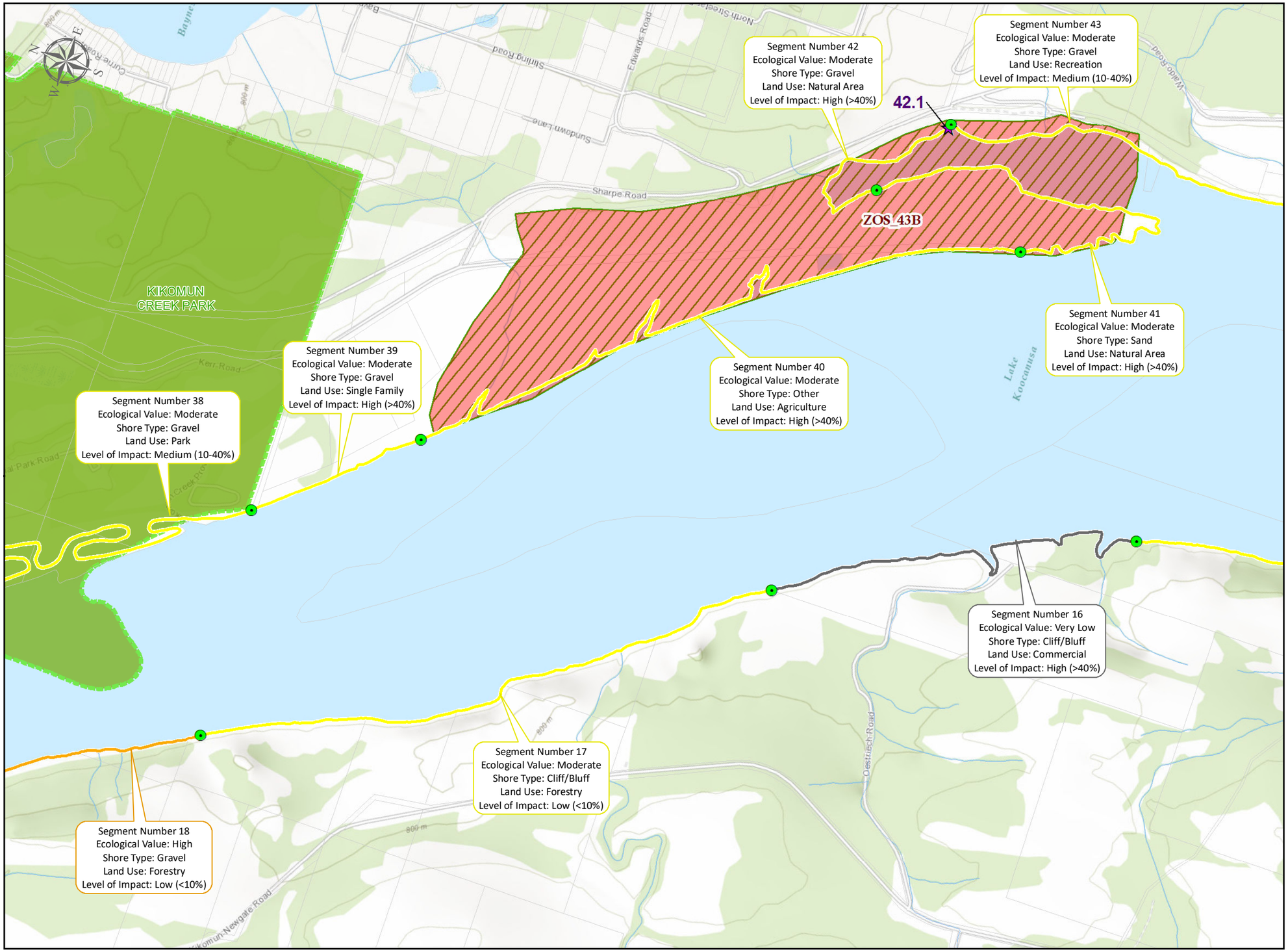
LAKE KOOCANUSA
Shoreline Colour Map Series

MAP NUMBER: 7



LEGEND

- Segment Break
- Sample Sites
- Provincial Park
- Wildlife Habitat Area (WHA)

SHORELINE COLOUR (Ecological Value)

- RED (Very High)
- ORANGE (High)
- YELLOW (Moderate)
- GREY (Low, Very Low)
- ZONES OF SENSITIVITY

MAP INFORMATION

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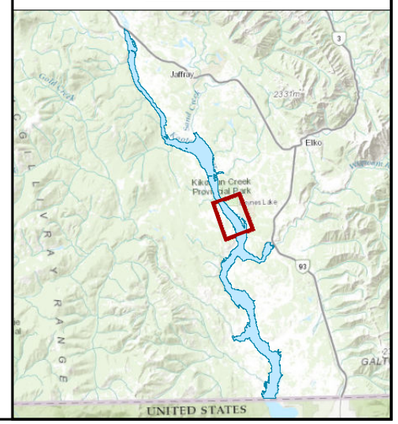

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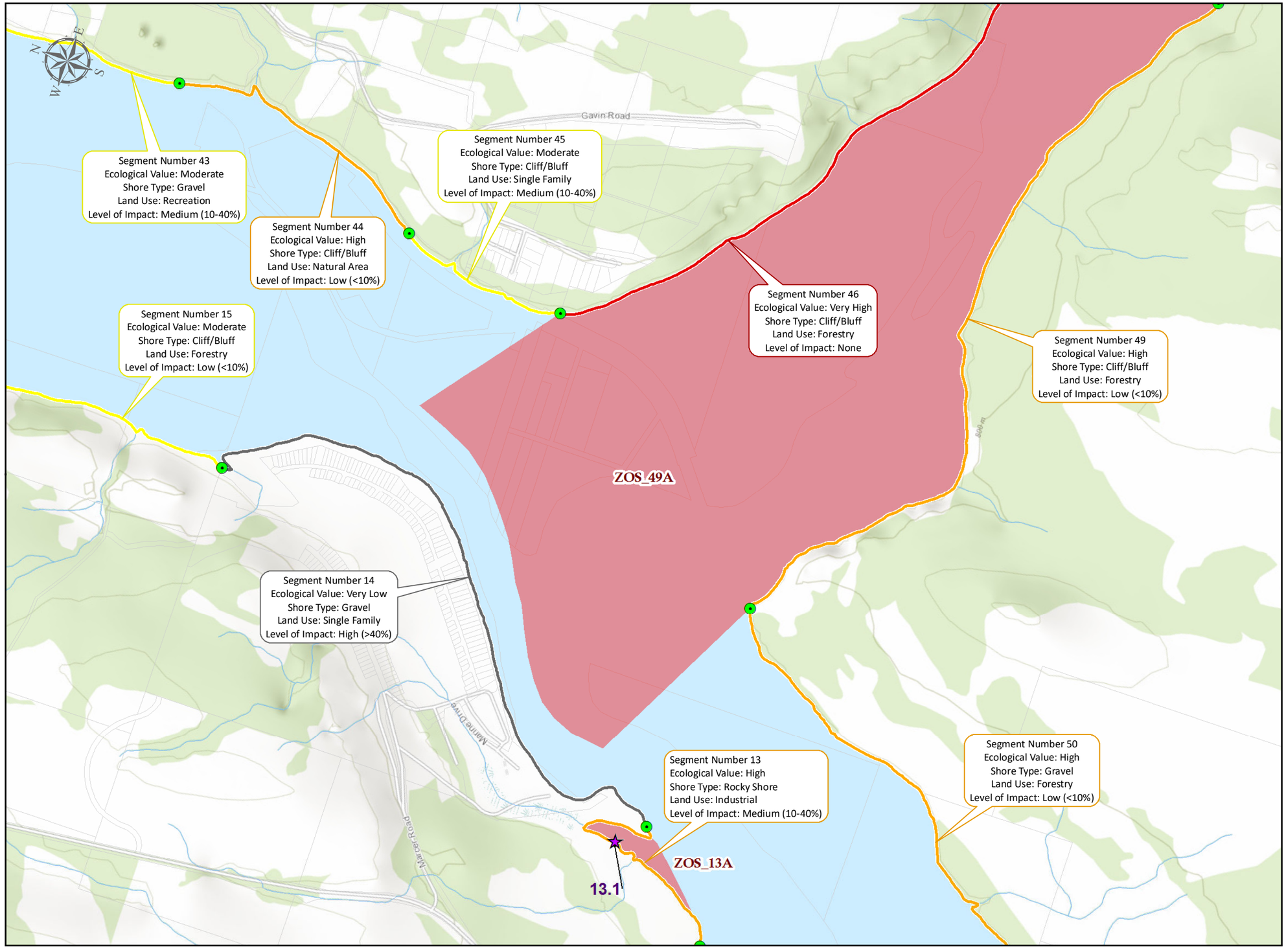

LAKE KOOCANUSA
Shoreline Colour Map Series

MAP NUMBER: 8

LEGEND

- Segment Break
- Sample Sites
- Provincial Park
- Wildlife Habitat Area (WHA)

SHORELINE COLOUR (Ecological Value)

- RED (Very High)
- ORANGE (High)
- YELLOW (Moderate)
- GREY (Low, Very Low)
- ZONES OF SENSITIVITY

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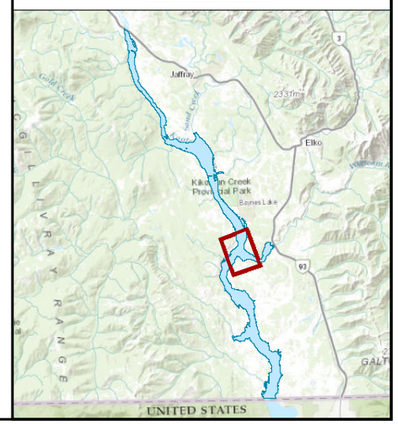
OVERVIEW MAP



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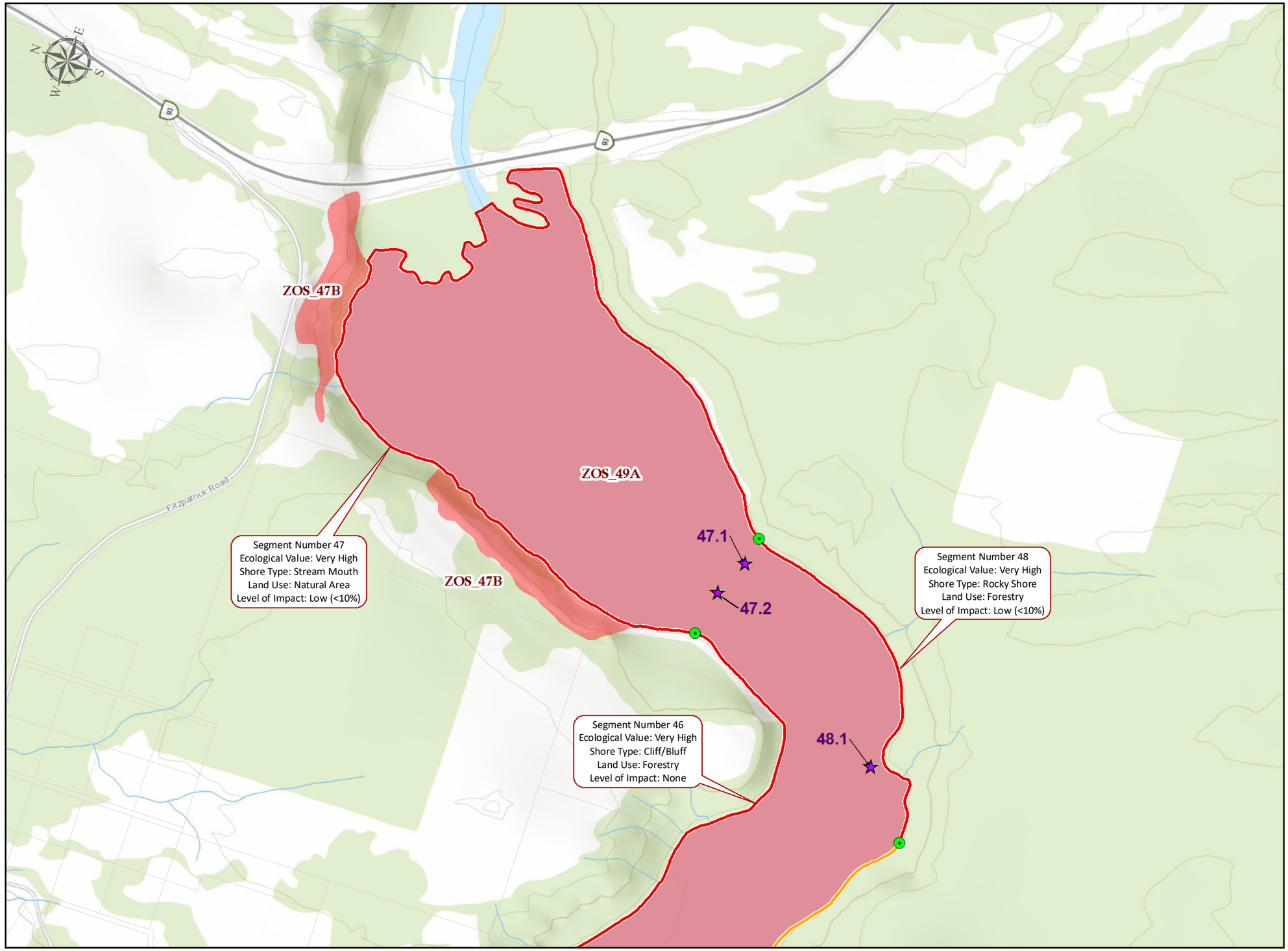

LAKE KOOCANUSA
Shoreline Colour Map Series

MAP NUMBER: 9

LEGEND

- Segment Break
- Sample Sites
- Provincial Park
- Wildlife Habitat Area (WHA)

SHORELINE COLOUR (Ecological Value)

- RED (Very High)
- ORANGE (High)
- YELLOW (Moderate)
- GREY (Low, Very Low)
- ZONES OF SENSITIVITY

MAP INFORMATION

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Meters

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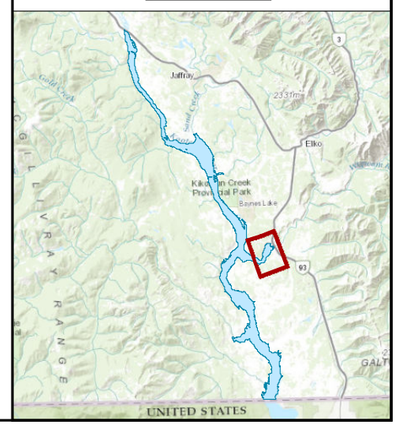
OVERVIEW MAP



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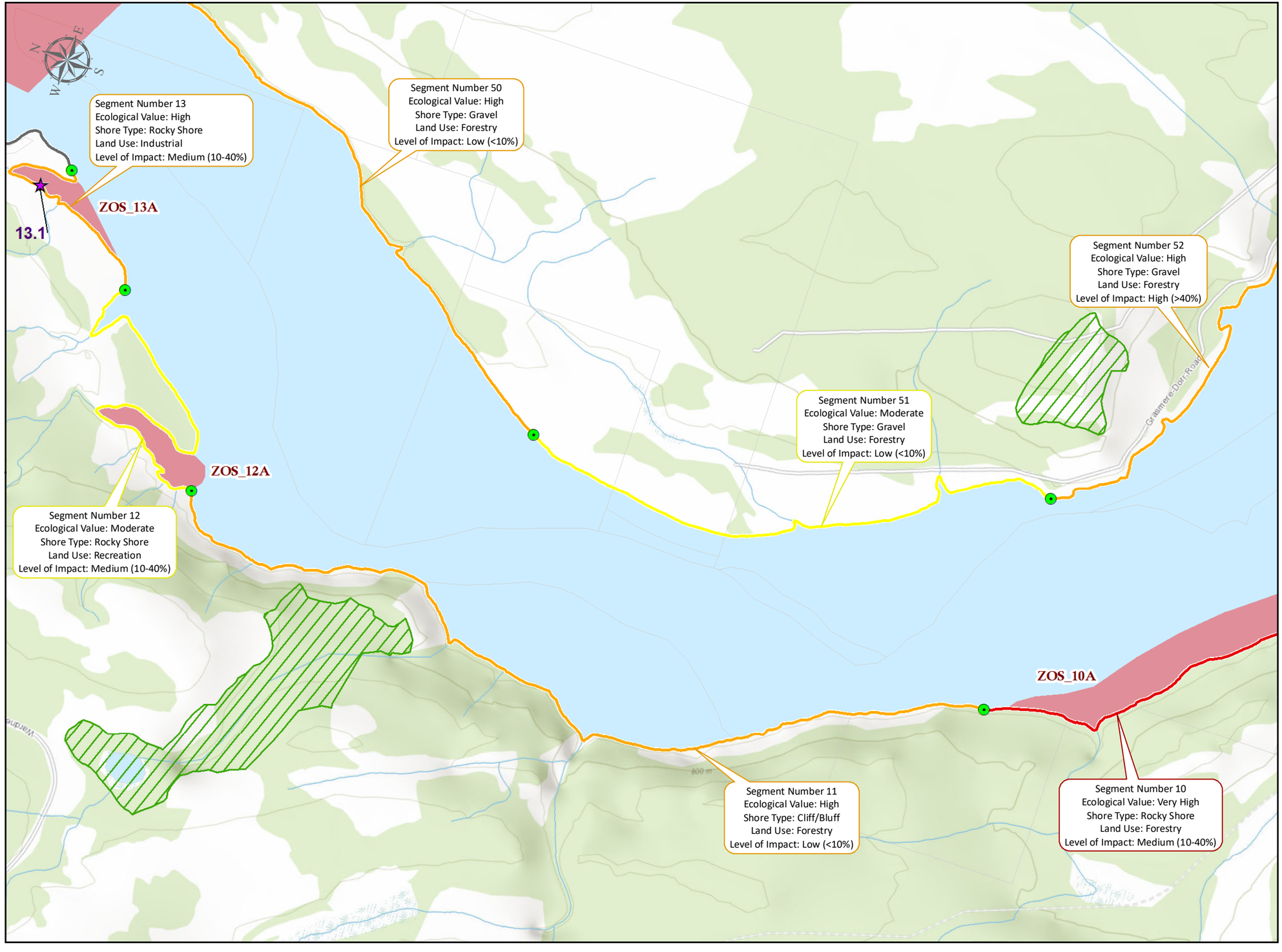

LAKE KOOCANUSA
Shoreline Colour Map Series

MAP NUMBER: 10

LEGEND

- Segment Break
- Sample Sites
- Provincial Park
- Wildlife Habitat Area (WHA)

SHORELINE COLOUR (Ecological Value)

- RED (Very High)
- ORANGE (High)
- YELLOW (Moderate)
- GREY (Low, Very Low)
- ZONES OF SENSITIVITY

MAP INFORMATION

1. MAP DATUM/PROJECTION: NAD 1983 UTM ZONE 11N.
2. THIS FIGURE IS PRODUCED AT A NOMINAL SCALE OF 1:15,000 FOR 11x17 (TABLOID) PAPER. ACTUAL SCALE MAY DIFFER ACCORDING TO CHANGES IN PRINTER SETTINGS OR PRINTED PAPER SIZE.

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DRAWING	DH	DATE	2017-Jul-28
REVIEW	EKILMP	DATE	2017-Jul-28
MXD ID	SHIM_KOOCANUSA_TABLOID		

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0 250 500 750

Meters

DATA SOURCES

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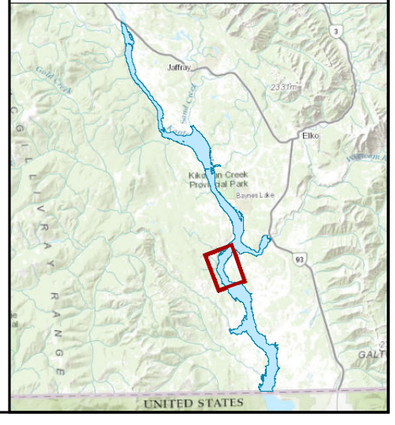
- ZOS: GeoBC WHA or digitized from available data
- Property boundary data provided by RDEK
- Parks/Protected Areas/WHA - GeoBC

OVERVIEW MAP



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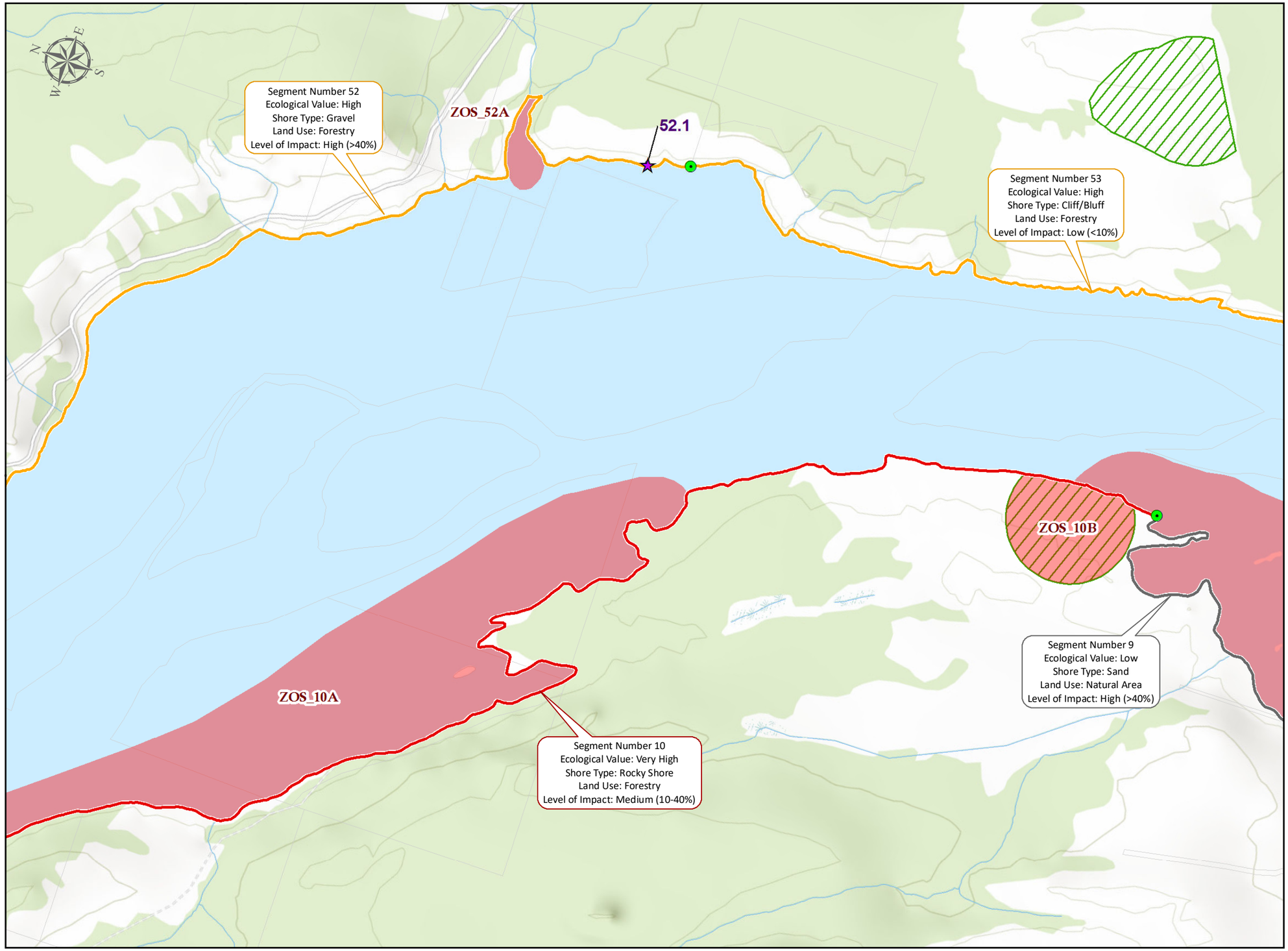

LAKE KOOCANUSA
Shoreline Colour Map Series

MAP NUMBER: 11

LEGEND

- Segment Break
- Sample Sites
- Provincial Park
- Wildlife Habitat Area (WHA)

SHORELINE COLOUR (Ecological Value)

- RED (Very High)
- ORANGE (High)
- YELLOW (Moderate)
- GREY (Low, Very Low)
- ZONES OF SENSITIVITY

MAP INFORMATION

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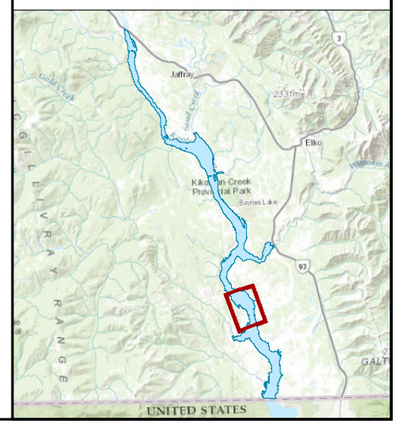
OVERVIEW MAP



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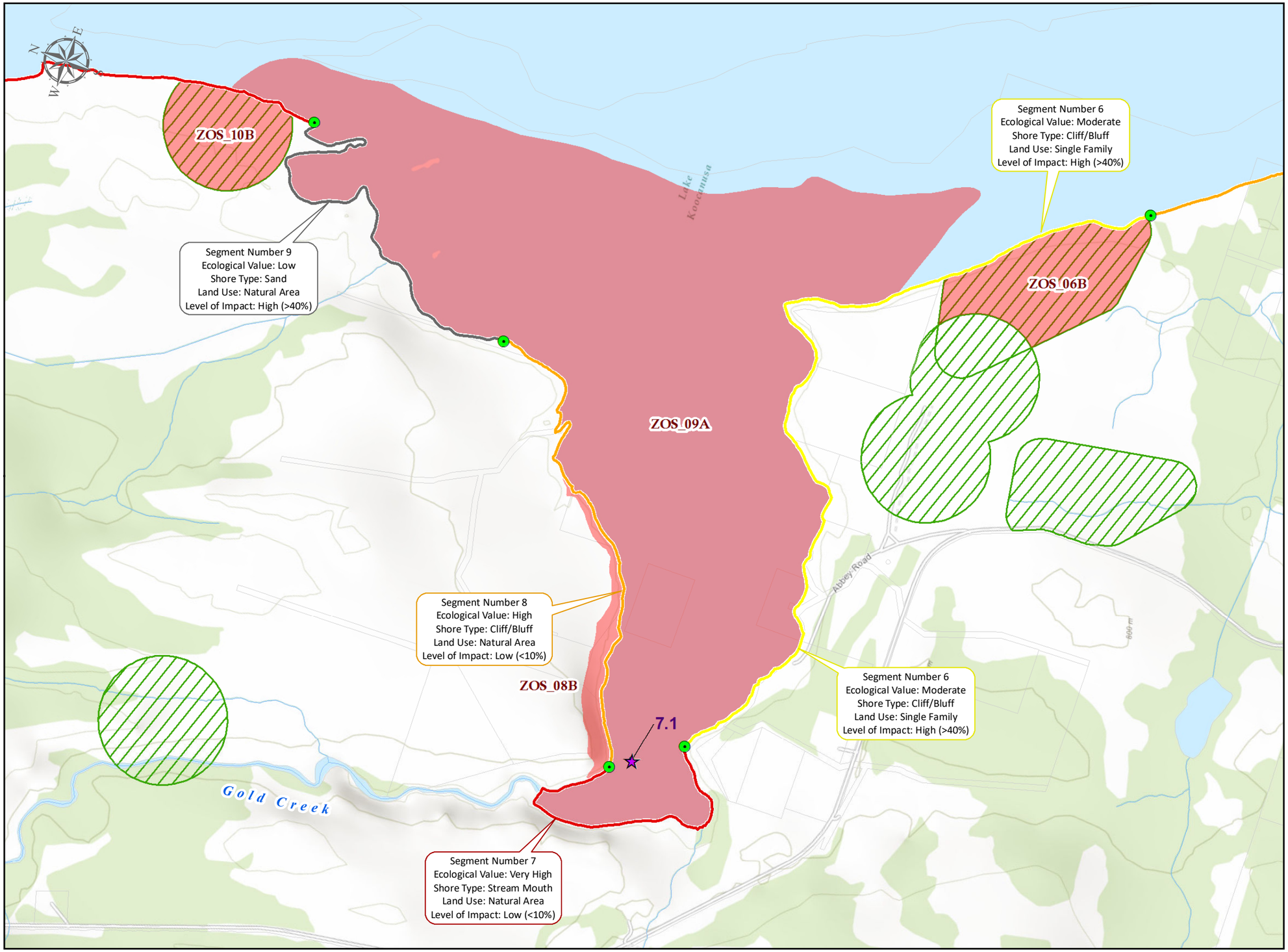

LAKE KOOCANUSA
Shoreline Colour Map Series

MAP NUMBER: 12

LEGEND

- Segment Break
- Sample Sites
- Provincial Park
- Wildlife Habitat Area (WHA)

SHORELINE COLOUR (Ecological Value)

- RED (Very High)
- ORANGE (High)
- YELLOW (Moderate)
- GREY (Low, Very Low)
- ZONES OF SENSITIVITY

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MXD ID	*SHIM_KOOCANUSA_TABLOID*		

1:15,000

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Meters

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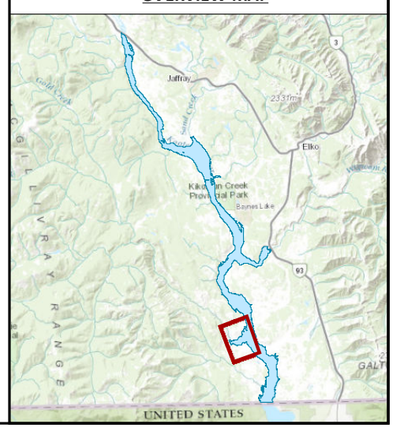
- Parks/Protected Areas/WHA - GeoBC

OVERVIEW MAP



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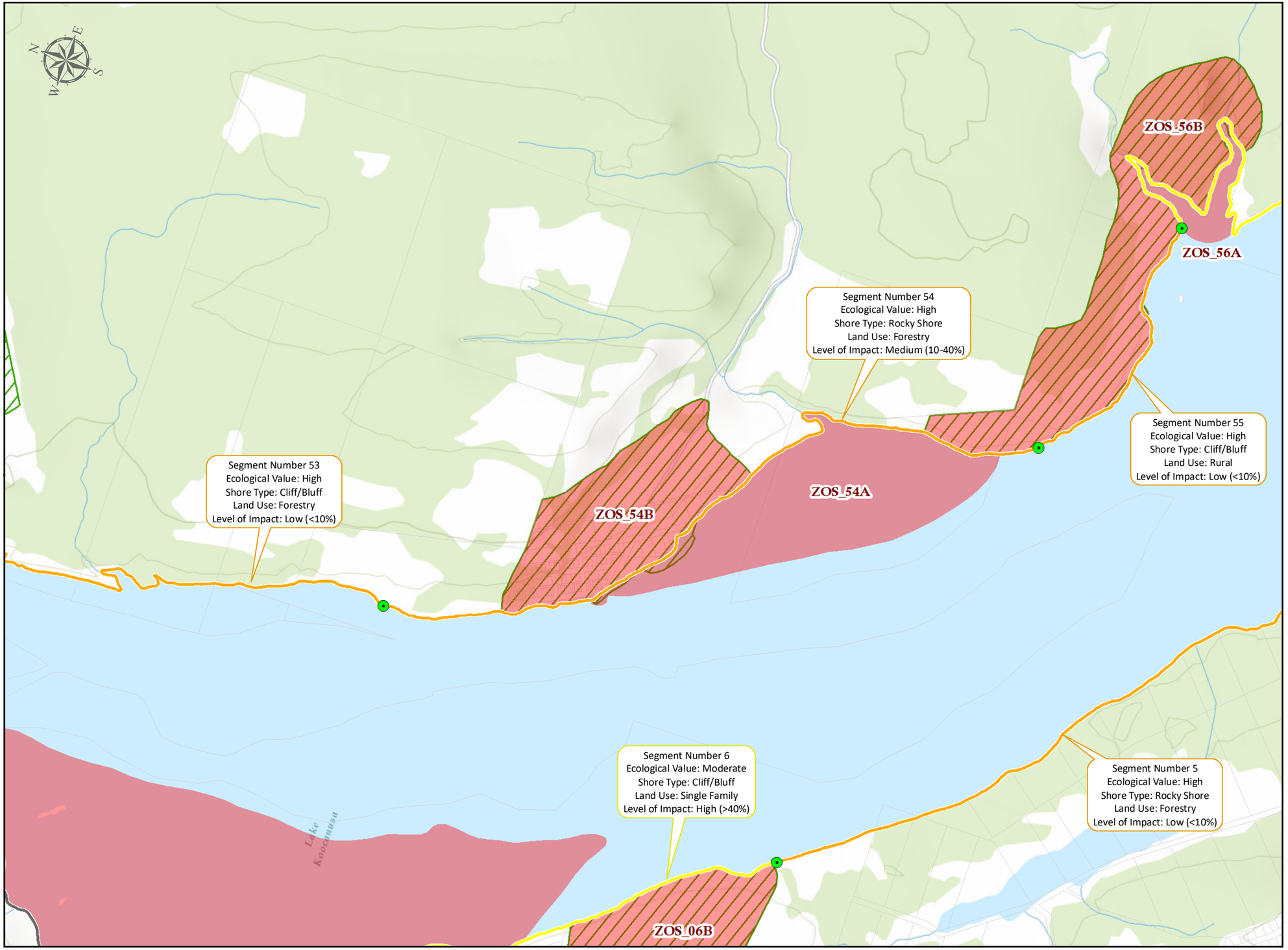

LAKE KOOCANUSA
Shoreline Colour Map Series

MAP NUMBER: 13

LEGEND

- Segment Break
- Sample Sites
- Provincial Park
- Wildlife Habitat Area (WHA)

SHORELINE COLOUR (Ecological Value)

- RED (Very High)
- ORANGE (High)
- YELLOW (Moderate)
- GREY (Low, Very Low)
- ZONES OF SENSITIVITY

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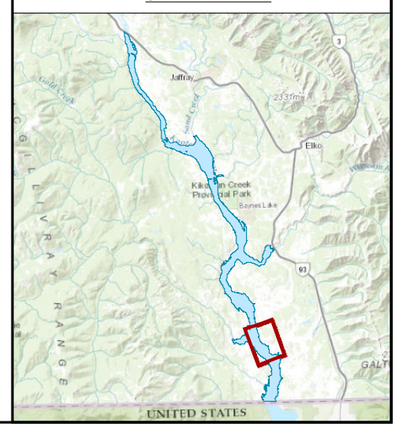
OVERVIEW MAP



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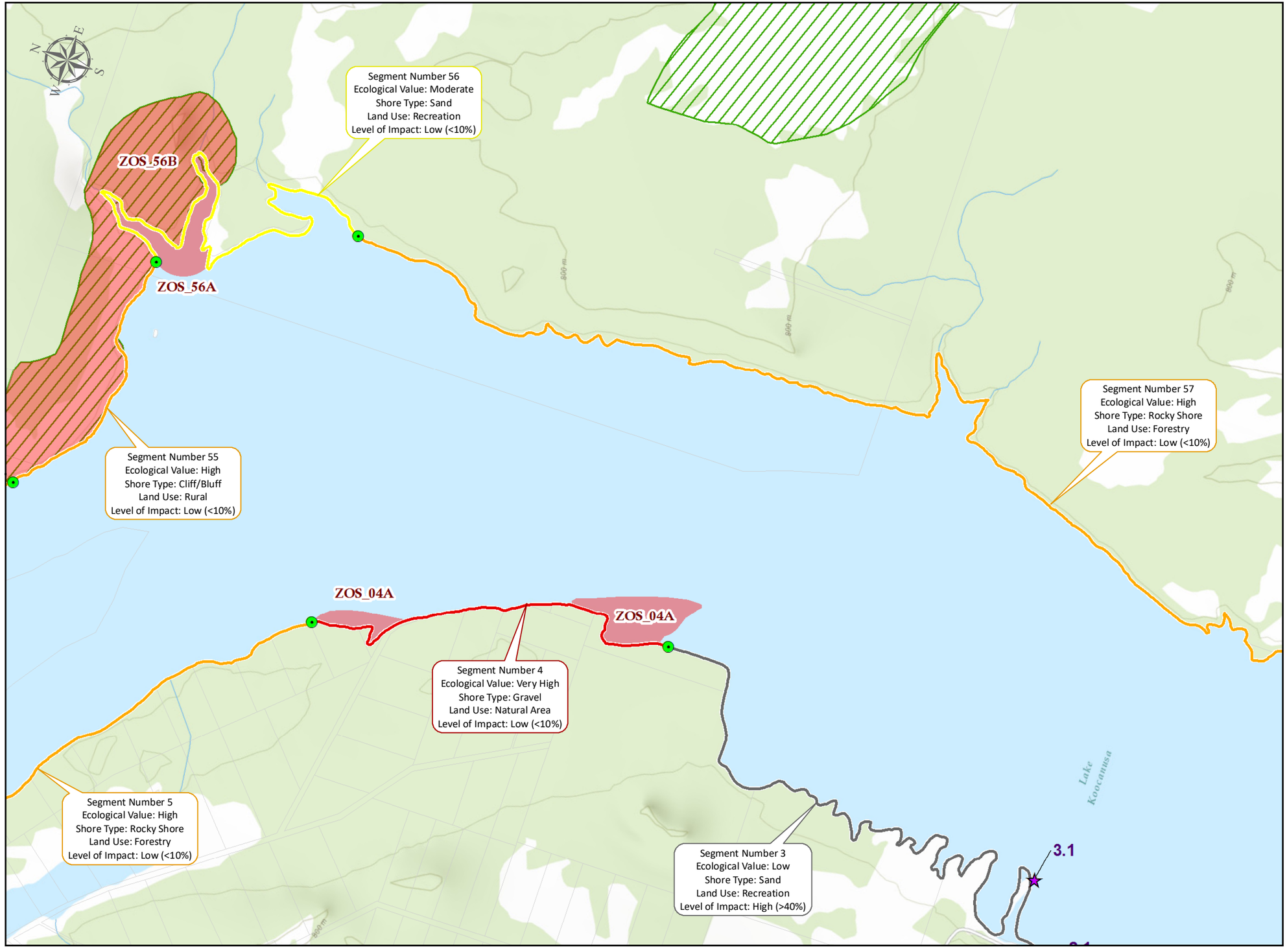
LAKE KOOCANUSA
Shoreline Colour Map Series

MAP NUMBER: 14



LEGEND

- Segment Break
- Sample Sites
- Provincial Park
- Wildlife Habitat Area (WHA)

SHORELINE COLOUR (Ecological Value)

- RED (Very High)
- ORANGE (High)
- YELLOW (Moderate)
- GREY (Low, Very Low)
- ZONES OF SENSITIVITY

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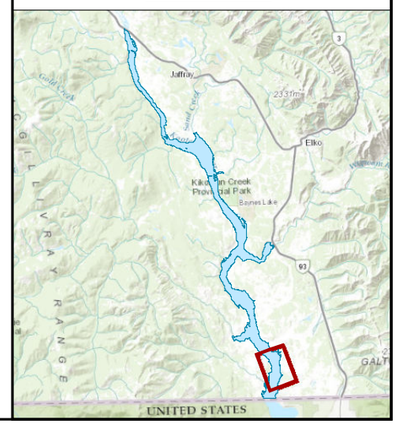
OVERVIEW MAP



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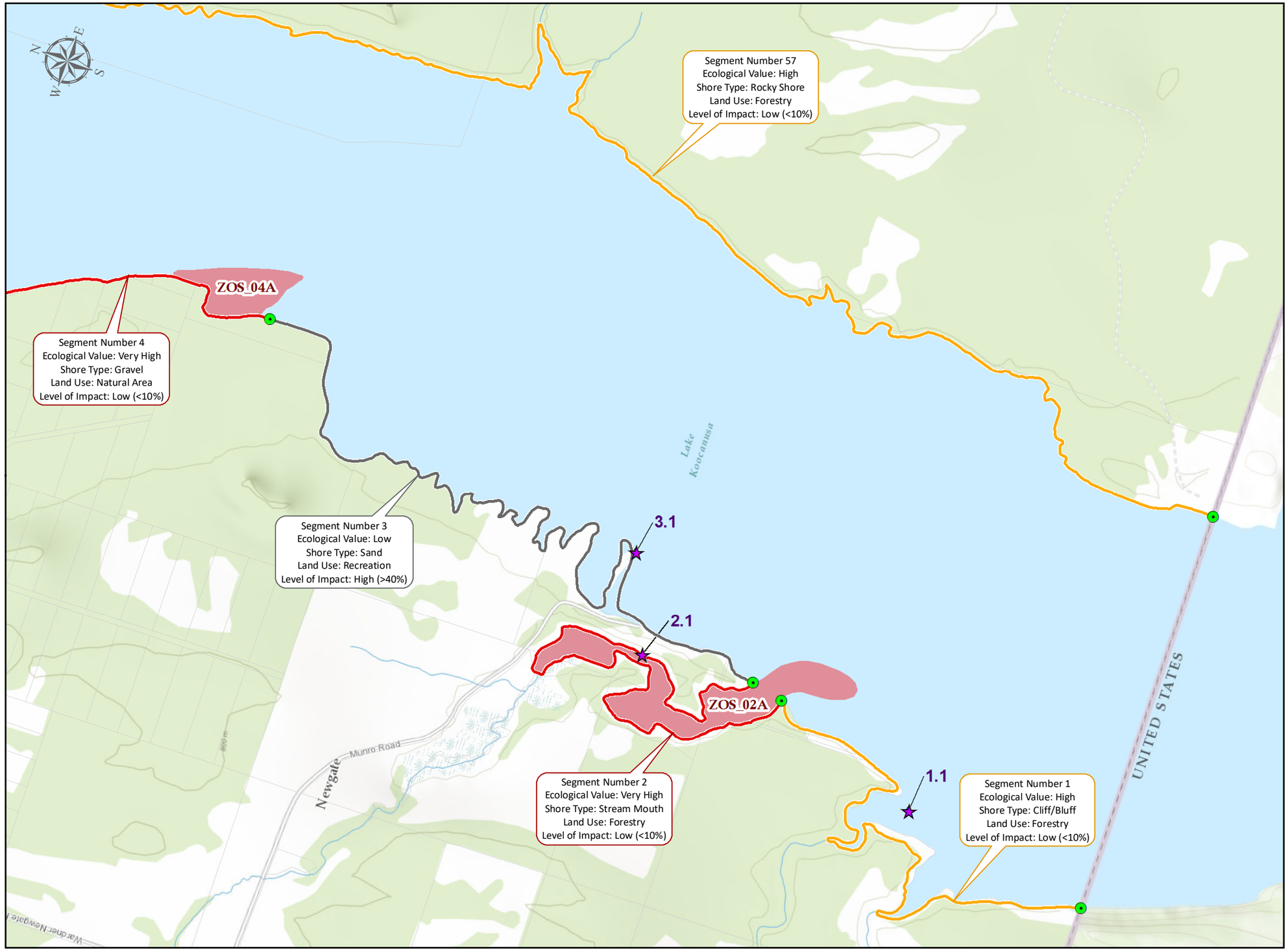

LAKE KOOCANUSA
Shoreline Colour Map Series

MAP NUMBER: 15

LEGEND

- Segment Break
- Sample Sites
- Provincial Park
- Wildlife Habitat Area (WHA)

SHORELINE COLOUR (Ecological Value)

- RED (Very High)
- ORANGE (High)
- YELLOW (Moderate)
- GREY (Low, Very Low)
- ZONES OF SENSITIVITY

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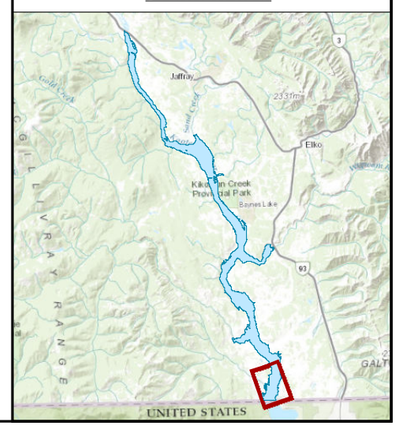
OVERVIEW MAP



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APPENDIX B: ADDITIONAL REGULATORY REQUIREMENTS

REGULATORY FRAMEWORK AND OPERATIONAL GUIDELINES

This section provides a summary of federal and provincial environmental legislation upon which protection and mitigation plans were developed for this project.

FEDERAL LEGISLATION

Canada Fisheries Act provides broad prohibition from polluting waters with substances that are deleterious to fish and fish habitat, and of works that result in "harmful alteration, disruption or destruction" (HADD) of fish habitat, unless authorized by the Minister of the Department of Fisheries and Oceans (DFO) in exchange for the compensation of similar habitat that avoids "no net loss" of productive habitat.

Species at Risk 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.

Canada Migratory Birds Convention 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 migratory game, insectivorous, or non-game birds is prohibited, except for permitted scientific or propagating purposes.

Canadian Environmental Protection Act addresses "cradle-to-grave" management of persistent toxic substances, and requires assessment of new substances prior to their introduction into Canada, placing the onus on manufacturers and importers of chemical compounds to prove their safety to human health and the environment.

Navigation Protection Act regulates works that may result in permanent or temporary obstacles or navigational hazards in all navigable Canadian waters.

Transportation of Dangerous Goods Act regulates the transport of all dangerous goods in Canada, whether by rail, road, air, or water, and establishes safety standards and documentation to be complied with such that all containers, packages, and means of transport are clearly marked with applicable prescribed safety marks. It also establishes requirements regarding emergency response assistance plans.

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).

PROVINCIAL LEGISLATION

British Columbia Wildlife Act prohibits, except by regulation, the taking, injuring, molesting, or destroying of: (a) a bird or its egg; (b) the nest of an eagle, peregrine falcon, gyrfalcon, 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.

British Columbia Water Sustainability Act and Fish Protection Act provides for the management of surface water through the allocation of rights to divert, store or use water for any purpose, and provides a means

to ensure access to an authorized source of water and to acquire land to protect water quality for domestic use. Establishes an approval mechanism to enable works "in and about a stream", as well as short-term use of water to facilitate construction needs.

British Columbia Environmental Management Act establishes, among others, the Contaminated Sites Regulation, Hazardous Waste Regulation, and Spill Reporting Regulation and provides a permitting system to enable the authorized discharge of effluent to water, disposal of solid waste to land, and discharge of emissions to the atmosphere. This Act provides guidelines for the regulation of activities which introduce waste into the environment, store special waste, or treat or recycle special waste.

British Columbia Heritage Conservation Act protects all archaeological sites on provincial Crown or private land that predate AD 1846.

British Columbia Fire Services Act establishes the B.C. Fire Code Regulation and the B.C. Fire Code which sets out requirements for the siting, installation, and secondary containment for storage tanks containing flammable and combustible materials.

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.

Lake Koocanusa Official Community Plan (OCP), Bylaw No. 2432, 2013.

The OCP is a long term strategic planning document intended to guide and direct decision making with respect to the change or conservation of land uses.

APPENDIX C: BEST MANAGEMENT PRACTICES AND REGIONAL OPERATING STATEMENTS

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