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Technical Memorandum

DATE: October 20, 2020

TO: Ron Storie, Director of Community Services
Thompson-Nicola Regional District

FROM: Sonya Oetterich, M.Sc., B.I.T.
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RE: **STUMP LAKE WATER LEVEL CONTROL STRUCTURE**
Environmental Overview Assessment
Our File 2755.008-300

1. Introduction

Stump Lake is located in the south-central interior of BC, approximately 40 km south of Kamloops and 40 km northeast of Merritt (Figure 1). Since 2017, lake levels have risen to elevations not seen in the recent memory. The elevation of the existing outlet channel cannot maintain lake levels below the elevation of some properties. This has resulted in flooding of private properties and other infrastructure around the lake since 2018. As a result of the higher lake levels, water has begun to flow into the outlet channel after several decades of being dry.

Thompson-Nicola Regional District (TNRD) retained in Kerr Wood Leidal Associates Ltd. (KWL) in fall 2020 to complete a water balance study and develop a conceptual design for the lake outlet structure. Following on from this work, TNRD retained KWL to conduct an Environmental Overview Assessment to identify key environmental components that may be impacted by changes in lake levels as a result of a modified outlet structure. The objectives of the EOA are:

1. to summarize, at a high level, existing environmental conditions in and around Stump Lake;
2. to identify key environmental changes that may result from lake drawdown; and
3. to prioritize next steps to move forward with the project.

Additional details on hydrological modeling for Stump Lake and proposed lake outlet design are provided in the Stump Lake Water Balance and Outlet Conceptual Design Report (KWL 2020).

2. Methods

High-level information on historic and current conditions in and around Stump Lake were gathered through desktop review and a field visit. This information informed the completion of this Environmental Overview Assessment and aided in identifying potential impacts of the proposed changes to lake levels.

Desktop Review

A desktop review was conducted to gather all available information on historical lake conditions, fish presence and stocking, recent lake conditions, and anecdotal observations. Resources included:

- Historical records;
- Fishing records and observations;
- Provincial databases including iMap BC, Habitat Wizard, and EcoCAT; and
- Consultation with local Provincial biologists.

Field Visit

A field visit was conducted on October 7, 2020 to conduct a high-level assessment of site conditions. This field survey included assessment of:

- Riparian vegetation conditions along the Stump Lake shoreline;
- Potential spawning habitat and fish access in Stumplake Creek upstream of the lake;
- Potential spawning habitat in the outlet channel and Stumplake Creek immediately downstream of the lake;
- Potential spawning habitat in Stumplake Creek downstream of the Highway 5A culvert;
- Flow conditions and potential spawning habitat in Stumplake Creek downstream of the confluence with Peter Hope Creek; and
- Potential suitable habitat conditions for species of conservation concern.

3. Historical Context

Stump Lake likely formed in the first half of the 18th Century, when a spruce swamp filled with water during a very wet year. It has been hypothesized that the outlet to Stumplake Creek may have been blocked by an earthquake or minor land tilt (Balf et al. 1978). The lake has a history of slowly flooding and receding every 20–25 years (BCHA 1983). In the 1870s, settlers deepened the outlet channel to support downstream irrigation practices (BCHA 1983).

Lands surrounding the lake, except for Mineral Hill, are a part of the Agricultural Land Reserve. The first subdivision of this land was approved in 1974. Further residential development continued around the lakeshore. Stump Lake Ranch was sold in 1998 to a developer who converted shoreline lands into properties that allowed for residential dwellings while maintaining cattle grazing functions for 25 years as required by the Agricultural Land Commission (GCC BC 2001).

Stump Lake has a long history of fish stocking in support of a recreational fishery. The lake was first stocked with cutthroat trout (*Oncorhynchus clarkii*) in 1911. Fish stocking began again in 1955 when rainbow trout (*Oncorhynchus mykiss*) were introduced and have been stocked annually since then. Stocking of kokanee (*Oncorhynchus nerka*) began in 1976 and has continued every year hatchery stock are available. Brook trout (*Salvelinus fontinalis*), a species native to eastern Canada, were experimentally stocked in the 1980s during a period of elevated pH. However, the species did not respond well to the alkaline conditions and has not been stocked since (BC MOE 2001).

In 1957, fish were eradicated from the lake as a fisheries management technique. Limited details are available on this event. However, based on other such projects in the 1950s and 1960s, this was likely done to clear the lake of northern pikeminnow (*Ptychocheilus oregonensis*), a non-sport fish that can compete with stocked sport fish, and was likely done using rotenone. Northern pikeminnow have not been documented in the lake since before the fish removal.

4. Existing Conditions

In recent years, with higher water levels and lower pH, Stump Lake has become a popular destination for anglers and other recreational users. Most of the lake is open for fishing, apart from a fisheries closure zone (January 1 to May 31) in the northeastern corner of the lake in the vicinity of Stumplake Creek. Recreational use includes boating and camping with three boat launches on the west bank of the lake, accessible from Highway 5A, and one provincial recreation site.

Land use surrounding Stump Lake is predominantly ranching and other agricultural practices. As such, water conservation and management are key to supporting the farmers in the area that rely on the Stump Lake watershed for water resources. There are also a number of residential dwellings along the north and west shoreline.

4.1 Existing Water Use

Existing water use in the Stump Lake watershed is predominantly in support of irrigation and other farming practices. Of the 31 water licenses in the watershed, 19 licenses are for withdrawals upstream of Stump Lake, specifically from Stumplake Creek and Frisken Creek, and eight are for withdrawals Stumplake Creek, between the outlet of Stump Lake downstream to Nicola Lake. The remaining four water licences are for withdrawal directly from Stump Lake (Table 1).

Table 1. Existing Water Licenses in Stump Lake Watershed

Licensee	Watercourse	Purpose	License No.	Withdrawal Amount
Stump Lake				
Stump Lake Ranch & Cattle Co. Ltd.	Stump Lake	Irrigation	C128242	123348 m^3/year
		Conservation: Use of Water	C128240	0.11327 m^3/sec
Fish & Wildlife Branch (Kamloops Fisheries Branch)		Conservation: Construct Works	C066988	163.65924 m^3/day
Private Property Owner		Domestic	C121261	2.27305 m^3/day

Licensee	Watercourse	Purpose	License No.	Withdrawal Amount
Upstream[1]				
Private Property Owner	Stumplake Creek	Irrigation & Stream Storage: Non-Power	C130950	55506.6 m^3/year
Frolek Cattle Co.		Irrigation	F008814	348704.796 m^3/year
		Domestic		6.81914 m^3/day
		Irrigation	F008816	286784.1 m^3/year
		Domestic		6.81914 m^3/day
		Irrigation	F008817	394096.86 m^3/year
		Domestic		6.81914 m^3/day
		Irrigation	C026253	308370 m^3/year
			C026252	61674 m^3/year
		Stream Storage: Non-Power	C130941	986785.472 m^3/year
			C130945	370044 m^3/year
Stump Lake Ranch and Cattle Co. Ltd.	Stumplake Creek	Irrigation	C128249	266184.984 m^3/year
		Stream Storage: Non-Power	C130553	493392 m^3/year
		Irrigation	C130508	34697.84459 m^3/year
		Stockwatering		2.27305 m^3/day
		Conservation: Construct Works	C130491	0.00459 m^3/sec
		Irrigation & Stream Storage: Non-Power	C130948	129515.5932 m^3/year
	Frisken Creek	Irrigation	C123447	75242.28 m^3/year
		Stream Storage: Non-Power		68211.444 m^3/year
		Conservation: Storage	C130544	0.0195 m^3/sec
		Conservation: Use of Water		246688.992 m^3/year
		Irrigation	C123447	75242.28 m^3/year
		Stream Storage: Non-Power		68211.444 m^3/year
Thai Gems Inc.	Frisken Creek	Irrigation	C123446	13074.888 m^3/year
		Stream Storage: Non-Power		11841.408 m^3/year
Macmillan Lecky Investments Ltd.		Irrigation	C123445	79682.808 m^3/year
		Stream Storage: Non-Power		72158.58 m^3/year
Private Property Owner		Irrigation	C123444	49832.592 m^3/year
		Stream Storage: Non-Power		45145.368 m^3/year

Licensee	Watercourse	Purpose	License No.	Withdrawal Amount
Downstream[2]				
Gerard Guichon Ranch Ltd.	Stumplake Creek	Stream Storage: Non-Power	C067142	55506.6 m^3/year
			C056311	18502.2 m^3/year
		Irrigation	C056310	18502.2 m^3/year
			C056308	55506.6 m^3/year
			F011586	61674 m^3/year
	Peter Hope Creek[3]	Irrigation	C112173	152334.78 m^3/year
		Stockwatering		45.4609 m^3/day
	Moore Spring[3]	Irrigation	F013302	24669.6 m^3/year
Gerard Guichon Ranch Ltd. and Ducks Unlimited Canada	Stumplake Creek	Conservation: Construct Works	C067143	Total demand for purpose

Source: iMap BC (Government of BC 2020a)
1 – Upstream of Stump Lake to Palmer Meadows Lake
2 – Downstream of Stump Lake to Nicola Lake
3 – Tributary to Stumplake Creek

4.2 Existing Environment

Stump Lake and the surrounding valley are set in the Bunchgrass Very Warm Hot (BGxw1) biogeoclimatic zone. Mineral Hill, at the south end of the east bank of the lake, is within the Ponderosa Pine Very Dry Hot (PPxh2) biogeoclimatic zone (FLNRORD 2016).

The main inflow sources feeding the lake are surface runoff and groundwater generated within the lake's watershed including the main tributary, Stumplake Creek, and precipitation on the lake surface. The lake is typically iced over from November until mid-April, de-icing earlier than most lakes in the area due to strong north-south winds along the main axis of the lake. Given the location of the lake and formation of ice on the surface, Stump Lake is likely holomictic dimictic (i.e., mixes completely twice a year – spring and fall). Based on historic bathymetry data the lake has a maximum depth of 21.3 m, average depth of 11.6 m, and surface area of approximately 780 ha (BC MOE 1988). However, these parameters fluctuate greatly with water levels.

Water Chemistry

Stump Lake has a relatively high pH when compared to other freshwater lakes in the area. Based on available data, pH has varied from 8.7 to 9.3, with pH changing based on sampling year and increasing with lake level (Godin et al. 1994, BC MOE 2001). In general, it is thought that fisheries productivity increases at higher water levels, likely due to decreased pH and improved water chemistry (Jim Arner, pers. comm.), and decreases when water levels recede. For example, experimental stocking of rainbow trout adapted to alkaline conditions (i.e., high pH) in the early 1990s noted a decrease in angler days and catch per unit effort and recorded the lake's area as 666 ha (Godin et al. 1994). This decline in fisheries success was thought to be a result of a cyclical drop in water levels that occurred at that time.

Fish and Fish Habitat

Stump Lake

Five freshwater fish species are known from Stump Lake (WSC 120-246600-53700; Table 2). The lake has a long history of being stocked with sport fish, most consistently rainbow trout, followed by kokanee. Four of the five species documented in Stump Lake were historically stocked. The only non-stocked native species known from the lake is prickly sculpin. Despite the presence of a fisheries closure zone, shore spawning by any species has not been observed in this area or elsewhere in the lake (Jim Arner, pers. comm.).

Table 2: Fish Species Documented in Stump Lake and Stumplake Creek

Common Name	Scientific Name	Stump Lake[1]	Stumplake Creek	Comments
Kokanee	*Oncorhynchus nerka*	X	X	Stocked when available since 1976.
Rainbow trout	*Oncorhynchus mykiss*	X	X	Stocked virtually annually since 1955.
Cutthroat trout	*Oncorhynchus clarkii*	X		Last stocked in 1911 and last documented occurrence in 1995.
Brook trout	*Salvelinus fontinalis*	X		Last stocked in 1990 and last documented occurrence in 1993.
Prickly sculpin	*Cottus asper*	X		Not stocked.

Source: Habitat Wizard (Government of BC 2020b)
1 – Northern pikeminnow (*Ptychocheilus oregonensis*) was present prior to the lake rehabilitation undertaken in fall 1957.
No documented fish occurrences in Frisken Creek, Kullagh Creek, or any of the unnamed watercourses flowing into Stump Lake.

There are two large marsh areas along the lakeshore at the inlet (north) and outlet (south) to the lake. Emergent vegetation included rushes, sedges, and grasses with willows along the border of the marsh areas. These areas of littoral habitat provide inputs of nutrients and detritus which fuel lake productivity and provide refuge and feeding areas for juvenile fish. Limnetic habitat (i.e., open water areas) within Stump Lake were not examined as a part of this field investigation due to timing and logistic constraints.

Riparian vegetation is limited on the west shoreline due to open grassland character of the land in the area, historic clearing, and the recent expansion of the highway. Riparian forest has been flooded in areas along the eastern shoreline.

Stumplake Creek Upstream of Lake

Stumplake Creek above Stump Lake was surveyed from Old Kamloops Road downstream to the north end of the lake on October 7, 2020. This section of the creek had a channel width of 2 m, riffle-pool morphology, average gradient of 0.3%, and the substrate was predominantly cobbles with large gravel. Substrate in this length of stream had a thick layer of periphyton in many areas, indicating high nutrient inputs – likely a combination of decomposing salmon carcasses and agricultural inputs. Flow dissipated moving downstream towards the lake, likely due to infiltration into porous substrate with limited fines (i.e., cobble). Dry pools with hundreds of dead fish (trout, kokanee, sculpin) were observed near the downstream end. Many redds were observed along this length, however the substrate size was not suitable for spawning and interstitial spaces may be clogged by periphyton leading to marginal egg survival. Many spawner carcasses were observed along this length and two spawners were observed holding in a pool. Stumplake Creek appears to dissipate into a marsh at the north end of the lake. No defined outlet channel into Stump Lake was observed. This likely limits the movement of fish upstream into the channel, especially when creek flows and lake levels are low.

Stumplake Creek Downstream of Lake

No spawning or potential spawning habitat was observed on Stumplake Creek between the lake outlet channel and the Highway 5A culvert on October 7, 2020. The channel width was 4 m with an increased gradient (6%). The substrate was predominantly vegetated soils with rare exposed mineral substrate. Rushes were rooted in the channel substrate, indicating the channel has not been active for some time. It is unclear how long it would take for suitable spawning habitat to establish in this reach.

Kokanee spawning was observed immediately downstream of the Highway 5A culvert on Stumplake Creek on September 23, 2020 and October 7, 2020. The spawning habitat was not optimal, but spawning will likely be successful.

Stumplake Creek was surveyed downstream of the confluence with Peter Hope Creek on October 7, 2020. The channel width was 2 m with a gradient of 4%; the substrate was predominantly cobble with large gravel. At the time of the survey, Stumplake Creek provided the larger proportion of flow. However, Peter Hope Creek likely feeds Stumplake Creek when Stump Lake is not overflowing into the outlet channel as there is no vegetation established in the channel substrate. The substrate is predominantly large cobbles, which is unsuitable spawning habitat. Peter Hope Creek had marginally suitable spawning habitat near the confluence.

4.3 Species of Conservation Concern

A search of element occurrence records on the BC Species and Ecosystem Explorer and within BC Conservation Data Centre databases returned three publicly available element occurrences within 5 km of Stump Lake (Table 3). A masked occurrence[1] was also documented within 5 km of Stump Lake; however, the species will not be discussed further as it is not likely to be adversely affected by changes to the lake level.

Table 3: Species of Conservation Concern within 5 km of Stump Lake

Common Name	Scientific Name	BC List	*Species at Risk Act* Status	Comments
Great Basin Spadefoot	*Spea intermontana*	Blue	Threatened	Core critical habitat east of the NE corner of Stump Lake[1] Sagebrush steppe
Lewis's Woodpecker	*Melanerpes lewis*	Blue	Threatened	Strong site fidelity
Suksdorf's Lupine	*Lupinus bingenensis var. subsaccatus*	Unknown	No Status	Grasslands and sagebrush steppe

Source: CDC Species and Ecosystems Explorer (Government of BC 2020a), iMap (Government of BC 2020b)
A masked occurrence was documented within 5 km of Stump Lake; however, the species is not likely to be adversely affected by changes to the lake level.
1 – ECCC 2017a

[1] Masked occurrences may be secured due to the species or ecosystems being susceptible to persecution or harm, or for proprietary reasons.

Great Basin Spadefoot

The great basin spadefoot (*Spea intermontana*) is a species of nocturnal amphibian adapted to the dry conditions of sagebrush flats. The species breeds from spring to summer (April to July) in shallow (< 1 m) temporary or permanent pools, attaching eggs to emergent vegetation or placing eggs on the bottom of the pool. Metamorphosis is typically complete within 1–2 months after egg laying. Individuals typically hibernate and take refuge in burrows of small mammals or dig their own burrow in loose soil (South Interior Reptile and Amphibian Working Group 2017). Marsh habitat at the north and south boundaries of Stump Lake may provide areas of suitable breeding habitat for the great basin spadefoot.

Lewis's Woodpecker

The Lewis's woodpecker (*Melanerpes lewis*) typically prefers open ponderosa pine (*Pinus ponderosa*) forests and riparian woodlands. Dead and downed woody debris are important habitat features for nest cavities, perch sites, and foraging of insects. Nesting pairs often return to the same nesting site year over year. Identification and protection of nesting sites is important to minimize impacts to individuals (ECCC 2017b). Multiple potentially suitable ponderosa pine snags and trees were identified along the banks of Stumplake Creek between the lake outlet channel and Highway 5A culvert.

Suksdorf's Lupine

Suksdorf's lupine (*Lupinus bingenensis var. subsaccatus*) is a vascular plant adapted to dry conditions of grassland and sagebrush steppe habitats. As with many plant species of conservation concern, there is little information available on the species.

5. Considerations for Lake Drawdown

Potential impacts to the lake, surrounding land and waters, and species that use these habitats must be considered when identifying an approach to maintain drawn down water levels in Stump Lake.

5.1 Potential Impacts to Stump Lake

Potential impacts to Stump Lake as a result of lake drawdown include changes to water chemistry and loss of littoral habitat. Transmission of invasive species was also considered but determined to be highly unlikely.

Water Chemistry

High lake levels in Stump Lake have previously been associated with decreased pH and increased fisheries productivity. Manipulation of lake levels to prevent flooding of properties has the potential to reduce the magnitude and duration of higher lake levels. Conversely, extended periods of low water levels in Stump Lake have been associated with increased pH and decreased fisheries productivity. Depending on how water levels are managed, the magnitude and duration of low water levels may or may not be increased with lake level control. At this time, other controls on water chemistry are not currently known.

Loss of Littoral Habitat

The littoral zone is the nearshore area where emergent vegetation grows. It acts as an interface between the terrestrial upland and limnetic or open water zone. The littoral zone is typically highly productive and provides inputs of dissolved oxygen and nutrients into deeper waters. In addition, the littoral zone is important habitat for waterfowl and provides refuge and feeding areas for juvenile fish. Limits to the current range of water level fluctuations will likely result in loss of littoral habitat.

Aquatic Invasive Species

Spread of aquatic invasive species into Stump Lake could potentially be a result of improved surface water connectivity to Stumplake Creek downstream of the lake via the outlet channel. Yellow perch (*Perca flavescens*) is a known aquatic invasive species in other BC interior watersheds. However, while present in the upstream watershed, yellow perch has not yet been documented in Nicola Lake, and the proposed culvert between the Stump Lake outlet structure and the outlet channel is not currently designed to be fish passable. As a result, introduction of this species to the lake from downstream areas via the outlet channel is not considered to be a risk at this time.

5.2 Potential Impacts to Species at Risk

The great basin spadefoot may breed in shallow areas of Stump Lake with emergent vegetation. Marsh habitat at the north and south boundaries of the lake provide areas of potentially suitable breeding habitat. Decrease in lake levels may result in loss of potentially suitable habitat present at higher lake levels. Considerable changes in water levels and changes to hydrologic patterns has been identified a likely to impact the species particularly when it results in premature drying of breeding habitat prior to complete metamorphosis of tadpoles (South Interior Reptile and Amphibian Working Group 2017).

Potential impacts to Lewis's woodpecker and Suksdorf's lupine are not expected as a result of the changes to the lake levels. Potential impacts during construction of the modified outlet structure can be mitigated through proper timing, monitoring, and avoidance of impacts to key habitat features.

5.3 Potential Impacts to Surrounding Waterways

The outlet channel of Stump Lake is now receiving flow from the lake for the first time in several decades. Abundant spawning of kokanee was observed in this channel (downstream of the Highway 5A culvert) as a result of rewatering and reconnection to the lake. If spawning habitat becomes established in the reach upstream of the highway before changes to the outlet structure of the lake, there may be greater impacts to fish and fish habitat as a result of decreased outputs from Stump Lake into Stumplake Creek.

Potential impacts to the reach of Stumplake Creek upstream of the lake are expected to be minimal. At the current high-water levels, upstream fish passage is limited due to lack of a channel through the marsh and porous substrate that does not retain flow.

6. Recommendations for Next Steps

In order to move forward this project forward, more in-depth investigations are needed to quantify the potential ecological impacts of changes to the hydrologic regime of Stump Lake and Stumplake Creek and potential impacts to fish and fish habitat that may result from installation and operation of the proposed outlet structure. The following have been identified as priority next steps if the long-term solutions outlined in the water balance study were to proceed:

1. Prepare an Environmental Flow Needs Assessment for the installation and operation of the proposed outlet structure. This should include ongoing consultation with the Ministry of Forests, Lands, Natural Resource Operations, and Rural Development (the Ministry) to inform the scope, methods, and focus of the assessment.
2. Conduct a detailed aquatic effects assessment to quantify the potential impacts to fish and fish habitat that may result from installation and operation of the proposed outlet structure. This assessment will contribute to a Request for Review application to be submitted to Fisheries and Oceans Canada (DFO) under the federal *Fisheries Act*. Methods for assessing impacts may include:
    - Changes to the percent littoral zone or shoreline development index as a proxy for changes in fisheries productivity. This may require updated bathymetry of Stump Lake.
    - Assessing the changes in flow regime in the outlet channel likely to occur as a result of installation and operation of the proposed outflow structure compared to the existing uncontrolled condition.
    - Further investigation into the degree of change in water chemistry that may result from decreased water levels.

If the short-term solution (pumping) were to proceed, consultation with both the Ministry and DFO is still needed but will likely be less intensive than what is needed for the long-term solution. The level of detail required for review should be determined through consultation with regulators.

Ongoing communication with both the Ministry and DFO is recommended to ensure all necessary knowledge gaps are addressed and that further work is sufficient to meet senior regulatory review and licencing requirements.

Closure

We hope this technical memo meets your needs at this time. If you have any questions, please do not hesitate to contact Patrick Lilley at (604) 812 2578 or <PLilley@kwl.ca>.

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Attachment.: Figure 1: Area of Interest

Statement of Limitations

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Revision History

Revision #	Date	Status	Revision Description	Author
0	October 20, 2020	FINAL	Issued as final for client copy	SBO

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Thompson Nicola Regional District

Stump Lake Environmental Overview Assessment

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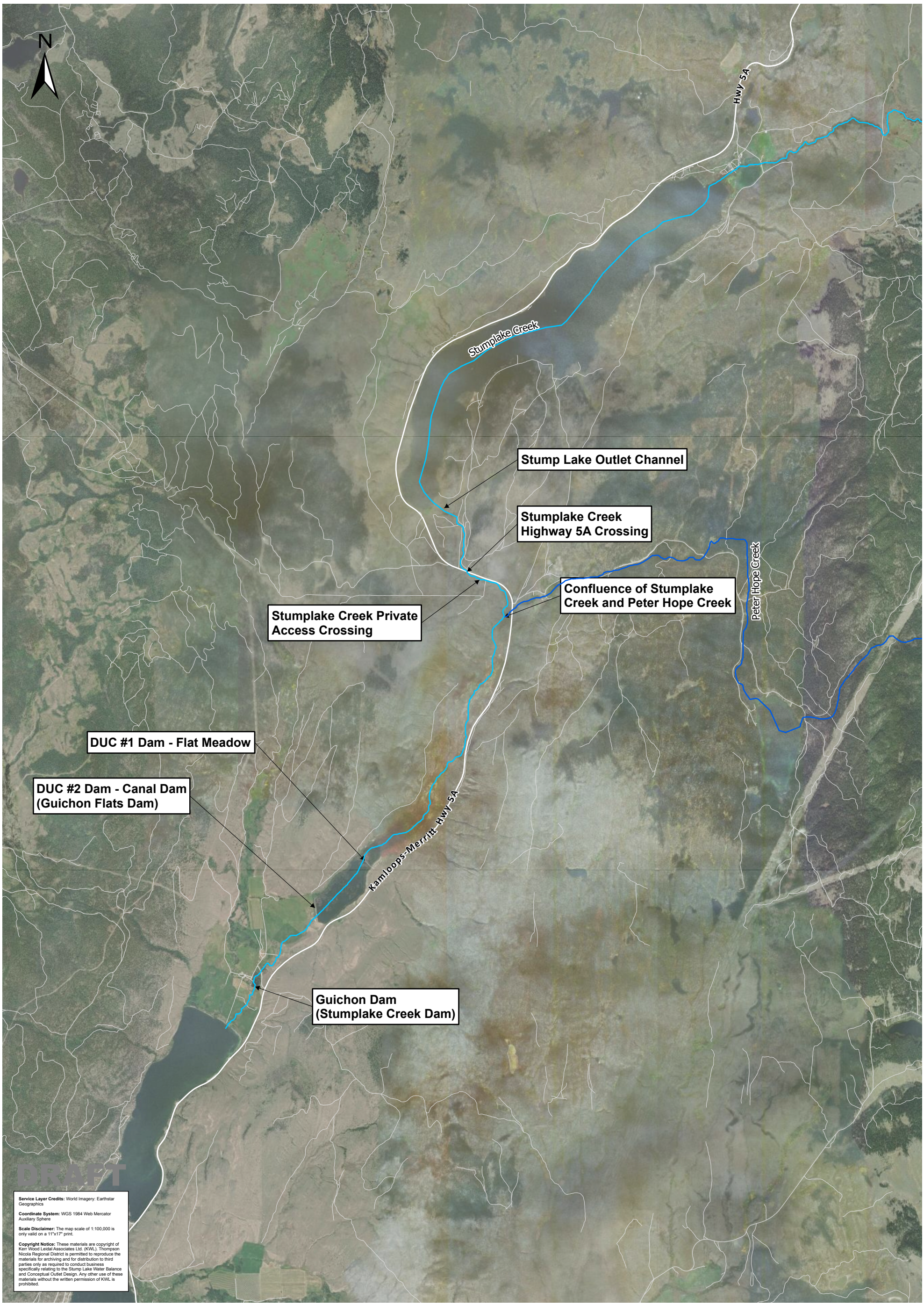

Service Layer Credits: World Imagery: Earthstar Geographics

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere

Scale Disclaimer: The map scale of 1:100,000 is only valid on a 11"x17" print.

Project No.	2755-008
Date	October 2020
Scale	1:100,000

0 1 2 4 Kilometers

Areas of Interest

Figure 1