Shovelnose Creek Off-Channel Complex Berm Repair

Recent high discharge events have put valuable off-channel salmonid rearing and spawning habitat at risk in the upper Squamish River. This document is a request for funding to perform the necessary berm repairs to keep the Squamish mainstem out of the Shovelnose Creek restoration complex.

Background

Shovelnose Creek is a tributary to the Squamish River, located at approximately mile 30 on the Squamish Valley Road. In the 1980's, a major debris slide occurred in the Squamish River which damaged the lower reaches of the Shovelnose Creek. Several projects have occurred since then to restore, create and protect the important off-channel habitat:

- 1994 – 400m dyke built to keep Squamish flows (cold and silt-laden) out of Shovelnose Creek
- 1995 – Recovery of 800m channel with rearing, pool and spawning habitat created and complexed
- 1995 – Groundwater channels, infiltration galleries and alcoves excavated, stream enrichment
- 2003 – 1.2km extension channel excavated and complexed with large wood and boulders
- 2007 – Bank stabilization on Squamish River mainstem
- 2009 – 150m of groundwater channels excavated and complexed with large wood and boulders

To this day the highest mean juvenile steelhead densities in the Squamish River are found in the artificially constructed Shovelnose side-channel complex. Historically, Shovelnose Creek met with the Squamish River at approximately mile 33.8 of the Squamish Valley Road but following the above listed restorative efforts, the creek converges with the Squamish at mile 30. In recent years, some of the bottom end (~200m) has been lost due to inundation from the Squamish River mainstem.

Issue

Discharge on the Squamish River has been recorded by the federal Water Office at Brackendale (Since 1922) and on the Elaho River (since 1981). Figure 1 summarizes the historic discharge records for the Brackendale flow gauge and Figure 2 summarizes the Elaho. Of the 5 highest recorded discharge levels on the Squamish River, 3 occurred through the early 1980s and the largest event occurred in October of 2003 at 2630 cubic meters per second (m^3/s). The berm and channel complex has been functioning as designed for 20 years until a recent high rainfall event changed everything.

Three systems drain from Mount Cayley, with Turbid Creek (aka Mud Creek) being the most volatile in terms of amounts of debris depositing into the Squamish River. Similar to large debris torrent

events in the past, sediment loads from Turbid Creek were exacerbated by the long dry summer of 2015. During long, dry summer spells, the edifice rock dries, becomes friable and significant rockfall occurs accumulating in gully channels. The fall rains trigger debris flows sending massive debris torrents downstream towards the Squamish River.

In late September 2015, heightened precipitation, combined with dry, less-permeable surfaces combined to create a massive debris torrent on Turbid Creek that washed out the culvert and Squamish Forestry Service Road, introduced huge quantities of sediment into the Squamish River and temporarily blocked and backwatered the Squamish River.

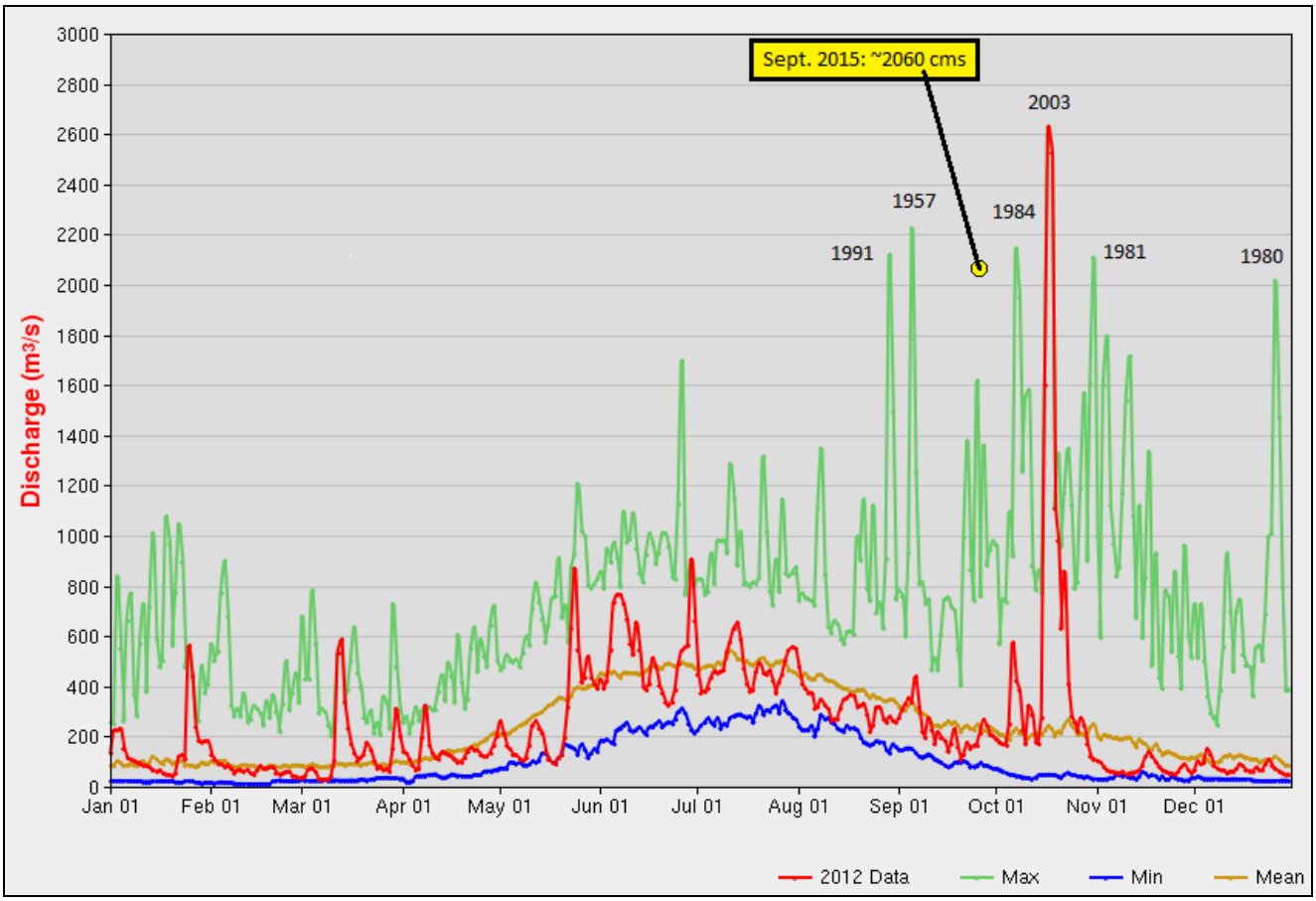

Figure 1: *Historic data for the Squamish River from 1922 to 2012 summarizing the minimum (blue line), mean (brown), maximum (green), and 2012 (red) discharges. For reference, the September 2015 high flow event that triggered the berm breach on the Shovelnose is highlighted in yellow.*

The magnitude of the event that occurred on September 20, 2015 was the sixth highest ever recorded (Figure 1) at the Brackendale water survey gauge dating back more than 90 years but was the highest recorded discharge (Figure 2) on the Elaho dating back 34 years. The Squamish FSR also

washed out in a number of location with particular damage occurring south (downstream) of the Shovelnose Creek tributary to the mainstem.
Once the road re-opened, Steve Rochetta, Ecosystem Specialist from the BC Ministry of Forests, Lands and Natural Resource Operations toured the site to assess damages. He saw significant evidence that the gravel berm, constructed in 1994, had been breached. This information was passed along and a site visit was organized by SSBC directors.

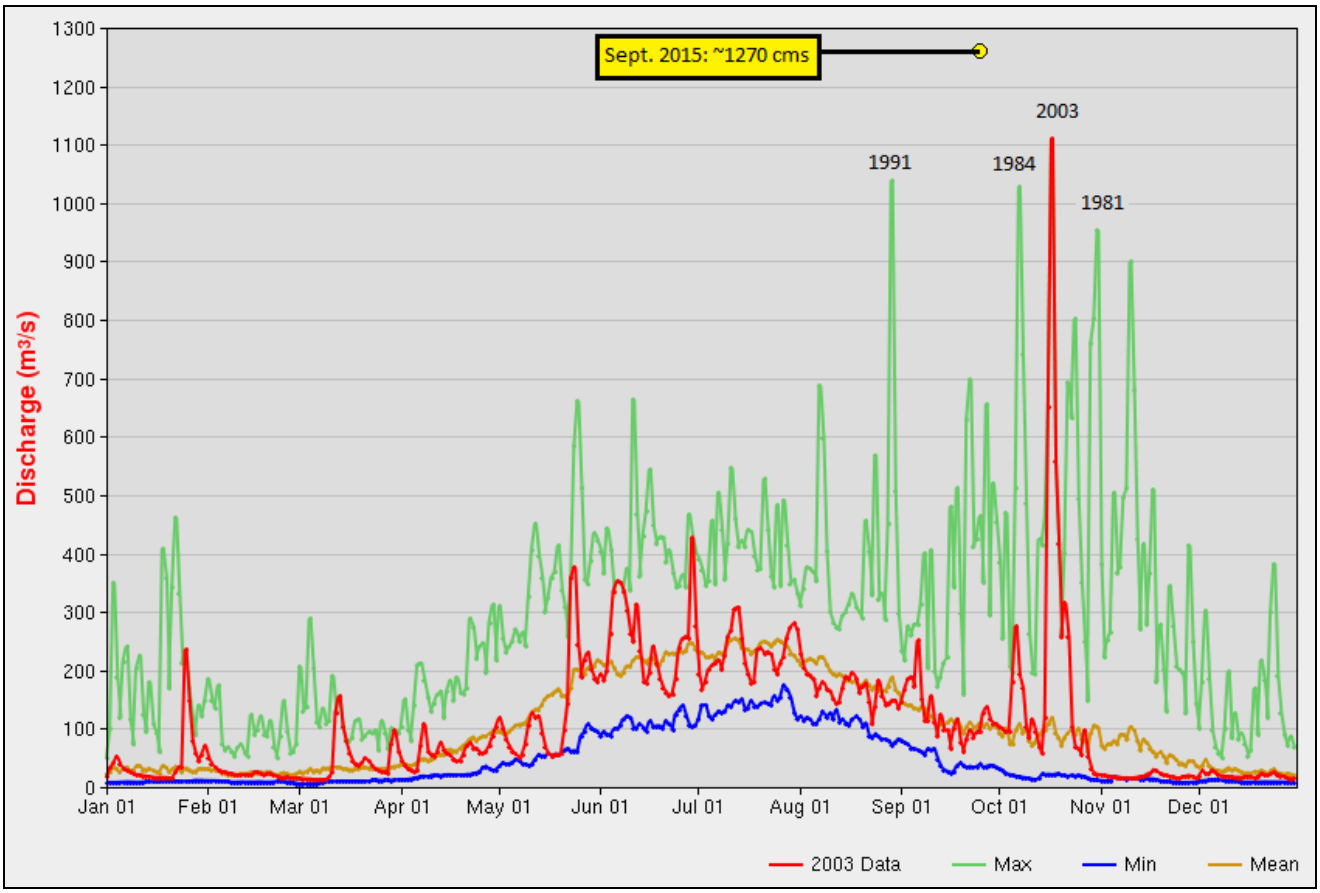

Figure 2: *Historic data for the Elaho River from 1981 to 2012 summarizing the minimum (blue line), mean (brown), maximum (green), and 2012 (red) discharges. For reference, the September 2015 high flow event that triggered the berm breach on the Shovelnose is highlighted in yellow.*

On October 22, 2015, the site was inspected by Al Jonsson and Dave Nanson (DFO), Kenji Miyazaki (MFLNRO), Pat Slaney (biologist who led habitat restoration at Shovelnose in the 90s), Ralf Kroning and Dave Harper (SSBC Directors), and Randall Lewis (Squamish Nation). Figures 3-6 document the observations recorded that day.

Figure 3: *Looking downstream on the Squamish River mainstem showing the gap (exposed rocks) remaining after the high water event over-topped the gravel berm (out of photo to the left).*

Figure 4: *Looking downstream of the berm showing the damage caused when heightened flows from the Squamish River mainstem overtopped the protective berm built in 1994. Despite many trees being pushed over and fine sediment accumulating in depositional areas, the channel survived relatively well with no significant structural weaknesses observed.*

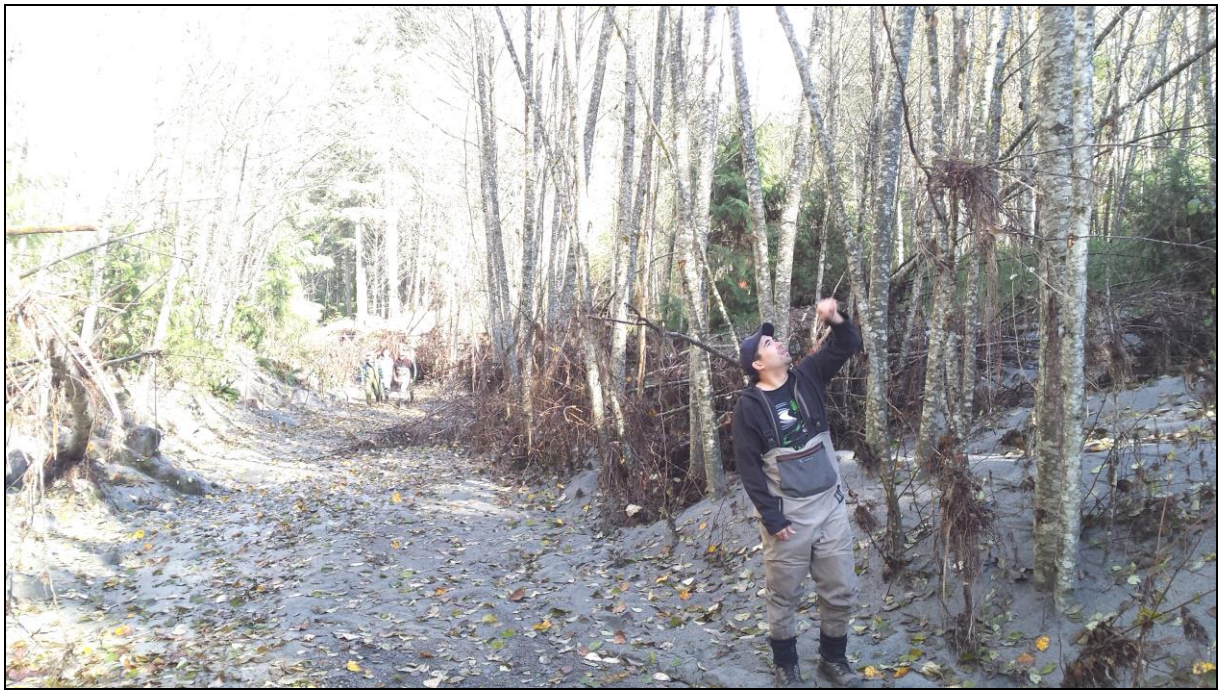

Figure 5: *Leaf debris was observed approx. 8 feet up a tree in this photo. In other areas, evidence of debris was even higher indicating that a wall of water up to 15 feet tall came rushing over the berm and down the channel.*

Figure 6: *Photo of the 'layered' effect left behind in the fine sediments that were deposited along the banks of the off-channel indicate that the water receded very rapidly.*

Assessment of Damage at Berm and in Groundwater Channels

Based on the evidence observed, a significant portion of the flow breached the dyke and began running down through the upstream-most groundwater channel and down the mainstem of the restored reach of Shovelnose Creek. It is evident that the river will routinely breach the dyke in each subsequent high flow event. Over time the bank integrity will continue to unravel, and without corrective action, there is a high likelihood that the entire Squamish River mainstem could be forced through this location. This would be disastrous for the downstream complex; many of you are intimately familiar with the power of the Squamish River.

Other observations noted and discussed while assessing the damage:

- The water that inundated the off-channel complex from the Squamish was a very large event.
- Portions of the berm have eroded away but will still be able to protect the channel downstream in future medium-high discharge events.
- Minor additions to the berm in its current location will be undertaken as a first line of defense.
- Building a larger berm a bit further downstream in the groundwater channel will act to be the major defense against significantly high discharge events now and also into the future. Simply augmenting the berm in its current location will not protect the channel should the Squamish mainstem find a route around the existing berm location.
- The previous access road is still in good condition and only one stream crossing will be required to bring heavy machinery and materials to the site.
- All parties agreed that repairs are required immediately to keep future high flow events from destroying the downstream channels.

Further Assessment Following Upstream Investigation

After conducting the site tour of the damaged berm and Shovelnose off-channel complex, we headed up the Squamish FSR to check on the large tributaries coming off Mount Cayley. Here we pieced together the final pieces in understanding why the berm at the Shovelnose had been breached (Figures 7 and 8). At some point during the high discharge event, there was a massive debris torrent from Turbid Creek. Not only did it take out the culvert and road, but it shot across the Squamish River mainstem, blocking and backwatering the river for an undetermined length of time until it eventually broke over the top. Once the backwatered flow on the Squamish broke through, the debris blockage likely unraveled quickly and the resulting surge of water rushed down the mainstem and over-topped the berm at Shovelnose. This scenario also explains why the fine sediment in the off-channel complex was deposited and why the ‘layered’ effect is present; the water came up quickly and receded quickly.

Figure 7: *Photo looking upstream from the repaired road crossing where Turbid Creek took out the culvert and road in a significant earth-moving, debris torrent. Some of the bigger rocks transported in the event exceeded 6 feet in diameter. Photo taken after much debris had already been removed with an excavator.*

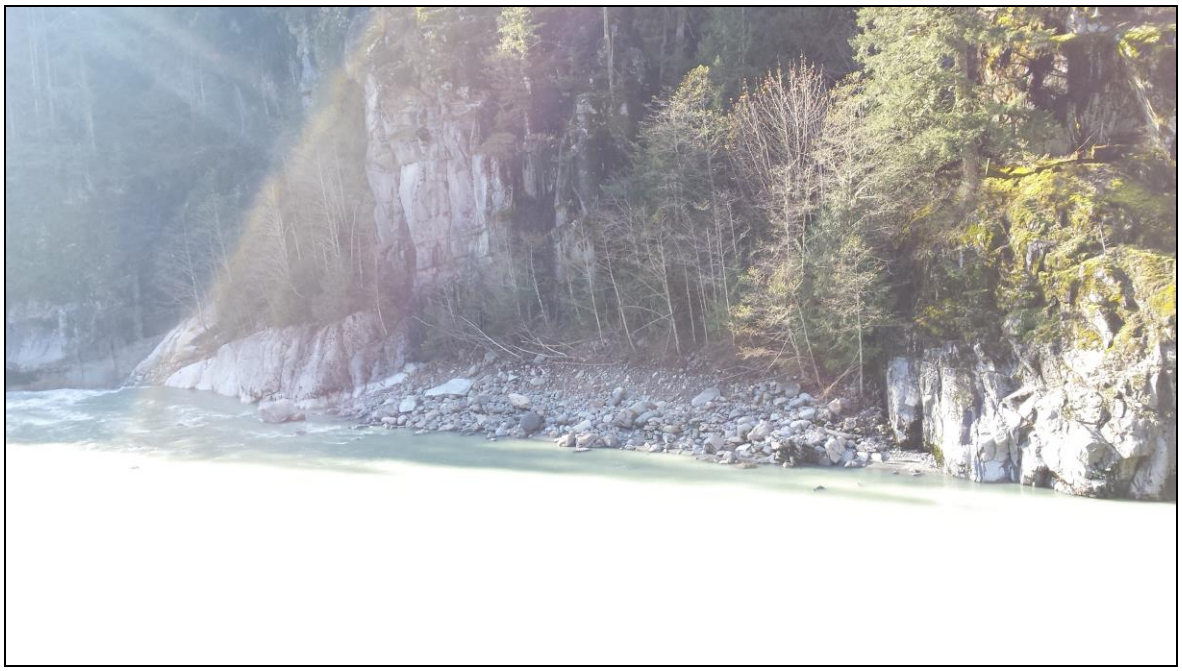

Figure 8: *Looking across the Squamish River mainstem from the confluence with Turbid Creek. The debris torrent that shot down Turbid Creek extended completely across the Squamish. There is still a 20 foot high debris arc visible up the far bank. Based on these observations, it is evident that the debris blocked the mainstem for a period of time before being over-topped and much of the debris carried away downstream.*

Plan for Repairs

Al Jonsson summarized the plan that was discussed at length while on site. The following images (Figures 9 and 10) are the conceptual plans. Prior to conducting the work, surveys will be performed to solidify these plans as we move towards project implementation.

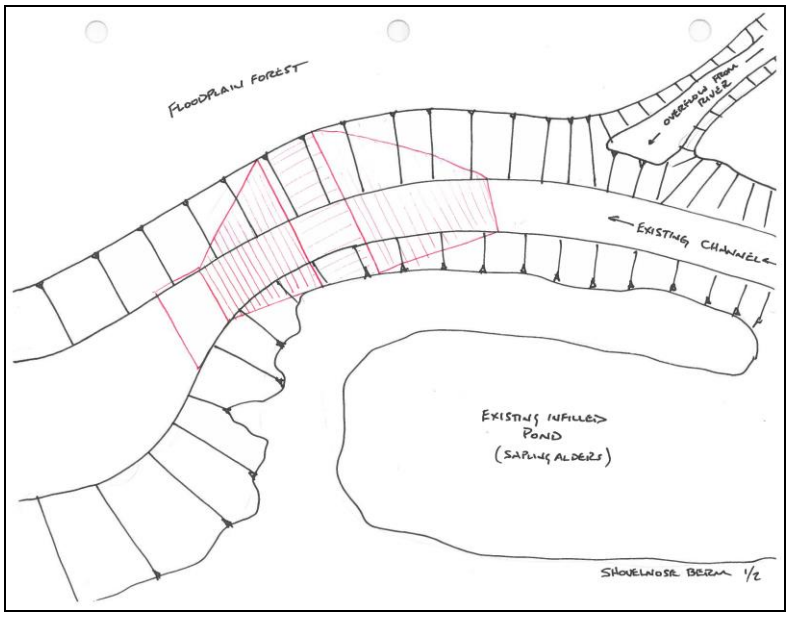

Figure 9: *Proposed location of the new berm to be constructed (red polygon). Locating the berm further from the Squamish River mainstem will ensure that future high flow events are not able to erode past the berm.*

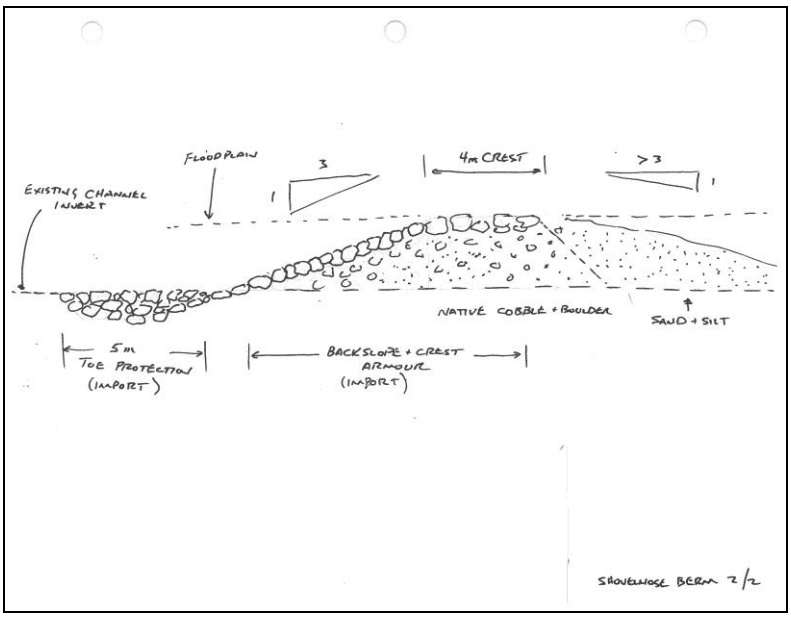

Figure 10: *Proposed design of the berm including the slopes and composition of material needed.*

Budget

Al Jonsson prepared a budget estimate based on the agreed upon design plan.

This budget includes:

- 6.5 days with a 300-series excavator
- 3 days with an articulated rock
- 2 – 600mm HDPE culverts (temporary install)
- 6 truck loads of river gravel (temporary channel crossing)
- 10 truck loads of angular rock (300-900mm diameter)

At typical rates, a best-case budget for construction would be in the neighbourhood of $16,000. Project management and technical support during construction will be provided in-kind. Increasing the project budget to $20,000 will provide a reasonable contingency reserve.

Funding

At the November monthly meeting of the directors of the Steelhead Society of BC, all in attendance were in agreement to contribute to this project. We are seeking partnership funding from a variety of sources to distribute the project costs. Project management and technical supervision during construction will be provided in-kind and additional funding sources will be sought.

If you would like more information, please let me know.

Sincerely,

Brian Braidwood
President, Steelhead Society of BC