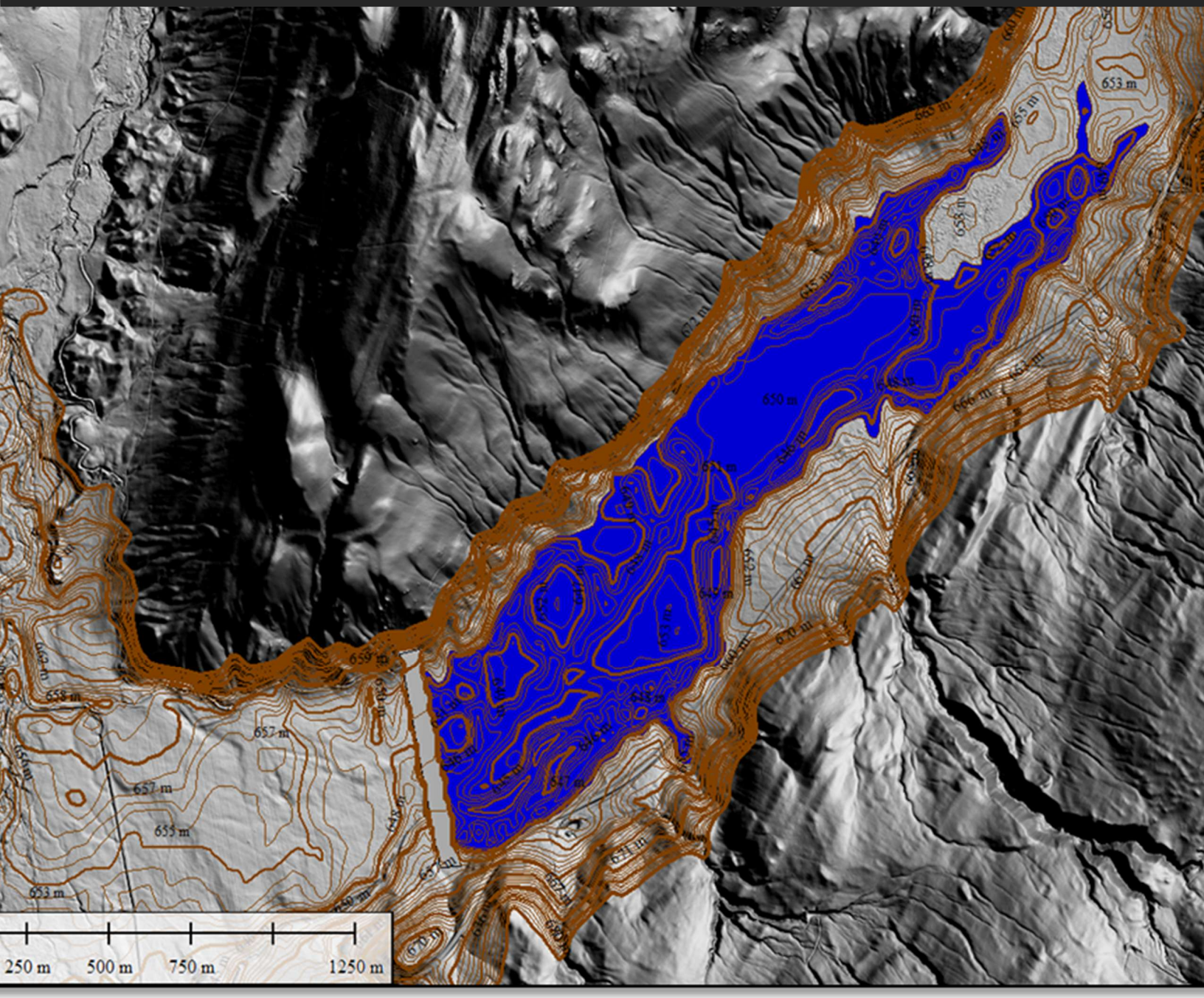
Reservoir Storage Investigation

Nicola and Coldwater River watersheds



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Nicola Watershed Governance Partnership
June 26, 2025

NICOLA AND COLDWATER RIVER WATERSHEDS

RESERVOIR STORAGE INVESTIGATION

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1.0 INTRODUCTION

Ecoscape Environmental Consultants Ltd. (Ecoscape) was retained by Nicola Watershed Governance Partnership (NWGP) to assess potential locations for water storage reservoirs in the Nicola and Coldwater River watersheds upstream from Merritt, B.C. NWGP is a government-to-government initiative comprised of the Nicola 5 First Nations and the Province of B.C. to improve water health and advance reconciliation. Ecoscape engaged BGC Engineering Inc. (BGC) as a subcontractor to support with the project.

Water storage reservoirs are being considered as a potential mitigation option to supplement streamflow for critical salmonid fish species during the low flow summer period. This report summarizes the watershed history and geography as well as the methods used to identify, evaluate, and prioritize potential water storage reservoir locations. The report then summarizes the highest priority reservoir locations in each sub-watershed based on physical characteristics and input from NWGP as well as other stakeholders and rightsholders.

1.1. Overview

The majority of the Nicola River watershed is located within the rain shadow of the Coast Mountains, producing hot and arid conditions in the summer. The watershed experiences pronounced low flows in summer months and, as a result, instream flows have been an ongoing concern. This has created ongoing conflict between water users, some with licenses dating back to the 1800s, and environmental flow needs for aquatic species (Hatfield, 2006).

Dry years in the 1970s to 1980s spurred the creation of the Nicola Basin Strategic Plan in 1983. The plan was intended to address competing water needs by developing guidelines for water management and allocation (Rosenau & Angelo, 2003). Nicola Lake Dam was also reconstructed in 1985 to improve water storage, but the intended benefits were not fully realized due to incomplete dredging of a high spot within the reservoir, resulting in substantial dead (i.e., inaccessible) storage within Nicola Lake (Water Use Management Plan [WUMP], 2010).

The Nicola WUMP (2010) culminated from a workshop held in the fall of 2004. The intended purpose of the WUMP was to “ensure that the future water supply will be divided equitably among all water users balancing the community’s social, economic, traditional and ecological values” (WUMP, 2010). The WUMP identified several overarching issues including: insufficient flow in drought years for both fish and agriculture, tension between recreation use and water storage, and groundwater use by new developments.

1.2. Future Water Challenges

Since the creation of the WUMP in 2010 the situation has continued to worsen in the Nicola River watershed due to population growth, forest disturbance related to mountain pine beetle and wildfires, and more recently the 2021 atmospheric river-induced flooding. Kosakoski and Hamilton (1982) defined minimum flow recommendations for fish on the Nicola River (from Nicola Lake to Merritt) of 1.7 m^3/s and on the Coldwater River at Merritt of 1.4 m^3/s. The WUMP (2010) stated that these values likely remained valid at that time because "…there is evidence that channel morphology is in a form of dynamic equilibrium. That is, channel changes occur through time at any one location, but river-wide patterns in habitat availability remain fairly constant…"

Although Kosakoski and Hamilton's 1982 minimum flow requirements may remain valid on the Nicola River, the large-scale morphologic change resulting from the 2021 flood has invalidated the findings on the Coldwater River. The November 2021 flood discharge peaked at a discharge of 325 m^3/s based on a subsequent estimate by the Water Survey of Canada and as high as 400 m^3/s based on hydraulic modelling completed by BGC (February 19, 2025); the estimated magnitude was double (or more) the magnitude of the previous flood of record (166 m^3/s) recorded at the *Coldwater River at Merritt* (08LG010) gauge. The flood changed the morphology of the Coldwater River dramatically, eliminating habitat complexity and especially thermal refugia. As a result, higher flows are likely now needed in the widened river to provide sufficient depths for fish.

Climate change also poses an additional threat to water management in the Nicola River watershed. Overall runoff is anticipated to increase in the future in the Coldwater River and Spius Creek watersheds due to increased precipitation in fall and winter, while decreasing throughout the rest of the Nicola River watershed (Chernos et al., 2022). Air temperature is projected to increase up to 2.7°C within the watershed by the 2050s, highlighting the need for thermal refugia in summer months (Chernos et al., 2022). The changing climate will also affect flow timing and magnitude. In general, a shortening of the snow accumulation season combined with earlier snowmelt is likely to further decrease low flows in the summer (Schnorbus et al., 2014; Islam et al. 2019).

Climate change will also have less direct, and less predictable impacts on the watershed. For example, increasingly common atmospheric river-generated floods in the fall months are projected to increase peak flood magnitudes in the Coldwater River (Gillett et al., 2022), resulting in more frequent watershed-scale morphologic change and habitat disruption.

1.3. Scope of Work

The objective of this work is to identify locations with sufficient water storage capacity and inflow to support the development of new water storage reservoirs or augment storage in

existing reservoirs. The scope was outlined in a proposal to NWGP dated February 29, 2024 and consists of:

- ***Engaging*** with members of NWGP and local stakeholders and rightsholders to establish selection criteria and evaluate potential water storage reservoirs. This task also involves reviewing past work within the watershed.
- ***Identifying*** potential water storage reservoirs through a high-level assessment of topographic and hydrological data.
- ***Assessing*** potential water storage capacity and inflow volume in more detail for a longlist of sites.
- ***Prioritizing*** sites based on capacity and inflow as well as other criteria identified in meetings with NWGP and other project partners (e.g., cost, land ownership type).

Figure 1-1 provides an overview of the project workflow.

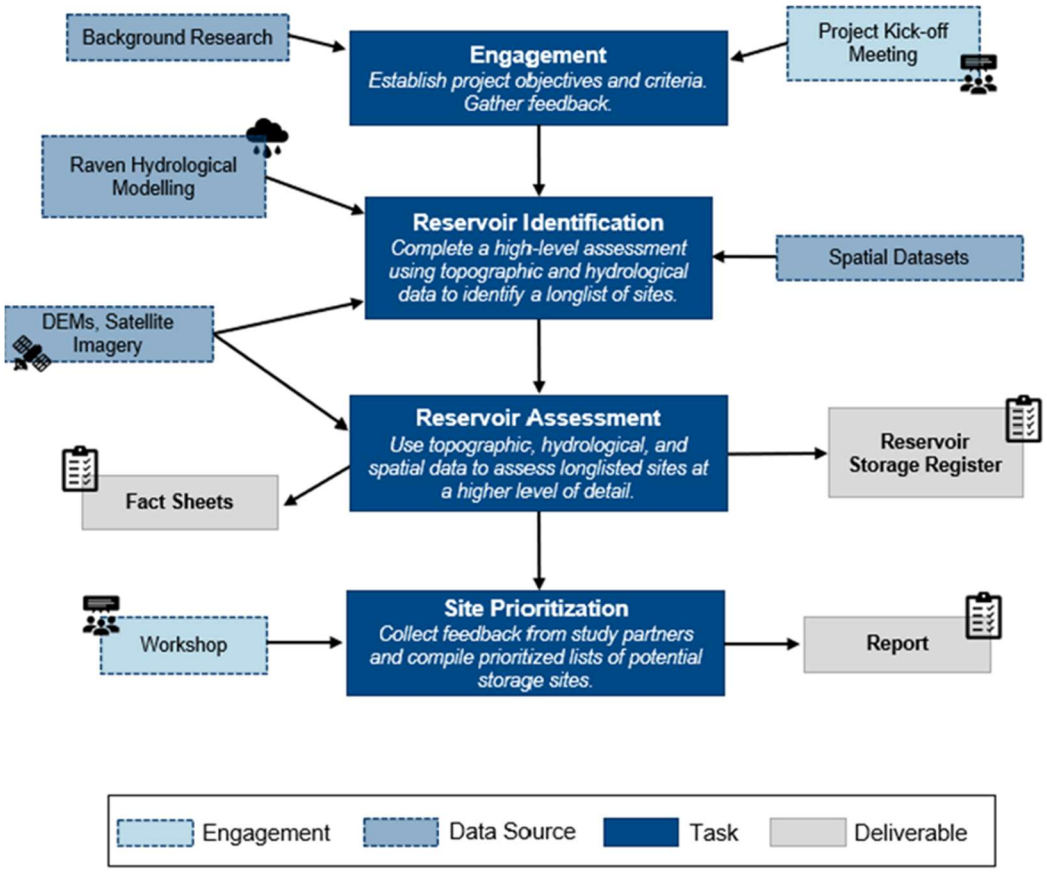


Figure 1-1 Overview of the project workflow.

The key project deliverables are:

- This report documenting the methods used and a summary of the study results.

- A 'Storage Reservoir Register' (herein referred to as the Register) provided as an Excel spreadsheet. The Register contains the compiled data and analysis results for a longlist of 78 sites assessed for water storage capacity and inflow. It also includes additional information for these sites from publicly available data such as existing dam information, land ownership type, fish presence, and estimated cost.
- 'Fact Sheets' for the 36 sites considered the most advantageous to pursue (Appendix A). The Fact Sheets include additional information such as water temperature and provide a visual overview of each site, including inundation extents.
- Reservoir Matrix for the 36 sites that allows for side by side comparison of all the options and their defining characteristics and metrics (Appendix B)

The current work was completed as a high-level desktop study and does not represent a feasibility study for any individual site. The project team intends for these deliverables to be used by NWGP i) to select the most beneficial reservoir locations to evaluate in a more detailed feasibility study, ii) to support funding applications, and iii) to use as a foundation for detailed design once a site is selected.

The scope of work was authorized under a Consulting Services Agreement between Scw'exmx Tribal Council (on behalf of NWGP) and Ecoscape dated April 30, 2024.

2.0 WATERSHED DESCRIPTION

This study Coldwater River and Nicola River watersheds[1] are located within the traditional territory of the Nlaka'pamux Nation and encompass both watersheds upstream from Merritt, B.C. (Figure 2-1). Although these watersheds are both located within glacially influenced terrain (Fulton, 1969) and used heavily for agriculture, they vary in their topography, hydroclimate, and water regulation. The following sections summarize each watershed as well as relevant previous studies.

2.1. Coldwater River

The Coldwater River is the largest tributary to the Nicola River and originates at the Coquihalla Summit in the Cascade Mountains at an elevation of approximately 2,120 m. The river flows northeast towards its confluence with the Nicola River at Merritt, where it has a watershed area of 970 km^2. The Coldwater watershed is in the Interior Transition Ranges Ecosection (Demarchi, 2011) and is cooler and wetter than the remainder of the Nicola River watershed within the study area; the historical mean annual precipitation in the upper reaches of the Coldwater is 1,965 mm compared with an average of 400 mm in

[1] The Coldwater River watershed is part of the Nicola River watershed. They are discussed separately throughout this report to distinguish between different areas within the overall study area.

the Upper Nicola (Wang et al., 2016). The roughly west-east orientation of the mountainous watershed enables it to act as a conduit for rainfall from the Cascade Mountains. As a result, fall and winter rainfall originating from the coast generate rainfall-driven flooding on the Coldwater River in a watershed that is otherwise snowmelt-dominated.

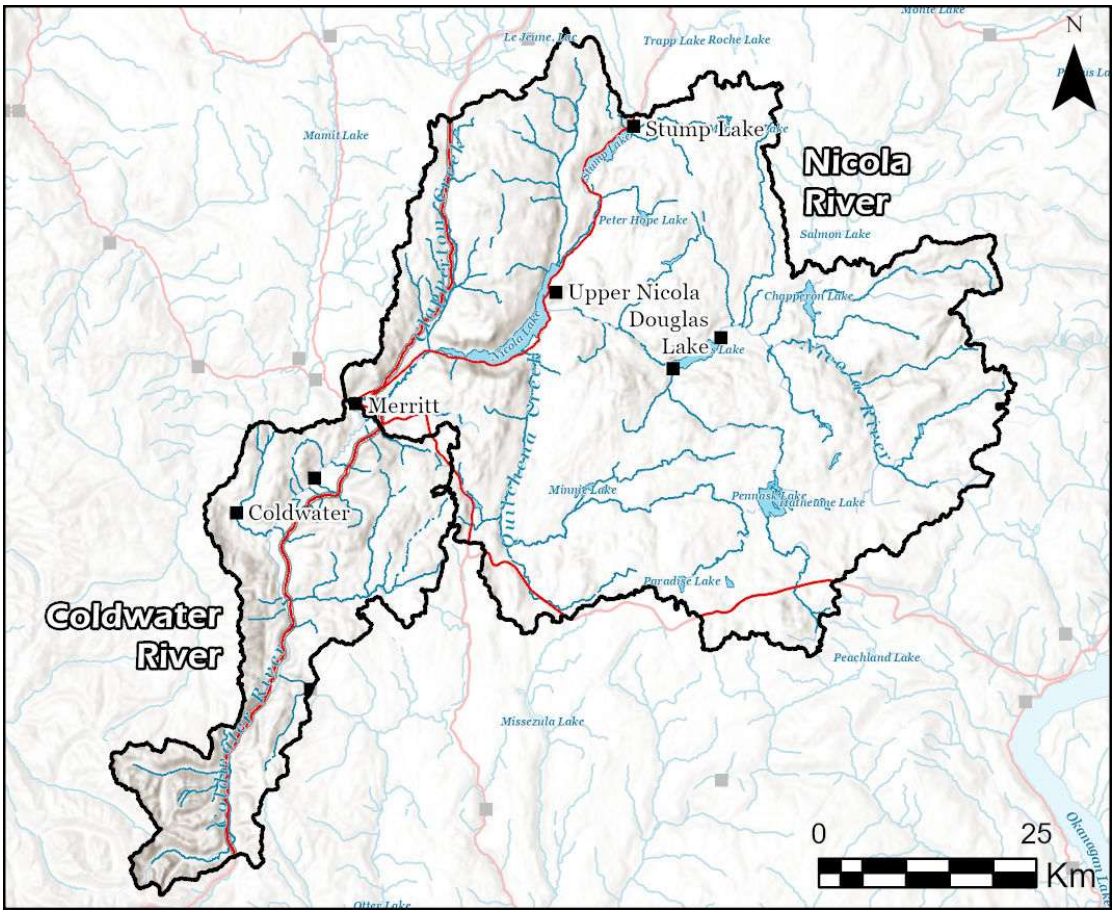


Figure 2-1 Overview of the project study area.

The Coldwater watershed is forested with a range of spruce and fir at high and moderate elevations, with grasslands at lower elevations. Land use within the valley bottoms is primarily agricultural. Infrastructure within the watershed includes Highway 5 (i.e., the Coquihalla Highway) and multiple transmission pipelines. The watershed has been moderately disturbed due to a combination of wildfires and forest harvesting (Chernos et al., 2022) and a recent study by Hou and Weir (2024) found that the equivalent clearcut area required within the Coldwater watershed to cause 'significant hydrological impacts' (only 7%), was passed in 1995.

The Coldwater supports populations of three of the seven species of Pacific salmon: Coho (O. kisutch), Steelhead (O. mykiss) and Chinook (O. tshawytscha), as well as the non-anadromous forms (freshwater only) Rainbow Trout (O. mykiss). Other salmonid fish species include the Rocky Mountain Whitefish (Prosopium williamsoni) and Bull Trout

(Salvelinus confluentus). Non-salmonid fish include suckers (Catastomus spp.), sculpin (Cottidae spp.), Redside Shiner (Richardsonius balteatus), Longnose Dace (Rhinichthys cataractae), Leopard Dace (Rhinichthys falcatus), and Pacific Lamprey (Entosphenus tridentatus).

The are no major lakes in the watershed and there is minimal flow regulation. Of the 20 inventoried dams within the B.C. dam database, all are in the northern half of the Coldwater watershed, mostly within the Voght Creek and Midday Creek watersheds. Dam heights range from 0 to 5.3 m and crest lengths of up to 110 m. Most of the dams are classified as earthfill dams with low failure consequence.

2.2. Nicola River

The Nicola River originates in the headwaters of the Thompson Plateau approximately 20 km northwest of Kelowna, B.C., at a maximum elevation of approximately 2,000 m. The river flows west into Nicola Lake near Quilchena, B.C., and out through the Nicola Lake Dam to the southwest through Merritt, where it has a watershed area of 3,330 km^2.

The upper Nicola River watershed is located within the Thompson-Okanagan Plateau Ecoregion, which is characterized as a low elevation, rolling plateau (Demarchi, 2011). The Nicola River and its largest tributaries upstream from Merritt, Clapperton Creek and Quilchena Creek, all originate in upland plateaus. Although the watershed lies in the rain shadow of the Coast Mountains and is one of the warmest areas in Canada, there is a dramatic climatic gradient within the watershed; headwater reaches within the Nicola River and Quilchena Creek are cooler and wetter, whereas the lower elevation valley bottoms – and the Clapperton Creek and Stumplake Creek watersheds – are warm and dry (Chernos et al., 2022).

The Nicola watershed is characterized by spruce and fir forests at higher elevations and grasslands used extensively for agriculture within the valley bottoms. Parts of the watershed exceed 25% forest disturbance, especially in areas like Clapperton Creek which have been extensively harvested over the past 20 years (Chernos et al., 2022). Although timber extraction goes back several decades, harvesting (especially salvage logging) accelerated abruptly in the early 2000s in response to the mountain pine beetle epidemic. Forest removal has also occurred as part of construction of Highway 5 in the early 1980s, ongoing pipeline construction, and to support ranching and other agricultural activities within the watershed.

The Nicola River watershed supports populations of five of the seven species of Pacific salmon: Pink (*Oncorhynchus gorbuscha*), Coho (*O. kisutch*), Sockeye (*O. nerka*), Steelhead (*O. mykiss*), and Chinook (*O. tshawytscha*), as well as the non-anadromous forms (freshwater only) Kokanee (*O. nerka*) and Rainbow Trout (*O. mykiss*). Other salmonid fish species include the Rocky Mountain Whitefish (*Prosopium williamsoni*), Bull Trout

(*Salvelinus confluentus*), and Dolly Varden (*Salvelinus malma*). Non-salmonid fish include suckers (*Catastomus spp.*), Peamouth Chub (*Mylocheilus caurinus*), Chiselmouth Chub (*Acrocheilus alutaceus*), sculpins (*Cottus spp.*), Prickly Sculpin (*Cottus asper*), Redside Shiner (*Richardsonius balteatus*), Slimy Sculpin (*Cottus cognatus*), Longnose Dace (*Rhinichthys cataractae*), Leopard Dace (*Rhinichthys falcatus*), Northern Pikkeminnow (*Ptychocheilus oregonensis*), and Burbot (*Lota lota*).

Several major undammed lakes are present within the Nicola River watershed upstream from Merritt (Pennask Lake, Chapperon Lake, Stump Lake, and Douglas Lake). The watershed also includes 59 inventoried dams with dam heights ranging from 0 to 7.5 m and crest lengths of up to 520 m. The existing dams are largely earthfill, though steel and concrete dams are also present. Nearly half of the dams have a failure consequence of Very High or Significant (27 dams). The largest dam in the Upper Nicola watershed is Nicola Lake dam, which was built in the 1920s and reconstructed in the mid 1980s to provide water for irrigation expansion, maintenance of flow for fisheries resources, and downstream flood control within the Nicola Valley. Since the 1990s, the dam has been operated by the province of British Columbia. The Nicola Lake dam is outside of the scope of the current study, as options to enhance storage in this reservoir are being undertaken separately.

3.0 DROUGHT HISTORY AND MANAGEMENT

Droughts in the B.C. interior in the 2000s highlighted the ongoing need for improved water management within the Coldwater and Nicola River watersheds. The Coldwater River Watershed Recovery Plan was developed in 2001 (Nelson et al., 2001) and a water storage study was undertaken in 2002 (Summit Environmental Consultants Limited [Summit], December 20, 2002) but no new water storage reservoirs were constructed after the study was completed. A subsequent water balance study by Water Management Consultants (WMC, October, 2008) concluded that there was insufficient water supply throughout the watershed to meet current or future water needs in drought years.

Currently water use restriction is the primary tool to address water scarcity in times of drought in the Nicola and Coldwater watersheds. This section introduces the provisions within the Water Sustainability Act (WSA) that are used to restrict water use and provides additional context on historical low flows within the study area.

3.1. Water Sustainability Act

The WSA was enacted in 2016 and guides the management and use of water in British Columbia. In 2023 the WSA was consolidated under the Ministry of Water, Land and Resource Stewardship (WLRS). During a drought, the WSA allows officials to use temporary protection orders (TPOs) to regulate both groundwater and surface water. The first step is

to issue a Section 86, which is the Declaration of a Significant Water Shortage. This may lead to the issuance of a Section 87, which requires that the province define the Critical Environmental Flow Threshold (CEFT) for each stream covered by the order. A CEFT defines the flow below which significant, irreversible harm to aquatic ecosystems is likely to occur.

Following the issuance of a Section 86 and 87, the Minister may issue a Section 88 Fish Population Protection Order (FPPO). An FPPO is used if available data and forecasts for streamflow, groundwater, snowpack, and soil conditions show that low flows are likely to occur that will irreversibly harm fish populations. Section 88 allows the Minister to override the precedence of rights to regulate water use. Specifically it:

"…authorizes the minister, after considering all relevant monitoring data and agricultural needs, to make an order respecting the diversion and use of water from a specified stream or hydraulically connected aquifer. If the flow in a stream is so low that the survival of a fish population may become threatened, a fish population protection order can be used to regulate specific water users when its application is expected to yield immediate, direct benefits to a fish population."

Fish protection orders were issued for the Nicola River in 2009 and for the Coldwater River in 2015 under the previous water act. Numerous FPPOs were issued in nearby southern B.C. watersheds in 2021 (West Kettle River, Koksilah River, Bessette Creek, and Salmon River) and 2023 (Tsolum River, Koksilah River, Bessette Creek, and Salmon River). FPPOs are not always issued when flows decrease below the CEFT and, when issued, are often implemented too late; the orders issued in the study area in 2009 and 2015 were invoked 1-2 months after flows decreased below the CEFT (Raincoast Conservation Foundation, April 10, 2024). Furthermore, although no FPPO has been issued in the Coldwater River since 2015, summer flows have decreased below the Fisheries Resource Maintenance Flows defined by Kosakoski and Hamilton (1982) in every year from 2016-2024, and below the CEFT in some years (see Section 3.2 for a more detailed description of the CEFTs).

The maximum duration of an FPPO is 90 days, and in most previous cases FPPOs have been issued in mid- to late-August and repealed near the end of September. Agricultural irrigators are typically the largest water users in rural watersheds in southern B.C. and are therefore disproportionately affected by TPOs. For example, Summit (2007) reported that agricultural users account for 49% of annual water use in the Coldwater River watershed and 58% of water use in August and September. The Minister is required by Section 88(2) to "give due consideration to the needs of the agricultural users."

3.2. Flow Thresholds

Critical flow thresholds for fish are defined based on flow needs of specific fish life stages. For example, the period from July 1 to September 30 is a critical period for summer rearing for many species. Streamflow records are used to estimate:

- the rolling 30-day mean discharge for each day in the summer CPSF
- the long-term mean annual discharge (LT MAD) and related benchmark flows (5%, 10%, and 20% LT MAD)

The greater of the lowest 30-day mean discharge and the 5% LT MAD is used to define the CEFT. Using data from the period from 1996 to 2010, McLeary and Ptolemy (2017) calculated a rolling 30-day minimum discharge of 0.33 m^3/s for the *Coldwater River near Brookmere* (08LG010) and a 5% LT MAD of 0.34 m^3/s. As a result, the CEFT for the gauge was defined at that time as 0.34 m^3/s (McLeary & Ptolemy, 2017).

The MAD-estimated CEFT is typically low relative to environmental flow needs to sustain healthy fish populations. Kosakoski and Hamilton (1982) defined minimum flow recommendations for fish on the Nicola and Coldwater River based on habitat suitability indices. This approach considers the suitability of habitat based on the velocity or depth compared to the preferred range for a species and life stage; habitat quality and carrying capacity are related to the availability of suitable habitat (or "usable area") at a given flow, and a minimum flow can be defined where usable area begins to decline.

Kosakoski and Hamilton (1982) defined a minimum Fisheries Resource Maintenance Flows during the period from August to November of 1.7 m^3/s on the Nicola River (from Nicola Lake to Merritt) and 1.4 m^3/s on the Coldwater River at Merritt. The latter is approximately four times the CEFT flow defined by McLeary and Ptolemy (2017).

3.3. Low Flow Hydrology

Gauge records at the *Coldwater River at Merritt* (08LG010), *Coldwater River near Brookmere* (08LG048) and *Nicola River at Outlet of Nicola Lake* (08LG065) were used to assess low flows in the study area over the 15-year period from 2006 to 2020 using the methods described by McLeary and Ptolemy (2017).

Table 3-1 provides gauge information and summarizes select threshold flows presented in the previous subsections. Flow statistics were calculated in the open-source R package *fasstr* (R Version 4.3.0). LT MAD and the associated benchmark flows (5%, 10%, and 20%) were calculated using all available daily flow data throughout the period. The rolling 30-day average discharge was calculated for the period from July 1 to September 30 in each year; Table 3-1 shows the minimum value over the 15-year period as well as the date on which it occurred.

Figure 3-1 shows flows throughout the year at three gauges located within the study area. Low flows on the Coldwater River (Figure 3-1 a, b) typically occur in August and September, with flows increasing in the fall and winter due to rainfall events originating from coastal systems. In 2015, the last time that a FPPO was issued on the Coldwater River, the daily flows from mid-May to mid-August were the lowest recorded from 2006 to 2020 (Figure 3-1 a, b). The *Nicola River at Outlet of Nicola Lake* (08LG065; Figure 3-1 c) is regulated by

the Nicola Lake dam. The regulation, combined with the lack of fall and winter rainfall events in the Nicola watershed, result in low flows in August and September that continue to decrease through the winter as precipitation is stored in snowpack.

Table 3-1 Flow thresholds for select WSC gauges within the study area.

Parameter	08LG048	08LG010	08LG065	08LG016
Gauge Name	*Coldwater River near Brookmere*	*Coldwater River at Merritt*	*Nicola River at Outlet of Nicola Lake*	*Pennask Creek near Quilchena*
Watershed Area (km^2)	316	917	2,960	88
LT MAD (m^3/s)	6.8	7.8	5.6	0.70
5% LT MAD (m^3/s)	0.34	0.39	0.28	0.034
30-day Min. (m^3/s)	0.39 (Sep. 16, 2017)	0.24 (Aug. 29, 2006)	1.5 (Sep. 30, 2008)	0.067 (Aug. 29, 2006)
CEFT (m^3/s)	0.39	0.39	1.5	0.067

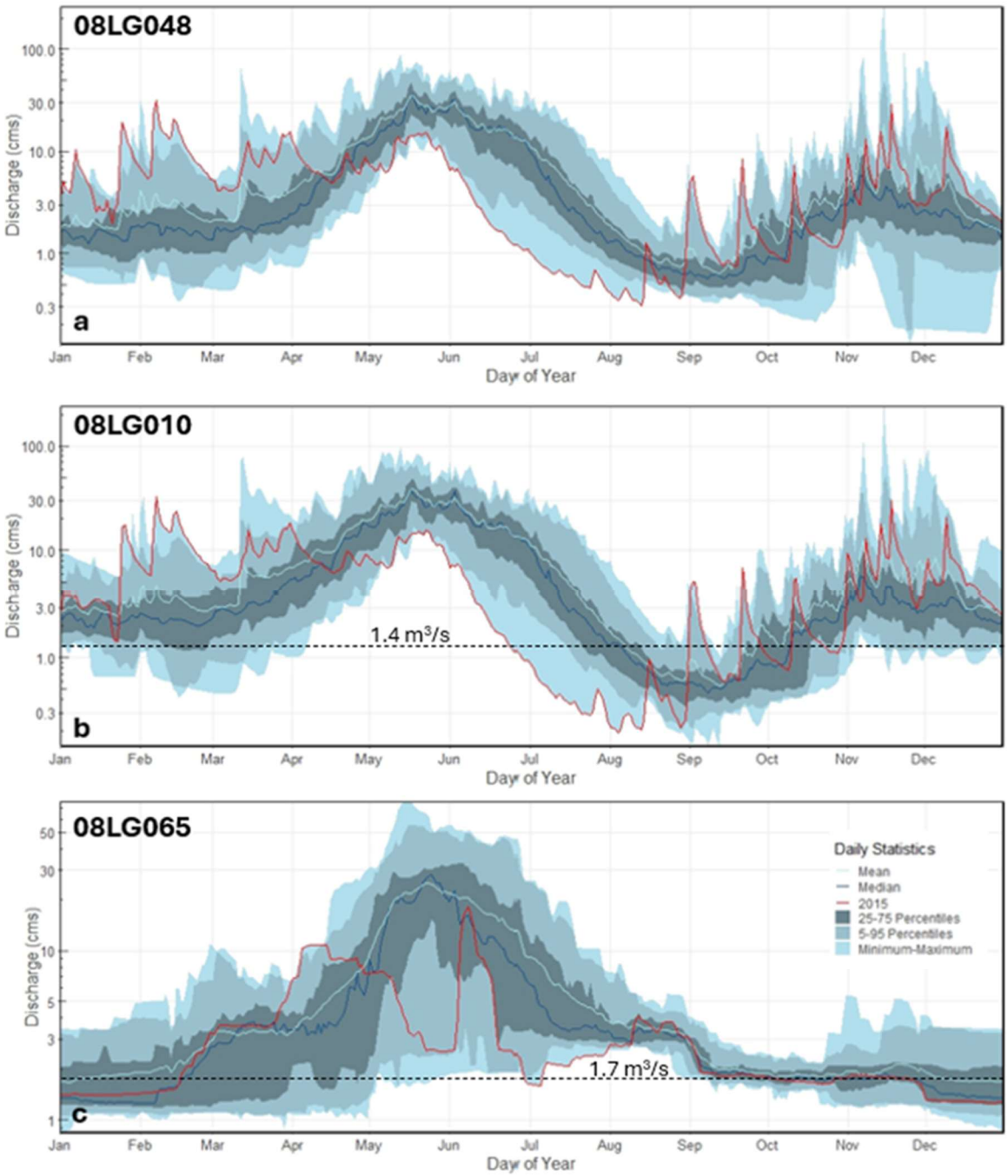


Figure 3-1 Distribution of daily flows over the period from 2006 to 2020 at a) Coldwater River near Brookmere, b) Coldwater River at Merritt, and c) Nicola River at Outlet of Nicola Lake. The red line shows daily flows in 2015 when an FPPO was last issued for the Coldwater River. The dashed black line shows the Fisheries Resource Maintenance Flows (Kosakoski & Hamilton, 1982).

Figure 3-1 also shows the minimum Fisheries Resource Maintenance Flows defined by Kosakoski and Hamilton (1982). These minimum flows are often not met during the low flow period of August and September, illustrating the need for flow augmentation within this critical period for summer rearing.

4.0 RESERVOIR STUDY

The overarching purpose of the water reservoir study is to investigate storage options that will enable flow releases during the low flow period in August and September, when flow augmentation is needed to support in-stream flow needs for fish.

Ecoscape and BGC leveraged local knowledge of the Coldwater and Nicola River watersheds, as well as publicly available data sources, to complete the study objectives. This section outlines the data sources and engagement activities undertaken to support the study. It also presents the methods used to identify, assess, and prioritize potential reservoir locations.

4.1. Data Sources

The project team used the best available data to inform the study. Table 4-1 identifies the data layers and sources used to identify and assess water storage reservoirs.

4.2. Engagement

This project was shaped by input from NWGP as well as local landowners and First Nations. The project team used this input i) to understand what additional data to compile (e.g., unit cost of dam construction, water temperature), ii) to develop criteria for site prioritization, and iii) to understand local preferences and concerns about individual sites.

Input from a broad group of NWGP members, stakeholders, and rightsholders was gathered in two meetings:

- A project start-up meeting was held in Merritt on April 23, 2024. The meeting was used to introduce the project scope and team members. During the meeting the project team gained a better understanding of the motivation for the study and the definition of project success. The team also gathered feedback on data and criteria to consider in identifying, assessing, and prioritizing potential reservoir locations.
- A workshop was held in Merritt on January 13, 2025, near the completion of the study, to solicit feedback on the sites the project team had assessed. The intention of the workshop was to inform site prioritization by integrating additional local knowledge into the process, as advantages or constraints related to individual sites may not be apparent from publicly available data alone.

The project team met with a smaller group of NWGP members throughout the project. While the overall direction of the project was shaped by this engagement, specific changes in project methods related to feedback are highlighted throughout this section, and feedback on individual sites is documented in Section 4.5.3.

Table 4-1 Project data layers, sources and uses

Data Layer	Source	Use
BC TRIM Digital Elevation Model (DEM)	https://open.canada.ca/data/en/dataset/7b4fef7e-7cae-4379-97b8-62b03e9ac83d	~18m resolution, used for topographic analysis
Canadian DEM (CDEM)	https://open.canada.ca/data/en/dataset/7f245e4d-76c2-4caa-951a-45d1d2051333	~23m resolution, used to assess storage
Medium Resolution DEM (MRDEM)	https://open.canada.ca/data/dataset/18752265-bda3-498c-a4ba-9dfe68cb98da	~30m resolution, used to assess storage
Lidar	McElhanney (October 2022)	0.5m resolution, used to assess storage
Lidar (Upper Colwater)	McElhanney (October 2023)	0.5m resolution, used to assess storage
Roads	https://catalogue.data.gov.bc.ca/	Used to define distance from roads to reservoirs and infrastructure affected by inundation.
BC Hydro Transmission Lines		The provincial layer of mapped high voltage BC Hydro Transmission lines was used to identify infrastructure affected by inundation.
Water Survey of Canada (WSC) Gauges		Used to assess the distance from potential water reservoir location to the nearest flow measurement location and for low flow thresholds.
Recreation Trail		Used to identify trails that could be affected by inundation or reservoir development.
Range/Grazing Tenure		Used to identify holdings around potential reservoirs.
Fish observations		Used to identify salmonid presence within stream segments affected by reservoir development.
Water rights licenses		Used to identify water allocations in areas affected by reservoir development.
Provincial Parks and Recreation Sites		Used to identify parks and recreation areas that could be affected by reservoir creation.
Dams		Used to evaluate existing dam characteristics.
First Nation Reserves		Reserve boundaries were used to evaluate whether potential reservoir locations overlap reserve areas.
Parcel map		Parcel maps were used to evaluate land ownership in areas affected by reservoir development.
FWA Watersheds		Hydrography and supporting information were used to identify existing stream and lake locations and watershed area. This information was used to support inflow estimates based on modelling by Chernos et al., 2022.
FWA Stream Network		
FWA Wetlands		
FWA Lakes		
Thermalscape data	https://www.tandfonline.com/doi/full/10.1080/07011784.2023.2267028	Used to assess stream temperature at sites in August, when water would likely be released.
Imagery	ESRI world imagery	Used to evaluate and visualize potential reservoir locations.

4.3. Reservoir Identification

The project team used the CDED Digital Elevation Model and stream network data (Table 4-1) in combination with a hydrological model developed by MacHydro Hydrology Consultants Limited (MacHydro) for the entire Nicola River watershed (Chernos, et al., 2022) to identify potential water storage sites.

4.3.1 Topographic Analysis

A coarse delineation of depressions was completed to identify potential storage opportunities within the study area to be further reviewed and refined. A GIS tool developed by Wu Lane (2017) was used to identify areas in the 18 m BC TRIM DEM with a depression depth of at least 1 m and an area greater than 0.5 ha. The analysis identified over 5,000 depressions meeting these criteria within the study area (Figure 4-1).

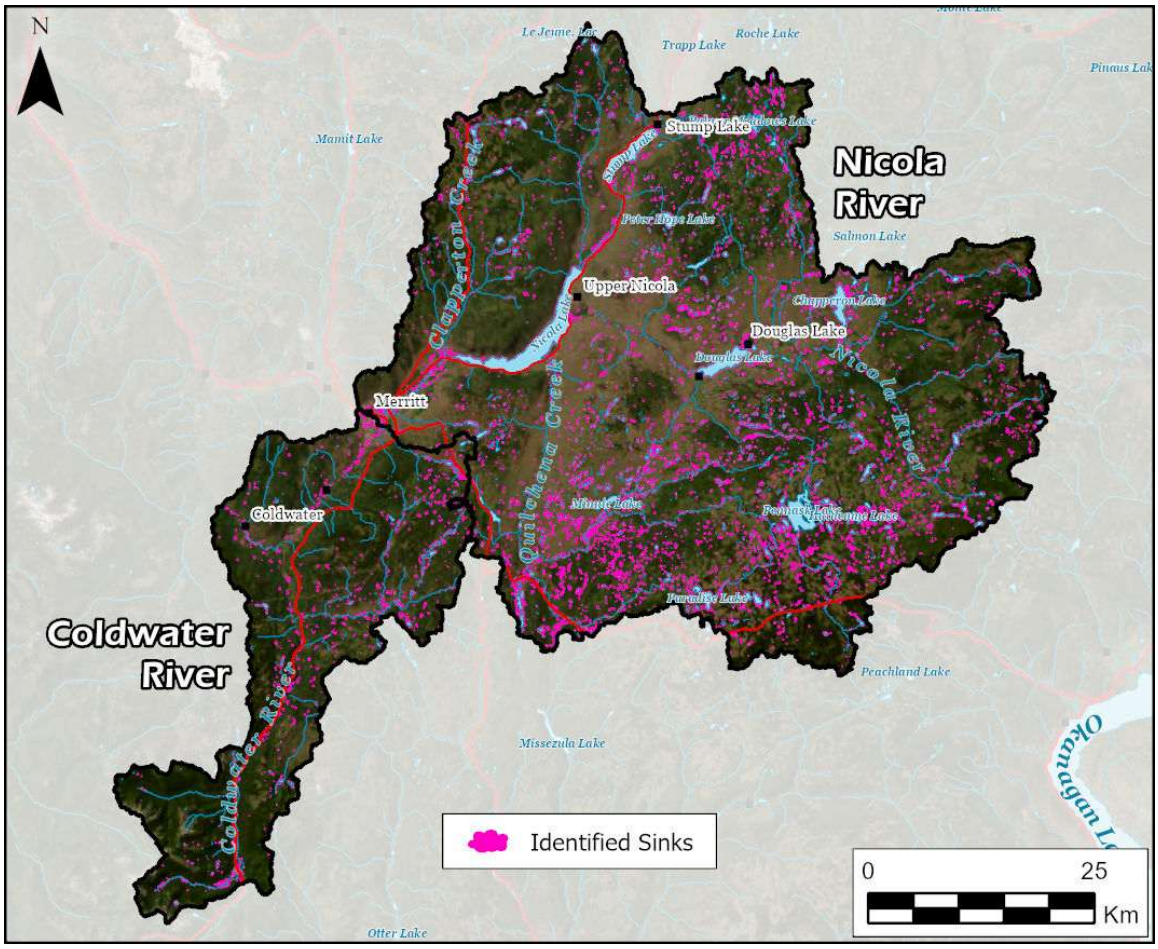


Figure 4-1 Overview of over 5,000 depressions identified in the high-level topographic analysis.

4.3.2 Hydrological Analysis

MacHydro used the Raven Hydrological Framework (Raven) version 3.5 (Craig et al., 2020) to develop a hydrological model of the Nicola River watershed in 2022 (Chernos et al., 2022). The Nicola watershed model is an adapted version of the HBV-EC model that is

emulated within Raven at a daily timestep. The model domain is divided into smaller hydrologic response units (HRUs) based on elevation, land cover, and forest history, as well as other factors that could affect hydrologic response (Chernos et al., 2022). Data from weather stations is spatially distributed across the model domain and hydrological processes (canopy interception, snowmelt, soil infiltration, potential evapotranspiration, etc.) are evaluated for individual HRUs. In short, water is input as either rain or snow and translated eventually into surface runoff, interflow, and baseflow. Water use was then incorporated based on the Agriculture Water Demand Model (AWDM) developed by van der Gulik et al. (2013).

The project team was provided with the model files, and accompanying documentation, by WLRS who own the Nicola River watershed model. The project team also sought input from MacHydro directly on use of the model. As the model is already calibrated to WSC gauge data, the project team did not change any input parameters or calculations, and the outputs used in this study (i.e., surface runoff) are consistent with those presented by Chernos et al. (2022).

*Figure **4-1*** shows the distribution of average annual modelled surface runoff throughout the project area for the current period (1991 to 2020), measured in runoff depth (mm). The highest runoff occurs in HRUs located in the upper Coldwater River watershed, which receives the highest precipitation in the Nicola River watershed (see Section 2.0 for a more detailed description). Surface runoff generation is also higher in the headwaters of the Upper Nicola River and Quilchena Creek due to lower temperatures and substantial snowpack. Surface runoff is much lower in the hotter and drier areas surrounding Merritt, as well as the Clapperton Creek headwaters and the area surrounding Stump Lake.

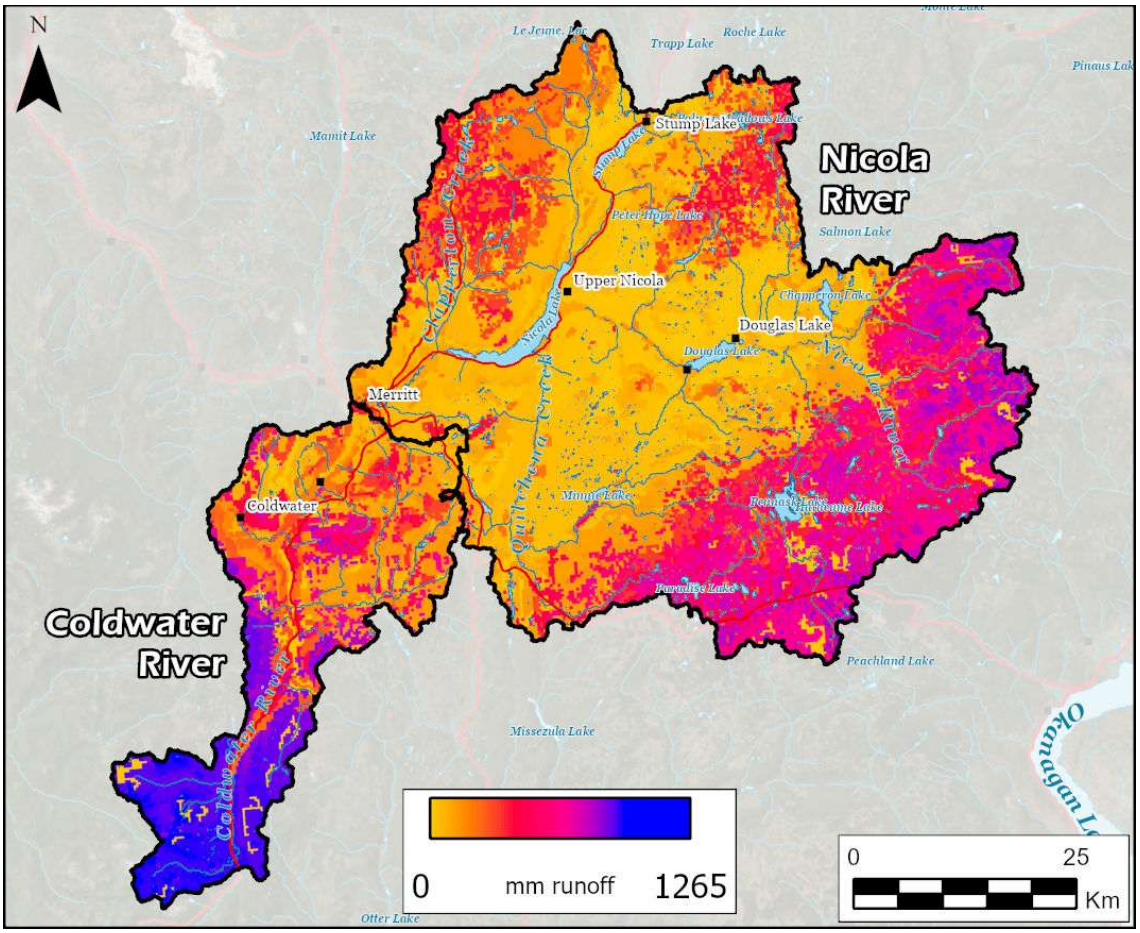


Figure 4-1 Modelled average annual surface runoff (in mm) within the HRUs located within the study area for the current period (1991 to 2020). Blues represent higher surface runoff values and reds reflect lower runoff.

The hydrological modelling completed by MacHydro also considers the effects of climate change on surface runoff for the period from 2021-2050 and 2051-2080. Chernos et al. (2022) show that surface runoff is projected to increase from 2021-2050 in the upper Coldwater River watershed, with more modest increases from 2051-2080 relative to the current period (i.e., 1991 to 2020) (*Figure 4-2*). Surface runoff is projected to remain constant or decrease in most other parts of the study area.

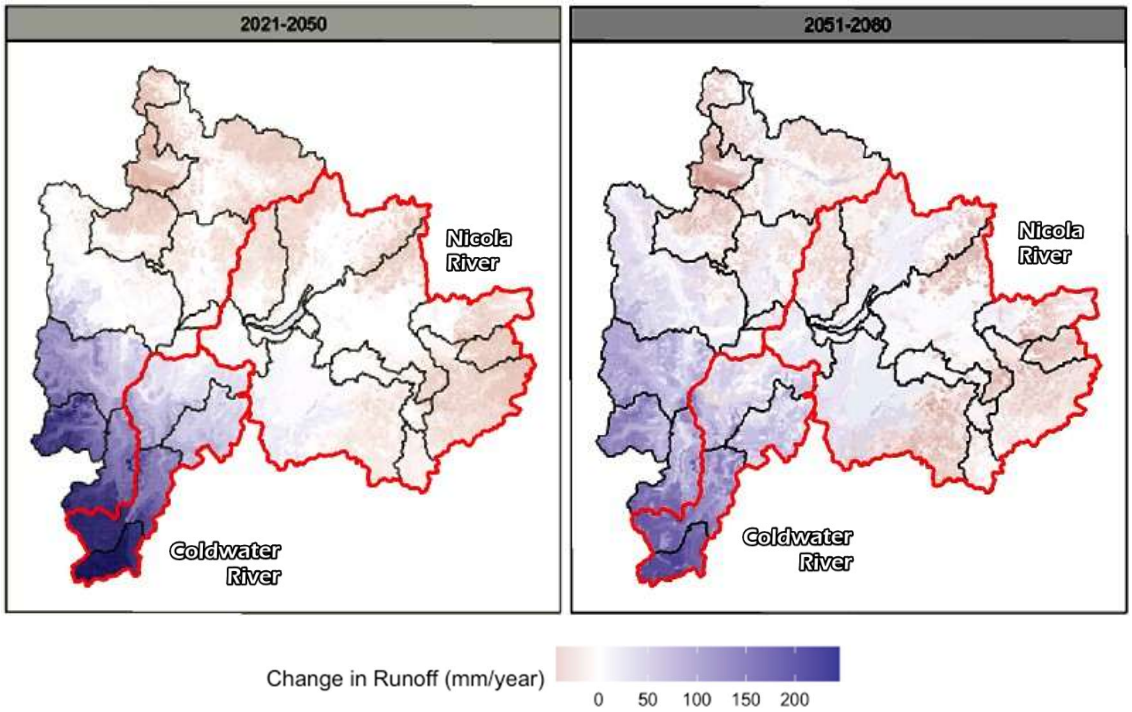


Figure 4-2 Projected changes in average annual surface runoff relative to the current period (adapted from Chernos et al., 2022). Red lines indicate the study area boundary.

4.3.3 Longlist Development

Given the strong climatic gradients within the study area, watershed area alone does not dictate inflows at potential storage reservoir locations. The project team therefore combined the stream network data with the modelled surface runoff for individual HRUs (*Figure 4-1*) to assess cumulative runoff in individual stream segments intersecting depressions identified in Section 4.3.1 for the current climate conditions (i.e., 1991-2020).

The team then used engineering and geoscience judgement to develop a longlist of 78 potential reservoir locations from the more than 5,000 depressions identified within the study area.

4.4. Reservoir Assessment

The project team assessed the longlist of 78 sites (and 92 potential dam locations as described below) identified in Section 4.3.3 in greater detail, as described in the following sub-sections.

4.4.1 Storage Capacity

Storage capacity was evaluated for each of the 78 longlist sites in a GIS using the most suitable DEM for that area (see Table 4-1 for a list of sources). The Register lists the DEM used at each site. The optimal dam location was first selected based on variations in the terrain; locations were selected that minimized dam length while maximizing storage, resulting typically in dam placement across the most confined location.

In some cases, multiple dam locations were modelled for a single stream segment. These alternate locations are included in the Register with an additional qualifier (e.g., "dam A" or "dam B") after the site name. In total, the storage capacity was assessed for 92 separate dam locations. In each case dam heights ranging from 1 m to 5 m (at 1 m intervals) were considered (*Figure 4-3*). The storage values associated with each dam height are provided for all locations in the Register, as well as additional information such as the required dam length, and data regarding existing dams at the site where applicable.

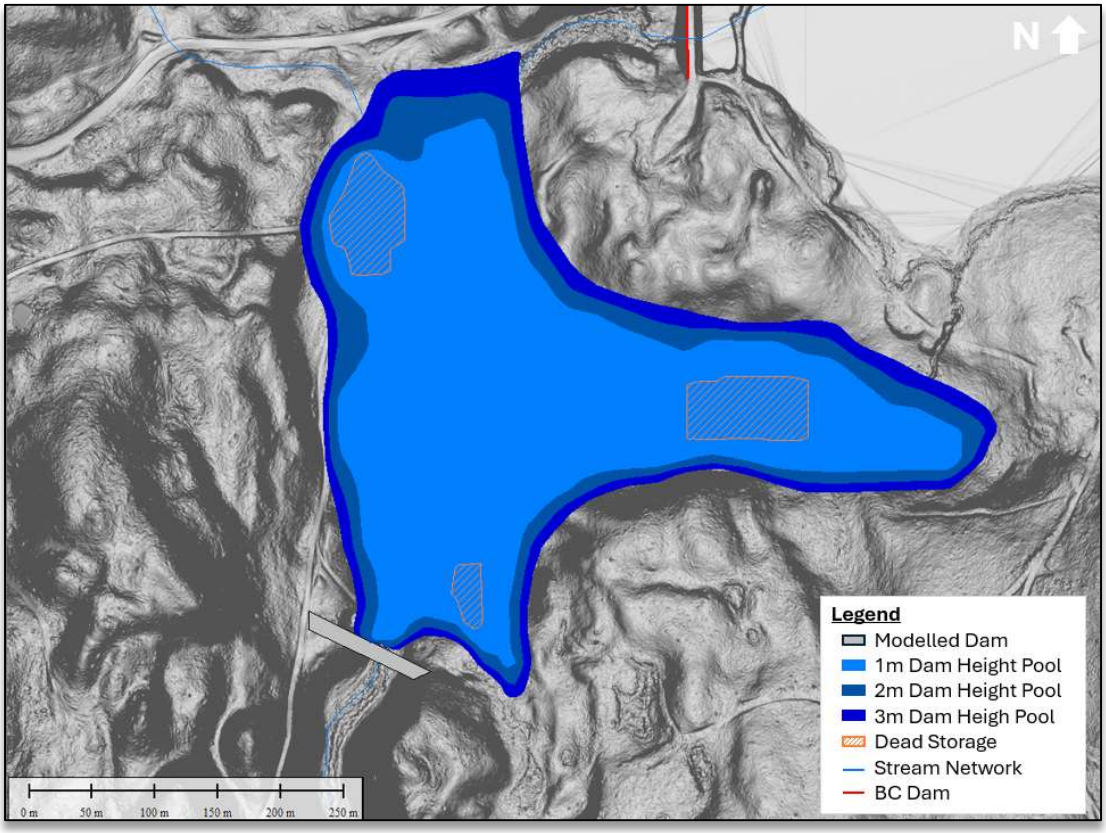


Figure 4-3 Example of the storage capacity assessment at Englishman Lake Marsh. The base hillshade is from McElhanney lidar (October, 2023).

Dead storage was estimated for each site as the volume located below the minimum dam elevation, and subtracted from the storage estimate as this inaccessible volume of water is not available to release for flow augmentation. Water already in existing lakes was also not considered part of the storage capacity; water is not penetrated by lidar so this volume was already incorporated into the terrain of the DEMs used.

Of the 92 modelled locations, nine lost confinement with even a 1 m high dam. At these sites, at least two separate dams would be needed to enable water storage. Conversely, 61 of the modelled locations could sustain a 5 m dam without loss of confinement (i.e., without the need for a second "saddle dam"). The total storage capacity ranged from as low as 0 Mm^3 for sites without confinement up to a maximum of 88 Mm^3 (or 8.8 x 10^7 m^3)

for a 5 m high dam on Stump Lake. The median storage capacity ranged from 0.13 Mm^3 for a 1 m high dam to 1.8 Mm^3 for a 5 m high dam (*Figure 4-4*).

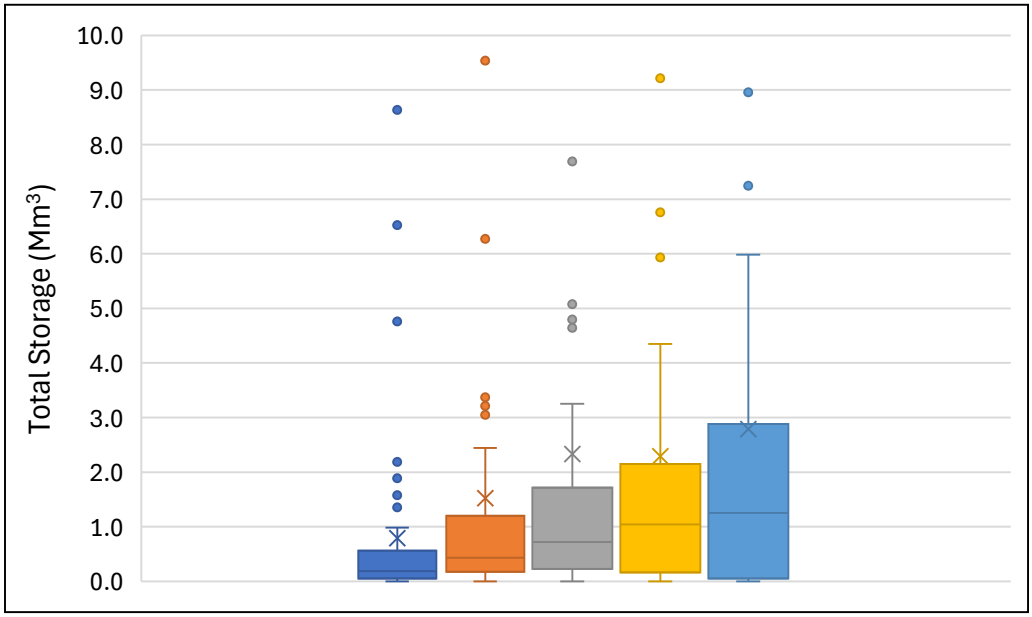


Figure 4-4 Box and whisker plots showing the estimated storage capacity for dam heights ranging from 1 m (left) to 5 m (right).

4.4.2 Flow Augmentation

The potential flow augmentation from a storage reservoir depends on the volume of water that can be stored. The Register provides two estimates of flow augmentation over the period from August 1 to September 30 (60 days) for each dam height. The first estimate is based on the total storage capacity of the site. The median value ranges from 0.025 m^3/s (25 L/s) for a 1 m high dam to 0.33 m^3/s (330 L/s) for a 5 m high dam. A second, more detailed estimate accounting for evaporation losses was generated for higher priority sites, as described in Section 4.5.2.2.

4.4.3 Inflow

So far, the reservoir assessment has focussed on storage capacity. To provide flows for augmentation, however, water storage reservoirs also require sufficient inflow to fill the storage area. Reservoirs can be divided into two types (Yassin et al., 2019):

- Within-year reservoirs have a lower ratio of storage capacity to annual inflow and can therefore (re)fill within a single year.
- Multi-year reservoirs have a higher ratio of storage capacity to annual inflow and require multiple years to (re)fill.

Researchers have proposed threshold ratios for within-year reservoirs ranging from 0.5 (Hanasaki et al., 2006) to 0.3 (Wu & Chen, 2012). At a high level, the higher inflow relative

to storage capacity (at least double based on Hanasaki et al., 2006) accounts for the need to allow water pass through the reservoir during reservoir filling[2].

Inflow was assessed for all 78 stream segments by integrating the runoff from contributing HRUs, as described in Section 4.3.2. The modelled annual inflow and March-June inflow (the typical period of reservoir filling) are provided for each site in the Register for both the current and future climate conditions.

The maximum within-year storage that could be supported at each site by the currently available annual inflow (and associated dam height) is provided in the Register. Consider for example a site with a maximum storage capacity of 20 Mm^3 for a 5 m high dam and average annual inflows of 30 Mm^3. Using a ratio of 0.5 (Hanasaki et al., 2006) the most water that could be stored in a within-year reservoir for an average runoff year would be 15 Mm^3. If the objective is to create a within-year reservoir capable of refilling in a single year, the optimal dam height would likely be closer to 3 m to 4 m. However, if the objective is to develop a multi-year reservoir then a 5 m high dam (or higher) may be the preferred option to maximize storage potential.

4.5. Reservoir Prioritization

The reservoir assessment was used to identify high priority sites for more detailed evaluation. This section outlines the criteria used to create and prioritize a shortlist of 36 sites.

4.5.1 Shortlist Development

Storage capacity and inflow were first used to generate a shortlist based on the following criteria:

- Coldwater River watershed:
  - A minimum total storage capacity of 0.3 Mm^3 for a 2 m high dam. The associated flow augmentation of approximately 0.06 m^3/s (60 L/s) over a 2-month period is about 15% of the CEFT for the Coldwater River.
  - An average inflow of at least 1.0 Mm^3 to enable within-year refilling of the 0.3 Mm^3 storage volume (assuming a ratio of 0.3 from Wu & Chen, 2012).
- Nicola River watershed:
  - A minimum total storage capacity of 0.35 Mm^3 for a 2 m high dam[3].

[2] These values from the literature provide a first order approximation of the required inflow needed to support a given storage capacity for a within-year reservoir; more detailed modelling is needed during future feasibility work to ensure that available inflow is sufficient to support downstream flow needs during reservoir filling

[3] One site (Guichon Lake Flats) did not meet this criterion for a 2 m high dam but was included due to its substantial storage with a 3 m high dam (or higher).

- An average inflow of at least 1.2 Mm^3 to enable within-year refilling of the 0.35 Mm^3 storage volume (assuming a ratio of 0.3 from Wu & Chen, 2012).

The criteria reflected input from NWGP and project partners. Slightly different criteria were used on the Nicola River and Coldwater River to reflect the smaller number of potential storage sites on the Coldwater River and a strong desire from project partners – as expressed in the January 13, 2025 workshop – to identify storage sites in the Coldwater watershed. *Figure 4-5* shows the location of the 36 sites on the shortlist.

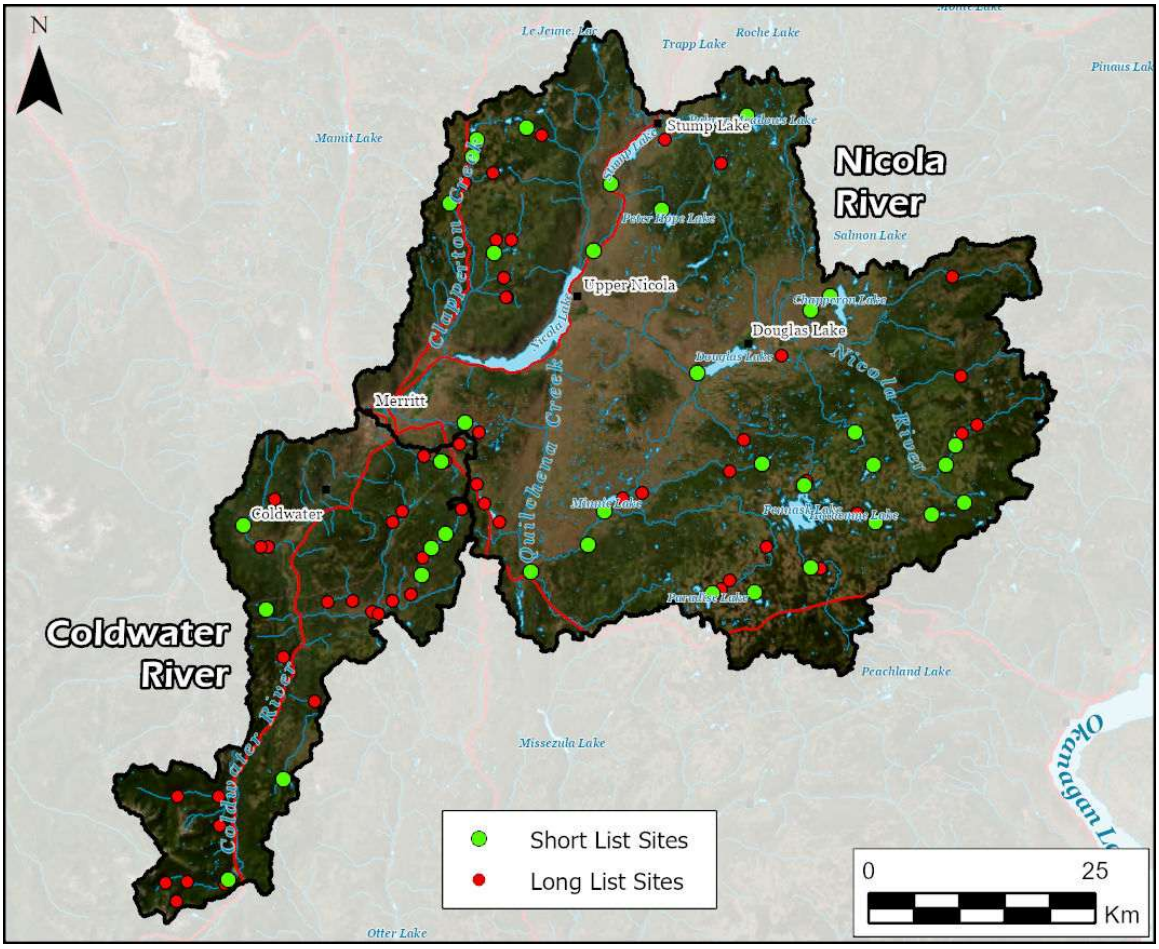


Figure 4-5 Overview of the shortlist sites (in green). Longlist sites that were not selected for the shortlist are shown in red.

4.5.2 Additional Analyses

The ultimate selection of storage reservoir locations will depend on additional factors beyond storage capacity and hydrology. The project team considered additional spatial data and conducted more depth analyses (e.g., consideration of evaporation) for the 36 shortlist sites, as described in the following subsections. This information is provided in the Fact Sheets (Appendix A) and the Reservoir Matrix (Appendix B) developed for each shortlist site, and select information is also provided in the Register.

4.5.2.1. Spatial Data

Table 4-2 summarizes the additional spatial data that were evaluated for each of the 36 shortlist sites. The Register and Fact Sheets provide information on existing dams, land ownership, fish use, stream temperature, and other potential considerations for site selection.

Table 4-2 Spatial data assessed for shortlist sites.

Reservoir Property	Definition
Contributing Watershed Area (km^2)	Total watershed area at the outlet of proposed/existing reservoir.
Sub-watershed	The sub-watershed that the reservoir would be located within.
Salmonoids Present (Y/N)	Defines whether salmonids are present or not present within the system between the reservoir and the closest WSC Gauge.
Land Ownership	Defines the land ownership type as Crown, Private, Reserve, or a combination within the reservoir inundation area.
Surrounding Properties (Y/N)	Provincial cadastre was data used to identify if there is private property around a proposed reservoir.
Distance From Existing Road (m)	The straight-line distance from the proposed reservoir to provincially mapped roads.
Mean Annual August Flow Temp (2001-2020) (°C)	Reported modelled mean august flow for stream reach at each proposed/existing dam location for relative system temperature
Existing Dam (Y/N)	The presence or absence of an existing dam was evaluated using the Provincial dam layer.
Existing Dam Height (m)	Height of an existing dam based on the Provincial dam layer.
Existing Dam Crest (m)	Crest length of an existing dam based on the Provincial dam layer.
Existing Storage License (Y/N)	Existence of a storage license based on the Provincial dam layer.
Existing Dam(s) Failure Consequence	Consequence of dam failure based on the Provincial dam layer.
Existing Dam(s) Risk Level	Dam risk level as documented in the Provincial dam layer.
WSC Gauge ID	Station ID for the closest downstream real-time gauge where the effects of a flow release effects would be measured.
Distance to Closest WSC Gauge (km)	Distance to the closest downstream real-time gauge where the effects of a flow release effects would be measured.
Number of PODs to Gauge	Count of the number of active Points of Diversion between the proposed reservoir and the closest downstream gauge.
Total Allocated Volume to Gauge (Mm^3)	Total withdrawal volume in m^3 allocated into the PODs identified between the gauge and the reservoir.
Infrastructure Flooded	Features immediately around the proposed reservoir that may be affected by inundation.
Downstream Hazards	Downstream infrastructure and features that may be at risk from an unwanted release or potential dam failure.

The majority of sites are on existing lakes with only three of the 36 shortlist sites (8%) on streams (Chapperon Creek, Upper Coldwater River, and Upper Pennask Creek). Although many of the streams investigated had sufficient inflow to support flow augmentation, the higher gradients in most reaches limited the potential storage capacity. For example, a 4 m

high dam on Juliet Creek (approximately 2 km upstream from the Highway 5 bridge) would provide only 0.003 Mm^3 of storage and 0.0006 m^3/s (0.6 L/s) of July-August flow augmentation. Of the 33 shortlist sites identified on existing lakes, 16 (48%) have existing dams and 17 (52%) are new potential dam sites.

Approximately one third (31%) of the sites are on crown land and seven of the sites (19%) are on private land. Two sites (West Midday Creek and Douglas Lake) partially occupy reserve land. The remaining sites occupy a combination of crown and private land. Approximately 40% of the identified sites (14 of 36) have residences located within the reservoir boundaries for some or all of the dam heights considered.

Stream temperature was estimated based on Thermalscape data for each stream segment. The august temperature varied from a low of 10.6° to a high of 16.4°, with a median of 12.8°. The sites with the lowest temperatures (Brook Lake, Gillis Lake, Reservoir Lake, Pennask Lake, and Upper Coldwater River) all had elevations exceeding 1,100 m. The sites with the highest temperatures (Chapperon Creek, Chapperon Lake, Douglas Lake, Minnie Lake, and Tommy Lake) ranged in elevation from 800 to 1,050 m. Of the 36 sites, 29 (80%) are listed as supporting salmonids in the Freshwater Atlas.

4.5.2.2. Adjusted Flow Augmentation

Evaporation is an important consideration for reservoir storage, especially in arid regions where high temperatures promote evaporative losses. Evaporation was estimated for each site using the method outlined by Oudin et al. (2005). Temperature data from 2013-2024 at the Environment and Climate Change Canada (ECCC) weather station *Merritt* (ID 1125079) was first used to calculate the average daily temperature for the station elevation of 609 m. Evaporation was then calculated based on the average temperature and Julian day (i.e., the day of the year) for the station location (Oudin et al., 2005). Finally, the evaporation (in mm) was estimated for other elevation bands by adjusting the average temperature values by the adiabatic lapse rate of -0.6°/100 m such that evaporations decreased at higher elevations.

To understand potential storage losses due to evaporation, the evaporation (converted to metres) was multiplied by the surface area of the modelled storage reservoir for each dam height. The modelled storage losses are provided in the Register for shortlist sites. The median evaporation losses ranged from 0.15 Mm^3 for a 1 m high dam to 0.26 Mm^3 for a 5 m high dam. Proportional losses to evaporation decrease with increasing dam height; because total evaporation is a function of reservoir surface area, a smaller proportion is lost to evaporation in a deeper reservoir.

The net storage capacity (i.e., storage capacity - evaporation) is provided in the Register for shortlist sites and ranges from a median value of 0.16 Mm^3 for a 1 m high dam to 2.2 Mm^3 for a 5 m high dam. The net storage capacity was used to generate an evaporation-adjusted estimate of flow augmentation potential for the shortlist sites.

Considering evaporation losses, the median flow augmentation ranges from 0.031 m^3/s (31 L/s) for a 1 m high dam to 0.43 m^3/s (430 L/s) for a 5 m high dam (*Figure 4-6*).

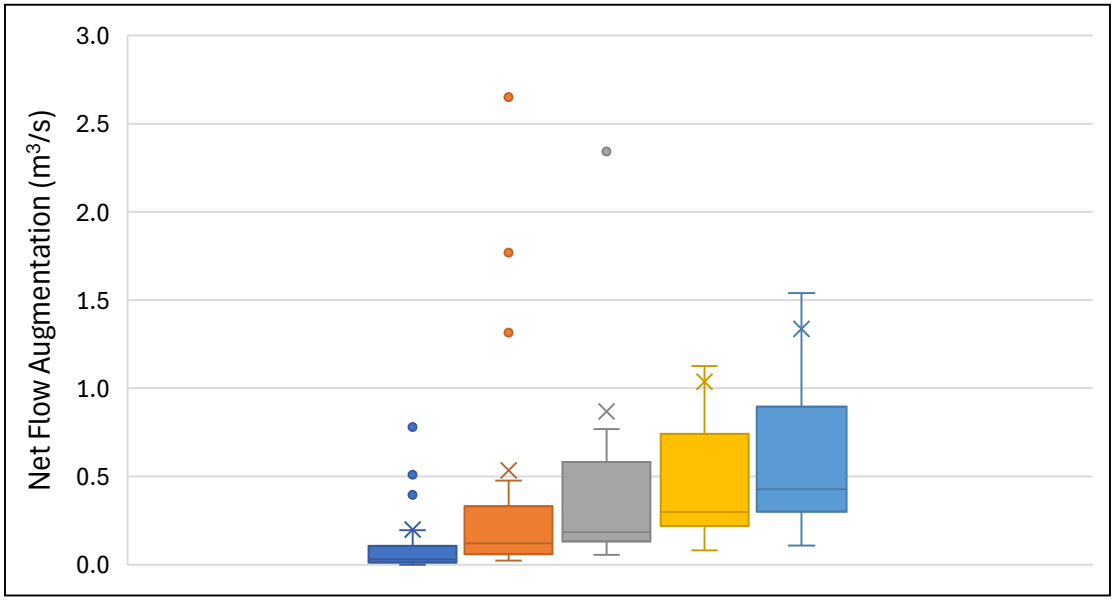


Figure 4-6 Box and whisker plots showing the net flow augmentation for dam heights ranging from 1 m (left) to 5 m (right) for the 36 shortlist sites.

4.5.2.3. Cost Estimates

Throughout the engagement process NWGP and other project partners requested information on the cost effectiveness of each site to assist in site prioritization. Limited data is available from the study area as a new dam has not been constructed in decades. In the absence of region-specific cost data, the project team leveraged a study completed by Petheram and McMahon (2019) relating total cost from completed projects worldwide to dam volume (e.g., the volume of an earthfill dam) and dam height. The dam volume for each dam height at each site was first estimated by assuming a simple, consistent dam geometry consisting of a 2 m dam crest width and 2H:1V side slope angles. As the same geometry was used for all sites, the dam volume varied based on dam length and height.

The regressions from Petheram and McMahon (2019) were used to estimate two costs for each dam height based on dam volume and dam height. These costs were then divided by the net storage capacity (i.e., including evaporation losses) to produce the costs per unit water storage. The unit costs for the range of dam heights are shown in *Figure 4-7*.

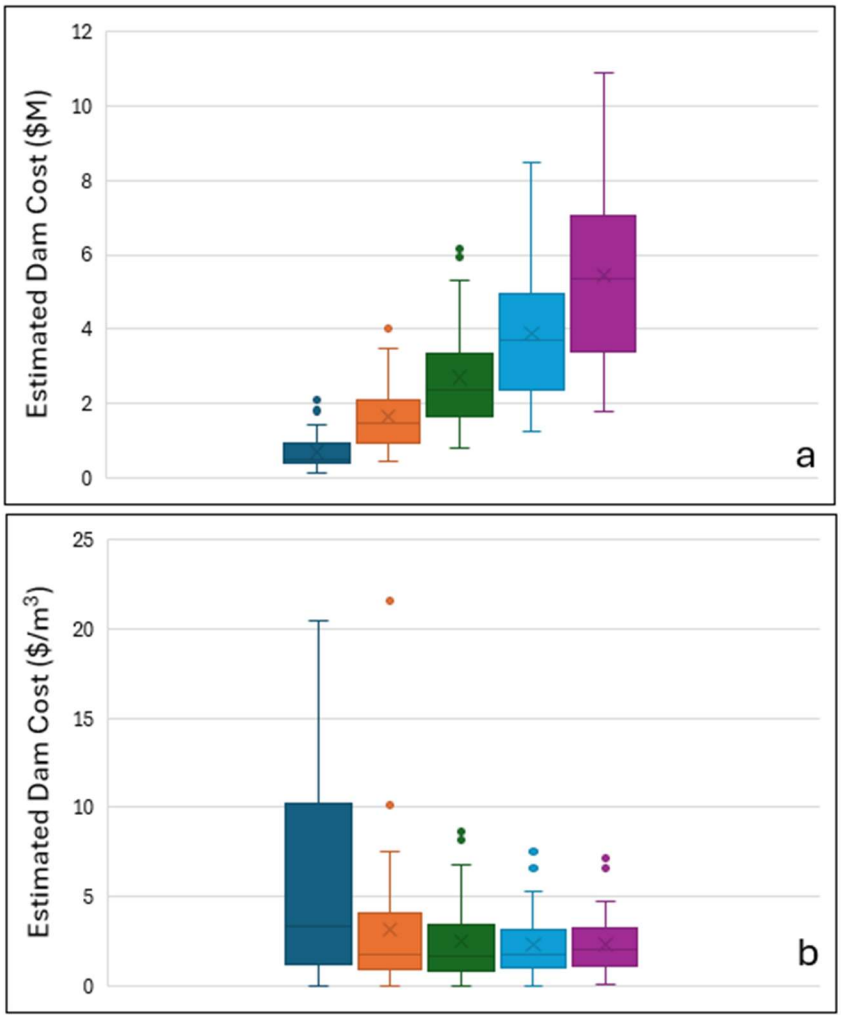


Figure 4-7 Comparison of the total dam cost in millions of dollars (a) and normalized dam cost (i.e., cost per unit of water storage) (b) for dam heights ranging from 1 m (left) to 5 m (right). In both panels the cost was estimated based on the dam volume based on regressions from Petheram and McMahon (2019).

A project partner communicated that a current dam raise on Helmer Lake is underway and is estimated to cost $2M to $3M to complete. The anticipated total cost for a 2 m high dam at Helmer Lake is $2.7M based on the dam volume regression and $5.6M for the dam height regression (Petheram & McMahon, 2019). The approximate cost of $2M to $3M is consistent with the estimate based on dam volume and approximately half of the estimate based on dam height. The dam volume regression was therefore assumed to provide better estimates of the anticipated dam costs, and this value is provided on the Fact Sheets and the Register. The median estimated cost ranged from $0.5M for a 1 m high dam to $5.3M for a 5 m high dam. This corresponded to normalized costs (i.e., the cost per unit of water storage) ranging from $3.40/m^3 for a 1 m high dam to $2.10/m^3 for a 5 m high dam. The lowest median normalized cost ($1.70/m^3) was associated with a 3 m high dam.

4.5.3 Preferred Sites

NWGP and project partners expressed a strong desire for prioritizing storage in different sub-watersheds. For example, most attendees at the January 13, 2025 workshop agreed that storage within the Coldwater watershed is essential, and others highlighted the advantages of water storage within the Clapperton watershed, which is already heavily regulated.

In recognition of the strategic importance of different locations, Table 4-1 presents preferred sites by sub-watershed. Each water storage reservoir location was assigned a score according to its flow augmentation potential, normalized (i.e., unit) dam cost, and land ownership type. As shown in *Figure 4-8*, the maximum score based on the categories was 25, and storage and unit cost were more heavily weighted than land ownership considerations.

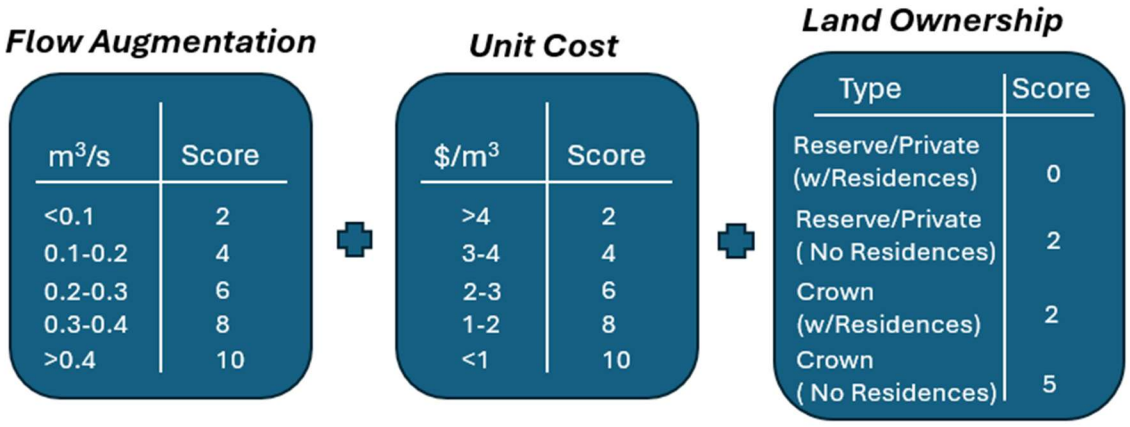


Figure 4-8 Overview of scoring matrix used to assign a prioritization score to each shortlist site.

The highest scores were allocated to sites with the most storage, lowest cost per unit storage, and most favourable land ownership (crown land with no properties present), as shown in the Register. Although the five highest-ranked shortlist sites are provided in for each sub-watershed in the subsections below, it should be emphasized that the same information was compiled for all 36 shortlist sites and this prioritization is only intended to facilitate presentation of the results within the report.

Of the 92 individual locations considered on the longlist, 34 sites (37%) are in the Coldwater watershed. However, only eight of the 35 sites on the shortlist (22%) are in the Coldwater watershed, despite the more lenient criteria used. The relative paucity of suitable sites for water storage in the Coldwater system is consistent with the difficulty that NWGP and others have experienced in attempting to implement the earlier work completed by Summit (December 20, 2002) and largely relate to the relative steepness of the terrain which makes it less conducive to water storage.

Overall, the sites with the highest scores in Table 4-1 align well with the preferences of NWGP and project partners. The five highest priority sites identified by participants in the January workshop – Brook Lake, Douglas Lake, Sussex Lake, Chapperon Lake, and Englishman Lake – all scored highest or second highest in their respective sub-watershed (Table 4-1).

Table 4-3 Summary of highest scoring sites in each sub-watershed.

Site Characteristics					Hydrological Characteristics				Proposed Reservoir Characteristics (for a 2 m High Dam)					Prioritization
Site Name	**Watershed Area (km^2)**	**Land Ownership Type**	**Residence in Footprint**	**Existing Dam Name**	**Nearest (D/S) WSC Gauge**	**CEFT (m^3/s)**	**Current Annual Inflow (Mm^3)**	**Future Annual Inflow (Mm^3)**	**Dam Length (m)**	**Net Water Storage (Mm^3)**	**Net Flow Augmentation (m^3/s)**	**Total Dam Cost ($M)**	**Normalized Dam Cost ($/$m^3$)**	**Total Score (out of 30)**
Coldwater River														
Brook Lake	10	Crown	N	N/A	08LG048	0.39	5.2	5.6	5	0.4	0.07	0.7	2.06	15
Englishman Lake	41	Private	N	ENGLISHMAN LAKE DAM	08LG010	0.39	3.8	4.3	30	0.2	0.04	0.9	4.14	12
Upper Coldwater C	24	Private	N	N/A	08LG048	0.39	18.9	20.8	25	0.5	0.09	0.8	1.70	12
Upper Kane Lake	12	Private	N	KANE LAKE UPPER	08LG010	0.39	1.2	1.3	40	0.3	0.05	1.7	6.71	12
West Midday Creek	79	Reserve/Private	N	WEST MIDDAY CK POND DAM	08LG010	0.39	10.6	11.3	85	0.3	0.06	1.7	5.48	12
Clapperton Creek														
Sussex Lake	18	Crown	N	SUSSEX LAKE DAM	08LG070	1.5	2.7	2.6	90	0.5	0.10	1.7	3.32	17
Surrey Lake	12	Crown/Private	Y	SURREY LAKE DAM	08LG070	1.5	1.8	1.7	80	0.9	0.17	1.6	1.82	12
Kirby Meadow	15	Crown/Private	N	KIRBY MEADOW DAM	08LG070	1.5	2.1	2.0	30	0.4	0.08	0.9	2.24	12
Helmer Lake	59	Crown	Y	HELMER (LOST) LAKE DAM	08LG070	1.5	8.6	8.2	45	0.3	0.05	2.7	10.11	10
Quilchena Creek														
Pennask Lake A	122	Private/Crown	Y	N/A	08LG017	0.14	32.1	32.5	40	13.7	2.65	1.2	0.09	20
Tommy Lake	395	Private/Crown	N	TOMMY LAKE DAM	08LG017	0.14	53.7	52.9	25	1.6	0.31	1.2	0.77	20
Reservoir Lake	21	Crown	N	RESERVOIR DAM	08LG017	0.14	5.0	4.9	135	1.1	0.22	2.0	1.73	19
Paradise Lake	25	Crown/Private	Y	N/A	08LG017	0.14	6.1	6.0	40	2.1	0.40	1.0	0.48	18
Minnie Lake	134	Private	N	MINNIE LAKE DAM	08LG017	0.14	7.4	7.3	360	2.2	0.43	3.4	1.54	18
Upper Nicola River														
Chapperon Lake	197	Mixed	Y	CHAPPERON LAKE DAM	08LG028	0.25	33.1	32.1	35	6.8	1.32	1.3	0.19	20
Douglas Lake	1277	Private/Reserve	Y	N/A	08LG028	0.25	198.4	193.8	160	9.2	1.77	2.2	0.24	20
Windy Lake	7	Crown	Y	N/A	08LG028	0.25	1.7	1.7	20	1.3	0.24	1.2	0.96	18
Old Dave Lake	80	Crown	N	N/A	08LG028	0.25	20.5	20.0	30	0.7	0.14	0.9	1.27	17
Rock Lake	5	Crown	N	N/A	08LG028	0.25	1.2	1.2	180	1.1	0.22	2.6	2.32	17
Nicola River														
Peter Hope Lake	31	Crown / Private	Y	PETER HOPE LAKE DAM	08LG065	1.5	2.9	2.7	65	2.5	0.48	1.4	0.58	20
Stump Lake	191	Private	Y	N/A	08LG065	1.5	14.3	13.7	115	43.6	8.42	2.0	0.05	20
Palmer Meadows	40	Private	N	PALMER MEADOWS DAM	08LG065	1.5	4.7	4.2	155	2.2	0.42	3.5	1.59	18
Frogmoore Lake B	31	Crown / Private	N	FROGMOORE LAKE #3 DAM	08LG065	1.5	3.7	3.6	215	1.8	0.34	2.5	1.40	16
Hamilton Lake	26	Crown	N	HAMILTON LAKE DAM	08LG065	1.5	1.2	1.3	25	0.5	0.10	0.8	1.62	15

5.0 SUMMARY AND RECOMMENDATIONS

The Nicola Water Use Management Plan (WUMP) identified several overarching issues in the watershed including insufficient flow in drought years for both fish and agriculture and tension between recreational use and water storage. Since publication of the WUMP in 2010 the situation has worsened due to population growth, forest disturbance, and geomorphic changes related to the 2021 atmospheric river-induced flooding. Fish protection orders were issued in 2009 and 2015 in recognition of the potential for irreversible harm to fish. Although an FPPO has not been issued in the study area since 2015, summer flows on both the Nicola and Coldwater River have decreased below the Fisheries Resource Maintenance Flows defined by Kosakoski and Hamilton (1982) in every year from 2016-2024, and below the CEFT in some years.

The objective of this work was to identify locations with sufficient water storage capacity and inflow to support the development of water storage reservoirs. The following subsections summarize the results of the study, outline key assumptions and limitations, and provide guidance for future work.

5.1. Overview

This study leveraged diverse data sources to identify, assess, and prioritize potential water storage reservoir locations within the Nicola and Coldwater River watersheds. Engagement with NWGP and other project partners was integral to shaping both the study itself and the ultimate shortlist of 36 sites.

The team initiated the project with a kick-off meeting in April 2024 to clarify project objectives. Topographic data was then used to identify depressions within the study area, resulting in the identification of over 5,000 sites. Discretized runoff from a hydrological model developed by Chernos et al. (2022) was used in combination with engineering and geoscience judgement to identify a longlist of 78 locations with a potential for reservoir creation based on both topography and inflow.

The longlist sites were assessed in more detail and documented in the Register (provided as a spreadsheet). The team first used the topography of each site to determine the optimal dam location(s). Dams ranging from 1 m to 5 m high were then modelled at each site in a GIS to evaluate storage capacity; a total of 92 potential dams[4] were modelled at the 78 locations. The potential flow augmentation from a 2-month release (July and August) was evaluated for each site based on both storage capacity and inflow.

[4] The results for all 92 modelled dams are provided in the Register.

Simple criteria relating to storage capacity and inflow were used to develop a shortlist of 36 sites. All sites had at least 0.3 Mm^3 of storage capacity and average annual inflow of 1.0 Mm^3 for a modelled 2 m high dam[5]. This storage capacity represents a potential 2-month flow augmentation of at least 0.06 m^3/s (60 L/s). Additional analyses were conducted to evaluate losses due to evaporation based on average temperature (adjusted based on elevation) and reservoir surface area for the 36 shortlist sites. The unit cost per volume of water storage (adjusted for evaporation) was then assessed for each site based on regressions relating dam cost to dam volume and height (Petheram & McMahon, 2012). Finally, a simple prioritization metric was developed based on potential storage, normalized (i.e., unit) dam cost, and land ownership information.

Fact Sheets are provided for each site, detailing the most pertinent information from the storage capacity and hydrological assessments, as well as additional spatial data layers and dam cost estimates. Key parameters such as storage potential, flow augmentation, and cost estimates are provided in the Register for all sites. The site prioritization is provided in the Register for all shortlist sites, and the top 5 sites in each sub-watershed are provided in this report.

5.2. Assumptions and Limitations

The following assumptions and limitations should be considered in reading and interpreting this report:

- Topographic analysis: relatively low resolution DEMs were used throughout most of the study area to evaluate water storage. In some cases, the use of higher resolution data (e.g., lidar) may show that confinement is lost at a lower dam elevation, resulting in a loss of storage capacity and/or the need for additional saddle dams. Alternatively, the use of higher resolution data may show that potential reservoir locations have been omitted. Higher resolution data should be obtained and used to refine the storage assessment prior to detailed design at a selected reservoir location.
- Hydrological modelling: the hydrological modelling used for this project was conducted by MacHydro (Chernos et al., 2022) and not updated as part of this project. Chernos et al., (2022) found that the model performance was poor in the Guichon and Spius Creek watersheds (both outside of the study area) but generally good within the project area. Water use was estimated based on the Agriculture Water Demand Model (AWDM) for Nicola watershed and should be considered approximate (van der Gulik et al., 2013).

[5] Guichon Flats did not meet this criteria for a 2 m high dam but was included due to the favourable inflow and storage capacity for a 3 m high dam.

- **Flow augmentation**: the estimates of flow augmentation assume that flow released from a reservoir will travel downstream to the nearest WSC gauge. In some cases, water may instead travel into short-term groundwater storage or deep aquifers. More detailed work is needed to assess the accessibility of flow releases at individual sites. Similarly, it is assumed that downstream water users will not increase withdrawals if flows are released.
- **Water quality:** water quality is an important consideration in site selection. August stream temperature, assessed based on thermalscape data at the shortlist locations, is likely not representative of the actual water temperature within a reservoir. Temperature may vary with other factors such as water depth and should be considered in more detail in subsequent work, in addition to other factors influencing water quality.
- **Cost estimates:** costs were estimated based on a study by Petheram and McMahon (2019). Their study focussed on large dams with heights and dam volumes generally exceeding the size of the dams considered in this study. As such, the dam costs should be considered high level approximations.
- **Spatial data analysis:** the data analysis was conducted using publicly available data sourced from the Government of British Columbia through their Open Data Portal and the assumption is that the data is assumed to be correct as it is presented. As such, there may be instances where there is disagreement between these sources and local knowledge or understanding. This analysis provides a summary of the data presented rather than an inference of absolute fact.

5.3. Next Steps

This assessment is intended to lay the groundwork for selecting sites for additional feasibility assessment (including site-specific streamflow data collection), detailed design, and eventual construction. The Register and Fact Sheets are provided to aid in site selection and to provide a foundation for future work. Following site selection, the project team suggests that NWGP conduct more detailed work to address the limitations summarized in Section 5.2.

6.0 LIMITATIONS

This report has been prepared by BGC and Ecoscape and is intended for the sole and exclusive use of Nicola Watershed Governance Partnership, for the purposes set out in this report. BGC/Ecoscape has prepared this report with the understanding that all available information on the past, present, and proposed conditions of the subject property have been disclosed. BGC/Ecoscape has relied upon personal communications with Nicola Watershed Governance Partnership and other information sources to corroborate the documents and other records available for the subject property. Nicola Watershed Governance Partnership has also acknowledged that in order for BGC/Ecoscape to properly

provide the professional service, BGC/Ecoscape is relying upon full disclosure and accuracy of this information.

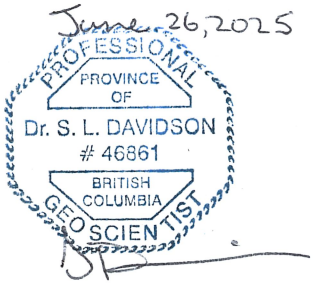
Any use of this report by a third party, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. BGC/Ecoscape accepts no responsibility for damages, if any, suffered by any third party as a result of actions or decisions made based on this report. This report should not be interpreted as an endorsement of the proposed works, but rather be used as a municipal tool for decision making.

7.0 CLOSURE

We trust that this report satisfies the present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

Respectfully Submitted
Ecoscape Environmental Consultants Ltd.,

Written By:



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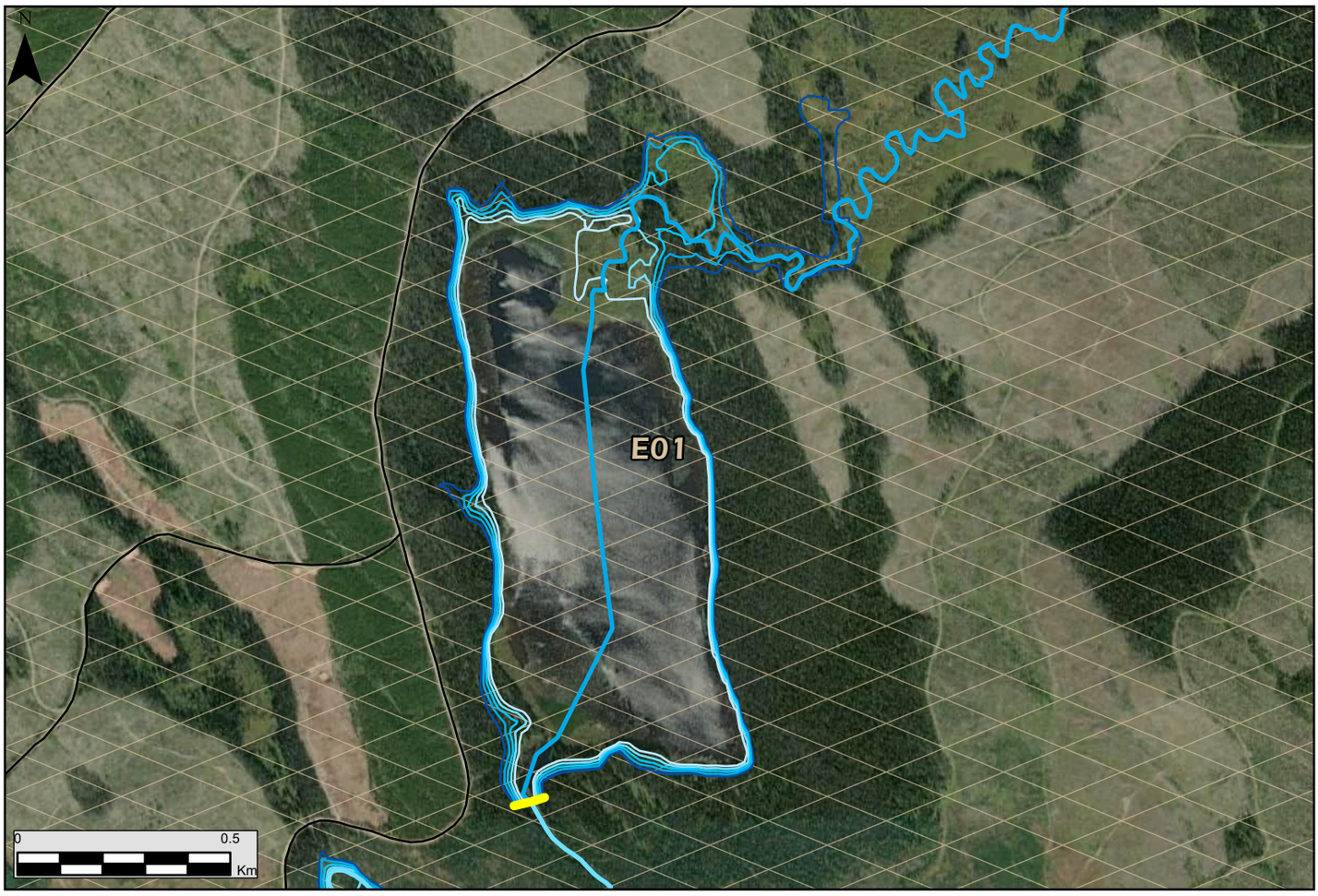
APPENDIX A: Reservoir Fact Sheets

Barton Lake



Tributary To: **Upper Nicola**
Distance to Closest WSC Gauge: **55.8 km**
Reference Gauge: **08LG028**
Number of PODs to the Gauge: **13**
Total Allocated Annual Volume to the Gauge: **2.85 Mm^3**

Contributing Watershed Area: **71 km^2**
Distance from Road (est.): **140 m**
Land Ownership (crown/private/reserve): **Crown**
Infrastructure Flooded: **None**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **12.34**
Salmonids Present (Y/N): **Y**

Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating: **na**
Existing Dam Consequence Rating: **na**
Existing Storage License: **N**

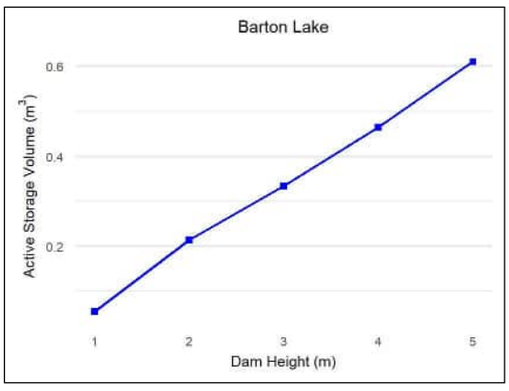
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **30 - 75 m**
Proposed Additional Storage min/max (Mm^3): **0.27 / 3.15**
Proposed Dam Cost Range $/m^3: **12.0 - 2.8**
Potential Evapotranspiration (Mm^3): **0.13 - 0.30**

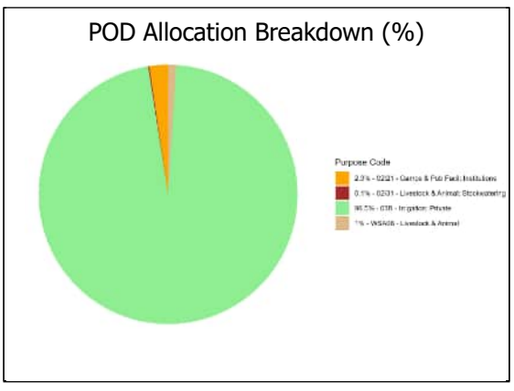
Flow augmentation (min - max): **0.03 - 0.55 m^3/s**
(storage volume / (60*24*60*60)

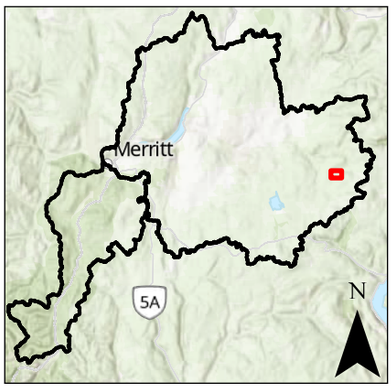
Proposed Dam Location
Existing Road (mapped)
Range Tenures*

Proposed Dam Height Pool
1m
2m
3m
4m
5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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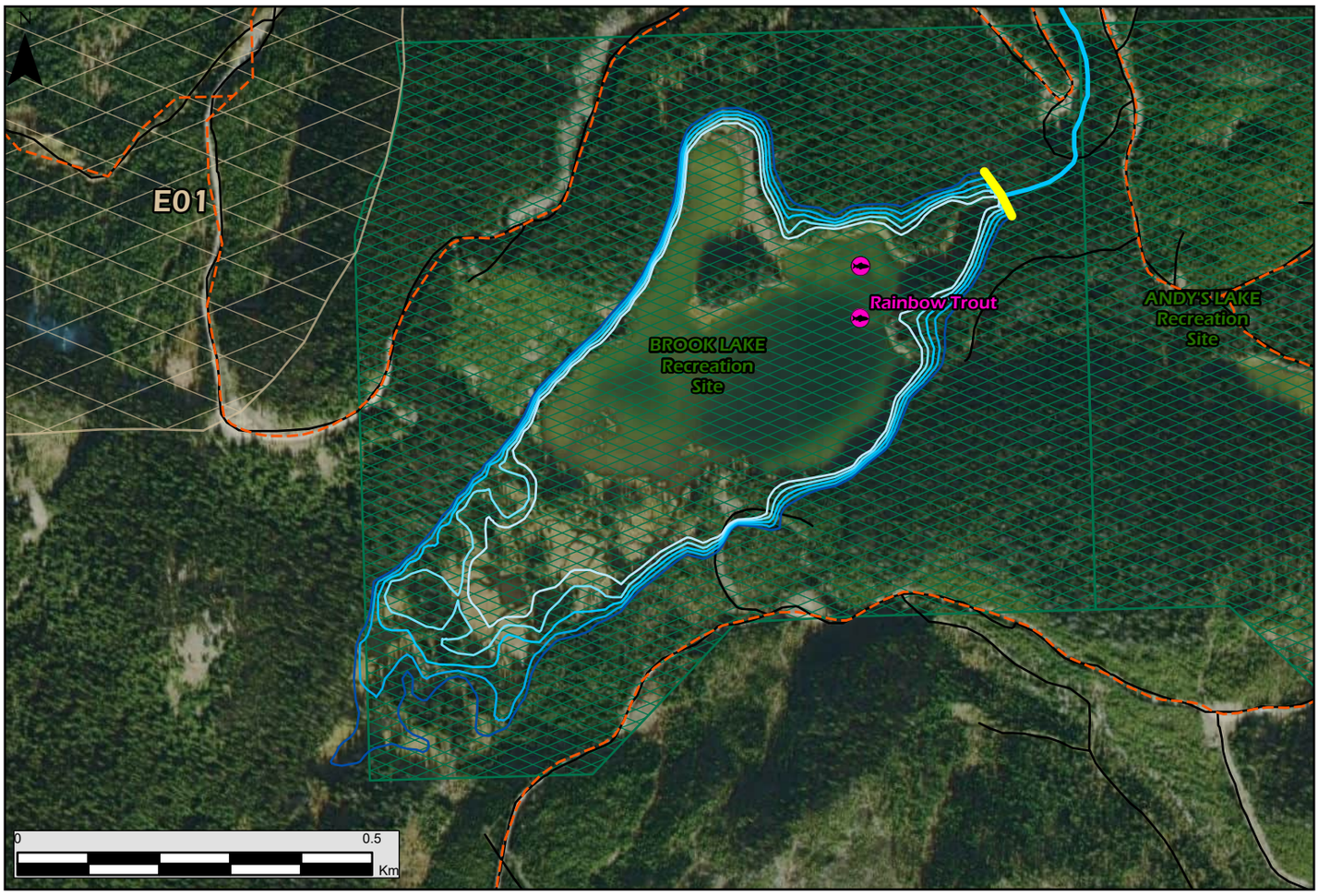
Brook Lake



Tributary To: **Coldwater River**
Distance to Closest WSC Gauge: **18 km**
Reference Gauge: **08LG048**
Number of PODs to the Gauge: **245**
Total Allocated Annual Volume to the Gauge: **0.52 Mm^3**

Contributing Watershed Area: **10 km^2**
Distance from Road (est.): **195 m**
Land Ownership (crown/private/reserve): **Crown**
Infrastructure Flooded: **Rec Site, Road**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **11**
Salmonids Present (Y/N): **Y**

Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating: **na**
Existing Dam Consequence Rating: **na**
Existing Storage License: **N**

Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **5 - 75 m**
Proposed Additional Storage min/max (Mm^3): **0.21 / 1.34**
Proposed Dam Cost Range $/m^3: **13.7 - 6.4**
Potential Evapotranspiration (Mm^3): **0.09 - 0.12**

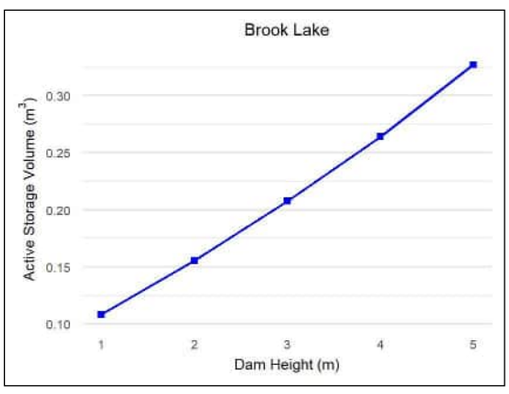
Flow augmentation (min - max): **0.02 - 0.24 m^3/s**
(storage volume / (60*24*60*60)

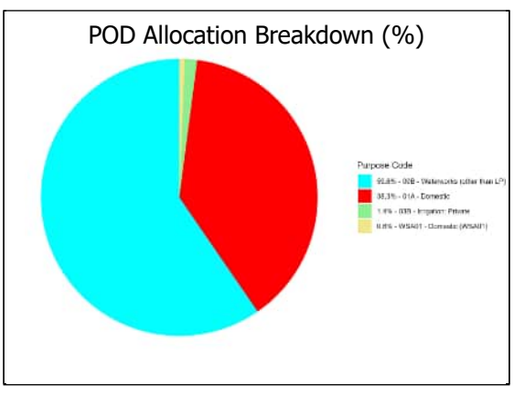
- Fish Observations
- Recreation Site
- Proposed Dam Location
- Existing Road (mapped)
- Recreation Trail
- Range Tenures*

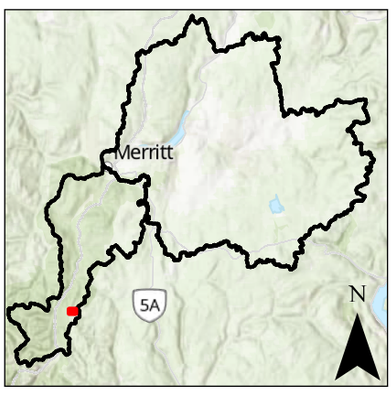
Proposed Dam Height Pool

- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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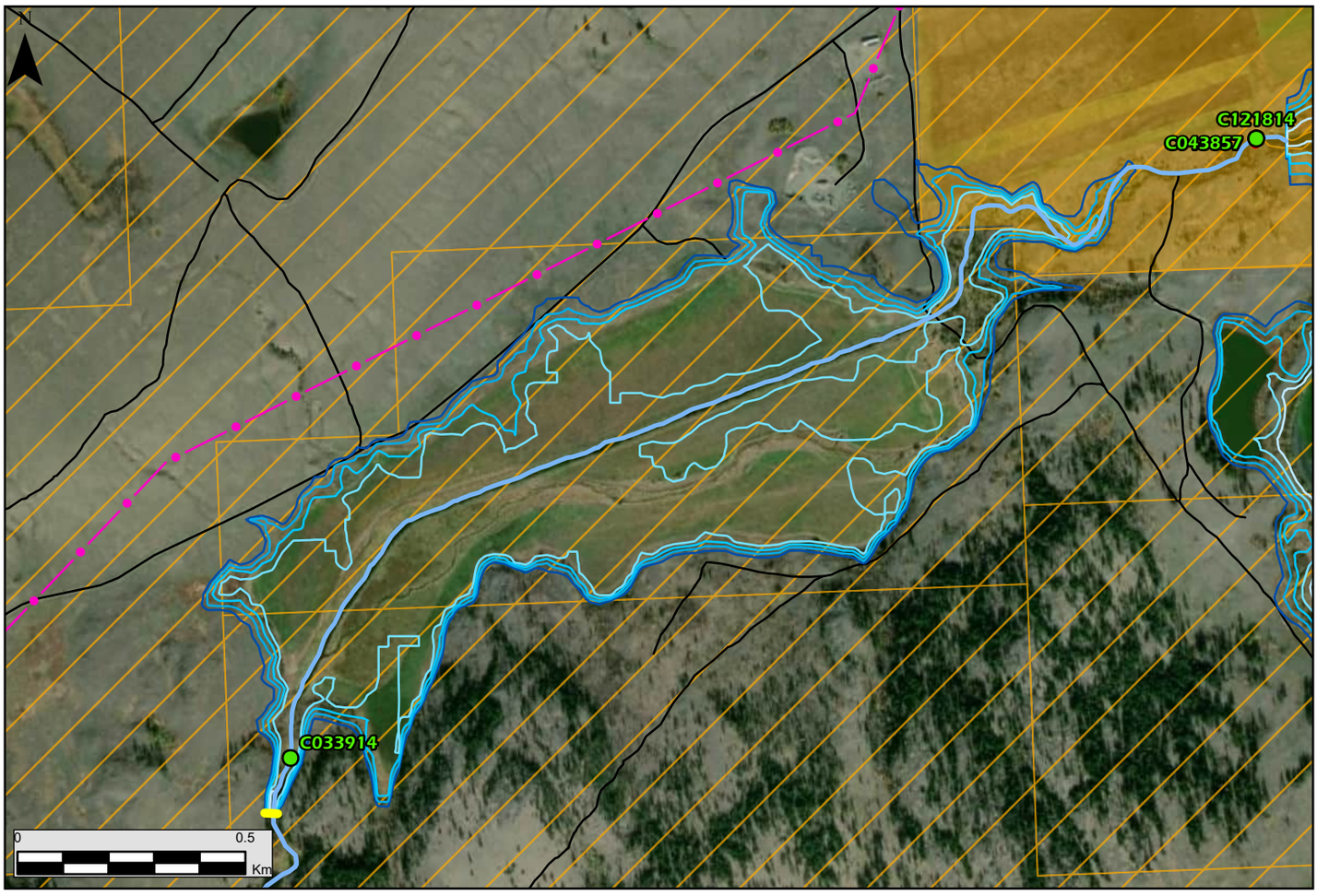
Chapperon Creek



Tributary To: **Upper Nicola**
Distance to Closest WSC Gauge: **21.6 km**
Reference Gauge: **08LG028**
Number of PODs to the Gauge: **16**
Total Allocated Annual Volume to the Gauge: **6.31 Mm^3**

Contributing Watershed Area: **205.1 km^2**
Distance from Road (est.): **470 m**
Land Ownership (crown/private/reserve): **Mixed**
Infrastructure Flooded: **Road, Hydro**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **15.2**
Salmonids Present (Y/N): **N**

Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating: **na**
Existing Dam Consequence Rating: **na**
Existing Storage License: **N**

Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **10 - 30 m**
Proposed Additional Storage min/max (Mm^3): **0 / 2.97**
Proposed Dam Cost Range $/m^3: **7105.1 - 2.7**
Potential Evapotranspiration (Mm^3): **0.00 - 0.34**

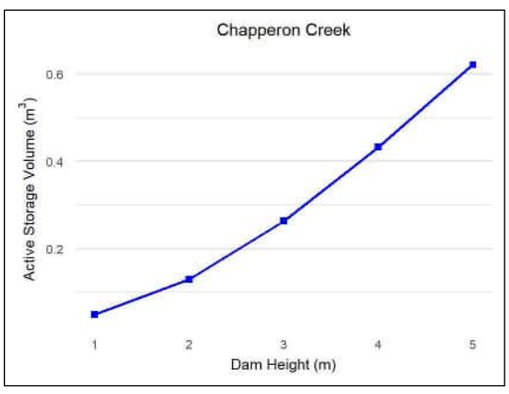
Flow augmentation (min - max): **0.00 - 0.51 m^3/s**
(storage volume / (60*24*60*60)

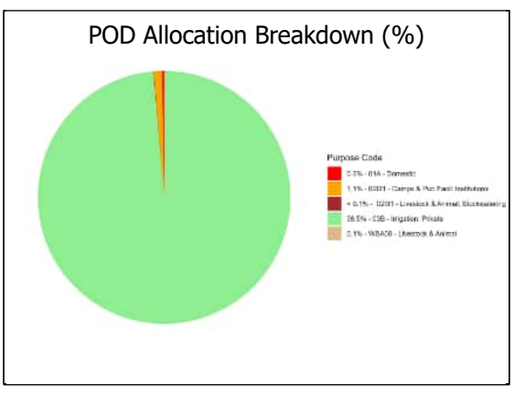
Water Rights License (POD)
- Active
- Proposed Dam Location
- BC Hydro Transmission Line
- Existing Road (mapped)

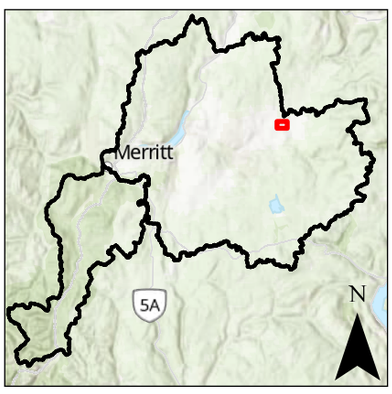
- Reserve Land
- Range Tenures*
- Parcel Fabric

Proposed Dam Height Pool
- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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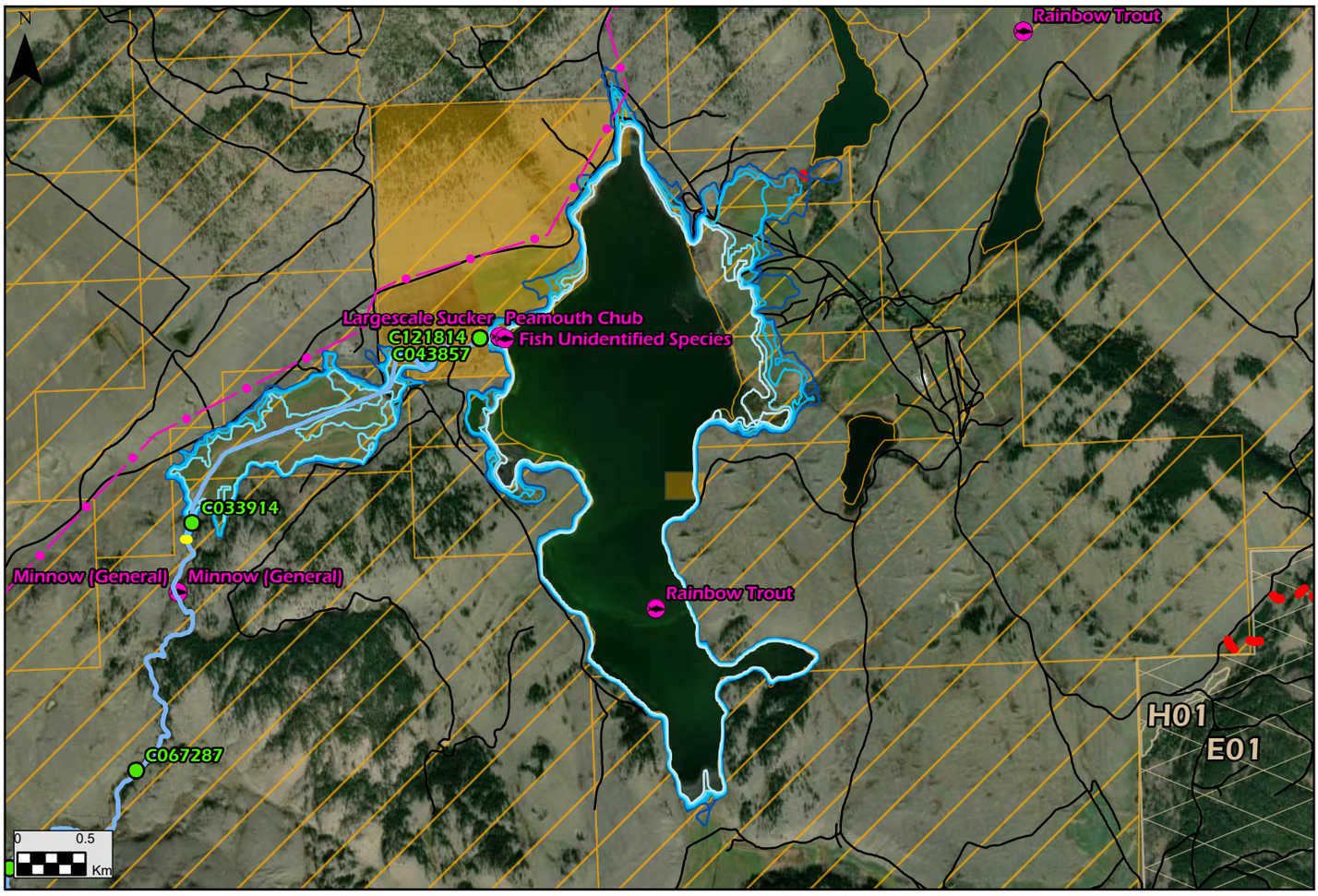
Nicola Watershed GOVERNANCE PARTNERSHIP

Prepared By:

BGC

ECOSCAPE Environmental Consultants Ltd.

Chapperon Lake



Tributary To: **Upper Nicola**
Distance to Closest WSC Gauge: **24.7 km**
Reference Gauge: **08LG028**
Number of PODs to the Gauge: **20**
Total Allocated Annual Volume to the Gauge: **11.2 Mm^3**

Contributing Watershed Area: **196.58 km^2**
Distance from Road (est.): **180 m**
Land Ownership (crown/private/reserve): **Mixed**
Infrastructure Flooded: **Road, Hydro**
Surrounding Properties: **Y**

Average August Temperature - Historical* (°C): **15.14**
Salmonids Present (Y/N): **Y**

Existing Dam: **Y (2)**
Existing Dam Height / Crest (m): **2.9 / 93**
Existing Dam Risk Rating: **4 / 5**
Existing Dam Consequence Rating: **High / Low**
Existing Storage License: **Y**

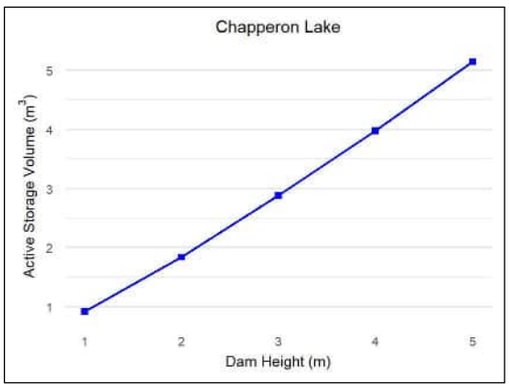
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **35 - 190 m**
Proposed Additional Storage min/max (Mm^3): **4.76 / 26.66**
Proposed Dam Cost Range $/m^3: **0.8 - 0.4**
Potential Evapotranspiration (Mm^3): **2.71 - 3.04**

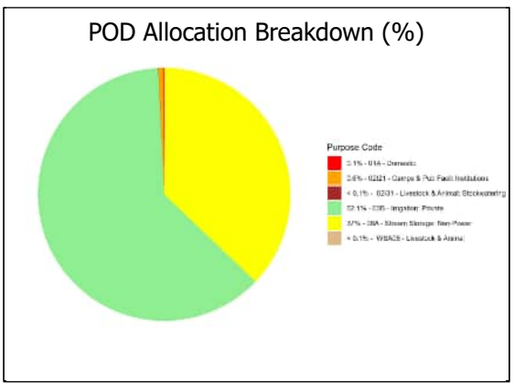
Flow augmentation (min - max): **0.40 - 4.56 m^3/s**
(storage volume / (60*24*60*60)

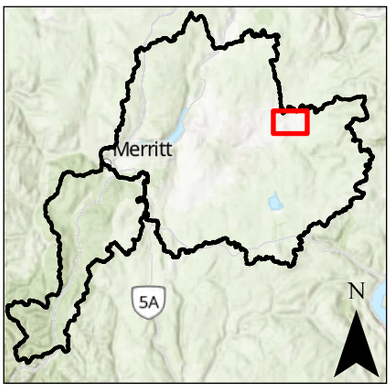
- Fish Observations
- Water Rights License (POD)
  - Active
- Existing Dam
- Proposed Dam Location
- BC Hydro Transmission Line
- Existing Road (mapped)
- Reserve Land
- Range Tenures*
- Parcel Fabric

Proposed Dam Height Pool
- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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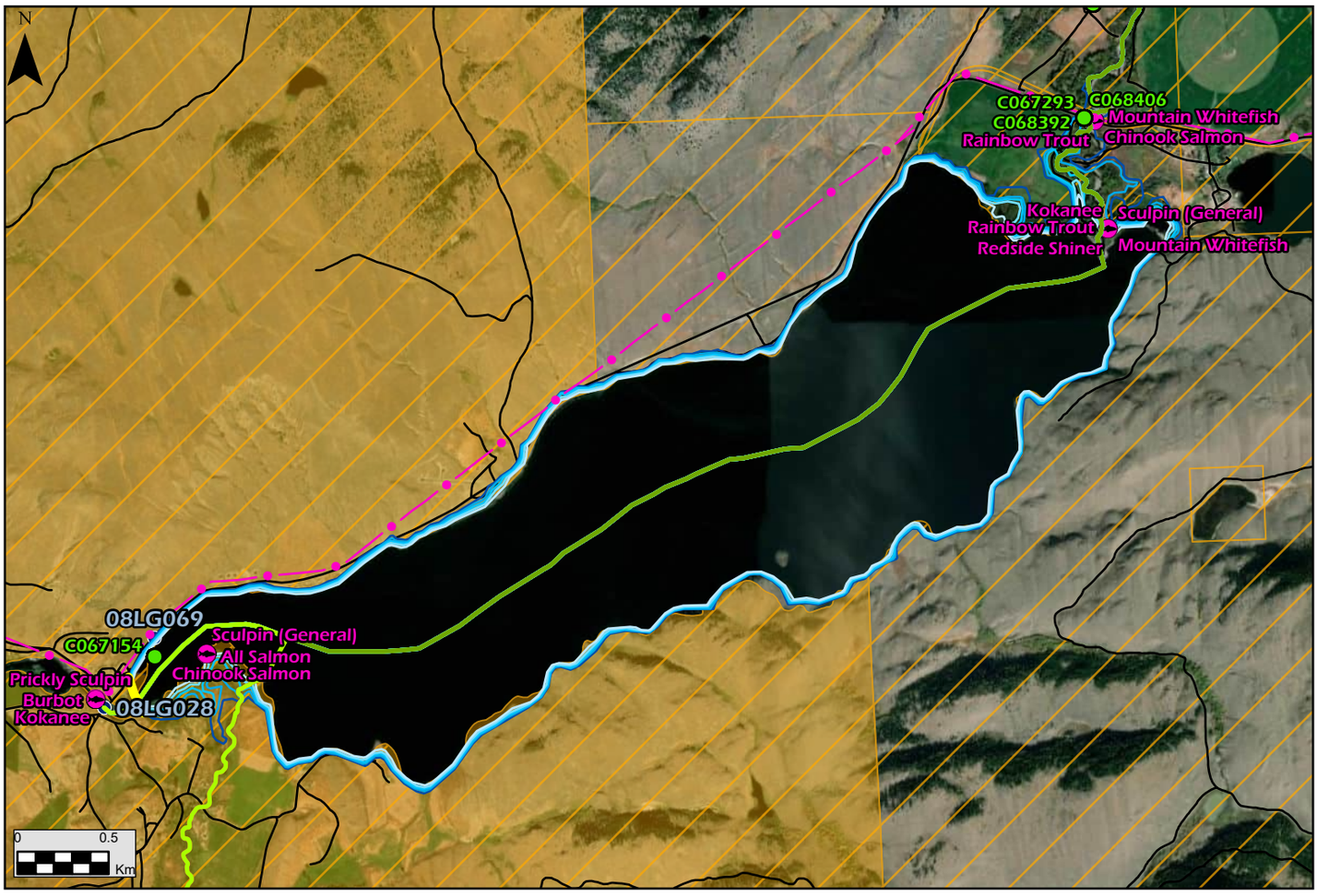
Douglas Lake



Tributary To: **Upper Nicola**
Distance to Closest WSC Gauge: **0.2 km**
Reference Gauge: **08LG028**
Number of PODs to the Gauge: **20**
Total Allocated Annual Volume to the Gauge: **0.07 Mm^3**

Contributing Watershed Area: **1,277.26 km^2**
Distance from Road (est.): **0 m**
Land Ownership (crown/private/reserve): **Private / Reserve**
Infrastructure Flooded: **Road, Hydro**
Surrounding Properties: **Y**

Average August Temperature - Historical* (°C): **16.42**
Salmonids Present (Y/N): **Y**

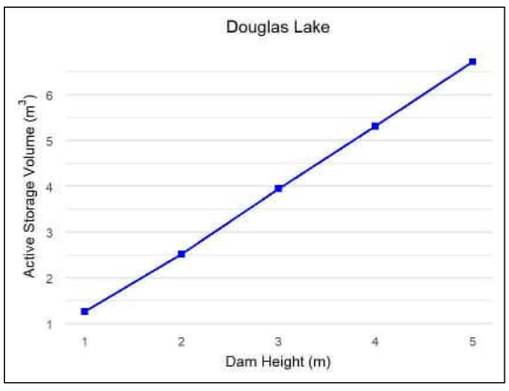
Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating: **na**
Existing Dam Consequence Rating: **na**
Existing Storage License: **N**

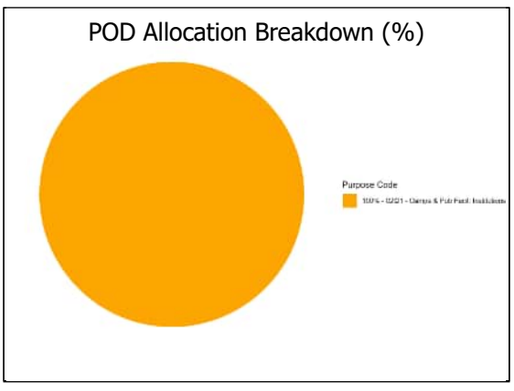
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **160 - 255 m**
Proposed Additional Storage min/max (Mm^3): **6.53 / 34.85**
Proposed Dam Cost Range $/m^3: **0.8 - 0.3**
Potential Evapotranspiration (Mm^3): **3.88 - 4.15**

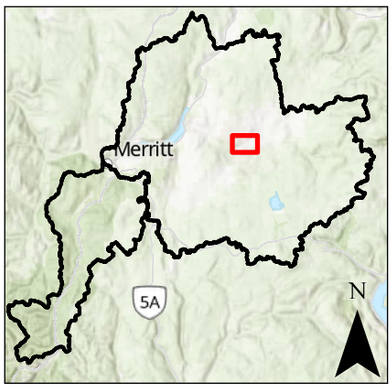
Flow augmentation (min - max): **0.51 - 5.92 m^3/s**
(storage volume / (60*24*60*60)

- Fish Observations
- WSC Gauge
- Water Rights License (POD)
  - Active
- Proposed Dam Location
- BC Hydro Transmission Line
- Existing Road (mapped)
- Reserve Land
- Range Tenures*
- Parcel Fabric
- Proposed Dam Height Pool
  - 1m
  - 2m
  - 3m
  - 4m
  - 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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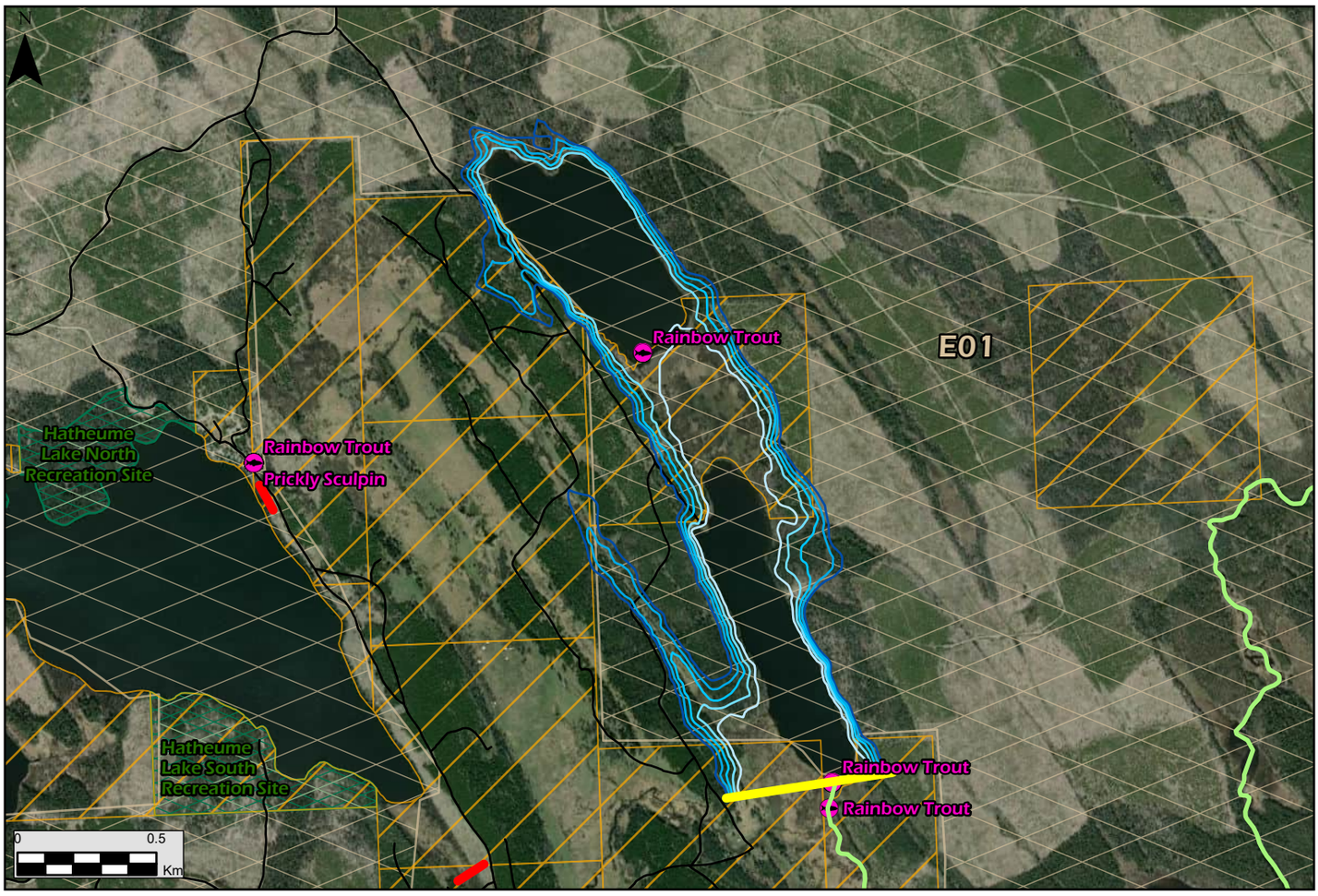
Ellen Lake



Tributary To: **Upper Nicola**
Distance to Closest WSC Gauge: **57.9 km**
Reference Gauge: **08LG028**
Number of PODs to the Gauge: **13**
Total Allocated Annual Volume to the Gauge: **2.85 Mm^3**

Contributing Watershed Area: **19.37 km^2**
Distance from Road (est.): **370 m**
Land Ownership (crown/private/reserve): **Private / Crown**
Infrastructure Flooded: **Road**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **13.92**
Salmonids Present (Y/N): **Y**

Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating: **na**
Existing Dam Consequence Rating: **na**
Existing Storage License: **N**

Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **460 - 575 m**
Proposed Additional Storage min/max (Mm^3): **0.32 / 4.26**
Proposed Dam Cost Range $/m^3: **15.3 - 3.1**
Potential Evapotranspiration (Mm^3): **0.15 - 0.40**

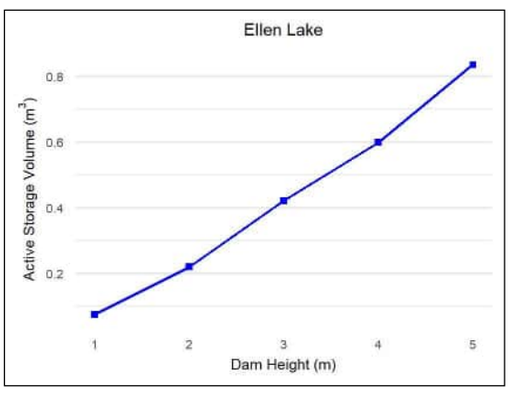
Flow augmentation (min - max): **0.03 - 0.74 m^3/s**
(storage volume / (60*24*60*60)

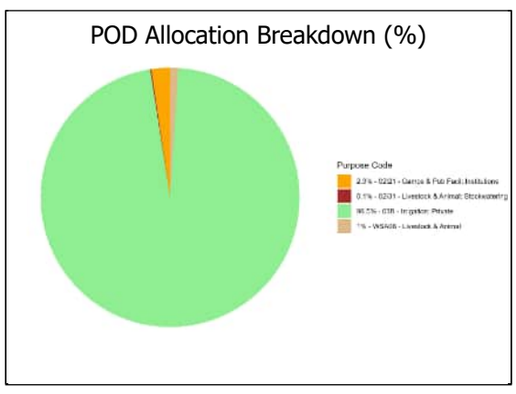
- Fish Observations
- Proposed Dam Location
- Existing Road (mapped)
- Range Tenures*
- Parcel Fabric
- Recreation Site

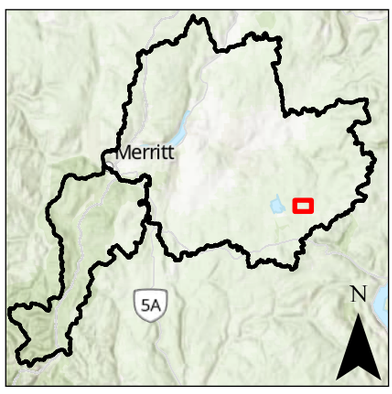
Proposed Dam Height Pool

- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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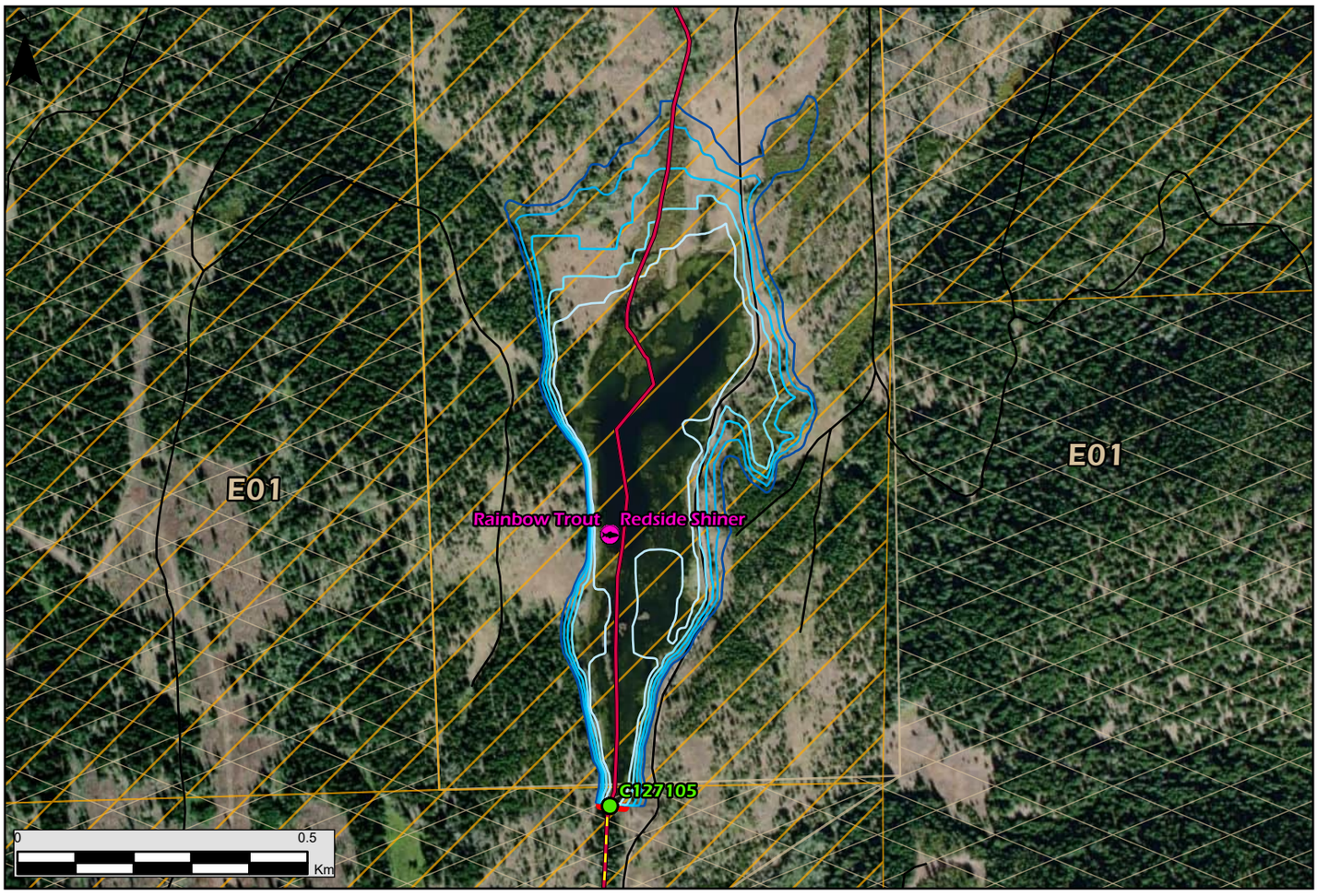
Englishman Lake



Tributary To: **Coldwater River**
Distance to Closest WSC Gauge: **59.2 km**
Reference Gauge: **08LG010**
Number of PODs to the Gauge: **72**
Total Allocated Annual Volume to the Gauge: **13.81 Mm^3**

Contributing Watershed Area: **40.63 km^2**
Distance from Road (est.): **55 m**
Land Ownership (crown/private/reserve): **Private**
Infrastructure Flooded: **Road**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **13.8**
Salmonids Present (Y/N): **Y**

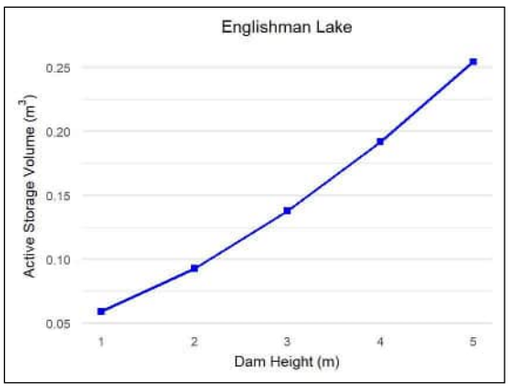
Existing Dam: **Y**
Existing Dam Height / Crest (m): **1.7 / 23**
Existing Dam Risk Rating: **5**
Existing Dam Consequence Rating: **Significant**
Existing Storage License: **Y**

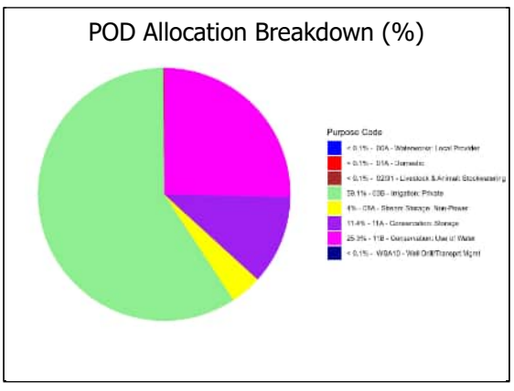
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **30 - 85 m**
Proposed Additional Storage min/max (Mm^3): **0.13 / 1.15**
Proposed Dam Cost Range $/m^3: **27.6 - 7.8**
Potential Evapotranspiration (Mm^3): **0.07 - 0.12**

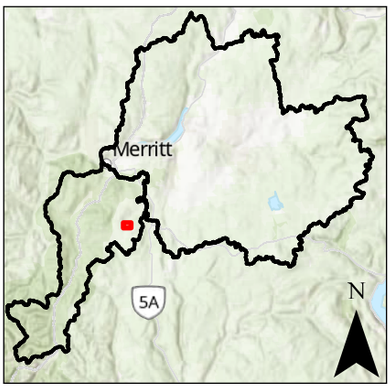
Flow augmentation (min - max): **0.01 - 0.20 m^3/s**
(storage volume / (60*24*60*60)

- Fish Observations
- Water Rights License (POD)
  - Active
  - Existing Dam
  - Proposed Dam Location
- Existing Road (mapped)
- Range Tenures*
- Parcel Fabric
- Proposed Dam Height Pool
  - 1m
  - 2m
  - 3m
  - 4m
  - 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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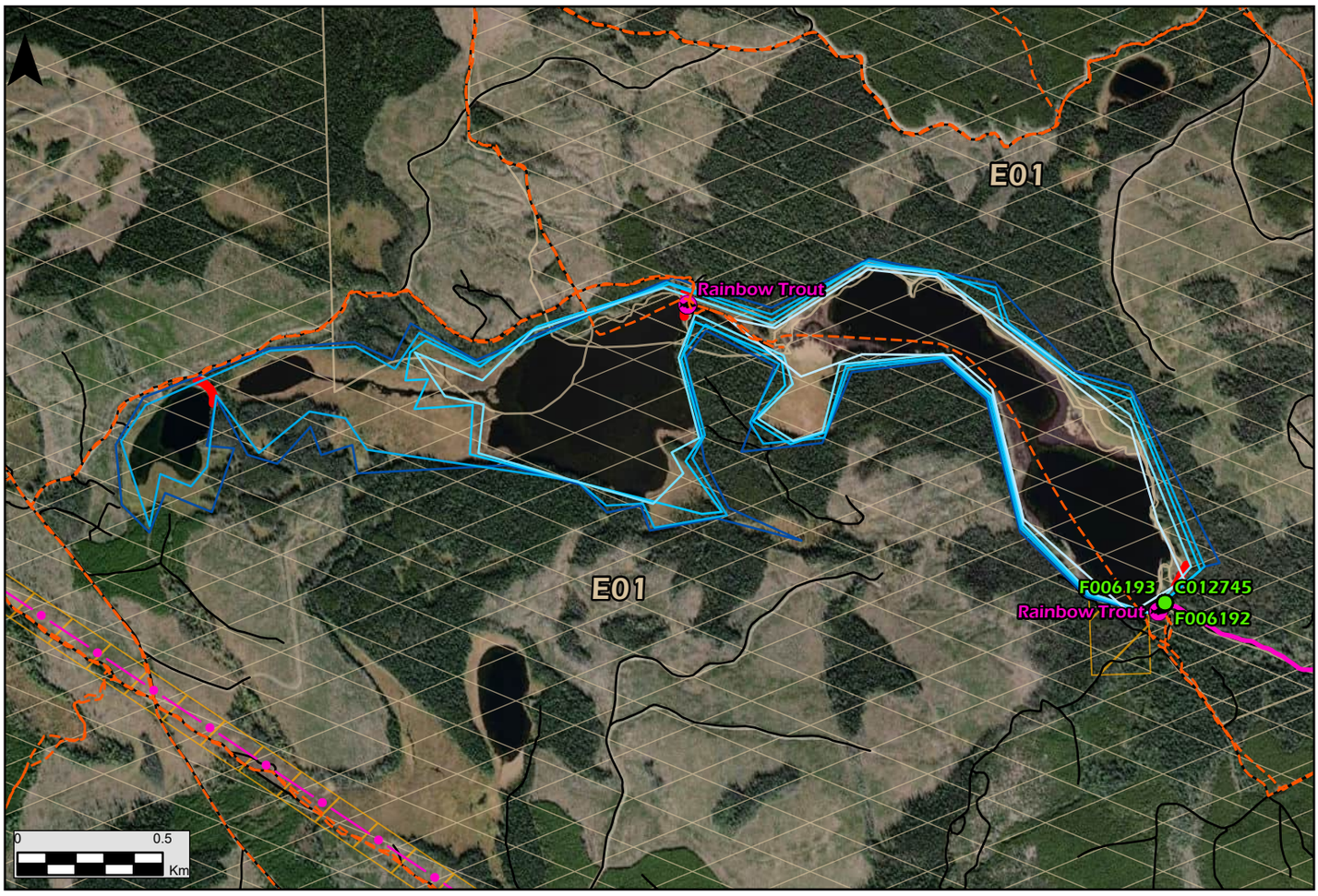
Frogmoore Lake



Tributary To: **Nicola River**
Distance to Closest WSC Gauge: **43.9 km**
Reference Gauge: **08LG065**
Number of PODs to the Gauge: **39**
Total Allocated Annual Volume to the Gauge: **157.01 Mm^3**

Contributing Watershed Area: **31.08 km^2**
Distance from Road (est.): **35 m**
Land Ownership (crown/private/reserve): **Crown / Private**
Infrastructure Flooded: **Rec Trail, Road**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **12.63**
Salmonids Present (Y/N): **Y**

Existing Dam: **Y (4)**
Existing Dam Height / Crest (m): **3.2 / 125**
Existing Dam Risk Rating: **5 / 4 / 4 / 5**
Existing Dam Consequence Rating: **Low / Low / Sig / Low**
Existing Storage License: **Y**

Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **215 - 300 m**
Proposed Additional Storage min/max (Mm^3): **0.34 / 5.99**
Proposed Dam Cost Range $/m^3: **11.9 - 1.8**
Potential Evapotranspiration (Mm^3): **0.16 - 0.56**

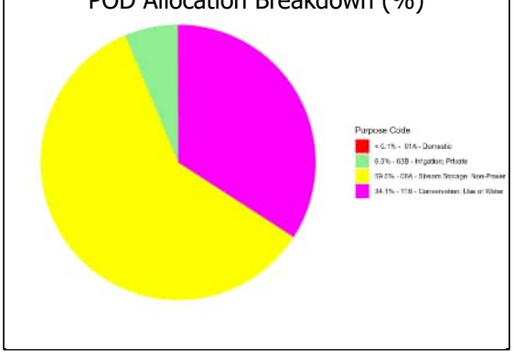
Flow augmentation (min - max): **0.04 - 1.05 m^3/s**
(storage volume / (60*24*60*60)

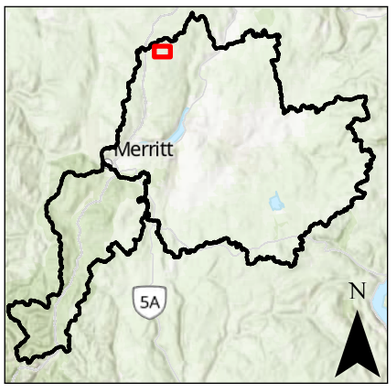
Fish Observations
Water Rights License (POD)
Active
Existing Dam
Proposed Dam Location
BC Hydro Transmission Line
Existing Road (mapped)
Recreation Trail
Range Tenures*
Parcel Fabric

Proposed Dam Height Pool
1m
2m
3m
4m
5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023

POD Allocation Breakdown (%)





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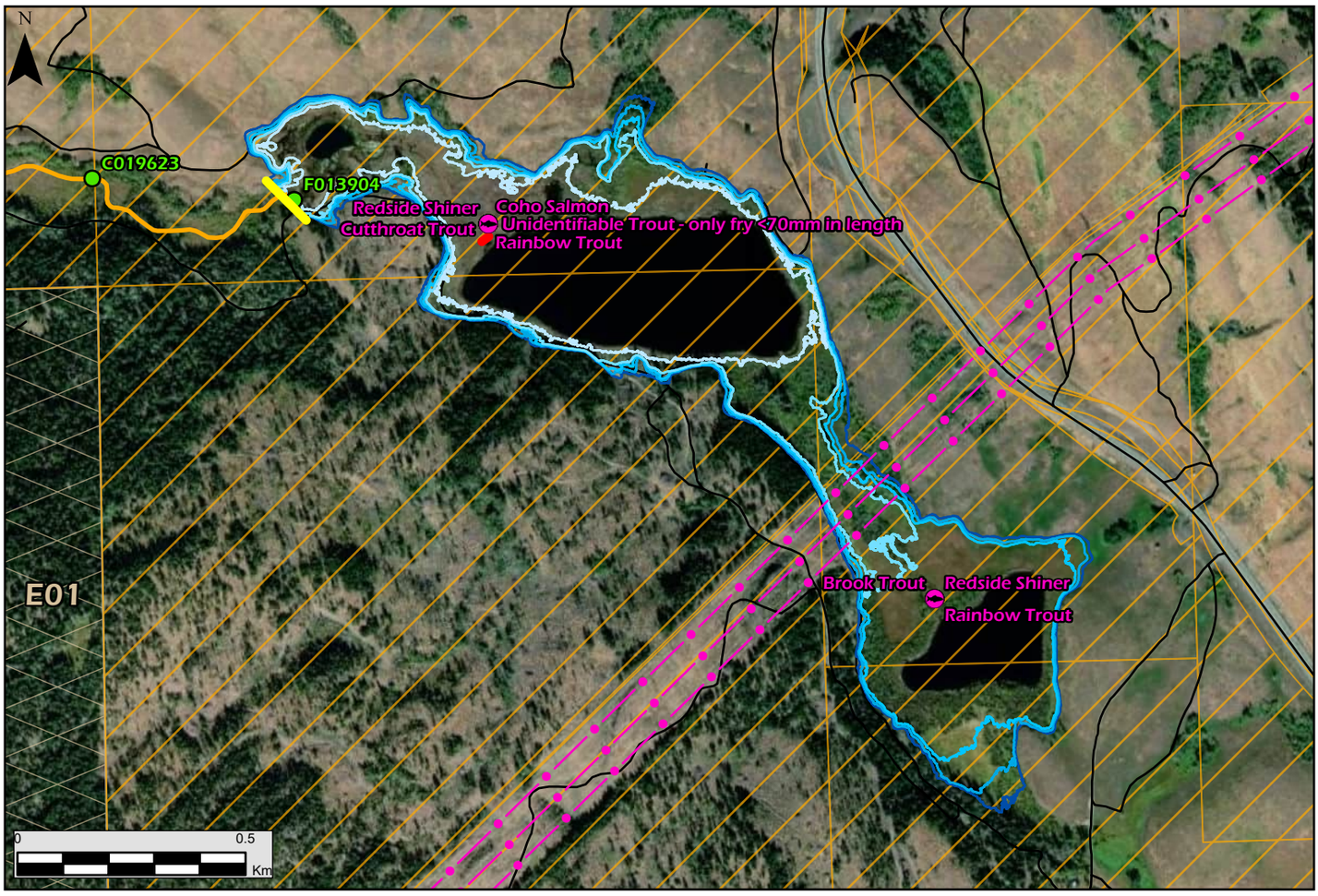
Garcia Lake B



Tributary To: **Coldwater River**
Distance to Closest WSC Gauge: **22.5 km**
Reference Gauge: **08LG010**
Number of PODs to the Gauge: **24**
Total Allocated Annual Volume to the Gauge: **4.625377 Mm^3**

Contributing Watershed Area: **26.83 km^2**
Distance from Road (est.): **70 m**
Land Ownership (crown/private/reserve): **Private**
Infrastructure Flooded: **Road, Hydro**
Surrounding Properties: **Y**

Average August Temperature - Historical* (°C): **13.16**
Salmonids Present (Y/N): **Y**

Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating: **na**
Existing Dam Consequence Rating: **na**
Existing Storage License: **N**

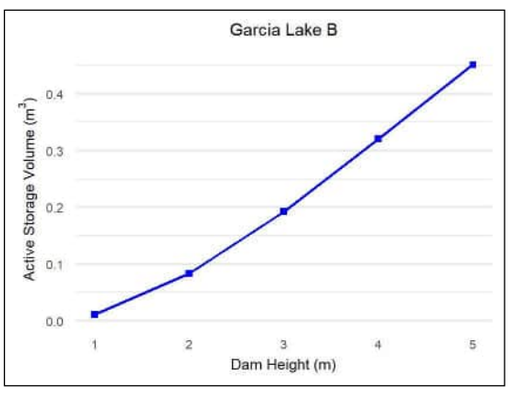
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **70 - 130 m**
Proposed Additional Storage min/max (Mm^3): **0.05 / 2.34**
Proposed Dam Cost Range $/$m^3$: **74.8 - 4.1**
Potential Evapotranspiration (Mm^3): **0.03 - 0.25**

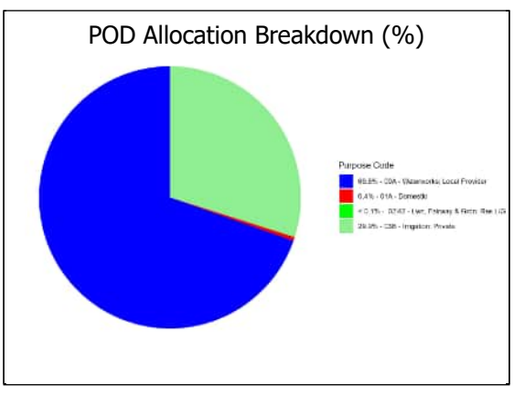
Flow augmentation (min - max): **0.00 - 0.40 m^3/s**
(storage volume / (60*24*60*60)

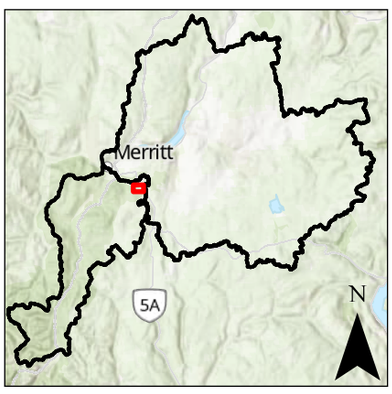
- Fish Observations
- Water Rights License (POD)
  - Active
  - Existing Dam
  - Proposed Dam Location
  - BC Hydro Transmission Line
- Existing Road (mapped)
- Range Tenures*
- Parcel Fabric

Proposed Dam Height Pool
- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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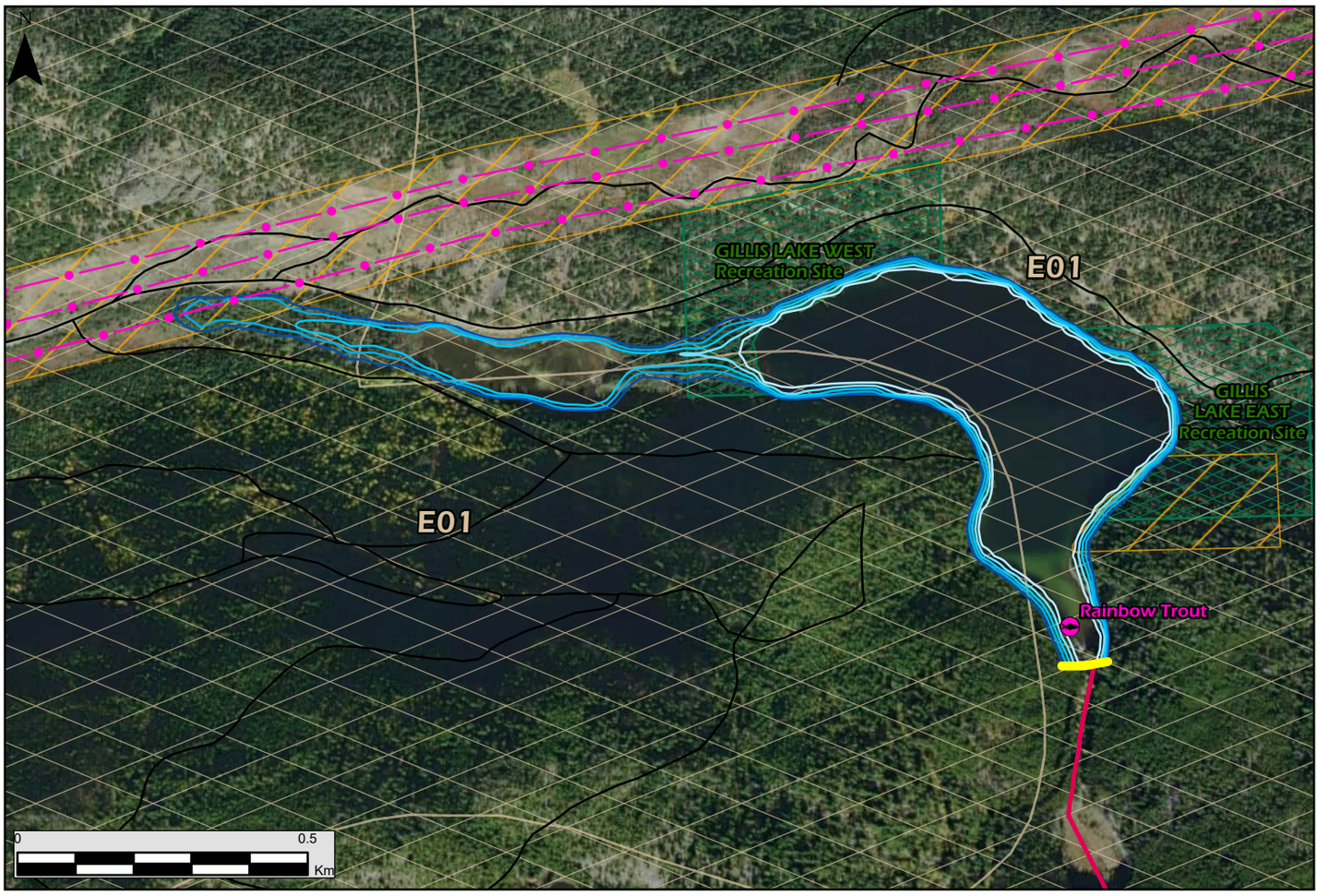
Gillis Lake



Tributary To: **Coldwater River**
Distance to Closest WSC Gauge: **40.6 km**
Reference Gauge: **08LG010**
Number of PODs to the Gauge: **39**
Total Allocated Annual Volume to the Gauge: **10.647158 Mm^3**

Contributing Watershed Area: **4.79 km^2**
Distance from Road (est.): **360 m**
Land Ownership (crown/private/reserve): **Crown / Private**
Infrastructure Flooded: **Road, Hydro, Rec Site**
Surrounding Properties: **Y**

Average August Temperature - Historical* (°C): **11.79**
Salmonids Present (Y/N): **Y**

Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating: **na**
Existing Dam Consequence Rating: **na**
Existing Storage License: **N**

Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **40 - 85 m**
Proposed Additional Storage min/max (Mm^3): **0.17 / 1.18**
Proposed Dam Cost Range $/$m^3$: **21.9 - 7.6**
Potential Evapotranspiration (Mm^3): **0.09 - 0.12**

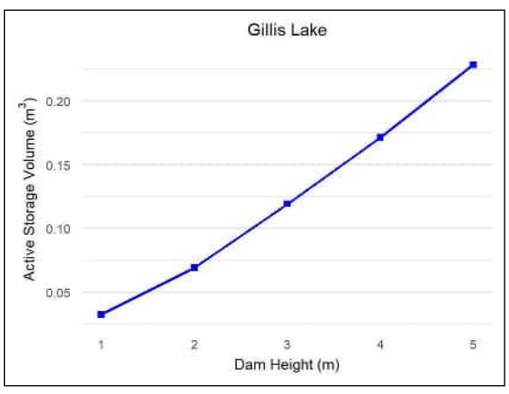
Flow augmentation (min - max): **0.02 - 0.20 m^3/s**
(storage volume / (60*24*60*60)

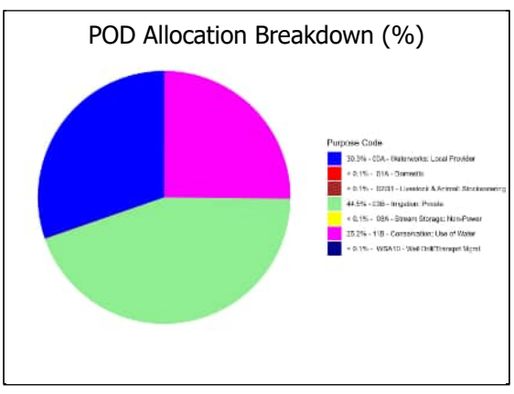
- Fish Observations
- Proposed Dam Location
- BC Hydro Transmission Line
- Existing Road (mapped)
- Range Tenures*
- Parcel Fabric
- Recreation Site

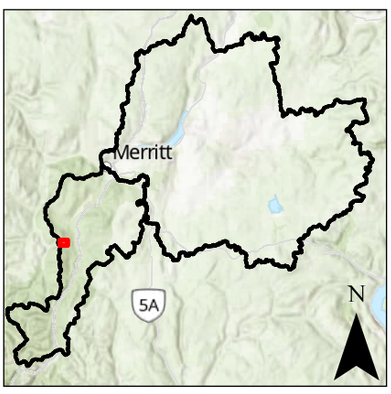
Proposed Dam Height Pool

- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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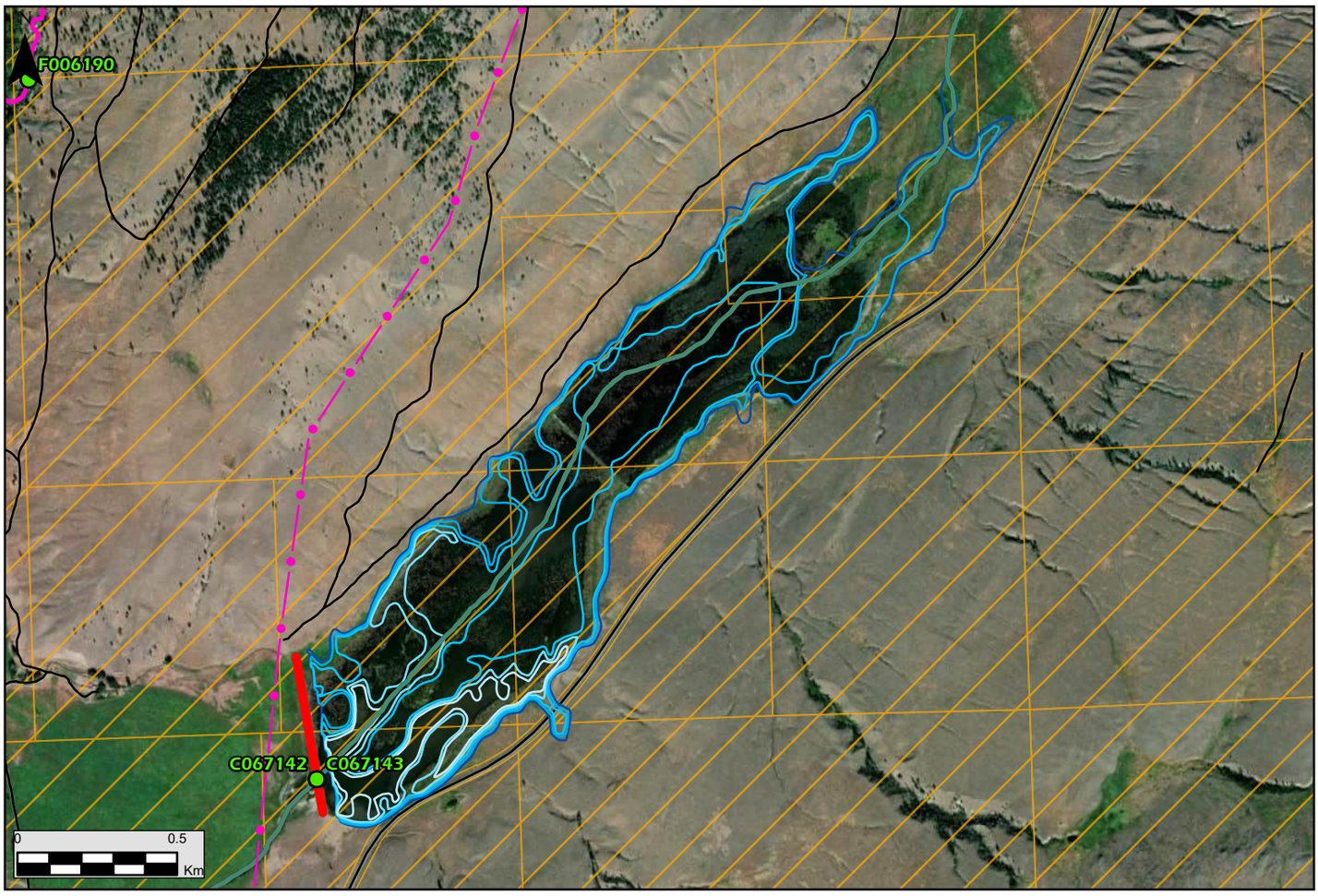
Guichon Flats Lake



Tributary To: **Nicola**
Distance to Closest WSC Gauge: **24.6 km**
Reference Gauge: **08LG046**
Number of PODs to the Gauge: **10**
Total Allocated Annual Volume to the Gauge: **144.1 Mm^3**

Contributing Watershed Area: **291.95 km^2**
Distance from Road (est.): **185 m**
Land Ownership (crown/private/reserve): **Private**
Infrastructure Flooded: **Road**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **16.96**
Salmonids Present (Y/N): **Y**

Existing Dam: **Y**
Existing Dam Height / Crest (m): **3 / 520**
Existing Dam Risk Rating: **5**
Existing Dam Consequence Rating: **Low**
Existing Storage License: **Y**

Proposed Dam Heights: **1-5 m**
Proposed Dam Length: **240 - 550 m**
Proposed Additional Storage min/max (Mm^3): **0.09 / 2.79**
Proposed Dam Cost Range $/m^3: **25.4 - 4.2**
Potential Evapotranspiration (Mm^3): **0.05 - 0.35**

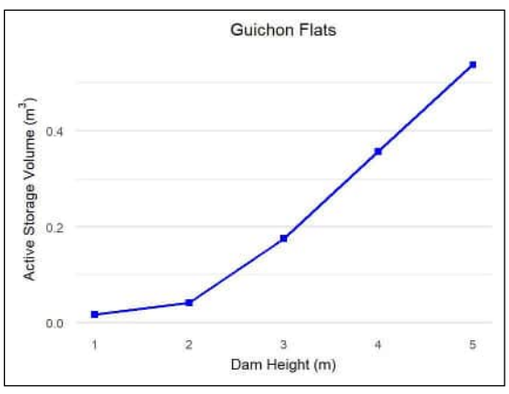
Flow augmentation (min - max): **0.02 - 0.54 m^3/s**
(storage volume / (60*24*60*60)

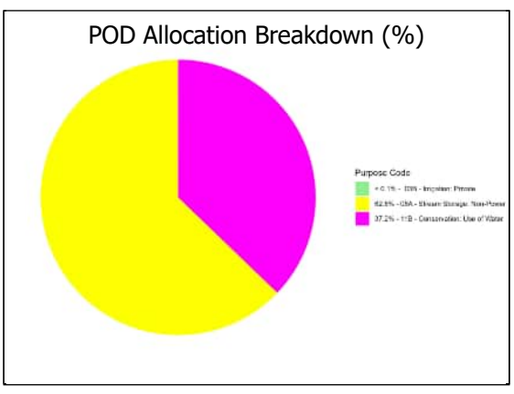
Water Rights License (POD)
- Active
- Existing Dam
- Proposed Dam Location
- BC Hydro Transmission Line

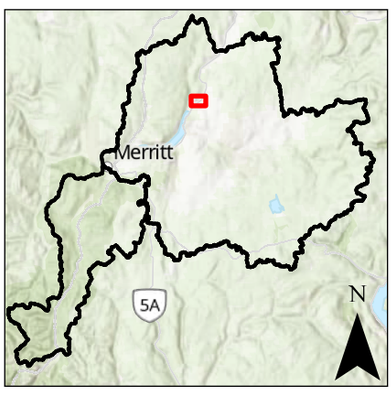
- Existing Road (mapped)
- Range Tenures*
- Parcel Fabric

Proposed Dam Height Pool
- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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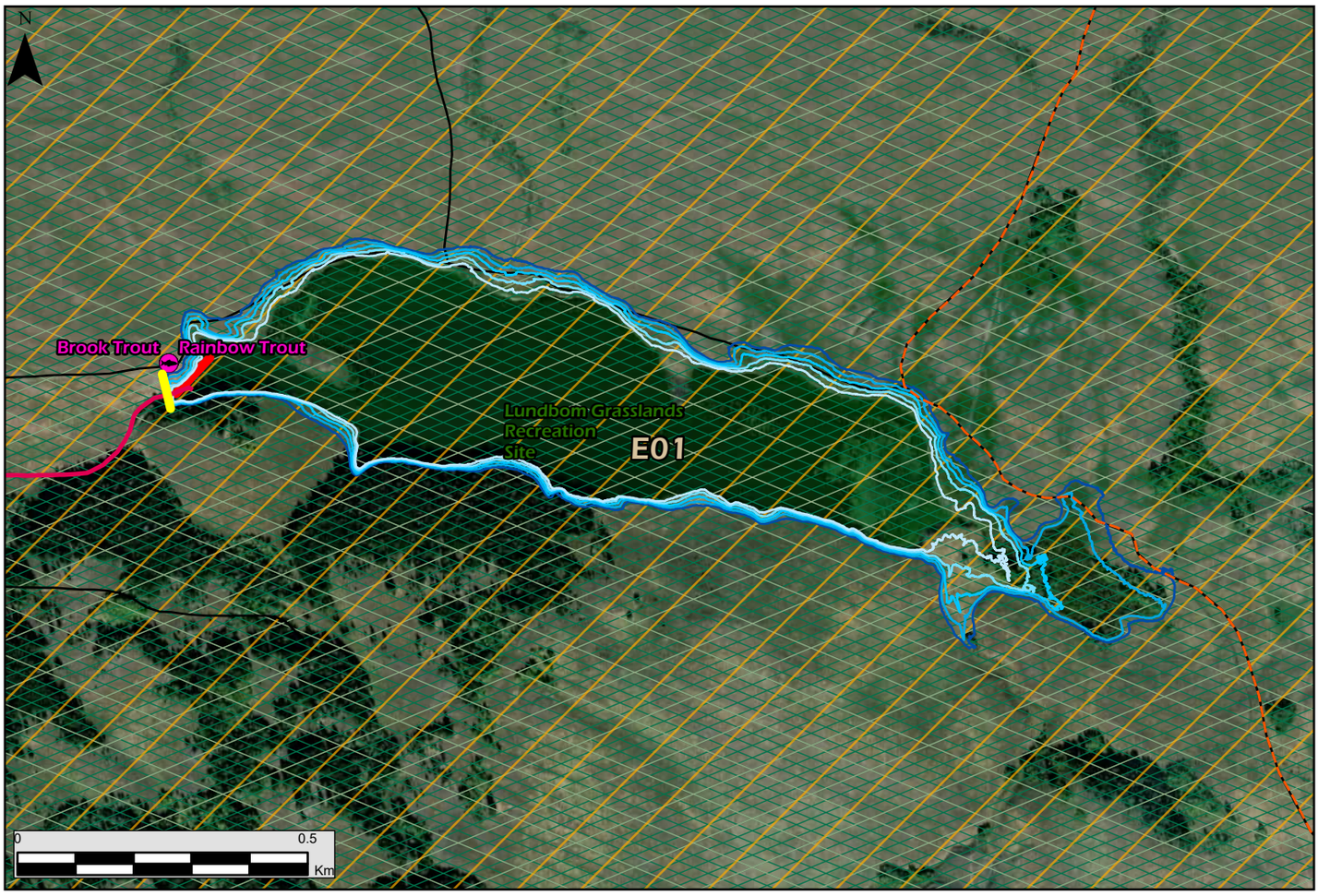
Hamilton Lake



Tributary To: **Nicola River**
Distance to Closest WSC Gauge: **67.3 km**
Reference Gauge: **08LG065**
Number of PODs to the Gauge: **28**
Total Allocated Annual Volume to the Gauge: **4.4085 Mm^3**

Contributing Watershed Area: **25.6 km^2**
Distance from Road (est.): **0 m**
Land Ownership (crown/private/reserve): **Crown**
Infrastructure Flooded: **Road, Rec Site, Trail**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **13.74**
Salmonids Present (Y/N): **Y**

Existing Dam: **Y**
Existing Dam Height / Crest (m): **6.8 / 21**
Existing Dam Risk Rating: **5**
Existing Dam Consequence Rating: **Low**
Existing Storage License: **N**

Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **25 - 60 m**
Proposed Additional Storage min/max (Mm^3): **0.33 / 1.92**
Proposed Dam Cost Range $/m^3: **11.2 - 4.5**
Potential Evapotranspiration (Mm^3): **0.18 - 0.21**

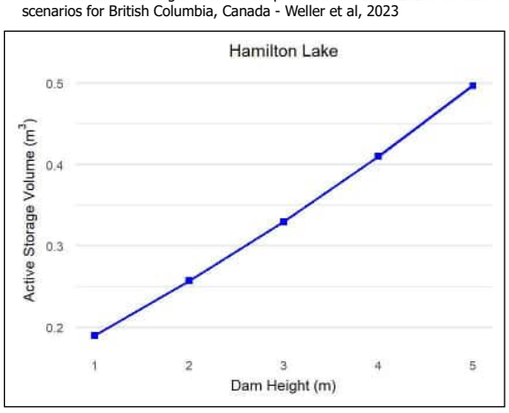
Flow augmentation (min - max): **0.03 - 0.33 m^3/s**
(storage volume / (60*24*60*60)

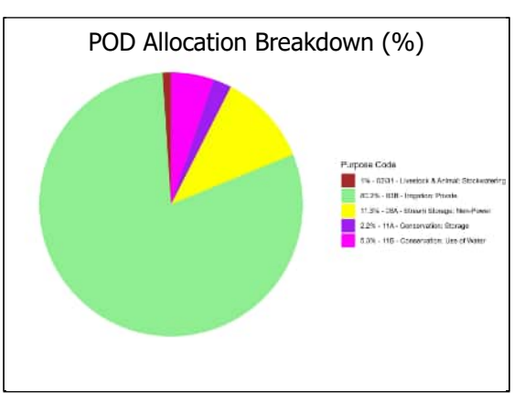
- Fish Observations
- Existing Dam
- Proposed Dam Location
- Existing Road (mapped)
- Recreation Trail
- Range Tenures*
- Parcel Fabric
- Recreation Site

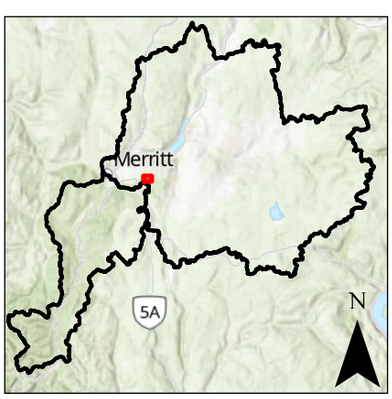
Proposed Dam Height Pool

- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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Nicola Watershed GOVERNANCE PARTNERSHIP

Prepared By:

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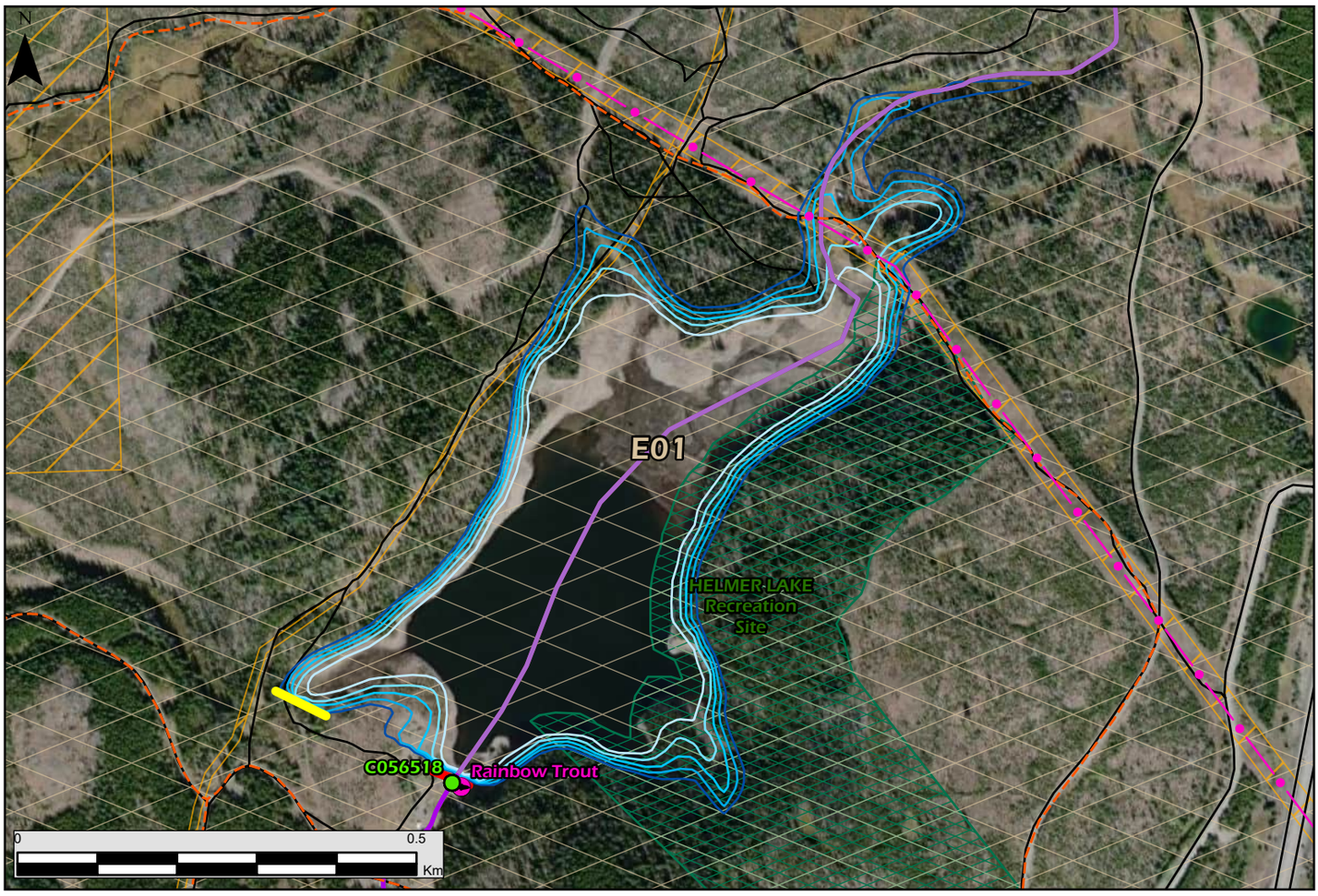
Helmer Lake



Tributary To: **Clapperton Creek**
Distance to Closest WSC Gauge: **48.4 km**
Reference Gauge: **08LG006**
Number of PODs to the Gauge: **43**
Total Allocated Annual Volume to the Gauge: **20.44 Mm^3**

Contributing Watershed Area: **58.76 km^2**
Distance from Road (est.): **0 m**
Land Ownership (crown/private/reserve): **Crown**
Infrastructure Flooded: **Rec Site / Trail, Road, Hydro**
Surrounding Properties: **Y**

Average August Temperature - Historical* (°C): **13.08**
Salmonids Present (Y/N): **Y**

Existing Dam: **Y**
Existing Dam Height / Crest (m): **6.7 / 121**
Existing Dam Risk Rating: **4**
Existing Dam Consequence Rating: **High**
Existing Storage License: **Y**

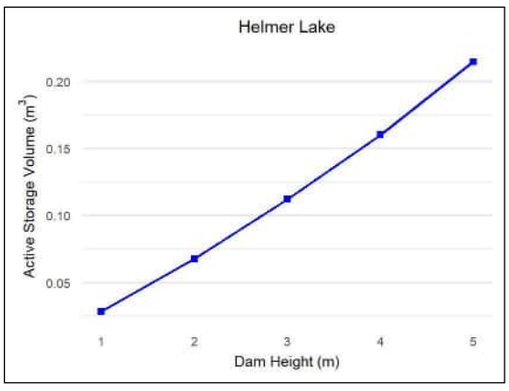
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **45 - 295 m**
Proposed Additional Storage min/max (Mm^3): **0.14 / 1.11**
Proposed Dam Cost Range $/$m^3$: **23.5 - 9.9**
Potential Evapotranspiration (Mm^3): **0.07 - 0.11**

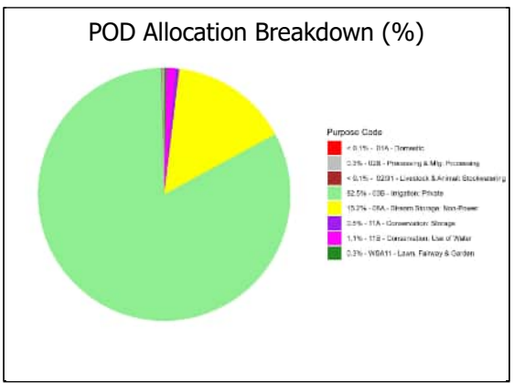
Flow augmentation (min - max): **0.01 - 0.19 m^3/s**
(storage volume / (60*24*60*60)

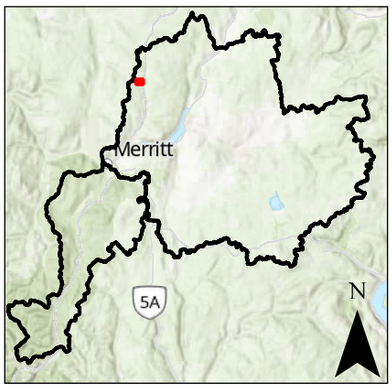
- Fish Observations
- Water Rights License (POD)
  - Active
- Existing Dam
- Proposed Dam Location
- BC Hydro Transmission Line
- Existing Road (mapped)
- Recreation Trail
- Range Tenures*
- Parcel Fabric
- Recreation Site

Proposed Dam Height Pool
- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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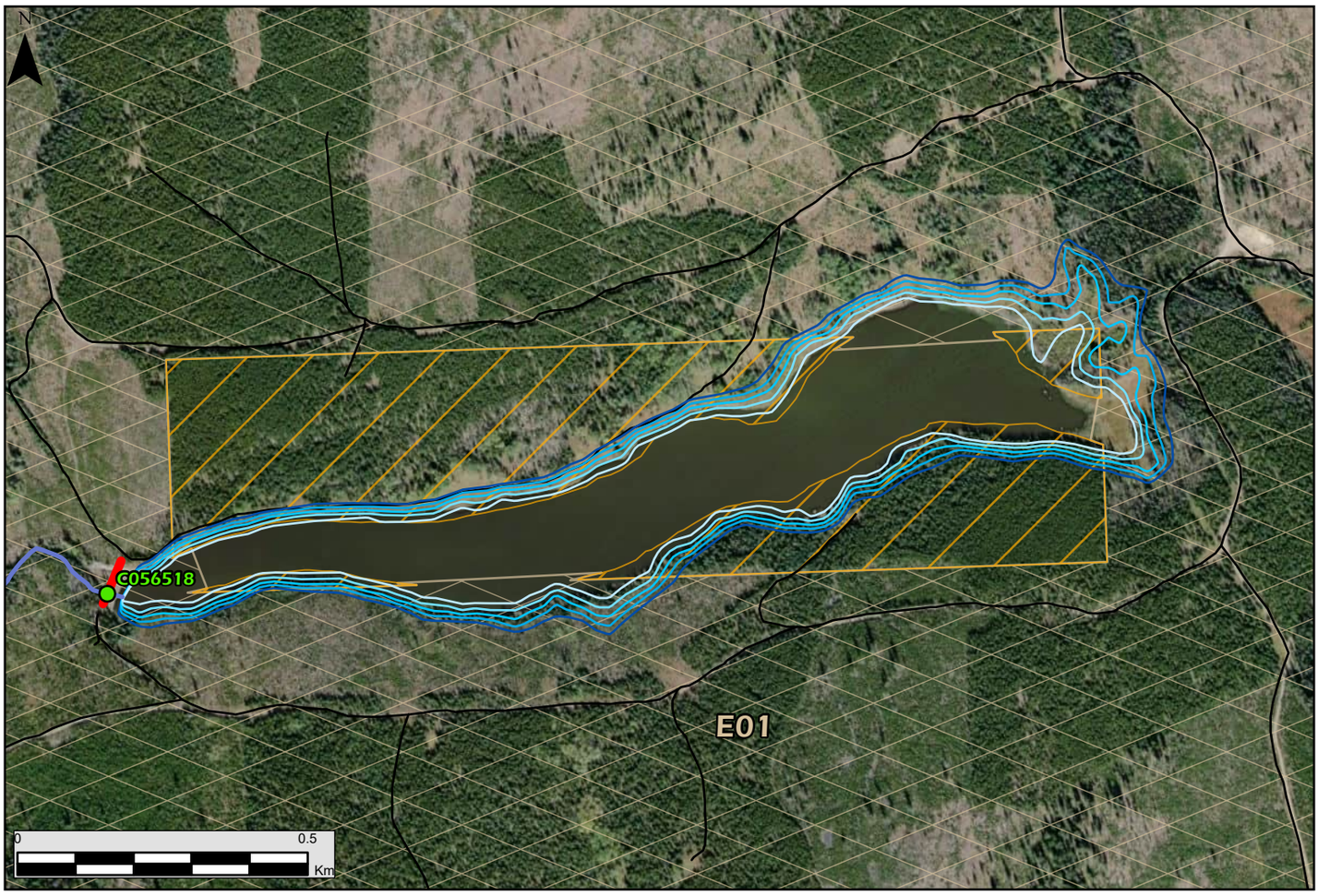
Kirby Lake



Tributary To: **Clapperton Creek**
Distance to Closest WSC Gauge: **42.3 km**
Reference Gauge: **08LG006**
Number of PODs to the Gauge: **43**
Total Allocated Annual Volume to the Gauge: **20.44 Mm^3**

Contributing Watershed Area: **15.02 km^2**
Distance from Road (est.): **0 m**
Land Ownership (crown/private/reserve): **Crown / Private**
Infrastructure Flooded: **Road**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **12.83**
Salmonids Present (Y/N): **N**

Existing Dam: **Y**
Existing Dam Height / Crest (m): **7.2 / 61**
Existing Dam Risk Rating: **4**
Existing Dam Consequence Rating: **Significant**
Existing Storage License: **Y**

Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **30 - 90 m**
Proposed Additional Storage min/max (Mm^3): **0.24 / 1.73**
Proposed Dam Cost Range $/m^3: **13.8 - 5.2**
Potential Evapotranspiration (Mm^3): **0.12 - 0.17**

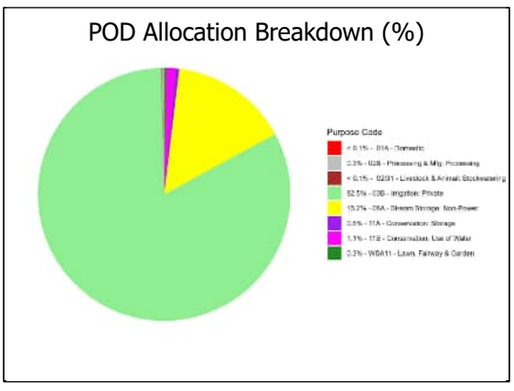
Flow augmentation (min - max): **0.02 - 0.30 m^3/s**
(storage volume / (60*24*60*60)

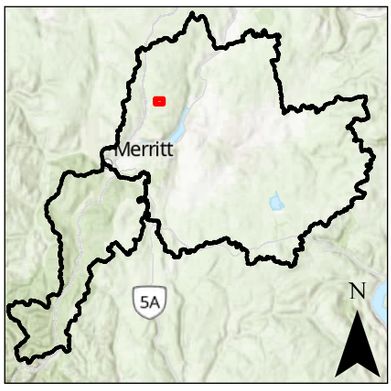
Water Rights License (POD)
- Active
- Existing Dam
- Proposed Dam Location
- Existing Road (mapped)

- Range Tenures*
- Parcel Fabric

Proposed Dam Height Pool
- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023





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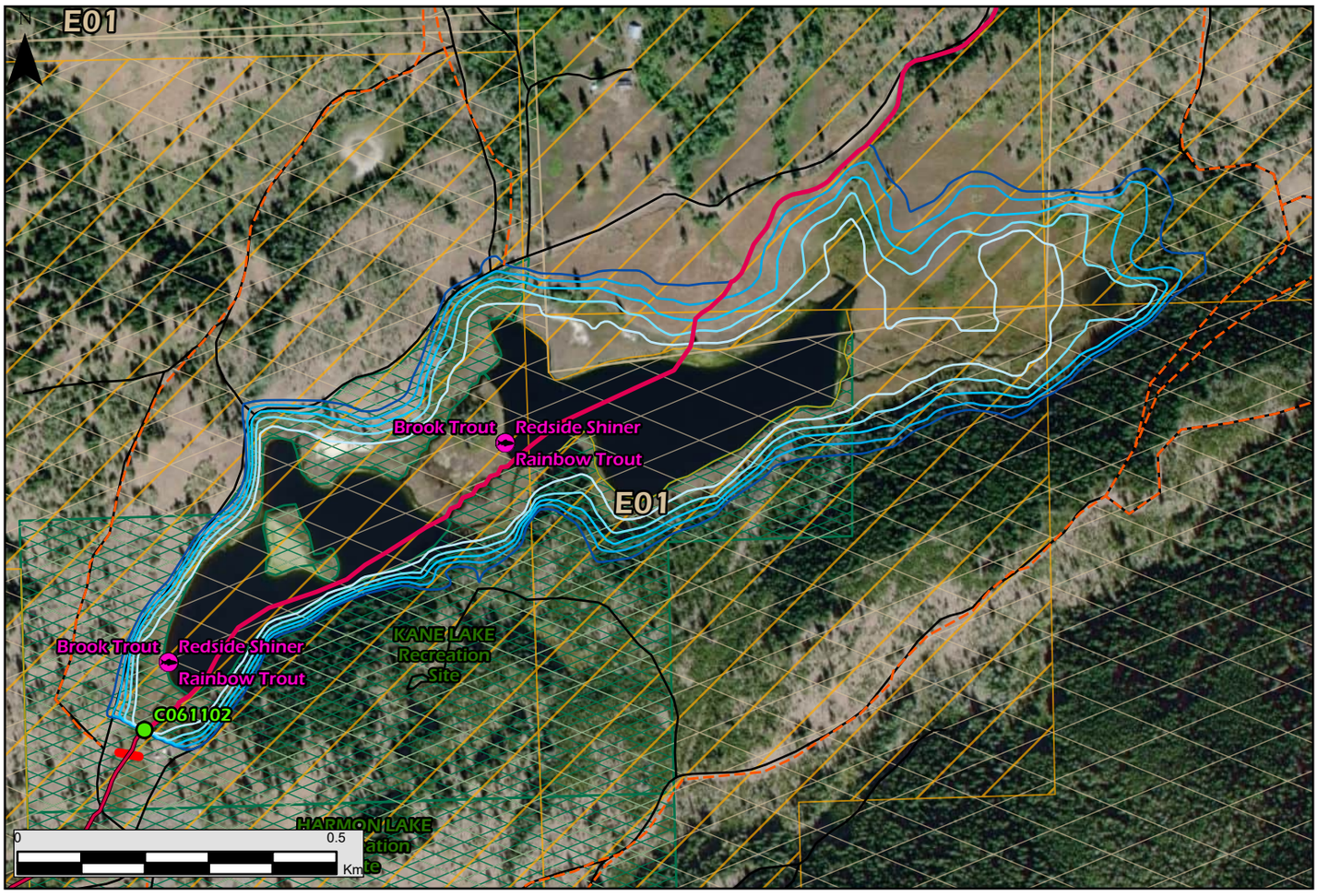
Lower Kane



Tributary To: **Coldwater River**
Distance to Closest WSC Gauge: **62.7 km**
Reference Gauge: **08LG010**
Number of PODs to the Gauge: **80**
Total Allocated Annual Volume to the Gauge: **14.48 Mm^3**

Contributing Watershed Area: **22.36 km^2**
Distance from Road (est.): **0 m**
Land Ownership (crown/private/reserve): **Private / Crown**
Infrastructure Flooded: **Rec Site, Road**
Surrounding Properties: **Y**

Average August Temperature - Historical* (°C): **13.42**
Salmonids Present (Y/N): **Y**

Existing Dam: **Y**
Existing Dam Height / Crest (m): **1.3 / 40**
Existing Dam Risk Rating: **5**
Existing Dam Consequence Rating: **Low**
Existing Storage License: **Y**

Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **50 - 145 m**
Proposed Additional Storage min/max (Mm^3): **0.25 / 2.18**
Proposed Dam Cost Range $/m^3: **15.0 - 4.5**
Potential Evapotranspiration (Mm^3): **0.13 - 0.23**

Flow augmentation (min - max): **0.02 - 0.38 m^3/s**
(storage volume / (60*24*60*60)

- Fish Observations

Water Rights License (POD)

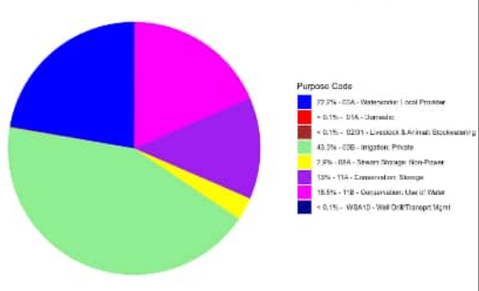
- Active
- Proposed Dam Location
- Existing Road (mapped)
- Recreation Trail
- Range Tenures*
- Parcel Fabric
- Recreation Site

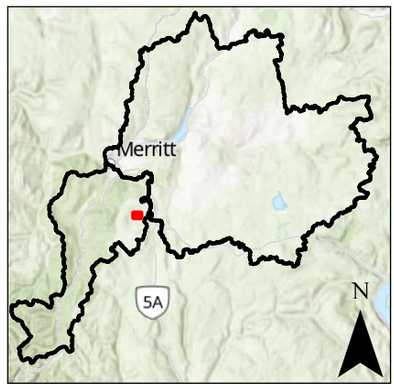
Proposed Dam Height Pool

- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023

POD Allocation Breakdown (%)





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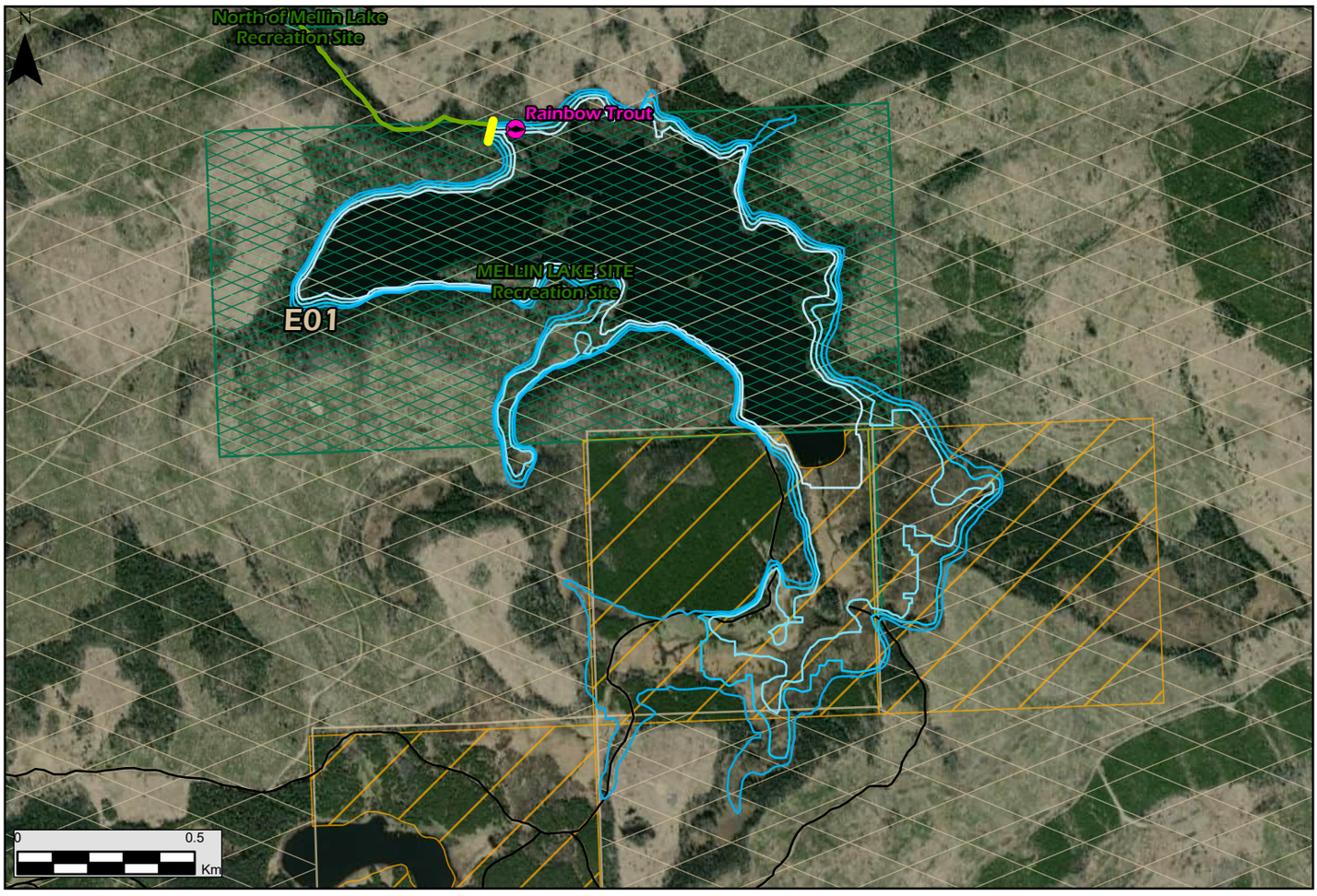
Mellin Lake



Tributary To: **Upper Nicola**
Distance to Closest WSC Gauge: **32.5 km**
Reference Gauge: **08LG028**
Number of PODs to the Gauge: **14**
Total Allocated Annual Volume to the Gauge: **4.12 Mm^3**

Contributing Watershed Area: **12.01 km^2**
Distance from Road (est.): **1150 m**
Land Ownership (crown/private/reserve): **Crown / Private**
Infrastructure Flooded: **Rec Site, Road**
Surrounding Properties: **Y**

Average August Temperature - Historical* (°C): **12.69**
Salmonids Present (Y/N): **Y**

Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating: **na**
Existing Dam Consequence Rating: **na**
Existing Storage License: **N**

Proposed Dam Heights: **1 - 4 m**
Proposed Dam Length: **20 - 65 m**
Proposed Additional Storage min/max (Mm^3): **0.56 / 3.69**
Proposed Dam Cost Range $/m^3: **5.6 - 0.0**
Potential Evapotranspiration (Mm^3): **0.26 - 0.43**

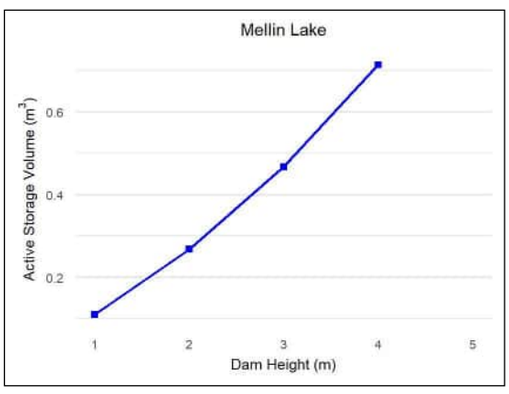
Flow augmentation (min - max): **0.06 - 0.00 m^3/s**
(storage volume / (60*24*60*60)

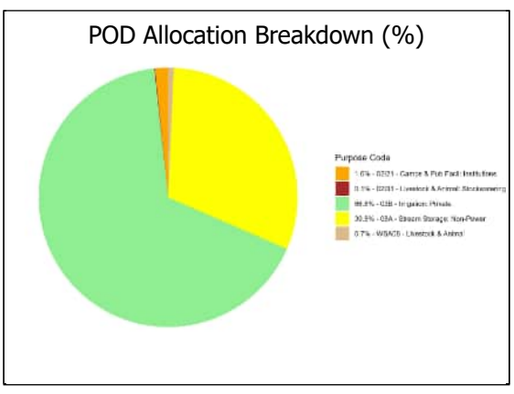
- Fish Observations
- Proposed Dam Location
- Existing Road (mapped)
- Range Tenures*
- Parcel Fabric
- Recreation Site

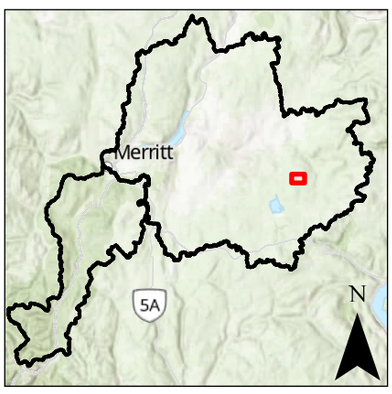
Proposed Dam Height Pool

- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







Prepared For:

Nicola Watershed Governance Partnership

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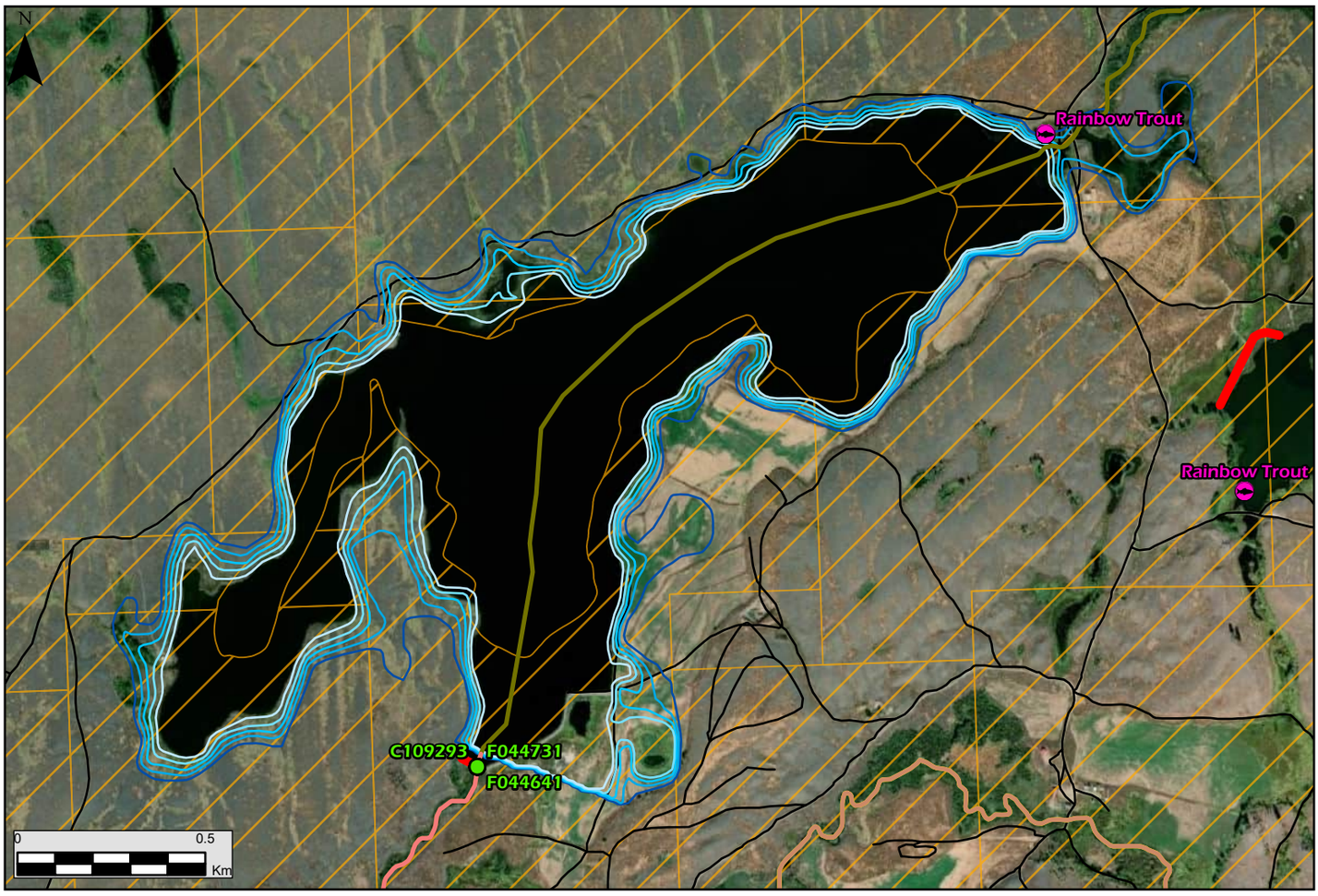
Minnie Lake



Tributary To: **Quilchena Creek**
Distance to Closest WSC Gauge: **49.2 km**
Reference Gauge: **08LG017**
Number of PODs to the Gauge: **49**
Total Allocated Annual Volume to the Gauge: **12.66 Mm^3**

Contributing Watershed Area: **134.03 km^2**
Distance from Road (est.): **250 m**
Land Ownership (crown/private/reserve): **Private**
Infrastructure Flooded: **Road**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **15.25**
Salmonids Present (Y/N): **Y**

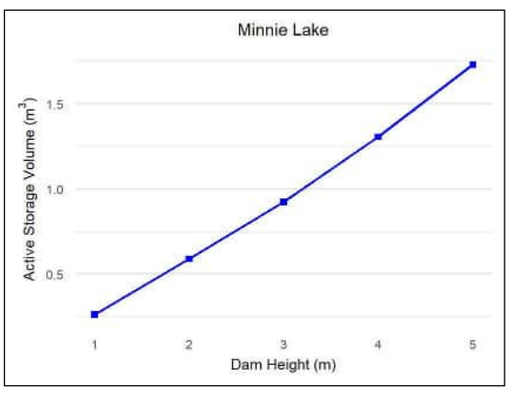
Existing Dam: **Y**
Existing Dam Height / Crest (m): **3.8 / 510**
Existing Dam Risk Rating: **4**
Existing Dam Consequence Rating: **High**
Existing Storage License: **Y**

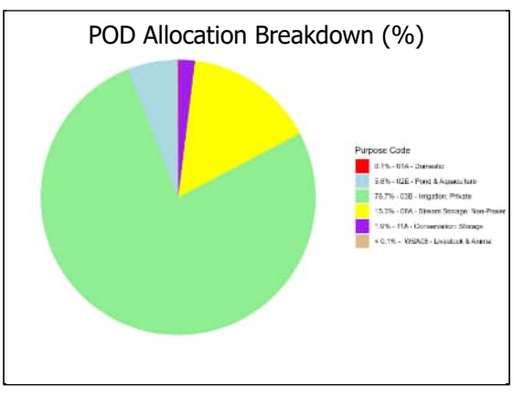
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **360 - 470 m**
Proposed Additional Storage min/max (Mm^3): **1.34 / 8.95**
Proposed Dam Cost Range $/m^3: **3.9 - 1.4**
Potential Evapotranspiration (Mm^3): **0.72 - 0.96**

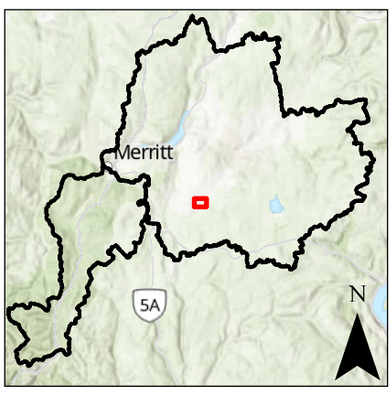
Flow augmentation (min - max): **0.12 - 1.54 m^3/s**
(storage volume / (60*24*60*60)

- Fish Observations
- Water Rights License (POD)
  - Active
  - Existing Dam
  - Proposed Dam Location
- Existing Road (mapped)
- Range Tenures*
- Parcel Fabric
- Proposed Dam Height Pool
  - 1m
  - 2m
  - 3m
  - 4m
  - 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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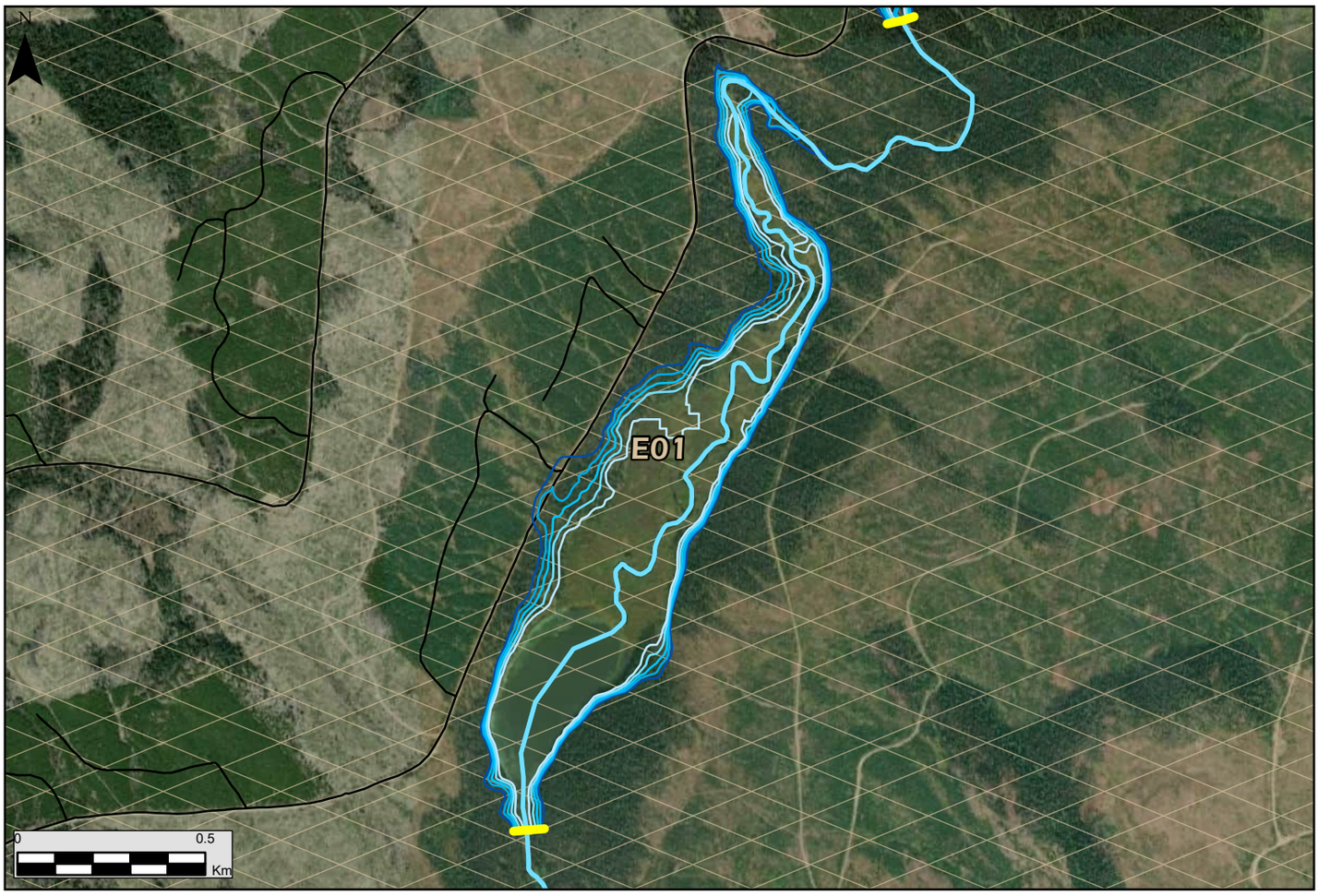
Old Dave Lake



Tributary To: **Upper Nicola**
Distance to Closest WSC Gauge: **52 km**
Reference Gauge: **08LG028**
Number of PODs to the Gauge: **13**
Total Allocated Annual Volume to the Gauge: **2.85 Mm^3**

Contributing Watershed Area: **79.81 km^2**
Distance from Road (est.): **380 m**
Land Ownership (crown/private/reserve): **Crown**
Infrastructure Flooded: **Road**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **12.51**
Salmonids Present (Y/N): **Y**

Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating: **na**
Existing Dam Consequence Rating: **na**
Existing Storage License: **N**

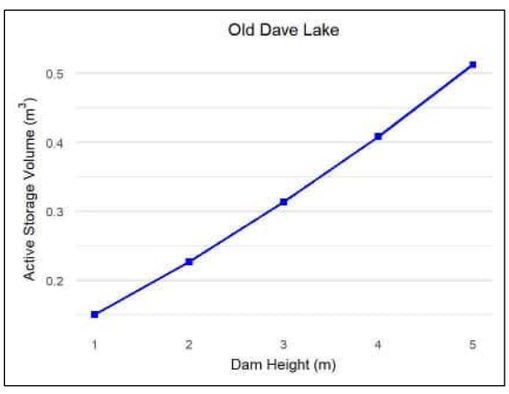
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **30 - 80 m**
Proposed Additional Storage min/max (Mm^3): **0.56 / 2.45**
Proposed Dam Cost Range $/m^3: **5.8 - 3.6**
Potential Evapotranspiration (Mm^3): **0.27 - 0.23**

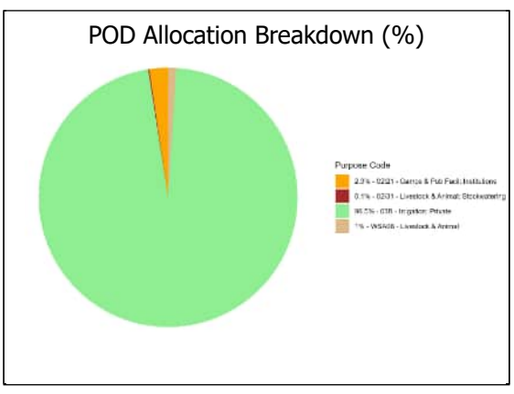
Flow augmentation (min - max): **0.06 - 0.43 m^3/s**
(storage volume / (60*24*60*60)

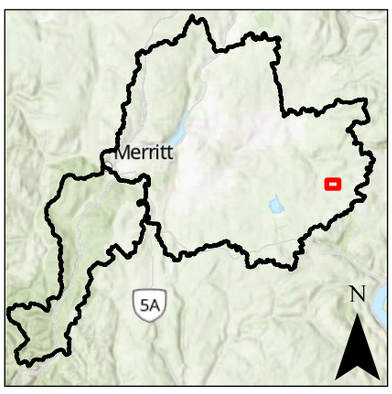
Proposed Dam Location
Existing Road (mapped)
Range Tenures*

Proposed Dam Height Pool
1m
2m
3m
4m
5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







Prepared For:

Nicola Watershed GOVERNANCE PARTNERSHIP

Prepared By:

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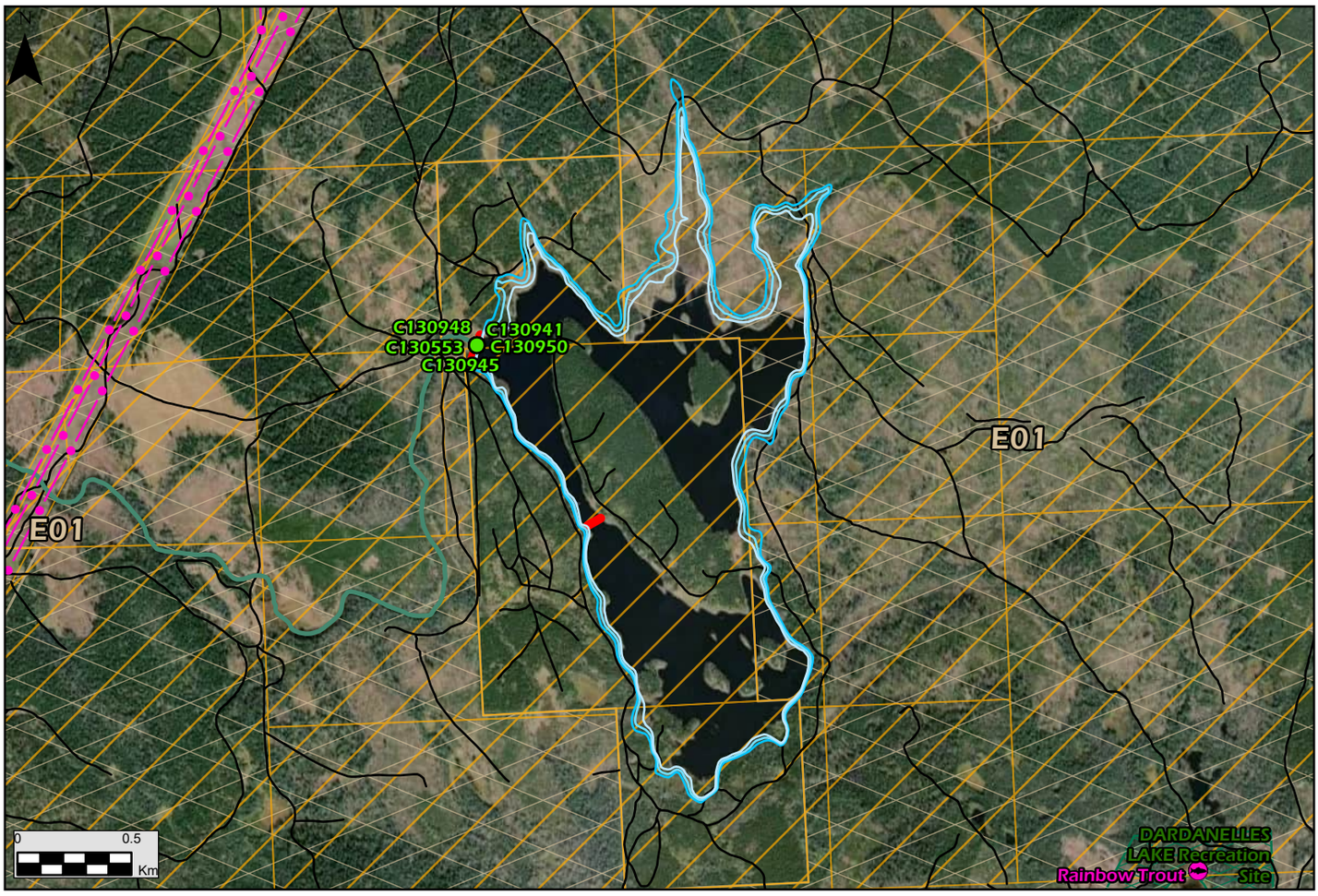
Palmer Lake



Tributary To: **Nicola River**
Distance to Closest WSC Gauge: **57.6 km**
Reference Gauge: **08LG065**
Number of PODs to the Gauge: **46**
Total Allocated Annual Volume to the Gauge: **154.34 Mm^3**

Contributing Watershed Area: **40.49 km^2**
Distance from Road (est.): **50 m**
Land Ownership (crown/private/reserve): **Private**
Infrastructure Flooded: **Road**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **14.44**
Salmonids Present (Y/N): **N**

Existing Dam: **Y (2)**
Existing Dam Height / Crest (m): **5.5 / ***
Existing Dam Risk Rating: **na / 4**
Existing Dam Consequence Rating: **na / Significant**
Existing Storage License: **Y**

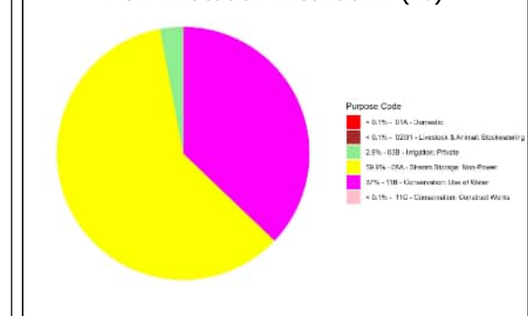
Proposed Dam Heights: **1 - 3 m**
Proposed Dam Length: **155 - 415 m**
Proposed Additional Storage min/max (Mm^3): **1.31 / 4.82**
Proposed Dam Cost Range $/m^3: **3.3 - 0.0**
Potential Evapotranspiration (Mm^3): **0.68 - 0.83**

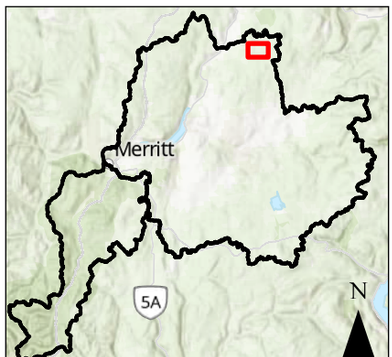
Flow augmentation (min - max): **0.12 - 0.00 m^3/s**
(storage volume / (60*24*60*60)

- Fish Observations
- Water Rights License (POD)
  - Active
  - Existing Dam
  - Proposed Dam Location
  - BC Hydro Transmission Line
- Existing Road (mapped)
- Range Tenures*
- Parcel Fabric
- Recreation Site
- Proposed Dam Height Pool
  - 1m
  - 2m
  - 3m
  - 4m
  - 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023

POD Allocation Breakdown (%)





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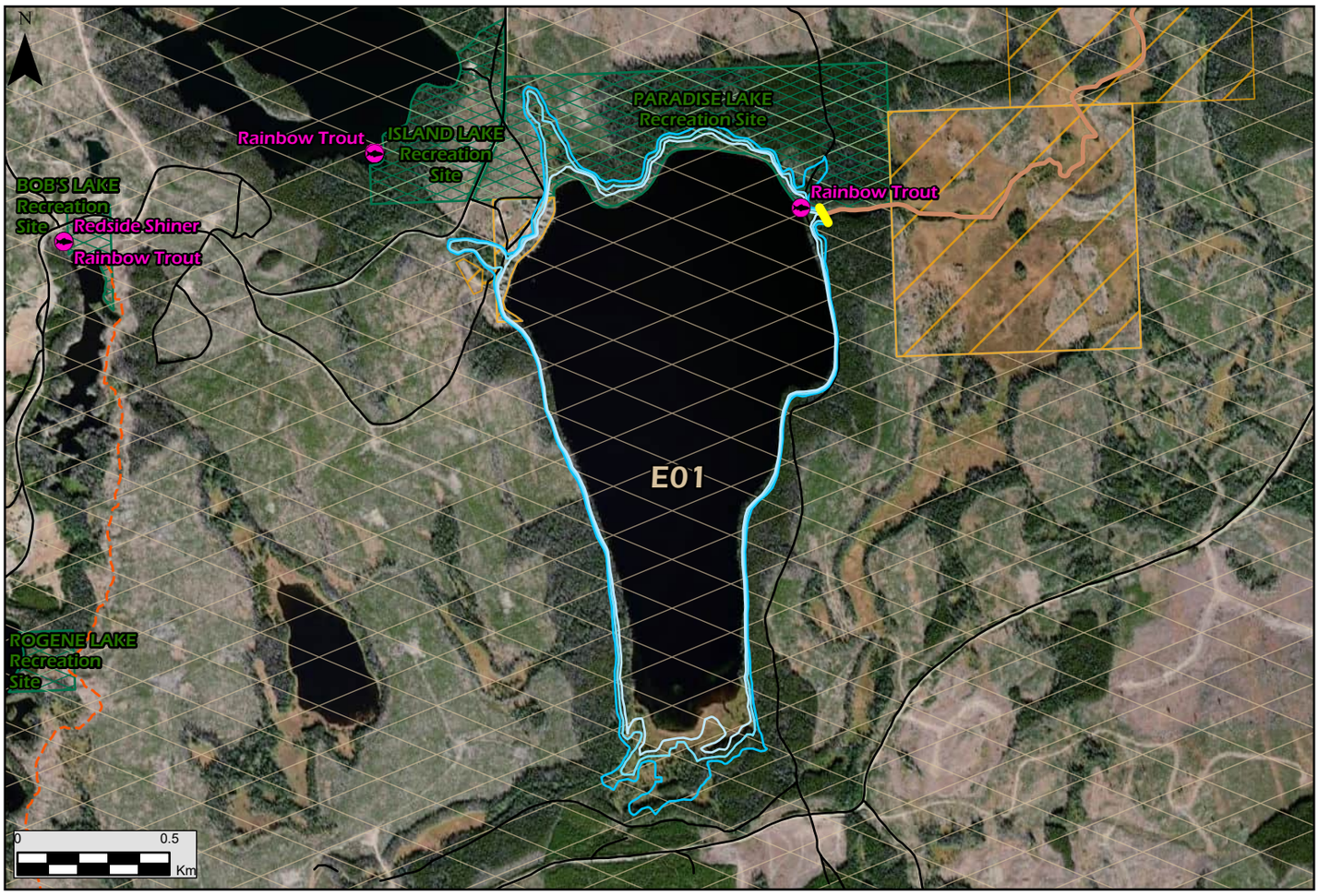
Paradise Lake



Tributary To: **Quilchena Creek**
Distance to Closest WSC Gauge: **96.5 km**
Reference Gauge: **08LG017**
Number of PODs to the Gauge: **60**
Total Allocated Annual Volume to the Gauge: **16.56 Mm^3**

Contributing Watershed Area: **25.49 km^2**
Distance from Road (est.): **10 m**
Land Ownership (crown/private/reserve): **Crown / Private**
Infrastructure Flooded: **Rec Site, Road**
Surrounding Properties: **Y**

Average August Temperature - Historical* (°C): **13.05**
Salmonids Present (Y/N): **Y**

Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating: **na**
Existing Dam Consequence Rating: **na**
Existing Storage License: **N**

Proposed Dam Heights: **1 - 4 m**
Proposed Dam Length: **40 - 90 m**
Proposed Additional Storage min/max (Mm^3): **1.29 / 5.61**
Proposed Dam Cost Range $/m^3: **2.5 - 0.0**
Potential Evapotranspiration (Mm^3): **0.58 - 0.63**

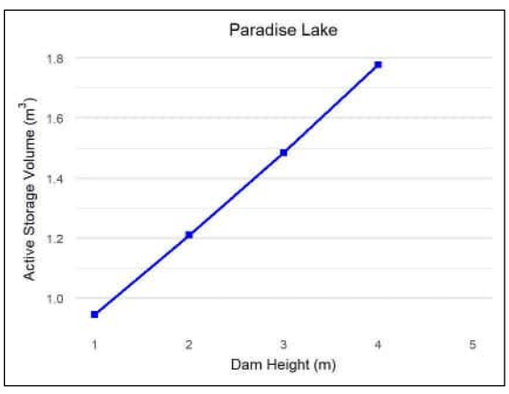
Flow augmentation (min - max): **0.14 - 0.00 m^3/s**
(storage volume / (60*24*60*60)

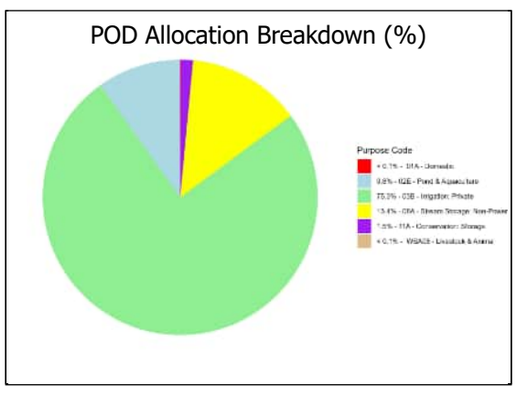
- Fish Observations
- Proposed Dam Location
- Existing Road (mapped)
- Recreation Trail
- Range Tenures*
- Parcel Fabric
- Recreation Site

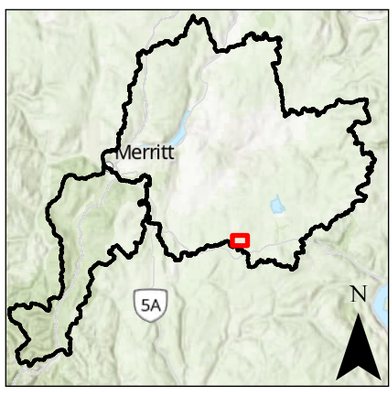
Proposed Dam Height Pool

- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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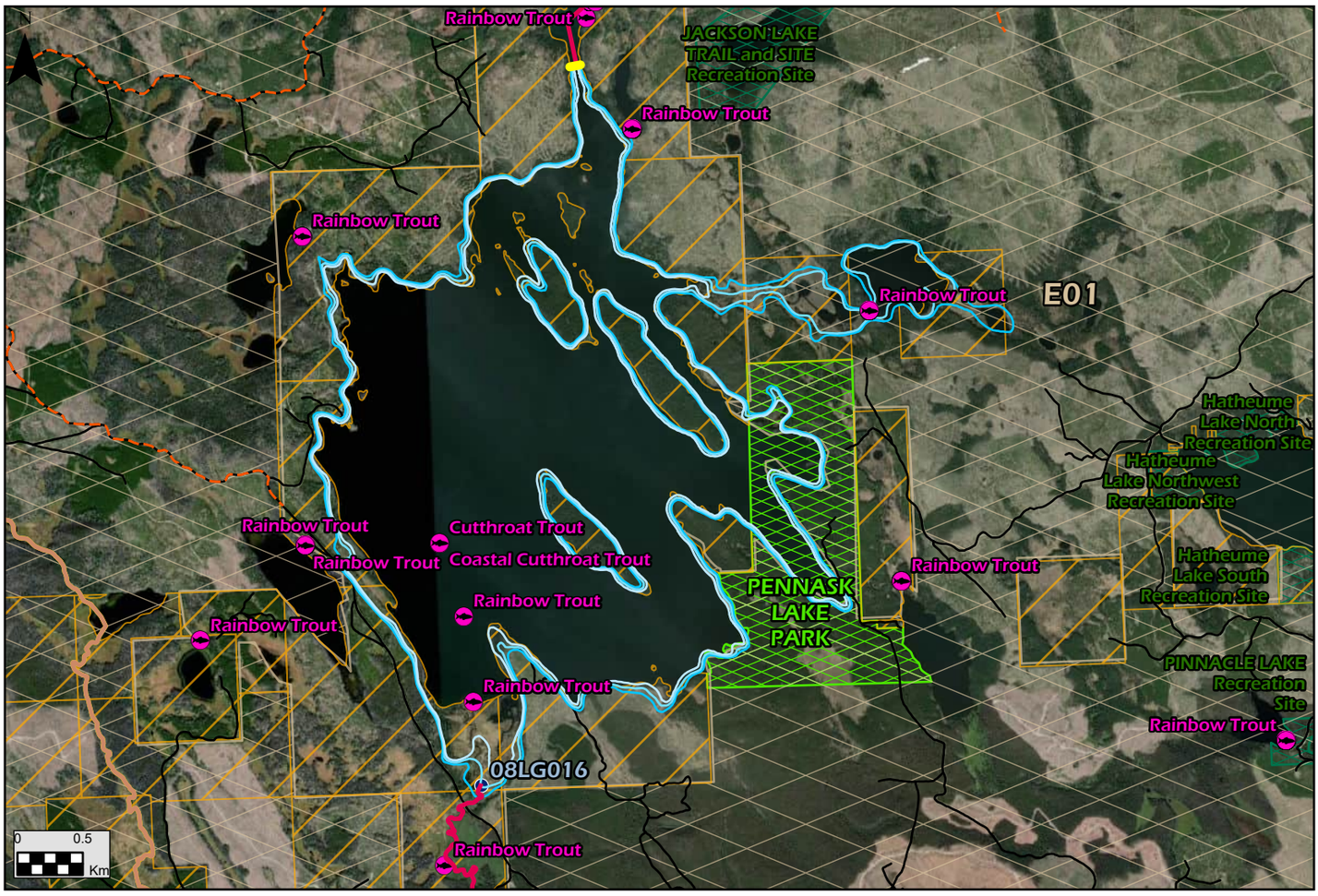
Pennask Dam A



Tributary To: **Quilchena Creek**
Distance to Closest WSC Gauge: **28 km**
Reference Gauge: **08LG017**
Number of PODs to the Gauge: **40**
Total Allocated Annual Volume to the Gauge: **79.76 Mm^3**

Contributing Watershed Area: **121.61 km^2**
Distance from Road (est.): **655 m**
Land Ownership (crown/private/reserve): **Private / Crown**
Infrastructure Flooded: **Prov Park, Rec Site, Road**
Surrounding Properties: **Y**

Average August Temperature - Historical* (°C): **13.6**
Salmonids Present (Y/N): **Y**

Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating: **na**
Existing Dam Consequence Rating: **na**
Existing Storage License: **N**

Proposed Dam Heights: **1 - 3 m**
Proposed Dam Length: **40 - 90 m**
Proposed Additional Storage min/max (Mm^3): **7.6 / 28.97**
Proposed Dam Cost Range $/m^3: **0.4 - 0.0**
Potential Evapotranspiration (Mm^3): **3.55 - 4.52**

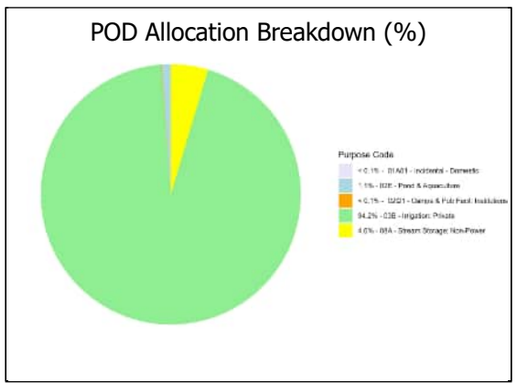
Flow augmentation (min - max): **0.78 - 0.00 m^3/s**
(storage volume / (60*24*60*60)

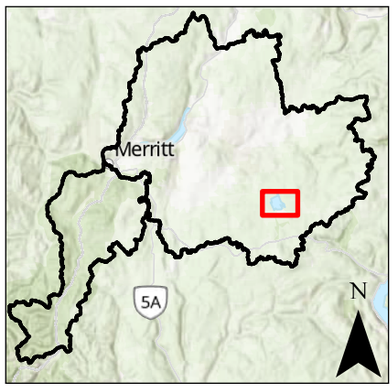
- Fish Observations
- WSC Gauge
- Proposed Dam Location
- Existing Road (mapped)
- Recreation Trail
- Range Tenures*
- Parcel Fabric
- Recreation Site
- Povincial Park

Proposed Dam Height Pool

- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023





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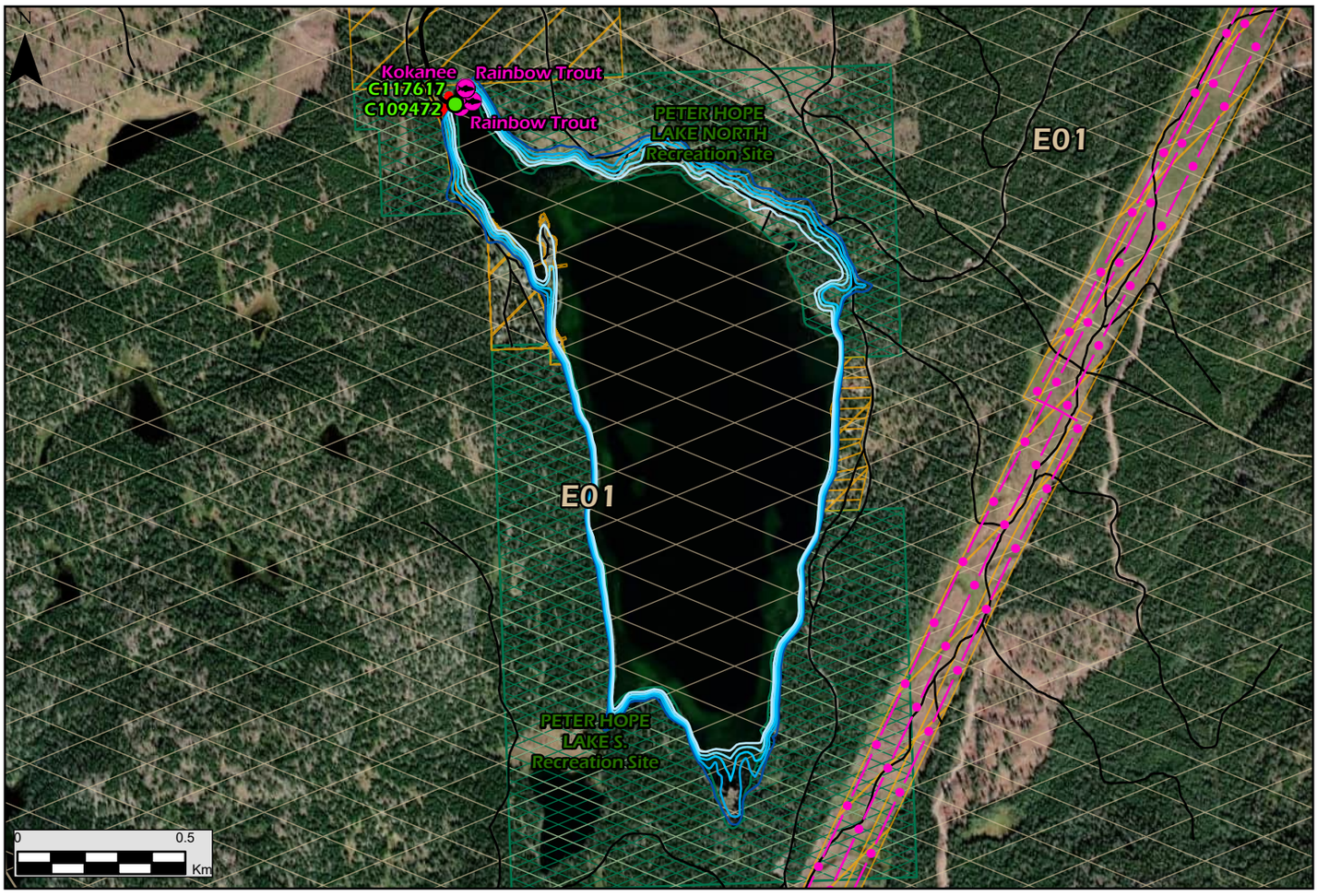
Peter Hope Lake



Tributary To: **Nicola River**
Distance to Closest WSC Gauge: **39.4 km**
Reference Gauge: **08LG065**
Number of PODs to the Gauge: **17**
Total Allocated Annual Volume to the Gauge: **148.34 Mm^3**

Contributing Watershed Area: **30.79 km^2**
Distance from Road (est.): **0 m**
Land Ownership (crown/private/reserve): **Crown / Private**
Infrastructure Flooded: **Rec Site, Road**
Surrounding Properties: **Y**

Average August Temperature - Historical* (°C): **14.42**
Salmonids Present (Y/N): **Y**

Existing Dam: **Y**
Existing Dam Height / Crest (m): **3.8 / 79**
Existing Dam Risk Rating: **4**
Existing Dam Consequence Rating: **High**
Existing Storage License: **Y**

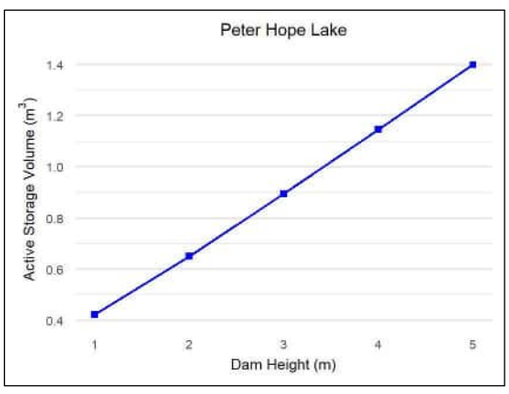
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **65 - 170 m**
Proposed Additional Storage min/max (Mm^3): **2.19 / 7.25**
Proposed Dam Cost Range $/m^3: **1.8 - 1.4**
Potential Evapotranspiration (Mm^3): **1.17 - 0.78**

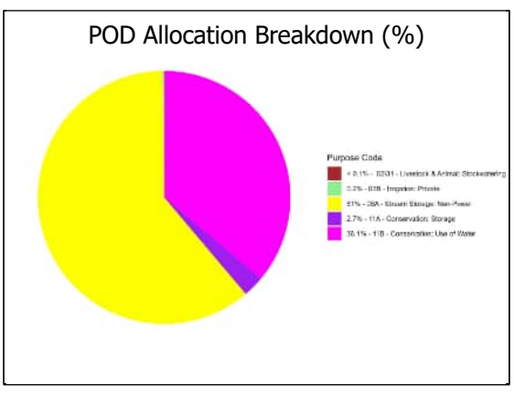
Flow augmentation (min - max): **0.20 - 1.25 m^3/s**
(storage volume / (60*24*60*60)

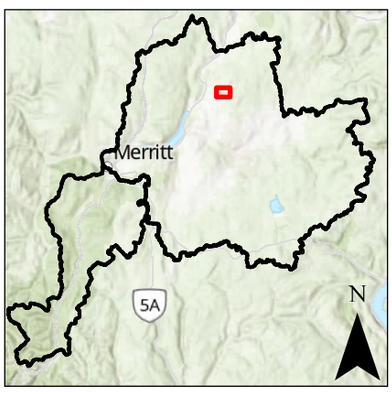
- Fish Observations
- Water Rights License (POD)
  - Active
- Existing Dam
- Proposed Dam Location
- BC Hydro Transmission Line
- Existing Road (mapped)
- Range Tenures*
- Parcel Fabric
- Recreation Site

Proposed Dam Height Pool
- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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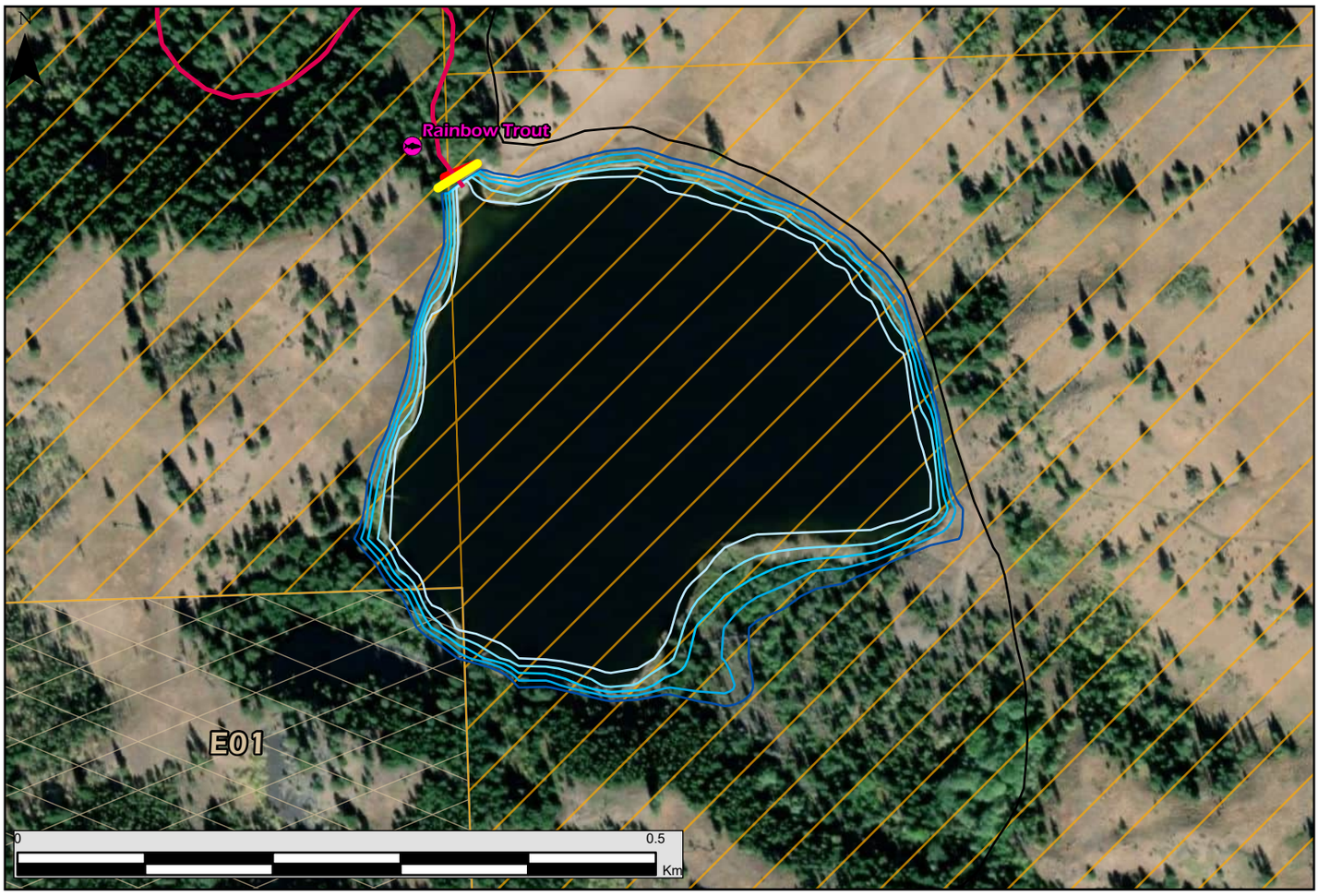
Pothole Lake



Tributary To: **Quilchena Creek**
Distance to Closest WSC Gauge: **35 km**
Reference Gauge: **08LG017**
Number of PODs to the Gauge: **43**
Total Allocated Annual Volume to the Gauge: **9.388365 Mm^3**

Contributing Watershed Area: **101.04 km^2**
Distance from Road (est.): **0 m**
Land Ownership (crown/private/reserve): **Private / Crown**
Infrastructure Flooded: **Road**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **13.04**
Salmonids Present (Y/N): **Y**

Existing Dam: **Y**
Existing Dam Height / Crest (m): **3.2 / 22**
Existing Dam Risk Rating: **4**
Existing Dam Consequence Rating: **Significant**
Existing Storage License: **N**

Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **45 - 100 m**
Proposed Additional Storage min/max (Mm^3): **0.11 / 0.63**
Proposed Dam Cost Range $/m^3: **38.7 - 14.6**
Potential Evapotranspiration (Mm^3): **0.06 - 0.07**

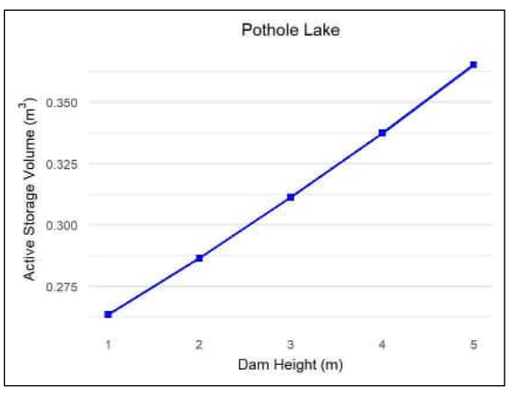
Flow augmentation (min - max): **0.01 - 0.11 m^3/s**
(storage volume / (60*24*60*60)

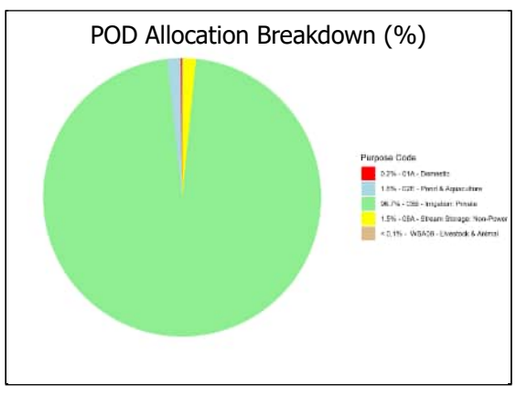
- Fish Observations
- Existing Dam
- Proposed Dam Location
- Existing Road (mapped)
- Range Tenures*
- Parcel Fabric

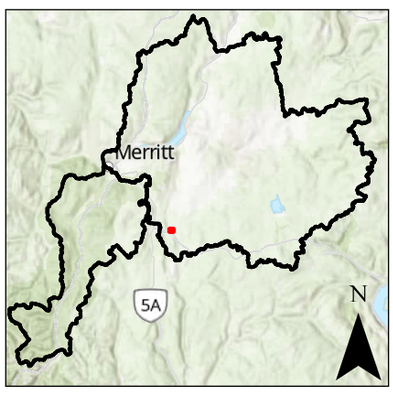
Proposed Dam Height Pool

- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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Nicola Watershed GOVERNANCE PARTNERSHIP

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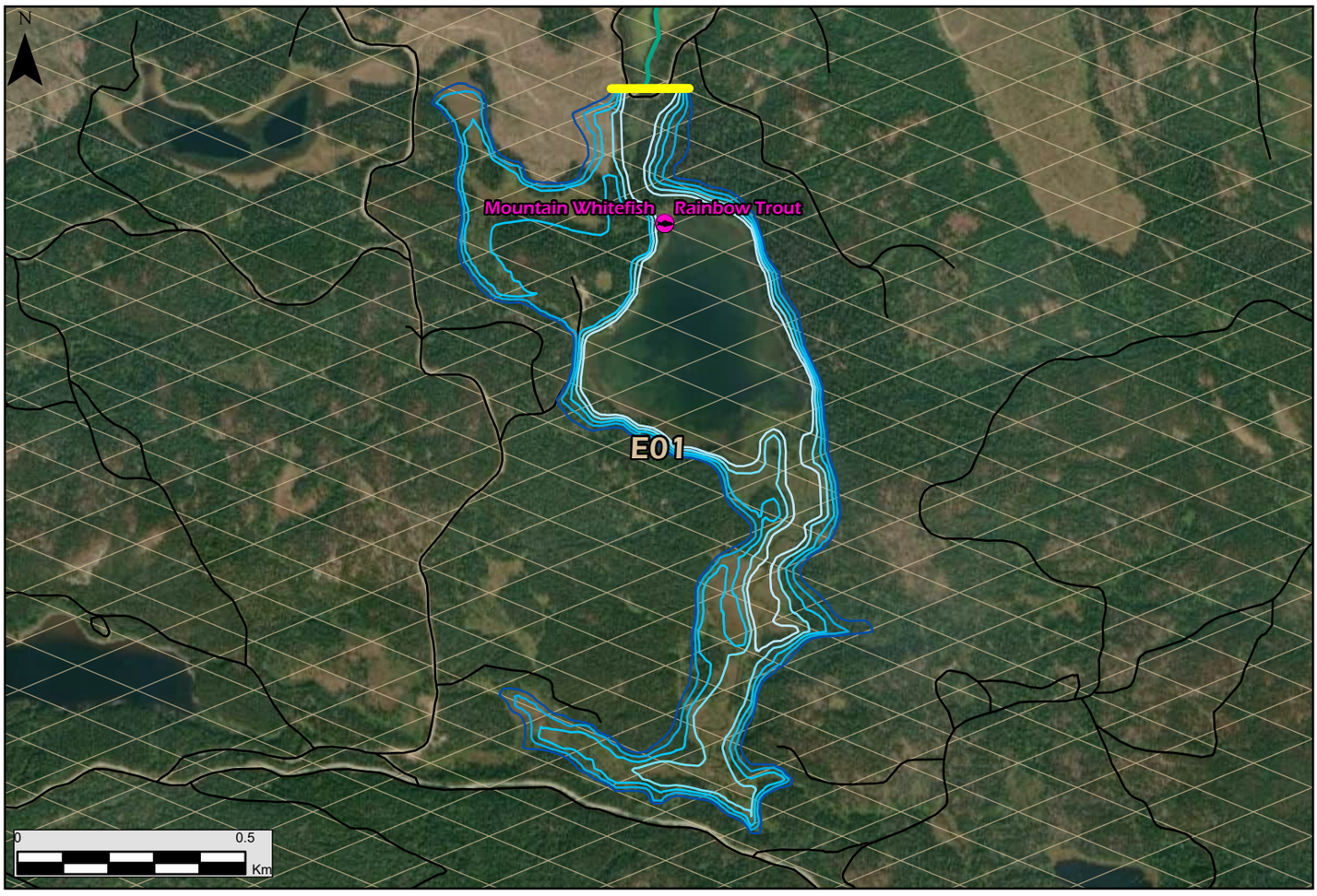
Raymer Lake



Tributary To: **Upper Nicola**
Distance to Closest WSC Gauge: **53.7 km**
Reference Gauge: **08LG028**
Number of PODs to the Gauge: **13**
Total Allocated Annual Volume to the Gauge: **2.85 Mm^3**

Contributing Watershed Area: **11.31 km^2**
Distance from Road (est.): **130 m**
Land Ownership (crown/private/reserve): **Crown**
Infrastructure Flooded: **Road**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **12.41**
Salmonids Present (Y/N): **Y**

Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating: **na**
Existing Dam Consequence Rating: **na**
Existing Storage License: **N**

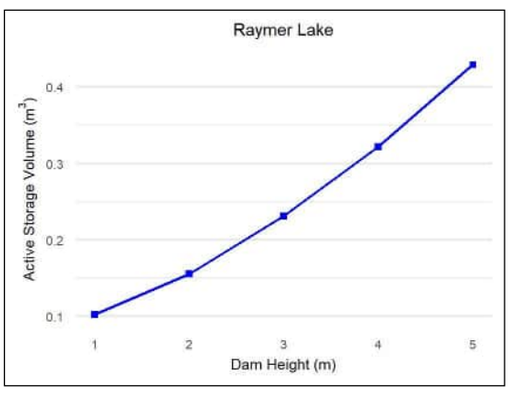
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **100 - 160 m**
Proposed Additional Storage min/max (Mm^3): **0.24 / 1.94**
Proposed Dam Cost Range $/m^3: **14.8 - 5.0**
Potential Evapotranspiration (Mm^3): **0.11 - 0.18**

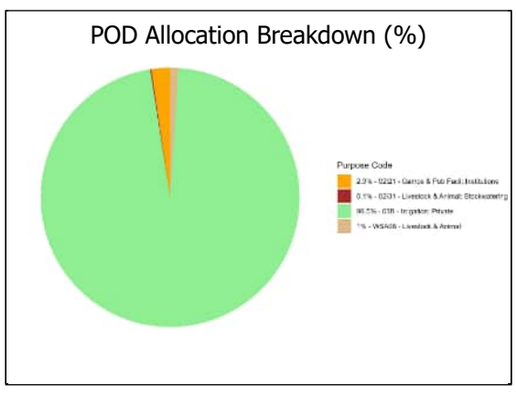
Flow augmentation (min - max): **0.03 - 0.34 m^3/s**
(storage volume / (60*24*60*60)

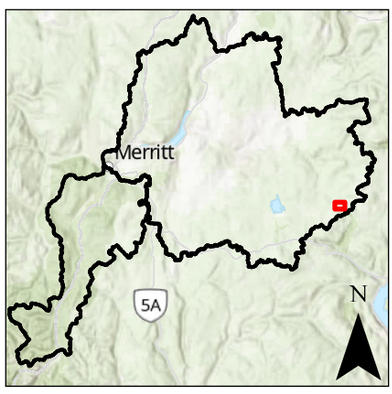
- Fish Observations
- Proposed Dam Location
- Existing Road (mapped)
- Range Tenures*

Proposed Dam Height Pool
- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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Nicola Watershed Governance Partnership

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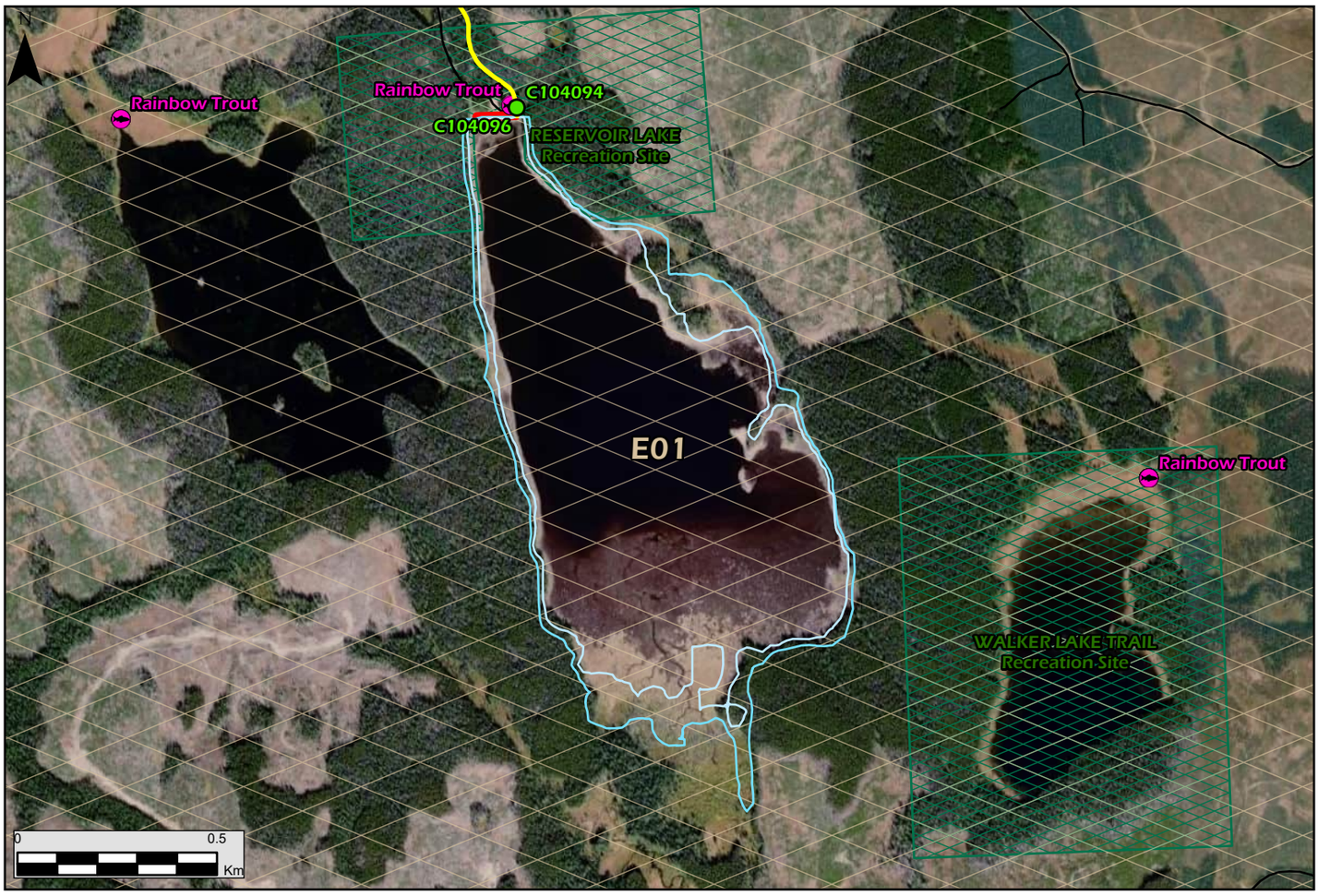
Reservoir Lake



Tributary To: **Quilchena Creek**
Distance to Closest WSC Gauge: **91.8 km**
Reference Gauge: **08LG017**
Number of PODs to the Gauge: **62**
Total Allocated Annual Volume to the Gauge: **17.42 Mm^3**

Contributing Watershed Area: **20.56 km^2**
Distance from Road (est.): **10 m**
Land Ownership (crown/private/reserve): **Crown**
Infrastructure Flooded: **Rec Site**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **11.94**
Salmonids Present (Y/N): **Y**

Existing Dam: **Y**
Existing Dam Height / Crest (m): **4.5 / 45**
Existing Dam Risk Rating: **4**
Existing Dam Consequence Rating: **Significant**
Existing Storage License: **Y**

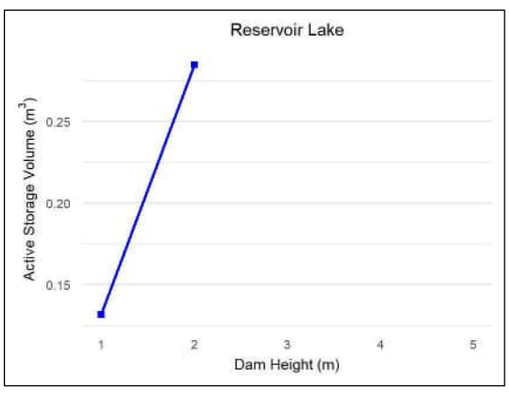
Proposed Dam Heights: **1 - 2 m**
Proposed Dam Length: **135 - 155 m**
Proposed Additional Storage min/max (Mm^3): **0.68 / 1.48**
Proposed Dam Cost Range $/m^3: **5.3 - 0.0**
Potential Evapotranspiration (Mm^3): **0.30 - 0.33**

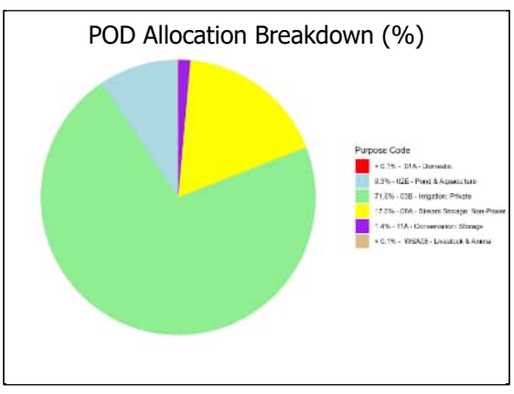
Flow augmentation (min - max): **0.07 - 0.00 m^3/s**
(storage volume / (60*24*60*60)

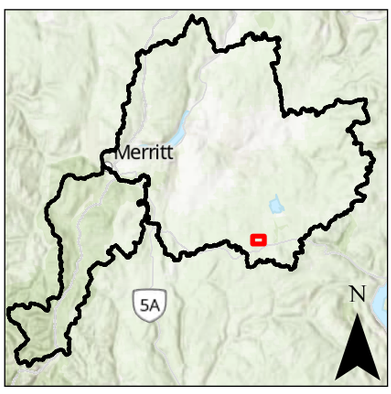
- Fish Observations
- Water Rights License (POD)
  - Active
  - Existing Dam
  - Proposed Dam Location
- Existing Road (mapped)
- Range Tenures*
- Recreation Site

Proposed Dam Height Pool
- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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Nicola Watershed GOVERNANCE PARTNERSHIP

Prepared By:

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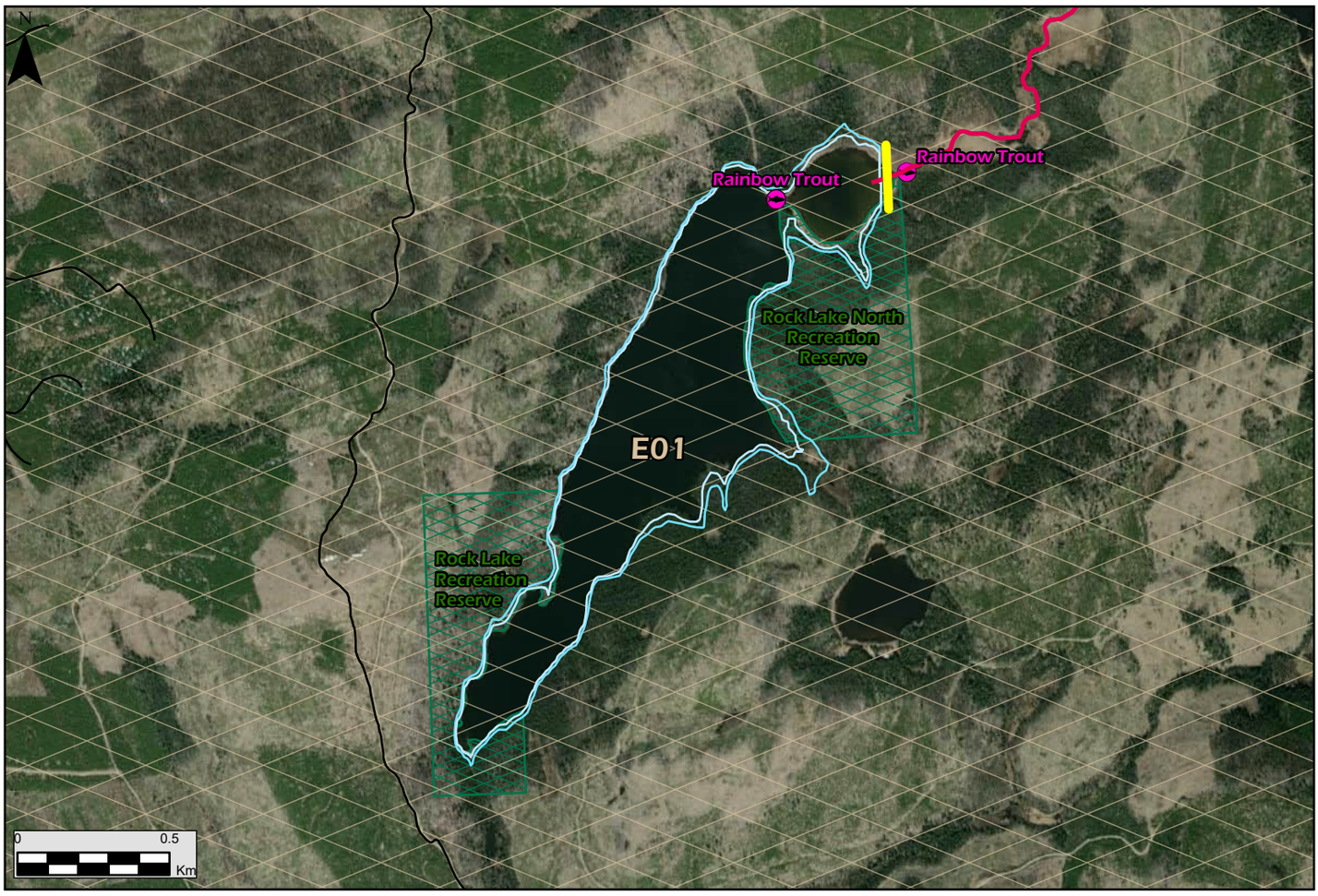
Rock Lake



Tributary To: **Upper Nicola**
Distance to Closest WSC Gauge: **53.2 km**
Reference Gauge: **08LG028**
Number of PODs to the Gauge: **12**
Total Allocated Annual Volume to the Gauge: **2.223664 Mm^3**

Contributing Watershed Area: **4.89 km^2**
Distance from Road (est.): **1579 m**
Land Ownership (crown/private/reserve): **Crown**
Infrastructure Flooded: **Rec Site**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **12.54**
Salmonids Present (Y/N): **Y**

Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating:
Existing Dam Consequence Rating:
Existing Storage License: **N**

Proposed Dam Heights: **1 - 2 m**
Proposed Dam Length: **180 - 240 m**
Proposed Additional Storage min/max (Mm^3): **0.64 / 1.45**
Proposed Dam Cost Range $/$m^3$: **6.1 - 0.0**
Potential Evapotranspiration (Mm^3): **0.29 - 0.34**

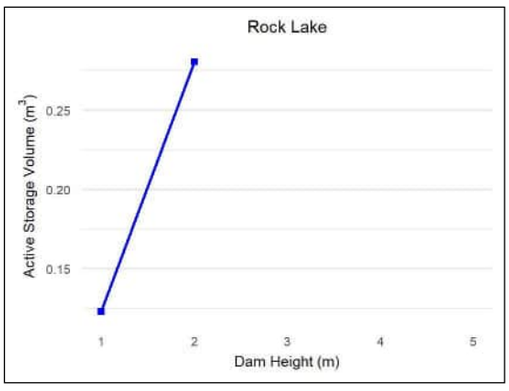
Flow augmentation (min - max): **0.07 - 0.00 m^3/s**
(storage volume / (60*24*60*60)

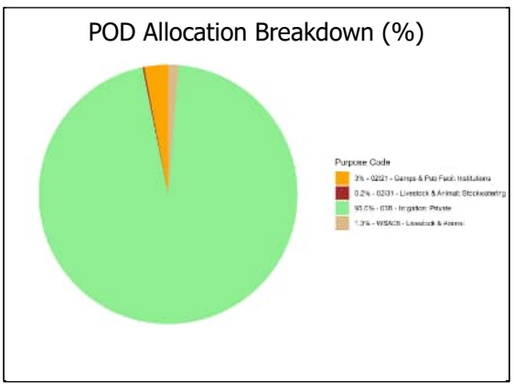
- Fish Observations
- Proposed Dam Location
- Existing Road (mapped)
- Range Tenures*
- Recreation Site

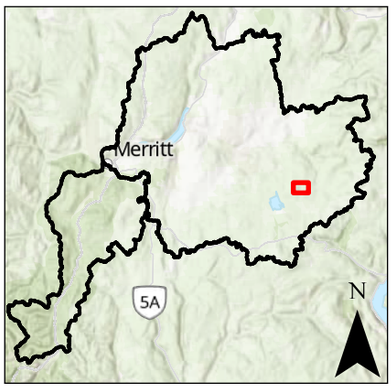
Proposed Dam Height Pool

- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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Nicola Watershed GOVERNANCE PARTNERSHIP

Prepared By:

BGC

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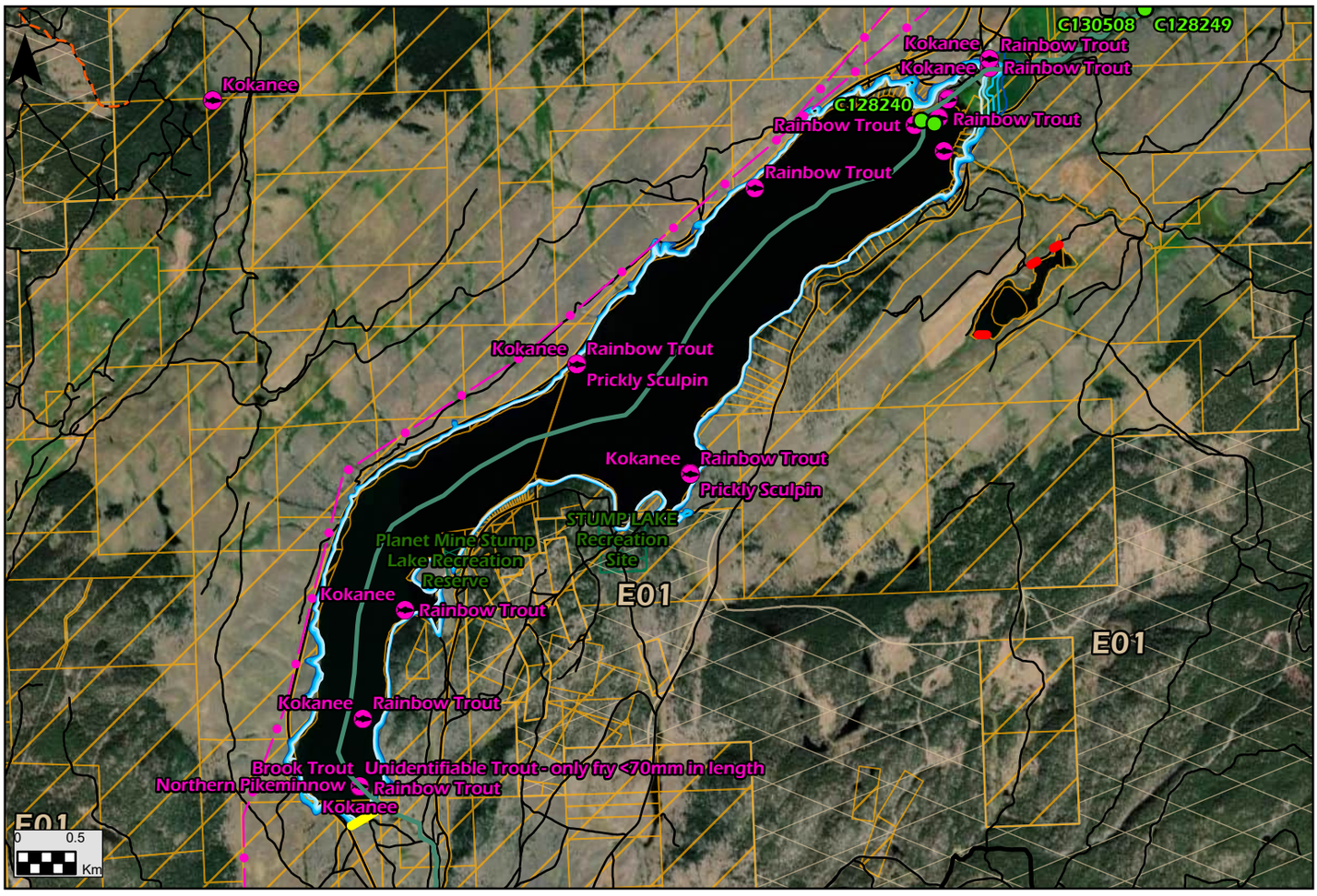
Stump Lake



Tributary To: **Nicola River**
Distance to Closest WSC Gauge: **34.5 km**
Reference Gauge: **08LG065**
Number of PODs to the Gauge: **11**
Total Allocated Annual Volume to the Gauge: **144.16 Mm^3**

Contributing Watershed Area: **191.14 km^2**
Distance from Road (est.): **180 m**
Land Ownership (crown/private/reserve): **Private**
Infrastructure Flooded: **Rec Site, Road, Hydro**
Surrounding Properties: **Y**

Average August Temperature - Historical* (°C): **12.41**
Salmonids Present (Y/N): **Y**

Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating: **na**
Existing Dam Consequence Rating: **na**
Existing Storage License: **N**

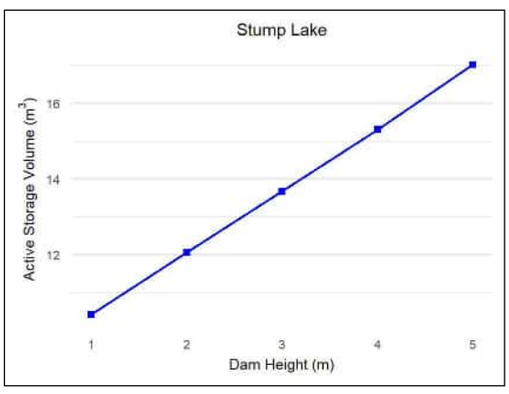
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **115 - 260 m**
Proposed Additional Storage min/max (Mm^3): **54.01 / 88.25**
Proposed Dam Cost Range $/m^3: **0.1 - 0.1**
Potential Evapotranspiration (Mm^3): **32.71 - 10.69**

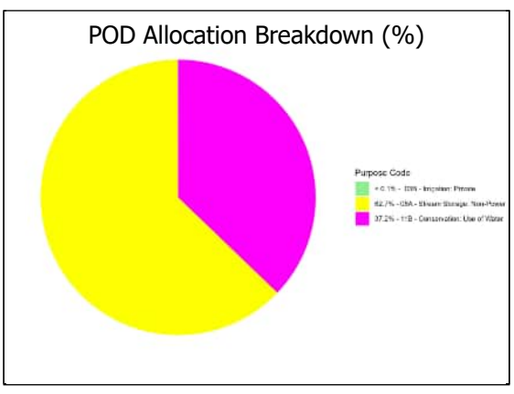
Flow augmentation (min - max): **4.11 - 14.96 m^3/s**
(storage volume / (60*24*60*60)

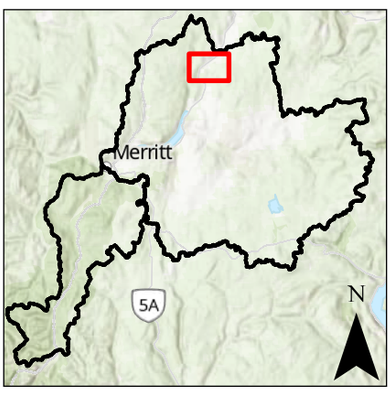
- Fish Observations
- Water Rights License (POD)
  - Active
- Proposed Dam Location
- BC Hydro Transmission Line
- Existing Road (mapped)
- Recreation Trail
- Range Tenures*
- Parcel Fabric
- Recreation Site

Proposed Dam Height Pool
- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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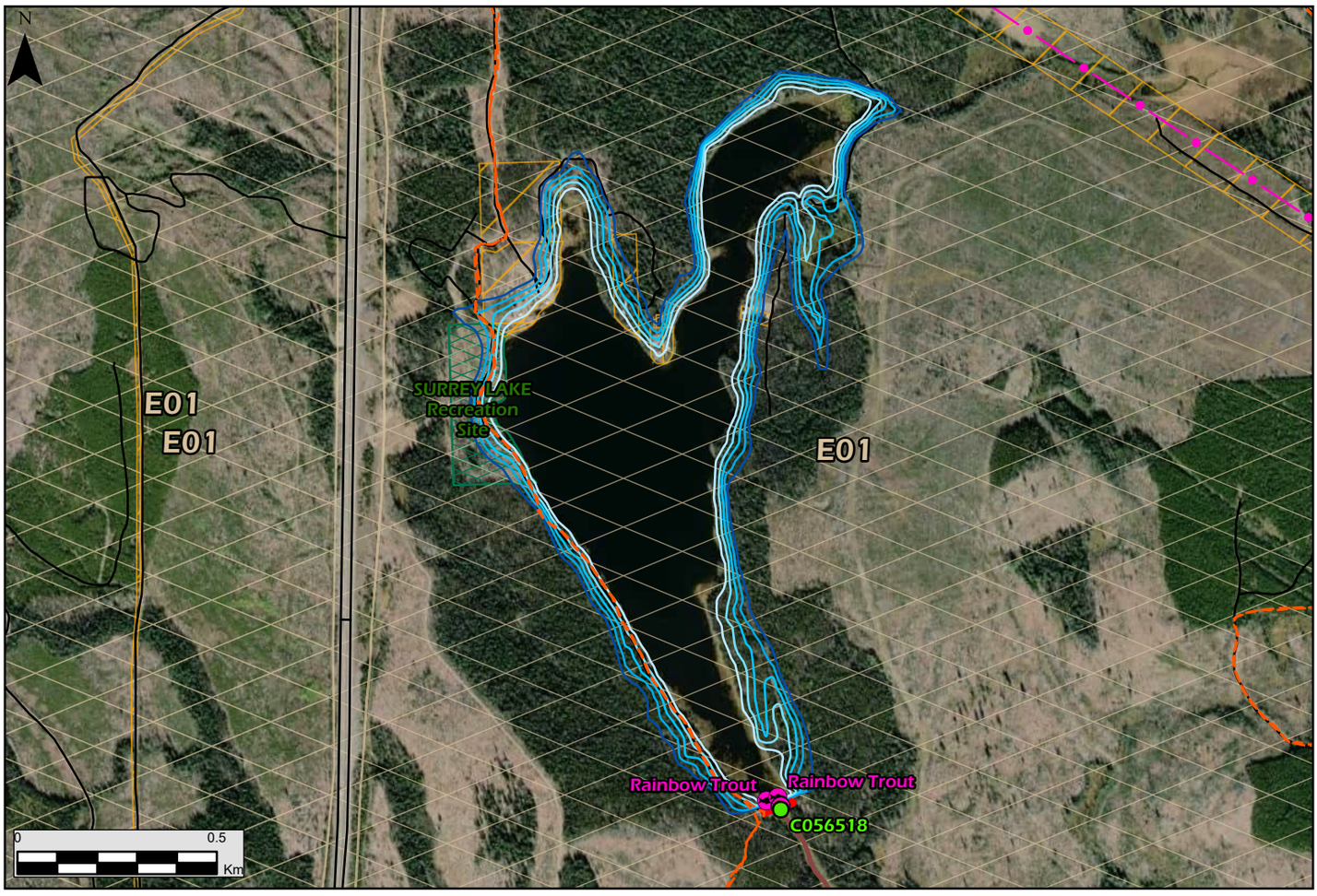
Surrey Lake



Tributary To: **Clapperton Creek**
Distance to Closest WSC Gauge: **57.9 km**
Reference Gauge: **08LG006**
Number of PODs to the Gauge: **45**
Total Allocated Annual Volume to the Gauge: **26.61 Mm^3**

Contributing Watershed Area: **12.47 km^2**
Distance from Road (est.): **0 m**
Land Ownership (crown/private/reserve): **Crown / Private**
Infrastructure Flooded: **Rec Site / Trail, Road**
Surrounding Properties: **Y**

Average August Temperature - Historical* (°C): **12.46**
Salmonids Present (Y/N): **Y**

Existing Dam: **Y**
Existing Dam Height / Crest (m): **2.7 / 91.4**
Existing Dam Risk Rating: **4**
Existing Dam Consequence Rating: **Significant**
Existing Storage License: **Y**

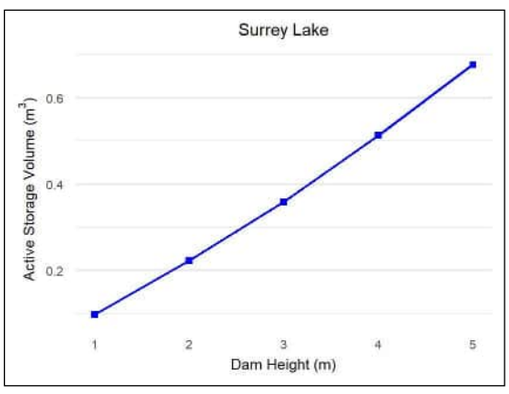
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **80 - 230 m**
Proposed Additional Storage min/max (Mm^3): **0.51 / 3.51**
Proposed Dam Cost Range $/m^3: **7.0 - 3.0**
Potential Evapotranspiration (Mm^3): **0.24 - 0.33**

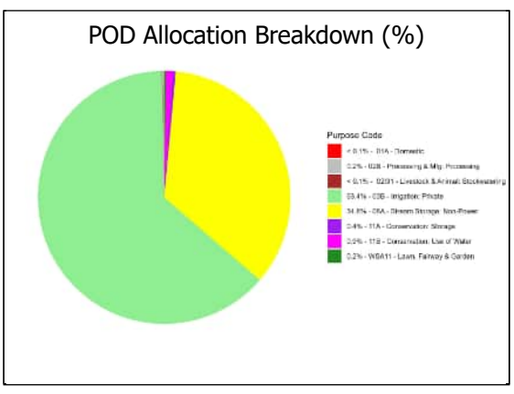
Flow augmentation (min - max): **0.05 - 0.61 m^3/s**
(storage volume / (60*24*60*60)

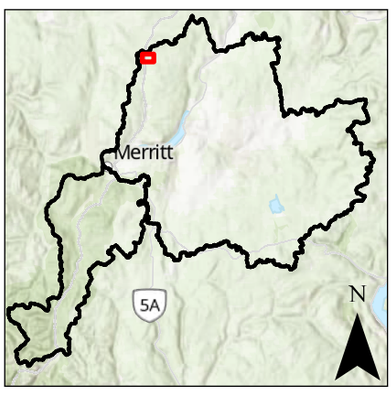
- Fish Observations
- Water Rights License (POD)
  - Active
- Existing Dam
- Proposed Dam Location
- BC Hydro Transmission Line
- Existing Road (mapped)
- Recreation Trail
- Range Tenures*
- Parcel Fabric
- Recreation Site

Proposed Dam Height Pool
- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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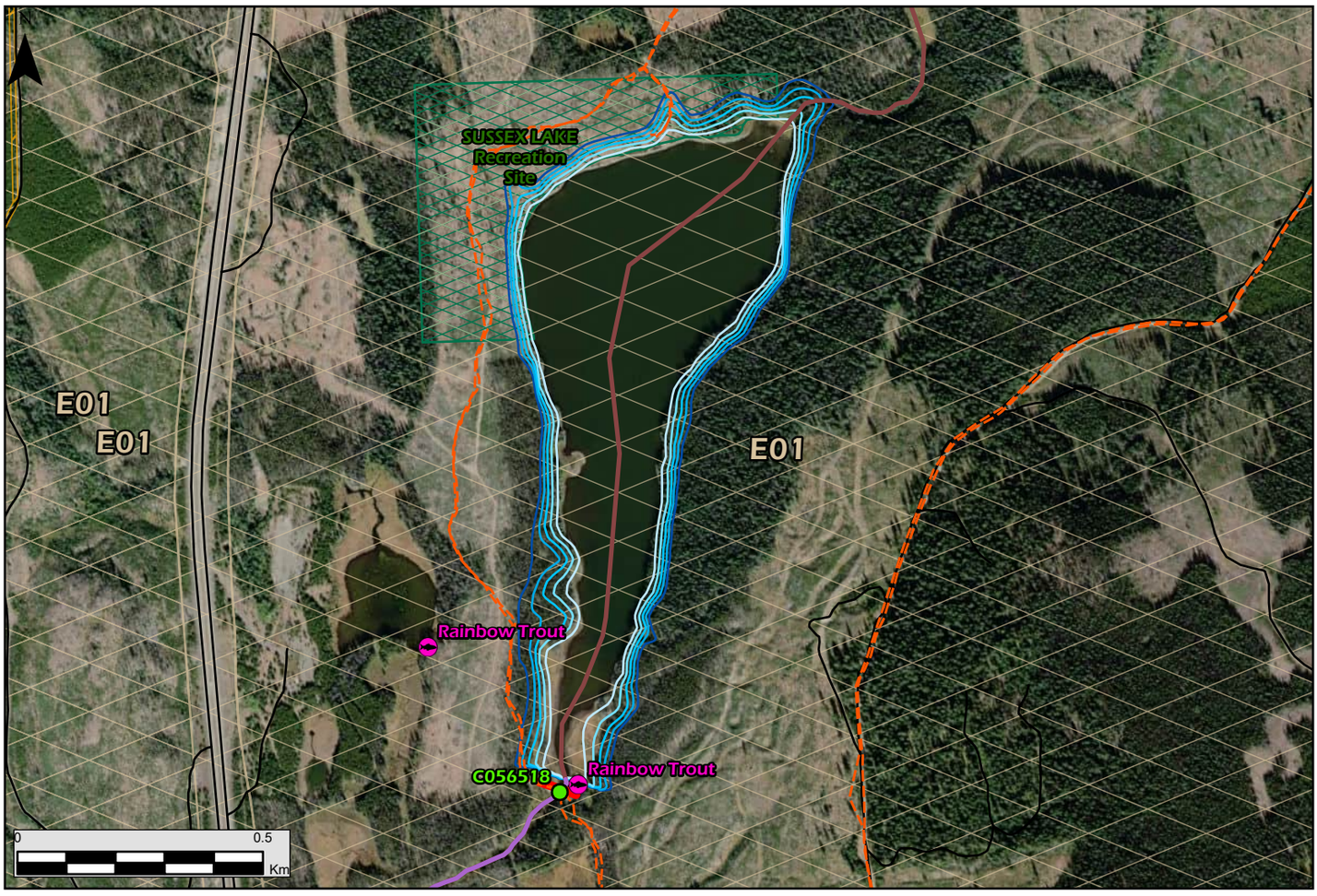
Sussex Lake



Tributary To: **Clapperton Creek**
Distance to Closest WSC Gauge: **55.4 km**
Reference Gauge: **08LG006**
Number of PODs to the Gauge: **44**
Total Allocated Annual Volume to the Gauge: **23.52 Mm^3**

Contributing Watershed Area: **18.36 km^2**
Distance from Road (est.): **550 m**
Land Ownership (crown/private/reserve): **Crown**
Infrastructure Flooded: **Rec Site / Trail**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **12.82**
Salmonids Present (Y/N): **Y**

Existing Dam: **Y**
Existing Dam Height / Crest (m): **1.8 / 38.1**
Existing Dam Risk Rating: **6**
Existing Dam Consequence Rating: **None**
Existing Storage License: **Y**

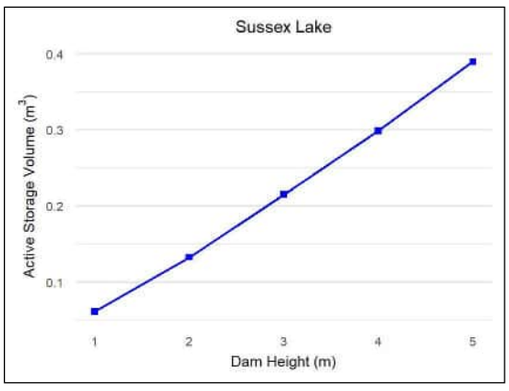
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **90 - 185 m**
Proposed Additional Storage min/max (Mm^3): **0.32 / 2.02**
Proposed Dam Cost Range $/m^3: **11.4 - 5.0**
Potential Evapotranspiration (Mm^3): **0.15 - 0.19**

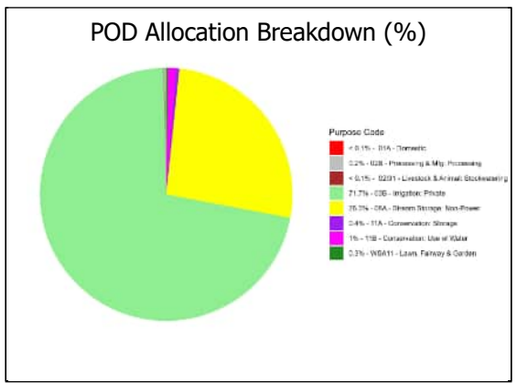
Flow augmentation (min - max): **0.03 - 0.35 m^3/s**
(storage volume / (60*24*60*60)

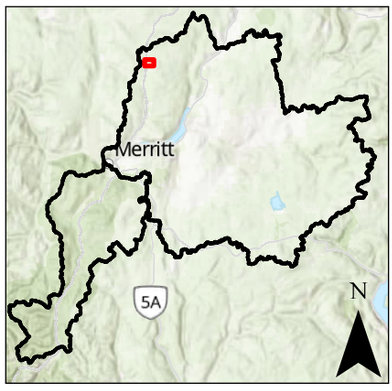
- Fish Observations
- Water Rights License (POD)
  - Active
- Existing Dam
- Proposed Dam Location
- Existing Road (mapped)
- Recreation Trail
- Range Tenures*
- Parcel Fabric
- Recreation Site

Proposed Dam Height Pool
- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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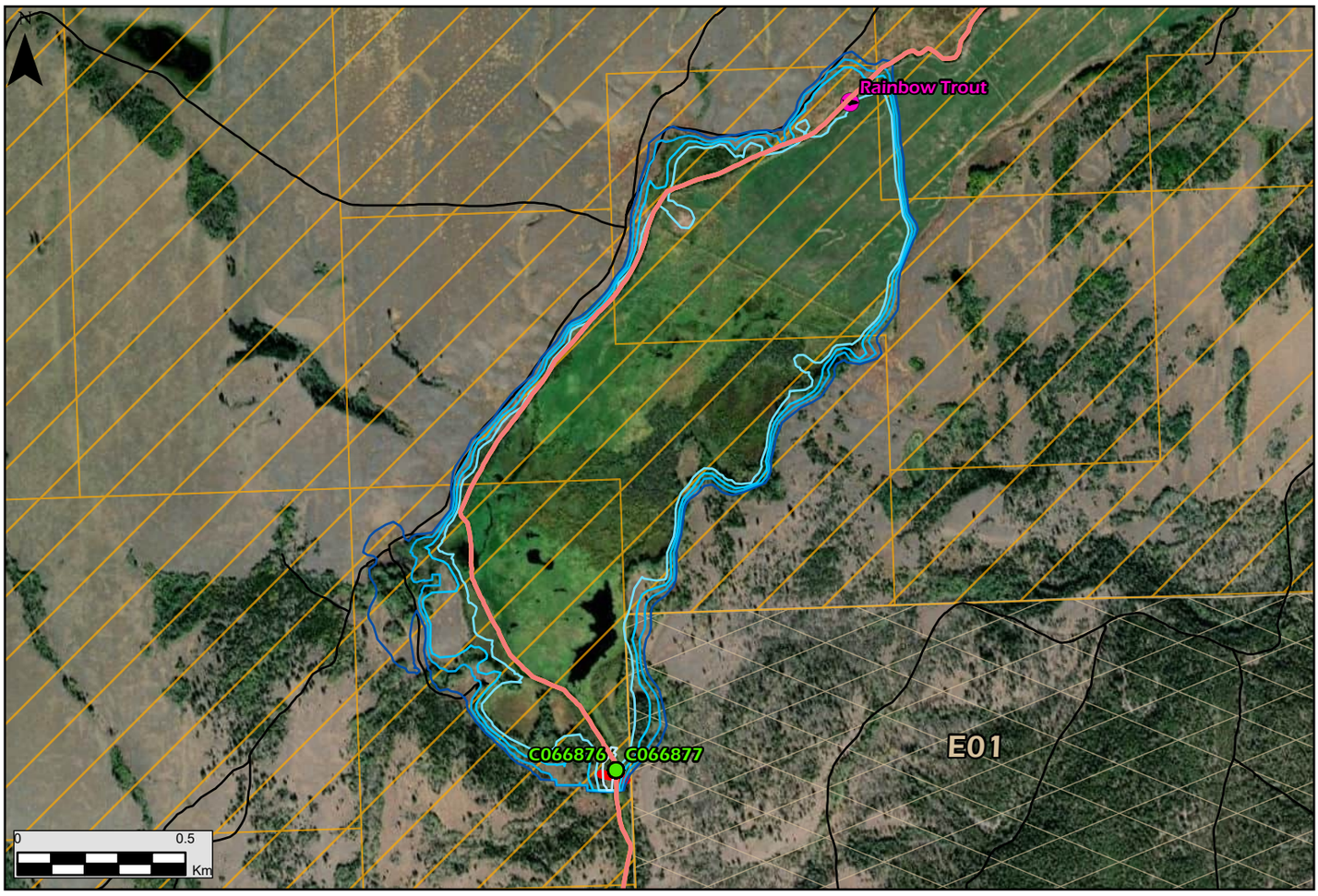
Tommy Lake



Tributary To: **Quilchena Creek**
Distance to Closest WSC Gauge: **44 km**
Reference Gauge: **08LG017**
Number of PODs to the Gauge: **45**
Total Allocated Annual Volume to the Gauge: **10.61 Mm^3**

Contributing Watershed Area: **395.4 km^2**
Distance from Road (est.): **440 m**
Land Ownership (crown/private/reserve): **Private / Crown**
Infrastructure Flooded: **Road**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **15.13**
Salmonids Present (Y/N): **N**

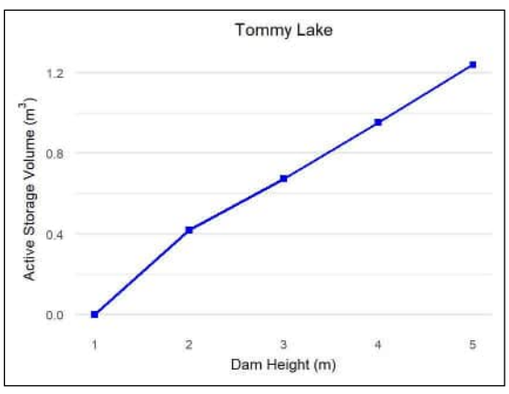
Existing Dam: **Y**
Existing Dam Height / Crest (m): *** / ***
Existing Dam Risk Rating: **4**
Existing Dam Consequence Rating: **Significant**
Existing Storage License: **Y**

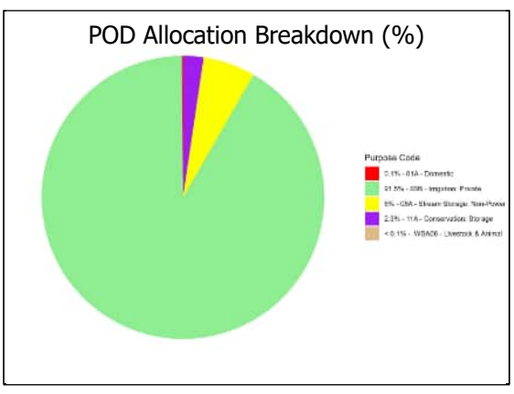
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **25 - 275 m**
Proposed Additional Storage min/max (Mm^3): **0 / 6.42**
Proposed Dam Cost Range $/m^3: **4316.0 - 1.7**
Potential Evapotranspiration (Mm^3): **0.00 - 0.70**

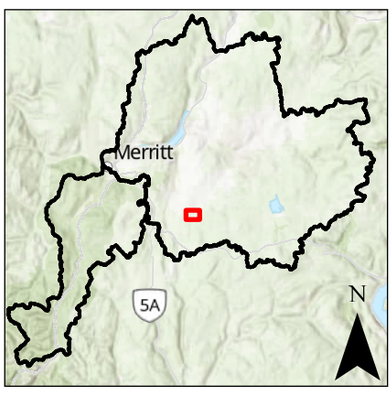
Flow augmentation (min - max): **0.00 - 1.11 m^3/s**
(storage volume / (60*24*60*60)

- Fish Observations
- Water Rights License (POD)
  - Active
  - Existing Dam
  - Proposed Dam Location
- Existing Road (mapped)
- Range Tenures*
- Parcel Fabric
- Proposed Dam Height Pool
  - 1m
  - 2m
  - 3m
  - 4m
  - 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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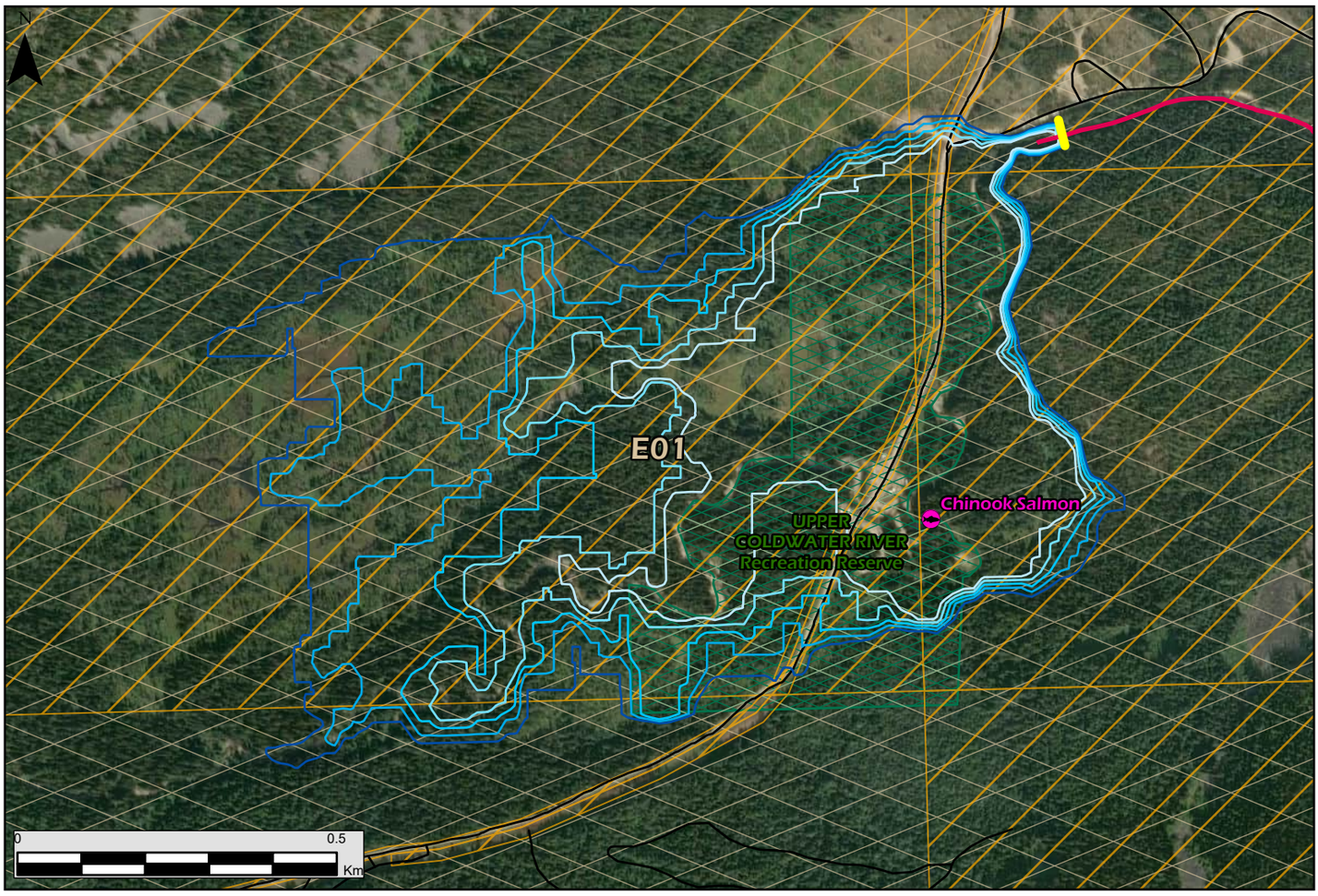
Upper Coldwater C



Tributary To: **Coldwater River**
Distance to Closest WSC Gauge: **34.6 km**
Reference Gauge: **08LG048**
Number of PODs to the Gauge: **0**
Total Allocated Annual Volume to the Gauge: **0 Mm^3**

Contributing Watershed Area: **24 km^2**
Distance from Road (est.): **0 m**
Land Ownership (crown/private/reserve): **Private**
Infrastructure Flooded: **Road, Rec Site**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **11.1**
Salmonids Present (Y/N): **Y**

Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating: **na**
Existing Dam Consequence Rating: **na**
Existing Storage License: **N**

Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **25 - 45 m**
Proposed Additional Storage min/max (Mm^3): **0.26 / 2.58**
Proposed Dam Cost Range $/m^3: **13.9 - 3.2**
Potential Evapotranspiration (Mm^3): **0.14 - 0.27**

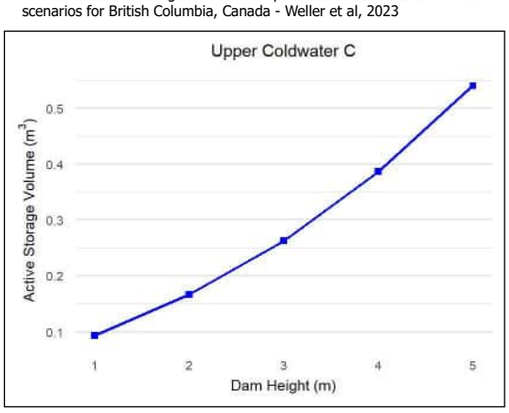
Flow augmentation (min - max): **0.02 - 0.44 m^3/s**
(storage volume / (60*24*60*60)

- Fish Observations
- Recreation Site
- Proposed Dam Location
- Existing Road (mapped)
- Range Tenures*
- Parcel Fabric

Proposed Dam Height Pool

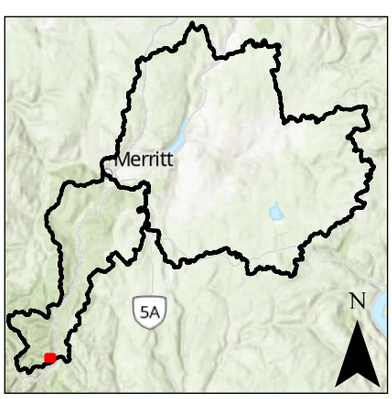
- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023



POD Allocation Breakdown (%)

No PODs to Summarize



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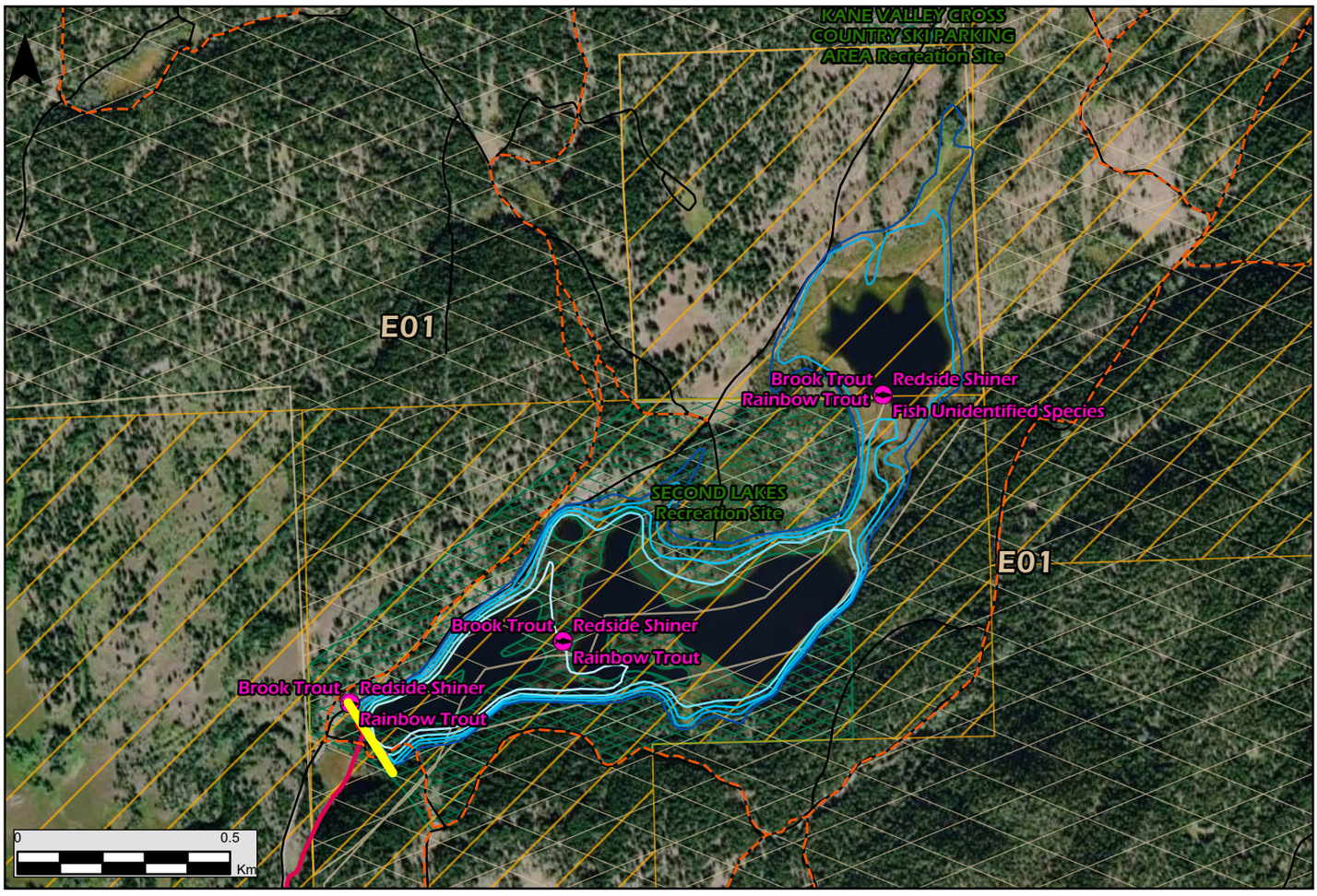
Upper Kane Lake



Tributary To: **Coldwater River**
Distance to Closest WSC Gauge: **65 km**
Reference Gauge: **08LG010**
Number of PODs to the Gauge: **84**
Total Allocated Annual Volume to the Gauge: **14.374079 Mm^3**

Contributing Watershed Area: **12.3 km^2**
Distance from Road (est.): **0 m**
Land Ownership (crown/private/reserve): **Private**
Infrastructure Flooded: **Road, Rec Site, Trail**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **12.31**
Salmonids Present (Y/N): **Y**

Existing Dam: **Y**
Existing Dam Height / Crest (m): **2 / 36.6**
Existing Dam Risk Rating: **3**
Existing Dam Consequence Rating: **Low**
Existing Storage License: **N**

Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **40 - 180 m**
Proposed Additional Storage min/max (Mm^3): **0.05 / 1.73**
Proposed Dam Cost Range $/m^3: **74.7 - 5.8**
Potential Evapotranspiration (Mm^3): **0.03 - 0.18**

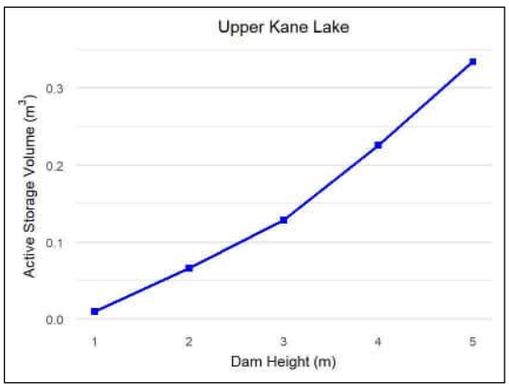
Flow augmentation (min - max): **0.00 - 0.30 m^3/s**
(storage volume / (60*24*60*60)

- Fish Observations
- Existing Dam
- Proposed Dam Location
- Existing Road (mapped)
- Recreation Trail
- Range Tenures*
- Parcel Fabric
- Recreation Site

Proposed Dam Height Pool

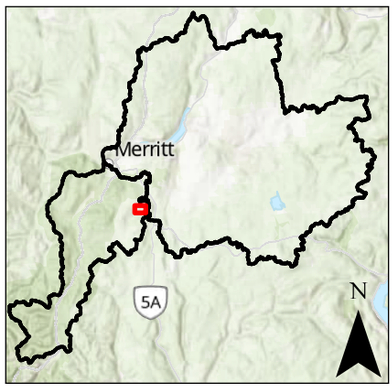
- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023



POD Allocation Breakdown (%)

No PODs to Summarize



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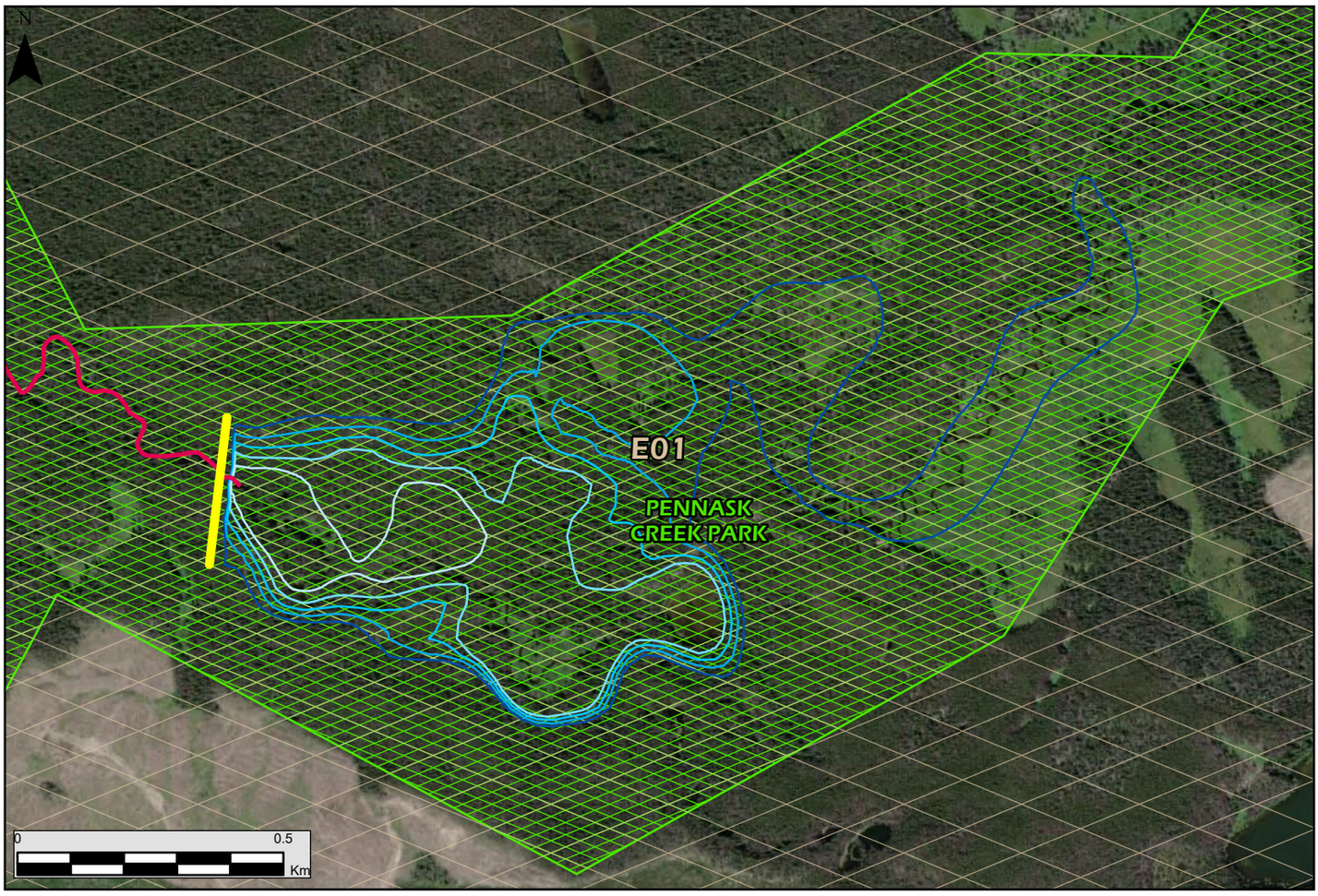
Upper Pennask Lake



Tributary To: **Quilchena Creek**
Distance to Closest WSC Gauge: **6 km**
Reference Gauge: **08LG017**
Number of PODs to the Gauge: **2**
Total Allocated Annual Volume to the Gauge: **5.357966 Mm^3**

Contributing Watershed Area: **80 km^2**
Distance from Road (est.): **650 m**
Land Ownership (crown/private/reserve): **Crown**
Infrastructure Flooded: **Park**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **10.55**
Salmonids Present (Y/N): **Y**

Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating: **na**
Existing Dam Consequence Rating: **na**
Existing Storage License: **N**

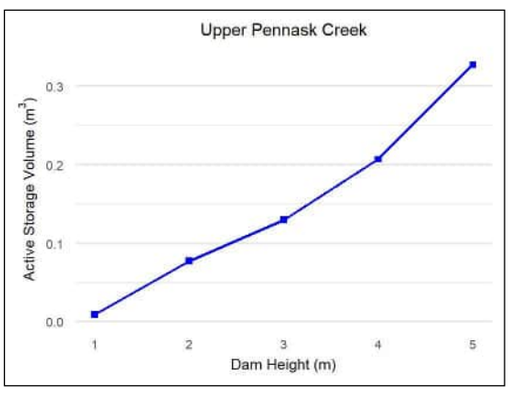
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **60 - 300 m**
Proposed Additional Storage min/max (Mm^3): **0.04 / 1.69**
Proposed Dam Cost Range $/$m^3$: **85.3 - 6.5**
Potential Evapotranspiration (Mm^3): **0.02 - 0.15**

Flow augmentation (min - max): **0.00 - 0.30 m^3/s**
(storage volume / (60*24*60*60)

Proposed Dam Location
Existing Road (mapped)
Range Tenures*
Povincial Park

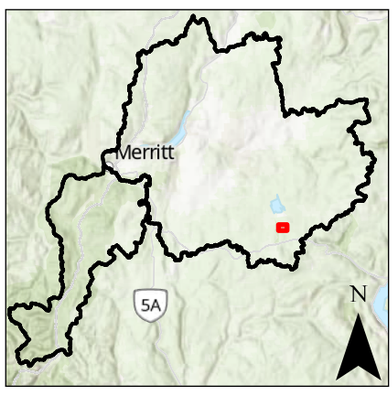
Proposed Dam Height Pool
1m
2m
3m
4m
5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023



POD Allocation Breakdown (%)

No PODs to Summarize



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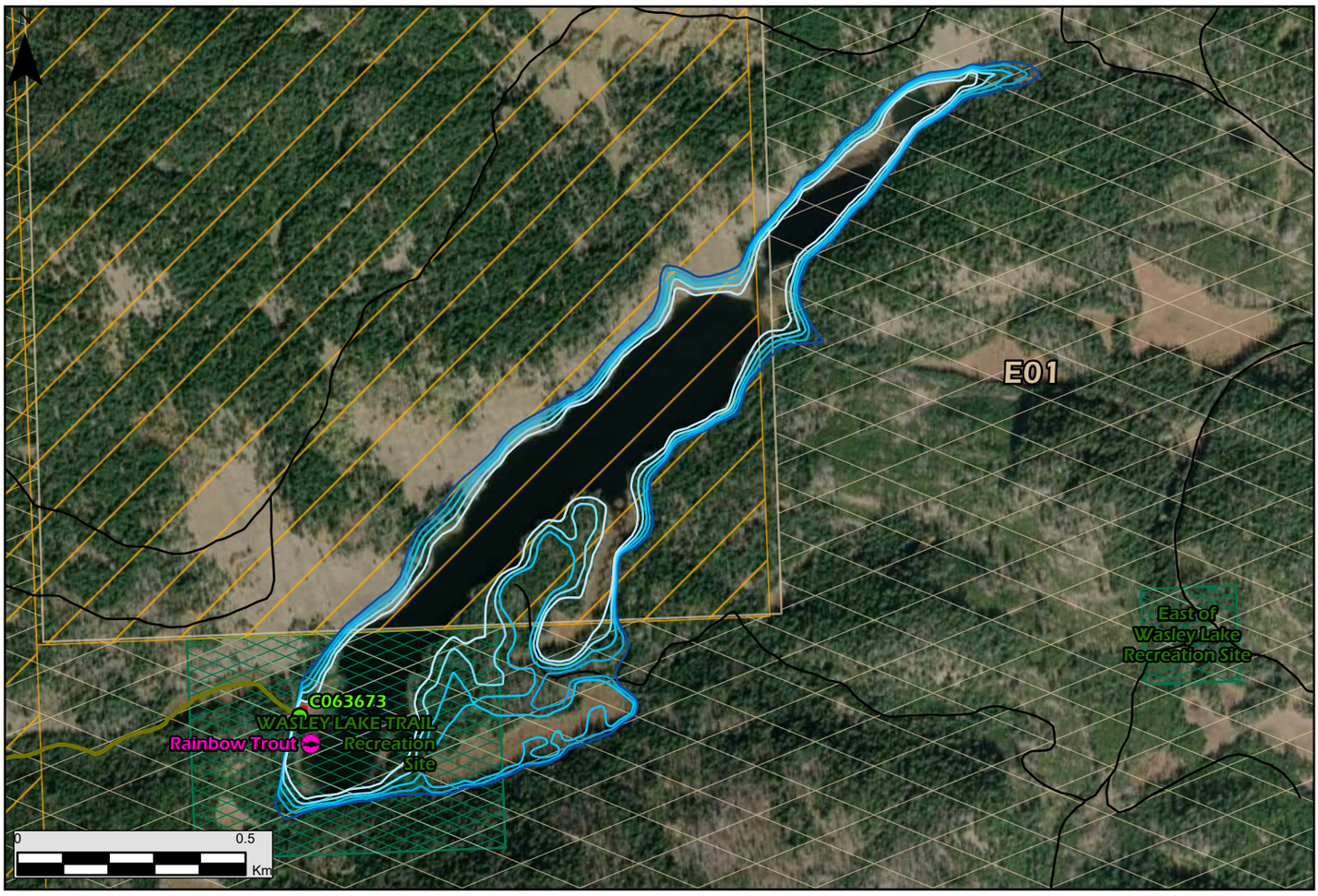
Wasley Lake



Tributary To: **Quilchena Creek**
Distance to Closest WSC Gauge: **73.9 km**
Reference Gauge: **08LG017**
Number of PODs to the Gauge: **63**
Total Allocated Annual Volume to the Gauge: **15.24 Mm^3**

Contributing Watershed Area: **14.98 km^2**
Distance from Road (est.): **275 m**
Land Ownership (crown/private/reserve): **Crown / Private**
Infrastructure Flooded: **Rec Site**
Surrounding Properties: **Y**

Average August Temperature - Historical* (°C): **13.14**
Salmonids Present (Y/N): **Y**

Existing Dam: **Y**
Existing Dam Height / Crest (m): **2.5 / 53**
Existing Dam Risk Rating: **5**
Existing Dam Consequence Rating: **Low**
Existing Storage License: **Y**

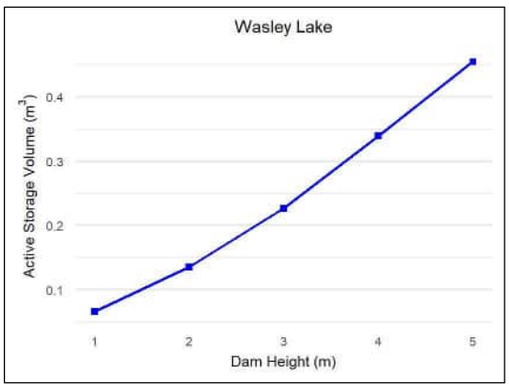
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **130 - 290 m**
Proposed Additional Storage min/max (Mm^3): **0.34 / 2.35**
Proposed Dam Cost Range $/m^3: **12.0 - 4.7**
Potential Evapotranspiration (Mm^3): **0.17 - 0.24**

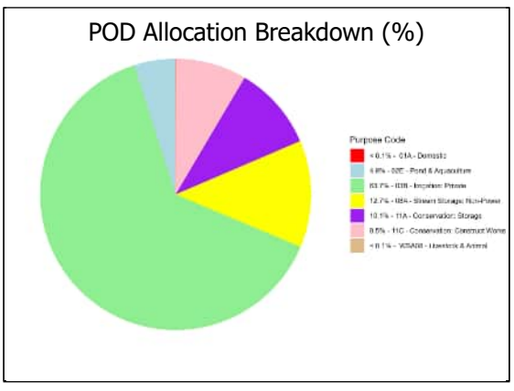
Flow augmentation (min - max): **0.03 - 0.41 m^3/s**
(storage volume / (60*24*60*60)

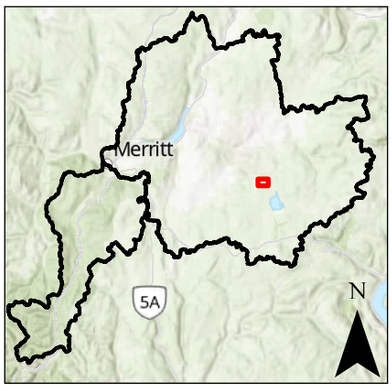
- Fish Observations
- Water Rights License (POD)
  - Active
- Existing Dam
- Proposed Dam Location
- Existing Road (mapped)
- Range Tenures*
- Parcel Fabric
- Recreation Site

Proposed Dam Height Pool
- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







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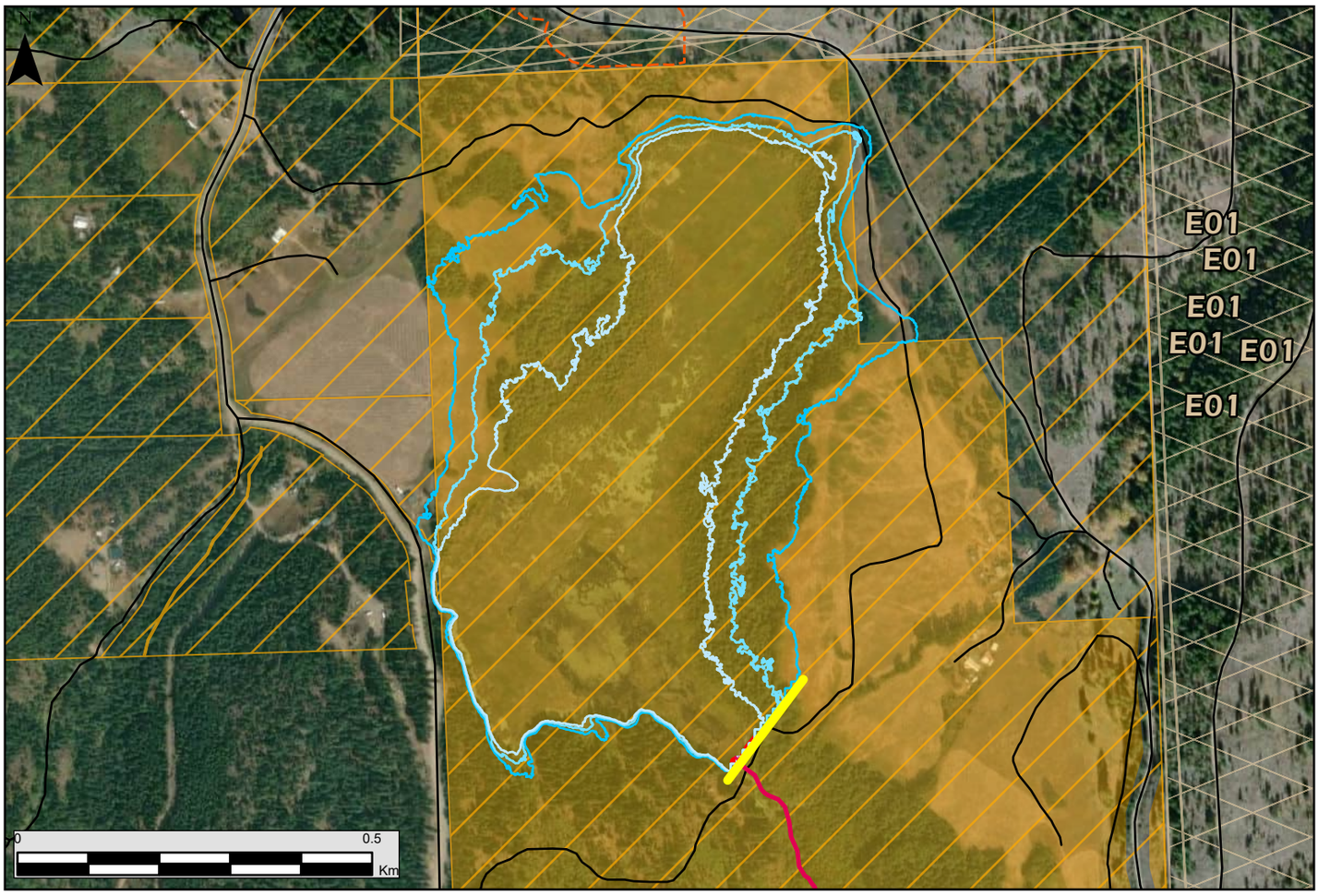
West Midway Lake



Tributary To: **Coldwater River**
Distance to Closest WSC Gauge: **43.6 km**
Reference Gauge: **08LG010**
Number of PODs to the Gauge: **55**
Total Allocated Annual Volume to the Gauge: **11.509007 Mm^3**

Contributing Watershed Area: **78.6 km^2**
Distance from Road (est.): **0 m**
Land Ownership (crown/private/reserve): **Reserv / Private**
Infrastructure Flooded: **Road**
Surrounding Properties: **N**

Average August Temperature - Historical* (°C): **12.54**
Salmonids Present (Y/N): **N**

Existing Dam: **Y**
Existing Dam Height / Crest (m): *** / ***
Existing Dam Risk Rating: **5**
Existing Dam Consequence Rating: **Low**
Existing Storage License: **N**

Proposed Dam Heights: **1 - 3 m**
Proposed Dam Length: **85 - 175 m**
Proposed Additional Storage min/max (Mm^3): **0.14 / 0.84**
Proposed Dam Cost Range $/m^3: **33.3 - 0.0**
Potential Evapotranspiration (Mm^3): **0.08 - 0.17**

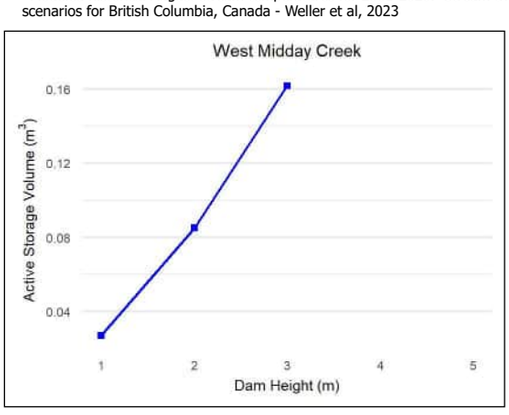
Flow augmentation (min - max): **0.01 - 0.00 m^3/s**
(storage volume / (60*24*60*60)

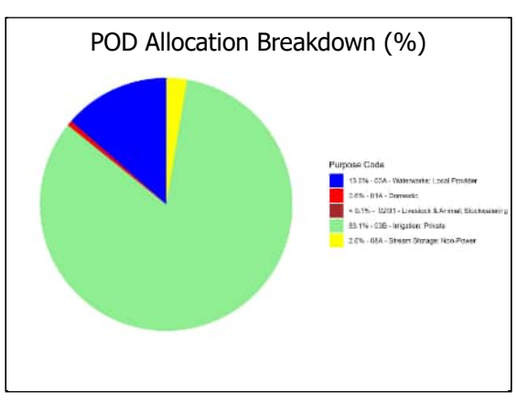
- Existing Dam
- Proposed Dam Location
- Existing Road (mapped)
- Recreation Trail
- Reserve Land
- Range Tenures*
- Parcel Fabric

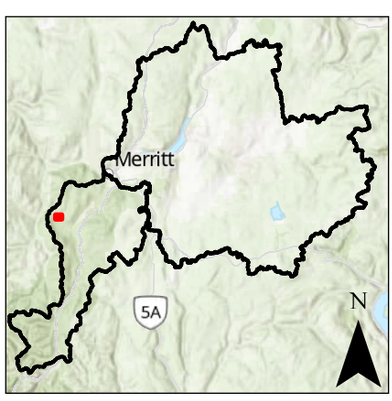
Proposed Dam Height Pool

- 1m
- 2m
- 3m
- 4m
- 5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







Prepared For:

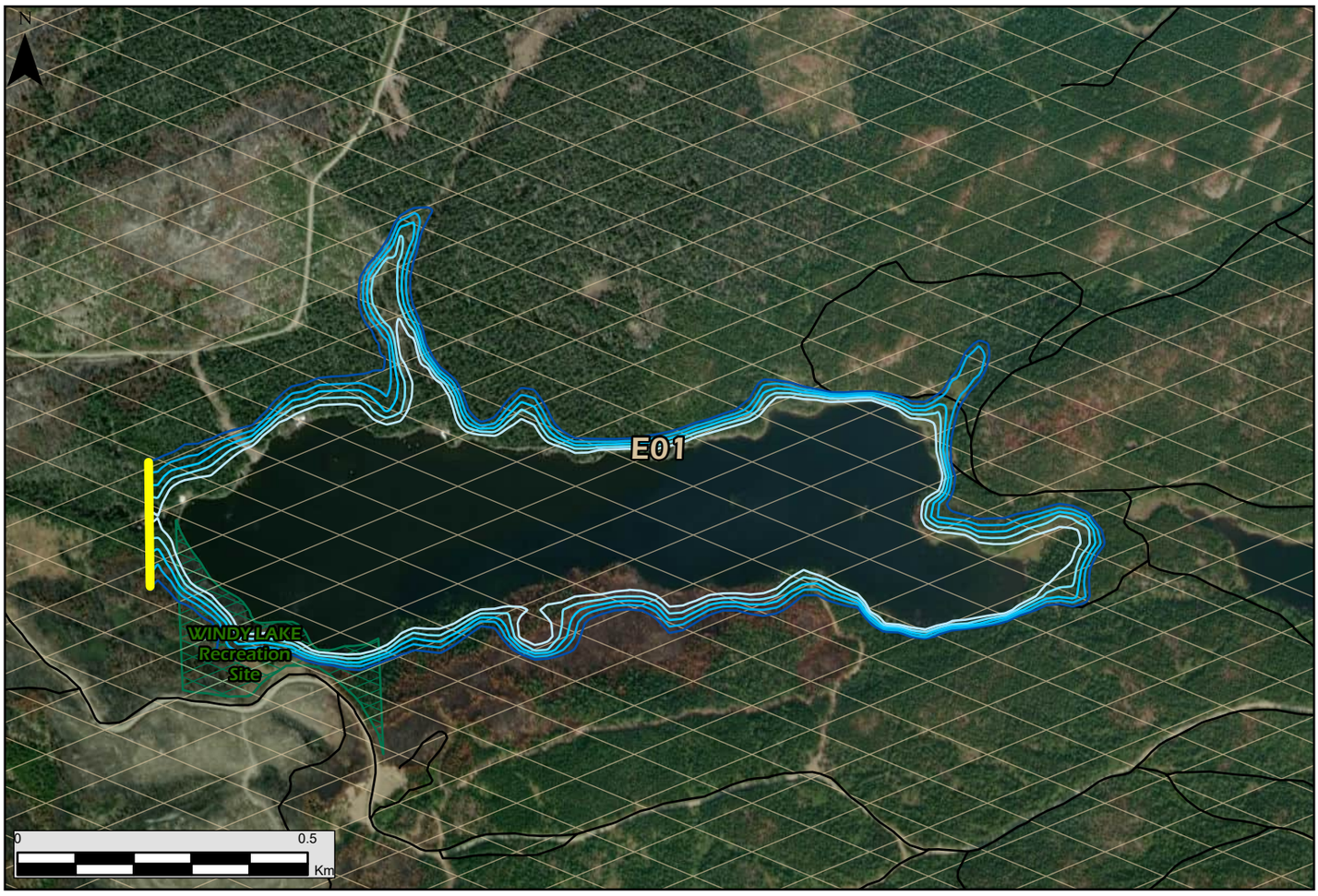
Nicola Watershed GOVERNANCE PARTNERSHIP

Prepared By:

BGC

ECOSCAPE Environmental Consultants Ltd.

Windy Lake



Tributary To: **Upper Nicola**
Distance to Closest WSC Gauge: **53.9 km**
Reference Gauge: **08LG028**
Number of PODs to the Gauge: **13**
Total Allocated Annual Volume to the Gauge: **2.85 Mm^3**

Contributing Watershed Area: **6.94 km^2**
Distance from Road (est.): **230 m**
Land Ownership (crown/private/reserve): **Crown**
Infrastructure Flooded: **Rec Site, Road**
Surrounding Properties: **Y**

Average August Temperature - Historical* (°C): **12.6**
Salmonids Present (Y/N): **N**

Existing Dam: **N**
Existing Dam Height / Crest (m): **na / na**
Existing Dam Risk Rating: **na**
Existing Dam Consequence Rating: **na**
Existing Storage License: **N**

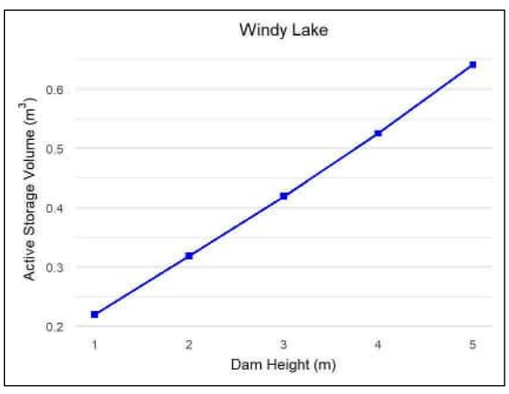
Proposed Dam Heights: **1 - 5 m**
Proposed Dam Length: **20 - 215 m**
Proposed Additional Storage min/max (Mm^3): **1.14 / 3.32**
Proposed Dam Cost Range $/m^3: **2.7 - 3.1**
Potential Evapotranspiration (Mm^3): **0.53 - 0.31**

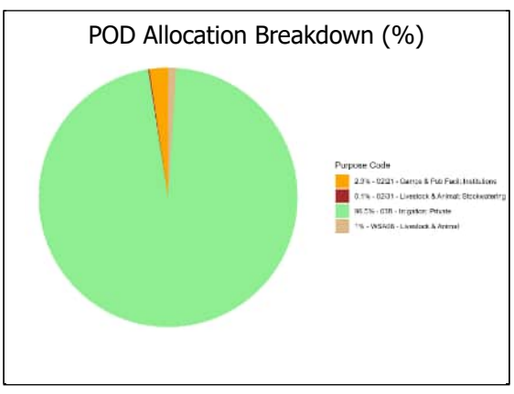
Flow augmentation (min - max): **0.12 - 0.58 m^3/s**
(storage volume / (60*24*60*60)

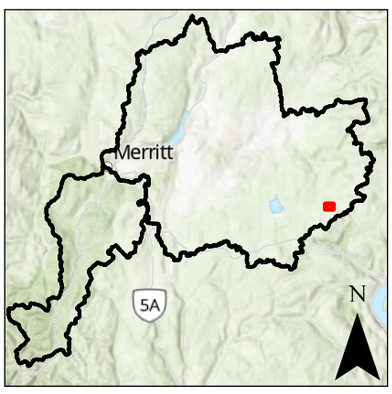
Proposed Dam Location
Existing Road (mapped)
Range Tenures*
Recreation Site

Proposed Dam Height Pool
1m
2m
3m
4m
5m

Range Tenure Class Codes: E01 - Grazing License • E02 - Grazing Permit • H01 - Haycutting License • H02 - Haycutting Permit
*Modeled historical August stream temperatures for 2001-2020. Stream thermalscape scenarios for British Columbia, Canada - Weller et al, 2023







Prepared For:

Nicola Watershed GOVERNANCE PARTNERSHIP

Prepared By:

BGC

ECOSCAPE Environmental Consultants Ltd.

APPENDIX B: Reservoir Matrix

Watershed Description							Hydroclimatic Details		Existing Dam Description						Water Survey of Canada Gauge Details				Proposed Dam Details							
Reservoir Name	Elevation (masl)	Contributing Watershed Area (km^2)	Tributary To	Salmonids Present (Y/N)	Land Ownership	Surrounding Properties (Y/N)	Distance From Existing Road (m)	Mean Annual August Flow Temp (2001-2020) (°C)	Potential Evaporation Range (Mm3)	Existing Dam (Y/N)	Existing Dam Height (m)	Existing Dam Crest (m)	Existing Storage License (Y/N)	Existing Dam(s) Failure Consequence	Existing Dam(s) Risk Level	Closest Downstream WSC Gauge	Distance to Closest WSC Gauge (km)	Number of PODs to Gauge	Total Allocated Volume to Gauge (Mm^3)	Proposed Dam Heights (m)	Proposed Dam Lengths (m)	Proposed Additional Storage Min (Mm^3)	Proposed Additional Storage Max (Mm^3)	Flow Augmentation Min - Max (m^3/s)	Dam Cost by Dam Height ($/$m^3$)‡	Infrastructure Affected	Downstream Hazards
Barton Lake	1395	71	Upper Nicola	Y	Crown	N	140	12.34	0.13 - 0.30	N	na	na	N	na	na	08LG028	55.8	13	2.85	1 - 5	30 - 75	0.27	3.15	0.03 - 0.55	2.81 / 1.03 / 1.01 / 1.08 / 1.1	None	FSR Bridge, Salmonid Habitat, Agriculture & Feedlot, Rural Roads and Bridges, Douglas Lake Road, Douglas Lake
Brook Lake	1508	10	Coldwater River	Y	Crown	N	195	11.00	0.09 - 0.12	N	na	na	N	na	na	08LG048	18.0	245	0.52	1 - 5	5 - 75	0.21	1.34	0.02 - 0.24	1.16 / 2.06 / 2.22 / 2.4 / 2.56	Rec Site, Road	Brookmere, Forest Road Bridge, KVR Trail, Salmonid Habitat. Coldwater River
Chapperon Creek	921	205	Upper Nicola	N	Mixed	N	470	15.20	0.00 - 0.34	N	na	na	N	na	na	08LG028	21.6	16	6.31	1 - 5	10 - 30	0.00	2.97	0.00 - 0.51	902.94 / 1.57 / 0.93 / 0.75 / 0.68	Road, Hydro	Rural Road and Bridges, Agricultural area, Salmonid Habitat, Douglas lake Road, Douglas Lake
Chapperon Lake	925	197	Upper Nicola	Y	Mixed	Y	180	15.14	2.71 - 3.04	Y	2.9	93	Y	High / Low	4 / 5	08LG028	24.7	20	11.20	1 - 5	35 - 190	4.76	26.66	0.40 - 4.56	0.21 / 0.19 / 0.2 / 0.22 / 0.23	Road, Hydro	Rural Road and Bridges, Agricultural area, Salmonid Habitat, Douglas lake Road, Douglas Lake
Douglas Lake	801	1277	Upper Nicola	Y	Private / Reserve	Y	0	16.42	3.88 - 4.15	N	na	na	N	na	na	08LG028	0.2	20	0.07	1 - 5	160 - 255	6.53	34.85	0.51 - 5.92	0.42 / 0.24 / 0.2 / 0.21 / 0.22	Road, Hydro	Major Roads and Bridges, Personal Property, Salmonid Habitat, Agricultural Areas, Nicola Lake
Ellen Lake	1396	19	Upper Nicola	Y	Private / Crown	N	370	13.92	0.15 - 0.40	N	na	na	N	na	na	08LG028	57.9	13	2.85	1 - 5	460 - 575	0.32	4.26	0.03 - 0.74	12.59 / 4.91 / 3.46 / 3.18 / 2.82	Road	Forest Roads and Bridges, Salmonid Habitat, Douglas Lake
Englishman Lake	1088	41	Coldwater River	Y	Private	N	55	13.80	0.07 - 0.12	Y	1.7	23	Y	Significant	5	08LG010	59.2	72	13.81	1 - 5	30 - 85	0.13	1.15	0.01 - 0.20	6.46 / 4.14 / 3.66 / 3.35 / 3.3	Road	Transmission Line, Salmonid Habitat, Kane Valley Road, Harrison Dam/Res, Englishman Lake #3,
Frogmoore Lake	1427	31	Nicola River	Y	Crown / Private	N	35	12.63	0.16 - 0.56	Y	3.2	125	Y	Low / Low / Sig / Low	5 / 4 / 4 / 5	08LG065	43.9	39	157.01	1 - 5	215 - 300	0.34	5.99	0.04 - 1.05	7.3 / 1.4 / 1.38 / 1.35 / 1.35	Rec Trail, Road	Forest Roads and Bridges, Salmonid Habitat, Transmission Lines, Agriculture, Nicola Lake
Garcia Lake B	1046	27	Coldwater River		Private	Y	70	13.16	0.03 - 0.25		na	na	N	na	na	08LG010	22.5	24	4.63	1 - 5	70 - 130	0.05	2.34	0.00 - 0.40	27.21 / 4.81 / 2.9 / 2.31 / 2.1	Road, Hydro	Forest Roads, Highway #5, Park, Merritt
Gillis Lake	1155	5	Coldwater River		Crown / Private	Y	360	11.79	0.09 - 0.12		na	na	N	na	na	08LG010	40.6	39	10.65	1 - 5	40 - 85	0.17	1.18	0.02 - 0.20	5.97 / 3.98 / 3.36 / 3.09 / 3.19	Road, Hydro, Rec Site	Forest Roads, Salmonid Habitat, Coldwater River
Guichon Flats Lake	647	292	Nicola	Y	Private	N	185	16.96	0.05 - 0.35	Y	3.0	520	Y	Low	5	08LG046	24.6	10	144.10	1-5	240 - 550	0.09	2.79	0.02 - 0.54	72.57 / 21.55 / 8.62 / 5.3 / 4.39	Road	Major Roads and Bridges, Agricultural Area, Stump Lake Creek Dam, Nicola Lake
Hamilton Lake	1079	26	Nicola River		Crown	N	0	13.74	0.18 - 0.21		6.8	21	N	Low	5	08LG065	67.3	28	4.41	1 - 5	25 - 60	0.33	1.92	0.03 - 0.33	2.37 / 1.62 / 1.58 / 1.53 / 1.6	Road, Rec Site, Trail	Salmond Habitat, Recreation Site, Forest Roads, Nicola River
Helmer Lake	1350	59	Clapperton Creek	Y	Crown	Y	0	13.08	0.07 - 0.11	Y	6.7	121	Y	High	4	08LG006	48.4	43	20.44	1 - 5	45 - 295	0.14	1.11	0.01 - 0.19	6.83 / 10.11 / 8.22 / 7.55 / 7.2	Rec Site / Trail, Road, Hydro	Highway #5, Forest Roads and Bridges, Major Roads and Bridges, Salmonid Habitat, Personal Property, Highway #5A, Mammette Lake Community, Nicola River
Kirby Lake	1315	15	Clapperton Creek	N	Crown / Private	N	0	12.83	0.12 - 0.17	Y	7.2	61	Y	Significant	4	08LG006	42.3	43	20.44	1 - 5	30 - 90	0.24	1.73	0.02 - 0.30	3.23 / 2.24 / 2.17 / 2.12 / 2.25	Road	Forest Roads and Bridges, Major Roads, Salmonid Habitat, Highway #5A, Mammette Lake Community, Nicola River
Lower Kane	1111	22	Coldwater River	Y	Private / Crown	Y	0	13.42	0.13 - 0.23	Y	1.3	40	Y	Low	5	08LG010	62.7	80	14.48	1 - 5	50 - 145	0.25	2.18	0.02 - 0.38	4.6 / 2.85 / 2.58 / 2.41 / 2.41	Rec Site, Road	Harmon Lakes Dams, Transmission Line, Forestry Roads and Bridges, Salmonid Habitat, Kane Valley Road, Harrison Dam/Res, Englishman Lake #3,
Mellin Lake	1421	12	Upper Nicola	Y	Crown / Private	Y	1,150	12.69	0.26 - 0.43	N	na	na	N	na	na	08LG028	32.5	14	4.12	1 - 4	20 - 65	0.56	3.69	0.06 - 0.00	1.05 / 0.62 / 0.67 / 0.7	Rec Site, Road	Salmonid Habitat, Recreation Sites, Forestry Roads and Bridges, Agriculture & Feedlot, Rural Roads and Bridges, Douglas Lake Road, Douglas Lake
Minnie Lake	1074	134	Quilchena Creek	Y	Private	N	250	15.25	0.72 - 0.96	Y	3.8	510	Y	High	4	08LG017	49.2	49	12.66	1 - 5	360 - 470	1.34	8.95	0.12 - 1.54	2.94 / 1.54 / 1.35 / 1.27 / 1.2	Road	Agricultural Land, Tommy Lake Dam, Salmonid Habitat, Forest Roads and Bridges, Reserve Land, Nicola Lake
Old Dave Lake	1381	80	Upper Nicola	Y	Crown	N	380	12.51	0.27 - 0.23	N	na	na	N	na	na	08LG028	52.0	13	2.85	1 - 5	30 - 80	0.56	2.45	0.06 - 0.43	1.35 / 1.27 / 1.37 / 1.42 / 1.47	Road	FSR Bridge, Salmonid Habitat, Farm & Feedlot, Rural Roads, Douglas Lake Road, Douglas Lake
Palmer Lake	1169	40	Nicola River	N	Private	N	50	14.44	0.68 - 0.83	Y	5.5	*	Y	na / Significant	na / 4	08LG065	57.6	46	154.34	1 - 3	155 - 415	1.31	4.82	0.12 - 0.00	1.72 / 1.59 / 1.33	Road	Forest Roads and Bridges, Transmission Lines, Salmonid Habitat, Agricultural Land, Stump Lake
Paradise Lake	1500	25	Quilchena Creek	Y	Crown / Private	Y	10	13.05	0.58 - 0.63	N	na	na	N	na	na	08LG017	96.5	60	16.56	1 - 4	40 - 90	1.29	5.61	0.14 - 0.00	0.67 / 0.48 / 0.49 / 0.56	Rec Site, Road	Recreation Site, Salmonid Habitat, Transmission Line, Forest Roads and Bridges, Tommy Lake Dam, Nicola Lake
Pennask Dam A	1419	122	Quilchena Creek	Y	Private / Crown	Y	655	13.60	3.55 - 4.52	N	na	na	N	na	na	08LG017	28.0	40	79.76	1 - 3	40 - 90	7.60	28.97	0.78 - 0.00	0.12 / 0.09 / 0.09	Prov Park, Rec Site, Road	Rec Site, Trails Forest Roads and Bridges, Reserve Land, Salmonid Habitat, Personal Property, Douglas Lake
Peter Hope Lake	1092	31	Nicola River	Y	Crown / Private	Y	0	14.42	1.17 - 0.78	Y	3.8	79	Y	High	4	08LG065	39.4	17	148.34	1 - 5	65 - 170	2.19	7.25	0.20 - 1.25	0.63 / 0.58 / 0.64 / 0.72 / 0.8	Rec Site, Road	Salmonid Habitat, Forest Roads and Bridges, Guichon Flats Dan, Agricultural Land, Stump Lake Creek Dam, Stump Lake
Pothole Lake	940	101	Quilchena Creek		Private / Crown	N	0	13.04	0.06 - 0.07		3.2	22	N	Significant	4	08LG017	35.0	43	9.39	1 - 5	45 - 100	0.11	0.63	0.01 - 0.11	11.23 / 7.58 / 6.78 / 6.63 / 6.65	Road	Salmonid Habitat, Forest Roads, Transmission Line, Agriculture, Nicola Lake
Raymer Lake	1418	11	Upper Nicola	Y	Crown	N	130	12.41	0.11 - 0.18	N	na	na	N	na	na	08LG028	53.7	13	2.85	1 - 5	100 - 160	0.24	1.94	0.03 - 0.34	6.42 / 4.16 / 3.38 / 3.05 / 2.83	Road	Salmonid Habitat, Forest Roads and Bridges, Agricuture & Feedlot, Rural Roads and Bridges, Douglas Lake Road, Douglas Lake
Reservoir Lake	1531	21	Quilchena Creek	Y	Crown	N	10	11.94	0.30 - 0.33	Y	4.5	45	Y	Significant	4	08LG017	91.8	62	17.42	1 - 2	135 - 155	0.68	1.48	0.07 - 0.00	2.65 / 1.73	Rec Site	Recreation Site, Salmonid Habitat, Transmission Line, Forest Roads and Bridges, Tommy Lake Dam, Nicola Lake
Rock Lake	1446	5	Upper Nicola		Crown	N	1,579	12.54	0.29 - 0.34		na	na	N			08LG028	53.2	12	2.22	1 - 2	180 - 240	0.64	1.45	0.07 - 0.00	3.48 / 2.32	Rec Site	Salmonid Habitat, Forest Roads, Nicola River
Stump Lake	749	191	Nicola River	Y	Private	Y	180	12.41	32.71 - 10.69	N	na	na	N	na	na	08LG065	34.5	11	144.16	1 - 5	115 - 260	54.01	88.25	4.11 - 14.96	0.04 / 0.05 / 0.06 / 0.07 / 0.09	Rec Site, Road, Hydro	Forest Roads and Bridges, Highway #5A, Transmission Lines, Guichon Flats Dan, Agricultural Land, Stump Lake Creek Dam, Stump Lake
Surrey Lake	1397	12	Clapperton Creek	Y	Crown / Private	Y	0	12.46	0.24 - 0.33	Y	2.7	91	Y	Significant	4	08LG006	57.9	45	26.61	1 - 5	80 - 230	0.51	3.51	0.05 - 0.61	2.72 / 1.82 / 1.74 / 1.81 / 1.96	Rec Site / Trail, Road	Trails, Rec Sites, Salmonid Habitat, Sussex Lake Dam, Highway #5, Transmission Line, Helmer Lake Dam, Forest Roads and Bridges, Major Roads and Bridges, Personal Property, Highway #5A, Mammette Lake Community, Nicola River
Sussex Lake	1385	18	Clapperton Creek	Y	Crown	N	550	12.82	0.15 - 0.19	Y	1.8	38	Y	None	6	08LG006	55.4	44	23.52	1 - 5	90 - 185	0.32	2.02	0.03 - 0.35	4.7 / 3.32 / 3.1 / 3 / 2.98	Rec Site / Trail	Trails, Rec Sites, Salmonid Habitat, Sussex Lake Dam, Highway #5, Transmission Line, Helmer Lake Dam, Forest Roads and Bridges, Major Roads and Bridges, Personal Property, Highway #5A, Mammette Lake Community, Nicola River
Tommy Lake	1062	395	Quilchena Creek	N	Private / Crown	N	440	15.13	0.00 - 0.70	Y	*	*	Y	Significant	4	08LG017	44.0	45	10.61	1 - 5	25 - 275	0.00	6.42	0.00 - 1.11	915.64 / 0.77 / 0.76 / 1.13 / 1.21	Road	Agricultural Land, Salmonid Habitat, Forest Roads and Bridges, Reserve Land, Nicola Lake
Upper Coldwater C	1123	24	Coldwater River		Private	N	0	11.10	0.14 - 0.27		na	na	N	na	na	08LG048	34.6	0	0.00	1 - 5	25 - 45	0.26	2.58	0.02 - 0.44	2.96 / 1.7 / 1.36 / 1.18 / 1	Road, Rec Site	Mainstem Coldwater River, Salmonid Habitat, Highway #5, Quarry
Upper Kane Lake	1124	12	Coldwater River		Private	N	0	12.31	0.03 - 0.18		2	36.6	N	Low	3	08LG010	65.0	84	14.37	1 - 5	40 - 180	0.05	1.73	0.00 - 0.30	20.4 / 6.71 / 5.19 / 3.82 / 3.45	Road, Rec Site, Trail	Lower Kane Lake Dam, Harmon Lakes Dams, Transmission Line, Forestry Roads and Bridges, Salmonid Habitat, Kane Valley Road, Harrison Dam/Res, Englishman Lake #3,
Upper Pennask Lake	1485	80	Quilchena Creek		Crown	N	650	10.55	0.02 - 0.15		na	na	N	na	na	08LG017	6.0	2	5.36	1 - 5	60 - 300	0.04	1.69	0.00 - 0.30	28.73 / 5.85 / 5.57 / 5.22 / 4.75	Park	Salmonid Habitat, Pennask Lake
Wasley Lake	1242	15	Quilchena Creek	Y	Crown / Private	Y	275	13.14	0.17 - 0.24	Y	2.5	53	Y	Low	5	08LG017	73.9	63	15.24	1 - 5	130 - 290	0.34	2.35	0.03 - 0.41	5.89 / 4.16 / 3.7 / 3.39 / 3.38	Rec Site	Recreation Site, Forest Roads and Bridges, Salmonid Habitat, Mule Deer Marsh Dam, Bunchgrass Marsh Dam, Transmission Line, Flume Marsh Dam, Pennask FSR, Minnie Lake Dam, Nicola Lake
West Midday Creek	805	79	Coldwater River		Reserv / Private	N	0	12.54	0.08 - 0.17		*	*	N	Low	5	08LG010	43.6	55	11.51	1 - 3	85 - 175	0.14	0.84	0.01 - 0.00	13.32 / 5.48 / 4.66	Road	Reserve Land, Forest Roads and Bridges, Salmonid Habitat, Coldwater River
Windy Lake	1425	7	Upper Nicola	N	Crown	Y	230	12.60	0.53 - 0.31	N	na	na	N	na	na	08LG028	53.9	13	2.85	1 - 5	20 - 215	1.14	3.32	0.12 - 0.58	0.51 / 0.96 / 1.29 / 1.71 / 1.98	Rec Site, Road	Recreation Site, Salmonid Habitat, Forest Roads and Bridges, Farm & Feedlot, Rural Roads, Douglas Lake Road, Douglas Lake

* A dam is present, but the existing dam information is not recorded.

‡ Values recorded for Dam Cost by Dam Height ($/$m^3$) represent the estimated cost per cubic meter of storage added for each dam height that was modeled, listed in ascending order from 1 meter up to the maximum assessed height.