GEOMORPHIC
CONSULTING

Xwulqw'selu Sto'lo / Koksilah River Environmental Flow Assessment

Prepared For:
COWICHAN WATERSHED BOARD
4335 Riverside Drive
Duncan, BC Canada
V9L 6M8

Prepared By:
GEOMORPHIC CONSULTING
3820 Alfred Avenue
Smithers, BC Canada
V0J 2N0
+1-250-643-2040

March 4, 2022

CWB – 2022 – 1 – Rev. 005

Executive Summary

Water holds a prominent place in culture, science, policy, community values and recreational pursuits. Yet, it remains under valued in comparison to the role that it plays in society and in the cycle of life in the Cowichan Valley, British Columbia. To explore the importance of water in the Xwulqw'selu Sto'lo (Koksilah River), an *Environmental Flow Assessment* (EFA) was performed.

To investigate the environmental flows of the Koksilah River, several assessments, each complementing one another, were conducted between April and October of 2021. The three assessments included (i) an evaluation of channel condition, (ii) an evaluation of water supply, and (iii) an evaluation of instream habitat-flow relationships for rearing Coho and Steelhead fry in addition to looking at Chinook passage through riffles.

Chapter 1 provides an overview of environmental flows to contextualize the three components of the EFA that were performed. This chapter frames *environmental flows* first in the global context with the establishment of the *Brisbane Declaration* (2007), then by the Global Call to Action on *Environmental Flows* (2017), and finally, by their history and application in riverine environments.

Chapter 2 presents the first component of the EFA which was an assessment of channel and riverscape condition. This assessment was accomplished through a Meso-Habitat Evaluation (MHE) for the lower Koksilah River, a 5,775 m segment upstream of the Island Highway bridge. The MHE characterized riverscape condition within this segment of the Koksilah River.

The main outcome of the MHE was defining the evolutionary stages of the stream channel and recognizing the associated ecological value (current conditions) is very low. These degraded / ecologically depleted evolutionary stream stages are the legacy of land-use. To contextualize the MHE results a peak-flow assessment of the Koksilah River was performed. Peak-flow conditions were investigated with the use of the Canadian Climate Normal Windows (e.g., 1951-1980. 1961-1990, etc.) for potential changes in the timing or magnitude of peak flows due to climate change.

Chapter 3 presents the second component of the EFA which was a desktop scoping exercise to investigate water supply and current *environmental flow needs (EFN)*. The EFA was conducted using five different hydrologic (historic), *standard-setting,* EFN methods. Each method relied on Water Survey of Canada (WSC) hydrometric data (1960-2021). To contextualize water supply impacts a low-flow assessment of the Koksilah River was performed. Low-flow conditions were investigated with the use of the Canadian Climate Normal Windows for potential changes in the timing or magnitude of peak flows due to climate change.

The main finding of the EFN scoping exercise was the sheer magnitude of water supply deficits. The scoping exercise focused on the life history needs of summer rearing Coho and Steelhead fry. Results from the assessment identified profound EFN deficits in the Koksilah River between April and November. Water deficits in the Koksilah River ranged between 250% and 950%.

Chapter 4 presents the third component of the EFA which is a field-based Instream Flow Incremental Methodology (IFIM) employed to explore instream habitat-flow relationships for rearing Coho and Steelhead fry along with passage of adult Chinook through riffles.

Using the habitat-hydraulic model, five main investigations were made that included: (i) max rearing potential for Coho fry, (ii) max rearing potential for summer Steelhead fry, (iii) insect production in riffles, (iv) fine sediment deposition in glides, and (v) adult chinook passage through riffles. From these five investigations a multi-value environmental flow range was presented.

To maximize aquatic health, and to plan for sustainable salmon and Steelhead populations in the Koksilah River, meeting or exceeding the following summer baseflows could be considered as essential:

1. Coho fry: 0.25 - 0.75 m3/s | 2.5 - 7.5% MAD
2. Steelhead fry: 0.25 - 0.7 m3/s | 2.5 - 7% MAD
3. Insect production: 1 - 6 m3/s | 10 - 60% MAD
4. Siltation of glides: >0.3 m3/s | >3% MAD
5. Chinook passage: >1.0 m3/s | >10% MAD

Chapter 5 presents a synthesis of each chapter and recommends next steps. The most notable outcome from the Meso-Habitat Evaluation was revealing the degraded evolutionary stage(s) the lower Koksilah River. These findings are sharply contrasted by the historical knowledge of healthy ecosystems and thriving salmon runs in the Koksilah River. Therefore, this speaks towards the need to restore the riverscape [floodplain, riparian, stream] in order to increase the available environmental water / environmental flows.

Collectively, the results from the three components of the EFA speak towards the interplay between *environmental flows* stream restoration, as the study results indicate that during summer low-flow conditions, EFN are not being met for either people or nature. The concluding remarks in Chapter 5 are that the magnitude of these water supply deficits suggests the mechanisms are watershed scale. From this analysis it is suggested that a loss of watershed integrity has destabilised key ecological functions in the Koksilah Watershed. As such, both people and nature are in water deficit for 4+ months of the year.

Problems of this scale are best suited to larger scale processes such as watershed planning processes or watershed management plans that are able to address the mechanisms [to peak flows]. In such processes goals and objectives around the restoration of watershed integrity, ecological function, and riverscape condition would be appropriate. Such a progression would build on the Forest Practices Board's (2018) findings that ‘watershed scale planning is both missing and essential’.

The Xwulqw'selu Sto'lo (Koksilah River) Environmental Flow Assessment was designed to investigate several objectives, including: (1) Coho fry rearing; (2) Steelhead fry rearing; and (3) adult Chinook passage. Next steps that can be taken to address each of the restoration goals presented in Chapters 2-4 include:

1. **Meso-habitat mapping** – Mapping in key tributaries can advance restoration planning and deepen the understanding of habitat condition, stream evolution and restorative goals in those tributaries.
2. **Expanding the Tier 1 EFA -** Adding Indigenous, agricultural and community flow needs would enhance a 'whole of watershed' approach and provide a platform to understand water needs.
3. **Expanding the Tier 2 EFA –** Both validating HSI's and adding bioenergetics suite of tools would each strengthen the scientific understanding of limiting factors in the Koksilah River.
4. **Historical aerial photo analysis** – Reviewing historical aerial photographs can assist with restoration planning by identifying risks and opportunities for restoration design and implementation.
5. **Regional analysis** – Performing a regional analysis would provide an opportunity to compare how different watersheds are responding to precipitation events and land-use impacts as compared to the Koksilah. Further, complementing the peak flow and low flow analyses that were performed.
6. **Watershed Assessment / Water Balance** – Understanding the mechanisms behind extreme high flows and low flows will first require an understanding the total water supply (precipitation), followed by an understanding of how precipitation is routed through the Koksilah Watershed (water balance).
7. **Watershed Restoration Plan** – The stated goals of the Watershed Restoration Program, presented in Chapter 2, Section 2.3-2, will never grow stale, and could be adopted directly into a watershed sustainability planning process.
8. **Process-Based Restoration Team** - It is self-evident that the Koksilah River and its tributaries will require on-going, process-based restoration / ecological restoration. This is an opportunity to create jobs in stream restoration through the expansion of a Guardian program.