KEOGH (GIUYUX) RIVER

TRANSPORT CANADA
BRIDGE REPLACEMENT PROJECT
FISH HABITAT ASSESSMENT

Prepared for:
PUBLIC SERVICES AND PROCUREMENT CANADA
#219 – 800 BURRARD STREET
VANCOUVER, BC
V6Z 0B9

Prepared by:

AQUATERRA ENVIRONMENTAL LTD.

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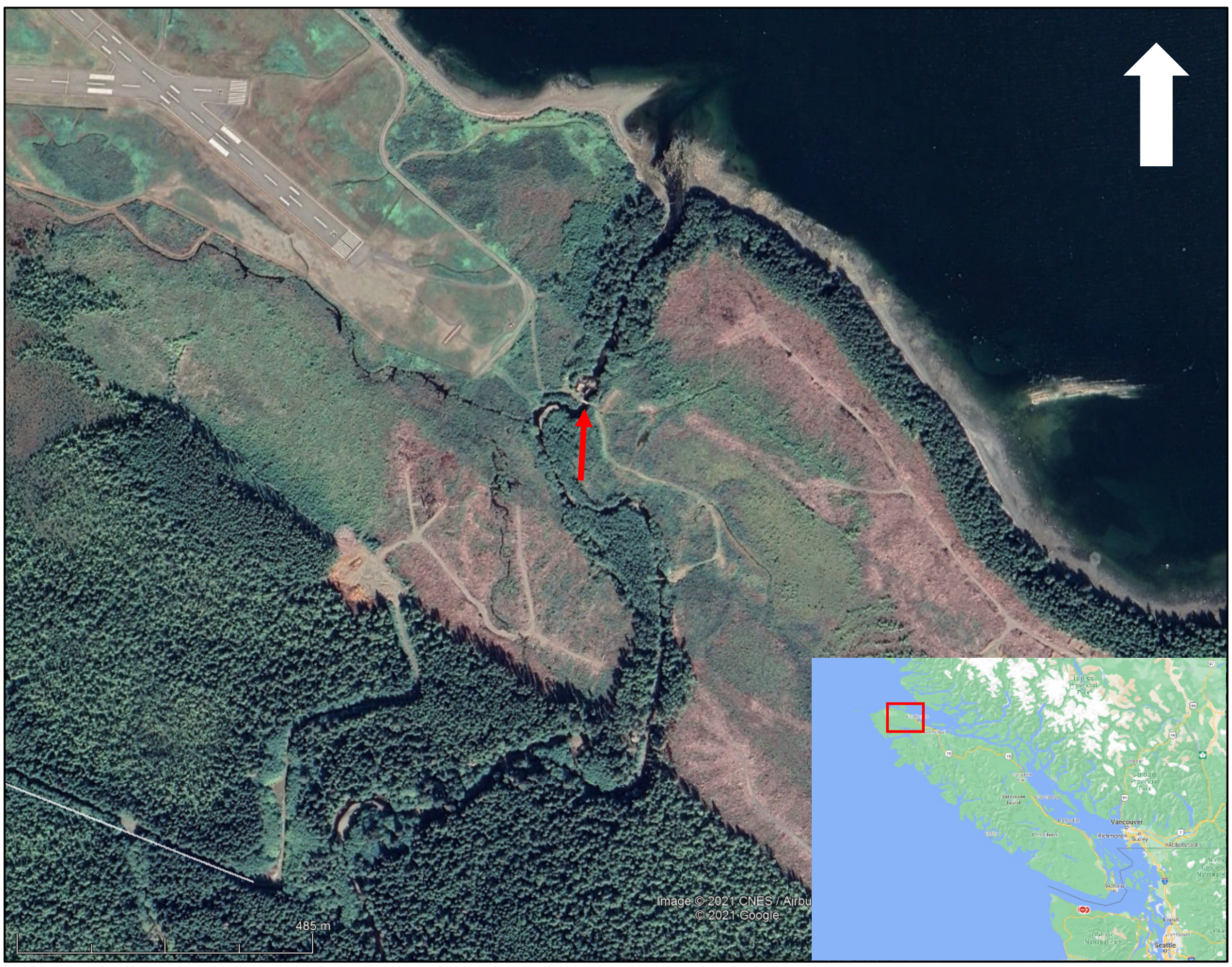
1 Project Background

The Keogh River (‘Giuyux’; the ‘river’) is a 31 km, third-order coastal stream that is situated in the traditional territory of the Kwakiutl First Nation (‘Kwakiutl’). The river drains an area of approximately 129 km^2 and flows northwestward into Queen Charlotte Strait near Port Hardy on Northern Vancouver Island. The Port Hardy regional airport lands are located adjacent and northwest of the Keogh River and is serviced by an emergency secondary access point that includes an existing bridge spanning the river (**Figure 1**). The location of the bridge is in an area that is of cultural and historical significance to the Kwakiutl Nation, which included a nearby historical fish weir, stone trap, and community harvests. Transport Canada has determined that the bridge has reached the end of serviceable life and requires a full replacement including new footings and abutments.

Figure 1: Port Hardy Airport, Keogh River, and Transport Canada Bridge Location (Red Arrow).



2 Project Scope and Objectives

The existing Keogh River bridge consists of a 21 m (70 ft.) span Acrow-panel bridge. The bridge is owned by Transport Canada and provides the only means for vehicle access to the east side of the Keogh (Giuyux) River, which serves as an emergency access and provides access to fish counting facilities. The bridge, located approximately 500 m east of the airport runway terminus, was constructed in the 1970s and a recent engineering report completed by WSP (Engineering Service For Keogh Bridge Replacement – Phase 2 Options Study Report; 31 March 2020) concluded that the structural panels illustrated some signs of corrosion, with the bridge abutments constricting the width of the river channel with a risk of erosion failure. The report also noted that the existing timber crib wall abutments are rotting and showing signs of settlement and rotation. The report concluded that the bridge has an estimated live load rating of 9,100 kg, which is considerably less than the original design rating and the required load for use by emergency vehicles. As such, bridge replacement was deemed to be required to ensure continued emergency access to and from the airport.

AquaTerra was retained through PSPC to undertake a Fish Habitat Assessment report to support bridge design considerations and to evaluate potential impacts associated with new bridge construction and existing bridge disassembly. An evaluation of potential cumulative effects associated with construction of the high flow bypass channel, situated upstream of the bridge site, was also evaluated as a component of this assessment. This Fish Habitat Assessment report also serves to provide regulatory agencies (i.e., Fisheries and Oceans Canada [DFO]) with the necessary information to make a determination as a companion document for the submittal of a DFO Project Review application. TC will also review the information and complete the Environmental Effects Evaluation (EEE) in order to make a determination under S.82 of the *Impact Assessment Act*.

3 Background Documentation Review

AquaTerra personnel reviewed available Keogh River background information, as recommended by Fisheries and Oceans Canada (DFO) and the Ministry of Forests Lands and Natural Resource Operations and Rural Development (MFLNRORD) – sourced via EcoCat - as well as information made available by PSPC and the Kwakiutl Band. Pertinent details from reviewed documentation is provided chronologically in the following sections.

3.1 Evaluation of In-stream Enhancement Structures for the Production of Juvenile Steelhead Trout and Coho Salmon in the Keogh River: Progress 1977 and 1978.

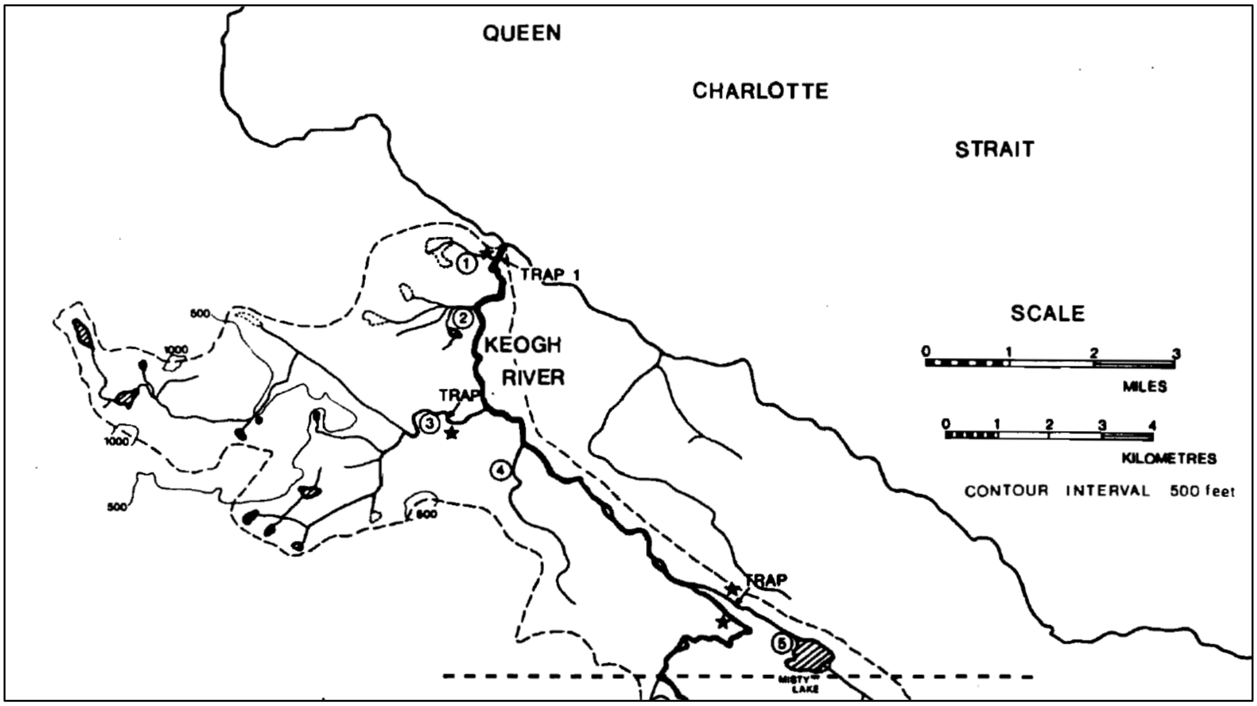
The Keogh (Giuyux) River watershed is reported as being 129 km^2 in area. Riparian habitat was documented as being dominated by Western Hemlock (*Tsuga heterophylla*), Western Redcedar (*Thuja plicata*), Sitka Spruce (*Picea sitchensis*) and Red Alder (*Alnus rubra*), with on-going deforestation in the watershed for at least the preceding 25 years. In 1979, The Ministry of Environment issued an evaluation of In-stream Enhancement Structures for the Production of Juvenile Steelhead Trout (*Oncorhynchus mykiss*) and Coho Salmon (*O. kisutch*). Seven (7) instream structures were installed within the Keogh River including boulder clusters, deflectors with log cover, deflectors, and v-notch weirs.

The Trap 1 location was situated immediately downstream of the existing bridge location (**Figure 2**). Assessed escapements included Pink Salmon (*Oncorhynchus gorbuscha*), Coho Salmon, Chum Salmon (*O. keta*), Sea-run Cutthroat Trout (*O. clarkii*), Dolly Varden (*Salvelinus malma*), Sculpin (*Cottus asper* and *C. aleuticus*), Pacific Lamprey (*Entosphenus tridentatus*), and Three-spine Stickleback (*Gasterosteus aculeatus*).

Water samples, collected at Trap 2 (situated upstream of the bridge site), indicated low nutrient levels in the river (comprised of total nitrogen, total phosphorus), inclusive of low dissolved anions (chloride, phosphate) and cations (magnesium, sodium, potassium) as well as low dissolved solids (less than 40 mg/L in any given month). The dark colouration was noted as being leachate from cedar-hemlock forest and bog habitats.

The results of the study noted that salmonid biomass was higher in boulder enhanced habitats relative to gabion structures during the summer months, with increased density of steelhead parr where increased cover objects were provided. Measured Coho Salmon biomass was highest relative to other species.

Figure 2: 1977 and 1978 Fish Sampling Areas, inclusive of Trap 1 & Trap 2 Locations.



3.2 Adult Steelhead Trout (*Oncorhynchus mykiss*) and Salmonid Smolt Migrations at the Keogh River, BC during Winter 2019 and Spring 2020.

In 2020, Instream Fisheries Research Inc., issued a report entitled 'Adult Steelhead Trout and Salmonid Smolt Migrations at the Keogh River, BC during Winter 2019 and Spring 2020' to MFLNRORD. Mean discharge annually during the reporting period was 5.6 $m^3 s^{-1}$. The report summarized the number of returning adult Steelhead Trout in 2019 (n=27, comprised of 25 wild; 10 female/15 male, and 2 hatchery). A total of 2,143 Steelhead smolts and 184 steelhead parr were captured in 2020, situated adjacent and downstream of the existing bridge. Mean steelhead smolt abundance from 1990 to 2020 was 2,501. Coho smolt abundance in 2020 was estimated at 80,294 individuals, which is higher than the average number of coho smolts enumerated from 1977 to 2019 (n=67,718), following several years of high smolt production that reportedly appear unrelated to adult spawner escapements.

The report, which is the 46th annual report in its series, notes that freshwater productivity, marine survival, and returning adult Steelhead counts have declined since 1990, with highly variable returns each year. Extensive habitat restoration between 1998 and 2002 in an attempt to reinvigorate Steelhead survivorship and utilization were reportedly met with limited success.

Adult Steelhead enumeration was undertaken using a fish counter between 01 December 2019 and 15 June 2020 approximately 300 m upstream of the smolt fence, near the existing bridge.

Live capture methods were also taken to estimate adult abundance, completed between 15 February and 12 April 2020. Outmigration of juveniles was assessed between 06 April and 08 June 2020, with a combined outmigration of parr and smolts on 14 May 2020 (n=205). A total of 2,143 steelhead smolts and 174 steelhead parr were captured in 2020. Hatchery strays from the nearby Quatse and Cluxewe Rivers also return to the Keogh River annually, comprising up to 28% of the total count in some years.

Coho Salmon were enumerated between 01 September and 30 November 2019. Pink Salmon migration had reportedly concluded by 15 October 2020. The 2019 population estimate for Coho Salmon returns was 684, down from 993 estimated in 2018. Coho smolt abundance and survival had been previously decreasing, reportedly influenced by extensive dry condition reducing utilizable habitat area and increased water temperature during rearing, as well as marine conditions that negatively affect growth and ocean survival.

The presence of both adult Steelhead and Coho Salmon as well as outmigrating juveniles in the vicinity of the bridge indicate utilization by salmonids during migration, rearing and overwintering life stages.

3.3 Keogh River Historic Outflow Channel Restoration

On 01 September 2020, Instream Fisheries Research Inc., issued a report to DFO, Transport Canada, and MFLNRORD relating to the summer 2020 progress associated with the spring 2020 works to restore a historic overflow channel in the lower reaches of the Keogh River. The historical overflow channel was originally constructed along with the Port Hardy Airport with the intended function of distributing water during high flow events that were creating an oxbow and putting airport infrastructure at risk.

The resulting overflow channel was not maintained and became infilled with gravel, large woody debris and vegetation. Over time, a 1.5 m high gravel berm accumulated at the upstream end of the bypass channel, resulting in the resumption of scour and gravel transport in the mainstem during high flow events. Channel restoration efforts were undertaken between 21 July and 26 August 2020. Works included reducing the accumulated gravel within the overflow channel, excavation of the ‘gravel island’ at the fish fence concrete sill (**Figure 3**), reconfiguring large boulders downstream of the fish fence, and restoring the historic channel between the counter site and fish fencing.

Figure 3: 2020 Outflow Channel Restoration Works – adapted from Instream Fisheries Research Inc. Report.

Following completion of the works near the bridge, the overflow channel was constructed, commencing with excavation of the overflow channel at the downstream end with a slight increase in elevation relative to the mainstem to ensure the channel is only active during high flow events (**Figure 4**). The entrance to the restoration channel is to be reinforced with boulders and a rock groyne pending funding in 2021.

Figure 4: 2020 Overflow Channel Restoration Details – adapted from Instream Fisheries Research Inc. Report.

The channel was reportedly completed as a flat-bottomed U-shaped channel with limited channel complexity (**Figure 5**). Presumably this was intended to provide flow conveyance and localized detention capacity only and to reduce the potential for fish stranding. The report confirms this assertion noting that the channel was excavated with a steady downstream gradient to mitigate potential risks associated with stranding and to facilitate fish returning to the mainstem following high flow events.

During channel restoration works, concrete material was uncovered and excavated, which was reportedly used for original channel construction. The material was broken up and re-purposed as bank stabilization along the left bank of the excavated overflow channel. Grass seed and willow (*Salix* sp.) whips were installed to enhance bank stabilization and recruitment of pioneer species.

Figure 5: Restored Channel looking Upstream – adapted from Instream Fisheries Research Inc. Report.

4 Regulatory Correspondence

On 08 March 2021, AquaTerra attended a conference call attended by Trevor Davies, Ph.D., a fisheries stock assessment scientist from the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO), Matt Clarke – Stock Assessment Biologist with DFO, and Mark Tilley, RPBio (Kwakiutl).

Matt Clarke noted that there is a small amount of salmon spawning habitat when conditions are atypical and Pink Salmon redds have been historically observed downstream of the bridge during high returns. Other salmon species likely utilize spawning areas >100 m upstream of the bridge, whereas Cutthroat Trout have been observed utilizing the bridge interface habitat areas. Typical adult migration periods were estimated as early as August 6th for Pink Salmon, early September for Coho Salmon, and Chum Salmon often entering the river along with Coho Salmon. No

Steelhead redds have been reported in the vicinity of the bridge, noting that Steelhead tend to spawn in upper, non-tidal reaches of the river.

Historically, a ford was constructed within 50 m downstream of the bridge (downstream of the counting sill). Excavators have historically crossed the river at this location, which remains shallow and is the recommended crossing location, if an instream crossing is required.

Trevor Davies noted that the Keogh River is a ‘flashy system’, where water levels can fluctuate rapidly contingent on rainfall. A few decades ago, the airport reportedly constructed an overflow channel with an alternative discharge upstream of the bridge. The absence of maintenance resulted in flooding on airport lands and associated sedimentation. Upstream activities, including forestry/deforestation has increased the bedload movement, which was the primary purpose for the construction of the overflow channel. Gravel removal downstream of the bridge via excavator have occurred every 1-2 years as a result of on-going bedload deposition.

5 Fish Habitat Assessment

On 15-16 March 2021, AquaTerra and Kwakiutl personnel attended the site to evaluate Keogh River fish, aquatic and riparian habitat parameters as well as to evaluate existing bridge conditions, potential impacts associated with the prospective alignment(s), and to collect samples of the bridge and abutments for lead paint and creosote, respectively. Initially, the river was assessed from the bridge deck, evaluating the river flow dynamics, morphology, banks, and riparian vegetation assemblage downstream and upstream of the existing bridge (Photos 1 & 2).

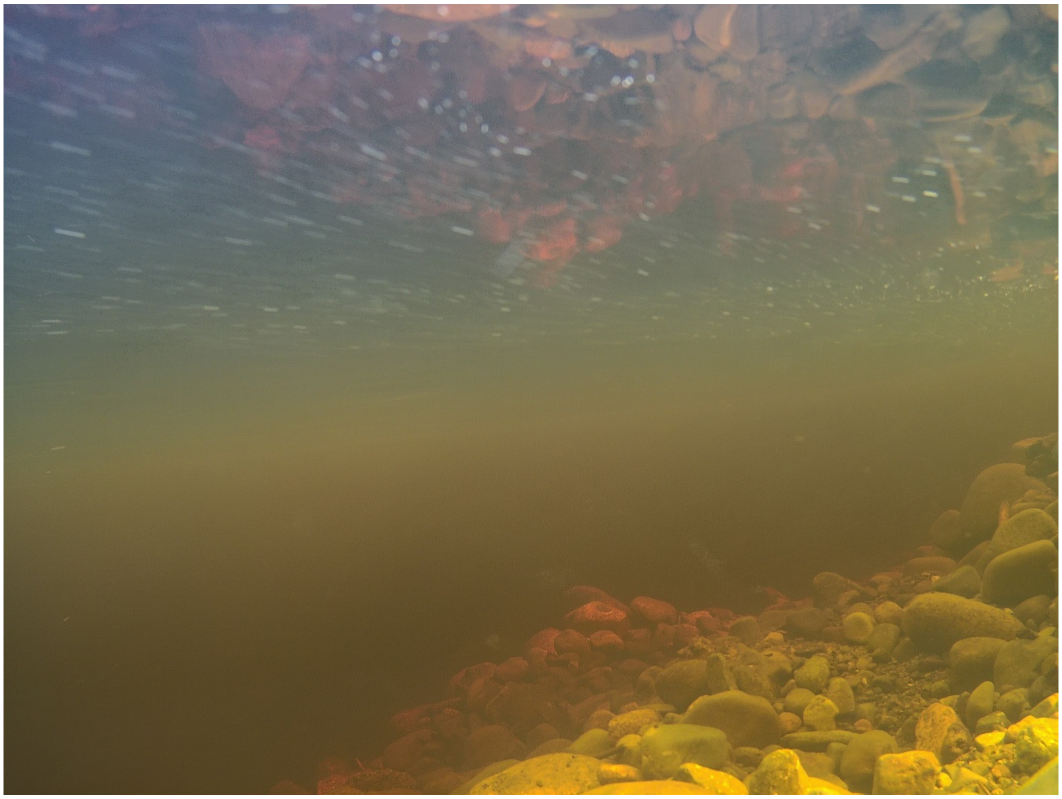
5.1 Substrate Composition

A Remotely Operated Vehicle (RoV) was deployed to the northwest of the bridge. Given the depth and elevated flow rate of the river, the intent of deploying the RoV was to evaluate substrate composition in the vicinity of the bridge. The RoV was fitted with LED lights given the heavily tannin stained water (Photo 3), which limited substrate composition visibility from upland areas and the existing bridge.

Photo 1: Keogh (Giuyux) River looking downstream from the existing bridge.

Photo 2: Keogh (Giuyux) River looking upstream from the existing bridge.

Photo 3: Visibility of Water Column near Existing Bridge.



Substrate downstream of the bridge included isolated boulders (<5%) with cobble (70%) and gravel (25%) (Photo 4). Within the northwestern corner of the bridge, substrate was dominated by coarser cobble (40-50%) with lesser gravel (20-30%) and fines (20-30%) (Photo 5). Kwakiutl personnel noted that some of this material had been reportedly imported to facilitate access to the bridge for pre-construction survey work. Under the bridge (west side), the material was dominated by gravel (60-70%) with 10-20% cobble and fines (Photo 6). To the southwest of the bridge is a localized backwater area where flow is reduced. At this location, substrate was dominated by fines and gravel with some minor Small Woody Debris (SWD). Similarly, the substrate beneath the east side of the bridge was comprised of cobble (10-20%), gravel (40-60%) and fines (20-30%) with SWD present sporadically (Photo 7).

Photo 4: Substrate Downstream of the Existing Bridge - <5% boulders, 70% cobble and 25% gravel.

Photo 5: Substrate – Northwest Corner of the Bridge. 40-50% cobble, 20-30% gravel and 20-30% fines.

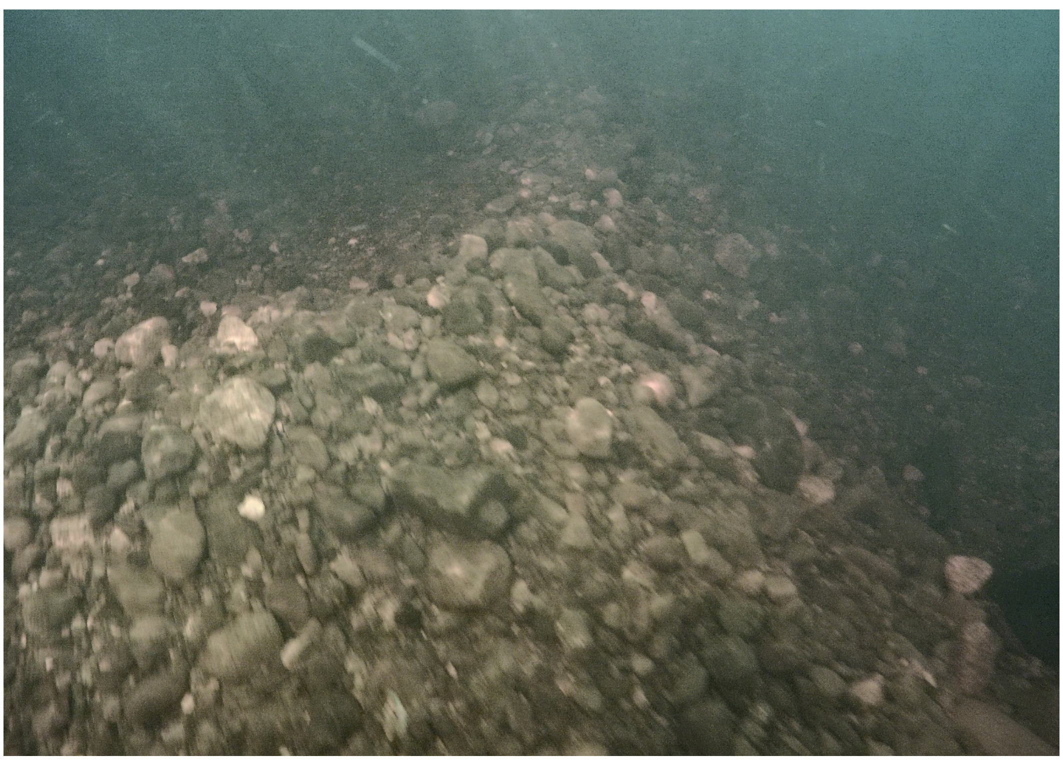


Photo 6: Substrate Under the Bridge – West Side. 60-70% gravel, 10-20% cobble and fines.

Photo 7: Substrate Under the Bridge – East Side. 10-20% cobble, 40-60% gravel and 20-30% fines.

5.2 Riparian Habitat

Riparian vegetation in proximity to the bridge (i.e., from the interface of the water to those areas 15 m beyond the top of bank), included Red Alder (*Alnus rubra*), Western Hemlock (*Tsuga heterophylla*), Western Redcedar (*Thuja plicata*), Salmonberry (*Rubus spectabilis*), Hardhack (*Spiraea douglasii*), Willow (*Salix* sp.) and Swordfern (*Polystichum munitum*) (Photo 8). Given the time of the assessment (15-16 March 2021), some dormant species may also be present that weren't readily observed.

Photo 8: Riparian Area Adjacent to the Bridge. Western Hemlock in Foreground and Salmonberry on Right (East) Bank with Sporadic Swordfern Beneath Bridge Deck.

5.3 Fish Sampling and Results

Four (4) Gee / minnow traps were installed on each of the four corners of the bridge (Photo 9) in lower velocity flow areas, and were baited with salmon roe. Traps were set on 15 March 2021 and left to soak overnight and retrieved the following day, after approximately 24 hours. Each trap was slowly retrieved; however, none of the traps resulted in any captures (Photo 10). The timing of the trapping, coinciding with cold water temperatures (4°C on March 15 and 3.5°C on March 16), and occurring prior to salmon fry emergence and smolt/parr outmigration and during a low salmonid productivity/activity period, are anticipated to be the predominant factors contributing to the null captures, and does not indicate an absence of fish utilizing the river at the existing bridge location.

Photo 9: Deployed Gee / Minnow Trap

Photo 10: Empty Retrieved Trap Upstream of the Bridge.

6 Paint and Wood Sampling and Analytical Results

6.1 Sampling Methodology

The bridge railings were sampled for lead paint at two locations (**Figure 6**). Additionally, the abutments were sampled at two locations for creosote (**Figure 6**). The sampling methodology for lead paint consisted of using nitrile gloves and a paint scraping tool to loosen and remove paint from the bridge railings. The resulting paint chips were placed into laboratory-provided sampling bags and subsequently labelled and sealed.

To collect wood samples from the bridge abutments, AquaTerra personnel wore Personal Floatation Devices (PFDs) and located portions of the abutments above the typical High Water Mark (HWM) given that prolonged submergence could reduce the prevalence of creosote at the wood surface-water interface, over time. A boring tool was used to remove the top layer of wood so that the underlying, dry layer could be sampled. Wood samples were collected from the east abutment and the end of the abutment on the west abutment. Approximately 10-20 grams (g) of material were placed into laboratory-provided sampling bags and subsequently labelled and sealed.

Figure 6: Paint (Red Icon) and Wood (Orange Icon) Sampling Locations

6.2 Analytical Results

Table 1 summarizes the analytical results for the paint sample (KRB21-01 and KRB21-02) tested for lead and the wood samples (KRB21-03 and KRB21-04) tested for creosote. Results were compared to the BC Contaminated Sites Regulation Residential Land-use (RL) standard. The results confirm an elevated concentration of lead in the paint samples, approximately 58-60x the RL threshold. With the exception of 2-Methylphenol is sample KRB21-03, the components of creosote were all below detection limits. 2-Methylphenol is also known as *o*-Cresol, and can be a natural component of cedar, or may result from burning or from dipping the ends of wooden abutments in a creosote product. Given that the other constituents were below the detection limits for constituents associated with creosote, the potential for creosote in the wooden abutments are deemed to be 'low'. Although creosote may have been washed away from the surface layers of the wood over time, wood samples were collected above the typical HWM and below the surface of the wood and are therefore anticipated to be representative. Contingent on the ultimate use-case for the wooden abutments, a follow-up sampling event(s) may be warranted at currently inaccessible portions of the abutments.

Table 1: Keogh River Bridge Paint and Wood Abutment Sample Results.

Analyte	Sample ID CSR RL Standard	KRB21-01	KRB21-02	KRB21-03	KRB21-04
Lead	550	**32200**	**33800**		
Phenol	7.5			<0.090	<0.500
2-Methylphenol	1			0.051	<0.200
3 & 4-Methylphenol	-			<0.054	<0.300
2,4-Dimethylphenol	1			<0.072	<0.400

Table 1: Con't.

Analyte	Sample ID / CSR RL Standard	KRB21-01	KRB21-02	KRB21-03	KRB21-04
2-Nitrophenol	1			<0.090	<0.500
4-Nitrophenol	1			<0.090	<0.500
2,4-Dinitrophenol	1			<0.143	<0.800
2-Methyl-4,6-dinitrophenol	1			<0.143	<0.800
Acenaphthene	950			<0.090	<0.330
Acenaphthylene	-			<0.090	<0.330
Anthracene	2.5			<0.090	<0.330
Benz(a)anthracene	1			<0.090	<0.330
Benzo(a)pyrene	5			<0.090	<0.330
Benzo(b+j)fluoranthene	1			<0.090	<0.330
Benzo(g,h,i)perylene	-			<0.090	<0.330
Benzo(k)fluoranthene	1			<0.090	<0.330
2-Chloronaphthalene	1500			<0.090	<0.330
Chrysene	200			<0.090	<0.330
Dibenz(a,h)anthracene	1			<0.090	<0.330
Fluoranthene	50			<0.090	<0.330
Fluorene	600			<0.090	<0.330
Indeno(1,2,3-cd)pyrene	1			<0.090	<0.330
1-Methylnaphthalene	250			<0.090	<0.330
2-Methylnaphthalene	60			<0.090	<0.330
Naphthalene	0.6			<0.090	<0.330
Phenanthrene	5			<0.090	<0.330
Pyrene	1000			<0.090	<0.330
Quinoline	2.5			<0.090	<0.330

7 Fish Habitat Assessment Conclusions

7.1 Salmonid Utilization Potential

Based on the review of available background information and the field assessment completed by AquaTerra and Kwakiutl, the project team concludes that the area within 25 m upstream and downstream of the bridge provides suitable rearing and overwintering habitat for juvenile Steelhead and Coho Salmon and all life history stages of Cutthroat Trout given the deep pool at the bridge crossing, eddies, functional instream woody debris and overstorey vegetation. The pool at the bridge crossing was reported to provide holding habitat and high stream velocity refugia for all life stages of Cutthroat Trout and upstream migrating pre-spawn adult Steelhead and Pink, Chum and Coho Salmon. There is a possibility that, despite the Keogh river backwatering and becoming inundated with sea water at very high tides, Pink Salmon may successfully spawn in the vicinity of the bridge given that developing embryos and possibly alevins can tolerate periodic, low levels of salinity. It is possible that even at very high tide levels, little-to-no seawater reaches the gravels suitable for spawning downstream of the bridge.

8 Potential Fish Habitat Impact Evaluation

8.1 Bridge Construction

Based on the 30 March 2021 meeting with WSP design engineers, AquaTerra understands that the existing bridge can be constructed without requiring any machinery / excavators in the water, and can be accomplished via temporarily reinforcing the existing bridge to accommodate equipment. Given that the new bridge abutments are situated near the top-of-bank, and that there are no pilings or other in-water structures associated with the new bridge design, the impacts associated with the physical construction of the new bridge is anticipated to be ‘low’. The design does include a large volume of rip-rap, to be placed on both banks both upstream and downstream of the new bridge to accommodate the new bridge elevation and approaches. The estimated rip-rap area for the left and right banks are 210 m^2 and 200 m^2, respectively. Approximately 80% of the area to be rip-rapped is already occupied by the existing bridge infrastructure. As such, rip-rap coverage in new areas necessitating riparian vegetation removal comprise an area of approximately 80 m^2, which is predominantly within the southwest (left) upstream corner of the new bridge alignment. As such, in the absence of mitigation, there will be a reduction in riparian vegetation (i.e., indirect fish habitat loss) cover in the immediate area of the new bridge. If the design methodology changes and access to the right (east) bank necessitates crossing the channel, there is a potential for direct impact to fish and fish habitat in the absence of appropriate mitigation (discussed in Section 10).

During construction, placement of rip-rap will potentially result in temporary increases in turbidity. Additionally, there is a ‘low’ potential that fish mortality may result, in the absence of mitigation, if fish are entrained in active work areas during rip-rap placement.

8.2 Bridge Demolition

During existing bridge demolition, potential fish and fish habitat impacts are anticipated to include works associated with timber abutment removal, which have the potential to destabilize the banks and result in localized water quality issues, as well as a low potential for direct mortality during removal. Moreover, there is a potential for impact associated with bridge deck removal, given the confirmed presence of lead paint. Additionally, although 2-methylphenol may be naturally present in natural cedar, it may also be indicative of creosote residue. Appropriate mitigation strategies are discussed in Section 10.

9 Cumulative Effects – High Flow Bypass Channel

The high flow bypass channel is designed to receive flow predominantly during high flow events, increasing instantaneous flow capacity for the system locally and reducing erosive forces via the dissipation of flow energy between the main stem and bypass channel (Photo 11). During the assessment, only a minor inflow into the channel was observed, with a uniform gradient from the upstream-to-downstream portion of the bypass. Observed pools were assessed for fish presence; however, no fish were observed. There is a potential that during summer low-flow events, the bypass channel will become dewatered, resulting in fish stranding, given a number of isolated shallow pools (Photo 12). Although the channel appears to have been designed to minimize this potential, changes in channel morphology over time, and the natural sorting and erosion/deposition within the channel may increase stranding risk.

The upstream end of the bypass channel is not armoured, which poses a risk for erosion during high flow events. Willow had been staked along the right bank and localized portions of the left bank near the top-of-bank and appeared viable. Near the bottom of the bypass channel, AquaTerra and Kwakiutl personnel noted concrete debris placed along the right bank, which was reportedly excavated from the channel and part of the original ‘flume’ design. As a cost-savings measure, the rip-rap was broken up and used as bank armouring (Photo 12).

In summary, AquaTerra does not anticipate any significant cumulative effects as a result of the high flow bypass channel works as it relates to bridge works.

Photo 11: High Flow Bypass Channel looking downstream (northward).

Photo 12: Broken concrete from the original bypass channel used to armour the banks near the downstream end of the bypass channel.

10 MITIGATION RECOMMENDATIONS

This section provides an overview of mitigation recommendations to minimize potential impacts associated with new bridge construction and existing bridge demolition.

1. The reduced risk window (i.e., the window in which the potential impacts to salmonids are minimized, that accounts for all species – is June 15th to September 15th. Generally, the potential risk of working beyond September 15th incrementally increases as adult salmonids return, necessitating supplementary mitigation measures. The specific windows, by key species are as follows: June 15 to Aug 15 for Pink Salmon, June 15 to Sept 01 for Dolly Varden and Aug 15 – Sept 15 for Cutthroat / Rainbow Trout.

2. Turbidity thresholds are to be monitored / maintained over the duration of instream works within unisolated portions of the river, limited to 8 Nephelometric Turbidity Units (NTUs) above background within a 24 hour period, or <10% of an increase in turbidity when the

background is >50 NTU per the BC Water Quality Guidelines. Fisheries and Oceans Canada (DFO) recommends a maximum of 25 NTU during dry weather conditions and 100 NTU during wet conditions (i.e., >25 mm within a 24 hour period)[1].

3. Bridge installation and bridge demolition must not impede Indigenous fishing activities and unfettered access is to be maintained both during and post-construction.

4. An overarching Environmental Management Plan (EMP) and contractor, site-specific Environmental Protection Plan (EPP) are recommended to ensure compliance with environmental mitigation strategies and adherence to industry Best Management Practices (BMPs). These BMPs include items relating to spill response, re-fueling procedures, and Erosion & Sediment Control (ESC).

5. A Qualified Environmental Professional (QEP) or designated Qualified Environmental Monitor (QEM) under direction of the QEP should be on-site to monitor instream works on a full-time basis, and riparian/bank works on a part-time basis over the duration of works.

6. A fish salvage (two salvage methods, at a minimum) following site isolation are recommended during bridge deconstruction / abutment removal works, and during any instream works (i.e., rip-rap placement) associated with new bridge construction.

7. If equipment / excavators are required to cross the river channel, the crossing is to be designated approximately 20 m downstream at the shallowest point immediately downstream of the fence isolation infrastructure, as this area has been utilized previously by an excavator(s) associated with accumulated gravel removal. Equipment should only enter the water following appropriate isolation of the active work area with rebar and mesh and a fish salvage. Biodegradable lubricants and hydraulic fluids (e.g. vegetable-based lubricants fluids) should be used whenever possible.

[1] I.K. Birtwell, M. Farrell, and A. Jonsson. 2008. The Validity of Including Turbidity Criteria for Aquatic Resource Protection in Land Development Guideline. Fisheries and Oceans Canada. Canadian Manuscript Report of Fisheries and Aquatic Sciences 2852.

8. During rip-rap placement below the high water mark on the new bridge and abutment removal at the existing bridge, silt / turbidity curtains are to be installed parallel to the banks and secured via lead line / chains. Efforts must be made to prevent the silt curtain skirt from getting buried by rip-rap during placement. The area between the curtain and bank is to be isolated and fish, amphibians, snakes and semiaquatic mammals are to be salvaged prior to the onset of works.

9. Contractor shall provide a debris containment system (if required) during removal of the existing bridge to reduce the risk of paint chips or debris from entering the watercourse. Any resulting paint chips and paint on the bridge span should be appropriately managed and disposed of off-site.

10. Advise DFO of the timing of the bridge restoration works, such that any prospective Phase 3 & 4 overflow channel upgrade works could potentially occur concurrently to reduce the disturbance to the Keogh River.

11. If any vegetation removal to accommodate rip-rap placement, new bridge alignment, or existing bridge demolition is required during the peak bird nesting season (15 March – 31 August), a bird nest survey is to be conducted in advance of vegetation clearing. Generally, the nest survey results are valid for 48 hours after the last survey, with the potential to extend up to 5 days contingent on bird activity. Any culturally or ecologically significant plants occurring within areas where vegetation may be removed are to be identified and, if feasible, relocated.

12. A wildlife salvage is to occur prior to rip-rap placement in areas between the high water mark and top-of-bank given the noted amphibian presence in the vicinity of the works.

11 CLOSURE

This report provides comprehensive assessment of fish habitat, with a focus on salmonid species, at the Keogh River Bridge. In the absence of mitigation measures, there is anticipated to be a loss of approximately 80 m^2 of riparian habitat, deemed as an indirect impact to fish habitat. The report has been prepared by Qualified Environmental Professionals from AquaTerra with input from Kwakiutl First Nation, with experience in fish habitat assessments and habitat restoration/enhancement design. Please contact the undersigned if you have any questions.

AQUATERRA ENVIRONMENTAL LTD.

Digitally signed by Chris Lee
DN: cn=Chris Lee, o=AquaTerra Environmental Ltd., ou, email=chris@aquaterra.ca, c=CA
Date: 2021.05.18 09:43:09 -07'00'

Chris Lee, M.Sc., RPBio, QEP
Principal / Senior Biologist