British Columbia Conservation Foundation

Stoltz Bluff Sediment Remediation – 2017 Emergency Maintenance Proposal

(drone photo courtesy of Vadeboncoeur Consulting Inc.).

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Introduction:

Stoltz Bluff is an extensive left bank (viewing d/s) deposit of glacial sediment that extends for approximately 600 m at the outside of a natural meander bend on the Cowichan River, 27 km upstream of Cowichan Bay (Fig. 1). Total height of the exposed deposit is about 50–60 m and it consists of nine major strata of distinct sediment textures. A pooled grain size distribution was estimated for this deposit and included 24% gravel and coarser material (>2mm), 21% sand, 37% silt and 17% clay (KWL Associates Ltd. 2005).

Figure 1. Location of Stoltz Bluff on the Cowichan River, in relation to Lake Cowichan and City of Duncan.

Given the bluff's strategic location along the full length of this *Canadian and BC Heritage River* (i.e., approximately half way between Cowichan Bay and Lake), and the long-held economic, cultural and social values of Cowichan fish resources (Burt and Wightman 1997), there had been fisheries agency interest in better managing the annual sediment load from Stoltz since the late 1960s.

Consequently, the primary objective of a potential Stoltz Bluff project evolved over 25 years to become "the effective control of massive sediment transport from the bluff (i.e., 10,000-28,000 m^3/year since 1993; KWL Associates Ltd. 2005), that had been negatively affecting Cowichan River fish habitats and stocks for many kilometres downstream (Burt, Wright and Sheng, 2005; Burt and Ellis 2006)."

Stoltz Bluff Sediment Remediation Project (2006):

Starting in July 2006, under a 30-year BC Park Use Permit (VI0610268), the BC Conservation Foundation (BCCF) coordinated a major sediment remediation project at Stoltz Bluff (Fig. 1). Work included construction of an engineered 600 m rip-rap berm and terrace, complete with a series of bend-way weirs, channel gradient controls and bioengineering treatments designed to move river flows away from the base of the bluff and prevent further bank erosion and major slope failures.

The initial phase of the project took 10 weeks to build, and was supported by a group of seven partners who contributed $0.83M in funds and in-kind construction materials. The provincial Ministry of Environment, Fisheries and Oceans Canada and Cowichan Tribes all formally endorsed the project, and participated in its implementation.

For 10 years following the project's inception, there was a significant improvement in the river's water quality (i.e., TSS and turbidity) and downstream fish habitats (Gaboury *et al* 2012*)*, contributing to incremental gains in annual returns of the river's fall Chinook and Chum salmon stocks, in particular (Figs. 2, 3).

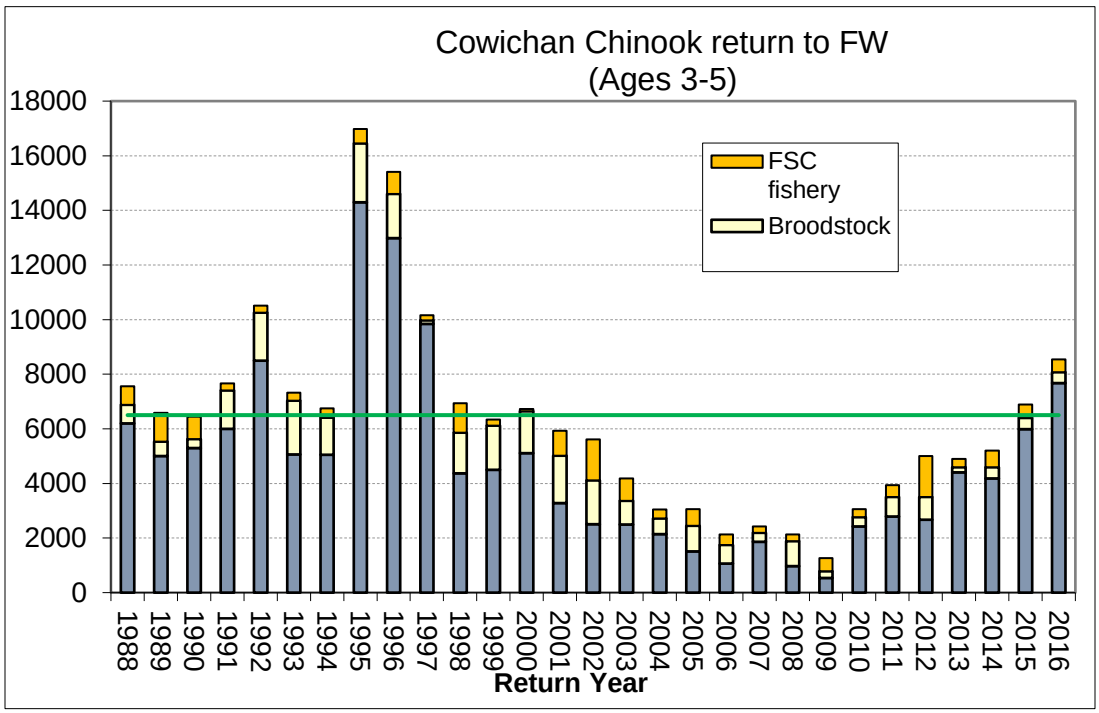

Figure 2. Trend in Cowichan fall Chinook salmon returns from DFO annual escapement estimates, 1998 – 2016. Stoltz Bluff major construction year was 2006.

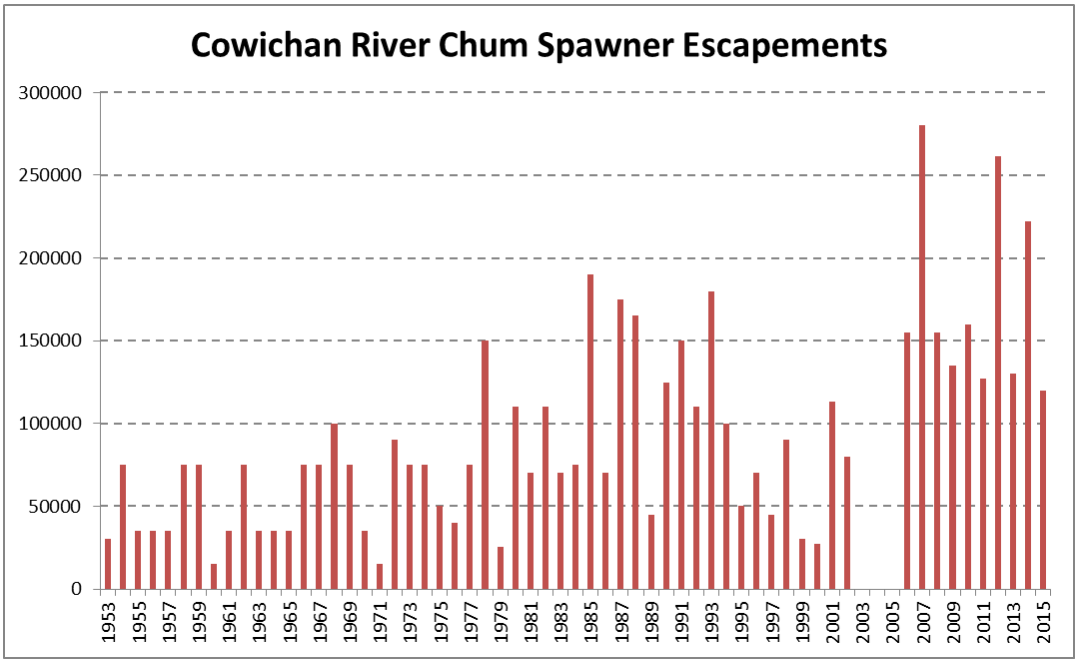

Figure 3. Trend in Cowichan Chum salmon returns from annual DFO escapement estimates, 1953 – 2015. Stoltz Bluff major construction year was 2006. Beginning that year, DFO changed its Chum escapement estimate method from largely visual counts to in-stream Didson sonar technology.

In the past there has been a range of positive views expressed about the project's benefits for wild salmon including those of Wilf Luedke, Chief Stock Assessment Biologist, DFO, Nanaimo (pers. comm.). Moreover, effectiveness monitoring of a suite of 'aquatic health' metrics demonstrated generally improved habitat conditions for fish, stream invertebrates and water quality downstream of Stoltz since the project's initiation in 2006 (Gaboury and Robichaud, 2011; Gaboury *et al*, 2012; Deb Epps, Head, Environmental Quality Section, MoE, Nanaimo, pers. comm.; Ron Irwin, Ass't Shift Engineer, Catalyst Paper Corp., Crofton Mill, pers. comm.).

Stoltz Bluff Project Maintenance:

Since 2008, BCCF has led annual maintenance of Stoltz Bluff, in cooperation with the landowner, BC Parks (Fig. 4). This has generally entailed reinforcing and raising containment berms, excavating sediment ponds, clearing the project's access road and preserving fixed drainage paths, particularly for 'Clearwater Creek,' the largest tributary to Cowichan River through the Bluff and project site.

Up to 2014, the annual cost of Stoltz maintenance was borne entirely by BCCF, using its Living Rivers – Georgia Basin/Vancouver Island program funds. Annual costs typically ranged from $3,500 – $25,000, depending on the magnitude of hillslope sloughing and sediment release during the seasonal wet period (i.e., October – March). However, as Living Rivers' funds were steadily depleted, BCCF began soliciting maintenance funding from other organizations, including the Habitat Conservation Trust Foundation, Catalyst Paper Corp. and the Cowichan

Valley Naturalists Society. This discretionary funding model is not sustainable and is unable to adequately respond to significant slope failure events, such as occurred in late March 2017.

To date, the aggregate cost of Stoltz Bluff remediation and maintenance is estimated at approximately $1.4M, with $0.83M spent on original construction in the summer of 2006. This does not include a sizeable investment in original concept development, construction design, EMP's and regulatory approvals (est. >$100,000).

Figure 4. View looking downstream of primary sediment basin and uppermost check dam,near the end of maintenance excavation on September 17, 2014.

Prelude to Late March 2017 Major Slope Failure:

BCCF conducted two on-site inspections of the Stoltz Bluff project in March 2017. The first was on March 7th which indicated the very wet, cold and extended winter of 2016-17 was taking a heavy toll on slope stability and sediment generation at, and immediately upstream, of the bluff formation (Fig. 5). Sediment containment ponds were at or near capacity, and 'Clearwater Creek' was contributing a heavy, viscous slurry across the access road and into the Cowichan River (Figs. 6, 7). This was despite recent maintenance in September 2016.

In addition, a new (left bank) slope failure immediately upstream of the Stoltz access road was also contributing fine sediment to the river. This new site threatens to become a growing source of water contamination beyond the 'reach' of the existing Stoltz Bluff road system (Fig. 8), complicating opportunities for future remedial treatment.

Figure 5. Sediment containment pond draining 'Clearwater Creek' across Stoltz access road and into the Cowichan River on March 7, 2017.

Figure 6. 'Clearwater Creek" as it entered the Cowichan River on March 7, 2017. The plume of silt-laden water coloured the river for the 27 km to tidewater.

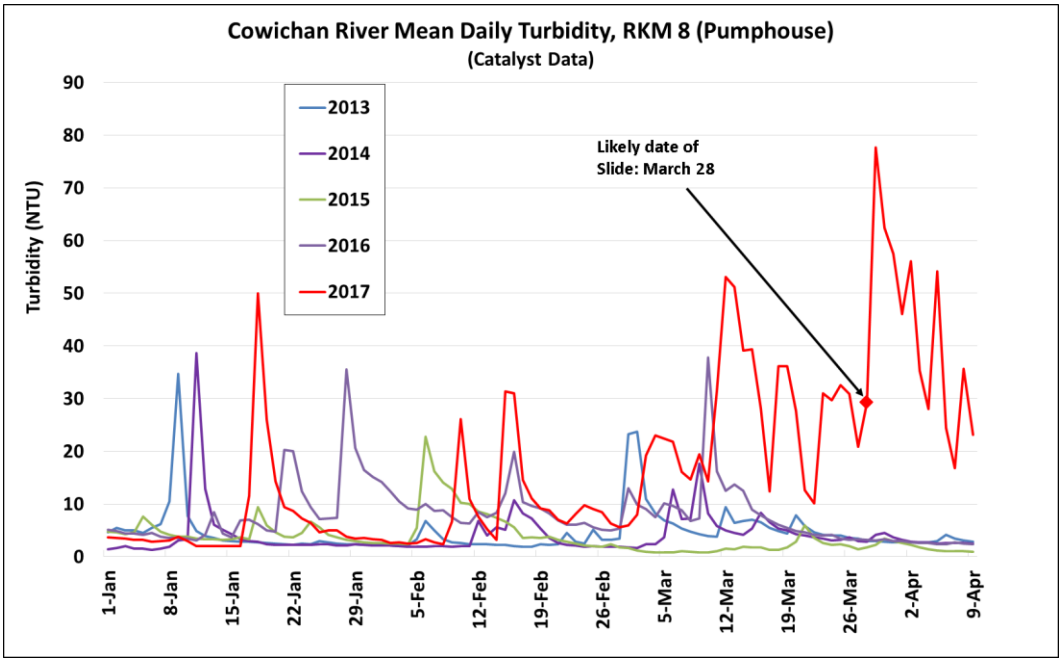

Figure 7. Cowichan River daily turbidity, as measured at Catalyst Paper pump house intake, showing the effect of the late March major slope failure at Stoltz Bluff (data courtesy of Brian Houle, P.Eng.).

Figure 8. New slope failure (red arrow) is just evident in this photo's upper left, past the upstream end of the snow covered berm.

‘Clearwater Creek’ Major Gully Failure:

The March 7th inspection confirmed that an interim ’fix’ was urgently needed for ‘Clearwater Creek’ in particular. As a result, James Craig (BCCF) returned to the site on March 31st to obtain measurements for installation of a temporary hay bale dam at the head of the creek’s primary drainage path across the Stoltz access road. This field trip led to a more ominous discovery.

As indicated above, there has been a major slope failure involving the lower ‘Clearwater Creek’ gully which has deposited a preliminary estimate of 5-7 thousand cubic meters of fine sediment and woody debris on the Stoltz terrace, extending across the road and into the Cowichan River (Figs 9, 10). The sheer volume of slide material represents the largest single failure at the site since the project’s initial construction in 2006. To put this into better perspective, the estimated slide volume represents from 625 to 875 standard dump truck loads of sediment!

As a result of the new slide, the primary drainage path of ‘Clearwater Creek’ shifted 30 m upstream, with the creek now cutting its way through the existing 2.5 m-high containment berm before entering the Cowichan River. New slide material on the Stoltz terrace and containment berm system ranges up to 5 m in height (over and above full containment ponds that were already 4 m+ in depth).

Figure 9. Aerial view from drone of ‘Clearwater Creek’ slope failure run-out zone, across the constructed terrace at the base of Stoltz Bluff. Plume of silty water is visible below the creek’s new entry point into the Cowichan River (photo courtesy of Vadeboncoeur Consulting Inc.).

Figure 10. Close-up of slide material and debris deposited on the Stoltz Bluff terrace from suspected March 28th event.

LWD and whole trees are part of the slide debris now covering an 83 m long section of the Stoltz access road.

This new and significant slide event raises an immediate concern for project maintenance in 2017, as well as longer-term issues facing project partners and Cowichan stakeholders with vested interests in water quality and the river's overall state of health.

Options for Future Project Maintenance and Slope Stability Measures:

(1) Clearwater Creek Slide Remediation and Stoltz Containment Berm Repairs

The most immediate problem facing BCCF, BC Parks and Stoltz project partners is acquiring a sufficient budget to largely remediate the effects of the 'Clearwater Creek' slide of late March. **Though volumes to be addressed need to be confirmed**, a preliminary estimate based on experience is that a minimum of $50,000 will be needed by late summer (Labour Day) to mobilize 2 excavators and 2 tandem dump trucks to remove slide material and end-haul off-site and/or incorporate sediment into reconstruction of the containment berm/retention pond system along the Stoltz Bluff terrace.

In mid-April 2017, there are no guarantees that current sediment volumes will remain static, as further spring rain events may result in additional slope failures and accumulations needing urgent attention. If much of the main slide volume needs to be moved off-site, costs could escalate quickly depending on hauling distance. It is also worth noting that slide material must be reasonably dry for safe and efficient handling by heavy equipment. Consequently, there may need to be some preliminary work to drain accumulated sediment and debris, as well as the series of retention ponds along the base of the slope. Ideally, most of the removed material will only need to be 'handled' once by an excavator, and not again at end-haul locations, if needed.

Based on existing sediment volumes, it is anticipated that 7-10 days of work on-site may be required in 2017, including prep. time to help dry-out accumulated sediment to depth. This does not include any restoration of riparian vegetation along the main rip-rap berm adjacent to the river, which was impacted by the sediment/debris overflow from the 'Clearwater Creek' gully failure.

Notionally, BCCF foresees a preliminary 2017 Stoltz maintenance budget with several partners including:

BCCF/Living Rivers: $10,000
Fisheries & Oceans Canada: $10,000
CVRD: $10,000
Cowichan Tribes: $10,000
Catalyst Paper Corp.: $10,000
BC Parks/PFO contract: $5,000
Others/TBD: $10,000 (possibly SSBC; Sidney Anglers Assoc.; Sport Fishing Institute of BC)

This proposal means no single partner will bear the majority of maintenance costs in 2017. BCCF is prepared to design and supervise the maintenance work, with approval of BC Parks (as in past years).

(2) A Long-Range View of Stoltz Bluff Maintenance Requirements

Assuming there remains strong support for an effective Stoltz Bluff project in future, we collectively need to investigate and better identify the primary causes for continued instability at the Bluff and adjoining slopes. This is particularly true for 'Clearwater Creek,' and likely for the new slope failure immediately upstream of the end of the Stoltz access road (refer to Fig. 8).

There is a growing suspicion that flow from a beaver pond/wetland complex at the source of 'Clearwater Creek' needs to 'captured' or re-directed before it can interact with unstable side walls of the gully above the Stoltz Bluff terrace and access road. This will require both

hydrological and geotechnical assessments involving engineers, who could also complete a synoptic survey of other water sources interacting with the Bluff's natural gullies. Intuitively, capturing/re-routing as much surface water as possible away from the Bluff's face should help with its overall stability. The main issue will be locating and quantifying all surface water sources, and then designing controlled conveyance systems to strictly minimize unregulated flows reaching the crest of the bluff. This is exacerbated by annual winter storms and freeze-thaw events.

At present we have no cost estimate for engineering services, but $25,000 – $30,000 seems like a minimum for their timely involvement in this issue. On-going discussions with KWL Assoc. Ltd., the primary engineering firm for the original Stoltz Bluff project in 2006, should help to refine future engineering costs.

The longer-term slope stability 'cause and effect' studies could be subject to inclusion in new funding proposals developed by BCCF for the 2018-19 grant application year.