Brilliant Headpond Foreshore Inventory and Mapping

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EXECUTIVE SUMMARY

The Brilliant Headpond is an 18 km section of the lower Kootenay River adjacent to the communities of Shoreacres, South Slocan, Tarrys, Glade and Thrums in southeast British Columbia. Water levels in the Brilliant Headpond are regulated by the South Slocan and Kootenay Canal dams at the upstream extent and by the Brilliant and Brilliant Expansion dams at the downstream end. Natural inflows also enter from unregulated tributaries, the largest being the Slocan River. The Brilliant Headpond and adjacent lands provide habitat for species including fish, turtles, reptiles and birds.

Foreshore Inventory and Mapping (FIM) is a standard technique that uses GIS, GPS and field observation to identify and document 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 a lake shoreline. Shoreline biophysical attribute data collected during the FIM survey, fish and wildlife sampling results and information from other data and literature sources are used to create an Aquatic Habitat Index (AHI) which ranks the sensitivity of homogenous shoreline segments. Shoreline Management Guidelines are used to guide development and restoration activities within each shoreline segment according to its sensitivity or AHI rank. A FIM survey was conducted on the Brilliant Headpond on July 4 and 5, 2017. Fish sampling was not conducted because extensive data is available for the headpond. Wildlife surveys were conducted on July 18 and September 28, 2017. An AHI was subsequently developed to rank the relative value of shoreline habitats. The AHI of each shoreline segment was calculated and a potential AHI analysis was completed to identify locations where restoration could improve the value of aquatic habitats.

Mapping was completed along 36,564 m of the Brilliant Headpond shoreline. The majority of the shoreline was in natural condition (22,142 m; 61%) while the remainder was disturbed (14,422 m; 39%). The majority of the headpond shoreline had a high level of impact (19,405 m; 53%); segments with railways were considered to have a high level of impact though shoreline areas remained mainly in natural condition. Remaining areas had either no (9,481 m; 26%) or a low (7,679 m; 21%) level of impact. The primary land use observed was forestry (13,677 m; 37%). Rocky shore was the most prevalent shore type, observed along 22,920 m (63%) of the Brilliant Headpond. Sand shore was observed along 13,256 m (36%) and cliff/bluff along 400 m (1%). Other land use classifications observed were single family residential (11,084 m; 30%), industrial (7,110 m; 19%), natural area (3,482; 10%) and rural (1,210 m; 3%). Brilliant Headpond shoreline substrates consisted primarily of boulder and sand with lesser amounts of gravel, cobble, bedrock, fines and organic materials. Aquatic vegetation was observed along 13,812 m (38%) of the shoreline primarily consisting of submergent vegetation. Wetlands were identified along the shoreline, in embayments or separated from the shore by a grassy area.

The most commonly observed shoreline modification were docks (n=37) followed by groynes (n=17). Boat launches (n=7) and retaining walls (n=4) were also observed. Lineal shoreline modifications were observed along 8,926 m (24%) of the Brilliant Headpond shoreline, the most common being roadways (5,359 m; 14%) and railways (3,435 m; 9%).

Wildlife surveys recorded 43 bird species, six mammals, one amphibian and one reptile. Great Blue Heron (*Ardea Herodias*; n=14) were the only species of conservation concern observed during the wildlife surveys. Based on background information, 19 fish species, including five of

conservation concern, have been documented in the Brilliant Headpond. Fish species of conservation concern include Bull Trout (*Salvelinus confluentus*), Umatilla Dace (*Rhinichthys umatilla*), Shorthead Sculpin (*Cottus confuses*) and Columbia Sculpin (*Cottus hubbsi*). White Sturgeon (*Acipenser transmontanus*) were historically able to access the Brilliant Headpond but dam construction in 1944 prevented upstream migration from the Columbia River. Although sturgeon may have become isolated between the dams, they have not been captured during fish inventory surveys and it is unlikely a self-sustaining population exists. Chinook Salmon (*Oncorhynchus tshawytscha*), Sockeye Salmon (*Oncorhynchus nerka*) and Steelhead Rainbow Trout (*Oncorhynchus mykiss*) were also able to access the Kootenay and Slocan rivers until construction of the Grand Coulee Dam on the Columbia River (Washington) was completed in 1941 and prevented these species from migrating upstream into Canada.

Zones of Sensitivity (habitats for sensitive species, species of regional significance or habitats supporting critical life stages of native fish and riparian wildlife species) identified in the Brilliant Headpond included wetlands areas, tributary mouths and wildlife habitat features. Other sensitive habitat features (e.g. freshwater mussel habitat) were identified, however, the data available at this time was not sufficient to map the boundaries or point locations of these features.

The majority of the shoreline was classified by an AHI of High (40.5%), followed by Moderate (22.5%), Very Low (18.5%), Very High (17.4%) and Low (1.1%). All Very High and the majority of High shorelines occurred adjacent to rocky shores. Low and Very Low shorelines occurred along sand shores. Moderate shorelines occurred along similar proportions of rocky and sand shores. The AHI rank of three segments improved during the potential AHI analysis. Segments adjacent to Thrums and Shoreacres improved from Very Low to Moderate and the segment adjacent to Glade improved from Moderate to High. This analysis highlights the improvement community led foreshore vegetation restoration could have in these areas.

Recommendations for future inventory work included a comprehensive assessment of native freshwater mussels, aquatic vegetation and shoreline erosion. Habitat restoration could benefit shoreline areas that have been modified and saw improvement in the AHI ranking during the potential AHI analysis including areas adjacent to Thrums, Shoreacres and Glade. Habitat conservation efforts could be directed towards segments with Very High and High AHI rankings such as the area around the Slocan River mouth, Slocan Pool and the east shore across from Thrums.

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1.0 INTRODUCTION

The Brilliant Headpond encompasses a section of the lower Kootenay River adjacent to the communities of Shoreacres, South Slocan, Tarrys, Glade and Thrums in southeast British Columbia (Figure 1). Water levels and flow in the Brilliant Headpond are controlled by hydroelectric dams at the upstream and downstream boundaries while natural inflows enter from unregulated tributaries, the largest being from the Slocan River. The Brilliant Headpond and adjacent lands provide habitat for species of conservation concern including fish, turtles, reptiles and birds.

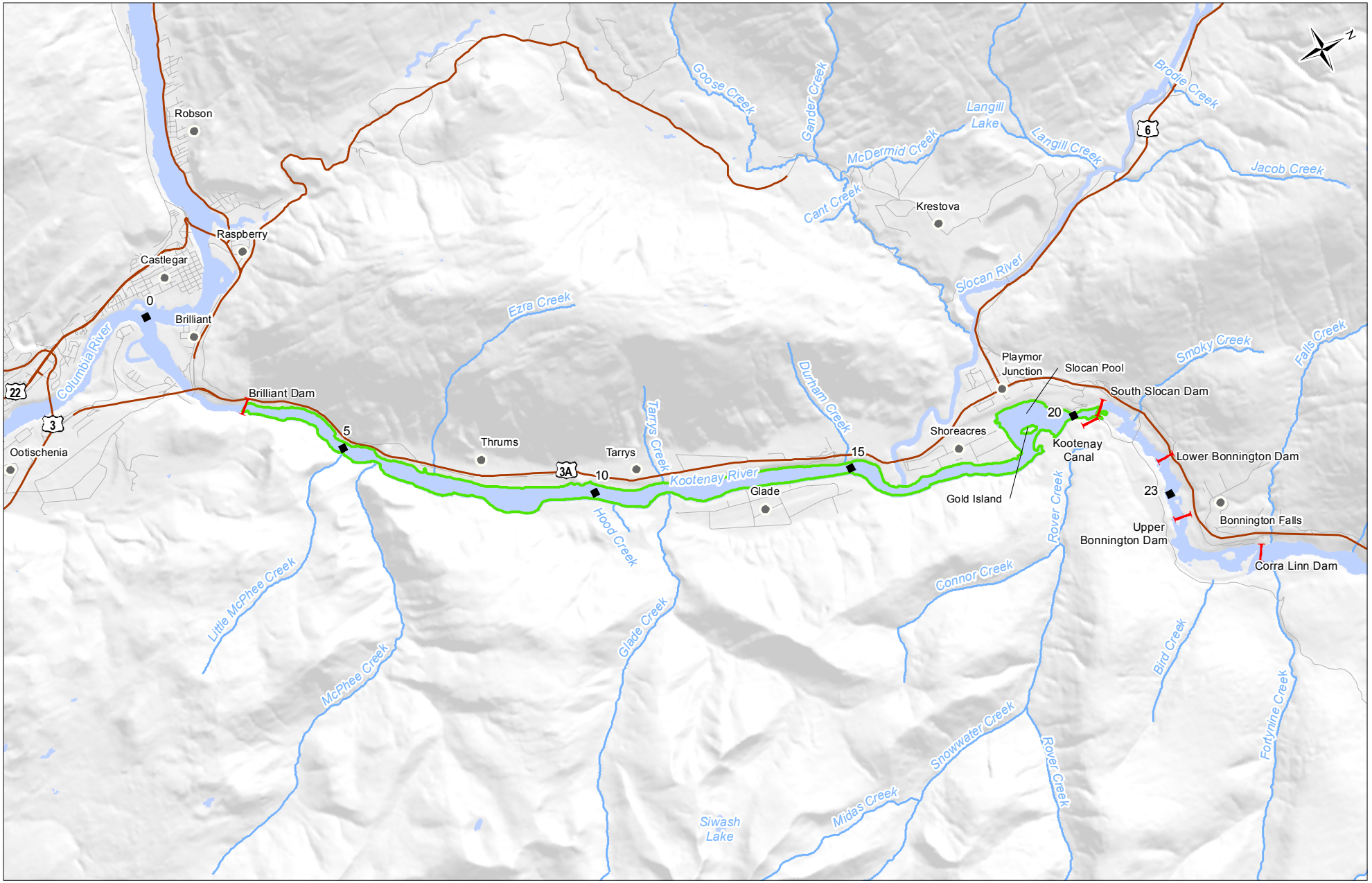
The Brilliant Headpond (Gazetted Name: Kootenay River (Lower); Watershed Code: 340; Waterbody Identifier: 00000KOTL) is an 18 km section of the lower Kootenay River. The headpond is bounded by South Slocan (1928) and Kootenay Canal (1976) dams at the upstream extent and Brilliant Dam (1944) and Brilliant Expansion (2007) at the downstream extent. The headpond has a mean annual inflow of 883 m^3/s and operated as a run-of-the-river reservoir resulting in a water retention time of approximately 0.7 days (R.L. & L. 1999). Prior to construction of the dams, a natural barrier to fish migration existed at Bonnington Falls, located approximately 3 km upstream of South Slocan Dam, isolating fish populations in Kootenay Lake from those in the Columbia River (Westslope 2001). The construction of Brilliant Dam in 1944 and creation of Brilliant Headpond Reservoir further isolated fish populations in the lower Kootenay River from populations downstream in the Columbia River system. The Slocan River is the largest tributary within the Brilliant Headpond (also referenced herein as the headpond) and is unregulated; fish populations can move freely between the two systems today as they could prior to dam construction. Other tributaries to the headpond include Glade, McPhee, Durham, Ezra, Hood, Little McPhee and Tarry creeks; other minor tributaries also exist (Selkirk College 2015).

The Brilliant Headpond is situated in the Regional District of Central Kootenay Area I. Road access is available at various points along the west bank but is limited along the east bank, restricted to areas around Glade including Glade Regional Park (Figure 1). Glade is accessed by ferry and is the only community on the east shoreline of the reservoir. Residential development along the foreshore is more common on the west side of the reservoir and includes the communities of Shoreacres, Tarrys and Thrums that are directly accessed from Highway 3A (Figure 1). A railway parallels the east bank and is directly adjacent to the headpond between Thrums and the Brilliant Dam navigational buoys (Figure 1).

Background scientific reports and studies related to the ecology of the headpond were recently compiled by Amec Foster Wheeler (2017) on behalf of the Brilliant Headpond Stewardship Initiative (BHPSI). The BHPSI was initiated by the Regional District of Central Kootenay (RDCK) Area I Advisory Planning Commission and Area I Regional Director and is comprised of local headpond and community stakeholder representatives.

Living Lakes Canada contracted Amec Foster Wheeler to assist with field data collection and complete a Foreshore Inventory and Mapping report, Aquatic Habitat Index and Shoreline Management Guidelines document for the Brilliant Headpond, a process known as Sensitive Habitat Inventory and Mapping (SHIM). SHIM was developed by Fisheries and Oceans Canada and has been competed on 12 other lakes in the Kootenay region, including most recently Kootenay Lake. This staged process is used to integrate biophysical data into planning processes and assist community lake stewardship groups. 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. Aquatic Habitat Index (AHI) – is generated using the FIM data to determine the relative habitat value of a shoreline. The AHI uses data collected during the FIM survey, additional field reviews (e.g., fish and wildlife surveys) and data from other sources to identify zones of sensitivity and develop an index that ranks the sensitivity of each shoreline segment. The index that is developed is specific to the waterbody of interest and compares the ecological sensitivity of different shoreline areas within that waterbody.
3. Shoreline Management Guidelines – are prepared to identify the shoreline vulnerability, based on the output of the AHI described above. The Shoreline Management Guidelines are 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 vulnerability ratings for all shoreline areas, an activity risk table and a decision making flow chart for proposed works along the shoreline.



Legend

- Populated Place
- Km Mark
- Dam
- Brilliant Headpond
- Highway
- Road
- Stream
- Lake

0 0.5 1 2

Kilometers

Scale: 1:100,000

Reference:

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)

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1.1 Objectives

The following are the objectives of the project:

- Conduct a Foreshore Inventory and Mapping project to identify, inventory, assess and map the foreshore of Brilliant Headpond, including the associated riparian habitats and important fisheries and wildlife habitat features, including “Zones of Sensitivity”.
- Prepare an Aquatic Habitat Index that will be used to identify a ranking for the sensitive shoreline features and habitats surrounding the headpond. This Aquatic Habitat Index uses inventory data (above), existing fisheries data or field sampling (if required), and air photo interpretation (if available) to index the habitat value of shoreline segments.
- Prepare a Shoreline Management Guidelines document for Brilliant Headpond that can be integrated into regional planning initiatives. This document will help facilitate local government planning, such as wetland and riparian area management planning.

2.0 METHODS

This project followed standard Foreshore Inventory and Mapping (FIM) methodology, an inventory technique based on standards developed for Sensitive Habitat Inventory and Mapping (SHIM) and Coastal Shoreline Inventory and Mapping (CSIM; Mason and Knight 2001, Mason and Booth 2004).

2.1 Foreshore Inventory and Mapping

A comprehensive guide to FIM methodology was prepared by Schleppe and Mason (2009) and has been included in Appendix A of this report. The concepts of FIM are similar to other land based spatial mapping initiatives, however, the primary feature under review is the shore zone area. The shore zone is defined as the area from the pelagic (deep water) regions of a lake to 30-50 m past the high water level in the upland/riparian zone (Schleppe and Mason 2009).

The following section provides an overview of the Brilliant Headpond FIM and additional details of standard FIM methodology can be found in Appendix A.

2.1.1 Foreshore Inventory and Mapping Field Surveys

Field surveys were conducted on July 4 and 5, 2017 to collect standard FIM data. Weather conditions during the survey were clear, wind was mild and viewing conditions were favourable. Brilliant Headpond water elevation during the surveys ranged between 449.7 and 449.9 m (unpublished power records provided by FortisBC). There is no Water Survey of Canada (WSC) gauging station in the Brilliant Headpond and publically accessible elevation data is not available at this time. However, the Slocan River (WSC station: 08N013) discharge and water level were decreasing following spring freshet which peaked in early June 2017 (Government of Canada 2018). The entire shoreline of the Brilliant Headpond was surveyed except for the area immediately downstream of South Slocan Dam/Kootenay Canal and the area directly upstream of Brilliant Dam to the navigational buoys where public access is limited due to the additional safety requirements for travel within these areas (i.e. dam lock out procedures). Three observers, all with previous FIM

experience, conducted the survey from Ktunaxa Nation Council's aluminum jetboat, traveling at a slow speed approximately 20 m from the shoreline. One Trimble Pathfinder GPS unit loaded with the SHIM Lake v.2.6 (FIM data dictionary) was used to create segment breaks and enter segment inventory data (Appendix B). Geo-referenced photos were taken with an iPad using the Avenza Maps application loaded with an overview map of the Brilliant Headpond. Field observations were also recorded.

The FIM methodology provided in Appendix A was followed throughout the field assessment. The information prepared by Schleppe and Mason (2009) provides a comprehensive description of all characteristics assessed during the survey (Appendix A). The document also provides detailed descriptions of categories used to describe various shoreline characteristics.

The following exceptions to the FIM protocol were made during the survey:

- Geo-referenced video of the Brilliant Headpond shoreline was not recorded during the survey; and,
- Aquatic vegetation categories (submergent, emergent and floating) were quantified by their relative proportion to the total amount of aquatic vegetation within the segment, not based on the total proportion of the segment that is occupied by each category. For example, if aquatic vegetation was identified along 10% of the segment (1000 meters lineal length) and submergent vegetation comprised 80% then 8% of the lineal length contained submergent vegetation (800 meters).

Segment inventory data is collected using the Lake_Sho form during a FIM survey. Other forms can be used to georeferenced point locations that are not recorded during the FIM survey. The following georeferenced point data was collected on subforms within the project data dictionary:

- Wetlands were added to the dataset using the "Site" form. Wetland length was recorded as was the proportion that was natural, landscaped and disturbed. A general description of each wetland was also recorded.
- Confluences of major tributaries were recorded using the "Waterbod" form.
- Major modifications (utility crossings, pipeline crossing and the ferry launch) were recorded using the "Modifica" form.

2.1.2 Fish Survey

Fish surveys were not conducted as part of the FIM survey. Fish information has been collected throughout the headpond during previous studies. Brilliant Headpond fish and fish habitat information was recently summarized by Amec Foster Wheeler (2017). Fisheries work in the headpond has been conducted during Brilliant Expansion and Brilliant Dam upgrade related studies (e.g. R.L.&L. 1999), species-at-risk studies (e.g. R.L.&L. 1996, AMEC 2011, AMEC 2012, Baxter and Irvine 2017), surveys by Selkirk College (e.g. Vandenbos 2013) and more recently during stranding risk surveys conducted for FortisBC (Amec Foster Wheeler, unpublished).

2.1.3 Wildlife Survey

Two wildlife surveys were conducted separate from the FIM survey to inventory habitat availability, nesting, roosting and/or denning sites for aquatic and terrestrial wildlife in the Brilliant Headpond.

Boat-based wildlife surveys were conducted between mid-morning and mid-afternoon on July 18 and September 28, 2017 using Amec Foster Wheeler's Ironwood aluminum jetboat. Weather was clear during both surveys. The same wildlife biologist was present during each survey along with a boat operator and one (September 28) or two (July 18) additional crew members that assisted with navigation, sightings and data collection.

During each survey the boat travelled slowly along the entire perimeter of the Brilliant Headpond, approximately 20 m from the shore. Point counts were used to identify bird species following standard methods for the assessment of forest and grassland songbirds (RIC 1999). Each survey lasted approximately 3 to 4 hours. Preliminary maps generated from the FIM survey data were viewed on an iPad using the Avenza Maps application during the surveys and allowed the crew to geo-reference wildlife sightings and identify the associated shoreline segment. Observations were made along the foreshore and into the riparian band as far as was visible from the water. At times it was necessary to navigate the boat ashore for a better perspective/search on wildlife values observed from the water. All species were documented via live observations or by the presence of scat, tracks, nests or other animal signs. During each survey, a 20-minute sweep for snakes (primarily Rubber Boas, *Charina bottae*) was conducted in potential habitat identified in Segment 2 using a standard walk-around technique (RIC 1998).

2.1.4 Additional Fields Added to the Foreshore Inventory and Mapping Dataset

Additional fields were added to the project dataset to capture Zones of Sensitivity within the Brilliant Headpond. The following point locations recorded during headpond wildlife surveys were added to the FIM dataset shapefiles:

- Bank Swallow (*Riparia riparia*), Northern Rough-Winged Swallow (*Stelgidopteryx serripennis*) and Belted Kingfisher (*Megaceryle alcyon*) nesting locations;
- Raptor nesting locations;
- North American River Otter (*Lontra canadensis*) dens; and,
- Beaver (*Castor canadensis*) lodges.

Information collected during background information and data reviews that was used during the AHI evaluation was also included in the FIM dataset as categorical values (e.g. presence/absence). This included juvenile rearing habitat value, migration corridors, staging areas, provincially listed fish observations, Floater mussel (*Anodonta* sp.) presence, provincially listed wildlife observations, raptor nests, bank nesting bird nests, beaver lodges, otter dens, AHI ratings and potential AHI ratings (see Section 2.2). Zones of Sensitivity are defined as habitats for sensitive species, species of regional significance or habitats supporting critical life stages of native fish and riparian wildlife species. Zones of Sensitivity identified in the headpond were added to the dataset as either polygon areas or point locations and included wetland areas, tributary mouths and wildlife habitat features.

2.1.5 Foreshore Inventory and Mapping GIS Analysis

Section breaks and other point features were interpolated using GPS data, overlaid with TRIM level lake line work and available imagery. Data was post-processed and shape files for each lake segmented by GPS section breaks were created. The lakeshore sections depicted in Appendix C should be used for cartographic purposes and larger scale mapping may require further

refinement. Bing Map imagery was included with the maps to provide context as orthophotos of the headpond were not available and air photo interpretation did not occur. Offsets used during the field survey were automatically incorporated by the Trimble unit and further processing was not warranted. Zones of Sensitivity were added to the dataset and maps using the georeferenced locations outlined in Section 2.1.4 and by manually delineating the boundaries of tributary mouth/fans and intermittent wetland areas.

2.1.6 Foreshore Inventory and Mapping Data Analysis

Segment summaries were created that included representative photographs and all inventory data collected during the FIM survey (Appendix D). The following shoreline characteristics were summarized by evaluating the proportions of each category within a segment and summing each category for the entire Brilliant Headpond:

- Natural vs. disturbed shoreline;
- Shore type including the proportion of natural vs. disturbed shoreline within each shore type;
- Land use including the proportion of natural vs. disturbed shoreline within each land use type;
- Substrate type;
- Aquatic vegetation and littoral zone;
- Shoreline modifications; and,
- Level of impact.

Definitions of the different categories and subcategories are provided in Appendix A. Riparian characteristics were summarized qualitatively, where possible.

2.2 Aquatic Habitat Index

An Aquatic Habitat Index (AHI) is a means of assessing the value of aquatic habitat or the sensitivity of the aquatic habitat along a lake's shoreline. The AHI score is calculated for various segments within a lake and a comparison made to determine higher valued aquatic habitats. The AHI uses inventory information collected during the FIM as well as inventory data from fish and wildlife surveys, data reports and other sources. Parameters included in the index can be broken down by the following categories:

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

The index assigns values to various criteria (Table 1) that are added together to provide an overall AHI score for each shoreline segment. The AHI assigns higher scores to 'natural' and sensitive

aquatic habitat features (e.g., confluence and wetland areas), while modifications present along the natural shoreline (e.g., retaining walls, docks, marinas) receive a lower score (Table 1).

The AHI developed for the Brilliant Headpond followed that developed for Kootenay Lake by Schleppe and Cormano (2016) with slight changes to weighting of some criteria (e.g. modifications) to accommodate differences in the criteria used within the index outlined below. Rationale for the biophysical, riparian (referred to as shoreline vegetation) and modification parameters are detailed by Schleppe and Cormano (2016). Rationale for additional criteria that were added to the Brilliant Headpond AHI is provided below. The model weight provides an indication of how much specific criteria influence the results generated by the AHI (Table 1).

Table 1: Aquatic Habitat Index for the Brilliant Headpond

Category	Criteria	Maximum Point	Logic	Values of Designations	Model Weight (% of Total)
Biophysical	Shore Type	15	% of Segment * Shore Type Value (summated for all shore types in that segment)	**Shore Type Value** Stream Mouth = Wetland (15) > Gravel Beach = Rocky Shore (12) > Sand Beach = Cliff/Bluff = Vegetated (8), Other (5)	11.5
	Substrate	12	% of Segment * Substrate Value (summated for all substrates in that segment)	**Substrate Value** Cobble (12) > Gravel (10) > Boulder = Organic = Mud = Marl = (8) > Fines = Sands (4) > Bedrock (2)	9.2
	Percent Natural	10	% Natural * Natural Score		7.7
	Aquatic Vegetation	8	% Aquatic Vegetation * Aquatic Vegetation Score		6.2
	Overhanging Vegetation	4	% Overhanging Vegetation * Overhanging Vegetation Score		3.1
	Large Woody Debris	4	LWD/km Relative Value*LWD Score	**Relative Value** ≥16 LWD/km (1) > 11-15 LWD/km (0.8) > 6-10 LWD/km (0.6) > 1-5 LWD/km (0.4) > 0	3.1
	Wetlands	3	≥5 wetlands (3) > 1-5 wetlands (1) > 0	≥5 wetlands (3) > 1-5 wetlands (1) > 0	2.3
Biophysical Total		*56*			*43.1*
Riparian	Riparian Band 1	12	Vegetation Bandwidth Value * Vegetation Class Value * Riparian Band 1 Score	**Vegetation Bandwidth Value** 0 to 5 m (0.2) < 5 to 10 m (0.4) < 10 to 15 m (0.6) < 15 to 20 m (0.8) < 20 m (1) **Vegetation Class Value** Natural Wetland = Disturbed Wetland = Broadleaf = Shrubs (1) > Coniferous Forest = Mixed Forest (0.8) > Herbs/Grasses = Unvegetated (0.6) > Lawn = Landscaped = Row Crops (0.3) > Exposed Soil (0.05)	9.2
Riparian Subtotal		*12*			*9.2*

Category	Criteria	Maximum Point	Logic	Values of Designations	Model Weight (% of Total)
Fish and Aquatics	Juvenile Rearing Habitat	10	High (10), Moderate (6), Low (2)	High (10), Moderate (6), Low (2)	7.7
	Migration Corridor	5	Present (5), Absent (0)	Present (5), Absent (0)	3.8
	Staging Area	3	Present (3), Absent (0)	Present (3), Absent (0)	2.3
	Provincially-Listed Fish Observations	5	Present (5), Absent (0)	Present (5), Absent (0)	3.8
	Freshwater Mussels	5	Present (5), Potentially Present (1), Absent (0)	Present (5), Potentially Present (1), Absent (0)	3.8
Fish and Aquatics Subtotal		*28*			*21.5*
Wildlife	CDC Listed	5	Present (5), Absent (0)	Present (5), Absent (0)	3.8
	Raptor Nest	5	Present (5), Absent (0)	Present (5), Absent (0)	3.8
	Beaver Lodge	2	Present (2), Absent (0)	Present (2), Absent (0)	1.5
	Bank Nesting Bird Nests	2	Present (2), Absent (0)	Present (2), Absent (0)	1.5
	Otter Dens	2	Present (2), Absent (0)	Present (2), Absent (0)	1.5
Wildlife Subtotal		*16*			*12.3*
Modifications	Retaining Wall	-2	% Retaining Wall * -10		1.5
	Docks	-8	# Docks * -0.5		6.2
	Groynes	-5	# Groynes * -0.5		3.8
	Boat Launch	-2	# Launches * -0.5		1.5
	Substrate Modification	-1	% Substrate Modification * -10		0.8
Modifications Subtotal		*-18*			*13.8*

Rationale for criteria that vary from the Kootenay Lake AHI are summarized below:

1. Biophysical Parameters

    a) Wetlands – wetlands were identified and inventoried during the Brilliant Headpond FIM and were included in the AHI as a value based on the density within a segment. Wetlands are an important component of a healthy ecosystem providing habitat, flood control, water filtration and food resources. In Brilliant Headpond, wetlands can buffer the shoreline from the impacts of daily water level fluctuation.

2. Riparian Parameter

    a) Riparian Band 1 – shoreline vegetation (Band 1) was assessed during the FIM survey while upland areas (Band 2) were not. As a result, the relative value of this band was increased to provide a similar contribution to the total index score as Kootenay Lake.

3. Fish and Aquatic Invertebrate Parameter

    a) Juvenile Rearing Habitat – A juvenile rearing habitat suitability index developed by Schleppe and Cormano (2016) for Kootenay Lake was used to assess the relative value of juvenile rearing habitat in the Brilliant Headpond as a targeted assessment of juvenile habitat was not conducted during the FIM surveys (Table 2). The results generated using this index were reviewed by the study team's aquatic biologists whom are familiar with habitats in the Brilliant Headpond to ensure they adequately represented juvenile habitat availability.

Table 2: Parameters and logic of the Juvenile Rearing Habitat index for the Brilliant Headpond.

Criteria	Maximum Point	Logic	Values of Designations	Model Weight (% of Total)
Shore Type	12	% of Segment * Shore Type Value (summated for all shore types in that segment)	**Shore Type Value** Stream Mouth (12) > Wetland (8) = Sand Beach (8) > Gravel Beach = Rocky Shore (6) > Cliff/Bluff = Vegetated (4), Other (1)	22.6
Substrate	9	% of Segment * Substrate Value (summated for all substrates in that segment)	**Substrate Value** Organic = Mud = Marl = Fines (9) > Boulder (8) > Cobble (7) > Gravel (7) > Sand (6) > Bedrock (4)	17.0
Aquatic Vegetation	5	Aquatic Vegetation Category Score	**Aquatic Vegetation Category** Aq. Veg >80% = 5, Aq. Veg 50% to 80% = 3, Aq. Veg 1% to 50% = 1	9.4
Littoral Width	12	Littoral Width Category Score	**Littoral Width Category** Wide (≥50m) = 12, Moderate (10 to 49 m) = 8, Narrow (<10 m) = 3	22.6
Overhanging Vegetation	1	% Overhanging Vegetation * Overhanging Vegetation Score		1.9
Large Woody Debris	4	Large Woody Debris Category Score* Maximum Point	**Relative Value** ≥16 LWD (1) > 11-15 LWD (0.8) > 6-10 LWD (0.6) > 1-5 LWD (0.4) > 0	7.5
Migration Corridor	5	Present (5), Absent (0)	Present (5), Absent (0)	9.4
Spawning Stream Present	5	Present (5), Absent (0)	Present (5), Absent (0)	9.4

b) Fish Migration Corridors – Locations with creek or river mouths that have been identified to be utilized by native fish species for spawning are considered migration corridors. These corridors provide immigration routes for spawners and outmigration for juveniles following egg incubation, hatch and instream rearing. Spawning by Rainbow Trout, Bull Trout and/or Kokanee has been identified or is very likely to occur in the Slocan River, McPhee Creek, Little McPhee Creek and Glade Creek (Amec Foster Wheeler 2017).

c) Staging Area – Staging areas were identified based on the presence of tributaries where spawning has been identified and fish stage in shoreline areas prior to spawning (Amec Foster Wheeler 2017). These areas tended to overlap with juvenile migration corridors and are intended to capture habitat requirements of staging adults.

d) Provincially-Listed Fish Species Presence – Umatilla Dace, Shorthead Sculpin, Columbia Sculpin and White Sturgeon have been documented in the Brilliant Headpond and Slocan River (Table 1). Locations of these species were exported from the provincial Fisheries Inventory Data Query (FIDQ) database and reviewed against segment break locations (BC MOE 2018). Segments with observations of one or more of the listed species were recorded in the AHI dataset as having listed fish species present. White Sturgeon (Red-Listed, SARA Endangered) could historically access the Brilliant Headpond prior to construction of Brilliant.

e) Mussels – Known locations for native Floater mussels (*Anodonta* sp.) in the Brilliant Headpond were provided by the Ktunaxa and Okanagan Nation Alliance (ONA) and included in the index. Mussels identified during recent stranding risk surveys conducted by Amec Foster Wheeler on behalf of FortisBC were also included. A 3-scale value (present, potentially present and absent) used in the index to account for areas where mussel surveys have not been conducted.

4. Wildlife Parameter

a) CDC Listed – The B.C. Conservation Data Center (CDC) mapping tools were used to evaluate the Brilliant Headpond for any occurrences of provincially-listed species of conservation concern (CDC 2018). Occurrences of fish species were removed as these were captured under the fisheries parameter of the AHI. One occurrence of blue-listed Painted Turtle (*Chrysemys picta*) was found and included in the index. The index was modified from the Kootenay Lake AHI to only include one value for listed wildlife species not separate values for masked, red and blue listed species.

b) All other wildlife variables included in the Brilliant Headpond AHI were based on observations recorded during the two wildlife surveys in July and September 2017. Species-specific habitat structures including lodges, dens and nests were included in the AHI but observations of wildlife species themselves were not because the presence of wildlife in a segment at one point in time does not necessarily indicate they reside in that segment permanently.

5. Modification Parameter

a) Docks – Used total number rather than number per kilometer for docks as was done on Kootenay Lake. The numbers of docks were generally low and segment length did not vary as significantly as for Kootenay Lake. Based on the data for the

Brilliant Headpond, the count of docks was a more reasonable means of visualizing the impact of this modification type.

b) Groynes – As with docks, the total number rather than number per kilometer was used in the index.

c) Substrate Modification – Was added to the index as proportion of the segment where substrate has been modified, similar to retaining walls. Substrate modification was not included in the Kootenay Lake index but has been included in the AHI for other lakes in the Kootenays (e.g. Tie Lake).

2.2.1 Aquatic Habitat Index Analysis and Ranking

Scores were assigned to each criteria based on FIM or other inventory data and tallied for each segment within the Brilliant Headpond as outlined in Table 2 to generate an AHI value specific to the segment. A five class ranking system with categories including Very Low, Low, Moderate, High and Very High was applied to the values generated by the AHI. The distribution of the AHI scores were reviewed and logical score breaks were used to determine values within each category.

2.2.2 Potential Aquatic Habitat Index Analysis

The Potential AHI is the habitat value of a segment when modifications are removed. The potential AHI analysis was completed by removing the negative value associated with shoreline modifications. This evaluation is conducted to highlight segments where habitat restoration is possible and evaluate where restoration could have the most potential benefit.

3.0 RESULTS

Biophysical characteristics of the Brilliant Headpond are summarized below. Segment summaries including all FIM data collected during the survey as well as representative photographs are provided in Appendix D.

3.1 Natural vs. Disturbed Shoreline

FIM was completed along 36,564 m of the Brilliant Headpond shoreline. The shoreline was divided into 17 segments ranging in length from 353 to 5,673 m. The total length of disturbed shoreline was 14,422 m (39%) while the total length of shoreline that remained in natural condition was 22,142 m (61%); (Figure 2).

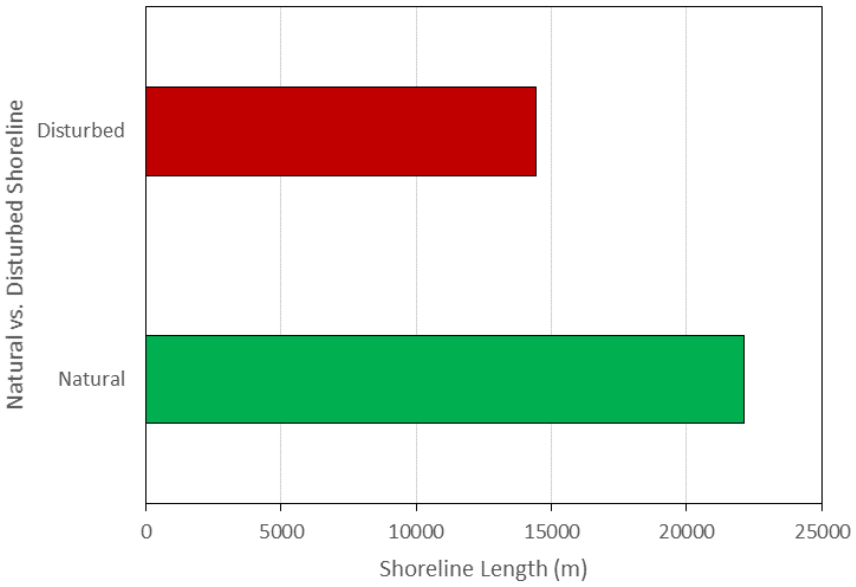

Figure 2: Total shoreline length (m) that is disturbed or natural along the foreshore of the Brilliant Headpond.

3.2 Shore Type

The predominant shore type was rocky shore which was observed along 22,920 m (63%) of the Brilliant Headpond shoreline (Figure 3). Sand shore types were observed along 13,256 m (36%) and cliff/bluff shore type along 388 m (1%). No stream mouth, gravel beach or wetland shore types were observed, though these values did exist within rocky, sand and/or cliff bluff shore types. Most of the rocky shore segments were in natural condition (84%) in contrast to most of the sand shore segments that were disturbed (82%). All cliff/bluff segments were in natural condition.

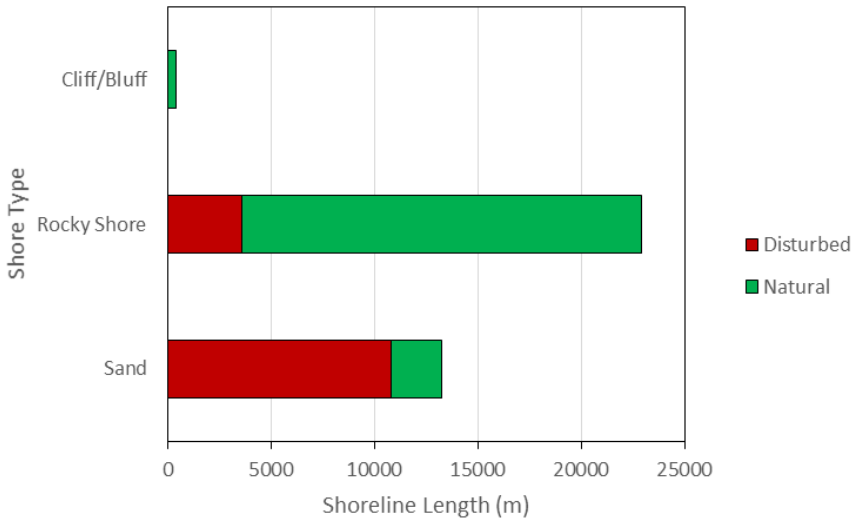

Figure 3: Shore types and length of natural vs. distrubed shoreline on Brilliant Headpond.

3.3 Land Use

The predominant land use along the Brilliant Headpond shoreline was forestry which covered 13,677 m (37%) of the total shoreline (Figure 4). Other land use classifications observed were single family residential (11,084 m; 30%), industrial (7,110 m; 19%), natural area (3,482; 10%) and rural (1,210 m; 3%). There were no agricultural, commercial, conservation, institutional, multi-family residential, park, recreation or urban parkland land use segments identified. Forestry segments were 99% natural; a small section of shoreline (37 m) was designated as disturbed at an underground pipeline crossing upstream of the Slocan River mouth on the east shore. Single family residential and rural area were primarily disturbed (90% and 80%, respectively), natural areas were primarily (97%) undisturbed and approximately half of industrial areas were disturbed.

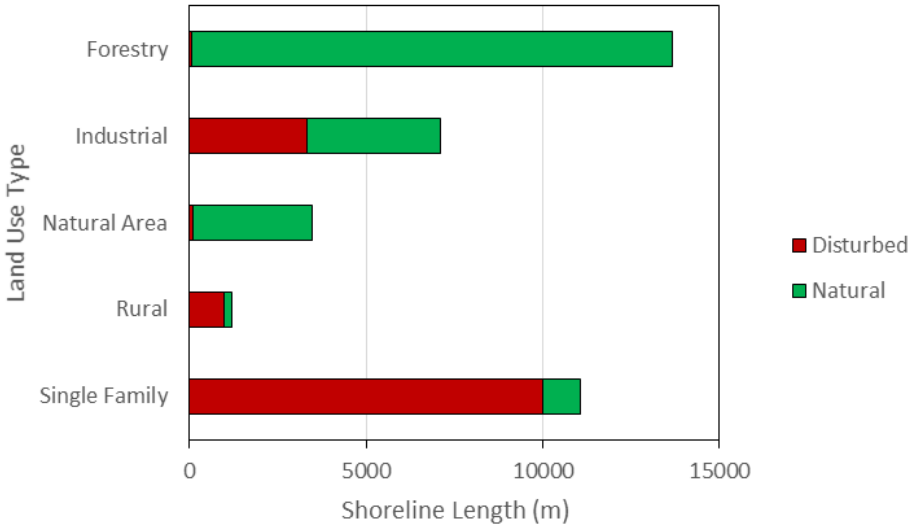

Figure 4: Land use types and length of natural vs. distrubed shoreline on Brilliant Headpond.

3.4 Substrate Type

Boulder (13,871 m; 38%) and sand (13,186 m; 36%) were the predominant substrate types observed along the foreshore of the Brilliant Headpond (Figure 5). Cobble and gravel substrates were observed along approximately 3,000 m (9%) of the shoreline and bedrock along 2,277 m (6%). Organic and fine substrates were both observed along 221 m (<1%) of the shoreline.

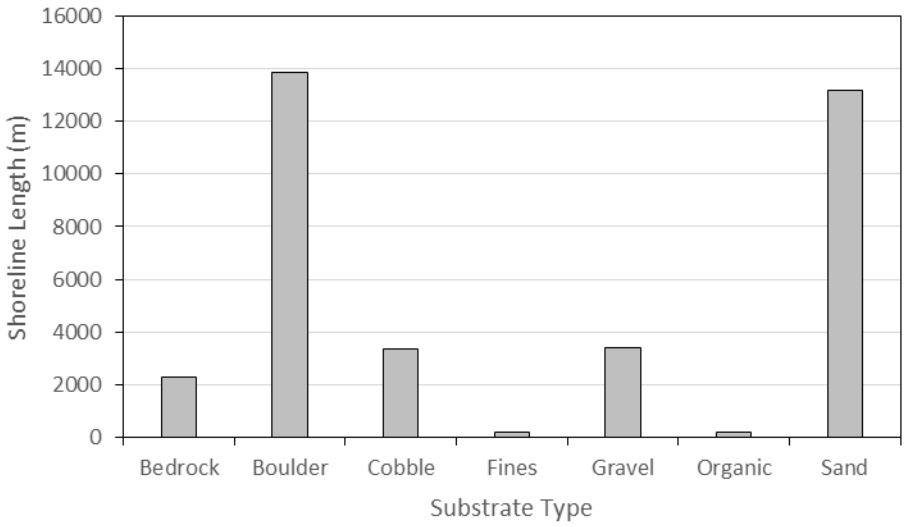

Figure 5: Substrate types observed along the shoreline of Brilliant Headpond.

3.5 Aquatic Vegetation

Aquatic vegetation was observed along 13,812 m (38%) of the Brilliant Headpond shoreline (Figure 6). Submergent vegetation (e.g. genus *Elodea*) was the dominant aquatic vegetation type observed (13,481 m). Emergent vegetation (e.g. genus *Typha*) was a minor component. Segments 1, 7 and 16 contained 331 m of emergent vegetation. Wetlands were identified in Segments 1, 5, 8 and 16 and consisted of both submergent and emergent aquatic vegetation (Section 3.6.3).

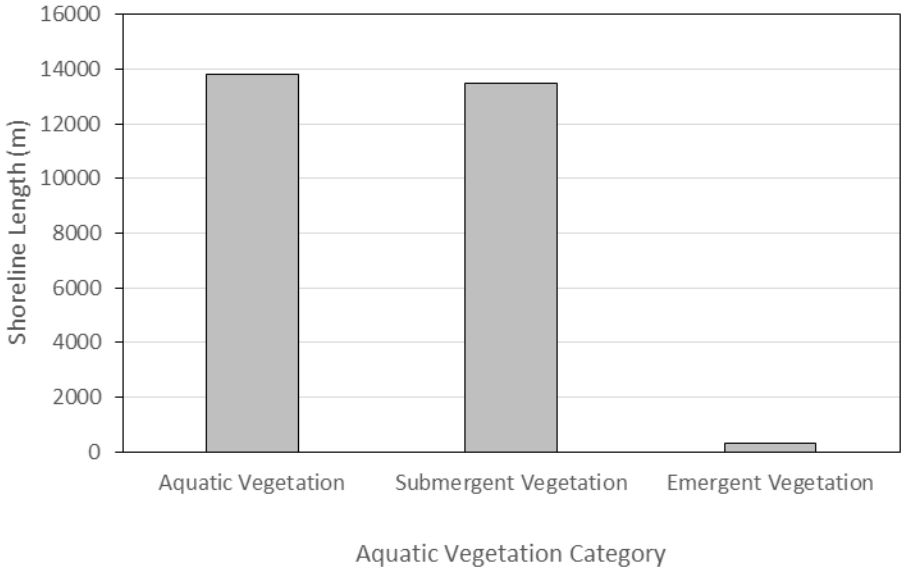

Figure 6: Aquatic vegetation types observed along the shoreline of Brilliant Headpond.

3.6 Shoreline Characteristics

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

3.6.1 Riparian Vegetation

The width of the riparian area (i.e., Riparian Band 1) assessed along the Brilliant Headpond ranged between 20 and 30 m (Appendix D). The riparian class of the entire nearshore riparian area of the Brilliant Headpond was composed of similar proportions of herbs/grasses (34%), coniferous forest (33%) and mixed forest (28%) with a smaller proportion of shrub areas (5%). The shoreline vegetation was predominantly mature forest (59%) followed by grass/herb (34%), low shrub <2 m (5%) and mixed age forest (2%). Overhanging vegetation was observed along most of the shoreline (26,831 m; 73%) and varied in width from 0 to 80 m. Shrub and/or tree cover was classified as being moderate or abundant in all segments except Segments 1, 5, 11, 13 and 16 (shoreline near Thrums, Glade and Shoreacres) where both cover types were sparse.

3.6.2 Littoral Areas

Large woody debris (LWD) was observed in all segments with total numbers ranging between 4 and 100 pieces. Segments 4 and 15 (east shore across from Thrums and west shore adjacent to the ferry) had the most significant accumulations of LWD (>75 pieces) and Segments 2, 5, 10, 13, and 17 had the least (<5 pieces). The width of the littoral zone ranged between 1 and 50 m; Segments 2, 3, 8, 9, 14, 15 and 17 had the narrowest littoral areas (<10 m) while Segment 16 had the widest (50 m).

3.6.3 Wetlands

Wetlands were observed in Segments 1, 5, 8 and 16 (Appendix D). The primary vegetation type identified in the wetlands were cattails (*Typha latifolia*) and wetlands were located either in embayment areas (Figure 7), directly adjacent to the shoreline or separated from the headpond by a grassy area.

Figure 7: Example of an embayment wetland in Segment 1.

3.7 Brilliant Headpond Fish Species Information

Nineteen fish species, including five of conservation concern, have been identified in the Brilliant Headpond (Table 3; Amec Foster Wheeler 2017). Bull Trout are provincially Blue-listed (species of special concern) and have been sporadically captured in the headpond as well as in Glade Creek (R.L. & L. 1999, Vandenbos 2013). Bull Trout (*Salvelinus confluentus*) may spawn in Glade Creek as juveniles have been captured within the creek though actual spawning has not been observed (Baxter and Irvine 2017). Three small bodied, nearshore fish species have been documented in the headpond: Umatilla Dace (*Rhinichthys umatilla*; provincially Red-listed (endangered/ threatened), SARA Special Concern); Shorthead Sculpin (*Cottus confuses*; provincially Blue-listed, SARA Special Concern); and Columbia Sculpin (*Cottus hubbsi*; provincially Blue-listed, SARA Special Concern). Both sculpin species have been captured in areas around the Slocan River mouth while Umatilla dace have been captured throughout the Brilliant Headpond (Amec Foster Wheeler 2017).

White Sturgeon (*Acipenser transmontanus*) are listed as Endangered under the Species-At-Risk-Act (SARA) and are red-listed (endangered) in BC. Prior to construction of the Brilliant Dam, Columbia River White Sturgeon were able to move between the Columbia, lower Kootenay and Slocan rivers, however, following construction in 1944 any White Sturgeon within the Brilliant Headpond became isolated. White Sturgeon have not been captured during fish inventories or targeted White Sturgeon sampling and it is unlikely a self-sustaining population exists in the headpond or Slocan Lake upstream (R.L. & L. 1996; Amec Foster Wheeler 2017) but a few individuals may still reside in Slocan Lake (Porto 2008).

Rainbow Trout (*Oncorhynchus mykiss*) have been documented throughout the headpond and have been observed to spawn in Glade Creek, around the mouth of the Slocan River and near Gold Island (R.L. & L. 1999, Amec Foster Wheeler 2017). Mountain Whitefish (*Prosopium williamsoni*) have been documented in higher abundances in the upper section of the headpond and decreased with increasing distance downstream of South Slocan Dam (R.L.& L. 1999). Kokanee (*Oncorhynchus nerka*) have been documented in the headpond but abundance was lower than all other fish species captured (R.L.& L. 1999) and they may have been entrained from Kootenay Lake through dams upstream of the headpond. Amec Foster Wheeler (2017) provides a comprehensive summary of each fish species observed in Brilliant Headpond.

Table 3: Fish species know to occur or have occurred in the Brilliant Headpond 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) Listing
Bull Trout	*Salvelinus confluentus*	Blue	-
Rainbow Trout	*Oncorhynchus mykiss*	Yellow	-
Mountain Whitefish	*Prosopium williamsoni*	Yellow	-
Kokanee	*Oncorhynchus nerka*	Yellow	-
Redside Shiner	*Richardsonius balteatus*	Yellow	-
Peamouth Chub	*Mylocheilus caurinus*	Yellow	-
Largescale Sucker	*Catostomus macrocheilus*	Yellow	-
Longnose Sucker	*Catostomus catostomus*	Yellow	-
Bridgelip Sucker	*Catostomus columbianus*	Yellow	-
Northern Pikeminnow	*Ptychocheilus oregonensis*	Yellow	-
Torrent Sculpin	*Cottus rhotheus*	Yellow	-
Prickly Sculpin	*Cottus asper*	Yellow	-
Slimy Sculpin	*Cottus cognatus*	Yellow	-
Columbia Sculpin	*Cottus hubbsi*	Blue	Special Concern
Shorthead Sculpin	*Cottus confuses*	Blue	Special Concern
Longnose Dace	*Rhinichthys cataractae*	Yellow	-
Leopard Dace	*Rhinichthys falcatus*	Yellow	-
Umatilla Dace	*Rhinichthys umatilla*	Red	Special Concern
White Sturgeon	*Acipenser transmontanus*	Red	Endangered

3.7.1 Historical Fish Use Information

Slocan Pool was historically an important fishing location for First Nations prior to the construction of dams downstream. Sockeye Salmon, Chinook Salmon and other migratory fish like Bull Trout (*Salvelinus confluentus*) and Steelhead (Rainbow Trout that migrate to the ocean) were plentiful in Slocan Pool and the area was a gathering spot for fishing and hunting (Scholz and Bromberg 2017). First Nations would gather on Gold Island in the Slocan Pool in the fall to fish for these species (Westslope 2001). Additional information on historical fisheries in the Brilliant Headpond is provided in Amec Foster Wheeler (2017).

3.8 Wildlife and Wildlife Habitat Observations

Observations recorded during the wildlife surveys are summarized in Appendix E.

Forty-three bird species were recorded by sight or sound during the two surveys, most occurring only during the July 18th survey (Appendix E). Six mammal species were recorded, along with one amphibian, Columbia Spotted Frog (*Rana luteiventris*). In addition, one reptile species was encountered, however, this was during a site visit related to a separate project by a crew member who sighted two Northern Alligator Lizards (*Elgaria coerulea*) on September 14, 2017 in Segment 6.

Great Blue Heron (*Ardea herodias*; provincially Blue-listed; SARA Special Concern) was the only species of conservation concern observed during the wildlife surveys. A single Great Blue Heron was sighted on July 18, 2017 and thirteen individuals were observed on September 28, 2018. Herons were mostly fishing in the shallows or flying across the headpond; no nests were observed.

The following wildlife attributes observed in the Brilliant Headpond during the July and September 2017 wildlife surveys were incorporated into the AHI:

- One Osprey (*Pandion haliaetus*) nest observed in Segment 14 and one unidentified raptor nest was observed in the same segment that appeared too small for an Osprey or Bald Eagle (*Haliaeetus leucocephalus*) but may have been under construction at the time of observation;
- Belted Kingfisher (*Megaceryle alcyon*) nesting observed in Segment 15;
- North American Rough-Winged Swallow (*Stelgidopteryx serripennis*) nesting observed in Segment 3 (Figure 8);
- Bank Swallow (*Riparia riparia*) colony observed in Segment 16.
- Ten Beaver (*Castor canadensis*) lodges observed in Segments 3 (n=3), 4 (n=1), 12 (n=1), 13 (n=1), 14 (n=1), 15 (n=1) and 17 (n=2); and,
- One North American River Otter (*Lontra canadensis*) den observed in Segment 15 (Figure 8).

Figure 8: North American River Otter den entrance observed in Segment 15 (left) and North American Rough-Winged Swallow colony in Segment 3 (right).

3.9 Shoreline Modifications

Docks were the most prevalent shoreline modification observed in the Brilliant Headpond. Docks (n=37) were observed in 5 segments with the majority (n=21) occurring in shoreline areas around Thrums (Segment 1; Figure 9; Figure 10). The next most common shoreline modification were groynes (n=17) with the majority (n=11) observed along the Shoreacres shoreline (Segment 11). Boat launches (n=7) and retaining walls (n=4; approximately 95 m total length) were the other modification types observed. Other modifications not included in the FIM data dictionary were also recorded during the survey including fences, rip-rap, historic industrial shoreline structures, swim platforms, sand beaches, mooring buoys, pilings, stairs, sun decks, hydro line, drainage culvert, ferry landing and boat racks (Appendix D).

Lineal shoreline modifications observed included railways, roadways and substrate modification (Figure 11). Lineal shoreline modifications were observed along 8,926m (24%) of the Brilliant Headpond shoreline. The most prevalent lineal development was roadways that occurred along 5,359 m (15%) of the shoreline, followed by railways along 3,435 m (9%) and substrate modification along approximately 130 m (<1%).

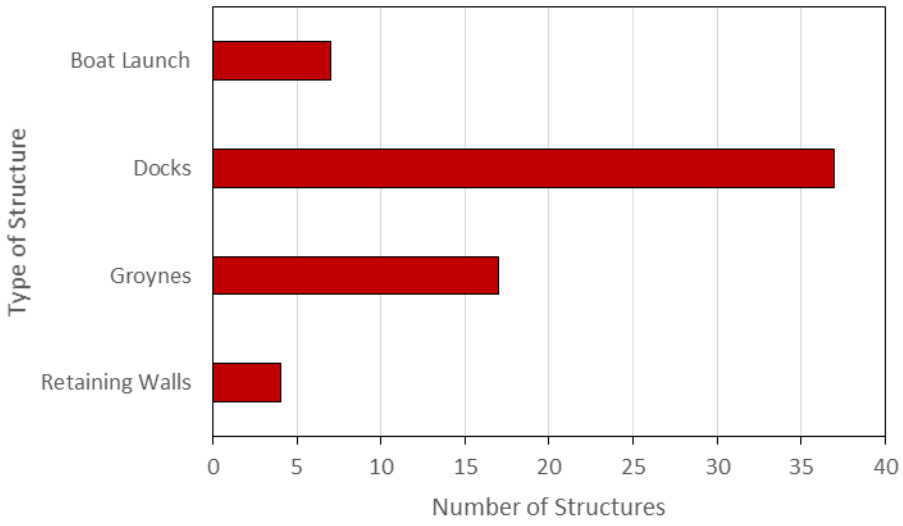

Figure 9: Total number of shoreline modifications observed along the shoreline of Brilliant Headpond.

Figure 10: Example of shoreline modifications observed along Brilliant Headpond including a dock in Segment 1 and a retaining wall in Segment 11.

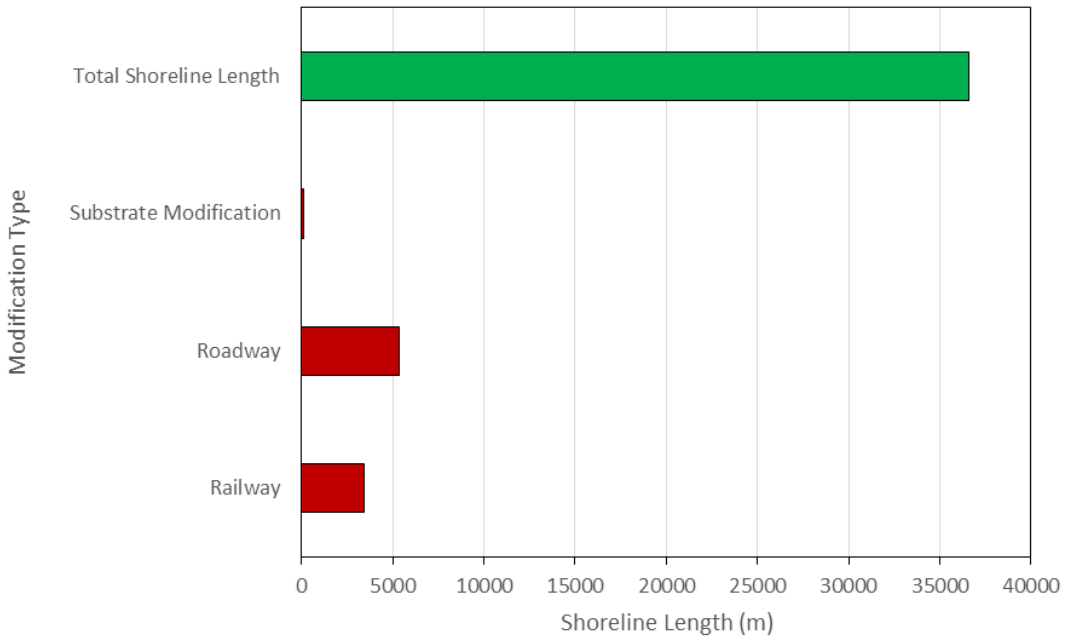

Figure 11: Total shoreline length that has been impacted by substrate modification, roadways and railways along the shoreline of Brilliant Headpond

3.10 Level of Impact

The majority of the Brilliant Headpond shoreline had a high level of impact resulting from various shoreline structures, riparian removal and lineal developments (Figure 12). In total, 19,405 m (53%) of the shoreline was considered to have a high level of impact (>40% disturbance). Areas with no impact (0% disturbance) were observed along 9,481 m (26%) of the shoreline while a low level of impact (<10% disturbance) was observed along the remaining 7,679 m (21%). No areas were classified as having a moderate level of impact along the Brilliant Headpond.

The highest level of disturbance (≥90%) was observed adjacent to Thrums (Segment 1), Shoreacres (Segment 11) and Glade (Segment 5). The shoreline adjacent to Thrums had the highest concentration of docks in the headpond (n=21; 5.7 docks/km) as well as other shoreline modifications including retaining walls (approximately 37 m total length), groynes (n=3; 1 groyne/km), road modification (approximately 2,975 m total length), boat launches (n=2) as well as placed gravels and rip rap. The invasive weed Yellow Flag Iris (*Iris pseudacorus*) was documented adjacent to Thrums. The shoreline adjacent to Shoreacres had the highest concentration of groynes in the headpond (n=11; 3.6 groynes/km) as well as other shoreline modifications including docks (2.6 docks/km), retaining walls (approximately 30 m total length), road modification (approximately 153 m total length), boat launches (n=4) as well as substrate modification, mooring buoys (n=4), fences (n=10), pilings (n=5), sun decks (n=3), stairs and a swim platform. The shoreline adjacent to Glade had docks (n=6; 1.5 dock/km), groynes (n=3; 1 groyne/km), road modification (approximately 397 m total length), a boat launch as well as substrate modification. Shoreline erosion has been observed in all three segments and is most notable adjacent to Shoreacres.

The shoreline downstream of Thrums on the northeast bank (Segment 2) had been modified by a railway line for the entirety of its length (2,715 m) and the shoreline adjacent to the ferry access road and ferry landing on the east shore to Tarrys (Segment 15) had been modified by both road and railway. Although both segments were classified as having a high level of impact, the majority of each segment was classified as natural due to the presence of intact riparian buffers between the lineal modifications and the shoreline.

No impacts were observed along the east shore across from Thrums (Segment 3), east shore downstream from Glade (Segment 4), Gold Island (Segment 10) or bluffs on west shore in Thrums (Segment 17). Figure 13 provides examples of each level of impact assessed.

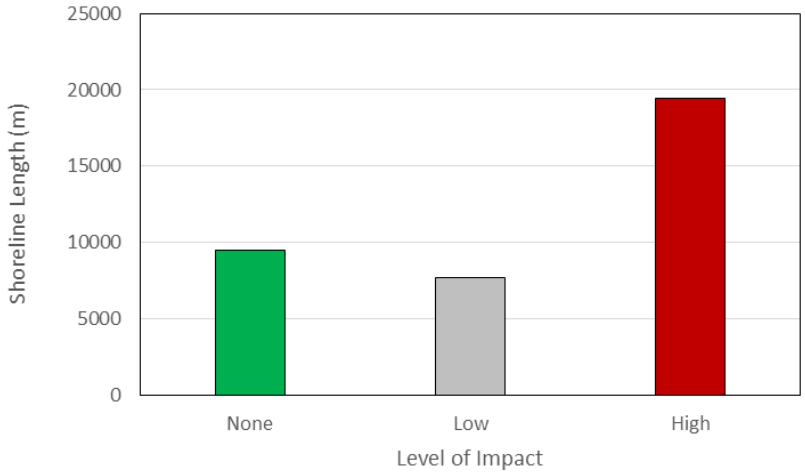

Figure 12: Level of Impact (None, Low, Moderate or High) observed along the shoreline of Brilliant Headpond.

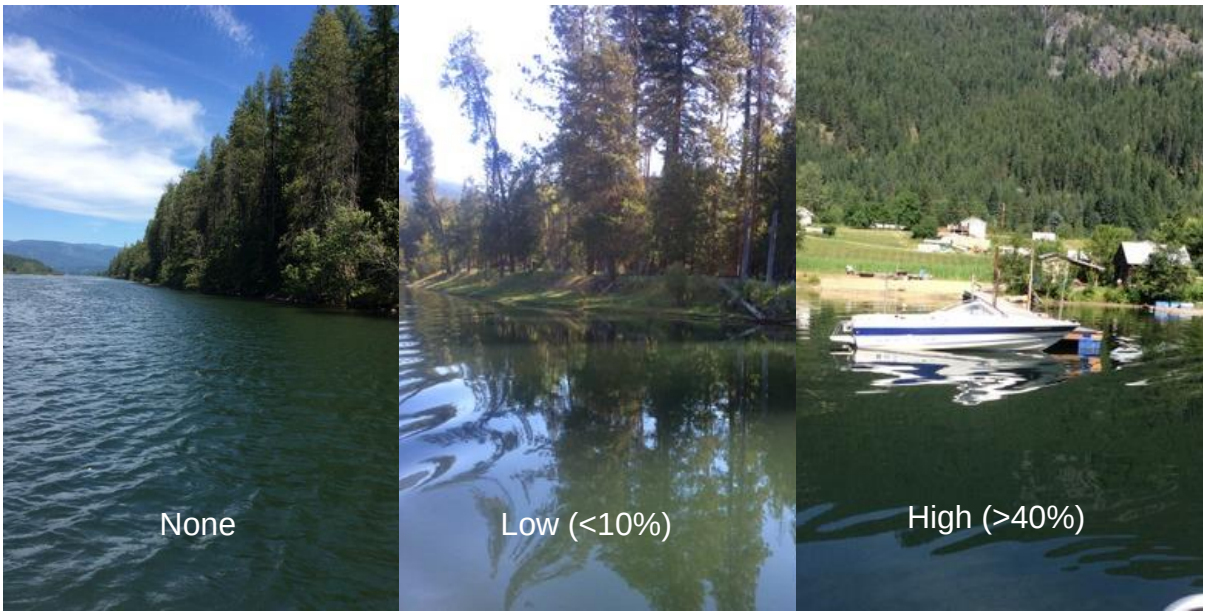

Figure 13: Examples of the different levels of impact assessed along the shoreline of Brilliant Headpond.

3.11 Zones of Sensitivity

Zones of Sensitivity identified during FIM surveys, fish and wildlife assessment and background data review are described below. Zones of Sensitivity are identified on maps provided in Appendix D.

- Wetlands – Wetlands were identified and inventoried during the Brilliant Headpond FIM. Wetlands are an important component of a healthy ecosystem providing habitat, flood control, water filtration and food resources. In Brilliant Headpond, wetlands can buffer the shoreline from the impacts of daily water level fluctuation.

- Tributary Mouths – Tributary mouth/fan areas provide important habitat for fish migration and staging. Tributaries to the Brilliant Headpond provide habitat spawning, egg incubation and juvenile rearing habitat. Spawning by Rainbow Trout, Bull Trout and/or Kokanee has been identified or is very likely to occur in the Slocan River, McPhee Creek, Little McPhee Creek and Glade Creek. Tributary mouths can also provide cool water refuge during periods of high water temperatures.

- Wildlife Features – Wildlife habitat structures identified during wildlife surveys included raptor nests, Bank Swallow colonies, North American Rough-Winged nests, Belted Kingfisher nests, River Otter dens and Beaver lodges. The fixed placement habitat structures themselves may be sensitive to habitat disturbance as may the wildlife that use them during critical life history periods (e.g. fledging).

The level of detail currently available data for other sensitive habitat areas including native freshwater mussel locations and high value juvenile fish rearing habitats was not specific enough to be presented spatially on the maps in Appendix D. Native Floater mussels have been documented sporadically throughout the Brilliant Headpond. Mussels are important to water quality, filtering substantial volumes of water and possibly reducing turbidity. Mussels are also a key part of food webs, filtering algae, bacteria, zooplankton and sediment from the water while being a food source for predators such as River Otters. Floater mussels are very sensitive to environmental changes including pollution and habitat disturbance including water level fluctuations associated with reservoir operations. High value juvenile rearing habitat provides food, cover and refuge for fish species of conservation concern (e.g., Umatilla Dace) and fish species of cultural and recreational importance (e.g., Rainbow Trout). Maps can be updated in the future to capture these and other sensitive sites if more detailed data becomes available.

3.12 Aquatic Habitat Index

A summary of the current and potential AHI values for the Brilliant Headpond is provided in Table 4. Maps of shoreline segments with AHI rating are provided in Appendix C. Calculations for each parameter for all segments are provided in Appendix F.

Most of the shoreline was rated as High (40.5%) value aquatic habitat followed by Moderate (22.5%), Very Low (18.5%), Very High (17.4%) and Low (1.1%).

Very High value shoreline was identified in Segment 3 (east shore across from Thrums) and Segment 12 (Slocan River mouth). Segment 3 was in 100% natural condition, had high value riparian, fish and wildlife habitat and no modifications. Nearly all of Segment 12 was in natural condition (95%) with high value riparian, fish and wildlife habitat. One small section of substrate modification was identified in Segment 12 associated with a historical aerial pipeline crossing structure.

High value segments (4, 6-10, 14 and 15) were located on the east shore of the headpond, in the Slocan Pool area or up and downstream of the ferry on the west shore. Access is relatively limited in all of these areas. High value segments were typically <30% disturbed, had high ranking biophysical and riparian characteristics, either high value fish or wildlife habitats and no modifications (the only exception being Segment 6 (east shore across from Shoreacres) where a new dock and trail were observed). Moderate value segments (2, 5, 13 and 16) were generally >40% disturbed leading to reduced value of biophysical and riparian habitat compared to High

segments. Moderate value segments also had at least one type of modification including either retaining walls, docks, groynes, boat launches and/or substrate modification. Segment 17, a rock bluff on the east shore between Thrums and Tarrys, was the only segment ranked as Low. While the segment was 100% natural with intact riparian habitat, the steep shoreline, lack of aquatic vegetation and other sources of cover provides limited habitat for fish and wildlife.

Segment 1 (Thrums) and Segment 11 (Shoreacres) were rated as Very Low. Segment 1 had a sand shoreline with wetlands and interspersed high value fish rearing habitats, but it was 90% disturbed with extensive residential development including riparian vegetation removal, many modifications including docks, groynes and boat launches, and road access. Segment 11 was 95% disturbed resulting in low value riparian habitat and the negative value associated with modifications (e.g. groynes) was the highest of all segments (Appendix F). Segment 1 and Segment 11 AHI ratings could be improved from Very Low to Moderate with community led foreshore vegetation restoration (Table 4). Opportunity for restoration also exist in Segment 5 (Glade) which was rated Moderate but could be restored back to High value. Segment 5 was 90% disturbed, had the lowest biophysical feature (e.g. shore type, substrate, aquatic vegetation, etc.) score of all segments and had modifications including docks, groynes, boat launches and substrate modification.

Table 4: Current and Potential AHI rankings for Brilliant Headpond.

AHI Ranking	Current AHI			Potential AHI		
	# of Segments	Shoreline Length (m)	% of Shoreline	# of Segments	Shoreline Length (m)	% of Shoreline
Very High	2	6,371	17.4	2	6,371	17.4
High	8	14,796	40.5	8	17,965	49.1
Moderate	4	8,243	22.5	6	11,841	32.4
Low	1	388	1.1	1	388	1.1
Very Low	2	6,766	18.5	0	0	0
Total	17	36,564	100	17	36,564	100

The current AHI ranking was analyzed for the different segment shore type designations observed in the Brilliant Headpond (Table 5). All Very High value and the majority of High value shorelines occurred adjacent to rocky shores. Moderate value shorelines occurred adjacent to either rocky shore or sand shore types. Low value shorelines occurred adjacent to cliff/bluff shore type types and Very Low value shorelines occurred adjacent to sand shore types.

Table 5: Summary of the current Aquatic Habitat Index results for the different shoretypes along the shoreline of Brilliant Headpond.

Categories	Cliff/Bluff Shore		Rocky Shore		Sand Shore	
	Length (m)	%	Length (m)	%	Length (m)	%
Very High	0	0	6,371	100	0	0
High	0	0	13,481	91.1	1,316	8.9
Moderate	0	0	3,068	37.2	5,175	62.8
Low	388	100	0	0	0	0
Very Low	0	0	0	0	6,766	100

4.0 DISCUSSION

The highest level of shoreline disturbance along Brilliant Headond (>50% of the segment) was observed adjacent to the communities of Shoreacres, Glade and Thrums as well as along the west shoreline adjacent to the railroad and Glade Ferry Rd. The majority of disturbance was associated with residential shoreline development and modifications including docks, groynes, boat launches, retaining walls, substrate modification to create beaches, rip-rap, fences, mooring buoys, swim platforms and stairs. Disturbance was also associated with industrial shoreline development including railways, roads, ferry landings, transmission line and the abutments associated with a historic aerial pipeline crossing.

The AHI suggested nearly 60% of the Brilliant Headpond shoreline was of High or Very High quality aquatic habitat. Segments ranked as High or Very High were primarily located along the east shoreline where limited shoreline access is available at this time and consequently, there has been limited development. Other locations of Very High and High ranking shorelines included the Slocan River mouth, Slocan Pool and the areas up and downstream of the ferry on the west shore. The Slocan River mouth is a very high value fish migration area and provides habitat for at-risk sculpin and dace species. The east and west shorelines of Slocan Pool, as well as Gold Island, are primarily undisturbed with functional riparian, littoral and wetland areas as well as high value juvenile rearing habitat. One segment identified as Low aquatic value shoreline consisted of steep-sided banks with limited fish and wildlife values (Segment 17 between Tarrys and Thrums). Very Low quality aquatic habitat occurred in areas where the shoreline was heavily disturbed and had the highest number of shoreline modifications including Segment 1 (Thrums) and Segment 11 (Shoreacres). Both areas were evaluated as very low due to the extensive development impacts. However, important aquatic habitat values including wetlands, LWD, aquatic vegetation and/or juvenile fish rearing habitat were still present. As identified during the potential AHI analysis, restoration efforts focused at the Thrums and Shoreacres shoreline areas have the potential to improve the value of aquatic habitat from its current condition.

Brilliant Headpond provides habitat for several at-risk fish species including Columbia Sculpin, Shorthead Sculpin, Umatilla Dace and Bull Trout and habitats used by these species can be impacted by shoreline development. Sculpin and dace species are found in shallow, nearshore habitats, typically associated with cobble/boulder substrates and/or aquatic vegetation. All three at-risk sculpin and dace species were identified along the shoreline upstream of the Slocan River mouth by AMEC (2014). Adfluvial Bull Trout migrate into tributaries in the late summer and typically spawn downstream of barriers in locations with suitable gravels (Amec Foster Wheeler 2017). Bull

Trout spawning likely occurs in upstream tributaries to the Slocan River and Slocan Lake and when conditions are suitable in Glade Creek (Baxter and Irvine 2017) and potentially in smaller tributaries to the Brilliant Headpond (R.L. & L. 1999). Stream mouth areas within the headpond are critical staging and migration locations for this species while water quality, water quantity and the riparian buffer along tributaries are important aspects of migration and spawning habitat for at-risk Bull Trout.

One at-risk avian species, Great Blue Heron, was observed during wildlife surveys in both July and September 2017. However, no heron rookeries were observed during the survey though it was during the incubation and nestling period (mid-April to July). The nearest rookery was identified in 2005 within the vicinity of Brilliant Headpond near Goose Creek, a tributary to the Slocan River, however, this location was no longer active during follow-up assessments in 2006 and 2007 (Machmer 2009). Wildlife surveys for this program were conducted in the summer and early fall. It is possible that other wildlife species use the Brilliant Headpond at different times of the year and surveys conducted during other periods such as spring and winter could provide additional information on wildlife use of the foreshore.

Known locations for native Floater mussels (*Anodonta* sp.) in the Brilliant Headpond were provided by the Ktunaxa and Okanagan Nation Alliance (ONA). Surveys were conducted in 2016 and 2017 to identify mussel locations. To date, mussels have been identified at the two formal sample locations, Gold Island and Shoreacres, as well as near the Glade public boat launch and shoreline adjacent to Thrums (Kenton Andreashuk, Ktunaxa, pers. comm. 2018). Mussels have also been identified by recent stranding risk surveys conducted by Amec Foster Wheeler on behalf of FortisBC. Although a comprehensive assessment covering areas within each segment of the Brilliant Headpond shoreline has not been completed, the existing observations were included in the AHI to capture the information that is available at this time. Floater mussels are sensitive to habitat disturbances including water level fluctuations associated with reservoir operations (Nedeau et al. 2009).

The data types included in the AHI include data sets that were considered comprehensive enough to represent all shoreline areas. The AHI can be easily modified to include additional data types in the future.

5.0 RECOMMENDATIONS

- Complete comprehensive assessment of the presence of mussels throughout the Brilliant Headpond. Mussels have been documented in various areas during either direct or indirect assessments by Ktunaxa, ONA and FortisBC. However, a comprehensive inventory including assessment in all shoreline segments has not been conducted. The information available at this time has been included in the AHI which can easily be updated if additional mussel inventories are conducted.
- Complete a detailed survey of wetlands and aquatic vegetation types. This can be completed by following wetland classification standards (Mackenzie and Moran 2004) in the field or as a desktop exercise when high resolution air photos are available. Update the FIM database to include these polygons, similar to assessments completed during the Kootenay Lake FIM.
- Identify areas of erosion in the Brilliant Headpond and update the FIM database to include these areas. Schleppe and Cormano (2016) developed an erosion hazard rating during the Kootenay Lake FIM and a similar survey and evaluation could be utilized. Erosion was noted in the shore type comments for Segments 3 and 4, however an extensive inventory and assessment has not been completed.
- Focus habitat restoration effort in areas where aquatic habitat improvement could increase the AHI. For example, the potential AHI analysis suggested restoration of shoreline areas adjacent to Thrums (Segment 1), Shoreacres (Segment 11) and Glade (Segment 5) could substantially improve the habitat quality.
- Focus habitat conservation and protection in areas with high and very high value AHI rankings. High priority locations include the Slocan River mouth (Segment 12) and the east shoreline upstream from Brilliant Dam to Thrums (Segment 3).
- Use previous examples of successful habitat restoration projects within the Brilliant Headpond when selecting future restoration projects. For example, a wetland habitat restoration project was completed near Thrums in 2005 (Segment 1) and a terrestrial restoration project was completed in 6 hectares of the Skattebo Educational Forest (Segments 3 and 4) adjacent to the Brilliant Headpond shoreline by Selkirk College in 2001 (as cited in Amec Foster Wheeler 2017). More recently, a bank stabilization and riparian restoration project was completed by Columbia Power and ONA in November 2017 in the Slocan Pool area (Segment 9; Dave DeRosa, ONA, Major Projects, pers comm. 2018).
- Identify site sensitivites within segments, regardless of the AHI ranking, during the design, planning and permitting of proposed developments. Though a segment was ranked as Very Low or Low quality aquatic habitat, Zones of Sensitivity (high value habitat features) were observed within some of these segments. Development applications proposed in these areas should accommodate for the presence of these small but important habitat features.
- Consider environmentally sensitive habitats throughout the Brilliant Headpond during the preparation of guidance, policy and planning documents such as Official Community Plans, Bylaws, and Shoreline Management Guidelines.

6.0 REFERENCES

AMEC. 2011. B.C. Ministry of Environment Scientific Fish Collection Permit Submission CB11-73361. Available at http://www.env.gov.bc.ca/ecocat/.

AMEC. 2012. B.C. Ministry of Environment Scientific Fish Collection Permit Submission CB12-79007. Available at http://www.env.gov.bc.ca/ecocat/.

AMEC. 2014. Lower Columbia River Sculpin and Dace Life History Assessment (CLBMON-43). Year 5 Technical Report. Report Prepared for: BC Hydro, Burnaby, BC. Prepared by: AMEC Environment & Infrastructure Ltd. 117 pp + 8 App.

Amec Foster Wheeler. 2017. Brilliant Headpond Reservoir Ecological Studies Review. Report Prepared for Living Lakes Canada, Nelson, BC. 21 pp. + 1 app.

Baxter, JTA and R. Irvine. Slocan Lake Bull Trout Redd Counts - 2016. Prepared for the Fish and Wildlife Compensation Program - Columbia. 19 p.

British Columbia Ministry of Environment (BC MOE). 2018. Fisheries Inventory Data Queries. Accessed on January 31, 2018. Available at: http://www.env.gov.bc.ca/fish/fidq/

Conservation Data Center (CDC). 2018. BC Species & Ecosystem Explorer and CDC iMap. Accessed on January 31, 2018 Available at: http://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/conservation-data-centre/explore-cdc-data/species-and-ecosystems-explorer

Government of Canada. 2018. Real-Time Hydrometric Data Search. Accessed on February 1, 2018. Available at: https://wateroffice.ec.gc.ca/search/real_time_e.html

Machmer, M. 2009. Great Blue Heron and Bald Eagle Inventory and Stewardship in the Columbia Basin (2008-2009). Prepared by Pandion Ecological Research Ltd. for the Columbia Basin Fish and Wildlife Compensation Program, Nelson, BC. 23 p + 2 app.

Mason, B. and J. Booth. 2004. Coastal Shoreline Inventory and Mapping. Community Mapping Network, Vancouver, BC.

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

Nedeau, E., A. Smith and J. Stone. 2009. Freshwater Mussels of the Pacific Northwest. Prepared for the U.S. Fish and Wildlife Service, Water Tenders and the Xerces Society for Invertebrate Conservation. 45 p.

Porto, L. 2008. White Sturgeon populations in the BC Hydro dam footprint impacts area. Report prepared for the Columbia Basin Fish and Wildlife Program, Columbia Basin, Nelson, BC. 45 p. + 1 app.

Porto, L. and C. Lawrence. 2016. Morphology and Timing of Spawning of Umatilla Dace (Rhinichthys umatilla) in the Slocan River, British Columbia. Canadian Field Naturalist 130: 224-229.

R.L. & L. Environmental Services Ltd. 1996. The distribution and status of white sturgeon in isolated waterbodies within the Columbia River Basin in B.C., 1995 study results. Report prepared for B.C. Ministry of Environment, Lands and Parks. R.L. & L. Report No. 468aD: 12 p. + 2 app.

R.L. & L. Environmental Services Ltd. 1999. Brilliant Expansion Project: Summary of aquatic inventory data of the Kootenay system near Brilliant Dam. Report prepared for Columbia Power Corporation, Castlegar, B.C. R.L. & L. Report No. 552F: 72 p. + 3 app.

Resources Inventory Committee (RIC). 1998. Inventory methods for snakes. Resources Inventory Committee and Ministry of Environment, Lands and Parks. Victoria, BC.

Resources Inventory Committee (RIC). 1999. Inventory methods for forest and grassland songbirds Version 2.0. Resources Inventory Committee and Ministry of Environment, Lands and Parks. Victoria, BC.

Schleppe, J. and A. Cormano, 2016. Kootenay Lake Foreshore Inventory and Mapping and Aquatic Habitat Index. Ecoscape Environmental Consultants Ltd. Project File: 12-952. May 2016. Prepared for: Kootenay Lake Partnership & Fisheries and Oceans Canada.

Schleppe, J. and B. Mason. 2009. Standard Methods for Completion of Foreshore Inventory and Mapping Projects. Prepared by Ecoscape Environmental Consultants Ltd. And the Community Mapping Network. 37 p + 4 app.

Scholz, A. and A. Bromberg. 2017. Indians of the Upper Columbia River Basin and Their Salmon Fisheries. Presentation by the Eastern Washington University Department of Biology Fisheries Research Center. Available at: http://wabc-afs.org/w/wp-content/uploads/2017/05/Dr.-Al-Scholz-II-Indians-of-the-Upper-Columbia-River-Basin.pdf

Vandenbos, R. 2013. B.C. Ministry of Environment Scientific Fish Collection Permit Submission CB13-90126. Available at: http://www.env.gov.bc.ca/ecocat/

Appendix A

Standard Methods for Completion of Foreshore Inventory and Mapping Projects

FORESHORE INVENTORY AND MAPPING

Standard Methods for Completion of Foreshore Inventory And Mapping Projects

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District of Lake Country
District of Invermere
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East Kootenay Integrated Lake Management Partnership
Ducks Unlimited
Fraser Salmon and Watersheds Program
BC Conservation Foundation
BC Real Estate Foundation
Okanagan Basin Water Board
Various different private companies and sponsors

With proper management, we may begin to find a balance within our ecosystems. Without the ongoing support for inventory and mapping initiatives, the objective of sustainable development and balance will not be achieved.

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1.0 INTRODUCTION

Foreshore Inventory and Mapping is a methodology currently being employed to map the larger lakes of British Columbia experiencing land use and recreational pressures. The protocol for Foreshore Inventory and Mapping (FIM) was first developed by the Regional District Central Okanagan, in conjunction with the Department of Fisheries and Oceans, Ministry of Environment, City of Kelowna, District of Lake Country, BC Conservation Foundation, and the Real Estate Foundation of British Columbia (Magnan and Cashin, 2004). The intent of the project was to characterize shoreline areas around the central regions of Okanagan Lake so that sensitive ecosystems could be better managed.

Since 2005, numerous other lakes have been mapped using this methodology. During 2008, the Ministry of Environment, Department of Fisheries and Oceans (Community Mapping Network) and other stakeholders worked to update information collected during FIM to better reflect how this information is being used. With the numerous ongoing works on FIM projects, it was in the best interest of land use managers to ensure a standardization of the FIM methodology.

2.0 FORESHORE INVENTORY AND MAPPING OVERVIEW

Foreshore Inventory and Mapping (FIM) is a GPS/GIS assessment of lake shorelines. The methodology closely resembles that of Sensitive Habitat Inventory and Mapping (Mason and Knight, 2001), a GPS/GIS methodology developed for mapping streams and watercourses. The concepts are similar to other land based spatial mapping initiatives (e.g., Terrestrail Ecosystem Mapping (TEM), Sensitive Habitat Inventories (SEI)). However, for lake shorelines, the primary feature under review is the shore zone area. For the purposes of this methodology, the shorezone is the area from the pelagic regions of the lake (deepwater) to 30 to 50 m past the high water level in the upland/riparian zone. In FIM, spatial data describing the shore zone area is attributed to shoreline using a line feature.

The methodology developed incorporates standard practices developed by the Resource Inventory Committee for mapping of fish and fish habitat features. It also adapts standards developed for stream SHIM mapping (Mason and Knight, 2001). The methodology is typically completed in a three step process as follows:

1. Video Documentation of the Lake Shoreline;
2. Data Collection of biophysical and habitat attributes along the lake shoreline;
3. Reporting and Data Analysis;

The intent of FIM projects is to catalogue and describe land uses (e.g., Residential Development), shoreline modifications (e.g., docks), and biophysical attributes (e.g., substrates) along lake shoreline. Information collected allows resource managers at all levels of government to incorporate the information into a variety of land use planning documents including but not limited to:

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1. Official Community Plans;
2. Shoreline Management Plans;
3. Land and Resource Management Plans;

For a complete review of background information or for use of a GPS/GIS software/hardware, readers should refer to the Sensitive Habitat Inventory and Mapping (Mason and Knight, 2001) and the Technical Addendum in Part 3 of the Central Okanagan Forshore Inventory and Mapping (Magnan and Cashin, 2004). These documents provide in depth documentation of background information for use of GPS/GIS technologies for mapping habitat features and watercourses. A brief summary of some GIS techniques is found in Appendix D.

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2.1 Development of the Foreshore Inventory and Mapping Protocol

The following provides a summary of projects that have currently been completed using this methodology in British Columbia:

Table 1: Foreshore Inventory and Mapping of Lakes Completed to Date

Lake	Region	Year Completed
Okanagan Lake (Central portions)	Okanagan	2004
Osoyoos Lake	Okanagan	2002
Winderemere		2006
Skaha Lake	Okanagan	2008
Shuswap	Thompson	2008
Nicola Lake (Video)	Thompson	2006
Mara Lake	Thompson	2008
Moyie Lake	Kootenay	2008
Monroe Lake	Kootenay	2008
Rosen	Kootenay	2008
Tie	Kootenay	2008
Columbia	Kootenay	2007
Wasa	Kootenay	2008
Windemere	Kootenay	2008
Charlie	Peace	2008
Swan	Peace	2008
Dragon	Cariboo	2008
Sheridan	Cariboo	2008
Williams	Cariboo	2008
Bigelow	Skeena	2008
Call	Skeena	2008
Kathlyn	Skeena	2008
Lakelse	Skeena	2008
Round	Skeena	2008
Seymore	Skeena	2008
Tyhee	Skeena	2008
Gun	Thompson	2008
Montana	Thompson	2008
Pinantan	Thompson	2008
Sakinaw	Lower Mainland	2008
Ruby	Lower Mainland	2008
Sproat	Vancouver Island	2008
Horne	Vancouver Island	2008
Kemp	Vancouver Island	2008
Langford	Vancouver Island	2008
Prospect	Vancouver Island	2008
Cowichan Lake (Video)	Vancouver Island	2006

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Since 2004, when the methodology was first developed for Okanagan Lake, land resource managers at local, provincial, and federal levels have begun to utilize data collected during FIM. Data collected during these inventories has been incorporated into Official Community Plans, has been used to prepare Aquatic or Ecological Habitat Indices (e.g., Schleppe and Arsenault, 2006; McPherson and Hlushak, 2008), and has been used to facilitate making informed land use decisions. The baseline inventory information collected can also be used for monitoring purposes, to develop land management objectives for a shoreline, and to develop shoreline management plans and policies.

Development of the data dictionary, or database, for FIM has undergone several different iterations over the past few years. Contributors to the ongoing FIM projects, the database and methodology are summarized in the acknowledgements section of this document. All funding partners who have provided to the development of the FIM protocol should be given recognition for the investments towards improved lake management.

During the summer of 2008, meetings were coordinated with the Regional District Central Okanagan, Regional District Okanagan Similkameen, City of Kelowna, Ministry of Environment, and Department of Fisheries and Oceans to update the data dictionary to reflect current usage of the database and to ensure data collected is most appropriate to guide shoreline management. As part of these meetings, it was determined that there was a need to standardize the methodology for FIM, as recommended in the Foreshore Inventory and Mapping report prepared for the central regions of Okanagan Lake (Magnan and Cashin, 2004). The following document is intended to provide this standardization by:

1. Providing an overview of field assessment techniques and methodologies;
2. Providing a detailed summary of the most recent FIM Data Dictionary (SHIM LAKE v. 2.6) (full dictionary is in Appendix C);
3. Reconciling previous versions of the database with the most current version so end users understand how the different fields have been adapted over time (see Appendix B for tabular summary);

3.0 FOREHORE INVENTORY AND MAPPING OVERVIEW

Foreshore Inventory and Mapping is generally a three step process, as follows:

1. Shoreline Video Documentation;
2. Shoreline Data Collection;
3. Data Analysis and Reporting;

During the Video Documentation (Step 1), a video is collected for the entire shoreline of a lake. The video is stamped with GPS coordinates that can be used to help with determination of where you are along the shoreline. The video documentation is typically referred to as Pass 1. During this pass, assessors should make note of significant features and begin to asses where shore segment breaks will be made.

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Shoreline Data Collection (Step 2) is where most of the field data for the assessment is collected. This is often referred to as Pass 2. During this stage, data is entered into the GPS data dictionary for all applicable fields. Other information that may be collected includes shoreline habitat mapping (e.g., delineating the extent of shore marshes on air photos), mapping significant changes in substrates within a segment, etc.

During The Data Analysis and Reporting stage, data is transferred to a computer and then is processed. During this step, data is reviewed and corrections are made as necessary. It is preferred if data collectors also process data, as they have had first hand experience with field collection. This review and correction of the data acts as a quality assurance process and is one of the most important steps in the process. Finally, data is transferred to the shoreline, and segment breaks are adjusted so that they occur where intended during the field assessment.

Once these steps have been completed, this work is often times followed by more detailed data collection such as shoreline wildlife habitat mapping, shore marsh habitat mapping, shore spawning mapping, etc. Other data bases have also been developed that are currently being used to assess compliance with best management practices and permitting. With the accumulation of multiple data sets, end users then may also pursue Aquatic Habitat Index development (e.g., Schleppe and Arsenault, 2006; McPherson and Hlusak, 2008). The focus of this document is to detail data collection for items 1 through 3 above. However, recommendations are presented to help facilitate future data management and integration (see Section 7.0).

4.0 FIELD ASSESSMENT

The field assessment, as discussed above, typically occurs during two steps. The following sections will provide methodology for pre field requirements, shoreline video documentation, and shoreline data field collection.

4.1 Pre-Field Overview

During the pre field overview, assessors should gather as much background information as possible. The pre field overview will help guide the field assessment to ensure that all information is collected.

During the pre field overview, the following information should be gathered, if possible:

1. The most recent digital (GIS) air photographs of the entire shoreline. Air photos are valuable to help determine segment breaks, assess land uses, and to help assess important features such as the location of stream mouths. Air photos are available for most areas of the province and have been flown at varying times. Preferably, air photos will be included in budgets for these projects to ensure the most recent information is available.

2. Any topography information for the shoreline. Topographic information is available for almost all areas of the province from the TRIM mapsheets and can be obtained digitally (GIS files). This information can help assessors determine reach breaks and assess slope.

3. Local cadastre information for private holdings that occur along the shoreline. This information is typically available digitally (GIS or AutoCAD files) from the local government, first nations offices, or regional districts.

4. Jurisdiction and Zoning information from local government, first nations, and regional districts. This information can help assessors determine land uses and segment breaks. In some instances, this information is available digitally (GIS files), but may also be available as map sheets from the local jurisdiction.

5. Any provincial parks boundaries, conservations areas, or other known features that occur along the shoreline. Much of this information is available from the Land and Data Warehouse, provided by the Integrated Land Management Bureau.

Once the above information has been collected, assessors should prepare field maps that can be used to document information during their survey. Field maps should show all available information possible in a concise manor. Field maps are not required to complete the assessment, but are extremely valuable as they provide a method to record field observations that can be digitized in GIS later. Field maps are especially valuable to help with defining the locations of important shore marsh habitats and stream mouths, because often times the location of these features is not spatially accurate. Matching field map grid sheets to the local government sheets can be helpful.

If field maps are generated, assessors can provide a pre field assessment of the shoreline. During this assessment, possible segment breaks and other information can be set up to assist with the field inventory.

4.2 Shoreline Video

The purpose of recording lake shoreline video is to assist in classifying lake shore substrates, land use and land cover. Detecting change over time as a result of development or natural disturbance can then be examined. The video can also be used to classify or validate the classification of shoreline segments and to assist in quantifying structures such as boat ramps and retaining walls. Depending on the lake, it may be appropriate to capture video at a particular elevation such as high or low water. For example, if video is captured during high water, the number of retaining walls that become submerged or partially submerged can be enumerated.

The selection of a boat is critical. If possible, choose a boat that is stable under windy conditions and that has a small draft to avoid grounding when navigating near the shore. An appropriate power supply such as a car or RV battery should be used with a power inverter to ensure there is adequate power for all of the recording equipment.

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The following is a guide for recording georeferenced lake shoreline video. Video equipment is constantly being improved as well as recording methods. However, the tools are only as good as the operator so nothing replaces training, personal experience and practice. There are several models and several setup options for recording shoreline video so the following is to be used only as a guide.

Almost any digital video camera can be used successfully, however, users must become familiar with the video camera controls prior to going into the field. The video should be recorded no more than 50 m from shore if possible. One to two homes should be in the view of the video at one time. Do not use the digital zoom and try not to use the optical zoom if possible, otherwise the video will become blurry especially in rough conditions. The video should be recorded on dry, calm days if possible. A general rule is that the larger the waves, the poorer the quality of the resulting video. Other considerations include:

- good image stabilization
- analog output (mandatory)
- durability for use in the field conditions
- easy to use and reach buttons
- a lense shrowd to protect from direct sunlight
- a polarized lense
- an excellent tripod with easy to use controls
- tape or harddrive storage media

Geo-referencing the video output by tagging each frame with a latitude and longitude is recommended. In addition, a GPS track line should be recorded at the same time using one second intervals. This will allow synchronization of the video with the GPS trackline for each shoreline segment.

Analog output from a digital video camera connects to a GPS stamper unit such as Horita or SeaTrak (figure 1). GPS output also connects to the GPS stamper unit. Ouput from the GPS stamper unit is recorded onto a digital video recorder or a personal computer. In the case of a digital video recorder, the use of a digital video player is useful in order to ensure the video output is correct.

Video files should be edited to remove any unwanted frames. A digital video recorder is very efficient for doing this task. Alternatively, video can be edited using video editing software such as Pinacle or Adobe on a PC.

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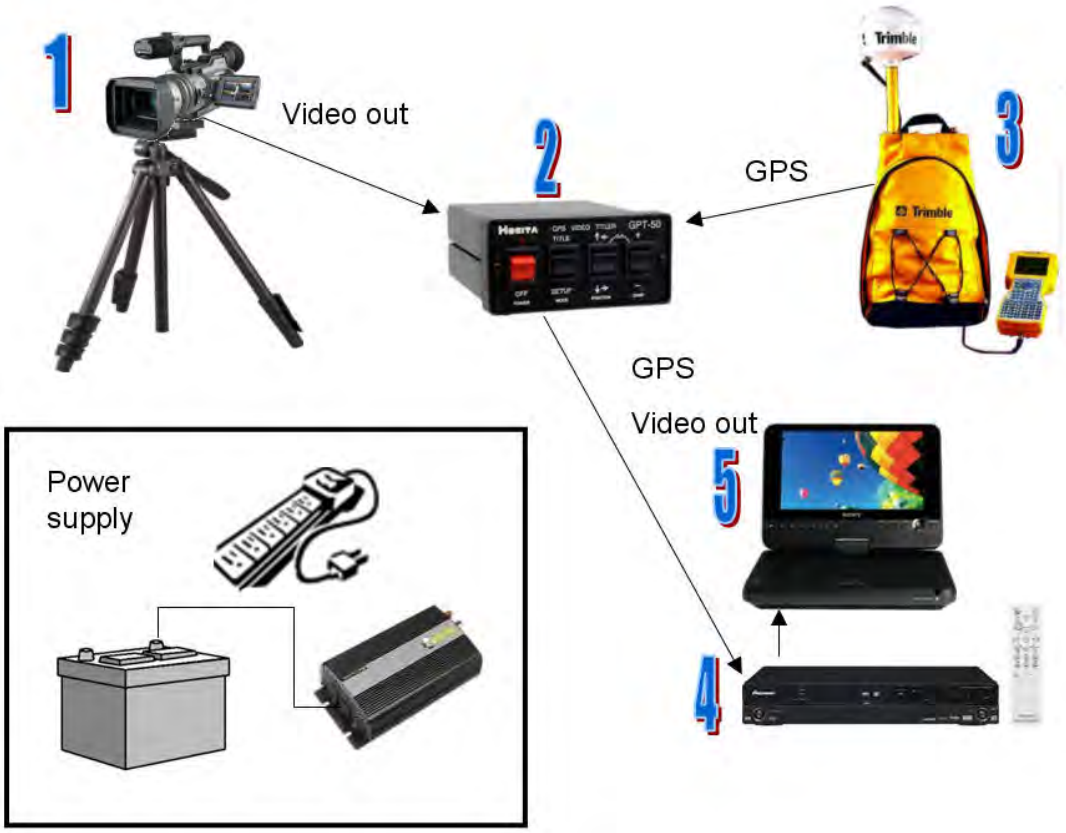

Figure 1: Shoreline video setup. 1) Digital video camera, 2) GPS stamper unit, 3) GPS data logger and receiver, 4) Digital video recorder, 5) Digital video player

4.3 Shoreline Data Field Collection

The shoreline field data collection involves the following different categories of information:

1. *Lake Reference* – This section of the data dictionary includes summary information for the lake being assessed and the crew assessing the information.
2. *Segment Class* – This section of the data dictionary includes a summary of the dominant features of the shore segment, such as land use, shore type, slope, etc.
3. *Shore Type* – This section includes specific information regarding the different shore types that occur along the shore segment.
4. *Land Use* – This section includes specific information regarding the different land uses that occur along the shore segment.
5. *Substrates* – This section includes specific information regarding substrates that occur along the shore segment.
6. *Vegetation Band 1* – This section includes specific information regarding the first distinctive band of vegetation. This section was previously called Riparian (See Appendix A)

7. *Vegetation Band 2* – This section includes specific information regarding the second distinctive band of vegetation. This section was previously called Upland (See Appendix A)
8. *Littoral Zone* – This section contains specific information regarding littoral zone features of the shore segment.
9. *Modifications* – This section contains specific information regarding shoreline modifications, such as retaining walls and docks, that exist along the shoreline.
10. *Flora and Fauna* – This section contains specific information regarding flora and fauna information, such as veterans and snags, that exists along the shoreline segment.

Within each of the different sections above, data fields allow assessors to enter specific information into the GPS unit. A field crew of three to four people (plus a boat skipper) is optimal for these assessments. As there are many items that need to be counted and there is some interpretation required, at least one crew member should be very familiar with the database and have a good understanding of the methodology to guide other members of the crew. During the assessment, crew members will assume different roles, such as counting docks, paying attention to substrates, etc. and it is preferred if crew members focus on their particular tasks rather than trading off part way through the assessment. If assessors intend on trading of tasks part way through, they should thoroughly discuss their criteria and ensure that the other is familiar with their task. A paper photo log should also be completed. Assessors should take as many representative photos as possible of the shoreline to aid with data management and quality assurance review.

The following is a list of some of the field equipment that should be taken on the field assessment vessel:

1. Four to Eight Thumb Counters;
2. Field Maps for the entire shoreline (if available);
3. At least one GPS Unit with the data dictionary loaded (with a back up if available);
4. Digital Camera, or preferably a Digital Camera with GPS stamp;
5. Water proof field paper for field notes and data sheets (in case GPS unit fails);
6. Binoculars for viewing shore substrates and other features;
7. Required Safety Equipment such as life vests, rain gear, etc.

The following sections will provide specific information for interpreting and entering data into the data fields of the GPS unit. Appendix A provides a summary of the following sections in tabular format.

4.3.1 Lake Reference

The Lake Reference section is intended to provide background information regarding the lake that is being assessed, field conditions during the assessment, and the crew completing the assessment. The following is a summary of data fields and methods for this section of the dictionary (summarize in Appendix A).

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1. *Lake Name* – This field is for the local lake name (gazetted or common name);

2. *Lake Level* – This field is for the level or elevation of gauges lakes on the date of the assessment. On gauged lakes, lake level is typically the geodetic level (i.e., above sea level) of the lake the day the assessment was completed. However, each gauging station will be benchmarked to a certain level and this standard should be used. This will help people utilizing data understand at what water level the data was collected. This field should be left blank if the lake level is unknown or if the lake is not gauged. Some lake levels are available online at http://scitech.pyr.ec.gc.ca/waterweb/formnav.asp

3. *Secchi Depth* – This field is for entering the Secchi depth. Secchi depth is a measure of the point where a 20 cm weighted white line disappears from view when lowered from the shaded side of a vessel and that point where it reappears upon raising it. This measurement should be made at mid-day as the results are more variable at dawn and dusk. Secchi depths vary depending upon the time of year measured and productivity of a lake, particularly in lakes with increased particulate matter (e.g., algae). This measurement is not required, but can be included if assessors have the necessary equipment to complete it.

4. *Organization* – This field is to enter the organization that is completing the work. Organizations include government, non-profit organization, or companies who are responsible for collection of the field data.

5. *Date and Time* – This field is for the date and time. These fields allow assessors to enter the date and time of the assessment. Some GPS units may enter this information automatically.

6. *Crew* – This field is for the crew completing the field assessment. Assessors should enter the initials of all crew members on the vessel who are completing the assessment.

7. *Weather* - The weather is a categorical field. Available options include Light Rain, Heavy Rain, Snow/Sleet, Over Cast, Clear, Partly Cloudy, and other. This field should be filled in with the most appropriate weather observed throughout the day. If the Other category is chosen, field assessors should identify the weather in the comments field.

8. *Air and Water Temperature* – The air and water temperature fields allows assessors to enter in the temperature during the assessment.

9. *Jurisdiction* – The jurisdiction field is to identify the governmental entity that has predominant governance over the shore segment being assessed. Typically, this would be a local government, regional district or first nations band. In some cases, the shoreline may occur along crown land or within a provincial park. If possible, field assessors should break segments at all major changes in jurisdiction to allow

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for better management of shore line segments. If a segment break is not included at a change in jurisdiction, the jurisdiction with the predominant length of shoreline should be listed here and the secondary jurisdiction should be noted in the comments field.

10. *Comments* – The comments field is for assessors to enter any relevant information regarding the lake information.

4.3.2 Segment Class

The Segment Class section is intended to provide a summary of the dominant land uses, shore types, and other characteristics of the entire shore segment. The following is a summary of data fields and methods for this section of the dictionary (summarize in Appendix A).

1. *Segment Number* – The shoreline segment number is a field that identifies the shore segment. The shore segment if the fundamental unit of FIM and each shore segment is characterized by attributes (e.g., land use, shore type, vegetation) that are similar. Typically, shore segments begin at 1 and continue until the entire shoreline has been mapped. However, in some instances, shore segments may begin at another number, particularly in cases where only portions of a lake are mapped at various different time periods. Shore segments should generally have a similar land use, shore type, vegetation, and substrates. The minimum length of shoreline for a shore segment is 50 m and there is no maximum to the length of a shore segment. Generally, assessors will create more segments in densely developed areas due to changes in vegetation cover and land use than they will under more natural conditions, when shorelines tend to be more similar for longer stretches.

   Determining Shore Segment Breaks

   Shore segments should consider the following different criteria:

   a. Shore Type is a primary characteristic (defined below) that should be used to assess shore breaks;
   b. Land Use is another primary characteristic (discussed below) that should be used to assess shore segments. Changes from residential development to single family development, for instance, could warrant a segment break.
   c. Vegetation is another characteristic that can be used to determine segment breaks. Significant differences in vegetation coverage are typically associated with changes in land use also, but sometimes can be due to differences in property management.
   d. Stream Mouths are extremely important shore types and should be given their own segments for important fish habitat streams.

2. *Shore Type*– Shore type is a categorical field that describes the predominant shore type that occurs along the length of the shore segment (i.e., the highest percentage

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of the linear shoreline length). Shore types include Cliff/Bluff, Rocky Shore, Gravel, Sand, Stream Mouth, Wetland, and Other. If other is selected, comments should be included to describe the shore type observed. Definitions for each of the above shore types are found in the Shore Type Section discussed below.

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

    a. *Log Yard* – A log yard is an area where logs are temporarily stored until they all moved to a lumber mill. Log yards typically have large log breakwaters, log booms, and associated loading / unloading facilities.
    b. *Large and Small Marina* – A marina is any type of location where boats are moored. A boat slip is where each boat is moored and each finger of a dock may be used to moor two boats (i.e., one on each side). Marinas can either be on pile supported or floating structures. Marinas may have associated break waters, fueling stations, boat launches, etc. Also, marinas can be associated with commercial or multi family dwellings.
    c. *Railway* – Railways constructed within 5 to 10 m or below the high water level are another shore type modifier. Railways should only be considered a modifier if they are within 0 to 15 m of the shoreline and there is no private holdings between the railway and the shoreline. Decommissioned railways can be considered a railway modifier.
    d. *Roadway* – The roadway modifier identifies shore segments where a roadway occurs directly adjacent to the shoreline. Roadway should only be considered a modifier when they are within 10 to 15 m of the shoreline and there are no private holdings between the roadway and the shoreline. Boat Launch access roads are not considered a roadway modifier.

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

5. *Land Use* – Land use is a categorical field that is used to describe the predominant land use observed along the segment. Categories include Agriculture, Commercial, Conservation, Forestry, Industrial, Institution, Multi-Family, Natural Area, Park, Recreation, Single Family, Rural, and Urban Park. Land use can be determined based upon a combination of field observation, review of zoning and bylaw maps,

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and air photo interpretation. Please refer to detailed definitions of the different land use types to better understand the different categories below.

6. *Level of Impact* Level of impact is a categorical field that is used to describe the general disturbance that is observed along the shoreline. Disturbances are considered any anthropogenic influence that has altered the shoreline including foreshore substrates, vegetation, or the shoreline itself (e.g., retaining walls). Level of impact is considered both looking at the length of the shore line (i.e., along the segment) and the depth of the shore zone area to between 15 to 50 m back. In more rural settings, typically the assessment area is greater (i.e., 50 m) and in more developed shorelines, typically the assessment area is less (i.e., 15 to 30 m). In cases of roadways or railways, one should generally consider the location of the rail or roadway along the segment (i.e., how far back is it set, is the lake infill, etc.). To facilitate interpretation of this category, air photo interpretation is recommended to better estimate disturbance. Disturbance categories include High (>40%), Medium (10-40%), Low (<10%), or None. Consistency of determination is very important and assessors should use the same criteria to determine the level of impact. The RDCO Foreshore Inventory and Mapping report defines the *Level of Impact* as follows (Magnan and Cashin, 2004):
    a. *Low*- Segments that show little or limited signs of foreshore disturbance and impacts. These segments exhibit healthy, functioning riparian vegetation. They have substrates that are largely undisturbed, limited beach grooming activities, and no to few modifications.
    b. *Moderate* - Segments that show moderate signs of foreshore disturbance and impacts. These segments exhibit isolated, intact, functioning riparian areas (often between residences). Substrates (where disturbed) exhibit signs of isolated beach grooming activities. Retaining walls (where present) are generally discontinuous. General modifications are well spaced and do not impact the majority of the foreshore segment.
    c. *High* - Segments that show extensive signs of disturbance and impacts. These segments exhibit heavily disturbed riparian vegetation, often completely removed or replaced with non-native species. Modifications to the foreshore are extensive and likely continuous or include a large number of docks. Generally, residential development is high intensity. Modifications often impact a majority of the foreshore.

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

8. *Disturbed* – The disturbed field allows assessors to enter the percentage of the shoreline that is disturbed by anthropogenic influence. This is a measurement of the approximate length and depth of the shore zone that has been disturbed. Assessors should use a combination of field observations and air photo interpretation to determine the percentage disturbed. Generally, the percentage

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disturbed should correspond to the level of impact (i.e., a high percentage of disturbance should translate into a High level of impact). The summation of the Percentage Disturbed and the Percentage Natural should equal 100%. If air photo field maps are available, use of a scale ruler can help assessors determine the percentage that has been disturbed. Although this field is somewhat qualitative, assessors should do their best to be consistent and to be as quantitative as possible.

9. *Natural* – The natural field is the percentage of the shoreline that is natural. This is a measurement of the approximate length and depth of the shore zone that remains in a natural condition. Assessors should use a combination of field observations and air photo interpretation to determine the percentage disturbed. Generally, the percentage natural should correspond to the level of impact. The summation of the Percentage Disturbed and the Percentage Natural should equal 100%. If air photo field maps are available, use of a scale ruler can help assessors determine the percentage that has been disturbed. Although this field is somewhat qualitative, assessors should do their best to be consistent and to be as quantitative as possible.

The remaining fields that are included in the data dictionary are described in Appendix A. These fields do not have any specific methodology and are for information purposes.

4.3.3 Shore Type

The Shore Type section is intended to provide a summary of the different shore types that may occur over the entire shore segment. In many cases, one shore type will be predominant in a segment, with other shore types occurring to a smaller extent. Examples of this include rocky shorelines, with intermittent gravel beach areas in depositional areas. The shore type section allows assessors to enter in the approximate percentage of the shore segment that is occupied by the different shore types.

When determining the percentage of a segment that a shore type occupies, assessors should utilize whatever data is available to them. During the field assessments, scaled air photos can be used to determine the approximate percentage. If field maps are not available, assessors should use best judgment to estimate the percentages. As segment lengths become longer, it becomes more difficult to estimate the percentage of a segment a particular shore type occupies. Given this, an assessor should be cognizant of the distance traveled, boat speed, and other factors when judging the percentage of the segment.

Initial shore type fields were developed by the Resources Inventory Committee (RIC, 2001) and were subsequently refined and adapted for the Foreshore Inventory and Mapping of Okanagan Lake (Magnan and Cashin, 2004). The shore types below were again refined during the summer of 2008 in discussions with the Ministry of Environment, Department of Fisheries and Oceans, and local government stakeholders and consultants. The most significant change in SHIM Lake v.2.6 is the removal of the Vegetated Shore Type. This shore type was removed because all shore types describe physical aspects of the shoreline whereas the vegetated shore type described vegetation characteristics. The following is a

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summary of data fields and methods for this section of the dictionary (summarize in Appendix A).

1. *Cliff / Bluff* – The Cliff / Bluff field allows assessors to enter the percentage of the segment, based upon the shore segment length, that is a cliff or bluff shore type. A cliff shore type is typically very steep with substantial vertical elements that are greater than 70º or 275%. A bluff shore type is typically steep or very steep, and then flat for a substantial distance, typically formed by the fast recession of water levels during glacial periods. Bluff substrates tend to consist mostly of silts and clays.

The above photos are examples of a cliff shoreline (left) and a bluff shoreline (right).

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

The photo above is an example of a typical rocky shoreline. Sometimes, a rocky shoreline may contain less bedrock and larger boulders. Substrates on these shoreline should consist predominantly of larger cobbles, boulders, and bedrock.

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3. *Gravel Shoreline* – The Gravel shore type field contains the percentage of the segment, based upon the shore segment length, that is a gravel beach. Gravel beach shorelines tend to occur on Low or Moderate slopes, and substrates are predominantly gravels and cobbles. These shore types may also contain small percentages of boulders and / or bedrock. Often times, gravels beaches and rocky shores occur along one segment, with gravel shore types occurring in depositional areas (i.e., in bays) and rocky shores (i.e., at points) occurring in erosion areas. Previous data base versions may have also referred to these shorelines as vegetated shores.

The photo above shows a typical gravel beach. Notice that substrates consist mostly of gravels and cobbles. Gravel shorelines may also have boulders and periodic patches of bedrock in some instances. In previous database versions, a shoreline such as this may also have been referred to as a vegetated shore.

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

The photo above shows a typical sandy shoreline.

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

The photo above is the Adams River on Shuswap Lake. This is a good example of a stream mouth segment.

6. *Wetland* – The Wetland shore type field contains the percentage of the shoreline, based upon the shore segment length, which is a shore marsh wetland. A wetland segment typically occurs on low gradient sites, the littoral zones is wide and shallow, substrates are predominantly silts, organics, or clays, and there is emergent vegetation present. The Wetlands of British Columbia defines a shore marsh as a seasonally or permanently flooded non tidal mineral wetland that is dominated by emergent grass like vegetation. The BC Wetland book contains descriptions of some of the wetland shore types that may be observed along lake shorelines

The photo above shows an example of a wetland shore type. Notice the significant amounts of emergent vegetation. The Wetlands of British Columbia A Guide to Identification (MacKenzie and Moran, 2004) book provides specific classifications for the different types of marshes that occur.

The remaining fields that are included in the data dictionary are described in Appendix A. These fields do not have any specific methodology and are for information purposes.

4.3.4 Land Use

The Land Use section allows assessors to provide more detail regarding existing land uses. Land use categories have been created to generally correspond with a broad range of local government zoning bylaws. Other categories have been created to correspond with provincial, non-profit, and federal government land use types (e.g., natural areas parks, conservations areas, etc.). In many cases, shore segments will have only one land use type. However, in some instances, land uses may slightly vary along a segment and the differences do not warrant creation of a new shore segment. These fields allows users to enter the percentage of the shoreline, based upon the shore segment length, which the different land uses occupy.

When determining the percentage of a segment that a shore type occupies, assessors should utilize whatever data is available to them. During the field assessments, scaled air photos can be used to determine the approximate percentage. If field maps are not available, assessors should use best judgment to estimate the percentages. As segment lengths become longer, it becomes more difficult to estimate the percentage of a segment a

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particular shore type occupies. Given this, an assessor should be cognizant of the distance traveled, boat speed, and other factors when judging the percentage of the segment.

1. *Agriculture* – The agriculture land use field is the percentage of the shoreline, based upon the shore segment length, which is predominantly used for crop based agricultural or as active livestock range lands (i.e., extensive holding areas, large numbers of cattle etc.). Livestock pastures that are not active rangelands (i.e., a few cows or horses) are typically considered a rural land use and not an agriculture land use (see rural). These lands are typically part of the Agriculture Land Reserve or a provincial range tenure.

2. *Commercial* - The Commercial Land use field is the percentage of the shoreline, based upon the shore segment length, which is predominantly used for commercial purposes. Commercial purposes include retail, hotels, food establishments, marinas with fuel, stores, etc. Commercial areas tend to occur along highly impacted shorelines. Where feasibly, significant commercial areas should be part of one segment because the land use on these shore types has a different assortment of potential impacts. Commercially zoned, but yet to be constructed areas, may also warrant there own segment.

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

4. *Forestry* - The Forestry Land use field is the percentage of the shoreline, based upon the shore segment length, which is predominantly used for forestry. These areas are typically Crown Lands that are part of active cut blocks or forestry operations. Log Yards are considered an Industrial Land Use and are not considered a Forestry Land because they tend to have associated industrial infrastructure.

5. *Industrial* - The Industrial Land use field is the percentage of the shoreline, based upon the shore segment length, which is predominantly used for industrial purposes. Examples of industrial purposes include log yards, processing facilities, lumber mills, etc. These shorelines are typically heavily impacted by infrastructure, impervious surfaces, buildings, etc.

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

7. *Multi Family Residential* - The Multi-Family Land Use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for

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multi-family residences. Multi-family developments are typically condominiums, apartments, or town homes.

8. *Natural Areas* - The Natural Areas Land use field is the percentage of the shoreline, based upon the shore segment length, which are predominantly undisturbed crown lands. These areas do not occur in provincial or federal parklands and cannot be privately held.

9. *Park* - The Park Land Use field is the percentage of the shoreline, based upon the shore segment length, which are predominantly natural areas parklands. These parks areas can be provincial, federal, or local government parks. These parks tend to be relatively undisturbed and natural. They differ from urban parks (discussed below), which are used intensively for recreational purposes (e.g., public beaches).

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

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

12. *Single Family Residential* - The Single Family Residential Land Use is the percentage of the shoreline, based upon the shore segments length, which is predominantly used for single family residential purposes. Typically, single family residential occurs in more densely developed areas. However, seasonal use cottages or cabins can often be considered single family residential areas if the dwellings have associated outbuildings, docks, and other features consistent with more densely developed areas. In areas where the there are numerous seasonal use cabins and cottages, assessors should consider this single family residential if lots have smaller lake frontages and land uses and buildings are consistent with single family types of development. If lake frontages for seasonal use cabins and cottages are quite large, the land use would be considered rural. The differentiation between rural and single family in these cases can be difficult and assessors should be consistent in their determination.

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

The remaining fields that are included in the data dictionary are described in Appendix A. These fields do not have any specific methodology and are for information purposes.

4.3.5 Substrates

The substrate section of the data dictionary allows assessors to enter in detailed information regarding foreshore substrates. Shore substrates are important for a variety of reasons and can influence primary productivity. When describing shore substrates, assessors should describe a *representative distribution* of substrates along the shoreline. It is acknowledge that shore substrates are variable along shore segments; with many areas have concentrations of coarse or fine materials. Thus, this section provides a description of the distribution of substrates and may not be representative of particular micro-sites that occur along the segment.

When assessing substrates, the entire shore segment should be considered. In many cases, small amounts of a particular substrate type may be observed (e.g., one small bedrock outcrop along a gravel shoreline). In these cases, a value of 1% should be used to acknowledge the presence of this substrate type along the shore segment.

Shore substrates are best viewed at low water levels because more of the foreshore is visible. However, often assessments do not coincide with these periods. Thus, binoculars are extremely helpful to help determine substrates along a shoreline. They allow assessors to better assess particle size to appropriately fill in data fields. Assessors may also wish to exit the vessel and visually inspect the shoreline substrates. The data fields in the data dictionary allow assessors to enter in detailed information for highly visible shorelines and summary information for less visible shorelines (e.g., Gravels can be entered as total gravels or sub described as fine and coarse gravels). As segment lengths become longer, it becomes more difficult to estimate the percentage of a segment a particular shore type occupies. Given this, an assessor should be cognizant of the distance traveled, boat speed, and other factors when judging the percentage of the segment.

The following are descriptions of the different substrate type fields that occur within the data dictionary. Substrate definitions below are derived from the Sensitive Habitat Inventory and Mapping manual (Mason and Knight, 2001) and Reconnaissance (1:20,000) Fish and Fish Habitat Inventory: Standards and Procedures (2001)

1. *Marl* - The Marl substrate field allows assessors to enter the relative percentage of marl occurring along the shoreline. Marl is a substrate that is typically white in color, associated with clear lakes and consists of loose clay, precipitated calcium

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carbonate, mollusk/invertebrate shells, and other impurities. Marl substrates would often be associated with fines, mud, or organics depending upon the lake.

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

3. *Organics* - - The Organic substrate field allows assessors to enter the relative percentage of organic materials that occur along the shoreline. Organic substrates are typically associated with wetland sites and consist of detritus material that is identifiable to some extent (e.g., sticks, leaves, etc.). Organics generally do not form a large proportion of the substrates unless the shore segment is an extremely productive wetland.

4. *Fine Substrates* - The Fines substrate field allows assessors to enter the relative percentage of fines that occur along the shoreline. Fines consist of silts and clays and these substrates are typically less than 0.06 mm in size. Fines are differentiated from mud because there is little to no organic content.

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

6. *Gravel Substrates* - The Grave substrates field allows assessors to enter the relative percentage of gravels that occur along the shoreline. Gravels are particles that range from 2 mm to approximately 64 mm. Thus, they are the size of a lady bug to the size of a tennis ball or orange. This field should only be used when substrates are difficult to identify and assessors cannot determine whether fine and course gravels (see below).

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

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

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

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

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

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

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

14. *Embeddedness of Substrates* - Embeddedness is a categorical field that allows assessors to enter the approximate embeddedness of substrates. Embeddedness is a measure of the degree to which boulders, cobbles and other large materials are covered by fine sediments. Categories for embeddedness include None (0%), Low (0 to 25%), Medium (25-75%), High (>75%), or Unknown. When assessors are unclear of the embeddedness they should either complete measurements of foreshore substrates or leave the field as unknown.

15. *Substrate Shape* - Shape is a categorical field that allows assessors to identify the shape of larger particles such as cobble or boulders. Angular shapes refer to naturally occurring angular rock material that has not been substantially weathered. Blast rock refers to angular blast rock materials, such as rip rap. Smooth materials are rocks that are generally rounded. This field should be used to describe the predominant substrates that occur along the shoreline (e.g., if 85 % of the substrates are round and smooth, and 10% are blast rock, the field should be used to describe the 85%).

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The remaining fields that are included in the data dictionary are described in Appendix A. These fields do not have any specific methodology and are for information purposes.

4.3.6 Vegetation Bands (Vegetation Band 1 & 2)

The Vegetation Bands sections of the data dictionary are intended to allow assessors to describe lake side vegetation that occurs. The data dictionary includes two sections, Vegetation Band 1 and Vegetation Band 2, which are almost identical. The addition of a second Vegetation Band occurred during the summer of 2008 because in many cases there are two distinctive vegetation zones that exist adjacent to lakes. Other dictionaries have called these two sections Riparian and Upland. The riparian zone, tends to occur in moist areas, and often transitions to drier upland areas. Also, in many wetlands, there is a wide band of emergent shrubs and willows, and then a riparian zone beyond the wetland features. When assessing Vegetation Bands, assessors should consider everything within 50 m of the shoreline and possible the band of emergent riparian vegetation associated with wetland features. The approximate length of the bands considered is the sum of Vegetation Band 1 and 2 Bandwidths.

Vegetation bands can be extremely variable along a segment. Assessors should focus on the primary or dominant vegetation observed along the segment and people utilizing the data must understand that this overview inventory cannot describe every micro-site that may exist. When assessing the different bands, assessors should consider both the linear length and depth of the bands. The intent is to describe a representative section of the shore segment.

In highly urbanized or impacted areas, it is often difficult to define a clear band. In these cases, it is generally preferred to limit the assessment to the first row of development, which often times results in describing only one vegetation band. In other cases, shorelines may not contain two distinctive bands of vegetation. In these circumstances, assessors should only describe the shoreline with one vegetation band, leaving the second band blank. The comments field is a useful section that allows assessors to describe exactly what is being described. Also, the bandwidth fields (discussed below) are helpful because they give an indication of the width of the band.

The following sections describe all fields that occur in Vegetation Band 1 and 2. Fields are duplicated in Vegetation Band 2 and are therefore only described one here. Please refer to Appendix A for a tabular description of information below.

1. *Vegetation Class* - The Vegetation Band 1 Land Cover Class is a description of the predominant vegetation class present. Categories are largely derived from the Sensitive Habitat Inventory and Mapping Module 4 (Mason and Knight, 2001).

    a. The Coniferous Class occurs where tree cover is at least 20% of the shore zone area and at least 80% of the trees are coniferous.

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b. The Broadleaf Class occurs where the tree cover is at least 20% and at least 65% of the trees are broadleaf or deciduous.
c. The Mixed Forest Class occurs where tree cover is at least 20% and there are no more than 80% coniferous trees and no more than 65% broadleaf trees.
d. The Shrubs Class occurs where tree coverage is less than 10% and there shrubs cover at least of 20%. Shrubs are defined as multi-stemmed woody perennial plants.
e. The Herbs / Grasses Class occur where there is at less than 10% tree coverage and less than 20% of shrubs.
f. The Exposes Soil Class occurs where recent disturbance, either anthropogenic or natural, has occurred and mineral soils are exposes.
g. The Landscape Class refers to urbanized areas where most natural vegetation has been replaced by at least 30% coverage of ornamental trees, shrubs, and other vegetation.
h. The Lawn Class occurs in urbanized areas where turf grasses cover at least 30% of the shore zone area and landscaping with ornamental shrubs or trees is less than 30% coverage.
i. The Natural Wetland Class occurs where shore marshes dominate the shore zone area and they have not been significantly influenced by human disturbance.
j. The Disturbed Wetland Class occurs where shore marshes predominate the shore zone area and they have experience significant disturbance (i.e., greater than 30%).
k. The Row Crops Class occurs in agricultural areas where crops are growing. If sites are agricultural, but are not used for row crops (e.g., pasture lands), they should be described as Herbs/Grasses and comments should be used to indicate the agricultural nature of the shore segment.
l. Un-vegetated Sites occur where there is less than 5% vegetation cover and at least 50% of the vegetation cover is mosses or lichens. Un-vegetated sites tend to occur on rocky, exposed shorelines.

2. *Vegetation Stage* - The Vegetation Band 1 Stage is a description of the structural stage of the dominant vegetation. Categories are largely derived from the Sensitive Habitat Inventory and Mapping Module 3 and the Field Manual for Describing Terrestrial Ecosystems (MoE, 1998). On highly developed shorelines, assessors should attempt to describe the structural of the dominant vegetation type observed.

   a. The Sparse Stage describes sites that are in the primary or secondary stages of succession, with vegetation consisting mostly of lichens and mosses, and the total shrub coverage is less than 20% and tree coverage is less than 10%.
   b. The Grass Herb Stage describes sites where shore zones are dominated by grasses and herbs, as a result of persistent disturbance of natural conditions (e.g., grasslands).
   c. The Low Shrubs stage describes sites that are dominated by shrubby vegetation less than 2 m in height.

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d. The Tall Shrubs Stage is dominated by vegetation that is 2 to 10 m in height and seedlings and advance regeneration may be present.
e. The Pole / Sapling Stage describes sites that contain trees greater than 10 m in height, typically densely stocked, and there is little evidence of self thinning or vertical structure.
f. The Young Forest Stage describes sites that are typically less than 40 years old (but could be as great as 50 to 80 years depending upon the forest community), self thinning is evident, and the forest canopy has begun to differentiate into distinct layers.
g. The Mature Forest Stage describes sites that are typically 40 to 80 years old (but could be as high as 140 years), and the under story is well developed with a second cycle of shade trees.
h. The Old Forest Stage describes sites that are typically greater than 80 years old and the stands are structurally complex. Old Forests contain abundant coarse woody debris at varying stages of decay. Old Forests are at least 80 years in age, but may be as old as 250 years and should be considered relative to the forest community assessors are in.

3. *Shrub Cover* - The Shrub Coverage categorically describes shrub coverage within the shore zone. Shrubs are defined as multi-stemmed woody perennial plants. Sparse sites have less than 10% shrub coverage. Moderate shrub coverage occurs on sites that have between 10 to 50% coverage. Abundant shrub coverage occurs on sites that have greater than 50% shrub coverage.

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

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

6. *Bandwidth* - The Vegetation Band 1 Bandwidth field is used to provide an estimate of the approximate width of the band being described. In cases where bandwidth varies along the segment, a representative width should be used to describe the shore segment. The intent of this field is to provide a general description of the width of the vegetation band that is being described and users of the database need to consider this when assessing data within the database.

7. *Overhanging Vegetation* - The Overhanging Vegetation field is used to describe the percentage of the shore segment length that contains significant overhanging

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vegetation. Overhanging vegetation should be considered as if the lake was at full pool or the mean annual high water level.

8. *Aquatic Vegetation* - The Aquatic Vegetation field is used to describe the percentage of the shoreline that contains emergent, submergent, and floating aquatic vegetation. This field is the combined length of aquatic vegetation along the segment, not considering overlapping areas.

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

10. *Submergent Vegetation Presence* - The Submergent Vegetation Presence field is used to indicate whether submergent vegetation is present along the segment. In cases where assessors cannot determine the percentage of the segment but are aware it is present, this field should be used.

11. *Emergent Vegetation* - The Emergent Vegetation field is used to describe the percentage of the shoreline segment that contains emergent vegetation. Emergent vegetation includes species such as cattails, bulrushes, varies sedges, willow and cottonwood on floodplains, grasses, etc.

12. *Emergent Vegetation Presence* - The Emergent Vegetation Presence field is used to indicate whether emergent vegetation is present along the segment. In cases where assessors cannot determine the percentage of the segment but are aware it is present, this field should be used.

13. *Floating Vegetation* - The Floating Vegetation field is used to describe the percentage of the shoreline segment that contains floating vegetation. Floating vegetation includes species such as pond lilies, etc.

14. *Floating Vegetation Presence* - The Floating Vegetation Presence field is used to indicate whether floating vegetation is present along the segment. In cases where assessors cannot determine the percentage of the segment but are aware it is present, this field should be used.

The remaining fields that are included in the data dictionary are described in Appendix A. These fields do not have any specific methodology and are for information purposes.

4.3.7 Littoral Zone

The Littoral Zone section of the data dictionary includes biophysical information about the littoral zone within the segment. Air photos are extremely helpful for determining the width of this zone, but are not necessary. The data fields in this section are quite easy to fill out and interpretation is not that difficult.

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

2. *Large Woody Debris* - The Large Woody debris presence field allows assessors to indicate whether LWD is present along the segment. Categories include Less than 5 Pieces, 5 to 25 Pieces, and Greater than 25 Pieces.

3. *Large Woody Debris Number* - The Large Woody debris count field allows assessors to enter the total number of large woody debris pieces counted along the shore segment. Only significant pieces of large woody debris, which are contributing to fish habitat, should be counted.

4. *Littoral Zone Width* - The Littoral Width field allows assessors to enter the average littoral width of the segment. This field can be determined using air photo interpretation or field measurements. Typically, the field is rounded to the nearest 5 m as the number is intended to be representative of the segment.

The remaining fields that are included in the data dictionary are described in Appendix A. These fields do not have any specific methodology and are for information purposes.

4.3.8 Modifications

The Modifications section allows assessors to enter a summary of all of the different types of shoreline modifications that may occur along the shore segment. Most of the categories described in this section are features or structures that are counted. However, some of the fields require assessors to pay attention to the percentage of the segment that modifications are observed along. As mentioned above, assessors need to be cognizant of boat speed, distance traveled, and this relationship to the feature in question. Again, use of air photos to estimate and scale shoreline length to determine the percentage is extremely beneficial and improves the accuracy of measurements.

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

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

3. *Docks* - The Docks Count field is the total number of pile supported or floating docks or swimming platforms that occur along the segment. Properties may have more than one dock present and each different structure is considered a separate dock. For instance, a property could have one swimming float and one dock.

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4. *Docks per Kilometer* - The Docks per Kilometer field is determined during post processing. This field is calculated by dividing the total number of docks observed by the total length of the shore segment.

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

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

7. *Groynes per Kilometer* - The Groynes per Kilometer field is determined during post processing of data. This field is calculated by dividing the total number of groynes observed by the total length of the shore segment.

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

9. *Percent Rail Modifier* - The Percent Rail Modifier field is used to describe the percentage of the linear shore segment length that contains railways in close proximity to the shoreline.

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

11. *Marine Railways* - The Marine Rail Count field is the total number of marine rails that occur along a shore segment. Marine Rails are a track system that is used to remove boats from a lake during the winter months.

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

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

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

The remaining fields that are included in the data dictionary are described in Appendix A. These fields do not have any specific methodology and are for information purposes.

4.3.9 Flora and Fauna

The Flora and Fauna sections contain specific information for flora and fauna observations and data along the shore segment. The fields in this section are quite self explanatory and are either count or comments fields.

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

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

3. *Flora and Fauna Comments* – These field are important to note observations made. Examples of important observations are known spawning areas, osprey or other birds of prey nesting locations, etc. Significant features should be individually mapped if possible, especially sensitive nesting areas, etc.

5.0 DATA PROCESSING AND QUALITY ASSURANCE

The data processing and quality assurance portions of these projects are extremely important. It is preferred if assessors carry out these steps because they have first hand knowledge of the shoreline and it's condition. Although data entry into the GPS unit results in minimal errors (i.e., forgotten fields, etc.), there is often times small items that are

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missed or accidentally overlooked. It is during the data processing stages that data gets reviewed and finalized.

5.1 Data Processing

Data processing for FIM projects is slightly different than Sensitive Habitat Inventory and Mapping Projects (SHIM) (Mason and Knight, 2001). Module 5 of the SHIM manual provides very detailed information regarding accuracy requirements for stream mapping. This manual should be referred to as it contains useful information regarding standard GPS receivers, data logging, and other requirements that field assessors need to know and be able to do. The methodology below is intended to provide assessors with a summary of the post processing steps that occur as part of a FIM project and does not contain a summary of methods for use of the GPS or GIS software.

5.1.1 Accuracy and Determining the Shoreline Location

Typically accuracy targets for stream mapping are 5 m (Mason and Knight, 2001). These targets are realistic for stream mapping, but are not possible while carrying out boat surveys of a shoreline. Generally, boat surveys are done 20 to 30 m from the actual shoreline being measured. Thus, there is an immediate accuracy issue, as the line feature being collected with the GPS unit is already inaccurate because it is 20 to 30 m from the shoreline. Thus, precision mapping with the GPS is not required for FIM projects (i.e., PDOP values) because of the inherent data inaccuracies.

Accuracy of shore segment information ultimately relates to the accuracy of the shoreline. Mapped shorelines and the spatial data associated with them should be attached the approximate high water level of the shoreline. The above highlights how accuracy is not feasible with a FIM boat survey. Thus, shoreline accuracy with these surveys is typically obtained using air photo interpretation, detailed topographic modeling, or by using existing lake shoreline information. Each of the above provides a different level of accuracy, and typically a combination approach is preferred. Accuracy of the shoreline segment features can affect the following:

1. The length of the shoreline segment;
2. The location of segment breaks;
3. Calculation in the data base such as docks per kilometer;

The first step in post processing is to accurately identify the location of the approximate high water level of the lake being assessed. This can be accomplished, as mentioned above, by using one or a combination of the following:

1. Creation of the shoreline by air photo interpretation using changes in vegetation, retaining walls, and other visible features;
2. Using a topographical model and spatial analyst software to calculate an elevation, which can be used for a shoreline (e.g., 343 m asl is often used for Okanagan Lake); and,

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3. Using existing Terrain Resource Information Mapping shorelines;

There are distinct advantages and disadvantages to each of the above. Advantages of air photo interpretation are that it tends to be quite accurate with good air photos. However, it also tends to be quite time consuming to complete. Use of spatial analyst software is possible, but often times data available to create the model is not very accurate and the software is extremely costly. Use of the TRIM shorelines is very cost efficient, but often times this line work can be quite inaccurate (i.e., up to 20 linear m in some instances). Given the above, assessors must consider the accuracy requirements of their assessments to ensure that the desired accuracy is achieved. Assessors should attempt to achieve the 5 m accuracy recommendations of SHIM and utilize whatever means necessary within allowable budgets to achieve these results. GIS software allows data to be updated as increased accuracy becomes possible.

5.1.2 Segment Breaks

Segment breaks are often determined in field assessments by marking field air photos that were produced for the survey because it is more efficient than manually marking the point using the GPS. These visual markers allow Segment breaks to be easily added to the shoreline once it has been determined (above) and allows field crews to be very specific about where the break is being made from the boat. If air photo field maps are not possible, assessors are strongly encouraged to manually mark the segment break using a point feature on the GPS unit. Using offset features, it is possible to mark this from the vessel. This is recommended because it is the most accurate ways to ensure the segment break occurs where desired on lakes without high resolution air photos.

Once the shoreline has been mapped, and segment breaks have been determined, the database should be "transferred" to the shoreline. This process involves moving the spatial line features to the shoreline with the appropriate breaks. Some databases include the transferred GPS settings (e.g., PDOP data). This data can be retained, but is somewhat unnecessary because it is associated with line features collected in the boat survey and not associated with the manually determined shoreline features discussed above.

5.2 Data Management and Quality Assurance

Data management is extremely important. One of the typical GPS settings used is a copy feature that allows assessors to quickly begin a segment. However, use of this feature can result in data field carry over (i.e., substrate data from Segment 25 is carried over to Segment 26. The assessor forgets to zero a substrate percentage and the number carries over. The substrates total now exceeds 100%). Therefore, once data has been collected, it must be proofed. This process involves review of photos, data fields, etc. The following are specific items that should be reviewed:

1. Lake Reference – Errors in data collection are not common in this section. Clean up of spelling and comments is most common.

2. Segment Class – In this section, the shore type and shore modifier fields are most important and percentages in other sections should be consulted to confirm. Review percentages and ensure that photo numbers are correct. Video time can be entered if available.
3. Shore Type – Field pictures and air photos should be reviewed in conjunction with field data entered. Typically, only minor adjustments are required to ensure data adds to 100%.
4. Land Use – Land use is often more difficult to determine in rural areas. Often times, digital data is lacking and land use is assessed by field interpretation. Review of local government zoning is helpful as it provides a basis for interpretation. Assessors should do their best to document land uses as observed, and adjustments should be made as necessary.
5. Substrates – Field photos can be reviewed, to assist in final determination of substrates. Generally, these fields just need to be reviewed to determine that they add to 100%. Substrates are intended to provide a broad overview of the distribution of segment.
6. Vegetation Bands – Review of field photos is extremely helpful to review these fields. Having a large number of photos can help assessors in ensuring these sections are accurate. Adjustments should be made as necessary.
7. Littoral Zone – These fields are usually quite accurate. A review of air photos to look at the littoral zone widths will help improve accuracy.
8. Modifications – In these fields, the docks per kilometer and groynes per kilometer need to be calculated. These field as calculated as follows:
    a. Dock (or groynes) per Kilometer = # of Docks / Shore Segment Length

   Other items to pay attention to are modifiers. Airp hotos and photos should be carefully reviewed to confirm these fields.
9. Flora and Fauna – These fields usually just need to be briefly reviewed and added as necessary.

Review and finalization of the spatial location of the shoreline, segment breaks, and associated data is very important and assessors should do their best to review data sets.

6.0 REPORTING

Reporting for Foreshore Inventory and Mapping is a budget dependant item. Reporting is not as important as field data collection, review, and verification. Thus, a variety of different reporting can be completed and the reporting completed varies with budgets and time allotted for the project. Reporting should focus on identification of key concerns observed along the shoreline and data analysis should be used to corroborate findings.

6.1 Data Analysis

Data analysis can be completed in numerous different ways using FIM databases. Most reports prepared to date have followed the templates developed by the Regional District Central Okanagan for the central regions of Okanagan Lake. There reports contain numerous different graphs, figures, and correlations prepared using the dataset, and all help

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with understanding and interpreting data. Important correlations can lead to a better understanding of modified shorelines.

Integration of biophysical data with spatial data and analysis is also important. These types of analyses often follow and examples include the various different aquatic habitat indices that have been developed. Ultimately, the shore segments described above provide a basis for long term monitoring and data analysis for lake shorelines because new spatial and biophysical data may be appended to the database from future assessments.

7.0 RECOMMENDATIONS FOR ONGOING DATA MANAGEMENT

The following are recommendations for management of these data sets:

- One location should be determined to hold the master database for the different lake systems being assessed. Spatial data management is a big responsibility and one authority should be determined to hold master data sets. However, municipalities, consultants, non-profit organizations, and the public should all have access to data. Local governments are also good at holding and managing data sets because often times they routinely utilize data on a day to day basis. Regardless, one government body should maintain responsibility for data sets.

- As new data is gathered (e.g., Aquatic Habitat Indexes), it should be appended to the Foreshore Inventory and Mapping data base. Sub databases should be considered (e.g., detailed substrate mapping, more detailed modifications inventories, etc.) as they are developed. Any sub data bases should be referenced in the FIM Database as a field or column of data. The **Shore Segment Number** should be used as the unique identifier for all sub data sets created. Examples of this include geo hazard assessments, shore spawning assessments, substrate mapping, etc.

- Funding should be allocated at all levels to facilitate ongoing data management and collection. These inventories form the basis for all future land management and land use decisions for large lakes. They will help managers at all levels of government work within a unified framework for understanding environmental data and managing the complex aquatic systems associated with our large interior lakes.

- The most recent data base version is SHIM LAKE v. 2.6. This report has attempted to identify and consolidate versions of the dictionary. Future revisions of the methodology should provide a reference guide for changes / additions.

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8.0 REFERENCES

Magnan, B. and T. Cashin. 2004. Regional District of Central Okanagan, 2005. Okanagan Lake Foreshore Inventory and Mapping:. Kelowna, BC.

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

Mackenzie, W.H., and Jennifer Moran. 2004. Wetlands of British Columbia - A guide to identification. British Columbia Ministry of Forests, Forests Science Program. 287pp.

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

MoE, 1998. Field Manual for Describing Terrestrial Ecosystems. BC Ministry of Environment, Lands, and Parks and BC Ministry of Forests. Land Management Handbook 25.

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

RIC. 2001. Reconnaissance Fish and Fish Habitat Inventory: Standards and Procedures. Prepared by: BC Fisheries Information Services Branch. Prepared for: Resources Inventory Committee.

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Appendix A – Foreshore Inventory and Mapping Field Code Definitions

Dictionary Section	Abbreviated Database Column Heading	Un-Abbreviated Column Heading	Previous Database Column Headings (if different)	Type	Definition	Unit of Measurement
Lake Reference	LAKE_NAME	Lake Name		Alphanumeric	Local lake name	
	LAKE_LEVEL	Lake Level		Numeric	On gauged lakes, lake level is the geodetic level (i.e., above sea level) of the lake the day the assessment was completed. This will help people utilizing data understand at what water level the data was collected. This field should be left blank if the lake level is unknown or if the lake is not gauged.	
	SECHI_DEPT	Secchi Depth		Numeric	Secchi depth is a measure of the point where a 20 cm weighted white line disappears from view when lowered from the shaded side of a vessel and that point where it reappears upon raising it. This measurement should be made at mid-day as it results are more variable at dawn and dusk. Secchi depths vary depending upon the time of year measured and productivity of a lake, and in lakes with increased particulate matter (e.g., algae).	Meter
	ORGANIZATI	Organization		Alphanumeric	Organization is the government, non-profit organization, or companies who are responsible for collection of the field data.	
	DATE_	Date		Alphanumeric	Date field data was collected.	
	TIME_	Time		Time	Time field data was collected.	
	CREW	Crew		Alphanumeric	The initials of all field crew, including boat skippers, should be included.	
	WEATHER	Weather		Categorical	The weather is a categorical field. Available options include Light Rain, Heavy Rain, Snow/Sleet, Over Cast, Clear, Partly Cloudy, and other. This field should be filled in with the most appropriate weather observed throughout the day. If the Other category is chosen, field assessors should identify the weather in the comments field.	
	AIR_TEMP_	Air temperature		Numeric	Air temperature is the temperature observed during the assessment.	Celsius
	WATER_TEMP	Water Temperature		Numeric	Water temperature is the water temperature observed during the assessment. This field is not mandatory.	Celsius
	JURISDICTI	Jurisdiction		Alphanumeric	Jurisdiction is the governmental entity that has predominant governance over the shoreline being assessed. Typically, this would be a local government, regional district or native band. In some cases, the shoreline may occur along crown land or within a provincial park. If possible, field assessors should break segments at all major changes in jurisdiction to allow for better management of shore line segments. If a segment break is not included at a change in jurisdiction, the jurisdiction with the predominant length of shoreline should be listed here and the secondary jurisdiction should be noted in the comments field.	
	COMMENTS	Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the data field above.	
Segment Class	SEGMNT_NUM	Shoreline Segment Number		Numeric	The shoreline segment number is a field that identifies the shore segment. Typically, shore segments begin a 1 and continue until the entire shoreline has been mapped. A shore segment is an area of with similar land use, shore type, vegetation, and substrates.	
	SHORE_TYPE	Shore Type		Categorical	Shore type is a categorical field that describes the predominant shore type that occurs along the length of the shore segment (i.e., the highest percentage of the linear shoreline length). Shore types include Cliff/Bluff, Rocky Shore, Gravel, Sand, Stream Mouth, Wetland, and Other. If other is selected, comments should be included to describe the shore type observed.	
	SHORE_MODI	Shore Type Modifier		Categorical	The shore type modifier field is used to describe significant shoreline activities that influence the shoreline. The field is categorical and choices include Log Yard, Small Marina (6-20 slips), Large Marina (greater than 20 slips), Railway, Roadway, None, and Other. If other is selected, the comments field should be used to identify the modifier. If the field is left blank, users should assume that there is no shoreline modifier.	
	SLOPE	Slope		Categorical	Slope is a categorical determination of the slope or gradient of the shoreline. Categories include Low (less than 5%), Moderate (5-20%), Steep (20-60%), Very Steep (>60%), and Bench. A bench is a shoreline that rises, typically steep or very steep, has a flat area typically greater than 15 horizontal meters, and then becomes steep or very steep again. On bluff shore types, where the shoreline rises sharply and then flattens, the categorical statement should describe the steep portion of the shoreline (i.e., do not use bench).	

Dictionary Section	Abbreviated Database Column Heading	Un-Abbreviated Column Heading	Previous Database Column Headings (if different)	Type	Definition	Unit of Measurement
Segment Class	LAND_USE	Land Use		Categorical	Land use is a categorical field that is used to describe the dominant land use observed along the segment. Categories include Agriculture, Commercial, Conservation, Forestry, Industrial, Institution, Multi-Family, Natural Area, Park, Recreation, Single Family, Rural, and Urban Park. Land use can be determined based upon a combination of field observation, review of zoning and bylaw maps, and air photo interpretation. Please refer to detailed definitions of the different land use types to better understand the different categories.	
	LEV_OF_IMP	Level of Impact		Categorical	Level of impact is a categorical field that is used to describe the general disturbances that are observed along the shoreline. Disturbances are considered any anthropogenic influence that has altered shoreline including foreshore substrates, vegetation, or the shoreline (e.g., retaining walls). Level of impact is considered both looking at the length of the shore line (i.e., along the segment) and the depth of the shore zone area to between 15 to 50 m back. In more rural settings, typically the assessment area is greater (i.e., 50 m) and in more developed shorelines, typically the assessment area is less (i.e., 15 m). In cases of roadways or railways, one should generally assess the location of the rail or roadway along the segment. To facilitate interpretation of this category, air photo interpretation is recommended to better estimate disturbance. Disturbance categories include High (>40%), Medium (10-40%), Low (<10%), or None. Consistency of determination is very important and assessors should consistently use the same criteria to determine the level of impact.	
	LIVEST_ACC	Livestock Access		Categorical	Livestock access is a categorical field that is used to determine whether livestock, such as cattle, have access to the foreshore. Choices include Yes or No or blank. If the field is left blank, one should assume that cattle do not have access.	
	DISTURBED	Percentage of the Shoreline that is Disturbed		Numeric	Percentage of the shoreline that is disturbed is a measurement of the approximate length and depth of the shore zone that has been disturbed. Assessors should use a combination of field observations and air photo interpretation to determine the percentage disturbed. Generally, the percentage disturbed should correspond to the level of impact (i.e., a high percentage of disturbance should translate into a High level of impact). The summation of the Percentage Disturbed and the Percentage Natural should equal 100%.	%
	NATURAL_	Percentage of the Shoreline that is Natural		Numeric	Percentage of the shoreline that is natural is a measurement of the approximate length and depth of the shore zone that remains in a natural condition. Assessors should use a combination of field observations and air photo interpretation to determine the percentage disturbed. Generally, the percentage natural should correspond to the level of impact. The summation of the Percentage Disturbed and the Percentage Natural should equal 100%.	%
	PHOTONUM	Photo Number		Alphanumeric	Photo number is a field that is used to enter in digital or still photos taken during the assessment.	
	TAPE_NUMB	Tape Number		Alphanumeric	Original Video tape number	
	VIDEO_TIME	Video Time		Alphanumeric	Delineates that start and stop time of the video segments. Assessors may also just enter in the start time of the segment, as it is generally inferred that the start time of one segment corresponds with the stop time of a previous segment.	
	CMMNT_CLAS	Class Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the class data fields above.	
Shore Type	CLIFF_BLUF	Cliff and/or Bluff Shore Type		Numeric	The Cliff / Bluff field contains the percentage of the segment, based upon the shore segment length that is a cliff or bluff shore type. A cliff shore type is typically very steep with substantial vertical elements. A bluff shore type is typically steep or very steep, and then flat for a substantial distance, typically formed by the fast recession of water levels during glacial periods.	%
	ROCKY	Rocky Shore Type	Low Rocky Shoreline and/or Vegetated Shoreline	Numeric	The Rocky Shoreline field contains the percentage of the segment, based upon the shore segment length that is rocky. Rocky shores consist mostly or boulders and bedrock, with components of large cobble and some gravels. These shores tend to occur on steeper shorelines. Previous versions of the data dictionary called these shorelines low rocky shorelines or possible (but less so) vegetated shorelines.	%

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Shore Type	GRAVEL2	Gravel Shore Type	Gravel Beach Shore Type	Numeric	The Gravel shore type field contains the percentage of the segment, based upon the shore segment length that is a gravel beach. Gravel beach shorelines tend to occur on Low or Moderate slopes, and substrates are predominantly gravels and cobbles. These shore types may also contain small percentages of gravels and or bedrock. Often times, gravels beaches and rocky shores occur along one segment, with gravel shore types occurring in depositional areas (i.e., in bays) and rocky shores (i.e., at points) occurring in erosion areas.	%
	SAND2	Sand Shore Type	Sand Beach Shore Type	Numeric	The Sand shore type field contains the percentage of the shoreline, based upon the shore segment length that is a sand beach. Sand beach shorelines tend to occur in low gradient shorelines and are predominated by sands and small gravels. These shore types may also contain some gravel shoreline areas in places that are more exposed to wind and wave action (e.g., points).	%
	STREAM_MOU	Stream Mouth Shore Type	Alluv_Fan or Alluvial Fan	Numeric	The Stream Mouth shore type field contains the percentage of the shoreline, based upon the shore segment length that is a stream mouth. A stream mouth is defined as the space where there is a confluence between a lake and a stream or a river and the stream has direct influence on sediment movements and deposition or is part of the active floodplain. Typically, the stream mouth segment is larger for rivers and smaller for creeks. A separate segment should be created for significant fisheries streams, such as those known to contain spawning populations of anadramous salmon.	%
	WETLAND	Wetland Shore Type		Numeric	The Wetland shore type field contains the percentage of the shoreline, based upon the shore segment length that is a shore marsh wetland. A wetland segment typically occurs on low gradient sites, the littoral zones is wide and shallow, substrates are predominantly silts, organics, or clays, and there is emergent vegetation present. The Wetlands of British Columbia defines a shore marsh as a seasonally or permanently flooded non tidal mineral wetland that is dominated by emergent grass like vegetation. The BC Wetland book contains descriptions of some of the wetland shore types that may be observed along lake shorelines	%
	OTHER	Other Shore Type		Numeric	The Other shore type field allows assessors to enter in shore types that do not fit into one of the general categories above. If the other shore type field is used, assessors should add comments to describe the shore type and provide justification for use of the other field. Examples of other shore types may include constructed boat access canals.	%
	STYPE_COMM	Shore Type Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the shore type data fields above.	
Land Use	AGRICULTUR	Agriculture Land Use		Numeric	The agriculture land use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for crop based agricultural or as active livestock range lands (i.e., extensive holding areas, large numbers of cattle). Livestock pastures that are not active rangelands (i.e., a few cows or horses) are not considered an agriculture land use (see rural).	%
	COMMERCIAL	Commercial Land Use		Numeric	The Commercial Land use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for commercial purposes. Commercial purposes include retail, hotels, food establishments, marinas with fuel, stores, etc. Commercial areas tend to occur along highly impacted shorelines.	%
	CONSERVATION	Conservation Land Use		Numeric	The Conservation Land use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for conservation of critical or important habitats. Examples of conservation shorelines include lands held by the Land Conservancy, biological reserves, etc. Conservation lands cannot occur on privately held shorelines, unless conservation covenants or other agreements are in place to protect areas in perpetuity.	%
	FORESTRY	Forestry Land Use		Numeric	The Forestry Land use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for forestry. These areas are typically Crown Lands that are part of active cut blocks. Log Yards are not considered a Forestry Land use as they are Industrial.	%
	INDUSTRIAL	Industrial Land Use		Numeric	The Industrial Land use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for industrial purposes. Examples of industrial purposes include log yards, processing facilities, lumber mills, etc. These shorelines are typically heavily impacted.	%

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Land Use	INSTITUTIO	Institutional Land Use		Numeric	The Institutional Land Use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for institutional purposes. Examples of institutional land uses include schools, public libraries, etc.	%
	MULTI_FAMI	Multi-Family Land Use	LU_URB_RES or Urban Residential Land Use	Numeric	The Multi-Family Land Use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for multi-family residences. Multi-family developments are typically condominiums or town homes.	%
	NATURAL_AR	Natural Areas		Numeric	The Natural Areas Land use field is the percentage of the shoreline, based upon the shore segment length that is predominantly natural crown lands. These areas do not occur in provincial parklands and cannot be privately held.	%
	PARK	LU_PARK or Park			The Park Land Use field is the percentage of the shoreline, based upon the shore segment length that is predominantly natural areas parklands. These parks areas can be provincial, federal, or municipal parks. These parks tend to be predominantly natural and are different from urban parks, which are used intensively for recreational purposes (e.g., public beaches).	%
	RECREATION	Recreation Land Use		Numeric	The Recreation Land Use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for recreational purposes. Examples include public or private campgrounds, areas of known cabin rentals, etc. In some cases recreational shoreline may also be referred to as single family land uses, depending upon how much are known about them. Generally, if a shoreline contains privately held cabins that are rented out occasionally, these should be referred to as single family land uses rather than recreational.	%
	RURAL	Rural Land Use		Numeric	The Rural Land Use field is the percentage of the shoreline, based upon the shore segment length that is predominantly used for rural purposes. These shorelines are typically large lots, private estates, or hobby farms. Differentiation between rural and single family land use can be difficult when lots are narrow but deep (i.e., appear dense on the shoreline but extend quite far back). When doubt exists between a rural designation and a single family land use, assessors should be consistent in their judgments and refer back to local government zoning or bylaws to help decide on the appropriate land use type.	%
	SINGLE_FAM	Single Family Residential	LU_URB_RES or Urban Residential Land Use	Numeric	The Single Family Residential Land Use is the percentage of the shoreline, based upon the shore segments length that is predominantly used for single family residential purposes. Typically, single family residential occurs in more densely developed areas. However, seasonal use cottages or cabins can often be considered single family residential areas if the dwellings have associated outbuildings, docks, and other features consistent with more densely developed areas.	%
	URBAN_PARK	LU_PARK or Park			The Urban Park Land Use is the percentage of the shoreline, based upon the shore segments length that is predominantly used as an urban park. Examples of this land use include public beaches, picnic areas, etc. Shorelines dominated by this land use tend to have limited riparian vegetation and contain extensive areas of turf in the under story.	%
	LANDU_COMM	Land Use Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the shore type data fields above.	%
Substrates	MARL	Marl Substrate	SUB_FINES or Fine Substrates	Numeric	The Marl substrate field allows assessors to enter the relative percentage of marl occurring along the shoreline. Marl is a substrate that is typically white in color associated with clear lakes and consists of loose clay, precipitated calcium carbonate, mollusk/invertebrate shells, and other impurities.	%
	MUD	Mud Substrates	SUB_FINES or Fine Substrates	Numeric	The Mud substrate field allows assessors to enter the relative percentage of mud occurring along the segment. Mud is a substrate that is typically dark in color and consists of a mixture of silts, clays, and finely decayed organic material that is not typically discernable.	%
	ORGANIC	Organic Substrates	SUB_FINES or Fine Substrates	Numeric	The Organic substrate field allows assessors to enter the relative percentage of organic materials that occur along the shoreline. Organic substrates are typically associated with wetland sites and consist of detritus material that is identifiable to some extent (e.g., sticks, leaves, etc.).	%
	FINES	Fine Substrates	SUB_FINES or Fine Substrates	Numeric	The Fines substrate field allows assessors to enter the relative percentage of fines that occur along the shoreline. Fines consist of silts and clays and these substrates are typically less than 1 mm in size. Fines are differentiated from mud because there is little to no organic content.	%

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Substrates	SAND	Sand Substrates	SUB_FINES or Fine Substrates	Numeric	The Sand substrates field allows assessors to enter the relative percentage of sands that occur along the shoreline. Sands are any particle that contains granular particles visible to the naked eye. These particles are typically .06 to 2 mm in size.	%
	GRAVEL	Gravel Substrates	SUB_GRAVEL or Gravel Substrates	Numeric	The Grave substrates field allows assessors to enter the relative percentage of gravels that occur along the shoreline. Gravels are particles that range from 2 mm to approximately 64 mm. Thus, they are the size of a lady bug to the size of a tennis ball or orange. This field should only be used when substrates are difficult to identify and assessors cannot determine whether fine and course gravels.	%
	GRAVEL_FIN	Fine Gravel Substrates	SUB_GRAVEL or Gravel Substrates	Numeric	The Fine Gravel substrates field allows assessors to enter the relative percentage of fine gravels that occur along the shoreline. Fine gravels are particles that are 2 mm to approximately 16 mm or the size of a ladybug to the size of a grape. This field should only be used when assessors have good visibility and can confidently identify fine gravels. If this field is used, the generally gravel category should *not* be used.	%
	GRAVEL_COA	Coarse Gravel Substrates	SUB_GRAVEL or Gravel Substrates	Numeric	The Coarse Gravel substrates field allows assessors to enter the relative percentage of course gravels that occur along the shoreline. Coarse gravels are particles that are 16 mm to approximately 64 mm or the size of a grape to the size of a tennis ball or orange. This field should only be used when assessors have good visibility and can confidently identify coarse gravels. If this field is used, the generally gravel category should *not* be used.	%
	COBBLE	Cobble Substrates	SUB_COBBLE or Cobble Substrates	Numeric	The Cobble substrates field allows assessors to enter the relative percentage of cobbles that occur along the shoreline. Cobbles are particles that are 64 to 256 mm in size (Tennis ball to basketball).	%
	COBBLE_FIN	Fine Cobble Substrates	SUB_COBBLE or Cobble Substrates	Numeric	The Fine Cobble substrates field allows assessors to enter the relative percentage of fine cobbles that occur along the shoreline. Fine cobbles are particles that are 64 to 128 mm in size (tennis ball to coconut). This field should only be used when assessors have good visibility and can confidently identify fine cobbles. If this field is used, the general cobble category should *not* be used.	%
	COBBLE_COA	Coarse Cobble Substrates	SUB_COBBLE or Cobble Substrates	Numeric	The Coarse Cobble substrates field allows assessors to enter the relative percentage of course cobbles that occur along the shoreline. Coarse cobbles are particles that are 128 to 256 mm in size (coconut to basketball). This field should only be used when assessors have good visibility and can confidently identify coarse cobbles. If this field is used, the general cobble category should *not* be used.	%
	BOULDER	Boulder Substrates	SUB_BOULDE or Boulder Substrates	Numeric	The Boulder substrates field allows assessors to enter the relative percentage of boulders that occur along the shoreline. Boulders are particles that are greater than 256 mm in size (bigger than a basketball). These substrates can not typically be lifted by one person as they are too heavy.	%
	BEDROCK	Bedrock Substrates	SUB_BEDROC or Bedrock Substrates	Numeric	The Bedrock substrates field allows assessors to enter the relative percentage of bedrock that occurs along the shoreline. Bedrock is consider any rock where blocks are larger than 4 m or is solid, un-weathered underlying rock.	%
	EMBEDDEDNE	Embeddedness	COMPACTION or Compaction	Categorical	Embeddedness is a categorical field that allows assessors to enter the approximate embeddedness of substrates. Embeddedness is a measure of the degree to which boulders, cobbles and other large materials are covered by fine sediments. Categories for embeddedness include None (0%), Low (0 to 25%), Medium (25-75%), High (>75%), or Unknown. When assessors are unclear of the embeddedness they should either complete measurements of foreshore substrates or leave the field as unknown.	
	SHAPE_1	Shape of Substrates		Categorical	Shape is a categorical field that allows assessors to identify the shape of larger particles such as cobble or boulders. Angular shapes refer to naturally occurring angular rock material that has not been substantially weathered. Blast rock refers to angular blast rock materials, such as rip rap. Smooth materials are rocks that are generally rounded. This field should be used to describe the predominant substrates that occur along the shoreline (e.g., if 85 % of the substrates are round and smooth, and 10% are blast rock, the field should be used to describe the 85%).	
	COMMNT_SUB	Substrate Comments		Categorical	The comments field allows assessors to enter applicable information that is not included in the data field above.	

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Vegetation Band 1	B1_CLASS	Vegetation Band 1 Land Cover Class	RIP_CLASS of Riparian Class	Categorical	The Vegetation Band 1 Land Cover Class is a description of the predominant vegetation class present. Categories are largely derived from the Sensitive Habitat Inventory and Mapping Module 4. The Coniferous Class occurs where tree cover is at least 20% of the shore zone area and at least 80% of the trees are coniferous. The Broadleaf Class occurs where the tree cover is at least 20% and at least 65% of the trees are broadleaf or deciduous. The Mixed Forest Class occurs where tree cover is at least 20% and there are no more than 80% coniferous trees and no more than 65% broadleaf trees. The Shrubs Class occurs where tree coverage is less than 10% and there shrubs cover at least of 20%. Shrubs are defined as multi-stemmed woody perennial plants. The Herbs / Grasses Class occur where there is at less than 10% tree coverage and less than 20% of shrubs. The Exposes Soil Class occurs where recent disturbance, either anthropogenic or natural, has occurred and mineral soils are exposes. The Landscape Class refers to urbanized areas where most natural vegetation has been replaced by at least 30% coverage of ornamental trees, shrubs, and other vegetation. The Lawn Class occurs in urbanized areas where turf grasses cover at least 30% of the shore zone area and landscaping with ornamental shrubs or trees is less than 30% coverage. The Natural Wetland Class occurs where shore marshes dominate the shore zone area and they have not been significantly influenced by human disturbance. The Disturbed Wetland Class occurs where shore marshes predominate the shore zone area and they have experience significant disturbance (i.e., greater than 30%). The Row Crops Class occurs in agricultural areas where crops are growing. If sites are agricultural, but are not used for row crops (e.g., pasture lands), they should be described as Herbs/Grasses and comments should be used to indicate the agricultural nature of the shore segment. Un-vegetated Sites occur where there is less than 5% vegetation cover and at least 50% of the vegetation cover is mosses or lichens. Un-vegetated sites tend to occur on rocky, exposed shorelines.	
	B1_STAGE	Vegetation Band 1 Stage	RIP_STAGE or Riparian Stage	Categorical	The Vegetation Band 1 Stage is a description of the structural stage of the dominant vegetation. Categories are largely derived from the Sensitive Habitat Inventory and Mapping Module 3 and the Field Manual for Describing Terrestrial Ecosystems. The Sparse Stage describes sites that are in the primary or secondary stages of succession, with vegetation consisting mostly of lichens and mosses, and the total shrub coverage is less than 20% and tree coverage is less than 10%. The Grass Herb Stage describes sites where shore zones are dominated by grasses and herbs, as a result of persistent disturbance of natural conditions (e.g., grasslands). The Low Shrubs stage describes sites that are dominated by shrubby vegetation less than 2 m in height. The Tall Shrubs Stage is dominated by vegetation that is 2 to 10 m in height and seedlings and advance regeneration may be present. The Pole / Sapling Stage describes sites that contain trees greater than 10 m in height, typically densely stocked, and there is little evidence of self thinning or vertical structure. The Young Forest Stage describes sites that are typically less than 40 years old (but could be as great as 50 to 80 years depending upon the forest community), self thinning is evident, and the forest canopy has begun to differentiate into distinct layers. The Mature Forest Stage describes sites that are typically 40 to 80 years old (but could be as high as 140 years), and the under story is well developed with a second cycle of shade trees. The Old Forest Stage describes sites that are typically greater than 80 years old and the stands are structurally complex. Old Forests contain abundant coarse woody debris at varying stages of decay. Old Forests are at least 80 years in age, but may be as old as 250 years and should be considered relative to the forest community assessors are in.	
	B1SHRUB_CO	Vegetation Band 1 Shrub Coverage	SHOR_COVER or Shore Cover	Categorical	The Shrub Coverage categorically describes shrub coverage within the shore zone. Sparse sites have less than 10% shrub coverage. Moderate shrub coverage occurs on sites that have between 10 to 50% coverage. Abundant shrub coverage occurs on sites that have greater than 50% shrub coverage.	
	B1TREE_COV	Vegetation Band 1 Tree Coverage	SHOR_COVER or Shore Cover	Categorical	The Tree Coverage categorically describes Tree coverage within the shore zone. Sparse sites have less than 10% Tree coverage. Moderate Tree coverage occurs on sites that have between 10 to 50% coverage. Abundant Tree coverage occurs on sites that have greater than 50% Tree coverage.	

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Vegetation Band 1	B1_DISTRIB	Vegetation Band 1 Distribution		Categorical	The Distribution field is used to describe whether the vegetation band described is continuous along the entire shore segment. Categories include Continuous and Patchy (for sites where the dominant vegetation band occurs in patches along the segment). An example of a patchy distribution is a shore segment where most areas are extensively landscape, with the exception of a few shore lots which remain relatively natural. In this case, the dominant landscaped area would be described and comments would be used to identify residual natural areas.	
	B1_BANDWI	Vegetation Band 1 Bandwidth		Numeric	The Vegetation Band 1 Bandwidth field is used to provide an estimate of the approximate width of the band being described. In cases where bandwidth varies along the segment, a representative width should be used to describe the shore segment. The intent of this field is to provide a general description of the width of the vegetation band that is being described and users of the database need to consider this when assessing data within the database.	
	B1_OVERHAN	Overhanging Vegetation		Numeric	The Overhanging Vegetation field is used to describe the percentage of the shore segment length that contains significant overhanging vegetation. Overhanging vegetation should be considered as if the lake was at full pool or the mean annual high water level.	
	AQUATIC_VE	Aquatic Vegetation		Numeric	The Aquatic Vegetation field is used to describe the percentage of the shoreline that contains emergent, submergent, and floating aquatic vegetation.	
	SUBMERGENT	Submergent Vegetation Quantity		Numeric	The Submergent Vegetation field is used to describe the percentage of the shoreline segment that contains submergent vegetation. Submergent vegetation includes species such as milfoil, *Potamogeton* spp., etc.	
	SUBMERG_VE	Submergent Vegetation Presence		Categorical	The Submergent Vegetation Presence field is used to indicate whether submergent vegetation is present along the segment. In cases where assessors cannot determine the percentage of the segment but are aware it is present, this field should be used.	
	EMERGENT_V	Emergent Vegetation Quantity		Numeric	The Emergent Vegetation field is used to describe the percentage of the shoreline segment that contains emergent vegetation. Emergent vegetation includes species such as cattails, bulrushes, varies sedges, etc.	
	EMERGED_VE	Emergent Vegetation Presence		Categorical	The Emergent Vegetation Presence field is used to indicate whether emergent vegetation is present along the segment. In cases where assessors cannot determine the percentage of the segment but are aware it is present, this field should be used.	
	FLOATING_V	Floating Vegetation Quantity		Numeric	The Floating Vegetation field is used to describe the percentage of the shoreline segment that contains floating vegetation. Floating vegetation includes species such as pond lilies, etc.	
	FLOATING_1	Floating Vegetation Presence		Categorical	The Floating Vegetation Presence field is used to indicate whether floating vegetation is present along the segment. In cases where assessors cannot determine the percentage of the segment but are aware it is present, this field should be used.	
	AVEG_CMT	Aquatic Vegetation Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the data field above.	
	B1_COMMNT	Vegetation Band 1 Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the data field above.	
Vegetation Band 2	B2_CLASS	Vegetation Band 2 Class	UP_CLASS or Upland Class	Categorical	See Vegetation Band 1 Class for a description.	
	B2_STAGE	Vegetation Band 2 Stage	UP_STAGE or Upland Stage	Categorical	See Vegetation Band 1 Stage for a description.	
	B2SHRUB_CO	Vegetation Band 2 Shrub Cover	UP_SHORE_COVER or Upland Shore Cover	Categorical	See Vegetation Band 1 Shrub Cover for a description.	
	B2TREE_COV	Vegetation Band 2 Tree Cover	UP_SHORE_COVER or Upland Shore Cover	Categorical	See Vegetation Band 1 Tree Cover for a description.	

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Vegetation Band 2	B2_DISTRIB	Vegetation Band 2 Distribution	UP_BANDWI or Upland Bandwidth	Categorical	See Vegetation Band 1 Distribution for a description.	
	B2_BANDWID	Vegetation Band 2 Width		Categorical	See Vegetation Band 2 Width for a description.	
	B2_COMMNT	Vegetation Band 2 Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the data field above.	
Littoral Zone	LITTORAL_Z	Littoral Zone Width Categories		Categorical	The Littoral Zone Width Category provides a general classification of the littoral zone. Wide littoral zones are greater than 50 m. Moderate littoral zones are 10 to 50 m in width, and Narrow littoral zones are less than 10 m wide.	
	LWD	Large Woody Debris Presence		Categorical	The Large Woody debris presence field allows assessors to indicate whether LWD is present along the segment. Categories include Less than 5 Pieces, 5 to 25 Pieces, and Greater than 25 Pieces.	
	LWD_NUMBER	Large Woody Debris Count		Numeric	The Large Woody debris count field allows assessors to enter the total number of large woody debris pieces counted along the shore segment. Only significant pieces of large woody debris, which are contributing to fish habitat, should be counted.	
	WIDTH_LITT	Littoral Width	LITTORAL_W or Littoral Width	Numeric	The Littoral Width field allows assessors to enter the average littoral width of the segment. This field can be determined using air photo interpretation or field measurements. Typically, the field is rounded to the nearest 5 m as the number is intended to be representative of the segment.	
	COMMNT_LIT	Littoral Zone Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the data field above.	
Modifications	RETAIN_WAL	Retaining Wall Count		Numeric	The Retaining Wall Count field is the total number of retaining walls occurring along the segment. Retaining walls should only be counted if they are within 5 to 10 m of the high water level. Retaining walls must have a vertical element that is greater than 30 cm and must be retaining earth to some degree. On steep sloping sites, more than one retaining wall may be present (i.e., the property is tiered). In these cases each retaining wall is counted.	#
	PERRETAIN_	Percent Retaining Wall	RET_WAL_TY	Numeric	The Percent Retaining Wall field indicates that approximate percentage of the shore segment length where retaining walls occur.	%
	DOCKS	Docks Count		Numeric	The Docks Count field is the total number of pile supported or floating docks or swimming platforms that occur along the segment. Properties may have more than one dock present and each different structure is considered a separate dock. For instance, a property could have one swimming float and one dock.	#
	DOCKS_KM	Docks Per Kilometer		Numeric	The Docks per Kilometer field is determined during post processing. This field is calculated by dividing the total number of docks observed by the total length of the shore segment.	#
	BOAT_HOUSE	Boat House Count		Numeric	The Boat House Count field is used to count boat houses that occur along the segment. Boat Houses are structures that are specifically designed to house boats or watercraft. Boat Houses can either be located on land or as structures over the water. If only structures over the water are counted, assessors should be consistent and make note of this so end users are aware of what definition was used for a boat house. If structures on land are considered as boat houses, a rail or boat launch should be present that land owners use to launch the boat to the lake. Garages that house boats should not be counted as boat houses because there is not an associated launch structure.	#
	GROYNES	Groyne Count		Numeric	The Groyne Count field is used to count any structure that is perpendicular to the shoreline that is impacting regular sediment drift along the shoreline. Groynes can be constructed out of concrete, rock, piles, wood, or other materials. Docks or other structures that are acting as groynes, and affecting sediment movement should be included in the groyne count. Rock lines that are too small to significantly impact sediment movement should not be counted as a groyne.	#
	GROYNES_KM	Groynes per Kilometer		Numeric	The Groynes per Kilometer field is determined during post processing of data. This field is calculated by dividing the total number of groynes observed by the total length of the shore segment.	#

Dictionary Section	Abbreviated Database Column Heading	Un-Abbreviated Column Heading	Previous Database Column Headings (if different)	Type	Definition	Unit of Measurement
Modifications	BOAT_LAUNC	Boat Launch Count		Numeric	The Boat Launch Count field is the total number of boat launches that were observed along the shoreline. Generally, only permanent boat launches are counted (e.g., made of concrete). However, on small systems assessors may choose to count gravel boat launches as these may be the only type present. Assessors should document criteria used to determine what constitutes a boat launch during the assessment.	#
	PERRAIL_MO	Percent Rail Modifier		Numeric	The Percent Rail Modifier field is used to describe the percentage of the linear shore segment length that contains railways in close proximity to the shoreline.	%
	PERROAD_MO	Percent Road Modifier		Numeric	The Percent Road Modifier field is used to describe the percentage of the linear shore segment length that contains a roadway in close proximity to the shoreline.	%
	MARIN_RAIL	Marine Rail Count		Numeric	The Marine Rail Count field is the total number of marine rails that occur along a shore segment. Marine Rails are a track system that is used to remove boats from a lake during the winter months.	#
	MARINAS	Marina Count		Numeric	The Marinas Field is the total number of large and small marinas that were documented along the shoreline. A marina is considered to be any pile supported or floating structure that has slips for 6 or more boats.	#
	SUB_MODIFI	Substrate Modification Presence	BEACH_GROO or Beach Grooming	Categorical	The Substrate Modification Presence field is used to document whether substrate modification is occurring along the shore segment. Substrate modification includes any type of importation of sands, significant movement of natural substrates (e.g., to construct groynes), or earthworks.	
	PERSUB_MOD	Percent Substrate Modification		Numeric	The Percent Substrate Modification field is the estimated percentage of the shore segment where substrate modification has occurred.	%
	COMMNT_MOD	Modifications Comments		Alphanumeric	The comments field allows assessors to enter applicable information that is not included in the data field above.	
Flora and Fauna	VETERANS	Veteran Trees		Categorical	The Veteran Tree field is a categorical field to describe the number of veteran trees that occur along the shore segment. Veteran trees are defined as a tree that is significantly older than the dominant forest cover and provides increased structural diversity. Categories include No, Less than 5 Trees, 5 to 25 Trees, and Greater than 25 trees.	
	SNAGS	Snags		Categorical	The Snags field is a categorical field to describe the number of dead standing snags that occur along the shore segment. Snags are defined as dead standing trees that provide increased structural diversity. Categories include No, Less than 5 Trees, 5 to 25 Trees, and Greater than 25 trees.	
	CMMNT_FLRA	Flora Comments		Alphanumeric	The flora comments field allows users to enter in comments regarding flora observed within the shore segment.	
	CMMNT_FAUN	Fauna Comments			The fauna comments field allows users to enter in comments regarding fauna observed within the shore segment.	

Appendix B

SHIM Lake v2.6 Data Dictionary

Shim Lake 2008
June 23, 2008

Lake_Shoreline	Line Feature, Label 1 = Segmnt_Num, Label 2 = Aquatic_Veg
	Lake shore
_____	Separator
LAKE REFERENCE	Separator
Lake_Name	Text, Maximum Length = 100
	Normal, Normal
Lake_level	Numeric, Decimal Places = 2
	Minimum = 0, Maximum = 3000, Default Value = 0
	Normal, Normal
Sechi_depth	Numeric, Decimal Places = 1
	Minimum = 0, Maximum = 50, Default Value = 0
	Normal, Normal
Organization	Text, Maximum Length = 50
	Normal, Normal
Date	Date, Auto generate Create, Year-Month-Day Format
	Normal, Normal
Time	Time, Auto generate Create, 24 Hour Format
	Normal, Normal
Crew	Text, Maximum Length = 50
	Normal, Normal
Weather	Menu, Normal, Normal
Light Rain [L]	
Heavy Rain [H]	
Snow/Sleet [N]	
Over cast [OV]	
Clear [S]	
Partly Cloudy [PC]	
Other [O]	
Air_Temp	Numeric, Decimal Places = 1, degrees centigrade
	Minimum = -25, Maximum = 45, Default Value = 0
	Normal, Normal
Water_Temp	Numeric, Decimal Places = 1, degrees celsius
	Minimum = -2, Maximum = 29, Default Value = 0
	Normal, Normal
Jurisdiction	Text, Maximum Length = 100, Jurisdiction
	Normal, Normal
Comments	Text, Maximum Length = 100
	Normal, Normal
_____	Separator
SEGMENT CLASS	Separator
Segmnt_Num	Numeric, Decimal Places = 1, Unique Identification number for segment
	Minimum = 0, Maximum = 99999, Default Value = 0
	Required, Required
Shore_Type	Menu, Required, Normal
Cliff/Bluff	
Rocky Shore	
Gravel	
Sand	
Stream Mouth	
Wetland	
Other	
Shore_Modifier	Menu, Normal, Normal
Log Yard	
Marina_small (6-20)	
Marina_large (20+)	
Railway	
Road	
None Default	
Other	
Slope	Menu, Normal, Normal, general slope of shore landward
Bench	
Low (0-5)	
Moderate (5-20)	
Steep (20-60)	
Very Steep (60+)	
Land_Use	Menu, Normal, Normal, observed
Agriculture	
Commercial	
Conservation	
Forestry	
Industrial	
Institution	
Multi Family	
Natural Area	
Park	
Recreation	

```
   Rural
   Single Family
   Urban Park
Lev_of_Imp          Menu, Normal, Normal, Level of Impact
   None   Default
   Low (<10%)
   Medium (10-40%)
   High (>40%)
Livest_Acc          Menu, Normal, Normal, Stream segmnet accessible to live-stock
   Yes
   No   Default
Disturbed           Numeric, Decimal Places = 0, Percent of segment disturbed
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Natural             Numeric, Decimal Places = 0, Percent of segment natural
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
PhotoNum            Text, Maximum Length = 100, Roll and print number of photograph
                    Normal, Normal
Tape_Numb           Text, Maximum Length = 100, Original Video Tape Number
                    Normal, Normal
Video_Time          Text, Maximum Length = 100, Time stamp on original video tape
                    Normal, Normal
Cmmnt_Clas          Text, Maximum Length = 100, Comments for Segment
                    Normal, Normal
____________________      Separator
SHORE TYPE          Separator
Cliff/Bluff         Numeric, Decimal Places = 0, Percent
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Rocky               Numeric, Decimal Places = 0, Rocky Shore
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Gravel              Numeric, Decimal Places = 0, Gravel Shore
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Sand                Numeric, Decimal Places = 0, Sand Beach
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Stream_mouth        Numeric, Decimal Places = 0, Stream mouth
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Wetland             Numeric, Decimal Places = 0, Percent
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Other               Numeric, Decimal Places = 0, Percent
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Stype_comm          Text, Maximum Length = 100, Comments for Segment
                    Normal, Normal
____________________      Separator
LAND USE            Separator
Agriculture         Numeric, Decimal Places = 0, Percent
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Commercial          Numeric, Decimal Places = 0, Percent
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Conservation        Numeric, Decimal Places = 0, Percent
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Forestry            Numeric, Decimal Places = 0, Percent
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Industrial          Numeric, Decimal Places = 0, Percent
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Institution         Numeric, Decimal Places = 0, Percent
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Multi Family        Numeric, Decimal Places = 0, Percent mult family residential (condo)
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Natural Area        Numeric, Decimal Places = 0, Percent
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Park                Numeric, Decimal Places = 0, Percent
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
```

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Recreation          Numeric, Decimal Places = 0, Percent
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Rural               Numeric, Decimal Places = 0, Percent
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Single Family       Numeric, Decimal Places = 0, Percent single family residential
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Urban Park          Numeric, Decimal Places = 0, Percent
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Landu_Commnt        Text, Maximum Length = 100, Comment Land use
                    Normal, Normal
____________________      Separator
SUBSTRATE           Separator
Marl                Numeric, Decimal Places = 0, Clay limestone
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Mud                 Numeric, Decimal Places = 0, Percent Mud
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Organic             Numeric, Decimal Places = 0, Percent Organic
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Fines               Numeric, Decimal Places = 0, Percent Fines
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Sand                Numeric, Decimal Places = 0, Percent Sand
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Gravel              Numeric, Decimal Places = 0, Percent Gravel
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Gravel_Fine         Numeric, Decimal Places = 0, Percent Fine Gravel
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Gravel_Coarse       Numeric, Decimal Places = 0, Percent Coarse Gravel
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Cobble              Numeric, Decimal Places = 0, Percent Cobble
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Cobble_Fine         Numeric, Decimal Places = 0, Percent Fine Cobble
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Cobble_Coarse       Numeric, Decimal Places = 0, Percent Coarse Cobble
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Boulder             Numeric, Decimal Places = 0, Percent Boulder
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Bedrock             Numeric, Decimal Places = 0, Percent Bedrock
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Embeddedness        Menu, Normal, Normal, Level of substrate embeddedness
   None
   Low (0-25%) [L]
   Medium (25-75%) [M]
   High (75%+) [H]
   Unknown   Default
Shape               Menu, Normal, Normal, man made refers to angularity
   angular
   blast rock
   smooth
Commnt_Sub          Text, Maximum Length = 100, Comment for Substrates
                    Normal, Normal
____________________      Separator
VEGETATION BAND1    Separator
B1_Class            Menu, Normal, Normal, Riparian Class
   Coniferous forest [VNF]
   Broadleaf forest [VBF]
   Mixed forest [VMF]
   Shrubs [VSH]
   Herbs/grasses [VHB]
   Exposed soil [NEL]
   Landscaped [LS]
   Lawn [L]
   Natural wetland [WN]
```

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   Disturbed wetland [DWN]
   Row Crops [NAG]
   Unvegetated
B1_Stage            Menu, Normal, Normal, Structural Stage
   Sparse [1]
   Grass/Herb [2]
   low shrubs <2m [3a]
   tall shrubs 2-10m [3b]
   sapling >10m [4]
   young forest [5]
   mature forest [6]
   old forest [7]
   Mixed age
B1Shrub_Cover       Menu, Normal, Normal, Shrub Cover
   None [ ]
   Sparse (<10%) [ ]
   Moderate (10-50%) [ ]
   Abundant (>50%) [ ]
B1Tree_Cover        Menu, Normal, Normal, Tree Cover
   None [ ]
   Sparse (<10%) [ ]
   Moderate (10-50%) [ ]
   Abundant (>50%) [ ]
B1_Distribution     Menu, Normal, Normal, Riparian Distribution
   Patchy [ ]
   Continuous [ ]
B1_Bandwi           Numeric, Decimal Places = 0, Band 1width
                    Minimum = 0, Maximum = 9999, Default Value = 0
                    Normal, Normal
B1_Overhang         Numeric, Decimal Places = 0, %  Overhang for segment
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Aquatic_Veg         Numeric, Decimal Places = 0, Length of aquatic vegetation in segment
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Submergent veg      Numeric, Decimal Places = 0, % submergent vegetation in segment
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Submerg_Veg         Menu, Normal, Normal, Submerged Aquatic Vegetation
   Yes
   No   Default
Emergent vegetation       Numeric, Decimal Places = 0, % emergent vegetation
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Emerged_Veg         Menu, Normal, Normal, Emergent Aquatic Vegetation
   Yes
   No   Default
Floating vegetatio  Numeric, Decimal Places = 0, % floating vegetation
                    Minimum = 0, Maximum = 100, Default Value = 0
                    Normal, Normal
Floating_Veg        Menu, Normal, Normal, Floating  Vegetation presence
   Yes
   No   Default
AVeg_Cmt            Text, Maximum Length = 100, Aquatic Vegetation Comment
                    Normal, Normal
B1_Commnt           Text, Maximum Length = 100, Comment Band 1 vegetation
                    Normal, Normal
____________________      Separator
VEGETATION BAND2    Separator
B2_Class            Menu, Normal, Normal, Vegetation Class
   Coniferous forest [VNF]
   Broadleaf forest [VBF]
   Mixed forest [VMF]
   Shrubs [VSH]
   Herbs/grasses [VHB]
   Exposed soil [NEL]
   Landscaped [LS]
   Lawn [L]
   Natural wetland [WN]
   Disturbed wetland [DWN]
   Row Crops [NAG]
   Rock [NNB]
B2_Stage            Menu, Normal, Normal, Structural Stage
   Sparse [1]
   Grass/Herb [2]
   low shrubs <2m [3a]
   tall shrubs 2-10m [3b]
   sapling >10m [4]
   young forest [5]
```

```
   mature forest [6]
   old forest [7]
   Mixed age
B2Shrub_Cover        Menu, Normal, Normal, Shrub Cover
   None [ ]
   Sparse (<10%) [ ]
   Moderate (10-50%) [ ]
   Abundant (>50%) [ ]
B2Tree_Cover         Menu, Normal, Normal, Tree Cover
   None [ ]
   Sparse (<10%) [ ]
   Moderate (10-50%) [ ]
   Abundant (>50%) [ ]
B2_Distribution      Menu, Normal, Normal, B2 Vegetation Distribution
   Patchy [ ]
   Continuous [ ]
B2_Bandwidth         Numeric, Decimal Places = 0, B2 vegetation Bandwidth
                     Minimum = 0, Maximum = 9999, Default Value = 0
                     Normal, Normal
B2_Commnt            Text, Maximum Length = 100, B2 vegetation Comment
                     Normal, Normal
_____________________      Separator
LITTORAL ZONE        Separator
Littoral_Z           Menu, Normal, Normal, Littoral Zone
   Narrow (<10m)
   Moderate (10-50m)
   Wide (>50m)
LWD                  Menu, Normal, Normal, Count of Large Woody Debris
   No   Default
   <5
   5-25
   >25
LWD_Number           Numeric, Decimal Places = 0, Number of LWD units
                     Minimum = 0, Maximum = 100, Default Value = 0
                     Normal, Normal
Width_Littoral       Numeric, Decimal Places = 0, Width of Littoral area
                     Minimum = 0, Maximum = 1000, Default Value = 0
                     Normal, Normal
Commnt_Lit           Text, Maximum Length = 100, Comment for Littoral zone
                     Normal, Normal
_____________________      Separator
MODIFICATIONS        Separator
Retain_Wal           Numeric, Decimal Places = 0, Retaining walls per segment
                     Minimum = 0, Maximum = 99999999, Default Value = 0
                     Normal, Normal
PerRetain_Wall       Numeric, Decimal Places = 0, Percent retaining wall on segment
                     Minimum = 0, Maximum = 100, Default Value = 0
                     Normal, Normal
Retain_Mat           Menu, Normal, Normal
   Bio_Eng
   Concrete
   Mixed
   Stonework
   Wood
   Metal
   Tires
   Rock
   Other
Docks                Numeric, Decimal Places = 0, Docks per segment
                     Minimum = 0, Maximum = 99999999, Default Value = 0
                     Normal, Normal
Docks_km             Numeric, Decimal Places = 0, Docks per km
                     Minimum = 0, Maximum = 1000, Default Value = 0
                     Normal, Normal
Boat_House           Numeric, Decimal Places = 0, Docks per segment
                     Minimum = 0, Maximum = 99999999, Default Value = 0
                     Normal, Normal
Groynes              Numeric, Decimal Places = 0, Groynes per segment
                     Minimum = 0, Maximum = 99999999, Default Value = 0
                     Normal, Normal
Groynes_km           Numeric, Decimal Places = 0, Groynes per km
                     Minimum = 0, Maximum = 1000, Default Value = 0
                     Normal, Normal
Boat_Launch          Numeric, Decimal Places = 0, Number of Boat launches
                     Minimum = 0, Maximum = 1000, Default Value = 0
                     Normal, Normal
PerRail_mod          Numeric, Decimal Places = 0, % of segment with a railway
                     Minimum = 0, Maximum = 100, Default Value = 0
                     Normal, Normal
```

```
   PerRoad_mod          Numeric, Decimal Places = 0, % of segment with a road
                        Minimum = 0, Maximum = 100, Default Value = 0
                        Normal, Normal
   Marin_Rail           Numeric, Decimal Places = 0, Marine Railways per segment
                        Minimum = 0, Maximum = 99999999, Default Value = 0
                        Normal, Normal
   Marinas              Numeric, Decimal Places = 0, Marinas per segment
                        Minimum = 0, Maximum = 99999999, Default Value = 0
                        Normal, Normal
   Sub_modification     Menu, Normal, Normal, Substrate modification / grooming
      Yes
      No
   PerSub_mod           Numeric, Decimal Places = 0, % of segment with substrate alteration
                        Minimum = 0, Maximum = 100, Default Value = 0
                        Normal, Normal
   Commnt_Mod           Text, Maximum Length = 100, Comments on modification
                        Normal, Normal
   ____________________       Separator
   FLORA & FAUNA        Separator
   Veterans             Menu, Normal, Normal, Number of Veterans
      No   Default
      <5
      5-25
      >25
   Snags                Menu, Normal, Normal, Presence of Snags
      No   Default
      <5
      5-25
      >25
   Cmmnt_Flra           Text, Maximum Length = 100, Flora Comment
                        Normal, Normal
   Cmmnt_Faun           Text, Maximum Length = 100, Fauna Comment
                        Normal, Normal

Site                    Point Feature, Label 1 = HWM, Label 2 = Land_Use
                        Site Description
   Lake_Name            Text, Maximum Length = 100
                        Normal, Normal
   Crew                 Text, Maximum Length = 50
                        Normal, Normal
   Date                 Date, Auto generate Create, Year-Month-Day Format
                        Normal, Normal
   Weather              Menu, Normal, Normal
      Light Rain [L]
      Heavy Rain [H]
      Snow/Sleet [N]
      Over cast [OV]
      Clear [S]
      Partly Cloudy [PC]
      Other [O]
   Jurisdiction         Text, Maximum Length = 100, Jurisdiction
                        Normal, Normal
   PID_Folio number     Text, Maximum Length = 50, Property Identifier
                        Normal, Normal
   HWM                  Numeric, Decimal Places = 1, High water mark
                        Minimum = 0, Maximum = 99999, Default Value = 0
                        Normal, Normal
   Lake_Level           Numeric, Decimal Places = 0
                        Minimum = 0, Maximum = 99999, Default Value = 0
                        Normal, Normal
   Length_frontage      Numeric, Decimal Places = 1, frontage length
                        Minimum = 0, Maximum = 99999, Default Value = 0
                        Normal, Normal
   Land_Use             Menu, Normal, Normal
      SF
      MF
      C
   Veg_removal          Menu, Normal, Normal, vegetation removal age
      historic
      recent
      NA
   Natural              Numeric, Decimal Places = 0, % natural vegetation state
                        Minimum = 0, Maximum = 99999, Default Value = 0
                        Normal, Normal
   Landscaped           Numeric, Decimal Places = 0, % landscaped vegetation state
                        Minimum = 0, Maximum = 99999, Default Value = 0
                        Normal, Normal
   no_vegetation        Numeric, Decimal Places = 0, % no vegetation
                        Minimum = 0, Maximum = 99999, Default Value = 0
```

```
                        Normal, Normal
   Disturbed            Numeric, Decimal Places = 0, % site state disturbed
                        Minimum = 0, Maximum = 99999, Default Value = 0
                        Normal, Normal
   PhotoNum             Text, Maximum Length = 100, Roll and print number of photograph
                        Normal, Normal
   Comments             Text, Maximum Length = 100
                        Normal, Normal

Modification            Point Feature, Label 1 = Point_number, Label 2 = Type_Modification
   Point_number         Numeric, Decimal Places = 1, unique point identification number
                        Minimum = 0, Maximum = 99999, Default Value = 0
                        Normal, Normal
   PID_Folio number     Text, Maximum Length = 50, Property Identifier
                        Normal, Normal
   Lot_number           Text, Maximum Length = 50, Property Identifier
                        Normal, Normal
   Type_Modification    Menu, Normal, Normal, Code for feature
      Boat House
      Boat_Launch
      Buoy
      Catchbasin [CB]
      Dam [HOD]
      Detention Pond [DP]
      Dock [DK]
      Dredging [HBDD]
      Effluent [E]
      Fences [HOF]
      Fill_Pile [FP]
      FloodGate [FG]
      Garbage/Pollution [WP]
      Gravel Pit [GP]
      Groyne [Gy]
      Hydro_thermal
      Infill
      Livestock access [LC]
      Log_Dump [LD]
      Logging [LG]
      Marina
      Outbuilding [OB]
      PipeCrossing [PL]
      Pump Station [PS]
      Retain Wall/Bank Stb [EHB]
      Rip_Rap [RR]
      Road [R]
      Trail [TR]
      Utility_Crossing [UC]
      Water Withdrawal [FUP]
      Other [O]
   Type_Material        Menu, Normal, Normal
      Asphalt [AS]
      Bark_Mulch [BM]
      Bio-engineered [BI]
      Concrete [C]
      Dyke [DY]
      Gabions [GB]
      Gravel [G]
      Metal [Mt]
      Mixed [Mx]
      Pilings [P]
      Rip_rap [RR]
      Sandbags [SB]
      Stonework [S]
      Synthetic [Sy]
      Treated_Wood [TW]
      Wood [W]
      Other [O]
   High_Water           Menu, Normal, Normal, Above or below high water level
      Above
      Below
      At
      Unknown   Default
   Sed_Movement         Menu, Normal, Normal, Sediment movement
      Erosion
      Accretion
      Unknown
      NA
   Conditions           Menu, Normal, Normal, Did it meet conditions
      Yes
```

```
   No
   Unknown   Default
Age_Modification    Menu, Normal, Normal, Age of modification
   Historic
   Recent
   Unknown   Default
Construction        Menu, Normal, Normal, state of modification
   complete
   ongoing
Length              Numeric, Decimal Places = 2, Feature length
                    Minimum = 0, Maximum = 1000, Default Value = 0
                    Normal, Normal
Width               Numeric, Decimal Places = 2, Width of Feature
                    Minimum = 0, Maximum = 1000, Default Value = 0
                    Normal, Normal
Height              Numeric, Decimal Places = 2, Height of feature
                    Minimum = 0, Maximum = 1000, Default Value = 0
                    Normal, Normal
_____________________      Separator
WATER ACT           Separator
WA_approval         Menu, Normal, Normal, Received Water Act approval
   Yes
   No
   Unknown
   NA   Default
WA_Notification     Menu, Normal, Normal, Received Water Act Notification
   Yes
   No
   Unknown
   NA   Default
Size_Compliant      Menu, Normal, Normal
   Yes
   No
   Unknown   Default
Mat_Compliant       Menu, Normal, Normal, Material Compliant
   Yes
   No
   Unknown   Default
SM_Compliant        Menu, Normal, Normal, Sediment movement compliant
   Yes
   No
   Unknown   Default
Roof_Compliant      Menu, Normal, Normal
   Yes
   No
   Unknown   Default
BMP                 Menu, Normal, Normal, Conforms with  Best Management Practices
   Yes
   No
   Unknown   Default
EIA                 Menu, Normal, Normal
   Yes
   No
   Unknown   Default
WAComments          Text, Maximum Length = 100, Water Act Comments
                    Normal, Normal
_____________________      Separator
LAND ACT            Separator
Land_Act            Menu, Normal, Normal
   Yes
   No
   Unknown
   NA   Default
LASize_Compliant    Menu, Normal, Normal, Land Act Size Compliant
   Yes
   No
   NA   Default
LAMat_Compliant     Menu, Normal, Normal, Material Compliant
   Yes
   No
   NA   Default
LASM_Compliant      Menu, Normal, Normal, Land Act Sediment movement compliant
   Yes
   No
   NA   Default
LARoof_Compliant    Menu, Normal, Normal
   Yes
   No
   NA   Default
```

```
   Slip_Compliant      Menu, Normal, Normal
      Yes
      No
      NA   Default
   PVT_MCompliant      Menu, Normal, Normal, pvt moorage compliant
      Yes
      No
      NA   Default
   LA_EIA              Menu, Normal, Normal, Land Act EIA
      Yes
      No
      NA   Default
   _____________________       Separator
   DEVELOPMENT PERMIT  Separator
   DP_Area             Menu, Normal, Normal, Development Permit compliant
      Yes
      No
   Dev_Permit          Menu, Normal, Normal, Development Permit
      Yes
      No
      Unknown   Default
   DP_Compliant        Menu, Normal, Normal, Development Permit compliant
      Yes
      No
      Unknown   Default
   DP_EIA              Menu, Normal, Normal, Development Permit EIA
      Yes
      No
      Unknown   Default
   RAR                 Menu, Normal, Normal
      Accepted
      Submitted
      Not_Submitted
      Unknown   Default
   PhotoNum            Text, Maximum Length = 100, Roll and print number of photograph
                       Normal, Normal
   Comments            Text, Maximum Length = 100
                       Normal, Normal

Discharge              Point Feature
   Point_number        Numeric, Decimal Places = 1, unique point identification number
                       Minimum = 0, Maximum = 99999, Default Value = 0
                       Normal, Normal
   Lot_Number          Text, Maximum Length = 30, Parcel lot number
                       Normal, Normal
   Type_Discharge      Menu, Normal, Normal, Code for feature
      Agricultural Runoff [WPA]
      HouseEffluent [WE]
      Landfill Leachates [WPML]
      Pollutant [WP]
      Pulp Mill/Effluent [WPP]
      Storm Drain [WPD]
      Septic Effluent [WPMP]
      Sewer [S]
      Tile Drain [WPI]
      Trench [WPE]
      Other [O]
   Culvert             Menu, Normal, Normal, Culvert material
      Concrete [C]
      Steel [S]
      Wood [W]
      Iron [I]
      PVC [P]
      Asphalt coded [AD]
      Corrugated Steel [CS]
      Other [O]
   Headwall            Menu, Normal, Normal, Does a headwall exist
      Concrete [C]
      Concrete Block [CB]
      Gabion [G]
      Sand bag [SB]
      Wood [W]
   Length              Numeric, Decimal Places = 2, Feature length
                       Minimum = 0, Maximum = 1000, Default Value = 0
                       Normal, Normal
   Width               Numeric, Decimal Places = 2, Width of Feature
                       Minimum = 0, Maximum = 1000, Default Value = 0
                       Normal, Normal
   Diameter            Numeric, Decimal Places = 2, Diameter of feature
```

```
                        Minimum = 0, Maximum = 1000, Default Value = 0
                        Normal, Normal
   Height               Numeric, Decimal Places = 2, Height of feature
                        Minimum = 0, Maximum = 1000, Default Value = 0
                        Normal, Normal
   Temperature          Numeric, Decimal Places = 2, Water temperature
                        Minimum = 0, Maximum = 100, Default Value = 0
                        Normal, Normal
   PhotoNum             Text, Maximum Length = 100, Roll and print number of photograph
                        Normal, Normal
   Comments             Text, Maximum Length = 100
                        Normal, Normal

Waterbody               Point Feature, Label 1 = Point_number, Label 2 = Type_Water
                        location of an adjacent waterbody
   Point_number         Numeric, Decimal Places = 1, unique point identification number
                        Minimum = 0, Maximum = 99999, Default Value = 0, Step Value = 1
                        Normal, Normal
   Water_Name           Text, Maximum Length = 100, Waterbody Name
                        Normal, Normal
   Type_Water           Menu, Normal, Normal, Code for feature
      Tributary [HMT]
      Groundwater Seep
      Natural Springs [HMS]
      Beaver Pond [BP]
      Other  [HM]
   Inlet/Outl           Menu, Normal, Normal
      Inlet
      Outlet
   Length               Numeric, Decimal Places = 2, Waterbody length
                        Minimum = 0, Maximum = 1000, Default Value = 0
                        Normal, Normal
   Width                Numeric, Decimal Places = 2, Bankfull Width
                        Minimum = 0, Maximum = 1000, Default Value = 0
                        Normal, Normal
   Depth                Numeric, Decimal Places = 2, Bankfull Depth
                        Minimum = 0, Maximum = 1000, Default Value = 0
                        Normal, Normal
   Temperatur           Numeric, Decimal Places = 2, Water temperature
                        Minimum = 0, Maximum = 100, Default Value = 0
                        Normal, Normal
   PhotoNum             Text, Maximum Length = 100, Roll and print number of photograph
                        Normal, Normal
   Comments             Text, Maximum Length = 100
                        Normal, Normal

Erosion                 Point Feature, Label 1 = Point_number, Label 2 = Source_Erosion
   Point_number         Numeric, Decimal Places = 1, unique point identification number
                        Minimum = 0, Maximum = 99999, Default Value = 0
                        Normal, Normal
   Source_Erosion       Menu, Normal, Normal, Code for feature
      Bank Erosion [HCEB]
      Culvert [CV]
      Headwall [H]
      Lack of Riparian Veg [WDL]
      Livestock Access [WDC]
      Lakeside Grazing [WDG]
      Landslide
      Sloughing
      Other [O]
   Severity             Menu, Normal, Normal
      Low (<5m sq) [L]
      Moderate (5-10m sq) [M]
      High (>10m sq) [H]
   Exposure             Menu, Normal, Normal
      Clay [C]
      Till [T]
      Bedrock [B]
      Roots [R]
      Soil [S]
      Other [O]
   Length               Numeric, Decimal Places = 2, Feature length
                        Minimum = 0, Maximum = 1000, Default Value = 0
                        Normal, Normal
   Width                Numeric, Decimal Places = 2, Width of Feature
                        Minimum = 0, Maximum = 1000, Default Value = 0
                        Normal, Normal
   Height               Numeric, Decimal Places = 2, Height of feature
                        Minimum = 0, Maximum = 1000, Default Value = 0
```

```
                        Normal, Normal
   Slope                Numeric, Decimal Places = 0
                        Minimum = 0, Maximum = 90, Default Value = 0
                        Normal, Normal
   PhotoNum             Text, Maximum Length = 100, Roll and print number of photograph
                        Normal, Normal
   Comments             Text, Maximum Length = 100
                        Normal, Normal

Flood plain             Point Feature, Label 1 = Point_number, Label 2 = Flood_plain
                        location of flood plain
   Point_number         Numeric, Decimal Places = 1, unique point identification number
                        Minimum = 0, Maximum = 99999, Default Value = 0, Step Value = 1
                        Normal, Normal
   PID_number           Text, Maximum Length = 50, Property Identifier
                        Normal, Normal
   Flood_plain          Menu, Normal, Normal, Elevation level
      200_yr
      MeanAH
      other
   Elevation            Numeric, Decimal Places = 2, Height above sea level
                        Minimum = 0, Maximum = 1000, Default Value = 0
                        Normal, Normal
   Distance             Numeric, Decimal Places = 2, Distance from building
                        Minimum = 0, Maximum = 1000, Default Value = 0
                        Normal, Normal
   Slope                Numeric, Decimal Places = 1, slope to flood plain from lake
                        Minimum = 0, Maximum = 100, Default Value = 0
                        Normal, Normal
   Bearing              Numeric, Decimal Places = 1, Bearing to building
                        Minimum = 0, Maximum = 360, Default Value = 0
                        Normal, Normal
   PhotoNum             Text, Maximum Length = 100, Roll and print number of photograph
                        Normal, Normal
   Comments             Text, Maximum Length = 100, Description of point location
                        Normal, Normal

Photo                   Point Feature, photo point location
   PhotoNum             Text, Maximum Length = 100, Photo number
                        Normal, Normal
   Comments             Text, Maximum Length = 100, Description of photo
                        Normal, Normal

Line_Modification       Line Feature, Modification Line feature
   Type_Modification    Menu, Normal, Normal, Code for feature
      Dredging [HBDD]
      Fences [HOF]
      Livestock crossing [LC]
      Log_Dump [LD]
      Logging [LG]
      Marina
      Railway
      Retain Wall/Bank Stb [EHB]
      Rip_Rap [RR]
      Road [R]
      Trail [TR]
      Other [O]
   Retain_Wal           Numeric, Decimal Places = 0, Retaining walls per segment
                        Minimum = 0, Maximum = 99999999, Default Value = 0
                        Normal, Normal
   Docks                Numeric, Decimal Places = 0, Docks per segment
                        Minimum = 0, Maximum = 99999999, Default Value = 0
                        Normal, Normal
   Groynes              Numeric, Decimal Places = 0, Groynes per segment
                        Minimum = 0, Maximum = 99999999, Default Value = 0
                        Normal, Normal
   Impact               Menu, Normal, Normal, Level of Impact
      Low
      Medium
      High
   High_Water           Menu, Normal, Normal, Above or below high water
      Above
      Below
   PhotoNum             Text, Maximum Length = 100, Roll and print number of photograph
                        Normal, Normal
   Commnt_Mod           Text, Maximum Length = 100, Comments on modification
                        Normal, Normal

1_Riparian              Line Feature
```

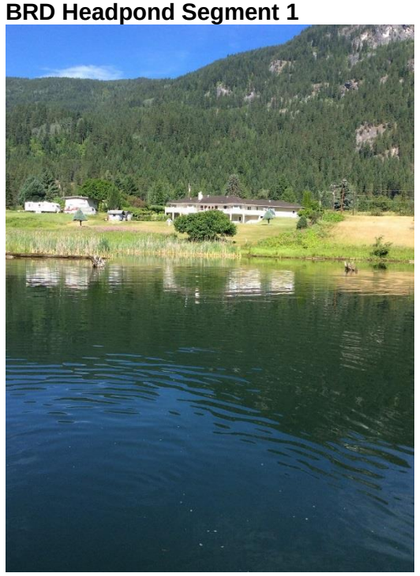
```
   Rip_Class           Menu, Normal, Normal, Riparian Class
      Coniferous forest [VNF]
      Broadleaf forest [VBF]
      Mixed forest [VMF]
      Shrubs [VSH]
      Herbs/grasses [VHB]
      Exposed soil [NEL]
      Landscaped [LS]
      Lawn [L]
      Natural wetland [WN]
      Disturbed wetland [DWN]
      Row Crops [NAG]
      Rock [NNB]
   Rip_Stage           Menu, Normal, Normal, Structural Stage
      low shrubs <2m [3a]
      tall shrubs 2-10m [3b]
      sapling >10m [4]
      young forest [5]
      mature forest [6]
      old forest [7]
   Shor_Cover          Menu, Normal, Normal, Shoreline Cover
      None [ ]
      Sparse (<5%) [ ]
      Moderate (5-20%) [ ]
      Abundant (>20%) [ ]
   Rip_Snag            Menu, Normal, Normal, Presence of Snags
      No   Default
      <5
      >=5
   Rip_Commnt          Text, Maximum Length = 100, Comment Riparian
                       Normal, Normal

2_Riparian             Line Feature
   Rip_Class           Menu, Normal, Normal, Riparian Class
      Coniferous forest [VNF]
      Broadleaf forest [VBF]
      Mixed forest [VMF]
      Shrubs [VSH]
      Herbs/grasses [VHB]
      Exposed soil [NEL]
      Landscaped [LS]
      Lawn [L]
      Natural wetland [WN]
      Disturbed wetland [DWN]
      Row Crops [NAG]
      Rock [NNB]
   Rip_Stage           Menu, Normal, Normal, Structural Stage
      low shrubs <2m [3a]
      tall shrubs 2-10m [3b]
      sapling >10m [4]
      young forest [5]
      mature forest [6]
      old forest [7]
   Shor_Cover          Menu, Normal, Normal, Shoreline Cover
      None [ ]
      Sparse (<5%) [ ]
      Moderate (5-20%) [ ]
      Abundant (>20%) [ ]
   Rip_Snag            Menu, Normal, Normal, Presence of Snags
      No   Default
      <5
      >=5
   Rip_Commnt          Text, Maximum Length = 100, Comment Riparian
                       Normal, Normal

1_Substrate            Line Feature, Label 1 = Substrate
   Substrate           Menu, Normal, Normal
      Mud
      Fines
      Gravel
      Gravel_Fine
      Gravel_Coarse
      Cobble
      Cobble_Fine
      Cobble_Coarse
      Boulder
      Bedrock
   Shape               Menu, Normal, Normal, man made refers to angularity
      angular
```

```
      blast rock
      smooth   Default
   Commnt_Sub          Text, Maximum Length = 100, Comment for Substrates
                       Normal, Normal

2_Substrate            Line Feature
   Substrate           Menu, Normal, Normal
      Mud
      Fines
      Gravel
      Gravel_Fine
      Gravel_Coarse
      Cobble
      Cobble_Fine
      Cobble_Coarse
      Boulder
      Bedrock
   Shape               Menu, Normal, Normal, man made refers to angularity
      angular
      blast rock
      smooth   Default
   Commnt_Sub          Text, Maximum Length = 100, Comment for Substrates
                       Normal, Normal

Sub_Veg                Line Feature, Label 1 = Comment
   Comment             Text, Maximum Length = 30
                       Normal, Normal

Emerg_veg              Line Feature, Label 1 = Comment
   Comment             Text, Maximum Length = 30
                       Normal, Normal
```

Appendix C

Segment Summaries

BRD Headpond Segment 1



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
3.71	Sand	Road	Low (0-5)	Single Family	High (>40%)	No	90%	10%	Silty with some placed coarser substrates

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
0%	1%	0%	74%	0%	20%	5%	modified shore

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape
0%	0%	0%	80%	5%	0%	15%	0%	Unknown	Smooth

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area
100%	0%	0%	0%	0%	0%	0%	0%	0%

Riparian Habitat

Veteran Trees	Snags	Flora Comments	Fauna Comments
No	<5	yellow flag iris	1 eagle, 30 Canada geese, 1 merganser, 5 shorebirds

Vegetation Band

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Herbs/grasses	Grass/Herb	Sparse <10%)	Sparse <10%)	Patchy	30	5%	Landscaped

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
20%	80%	20%	0%	pocket wetland cattails and embayment and pondweed

Littoral Zone

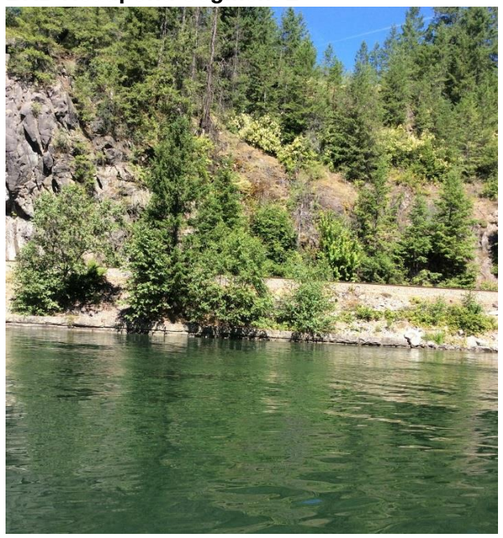
Littoral Zone	Large Woody Debris (LWD)	Number of LWD	Littoral Width	Littoral Comment
Moderate (10-50m)	5-25	25	20	N/A

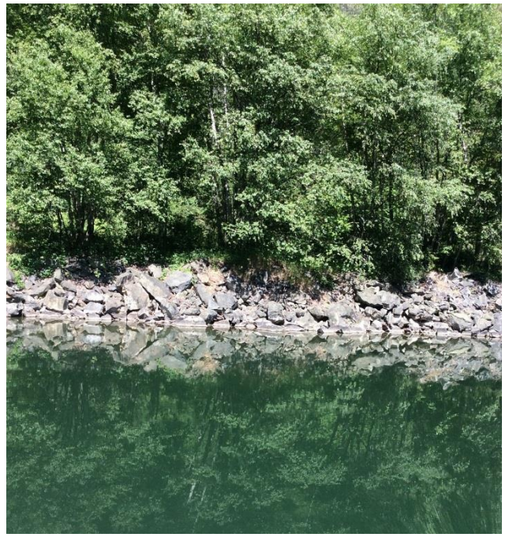
Modifications

Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.	Modification Comment
2	1%	Mixed	21	5.7	3	1	2	0%	80%	Yes	1%	placed gravel, rip rap

N/A = Not available

BRD Headpond Segment 2





General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
2.72	Rocky Shore	Railway	Steep (20-60)	Industrial	High (>40%)	No	40%	60%	Railroad with rip rap and bedrock

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
5%	85%	0%	0%	0%	0%	10%	modified shore

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape	Substrate Comment
0%	0%	0%	0%	5%	5%	80%	10%	Unknown	Smooth	N/A

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area	Land Use Comment
0%	0%	0%	0%	0%	0%	100%	0%	0%	N/A

Riparian Habitat

Veteran Trees	Snags	Flora Comments	Fauna Comments
5-25	No	Yellow flag iris	Shore birds

Vegetation Band

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Mixed forest	Mature forest	Moderate (10-50%)	Moderate (10-50%)	Continuous	30	1%	N/A

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
0%	0%	0%	0%	N/A

Littoral Zone

Littoral Zone	Large Woody Debris	Number of LWD	Littoral Width	Littoral Comment
Narrow (<10 m)	<5	5	3	1 sand bar d/s of rest area

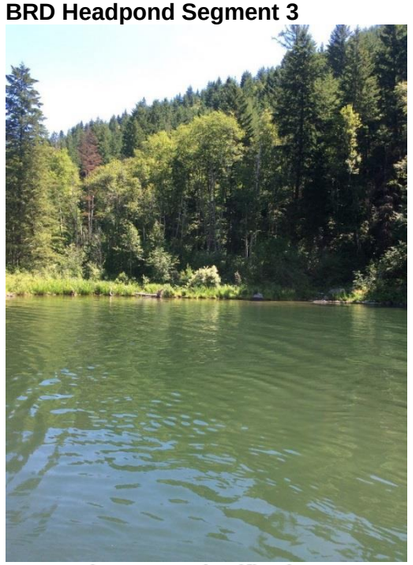
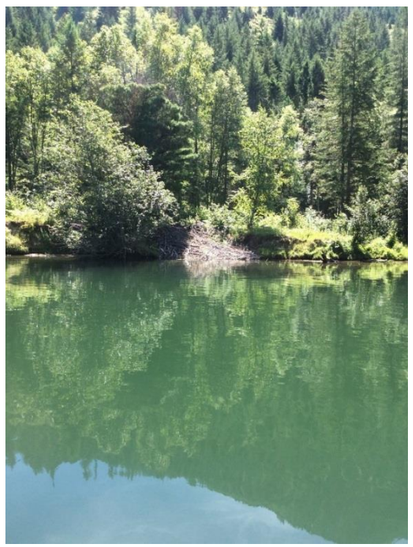
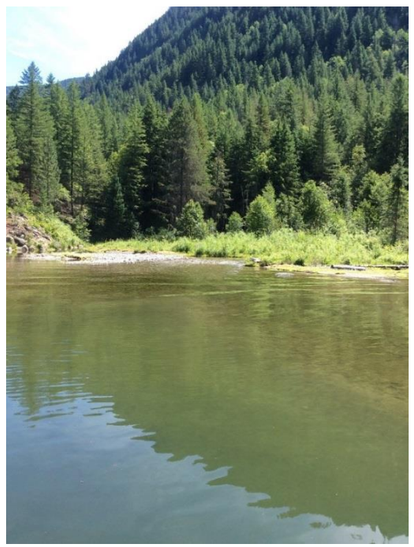
Modifications

Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.
1	1%	Other	0	0	0	0	0	100%	0%	No	0%

Modification Comment
concrete retaining wall 100 m, rip-rap, 1 swim platform

N/A = Not available

BRD Headpond Segment 3

General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
5.67	Rocky Shore	None	Steep (20-60)	Forestry	None	No	0%	100%	Combo rs/bedrock/clay banks/gravel

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
40%	45%	8%	6%	1%	0%	0%	Some eroding clay/sand banks

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape	Substrate Comment
0%	0%	0%	5%	5%	5%	55%	30%	Unknown	Smooth	N/A

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area	Land Use Comment
0%	0%	0%	0%	0%	0%	0%	100%	0%	N/A

Vegetation Band

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Coniferous forest	Mature forest	Sparse (<10%)	Abundant (>50%)	Continuous	30	5%	2 alluvial fans intact forest

Riparian Habitat

Veteran Trees	Snags	Flora Comments	Fauna Comments
>25	<5	Yellow flag iris at tributaries	2 mergansers, 3 mallards, 1 eagle, bank swallows and nests, 3 beaver lodges, shore birds

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
0%	0%	0%	0%	N/A

Littoral Zone

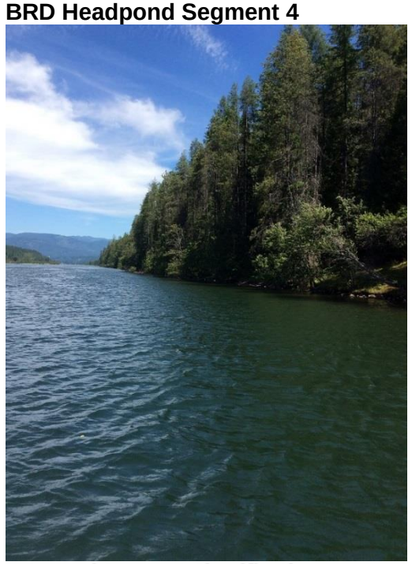
Littoral Zone	Large Woody Debris	Number of LWD	Littoral Width	Littoral Comment
Narrow (<10 m)	5-25	20	1	Steep drop off

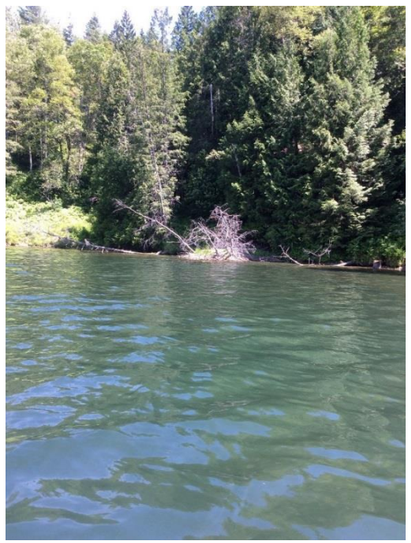
Modifications

Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.	Modification Comment
0	0%	Other	0	0	0	0	0	0%	0%	No	0%	N/A

N/A = Not available

BRD Headpond Segment 4





General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
2.62	Rocky Shore	None	Moderate (5-20)	Forestry	None	No	0%	100%	N/A

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
0%	80%	10%	10%	0%	0%	0%	Few eroding clay/sand banks

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape	Substrate Comment
0%	0%	0%	5%	10%	10%	75%	0%	Unknown	Smooth	N/A

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area	Land Use Comment
0%	0%	0%	0%	0%	0%	0%	100%	0%	N/A

Riparian Habitat

Veteran Trees	Snags	Flora Comments	Fauna Comments
>25	>25	Yellow flag iris at tribs	1 beaver lodge, 2 tv

Vegetation Band

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Coniferous forest	Mature forest	Moderate (10-50%)	Abundant (>50%)	Continuous	30	15%	N/A

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
2%	100%	0%	0%	1 small bay with pondweed near east end

Littoral Zone

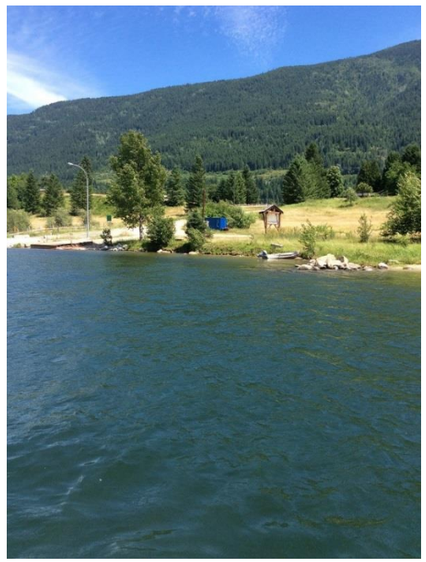
Littoral Zone	Large Woody Debris	Number of LWD	Littoral Width	Littoral Comment
Moderate (10-50m)	>25	100	20	N/A

Modifications

Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.	Modification Comment
0	0%	Other	0	0	0	0	0	0%	0%	No	0%	N/A

N/A = Not available

BRD Headpond Segment 5



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
3.96	Sand	None	Moderate (5-20)	Single Family	High (>40%)	No	90%	10%	N/A

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
0%	1%	4%	95%	0%	0%	0%	Grassy bench

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape	Substrate Comment
0%	0%	0%	95%	4%	0%	1%	0%	Unknown	Smooth	N/A

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area	Land Use Comment
100%	0%	0%	0%	0%	0%	0%	0%	0%	Most houses in b2

Riparian Habitat

Veteran Trees	Snags	Flora Comments	Fauna Comments
No	No	N/A	2 eastern kin birds, swallows, 1 osprey

Vegetation Band

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Herbs/grasses	Grass/Herb	Sparse (<10%)	Sparse (<10%)	Patchy	30	0%	N/A

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
2%	100%	0%	0%	Sparse

Littoral Zone

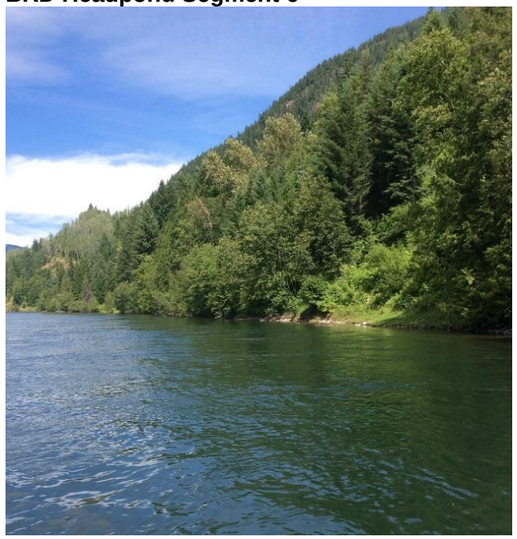
Littoral Zone	Large Woody Debris	Number of LWD	Littoral Width	Littoral Comment
Moderate (10-50m)	<5	4	20	N/A

Modifications

Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.	Modification Comment
0	0%	Other	6	1.5	3	1	1	0%	10%	Yes	1%	N/A

N/A = Not available

BRD Headpond Segment 6



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
3.69	Rocky Shore	None	Moderate (5-20)	Forestry	Low (<10%)	No	1%	99%	N/A

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
0%	70%	20%	10%	0%	0%	0%	N/A

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape	Substrate Comment
0%	0%	0%	15%	15%	20%	50%	0%	Unknown	Smooth	N/A

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area	Land Use Comment
0%	0%	0%	0%	0%	0%	1%	99%	0%	Gas line

Riparian Habitat

Veteran Trees	Snags	Flora Comments	Fauna Comments
>25	No	N/A	5 mergansers, 1 dipper

Vegetation Band

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Mixed forest	Mature forest	Moderate (10-50%)	Abundant (>50%)	Continuous	30	0%	N/A

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
0%	0%	0%	0%	N/A

Littoral Zone

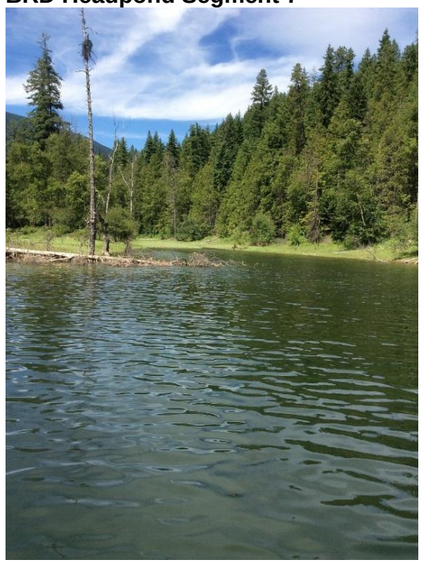
Littoral Zone	Large Woody Debris	Number of LWD	Littoral Width	Littoral Comment
Moderate (10-50m)	5-25	20	20	N/A

Modifications

Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.	Modification Comment
0	0%	Other	1	0	0	0	0	0%	0%	No	0%	1 new dock and trail

N/A = Not available

BRD Headpond Segment 7



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
5.19	Sand	None	Low (0-5)	Forestry	Low (<10%)	No	0%	100%	Sandy embayment with wetland features

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
0%	0%	5%	75%	0%	20%	0%	Pocket wetland area

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape	Substrate Comment
0%	20%	20%	50%	10%	0%	0%	0%	Unknown	Smooth	N/A

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area	Land Use Comment
0%	0%	0%	0%	0%	0%	0%	100%	0%	N/A

Riparian Habitat

Veteran Trees	Snags	Flora Comments	Fauna Comments
5-25	5-25	N/A	flicker, kingfisher

Vegetation Band

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Mixed forest	Mature forest	Sparse (<10%)	Abundant (>50%)	Continuous	30	0%	N/A

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
35%	60%	40%	0%	N/A

Littoral Zone

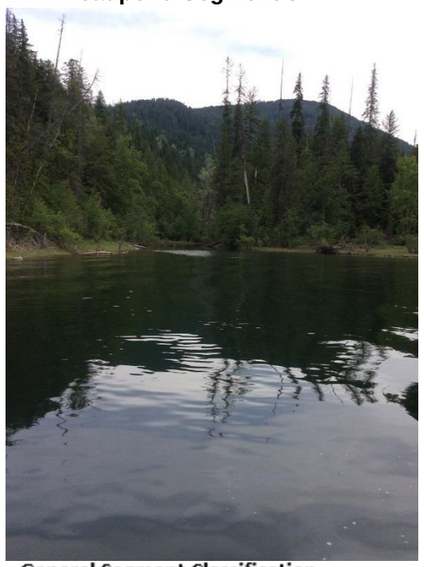
Littoral Zone	Large Woody Debris	Number of LWD	Littoral Width	Littoral Comment
Wide (>50 m)	5-25	20	30	N/A

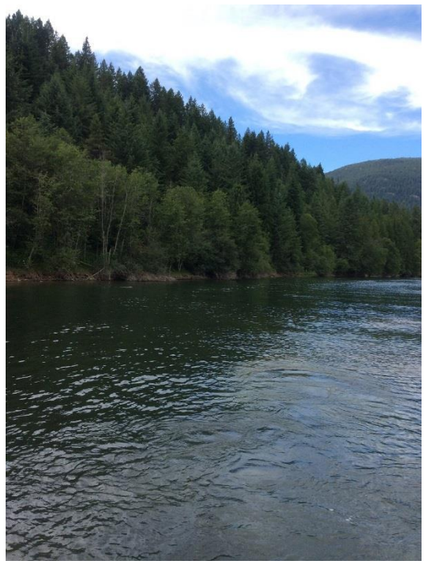
Modifications

Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.	Modification Comment
0	0%	Other	0	0	0	0	0	0%	0%	No	0%	N/A

N/A = Not available

BRD Headpond Segment 8





General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
1.17	Rocky Shore	None	Low (0-5)	Forestry	Low (<10%)	No	0%	100%	N/A

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
0%	60%	20%	10%	0%	10%	0%	Pocket wetland area near end of segment

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape	Substrate Comment
0%	10%	10%	10%	15%	15%	40%	0%	Unknown	Smooth	N/A

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area	Land Use Comment
0%	0%	0%	0%	0%	0%	0%	100%	0%	N/A

Riparian Habitat

Veteran Trees	Snags	Flora Comments	Fauna Comments
5-25	5-25	N/A	2 mergansers

Vegetation Band

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Mixed forest	Mature forest	Moderate (10-50%)	Abundant (>50%)	Continuous	30	0%	N/A

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
20%	100%	0%	0%	N/A

Littoral Zone

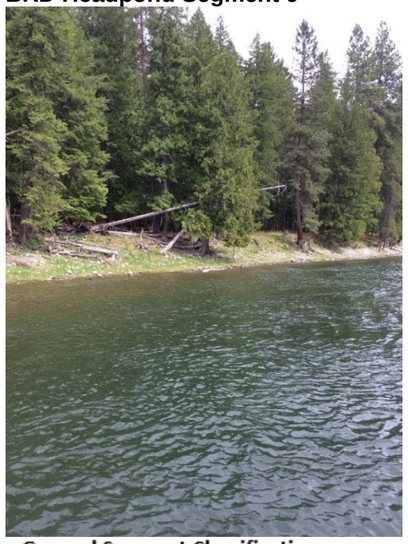
Littoral Zone	Large Woody Debris	Number of LWD	Littoral Width	Littoral Comment
Narrow (<10 m)	5-25	20	10	N/A

Modifications

Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.	Modification Comment
0	0%	Other	0	0	0	0	0	0%	0%	No	0%	N/A

N/A = Not available

BRD Headpond Segment 9



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
1.60	Rocky Shore	None	Moderate (5-20)	Natural Area	Low (<10%)	No	1%	99%	N/A

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
0%	98%	2%	0%	0%	0%	0%	Gravel swimming beach at start

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape	Substrate Comment
0%	0%	0%	10%	15%	15%	58%	2%	Unknown	Smooth	N/A

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area	Land Use Comment
0%	0%	0%	0%	0%	0%	0%	0%	100%	N/A

Riparian Habitat

Veteran Trees	Snags	Flora Comments	Fauna Comments
5-25	5-25	N/A	1 kingfisher, 12 Canada geese

Vegetation Band

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Mixed forest	Mature forest	Abundant (>50%)	Abundant (>50%)	Continuous	30	80%	N/A

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
0%	0%	0%	0%	N/A

Littoral Zone

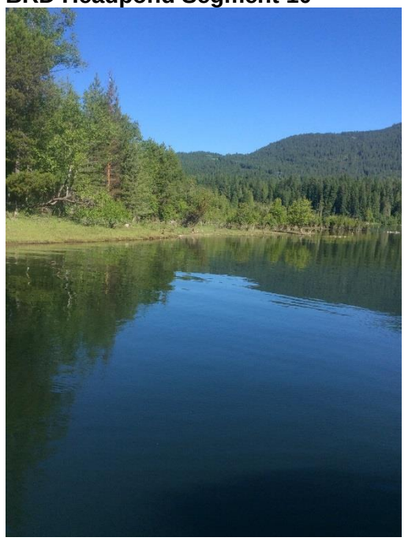
Littoral Zone	Large Woody Debris	Number of LWD	Littoral Width	Littoral Comment
Narrow (<10 m)	5-25	20	5	N/A

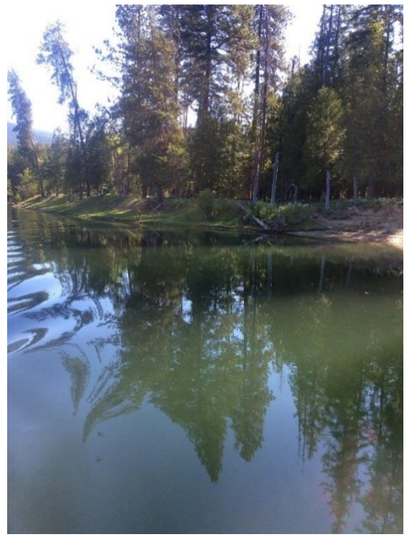
Modifications

Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.	Modification Comment
0	0%	Other	0	0	0	0	0	0%	0%	No	0%	N/A

N/A = Not available

BRD Headpond Segment 10





General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
0.80	Sand	None	Low (0-5)	Natural Area	None	No	5%	95%	Gold Island, sand predominant with gravel on NW side, cobble bar extends out along north point

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
0%	0%	15%	85%	0%	0%	0%	N/A

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape	Substrate Comment
0%	0%	0%	70%	15%	15%	0%	0%	Unknown	Smooth	N/A

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area	Land Use Comment
0%	0%	0%	0%	0%	0%	0%	0%	100%	Small beach 5m wide and unorganized campsite

Vegetation Band

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Coniferous forest	Mixed age	Moderate (10-50%)	Moderate (10-50%)	Patchy	20	2%	N/A

Riparian Habitat

Veteran Trees	Snags	Flora Comments	Fauna Comments
5-25	5-25	N/A	2 shore birds, mussel bed on west side

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
30%	100%	0%	0%	milfoil/pondweed

Littoral Zone

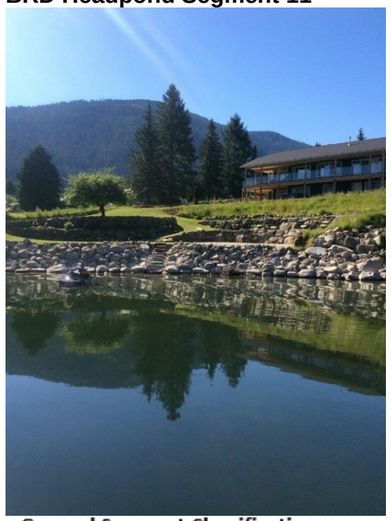
Littoral Zone	Large Woody Debris	Number of LWD	Littoral Width	Littoral Comment
Moderate (10-50m)	<5	4	30	Point bar extends 50 m on east end

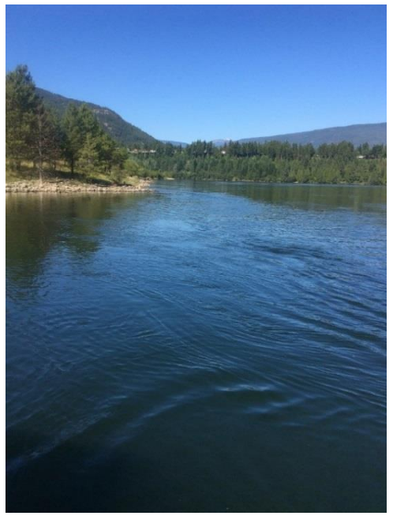
Modifications

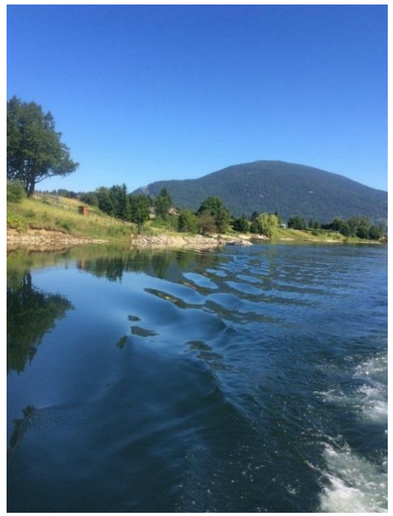
Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.	Modification Comment
0	0%	N/A	0	0	0	0	0	0%	0%	No	0%	N/A

N/A = Not available

BRD Headpond Segment 11







General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
3.05	Sand	None	Moderate (5-20)	Single Family	High (>40%)	Yes	95%	5%	Shoreacres

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
0%	10%	5%	70%	0%	0%	15%	10 sections round rip rap

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape	Substrate Comment
0%	0%	0%	65%	10%	15%	10%	0%	Unknown	Smooth	Boulders mostly placed

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area	Land Use Comment
98%	0%	0%	0%	2%	0%	0%	0%	0%	1 small farm with 2 cows

Vegetation Band

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Herbs/grasses	Grass/Herb	Sparse (<10%)	Sparse (<10%)	Patchy	30	2%	Small acreages, some new large homes

Riparian Habitat

Veteran Trees	Snags	Flora Comments	Fauna Comments
No	<5	N/A	osprey, crows, swallows & nests, 2 kingfishers, eastern kingbird, 15 geese, 5 adult mergansers & 2 juveniles; suckers

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
15%	100%	0%	0%	milfoil/pondweed

Littoral Zone

Littoral Zone	Large Woody Debris	Number of LWD	Littoral Width	Littoral Comment
Moderate (10-50m)	5-25	20	20	Wider at start with submergents

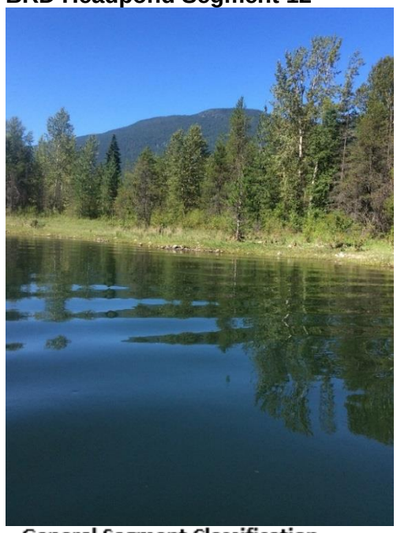
Modifications

Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.
1	0%	Concrete	8	2.6	11	3.6	4	0%	5%	Yes	1%

Modification Comment
4 mooring buoys, 10 fences, 5 pilings, 1 swim platform, 3 sun decks, 1 stairs

N/A = Not available

BRD Headpond Segment 12



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
0.70	Rocky Shore	None	Low (0-5)	Natural Area	Low (<10%)	No	5%	95%	Slocan River fan

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
0%	60%	10%	25%	0%	0%	5%	Old concrete structure from previous aerial pipeline

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape	Substrate Comment
0%	0%	0%	65%	15%	15%	5%	0%	Unknown	Smooth	N/A

Riparian Habitat

Veteran Trees	Snags	Flora Comments
5-25	5-25	N/A

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area	Land Use Comment
0%	0%	0%	0%	0%	0%	0%	0%	100%	N/A

Fauna Comments
2 shore birds, 1 kingfisher, 1 osprey, beaver lodge, 2 empty nest poles

Vegetation Band

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Mixed forest	Mature forest	Abundant (>50%)	Moderate (10-50%)	Patchy	30	5%	N/A

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
0%	0%	0%	0%	N/A

Littoral Zone

Littoral Zone	Large Woody Debris	Number of LWD	Littoral Width	Littoral Comment
Moderate (10-50m)	5-25	20	20	N/A

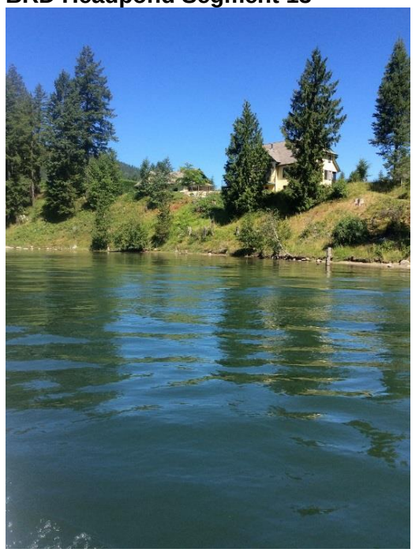
Modifications

Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.
0	0%	N/A	0	0	0	0	0	0%	0%	No	1%

Modification Comment
Historic aerial pipeline crossing concrete structure/gravel fill

N/A = Not available

BRD Headpond Segment 13



General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
0.35	Rocky Shore	None	Steep (20-60)	Single Family	High (>40%)	No	60%	40%	N/A

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
0%	80%	0%	20%	0%	0%	0%	N/A

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape	Substrate Comment
0%	0%	0%	20%	15%	15%	50%	0%	Unknown	Smooth	N/A

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area	Land Use Comment
100%	0%	0%	0%	0%	0%	0%	0%	0%	N/A

Vegetation Band

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Herbs/grasses	Grass/Herb	Sparse (<10%)	Sparse (<10%)	Patchy	30	2%	N/A

Riparian Habitat

Veteran Trees	Snags	Flora Comments	Fauna Comments
5-25	<5	N/A	1 beaver lodge

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
0%	0%	0%	0%	N/A

Littoral Zone

Littoral Zone	Large Woody Debris	Number of LWD	Littoral Width	Littoral Comment
Moderate (10-50m)	<5	4	20	Sandy

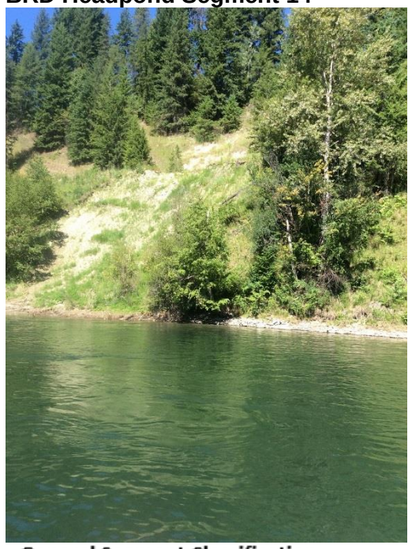
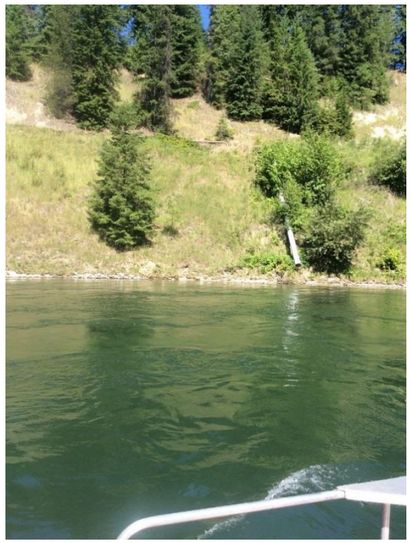
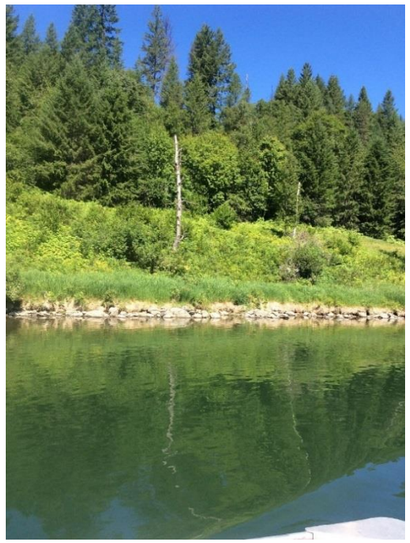
Modifications

Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.
0	0%	N/A	0	0	0	0	0	0%	0%	Yes	5%

Modification comment
Small sand beach constructed, some plain line, fence line, recent tree clearing

N/A = Not available

BRD Headpond Segment 14

General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
1.80	Rocky Shore	None	Steep (20-60)	Industrial	High (>40%)	No	80%	20%	Bouldery

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
0%	98%	0%	2%	0%	0%	0%	N/A

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape	Substrate Comment
0%	0%	0%	15%	10%	15%	60%	0%	Unknown	Smooth	N/A

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area	Land Use Comment
0%	0%	0%	0%	0%	0%	80%	0%	20%	Rail/road line

Vegetation Band 1

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Shrubs	Low shrubs <2m	Abundant (>50%)	Sparse (<10%)	Patchy	30	2%	historically altered rail/road/hydro rights of way

Riparian Habitat

Veteran Trees	Snags	Flora Comments	Fauna Comments
5-25	<5	N/A	1 active beaver lodge, osprey nest with occupant

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
0%	0%	0%	0%	N/A

Littoral Zone

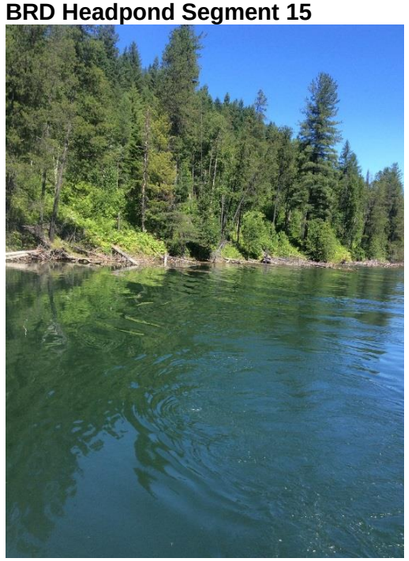
Littoral Zone	Large Woody Debris	Number of LWD	Littoral Width	Littoral Comment
Narrow <10m	5-25	10	10	Large boulders and silt/sand

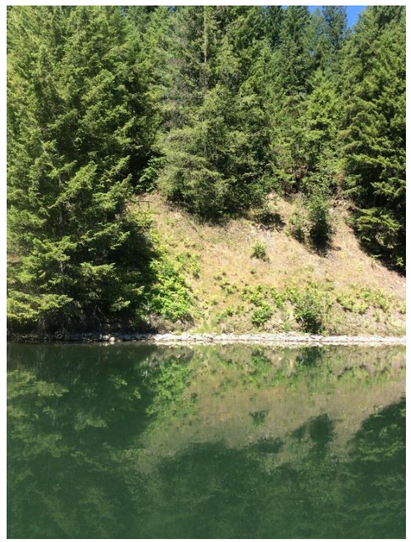
Modifications

Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.	Modification Comment
0	0%	N/A	0	0	0	0	0	40%	30%	No	0%	hydro line, drainage culvert

N/A = Not available

BRD Headpond Segment 15





General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
2.60	Rocky Shore	Railway	Steep (20-60)	Industrial	High (>40%)	No	30%	70%	N/A

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
0%	60%	40%	0%	0%	0%	0%	Stretches of gravel/cobble

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape	Substrate Comment
0%	0%	0%	20%	20%	20%	40%	0%	Unknown	Smooth	N/A

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area	Land Use Comment
0%	0%	0%	0%	0%	0%	70%	0%	30%	Rail/road line

Vegetation Band

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Coniferous forest	Mature forest	Sparse (<10%)	Abundant (>50%)	Continuous	30	2%	Ferry landing/road/rail

Riparian Habitat

Veteran Trees	Snags	Flora Comments	Fauna Comments
>25	<5	N/A	1 shorebird

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
0%	0%	0%	0%	N/A

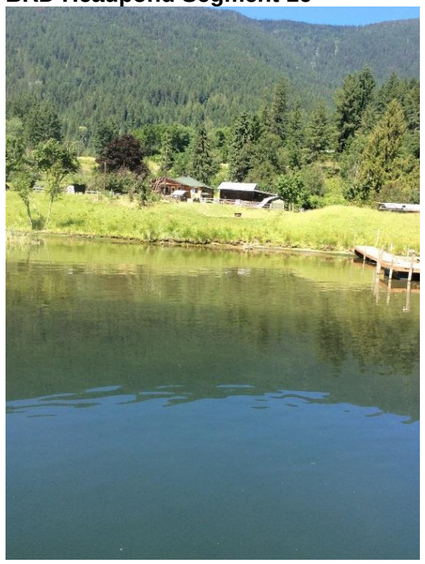
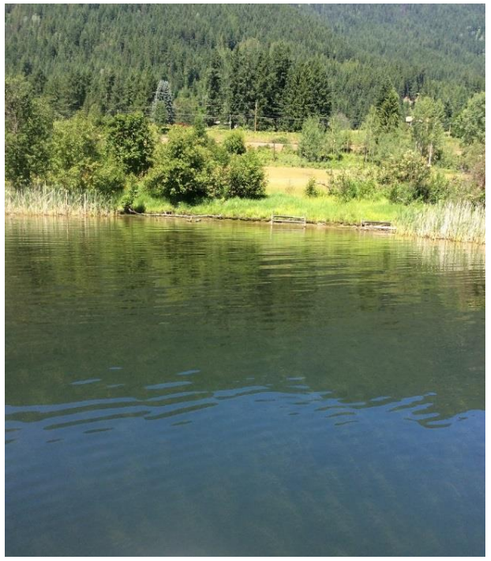
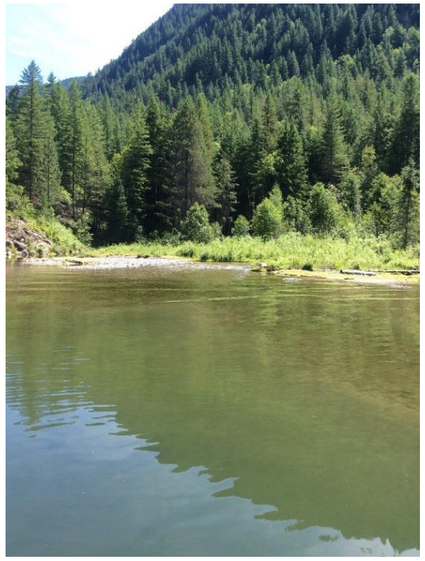
Littoral Zone

Littoral Zone	Large Woody Debris	Number of LWD	Littoral Width	Littoral Comment
Narrow <10m	>25	75	10	large boulders and silt/sand

Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.	Modification Comment
0	0%	N/A	0	0	0	0	0	0%	50%	No	0%	ferry landing

N/A = Not available

BRD Headpond Segment 16

General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
1.21	Sand	None	Bench	Rural	High (>40%)	Yes	80%	20%	N/A

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
0%	0%	0%	90%	0%	5%	5%	2 small cattail areas and 1 stretch of rip rap

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape	Substrate Comment
0%	0%	0%	90%	5%	0%	5%	0%	Unknown	Angular	N/A

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area	Land Use Comment
5%	0%	0%	75%	0%	0%	0%	0%	20%	N/A

Riparian Habitat

Veteran Trees	Snags	Flora Comments	Fauna Comments
No	<5	Hayfields	1 muskrat, 2 little brown birds, 1 kingfisher

Vegetation Band

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Herbs/grasses	Grass/Herb	Sparse (<10%)	Sparse (<10%)	Continuous	30	1%	Road bluff

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
100%	95%	5%	0%	N/A

Littoral Zone

Littoral Zone	Large Woody Debris	Number of LWD	Littoral Width	Littoral Comment
Wide >50	5-25	15	50	Pondweed

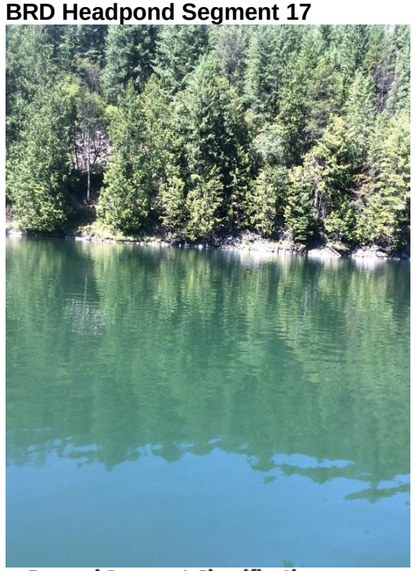
Modification Comment
rip rap, 1 fence line, 3 boat racks

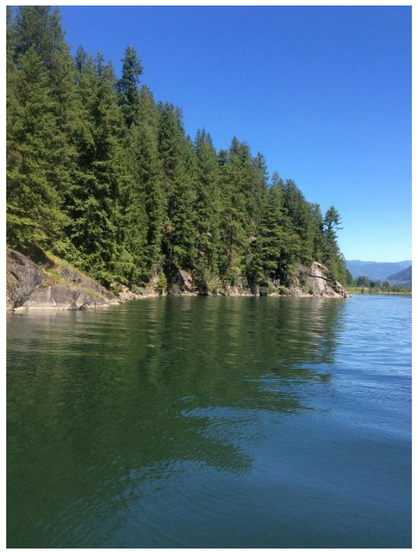
Modifications

Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.
0	0%	N/A	1	1	0	0	0	0%	0%	No	0%

N/A = Not available

BRD Headpond Segment 17





General Segment Classification

Segment Length (km)	Shore Type	Shore Type Modification	Slope	Land Use	Level of Impact	Livestock Access	Disturbed	Natural	Class Comment
0.39	Cliff/Bluff	None	Very Steep (60+)	Natural area	None	No	0%	100%	N/A

Shore Type

Cliff/Bluff	Rocky	Gravel	Sand	Stream Mouth	Wetland	Other	Shore Type Comment
90%	10%	0%	0%	0%	0%	0%	N/A

Substrates

Mud	Organic	Fines	Sand	Gravel	Cobble	Boulder	Bedrock	Embeddedness	Shape	Substrate Comment
0%	0%	0%	0%	5%	5%	20%	70%	Unknown	Angular	N/A

Land Use

Single Family	Commercial	Institutional	Rural	Agriculture	Park	Industrial	Forestry	Natural Area	Land Use Comment
5%	0%	0%	0%	0%	0%	0%	0%	95%	N/A

Vegetation Band

Class	Stage	Shrub Cover	Tree Cover	Distribution	Bandwidth (m)	Overhanging Vegetation	Vegetation Band Comment
Coniferous forest	Mature forest	Sparse (<10%)	Abundant (>50%)	Continuous	30	0%	N/A

Riparian Habitat

Veteran Trees	Snags	Flora Comments	Fauna Comments
5-25	5-25	N/A	N/A

Aquatic Vegetation

Aquatic Vegetation	Submergent	Emergent	Floating	Aquatic Vegetation Comment
0%	0%	0%	0%	N/A

Littoral Zone

Littoral Zone	Large Woody Debris	Number of LWD	Littoral Width	Littoral Comment
Narrow <10m	5-25	5	2	1 debris accumulation on bedrock reef

Modifications

Retaining Walls	%Ret.Wall	Ret. Wall Material	Docks	Docks per km	Groynes	Groynes per km	Boat Launches	% Rail Modifier	% Road Modifier	Substrate Modification	%Substrate Modi.	Modification Comment
0	0%	N/A	0	0	0	0	0	0%	0%	No	0%	N/A

N/A = Not available

Appendix D

Segment Maps

454400 454600 454800 5464600 455000 5464800 455200 5465000 455400 455600 455800 5465400

454400 5464000 454600 5463800 454800 5463600 455000 5463400

Segment Number 2
AHI Value: Moderate
Shoreline Type: Rocky Shore
Landuse: Industrial
Level of Impact: High (>40%)

Segment Number 3
AHI Value: Very High
Shoreline Type: Rocky Shore
Landuse: Forestry
Level of Impact: None

3A
4
Kootenay River
Beaver Lodge
2L290
Brillant Dam
3

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Legend

- Populated Place
- Substation
- Transmission Line
- Highway
- Existing Road
- Contour (25m)
- Watercourse
- Waterbody
- Km Mark
- Boat Launch
- Shoreline Segment Break
- Utility Crossing
- underground pipeline crossing

Zones of Sensitivity
- 2017 Wildlife Observation - Den/Lodge
- 2017 Wildlife Observation - Nest
- Wetland
- Intermittent Wetland Areas
- Tributary Mouth/Fan

AHI (Aquatic Habitat Index Rating)
- Very High
- High
- Moderate
- Low
- Very Low

0 50 100
Meters
Scale: 1:5,000

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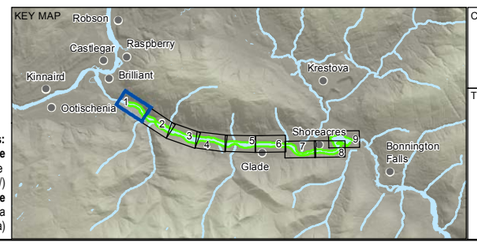

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PROJECT: Brilliant Headpond Foreshore Inventory and Mapping

DATE: March 29, 2018 | ANALYST: MY | QA/QC: CL

GIS FILE: 02-01-002_Foreshore_Inventory_v3

JOB No: VE52664

COORDINATE SYSTEM: NAD 1983 UTM Zone 11N

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5465400 456000 456200 456400 5465800 456600 5466000 456800 5466200 457000 5466400 457200 457400

456000 5465200 456200 5465000 456400 5464800 456600

Segment Number 1
AHI Value: Very Low
Shoreline Type: Sand
Landuse: Single Family
Level of Impact: High (>40%)

Segment Number 2
AHI Value: Moderate
Shoreline Type: Rocky Shore
Landuse: Industrial
Level of Impact: High (>40%)

Segment Number 3
AHI Value: Very High
Shoreline Type: Rocky Shore
Landuse: Forestry
Level of Impact: None

Lockout Rd
Kabaloff Rd
Tihrums Rd
3A
Ezra Creek
Thurms
Kootenay River
Columbia Spotted Frog
Beaver Lodge
McPhee Creek
Little McPhee Creek
5
6
N

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Legend

- Populated Place
- Substation
- Transmission Line
- Highway
- Existing Road
- Contour (25m)
- Watercourse
- Waterbody
- Km Mark
- Boat Launch
- Shoreline Segment Break
- Utility Crossing
- underground pipeline crossing

Zones of Sensitivity
- 2017 Wildlife Observation - Den/Lodge
- 2017 Wildlife Observation - Nest
- Wetland
- Intermittent Wetland Areas
- Tributary Mouth/Fan

AHI (Aquatic Habitat Index Rating)
- Very High
- High
- Moderate
- Low
- Very Low

0 50 100
Meters
Scale: 1:5,000

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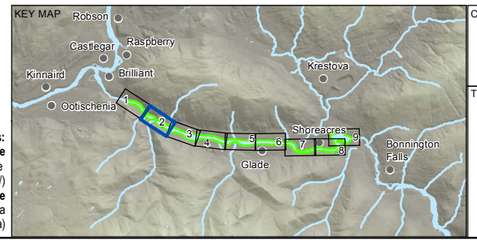

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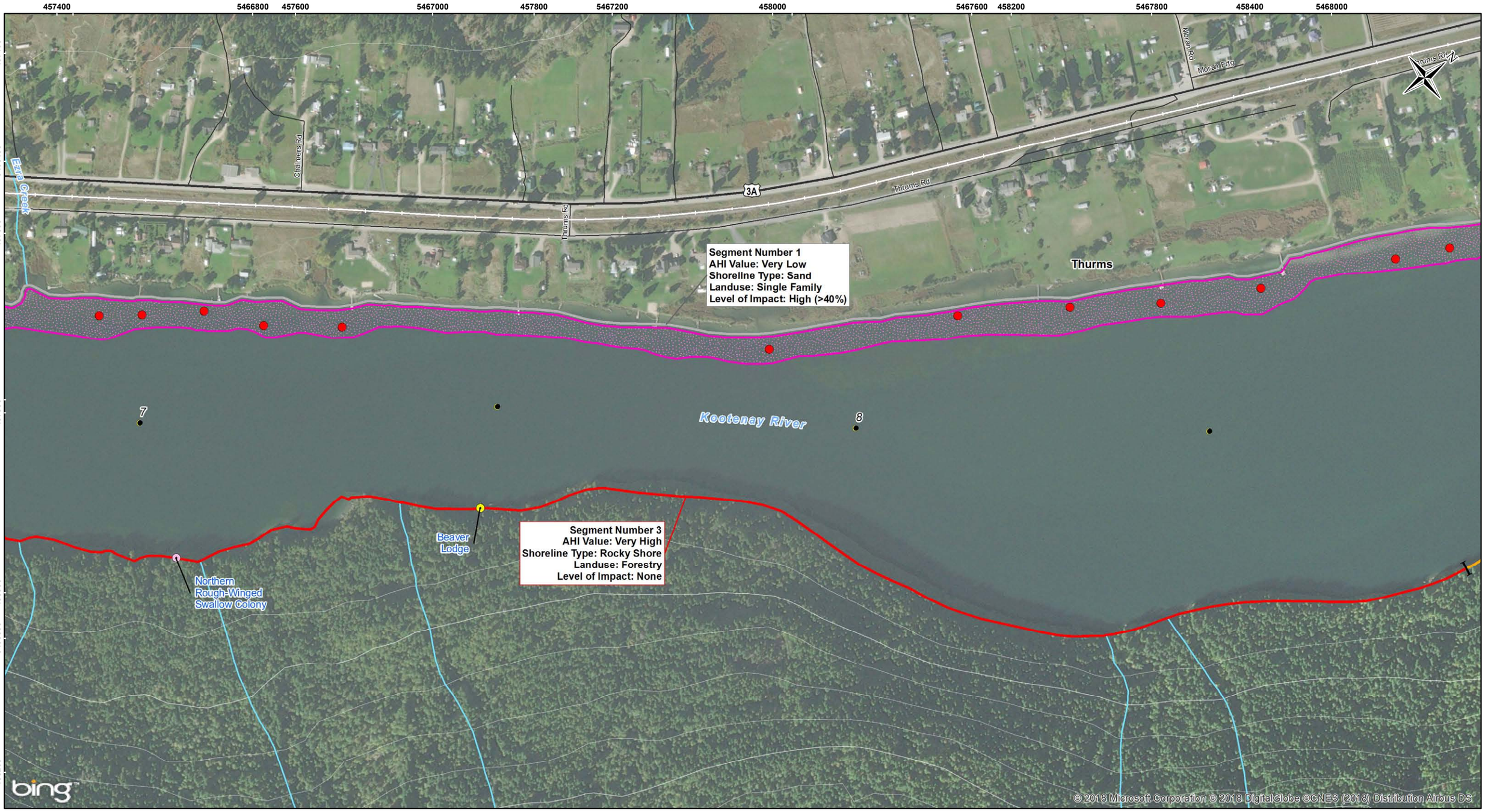

Legend

- Populated Place
- Substation
- Transmission Line
- Highway
- Existing Road
- Contour (25m)
- Watercourse
- Waterbody
- Km Mark
- Boat Launch
- Shoreline Segment Break
- Utility Crossing
- underground pipeline crossing

Zones of Sensitivity

- 2017 Wildlife Observation - Den/Lodge
- 2017 Wildlife Observation - Nest
- Wetland
- Intermittent Wetland Areas
- Tributary Mouth/Fan

AHI (Aquatic Habitat Index Rating)

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

0 50 100
Meters
Scale: 1:5,000

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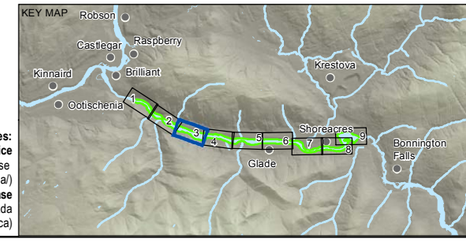

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5468000 5468200 458600 5468400 5468600 458800 5468800 5469000 4590005469200 5469400 459200 5469800

458600
458800
459000
5467600459200
459400

Thrums Rd
3A
Drazdoff Rd
Irving Rd

Segment Number 17
AHI Value: Low
Shoreline Type: Cliff/Bluff
Landuse: Natural area
Level of Impact: None

Segment Number 1
AHI Value: Very Low
Shoreline Type: Sand
Landuse: Single Family
Level of Impact: High (>40%)

Beaver Lodge

Segment Number 16
AHI Value: Moderate
Shoreline Type: Sand
Landuse: Rural
Level of Impact: High (>40%)

9
Kootenay River
10

Segment Number 4
AHI Value: High
Shoreline Type: Rocky Shore
Landuse: Forestry
Level of Impact: None

Hood Creek

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Legend

- Populated Place
- Substation
- Transmission Line
- Highway
- Existing Road
- Contour (25m)
- Watercourse
- Waterbody
- Km Mark
- Boat Launch
- Shoreline Segment Break
- Utility Crossing
- underground pipeline crossing

Zones of Sensitivity
- 2017 Wildlife Observation - Den/Lodge
- 2017 Wildlife Observation - Nest
- Wetland
- Intermittent Wetland Areas
- Tributary Mouth/Fan

AHI (Aquatic Habitat Index Rating)
- Very High
- High
- Moderate
- Low
- Very Low

0 50 100
Meters
Scale: 1:5,000

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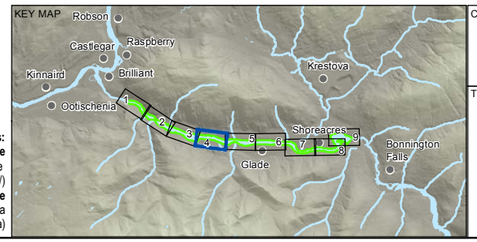

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5469800 5470000 459400 5470200 5470400 5470600 459600 5470800 5471000 5471200 459800 5471400 5471600

459400 5469600 459600 459800 460000 5469400 460200

Irving Rd
Tarrys Creek
Tarrys Rd
Loffil Rd
3A
N

Segment Number 16
AHI Value: Moderate
Shoreline Type: Sand
Landuse: Rural
Level of Impact: High (>40%)

Bank Swallow Colony

Segment Number 15
AHI Value: High
Shoreline Type: Rocky Shore
Landuse: Industrial
Level of Impact: High (>40%)

Belted Kingfisher Nest

River Otter Den

11

12

Kootenay River

Segment Number 4
AHI Value: High
Shoreline Type: Rocky Shore
Landuse: Forestry
Level of Impact: None

Beaver Lodge

Glade

Glade Creek

Prize Rd

Segment Number 5
AHI Value: Moderate
Shoreline Type: Sand
Landuse: Single Family
Level of Impact: High (>40%)

Antler Rd

Shame Rd

Glade Rd

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Legend

- Populated Place
- Substation
- Transmission Line
- Highway
- Existing Road
- Contour (25m)
- Watercourse
- Waterbody
- Km Mark
- Boat Launch
- Shoreline Segment Break
- Utility Crossing
- underground pipeline crossing

Zones of Sensitivity
- 2017 Wildlife Observation - Den/Lodge
- 2017 Wildlife Observation - Nest
- Wetland
- Intermittent Wetland Areas
- Tributary Mouth/Fan

AHI (Aquatic Habitat Index Rating)
- Very High
- High
- Moderate
- Low
- Very Low

0 50 100
Meters
Scale: 1:5,000

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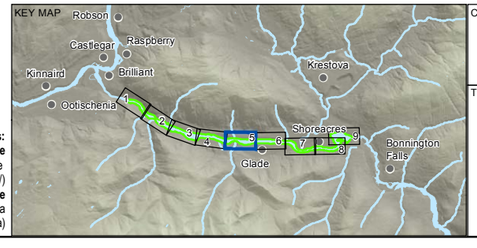

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5471600 5471800 460000 5472000 5472200 5472400 460200 5472600 5472800 5473000 460400 5473400

460000 460200 460400 460600 460800

Loff Rd
Graza Rd
Jenisa Rd
3A
Kovazelsoff Rd
Isazoff Rd
utility access road
Dejong Dr
Dejong Dr
Dejong Dr
Turnlift Lane
Turnlift Lane

Segment Number 15
AHI Value: High
Shoreline Type: Rocky Shore
Landuse: Industrial
Level of Impact: High (>40%)

River Otter Den
Beaver Lodge
Glade Ferry Rd
Osprey Nest
Beaver Lodge

Segment Number 14
AHI Value: High
Shoreline Type: Rocky Shore
Landuse: Industrial
Level of Impact: High (>40%)

Glade Ferry
13
Kootenay River
14
Utility Crossing

Segment Number 5
AHI Value: Moderate
Shoreline Type: Sand
Landuse: Single Family
Level of Impact: High (>40%)

Division Rd
Glade
Glade Rd
Glade Rd
Bernisoff Rd
Isazoff Rd
Labelle Rd
Moraine Rd
London Rd
Isazoff Rd
Bernisoff Rd

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Legend

- Populated Place
- Substation
- Transmission Line
- Highway
- Existing Road
- Contour (25m)
- Watercourse
- Waterbody
- Km Mark
- Boat Launch
- Shoreline Segment Break
- Utility Crossing
- underground pipeline crossing

Zones of Sensitivity
- 2017 Wildlife Observation - Den/Lodge
- 2017 Wildlife Observation - Nest
- Wetland
- Intermittent Wetland Areas
- Tributary Mouth/Fan

AHI (Aquatic Habitat Index Rating)
- Very High
- High
- Moderate
- Low
- Very Low

0 50 100
Meters
Scale: 1:5,000

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KEY MAP
Robson
Castlegar
Raspberry
Kinnaird
Brilliant
Krestova
Ootischenia
1 2 3 4 5 6 7 8 9
Shoreacres
Glade
Bonnington Falls

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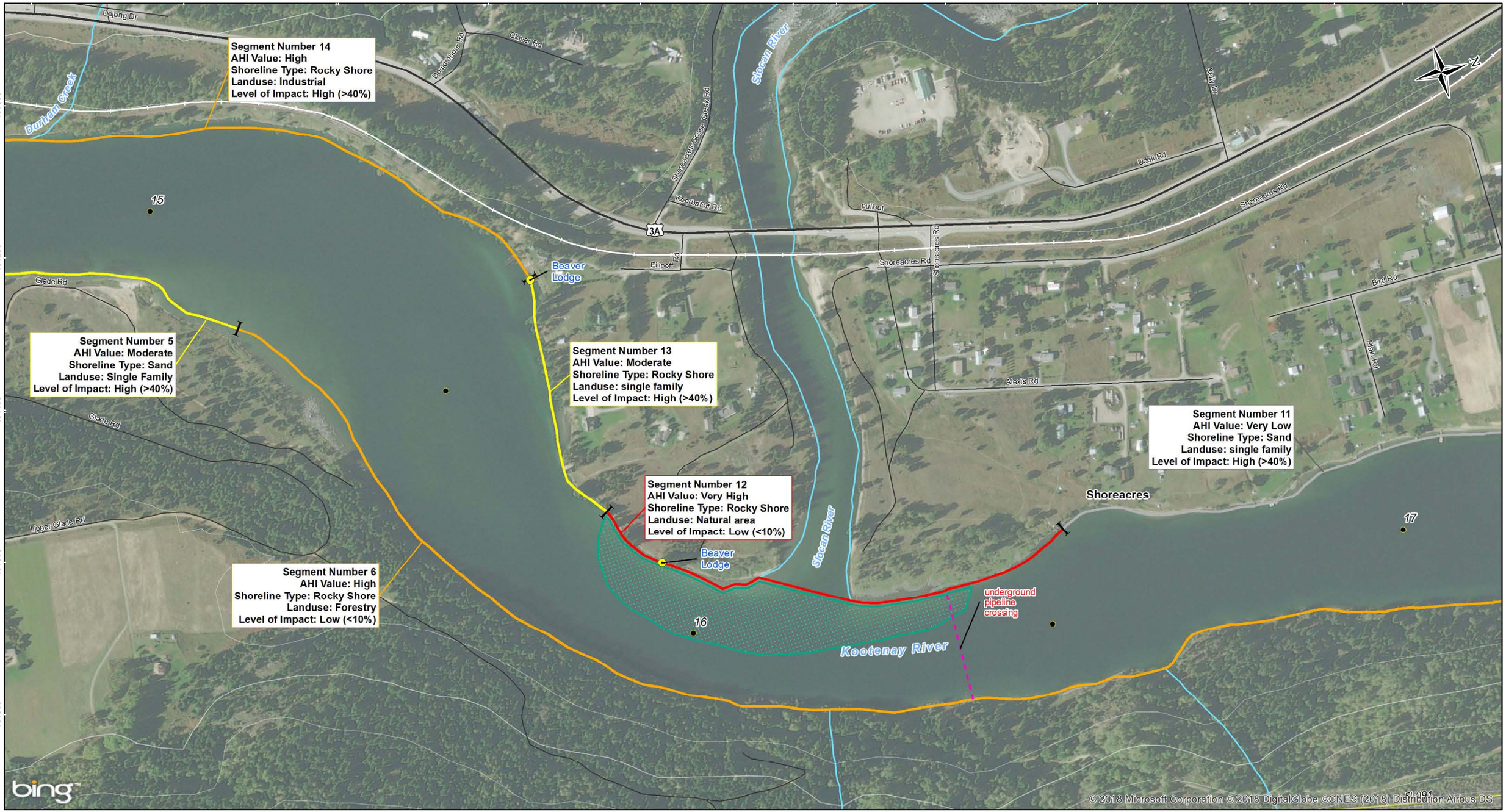

Legend

- Populated Place
- Substation
- Transmission Line
- Highway
- Existing Road
- Contour (25m)
- Watercourse
- Waterbody
- Km Mark
- Boat Launch
- Shoreline Segment Break
- Utility Crossing
- underground pipeline crossing

Zones of Sensitivity

- 2017 Wildlife Observation - Den/Lodge
- 2017 Wildlife Observation - Nest
- Wetland
- Intermittent Wetland Areas
- Tributary Mouth/Fan

AHI (Aquatic Habitat Index Rating)

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

0 50 100
Meters
Scale: 1:5,000

References:
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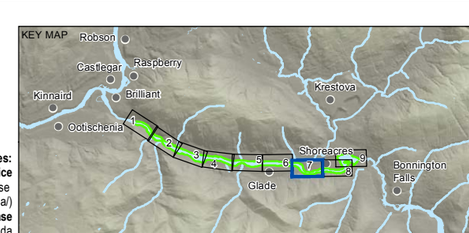

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TITLE: Brilliant Headpond Foreshore Inventory and Mapping

PROJECT: Brilliant Headpond Foreshore Inventory and Mapping

DATE:	ANALYST:	QA/QC:	
March 29, 2018	MY	CL	Page 7 of 9

GIS FILE: 02-01-002_Foreshore_Inventory_v3
JOB No: VE52664
COORDINATE SYSTEM: NAD 1983 UTM Zone 11N

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5475400 5475600 461600 5475800 5476000 5476200 461800 5476600 5476800 462000 5477200

461600 461800 462000 462200 5475000 462400

3A

Shoreacres

Shoreacres Rd

Bird Rd

James Rd

Marshall Rd

Davidson Rd

Jeffs Rd

Gold Island

Kootenay River

Segment Number 10
AHI Value: High
Shoreline Type: Sand
Landuse: Natural area
Level of Impact: None

19

Segment Number 8
AHI Value: High
Shoreline Type: Rocky Shore
Landuse: Forestry
Level of Impact: Low (<10%)

Segment Number 11
AHI Value: Very Low
Shoreline Type: Sand
Landuse: single family
Level of Impact: High (>40%)

Segment Number 7
AHI Value: High
Shoreline Type: Sand
Landuse: Forestry
Level of Impact: Low (<10%)

18

Segment Number 6
AHI Value: High
Shoreline Type: Rocky Shore
Landuse: Forestry
Level of Impact: Low (<10%)

5L091

2L295

2L299

bing

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Legend

- Populated Place
- Substation
- Transmission Line
- Highway
- Existing Road
- Contour (25m)
- Watercourse
- Waterbody
- Km Mark
- Boat Launch
- Shoreline Segment Break
- Utility Crossing
- underground pipeline crossing

Zones of Sensitivity
- 2017 Wildlife Observation - Den/Lodge
- 2017 Wildlife Observation - Nest
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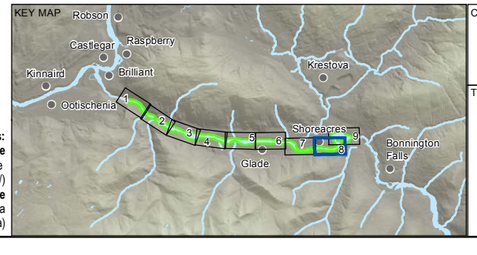

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5476400 461200 5476800 5477000 5477200 461400 5477400 5477600 5477800 461600 5478000 5478200

461200 461400 461600 5476200 461800 462000

Segment Number 9
AHI Value: High
Shoreline Type: Rocky Shore
Landuse: Natural Area
Level of Impact: Low (<10%)

Segment Number 11
AHI Value: Very Low
Shoreline Type: Sand
Landuse: single family
Level of Impact: High (>40%)

Segment Number 10
AHI Value: High
Shoreline Type: Sand
Landuse: Natural area
Level of Impact: None

Segment Number 8
AHI Value: High
Shoreline Type: Rocky Shore
Landuse: Forestry
Level of Impact: Low (<10%)

Slocan Pool
Kootenay River
Gold Island
Hwy 3A
Popoff Rd
Sentinel Rd
Fir Dr
Jacks Cres
Dogwood Dr
South Slocan Station Rd
Slocan Valley Rail Trail
3A
Saddle Rd
West Kootenay Rd
access road
Utility access road
6L091
20
19
Shoreacres Rd
Davidson Rd
2L299
2L295
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Legend

- Populated Place
- Substation
- Transmission Line
- Highway
- Existing Road
- Contour (25m)
- Watercourse
- Waterbody
- Km Mark
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- Shoreline Segment Break
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Zones of Sensitivity
- 2017 Wildlife Observation - Den/Lodge
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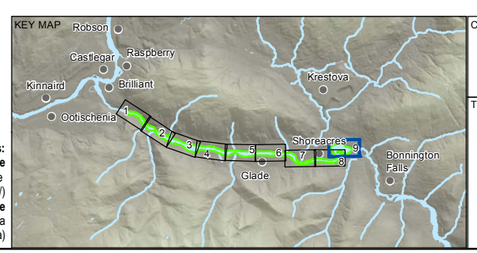

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Appendix E

Wildlife Survey Data

Appendix E. Wildlife Species Observations during Brilliant Headpond Surveys July 18 and September 28, 2017.

Common Name	Species Name	Number of visits observed	Segment																	Comment
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
Mammals																				
Beaver	*Castor canadensis*	1			x*	x*								x*	x*	x*	x*		x*	1 sighting, 10 lodges
American Black Bear	*Ursus americanus*	1			x				x											1 sighting, one set of tracks
Elk	*Cervus elaphus*	1			x															tracks
Muskrat	*Ondatra zibethicus*	1					x													sighting
North American River Otter	*Lontra canadensis*	1															x*			riverbank dens
White-tailed Deer	*Odocoileus virginianus*	1				x														1 sighting, one set of tracks
Birds																				
American Coot	*Fulica americana*	1											x							
American Crow	*Corvus brachyrhynchos*	1															x	x		throughout riverside forests
American Green-winged Teal	*Anas crecca*	2				x														
American Kestrel	*Falco sparverius*	1								x										
American Robin	*Turdus migratorius*	1											x					x		throughout riverside forests
American Wigeon	*Anas americana*	2										x								
Bald Eagle	*Haliaeetus leucocephalus*	1		x																throughout
Bank Swallow	*Riparia riparia*	2																x**		colony
Barn Swallow	*Hirundo rustica*	1															x**			boat launch
Belted Kingfisher	*Megaceryle alcyon*	1															x			
Black-capped Chickadee	*Poecile atricapillus*	2																	x	throughout riverside forests
Brewer's Blackbird	*Euphagus cyanocephalus*	1	x																	farm fields
Canada Goose	*Branta canadensis*	1	x		x													x		throughout
Cedar Waxwing	*Bombycilla cedrorum*	2			x															throughout riverside forests
Chipping Sparrow	*Spizella passerina*	1																x		throughout riverside forests
Common Merganser	*Mergus merganser*	1		x														x		throughout
Common Raven	*Corvus corax*	2		x																throughout riverside forests
Common Yellowthroat	*Geothlypis trichas*	1	x																	throughout riverside forests
Double-crested Cormorant	*Phalacrocorax auritus*	1		x																on floats near Brilliant Dam
Eastern Kingbird	*Tyrannus tyrannus*	1											x							
Golden-crowned Kinglet	*Regulus satrapa*	2			x															throughout riverside forests
Great Blue Heron	*Ardea herodias*	2	x	x			x	x		x		x				x	x	x		14 total, all but one in second survey
Killdeer	*Charadrius vociferus*	1						x												
Northern Flicker	*Colaptes auratus*	2	x																	throughout riverside forests
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	1		x	x**															colonies
Osprey	*Pandion haliaetus*	1			x											x**	x			one nest; one dead
Pacific Wren	*Troglodytes pacificus*	2			x															throughout riverside forests
Pacific-slope Flycatcher	*Empidonax difficilis*	1			x															throughout riverside forests

Common Name	Species Name	Number of visits observed	Segment																	Comment
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
Pileated Woodpecker	*Dryocopus pileatus*	1							x											
Red-breasted Nuthatch	*Sitta canadensis*	1																	x	throughout riverside forests
Red-tailed Hawk	*Buteo jamaicensis*	1																x		
Ring-billed Gull	*Larus delawarensis*	1	x									x								
Rufous Hummingbird	*Selasphorus rufus*	2															x			throughout riverside forests
Savannah Sparrow	*Passerculus sandwichensis*	2						x												fields
Song Sparrow	*Melospiza melodia*	1															x			throughout riverside forests
Spotted Sandpiper	*Actitis macularius*	1															x			
Steller's Jay	*Cyanocitta stelleri*	1						x												throughout riverside forests
Swainson's Thrush	*Catharus ustulatus*	1	x																	throughout riverside forests
Turkey Vulture	*Cathartes aura*	1										x								
Unknown Raptor		1														x**				small stick nest; Osprey or Bald Eagle in progress
Violet-green Swallow	*Tachycineta thalassina*	1	x																	
Willow Flycatcher	*Empidonax traillii*	1											x							
Yellow Warbler	*Setophaga petechia*	1		x																
Yellow-rumped Warbler	*Setophaga coronata*	1							x											
Reptiles																				
Northern Alligator Lizard	*Elgaria coerulea*	0						x												2, observed several days previous to first survey
Amphibians																				
Columbia Spotted Frog	*Rana luteiventris*	1			x															1, in shallows near creek outflow

Notes:

*den or lodge

**nest

Appendix F

Aquatic Habitat Index Data

Appendix F. Aquatic Habitat Index Data and Calculations

Segment Number	Biophysical							Riparian	Fisheries					Wildlife						Modifications																
	Percent Natural	Shore Type	Substrate	Aquatic Vegetation	Overhanging Vegetation	Large Woody Debris	Wetlands	Riparian Bandwidth	Juvenile Rearing Habitat	Migration Corridor	Staging Area	Provincially Listed Fish Observations	Mussels	CDC-Listed Wildlife	Raptor Nest	Bank Nesting Bird Nests	Beaver Lodge	Otter Dens	Retaining Wall	Docks	Groynes	Boat Launch	Substrate Modification		Segment	Parameter Totals: Biophysical	Riparian	Fisheries	Wildlife	Modification		Current AHI	AHI Rank	Potential AHI	Potential AHI Rank
1	1	9.29	4.9	1.6	0.2	2.4	3	7.2	6	0	0	0	5	0	0	0	0	0	-0.1	-8	-1.5	-1	-0.1		1	22.39	7.2	11	0	-10.7		29.89	Very Low	40.59	Moderate
2	6	11.1	7.7	0	0.04	1.6	0	9.6	2	0	0	5	1	0	0	2	0	0	-0.1	0	0	0	0		2	26.44	9.6	8	2	-0.1		45.94	Moderate	46.04	Moderate
3	10	10.19	6.3	0	0.2	1.6	0	9.6	10	5	3	5	5	5	0	2	2	0	0	0	0	0	0		3	28.29	9.6	28	9	0		74.89	Very High	74.89	Very High
4	10	11.6	8.4	0.16	0.6	4	0	9.6	6	0	0	5	1	0	0	0	2	0	0	0	0	0	0		4	34.76	9.6	12	2	0		58.36	High	58.36	High
5	1	8.2	4.28	0.16	0	1.6	1	7.2	10	5	3	5	5	0	0	0	0	0	0	-3	-1.5	-0.5	-0.1		5	16.24	7.2	28	0	-5.1		46.34	Moderate	51.44	High
6	9.9	11.6	8.5	0	0	2.4	0	9.6	6	0	0	5	1	0	0	0	0	0	0	-0.5	0	0	0		6	32.4	9.6	12	0	-0.5		53.5	High	54	High
7	10	9.6	5.4	2.8	0	4	0	9.6	10	0	0	5	1	0	0	0	0	0	0	0	0	0	0		7	31.8	9.6	16	0	0		57.4	High	57.4	High
8	10	11.9	8.1	1.6	0	4	1	9.6	6	0	0	5	1	0	0	0	0	0	0	0	0	0	0		8	36.6	9.6	12	0	0		58.2	High	58.2	High
9	9.9	12	8.38	0	3.2	3.2	0	9.6	6	0	0	5	1	0	0	0	0	0	0	0	0	0	0		9	36.68	9.6	12	0	0		58.28	High	58.28	High
10	9.5	8.6	6.1	2.4	0.08	2.4	0	9.6	6	0	0	5	5	0	0	0	0	0	0	0	0	0	0		10	29.08	9.6	16	0	0		54.68	High	54.68	High
11	0.5	8.15	6.2	1.2	0.08	2.4	0	7.2	6	0	0	5	1	0	0	2	0	0	-0.1	-4	-5	-2	-0.1		11	18.53	7.2	12	2	-11.2		28.53	Very Low	39.73	Moderate
12	9.5	10.65	6.3	0	0.2	4	0	9.6	10	5	3	5	5	0	0	0	2	0	0	0	0	0	-0.1		12	30.65	9.6	28	2	-0.1		70.15	Very High	70.25	Very High
13	4	11.2	8.1	0	0.08	3.2	0	7.2	6	0	0	0	1	0	0	0	2	0	0	0	0	0	-0.5		13	26.58	7.2	7	2	-0.5		42.28	Moderate	42.78	Moderate
14	2	11.92	8.2	0	0.08	2.4	0	12	6	0	0	0	1	0	5	0	2	0	0	0	0	0	0		14	24.6	12	7	7	0		50.6	High	50.6	High
15	7	12	8.4	0	0.08	4	0	9.6	6	0	0	0	1	0	0	2	2	2	0	0	0	0	0		15	31.48	9.6	7	6	0		54.08	High	54.08	High
16	2	8.2	4.5	8	0.04	3.2	1	7.2	10	0	0	0	1	0	0	2	0	0	0	-0.5	0	0	0		16	26.94	7.2	11	2	-0.5		46.64	Moderate	47.14	Moderate
17	10	8.4	4.1	0	0	3.2	0	9.6	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0		17	25.7	9.6	3	0	0		38.3	Low	38.3	Low
																									Max Possible	56	12	28	16	-17		112		112	
																									Max Observed	37	12	28	9	-11.2		75		75	
																									Min Observed	16	7	3	0	0		29		38	

Ranking Break Rationale	
Maximum	75
Minimum	29
Difference	46
Breaks	9.2

Rank	Range
Very Low	0-30
Low	31-40
Moderate	41-50
High	51-60
Very High	61-75