SKOOKUM CREEK RM 6.5 RESTORATION

PRELIMINARY DESIGN REPORT

Prepared for

SPSSEG

Prepared by

Waterfall Engineering

Skookum Creek STA 19+00 Upstream of Bridge

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1 INTRODUCTION

The Skookum Inlet Watershed including the marine water and drainages of Little Skookum Inlet encompasses 31 square miles—the portion of the watershed draining through Skookum Creek is about 20 square miles. The mainstem of Skookum Creek is 12 miles long. It begins in a series of lowland wetlands, and then runs down steep ridges of the Black Hills and through clay deposits of an ancient lakebed. Through much of the mid-valley, the channel has incised into the valley floor. Numerous wetlands are associated with the stream channel as it flows through the valley, although many are now disconnected from the stream channel because of its entrenchment. A well-developed estuary has formed at the mouth of the creek and offers extraordinary transitional habitat between fresh and salt water.

For the past 20 years the Squaxin Island Tribe (SIT) has been pursuing restoration opportunities through some construction projects and more recently land acquisition. To support this effort and develop an overall plan for restoration conceptual designs were identified. The reach selected is six miles in length, from SR 101 at RM 0.5 to RM 6.5. Projects were identified after reviewing the limiting factors, generating maps which show site features (old channels, off channel areas, etc.), conducting site reviews with biologists and hydrologists from the SIT and discussing the potential attributes of each. Potential land acquisitions in the middle valley opened many opportunities. The valley is unique in that the railroad grade on the left valley wall and SR 108 on the right valley wall are set back far enough for restoration to be successful.

One project identified which is on Tribal Land is at RM 6.5. The site includes 15 acres of floodplain, 2000 feet on mainstem channel and four groundwater of spring fed tributaries. The site is unique to Skookum Creek as the spawning gravel is abundant compared to lower reaches of the creek.

The overall restoration plan objective is to restore floodplain function and channel connectivity. This will be done by removing current impediments to channel migration, restoring large woody debris in the main channel and side channel, planting the floodplain to shade out invasives, and restoring spring fed tributaries which currently have fish use but productivity is limited.

For the large woody debris placement, the plan is to place key pieces in the channel associated with other loose wood with the intent of allowing the wood to move locally but not transport downstream. The loose wood approach is feasible because of the channel size relative to the wood size availability. The average bankfull channel width is 35 feet. To address concerns of risk and private downstream landowners two debris-catcher engineered log jams will be constructed at the downstream end of the project. These will be located with an existing area where wood tends to accumulate due to channel valley narrowing.

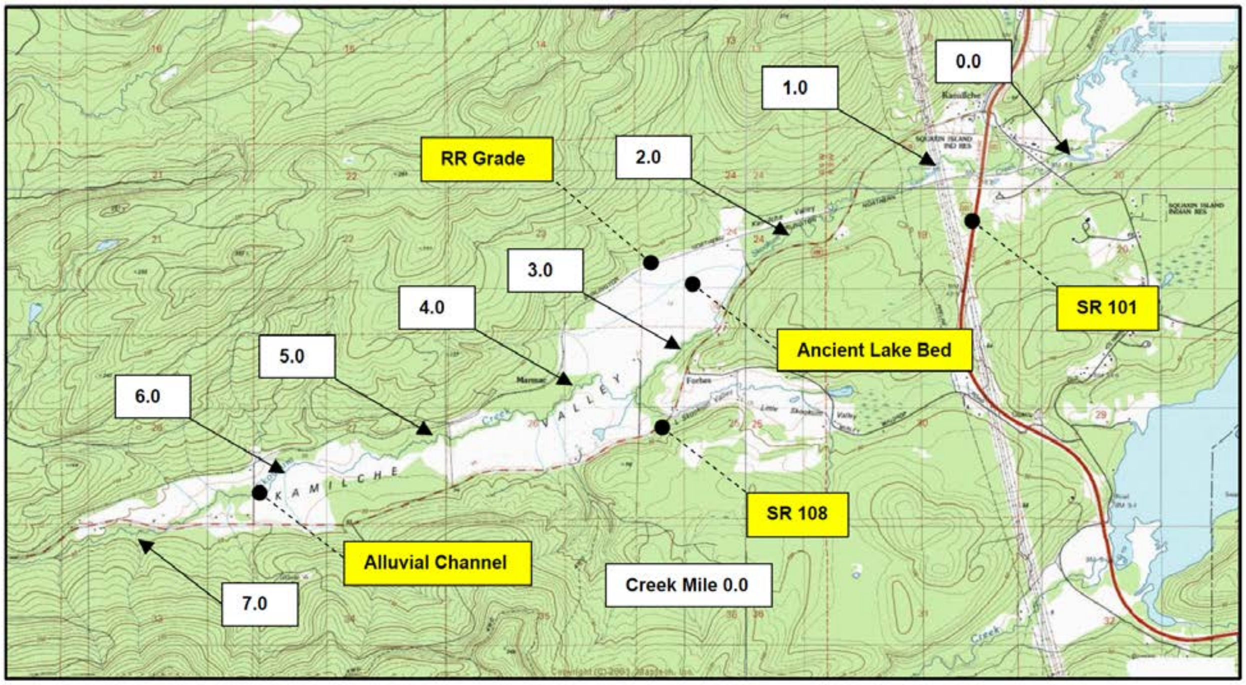

Figure 1 – Topographic Map showing Skookum Creek features.

2 SITE DESCRIPTION/HYDROLOGY

Skookum Creek has a basin size of 5.6 square miles. The mean basin elevation is 500 feet. Flow is driven mainly by rainfall. Using the USGS StreamStats Version 4.3 (Mastin, 2016), to calculate Peak Flood flows following flows were calculated (Table 1).

Design Flow	Flow (cfs)
Two-Year Peak Flood Flow	350
10-Year Peak Flood Flow	609
100-Year Peak Flood Flow	979

Table 1 – Skookum Creek flood flows.

3 LIMITING FACTORS

Limiting factors were assessed by several sources previously (see references). The following is a short description of each and some comments relative to current conditions and possible restoration options.

Fish Passage: No barriers are known to exist on the mainstem of the creek. Several tributaries have barriers. At RM 1.1 there is a left bank tributary which flows out into the creek floodplain and spills over a rock dam (gas pipeline) creating a fish barrier. McDonald Creek which is a right bank tributary at RM 4.3 is only passable when gravel is removed from the fishway and the stream bed adjusted to match the fishway outlet.

Riparian: There has been extensive removal of riparian vegetation from agricultural practices along the mainstem. Extensive riparian planting will help control summer water temperatures and reduce bank erosion in fine soils.

Streambank Condition: Generally rated as poor with over five miles of eroded banks in low gradient areas. Fine soils combined with an incised channel create natural bank erosion. A healthy and robust riparian is critical to keep the erosion to a sustainable level.

Floodplain Connectivity: The lower reaches of the channel are incised and lack floodplain connectivity but have artificial grade controls. At RM 1.2 there is rock ramp which protects a pipeline. At RM 1.3 to 1.4 there is a rock weir and a confined rocked channel at the SR 108 Bridge. At RM 2.2 the channel is less incised but is channelized and lacks floodplain connectivity. The channel has good floodplain connectivity at RM 5.5. The section of creek from RM 2.2 to 5.5 represent a good opportunity to reconnect old channels and floodplain. The site-specific land survey at RM 6.5 and the flood model show that this reach has poor floodplain connectivity relative to the 2-year and 100-year event.

Large Woody Debris: Abundance was rated as good, but key piece abundance was poor. Typical bankfull channel widths are 25 to 30 feet, so key piece size need to be 40 feet in length and two feet in diameter. Visual assessments at the RM 6.5 site and photos show that wood abundance in this reach is very low.

4 SURVEY DATA COLLECTION

Some site survey was completed for the right bank spring fed tributary, but the 2005 Puget Sound LiDAR data was used for a base map. Lidar Topographic maps were generated and compared to site conditions. Overall, the LiDAR did not define the main channel and side channel bottom elevations, so a more detailed survey was completed by Mountain2Coast Surveyors.

5 DESIGN APPROACH

The long-term restoration goal is to improve in-stream habitat and complexity, reconnect the main channel hydraulically to the floodplain by adding roughness (large woody debris), and to restore the floodplain through riparian planting. The large wood will be added in three forms:

1. Large woody debris complexity structures (15 total): A combination of 3 to 5 logs with slash per structure (Photo 1). These will be placed approximately 140 feet apart and use existing alder trees along the bank for buttress. Slash will be placed under the structures.

Photo 1 – Example of LWD complexity structure. Logs extend back into trees using weight of rootwads to ballast.

2. Single pieces of large wood with rootwads (5 per 140 feet), placed to interact with the low flow channel (Photo 2).

Photo 2 – Example of loose wood placement. Placed upstream of other more stable wood configurations with the intent to interact and move with flood flows. Right photo is a single piece with rootwad outside channel wrapped within alder and willow.

3. Two Large Woody Debris Trapping structures which are intended to trap and collect large wood from transporting downstream. There will be a total of 30 logs for the two trapping structures. The structures will be supported by driven wood pile. Two past projects downstream in Skookum Creek used wood piles which were easily pushed in with an excavator. The design of the structures follows a recently completed project on the Teanaway River (Photo 3). Trapping structures are flow through structures as opposed to log jams which block the flow and the channel scours around the structure.

Photo 3 – Wood trapping structure, ballasted with excavated material. Logs across channel were from loose wood placement before a 10-year flood.

6 RAS 2D MODELING

A HEC RAS 2D model of the project reach was developed for the existing LiDAR and for the surface which is a combination of the LiDAR and survey data. The model covered 2800 feet of channel length and a floodplain width of 400 feet. The modeling confirmed an on-site observation of the channel being incised and not connected to the floodplain. At the two-year flood of 350 cfs, the typical water depth is 2 to 3 feet.

At the 2-year flood peak event, the shear stress in the channel ranges from 1.5 to 2.2, which based on an incipient motion curves would move bed material 3 to 4 inches in diameter. Pebble counts have not yet been collected for the channel, but from observations the bed is a high percentage of one-inch sized spawning gravel which moves at a high frequency in the existing channel. The added wood will aggrade the channel 1 to 2 feet (more locally) and sort and stabilize the gravel for spawning.

7 REFERENCES

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Powers, P.D. and Caleb S. Saunders. 2002. Fish-Passage Design Flows for Ungaged Catchments in Washington. Appendix C. WDFW Culvert Manual.

WADNR. Washington LiDAR Portal.

SHRG. 2012 Stream Habitat Restoration Guidelines. Washington Departments of Fish and Wildlife, Natural Resources, Transportation and Ecology.

SPSSEG. 2018. Nisqually Steelhead Stream Habitat Assessment Report. Brighton, Harts, Horn. Lackamas and Toboton Creeks.

APPENDIX A – SITE PHOTOS

Photo 4 – View upstream of Bridge. Tributary of the right has cutthroat spawning.

Photo 5 – View downstream of bridge showing typical lack of large woody and gravel bed.

Photo 6 – Railcar Bridge spanning 25-foot-wide channel.

Photo 7 – Cut bank 12-foot-high just downstream of bridge.

Photo 8 – Concrete along right bank of channel upstream of bridge. Typical of other concrete and rock along channel.

Photo 9 – Upstream channel with view of bridge downstream showing lack of large wood and active gravel movement.

Photo 10 – Spring fed tributary along the left bank floodplain which enters the side channel. Flow is blocked by road and rock placed to shore up road.

Photo 11 – Brian Combs walking through floodplain area where proposed riparian restoration is planned.

Photo 12 – Downstream end of side channel which has been disconnected at the upstream end from road fill and riprap in channel. Gravel probe is sitting on gravel bed all groundwater flow but will go dry in the summer.

Photo 13 – View of channel upstream from area where right bank spring fed tributaries enter channel.

Photo 14 – View of outlet of 800-foot-long side channel at STA 5+00.

APPENDIX B – HEC RAS OUTPUT

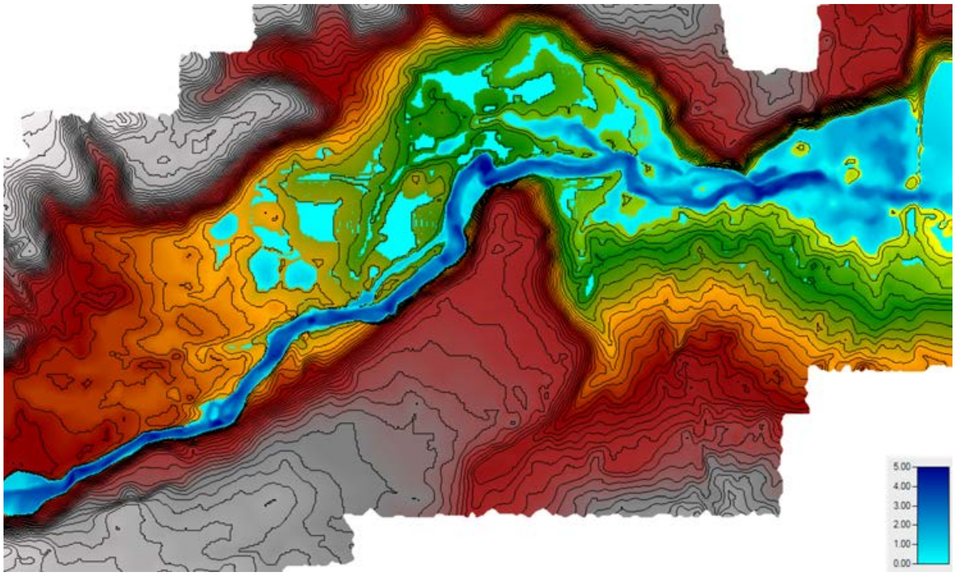

Figure 2 – Two-year flood depth map.

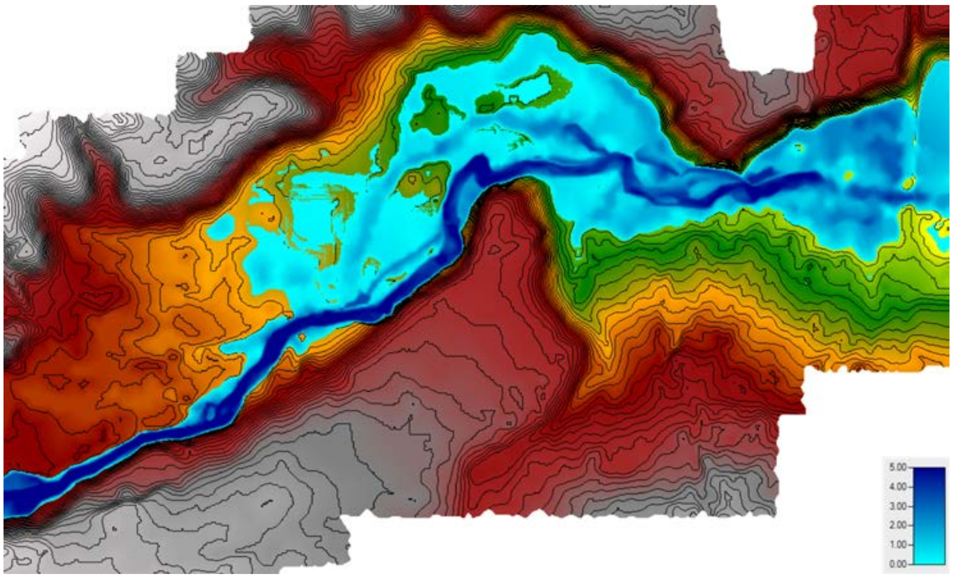

Figure 3 – 100-year flood depth map.

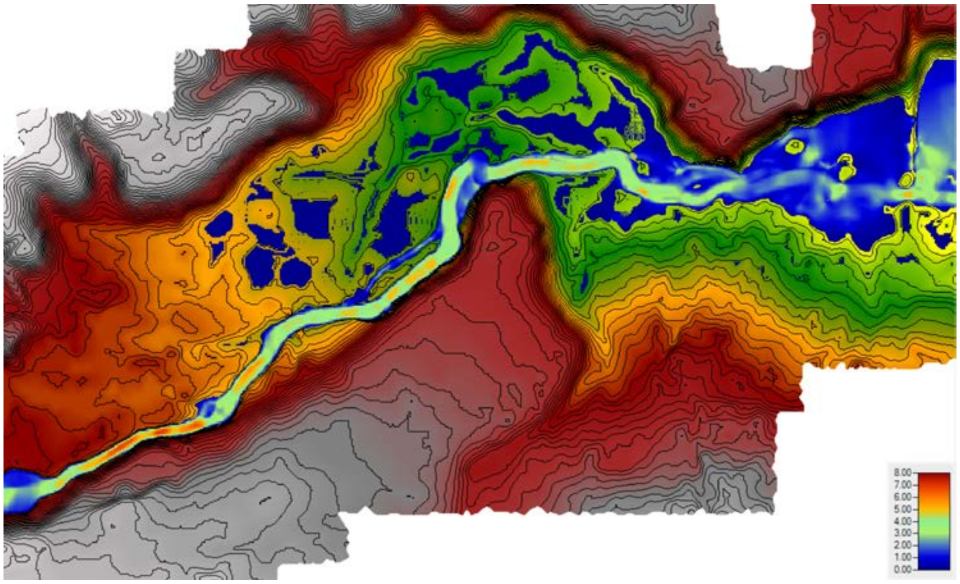

Figure 4 – Two-year flood velocity map.

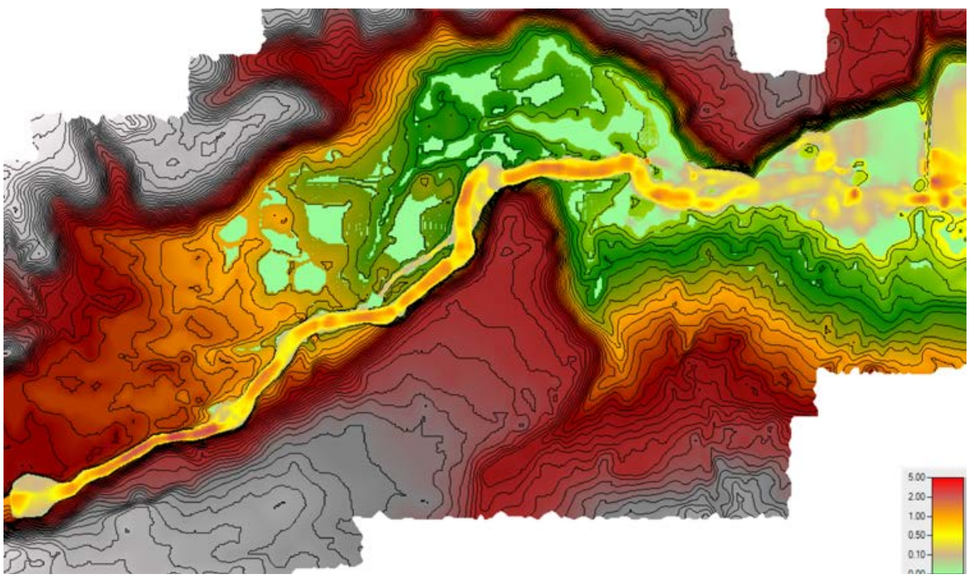

Figure 5 – Two-year flood shear stress map.

APPENDIX C - PRELIMINARY DESIGN