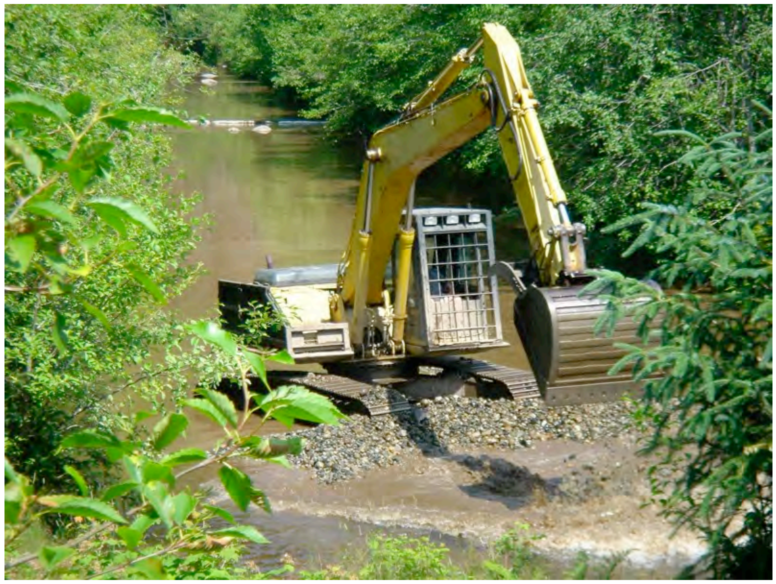
GLENDALE CHANNEL CLEANING REPORT – 2007



Report

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Cleaning Procedure & Methodology

After approval was given from Fisheries & Oceans Canada, the Province of BC and the First Nations and all of the concerns of other interested parties as to procedure and methodology were satisfied, the equipment to clean and remix the gravel beds in the channel was mobilized from Mitchell Bay to Glendale Cove on July 04, 2007.

Site preparation began immediately on arrival, July 5. Scouting out suitable locations for dry land pumping was initiated. Fish traps were placed in five separate locations, generally at the holding pool areas. All equipment was mobilized to the work site.

Since cobble removal from the beds would not be possible due to poor visibility once cleaning started, two passes down the full length of each channel leg was done. (Photo 1)

Photo 1 – Removing large rocks from beds

All large rocks were placed on the berm walls. Environmentally friendly, biodegradable oil was used as the hydraulic product. At the same time, all deadfall consisting of rotten alder trees lying on the beds was removed.

Another, two-man crew began the limbing of the lower riparian growth to allow the excavator operator to see well enough to clean up to the bed edges. All limbs were placed on the berms. (Photo 2)

Photo 2 – Limbing lower branches

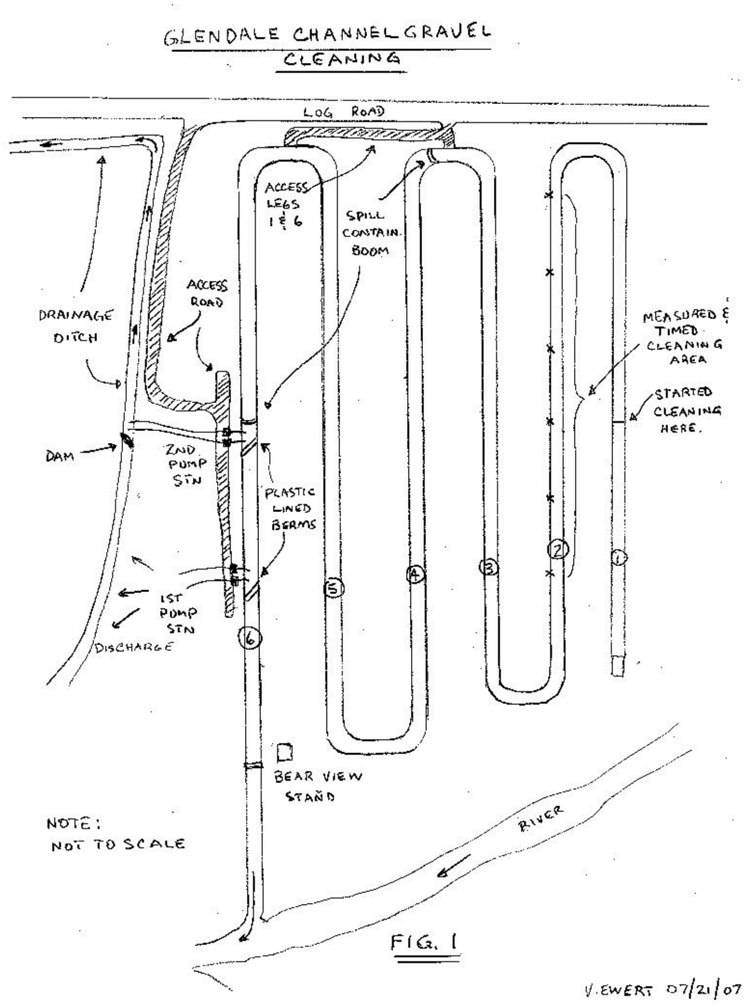
While the crews were removing the cobble and limbing lower branches, access to the first pumping location, approximately two-thirds of the way down the last leg was done.

Photo 3 – Access road

Nearly 20 years of alder growth needed to be removed. Access points were punched in - one at the bottom of Leg 3, the other at the bottom of Leg 6. (Photos 3 and 4)

Photo 4 – Entry – exit to the channel leg

All of the pumping gear was placed at the first pumping location. (Fig. 1)



With flows reduced, stop logs with a plastic lining were placed at the channel outlet to retain any turbid water. (Photo 5)

Photo 5 – Outlet plastic-lined dam

A retaining, plastic-lined gravel dam was made, pump intake hoses placed and the containment area behind the dam was pumped out. Fish salvage was conducted in this area. (Photos 6 and 7)

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Photo 6 – Fish Salvage

Photo 7 – Gravel plastic lined dam at first pumping station

Before cleaning was started, the excavator entered the bottom of the channel and scalped off high points of the gravel from the bottom to the top to permit a faster laminar flow and improve effluent transport. Gravel depth varied from near zero to approximately 90 cm. A reduced flow exposed high points and facilitated the rough leveling.

Two spill containment booms were placed in the channel legs in the event of a hydraulic oil spill. (Photo 8)

Photo 8 – Spill containment boom

During cleaning, flows were kept at the background level before arrival and were estimated to be less than 40 cfs (.85cu/m/s) since the pumps were rated at this level and were able to keep up with the flows when screens were clean.

In order to determine the desired rate of cleaning, taking into account the time restriction, a 165 m. section, taped every 33 m. was measured out. The pace of cleaning was 33 m. per hour.

The scoop and recast cleaning method, as described in the Gravel Assessment Report, was used. (Photo 9) To briefly recap: Using the water and current to flush out the silt and organic matter, including large numbers of dead eggs, the excavator scooped up and recast the gravel over a broad area until the gravel appeared clean and the bulk of the brown organic

Photo 9 – Scoop and recast cleaning method

matter was flushed out. This process was repeated three or four times in each area before the excavator was moved a short distance downstream. As cleaning continued, a progressively deeper layer of organic goop accumulated behind the machine. In order to move this material, it was necessary for the excavator to repeatedly rotate and plunge the bucket up and down vigorously, forcing this sludge downstream. During this necessary process, many small branches, extending well over the channel beds were broken off. These branches found there way to the pump intake screens and plugged them up, necessitating several cleanings per day. There was also a continual concern of the sharp ends of the broken limbs rupturing the hydraulic line hoses. (Photos 10 and 11)

Photo 10 – Cleaning close to the berms

Photo 11 – Accumulated organic goop

It was necessary to mark out and flag all the holding pools in the channel legs. (Photo 12) Once cleaning started, it was important to find them to prevent the excavator from backing into one. The ‘planned’ drawings in the authors’ possession did not reflect the ‘as-built’ locations.

Photo 12 - Marking the deep pools

The First Nations personnel, Alfred Coon and James Speck Jr., took daily sediment wedge readings as well as flagged and brushed out trails along both the left bank of the river as well as along the drainage ditch complex after the pumps were relocated. (Fig. 2)
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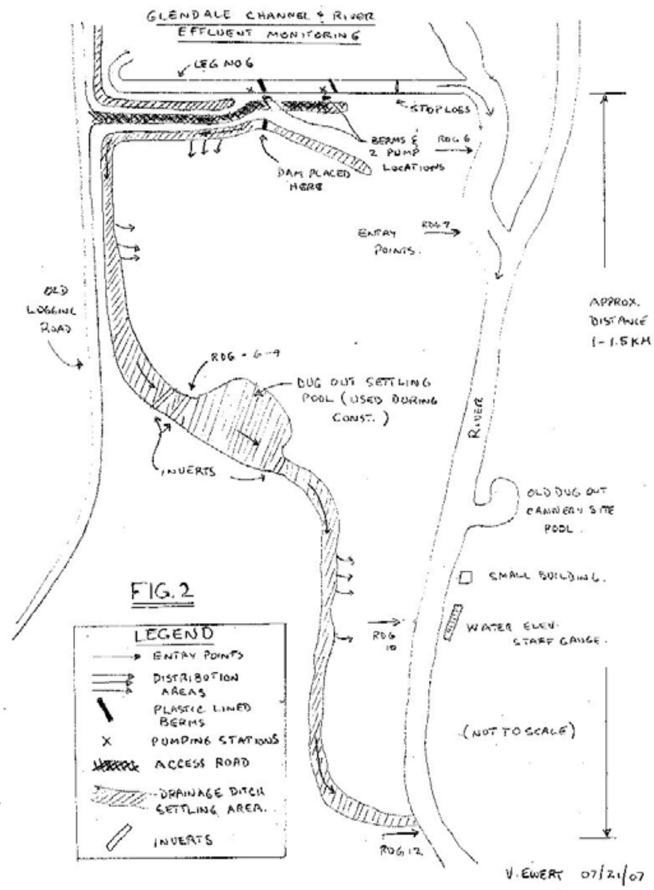

Fig. 2

After one and a half days of cleaning and pumping at the first location, a small amount of organic laden water, estimated to be .5 cfs (.01 cu/m/s), was observed entering the river at two locations nearest to the channel outflow area. (Fig. 2) No other entry points were discovered over a downstream distance estimated to be 1.5 km.

Although there was no concern of silt entering the river, the goal was to deny as much effluent into the watercourse as possible. It was felt that over time, if discharge continued at the first pump location, the ground would become saturated due to the high water table present, and more and more organic laden water would then find its way outside of the discharge area.

Cleaning was stopped and an alternate area was searched for. An extensive network of drainage ditches and settling areas was discovered. (Photos 13 and 14)

Photo 13 – Second pumping station

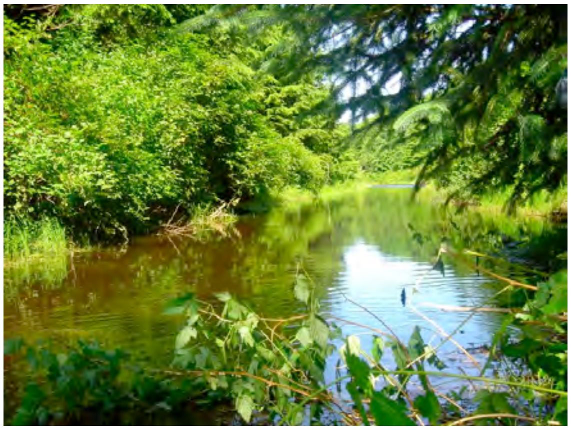

Photo 14 – Drainage ditch

To encourage flows in the desired direction, away from the river, a dam was put in a ditch adjacent to the cleared roadway to Station No. 1. (Fig. 2) This second location, Photo 15, approximately one-half way down Leg 6, (Fig. 1) proved superior with the vast majority of flow going down the ditches and into the settling areas. It overflowed at various points onto the forest floor. A total reentry amount of approximately 1 cfs, (.021 cu/m/s), or less than 2.5 % of the volume pumped was noted in four locations over the monitored area. A metered stick was used to ensure no backup of levels occurred. Sediment wedge readings are covered in the summary section.

Photo 15 - Plastic-lined dam and second pumping station – Cleaning the intake screens

The second station also had a plastic-lined dam below the pumps and this gave two holding areas for dirty water. (Photo 15) It was observed that since only the top sides of the dams were plastic-covered, once pumping started again (one pump shut down at a time) after the cleaning of the screens, the dirty water flowed back through the gravel dams and was pumped out. This ensured that while servicing the screens, this accumulated dirty water could effectively be removed.

As cleaning progressed, an odor similar to sulphur dioxide and decomposed eggs, permeated the air. This attracted a number of grizzlies who appeared to be undisturbed by the noisy pumping and cleaning activity. Daily sightings were the norm. Vigilance, noise, personal bear spray and two-man crews were employed as safety measures.

The entry points (Fig. 1) allowed for the entry and exit of the excavator for daily servicing and fuelling. No fuelling was done in the channel. Cleaned areas were not traveled on by the machine once cleaned. Travel in and out was restricted to the nearest downstream entry point as cleaning progressed.

The various holding pools in the channel legs were not only dangerous for the operator, but acted as a large sump or basin which collected the heavy organic material up to .5 meters deep. As much of this material as possible was dislodged by plunging the bucket up and down. It was impossible to remove all of it since there was no water flow to assist dispersal. This subject is also covered in the Recommendations section.

Cleaning operations were stopped approximately one hour before pumping stopped. This allowed for servicing the machine as well as all the dirty water to reach the pumps and be discharged. In the morning, while the dirty water had not yet reached the pumps, the two holding areas below the dams, were pumped out. Once several legs were cleaned, all broken branches, etc., were removed, as well as any cobble that showed up from the remixing process. This process was repeated with the result that all of the legs were covered three times in the large rock removal exercise.

Fabric liner was encountered in two locations. It was deteriorated and all of the pieces encountered were dug out and removed using hand shovels. At the same time, any excessive mounds of gravel resulting from the cleaning were leveled out. The goal was not to create a table top, flat gravel bed, just remove the highest points to increase laminar flow and reduce obstacles during freezing periods. An uneven surface is superior for spawners since undulations on the surface assist in intra-gravel water flows, and provide oxygen laden water during the development stages.

Summary & Concluding Remarks

Fish traps placed in the channel prior to cleaning, as well as during the night for several days after cleaning started resulted in a catch of the following: 23 coho; 62 sculpin and 20 bullhead. All of the fish were either relocated to the river (side channel) or taken (some coho) by Knight Inlet Lodge staff for a cap trough coho display. After dewatering the area below the first pumping station dam, salvage efforts resulted in the recovery and relocation of 28 sculpin and 2 coho.

It was interesting to note that the distinct odor emanating from the cleaning process had more of a dead egg smell in the first three legs and this reflects the initial assessment that most eggs were found in the upper section of the channel. This is what undoubtedly attracted the bears. After Leg 3, the odor was not as pervasive and changed to a decaying organic matter smell.

With the exception of Leg 2, after the cleaning/remixing was done, the gravel composition had the appearance and texture of a well-mixed, clean, fluffy gravel bed. Leg 2 appeared visually to lack the same amount of smaller particles as the other legs. The volume of gravel expanded visibly due to the loose nature of the medium. (Photos 16 and 17)

Photo 16 – Cleaned gravel with a good mix

Photo 17 – Cleaned gravel beds

Sediment wedge readings, using the Triton Sediment Wedge showed, as expected, that the lowest -0- (dirtiest) readings were close to the cleaning process with readings progressively higher over distance. (Photos 18 and 19)

Photo 18 – Sediment wedge readings

Photo 19 – Sediment wedge reading

Readings at the pumping locations were usually from 5 to 7 except when the cleaning came closer to the intake hoses. Then readings once again were 0 or 1. It was surprising to note that readings at the four river entry points (Fig. 2) ranged from 6 to 12, despite some locations being at least 1 km. away and having already passed through some large settling areas. This illustrates the extreme colloidal nature of the organic or volatile residue material. Obviously, any silt or non-filterable residue settled out quickly and never entered any watercourse.

Test holes dug after cleaning showed the gravel to be very loose, well mixed and at least 80 % cleaner then when started. Due to the time constraints and the budget allocated, a 100 % cleaning was not possible. With beds as filled with foreign material as this one was, another cleaning in a subsequent year is generally done.

The holding pools or 'settling pools' remain problematic. It is unfortunate that a considerable amount of organic material will be redistributed once the spawners arrive and this will recontaminate the cleaned gravel beds.

All disturbed sites were seeded, all the dams that were placed, the ditches that were obstructed, the disturbed entry points, etc., were all returned to an as-original condition as was possible. All stakes, flagging and garbage was removed. The cabin on site that was used to keep project equipment was cleaned and preexisting gear inside was organized. All the concerns expressed by all of the interested parties were met. The project was completed on schedule, by July 17, 2007, as originally forecast.

Although a comprehensive list of recommendations was not asked for and was not part of the cleaning/remixing exercise, it is recognized that a greater degree of operational monitoring and some infrastructure work is necessary to ensure quantifiable data and to maintain the physical integrity of the facility. Now that the gravel has been rejuvenated, there exists an opportunity to employ some basic protocols that are more in keeping to those of the channels in the Fraser watershed and those on Vancouver Island. It should be evident that an engineered facility requires maintenance, especially where gravel is concerned. Without a program to maintain the parameters that a facility was built to, it is inevitable that within a few short years, conditions will deteriorate, and the egg to fry survival levels will plunge. An opportunity currently exits with First Nations interest and the desire and proximity of the Knight Inlet Lodge, to become more involved.

Acknowledgements

The author wished to thank F&O Canada, the Province of BC, the First Nations people, Knight Inlet Lodge staff, the numerous donors who helped with this project and lastly, but no less important, all of the personnel who enthusiastically and energetically worked to make this a successful venture.

Recommendations:

Basic Operations – Adult Period – Density loading, adult timing in loading, sex ratio, fecundity, as well as prespawn mortality (PSM) numbers and egg retention should all be addressed. This sampling and monitoring regime would ensure that proper loading for background conditions (water temp., and dissolved oxygen – DO) was done; ensure that run timing was not altered; ensure a balance between female and males rather than early male dominant concentration; and would provide confident parameters to give reliable egg deposition numbers. Annual sampling of weight/length would track oceanic conditions, etc., over time. The installation of an electronic fish counter would be invaluable in order to achieve optimum density loading.

Basic Operations – Fry Emergence – Early fyke net installation based on accumulated thermal units (ATU) and timely enumeration equipment (dewatering screens, collection troughs and proportional sampler) needs to be set up and maintained throughout the emigration period. It is suggested that a more accurate proportional sampler be used and this would provide more accurate egg to fry survival (e/f) numbers and would also allow for easier installation and operation. Sub-sample weights and lengths throughout each migration should be done.

Basic Operations – Data Loggers – Keeping track of ATU's is a simple, effective tool to determine the development stages, especially the hatch and emergence stages. This tool allows for accurately predicting emigration and thus avoids missing any early emergence. Ideally, several should be employed in at least the top and bottom locations.

Basic Operations – Flow Regime –A water management regime that provides adequate flows (but not more) to reflect adult needs, hatch stage, fry emergence and 'off-season' or background flows while still ensuring reliable water storage in Tom Brown Lake is suggested. Flows need to be calibrated to staff gauge settings.

A channel can not be all things to every species. At the Glendale channel a specific species was targeted in order to enhance a specific area. A dewatering period as is common in many channels, allows for a fallow period where the gravel is partially sterilized by the sun, algal growth is severely reduced, and water storage is gained. A review of priorities is recommended.

Infrastructure & Maintenance:

Gravel Bed/Mix & Cleaning – It should be noted that due to the size (a generic sockeye channel mix) and the angular nature of the gravel medium, it is more important than would otherwise be the case, to keep the gravel clean and mixed in order to achieve the maximum e/f production. The two most critical components for vigorous and healthy fry production are a high quality water source and a high quality gravel medium. It is recommended that the degree of organics and stratification be noted annually and that the gravel be cleaned as required. Most channels are cleaned from every year to every fourth year.

Pool Removal – Holding pools were ill-conceived ideas that have more disadvantages than benefits. This is now understood and these pools have been filled in and the area used to increase spawning area. The Horsefly Channel is one example. It is recommended that this be done at Glendale Channel, especially since a stored gravel source is available on site. In the mean time, when another cleaning takes place, the use of small trash pumps would remove some of the deleterious matter. This process may not be possible at all six pool locations.

Valve- A complete range of opening and closing should be conducted at least once per year. If it is not possible to do this, as is the case at Glendale, consideration should be given for a valve replacement. At present, the actuator portion is not operating correctly. Plans are currently underway for its replacement.

Outlet Guide Posts – Most of the guide posts are no longer secure. These need to be replaced/repaired in order to be able to use the stop logs effectively for both adult and fry work.

Staff Gauge – The staff gauge at the top end presently reads the water elevation in the top leg and will change when the gravel profile changes and when the biomass of the spawners enter this leg. Stop logs (now missing) need to be placed in the outflow chamber. Once a range of flow volumes have been metered, volumes can be compared to the staff gauge readings. The system now in use is at best a guess.

Alder Tree Removal – It is recommended that the alder trees be progressively thinned over a three year period and if necessary, thin the coniferous growth as well, or plant some where needed. Already, branches extend half way across the beds in places. Keeping in mind that alders have a lifespan of 35 or 40 years and that as the trees get larger, more leaf litter will occur; it is highly recommended that some action be taken as soon as possible. Left alone, an identical accumulation of decomposing leaf liter will occur as has been the case, with the additional problem of the alders falling down into the channel beds. From an operational and production perspective, this is the single biggest cause of the deterioration of the gravel in the Glendale Channel.

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