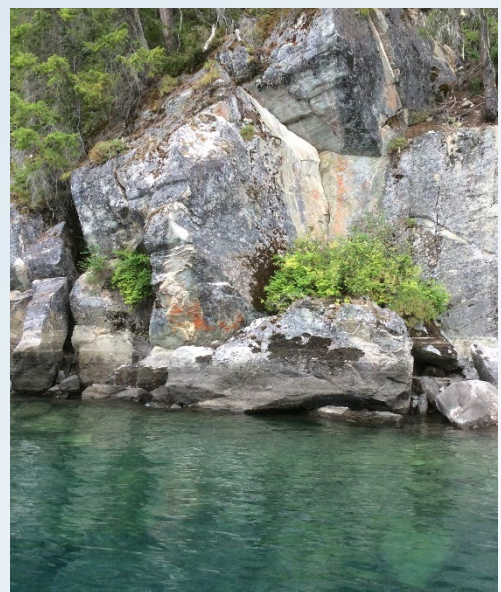




# Trout Lake Foreshore Integrated Management Planning – 2022

WSP E&I Canada Limited Project# VE52823-2022A



Prepared for:

**Living Lakes Canada**

Nelson, BC

31 March 2023



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**31 March 2023**

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## Executive Summary

Trout Lake, situated in the Selkirk mountains of the Kootenay region in southeast BC, is an oligotrophic lake with approximately 52 km of shoreline. Various tributaries provide inflows to the lake, the largest being Wilkie and Lardeau creeks, and the southern outlet of the lake is the Lardeau River which flows into the lower Duncan River before reaching Kootenay Lake. The community of Trout Lake is at the north end of the lake, rural properties are located sporadically around the lakeshore and there is a forest recreation campsite at the southwest of the lake. Historic and current resource extraction industries such as mining and forestry are prevalent in the Trout Lake watershed. The area is also popular for winter recreation and it is gaining attention as a summer lakefront destination.

As residential and recreational pressures on Trout Lake intensify, questions have been raised about what measures need to be taken to balance the social, cultural, ecological, and economic values of any given area. In response to these concerns, Foreshore Integrated Management Planning (FIMP) was completed on Trout Lake in the summer of 2022 to inventory and describe current shoreline attributes and modifications, identify sensitive habitats and provide guidance to land managers, homeowners, developers and stakeholders on how to protect sensitive habitats when land use changes are proposed.

In 2022, a FIM survey was completed along 52,665 m of the Trout Lake shoreline the majority of which was observed in natural condition (51,404 m; 97.5%) while the remainder was classified as disturbed (1,261 m; 2.5%). Most of the shoreline was classified as having a low level of impact (39,826 m; 76%), followed by no (11,830 m; 22%) and medium (1,008 m; 2%) level of impact. The most prevalent land use was natural area (51,045 m; 97%) followed by single family residential (1,008 m; 2%) and park (611 m; 1%). Shore type classifications observed included rocky shore (41,308 m; 78%), gravel (9,508 m; 18%), stream mouth (971 m; 2%) and sand (877 m; 2%).

Aquatic vegetation was observed along 774 m (1.5%) of the Trout Lake shoreline, all of which was submergent and/or emergent. Foreshore substrates were primarily boulder and cobble while littoral substrates were mainly sand and gravel. Large woody debris (LWD) was observed in foreshore areas of 12 of the 13 Trout Lake shoreline segments and the number of LWD pieces ranged from 1 to 260 per segment while in littoral areas LWD was observed in 8 segments and the number of LWD pieces ranged between 1 and 55 per segment. LWD clusters were observed in 7 of the 13 Trout Lake shoreline segments and the highest abundance (n=40 LWD clusters) were observed along the southwest side of the lake where LWD was recruited down steep slopes to the foreshore. The littoral area width of most of the shoreline (44,792 m; 85%) was classified as narrow (<10 m) followed by medium (10 – 50 m) (6,463 m; 12%) and wide (>50 m) (1,410 m; 3%). Nearshore riparian vegetation was mainly coniferous with small areas of shrubs and broadleaf while riparian stage was mostly mature forests. All segments where coniferous vegetation was dominant had abundant (>50%) tree cover while areas with broadleaf had medium (10-50%) tree cover and shrubs had sparse (<10%) tree cover. All shoreline segments had continuous riparian vegetation cover except for the southeast corner of the lake where it was patchy.

Fish sampling was conducted in shallow water habitats of Trout Lake in August 2022. Burbot (*Lota lota*) were the most prevalent fish species captured while Longnose Dace (*Rhinichthys cataractae*), Redside Shiner (*Richardsonius balteatus*), Slimy Sculpin (*Cottus cognatus*) and suckers were captured in lower numbers. Kokanee (*Oncorhynchus nerka*) and Bull Trout (*Salvelinus confluentus*) were also incidentally observed. Various bird species including Osprey (*Pandion haliaetus*), Bald Eagle (*Haliaeetus leucocephalus*) and Great Blue Heron (*Ardea herodias*) were observed during the FIM survey.

The most prevalent lineal shoreline modification was roadway which occurred along 1,881 m (4%) of the shoreline, followed by retaining walls (442 m; <1%), erosion protection (440 m; <1%) and substrate

modification (105 m; <1%). Other shoreline modifications included pilings (n=135), mooring buoys (n=18), docks (n=17), stairs (n=13), retaining walls (n=12), sheds (n=11), groynes (n=4), pile-supported structures (n=4), gravel boat launches (n=2), concrete boat launches (n=1), a boat lift (n=1), a fence (n=1), a marina (n=1), a pumphouse (n=1) and a historic rock abutment structure (n=1).

Most of the shoreline of Trout Lake was ranked as High (93.7%) ecological value followed by Very High (3.4%), Low (1.5%) and Moderate (1.4%). Most shoreline areas with Very High and High ecological value remained in natural condition (3.1% and 1.5% disturbed, respectively) while more disturbance was observed in shoreline areas with Moderate and Low ecological value (18.9% and 40% disturbed, respectively). Conservation zones are recommended at shoreline areas evaluated as having Very High ecological value (Lardeau and Asher creek confluences and the lake outlet to the Lardeau River) and/or where important riparian and fisheries habitat corridors were identified (Wilkie Creek confluence).

First Nations Traditional Ecological Knowledge (TEK) was incorporated into the Trout Lake FIMP. Representatives from Syilx Natural Resources and Okanagan Nation Alliance participated in the FIM field survey and contributed to this report.

The Trout Lake FDG provides development and planning guidelines that are aimed at protecting ecologically sensitive areas. Guidance is provided for landowners, regulators and other stakeholders on the permitting and review process for shoreline development. The FDG also identifies areas where development should be avoided.

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## List of Acronyms and Abbreviations

DFO	Fisheries and Oceans Canada
CSRD	Columbia Shuswap Regional District
CDC	Conservation Data Center
FIDQ	Fisheries Inventory Data Query
FDG	Foreshore Development Guidelines
FHSI	Foreshore Habitat Sensitivity Index
FIM	Foreshore Inventory and Mapping
FIMP	Foreshore Integrated Management Planning
GIS	Geographic Information Systems
GPS	Geographic Positioning Systems
HWM	High Water Mark
LiDAR	Light Detection and Ranging
LLC	Living Lakes Canada
LWD	Large Woody Debris
MFLNRORD	Ministry of Forests, Lands, Natural Resource Operations and Rural Development
OCP	Official Community Plan
RDCK	Regional District of Central Kootenay
SARA	Species-At-Risk-Act
SHIM	Sensitive Habitat Inventory and Mapping
TRIM	Terrain Resource Information Management
UAV	Unpiloted Aerial Vehicle
UTM	Universal Transverse Mercator
WSC	Water Survey of Canada
ZOS	Zones of Sensitivity

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Living Lakes Canada is a non-profit society that facilitates collaboration in education, monitoring, restoration and policy development initiatives for the long-term protection of Canada's lakes, rivers, wetlands and watersheds. Our mandate is to help residents of Canada understand, adapt and mitigate the impacts of climate change to water quality and quantity, biodiversity and healthy human communities through diverse water stewardship activities. Living Lakes Canada bridges the gap between science and action to foster and normalize citizen- based water stewardship.

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## 1.0 Introduction

Trout Lake is situated in the Selkirk mountains approximately 70 km north of Meadow Creek, BC. The lake has approximately 52 km of shoreline, a surface area of 2,792 ha, and is situated at 721 m elevation (MOE 2022). The lake is oligotrophic with a mean depth of 128 m and a maximum depth of 234 m (Burns 1978). Various tributaries provide inflows to the lake, the largest being Wilkie and Lardeau creeks, and the southern outlet of the lake is the Lardeau River which flows into the lower Duncan River before reaching Kootenay Lake. The community of Trout Lake is at the north end of the lake, rural properties are located sporadically around the lakeshore and there is a forest recreation campsite at the southwest of the lake.

Many native fish species have been documented in Trout Lake including Burbot (*Lota lota*) and Bull Trout (*Salvelinus confluentus*) which are species of regional and/or provincial conservation concern (FIDQ 2022). Sampling was conducted for White Sturgeon (*Acipenser transmontanus*), listed as Endangered under the federal Species at Risk Act (SARA), in Trout Lake in 1995 and although none were captured, many Burbot were captured as bycatch as was one Bull Trout (RL&L 1995). Burbot sampling was subsequently conducted in the 2000's and suggested there was a substantial Burbot population in Trout Lake (Baxter et al. 2002). Other than these surveys, there has been very little fish inventory work done in Trout Lake since the 1970's. FIDQ (2022) also includes a record of Cutthroat Trout (*Oncorhynchus clarkii*) being stocked to the lake in 1913 and it is unknown if these were of the Westslope subspecies, listed as Special Concern under SARA, and no other records of capture were located. The Trout Lake outlet to the Lardeau River is the primary spawning area for Gerrard Rainbow Trout (*Oncorhynchus mykiss*) from Kootenay Lake, a genetically unique trophy-sized Rainbow Trout native to the lake.

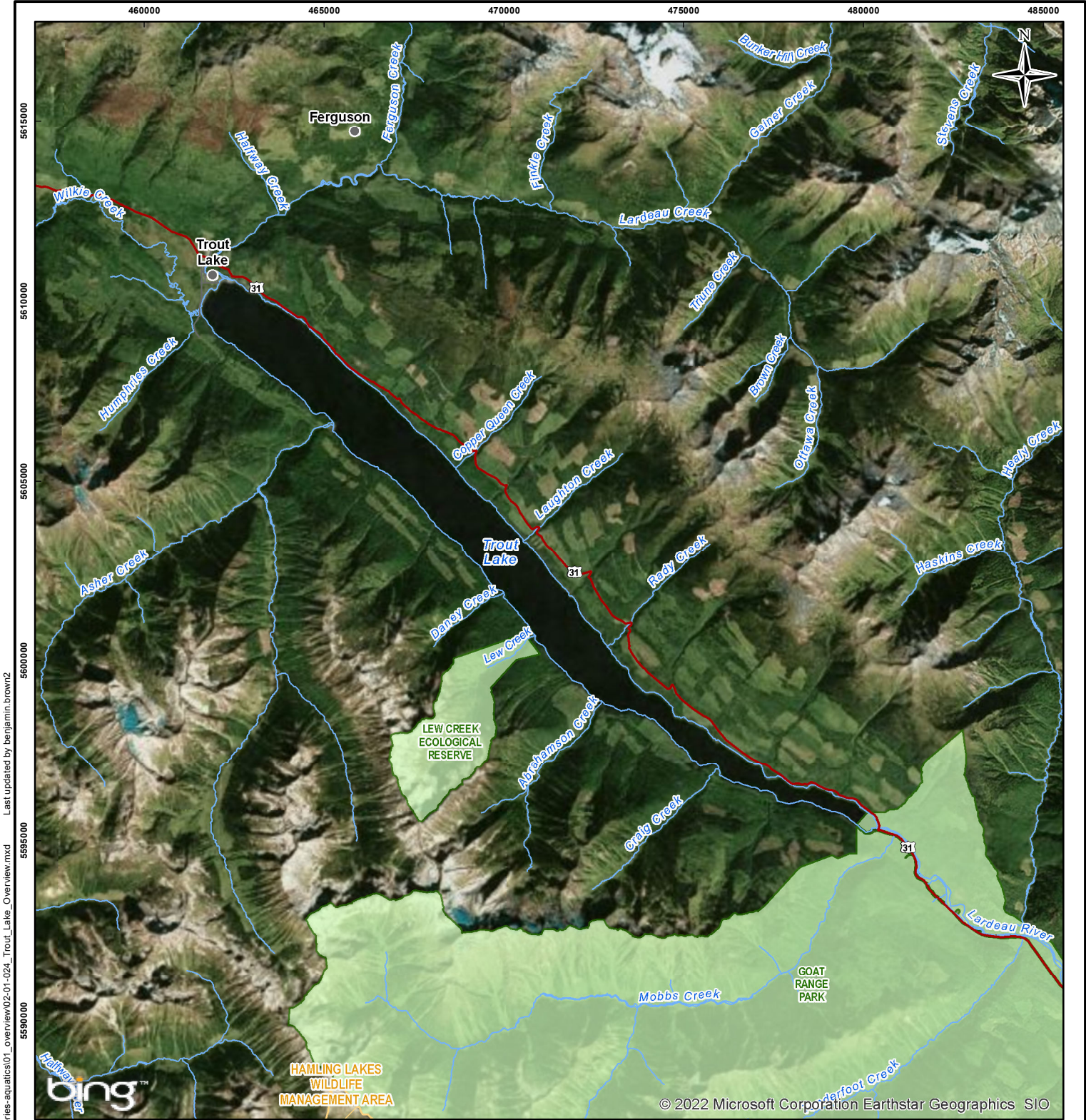
Unique and important terrestrial ecosystems are also found in the Trout Lake watershed. Holt and MacKillop (2006) identified old growth forests within unique inland temperate rainforest ecosystems within the valley. They also describe the extremely high ecosystem diversity within the extensive riparian complex of wetlands with marshes, swamps, cottonwoods and coniferous forests in the Wilkie Creek drainage at the north end of Trout Lake. Whitebark Pine (*Pinus albicaulis*), provincially blue-listed and federally listed as Endangered under SARA, has been identified in an upland area in the Laughton Creek drainage east of Trout Lake (CDC 2022).

Historic and current resource extraction industries such as mining and forestry are prevalent in the Trout Lake watershed. Trout Lake is a popular area for winter recreation and it is gaining attention as a summer lakefront destination. The Kootenays have long been regarded as a desirable place to vacation, recreate or reside. With expanding economic growth throughout western Canada in recent years, the Kootenays have experienced an increase not only in visitors, but also in permanent and seasonal residents. Along with increasing population comes a requirement for new infrastructure such as residential, commercial, and industrial developments. As residential and recreational pressures on Trout Lake intensify, questions have been raised about what measures need to be taken to balance the social, cultural, ecological, and economic values of any given area. Therefore, the Trout Lake FIMP was completed during summer 2022 to inventory and describe current shoreline attributes and modifications, identify sensitive habitats and provide guidance to land managers, homeowners, developers and stakeholders on how to protect sensitive habitats when land use changes are proposed.

The following summarizes the outcomes of each step of the process:

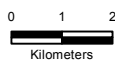
1. Foreshore Inventory and Mapping (FIM) – is a process that uses GIS, GPS and field observation to inventory and describe the land uses (e.g., residential and industrial development, etc.), shoreline modifications (e.g., docks, retaining walls, etc.), and biophysical attributes (e.g., wetlands, riparian vegetation, substrate, etc.) along the lake or reservoir shoreline. Information collected can be incorporated into a variety of land use planning documents including Official Community Plans, Shoreline Management Plans and Land and Resource Management Plans.
2. Foreshore Habitat Sensitivity Index (FHSI) – is the core technical analysis completed using FIM and non-FIM data to determine the relative habitat value of a shoreline. The FHSI uses data collected during the FIM survey, additional field reviews (e.g., fish and wildlife surveys) and data from other sources to determine the relative habitat value of a shoreline segment (one of five Ecological Ranks are assigned) and identify zones of sensitivity. The FHSI rankings are a relative measure of habitat value or sensitivity that are waterbody specific.
3. Foreshore Development Guide (FDG) – is a report that used the FHSI results to recommend development guidelines that aim to protect sensitive foreshore habitats. The FDG is intended to provide background information to land managers, homeowners, developers and stakeholders when land use changes or activities are proposed that could alter the shoreline thereby affecting fish and wildlife habitat. The guidelines include the Ecological Rankings for all shoreline areas, an activity risk table and a decision-making flow chart for proposed works along the shoreline. The FDG also contains fish and wildlife habitat conservation areas and/or strategies.

The following report includes all three phases of FIMP, which includes reporting on the FIM survey, the FHSI and the FDG.



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- Legend**
- Populated Place
  - +++ Railway
  - Highway
  - Road
  - Watercourse
  - Waterbody
  - Parks & Protected Areas



**References:**  
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CLIENT: <b>LivingLakes</b>			
PROJECT: <b>Trout Lake FIMP</b>			
TITLE: <b>Trout Lake Overview Map</b>			
DATE: October 27, 2022	SCALE: 1:150,000	<b>Figure 1</b>	
GIS FILE: 02-01-024_Trout_Lake_Overview.mxd			
COORDINATE SYSTEM: NAD 1983 UTM Zone 11N	JOB No: VE52823	ANALYST: BB	QA/QC: CL



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## **2.0 Methods**

Methods presented herein provide a summary of the three phases of FIMP pertaining to Trout Lake. FIMP methods are outlined in Schleppe et al. (2021), unless otherwise specified below.

### **2.1 Foreshore Inventory Mapping (FIM)**

#### **2.1.1 Pre-Field Assessment**

Background information was compiled and baseline field maps prepared during the pre-field assessment to help guide field data collection activities and ensure all required information was acquired.

GIS map file layers including Columbia Shuswap Regional District (CSRD) and Regional District of Central Kootenay (RDCK) legal boundaries/jurisdiction/cadastral/zoning land uses, provincial data layers (e.g., Freshwater Atlas, TRIM, etc.), and Conservation Data Centre (CDC) BC Species and Ecosystems Explorer plants, animals and ecosystem mapping were obtained from online platforms.

Baseline maps were prepared in ArcGIS using imagery and overlay of GIS layers. World & Bing Imagery (2018-2022 satellite imagery, colour, 0.5 m pixels) were used to prepare the base maps. The high-water mark (HWM) was initially delineated using the Freshwater Atlas 1:50,000 Trout Lake shoreline layer. Trout Lake does not have an active hydrometric data station maintained by Environment and Climate Change Canada, so the HWM (i.e., shoreline layer) cannot be determined using staff gauge measurements (MOE 2009 as cited in Schleppe et al. 2021). In addition, there was no LIDAR available to use for HWM determination (CSRD 2022; RDCK 2022). Therefore, the initial HWM was using satellite imagery interpretation (0.5 m pixels; interpretation to within  $\pm 5$  m). Average littoral width was calculated by taking an average of, at minimum, three measurements from the shoreline out to the area where there was an obvious colour change on the satellite imagery that identified deeper water; these areas were also confirmed during the 2022 FIM survey.

Preliminary options for FIM segment breaks were evaluated by reviewing changes in shore type and property boundaries (Schleppe et al. 2021). However, actual segment breaks were confirmed during field surveys (Section 2.1.3).

A brief literature review was conducted to obtain any relevant studies for Trout Lake. This was done to ensure any necessary information required was collected during the FIM field surveys. Resources reviewed for fish, wildlife and ecological values included EcoCat: The Ecological Reports Catalogue, Conservation Data Centre (CDC) iMap, BC Species & Ecosystem Explorer and other web-based searches were consulted.

All digital datasets and mapping layers were loaded onto a tablet (e.g., iPad) prior to conducting the field portion of the FIM surveys (Section 2.1.2). A health and safety plan was prepared and reviewed with team members prior to conducting field surveys.

## 2.1.2 Field Data Collection Platform

The primary method for field data collection was a tablet (e.g., iPad) loaded with the *ArcGIS Collector™* application. Collector for ArcGIS is a map-driven, mobile data collection application that allows for easy and accurate field data capture. This application uses the device's GPS location services to identify your position and data can be captured in both a connected and disconnected (i.e., without Wi-Fi/cellular data) environment. Collector for ArcGIS is fully integrated with the ArcGIS platform so it can be seamlessly incorporated with other ArcGIS apps to maximize efficiency in workflows. This platform was successfully implemented and used during the Columbia, Slocan, Moyie and Whitetail lakes FIMP (Wood 2021a, 2021b, 2022a, 2022b).

Base maps developed during the pre-field assessment (Section 2.1) were loaded into the ArcGIS Collector application. The FIMP data dictionary previously developed for other FIM lake surveys (e.g., Slocan Lake) was also loaded onto the tablet for use in the ArcGIS Collector. This data dictionary included all segment line features as outlined in Schleppe et al. (2021; specifically Appendix B) which generates a layer within a file geodatabase that was then published and used by field assessors to populate. Other geometry types (e.g., point and polygon) feature layers that needed to be included in the re-FIM were created for any additional data collection that was outside of the segment break data dictionary (e.g., photographs and aquatic vegetation polygons). Photographs were directly embedded as a point location for each segment along with metadata including location (e.g., UTM), timestamp, segment number, photograph number and caption.

Field data were collected using the Trout Lake ArcGIS Collector data dictionary in a disconnected environment. Data was exported and backed up to a laptop, cloud-based storage and WSP's internal server daily. Data were also reviewed for completeness at this time.

Additional data collection tools and back ups also included bringing the following into the field daily:

- Digital and hard copies of Excel spreadsheets with a copy of the updated data dictionary.
- Avenza Maps, an alternative application for georeferenced photo collection, was also loaded onto the tablet, with baseline maps imported.
- Hard copy printouts of base maps were available for field assessors to mark up polygons and other feature information. And,
- Waterproof field notebooks and hand counters were also available for field assessors to take additional notes and tally counts.

## 2.1.3 Foreshore Inventory and Mapping Field Surveys

The FIM field survey was conducted over a 3-day period on 9 to 11 August 2022. Trout Lake was accessed via the public boat launch at the northwest end of the lake near the community of Trout Lake. As outlined in Schleppe et al. (2021), the field survey was conducted by navigating a boat along the shoreline of the lake, slowly and within a safe distance from shore to minimize wave action and avoid nearshore hazards. A four-person field crew, consisting of staff from WSP, Okanagan Nation Alliance and Syilx Natural Resources, was stationed on the deck of the boat and each crew member was responsible for ensuring specific data fields were collected. Data collection was accomplished via tablet using the ArcGIS Collector data dictionary (Section 2.1.2). Surveys began at a segment break closest to the boat launch or where surveys had ended the previous day and proceeded along the shoreline until all segments were inventoried. Preliminary segment breaks were reviewed and updated where required. Within each segment, all lake characteristics (i.e., data fields) outlined by Schleppe et al. (2021) were inventoried following standard methods.

Digital and hard copies of Schleppe et al. (2021) were available in the field and used as reference during inventory of all data entry fields. At least one photograph of each single-family residential lot, each shoreline modification as well as representative photographs of each segment were taken.

### **2.1.3.1 Fish Survey**

Information on fish and other aquatic resources was compiled during the background literature review. Fish species observations were compiled using the provincial Fisheries Inventory Data Query tool (FIDQ 2022) and reports relevant to aquatic resources in Trout Lake were obtained from provincial databases (e.g., FIDQ and Ecocat) and web searches. Data gaps related to the presence/absence of fish in nearshore habitats were identified during the background review. Therefore, fish surveys were conducted over a two-day period on 10 and 11 August 2022 as part of the Trout Lake FIM survey.

The conservation status of all fish species identified in the lake was reviewed against the federal (e.g., SARA and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)) and provincial (e.g., CDC) listings (Government of Canada 2022, CDC 2022). The information was summarized and presented in Section 3.1.6.

### **2.1.3.2 Wildlife Survey**

Wildlife surveys, outside of observational data collected during the standard FIM procedure, were not conducted as part of the FIM survey. Information on wildlife and other terrestrial resources in Trout Lake was compiled during the background literature review. The conservation status of all wildlife species identified in the lake was reviewed against the federal (e.g., SARA and COSEWIC) and provincial (e.g., CDC) species listings (Government of Canada 2022, CDC 2022). The information was summarized and presented in Section 3.1.7.

### **2.1.3.3 Unpiloted Aerial Vehicle (UAV) Survey**

Videography and still image photography via an Unpiloted Aerial Vehicle (UAV) (drone) survey was also conducted on 10 and 11 August 2022. The UAV survey collected video of the entire Trout Lake foreshore. The UAV survey was conducted up to a maximum height of 122 m (operator's permitted use) to capture these foreshore features as well as any areas that were not visible from the boat (e.g., vegetation bands in steeper areas).

### **2.1.4 Post-Processing and QA/QC**

Post-processing included extracting photos, converting data, modifying feature layers, shoreline mapping to match orthophoto representation of high-water mark, and another QA/QC of entire dataset. Shape files for each lake segment by section breaks were created. Aquatic vegetation GIS polygons were determined by reviewing maps, UAV imagery and field observations and were then delineated manually on maps, digitized and added to map templates. After post-processing, data were imported into map templates for report map production. The UAV footage was reviewed during post-processing to help QA/QC field survey data and extract relevant still images for reporting that highlight specific features of interest.

## 2.1.5 Data Analyses and Management

The following shoreline characteristics were summarized by evaluating the proportions of each category within a segment and summing each category for Trout Lake:

- Natural versus disturbed shoreline.
- Shore type segment class including the proportion of natural versus disturbed shoreline within each shore type.
- Land use segment class including the proportion of natural versus disturbed shoreline within each land use type.
- Foreshore, littoral and riparian (i.e., vegetation bands) characteristics.
- Aquatic vegetation.
- Shoreline modifications. And,
- Level of impact.

Note that the segment classification for shore type and land use, not the proportion within each segment, were evaluated against the proportion of the segment that was disturbed versus natural. Riparian characteristics were summarized qualitatively, where possible. Fish and wildlife observations/attributes were described based on background literature review and field observations.

All fish and wildlife-related datasets collected during the desktop review were exported digitally (e.g., shapefiles, file geodatabase, Excel) and provided to Living Lakes Canada as supporting documentation to this report.

## 2.2 Foreshore Habitat Sensitivity Index (FHSI)

A FHSI is a framework for assessing the relative aquatic and terrestrial habitat values along a lake's shoreline. The FHSI uses inventory information collected during the FIM survey, additional field surveys (e.g., fish and wildlife surveys), background literature reviews and/or data from other sources to develop a points-based index that assigns positive values to important and sensitive habitat features and negative values to modifications that have impaired habitat value. Non-FIM categories included in the FHSI can include fish, wildlife, herptile, waterfowl, ecosystem, rare or endangered species or ecosystems, and/or other criteria. The FHSI is then applied to each shoreline segment delineated during the FIM, resulting in a collection of habitat segment scores. A numerical range is used to define each Ecological Rank (e.g., Very Low, Low, Medium, High, and Very High), allowing each segment to be labelled accordingly. Methods outlined by Schleppe et al. (2021) were followed during development and calibration of the Trout Lake FHSI, calculation of segment FHSI scoring and determination of FHSI Ecological Ranks. Additional details are also provided below.

### 2.2.1 FHSI Weighting and Calibration

Each FIM and non-FIM category were assigned an initial weighting following the standardized procedure outlined by Schleppe et al. (2021) whereby each category value is initially equal, except for shoreline modifications, then weights of categories were adjusted based on the expected influence of the criterion. At the same time, the influence of each criterion was determined by adjusting the Percent Within Category to reflect the influence of each criterion on foreshore habitat. The FHSI score was then calculated by summing the score of all index criteria for each segment. Note that Band 1 data was used for both Band 1 and Band 2 calculations when Riparian Band 1 extended the entire 50 m assessment zone and no Riparian Band 2 was observed. Subcategories of substrate types were weighted the same as their primary category (e.g., fine gravel and coarse gravel received the same weight as gravel).



Five FHSI versions were developed, each with different category and/or criteria weightings, and were scrutinized by the study team; the version that best reflected Trout Lake’s habitat values was selected. The FHSI segment scoring was then used to develop FHSI Ecological Ranks, a five-class ranking system, ranging from Very Low to Very High ecological value, by reviewing the minimum, maximum, median and distribution of FHSI scores for the lake and creating appropriate boundaries for each ranking. Several iterations of the FHSI Ecological Rank breaks were conducted to determine if the ranks were reflective of values along the shoreline. Iterations were reviewed, mapped (Section 2.2.3) and updated using procedures outlined by Schleppe et al. (2021).

The FHSI was calibrated by reviewing the influences of each of the different FIM and non-FIM FHSI categories and criteria and associated weightings to ensure that the index is appropriately scored. Three versions of the FHSI were selected to represent the most reflective of shoreline habitat value for review/calibration by the LLC Technical Committee, including the version selected by the study team. Feedback was received from one committee member and was used to finalize FHSI criteria, FHSI Ecological Rank breaks and segment rankings.

## **2.2.2 Zones of Sensitivity**

Zones of Sensitivity (ZOS) are specific areas identified as important habitats for either species or general ecosystem function. ZOS are a way of displaying sensitive habitat areas that may or may not have been included in the FHSI rank calculation, as point, line or polygon features graphically on maps and using GIS mapping tools. ZOS often include wetlands, aquatic vegetation, creek mouths, native grasslands, wildlife habitat and corridors, gravel/cobble habitat, biologically productive areas and other unique unimpacted/natural areas because of their value to fish and wildlife (Schleppe et al. 2021, Caskenette et al. 2020, NRC 2002).

## **2.2.3 FHSI Mapping, Analysis and Reporting**

Mapping is the best framework for viewing results of the FHSI. Mapping products initially developed during the FIM were updated to include the FHSI Ecological Rank of each segment using the prescriptive colour and mapping requirements as specified in Schleppe et al. (2021). ZOS were also added to the maps as polygons and a 20 m buffer was added to each polygon to account for unknowns in the mapping of the ZOS and protect the core ZOS from potential impacts from adjacent activities. The buffer size was kept relatively narrow due to inherent buffering already included in the ZOS polygons during digitization for tributary mouths.

Standard analysis of FHSI Ecological Rank was completed. These included a summary of the total shoreline length and percentage of the total shoreline of each FHSI Ecological Rank with an additional summary of FHSI Ecological Rank by shore type and a plot of total length of natural and disturbed shoreline by rank (Schleppe et al. 2021).

Areas with unique, high value habitats were highlighted for designation as conservation zones. Potential conservation zones included areas with Very High or High FHSI Ecological Rank that also contain one or more ZOS.

## **2.3 First Nations Traditional Ecological Knowledge (TEK)**

FIMP recognizes the importance of including First Nations Traditional Ecological Knowledge (TEK), which can be included as non-FIM criteria and/or as points, polygons or lines on FHSI mapping and GIS products (Schleppe et al. 2021). The Trout Lake FIMP program was developed to include the direct involvement of Syilx Natural Resources (SNR) and Okanagan Nation Alliance (ONA) members during the FIM field survey as well as in the review of FHSI criteria, the FDG document and entire FIMP report. As a result, TEK was

incorporated directly into the assessment and inventory of shoreline variables, habitats and disturbance/modification observations.

## **2.4 Foreshore Development Guide (FDG)**

The FDG provides development planning guidelines, aimed at protecting sensitive fish and wildlife species and their habitats identified through the previous FIM and FHSI analyses. The template FDG provided by Schleppe et al. (2021) was populated with Trout Lake specific information including the FHSI Ecological Rank of each shoreline segment and ZOS. This information was also provided on FDG mapping products which were a streamlined version of the FHSI maps revised to only include FHSI Ecological Rank and ZOS using predetermined colour coding (Schleppe et al. 2021). The Trout Lake FDG is provided in Appendix G.

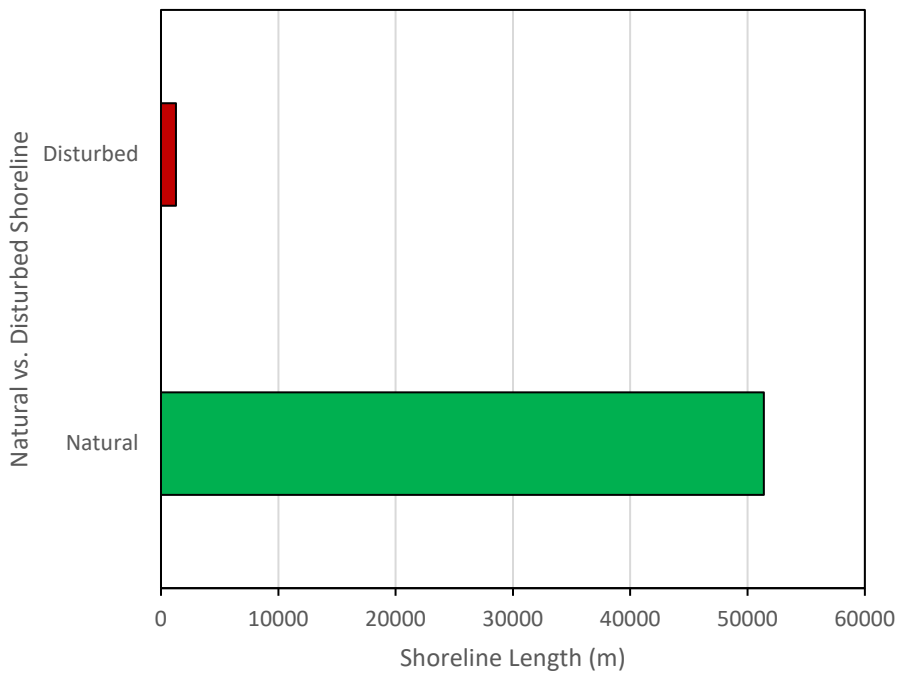
## 3.0 Results

### 3.1 FIM

Biophysical characteristics of Trout Lake are summarized below. Segment maps are provided in Appendix A and segment summaries are provided in Appendix B.

#### 3.1.1 Natural versus Disturbed Shoreline

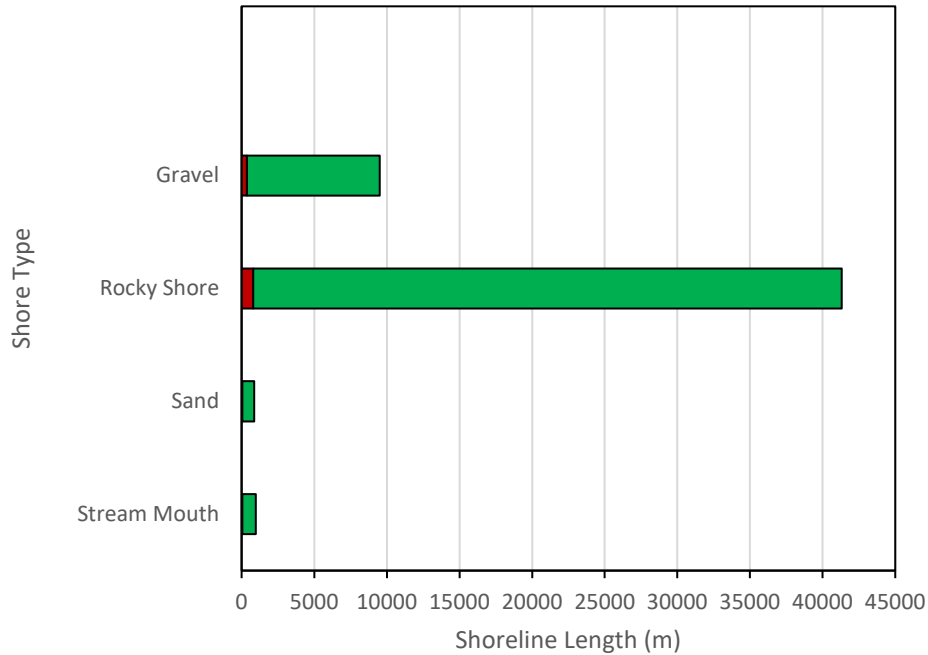
The FIM was completed along the entire 52,665 m of the Trout Lake shoreline. The shoreline was divided into 13 segments ranging in length from 203 to 20,403 m. The total length of disturbed shoreline was 1,261 m (2.5%) while the total length of shoreline that remained in natural condition was 51,404 m (97.5%); (Figure 2).



**Figure 2: Total shoreline length (m) that is disturbed or natural for Trout Lake.**

#### 3.1.2 Shore Type

The predominant shore type was rocky shore which was observed along 41,308 m (78%) of Trout Lake (Figure 3). Other shore types observed included gravel (9,508 m; 18%), stream mouth (971 m; 2%) and sand (877 m; 2%). Wetland and cliff/bluff shore types were not observed. In areas with rocky shores, 98% of the shoreline remained in natural condition while slightly more disturbance was observed in areas with gravel, sand and stream mouth shore types (96%, 95%, and 94%, respectively) (Figure 3). The Lardeau Creek outlet (Segment 1) and Lardeau River inlet (Segment 8) accounted for most of the stream mouth shore type observed with smaller tributary outlets distributed around the lake (Figure 1).



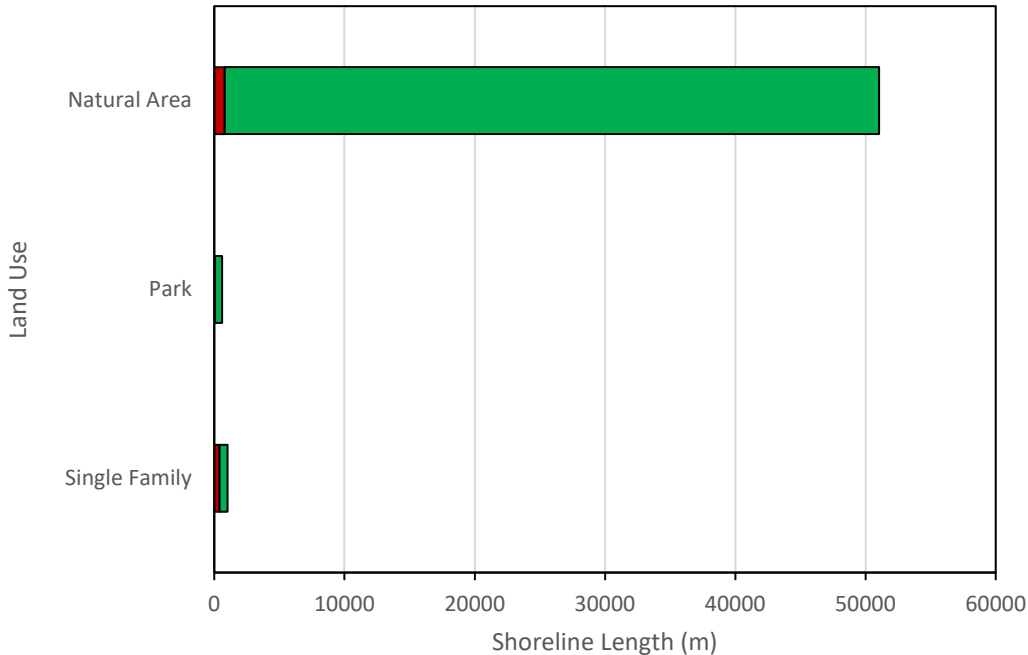
**Figure 3: Shore types and length of natural (green) versus disturbed (red) shoreline for Trout Lake.**

### 3.1.3 Land Use

The predominant land use along the Trout Lake shoreline was natural area (51,045 m; 97%) followed by single family residential (1,008 m; 2%) and park (611 m; 1%) (Figure 4).

Most of the shoreline in segments classified as natural area and park land use were in a natural state (2% and 9% disturbed, respectively) (Figure 4). Disturbance in natural areas was due to small areas of rural and single-family residential development as well as access roads. Disturbance in areas with park land use was due to transportation corridors (e.g., Highway 31) in a portion of the segment. More disturbance was observed in segments classified as single-family residential land use (41% disturbed) due to shoreline modifications including docks, groynes, retaining walls, boat launches, foot bridges, erosion protection and substrate modification.

Small areas of transportation and rural land uses were observed in segments that had other overall land use classifications. For example, Highway 31, including the bridge over the Lardeau River (Segment 8), was classified as transportation land use (55 m). Rural properties with limited shoreline development were also observed along the northeast (Segment 6; 39 m) and south (Segment 9; 204 m) sides of the lake.



**Figure 4: Land use types and length of natural (green) versus disturbed (red) shoreline for Trout Lake.**

### 3.1.4 Aquatic Vegetation

Aquatic vegetation was observed along 774 m (1.5%) of the Trout Lake shoreline. All aquatic vegetation observed was submergent and emergent; floating aquatic vegetation was not observed. Submergent aquatic vegetation was observed in six shoreline segments (740 m; 1.5%). Emergent vegetation was observed in three shoreline segments though it was very sporadic and covered less area than submergent (34 m; <1%). The highest concentration of aquatic vegetation was at the southeast corner of the lake near the outlet to the Lardeau River (Segment 8) where it was observed along approximately 30% (183 m) of the segment.

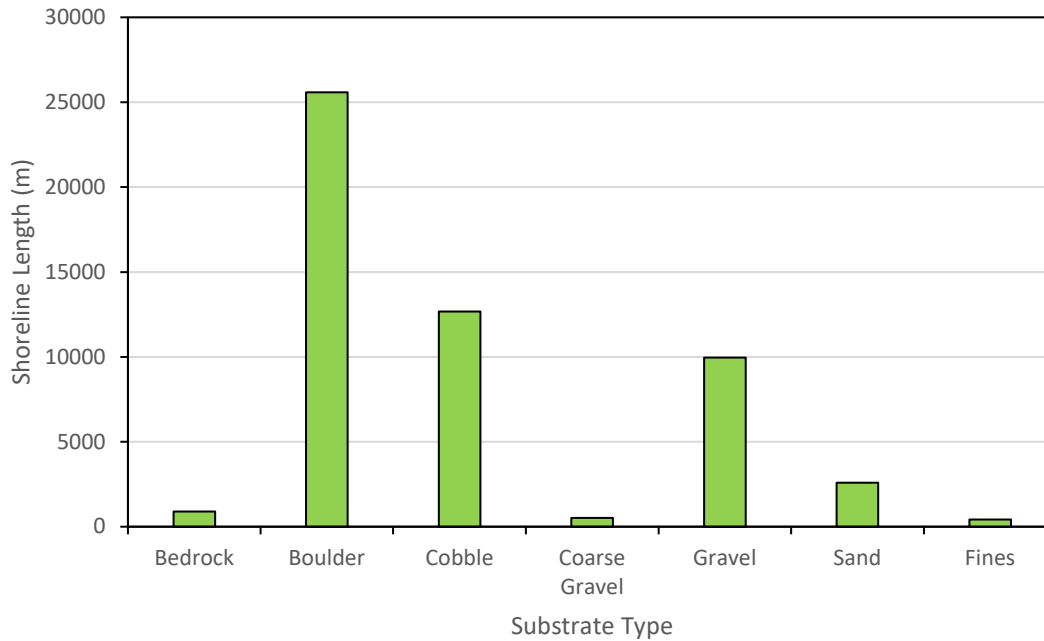
### 3.1.5 Shoreline Characteristics

Characteristics of foreshore, littoral, riparian, and wetland areas are described below.

#### 3.1.5.1 Foreshore Areas

Large Woody Debris (LWD) was observed along the foreshore in 12 of the 13 Trout Lake shoreline segments and the number of LWD pieces ranged from 1 to 260 per segment when observed (Appendix B). The highest abundance of foreshore LWD was observed along the southwest side of the lake (n=260; Segment 9) with high counts (>75 pieces LWD per segment) also observed along undeveloped areas of the northeast shoreline (Segments 3, 5 and 7). LWD clusters were observed in 7 of the 13 Trout Lake shoreline segments and the highest abundance (n=40 LWD clusters) were observed along the southwest side of the lake (Segment 9) where LWD was recruited down steep slopes to the foreshore.

Boulder (25,589 m; 49%) was the predominant substrate type observed along the foreshore of Trout Lake (Figure 5). Lesser amounts of cobble (12,672 m; 24%), gravel (9,961 m; 19%), sand (2,596 m; 5%), bedrock (901 m; 2%), coarse gravel (523 m; 1%) and fines (424 m; <1%) were also observed.

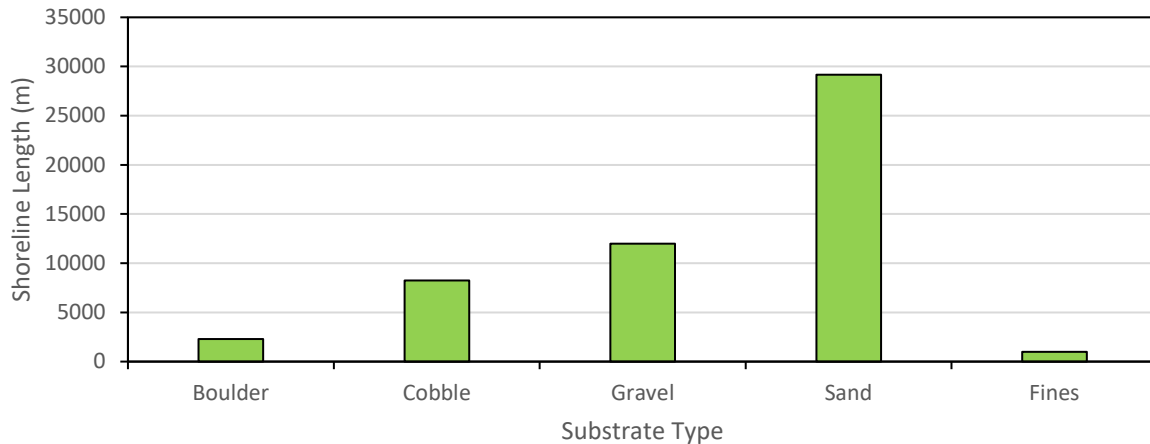


**Figure 5: Substrate types observed along the foreshore of Trout Lake.**

### 3.1.5.2 Littoral Areas

The littoral area was narrow (<10 m) along the majority (44,792 m; 85%) of the Trout Lake shoreline. Medium (10 – 50 m) littoral areas were observed along 6,463 m (12%) of the shoreline while wide (>50 m) littoral areas were observed along the remaining 1,410 m (3%) of the shoreline. Littoral width ranged between 1 and 60 m. Wide littoral areas were located at the northwest end of the lake (Segments 12 and 13). Littoral LWD was observed in 8 segments and the number of LWD pieces ranged between 1 and 55 in segments where it was present. The highest count of littoral LWD (n=55) was observed along the southwest side of the lake (Segment 9) where densely forested upslope areas provided an LWD source.

Substrates in the littoral zone varied from foreshore substrates observed in Trout Lake. Sand (29,180 m; 55%) was the predominant substrate type observed in littoral areas of Trout Lake (Figure 6). Lesser amounts of gravel (11,986 m; 23%), cobble (8,241 m; 16%), boulder (2,282 m; 4%) and fines (975 m; 2%) were also observed. No bedrock was observed in the littoral zone.



**Figure 6: Substrate types observed in littoral areas of Trout Lake.**

### 3.1.5.3 Riparian Areas (Vegetation Bands 1 and 2)

The nearshore riparian vegetation band (Vegetation Band 1) was 50 m or greater in nine of the 13 shoreline segments; secondary vegetation layers (i.e., Vegetation Band 2) within 50 m of the shoreline were observed in four segments (Segments 1, 2, 8 and 13; Appendix B). The majority of riparian vegetation in Vegetation Band 1 was coniferous (49,478 m; 94%) with small areas of shrubs (2,381 m; 5%) and broadleaf (805 m; 2%). All segments where coniferous vegetation was dominant had abundant (>50%) tree cover while areas with broadleaf had medium (10-50%) tree cover and shrubs had sparse (<10%) tree cover. The dominant stage of riparian vegetation was mature forest (50,284 m; 95%) with small areas of tall shrubs (2,381 m; 5%). Riparian vegetation was continuous in all shoreline segments except for Segment 8 at the southeast end of the lake where riparian vegetation was patchy. In Segment 9, historic forestry operations had removed trees from the riparian area to the Trout Lake shoreline (Figure 7).

Veteran trees and snags were observed in all shoreline segments, typically in high numbers (>25 of each per segment; Appendix B). Fewer veterans and snags (5-25 of each per segment) were observed in segments with shrub and broadleaf forest classes (e.g., Segments 1, 2, 11 and 13). The lowest count of veterans and snags (<5 of each per segment) was in the smallest segment (Segment 4) and a short segment dominated by shrub vegetation near the Wilke Creek outlet (Segment 12).

Overhanging vegetation was observed in all segments and present along 1% to 90% of the shoreline (Appendix B). Eight of the 13 shoreline segments had overhanging vegetation along >50% of the shoreline.

Multiple community members expressed concern about recent tree foliage mortality observed in the forests along the south side of the lake (Figure 8). The tree disease is likely Western Hemlock looper, a moth whose larval life form hatch and feed on foliage through spring and summer (Deb MacKillop, Research Ecologist, B.C. Ministry of Forests, pers. comm.). Defoliation from looper results in browning foliage and mortality in heavily defoliated conifers. Outbreaks usually last about three years (MOF 2022). The issue was observed primarily in upland areas but could impact riparian vegetation in the future.



**Figure 7: Vegetation removed from the riparian area during historic forestry operations in Segment 9 that has subsequently regenerated, 10 August 2022.**





**Figure 8: Tree foliage mortality (rust colour) observed in upland forests along the south shore of Trout Lake, 11 August 2022.**

### **3.1.6 Fish Species Information**

Fish observations made during the August 2022 field survey are provided in Appendix C. Fish species occurrence information compiled from FIDQ (2022), CDC (2022) and the 2022 fish inventory survey (Appendix C) is provided in Table 1.

**Table 1: Fish species known to occur or have occurred in Trout Lake including current provincial conservation status and federal Species-At-Risk (SARA) Listing.**

Common Name	Species Name	BC Provincial Conservation Status	Federal Species-At-Risk-Act (SARA) Status
Bull Trout	<i>Salvelinus confluentus</i>	Blue	-
Burbot	<i>Lota lota</i>	Yellow	-
Chub (General)	<i>Couesius spp.</i>	Yellow	-
Kokanee	<i>Oncorhynchus nerka</i>	Yellow	-
Lake Chub	<i>Couesius plumbeus</i>	Yellow	-
Lake Trout	<i>Salvelinus namaycush</i>	Yellow	-
Largescale Sucker	<i>Catostomus macrocheilus</i>	Yellow	-
Longnose Dace	<i>Rhinichthys cataractae</i>	Yellow	-
Longnose Sucker	<i>Catostomus</i>	Yellow	-
Mountain Whitefish	<i>Prosopium williamsoni</i>	Yellow	-
Northern Pikeminnow	<i>Ptychocheilus oregonensis</i>	Yellow	-
Prickly Sculpin	<i>Cottus asper</i>	Yellow	-
Rainbow Trout	<i>Oncorhynchus mykiss</i>	Yellow	-
Redside Shiner	<i>Richardsonius balteatus</i>	Yellow	-
Slimy Sculpin	<i>Cottus cognatus</i>	Yellow	-
Torrent Sculpin	<i>Cottus rhotheus</i>	Yellow	-
Westslope Cutthroat Trout*	<i>Oncorhynchus clarkii lewisi</i>	Blue	Special Concern

\* "Cutthroat Trout" were stocked to the lake in 1913. It is assumed but not confirmed that these were the Westslope subspecies.

Bull Trout, though not listed under SARA, are provincially blue-listed and have been documented in Trout Lake as well as spawning in tributaries to Trout Lake. Bull Trout (at the time referred to as Dolly Varden) were documented in Wilkie, Lardeau, Asher and Humphries Creek during tributary assessments in 1978 (Burns 1978). Bull Trout spawning assessments were conducted in tributaries to Trout Lake in 2014 as part of a Fish and Wildlife Compensation (FWCP) Project (F-F15-21). Bull Trout spawning was documented by observations of redds and unspawned females, however, specific locations are not available due to the sensitive nature of the data. During the August 2022 FIM survey, Bull Trout were observed being captured by anglers in the most downstream reach of Lardeau Creek near the outlet to Trout Lake in Segment 1 (Appendix C).

Radio telemetry data collected in 2002 suggested Burbot spawning occurs between late February and late April in Trout Lake (Baxter et al. 2002). The outlets of small creeks (e.g., Wilke, Asher and Daney creeks) were identified as potentially important spawning habitat while there was no use of the larger tributaries at the north end of the lake (Lardeau and Wilkie creeks). A population estimate was not generated and the authors suggested annual assessments were not required (Baxter et al. 2002). However, it was recommended that future assessments compare catch-per-unit-effort (CPUE) and life history characteristics to the 2002 baseline observations to monitor general population trends and assess angler impacts. Burbot were captured in the most downstream reach of Asher Creek during tributary assessments in 1978 (Burns 1978).

Cutthroat Trout (*Oncorhynchus clarkii*) were stocked to the lake in 1913 and it is unknown if these were of the Westslope subspecies (*O. clarkia lewisi*), listed as Special Concern under SARA, and no other records of

capture were located. Kokanee (*Oncorhynchus nerka*) spawning has been documented in Wilkie and Lardeau creeks (Burns 1978). Two deceased Kokanee fry were incidentally observed during the August 2022 FIM survey as were adult Kokanee observed in the catch of local anglers. The Trout Lake outlet to the Lardeau River is the primary spawning area for Gerrard Rainbow Trout from Kootenay Lake, a genetically unique trophy-sized Rainbow Trout native to the lake.

No live freshwater mussels, shells or shell fragments were observed during a beach walk/wade survey near the Trout Lake boat launch in Segment 13 in August 2007 (Moore and Machial 2007). Mussels were not observed during the FIM survey in August 2022.

In 2022, Burbot were the most prevalent fish species captured in Trout Lake while Longnose Dace (*Rhinichthys cataractae*), Redside Shiner (*Richardsonius balteatus*), Slimy Sculpin (*Cottus cognatus*) and suckers were captured in lower numbers (Appendix C). Kokanee and Bull Trout were also incidentally observed.

### 3.1.7 Wildlife and Wildlife Habitat Observations

Wildlife observations recorded during the 2022 FIM are included in the segment summaries in Appendix B and summarized by segment below:

- Segment 2 - Gulls (*Larus* sp.).
- Segment 3 – One each of Belted Kingfisher (*Megaceryle alcyon*), Chipmunk (*Tamias* sp.), Osprey (*Pandion haliaetus*), an Osprey stick nest and a wildlife trail.
- Segment 4 – Cedar Waxwing (*Bombycilla cedrorum*).
- Segment 5 – Osprey.
- Segment 6 – Loon (*Gavia* sp.) and wildlife den at east end of segment at base of large cottonwood tree.
- Segment 7 – Bald Eagle (*Haliaeetus leucocephalus*).
- Segment 8 – Bald Eagle.
- Segment 9 – Three Loons one Belted Kingfisher and one unidentifiable shore bird.
- Segment 10 – Two Bald Eagles and numerous Common Ravens (*Corvus corax*).
- Segment 11 – Bald Eagle.
- Segment 12 – Three American Wigeons (*Mareca americana*) and one Great Blue Heron (*Ardea herodias*).
- Segment 13 – Seven Canada Goose (*Branta canadensis*), one Great Blue Heron, and numerous Turkey Vulture (*Cathartes aura*) and Gulls. Also tracks/scat potentially belonging to River Otter (*Lontra canadensis*) observed.

Observations of at-risk wildlife species and their habitat in riparian and aquatic areas of Trout Lake include:

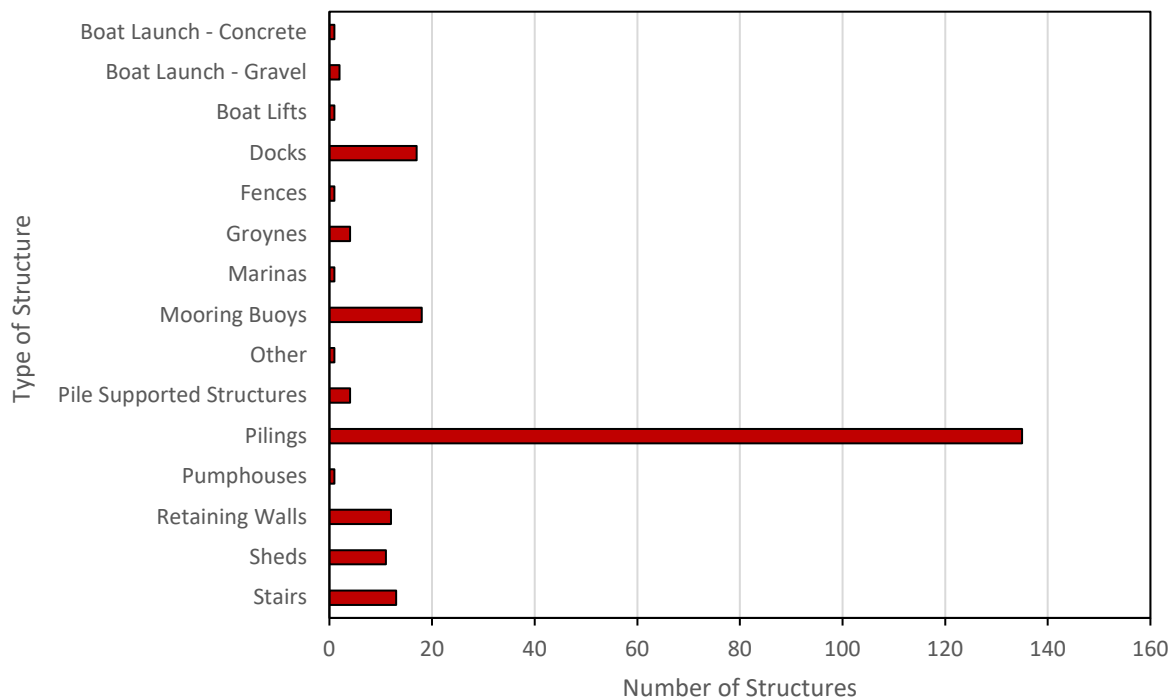
- Great Blue Heron, provincially blue-listed, observed in Segments 12 and 13 during the FIM survey (Appendix B).
- The Central Selkirk mountains provide habitat for Caribou (Southern Mountain Population; *Rangifer tarandus* pop. 1), provincially red-listed and Endangered under SARA. Potential Caribou habitat is located around the entire foreshore and adjacent upland areas of Trout Lake (CDC 2022).

- Though not within aquatic or riparian areas of Trout Lake, Whitebark Pine (*Pinus albicaulis*), provincially blue-listed and federally listed as Endangered under SARA, has been identified in an upland area in the Laughton Creek drainage east of Trout Lake (CDC 2022).

### 3.1.8 Shoreline Modifications

Pilings were the most prevalent shoreline modification observed in Trout Lake (Figure 9 and Figure 10). Pilings (n=135) were observed in two segments and the highest concentration was observed near a historic rock abutment structure at the northwest corner of the lake (Segment 13; n=120). The remaining pilings were at the opposite end of the lake near the Lardeau River inlet (Segment 8; n=15). The next most common shoreline modifications were mooring buoys (n=18), docks (n=17), stairs (n=13) and retaining walls (n=12). These modifications were mostly observed near single-family residences in Segment 3 (Figure 10; Appendix B). Other modifications observed along the Trout Lake shoreline included sheds (n=11), groynes (n=4), pile-supported structures (n=4), gravel boat launches (n=2), concrete boat launches (n=1), a boat lift (n=1), a fence (n=1), a marina (n=1), a pumphouse (n=1) and a historic rock abutment structure (n=1; Figure 10) (Figure 9). The highest concentrations of docks were observed near single-family residences at the northeast side of the lake (Segment 3 = 16 docks/km), a small boat-access property on the north side of the lake (Segment 4 = 5 docks/km) and two boat-access properties on the south side of the lake (Segment 9 = 0.1 docks/km). Figure 10 provides examples of some types of shoreline modifications observed in Trout Lake.

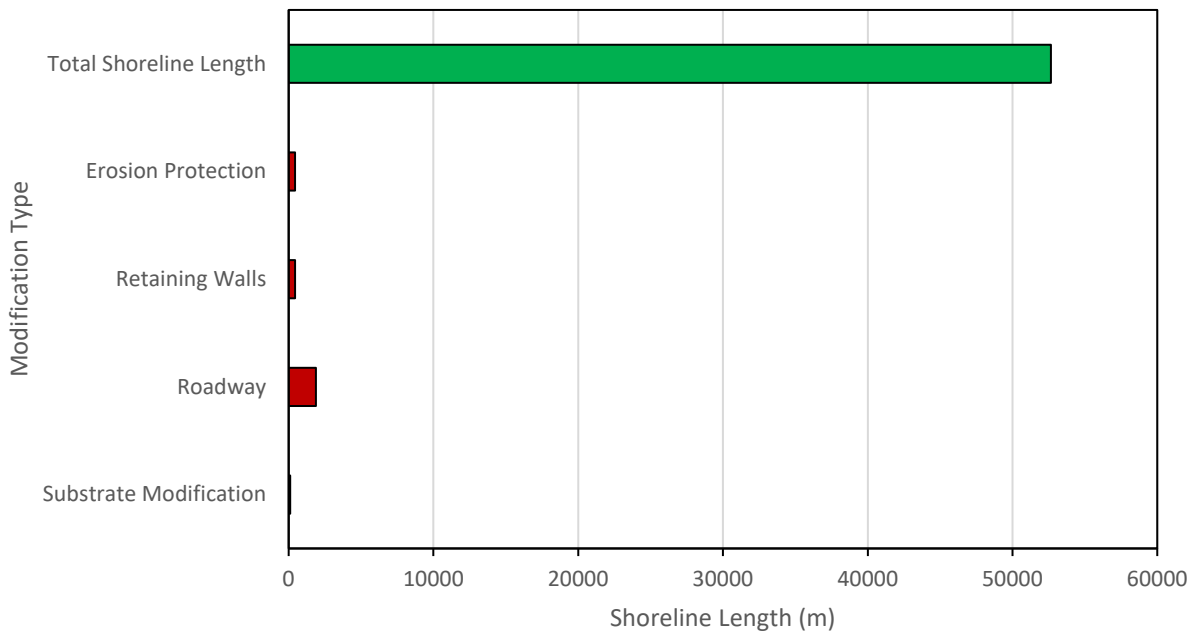
The most prevalent lineal modification was roadways, which occurred along 1,881 m (4%) of the shoreline, followed by retaining walls (442 m; <1%), erosion protection (440 m; <1%) and substrate modification (105 m; <1%) and (Figure 11). The most prevalent roadway was at the northwest end of the lake near the Wilkie Creek outlet (Segment 12 = 100% roadway) while other access roads and Highway 31 occurred along <20% of other segments. Substrate modification was mainly caused by beach grooming; retaining walls and other erosion protection structures were constructed of concrete, wood cribbing, cobble/boulder substrates and riprap (Appendix B).



**Figure 9: Total number of shoreline modifications observed along the foreshore of Trout Lake.**



**Figure 10: Example of shoreline modifications observed on Trout Lake docks, groynes, retaining walls, mooring buoys and stairs at residential properties in Segment 3 (left) and pilings and historic rock abutment in Segment 13 (right).**

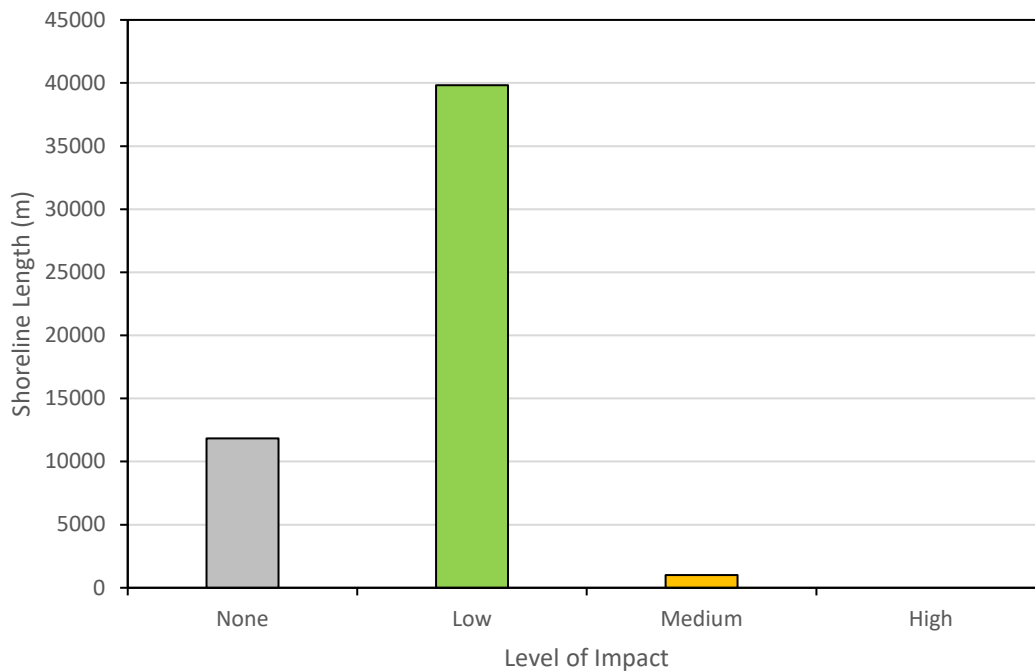


**Figure 11: Total shoreline length that has been impacted by lineal modifications along the shoreline of Trout Lake.**

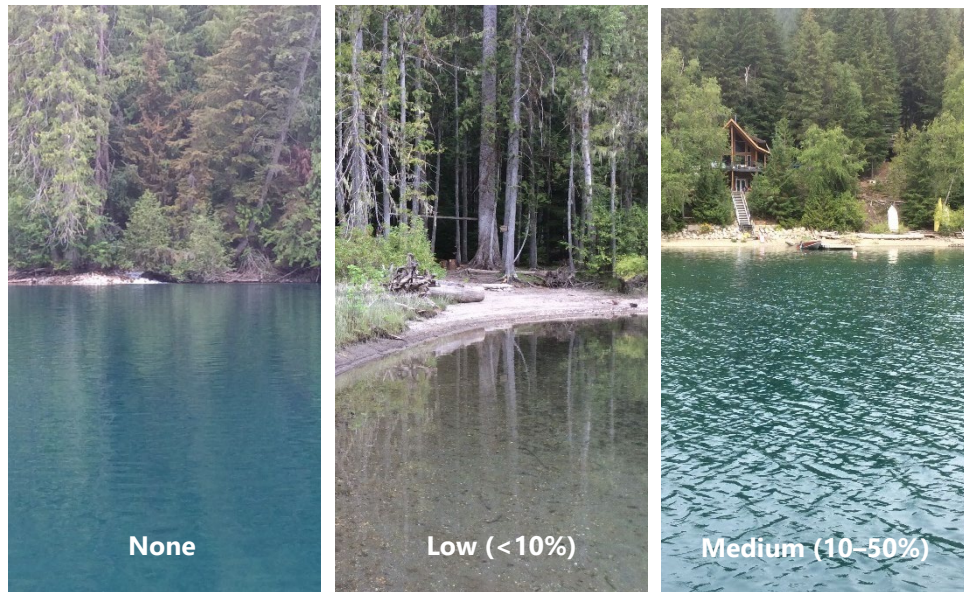
### 3.1.9 Level of Impact

In total, 39,826 m (76%) of the Trout Lake shoreline was considered to have a low level of impact (<10% disturbance; Figure 12). Areas with no impact were observed along 11,830 m (22%) of the shoreline and medium level of impact (10-50% disturbance) was observed along the remaining 1,008 m (2%; Figure 12). Examples of the different levels of impact assessed along the shoreline of Trout Lake are illustrated in Figure 13.

Medium level of impact (10-50% disturbance), the highest observed in Trout Lake, was observed in segments modified by single-family residential development including retaining walls, groynes, docks, mooring buoys and some riparian clearing (Segments 2 and 4). These segments were not given a high level of impact because relatively small portions of each single-family lot was developed and riparian vegetation was maintained along most of the shoreline including in front of most residences (e.g., Figure 13) and a large proportion of each segment was in natural condition. A low level of impact was observed in natural areas that had one or a few shoreline modifications such as a dock, riparian clearing near beaches or lake access points (e.g., Segments 6, 9 and 13) or where transportation corridors were near the shoreline (e.g., Segments 7 and 8). No impacts were observed along steep natural areas along the north and southwest shorelines (e.g., Segments 5, 10 and 11).



**Figure 12: Level of Impact (None, Low, Medium or High) observed along the shoreline of Trout Lake.**



**Figure 13: Examples of the different levels of impact assessed along the shoreline of Trout Lake. Segments with predominantly high levels of impact were not observed.**

### 3.2 FHSI

The Trout Lake FHSI included four categories:

1. Biophysical (FIM).
2. Fisheries (non-FIM).
3. Ecosystem (non-FIM). And,
4. Modifications (FIM).

Biophysical and modification criteria used data collected during the 2022 FIM survey, fisheries criteria used information compiled during the 2022 fish survey and background literature review, and criteria used background literature review. Other non-FIM categories outlined in Schleppe et al. (2021) (e.g., wildlife, herptile, waterfowl, and/or other criteria) were not included in the FHSI at this time as sufficient data did not exist to support the addition of these categories. Criteria that would apply to all areas of the Trout Lake foreshore were not included in the FHSI because equal points scored to all segments would not influence the outcome of FHSI scoring (e.g., potential Caribou habitat is located around the entire foreshore and adjacent upland areas of Trout Lake). Rationale for FIM criteria included in the Trout Lake FHSI is provided in Table 2. The Trout Lake FHSI is provided in Table 3.

**Table 2: Ecological Rationale for Criteria Included in the Foreshore Habitat Sensitivity Index for Trout Lake.**

Category	Criteria	ZOS	Rationale
<b>FIM</b>	Shore Type	No	Shore type is related to many aspects of fish and wildlife habitat and inherent characteristics in each shore type (e.g., complexity, slope, substrate, etc.) can be an overarching determinant of habitat value. As a result, shore type received the highest weighting in the biophysical FIM category. Shore types with complexity that provides a variety of rearing, feeding and breeding habitats for both fish and wildlife (e.g., stream mouth, wetland, gravel beach and rocky shore) received higher value than less complex shore types (e.g., cliff/bluff and sand beach) (e.g., Kennedy and Mayer 2002; Rice et al. 2008).
	Foreshore Substrate	No	Substrates received a moderate weighting in the category because they provide important spawning and rearing habitat for fish. Cobble and gravel substrates received higher value than others because of their use as juvenile rearing and spawning habitat for Burbot and salmonids in Trout Lake (McPhail 2007).
	Percentage Natural	No	Percent natural was weighted high in the biophysical FIM category to capture the habitat value of intact ecosystems found in natural areas.
	Aquatic Vegetation	Yes	Aquatic vegetation provides cover, food supply, primary production and filtration to aquatic ecosystems (Caskenette et al. 2020). The weight applied to aquatic vegetation was higher than other criteria that provide cover (e.g., overhanging vegetation, LWD) due to its limited distribution in the lake and numerous benefits. Aquatic vegetation was also included as a ZOS in Trout Lake (see Section ZOS).
	Overhanging Vegetation	No	Overhanging vegetation provides a source of nutrients to aquatic ecosystems, foraging areas for wildlife and can shade nearshore habitat (Caskenette et al. 2020). This criterion was weighted lowest of the biophysical FIM data because relative to other criteria, the influence is quite low due to large surface area of Trout Lake.
	Large Woody Debris	No	LWD provides instream cover for fish of all age classes and is an especially important habitat for rearing juvenile salmonids. This criteria was weighted higher than overhanging vegetation because much of the Trout Lake shoreline is moderately/steeply sloped with narrow littoral areas and not suitable for LWD recruitment and therefore it provides an important source of cover in areas where it is available.
	Band 1	No	Riparian Band 1 received a higher value than Riparian Band 2 because it inherently has more influence on foreshore habitat than riparian areas set back from the shoreline. Wider riparian areas received more value as did vegetation types that contribute to more to nutrient production than others (wetlands, broadleaf and shrubs) (Caskenette et al. 2020).
	Band 2	No	
<b>Fisheries</b>	Juvenile Burbot Rearing	No	Juvenile Burbot in Trout Lake were observed in nearshore habitats that provided cover, mainly from interstitial spaces in gravel, cobble and boulder substrates. FIM evaluation of shoreline substrates showed that the prevalence of these substrates was lower in littoral areas compared with foreshore areas. Therefore, a juvenile Burbot rearing criterion was created that ranked shorelines with predominantly gravel or rocky shore types higher than those with other substrate types. This criterion was weighted lower than other fisheries criterion because of the relatively wide extent of possibly suitable habitats around the lake.



Category	Criteria	ZOS	Rationale
	Migration Corridor	Yes	Tributaries to Trout Lake provide spawning, egg incubation and juvenile rearing habitat for salmonids including Bull Trout (Blue-listed and of local conservation concern), Kokanee, Rainbow Trout, and, potentially Westslope Cutthroat Trout (Special Concern under SARA). Migration corridors were identified as the aquatic habitat at and surrounding tributary mouths and was identified by reviewing watercourses that flow into or out of Trout Lake as delineated in the BC Freshwater Atlas. Tributary mouths were also included as a ZOS in Trout Lake (see Section ZOS).
	Staging Area	No	The fish staging criterion identifies locations that fish are known to stage or hold prior to migration. Staging locations have been documented for Bull Trout (e.g., observations during the FIMP project and FWCP Project (F-F15-2115)) and these locations provide potential staging habitat for other salmonids including Westslope Cutthroat Trout, Kokanee and Rainbow Trout. The lake outlet to the Lardeau River provides potential staging habitat for Rainbow Trout spawners from Kootenay Lake. Reference documents were used to identify staging locations as present or absent within a shoreline segment, however, reference information was limited.
Ecosystem	Riparian Connectivity Corridor	No	Enhancing connectivity corridors is a priority to the Sylix and residential development along the foreshore limiting uninterrupted wildlife access was a concern identified during the Slocan Lake FIMP (Wood 2022b). As part of the Kootenay Connect project, Proctor and Mahr (2021) identified important riparian corridors to be considered for enhanced protection and connectivity management in the Wilkie Creek wetland area between Trout and Staubert lakes as well as the Lardeau River valley including the Trout Lake outlet. Riparian Connectivity Corridors were identified as being present where mapping by Proctor and Mahr (2021) connected with the foreshore. Note that this field is intended to capture large landscape level corridors and important smaller scale riparian connectivity habitat is also present around the lake; the FIM Riparian Band criteria above considers all riparian habitat around the foreshore.
Modifications	Retaining Wall	No	Similar weights were given to all modification criteria. Docks were weighted slightly higher because they are often associated with various other foreshore modifications (e.g., riparian clearing, substrate modification) and can provide habitat for non-native fish species while groynes were weighted slightly lower because groyne density was low relative to docks and retaining walls. Schleppe et al. (2021) provides detailed description of the impacts modifications can have on foreshore habitats.
	Docks		
	Groynes		
	Boat Launch		
	Marina		

**Table 3: Foreshore Habitat Sensitivity Index for Trout Lake.**

Category	Criteria	Percentage of FHSI	Percent Within Category	Logic	Uses Weighted FIM Data	Value Categories
<b>FIM</b>	Shore Type	23.8	35	Proportion of Segment * Percentage of FHSI * Value Category	Yes	Stream Mouth = Wetland (1) > Gravel Beach = Rocky Shore (0.8) > Sand Beach = Cliff /Bluff (0.5), Other (0.3)
	Foreshore Substrate	11.6	17	Proportion of Segment * Percentage of FHSI * Value Category	Yes	Cobble = Gravel (1) > Boulder = Organic = Mud = Marl (0.8), Fines = Sands (0.5) > Bedrock (0.3)
	Percentage Natural	8.2	12	Proportion of Segment Natural * Percentage of the FHSI	No	
	Aquatic Vegetation	6.8	10	Proportion of Segment with Aquatic Vegetation * Percentage of the FHSI	No	
	Overhanging Vegetation	4.1	6	Proportion of Segment with Overhanging Vegetation * Percentage of the FHSI	No	
	Large Woody Debris	4.1	6	Percentage of the FHSI * Value Category	Yes	>20 LWD/km (1) > 10-20 LWD/km (0.8) > 5-10 LWD/km (0.6) > 0 - 5 LWD/km (0.4) > 0
	Band 1	6.8	10	Vegetation Bandwidth Category * Vegetation Quality * Percentage of the FHSI	Yes	<b>Vegetation Bandwidth Category</b> 1 to 5 m (0.2) < 6 to 10 m (0.4) < 11 to 15 m (0.6) < 16 to 20 m (0.8) < 21 m (1)
	Band 2	2.7	4	Vegetation Bandwidth Category * Vegetation Quality * Percentage of the FHSI	Yes	<b>Vegetation Quality Category</b> Natural Wetland = Disturbed Wetland = Broadleaf = Shrubs (1) > Coniferous Forest = Mixed Forest (0.8) > Herbs/Grasses = Unvegetated (0.6) > Lawn = Landscaped = Row Crops (0.3) > Exposed Soil (0.05)
<b>Category Subtotal</b>		68.0	100			
<b>Fisheries</b>	Juvenile Burbot Rearing	3.0	20	Juvenile Burbot Rearing habitat quality is categorized as High or Moderate. High = Percentage of the FHSI and Moderate (0.5*Percentage of the FHSI)	No	
	Migration Corridor	7.5	50	Present (Percentage of the FHSI), Absent (0)	No	
	Staging Area	4.5	30	Present (Percentage of the FHSI), Absent (0)	No	
	<b>Category Subtotal</b>		15.0	100		

Category	Criteria	Percentage of FHSI	Percent Within Category	Logic	Uses Weighted FIM Data	Value Categories
<b>Ecosystem</b>	Riparian Connectivity Corridor	7.0	100	Focal Corridor Present (Percentage of the FHSI), High-Value Potential Linkage Habitat (0.5*Percentage of the FHSI), Absent (0)	No	
	<b>Category Subtotal</b>		7.0	100		
<b>Modifications</b>	Retaining Wall	2.0	20	Proportion of Segment with Retaining Walls * (Percentage of the FHSI)	No	
	Docks	2.5	25	Dock Density is categorized as High, Moderate, Low or None using segment data. High = Percentage of the FHSI, Moderate (0.75*Percentage of the FHSI), Low (0.5*Percentage of the FHSI), None (0*Percentage of FHSI)	No	>0-1 docks/km (Low); >1-5 docks/km (Moderate); >5 docks/km (High)
	Groynes	1.0	10	Groyne Density is categorized as High, Moderate, Low or None using segment data. High = Percentage of the FHSI, Moderate (0.75*Percentage of the FHSI), Low (0.5*Percentage of the FHSI), None (0*Percentage of FHSI)	No	>0-1 groynes/km (Low); >1-5 groynes/km (Moderate); >5 groynes/km (High)
	Boat Launch	2.0	20	Boat Launch Density is categorized as High, Moderate, Low or None using segment data. High = Percentage of the FHSI, Moderate (0.75*Percentage of the FHSI), Low (0.5*Percentage of the FHSI), None (0*Percentage of FHSI)	No	>0-1 boat launch/km (Low); >1-2 boat launches/km (Moderate); >2 boat launches/km (High)
	Marina	2.5	25	Present (Percentage of the FHSI), Absent (0)	No	
<b>Category Subtotal</b>		10.0	100			
<b>Total</b>		<b>100.0</b>				

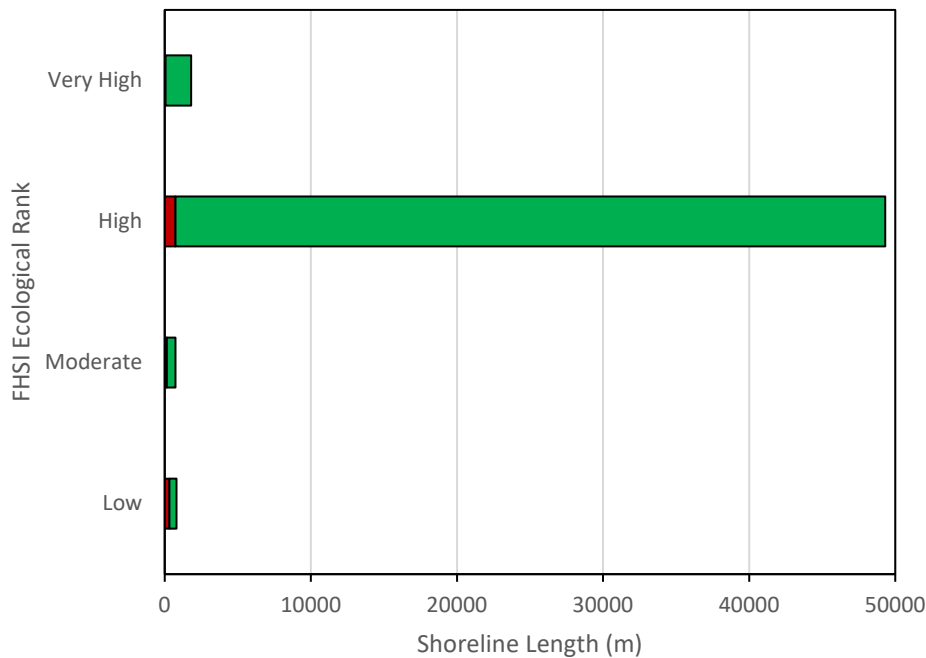
### 3.2.1 Summary of FHSI Values

A summary of the 2021 FHSI values for Trout Lake is provided in Table 4. Segment summary maps displaying FHSI Ecological Ranking are provided in Appendix A. Calculations for each criterion and category as well as Ecological Rank breaks are provided in Appendix D.

Most of the shoreline of Trout Lake was ranked as High (93.7%) ecological value followed by Very High (3.4%), Low (1.5%) and Moderate (1.4%) (Table 4). None of the shoreline was ranked as Very Low ecological value. Most shoreline areas with Very High and High ecological value remained in natural condition (3.0% and 1.5% disturbed, respectively) while more disturbance was observed in shoreline areas with Moderate and Low ecological value (18.9% and 40.0% disturbed, respectively) (Figure 14).

**Table 4: Trout Lake FHSI Ecological Rankings.**

FHSI Ecological Rank	# of Segments	Shoreline Length (m)	% of Shoreline
Very High	3	1,802	3.4
High	7	49,321	93.7
Moderate	2	735	1.4
Low	1	805	1.5
Very Low	0	0	0
Total	13	52,665	100



**Figure 14: FHSI Ecological Rankings and length of natural (green) versus disturbed (red) shoreline for Trout Lake.**

All Very High ecological value segments had rocky shore or stream mouth shore types present while High ecological value segments had gravel, rocky shore or sand shore types (Table 5). Moderate ecological value segments had gravel and rocky shore types while Low value segments had gravel shores (Table 5). Land uses observed in segments with Very High ecological value included natural areas and park while land uses in segments with High ecological value were natural area and with Moderate ecological value were natural area and single family (Table 6). Single family residential land use was observed in the segment with Low ecological value (Table 6).

**Table 5: Trout Lake FHSI Ecological Rankings by shore type.**

FHSI Ecological Rank	Gravel		Rocky Shore		Sand		Stream Mouth	
	Shoreline Length (m)	% of Shore Type Category	Shoreline Length (m)	% of Shore Type Category	Shoreline Length (m)	% of Shore Type Category	Shoreline Length (m)	% of Shore Type Category
Very High	0	0	831	2.0	0	0	971	100
High	8,170	85.9	40,274	97.5	877	100	0	0
Moderate	533	5.6	203	0.5	0	0	0	0
Low	805	8.5	0	0	0	0	0	0
Very Low	0	0	0	0	0	0	0	0

**Table 6: Trout Lake FHSI Ecological Rankings by land use.**

FHSI Ecological Rank	Natural Area		Park		Single Family	
	Shoreline Length (m)	% of Shore Type Category	Shoreline Length (m)	% of Shore Type Category	Shoreline Length (m)	% of Shore Type Category
Very High	1,191	2.3	611	100	0	0
High	49,321	96.6	0	0	0	0
Moderate	533	1	0	0	203	20.1
Low	0	0	0	0	805	79.9
Very Low	0	0	0	0	0	0

In general, Very High ecological value was identified at the shoreline adjacent to the Lardeau (Segment 1) and Asher (Segment 10) creek outlets and the Trout Lake outlet to the Lardeau River (Segment 8) where the shoreline consists of stream confluences that are in natural condition with no/very little shoreline disturbance observed. These shoreline areas also provide important migration and staging habitat for fish and riparian connectivity corridors. High ecological value shorelines also have no/very little shoreline disturbance and provide important juvenile Burbot rearing habitat, fish migration corridors, have intact riparian areas and other high value shoreline habitat features. Moderate ecological value shoreline areas have been partially disturbed by residential development (Segment 4) or lake access and historic industrial development (Segment 13) while Low ecological value was observed in Segment 2 which has been disturbed by residential shoreline development.

### 3.2.2 Zones of Sensitivity

A list of ZOS identified during the FIM field assessment and during the background data review are described below.

- Aquatic Vegetation – Aquatic vegetation contributes to the overall health of an ecosystem by providing an important source of nutrients, oxygenation and habitat for aquatic, terrestrial and avian species (Kennedy and Mayer 2002). Aquatic vegetation is an important component of wetlands, which provide habitat, flood control, water filtration and food resources (Mitsch and Gosselink 1993). Submergent and emergent aquatic vegetation on Trout Lake was mapped during the 2022 FIM survey and was observed along <2% of the foreshore. Note that wetlands were not included as a ZOS at this time because wetlands were not observed within the HWM of Trout Lake. This also highlights the important role aquatic vegetation plays in the lake in the absence of wetlands. All areas of aquatic vegetation were identified as ZOS.
- Tributary Mouths – Tributary mouth areas provide important habitat for fish rearing, migration and staging. Tributaries to Trout Lake may provide spawning, egg incubation and juvenile rearing habitat for salmonids. In addition to fisheries values, water quality parameters such as temperature, dissolved oxygen, turbidity and nutrients of tributary inflows play an important role in the overall water quality of lake ecosystems (Rice et al. 2008). Alluvial fans were observed adjacent to some of the tributary confluences with Trout Lake and these areas could provide connectivity corridors for wildlife between the lake and tributary valleys that connect to higher elevation habitats. Therefore, the confluence areas of all tributaries to and from Trout Lake delineated in the BC Freshwater Atlas dataset were identified as tributary mouth ZOS. This includes the outlet of the lake to the Lardeau River. Tributary mouth polygons of 100 m radius semicircle polygons were identified as a ZOS at the confluence of tributaries and Trout Lake.

### 3.2.3 Potential Conservation Zones

The Lardeau Creek outlet (Segment 1) at the northeast end of Trout Lake, adjacent to the community of Trout Lake, is the largest inflow system to the lake and includes outflows from both the Lardeau and Ferguson creek drainages. The FHSI analysis indicated this area has Very High ecological value and sensitive stream mouth habitat. Bull Trout, Kokanee and Slimy Sculpin have been documented in the creek and adfluvial Bull Trout from Trout Lake were observed ascending the creek during the 2022 FIM survey (FIDQ 2022). Proctor and Mahr (2019) also identified important riparian connectivity corridors along the northeast end of Trout Lake. The Lardeau Creek outlet remains in natural condition and conservation areas should be established along the foreshore to protect important fish migration and riparian connectivity corridor habitat.

Foreshore and riparian habitat adjacent to the outflow from Trout Lake to the Lardeau River (Segment 8) was identified as Very High ecological value by the FHSI analysis. The area is adjacent to the primary spawning habitat for Kootenay Lake Rainbow Trout located just downstream of the lake outlet in the Lardeau River and provides riparian connectivity corridor habitat between the Lardeau Duncan valley and Trout Lake. The majority of the segment is within Goat Range Provincial Park, however, small areas of private and undesignated Crown land are present. Enhancing Crown land conservation status on undesignated Crown land in this area was identified as a priority conservation action for the Lardeau Duncan wildlife and biodiversity corridor (Proctor and Mahr 2021).

The Asher Creek outlet and alluvial fan (Segment 10) were identified as Very High ecological value by the FHSI analysis. Burbot have been captured in the most downstream reach of Asher Creek and the stream mouth was identified as potentially important Burbot spawning habitat (Burns 1978, Baxter et al. 2002). Asher Creek was also identified as having the highest-ranking fisheries habitat values in the lake through the FHSI analysis including high value juvenile Burbot rearing habitat. The alluvial fan remains in natural condition and should be protected to maintain the high value riparian and aquatic values present.

The Wilkie Creek outlet (Segment 12) provides a connection between Trout Lake and wetlands to the northwest of the lake. Various migratory fish species, including Bull Trout and Kokanee, have been documented in Wilkie Creek and both the creek and associated wetlands provide complex, high-quality spawning and juvenile rearing habitat. Holt and MacKillop (2006) described the extremely high ecosystem diversity and biodiversity value of this unique low elevation wetland-lake complex and recommended conservation protections be placed on remnant old growth forests adjacent to Staubert Lake, the source of Wilkie Creek. Proctor and Mahr (2019) also identified this area as important riparian connectivity corridor. Unregulated recreational vehicle use below the high-water mark adjacent to the Wilke Creek stream mouth, observed during the 2022 FIM survey, has potential to impact foreshore and aquatic habitats by substrate modification, riparian clearing, introduction of foreign substances (e.g., spills and leaks) and recreational pressure. Conservation areas should be established along the foreshore to protect important fish migration and riparian connectivity corridor habitat.

### **3.3 FDG**

The FDG for Trout Lake is provided in Appendix E. The FDG is also provided under separate cover for distribution to landowners, regulators and other stakeholders.

## 4.0 Discussion

Most of the Trout Lake foreshore was classified as being in undisturbed, natural condition with intact continuous riparian habitat surrounding the lake. Overall, 97.5% of the Trout Lake shoreline remains undisturbed which is a higher percentage of natural area relative to other large lakes in the Kootenays where FIMP has recently been conducted. For example, similarly sized Columbia Lake had 59.1% natural shoreline while nearby Slocan Lake had 90.3% natural shoreline when re-FIM surveys were completed in 2021 (Wood 2022a, 2022b). Modification of the Trout Lake shoreline was mainly concentrated at the northwest end of the lake near the community of Trout Lake where residential, lake-access and historical industrial land uses were observed. A few rural properties on leased crown land, rustic campsites and remnants of historical industrial sites were observed in other areas of the lake. Other than near the community of Trout Lake there is very little private property around Trout Lake and most property is crown. The only protected foreshore area is within Goat Range Park located at the southeast corner of the lake near the Lardeau River outlet; the Lew Creek Ecological Reserve includes the Lew Creek watershed but doesn't extend to the foreshore.

Community planning documents, such as Official Community Plans (OCPs), have reflected the importance of preserving elements of the natural environment which epitomize the Trout Lake foreshore. The majority of Trout Lake is within the boundaries of the CSRD while southeast corner is within the RDCK Electoral Area 'D'. These areas have existing OCPs, some of which include measures to regulate development activities in and adjacent to watercourses to protect aquatic and riparian habitats. For example, the CSRD Electoral Area "B" OCP includes the Lakes 100 m Development Permit Area (DPA) within 100 m of the HWM (CSRD 2021). Meanwhile, the RDCK Electoral Area 'D' – North Kootenay Lake Land Use Bylaw 2435 (RDCK 2016) includes a Watercourse DPA within 30 m of the HWM. Going forward, results of the 2022 FIMP will be available for integration into existing OCPs as a means of informing landowners, stakeholders and regulators about the habitat values of a given shoreline area and the types of developments that may or may not be suitable at that location.



## 5.0 Recommendations

The following are recommendations to protect sensitive habitats around Trout Lake and improve the FIMP if additional data becomes available in the future:

### 1. Conduct inventories of fish species of conservation concern.

Bull Trout, a blue-listed species, were inventoried by spawning area assessments in tributaries to Trout Lake in 2014. Additional surveys were recommended after only partial assessments could be completed on most tributaries due to safety concerns, access issues and associated budgetary constraints or poor visibility related to glacial run-off. The Burbot population is not considered at-risk but may have important genetic contributions to restoration of populations in downstream watersheds including Kootenay Lake. The only Burbot population assessment in Trout Lake was completed over 20 years ago at which time the authors recommended future assessments compare CPUE and life history characteristics to the baseline observations to monitor general population trends and assess angler impacts.

### 2. Conduct inventories of terrestrial species of conservation concern.

The Kootenay Connect project recommended improving efforts to inventory SARA-listed species in focal wildlife corridors, including the Lardeau Duncan corridor, to capture existing biodiversity (Proctor and Mahr 2021). Identification of critical habitats and biodiversity hotspots and opportunities for protection was also recommended.

### 3. Update wetland mapping in valleys adjacent to Trout Lake.

Wetlands provide habitat, flood control, water filtration and food resources (Mitsch and Gosselink 1993). Wetlands are also vital carbon sinks that sequester carbon from the atmosphere and store it in sediment, soil and living plant communities (Kayranli et al. 2009). Proctor and Mahr (2021) recommended updating wetland mapping currently available for the Lardeau Valley to support habitat corridor linkage efforts in the region. Wetland restoration in areas that encourage/support beaver activities was also recommended.

### 4. Update existing ZOS to reflect any new information.

Additional sensitive habitat features can be added as polygons, points or lines to the FIMP dataset and maps. A field-based tributary assessment could be conducted to update the current dataset of tributary mouth ZOS.

### 5. Update the Trout Lake FIMP with additional TEK.

Additional TEK including background and generational indigenous knowledge was not available to be included in this report by contract deadlines. Additional TEK can be integrated with observations made during the August 2022 FIM field survey to include value considerations, areas of concern, and recommendations for the long-term protection of important habitats and cultural values and/or as maps summarizing observations.

### 6. Protect important foreshore habitats regardless of prevalence around the lake.

Juvenile Burbot in Trout Lake were observed in benthic habitats that provided cover, mainly from interstitial spaces in gravel, cobble and boulder substrates. FIM evaluation of shoreline substrates showed that the prevalence of these substrates was lower in littoral areas compared with foreshore areas suggesting rocky shorelines, though prevalent around the lake, are important to juvenile Burbot rearing. Shoreline development considerations, best management practices and permitting

requirements outlined in the FDG should be followed to protect and maintain important foreshore habitats regardless of their prevalence.

**7. Consider downstream impacts of industrial sites in the Trout Lake watershed.**

Community members expressed concern about the potential contamination of tributaries, wetlands and Trout Lake itself from both active and historical industrial sites. For example, the MAX Molybdenum and Mill Project includes a large settling pond and is located uphill from Wilkie Creek, the Wilkie Creek wetlands and 2 km from the Trout Lake shoreline. The mine has been inactive since 2011 but was purchased in 2021 potentially to re-initiate production (MDO 2022). Further production, restoration and decommissioning of industrial sites should consider the risk of downstream contamination.

**8. Consider downstream impacts of hydrological changes in tributaries to Trout Lake.**

Communities around Trout Lake, including Trout Lake and Ferguson, are situated near the major inflowing tributaries including Lardeau, Ferguson and Wilkie creeks. Re-planted areas suggested historic forestry operations had removed trees from the riparian area of tributaries and to the Trout Lake shoreline. Upstream alterations to streamflow to control future flooding (e.g., dykes), anthropogenic water withdrawals, and wastewater disposal have the potential to alter water quantity, timing of flows and water quality of inflows to the lake. Hydrological impacts of channel alterations to tributaries of Trout Lake, even those located in drainages well away from the foreshore, should be evaluated with consideration of downstream impacts.

**9. Consider downstream impacts related to road building in drainages with tributaries to Trout Lake.**

Improper road building practices in steep drainages could negatively impact downstream habitats by mobilization and transportation of exposed sediments. In the late 1960's, logging road construction in the Gerrard Creek drainage resulted in increased turbidity in the creek that flows into the Lardeau River just upstream of the Gerrard Rainbow Trout spawning area. This resulted in deposition of silt and clay on the spawning area and concern about impacts to incubating embryos (Hatter 1970). Sensitive habitats were identified during FIMP at tributary outlets to Trout Lake from drainages with historic and active logging operations and it is recommended that risks to downstream habitats are considered during road building, maintenance and road deactivation activities.

**10. Use various conservation tools and designations to protect conservation values on Crown land.**

The Kootenay Connect project has identified various tools and strategies to establish landscape level habitat corridors that support the conservation of wildlife species (Proctor and Mahr 2021). In the Lardeau focal corridor area, recommendations included enhancing Crown land conservation status on high value undesignated Crown land, using conservation tools such as Wildlife Management Areas, Section 16 and Environmentally Sensitive Areas to protect conservation values, and identifying high conservation value private lands for acquisition. The majority of the Trout Lake foreshore is undesignated Crown land and various conservation tools could be used to protect high and very high value shoreline areas.

**11. Make Development Permit Area setbacks consistent to protect conservation values on private land.**

Most of the Trout Lake foreshore is within CSRD Electoral Area "B" whose OCP includes the Lakes 100 m DPA within 100 m of the HWM (CSRD 2021) while a small area at the south end of the lake

(Segment 8) is within the RDCK whose Electoral Area 'D' – North Kootenay Lake Land Use Bylaw 2435 includes a Watercourse DPA within 30 m of the HWM (RDCK 2016). All residential development along the Trout Lake foreshore was within CSRD Electoral Area "B" where the 100 m setback resulted in a wider riparian buffer and less shoreline modification than what has been documented in jurisdictions with smaller setbacks. Setback requirements should be standardized across all regional jurisdictions to ensure protection of foreshore habitats.

## **12. Consider potential impacts of climate change during foreshore and lake planning.**

The effects of climate change have the potential to alter riparian and aquatic habitats in various ways such as altering hydrological patterns, increasing wildfire intensity and increasing water temperatures. Lake planning, such as FIMP, can help mitigate climate-related impacts by identifying sensitive habitats, directing development applications in a manner that conserves high value habitat such as wetlands and riparian areas that sequester carbon from the atmosphere, communicating to the public the value of these habitats to provide resilience to climate impacts such as mitigating flood impacts, and identifying opportunities for habitat restoration. Trout Lake provides an opportunity to study the effects of climate change on pelagic, littoral, foreshore, tributary and riparian habitats as it is one of few relatively large, undammed lakes with limited shoreline development in southeastern BC.

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## **Appendix A – Segment Maps**



Segment Number 12  
Shore Type: Sand  
Land Use: Natural Area  
Level of Impact: Low (< 10%)

Segment Number 13  
Shore Type: Gravel  
Land Use: Natural Area  
Level of Impact: Low (< 10%)

Segment Number 1  
Shore Type: Stream Mouth  
Land Use: Natural Area  
Level of Impact: None

Segment Number 2  
Shore Type: Gravel  
Land Use: Single Family  
Level of Impact: Medium (10-50%)

Segment Number 11  
Shore Type: Gravel  
Land Use: Natural Area  
Level of Impact: None

Segment Number 3  
Shore Type: Rocky Shore  
Land Use: Natural Area  
Level of Impact: Low (< 10%)

CLIENT: LivingLakes

PROJECT: Trout Lake FIMP

TITLE: Trout Lake Foreshore Inventory Mapping

LEGEND:

- Shoreline Segment
- Segment Break
- Modifications
  - Boat Launch - Concrete
  - Boat Launch - Gravel
  - Dock
  - Marina
  - Mooring Buoy
- Aquatic Vegetation
  - Emergent
- Base Data
  - Highway
  - Local Road
  - Watercourse
  - Wetland
  - Regional District Boundary
  - Provincial Parks, Eco Reserves and Protected Areas - All
  - Parcel Boundary

KEY MAP

0 50 100  
Meters  
Scale: 1:5,000

REFERENCE:  
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COORDINATE SYSTEM: NAD 1983 UTM Zone 11N	DATE: December, 2022
ANALYST: BB	CHK: CL
GIS FILE: 02-01-023_Trout_Lake_FIM.mxd	

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

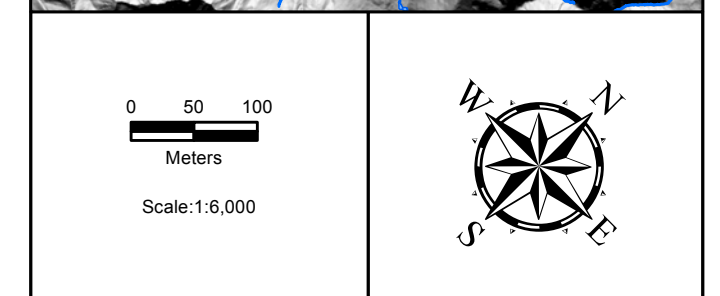
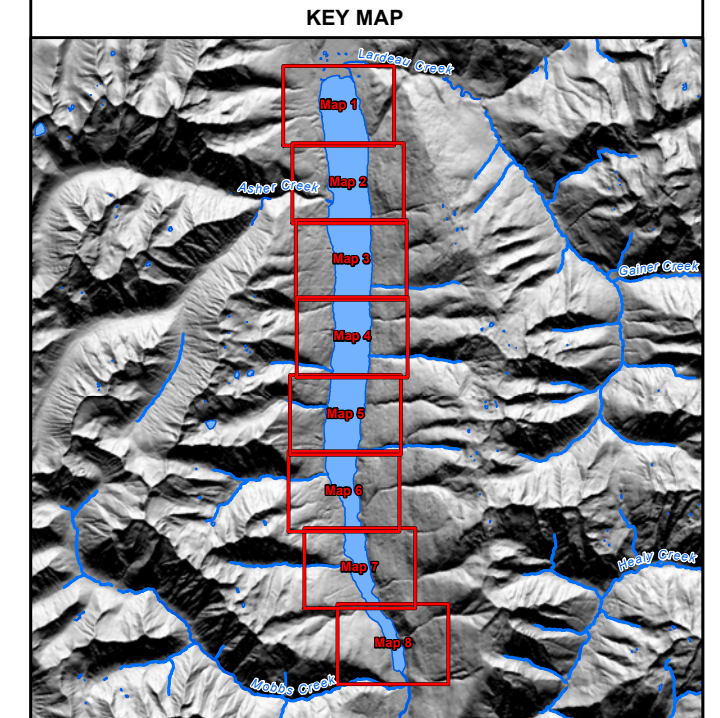


CLIENT:  
LivingLakes

PROJECT:  
Trout Lake FIMP

TITLE:  
Trout Lake Foreshore Inventory Mapping

- LEGEND:
- Shoreline Segment
  - | Segment Break
  - Modifications**
  - Boat Launch - Concrete
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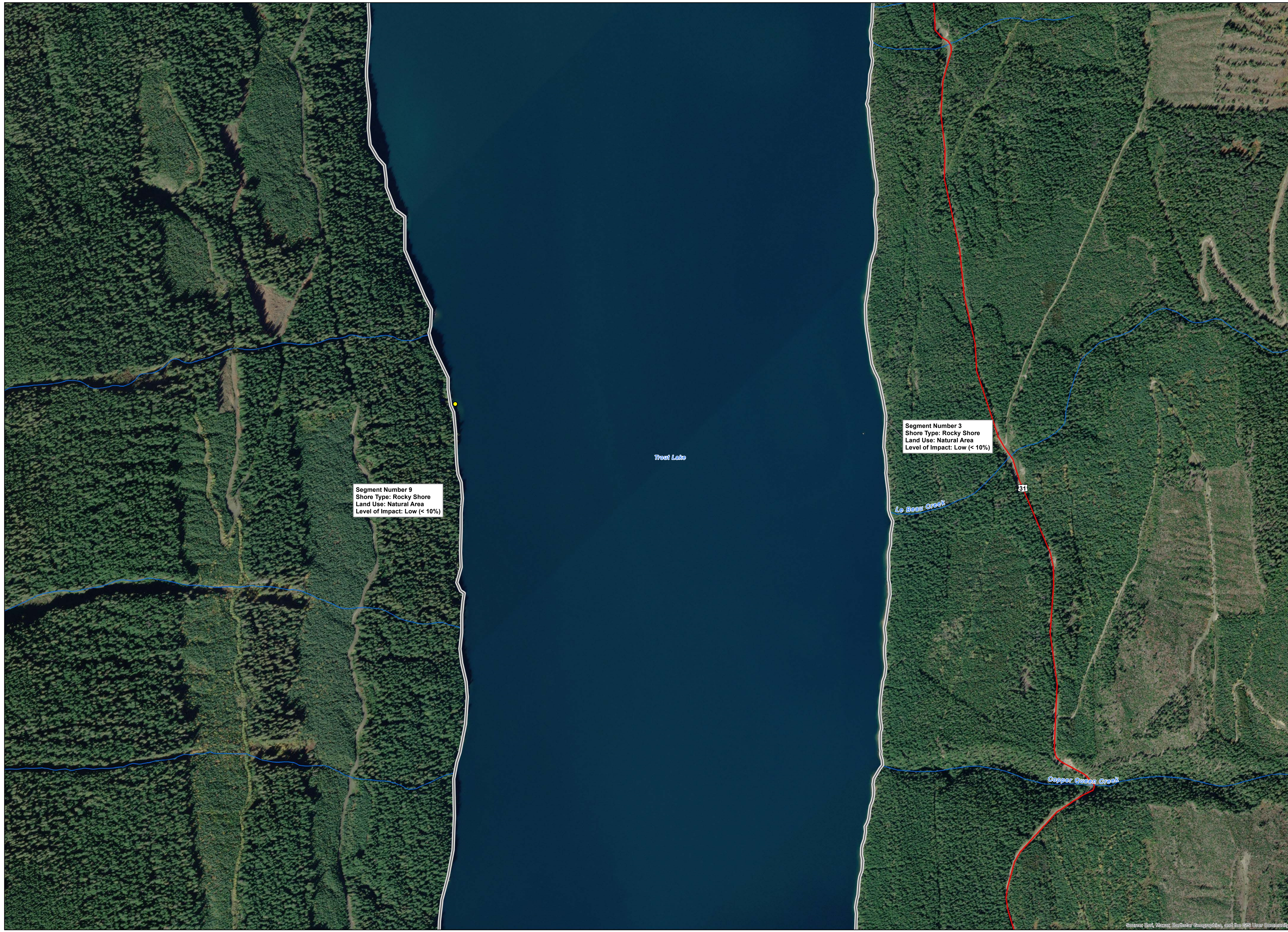
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PROJECT NO: VE52823-2022A	PAGE: 2 of 8
COORDINATE SYSTEM: NAD 1983 UTM Zone 11N	DATE: December, 2022
ANALYST: BB	CHK: CL
GIS FILE: 02-01-023_Trout_Lake_FIM.mxd	

Source: Esri, DeLorme, GeoEye, Earthstar Geographics, and the GIS User Community

Project: VE52823-2022A, LivingLakes, 10/10/2022, 10:00 AM, 10/10/2022, 10:00 AM, 10/10/2022, 10:00 AM





Segment Number 9  
 Shore Type: Rocky Shore  
 Land Use: Natural Area  
 Level of Impact: Low (< 10%)

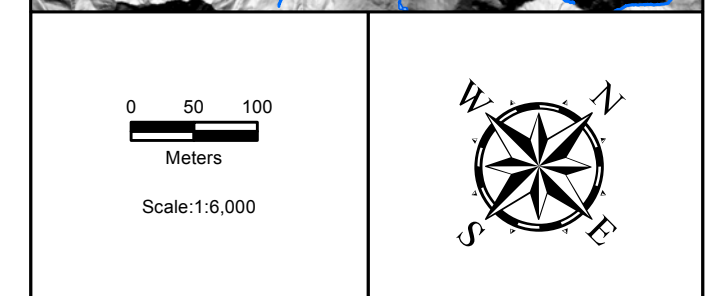
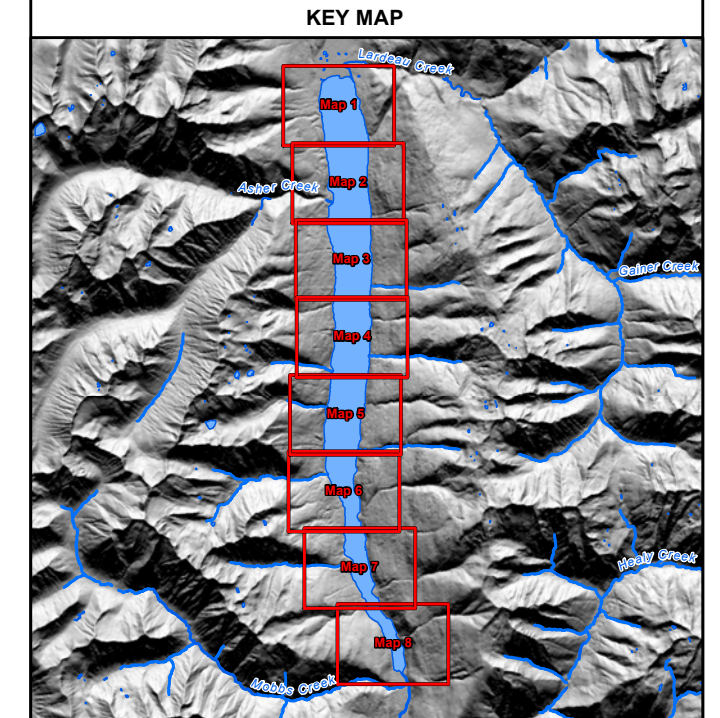
Segment Number 3  
 Shore Type: Rocky Shore  
 Land Use: Natural Area  
 Level of Impact: Low (< 10%)

CLIENT:  
 LivingLakes

PROJECT:  
 Trout Lake FIMP

TITLE:  
 Trout Lake Foreshore Inventory Mapping

- LEGEND:
- Shoreline Segment
  - | Segment Break
  - Modifications**
  - Boat Launch - Concrete
  - Boat Launch - Gravel
  - Dock
  - Marina
  - Mooring Buoy
  - Aquatic Vegetation**
  - Emergent
  - Base Data**
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  - Local Road
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  - Wetland
  - Regional District Boundary
  - Provincial Parks, Eco Reserves and Protected Areas - All
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COORDINATE SYSTEM: NAD 1983 UTM Zone 11N	DATE: December, 2022
ANALYST: BB	CHK: CL
GIS FILE: 02-01-023_Trout_Lake_FIM.mxd	

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

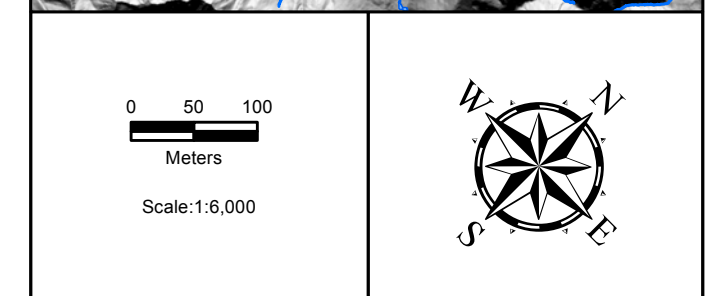
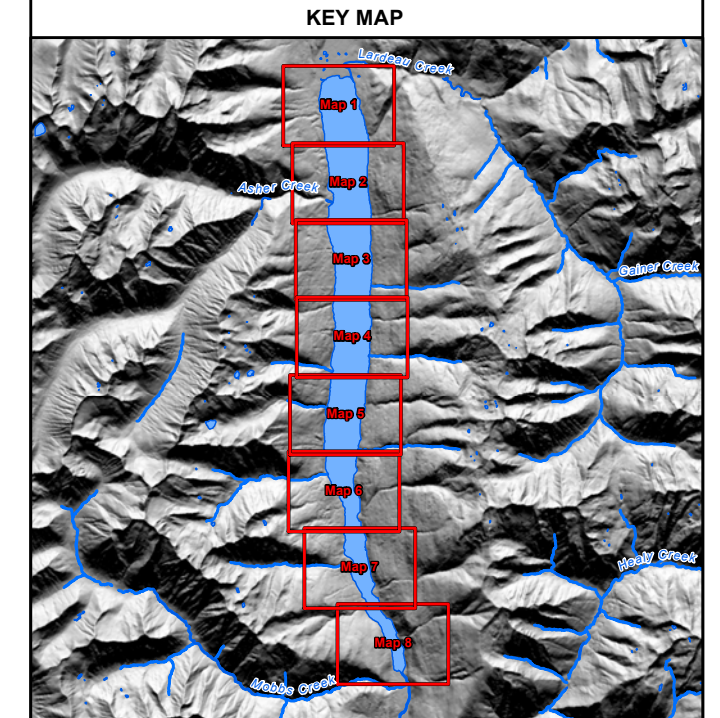


CLIENT:  
LivingLakes

PROJECT:  
Trout Lake FIMP

TITLE:  
Trout Lake Foreshore Inventory Mapping

- LEGEND:
- Shoreline Segment
  - | Segment Break
  - Modifications**
  - Boat Launch - Concrete
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  - Dock
  - Marina
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  - Aquatic Vegetation**
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COORDINATE SYSTEM: NAD 1983 UTM Zone 11N DATE: December, 2022

ANALYST: BB DSK: CL

GIS FILE: 02-01-023\_Trout\_Lake\_FIM.mxd

Source: Esri, DeLorme, Garmin, Geographic, and the 1985 Deer Community.



Segment Number 9  
 Shore Type: Rocky Shore  
 Land Use: Natural Area  
 Level of Impact: Low (< 10%)

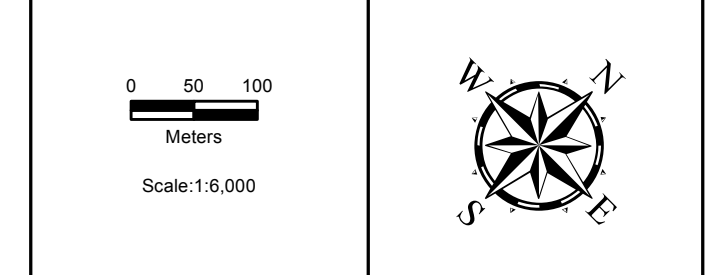
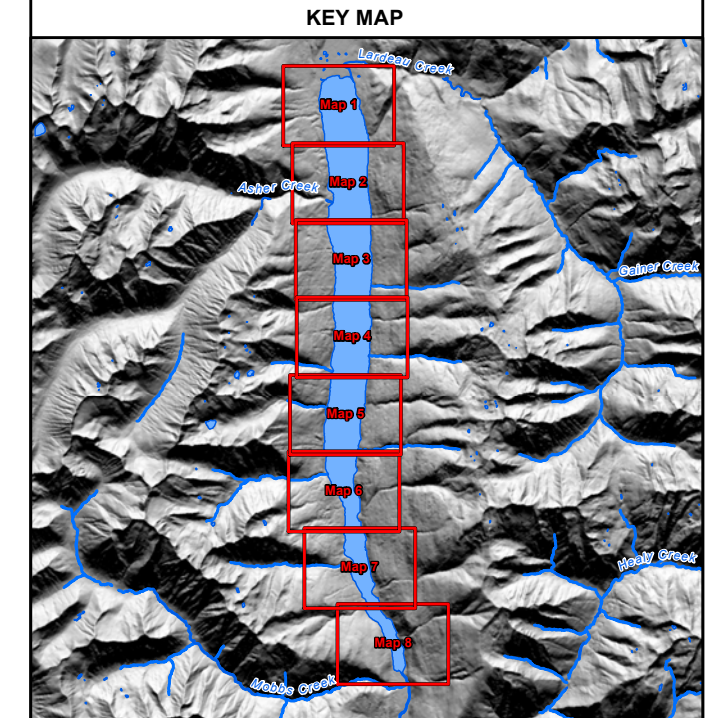
Segment Number 5  
 Shore Type: Rocky Shore  
 Land Use: Natural Area  
 Level of Impact: Low (< 10%)

CLIENT:  
 LivingLakes

PROJECT:  
 Trout Lake FIMP


TITLE:  
 Trout Lake Foreshore Inventory Mapping

- LEGEND:
- Shoreline Segment
  - Segment Break
  - Modifications**
    - Boat Launch - Concrete
    - Boat Launch - Gravel
    - Dock
    - Marina
    - Mooring Buoy
  - Aquatic Vegetation**
    - Emergent
  - Base Data**
    - Highway
    - Local Road
    - Watercourse
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    - Regional District Boundary
    - Provincial Parks, Eco Reserves and Protected Areas - All
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PROJECT NO: VE52823-2022A	PAGE: 5 of 8
COORDINATE SYSTEM: NAD 1983 UTM Zone 11N	DATE: December, 2022
ANALYST: BB	CHK: CL
GIS FILE: 02-01-023_Trout_Lake_FIM.mxd	

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Source: Esri, DeLorme, Earthstar Geographics, and the GIS User Community

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PROJECT:  
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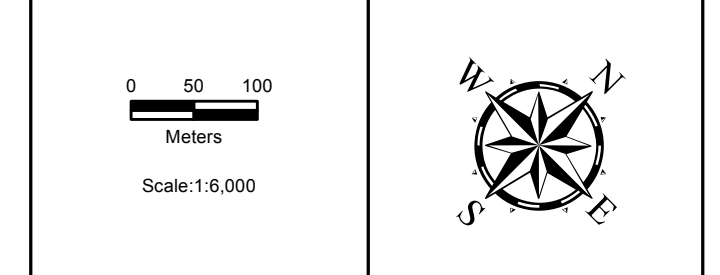
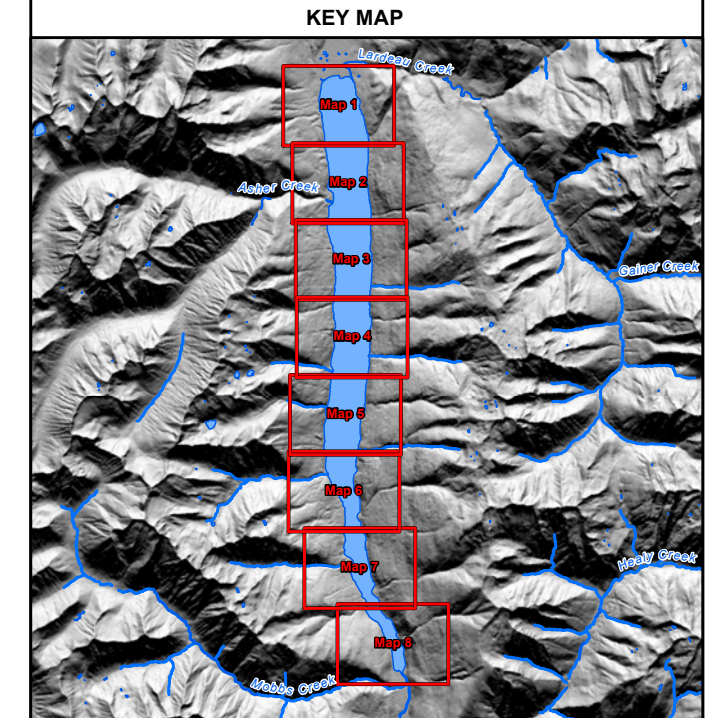
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Trout Lake Foreshore Inventory Mapping

- LEGEND:
- Shoreline Segment
  - Segment Break
  - Modifications**
    - Boat Launch - Concrete
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  - Base Data**
    - Highway
    - Local Road
    - Watercourse
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Segment Number 5  
Shore Type: Rocky Shore  
Land Use: Natural Area  
Level of Impact: Low (< 10%)

Segment Number 9  
Shore Type: Rocky Shore  
Land Use: Natural Area  
Level of Impact: Low (< 10%)

Segment Number 6  
Shore Type: Rocky Shore  
Land Use: Natural Area  
Level of Impact: Low (< 10%)




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COORDINATE SYSTEM: NAD 1983 UTM Zone 11N	DATE: December, 2022
ANALYST: BB	CHK: CL
GIS FILE: 02-01-023_Trout_Lake_FIM.mxd	

Sources: Esri, Microsoft, Earthstar, Geographic, and the GIS User Community



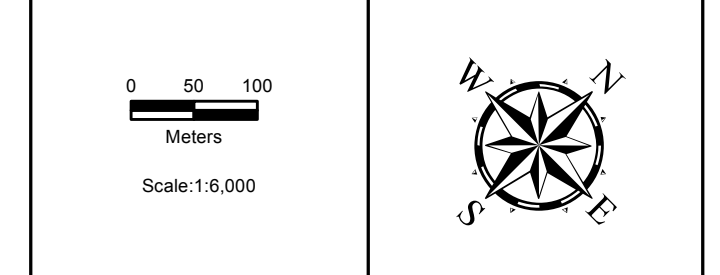
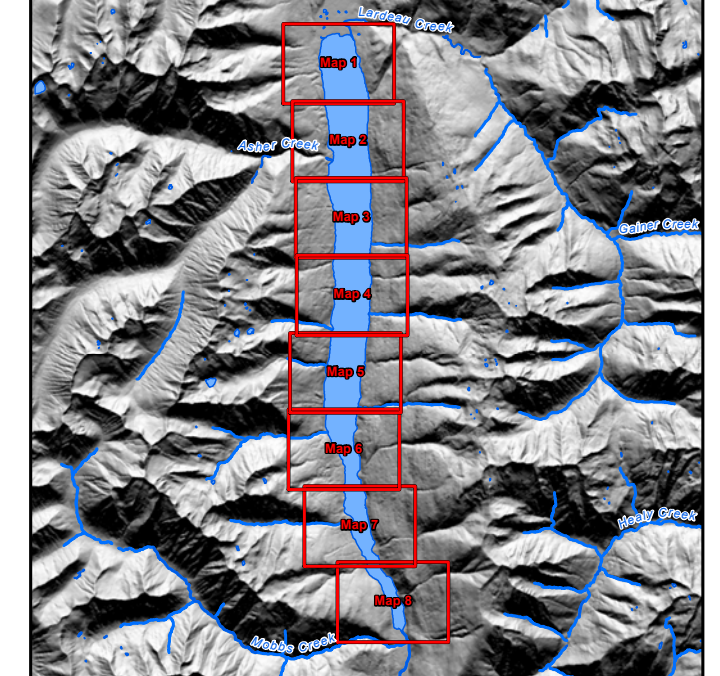
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PROJECT:  
Trout Lake FIMP

TITLE:  
Trout Lake Foreshore Inventory Mapping

- LEGEND:
- Shoreline Segment
  - Segment Break
  - Modifications**
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    - Dock
    - Marina
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  - Aquatic Vegetation**
    - Emergent
  - Base Data**
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    - Local Road
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    - Parcel Boundary

KEY MAP



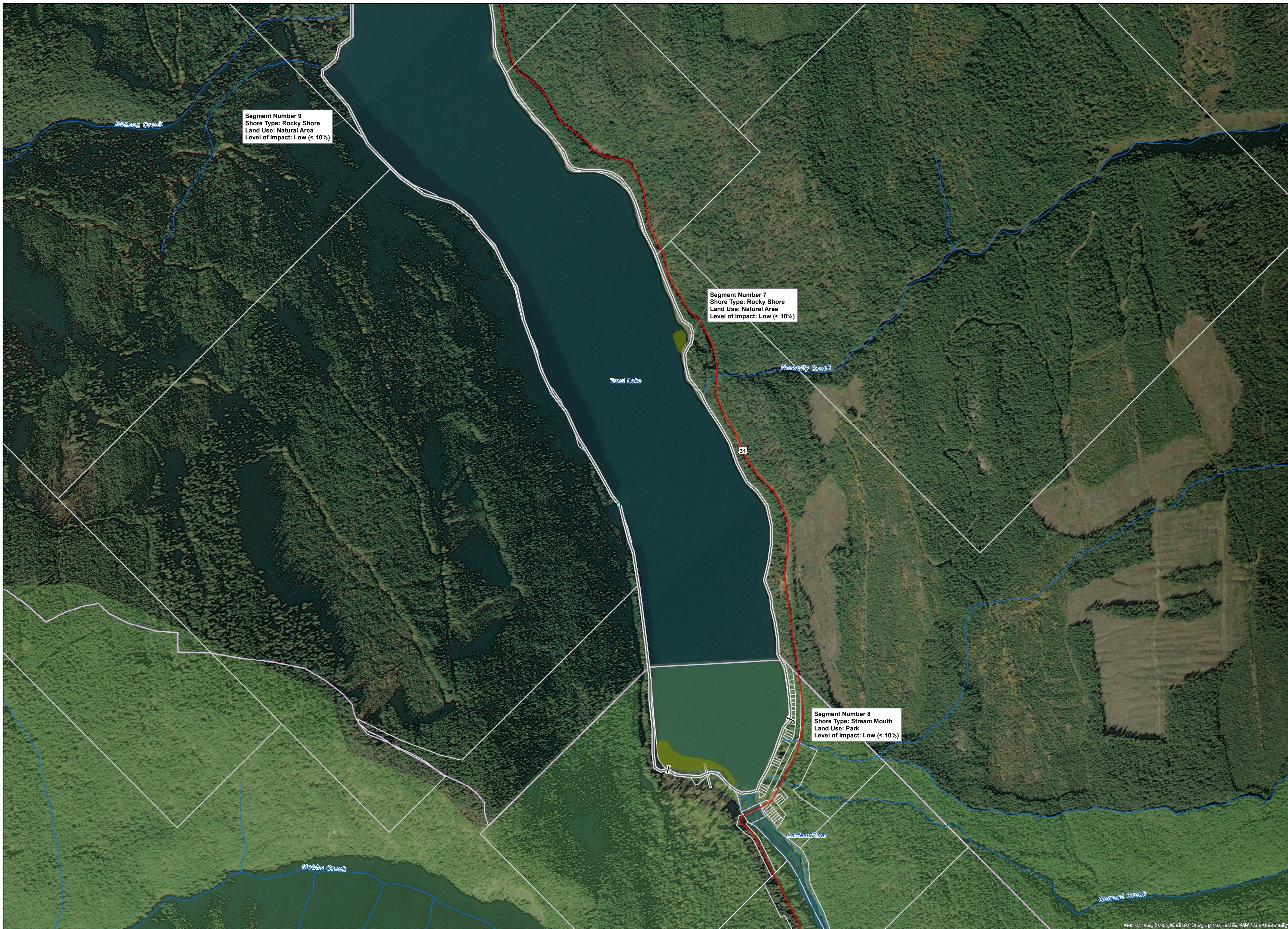
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PROJECT NO: VE52823-2022A	PAGE: 7 of 8
COORDINATE SYSTEM: NAD 1983 UTM Zone 11N	DATE: December, 2022
ANALYST: BB	CHK: CL
GIS FILE: 02-01-023_Trout_Lake_FIM.mxd	

Source: Esri, Maxar, Earthstar Geographics, and the IGN User Community



Segment Number 9  
Shore Type: Rocky Shore  
Land Use: Natural Area  
Level of Impact: Low (< 10%)

Segment Number 7  
Shore Type: Rocky Shore  
Land Use: Natural Area  
Level of Impact: Low (< 10%)

Segment Number 8  
Shore Type: Stream Mouth  
Land Use: Park  
Level of Impact: Low (< 10%)

CLIENT: LivingLakes

PROJECT: Trout Lake FIMP

TITLE: Trout Lake Foreshore Inventory Mapping

LEGEND:

- Shoreline Segment
- Segment Break
- Modifications
  - Boat Launch - Concrete
  - Boat Launch - Gravel
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KEY MAP

0 50 100  
Meters  
Scale: 1:5,000

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PROJECT NO:	VE52823-2022A	PAGE:	8 of 8
COORDINATE SYSTEM:	NAD 1983 UTM Zone 11N	DATE:	December, 2022
ANALYST:	BB	CHK:	CL
GIS FILE:	02-01-023_Trout_Lake_FIM.mxd		

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

## **Appendix B – Segment Summaries**







### Trout Lake Segment 3



**General:**

Segment Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
10453	Rocky Shore	Roadway	Steep (20-60%)	Natural Area	Low (< 10%)	No	1%	99%

**Shore Type:**

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

**Land Use:**

Agriculture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi-Family	Natural Area	Park	Rural	Single Family	Transportation	Urban Park	Utility Corridor	Land Use Comment
0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	

**Foreshore Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	0%	0%	0%	0%	5%	30%	0%	0%	60%	5%	Medium (25 - 75%)	Angular

**Littoral Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	0%	80%	0%	0%	0%	10%	0%	0%	10%	0%	Low (0 - 25%)	Smooth

**Vegetation Band 1:**

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Veg Band Comment
Coniferous	Mature Forest	Sparse (< 10%)	Abundant (> 50%)	Continuous	50	70%	Pictographs

**Aquatic Vegetation:**

Aquatic Vegetation	Submergent	Emergent	Floating	Aq Veg Comment
0%	0%	0%	0%	

**Large Woody Debris (LWD):**

LWD Range	Foreshore LWD (#)	LWD Clusters	LWD Comment
> 25 Pieces	100	3	

**Littoral Area:**

Littoral Zone	Littoral Width	Littoral LWD (#)	Littoral Comment
Narrow (< 10 m)	5	7	

**Shoreline Modifications:**

Ret. Walls	%Ret. Wall	Docks	Docks/km	Dock Groynes	Swim Float	Boat House Float	Boat House Land	Boat Cover	Groynes	Groynes/km	Boat Launch - Concrete	Boat Launch - Gravel	Marine Rail	Marinas	Fences	Stairs	Mooring Buoys	Boat Rack/Lift	Boat Basin	Shed	Pumphouse	Geothermal	Pond Pool	Pilings	Pile Support Struct	Tram	
0	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

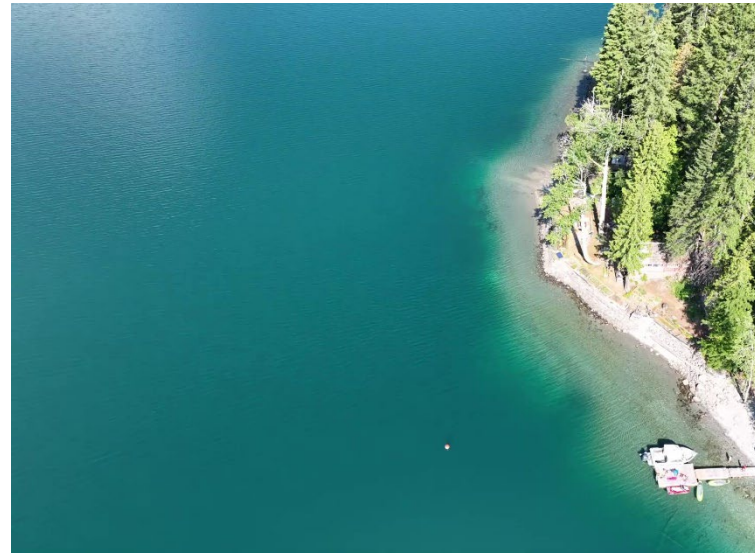
**Lineal Modifications:**

% Rail	% Road	Substrate Mod	% Substrate Mod	% Erosion Protect	Modification Comment
0%	3%	No	0%	0%	

**Flora and Fauna:**

Veteran Trees	Snags	Beaver Lodge	Wildlife Den	Wildlife Trail	Mineral Lick	Shellfish	Stick Nest	Flora Comments	Fauna Comments
> 25 Trees	> 25 Trees	0	0	1	0	0	1		Belted kingfisher; chipmunk; osprey nest with osprey nearby

**Trout Lake Segment 4**



**General:**

Segment Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
203	Rocky Shore	None	Medium (5-20%)	Single Family	Medium (10-50%)	No	45%	55%

**Shore Type:**

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

**Land Use:**

Agriculture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi-Family	Natural Area	Park	Rural	Single Family	Transportation	Urban Park	Utility Corridor
0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%

**Foreshore Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	0%	0%	20%	0%	0%	40%	0%	0%	40%	0%	Medium (25 - 75%)	Angular

**Littoral Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	10%	80%	10%	0%	0%	0%	0%	0%	0%	0%	Low (0 - 25%)	Smooth

**Vegetation Band 1:**

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation
Coniferous	Mature Forest	Medium (10 - 50%)	Abundant (> 50%)	Continuous	50	15%

**Aquatic Vegetation:**

Aquatic Vegetation	Submergent	Emergent	Floating	Aq Veg Comment
0%	0%	0%	0%	

**Large Woody Debris (LWD):**

LWD Range	Foreshore LWD (#)	LWD Clusters	LWD Comment
None	0	0	

**Littoral Area:**

Littoral Zone	Littoral Width	Littoral LWD (#)	Littoral Comment
Narrow (< 10 m)	8	1	

**Shoreline Modifications:**

Ret. Walls	%Ret.Wall	Docks	Docks/km	Dock Groyne	Swim Float	Boat House_Float	Boat House_Land	Boat Cover	Groynes	Groynes/km	Boat Launch - Concrete	Boat Launch - Gravel	Marine Rail	Marinas	Fences	Stairs	Mooring Buoys	Boat Rack/Lift	Boat Basin	Shed	Pumphouse	Geothermal	Pond_Pool	Pilings	Pile Support Struct	Tram
2	45%	1	5	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0

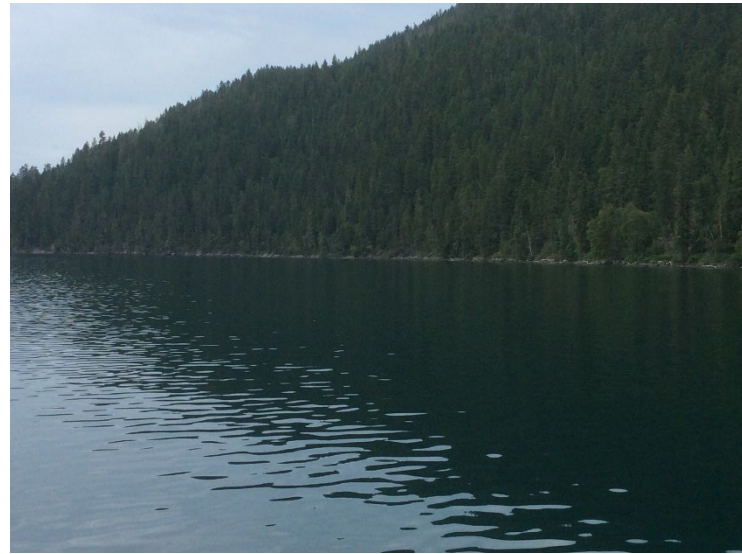
**Lineal Modifications:**

% Rail	% Road	Substrate Mod	% Substrate Mod	% Erosion Protect	Modification Comment
0%	0%	Yes	45%	45%	Leased land with two cabins, sauna, dock, retaining wall and footbridge bridge over creek

**Flora and Fauna:**

Veteran Trees	Snags	Beaver Lodge	Wildlife Den	Wildlife Trail	Mineral Lick	Shellfish	Stick Nest	Flora Comments	Fauna Comments
< 5 Trees	< 5 Trees	0	0	0	0	0	0		Cedar waxwing

**Trout Lake Segment 5**



**General:**

Segment Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
6325	Rocky Shore	None	Steep (20-60%)	Natural Area	Low (< 10%)	No	2%	98%

**Shore Type:**

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
4%	95%	0%	0%	1%	0%	0%

**Land Use:**

Agriculture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi-Family	Natural Area	Park	Rural	Single Family	Transportation	Urban Park	Utility Corridor
0%	0%	0%	0%	0%	0%	0%	98%	0%	0%	2%	0%	0%	0%

**Foreshore Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	95%	5%	Medium (25 - 75%)	Angular

**Littoral Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	0%	40%	0%	0%	0%	60%	0%	0%	0%	0%	Low (0 - 25%)	Smooth

**Vegetation Band 1:**

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation
Coniferous	Mature Forest	Sparse (< 10%)	Abundant (> 50%)	Continuous	50	70%

**Aquatic Vegetation:**

Aquatic Vegetation	Submergent	Emergent	Floating	Aq Veg Comment
0%	0%	0%	0%	

**Large Woody Debris (LWD):**

LWD Range	Foreshore LWD (#)	LWD Clusters	LWD Comment
> 25 Pieces	100	0	

**Littoral Area:**

Littoral Zone	Littoral Width	Littoral LWD (#)	Littoral Comment
Narrow (< 10 m)	5	5	

**Shoreline Modifications:**

Ret. Walls	%Ret.Wall	Docks	Docks/km	Dock Groyne	Swim Float	Boat House_Float	Boat House_Land	Boat Cover	Groynes	Groynes/km	Boat Launch - Concrete	Boat Launch - Gravel	Marine Rail	Marinas	Fences	Stairs	Mooring Buoys	Boat Rack/Lift	Boat Basin	Shed	Pumphouse	Geothermal	Pond_Pool	Pilings	Pile Support Struct	Tram	
1	0.2%	1	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

**Lineal Modifications:**

% Rail	% Road	Substrate Mod	% Substrate Mod	% Erosion Protect
0%	0%	No	0%	0.1%

**Flora and Fauna:**

Veteran Trees	Snags	Beaver Lodge	Wildlife Den	Wildlife Trail	Mineral Lick	Shellfish	Stick Nest	Flora Comments	Fauna Comments
> 25 Trees	> 25 Trees	0	0	0	0	0	0		Osprey

**Trout Lake Segment 6**



**General:**

Segment Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
3855	Gravel	None	Medium (5-20%)	Natural Area	None	No	0%	100%

**Shore Type:**

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0%	9%	80%	10%	1%	0%	0%

**Land Use:**

Agriculture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi-Family	Natural Area	Park	Rural	Single Family	Transportation	Urban Park	Utility Corridor
0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%

**Foreshore Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	0%	0%	80%	0%	0%	19%	0%	0%	1%	0%	Low (0 - 25%)	Smooth

**Littoral Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	0%	80%	20%	0%	0%	0%	0%	0%	0%	0%	Low (0 - 25%)	Smooth

**Vegetation Band 1:**

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation
Coniferous	Mature Forest	Sparse (< 10%)	Abundant (> 50%)	Continuous	50	20%

**Aquatic Vegetation:**

Aquatic Vegetation	Submergent	Emergent	Floating	Aq Veg Comment
0.5%	0.5%	0%	0%	

**Large Woody Debris (LWD):**

LWD Range	Foreshore LWD (#)	LWD Clusters	LWD Comment
> 25 Pieces	26	3	

**Littoral Area:**

Littoral Zone	Littoral Width	Littoral LWD (#)
Medium (10 - 50 m)	15	0

**Shoreline Modifications:**

Ret. Walls	%Ret.Wall	Docks	Docks/km	Dock Groyne	Swim Float	Boat House_Float	Boat House_Land	Boat Cover	Groynes	Groynes/km	Boat Launch - Concrete	Boat Launch - Gravel	Marine Rail	Marinas	Fences	Stairs	Mooring Buoys	Boat Rack/Lift	Boat Basin	Shed	Pumphouse	Geothermal	Pond_Pool	Pilings	Pile Support Struct	Tram	
0	0%	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

**Lineal Modifications:**

% Rail	% Road	Substrate Mod	% Substrate Mod	% Erosion Protect
0%	0%	No	0%	0%

**Flora and Fauna:**

Veteran Trees	Snags	Beaver Lodge	Wildlife Den	Wildlife Trail	Mineral Lick	Shellfish	Stick Nest	Flora Comments	Fauna Comments
> 25 Trees	> 25 Trees	0	1	0	0	0	0		Loon; wildlife den at end of segment in rustic campground at base of large cottonwood tree

**Trout Lake Segment 7**



**General:**

Segment Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
3093	Rocky Shore	Roadway	Steep (20-60%)	Natural Area	Low (< 10%)	No	2%	98%

**Shore Type:**

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

**Land Use:**

Agriculture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi-Family	Natural Area	Park	Rural	Single Family	Transportation	Urban Park	Utility Corridor	Land Use Comment
0%	0%	0%	0%	0%	0%	0%	90%	8%	0%	0%	2%	0%	0%	

**Foreshore Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	0%	0%	0%	0%	0%	10%	0%	0%	88%	2%	Medium (25 - 75%)	Angular

**Littoral Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	0%	20%	0%	0%	0%	40%	0%	0%	40%	0%	Low (0 - 25%)	Angular

**Vegetation Band 1:**

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Veg Band Comment
Coniferous	Mature Forest	Sparse (< 10%)	Abundant (> 50%)	Continuous	50	60%	

**Aquatic Vegetation:**

Aquatic Vegetation	Submergent	Emergent	Floating	Aq Veg Comment
1%	1%	0%	0%	

**Large Woody Debris (LWD):**

LWD Range	Foreshore LWD (#)	LWD Clusters	LWD Comment
> 25 Pieces	75	3	

**Littoral Area:**

Littoral Zone	Littoral Width	Littoral LWD (#)	Littoral Comment
Narrow (< 10 m)	5	15	

**Shoreline Modifications:**

Ret. Walls	%Ret.Wall	Docks	Docks/km	Dock Groyne	Swim Float	Boat House_Float	Boat House_Land	Boat Cover	Groynes	Groynes/km	Boat Launch - Concrete	Boat Launch - Gravel	Marine Rail	Marinas	Fences	Stairs	Mooring Buoys	Boat Rack/Lift	Boat Basin	Shed	Pumphouse	Geothermal	Pond_Pool	Pilings	Pile Support Struct	Tram	
0	0%	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

**Lineal Modifications:**

% Rail	% Road	Substrate Mod	% Substrate Mod	% Erosion Protect	Modification Comment
0%	2%	No	0%	0%	

**Flora and Fauna:**

Veteran Trees	Snags	Beaver Lodge	Wildlife Den	Wildlife Trail	Mineral Lick	Shellfish	Stick Nest	Flora Comments	Fauna Comments
> 25 Trees	> 25 Trees	0	0	0	0	0	0		Eagle

**Trout Lake Segment 8**



**General:**

Segment Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
611	Stream Mouth	Roadway	Low (< 5%)	Park	Low (< 10%)	No	9%	91%

**Shore Type:**

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0%	0%	30%	20%	50%	0%	0%

**Land Use:**

Agriculture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi-Family	Natural Area	Park	Rural	Single Family	Transportation	Urban Park	Utility Corridor	Land Use Comment
0%	0%	0%	0%	0%	0%	0%	0%	90%	1%	0%	9%	0%	0%	

**Foreshore Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	0%	20%	70%	0%	0%	10%	0%	0%	0%	0%	Low (0 - 25%)	Smooth

**Littoral Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	10%	30%	60%	0%	0%	0%	0%	0%	0%	0%	Low (0 - 25%)	Smooth

**Vegetation Band 1:**

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation
Shrubs	Tall Shrubs	Medium (10 - 50%)	Sparse (< 10%)	Patchy	10	60%

**Vegetation Band 2:**

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Mixed Forest	Mature Forest	Medium (10 - 50%)	Abundant (> 50%)	Patchy	40

**Aquatic Vegetation:**

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

**Large Woody Debris (LWD):**

LWD Range	Foreshore LWD (#)	LWD Clusters	LWD Comment
6 - 25 Pieces	20	1	

**Littoral Area:**

Littoral Zone	Littoral Width	Littoral LWD (#)	Littoral Comment
Medium (10 - 50 m)	25	8	

**Shoreline Modifications:**

Ret. Walls	%Ret.Wall	Docks	Docks/km	Dock Groyne	Swim Float	Boat House_Float	Boat House_Land	Boat Cover	Groynes	Groynes/km	Boat Launch - Concrete	Boat Launch - Gravel	Marine Rail	Marinas	Fences	Stairs	Mooring Buoys	Boat Rack/Lift	Boat Basin	Shed	Pumphouse	Geothermal	Pond_Pool	Pilings	Pile Support Struct	Tram
0	0.0%	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0

**Lineal Modifications:**

% Rail	% Road	Substrate Mod	% Substrate Mod	% Erosion Protect	Modification Comment
0%	9%	No	0%	0%	

**Flora and Fauna:**

Veteran Trees	Snags	Beaver Lodge	Wildlife Den	Wildlife Trail	Mineral Lick	Shellfish	Stick Nest	Flora Comments	Fauna Comments
> 25 Trees	> 25 Trees	0	0	0	0	0	0		Eagle

**Trout Lake Segment 9**



**General:**

Segment Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
20403	Rocky Shore	None	Medium (5-20%)	Natural Area	Low (< 10%)	No	2%	98%

**Shore Type:**

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
3%	80%	10%	5%	2%	0%	0%

**Land Use:**

Agriculture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi-Family	Natural Area	Park	Rural	Single Family	Transportation	Urban Park	Utility Corridor	Land Use Comment
0%	0%	0%	0%	0%	0%	0%	96%	1%	1%	1%	1%	0%	0%	Road at outlet end of segment

**Foreshore Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	0%	5%	5%	0%	0%	40%	0%	0%	50%	0%	Low (0 - 25%)	Smooth

**Littoral Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	0%	45%	45%	0%	0%	10%	0%	0%	0%	0%	Low (0 - 25%)	Smooth

**Vegetation Band 1:**

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Veg Band Comment
Coniferous	Mature Forest	Sparse (< 10%)	Abundant (> 50%)	Continuous	50	70%	

**Aquatic Vegetation:**

Aquatic Vegetation	Submergent	Emergent	Floating	Aq Veg Comment
2%	2%	0%	0%	

**Large Woody Debris (LWD):**

LWD Range	Foreshore LWD (#)	LWD Clusters	LWD Comment
> 25 Pieces	260	40	

**Littoral Area:**

Littoral Zone	Littoral Width	Littoral LWD (#)	Littoral Comment
Narrow (< 10 m)	5	55	

**Shoreline Modifications:**

Ret. Walls	%Ret.Wall	Docks	Docks/km	Dock Groyne	Swim Float	Boat House_Float	Boat House_Land	Boat Cover	Groynes	Groynes/km	Boat Launch - Concrete	Boat Launch - Gravel	Marine Rail	Marinas	Fences	Stairs	Mooring Buoys	Boat Rack/Lift	Boat Basin	Shed	Pumphouse	Geothermal	Pond_Pool	Pilings	Pile Support Struct	Tram
1	0.1%	2	0	0	0	0	0	0	0	0	0	1	0	0	0	2	1	0	0	9	0	0	0	0	2	0

**Lineal Modifications:**

% Rail	% Road	Substrate Mod	% Substrate Mod	% Erosion Protect	Modification Comment
0%	2%	No	0%	0.1%	

**Flora and Fauna:**

Veteran Trees	Snags	Beaver Lodge	Wildlife Den	Wildlife Trail	Mineral Lick	Shellfish	Stick Nest	Flora Comments	Fauna Comments
> 25 Trees	> 25 Trees	0	0	0	0	0	0		3 loons, eagle, kingfisher, unknown shore bird



**Trout Lake Segment 10**



**General:**

Segment Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
831	Rocky Shore	None	Low (< 5%)	Natural Area	None	No	0%	100%

**Shore Type:**

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0%	80%	0%	0%	20%	0%	0%

**Land Use:**

Agriculture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi-Family	Natural Area	Park	Rural	Single Family	Transportation	Urban Park	Utility Corridor	Land Use Comment
0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	

**Foreshore Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	10%	20%	20%	0%	0%	20%	0%	0%	30%	0%	None (0%)	Smooth

**Littoral Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	30%	30%	30%	0%	0%	10%	0%	0%	0%	0%	None (0%)	Smooth

**Vegetation Band 1:**

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Veg Band Comment
Coniferous	Mature Forest	Medium (10 - 50%)	Abundant (> 50%)	Continuous	50	85%	

**Aquatic Vegetation:**

Aquatic Vegetation	Submergent	Emergent	Floating	Aq Veg Comment
1%	0%	1%	0%	

**Large Woody Debris (LWD):**

LWD Range	Foreshore LWD (#)	LWD Clusters	LWD Comment
6 - 25 Pieces	15	2	

**Littoral Area:**

Littoral Zone	Littoral Width	Littoral LWD (#)	Littoral Comment
Medium (10 - 50 m)	15	0	

**Shoreline Modifications:**

Ret. Walls	%Ret.Wall	Docks	Docks/km	Dock Groynes	Swim Float	Boat House_Float	Boat House_Land	Boat Cover	Groynes	Groynes/km	Boat Launch - Concrete	Boat Launch - Gravel	Marine Rail	Marinas	Fences	Stairs	Mooring Buoys	Boat Rack/Lift	Boat Basin	Shed	Pumphouse	Geothermal	Pond_Pool	Pilings	Pile Support Struct	Tram	
0	0%	0	0.0	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

**Lineal Modifications:**

% Rail	% Road	Substrate Mod	% Substrate Mod	% Erosion Protect	Modification Comment
0%	0%	No	0%	0%	Two abandoned docks on shore as debris

**Flora and Fauna:**

Veteran Trees	Snags	Beaver Lodge	Wildlife Den	Wildlife Trail	Mineral Lick	Shellfish	Stick Nest	Flora Comments	Fauna Comments
> 25 Trees	> 25 Trees	0	0	0	0	0	0		2 eagles; ravens

**Trout Lake Segment 11**



**General:**

Segment Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
4315	Gravel	None	Medium (5-20%)	Natural Area	None	No	0%	100%

**Shore Type:**

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0%	0%	90%	9%	1%	0%	0%

**Land Use:**

Agriculture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi-Family	Natural Area	Park	Rural	Single Family	Transportation	Urban Park	Utility Corridor	Land Use Comment
0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	

**Foreshore Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	5%	5%	90%	0%	0%	0%	0%	0%	0%	0%	None (0%)	Smooth

**Littoral Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	10%	80%	10%	0%	0%	0%	0%	0%	0%	0%	None (0%)	Smooth

**Vegetation Band 1:**

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Veg Band Comment
Coniferous	Mature Forest	Sparse (< 10%)	Abundant (> 50%)	Continuous	50	90%	

**Aquatic Vegetation:**

Aquatic Vegetation	Submergent	Emergent	Floating	Aq Veg Comment
0%	0%	0%	0%	

**Large Woody Debris (LWD):**

LWD Range	Foreshore LWD (#)	LWD Clusters	LWD Comment
> 25 Pieces	37	10	

**Littoral Area:**

Littoral Zone	Littoral Width	Littoral LWD (#)	Littoral Comment
Narrow (< 10 m)	5	12	

**Shoreline Modifications:**

Ret. Walls	%Ret.Wall	Docks	Docks/km	Dock Groyne	Swim Float	Boat House_Float	Boat House_Land	Boat Cover	Groynes	Groynes/km	Boat Launch - Concrete	Boat Launch - Gravel	Marine Rail	Marinas	Fences	Stairs	Mooring Buoys	Boat Rack/Lift	Boat Basin	Shed	Pumphouse	Geothermal	Pond_Pool	Pilings	Pile Support Struct	Tram	
0	0%	0	0.0	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

**Lineal Modifications:**

% Rail	% Road	Substrate Mod	% Substrate Mod	% Erosion Protect	Modification Comment
0%	1%	No	0%	0%	

**Flora and Fauna:**

Veteran Trees	Snags	Beaver Lodge	Wildlife Den	Wildlife Trail	Mineral Lick	Shellfish	Stick Nest	Flora Comments	Fauna Comments
5 - 25 Trees	> 25 Trees	0	0	0	0	0	0		Eagle

**Trout Lake Segment 12**



**General:**

Segment Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
877	Sand	Roadway	Low (< 5%)	Natural Area	Low (< 10%)	No	5%	95%

**Shore Type:**

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0%	0%	8%	90%	2%	0%	0%

**Land Use:**

Agriculture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi-Family	Natural Area	Park	Rural	Single Family	Transportation	Urban Park	Utility Corridor	Land Use Comment
0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	

**Foreshore Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	0%	90%	10%	0%	0%	0%	0%	0%	0%	0%	None (0%)	Smooth

**Littoral Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	10%	80%	10%	0%	0%	0%	0%	0%	0%	0%	None (0%)	Smooth

**Vegetation Band 1:**

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Veg Band Comment
Shrubs	Tall Shrubs	Abundant (> 50%)	Sparse (< 10%)	Continuous	50	30%	

**Aquatic Vegetation:**

Aquatic Vegetation	Submergent	Emergent	Floating	Aq Veg Comment
10%	10%	0%	0%	

**Large Woody Debris (LWD):**

LWD Range	Foreshore LWD (#)	LWD Clusters	LWD Comment
< 5 Pieces	2	0	

**Littoral Area:**

Littoral Zone	Littoral Width	Littoral LWD (#)	Littoral Comment
Wide (> 50 m)	60	0	

**Shoreline Modifications:**

Ret. Walls	%Ret.Wall	Docks	Docks/km	Dock Groyne	Swim Float	Boat House_Float	Boat House_Land	Boat Cover	Groynes	Groynes/km	Boat Launch - Concrete	Boat Launch - Gravel	Marine Rail	Marinas	Fences	Stairs	Mooring Buoys	Boat Rack/Lift	Boat Basin	Shed	Pumphouse	Geothermal	Pond_Pool	Pilings	Pile Support Struct	Tram	
0	0%	0	0.0	0	0	0	0	0	0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

**Lineal Modifications:**

% Rail	% Road	Substrate Mod	% Substrate Mod	% Erosion Protect	Modification Comment
0%	100%	No	0%	0%	Unofficial camp spot; RVs parked below HWM

**Flora and Fauna:**

Veteran Trees	Snags	Beaver Lodge	Wildlife Den	Wildlife Trail	Mineral Lick	Shellfish	Stick Nest	Flora Comments	Fauna Comments
< 5 Trees	< 5 Trees	0	0	0	0	0	0		3 American wigeon; heron

**Trout Lake Segment 13**



**General:**

Segment Length (m)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural
533	Gravel	Small Marina (6-20 Slips)	Low (< 5%)	Natural Area	Low (< 10%)	No	9%	91%

**Shore Type:**

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other
0%	0%	80%	20%	0%	0%	0%

**Land Use:**

Agriculture	Commercial	Conservation	Forestry	Industrial	Institutional	Multi-Family	Natural Area	Park	Rural	Single Family	Transportation	Urban Park	Utility Corridor	Land Use Comment
0%	0%	0%	0%	20%	0%	0%	60%	0%	0%	0%	0%	20%	0%	Historic industrial

**Foreshore Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	10%	10%	80%	0%	0%	0%	0%	0%	0%	0%	None (0%)	Smooth

**Littoral Substrates:**

Marl	Mud	Organic	Fines	Sand	Gravel	Gravel Fine	Gravel Coarse	Cobble	Cobble Fine	Cobble Coarse	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	10%	80%	10%	0%	0%	0%	0%	0%	0%	0%	None (0%)	Smooth

**Vegetation Band 1:**

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation
Shrubs	Tall Shrubs	Abundant (> 50%)	Sparse (< 10%)	Continuous	15	50%

**Vegetation Band 2:**

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)
Broadleaf	Mature Forest	Abundant (> 50%)	Abundant (> 50%)	Continuous	35

**Aquatic Vegetation:**

Aquatic Vegetation	Submergent	Emergent	Floating	Aq Veg Comment
2%	2%	0%	0%	

**Large Woody Debris (LWD):**

LWD Range	Foreshore LWD (#)	LWD Clusters	LWD Comment
< 5 Pieces	1	0	

**Littoral Area:**

Littoral Zone	Littoral Width	Littoral LWD (#)	Littoral Comment
Wide (> 50 m)	60	0	

**Shoreline Modifications:**

Ret. Walls	%Ret.Wall	Docks	Docks/km	Dock Groyne	Swim Float	Boat House_Float	Boat House_Land	Boat Cover	Groynes	Groynes/km	Boat Launch - Concrete	Boat Launch - Gravel	Marine Rail	Marinas	Fences	Stairs	Mooring Buoys	Boat Rack/Lift	Boat Basin	Shed	Pumphouse	Geothermal	Pond_Pool	Pilings	Pile Support Struct	Tram	Other
0	0%	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	120	0	0	0

**Lineal Modifications:**

% Rail	% Road	Substrate Mod	% Substrate Mod	% Erosion Protect	Modification Comment
0%	20%	Yes	1%	0%	Other modification is rock footing/abutment; small marina

**Flora and Fauna:**

Veteran Trees	Snags	Beaver Lodge	Wildlife Den	Wildlife Trail	Mineral Lick	Shellfish	Stick Nest	Flora Comments	Fauna Comments
5 - 25 Trees	> 25 Trees	0	0	0	0	0	0		Possible otters; heron, 30 gulls, turkey vulture, 7 Canada geese



## **Appendix C – 2022 Fish Sampling**



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Suite 601E, 601 Front St.  
Nelson, BC  
Canada  
T: 250-354-1600

## Memo

---

**To:** Georgia Peck, Program Coordinator, Living Lakes Canada  
Bruce Mac Donald, Program Director, Living Lakes Canada

**From:** Crystal Lawrence, Aquatic Biologist, WSP E&I Canada Ltd.

**Date:** 6 December 2022

**Ref:** VE52823.2022A

**Re:** **Trout Lake Fish Sampling – August 2022**

---

WSP Environment & Infrastructure (E&I) Canada Ltd. was retained by Living Lakes Canada to complete a Foreshore Integrated Management Planning (FIMP) project on Trout Lake (Schleppe et al. 2021). During FIMP background literature reviews, data gaps related to the presence of fish species in nearshore habitats of Trout Lake were identified. Many native fish species have been documented in Trout Lake including Burbot (*Lota lota*) and Bull Trout (*Salvelinus confluentus*) which are species of regional and/or provincial conservation concern (FIDQ 2022). Sampling was conducted for White Sturgeon (*Acipenser transmontanus*), listed as Endangered under the federal Species at Risk Act (SARA), in Trout Lake in 1995 and although none were captured, many Burbot were captured as bycatch as was one Bull Trout (RL&L 1995). Burbot sampling was subsequently conducted in the 2000's and suggested there was a substantial Burbot population in Trout Lake (Baxter et al. 2002). FIDQ (2022) also reported a record of Cutthroat Trout (*Oncorhynchus clarkii*) being stocked to the lake in 1913 but it is unknown if these were of the Westslope subspecies, listed as Special Concern under SARA; no other capture records were listed. The Trout Lake outlet is the primary spawning area for Gerrard Rainbow Trout (*Oncorhynchus mykiss*) from Kootenay Lake, a genetically unique trophy-sized Rainbow Trout native to the lake.

Other than these surveys, there has been very little fish inventory work completed in Trout Lake since the 1970's and none of this work has focused on nearshore habitats. The current program conducted fish sampling in August 2022 to inventory fish use in nearshore habitats in support of the Trout Lake FIMP project.

## Methods

A scientific fish collection permit for inventory purposed was obtained from the B.C. Ministry of Forests prior to fish sampling (CB22-746745). Fish sampling was conducted on 10 and 11 August 2022 and capture methods included minnow trapping and backpack electrofishing. Minnow traps baited with roe were set overnight at depths between 0.3 and 1.1 m in select areas at the northeast corner of Trout Lake (Figure 1). Backpack electrofishing was conducted by a three-person crew during the day in wadeable, nearshore areas of Trout Lake (Figure 1). Incidental fish observations were also recorded over the duration of FIMP field surveys (9 to 11 August 2022).

Captured fish were placed in large buckets with fresh water. All fish were identified to the species level and measured for fork length (total length for Burbot and sculpins) to the nearest millimeter. Fish were held in freshwater until fully recovered from handling then released near the location of capture.

## Results

Fish sampling was conducted at seven sites in Trout Lake including four sites sampled by backpack electrofishing, three sites sampled by minnow trapping, and, two sites where incidental fish observations were recorded (Table 1; Figure 1). Details of site locations, effort, sampling methods and fish captured are provided in Tables A1 and A2 in the Attachments.

Burbot (n=16; 38 to 265 mm total length) were the most prevalent fish species captured and they were observed at five of the seven sample sites (Photo 1; Table 1). Burbot were mainly captured in large cobble/boulder substrates where interstitial spaces in the substrate provided cover (Photo 2). One was also captured in a minnow trap set off a dock in habitat dominated by fines with some nearby aquatic vegetation (Photo 2 and Photo 3). Two adult Bull Trout, each approximately 50 cm fork length, were incidentally observed being captured by anglers in Lardeau Creek about 20 m upstream of the confluence with Trout Lake (Table 1; Figure 1). Two deceased juvenile Kokanee (*Oncorhynchus nerka*), approximately 70 mm fork length, were observed floating along the shoreline at two locations (Table 1; Photo 4).

Other fish species captured included Longnose Dace (*Rhinichthys cataractae*), Redside Shiner (*Richardsonius balteatus*), Slimy Sculpin (*Cottus cognatus*) and sucker species (Table 1; Tables A1 and A2 in the Attachments).

**Table 1: Trout Lake nearshore fish species observations, 9 and 10 August 2022.**

FIMP Segment Number	Site Name	Number of Fish Observed						
		Burbot	Bull Trout*	Longnose Dace	Kokanee^	Redside Shiner	Slimy Sculpin	Sucker spp.
1	Lardeau Creek Outlet		2					1
2	Sawczuk Road Bay	1						3
3	Gravel Beach on Northeast Shore	2			1	1		1
5	Unnamed Creek Mouth near Cabins	4		3		1		
9	Daney Creek Mouth	7		8		1	2	
9	Southwest Shore				1			
10	Asher Creek Fan	2		1				4
13	South of Boat Launch					2		4

### Note(s):

\*Incidental observation of anglers catching Bull Trout (approximately 60 cm fork length) in Lardeau Creek 15 m upstream of the outlet to Trout Lake.

^Incidental observations of deceased juvenile Kokanee along shoreline (n=1 at each site).

## Closing

This memo was prepared exclusively for Living Lakes Canada by WSP E&I Canada Limited. The quality of information, conclusions and estimates contained herein are consistent with the level of effort involved in WSP E&I Canada Limited services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions and qualifications set forth in this report. This report is intended to be used only by Living Lakes Canada, subject to the terms and conditions of its contract with WSP E&I Canada Limited. Any use of, or reliance on, this report by any third party is at that party's sole risk.

Please contact the undersigned to discuss further or if you have any questions.

Sincerely,

### WSP E&I Canada Limited



**Crystal Lawrence**  
Senior Aquatic Biologist



**Louise Porto**  
Associate Fisheries Biologist

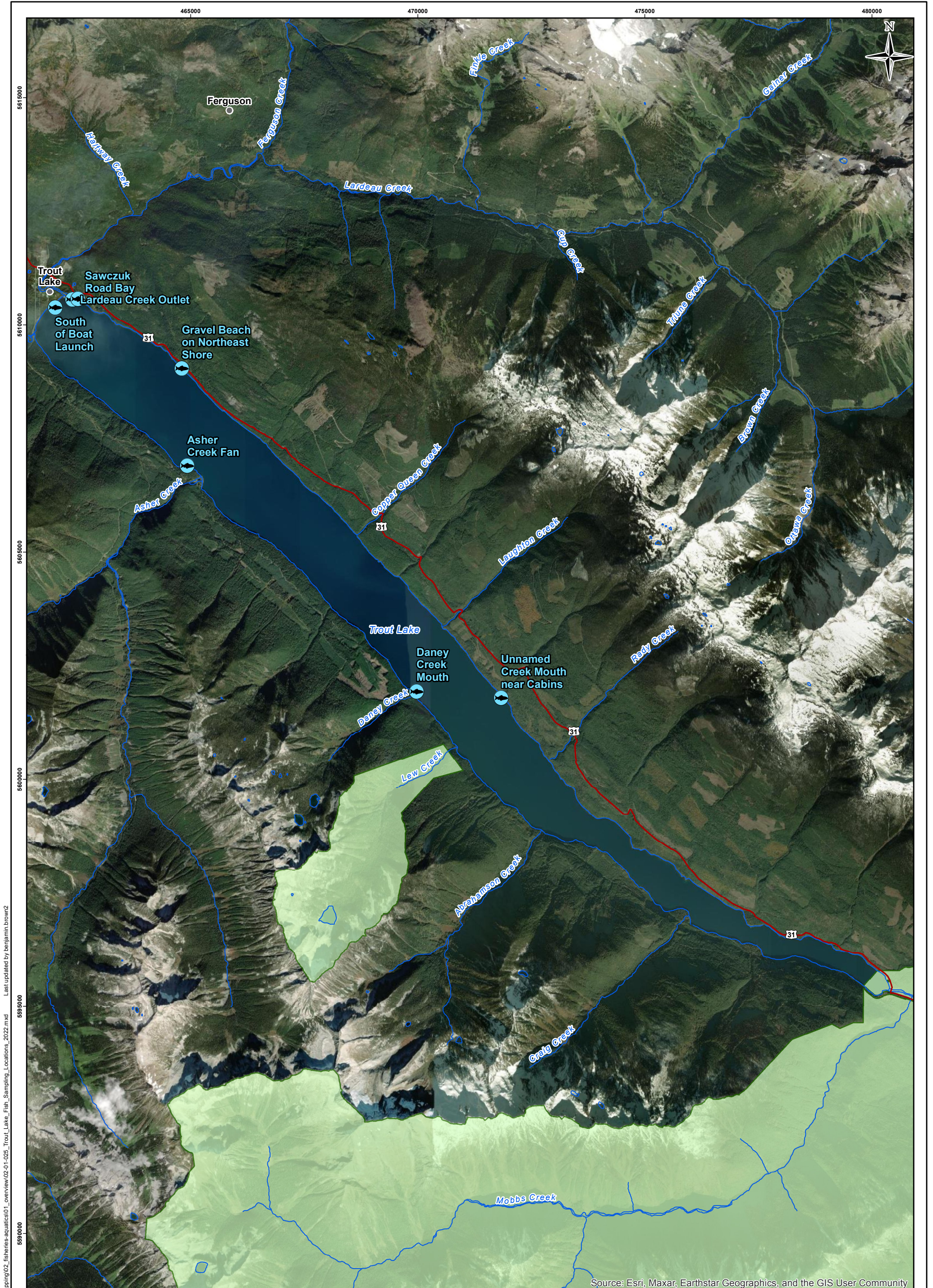
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- Schleppe, J., S. McPherson, L. Porto, and B. Mason. 2021. Foreshore Integrated Management Plan Methods. Prepared for Living Lakes Canada. Prepared by: Ecoscape Environmental Consultants Ltd., Lotic









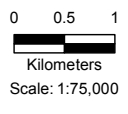


## **Attachments**



Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

- Legend**
-  Fish Sampling Site
  -  Populated Place
  -  Highway
  -  Watercourse
  -  Waterbody
  -  Parks & Protected Areas



**References:**  
 DataBC Data Distribution Service  
 Open Government License  
 (<http://www.data.gov.bc.ca/>)  
 Geogratis/Geobase  
 Open Government License - Canada  
 (<http://data.gc.ca/eng/about-datagcca>)

<p>CLIENT: <b>LivingLakes</b></p>	<p>PROJECT: <b>Trout Lake FIMP</b></p>																
<p>TITLE: <b>Trout Lake Fish Sampling Locations 2022</b></p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%;">DATE: December 06, 2022</td> <td style="width: 25%;">ANALYST: BB</td> <td style="width: 25%;">QA/QC: CL</td> <td style="width: 25%; text-align: center;"><b>Figure 1</b></td> </tr> <tr> <td colspan="4">GIS FILE: 02-01-025_Trout_Lake_Fish_Sampling_Locations_2022.mxd</td> </tr> <tr> <td colspan="4">JOB No: VE52823</td> </tr> <tr> <td colspan="4">COORDINATE SYSTEM: NAD 1983 UTM Zone 11N</td> </tr> </table>	DATE: December 06, 2022	ANALYST: BB	QA/QC: CL	<b>Figure 1</b>	GIS FILE: 02-01-025_Trout_Lake_Fish_Sampling_Locations_2022.mxd				JOB No: VE52823				COORDINATE SYSTEM: NAD 1983 UTM Zone 11N			
DATE: December 06, 2022	ANALYST: BB	QA/QC: CL	<b>Figure 1</b>														
GIS FILE: 02-01-025_Trout_Lake_Fish_Sampling_Locations_2022.mxd																	
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COORDINATE SYSTEM: NAD 1983 UTM Zone 11N																	



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 Last updated by benjamin.brown2



**Photo 1: Burbot captured by electrofishing at the Asher Creek alluvial fan (Segment 10) in Trout Lake, 11 August 2022.**



**Photo 2: Example of cobble/boulder substrate where Burbot were captured by electrofishing in Trout Lake. Photo taken at the Asher Creek alluvial fan (Segment 10) fish sampling site, 11 August 2022.**



**Photo 3: Dock at Sawczuk Road Bay (Segment 2) in habitat dominated by fines with some nearby aquatic vegetation (left) where one Burbot (right) was captured by minnow trapping, 11 August 2022.**



**Photo 4: Deceased Kokanee incidentally observed on the southwest shoreline of Trout Lake (Segment 9), 11 August 2022.**

**Table A1. Trout Lake Backpack Electrofishing (EF) Sampling Effort, 2022.**

Site	Segment Number	Date	Start time	End time	UTM Easting	UTM Northing	Water Temperature (°C)	Conductivity (µs)	EF seconds	Site length (m)	Site width (m)	EF Voltage	Substrate Type	Fish Captures (length in brackets)
Asher Creek Fan	10	11-Aug-22	9:30	9:45	464924	5606898	19.5	97	299	20	4	550	Cobble shoreline	Burbot (n=2; 265, 38 mm) Longnose Dace (n=1; 35 mm) Sucker sp. (n=4; 136, 95, 90, 85 mm)
Daney Creek Mouth	9	11-Aug-22	10:25	10:45	469975	5601930	19.9	96	514	40	3	550	Cobble/gravel shoreline	Burbot (n=7; 40 - 180 mm) Longnose Dace (n=8; 37-60 mm) Redside Shiner (n=1; 30 mm) Slimy Sculpin (n=2; 43, 49 mm)
Unnamed Creek Mouth near Cabins	5	11-Aug-22	11:17	11:30	471838	5601789	20	95	238	20	3	550	Boulder with sand	Burbot (n=4; 111, 180, 210, 230 mm) Longnose Dace (n=3; 18, 40, 65 mm) Redside Shiner (n=1; 70 mm)
Gravel Beach on Northeast Shore	3	11-Aug-22	12:02	12:20	464806	5609038	20	96	233	20	3	550	Boulder with sand	Burbot (n=2; 165, 180 mm) Kokanee (n=1; 80 mm - incidentally observed - mortality) Redside Shiner (n=1; 50 mm) Sucker sp. (n=1; 60 mm)

Table A2: Trout Lake Minnow Trapping (MT) Sampling Effort, 2022.

Site	Method	Segment Number	Set Date	Set time	Pull Date	Pull Time	Water Temperature (°C)	Set depth (m)	Dominant Substrate	UTM Easting	UTM Northing	Fish Captures (length in brackets)
Lardeau Creek Outlet	MT1	1	10-Aug-22	16:40	11-Aug-22	8:15	20	0.8	Fines	462401	5610555	-
Lardeau Creek Outlet	MT2	1	10-Aug-22	16:40	11-Aug-22	8:15	20	0.8	Fines	462401	5610555	Sucker sp. (n=1; 47 mm)
Lardeau Creek Outlet	MT3	1	10-Aug-22	16:40	11-Aug-22	8:15	20	0.5	Fines	462401	5610555	-
Sawczuk Road Bay	MT4	2	10-Aug-22	16:40	11-Aug-22	8:15	20	1.1	Aquatic Vegetation	462523	5610569	Sucker sp. (n=3; 47, 48, 48 mm)
Sawczuk Road Bay	MT5	2	10-Aug-22	16:40	11-Aug-22	8:15	20	0.6	Fines	462523	5610569	Burbot (n=1; 138 mm)
South of Boat Launch	MT6	13	10-Aug-22	15:45	11-Aug-22	13:13	20	0.8	Gravel	462022	5610379	-
South of Boat Launch	MT7	13	10-Aug-22	15:45	11-Aug-22	13:13	20	0.5	Sand	462022	5610379	-
South of Boat Launch	MT8	13	10-Aug-22	15:45	11-Aug-22	13:13	20	0.3	Gravel	462022	5610379	Redside Shiner (n=1; 62 mm) Sucker sp. (n=4; 42, 45, 48, 71 mm)
South of Boat Launch	MT9	13	10-Aug-22	15:45	11-Aug-22	13:13	20	0.5	Aquatic Vegetation	462022	5610379	-
South of Boat Launch	MT10	13	10-Aug-22	15:45	11-Aug-22	13:13	20	0.7	Fines	462022	5610379	Redside Shiner (n=1; 70 mm)



## **Appendix D – Foreshore Habitat Sensitivity Index (FHSI) Calculations**

Appendix Table D1. Trout Lake FHSI values by criteria.

Segment Number	FIM								Fisheries			Ecosystem	Modifications				
	Shore Type	Foreshore Substrate	Percent Natural	Aquatic Vegetation	Overhanging Vegetation	Large Woody Debris	Riparian Band 1	Riparian Band 2	Juvenile Rearing	Migration	Staging	Corridor	Ret Walls	Docks	Groynes	Boat Launches	Marinas
1	23.80	8.70	8.20	0.34	0.02	4.1	4.08	2.16	1.5	7.5	4.5	7	0	0	0	0	0
2	17.97	10.68	4.92	0.07	0.00	3.28	2.72	2.16	3.0	0	0	0	-0.8	-2.50	-0.75	-1.5	0
3	18.33	9.80	8.12	0	0	3.28	5.44	2.16	3.0	7.5	0	0	0	0	0	0	0
4	19.28	10.67	4.51	0	0	1.64	5.44	2.16	3.0	7.5	0	0	-0.9	-1.88	0	0	0
5	18.80	8.99	8.04	0	0	3.28	5.44	2.16	3.0	7.5	0	0	-0.004	0	0	0	0
6	18.37	11.58	8.20	0.03	0.00	2.46	5.44	2.16	3.0	7.5	0	0	0	0	0	0	0
7	19.04	9.40	8.04	0.07	0.00	4.1	5.44	2.16	3.0	7.5	0	0	0	0	0	0	0
8	19.99	10.44	7.46	2.04	0.12	4.1	2.72	2.16	1.5	7.5	4.5	7	0	0	0	0	0
9	18.56	10.15	8.04	0.14	0.01	3.28	5.44	2.16	3.0	7.5	4.5	0	-0.002	-1.25	0	-1	0
10	19.99	9.16	8.20	0.07	0.00	3.28	5.44	2.16	3.0	7.5	4.5	0	0	0	0	0	0
11	18.45	11.02	8.20	0	0	3.28	5.44	2.16	3.0	7.5	0	0	0	0	0	0	0
12	12.71	6.38	7.79	0.68	0.04	1.64	6.8	2.7	1.5	7.5	4.5	7	0	0	0	0	0
13	17.61	10.44	7.46	0.14	0.01	1.64	4.08	2.7	3.0	0	0	7	0	0	0	-1.5	-2.5

Appendix Table D2. Trout Lake FHSI values by category and rank.

Segment Number	FIM	Fish	Ecosystem	Modifications	FHSI Value	FHSI Rank
1	51.4	13.5	7	0	72	Very High
2	41.8	3.0	0	-5.6	39	Low
3	47.1	10.5	0	0	58	High
4	43.7	10.5	0	-2.8	51	Moderate
5	46.7	10.5	0	-0.004	57	High
6	48.2	10.5	0	0	59	High
7	48.2	10.5	0	0	59	High
8	49.0	13.5	7	0	70	Very High
9	47.8	15.0	0	-2.3	61	High
10	48.3	15.0	0	0	63	Very High
11	48.5	10.5	0	0	59	High
12	38.7	13.5	7	0	59	High
13	44.1	3.0	7	-4.0	50	Moderate

Appendix Table D3. Trout Lake FHSI Ecological Rank Categories

FHSI Ecological Rank	FHSI Value Range
Very Low	≤32
Low	33-42
Moderate	43-52
High	53-62
Very High	≥63





# **Appendix E – Foreshore Development Guidelines (FDG)**

# Foreshore Development Guide

## Trout Lake

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Prepared For:  
Living Lakes Canada

March 2023

## Suggested Citation

McPherson, S.<sup>1</sup>, J. Schleppe<sup>2</sup>, C. Lawrence<sup>3</sup> and L. Porto<sup>3</sup>. 2023. Foreshore Development Guide – Trout Lake. Prepared for Living Lakes Canada. Original template prepared by: Lotic Environmental Ltd.<sup>1</sup> and Ecoscape Environmental Consultants Ltd.<sup>2</sup>. Updated for Trout Lake by WSP Environment & Infrastructure Canada Limited<sup>3</sup>.

## Acknowledgements

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- Heather Leschied, Operations Director, Living Lakes Canada
- Ryan Cloutier, Acting Project Manager, Living Lakes Canada
- Bruce MacDonald, Project Director, Living Lakes Canada

The original template for the Foreshore Development Guide was completed in coordination with:

- Fisheries and Oceans Canada
- Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MFLNRORD) Branches include:
  - Water Stewardship
  - Habitat
  - Lands
- Okanagan Nation Alliance
- Ktunaxa Nation Council
- Regional District of East Kootenay
- Regional District of Central Kootenay
- WSP Environment & Infrastructure Canada Limited
- Foreshore Inventory and Mapping Technical Committee

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## 1. Introduction

In recent years, environmental impacts to lake shorelines (e.g., degraded habitat, recreational use conflicts, and water quality impacts) have prompted government agencies to initiate projects focused on increasing our understanding of lake shorelines to support evidence-based lake management strategies. For example, Living Lakes Canada has partnered with local, provincial and federal regulators to provide guidance on how to balance shoreline development with protection of important habitats. The guidelines presented in this document are founded on the concept that sustainable management is the shared responsibility of all stakeholders, including proponents, professionals and all levels of government.

This Foreshore Development Guide (FDG) provides development planning guidelines, aimed at protecting sensitive fish and wildlife species and their habitats identified through the previous FIM and FHSI analyses. The FDG is an initial tool used when planning for, prescribing, or reviewing riparian and shoreline alterations. Based on the environmental (species and habitat) values, the FDG identifies the levels of risk associated with shoreline alteration from various types of development activities. The risks identify the anticipated regulatory steps required to proceed with the project. The guidelines provide important information to support both the landowner in preparing foreshore work applications, and the government agencies during their review of the applications.

The FDG recommends areas to be conserved, where development may present very high or significant risk to high value species and their habitats that require shoreline areas to carry out their life-cycle. These sensitive habitats may be protected by various means, including local government inclusion in local planning processes such as Official Community Plans (OCP) and bylaws. Additionally, the FDG describes how restoration opportunities should be sought to improve habitat previously disturbed, and to potentially aid in obtaining regulatory support for new proposed projects.

The FDG methods were first developed for Windermere Lake by the East Kootenay Integrated Lake Management Partnership (EKILMP et al. 2009). These original methods used the BC Ministry of Environment (BC MoE) document - High Value Habitat Maps and Associated Protocol for Works along the Foreshore of Large Lakes within the Okanagan (BC MoE 2008), and input from the various EKILMP members including: Fisheries and Oceans Canada (DFO), BC MoE, Regional District of East Kootenay (RDEK) and Wildsight. Additional lake projects followed and expanded on the initial EKILMP FDG. Notable lake projects included: Moyie Lake (Schleppe 2009), Tie Lake (McPherson et al. 2012) and Kootenay Lake (Kootenay Lake Partnership 2019). With each iteration of these documents, the general process for developing a FDG were refined.

## 2. Important Contact Information

Proponents may use the contact information provided below when planning their proposed activities. Even with the use of this document, it is recommended that anyone who is planning work on Crown Land (such as the shoreline), first contact FrontCounterBC or retain the services of a Qualified Environmental Professional (QEP) who will contact FrontCounterBC on their behalf. Depending on the situation, FrontCounterBC will provide guidance on whether the proposed works are allowed or not allowed under the respective legislation. Similarly, works on private lands must also consider local government's requirements (e.g., permitting or notifications).

**FrontCounterBC** - *FrontCounterBC* should be contacted for any works planned on Crown Land, including work along the lake shoreline.

**Phone:** 1-877-855-3222

**Email:** [FrontCounterBC@gov.bc.ca](mailto:FrontCounterBC@gov.bc.ca)

**Regional District** – The applicable regional district should be contacted for any works planned on private land within the region’s jurisdiction.

Columbia Shuswap Regional District

**Phone:** 250- 832-8194 (Salmon Arm)

**Email:** [info@csrd.bc.ca](mailto:info@csrd.bc.ca)

Regional District of Central Kootenay

**Phone:** 250-352-6665 (Nelson)

**Email:** [info@rdck.bc.ca](mailto:info@rdck.bc.ca)

**Indigenous Peoples** – The following should be contacted for any works that require Indigenous Peoples engagement.

**Syilx Okanagan Nation Alliance**

**Phone:** 250-707-0095

**Website:** <https://www.syilx.org/>

**Shuswap Band**

**Phone:** 250-341-3678

**Email:** [reception@shuswapband.ca](mailto:reception@shuswapband.ca)

**Ktunaxa Nation Council**

**Phone:** 250-489-2464

**Email:** [news@ktunaxa.org](mailto:news@ktunaxa.org)

## 2.1. First Nations Traditional Ecological Knowledge (TEK)

The Trout Lake FIMP program was developed to include the direct involvement of Syilx Natural Resources (SNR) and Okanagan Nation Alliance (ONA) members during the FIM field survey as well as during development and review of the FHSI criteria, the FDG document and overall FIMP report. As a result, TEK was incorporated directly into the assessment and inventory of shoreline variables, habitats and disturbance/modification observations.

### 3. FDG Process Overview

The FDG provides a step-wise process to help direct applicants through the initial planning stages for their proposed shoreline development, project or activity (Figure 1).

**Step 1:** Identify the fish and wildlife habitat values where the project is situated using the FDG map. The FDG map was prepared using the FHSI outputs, and depicts: a) values by segment, with different colours representing high to low values; and b) where Zones of Sensitivity (ZOS) may be present. ZOS are areas with exceptionally high value, which should if at all possible, be conserved according to local, provincial or federal plans or through private land agreements.

**Step 2:** Review the general recommendations for the applicable colour zone and ZOS to understand associated habitat sensitivity of the area, and risk anthropogenic disturbances pose.

**Step 3:** Use the Activity Risk Matrix (ARM) to identify the level of risk of the proposed project on the habitat. The risk is indicative of the acceptability of a project to regulators.

**Step 4:** Determine the necessary regulatory approvals/permits/authorizations (collectively 'approvals') that must be obtained. This final step is project dependent and depends on many factors and is subject to change based on government policy. Hence, only an overview is provided here, along with logistical considerations.

*For areas of greater risk, a very high level of detail is needed in order to submit an application that can be considered for regulatory review. In these cases, it should not be expected that because information is submitted that approvals are forthcoming.*

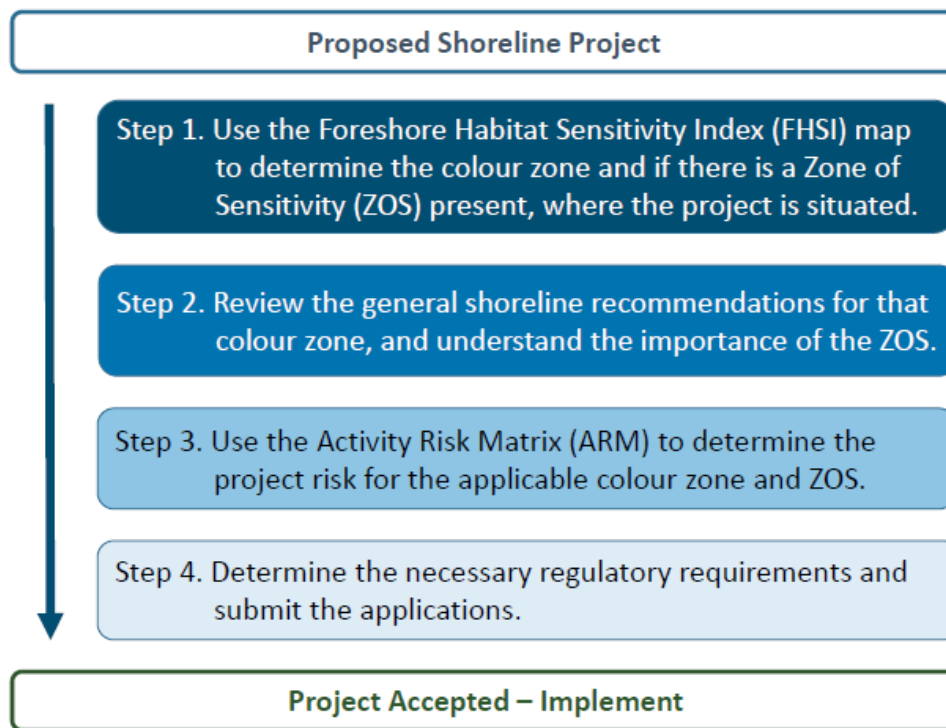


Figure 1. Four steps when planning to develop or modify foreshore habitat.

**3.1. Interpret the FDG Map**

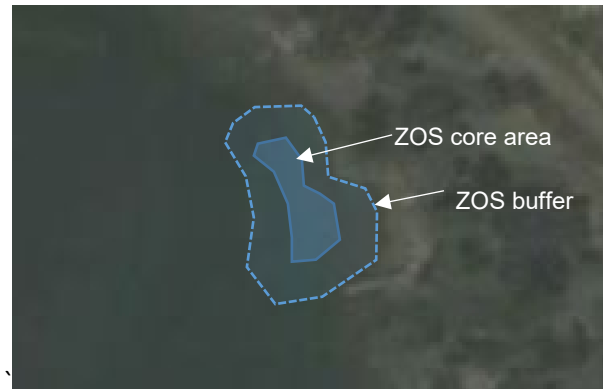
The key results of the FIM and FHSI are presented in tables and maps in WSP (2023). When planning foreshore development, the FDG map is the primary reference tool because it synthesizes the pertinent fish and wildlife information into an easy to understand map (Appendix A). In the FDG map, the FHSI ecological rankings for each segment are depicted as one of five colours zones, ranging from very high to very low value (Table 1).

**Table 1. FHSI ecological rank and ZOS colour scheme applied to the FDG map.**

Value type	Rank/Sensitivity	Map Colour
Ecological Rank	Very High	Red
	High	Orange
	Moderate	Yellow
	Low & Very Low	Grey
Zones of Sensitivity	Fisheries	Blue
	Wildlife	Brown
	Herptiles	Mauve
	Waterfowl	Teal
	Ecosystem/Habitat Feature	Green
	Rare occurrences	Purple
	Vegetation	Olive

The FDG map also depicts each ZOS in a specific colour scheme. Each ZOS is presented as either a polygon, line, or point, and should include an outer buffer. This buffer accounts for unknowns of the ZOS full extent, and protects the core ZOS from potential impacts from adjacent activities (Figure 2). Details on each ZOS, including how each was defined, and how the buffers were determined are presented in Section 5.2.





**Figure 2. Zone of Sensitivity with an appropriate buffer.**

**4. Step 1. Locate Project Relative to Shoreline Colour Zones and Zones of Sensitivity**

Use the FDG map to identify the values present along or within their proposed development area. Together, the FHSI colour zone and the ZOS mapped features provide a science-based tool to guide development planning. The fish and wildlife value/risk and subsequent regulatory review process are highest in red zones and areas with ZOS. Since these areas have the highest natural value and are at greatest risk to shoreline alteration, they require the highest level of on-going protection. The values/risk in the grey zones are lowest. Since there is already likely significant impact from development in grey zones, future development is less likely to cause negative impacts. The specific recommendations for each colour zone and ZOS are provided in the next section.

**5. Step 2 – Review Colour Zone, ZOS and Conservation Recommendations**

For this step, review the recommendations for the respective colour zone and ZOS that aligns with the proposed development. The summary tables below provide detail on the values present and identify how to potentially minimize impacts. Also, refer to the conservation recommendations to see how your project may align with an area that has been identified as a candidate for protection. Proposed development should adhere to these recommendations to reduce impacts on sensitive fish and wildlife values. Opportunities for restoration or re-development should be explored in any zone where work is proposed.

**5.1. Shoreline Colour Zone Recommendations**

<b>Red Shoreline</b>	
<b>Defined by:</b>	Very High FHSI ecological rank.
<b>FHSI summary:</b>	Red zones account for 3.4% of the total shoreline length of Trout Lake.
<b>Sensitivity Summary:</b>	Red shoreline areas have been identified as essential for the long-term maintenance of fish and/or wildlife values through the FHSI Analysis. These areas are essential for fish and/or wildlife populations. These shoreline areas are stream confluences in natural condition with no/very little shoreline disturbance observed. These shoreline areas contain one or more mapped ZOS. They also provide important fish migration and staging habitat, juvenile Burbot rearing habitat and/or riparian connectivity corridors.
<b>Recommendations:</b>	Due to their high value (sensitive communities present), Red shoreline areas are recommended to have limited development to promote conservation use (Section 5.3). Low impact water access recreation and traditional Indigenous Peoples uses are examples of acceptable activities in these areas, while permanent structures or alteration of habitats are not. Invasive aquatic plant removal is often acceptable, provided there is an approved aquatic plant removal program, including trained personnel, and appropriate permitting in place. Habitat restoration may be appropriate in these areas, where applicable. For example, appropriate native shrub and tree species could be planted to restore riparian vegetation that has been removed from the foreshore.

<b>Orange Shoreline</b>	
<b>Defined by:</b>	High FHSI ecological rank.
<b>FHSI summary:</b>	Orange zones account for 93.7% of the total shoreline length of Trout Lake.
<b>Sensitivity Summary:</b>	Orange shoreline segments have been identified as high value habitat areas for fish and/or wildlife. These areas are comprised of relatively natural undisturbed habitats that provide important fish and wildlife migration corridors and often have intact riparian areas and other high value shoreline habitat features. These areas are sensitive to development, continue to provide important habitat functions, but may be at risk from adjacent development pressures.

### Orange Shoreline

**Recommendations:** Proponents should consider moving high risk activities to other areas, if possible, or pursuing activities that have lower associated risks. The lake environment can benefit from having orange shoreline areas set aside to contribute to the overall lake conservation area. The conservation options identified in Section 5.3 would likely apply through most of the orange areas, benefitting the lake. Restoration opportunities potentially exist in these areas. For example, areas where foreshore vegetation has been removed and substrates modified to facilitate recreation and residential uses could be replanted to restore riparian habitat and prevent further modification.

### Yellow Shoreline

**Defined by:** Moderate FHSI ecological rank.

**Lake summary:** Yellow zones account for 1.4% of the total shoreline length of Trout Lake.

**Sensitivity summary:** These areas have experienced a moderate amount of development disturbance and pressure or have shoreline characteristics that provide limited habitat for fish and wildlife. Foreshore modifications associated with residential development including docks, groynes, retaining walls, boat launches, mooring buoys and a marina are observed in some segments with Moderate FHSI ecological rank. Although some of these areas have been impacted to some degree, they still are largely intact and their habitat values remain important.

**Recommendations:** Development along Yellow shoreline areas would likely result in less of an impact, than along Red or Orange areas. However, activities should incorporate protection of habitat features that remain, be well above the high water mark, and and/or be situated outside of the riparian area. Restoration may be an option in some areas that have experienced past developments. Development may proceed for low risk activities provided a Best Management Practice (BMP) or Regional Operating Statement (ROS) is available and followed (Appendix B). High risk activities without a BMP or ROS will require an environmental assessment from a QEP. Local Official Community Plans (e.g., CSRD Electoral Area "B" OCP and RDCK Electoral Area 'D' – North Kootenay Lake Land Use Bylaw 2435) also provide direction and bylaws for development adjacent to the foreshore.

<b>Grey Shoreline</b>	
<b>Defined by:</b>	Low and Very Low FHSI Ecological Rank.
<b>Lake summary:</b>	Grey zones account for 1.5% of the total shoreline length of Trout Lake.
<b>Sensitivity summary:</b>	Grey shorelines have a lower ecological ranking. Shorelines have been disturbed by residential development. However, they still may contain valuable habitats requiring some protection, such as aquatic or riparian vegetation. Their importance as corridors to neighboring high value areas should also be considered during development.
<b>Recommendations:</b>	Human development has been concentrated in these areas and has resulted in disturbances to the natural fish and wildlife habitat. Important habitats do exist in degraded and developed areas, and at least minimal standards are required to protect fish and wildlife habitat in the grey zone areas. 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. Re-development will also be considered. Proposals should incorporate fish and wildlife habitat restoration or improvement features, where feasible and practicable. For example, a retaining wall redevelopment may be moved back from the HWM and/or incorporate re-vegetation or other fish and wildlife features in the design. Obtain advice from a QEP for habitat restoration techniques.

**5.2. Zones of Sensitivity Recommendations**

A total of two types of ZOS were identified through the FHSI analysis. The ZOS with their corresponding buffers are identified on the FDG map. For this step, use the map and identify if the proposed development aligns with any of the mapped ZOS (use outer edge of buffer). Then refer to the corresponding ZOS summary table(s) below for general information on the values present and recommendations to reduce impacts.

<b>Fisheries – Tributary Mouth</b>	
<b>Lake summary:</b>	Tributary mouth ZOS are located at the confluence of Trout Lake and inflow and outflow tributaries. Tributary mouth areas were mapped as polygons that capture the confluence of the two waterbodies and include both shallow areas used for migration and deeper areas used for staging. This was done by outlining a 100 m radius semicircle polygon at the confluence of each tributary identified in the BC Freshwater Atlas and Trout Lake. A 20 m buffer was applied to the ZOS around its perimeter. Note that other tributary mouth locations, though not identified as ZOS at this time, may still provide important fish habitat and tributary mouths

### Fisheries – Tributary Mouth

identified as ZOS can be updated if additional information becomes available.

**Sensitivity summary:** Tributary mouths provide important habitat for fish rearing, migration and staging. Tributaries to Trout Lake provide spawning, egg incubation and juvenile rearing habitat for salmonids and can also provide a cool water refuge during summer when there are periods of higher water temperatures. In addition to fisheries values, water quality parameters such as temperature, dissolved oxygen, turbidity and nutrients of tributary inflows play an important role in the overall water quality of lake ecosystems.

**Recommendations:** These sensitive habitats are to be protected, with no permanent developments recommended both within and adjacent to the mapped polygon areas. A buffer of 20 m is recommended.

### Vegetation – Aquatic Vegetation

**Lake summary:** Submergent and emergent aquatic vegetation on Trout Lake was mapped during the 2022 FIM and was observed along 1.5% of the foreshore. Note that wetlands were not included as a ZOS at this time because wetlands were not observed within the high-water mark of Trout Lake. This highlights the important role aquatic vegetation plays in the lake in the absence of wetlands.

**Sensitivity summary:** Aquatic vegetation contributes to the overall health of an ecosystem by providing an important source of nutrients, oxygenation and habitat for aquatic, terrestrial and avian species. Aquatic vegetation is an important component of wetlands, which provide habitat, flood control, water filtration and food resources.

**Recommendations:** These sensitive habitats are to be protected, with no permanent developments recommended both within and adjacent to the mapped polygon areas. A buffer of 20 m is recommended.

### 5.3. Shoreline Conservation Recommendations

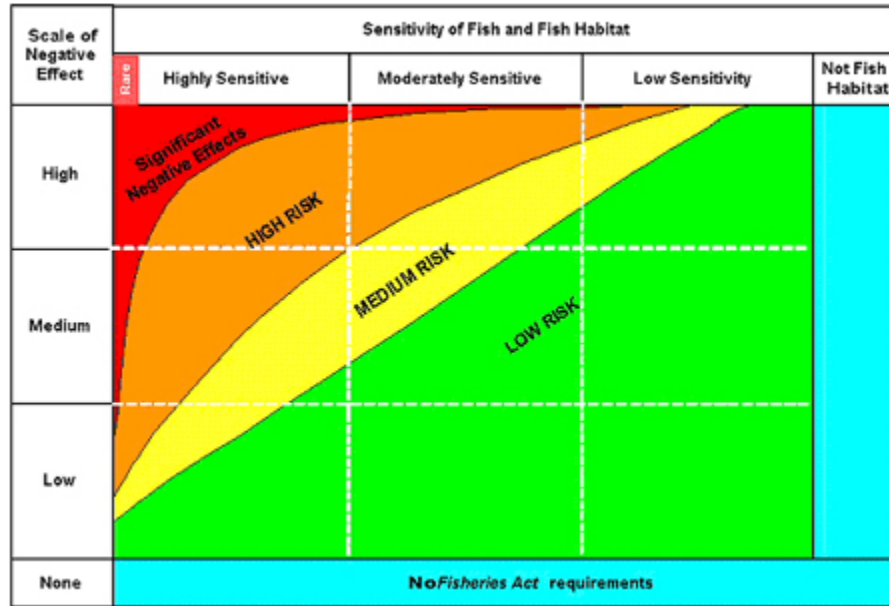
It is recommended that the following very high and high ecological value locations identified during the Trout Lake FIMP be considered for designation as conservation zones:

- Wilkie Creek confluence.
- Lardeau Creek confluence.
- Lardeau River outlet and adjacent riparian habitat.
- Asher Creek confluence and alluvial fan.

Protection of these areas could include: a) establishment of protected areas (potentially through any level of government); b) Section 16 Land Act Reserves; c) regional or municipal official community plans (OCPs) which designate these areas as development permit areas of limited development potential (e.g., not within an urban growth boundary as an example); or, d) through private land conservation agreements, such as tenure covenants or direct land sales to land conservancy organizations such as the Land Conservancy of Canada. Current OCPs such as the CSRD Electoral Area “B” OCP and RDCK Electoral Area ‘D’ – North Kootenay Lake Land Use Bylaw 2435 can be updated to include the results of the 2022 Trout Lake FIMP and FDG to identify shoreline areas with Very High (Red) and High (Orange) ecological ranks as well as ZOS as sensitive habitats. These OCPs already include Development Permit Areas with 100 m and 30 m setbacks, respectively, measured from the high-water mark of watercourses.

### 6. Step 3. Refer to the Activity Risk Matrix (ARM) to Determine Project Risk.

This step involves using the ARM to determine what the predicted level of risk is for your specific proposed activity, given the shoreline colour zone and ZOS present. It is a well understood concept that the potential for negative environmental impacts are deemed greatest in areas where values and risk are highest (Figure 3; DFO 2006). In the ARM, each colour zone and activity combination has been rated as having a risk of either: Very High (VH), High (H), Moderate (M), or Low (L) (Appendix B). These risk ratings reflect the potential impacts on fish and wildlife, with a Very High risk posing the greatest potential concern, and the Low Risk a lower level of concern. The ARM also identifies that if a ZOS is present, the risk also increases.



**Figure 3. How the potential for negative effects relates to sensitivity and risk (DFO 2006).**

### 6.1. Using the ARM

Clarifications for using the ARM are listed below:

1. If your activity is not listed, assume High Risk and contact FrontCounterBC for advice.
2. Where several activities with differing risk rating are proposed for a single Project, the cumulative risk may increase. Consequently, it is recommended to seek the advice of a QEP to determine if the higher of the two risk ratings effectively captures the cumulative risk, or if the highest risk rating should be used [e.g., Very High]).
3. The ARM distinguishes between several activities above and below the present natural boundary (NB). The NB is the legal term BC Crown Land Branch uses to define the Crown Land property boundary along the shoreline. High Water Mark (HWM) is a similar standard term used by DFO when considering impacts to fish values. The NB and HWM are often located in the same location, but this can vary. Only a registered BC Legal Land Surveyor may determine the NB.
4. In some instances, the project may not seem to have a high degree of risk. However, the ARM also accounts for other accompanying impacts likely to occur once the modification is in place. For instance, once a dock is in place, other likely associated impacts are: prop wash, maintenance, and boat traffic.

### 6.2. General Mitigation Hierarchy

The general principles of shoreline development are to design in such a way that there is “No Net Loss” in the quantity or quality of existing habitat. These principles are supported by the

federal and provincial policy<sup>1,2</sup>). In general, these principles are achieved through application of the following mitigation options: (1) avoidance of environmental impacts and associated components; (2) minimization of unavoidable impacts on environmental values and associated components; (3) restore on site environmental values and associated components, and, (4) offset impacts to environmental values of components for residual impacts that cannot be minimized.

### 6.3. Very High and High Risk Activities

Most in-stream works in Red and Orange shoreline zone areas are considered Very High and High Risk activities. All activities in a ZOS are considered Very High Risk. Development in these areas has the potential to cause long-term or irreparable disturbance to the highly sensitive/unique values present. The Very High Risk activities in particular, are known to have significant challenges related to providing adequate mitigation to address the loss of fish and/or wildlife habitat values. For example, the dredging activity is considered Very High Risk in all colour zones, since it results in a major disturbance to the substrate, aquatic vegetation that may be present, and has the potential for direct impacts on aquatic life, and processes (wave climate and sediment transport). There may also be indirect impacts, such as on water quality, if for example the dredge is to support a marina.

If your activity is identified as being Very High or High Risk, determine if you can modify the activity or location to reduce the risk. This may involve moving the project to a colour zone with less sensitive habitat, or selecting a lower risk activity (Figure 4). If reducing the risk is not possible by re-designing or re-locating the project, there is a high likelihood that a detailed environmental assessment would be required to support the project application. In these areas, the high risks may trigger a request for a Harmful Alteration, Disruption or Destruction of Fish Habitat (HADD) authorization under the federal *Fisheries Act*. If residual effects cannot be mitigated, compensation may be required. Acceptable mitigation and compensation measures would likely be very costly to implement. It is highly advised that a QEP be retained to assist with the project planning in all high and very high risk areas. A QEP should be knowledgeable about both the permitting and application process for proposed activities and will be able to provide guidance on potential environmental risks and impacts. A QEP would likely conduct an environmental assessment within the project area, confirm risks, and make recommendations to reduce impacts to aid in the regulatory permitting process. Applications for these types of developments may not be supported by regulators and may not be approved, even if extensive and detailed information is provided as part of a permitting process.

As an example, the type of information that might be required to support an application for a proposed project located in a sensitive area could include, a detailed erosion control plan that might require a BC Legal Land Surveyor to determine the location of NB and property boundaries, a QEP to provide recommendations to mitigate construction works as part of an environmental assessment, or an engineer may be needed to provide a detailed design for submission of permits under regulatory processes.

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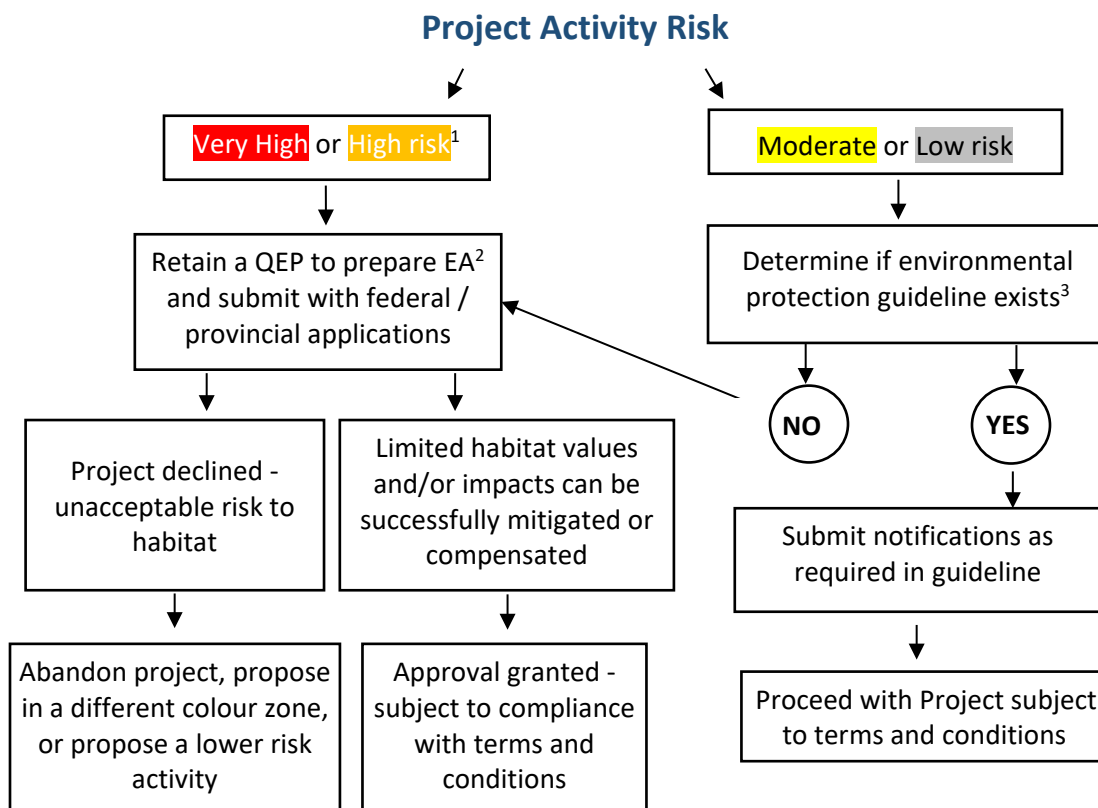
<sup>1</sup> DFO Projects Near Water website: <https://dfo-mpo.gc.ca/pnw-ppe/index-eng.html>

<sup>2</sup> BC Environmental Mitigation Policy website:

<https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/environmental-guidance-and-policy/environmental-mitigation-policy>.



**Figure 4. Typical Environmental Regulatory Review Decision-Making Process**



<sup>1</sup> Very High or High Risk activities have the potential to raise significant concerns. These activities have great challenges related to providing adequate mitigation or compensation to address the loss of fish and/or wildlife habitat values, and could be costly to implement (may require compensation).

<sup>2</sup> Environmental Assessment

<sup>3</sup>BMP – Best Management Practice; ROS –Regional Operating Statement

#### 6.4. Moderate and Low Risk Activities

With appropriate design and planning, Moderate and Low Risk activities could be incorporated along the foreshore with fewer impacts on fish and wildlife habitat values. Where available, these activities should follow applicable Best Management Practices (BMP), Standards and Codes of Practice (collectively BMP; see next section). Where BMPs are not available, or a deviation from the BMP is proposed, a QEP should be retained to complete the application. The application will be reviewed by the applicable agencies.

### 7. Step 4 – Determine Regulatory Requirements and Submit Applications

The final step when planning a foreshore development project is to determine the regulatory requirements necessary for the project to proceed and to submit those applications. Regulatory applications are to be made to the federal, provincial, or local governments for necessary permits, authorizations, notifications, and reviews etc. Essentially any shoreline development will require the preparation of at least one regulatory application. The regulatory application’s acceptance will be required for the project to proceed legitimately. Commencing work without approval may be considered unlawful and result in infractions such as trespass. Work that has not been approved may also be subject to enforcement actions by the

respective agencies, and may require additional effort to mitigate any undesired environmental impacts that occurred. Alternatively, the project proponent could be required to remove all infrastructure and restore the area.

Typical regulatory requirements for each activity listed in the ARM are provided in Appendix C. As well, Provincial BMPs have been listed in Appendix D<sup>3</sup>. Although summarized here, the requirements at the time of planning the project will need to be confirmed, as regulatory changes might occur. Also, the DFO website should be reviewed for applicable Standards and Codes of Practice that may help guide planning and development<sup>4</sup>. Contact FrontCounterBC to determine which provincial permits, approvals or authorizations you need, or retain a QEP for guidance.

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*This document does not provide a full summary of all potential requirements for a particular project. Proponents must ensure that they have adequately considered, consulted, and determined the necessary approvals required for a project to proceed prior to undertaking any works.*

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### 7.1. Other Considerations to Facilitate Project Approvals

This FDG addresses both existing and proposed works. Sometimes there are concerns with the installation of past structures, which may include, if the structures:

- Resulted in extensive impacts along the shoreline;
- Were installed without appropriate permits or approvals in place; and/or,
- Were not compliant with standard BMPs.

If any of the above concerns are present on the property where work is planned, then follow these steps, so that new applications, or applications for maintenance or expansion on existing projects, can be reviewed more effectively:

1. Determine if the existing works are on private land or Crown Land.
2. Determine if they are located in an Application Only Area/Reserve area established under the *Land Act*.
3. Determine if the works were authorized by the appropriate authority. If yes, skip to step 5.
4. Seek approval from the appropriate authority. Approval may or may not be granted depending on the situation. Previous projects installed without appropriate permits or approvals may be required to be removed as part of an application process.
5. Plan and update existing works to current Best Management Practices.
6. Include other mitigation practices, such as landscape restoration (planting native riparian vegetation), substrate improvement (removing or mitigating existing groynes), and other habitat improvements.

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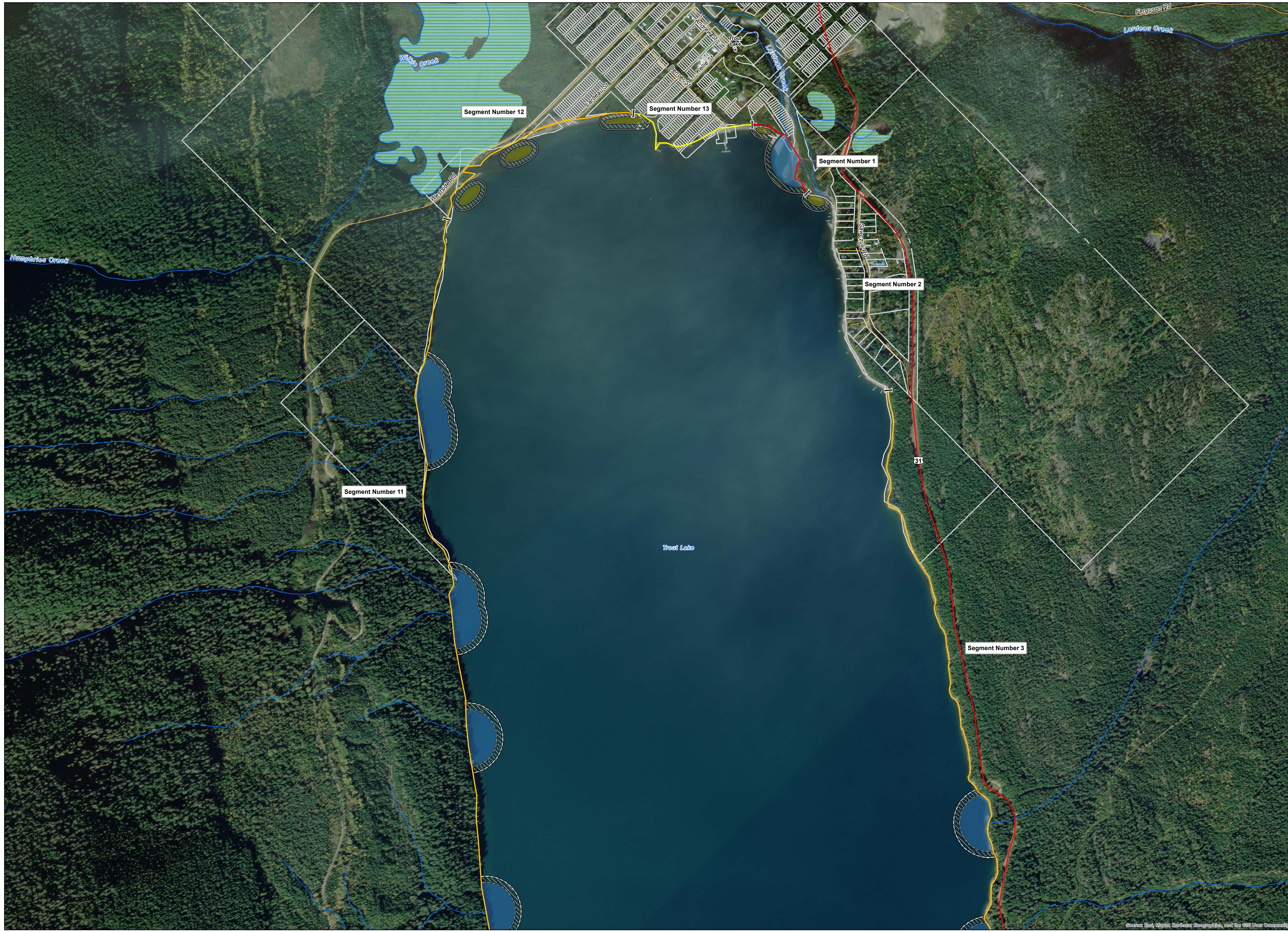
<sup>3</sup> A current list of provincial BMP's are available at:  
<https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/best-management-practices>

<sup>4</sup> DFO Project Near Water website: <https://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html>

## 8. References

- BC Ministry of Environment (BC MOE). 2008. High value habitat maps and Associated protocol for works along the foreshore of large lakes within the Okanagan, Region 8. Government memorandum.
- BC MOE. 2019. *Natural Resource Best Management Practices*. Retrieved from <https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/best-management-practices>
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- East Kootenay Integrated Lake Management Partnership (EKILMP), McPherson S. and Hlushak D. 2009. Windermere Lake Shoreline Management Guidelines for Fish and Wildlife Habitats. Combined agency and consultant (Interior Reforestation Co. Ltd) report.
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- McPherson<sup>1</sup> S.M., D.G. Paton<sup>2</sup> and M.D. Robinson<sup>1</sup>. 2012. Tie Lake Shoreline Management Guidelines of Fish and Wildlife Habitats. Consultant report prepared for Ministry of Forests Lands and Natural Resource Operations, Nelson BC. Prepared by Lotic Environmental Ltd<sup>1</sup>, Anatum Ecological Consulting Ltd<sup>2</sup>.
- Schleppe, J. 2009. Moyie Lake Foreshore Inventory and Mapping. Ecoscape Environmental Consultants Ltd. Prepared for: East Kootenay Integrated Lake Management Partnership.
- Schleppe, J.<sup>1</sup>, S. McPherson<sup>2</sup>, L. Porto<sup>3</sup>, and B. Mason<sup>4</sup>. 2020. Foreshore Integrated Management Plan Methods. Prepared for Living Lakes Canada. Prepared by: Ecoscape Environmental Consultants Ltd.<sup>1</sup>, Lotic Environmental Ltd.<sup>2</sup>, Wood Environment and Infrastructure Ltd.<sup>3</sup>, and BC Community Mapping Network<sup>4</sup>.
- WSP Environment & Infrastructure Canada Limited. 2023. Trout Lake Foreshore Integrated Management Planning – 2022. Final Report Prepared for Living Lakes Canada, Nelson, BC. 35 pp. + 5 App.

## **Appendix A. Foreshore Guidance Document Map**

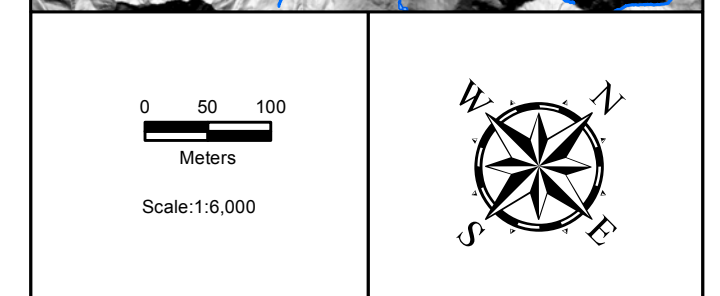
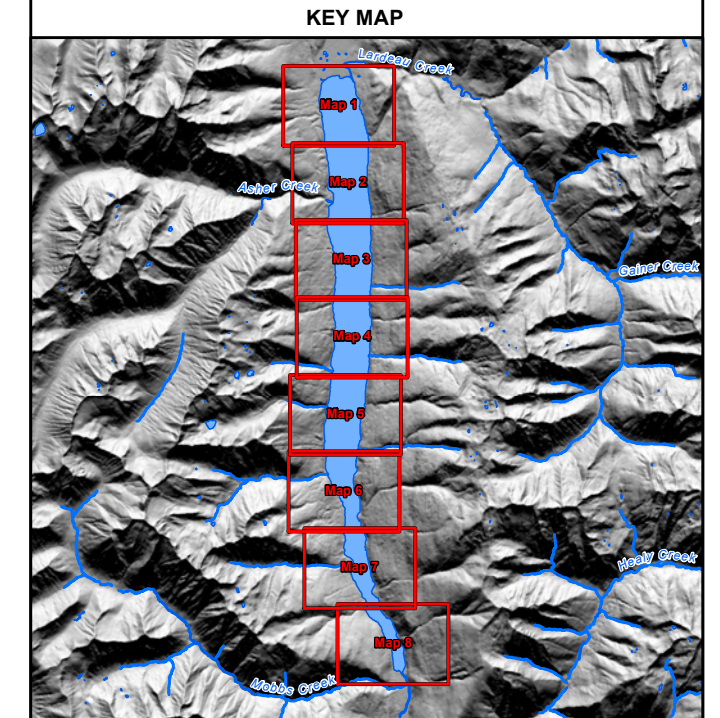


CLIENT:  
LivingLakes

PROJECT:  
Trout Lake FIMP

TITLE:  
Trout Lake Foreshore Development Guidelines (FDG) Mapping

- LEGEND:
- I Segment Break
  - FHSI Ecological Rank**
    - Very High
    - High
    - Moderate
    - Low and Very Low
  - Zones of Sensitivity**
    - Aquatic Vegetation – Emergent
    - Fisheries - Tributary Mouth
    - Zones of Sensitivity Buffer
  - Base Data**
    - Highway
    - Local Road
    - Watercourse
    - Wetland
    - Regional District Boundary
    - Provincial Parks, Eco Reserves and Protected Areas - All
    - Parcel Boundary




REFERENCE:

DataBC Data Distribution Service  
Open Government License (<http://www.data.gov.bc.ca/>)

Geographic/Geobase  
Open Government License - Canada (<http://data.gc.ca/eng/about-datagca>)

NOTE:

CAUTION:  
DO NOT USE THIS MAP FOR NAVIGATIONAL PURPOSES  
This map may not reflect current conditions.  
Uncharted hazards may exist.



<b>WSP</b>	
Suite 601E, 601 Front St. Nelson, BC V1L 4B6	
PROJECT NO: VE52823.2022A	PAGE: 1 of 8
COORDINATE SYSTEM: NAD 1983 UTM Zone 11N	DATE: February, 2023
ANALYST: BB	CHK: CL
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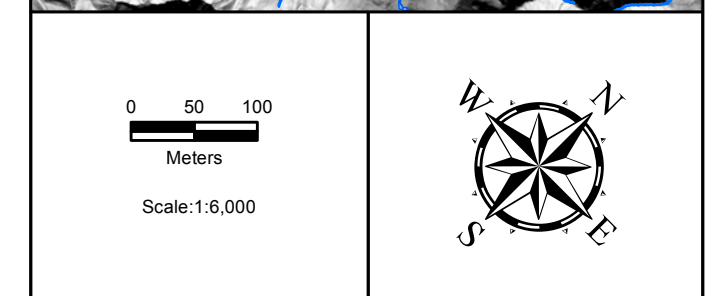
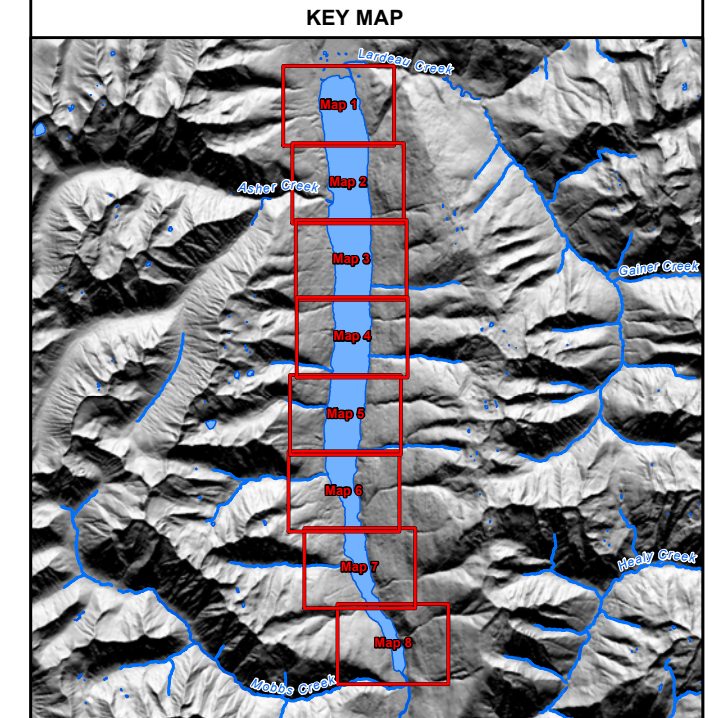


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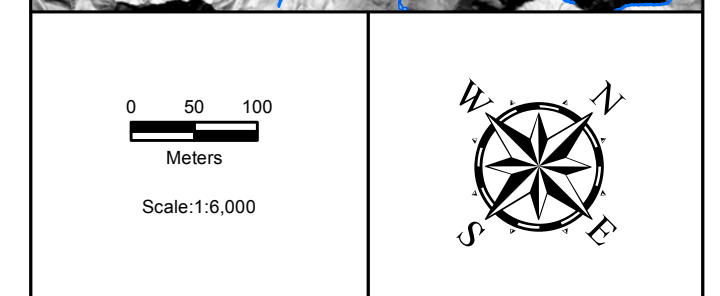
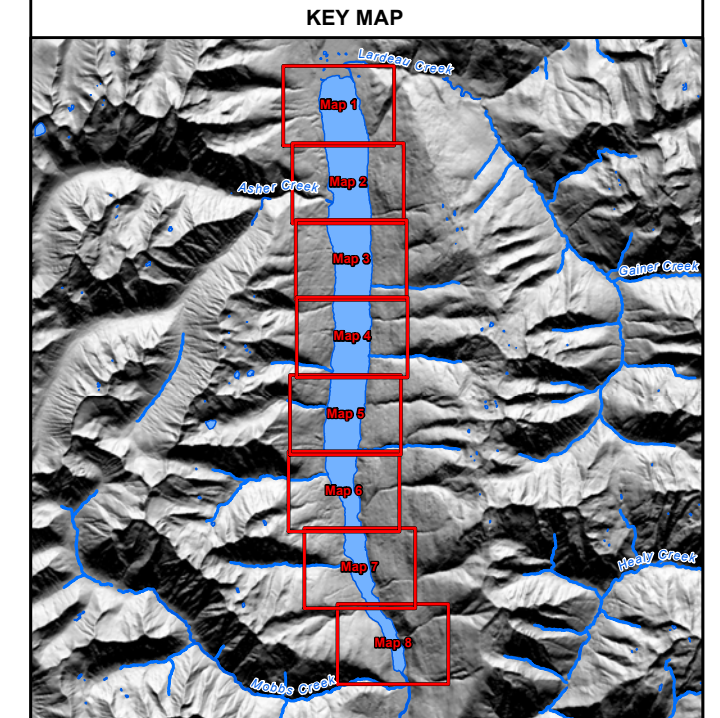


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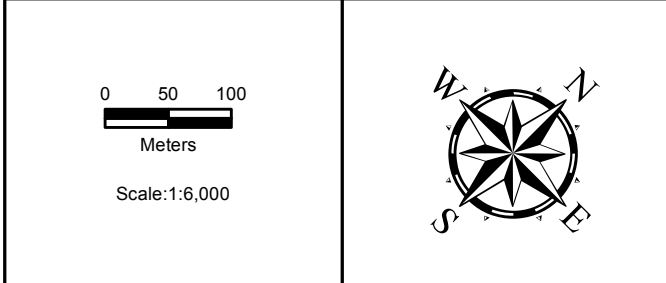
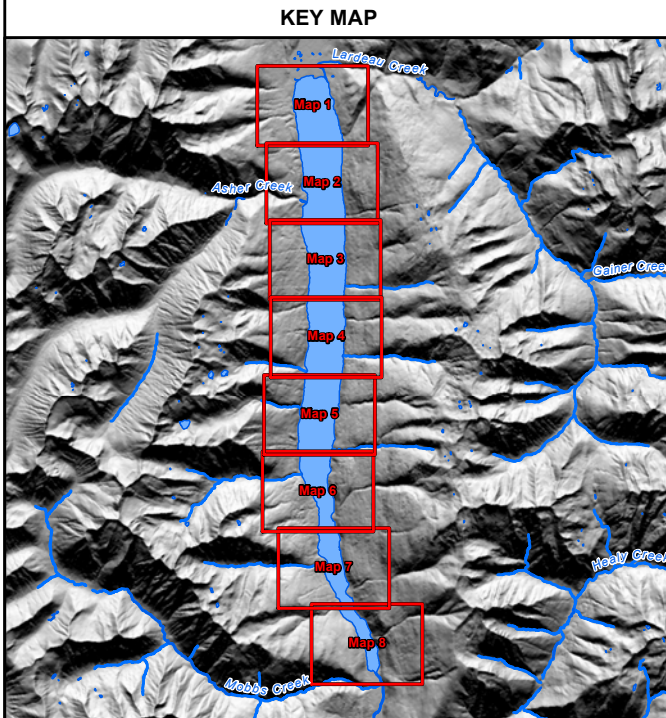


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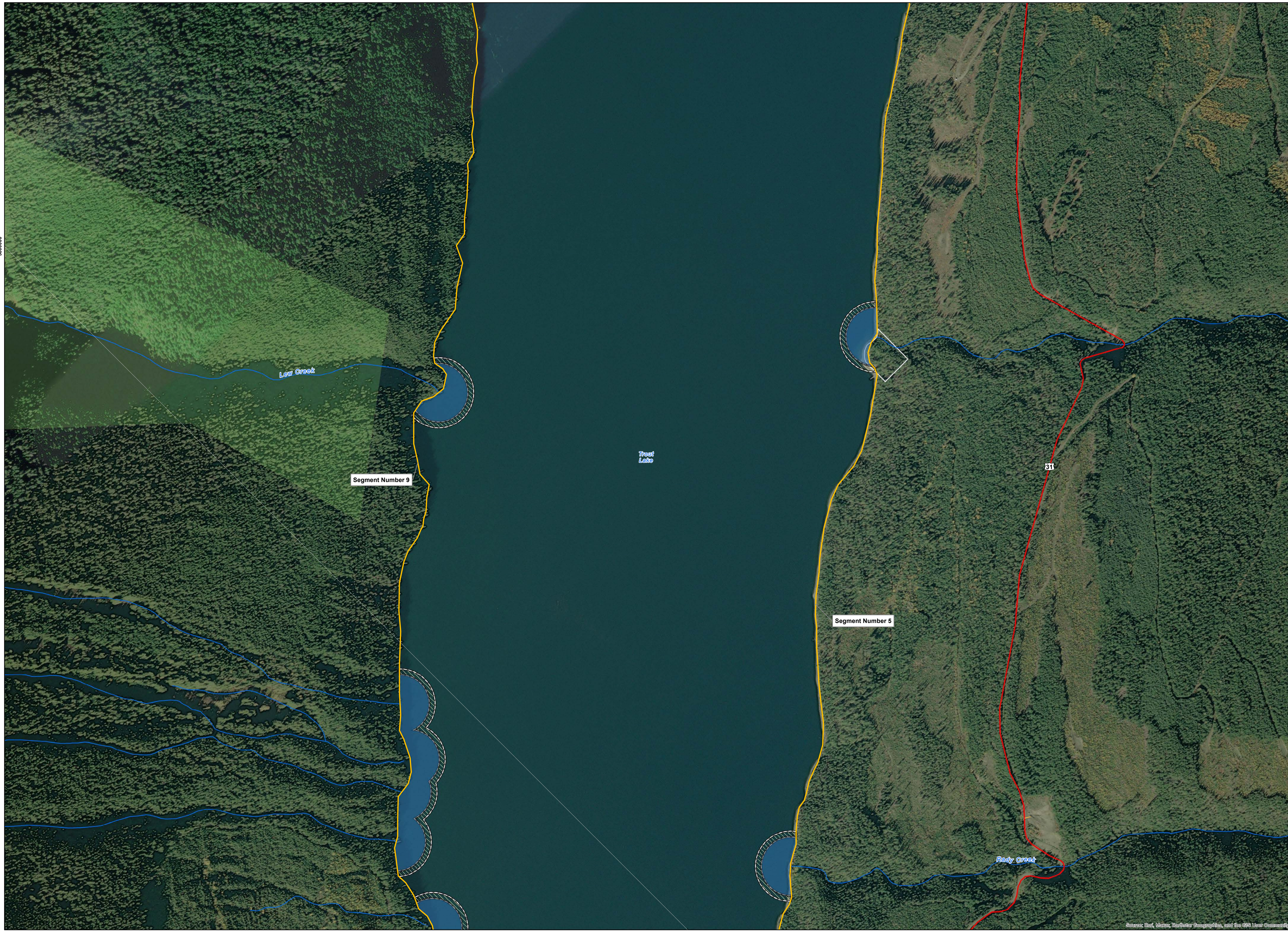
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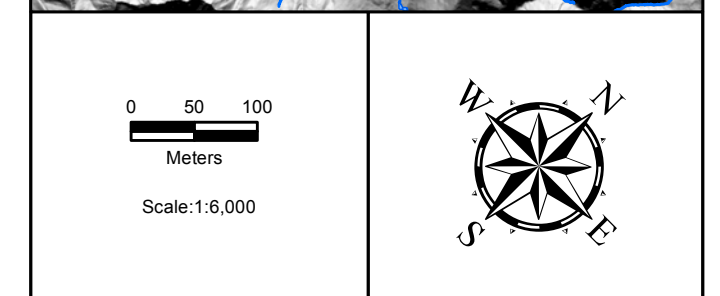
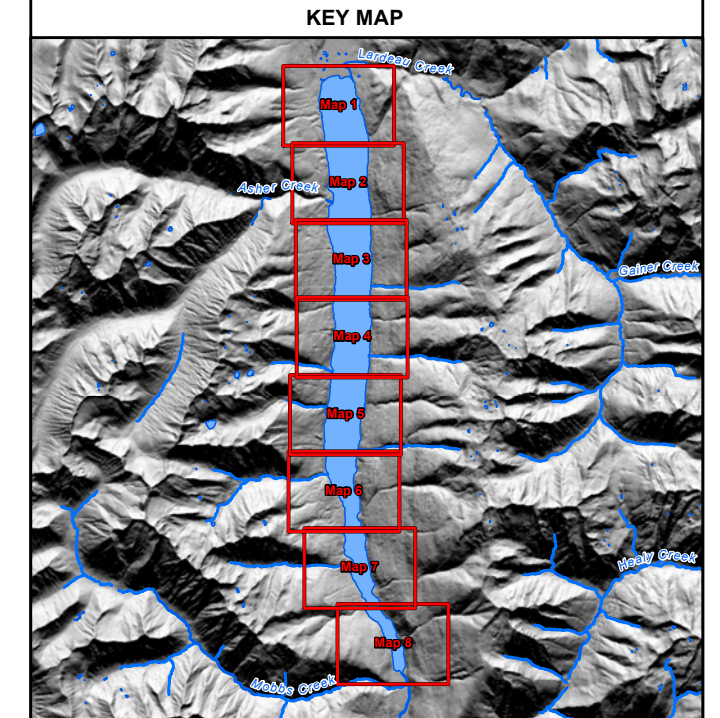


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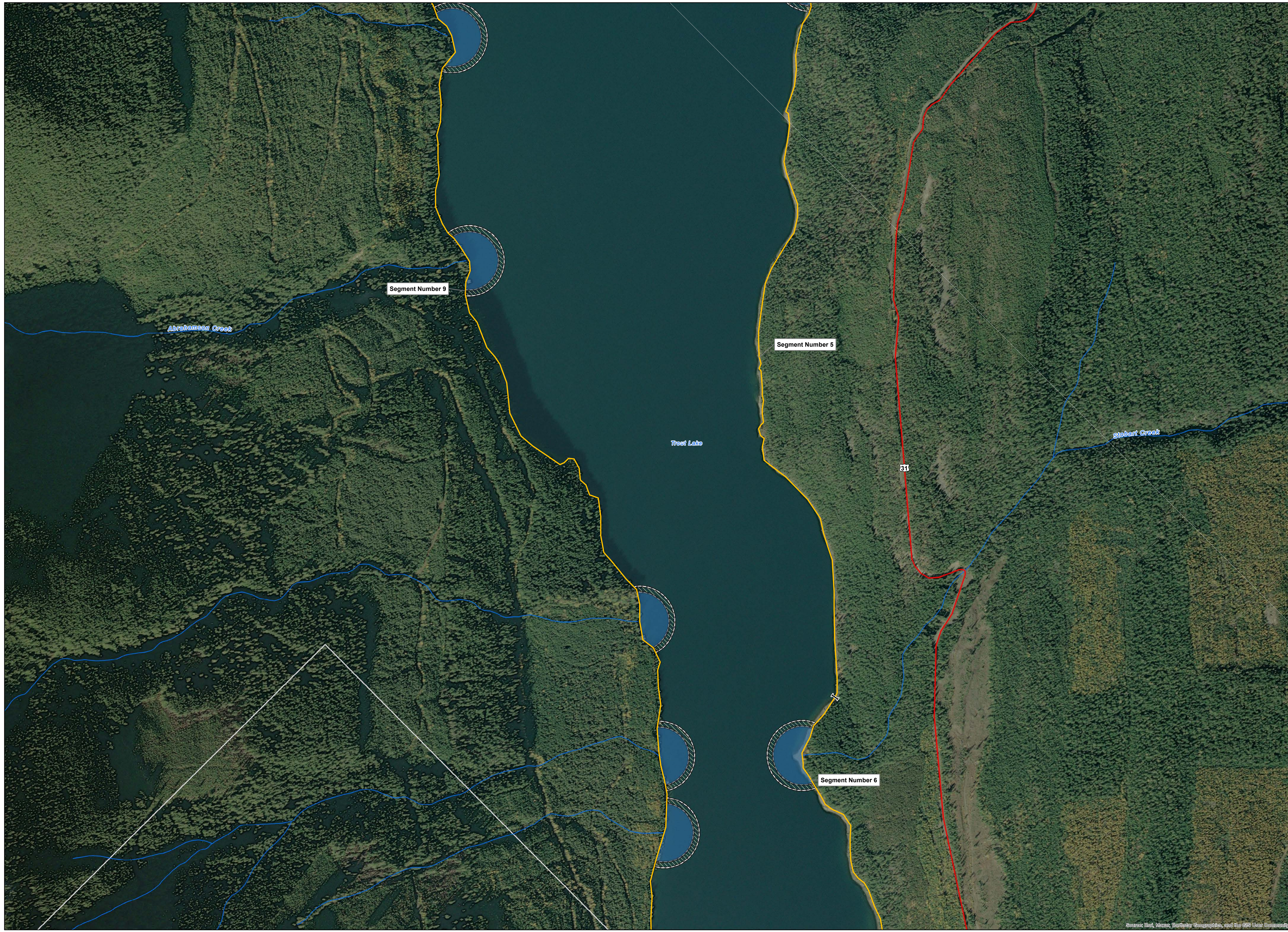
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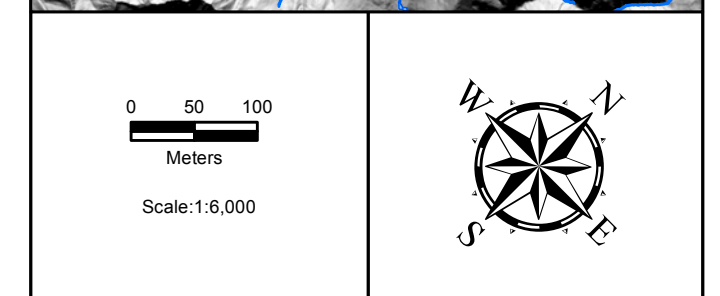
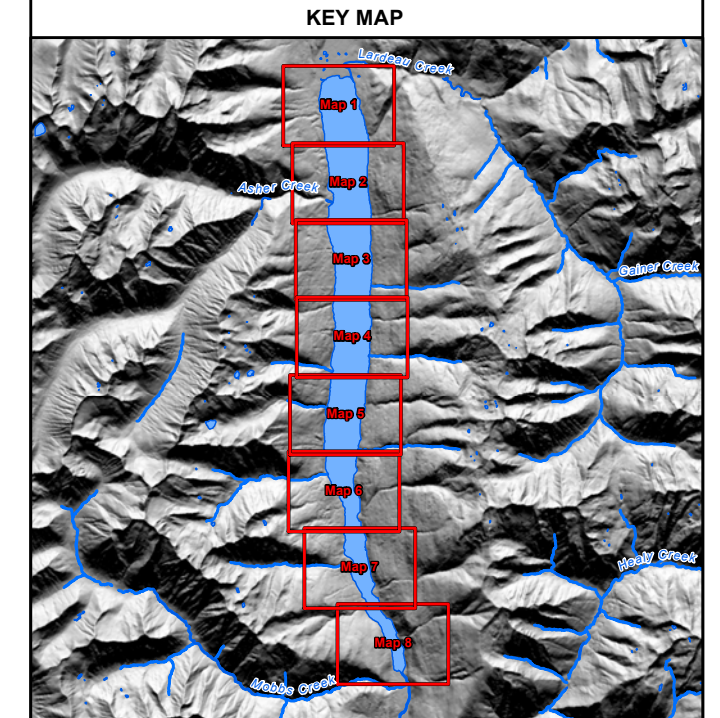


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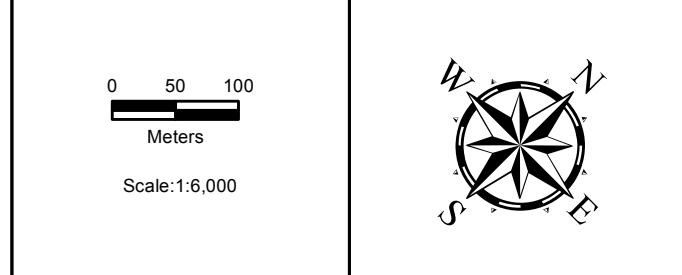
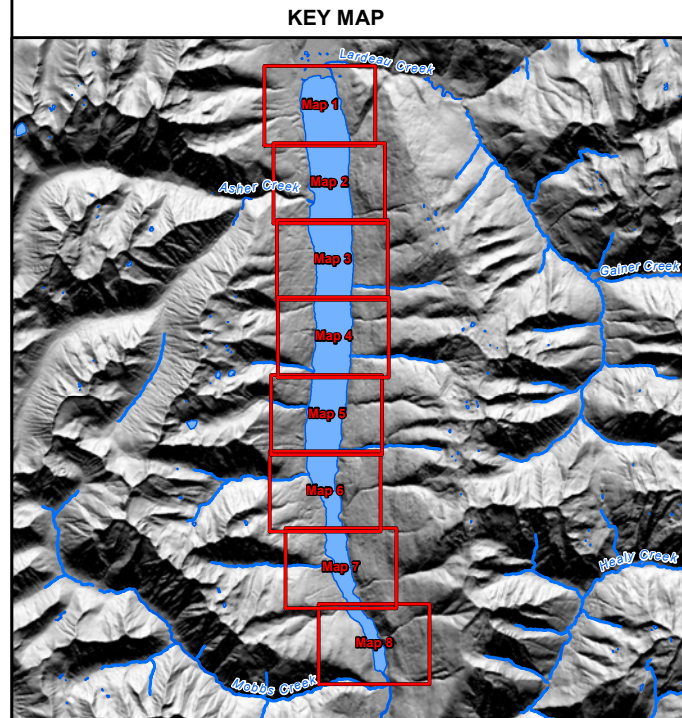


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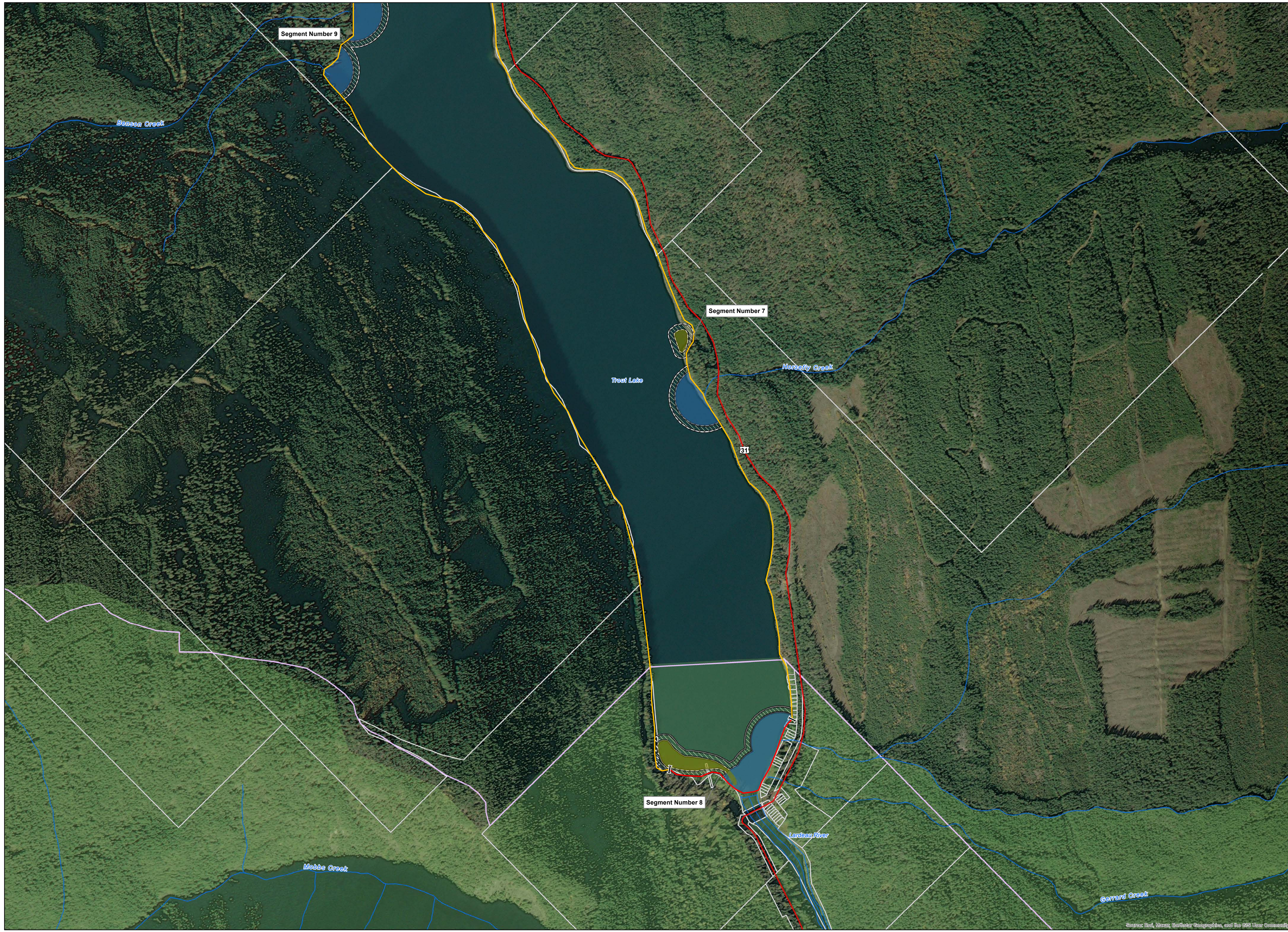
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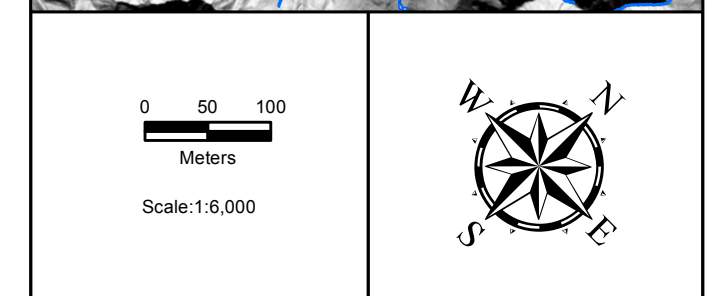
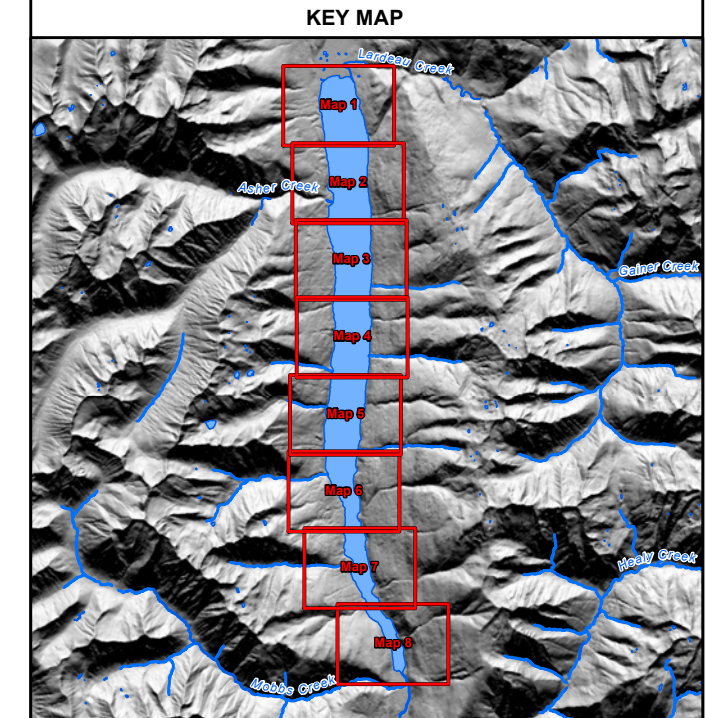


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**Appendix B. Activity Risk Matrix (Risk ratings: NA = Not Allowed, VH = Very High, H = High, M = Moderate, and L = Low)**

Activity <sup>1</sup>	Risk rating based on Ecological Ranking				Risk rating if Zone of Sensitivity Present <sup>2</sup>
	Very High	High	Moderate	Low / Very low	
<b>Aquatic Vegetation Removal</b>					
Removing native aquatic vegetation - by hand, or mechanical cutting for swimming areas and private beach access	VH	VH	VH	VH	NA
Removing non-native/invasive aquatic vegetation - by hand or mechanical cutting for swimming areas and private beach access	VH	VH	H	M	NA
<b>Dredging, Infilling and Beach Creation</b>					
Dredging - new or expansion works, no current tenure	VH	VH	VH	VH	NA
Maintenance dredging - dredged in last 10 years, no increase in footprint below the NB <sup>1</sup> , dredged material deposited on land, within existing tenure	VH	VH	VH	VH	NA
Lake infilling - e.g. extension of upland landscaping	VH	VH	VH	VH	NA
Beach creation below the lake NB	VH	VH	VH	VH	NA
Foreshore sediment disturbance and removal of lakebed substrate (e.g., beach grooming)	VH	VH	H	M	NA
<b>Foreshore Erosion, Sediment or Wave Control Structures</b>					
New groyne construction or increase in existing footprint	VH	VH	VH	VH	NA
Maintenance of existing groyne, no increase in existing footprint, within existing tenure	M	M	L	L	NA
Erosion control (e.g., concrete, rip rap, vegetation, etc.)	VH	VH	H	M	NA
Infill breakwaters or boat basins	VH	VH	H	H	NA
Wave control structures (e.g., log booms)	VH	VH	H	M	NA
<b>Boat Launches</b>					
Construction of new hard surface boat launch or repair/upgrade of existing hard surface boat launch without land tenure	VH	VH	VH	H	NA
Upgrade/repair of existing hard surface boat launch with land tenure and within existing footprint	VH	H	H	M	NA

Activity <sup>1</sup>	Risk rating based on Ecological Ranking				Risk rating if Zone of Sensitivity Present <sup>2</sup>
	Very High	High	Moderate	Low / Very low	
Upgrade/repair of existing hard surface boat launch with land tenure and increasing size of the existing allowable footprint	VH	VH	H	M	NA
Construction of new boat rail launch or repair/upgrade of existing boat rail launch without land tenure	VH	H	M	L	NA
Upgrade/repair of existing boat rail launch with land tenure and within existing footprint	H	H	M	M	NA
<b>Buoys</b>					
Placement of up to 2 helical screw anchor mooring buoys for non-commercial use.	VH	H	M	L	NA
Placement of up to 2 non-helical screw mooring buoys for non-commercial use.	VH	H	H	M	NA
Placement mooring buoys for commercial use	Moorage # dependent - see Marina Activity rankings				NA
<b>Docks, boathouses, pile supported structures, float home structures, and other - below NB</b>					
Docks - floating, pile supported or removable	VH	H	M	L	NA
Floating or lake access boat house, covered boat storage, or permanent non-moorage structures	VH	VH	VH	VH	NA
Land boat house - located on land with access directly to the water	VH	VH	VH	H	NA
Pumphouse	VH	VH	VH	H	NA
Boat lifts	VH	H	L	L	NA
Float homes and house boats - refers to long term storage area.	VH	VH	VH	VH	NA
Float home/ house boats - refers to short term mooring (in bays).	VH	H	M	L	NA
Submarine cables, including related land clearing and equipment access.	VH	VH	VH	H	NA
Submarine cables - no land clearing necessary.	L	L	L	L	NA
Overwater piled structure (e.g. building, deck, etc.)	VH	VH	VH	VH	NA
Elevated boardwalk over water	VH	H	H	H	NA
<b>Marinas</b>					
Private dock moorage = < 6	VH	H	M	M	NA
Small Marina = 6 – 20 slips	VH	H	H	H	NA

Activity <sup>1</sup>	Risk rating based on Ecological Ranking				Risk rating if Zone of Sensitivity Present <sup>2</sup>
	Very High	High	Moderate	Low / Very low	
Marina Large = >20 slips	VH	VH	VH	VH	NA
<b>Water Withdrawal, Use or Discharge</b>					
Waterline - directional drilling	M	M	M	M	NA
Waterline - open excavation	VH	VH	H	M	NA
Geothermal heating/cooling - commercial, industrial, strata or multi-family	VH	VH	VH	H	NA
Geothermal heating/cooling - single family residence	H	H	M	L	NA
Treated effluent discharge pipe	VH	VH	VH	VH	NA
Commercial water withdrawals (addressed through water licensing, with physical activities addressed elsewhere in this table)	-	-	-	-	-
<b>Transition to Private Land from Crown Land</b>					
Application to purchase or lease crown land (crown grant)	VH	H	M	L	NA
<b>Land development, on private land - above NB</b>					
Native vegetation modification/removal, including for: buildings (e.g., boathouses, covered boat storage, permanent non-moorage structures), beach creation, landscaping, and septic fields.	VH	VH	VH	H	NA
Non-native vegetation modification / removal, including for: buildings (see above), landscaping, beach creation, and septic fields.	VH	H	M	L	NA
Drilling and blasting	VH	VH	VH	H	NA

**Legend:**

<sup>1</sup>NB refers to present natural boundary. NB is the legal term BC Crown Land Branch uses to define the property boundary. Often NB and High Water Mark (HWM) are similar. Only a registered BC Legal Land Surveyor may determine NB.

<sup>2</sup>For all activities, if species or Critical Habitat listed under the Species at Risk Act are present, refer to DFO Projects Near Water Website for next steps (<https://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html>).

<sup>3</sup>Refer to DFO Land Development Guidelines ([http://stewardshipcentrebc.ca/PDF\\_docs/StewardshipSeries/LandDevelopmentGuidelines.pdf](http://stewardshipcentrebc.ca/PDF_docs/StewardshipSeries/LandDevelopmentGuidelines.pdf))

## Appendix C. Legal Requirements and Policy

The following provides a brief summary of environment related legislation that may be applicable to a proponent's project. While this list is fairly inclusive, other pieces of legislation may be applicable, and proponents are to ensure that they have identified all legislation that may apply to their project. The Federal Project Near Water website may be updated to reflect the integration of permitting under the *Species at Risk Act* and *Fisheries Act*. It is the proponents' responsibility to refer to the Projects Near Water website for any updates.

### Federal Acts:

- *The Department of Environment Act*
- *Fisheries Act*
- *Species at Risk Act (SARA)*
- *Migratory Birds Convention Act*
- *Canada Wildlife Act*
- *Navigable Waters Protection Act*
- *Pesticides Act*
- *Canadian Environmental Assessment Act (CEAA)*
- *Indian Act*

### Federal Regulations:

- *Canada Environmental Protection Act Regulations*
- *Migratory Birds Regulations*
- *Fisheries Act Regulations*
- *Wildlife Area Regulations*

### Provincial Acts:

- *Water Sustainability Act*
- *Fish Protection Act*
- *Wildlife Act*
- *Land Act*
- *Weed Control Act*
- *Environmental Management Act*
- (Contaminated Sites Regulations)
- *Local Government Act*
- *Heritage Conservation Act*
- *Health Act (e.g., Sewerage System Regulation)*

### Local Government:

- Development Permit Areas (DPAs)
- Subdivision Servicing Bylaw
- Official Community Plans
- Floodplain Management Bylaw
- Building Bylaw
- Zoning Bylaws

The Legal Requirements table, provided below (Table C1) identifies the main fish and wildlife habitat regulatory requirements for typical foreshore activities. These requirements involve three regulatory processes:

1. Obtaining a BC Crown Land tenure - to request permission for use of provincial Crown land.



2. Obtaining a BC Water Sustainability Act Section 11 notification or approval for making changes in and about a stream.
3. Obtaining necessary DFO acceptance through a Project Review. DFO staff will review the project plans to identify the potential risks of the project to the conservation and protection of fish and fish habitat. During the review, it will be determined if the project will: a) impact an aquatic species at risk, result in the death of fish and the harmful alteration, disruption or destruction of fish habitat, or need authorization under the *Fisheries Act*.

Although potential regulatory requirements (e.g., permits) are listed, the requirements at the time of planning the project should be confirmed, as regulatory changes do occur. FrontCounterBC should be contacted to confirm these requirements.

The Legal Requirements table only provides direction related to protecting fish and wildlife habitat values, and as such, does not consider other development factors (such as erosion hazards, drinking water quality, or navigation considerations). Proposed works may be subject to requirements such as: local government zoning or permitting, BC *Water Sustainability Act* approvals or notifications (in addition to those noted above) and Water License applications, Heritage Conservation Act permits, Land Act permits, licenses or permissions for occupation of Crown Lands, or Navigable Waters Protection Act approvals. It remains the responsibility of the project proponent to verify this information and meet all regulatory requirements that may apply to their project.

**Table C1. Summary of typical legal environmental requirements for select development activities.**

Activity <sup>1</sup>	Crown Land Tenure	BC Water Sustainability Act-Section 11 <sup>2</sup>	Federal Fisheries Act Review <sup>4</sup>	Other
<b>Aquatic Vegetation Removal</b>				
Removing native aquatic vegetation - by hand, or mechanical cutting for swimming areas and private beach access	N	Y	See DFO website	-
Removing non-native/invasive aquatic vegetation - by hand or mechanical cutting for swimming areas and private beach access	N	Y	See DFO website	-
<b>Dredging, Infilling and Beach Creation</b>				
Dredging - new or expansion works, no current tenure	Y	Y	Y	-
Maintenance dredging - dredged in last 10 years, no increase in footprint below the NB, dredged material deposited on land, within existing tenure.	N	Y	See DFO website, likely N	-
Lake infilling - e.g., extension of upland landscaping	Y	Y	Y	-
Beach creation below the lake NB	Y <sup>3</sup>	Y	Y	-
Beach creation above the lake NB, assumes on the applicant's land	N	Y	See DFO website, likely N	See DFO Land Development Guidelines <sup>5</sup>
Foreshore sediment disturbance and removal of lakebed substrate (e.g., beach grooming)	N	Y	See DFO website, likely Y	-
<b>Foreshore Erosion, Sediment or Wave Control Structures</b>				
-				
New groyne construction or increase in existing footprint	Y	Y	Y	-
Maintenance of existing groyne, no increase in existing footprint, within existing tenure	N	Y	N	-
Erosion control (e.g., concrete, rip rap, vegetation, etc.)	N	Y	See DFO website	-
Infill breakwaters or boat basins	Y	Y	See DFO website	-
Wave control structures (e.g., log booms)	Y	Y	See DFO website	-
<b>Boat Launches</b>				
-				
Construction of new hard surface boat launch or repair/upgrade of existing hard surface boat launch without land tenure	Y	Y	See DFO website	-
Upgrade/repair of existing hard surface boat launch, within land tenure, and within existing footprint	N	Y	N	-

Activity <sup>1</sup>	Crown Land Tenure	BC Water Sustainability Act-Section 11 <sup>2</sup>	Federal Fisheries Act Review <sup>4</sup>	Other
Upgrade/repair of existing hard surface boat launch, within land tenure, and increasing size of the existing allowable footprint	Y	Y	Y	-
Construction of new boat rail launch or repair/upgrade of existing boat rail launch without land tenure	Y	Y	See DFO website	-
Upgrade/repair of existing boat rail launch with land tenure and within existing footprint	N	Y	N	-
<b>Buoys</b>				
Placement of up to 2 helical screw anchor mooring buoys for non-commercial use.	Y <sup>3</sup>	Y	N	Federal Navigable Waters Act
Placement of up to 2 non-helical screw mooring buoys for non-commercial use.	Y <sup>3</sup>	Y	N	Federal Navigable Waters Act
Placement mooring buoys for commercial use	Y	Y	N	-
<b>Docks, boathouses, pile supported structures, float home structures, and other - below NB</b>				
Docks - floating, pile supported or removable	Y <sup>3</sup>	Y	See DFO website	-
Floating or lake access boat house, covered boat storage, or permanent non-moorage structures	Y	Y	Y	-
Land boat house - located on land with access directly to the water.	Y	Y	See DFO website	-
Pumphouse	Y	Y	Y	-
Boat lifts	Y <sup>3</sup>	Y	See DFO website	-
Float homes and house boats - refers to long term storage area.	Y	Y	Y	-
Float home/ house boats - refers to short term mooring (in bays).	Y	Y	See DFO website	-
Submarine cables, including related land clearing and equipment access.	N	Y	See DFO website	-
Submarine cables - no land clearing necessary.	N	Y	N	-
Overwater piled structure (e.g. building, deck, etc.)	Y	Y	See DFO website	-
Elevated boardwalk over water	Y	Y	See DFO website	-
<b>Marinas</b>				
Private dock moorage = < 6	Y <sup>3</sup>	Y	See DFO website, likely Y	-
Small Marina = 6 – 20 slips	Y	Y	Y	-
Marina Large = >20 slips	Y	Y	Y	-

Activity <sup>1</sup>	Crown Land Tenure	BC Water Sustainability Act-Section 11 <sup>2</sup>	Federal Fisheries Act Review <sup>4</sup>	Other
<b>Water Withdrawal, Use or Discharge</b>				
Waterline - directional drilling	N	Y	See DFO website	May require a Water License
Waterline - open excavation	N	Y	See DFO website	May require a Water License
Geothermal heating/cooling - commercial, industrial, strata or multi-family	Y <sup>3</sup>	Y	See DFO website	May require a Water License
Geothermal heating/cooling - single family residence	Y <sup>3</sup>	Y	See DFO website	May require Water License
Treated effluent discharge pipe	Y <sup>3</sup>	Y	N	Environment Canada
Commercial water withdrawals	Y <sup>3</sup>	Y	See DFO website	Requires Water License
<b>Transition to Private Land from Crown Land</b>				-
Application to purchase or lease crown land (crown grant)	Y	N	N	-
<b>Land development, on private land - above NB</b>				
Native Vegetation modification / removal	N	Y <sup>3</sup>	See DFO website	-
Non-native Vegetation modification / removal	N	Y <sup>3</sup>	See DFO website	-
Drilling and blasting	N	Y	See DFO website	If < 30 m NB, contact local government
Boathouses / covered boat storage / permanent non-moorage structures	N	Y <sup>3</sup>	See DFO website	Refer to Local Government
Building and development permit application	N	Y <sup>3</sup>	Y <sup>3</sup>	Refer to Local Government
Landscaping with Native Vegetation	N	N	See DFO website	Refer to Local Government
Landscaping with Non-native Vegetation	N	N	See DFO website	Refer to Local Government
Septic application	Y <sup>3</sup>	N	N	Refer to Health Authority

**Legend:**

<sup>1</sup>NB refers to present natural boundary. NB is the legal term BC Crown Land Branch uses to define the property boundary. Often NB and High Water Mark (HWM) are similar. Only a registered BC Legal Land Surveyor may determine NB.

<sup>2</sup>BC Water Sustainability Act Approval or Notification.

<sup>3</sup>Although indicated as Yes, the requirement is structure/location dependent. Refer to FrontCounterBC.

<sup>4</sup>DFO Projects Near Water Website (<https://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html>). For all activities, if species or Critical Habitat listed under the Species at Risk Act are present, refer to this website.

<sup>5</sup>Refer to DFO Land Development Guidelines ([http://stewardshipcentrebc.ca/PDF\\_docs/StewardshipSeries/LandDevelopmentGuidelines.pdf](http://stewardshipcentrebc.ca/PDF_docs/StewardshipSeries/LandDevelopmentGuidelines.pdf)).

## Appendix D. Best Management Practices

The BC Ministry of Environment (MOE 2019) defines best management practices (BMPs) as “guidelines that help development projects meet necessary legislation, regulations and policies. For example, legislation might dictate that projects cannot harm a stream, while best management practices provide practical methods to avoid harming a stream.”

The table below provides a summary of potentially applicable environmental and archaeological BMPs. This list is not exhaustive, other applicable BMPs may be available for a given project, and updates occur regularly. Thus, it is recommended that the website be accessed at the following link for a current updated list: <https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/best-management-practices>.

FrontCounterBC or a QEP should be contacted for more information on recent Provincial BMP's that may be specifically applicable to the Project. For Federal documents, the *Projects Near Water* website by Fisheries and Oceans Canada should also be referred to (<https://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html>).

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**Table D1. Summary of BMPs and guidelines that may be applicable to development in the Kootenay Region (Source: Kootenay Lake Partnership 2019).**

Provincial BMPs	Target - species habitat	Applicability	Web Link
Develop with Care: Environmental Guidelines for Urban and Rural Land Development in British Columbia (2014)	Sensitive Species Terrestrial Aquatic Riparian	Works involving any form of land development.	<a href="https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/best-management-practices/develop-with-care">https://www2.gov.bc.ca/gov/content/environment/natural-resource-stewardship/laws-policies-standards-guidance/best-management-practices/develop-with-care</a>
Guidelines for Amphibian and Reptile Conservation during Urban and Rural Land Development in British Columbia (2014)	Amphibians and Reptiles	Ecosystems comprised of aquatic habitats, rocky outcrops and forested areas.	<a href="https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/herptilebmp_complete.pdf">https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/herptilebmp_complete.pdf</a>
Guidelines for Raptor Conservation during Urban and Rural Land Development in British Columbia (2013)	Raptors	Terrestrial ecosystems comprised of mature coniferous and mixed woodlands.	<a href="http://www.env.gov.bc.ca/wld/documents/bmp/raptor_conservation_guidelines_2013.pdf">http://www.env.gov.bc.ca/wld/documents/bmp/raptor_conservation_guidelines_2013.pdf</a>
Best Management Practices Guidelines for Bats during Urban and Rural Land Development in British Columbia in BC (2016)	Bats	Terrestrial ecosystems, insect rich riparian zones, as well as wetlands, forest edges and open woodland.	<a href="http://a100.gov.bc.ca/pub/eirs/viewDocumentDetail.do?fromStatic=true&amp;repository=BDP&amp;documentId=12460">http://a100.gov.bc.ca/pub/eirs/viewDocumentDetail.do?fromStatic=true&amp;repository=BDP&amp;documentId=12460</a>
Standards and Best Practices for In-stream Works (2004)	Aquatic	Works undertaken in-stream.	<a href="http://www.env.gov.bc.ca/wld/documents/bmp/iswstdsbpsmarch2004.pdf">http://www.env.gov.bc.ca/wld/documents/bmp/iswstdsbpsmarch2004.pdf</a>
General BMPs and Standard Project Considerations	Aquatic	Any projects undertaken in and around a stream.	<a href="http://www.env.gov.bc.ca/wld/in-streamworks/generalBMPs.htm">http://www.env.gov.bc.ca/wld/in-streamworks/generalBMPs.htm</a>
Bank Stabilization Specific BMPs	Terrestrial Aquatic	Bank stabilization works that could impact fish or wildlife habitat.	<a href="http://www.env.gov.bc.ca/wld/in-streamworks/bankstabilization.htm">http://www.env.gov.bc.ca/wld/in-streamworks/bankstabilization.htm</a>
Best Management Practices for Hazard Tree and Non-Hazard Tree Limbing, Topping or Removal (2009)	Terrestrial Aquatic	Works involving tree removal.	<a href="https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/hazardtree_26may_09.pdf">https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/hazardtree_26may_09.pdf</a>

**Table D1. Summary of BMPs and guidelines that may be applicable to development in the Kootenay Region (Source: Kootenay Lake Partnership 2019).**

Provincial BMPs	Target - species habitat	Applicability	Web Link
Standards and Best Practices for In-stream Works	Terrestrial Aquatic	Wharves, piers, docks, boathouses, and small moorings in and about a stream	<a href="http://www.env.gov.bc.ca/wld/in-streamworks/downloads/Docks.pdf">http://www.env.gov.bc.ca/wld/in-streamworks/downloads/Docks.pdf</a>
Best Management Practices for Boat Launch Construction & Maintenance on Lakes (2006)	Terrestrial Aquatic	Boat Launch Construction & Maintenance on Lakes (Okanagan specific)	<a href="http://www.env.gov.bc.ca/okanagan/documents/BMPBoat_LaunchDraft.pdf">http://www.env.gov.bc.ca/okanagan/documents/BMPBoat_LaunchDraft.pdf</a>
Best Management Practices for Small Boat Moorage on Lakes (2006)	Terrestrial Aquatic	Small Boat Moorage on Lakes (Okanagan specific)	<a href="http://www.env.gov.bc.ca/okanagan/documents/BMPSmallBoatMoorage_WorkingDraft.pdf">http://www.env.gov.bc.ca/okanagan/documents/BMPSmallBoatMoorage_WorkingDraft.pdf</a>
Best Management Practices for Installation and Maintenance of Water Line Intakes (2006)	Aquatic	Installation and Maintenance of Water Line Intakes (Okanagan specific)	<a href="http://www.env.gov.bc.ca/okanagan/documents/BMPIntakes_WorkingDraft.pdf">http://www.env.gov.bc.ca/okanagan/documents/BMPIntakes_WorkingDraft.pdf</a>
Beaver Management Guidelines (2001)	Aquatic	Areas that support beaver communities.	<a href="http://www.env.gov.bc.ca/van-island/pa/pdf/Beaver-Guide.pdf">http://www.env.gov.bc.ca/van-island/pa/pdf/Beaver-Guide.pdf</a>
Tree replacement criteria (1996)	Terrestrial	Works involving tree removal and replacement.	<a href="http://www.env.gov.bc.ca/wld/documents/bmp/treereplcrit.pdf">http://www.env.gov.bc.ca/wld/documents/bmp/treereplcrit.pdf</a>
Kootenay-Boundary Water Sustainability Regulation Terms and Conditions (2018)	Aquatic	Changes in and around a stream of the kind listed in Part 3 of the <i>Water Sustainability Regulation</i> .	<a href="https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/iswstdsbpsmarch2004.pdf">https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/iswstdsbpsmarch2004.pdf</a>
Fish Habitat Rehabilitation Procedures (1997)	Aquatic	Works with an erosion and sediment risk near water.	<a href="https://www.for.gov.bc.ca/hfd/library/ffip/Slaney_PA1997_A.pdf">https://www.for.gov.bc.ca/hfd/library/ffip/Slaney_PA1997_A.pdf</a>
Guidelines for Wetland Protection and Conservation in British Columbia: Land Development (2009)	Wetlands	Wetland protection near development sites.	<a href="https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/wetland_ways_ch_10_development.pdf">https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/best-management-practices/wetland_ways_ch_10_development.pdf</a>



**Table D1. Summary of BMPs and guidelines that may be applicable to development in the Kootenay Region (Source: Kootenay Lake Partnership 2019).**

Provincial BMPs	Target - species habitat	Applicability	Web Link
Land Development Guidelines for the Protection of Aquatic Habitat (1992)	Aquatic	Works undertaken in areas adjacent to riparian features.	<a href="http://www.dfo-mpo.gc.ca/Library/165353.pdf">http://www.dfo-mpo.gc.ca/Library/165353.pdf</a>
Ktunaxa Nation Council BMPs	Target Area	Applicability	Web Link
Guidelines for Conducting Archaeological Assessment in Ktunaxa Territory	Archaeology	Activities with moderate to high risk to Archaeological values	<a href="http://www.ktunaxa.org/four-pillars/lands-resource-agency/archaeology-engagement-guidelines/">http://www.ktunaxa.org/four-pillars/lands-resource-agency/archaeology-engagement-guidelines/</a>