Upper Lillooet Hydro Project

Weekly Environmental Monitoring Report #49

Reporting Period: November 23 – November 30, 2014

Upper Lillooet River Hydroelectric Facility (Water File No. 2002561, Water licence No. C130613), Boulder Creek Hydroelectric Facility (Water File No. 2003049, Water licence No. C129969) & Transmission Line (TX Line)

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Owner Construction Permits and Approvals

Environmental Assessment Certificate No. E13-01 (Amendment 1, 2, 3, 4 & 5)
Fisheries Act Subsection 35(2)(b) Authorization No. 09-HPAC-PA2-000303 (Amendment 1, 2)
Letter of Advice for the Transmission Line No. 09-HPAC0-PA2-000303
Leave To Commence Construction (ULRHEF) File No. 2002561
Leave To Commence Construction (BDRHEF) File No. 2002453
Leave To Commence Construction (TX Line) File No. 2002561/2002453
Conditional Water Licence (ULRHEF C130613) File No. 2002561
Conditional Water Licence (BDRHEF C129969) File No. 2002453
Conditional Water Licence (BDRHEF C131153) File No. 2003601
Licence of Occupation (ULRHEF #232384) File No. 2409871
Licence of Occupation (BDRHEF #232386) File No. 2409998
Licence of Occupation (TX Line #2423386) File No. 2410654
Occupant Licence to Cut (ULRHEF Amendments 1, 2, 3, 4, 5) No. L49717
Occupant Licence to Cut (BDRHEF – KM 38 laydown) No. L49698
Occupant Licence to Cut (BDRHEF Amendments 1, 2, 3) No. L49816
Occupant Licence to Cut (TX Line Amendment 1, 2, 3, 4, 5) No. L49697
General Wildlife Measure Exemption Approval Letter (TX Line & BDRHEF) File No. 78700-35/06 UWR and 39585-20 WHA
Heritage Conservation Act – Alteration Permit (ULRHEF) File No. 11200-03/2014-0033
Road Use Permit No. 6123-13-02 (Lillooet River FSR); 5673-13-01 (Rutherford Creek FSR); 7977-13-01 (Lillooet South FSR); 8015-13-01 (Ryan River); 8188-13-01 (Pemberton Creek FSR); and 9717-13-01 (Miller Bench FSR)
Junction Permit (ULRHEF & BDRHEF) File No. 11250-32/6123 (Amendment 1)
Aeronautical Obstruction Approval (Tx Line - Lillooet River Crossing) File No. 2013-004
Aeronautical Obstruction Approval (Tx Line - Ryan River) File No. 2013-005
Aeronautical Obstruction Approval (Tx Line - North Miller) File No. 2013-006
Aeronautical Obstruction Approval (Tx Line - South Miller) File No. 2013-007
Aeronautical Obstruction Approval (Tx Line - Pemberton Creek) File No. 2013-008
Aeronautical Obstruction Approval (Tx Line - Lillooet River near Pemberton) File No. 2013-009
Aeronautical Obstruction Approval (Tx Line - Lillooet River near Meager Creek) File No. 2013-010
Navigable Water Protection Act (ULRHEF) File No. 8200-2009-500434-001
Navigable Water Protection Act (BDRHEF) File No. 8200-2012-501-032-001
Navigable Water Protection Act (Tx Line – North Creek) File No. 8200-2013-500103-001
Navigable Water Protection Act (Tx Line – Lillooet River) File No. 8200-2013-500101-001
Navigable Water Protection Act (Tx Line – Lillooet River) File No. 8200-2013-500102-01
Navigable Water Protection Act (Tx Line – Ryan River) File No. 8200-2013-500104-001
Navigable Water Protection Act (Tx Line – South Miller River) File No. 8200-2013-500100-001
Navigable Water Protection Act (Tx Line – Boulder Creek) File No. 8200-2013-500099-001
Navigable Water Protection Act – Extension Approval (ULRHEF, BDRHEF, Tx Line)
Navigable Water Protection Act (Bridge – Ryan River) File No. 8200-2013-500381
Navigable Water Protection Act (Bridge – Upper Lillooet Side Channel; Extension Approval) File No. 8200-2013-500383
Section 57 Authorization (ULRHEF) File No. 16660-20/REC202717
SLRD Temporary Use Permit No. 34 – Boulder Creek HEF
SLRD Temporary Use Permit No. 35 – Upper Lillooet River HEF
Works Permit for Construction within FSR Right-of-Way No. 6123-14-01
Section 52(1)(b) FRPA Authorization for Ryan River Wet Crossing File No. FOR-19400-01/2014

Contractor Construction Permits and Approvals

Magazine Licence File No. UL76018
Section 8 Approval – Short Term Use of Water File (Lillooet River and Tributaries) No. A2006123 (Amendment 1)
Waste Discharge under the Code of Practice for the Concrete and Concrete Products Industry under the Environmental Management Act (Authorization No. 107204) Tracking No. 326969
Wildlife Act Permits – Pacific Tailed Frog Salvage Permit # SU14-95304 & SU13-90538, Fish Salvage Permit # SU14-95329
Section 52 of the Fisheries (General) Regulations – Fish Salvage Licence # XR 139 2014
BC Safety Authority – Temporary Construction Electrical Service Permit EL-140698-2014
Municipal Wastewater Regulation - Authorization # 107032
Water Supply System Construction Permits – VCH-14-613 for Main Camp
Water Supply System Permit to Operate Issued July 30th, 2014 for Main Camp
Section 6(3) and Schedule 3 Wildfire Regulations Fire Exemption for Ryan River Bridge File No. 14350-07
SLRD Building Inspection Report dated August 13, 2014 - Construction Camp Building Permit No. 10830
Lillooet River FSR Temporary Road Closures Approval File No. 11250-32/6123 (Amendment 1, 2)
Lillooet South FSR Temporary Road Closures Approval File No. 11250-32/7977

ACRONYMS:

AMBNS	Active Migratory Bird Nesting Survey
ASMP	Archaeological Sites Management Plan
ARD/ML	Acid Rock Drainage and Metal Leaching
BCEAO	British Columbia Environmental Assessment Office
BCWQG	British Columbia Water Quality Guidelines
BDRHEF	Boulder Creek Hydroelectric Facility
BG	Background
BKL	BKL Consultants Ltd.
CE	CRT-ebc Construction Inc.
DFO	Fisheries and Oceans Canada
DS	Downstream
Ecofish	Ecofish Research Ltd.
Ecologic	Ecologic Consulting
EDI	Environmental Dynamics Inc.
EIR	Environmental Incident Report
ESC	Erosion and Sediment Control
FAM	Field Advice Memorandum
FSR	Forest Service Road
GWR	Mountain Goat Winter Range
Hedberg	Hedberg and Associates Ltd.
IE	Independent Engineer (True North Energy)
IEM	Independent Environmental Monitor
INX	Innergex Renewable Energy Inc.
ISW	Instream Works
ITM	Environmental Issue Tracking Matrix
JEM	JEM Energy Ltd. (Delegate Independent Engineer)
LTC	Leave to Construct
MFLNRO	Ministry of Forests, Lands and Natural Resource Operations
MOE	Ministry of Environment
NCD	Non Classified Drainage
OLTC	Occupational License to Cut
PAG	Potentially Acid Generating
RoW	Right of Way
RVMA	Riparian Vegetation Management Area
SES	Sartori Environmental Services
Stringer Line	Temporary Backfeed Transmission Line
TX Line	Transmission Line
ULRHEF	Upper Lillooet Hydroelectric Facility
UWR	Ungulate Winter Range
VC	Valued Component
WEL	Westpark Electric Ltd.
WEMR	Weekly Environmental Monitoring Report
WHA	Wildlife Habitat Area
WQ	Water Quality

1.0 Summary of Site Inspections for Reporting Period

The table presented below summarizes the IEM team site presence, weather and monitoring locations by component:

Date	IEM Team Personnel	Weather Conditions	Key Monitoring Locations & Activities
Sunday, November 23	ML, KM, TJ, DA	Rain and snow	***ULRHEF Intake – Upstream cofferdam*** • Continued installation of the impermeable cofferdam liner and 1 ton bags of crushed rock to the upstream side of the cofferdam (Phase 2) ***ULRHEF Penstock*** • Continued bulk excavation from 3+900 – 4+100 • ESC stabilization of fill side slopes between 2+725 – 3+025 completed and cut-off ditch installed across top of slope. ***ULRHEF Powerhouse*** • Site clean-up and winterization ***BDRHEF Intake Diversion Tunnel*** • Tunnel excavation (drilling/blasting/mucking) began on the bottom benches of the diversion tunnel starting from the downstream portal entrance ***BDRHEF Powerhouse*** • Formwork removal and site demobilization ***TX-Line*** • Segment 5 ➢ Dressing pole structures 88 – 95 • Segment 7 ➢ Ground works at structures 168
Monday November 24	ML, KM, TJ, BA, DA, SS	Snow	***ULRHEF Intake – Upstream cofferdam*** • Continued installation of the impermeable cofferdam liner patches to the upstream side of the cofferdam • Installation of 1 ton bags of crushed rock ~50m downstream of the cofferdam to create a sediment pond within the natural channel (additional Phase 2 mitigation) • Reshaping of the downstream face of the cofferdam and installation of geotextile fabric • Two pumps (10" and 6") were installed within the newly created sediment trap within the natural channel downstream of the cofferdam. Discharged water was directed to the upstream tunnel portal excavation • Stockpiling 0-300mm material closer to the cofferdam to allow for faster placement during construction of Phase 3 cofferdam. Note: a cofferdam design change was made by CE engineering due to the field conditions encountered onsite. The original design with an impermeable key was replaced with geotextile fabric between the 500-1500mm – 0-300mm interface. ***ULRHEF Penstock*** • Winterization and ditch installation from 3+900 – 4+100 ***ULRHEF Powerhouse*** • Removal of the pumps and flooding of the powerhouse structure ***BDRHEF Intake Diversion Tunnel*** • Tunnel excavation (drilling/blasting/mucking) began on the bottom benches of the diversion tunnel starting from the downstream portal entrance ***BDRHEF Powerhouse***

Date	IEM Team Personnel	Weather Conditions	Key Monitoring Locations & Activities
			• Formwork removal and site demobilization ***TX-Line*** • Segment 5 ➢ Dressing pole structures 88 – 95 • Segment 7 ➢ Ground works at structures 168 • Segment 8 ➢ Road upgrading along access road 197.2 ➢ Hand falling ROW within RVMA near structure 192
Tuesday, November 25	SS, TH, BA, AA	Rain and snow	***ULRHEF Intake – Upstream cofferdam*** • Placement of geotextile fabric on the downstream side of the cofferdam (500-1500mm) prior to placement of the 0-300mm material (Phase 3). Placement of the 0-300mm material took approximately 4 hours and resulted in the successful diversion of all flows through the diversion channel • Ecofish performed a fish salvage operation once flows were reduced and conditions downstream of the cofferdam were safe to do so. No fish were captured or observed • Once a seal was achieved the downstream side of the cofferdam was contoured and armoured with rip-rap material ***ULRHEF Penstock*** • Demobilization and winterization measures complete ***ULRHEF Powerhouse*** • Site demobilization of materials and equipment ***BDRHEF Intake Diversion Tunnel*** • Continued tunneling work (drilling/blasting/mucking/rock bolts) for the top section of the diversion tunnel ***BDRHEF Powerhouse*** • Formwork removal and site demobilization was completed. • A diversion ditch was constructed to direct water emanating from the tunnel to the powerhouse foundation and an outlet ditch ***TX-Line*** • Segment 5 ➢ Dressing pole structures 88 – 95 • Segment 7 ➢ Ground works at structures 168 • Segment 8 ➢ Road upgrading along access road 197.2
Wednesday, November 26	BA, TH, AA	Rain and snow	***ULRHEF Intake – Downstream Cofferdam*** • Instream works associated with construction of the downstream cofferdam were completed. Instream works were considered complete once water quality returned to background levels ***ULRHEF Intake – Upstream Cofferdam*** • Raising the height of the upstream cofferdam to design elevation began ***ULRHEF Powerhouse*** • Final demobilization and winterization completed ***BDRHEF Intake Diversion Tunnel*** • CE began demobilization of equipment and winterization of the work site ***TX-Line*** • Segment 5 ➢ Dressing pole structures 88 – 95 • Segment 7

Date	IEM Team Personnel	Weather Conditions	Key Monitoring Locations & Activities
			➢ Ground works at structures 168 • Segment 8 ➢ Road upgrading along access road 197.2
Thursday, November 27	BA, TH, AA	Rain and snow	***ULRHEF Intake – Upstream Cofferdam*** • Construction to design elevation and armouring of the upstream cofferdam was completed in the dry ***BDRHEF Intake Diversion Tunnel*** • Continued winterization of the works site and equipment demobilization ***TX-Line*** • Segment 5 ➢ Demobilizing equipment and crews • Segment 8 ➢ Road upgrading along access road 197.2
Friday, November 28	BA, TJ	Sun and Cloud	***ULRHEF Intake – Downstream Cofferdam*** • Construction to design elevation and armouring of the downstream cofferdam began in the dry ***BDRHEF Intake Diversion Tunnel*** • Winterization of the work site was completed and all equipment was demobilized ***TX-Line*** • Segment 8 ➢ Road upgrading along access road 197.2 • Stringer Line (Temporary Backfeed Transmission Line) ➢ Clearing of stringer line ROW along the Salmon Main Road
Saturday, November 29	BA, TJ	Clear skies	***ULRHEF Intake – Downstream Cofferdam*** • Final armouring of the downstream cofferdam completed • Demobilization of personnel and equipment began ***Tx-Line*** • Stringer Line ➢ Clearing of stringer line ROW along the Salmon Main Road
Sunday November 30	No IEM onsite	-	***ULRHEF Intake*** • Final demobilization of personnel and equipment completed ***Tx-Line*** • Stringer Line ➢ Clearing of stringer line ROW along the Salmon Main Road outside of RVMAs and CTF buffers • Segment 7 ➢ Ground works at structure 168

IEM Team Personnel: *TH – Tom Hicks; KM – Kathy Mai; SS – Stephen Sims; BA – Blake Aleksich; VD – Vanessa Dan; AA – Anthony Andrews; AS—Anne Sutherland; DA – Danita Abraham; TJ – Tammie Jenkins*

2.0 Administrative Summary

Key communications and meetings the IEM team had with the licensees, contractors and/or environmental authorities:

Date	Communication Type	Participants	Issues Discussed	ITM ID No.
November 25, 2014	*Onsite discussions*	INX, SES, CE	Average snow depth measured within the UWR near the BDRHEF intake was 9.2cm. Overnight snowfall likely to result in exceedance of the snow	-

Date	Communication Type	Participants	Issues Discussed	ITM ID No.
			threshold resulting in shutdown of construction activities at the intake work area. CE was advised to be prepared for site demobilization and winterization.	
	Site inspection	SES, WEL	Winterization and clean-up at Segment 5 access track intersections with the Lillooet River FSR.	-
	Onsite discussions	Ecofish, CE, SES, INX	The decision to begin construction of the downstream cofferdam was made by the CE Project Engineer in consultation with INX, Ecofish, and the IEM. The decision was based on field conditions and results of the projected SEV model.	-
November 26, 2014	*Site inspection, onsite discussion*	SES, CE	All construction at the BDRHEF intake was suspended for the season and site winterization and demobilization began. CE informed the IEM of the shutdown of all work activities and start of demobilization works in the morning prior to enactment of the formal shutdown.	-
	Email	SES, INX, CE	Snow depth measured within the Mountain Goat Migration Corridor at Truckwash exceeded the 30cm threshold, resulting in the enactment of the fall 2 consecutive week shutdown period. See Section 8.0 for further details	-
	Site inspection	BCEAO, INX, SES, CE	BC Environmental Assessment Office –Compliance and Enforcement Branch conducted a field inspection of all construction sites (with the exception of the ULRHEF downstream tunnel portal and BDRHEF intake) to inspect and verify that conditions of the EAC and CEMP were being met.	-
November 27, 2014	*Email*	Ecofish, CE, SES, INX	On behalf of CE, Ecofish summarized a mitigation strategy for remaining snow plowing and vehicular travel through the Mountain Goat Migration Corridor during the 2 consecutive week shutdown period. Snow plowing and travel within the Mountain Goat Migration corridor was necessary for the completion of the ULRHEF intake works and site demobilization. See Section 8.0 for further details.	-
	Email	CE, SES, INX	CE submitted a schedule for all remaining travel through the Mountain Goat Migration Corridor indicating that no further travel beyond November 30 will be required.	-
November 28, 2014	*Email*	INX, SES, WEL	WEL notified the IEM and INX of a wood box culvert failure in Segment 8 during road upgrade activities on access road 197.2. WEL will prepare and submit an incident report once a full investigation is performed.	*TX#2 - Open*
November 29 & 30, 2014	*Email*	CE, SES, INX	CE provided the IEM with a record of the number of vehicles and travel times through the migration corridor. All travel was completed outside of the daily sunrise and sunset shutdown periods. See Section 8.0 for further details.	-

3.0 Current Work Restrictions and Timing Windows

The table presented below outlines work restrictions applicable during the reporting period for each active Project component location:

Component	Location	Wildlife/Archeology Concern	Construction/Timing Restrictions & Mitigations
Tx-Line	Segments 1 –11, & 14	Within 150m of wetlands or 100m of Coastal Tailed-Frog Streams	IEM presence is required when clearing within 150m of wetlands or 100m of Coastal Tailed-Frog Streams, to ensure clearing area is minimized.
		Riparian Vegetation Management Areas (RVMA)	IEM monitoring is required during clearing within RVMAs.
		Old Growth Management Areas (OGMAs)	IEM monitoring is required when clearing within legally designated OGMAs, to ensure clearing area is minimized.
		Ungulate Winter Range (UWR)	IEM monitoring is required when clearing within identified deer and moose UWR, to ensure clearing area is minimized.
		Suitable Class 1 & 2 Grizzly Bear forage habitat	IEM monitoring is required when clearing within identified Class 1 & 2 Grizzly Bear forage habitat, to ensure clearing area is minimized. Blasting mats (or other noise reduction methods) are to be employed within 500m of Class 1 and Class 2 grizzly bear forage habitat during critical seasonal foraging periods (fall, September – October).
		Salmon Migration Period and Bald Eagle Roosts	Construction of the transmission line within 500m of Alena Creek, 29.2 km Tributary, South Creek, Rohb Creek must be conducted outside of October 15 – December 31 and Sampson Creek and Railroad Creek must be conducted outside of August 15 to December 31.
		Wildlife Habitat Area (WHA) 2-399	Construction of the transmission line within the Grizzly Bear WHA 2-399 must be construction outside of April 1 to June 1 and October 15 to December 31 to minimize disturbance to Grizzly Bears expected to use the WHA during spring and fall.
Tx-Line	Segment 5 & 7	Ungulate Winter Range (UWR)	According to EAC #E13-01 Amendment 5 and the General Wildlife Exemption Measures Approval dated October 28, 2014, the following mitigation measures must be enacted to extend Tx-line construction activities beyond November 1 and up to December 15 within Moose Winter Range Forest Management Zone u-5-002 J55/54-204-RE in Segment 5 & up to December 31 within MWRFMZ u-5-002 J55/54-204-RO in Segment 7: • The IEM must oversee all construction activities in Segment 5 & 7. • Helicopter flight paths must be determined by a QP in order to avoid, as much as possible,

Component	Location	Wildlife/Archeology Concern	Construction/Timing Restrictions & Mitigations
			wildlife and wildlife habitat within the vicinity of proposed works. • Snow fall accumulation within the Moose Winter Range Forest Management Zone (u-5-002 J55/54-204-RO; Segment 7) must be monitored daily along the Lillooet South FSR. If snow depth exceeds 30 cm and remains at that depth for 8 hours, construction must be suspended immediately and may not resume in 2014.
ULRHEF powerhouse, and Intake diversion channel	Within 50m of identified archeologically significant area	Archaeologically significant site EdRu-3	The ASMP recommends that an archaeological technician from the Lil'wat Nation be present to monitor initial ground-disturbance activities within 50m of the EdRu-3 site boundaries.
	Within 30m of the Upper Lillooet River	Riparian area and fish bearing streams	IEM presence is required when working within 30m of the Upper Lillooet River. Instream acoustic pressure monitoring required when blasting within 30m of the Upper Lillooet River.
Lillooet River FSR; ULRHEF downstream tunnel portal and penstock alignment	Access roads above the lower limit of the 200m buffer Truckwash Creek Migration Corridor to the ULRHEF intake; including FSR realignment at Truckwash Creek	Mountain Goat UWR and Migration Corridor	IEM was onsite to oversee daily construction equipment shutdowns (November 1 - 30) beginning one hour before and two hours after sunrise as well as two hours before and one hour after sunset. Noise monitoring equipment was installed to monitor background noise levels and exceedances of the 75dbA noise level maximum resulting from blasting activities. Initial data will be analyzed during the following reporting period and, if required, adaptive drilling/blasting noise mitigation strategies will be implemented. Daily snow depth monitoring will commence within the Truckwash Creek Migration Corridor once snow fall accumulations persist according to the Project's Mountain Goat Management Plan. A two week shutdown of work activities will occur once a significant snowfall is recorded (average snow depth of 10cm in forested habitat or 30cm in open terrain). Mountain Goat monitoring activities commenced on October 31, at three established observation stations (MG-OBS01, MG-OBS02 & MG-OBS03). Stations are established to monitor three Mountain Goat critical winter habitats (UL 11, UL 19, and Migration Corridor), and each station was visited for a minimum of two hours daily on a rotating schedule. If a goat is observed within 500m line of sight of construction operations, construction must cease for at least 48 hours. The IEM must record and submit all goat observations to FLNR within 48 hours.

Component	Location	Wildlife/Archeology Concern	Construction/Timing Restrictions & Mitigations
BDRHEF intake	Portion of intake access road and crane pad within UWR	Mountain Goat UWR	IEM monitoring is required when clearing within UWR to ensure that clearing areas are minimized. During winter months (November 1 – April 30), access to BDRHEF intake must be gated at least 500 m from UWR to restrict motorized use within the UWR, unless otherwise directed by MFLNRO. On November 13, 2014 MFLNRO granted approval to delay the timing restrictions associated with construction activities, including blasting, in Mountain Goat UWR u-2-002 UL12 from November 15 to up to November 30 according to the following restrictions: • The Contractor must cease construction works and demobilize if snow fall accumulation exceeds 10 cm depth within the forested portion of UWR u-2-002 UL12, and may not recommence in 2014. Snow depth within the UWR will be evaluated as an average depth from five sample sites selected by a QP that will be monitored daily by the IEM. • No helicopter flights will be permitted in or within 1,500 m of UWR u-2-002 UL12 If a goat is observed within 500m line-of-sight of construction operations, construction must cease for at least 48 hours. The IEM must record and submit all goat observations to MFLNRO within 48 hours.

4.0 Upper Lillooet River HEF – Monitoring Results

4.1 Intake (North & South Sides), Access Roads and Upstream Tunnel Portal

Construction Activities:

- Cofferdam Construction (Days 4 & 5) – CE installed additional layers of impermeable cofferdam liner (Photo 1) and 1 ton bags filled with crushed rock on the upstream side of the cofferdam (Photo 2), in order to reduce seepage through the cofferdam. The installation of additional cofferdam liner material proved to be marginally successful at further reducing seepage through the cofferdam. Once the liner installation was complete, CE reshaped the downstream side of the cofferdam (Photo 3) and installed geotextile fabric (Photo 4). CE also installed a wall of 1 ton bags filled with crushed rock ~50m downstream of the cofferdam (Photo 5; upstream of the diversion channel outlet) for the purpose of creating a sediment trap in the natural river channel and allowing CE to pump sediment laden water to the nearby upstream tunnel portal excavation. This additional mitigation strategy was developed to reduce the volume of sediment transported downstream during the placement of the 0-300mm material.
- Cofferdam Construction (Day 6) – CE completed the installation of geotextile fabric on

the downstream side of the cofferdam (500-1500mm) prior to placement of the 0-300mm material. Placement of the 0-300mm material took approximately 4 hours and resulted in the successful diversion of all flows through the diversion channel (Photo 6). Two pumps (10" and 6") were used within the newly created sediment trap to pump sediment laden water to the nearby upstream tunnel portal excavation during placement of the 0-300mm material (Photo 7). Once seepage through the cofferdam was fully stemmed by the placement and compaction of the 0-300mm material, the downstream side of the cofferdam was contoured to create an access to reach the downstream cofferdam location.

- Cofferdam Construction (Day 7) – CE began instream works associated with construction of the downstream cofferdam, which were completed by the end of shift. A culvert was installed at the base of the cofferdam to permit seepage water emanating from within the diversion reach to drain (Photo 8). Once the downstream cofferdam works were completed, CE began raising the height of the upstream cofferdam to design elevation (Photo 9).
- Cofferdam Construction (Days 8 - 10) - Construction to design elevation and armouring of the upstream and downstream cofferdams (Photo 10 & Photo 11, respectively) was completed in the dry. CE began to demobilize from site once cofferdam construction was complete (Photo 12).
- Cofferdam Construction (Day 11) – CE completed final demobilization of all personnel and equipment from the intake work area.

Environmental Summary:

- Instream work at the ULRHEF intake began on November 20, 2014 and was fully completed by November 26, 2014 during the extended 2014 instream works window as approved by DFO and MFLNRO. The IEM monitored all instream work and cofferdam construction activities, and communicated with CE and Ecofish via radio to receive real-time turbidity, flow stage, and Severity of Ill Effect Value (SEV) modeling information. This information helped guide field decisions made by the Construction Engineer. A detailed report has been prepared by Ecofish and is appended to this report; therefore reporting and discussion of the data and SEV modelling information collected by Ecofish has not be duplicated in the body of this report. The following points summarize the observations made by the IEM during each day of the cofferdam construction, highlight all key communications, and explain the reasons for any adaptive management decisions:

November 23 & 24, 2014 – Days 4 & 5

- Impacts to downstream turbidity were barely perceptible during placement of the additional layers of impermeable cofferdam liner, placement 1 ton bags filled with crushed rock, or during reshaping of the downstream side of the cofferdam. Turbidity sampling was not performed by the IEM during these activities, as the IEM was able to visually assess the works and received regular turbidity updates from Ecofish as data from the downstream gauges was transmitted.
- On November 24, a cofferdam design change was made by CE engineering due to the

field conditions encountered onsite. The original design included the installation of impermeable key after the placement of the 0-300mm material. The impermeable key was replaced with the installation of a layer of geotextile fabric on the downstream side of the cofferdam between the 500-1500mm & 0 - 300mm interface (Photo 4).

November 25, 2014 – Days 6

- The IEM collected turbidity grab samples downstream of the diversion channel at regular intervals during the placement of the 0-300mm material as a back-up to the Ecofish turbidity gauges. Turbidity data collected by the IEM is included in Section 4.4.
- Water quality samples were collected and submitted for laboratory analysis of turbidity and total suspended solids (TSS) during the 0-300 mm material placement. Water quality grab samples were collected prior to placement of the 0-300mm material above the works area (ULL-BG) and downstream of the works area (ULL-KEYHOLE BR) to represent BG conditions. The collection of the downstream grab samples was timed to coincide with the expected lag time of the turbidity pulse generated by the cofferdam construction works, which was confirmed visually as the samples were collected. Two samples were collected at each downstream location. The first sample was collected to coincide with the first indication of elevated turbidity (SAMPLE 1) and the second sample was collected to coincide with the peak of the turbidity pulse (SAMPLE 2). Downstream water quality sites were labelled as ULL-PWR and ULL-ALENA, which correspond to sampling locations near the ULRHEF powerhouse and near the confluence with Alena Creek, respectively. The results of the lab analyses were received on November 28, 2014 and are appended to this report. The lab results suggest that the peaks of turbidity and TSS arriving at confluence with Alena Creek were greatly diminished (TSS = 14.5 mg/L; Turbidity = 6.91 NTU) compared to those reaching the ULRHEF powerhouse site (TSS = 828 mg/L; Turbidity = 278 NTU).
- Ecofish completed a fish salvage within the diversion reach once seepage through the cofferdam was sufficiently stemmed and conditions were safe to enter the diversion reach on foot. A fish stranding assessment was also completed in sensitive downstream reaches.

November 26, 2014 – Day 7

- The IEM collected turbidity grab samples downstream of the diversion channel at regular intervals during instream works associated with construction of the downstream cofferdam as a back-up to the Ecofish turbidity gauges. Results of the turbidity grab samples collected by the IEM demonstrate that timing of the turbidity pulse generated by construction works was consistent with that measured by the Ecofish turbidity gauges; however the turbidity levels measured by the grab samples were lower on average. This is likely due to the differences in sampling methodologies. Turbidity data collected by the IEM is included in Section 4.4.
- All instream works affecting water quality were completed by the end of shift. Real time turbidity and SEV monitoring continued until downstream water quality values returned to background levels.

November 27 - 30, 2014 – Days 8 - 11

- The IEM collected turbidity grab samples downstream of the diversion channel at regular intervals during works associated with construction of the downstream cofferdam as a back-up to the Ecofish turbidity gauges. Turbidity data collected by the IEM is included in Section 4.4.
- Following enactment of the fall two consecutive week shutdown of construction works within the Mountain Goat Migration Corridor at Truckwash Creek, an adaptive management strategy was outlined to minimize impacts to Mountain Goats and permit travel through the migration corridor for the final four days of intake works. See Section 8.0 for further details.

Photos:

Photo 1 – Continued installation of cofferdam liner to the upstream cofferdam (November 23, 2014)

Photo 2 – Placing 1 ton bags of crushed rock on the upstream side of the cofferdam (November 23, 2014)

Photo 3 – Reshaping the downstream side of the cofferdam (November 24, 2014).

Photo 4 – Installing geotextile on the downstream face of the cofferdam (November 24, 2014).

Photo 5 – One ton bags filled with crushed rock installed downstream of the cofferdam to create a sediment trap (November 25, 2014).

Photo 6 – Looking downstream at the diversion reach during the fish salvage works once the 0-300mm material sealed the majority of seepage (November 25, 2014).

Photo 7 – ULRHEF upstream tunnel portion excavation filled with sediment laden water that was pumped during the cofferdam installation works. (November 25, 2104).

Photo 8 – Culvert installation being completed during the installation of the downstream cofferdam (November 26, 2014).

Photo 9 – Raising the height of the upstream cofferdam following completion of the downstream cofferdam works (November 26, 2014).

Photo 10 – Placement of riprap armouring on the front face of the upstream cofferdam once it was built to design height (November 27, 2014).

Photo 11 – Final riprap armouring of the downstream cofferdam (November 29, 2014)

Photo 12 – Staging equipment in preparation for demobilization through the Mountain Goat Migration Corridor (November 29, 2014)

4.2 Penstock

Construction Activities:

- Winterization and temporary drainage installation was completed at the 2+725 to 3+025m and 3+090 to 4+095m headings during this reporting period. Following the completion of the winterization works all equipment was demobilized from site.

Environmental Summary:

- Construction activities along the ULRHEF penstock alignment have been completed for 2014. The IEM recommends regular monitoring of this work area during the 2015 spring melt period to ensure winterization and ESC measures installed function as intended.

4.3 Powerhouse & Access Road

Construction Activities:

- Demobilization of equipment and material was completed during this reporting period (Photo 13).

Environmental Summary:

- The two pumps (6" and 10") previously installed in the sump draining seepage waters in the powerhouse excavation were removed once all equipment and materials were removed from the powerhouse foundation work area. Once the pumps were removed the area was naturally flooded by seepage water and ground water inputs. Winterization of the work area has been completed. Flooding of the powerhouse concrete structure presents no environmental concern.

Photos:

Photo 13 – Final demobilization from the ULRHEF powerhouse site. Note the flooded powerhouse area. (November 26, 2014).

4.4 Water Quality Results

The IEM collected turbidity grab samples from the Keyhole Falls Bridge during instream works associated with the installation of the upstream and downstream cofferdams at the ULRHEF intake. The grab sample turbidity data collected by the IEM is summarized in the below table. Results in bold font represent sampling instance where BCWQGs were exceeded. The IEM collected turbidity data as a backup to the water quality information collected by the real time turbidity gauges installed by Ecofish as part of the instream works monitoring program. A detailed discussion of the real time turbidity data collected during construction of the ULRHEF intake cofferdams is included in the appended Cofferdam Construction Instream Works Monitoring Report prepared by Ecofish.

Date	Time	Sample Location Description	pH	Turbidity (NTU)	Cond (*u*S)	Temp (°C)
Instream Works – Upstream Cofferdam Construction						
November 25	6:36	BG – Upstream of intake works	-	5.17	-	-
	7:25	Downstream of intake work area Keyhole Falls Bridge	-	7.03	-	-
	7:37		-	8.44	-	-
	7:46		-	**51.7**	-	-
	7:53		-	**109**	-	-
	8:04		-	**227**	-	-
	8:14		-	**184**	-	-
	8:24		-	**283**	-	-
	8:34		-	**252**	-	-
	8:45		-	**258**	-	-
	8:55		-	**296**	-	-
	9:05		-	**340**	-	-
	9:15		-	**357**	-	-
	9:25		-	**282**	-	-
	9:35		-	**261**	-	-
	9:45		-	**252**	-	-

Date	Time	Sample Location Description	pH	Turbidity (NTU)	Cond (*u*S)	Temp (°C)
	10:00		-	**164**	-	-
	10:15		-	**166**	-	-
	10:30		-	**57**	-	-
	10:45		-	**89**	-	-
	11:00		-	**49**	-	-
	11:15		-	**26.5**	-	-
	11:30		-	**19.9**	-	-
	11:45		-	**17.0**	-	-
	12:00		-	**16.7**	-	-
	12:15		-	**14.7**	-	-
	12:45		-	11.1	-	-
	13:10		-	12.3	-	-
	13:35		-	6.78	-	-
	14:00		-	12.0	-	-
	15:00		-	8.89	-	-
	16:00		-	8.42	-	-
	17:00		-	8.35	-	-
Instream Works – Downstream Cofferdam Construction						
November 26	11:30	Background – Upstream of intake works	-	7.36	-	-
	11:45	Downstream of intake work area Keyhole Falls Bridge	-	**132**	-	-
	12:00		-	**152**	-	-
	12:15		-	**98.1**	-	-
	12:30		-	**51.6**	-	-
	12:45		-	**39.5**	-	-
	13:00		-	**29.7**	-	-
	13:15		-	**28.8**	-	-
	13:45		-	**54.9**	-	-
	14:00		-	**43.6**	-	-
	14:30		-	**32.4**	-	-
	14:45		-	**16.7**	-	-
	15:00		-	**15.2**	-	-
	15:30		-	**18.4**	-	-
	16:00		-	14.3	-	-
	16:30		-	13.4	-	-
	17:00		-	13.1	-	-
Raising the Downstream Cofferdam to Design Elevation						
November 28	10:35	Background – Upstream of intake works	-	13.8	-	-
	10:45	Downstream of intake work area Keyhole Falls Bridge	-	15	-	-
	11:30		-	14.1	-	-
	12:30		-	13.5	-	-
	13:30		-	14.3	-	-

4.5 Recommendations

All construction activities have now ceased for 2014 and will resume in the spring of 2015. A small crew will work to monitor and maintain the construction camp and 38 km laydown area during the winter months. The IEM will perform bi-monthly audits during the winter shutdown period to document compliance with the Winter Operations Plan.

4.6 Upcoming Works

All construction activities have now ceased for 2014 and will resume in the spring of 2015. A small crew will work to monitor and maintain the construction camp and 38 km laydown area during the winter months. The IEM will perform bi-monthly audits during the winter shutdown period to document compliance with the Winter Operations Plan.

5.0 Boulder Creek Hydroelectric Facility – Monitoring Results

5.1 Intake Access Road & Crane Pad

Construction Activities:

- Sequences of drilling, controlled blasts, and blast rock excavation continued on the top bench of the diversion tunnel until November 25 (Photo 14). The blast rock was placed in a crane bucket and hoisted to the crane pad for stockpiling. Care was taken to prevent material from entering Boulder Creek, and no environmental or water quality concerns were noted during this reporting period.
- All construction activities were suspended for the season on the morning of November 26, 2014.

Environmental Summary:

- The average snow depth measured within the forested Mountain Goat UWR near the BDRHEF intake on November 25 was 9.2cm (Photo 15). CE was advised that the forecasted overnight snowfall would likely result in exceedance of the 10cm snow threshold resulting in shutdown of construction activities at the intake work area, according to the conditions of the construction timing window extension approved by MFLNRO. On the morning of November 26, CE notified the IEM that all construction activities at the BDRHEF intake had been proactively suspended for the season and that site demobilization and winterization were underway.
- The IEM completed regular inspections of the BDREHF intake diversion tunnel excavation on day shift and night shift throughout the active work period. Snow depth was monitored following new snowfalls within the forested Mountain Goat UWR near the intake area (Photo 15).

Photos:

Photo 14 – Excavator completing mucking activities inside the BDRHEF diversion tunnel excavation (November 25, 2014).

Photo 15 – Snow depth measured within the forested Mountain Goat UWR near the BRDHEF intake (November 25, 2014).

5.2 Downstream Tunnel Portal and Powerhouse

Construction Activities:

- The removal of form works and winterization of the powerhouse site was completed on November 25 (Photo 16).

Environmental Summary:

- As part of the winterization measures for the tunnel portal and powerhouse site, CE constructed a diversion ditch to direct all seepage emanating from the tunnel excavation to the powerhouse foundation excavation (Photo 17), which has been flooded. An outlet ditch has constructed to channel any overflow from the powerhouse excavation to a natural depression prior to reaching Boulder Creek.
- No environmental issues were observed during this reporting period at the BDRHEF powerhouse or downstream tunnel portal.

Photos:

Photo 16 – Flooded BDRHEF powerhouse area following demobilization of dewatering equipment. (November 26, 2014).

Photo 17 – A cut-off ditch installed to direct seepage from the tunnel excavation to the powerhouse excavation (November 26, 2014).

5.3 Water Quality Results

The following table presents the results of the routine water quality sampling program for the BDRHEF. The IEM is undertaking a weekly monitoring program according to the conditions outlined in the Surface Water Quality Protection Plan. The regular monitoring sites have been selected to quantify WQ conditions within the Lillooet River upstream and downstream of active construction areas. The IEM acknowledges the natural variability of instream WQ conditions in Boulder Creek due to seasonal fluctuations in snowmelt. In the event that an exceedance of *in-situ* water quality (turbidity or pH) is deemed to be caused by project-related activities, the IEM will highlight the exceedance, discuss the cause, and outline measures undertaken by the Contractor to correct the issue. When an exceedance cannot be attributed to project related activities, the exceedance will be marked by an asterisk (*).

Date	Time	Sample Location Description	pH	Turbidity (NTU)	Cond (uS)	Temp (°C)
Routine Water Quality During Diversion Tunnel Excavation						
November 23	21:05	**BDR BG** –Upstream of BDRHEF intake *accessed by crane operated man-basket*	7.62	5.50	n/a	4.1
November 23	22:45	**BDR #1** – Downstream of BDRHEF intake *accessed by crane operated man-basket*	7.83	5.62	n/a	4.2
November 24	00:20	**BDR #1** – Downstream of BDRHEF intake *accessed by crane operated man-basket*	7.81	8.41	n/a	5.1
November 24	04:15	**BDR Background** –Upstream of BDRHEF intake *accessed by crane operated man-basket*	7.87	5.97	n/a	4.0
BDR #2 – Upstream of BDRHEF Powerhouse			No sampling - works did not impact downstream water quality			
BDR #3 – Downstream of BDRHEF Powerhouse at Pebble Creek Bridge			No sampling - works did not impact downstream water quality			

5.4 Recommendations

IEM recommendations for the BDRHEF are as follows:

- The IEM recommends that work sites are closely monitored during the spring melt period to verify the effectiveness of installed winterization and ESC measures, and ensure that regular maintenance is performed as needed.

5.5 Upcoming Works

The following new and/or environmentally sensitive construction activities are scheduled to occur at the BDRHEF in the upcoming reporting period(s):

- All construction activities have now ceased for 2014 and will resume in the spring of 2015. A small crew will work to monitor and maintain the construction camp and 38 km laydown area during the winter months. The IEM will perform bi-monthly audits during the winter shutdown period to document compliance with the Winter Operations Plan.

6.0 Transmission Line – Monitoring Results

6.1 Transmission Line Construction Activities

Right-of-Way Clearing:

- RVMA clearing in Segment 8 near structure 192.
- Clearing the Stringer Line (temporary backfeed transmission line) RoW alignment began.

Existing Road Upgrades and Access Road Construction

- Transmission line access road upgrades/construction (including brushing, ballasting, and road surfacing) were conducted in Segment 8 (road 197.2; Photo 18).
- On November 28, WEL notified the IEM and INX of a wood box culvert failure in Segment 8 during road upgrade activities on access road 197.2. WEL will prepare and submit an incident report once a full investigation is performed.

Transmission Line Pole Installation, Line Stringing and Clipping

- On November 27 construction equipment in Segment 5 was demobilized to the laydown at 5km of the Lillooet River FSR.
- Foundation construction and structure framing works occurred in Segments 5 & 7 (Photo 19).

Environmental Summary:

- In accordance with EAC #E13-01 Amendment 5, the IEM was onsite to oversee construction activities in Segment 5 & 7 during this reporting period. Snow fall accumulation was recorded following new snow fall, within the Moose Winter Range Forest Management Zone (u-5-002 J55/54-204-RO) at 2.5km of the Lillooet South FSR, and did not exceed 30cm during this reporting period.

- The IEM was present as required when clearing activities occurred within 150m of wetlands, 15m RVMAs (30m for CTF streams), 100m of Coastal Tailed Frog Streams, Class 1 & 2 suitable Grizzly Bear WHA and/or suitable forage habitat, moose and deer UWR, and within legally designated Old Growth Management Areas (OGMAs). All flagged boundaries were respected during clearing activities. No environmental issues were observed.

Photos:

Photo 18 – Segment 8 RVMA clearing near structure 192 (November 24, 2014)

Photo 19 – Segment 5 pole dressing works (November 25, 2014).

6.2 Water Quality Results

Date	Time	Sample Location Description	pH	Turbidity (NTU)	Cond (uS)	Temp (°C)
Routine Water Quality						
No WQ measurements were recorded at active Tx-line work areas during this reporting period. Construction and clearing activities had no visual effect on WQ.						

6.3 Recommendations

- Pre-existing water crossing structures (culverts, bridges) should be regularly inspected prior to and during their use in conjunction with road upgrade activities. Once identified, suspect or inadequate crossing structures should be repaired and/or replaced prior to being crossed.

6.4 Upcoming Works

The following new and/or environmentally sensitive construction activities are scheduled to occur along the Tx line in the upcoming reporting period(s):

- Road upgrades in Segments 8 have been suspended until the wood box culvert failure along road 197.2 is repaired.

- Transmission line construction activities will continue in Segments 5 & 7.
- Clearing of the Stringer Line RoW will continue. Once clearing is complete pole structure foundation construction will begin.

7.0 Wildlife Sightings

As per the CEMP, a wildlife sightings record has been implemented and will be updated regularly by Project Personnel. It is mandatory for all personnel to report wildlife sightings including, but not limited to bears, cougars, mountain goats and deer. Wildlife sighting will be reported and recorded by the contractor(s) and will submitted to the IEM on a weekly basis. Wildlife Observation forms have been summarized for the month of November and included below. Observation or detection of the following species will trigger notification to identified parties according to the following table.

Species Observed or Detected	Notification Period	Agencies to be Notified
Northern Rubber Boa	Immediately	IEM, Owner
Grizzly Bear	24hrs	IEM, Safety Officer, Conservation Officer, Owner
Wolverine Den	24hrs	IEM, MFLNRO, Owner
Spotted Owls	24hrs	IEM, MOE, Owner
Mountain Goats	48hrs	IEM, MFLNRO, Owner

Upper Lillooet Hydro Project – November 2014 Wildlife Observation Form

Date	Time	Observer (Company)	Species or Description	Location
11/8/2014	10:50:00 AM	Anthony Andrews	Bald Eagle	Above Lillooet River in Seg. 5
11/8/2014	1:36:00 PM	Blake Aleksich	Red-tailed Hawk	ULRHEF Intake- South side
11/9/2014	10:24:00 AM	Blake Aleksich	Coyote	BDRHEF Intake access rd. @ KM 2.5
11/26/2014	11:00:00 AM	P. Lindgren (WEL)	Moose	Near structure 141 @ Lillooet River x-ing
11/26/2014	11:07:00 AM	Blake Aleksich	2 Sooty Grouse	42km Lillooet River FSR

8.0 Mountain Goat Monitoring Program

The following mitigation measures were implemented for work activity within the Migration Corridor during this monitoring period:

- Daily dawn and dusk shutdowns as outlined in the Mountain Goat Management Plan were followed.
- Noise level monitoring to ensure that the 75db noise level threshold is not exceeded as outlined in the Mountain Goat Management Plan.
- Daily snow depth monitoring within the Truckwash Creek Migration Corridor was

completed following each new snow fall according to the Project's Mountain Goat Management Plan. Please refer to the attached snow depth monitoring form for detailed snow depth measurements recorded on November 26, 2014, following a significant overnight snowfall on November 25th, 2014. The average snow depth measured at road sites exceeded 30cm resulting in the enactment of a two week fall shutdown. On November 27, on behalf of CE, Ecofish summarized a mitigation strategy for remaining snow plowing and travel through the Mountain Goat Migration Corridor during the 2 week shutdown period. Snow plowing and travel through the Mountain Goat Migration corridor was necessary for the completion of the ULRHEF intake works and site demobilization. All travel and snow removal within the migration corridor was coordinated to ensure vehicles travelled together, within a one hour period, a maximum of three times a day, and outside of the sunrise and sunset shutdown periods. Snow removal was performed to ensure that no snow berms were created. The final demobilization trip through the Mountain Goat migration corridor occurred on November 30, 2014.

As of October 31st, the IEM or designate was on site to monitor Mountain Goat activity within 500m of construction activities at the ULRHEF intake and the ULRHEF downstream tunnel portal. Mountain Goats were monitored from three sites:

- Truckwash Creek viewing river right of the Migration Corridor– MG-OBS01 (10U 467955 5612773):
- Keyhole Falls viewing the south side u-2-002 UL11 – MG-OBS02 (10U 466593 5613988); and,
- Garibaldi Pumice mine site viewing u-2-002 UL 19 – MG-OBS03 (10U 467388 561408).

Monitoring effort was split between all three sites between sunrise and sunset, unless safety concerns or weather conditions precluded monitors from doing so. The order of site visits rotated daily. Construction activities need to cease if a goat(s) are observed moving towards the ULRHEF intake and/or if a goat(s) are observed within a 500m line of site of a construction activity. No goats were observed within 500m line of sight of construction activities and no work stoppages were required.

Please refer to the attached Mountain Goat Monitoring Daily Observation Forms for a summary of observations from this reporting period.

9.0 Environmental Issues Tracking Matrix (ITM)

9.1 Hydroelectric Facilities (ULRHEF & BDRHEF)

ITM Tracking Legend:	
	Work Item Open
	Work Item Complete
	Issue Closed

Issue Tracking		Environmental Issue		Mitigation Measures			
ID No.	Status	Location	Issue Description	Action Taken/Recommended	Date of Identification	Targeted Date for Completion	Date Completed
							No outstanding environmental issues (next ITM – ULR#23)

9.2 Transmission Line

ITM Tracking Legend:	
	Work Item Open
	Work Item Complete
	Issue Closed

Issue Tracking		Environmental Issue		Mitigation Measures			
ID No.	Status	Location	Issue Description	Action Taken/Recommended	Date of Identification	Targeted Date for Completion	Date Completed
TX#2	**Open**	Segment 8 – Access road 197.2/tributary to Hillaby Creek	Wood box culvert failure during road upgrade works	1 Prepare and submit EIR#014 outlining the root cause of the incident and how it will be avoided in future. 2 A cross ditch was installed in the dry across the road surface to permit the area upstream of the access road to drain without causing significant erosion. The cross ditch was installed as temporary mitigation immediately following the wood box culvert failure. An appropriately sized culvert will be installed to replace the failed wood box culvert prior to resuming road upgrade works along access road 197.2.	November 28, 2014	November 30, 2014	-
							(next ITM – Tx#3)

Upper Lillooet River Hydroelectric Facility

Cofferdam Construction Instream Works: Monitoring Report

Prepared for:

Upper Lillooet River Power Limited Partnership
200 – 666 Burrard Street, Park Place
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December 19, 2014

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Published by Ecofish Research Ltd., Suite F, 450 8th St., Courtenay, B.C., V9N 1N5

Citation:

McDonnell, D., and A. Harwood. 2014. Upper Lillooet River Hydroelectric Facility Cofferdam Construction Instream Works: Monitoring Report. Consultant's report prepared for Innergex Renewable Energy by Ecofish Research Ltd, December 19, 2014.

Certification:

Certified: stamped version on file

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF MAPS

LIST OF APPENDICES

1. INTRODUCTION

1.1. Requirement for On-site Monitoring

Ecofish Research Ltd. (Ecofish) was retained by CRT-ebc, the Prime Contractor for civil works for the Upper Lillooet Hydro Project (the Project), to assess the risk to fish and fish habitat arising from the proposed extension of the instream work window for the cofferdam construction works at the Upper Lillooet River Hydroelectric Facility (HEF) intake (McDonnell *et al.* 2014a). This assessment was provided to assist CRT-ebc in their application for an extension to the instream work window that was submitted to the Statutory Decision Maker (SDM). An approval for the variance to the instream works window was subsequently issued by the Water Allocations section of the Ministry of Forests, Land and Natural Resource Operations (MFLNRO) (Rosenboom, pers. comm. 2014) and by Fisheries and Oceans Canada (DFO) (Fanos, pers. comm. 2014).

Following approval from the SDM, Ecofish provided a detailed Monitoring Plan (McDonnell *et al.* 2014b) for the cofferdam construction works, setting out monitoring and mitigation measures required to minimize adverse effects and incorporating those measures specified in the initial application (Mc Donnell *et al.* 2014a). The Monitoring Plan was provided to MFLNRO and DFO prior to commencement of construction works.

As part of the approval, it was required that Ecofish would provide on-site, real-time monitoring of the construction works, in the role of Qualified Professionals (QP) to advise the contractor on the management of risk as works progressed. This report presents an overview of the monitoring work undertaken by Ecofish during the instream works associated with cofferdam construction at the intake site, and addresses each of the monitoring protocols set out in the Monitoring Plan (McDonnell *et al.* 2014b).

Works were carried out from November 20 to 26, 2014. Ecofish attended site on November 19 to carry out elements of the baseline monitoring prior to works commencing, and left site on the night of November 26. There was a minimum of two Ecofish personnel on site at all times; monitoring the works in person at the intake site and via the real-time gauge data at the CRT-ebc office. An additional crew attended site to carry out sampling surveys during the works period at specified monitoring stations downstream of the intake. A series of photographs that shows the progress of works is provided in Appendix A along with photographs of sediment deposition and stranding sites.

1.2. Roles, Responsibilities and Communication

The roles and responsibilities during construction works on site were clearly identified in advance to define responsibilities, authority and reporting structure.

- The Upper Lillooet River Power Limited Partnership (ULRPLP) is the Owner of the Project and was primarily responsible for ensuring that the mitigation measures employed during the instream works were effective, and that no serious harm to fish resulted from the proposed works (Fanos, pers. comm. 2014).

- CRT-ebc was the primary contractor undertaking the construction works and was responsible for the adherence to all permits and authorizations of the Project, including the CEMP and EPPs and compliance with all applicable legislation, regulations and standards.
- Sartori Environmental Services Ltd. (Sartori) was the designated Independent Environmental Monitor (IEM) for the construction works, responsible for reporting directly to the Owner, ULRPLP and to Regulatory Agencies. The IEM had the authority to stop, halt or temporarily alter active work if site conditions or actions by the Contractor(s) represented an undue threat to the environment.
- Ecofish were employed as Qualified Professionals (QPs), responsible for providing on-site monitoring and advice directly to the Contractor (CRT-ebc) on management of risk during the cofferdam works. Ecofish also communicated advice and project updates to the IEM and ULRPLP simultaneously.
- JEM Energy Ltd. (JEM) was the Independent Engineer (IE) for the construction works, responsible for reporting directly to the Owner, ULRPLP and to the Regulatory Agencies. The IE had the authority to stop, halt or temporarily alter active work if site conditions or actions by the Contractor(s) represented an undue threat to the public and the environment.

2. METHODS

2.1. Turbidity and Severity of Ill Effects (SEV) Monitoring

2.1.1. Site Selection and Equipment Installation

Ecofish installed two Analite 395 SDI-12 Turbidity and Temperature Sensors and one Analite NEP9510GP Turbidity Sensor from October 29 to 31. Gauges were supplied by Geo Scientific Ltd. and installed at the following locations (see Map 1):

- Upstream of the proposed works to record background water quality (approximately 80 m downstream of Salal Creek: 465984, 561419 10U)
- Approximately 450 m downstream of Keyhole Falls, and 1.1 km downstream of the works (466903, 5613529 10U)
- At the Hot Springs, approximately 2.2 km downstream of the works (467535, 5612754 10U)

Data from each gauge was logged at two minute intervals and set to transmit every 10 minutes via Neon satellite terminals to the online EcoDAT webserver managed by Ecofish.

Prior to works commencing, the upstream gauge was repositioned by Ecofish technicians on November 19, 2014, as natural sediment deposition since installation had buried the standpipe in which the sensor was housed. Repositioning of this gauge also ensured that it would not dry out during the works period. Due to falling water levels in the Upper Lillooet River, the downstream gauge at the Hot Springs site was affected by low flow conditions which continued to decline during the works and this gauge was repositioned into deeper water on the morning of November 23. The location of the Keyhole Falls gauge meant that access to reposition into deeper water was not possible during the works period due to helicopter flying restrictions. This gauge was therefore affected by low flows during the latter portion of the works period, from November 24 to 26.

2.1.2.Data Collection Procedures

All three turbidity gauges were commissioned prior to works commencing. The recording of data during the works period for turbidity and Severity of Ill Effects (SEV) commenced with the start of instream works on November 20 at 09:15 and data was collected continuously. Data transmission via the Neon satellite terminals was generally reliable for all gauges; however, there were frequent lag periods where the regular ten minute transmission was delayed by an hour, and over three hours in one instance.

During the monitoring period the low flow conditions in the river resulted in the Keyhole Falls gauge becoming unreliable at flows of approximately 7.5 m^3/s on November 24. From this point forward the Hot Springs gauge replaced the Keyhole Falls gauge as the primary downstream monitoring gauge and it is this gauge that was utilized for reporting. The turbidity and SEV monitoring curve for the Hot Springs gauge had been running concurrently with the Keyhole Falls gauge as a contingency for such an event.

2.1.3.Rules and Criteria

As per McDonnell *et al.* (2014b), turbidity and SEV were monitored using the following criteria:

- ***Sensitive Period: The period of works during the placement of the 0-300 mm infill material and the bentonite (or equivalent) key are identified as the most sensitive works elements, where the risk of elevated turbidity is highest. However, the entirety of the proposed instream works for the construction of the cofferdam and the switch of flows to the temporary diversion channel have the potential to increase turbidity in the river.***
- The site-specific water quality objectives for the works utilize the SEV model (Newcombe 2003) and are designed for the avoidance of serious harm to fish populations downstream of the works. The SEV criteria, with reference to monitoring and determination of adverse effects of turbidity on fish, are paramount; additional criteria will be managed within this risk framework.
- The turbidity gauges, Neon satellite transmission and SEV online user interface will be confirmed to be fully functional in advance of works commencing.
- The criteria to be implemented on site are as follows:
    - If the SEV is ≤4 no management action is required.

- If the SEV value is >4 an evaluation is required as to the contribution of background turbidity. If construction inputs remain within the values of $SEV_{background}$ +1, works can continue up to and including SEV 8. However, it is highlighted that this would require a $SEV_{background}$ of 7, which is considered unlikely during this time of year for such a short duration window.
- If the SEV is >4, and the SEV due to construction works is greater than $SEV_{background}$ +1; work rates must be slowed or temporarily suspended by the IEM, as advised by the QP. Consultation between the QP and the IEM will establish the stage of construction works and whether it would be advantageous to complete the stage in order to avoid temporally extending washout in the river. Construction will be managed to minimize the SEV and the hourly loading rate of construction material may need to be reduced until instream turbidity levels return to within an acceptable range.
- SEV 8, measured at the downstream compliance point, must not be exceeded; where SEV 8 is the upper limit of the '*Significantly Impaired*' or moderate effects. SEV 9 – SEV 14 are within the range of paralethal to lethal effects on fish. With hourly, real-time monitoring it will be possible to predict the rate of advancement of SEV values and construction will be halted and the work practice will be revised (e.g., slow down rate of loading) as required under the direction of the IEM, as advised by the QP.

- The 100 NTU limit is introduced to manage turbidity on an hourly basis; loadings of this nature from short to medium-term exposures have been demonstrated to cause adverse effects to salmonids (Birtwell *et al.* 2008; Rosetta 2005). Maintenance of this value as a limit will be adaptively managed on site, weighted against the risk of temporally extending the duration of fines washout. SEV values and predictive modelling of the SEV curve relative to future work steps will be utilized as the primary criteria for the management of turbidity. There is no fixed turbidity threshold available in advance to determine SEV exceedance, as the SEV is a function of the background turbidity, work stage inputs and duration.

Further mitigation may be available on site to reduce TSS inputs and turbidity in the event that excessive levels are reached.

2.2. Sedimentation and Deposition Monitoring

2.2.1. Site Selection and Equipment Installation

Site selection for sediment deposition monitoring was based on locations with suitable spawning gravel identified during baseline studies for the Project (Faulkner *et al.* 2011) and site accessibility. The four sediment deposition monitoring sites utilized in the monitoring program were located on a stretch of the Upper Lillooet River mainstem adjacent to the powerhouse (see Map 1); within each of these sites a set of four survey samples were visually inspected to give a total of 16 monitoring records. The sites were paired according to the presence of suitable gravel habitat and were located as follows, labelled from upstream to downstream:

- ULL-DSSM01: (UTM: 468341, 5611947; 10U)
- ULL-DSSM02: (UTM: 468297, 5611851; 10U)
- ULL-DSSM03: (UTM : 468407, 5611634, 10U)
- ULL-DSSM04: (UTM : 468411, 5611579, 10U)

2.2.2. Data Collection Procedures

The sediment deposition monitoring protocol comprised a semi-quantitative visual assessment with photographic recording, after the survey methods of Clapcott *et al*. (2011) and the USDA Forest Service (2013). This methodology was selected over the use of invasive coring or placement of in situ trays, as it allowed for a rapid visual assessment that captured effects over the works duration, without physical disturbance of the gravel substrate or requirement for samples to be analyzed in a laboratory. The survey required instream visual assessment of spawning gravels, thus the results are dependent on water depth and clarity. Increasing flow levels and associated naturally elevated turbidity affected the final, post-works survey on November 27 by limiting visibility through the water column.

2.2.3. Rules and Criteria

As per McDonnell *et al*. (2014b), sediment deposition was monitored using the following criteria:

- ***Sensitive Period: The installation of the fine material infill (0-300 mm grade) was identified as the greatest risk of fine material release. However, all works elements associated with the cofferdam construction and diversion of flows to the temporary diversion channel have the potential for the release of suspended sediment which may be deposited downstream.***
- The sampling protocols allow for a semi-quantitative evaluation of change during the period of instream works. An increase in the accumulation of fines (particle size: <2 mm sand fraction) of 10% or more recorded in 25% of the visual assessments (i.e., 4 of the 16 assessments) will be recorded and reported to the IEM. Sedimentation accumulations associated with the works elements will influence decision-making on site and will be cross-referenced with turbidity and SEV values. Accumulations day to day that persist above this criterion and coincide with elevated turbidity and SEV will necessitate work stoppage and re-evaluation of materials being used.

2.3. Flow Monitoring

2.3.1. Site Selection and Equipment Installation

Three flow monitoring gauges are currently in place on the Upper Lillooet River in the Project area (see Map 1): upstream of the intake works; at the temporary diversion channel return to the natural river below the intake works; and downstream of the works at the powerhouse site. These gauges were installed and are managed by Knight Piésold Ltd. on behalf of Innergex. All three gauges were utilized in the monitoring program.

2.3.2. Data Collection Procedures

Flows at the upstream gauge at the intake were tracked prior to works to determine whether conditions were favorable for the safe and timely completion of works. This gauge was backwatered once works commenced and the initial rock infill restricted flows in the channel. Similarly the gauge downstream was backwatered once flows were diverted through the temporary diversion channel. Therefore the gauge at the powerhouse site was utilized for streamflow readings, while the upper gauges above and below the cofferdam provided water level data that informed the efficacy of the cofferdam in achieving the switch to the temporary diversion channel and in sealing flows from the natural channel.

Flow Forecasting

Two weeks and one week prior to the commencement of works, CRT-ebc delivered up-to-date flow data to ULRPLP for review prior to formal submission to the SDM. These data were presented in the context of historic and 2014 flows at the intake and at the Water Survey of Canada gauge in the Lillooet River near Pemberton (WSC gauge 08MG005). These data were also provided to ULRPLP, the IEM and Ecofish.

Flow Retention

CRT-ebc confirmed discharge immediately prior to works, measured at the upstream gauge at the intake. This was used to determine how much flow could be retained by the cofferdam construction process in order to back up water to the elevation required for flow to pass through the temporary diversion channel. The pre-work discharge of 7.6 m^3/s was communicated to the IEM and Ecofish for monitoring purposes. Criteria around maximum flow retention rates (Section 2.3.3) were implemented based on this discharge. Ecofish had responsibility for monitoring flows at the powerhouse gauge during and after the switch of flow from the main channel to the temporary diversion channel to determine whether there was a risk of a potential stranding event downstream of Keyhole Falls.

2.3.3. Rules and Criteria

As per McDonnell *et al.* (2014b), flow was monitored using the following criteria:

- ***Sensitive Period: The key periods with respect to flows in the river were identified as: immediately in advance of works, to ascertain that flows are favorable for the safe and timely completion of works, and during the switch from the main channel to the temporary diversion channel to ensure that there is no significant flow reduction downstream.***
- In the event that flows reaching or exceeding 60 m^3/s were predicted during the scheduled works window, taking account of forecasted precipitation events, works were to be postponed until flow level forecast declines to below this level.
- If flows at the intake gauging station were >7.4 m^3/s (i.e., 10^{th} percentile) immediately prior to the work commencing, then up to 25% of flow volume could be retained to backwater the channel at the intake site to induce the switch in flows to the temporary diversion channel.
- If flows are <7.4 m^3/s immediately prior to the work commencing, then only 10% of flows were permitted to be retained at the cofferdam site to induce a switch to the temporary diversion channel.

2.4. Fish Stranding and Salvage

2.4.1. Site Selection and Equipment Installation

The retention of flow to induce the switch from the natural channel to the temporary diversion channel at the intake site gave rise to the potential for a stage change in the Upper Lillooet River downstream of Keyhole Falls. Monitoring sites for this short-term event were located between the Upper Lillooet River powerhouse and downstream of the Meager Creek confluence with the Upper Lillooet River. Three sites were selected for monitoring based on the identification of stranding sensitive habitat during the EA (Lewis *et al.* 2012) and knowledge of the low gradient, braided channel in the vicinity of Meager Creek; these sites were located as follows (see Map 1):

- ULL-DSSD01 (UTM: 470496, 5609210, 10U)
- ULL-DSSD03 (UTM : 468374, 5611566, 10U)
- ULL-DSSD04 (UTM : 472915, 5606031, 10U)

Ecofish installed temporary Solinst leveloggers in the Upper Lillooet River at each of the above sites to record stage change during the construction period.

Cofferdam construction leading to the dewatering of the mainstem Upper Lillooet River channel between the cofferdam and the outlet of the temporary diversion channel was identified as potentially necessitating fish salvage. This was scheduled to be undertaken once conditions downstream of the cofferdam allowed safe access to the river bed and was dependent on the following factors: river flows; the stability of the cofferdam structure; and the amount of water penetrating the cofferdam.

2.4.2. Data Collection Procedures

Backwatering behind the cofferdam meant that the intake hydrometric gauge could not be used to monitor compliance with flow retention criteria. Flow data from the hydrometric gauge at the powerhouse were therefore monitored in real-time via the online Neon server to determine the risk of a potential stranding event downstream of Keyhole Falls. These data are managed by Knight Piésold and ULRPLP; however, Ecofish had access in real-time for monitoring purposes. This flow gauge was monitored, in addition to the water level stage change at the two upstream gauges, to inform timing of the fish stranding surveys undertaken at successive sites downstream. In addition, the three Solinst leveloggers were retrieved from the river and were analyzed post-event in order to determine the magnitude and extent of the event, and compare the stage changes recorded with DFO guidelines for ramping.

An Ecofish crew was in place at the upstream stranding-sensitive site (ULL-DSSD03) and worked downstream as the stage change event passed through the river. The crew made visual observations of the stage change and undertook surveys along the dewatered stretch for stranded fish.

Immediately following the effective sealing of flows in the main channel downstream of the cofferdam, Ecofish deployed a fish salvage crew into the natural river channel with the aim of identifying and/or relocating any Cutthroat Trout that may have been stranded within the dewatered reach downstream of the cofferdam.

2.4.3. Rules and Criteria

As per McDonnell *et al.* (2014b), fish stranding was monitored using the following criteria:

- ***Sensitive Period: The monitoring of stranding sensitive sites and potential fish stranding events is included as a contingency in the event that greater than 25% flow retention (or 10% under low flow conditions) occurs during the flow switch to the temporary diversion channel.***
- In the event that flow records at the powerhouse gauge suggest that >25% of flow at the intake was retained for greater than ten minutes (or >10% of flow at initial flows <7.4 m^3/s), then Ecofish will conduct an analysis of the levelogger data from the river to assess the stage change in the river compared to natural stage changes experienced at this time of year. This analysis will also draw upon any observations of fish stranding at the sensitive sites to determine the magnitude and extent of any potential stranding event.

3. RESULTS

3.1. Turbidity and Severity of Ill Effects (SEV) Monitoring

3.1.1. Summary of Monitoring Results

Turbidity

The turbidity values recorded during the monitoring program are presented in Figure 1 and the key turbidity events are described below. Works commenced on November 20, 2014 at 09:15. All three turbidity gauges were fully functioning at start of works. The Hot Springs turbidity gauge was relocated to deeper water on November 23, as flow levels continued to fluctuate below 8 m^3/s, dropping below 7.5 m^3/s and affecting readings from the gauge. The downstream compliance was monitored initially from the Keyhole Falls gauge; however, this was switched to the Hot Springs gauge on November 23 due to low flow conditions rendering the Keyhole Falls gauge unreliable. In order to maintain a continuous dataset for compliance and to avoid inaccurate data interference (i.e., low-flow induced 'noise'), a single dataset was produced from the Hot Springs gauge data which incorporated the turbidity elevations recorded at the Keyhole Falls gauge on November 20. This dataset is termed 'Hot Springs – smooth' for clarity.

Background turbidity at the start of works was recorded from the upstream turbidity gauge at 21 NTU. Rock placement in the river commenced at 11:50; following the installation of the first layer of washed rock in the river there was a 3 NTU increase recorded from the downstream turbidity gauge below Keyhole Falls (12:00). By 15:45 the initial rock layer of the cofferdam was 75% across the channel and turbidity levels downstream were still steady at 3 NTU above background. At 15:50 turbidity levels at the downstream gauge spiked to 280 NTU; this spike was short-lived, lasting approximately 6 minutes and turbidity returned to 20 NTU at 16:00. The temporary diversion channel was flooded and the Obermeyer weir crested at 15:55, the diversion connected to the downstream river channel between 15:55 and 16:00. As a result of the switch in flows through the temporary diversion channel a significant spike of 2,800 NTU was recorded passing the downstream Hot Springs turbidity gauge at 16:30. These values coincided with the diversion switch and the water level stage change that passed through the river at the same time. It is therefore possible that these values were influenced by low flow conditions at the gauges.

Instream works undertaken from Day 2 (November 21) to Day 6 (November 25) consisted of the installation of geomembrane liners on the upstream side of the cofferdam to limit flows through the cofferdam, and the creation of a temporary settlement pond downstream of the cofferdam. During these works, no turbidity events were recorded that required any management actions. Instream works on November 25 comprised the second layer of the cofferdam construction, with the infilling of fine material to seal flows. Works commenced at approximately 07:30, with the first elevations in turbidity recorded from the Hot Springs gauge downstream at 09:00. Turbidity downstream ranged between 188 NTU and 415 NTU during the hour from 09:00 to 10:00. Turbidity levels peaked after 10:00 with values between 527 NTU and 550 NTU. The average NTU for the work during this period was 193 NTU, with turbidity dropping below 100 NTU from 13:00 with a sharp decline to 25 NTU by 14:15.

On the final day of works the removal of instream mitigation materials and the installation of the fine material for the downstream cofferdam resulted in a short-term turbidity spike which peaked at 262 NTU and which lasted at over 100 NTU for less than one hour. Active instream works were completed at 16:30. However, due to backwatering at the point where flow through the temporary diversion channel re-enters the natural channel, there was a continuous low level of fine material displacement downstream through the evening. This meant that background turbidity levels were not achieved until 21:42 on the night of November 26, when it was considered that instream works had ceased.

The turbidity levels recorded during the cofferdam construction works must be understood in the context of the natural, background turbidity events that occur in the Upper Lillooet River, predominantly as a result of rainfall-induced high flow conditions during the October and November period. The following natural events were recorded from the upstream turbidity gauge preceding and following the completion of the current instream works:

- 340 NTU on October 30, 2014
- 845 NTU on November 6, 2014
- 235 NTU on November 27, 2014
- 140 NTU on November 28, 2014

SEV values

The SEV model calculations for the construction period were initially set for a three day works period between November 20 and 22; with the calculations commencing at the start of instream works at 09:15 on November 20, 2014. Following the spike in turbidity that occurred on the first day of works, the SEV values for the construction period rose to 2.5, remaining below the management criteria of SEV 4 and also within the range of $SEV_{background+1}$ (see Figure 2). SEV values at the downstream compliance point were calculated initially from the turbidity gauge below Keyhole Falls; however, due to falling water levels, in line with the turbidity monitoring program, the Hot Springs gauge was used for monitoring from November 24 onwards. Co-recording of SEV values had been commenced using the Hot Springs gauge data; therefore it is this dataset that is utilized in this reporting and for determining the final SEV value at the end of works (see Figure 2).

The continued increase in SEV values between November 20 and November 25 are a function of the ongoing cumulative effect of duration, tracking in line with background turbidity levels in the river. SEV 4 was exceeded on November 24; however, values remained close to or within $SEV_{background+1}$, and as the instream works underway during this time period (i.e., installation of the geomembrane liner on the upstream end of the cofferdam) were not resulting in spikes in turbidity, further management or mitigation measures were not required. It was at this point that the construction period was determined to require 7 days and this was inputted into the model. The infill of fine material, scheduled to commence on Day 6 (November 25), was considered to be a critical stage for the SEV model. The volume of material and the percentage of fine material that would potentially wash-out was unknown and, following a risk analysis of the many variables involved and utilizing the predicted input values provided by CRT-ebc, it was considered that values close to the threshold of SEV 8 may be reached.

Based on this analysis, CRT-ebc implemented additional mitigation measures, including the creation of a temporary settlement pond and the pumping of silt-laden water from downstream of the cofferdam to the upstream tunnel portal excavation. As a consequence of the implementation of these additional measures, the construction SEV values on November 25 were limited to 4.8, compared to upstream values of 3.7. Following construction of the downstream cofferdam on the last day of instream works, November 26, the final SEV values for the project were determined to be 4.9, with background SEV at 3.8. These values are considered to be significantly influenced by the extended duration of the cofferdam construction works, which allowed the few short-term peaks in turbidity to be averaged out over time and thus assimilated into the SEV model.

Figure 1. Chart showing the record of turbidity results from the monitoring period (November 20-26, 2014).

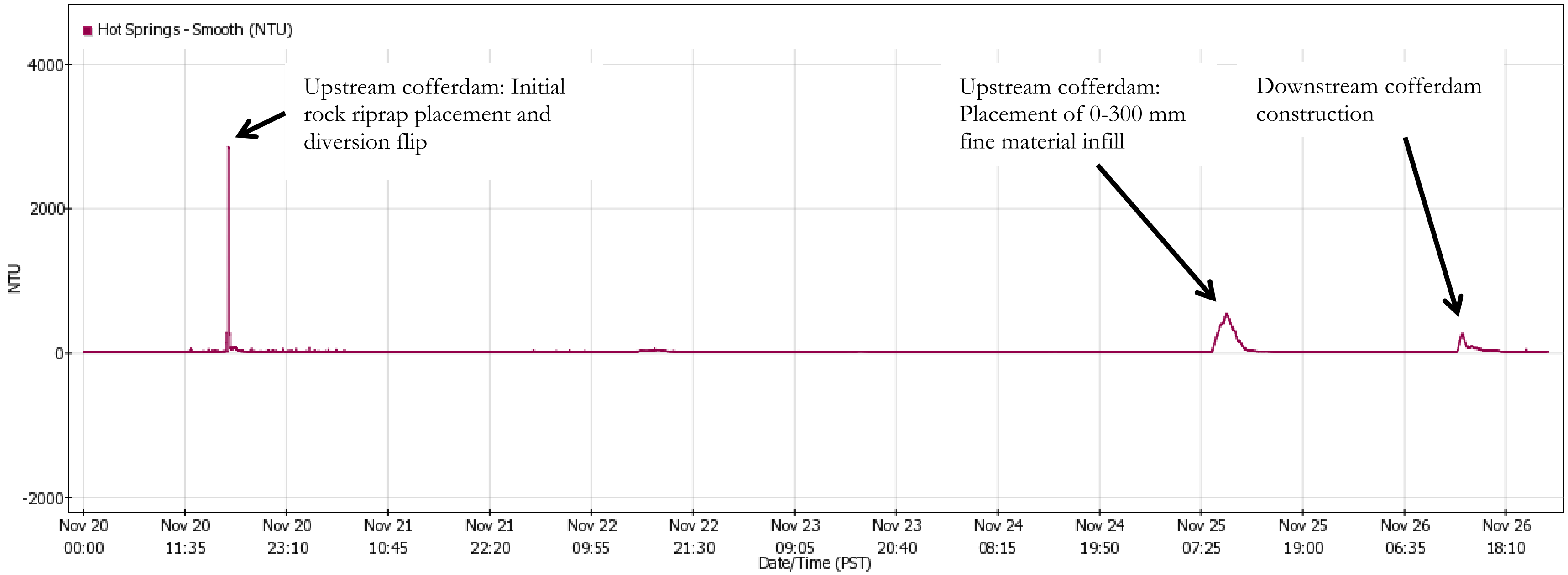
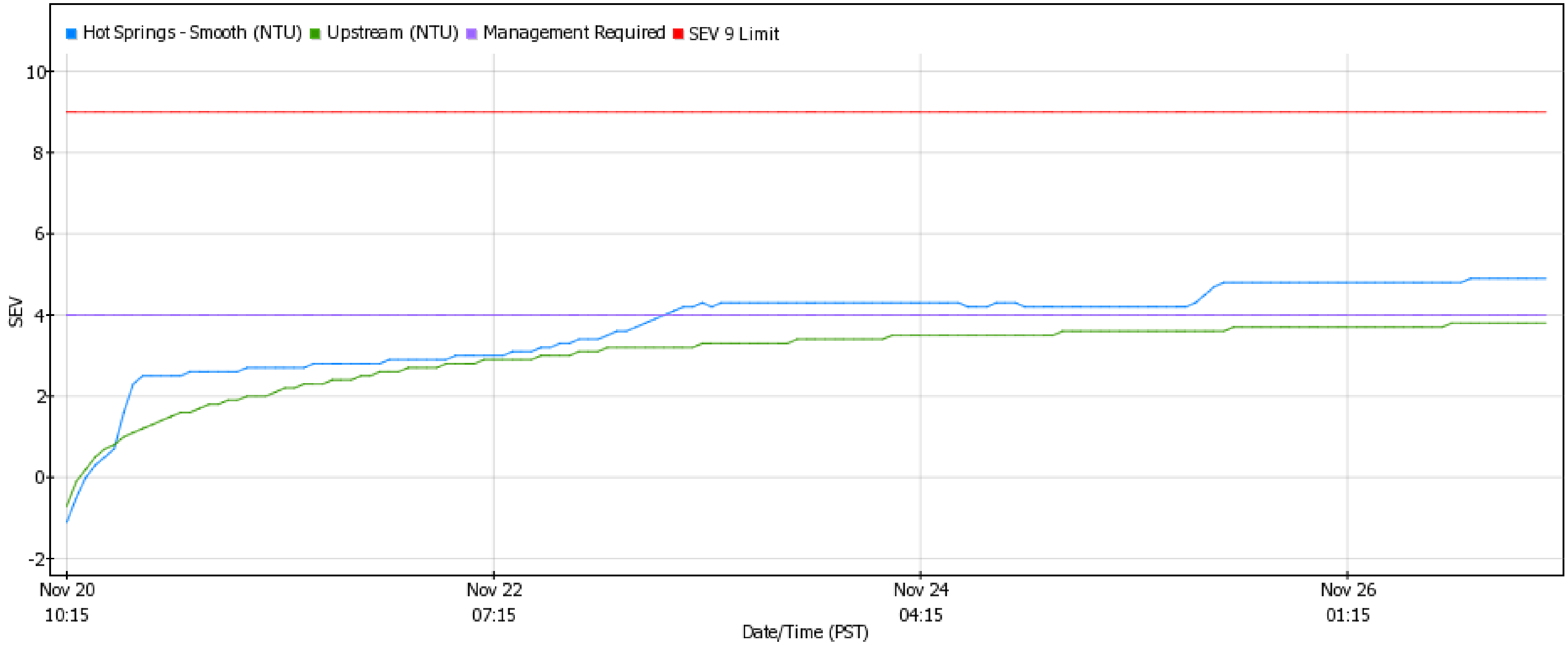


Figure 2. Chart showing the SEV progression over the duration of the cofferdam construction works between November 20 and 26, 2014. The construction-induced SEV values are taken from the hot springs turbidity gauge compliance point, shown in blue; while the upstream reference values are shown in green.



3.1.2. Compliance with Monitoring Criteria

Turbidity

The most significant turbidity inputs to the river occurred during the initial switch in flows on November 20; the elevated spike of approximately 2,800 NTU was the highest peak recorded, attributed to the washing out of the temporary diversion channel. This lasted for approximately 10 minutes in the river at the Keyhole Falls gauge. Additional spikes in turbidity were recorded during the infill of fine material and construction of the downstream cofferdam on November 25 and 26, respectively (Figure 1). All spikes were of relatively short duration and were evaluated within the context of the 100 NTU hourly average threshold.

The most significant hourly average spike in turbidity occurred on the first day of works, November 20, 2014, when the choking of flows in the natural river channel led to the flushing of the temporary diversion channel. This occurred between 15:30 and 16:30; averaging 603 NTU, and exceeding the 100 NTU hourly average criteria. However, the short duration of this spike and the fact that it was a one-off event, meant that there were no management actions that could be taken to reduce turbidity following this event. The average hourly turbidity in the following hour was reduced to 54 NTU.

The instream works associated with the infill of fine materials downstream of the first layer of rock infill, on November 25, also resulted in significant levels of turbidity, due to high volumes of water passing through the cofferdam at this stage. The average NTU for this works element was 193 NTU; however, the management decision in place was to complete the seal on the cofferdam to minimize further washout, despite short-term elevations. This was implemented with the addition of further mitigation measures downstream of the cofferdam works.

The nature of the construction works occurring during both peak turbidity events (November 20 and November 25) meant that it was not possible to delay or slow works phases, as this would have resulted in an extended duration and higher volumes of fine material being washed into the river. Achieving a choke in flows and then sealing the cofferdam were accomplished as quickly as possible to minimize the washout of fine material. Mitigation measures to reduce turbidity inputs were implemented as part of adaptive management actions when SEV values exceeded 4; with cognizance of the volume of material that was due to be deposited in the river during the fine material infill on November 25. In advance of this work activity a settlement pond was created below the cofferdam utilizing large bags filled with clear-crushed stone to create a temporary dam and settlement pond. Two pumps (10" and 6") were installed to extract water from this location and pump to the upstream tunnel portal excavation at the intake works site adjacent to the cofferdam works. This dual settlement pond and pumping effectively reduced the volume of fine material washed down the river, in addition to reducing the volume of turbid water discharged below the cofferdam during the works. Based on the pump capacity of the two pumps and the duration that they were operating, it is estimated that several thousand cubic meters of silt-laden water were prevented from flowing downstream (see Figure 3 and Figure 4).

Figure 3. View of the large bags of clear-crush stone used to create a settlement pond downstream of the upstream cofferdam, which effectively slowed flows during the installation of fine material and allowed for deposition.

Figure 4. View of the upstream tunnel portal excavation into which sediment-laden water was pumped from the temporary settlement pond downstream of the upstream cofferdam.

SEV values

Predictive modelling of the suspended sediment releases and turbidity values in the Upper Lillooet River undertaken by Ecofish suggested that it would be unlikely that the works could be managed within $SEV_{background+1}$; however, this was included within a suite of management criteria, as it is a standard recognized by MFLNRO. Due to the duration of the instream works period, which included a number of days that did not contribute turbidity over background conditions, the overall average turbidity released from the works was significantly reduced. This had the effect of mitigating short-term, short-duration spikes occasionally recorded during the works period and resulted in SEV values that tracked close to the management criteria of SEV 4, and $SEV_{background+1}$ when construction SEV was >4.

The final SEV values for the works period included the duration from the commencement of works on November 20 at 09:15 to the point when downstream turbidity aligned with the natural background turbidity values at 21:42 on November 26. Actual instream works were completed on November 26 at 16:30. Upon closing the SEV window for instream effects, the background SEV was recorded as 3.8 and construction SEV as 4.9.

The works are therefore considered to have been closely managed within the criteria and did not exceed SEV 8, which was identified as the limit above which serious harm would likely occur.

3.2. Sedimentation and Deposition Monitoring

3.2.1. Summary of Monitoring Results

Four sites were selected for sedimentation monitoring in the Upper Lillooet River. The objective of this monitoring element was to identify if the cofferdam works resulted in deposition of fine material within gravel habitat downstream. Due to the mobile nature of the gravel sites selected, identified as representative of spawning gravels within the Upper Lillooet River, there was found to be considerable and consistent variability at each site during the monitoring period. This was most noticeable for the naturally-occurring coarse sand fraction which was found to shift in density within the repeat samples, independent of the effects of the construction works (i.e., the river is naturally mobilizing high material loads which are redistributed locally on an ongoing basis).

In summary, there was no silt or fine fraction increase at any of the monitoring sites that was attributable to the construction works. Observed variability or fluctuation in the fine fractions recorded at all of the monitoring sites was attributed to natural geomorphological processes at a local scale within the river channel.

3.2.2. Compliance with Monitoring Criteria

The sampling methodology allowed for a semi-quantitative evaluation of fines accumulation (particle size: <2 mm sand fraction) of 10% or more recorded in 25% of the visual assessments (i.e., 4 of the 16 assessments). This 25% change was evaluated by Ecofish personnel to be with regard to works-induced sedimentation, discriminating between this and mobile fine and coarse sand that are naturally mobile in the river. On this basis the monitoring criteria were not exceeded.

3.3. Flow Monitoring and Stage Change

3.3.1. Summary of Monitoring Results

The three Solinst leveloggers installed at the sensitive stranding sites were retrieved following the completion of works and analyzed to determine the rate and duration of the stage change that passed through the river on November 20, arising from the switch in flows to the temporary diversion channel. Figure 5, Figure 6, and Figure 7 present the ramping rate graphs from the stage change event at ULL-DSSD03, ULL-DSSD01, and ULL-DSSD04, respectively. The stage change was most pronounced at the upstream monitoring station (DSSD03: Figure 5), dissipating in magnitude as it progressed down the river.

Figure 5. Levelogger data from the ULL-DSSD03 sensitive stranding site at the powerhouse.

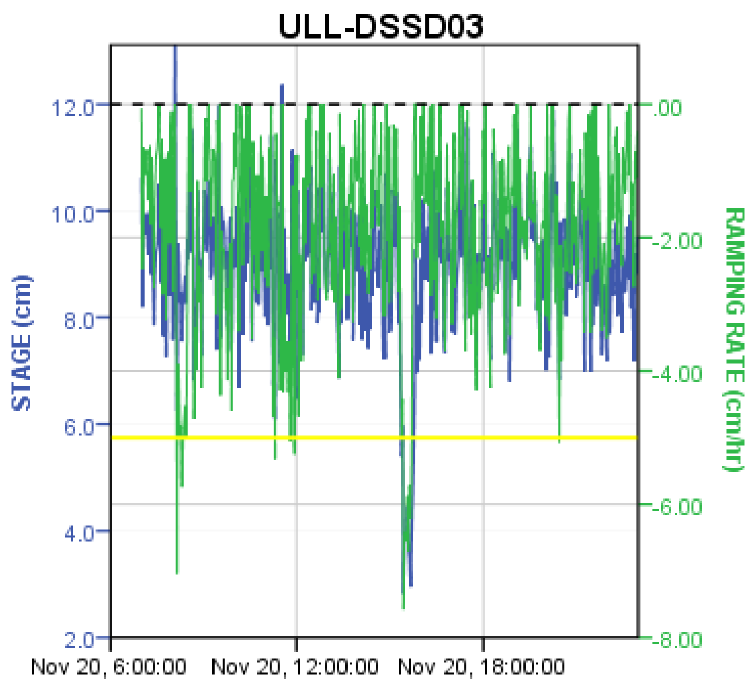


Figure 6. Levelogger data from the ULL-DSSD01 sensitive stranding site at the Boulder Creek confluence.

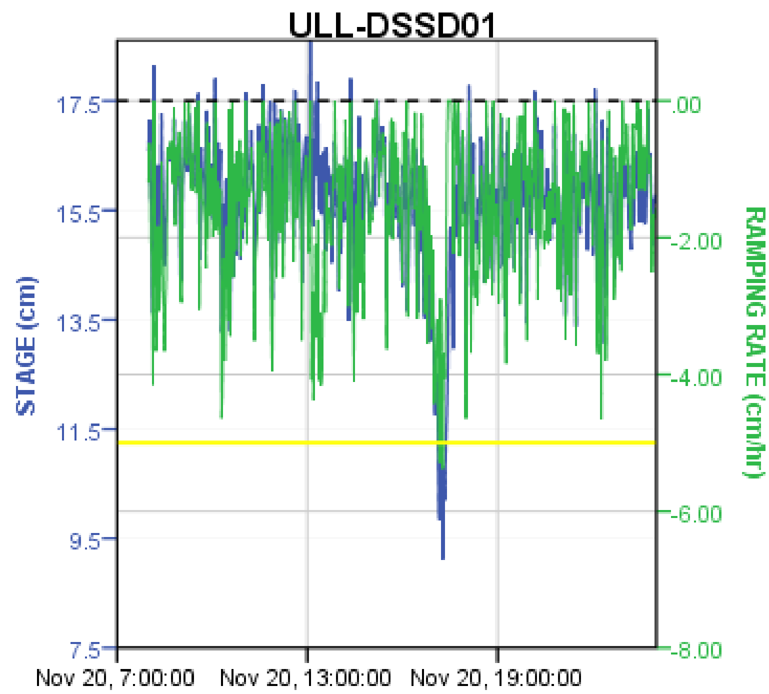
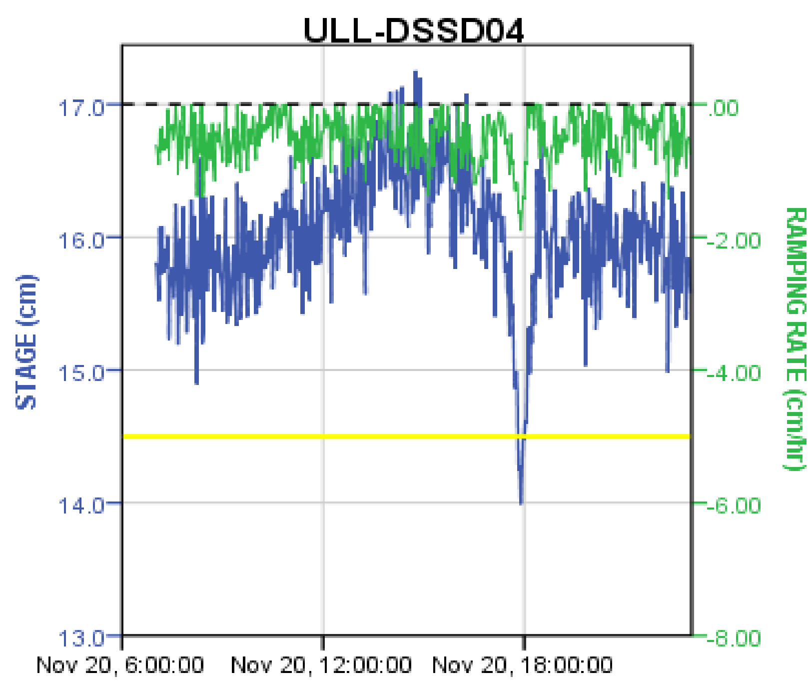


Figure 7. Level logger data from the ULL-DSSD04 sensitive stranding site at the monitoring site upstream of the Alena Creek confluence with the Upper Lillooet.



The pertinent information from the graphs above is summarized in Table 1. The analysis of the stage change identifies the duration of the event remained relatively constant at all three sites as it progressed down the river, averaging 30.6 minutes.

Table 1. Summary of the stage change duration and rate from November 20, 2014.

Site	Time (hh:mm)			Stage (cm)			Overall Stage Change (cm)	Maximum Ramping Rate (cm/hr)[2]	Time Out of Compliance (hh:mm)[3]
	Start	Minimum[1]	Back up	Start	Minimum[1]	Back up			
ULL-DSSD03	16:18	16:26	16:50	9.2	2.8	9.3	-6.4	-7.6	0:10
ULL-DSSD01	16:58	17:10	17:30	14.3	9.9	15.1	-4.4	-5.4	n/a
ULL-DSSD04	17:40	17:54	18:08	15.5	14.0	15.3	-1.5	-1.9	n/a

[1] The time and stage at which minimum water levels were reached

[2] The maximum ramping rate is calculated using the maximum stage change in the previous hour

[3] Events less than 10 minutes in duration are generally considered relatively low risk for fish mortality

3.3.2. Compliance with Monitoring Criteria

As flows exceeded 7.4 m^3/s on November 20, during the diversion flip the compliance criterion was that 25% of flows could be retained behind the cofferdam to induce the flip into the temporary diversion channel. Due to the difficulty in monitoring compliance with this criterion in real-time because of the backwatering of the intake gauge, and the lag time between the intake and the powerhouse gauge, an Ecofish crew were stationed at DSSD03 to search for stranded fish (Section 3.4).

In addition to conducting on-site searches, we determined the stage change rates at the sensitive stranding sites during the diversion flip and compared these to the standard DFO ramping criteria for when fry are not present (i.e., -5.0 cm/hr; Cathcart 2005). This rate was exceeded at the powerhouse (DSSD03) and near the Boulder Creek confluence (DSSD01); however, the duration of the event was short, thus limiting the risk of fish mortality. Stage change events that endure for less than 10 minutes are typically not considered non-compliance ramping events given the time required for the substrate to drain and for fish to asphyxiate. With the application of this general rule, the stage change event during the diversion flip exceeded standard DFO ramping criteria at the powerhouse site for a period of 10 minutes (see Table 1). The results of on-site stranding searches indicate that this exceedance did not result in serious harm to fish (Section 3.4).

3.4. Fish Stranding and Salvage

3.4.1. Summary of Monitoring Results

Fish Stranding

The switch in flow from the natural channel to the temporary diversion channel caused by the cofferdam works resulted in a short term stage change in the river. This was observed as occurring on November 20; between 15:50 and 16:00 at the intake site. Leveloggers were also in place, as described for the flow change in Section 3.3.1.

The stage change was recorded by the flow gauge at the powerhouse and was visually observed on the river bank by the Ecofish crew. The Ecofish crew stationed at this site conducted a stranding survey along the river left margin as flows receded. No fish were observed or recorded stranded.

The Ecofish field crew moved downstream at 16:48 to the stranding sensitive habitat identified upstream of the Alena Creek (DSSD04) confluence on the main channel of the Upper Lillooet River. This section was prioritized due to the sensitivity of habitat at this location and the field observations at the DSSD01 site (Boulder Creek confluence), which identified limited stranding sensitive habitat under the flow conditions recorded. The change in water level was also observed by the Ecofish crew at site DSSD04. Areas of shallow cobble were dewatered during the stage change, but were found to be highly compacted and embedded. No fish were observed and or recorded stranded.

Fish Salvage

On November 25, 2014, flows through the cofferdam were effectively sealed with the completion of the fine material infill at the downstream side of the cofferdam. This allowed an inspection of the dewatered natural river channel, within the canyon, for any fish that may have become stranded or required salvage. This survey was carried out by an Ecofish fisheries biologist on the morning of November 25, 2014; between 11:13 and 11:42. Due to cold water temperatures (<5°C), electrofishing was not permitted in the small amount of turbid water seeping through the cofferdam. Nevertheless, approximately 80% of the 640 m^2 channel was dewatered and could be effectively searched, with no fish or signs of fish observed. The large volume of fine material deposited within the canyon between the upstream cofferdam and the large bags filled with clear-crush stone downstream led to the conclusion that the survival of any fish within the dewatered section was unlikely. However, in evaluating the consequence of any potential fish mortality it is necessary to consider the high velocities and sub-optimal fish habitat present within the canyon prior to the commencement of works, and the likelihood that few if any fish were present. Furthermore, safety constraints prevented the fish salvage crew entering the confined natural canyon to search for fish until it was largely dewatered and the upstream cofferdam was confirmed to be sealed and stabilized.

3.4.2. Compliance with Monitoring Criteria

Fish Stranding

No fish were observed or required salvage at the stranding sensitive sites surveyed during the stage change in the river. No fish mortalities were recorded. From the stage change data set out in Table 1 it is considered that there was no significant risk to fish, where DFO (Cathcart 2005) guideline ramping rates were complied with at DSSD01 and DSSD04. Although these rates were exceeded at DSSD03, the ramping event was of short duration and did not result in serious harm to fish based on the on-site searches that found no stranded fish.

Fish Salvage

No fish or signs of fish were observed during the fish salvage survey within the dewatered natural river channel at the intake site, downstream of the cofferdam. High velocities in the canyon prior to the commencement of works means this location was considered sub-optimal for holding fish (Cutthroat Trout only), and there were likely few if any fish present. Any fish that were present are unlikely to have survived the conditions of elevated turbidity and sediment deposition during the infilling of fine material on the downstream side of the upstream cofferdam on November 25. However, safety constraints within this steep canyon reach precluded attempts to salvage fish prior to works commencing. In summary, no fish were recorded during this fish salvage exercise; no specific criteria with regard to the number of fish mortalities or fish salvaged were specified in the Monitoring Plan as criteria for compliance.

4. CONCLUSIONS

Ecofish were present on site for the duration of the instream cofferdam construction works at the Upper Lillooet River HEF intake area. The monitoring protocols described in the initial impact assessment (McDonnell *et al.* 2014a) and further detailed in the Monitoring Plan (McDonnell *et al.* 2014b) were fully implemented on site during the course of the works, with appropriate communication supplied to both the SDM and the active parties (CRT-ebc, IEM, ULRPLP and IE).

The turbidity and associated SEV criteria were monitored, with adaptive management decisions made during the course of the works. The monitoring criteria were complied with in full during the course of the works, with SEV values not exceeding 4.9. The sediment deposition monitoring was undertaken, with all results found to be in compliance with the monitoring criteria.

The flow monitoring results, in conjunction with the results of on-site stranding searches, indicate that the stage change in the river during the flow switch from the natural river channel to the temporary diversion channel at the intake site did not result in serious harm to fish. The stage change event was of short duration and no fish were recorded stranded at the sensitive stranding monitoring sites downstream. Furthermore, no fish were recorded in the dewatered river channel immediately downstream of the upstream cofferdam works. Therefore no fish required salvage as a result of these instream works.

It is therefore concluded that the monitoring criteria were adhered to during the instream works and that the works did not result in serious harm to fish. This is in large part due to the willingness of CRT-ebc to ensure the effectiveness of the mitigation measures employed (e.g., geomembrane liners installed on the upstream end of the cofferdam) and the adoption of additional mitigation measures to reduce adverse impacts (i.e., creation of a temporary settlement pond and pumping sediment-laden water to the upstream tunnel portal excavation).

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PROJECT MAPS

Path: M:\Projects-Active\1095_UPPERLILLOOETPROJECT_NEW\MXD\Construction\1095_ULL_ConstructionMonSites_2014Dec02.mxd

APPENDICES

Appendix A. Representative Photos from the Upper Lillooet River HEF Cofferdam Construction Monitoring.

LIST OF FIGURES

November 19, 2014 – Site Preparation Pre-works

Figure 1. View downstream to intake cofferdam site. Temporary diversion channel is located at right of image.

Figure 2. Rock armour placement at right bank of temporary diversion channel. View from river-left.

November 20, 2014 – Site Preparation and Initial Instream Works

Figure 3. **Placement of first rock layer of cofferdam instream.**

Figure 4. **Building out first rock layer of cofferdam across the river channel. Water level rising upstream.**

Figure 5. **Closing the first rock layer across the river channel. This induced a significant rise in water level upstream, reaching the temporary diversion channel and switching flows.**

Figure 6. **The initial flooding of the temporary diversion channel resulted in a significant flush of suspended sediment and turbidity which coincided with the flow stage change induced during the switch.**

Figure 7. **Once the initial flow diversion had taken place, turbidity in the river rapidly reverted to background values below the cofferdam.**

Figure 8. **Similarly, following the initial flush, the flows in the temporary diversion channel also achieved background values.**

November 21, 2014 – Preparation for geotextile installation

Figure 9. The first installation of the geomembrane did not reduce flows downstream of the cofferdam sufficiently, requiring an alternative methodology.

November 22, 2014 – Geomembrane Installation

Figure 10. The geomembrane was installed along the upstream cofferdam face using a frame fabricated on site. This allowed the membrane to be placed close to the base of the cofferdam.

November 23, 2014 – Site Preparation and Adjustment to Geomembrane

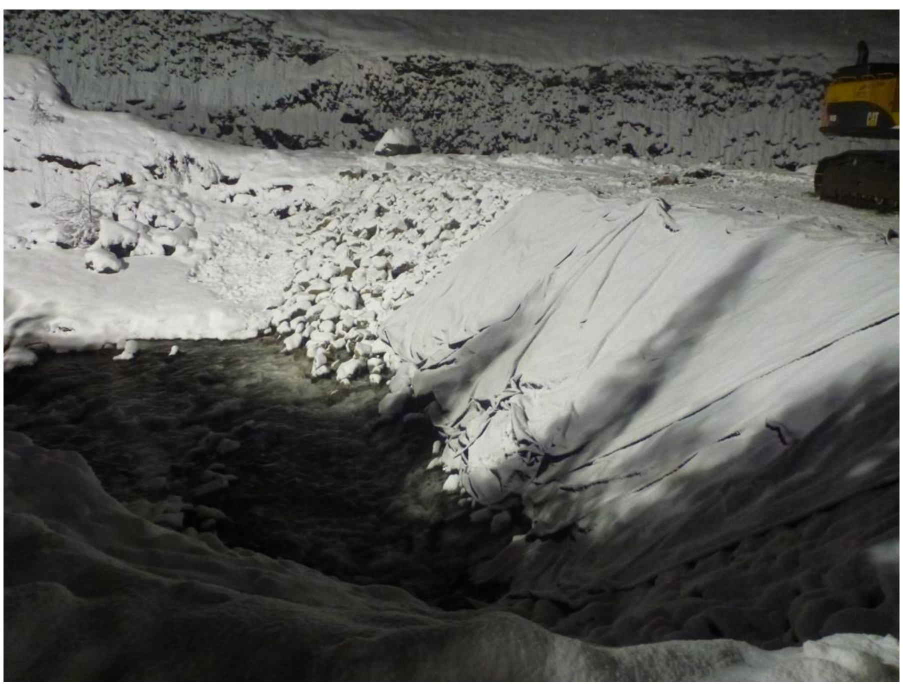
Figure 11. **Additional rock fill material was placed on the toe of the cofferdam to seal the geomembrane to the base.**

Figure 12. **Placement of this material resulted in a short duration release of turbidity from river left.**

November 24, 2014 – Mobilization of Pumps and Preparation for Fine Material Infill

Figure 13. Two pumps (10" and 6") were brought to the intake site to pump turbid water from below the cofferdam to the existing tunnel portal excavation which would act as a settlement pond. The crane was also in place to lower staff into the natural channel if fish salvage was required.

Figure 14. Additional geotextile was installed on the downstream side of the cofferdam, prior to fine material backfill.



November 25, 2014 – Fine Material Infill

Figure 15. View of the tunnel portal excavation to be used as settlement pond.

Figure 16. Installation of the fine material backfill began at river left and a full cofferdam width was packed in before proceeding section by section across the channel. The flows through the rock fill resulted in material washing out, elevating turbidity downstream.

Figure 17. Large bags of crushed stone were in place downstream of the cofferdam to create a check in flow velocities. Two pumps were pumping out water to the upstream tunnel portal excavation.

Figure 18. View of the upstream tunnel portal excavation settlement pond filling with turbid water from the river channel.

Figure 19. **As works progressed across the channel fine material was sloughing out from the bottom of the cofferdam, requiring fast work and additional material.**

Figure 20. **The flows through the cofferdam were sealed with the last section of fine material completed.**

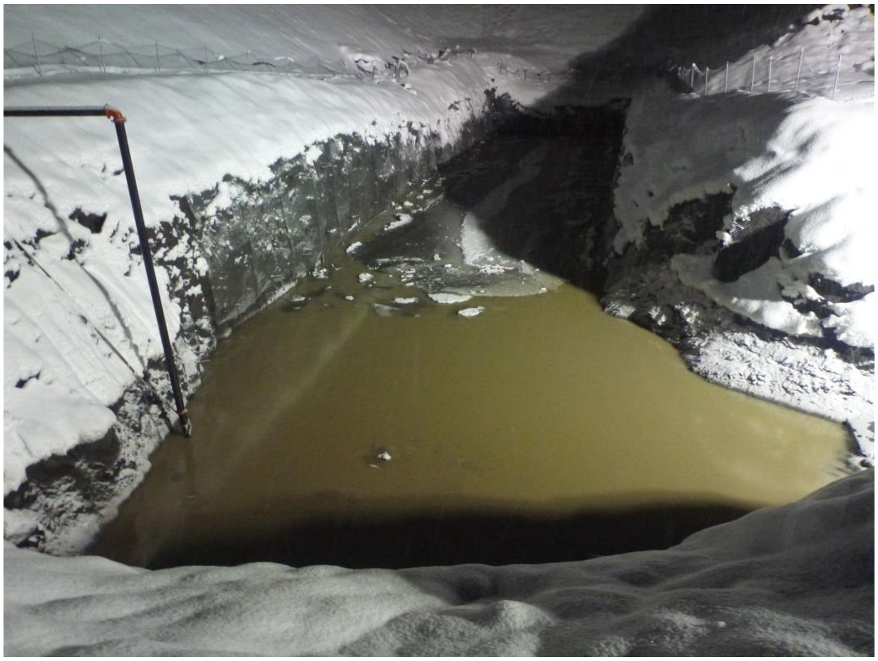
Figure 21. **View downstream from the top of the cofferdam along the dewatered natural river channel. Small volumes of seepage are visible from the right and left corners of the cofferdam.**

Figure 22. **Using the crane the pumps were removed from the channel downstream. The volume of coarse sand, gravel and fines that had deposited here illustrates the success of this mitigation measure.**

Figure 23. View of the upstream tunnel portal excavation settlement pond at the completion of the fine material infill.

Figure 24. View of the temporary diversion channel from river right. Machinery on river left is working on the newly constructed cofferdam. Flows are entirely diverted and running clear. The clean flow through the temporary diversion had a significant diluting effect on turbid flows where it met with the discharge from the cofferdam works at the downstream end.

Figure 25. **By the end of the day the level in the upstream tunnel portal excavation had lowered considerably, presumably discharging to groundwater. No long term elevation in turbidity downstream was noted.**



<u>**November 26, 2014 – Completion of Downstream Cofferdam**</u>

Figure 26. **Infill material was placed at the downstream end of the dewatered river channel to form the downstream cofferdam. This was required to prevent backwatering from the temporary diversion channel in the event of high flows.**

Figure 27. **The downstream cofferdam was completed on a natural ledge, elevated above river level and included a steel culvert pipe to allow for drainage of the dewatered river channel. This comprised the final stage of instream works for the cofferdam project element.**

<u>November 27, 2014 – Overview of Completed Cofferdam Works</u>

Figure 28. **Final rock armouring and stone placement was completed in the dry, on the downstream face of the downstream cofferdam.**

Figure 29. View of the completed cofferdams and dewatered river channel to the right of the image. The flows were successfully diverted through the temporary diversion channel, with the Obermeyer in place, to the left of the image.

Sediment Deposition Monitoring – Representative Photos at Four Sites

Site DSSM01: Upstream of the Powerhouse

Figure 30. DSSM01 – Site location (November 19, 2014).

Figure 31. DSSM01 – Representative image through bathyscope viewer: before works (November 19, 2014).

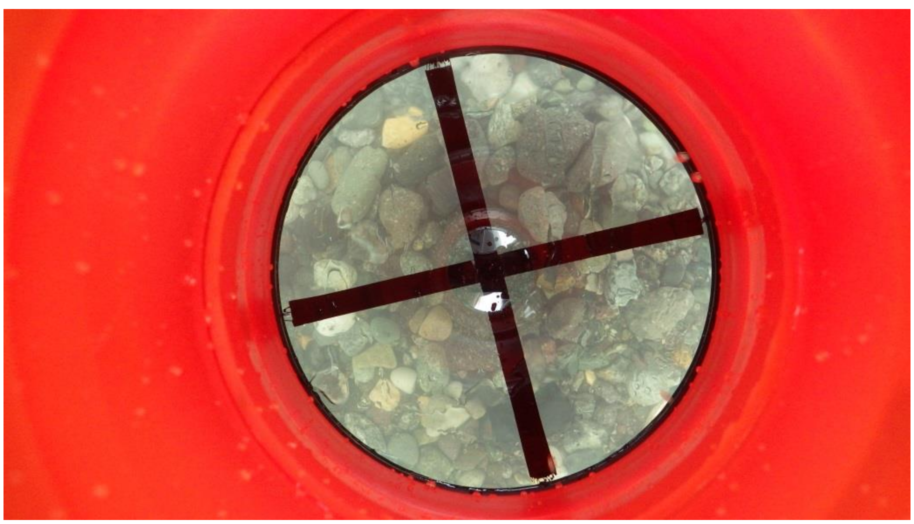


Figure 32. DSSM01 – Representative image through bathyscope viewer: during works (November 25, 2014).

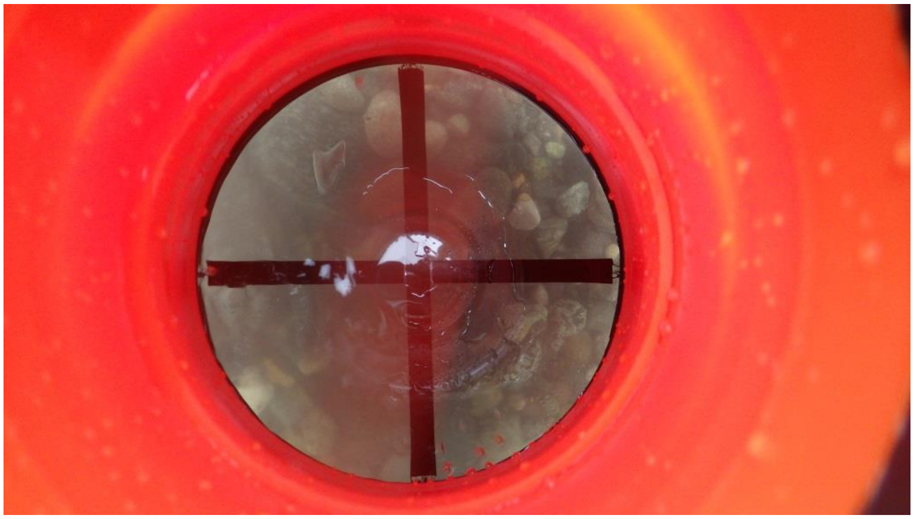
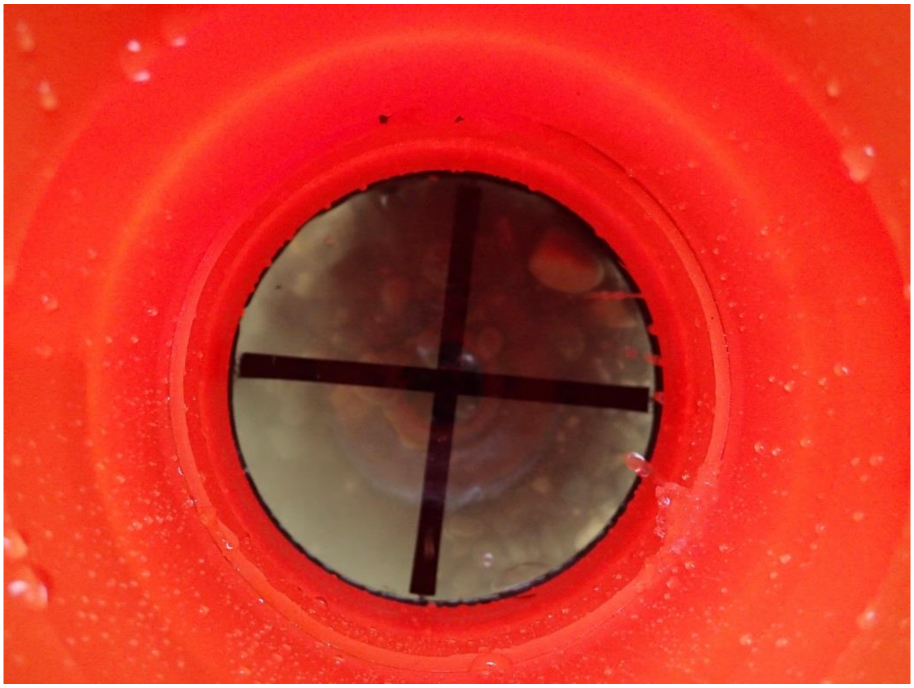


Figure 33. DSSM01 – Representative image through bathyscope viewer: after works. Rainfall-induced natural background turbidity event in the river impaired survey (November 27, 2014).



Site DSSM02: Upstream of the Powerhouse

Figure 34. DSSM02 – Site location (November 19, 2014).

Figure 35. DSSM02 – Representative image through bathyscope viewer: before works (November 19, 2014).

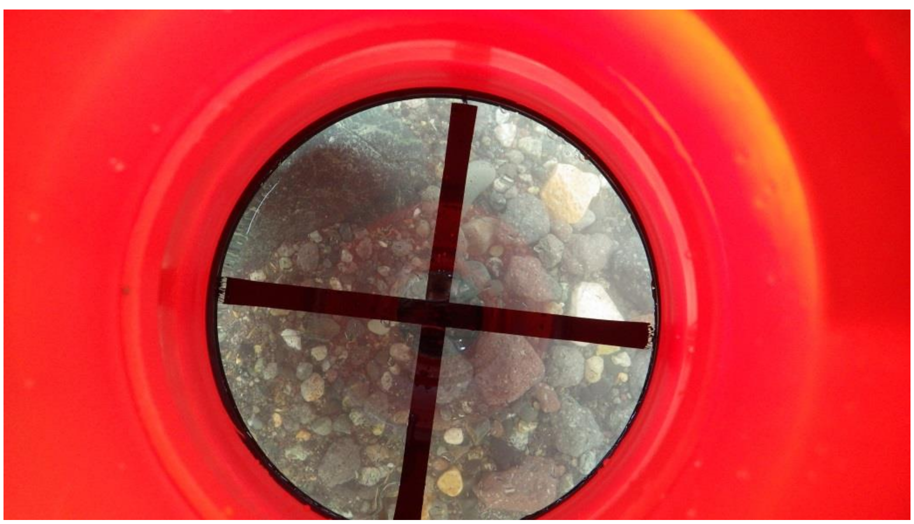


Figure 36. **DSSM02 – Representative image through bathyscope viewer: during works (November 25, 2014).**

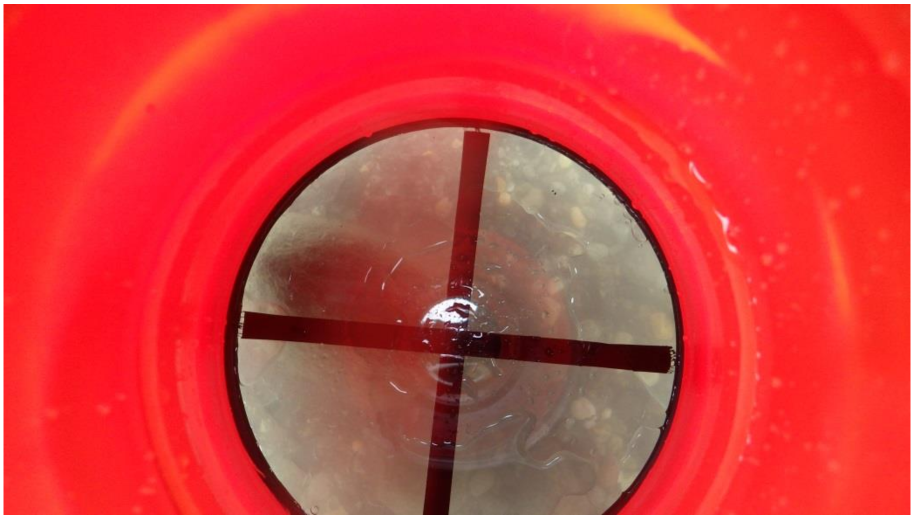
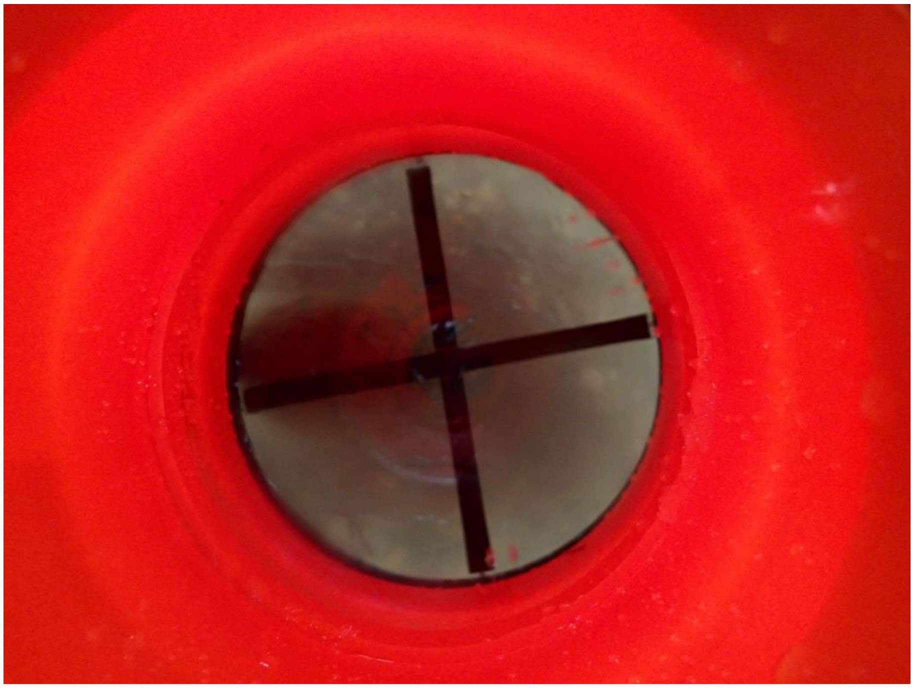


Figure 37. **DSSM02 – Representative image through bathyscope viewer: after works. Rainfall-induced natural background turbidity event in the river impaired survey (November 27, 2014).**



Site DSSM03: Downstream of the Powerhouse

Figure 38. DSSM03 – Site location (November 19, 2014).

Figure 39. DSSM03 – Representative image through bathyscope viewer: before works (November 19, 2014).

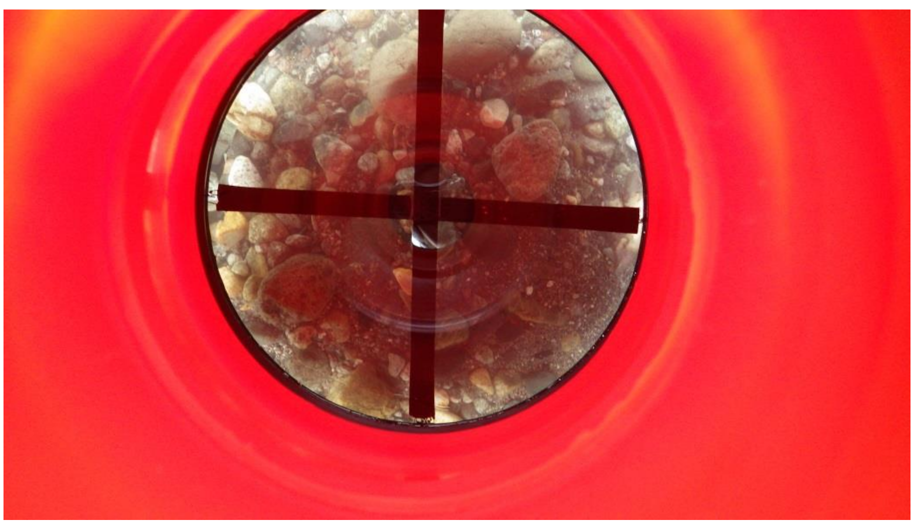


Figure 40. **DSSM03 – Representative image through bathyscope viewer: during works (November 25, 2014).**

Figure 41. **DSSM03 – Representative image through bathyscope viewer: after works. Rainfall-induced natural background turbidity event in the river impaired survey (November 27, 2014).**

Site DSSM04: Downstream of the Powerhouse

Figure 42. DSSM04 – Site location (November 19, 2014).

Figure 43. DSSM04 – Representative image through bathyscope viewer: before works (November 19, 2014).

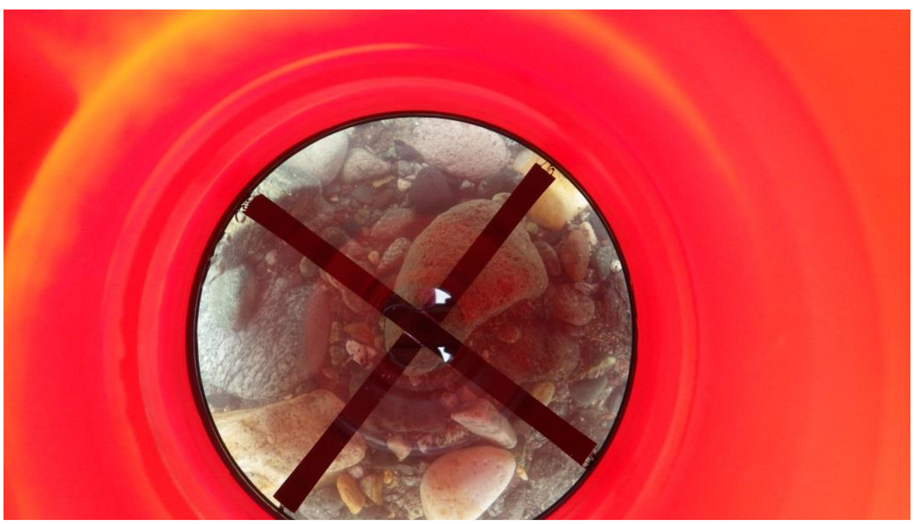


Figure 44. DSSM04 – Representative image through bathyscope viewer: during works (November 25, 2014).

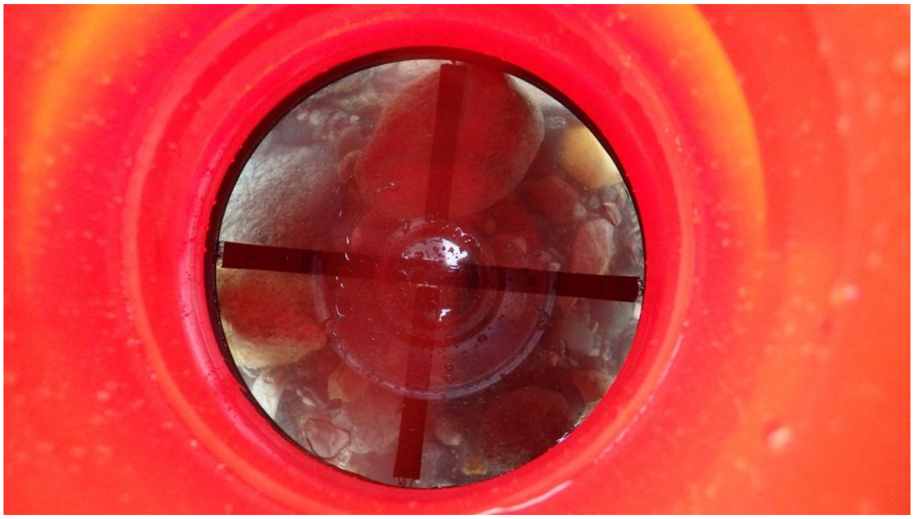
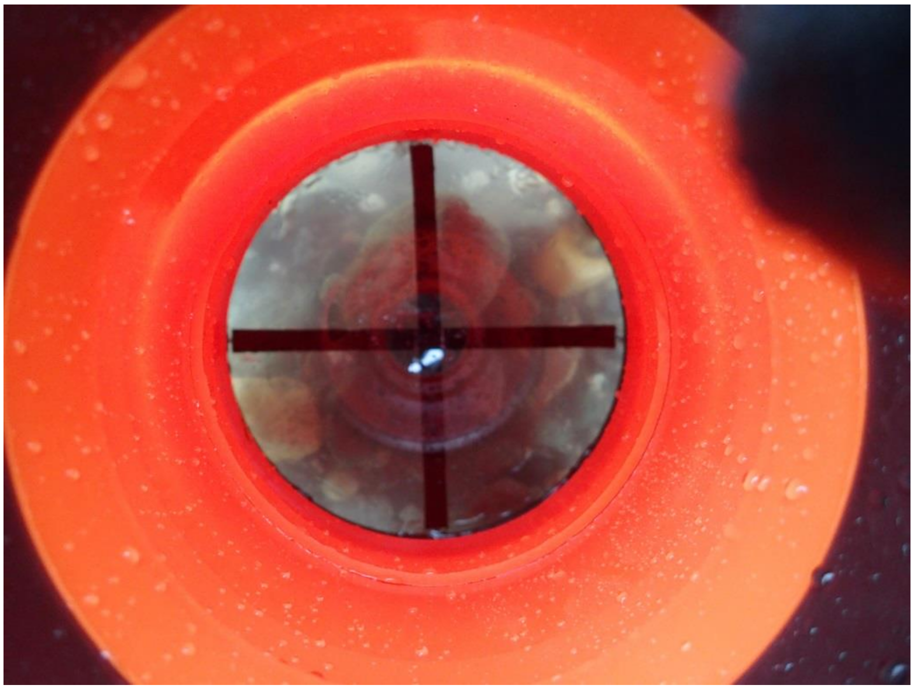


Figure 45. DSSM04 – Representative image through bathyscope viewer: after works. Rainfall-induced natural background turbidity event in the river impaired survey (November 27, 2014).



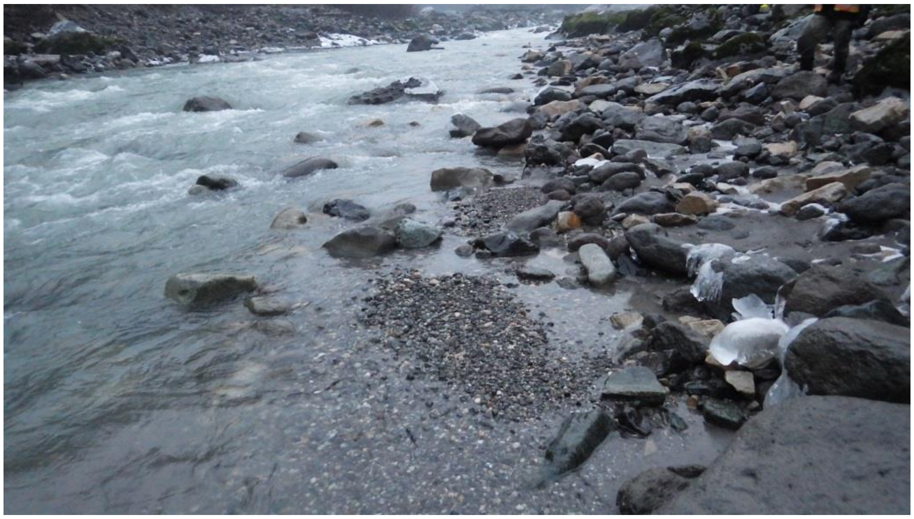
<u>Fish Stranding Site Surveys – Fish Stranding and Fish Salvage</u>

Site DSSD03: Powerhouse

Figure 46. DSSD03 – View of the upstream stranding monitoring site, with access points and sample location marked with rebar.

Figure 47. DSSD03 – View upstream along the sensitive stranding habitats on river left as levels started to drop.

Figure 48. DSSD03 – View of dewatered gravel habitats along the river margin at the bottom of the stage change, before flows started to rise.



Site DSSD01 – Boulder Creek Confluence

Figure 49. DSSD01 – View of the levelogger installation and boulder / large cobble dominated habitat at this site.

Figure 50. DSSD01 – Isolated channel dominated by boulder and cobble, identified as a stranding sensitive section.

Site DSSD04: Upstream of Alena Creek confluence

Figure 51. DSSD04 – View downstream to stranding sensitive side channel dominated by shallow cobble substrate.

Figure 52. DSSD04 – View downstream to stranding-sensitive shallow cobble side channel during the low flow from the works-induced stage change.

Water Quality Sampling – Representative photos from November 25, 2014

Figure 53. View upstream at sampling site DSSD03 before works-induced turbidity plume extended downstream.

Figure 54. Elevated turbidity at site DSSD03 during infill of fine material at the cofferdam upstream.

Figure 55. A water sample was also taken at site DSSD04, downstream of the Meager Creek confluence, calculated with lag-time to be during the peak of the turbidity event arising from works at the cofferdam upstream. No distinguishable change was observed.

SARTORI ENVIRONMENTAL SERVICES
ATTN: Stephen Sims
106-185 Forester Street
North Vancouver BC V7H 0A6

Date Received: 26-NOV-14
Report Date: 28-NOV-14 11:10 (MT)
Version: FINAL

Client Phone: 604-987-5588

Certificate of Analysis

Lab Work Order #: L1551450

Project P.O. #: NOT SUBMITTED
Job Reference: ULHP-WQ-2014.01
C of C Numbers: 14-428458
Legal Site Desc:

Dean Watt
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1551450-1	L1551450-2	L1551450-3	L1551450-4	L1551450-5
	Description	GRAB	GRAB	GRAB	GRAB	GRAB
	Sampled Date	25-NOV-14	25-NOV-14	25-NOV-14	25-NOV-14	25-NOV-14
	Sampled Time	06:36	07:25	09:20	10:47	10:15
	Client ID	1 ULL-BG (LEFT BANK U/S)	2 ULL-KEYHOLE BR	3 ULL-PWH (SAMPLE 1)	4 ULL-PWH (SAMPLE 2)	5 ULL-ALENA (SAMPLE 1)
Grouping	**Analyte**					
WATER						
Physical Tests	Total Suspended Solids (mg/L)	4.5	4.6	64.3	828	12.7
	Turbidity (NTU)	5.61	6.96	28.6	278	6.55

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1551450-6				
	Description	GRAB				
	Sampled Date	25-NOV-14				
	Sampled Time	11:37				
	Client ID	6 ULL-ALENA (SAMPLE 2)				
Grouping	**Analyte**					
WATER						
Physical Tests	Total Suspended Solids (mg/L)	14.5				
	Turbidity (NTU)	6.91				

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

14-428458

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Mountain Goat Daily Observation Form

UPPER LILLOOET HYDRO PROJECT

Goat Monitor's Name(s): Danita Abraham

Date (YYYY-MM-DD): 2014-11-23

Weather (*cloud cover*, precipitation *and temperature*): 85% cloud cover, snow in am

sartori environmental services

106-185 forester street, north vancouver, bc v7h 2m9
office tel 987.5588 fax 987.7740

Please submit **Mountain Goat Daily Observation Form** in person to a representative of Sartori Environmental Services (**Tom Hicks** or **Stephen Sims**) or by email to **steve@sartorienv.com** following each day of monitoring.

Mountain Goat Observation Site	UWR/Migration Corridor - Location	UTM Coordinates *(approximate center of observation area)*	Daily Start Time *(24hr clock)*	Daily End Time *(24hr clock)*
MG - OBS01	Migration Corridor - East side of Truckwash Creek	10U 467898 5612845	13:00	13:25
MG - OBS02	UWR u-2-002 UL 11 - Keyhole Falls	10U 466760 5613967	9:45	12:20
MG - OBS03	UWR u-2-002 UL 19 - Garibaldi Pumice	10U 469155 5614960	12:30	12:50

Daily form #	1	of	1

If more space is needed in the below table, fill out additional daily forms and indicate total number of forms above.

Observation Site *(indicate if location other than OBS site)*	Time *(use 24hr clock)*	UTM Coordinates or Waypoint *(10U)*	Species Observed *(indicate Mountain Goat or other species)*	Observations *(be specific - visual sign, track, other sign)*	# of Animals	Age *(if known - refer to attached info sheet)*	Sex *(if known - refer to attached info sheet)*	Description of Activities *(feeding, moving, etc.)*	Comments *(habitat, snow conditions, etc.)*	Photo #s
MG - OBS02	10:15	10U 466760 5613967	MG	Visual	2	Adult	Billy Nanny	feeding, licking snow/ground, possibly mating?	Down near river below mineral slide area. Noticed monitor and became vigilant for a time	45-74
MG - OBS03	12:45	10U 469155 5614960	none	n/a	0	n/a	n/a	n/a	Snow, low cloud, no visibility, slippery ground	75-76
MG - OBS01	13:15	10U 467898 5612845	none	n/a	0	n/a	n/a	n/a	ground slippery, access was not possible	77-78

MOUNTAIN GOAT DAILY OBSERVATION FORM

UPPER LILLOOET HYDRO PROJECT

Goat Monitor's Name(s): Danita Abraham

Date (YYYY-MM-DD): 2014-11-24

Weather (*cloud cover*, precipitation *and temperature*): 85% cloud cover, snow in am

sartori
environmental services

106-185 forester street, north vancouver, bc v7h 2m9
office tel 987.5588 fax 987.7740

Please submit **Mountain Goat Daily Observation Form** in person to a representative of Sartori Environmental Services (**Tom Hicks** or **Stephen Sims**) or by email to **steve@sartorienv.com** following each day of monitoring.

Mountain Goat Observation Site	UWR/Migration Corridor - Location	UTM Coordinates *(approximate center of observation area)*	Daily Start Time *(24hr clock)*	Daily End Time *(24hr clock)*
MG - OBS01	Migration Corridor - East side of Truckwash Creek	10U 467898 5612845	-	-
MG - OBS02	UWR u-2-002 UL 11 - Keyhole Falls	10U 466760 5613967	11:00	12:30
MG - OBS03	UWR u-2-002 UL 19 - Garibaldi Pumice	10U 469155 5614960	-	-

Daily form #	1	of	1

If more space is needed in the below table, fill out additional daily forms and indicate total number of forms above.

Observation Site *(indicate if location other than OBS site)*	Time *(use 24hr clock)*	UTM Coordinates or Waypoint *(10U)*	Species Observed *(indicate Mountain Goat or other species)*	Observations *(be specific - visual sign, track, other sign)*	# of Animals	Age *(if known - refer to attached info sheet)*	Sex *(if known - refer to attached info sheet)*	Description of Activities *(feeding, moving, etc.)*	Comments *(habitat, snow conditions, etc.)*	Photo #s
MG - OBS02	11:20	10U 466760 5613967	None	n/a	0	n/a	n/a	n/a	snow covered ground and snowing, limited visibility through fog and snow	79-87
MG - OBS03	-	10U 469155 5614960	-	-	-	-	-	-	Zero visibility	0
MG - OBS01	-	10U 467898 5612845	-	-	-	-	-	-	Zero visibility	0

Mountain Goat Daily Observation Form

UPPER LILLOOET HYDRO PROJECT

sartori environmental services

106-185 forester street, north vancouver, bc v7h 2m9
office tel 987.5588 fax 987.7740

Goat Monitor's Name(s): No monitoring due to weather

Date (YYYY-MM-DD): 2014-11-25

Weather (*cloud cover,* precipitation *and temperature*):

Please submit **Mountain Goat Daily Observation Form** in person to a representative of Sartori Environmental Services (**Tom Hicks** or **Stephen Sims**) or by email to **steve@sartorienv.com** following each day of monitoring.

Mountain Goat Observation Site	UWR/Migration Corridor - Location	UTM Coordinates *(approximate center of observation area)*	Daily Start Time *(24hr clock)*	Daily End Time *(24hr clock)*
MG - OBS01	Migration Corridor - East side of Truckwash Creek	10U 467898 5612845		
MG - OBS02	UWR u-2-002 UL 11 - Keyhole Falls	10U 466760 5613967		
MG - OBS03	UWR u-2-002 UL 19 - Garibaldi Pumice	10U 469155 5614960		

Daily form #		of	

If more space is needed in the below table, please fill out additional daily forms and indicate total number of forms above.

Observation Site *(indicate if location other than OBS site)*	Time *(use 24hr clock)*	UTM Coordinates or Waypoint *(10U)*	Species Observed *(indicate Mountain Goat or other species)*	Observations *(be specific - visual sign, track, other sign)*	# of Animals	Age *(if known - refer to attached info sheet)*	Sex *(if known - refer to attached info sheet)*	Description of Activities *(feeding, moving, etc.)*	Comments *(habitat, snow conditions, etc.)*	Photo #s

Mountain Goat Daily Observation Form

UPPER LILLOOETT HYDRO PROJECT

sartori environmental services

106-185 forester street, north vancouver, bc v7h 2m9
office tel 987.5588 fax 987.7740

Goat Monitor's Name(s): Tom Hicks

Date (YYYY-MM-DD): 2014-11-26

Weather (*cloud cover*, precipitation *and temperature*): Low cloud

Please submit **Mountain Goat Daily Observation Form** in person to a representative of Sartori Environmental Services (**Tom Hicks** or **Stephen Sims**) or by email to **steve@sartorienv.com** following each day of monitoring.

Mountain Goat Observation Site	UWR/Migration Corridor - Location	UTM Coordinates *(approximate center of observation area)*	Daily Start Time *(24hr clock)*	Daily End Time *(24hr clock)*
MG - OBS01	Migration Corridor - East side of Truckwash Creek	10U 467898 5612845	-	-
MG - OBS02	UWR u-2-002 UL 11 - Keyhole Falls	10U 466760 5613967	8:30	9:00
MG - OBS03	UWR u-2-002 UL 19 - Garibaldi Pumice	10U 469155 5614960	-	-

Daily form #	1	of	1

If more space is needed in the below table, please fill out additional daily forms and indicate total number of forms above.

Observation Site *(indicate if location other than OBS site)*	Time *(use 24hr clock)*	UTM Coordinates or Waypoint *(10U)*	Species Observed *(indicate Mountain Goat or other species)*	Observations *(be specific - visual sign, track, other sign)*	# of Animals	Age *(if known - refer to attached info sheet)*	Sex *(if known - refer to attached info sheet)*	Description of Activities *(feeding, moving, etc.)*	Comments *(habitat, snow conditions, etc.)*	Photo #s
MG - OBS02	8:55	10U 466760 5613967	None	N/A	N/A	N/A	N/A	N/A	poor visibility through fog/low cloud	Tablet
MG - OBS01 & MG - OBS03	-	-	-	-	-	-	-	-	No Visibility	-

Mountain Goat Daily Observation Form

UPPER LILLOOET HYDRO PROJECT

sartori
environmental services

106-185 forester street, north vancouver, bc v7h 2m9
office tel 987.5588 fax 987.7740

Goat Monitor's Name(s): Blake Aleksich

Date (YYYY-MM-DD): 2014-11-27

Weather (*cloud cover*, precipitation *and temperature*): overcast, rain and snow

Please submit **Mountain Goat Daily Observation Form** in person to a representative of Sartori Environmental Services (**Tom Hicks** or **Stephen Sims**) or by email to **steve@sartorienv.com** following each day of monitoring.

Mountain Goat Observation Site	UWR/Migration Corridor - Location	UTM Coordinates *(approximate center of observation area)*	Daily Start Time *(24hr clock)*	Daily End Time *(24hr clock)*
MG - OBS01	Migration Corridor - East side of Truckwash Creek	10U 467898 5612845	-	-
MG - OBS02	UWR u-2-002 UL 11 - Keyhole Falls	10U 466760 5613967	14:20	14:45
MG - OBS03	UWR u-2-002 UL 19 - Garibaldi Pumice	10U 469155 5614960	-	-

Daily form #	1	of	1

If more space is needed in the below table, please fill out additional daily forms and indicate total number of forms above.

Observation Site *(indicate if location other than OBS site)*	Time *(use 24hr clock)*	UTM Coordinates or Waypoint *(10U)*	Species Observed *(indicate Mountain Goat or other species)*	Observations *(be specific - visual sign, track, other sign)*	# of Animals	Age *(if known - refer to attached info sheet)*	Sex *(if known - refer to attached info sheet)*	Description of Activities *(feeding, moving, etc.)*	Comments *(habitat, snow conditions, etc.)*	Photo #s
MG - OBS02	14:35	10U 466760 5613967	None	n/a	0	n/a	n/a	n/a	snow covered ground, rain and snow	tablet
MG - OBS03	-	10U 469155 5614960	-	-	-	-	-	-	Zero visibility	0
MG - OBS01	-	10U 467898 5612845	-	-	-	-	-	-	Zero visibility	0