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EDI Job Number: 14-G-0576

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Attention: Kase Devries, Environmental Sustainability Coordinator

Re: Wapiti River Fish Telemetry Program – Final Summary Report

The Wapiti River watershed is experiencing significant and rapid changes on the landscape from an array of development activities, leading to intensified pressures on resource needs and availability. In particular, water withdrawals and diversions from the Wapiti River for multiple applications (e.g. industrial, agricultural, community/domestic) pose sustainable management challenges especially during base flow conditions.

In response, Alberta Environment and Sustainable Resource Development (AESRD) along with the City of Grande Prairie and other stakeholders developed the Wapiti River Water Management Plan (WRWMP) Steering Committee. The committee has been tasked with providing water management guidance and direction to balance economic, social and environmental needs. As such, one of the goals and objectives of the WRWMP is the "development of recommendations for Water Conservation Objectives under the *Water Act* that best balance water consumption and protection of the aquatic environment, while taking into consideration environmental, social and economic interests". One means to achieve this is to develop a "science-based environmental flow needs assessment that includes water quantity, water quality, physical habitat and aquatic species necessary for protection of the aquatic resource"[1].

To assist with implementation of this objective, the City of Grande Prairie retained EDI to conduct the Wapiti River mountain whitefish telemetry program. This program was intended to 1) identify locations of overwintering areas in the Wapiti River between Nose Creek and Smoky River, including significant tributaries, and 2) gather microhabitat data from these sites to augment existing information. This information in turn will be used by the WRWMP Steering Committee to evaluate environmental flow needs.

This document summarizes the findings of the program that was conducted from October 2014 through to March 2015. As requested in the RFP, data interpretation has not been provided within this report. Data will be provided in digital format, including shapefiles and metadata for geospatial information.

[1] CharettePellPoscente Environmental Corp. 2013. Terms of Reference for the Wapiti River Water Management Plan. http://www.cityofgp.com/index.aspx?page=1876

METHODS

Fish Capture and Tagging Protocol

Due to its efficacy, sampling for suitable mountain whitefish for the telemetry and microhabitat program was conducted entirely through the use of boat electrofishing over a four-day period between October 16 and 19, 2014. During these dates, the crew focused on capturing fish from two distinct zones on the Wapiti River with multiple sites located within each zone.

Boat electrofishing was conducted with the assistance of a Smith-Root GPP 2.5. Dip netters were positioned to the port and starboard sides of the bow with a third netter at the stern of the vessel to intercept fish missed by the bow crew. Effort at each site varied, contingent upon success with the target species and appropriate size class. All captured fish were held in an aerated tank until such time as they could be processed. Non-target species were quickly released at or near the capture location. Individual fish data recorded from captured mountain whitefish included fork length (mm) and weight (g). Prior to surgery, fish deemed acceptable for tag implantation were monitored for evidence of distress following capture to ensure the greatest chance of tagging success. Any individual deemed unsuitable was released to the river.

Forty Lotek Wireless Inc. (Lotek) MST-930 radio tags were used for the telemetry program. Each tag weighed approximately 4.0 grams (g) and had a lifespan estimated to be 177 days. The tags functioned on one of two frequencies: 148.84 Hz or 149.34 Hz.

Only fish in healthy condition with a minimum weight of 200 g (required for the tag to remain under 2% of the total body weight of the fish) were selected for tagging. Once under anesthesia, fish were measured and weighed. Fish selected for radio-tag placement underwent surgical procedures based on Wagner et al. (2011)[2] and the field experience of EDI Senior Fish Biologist Jason Yarmish, who was present during tagging operations. After the surgical procedure was complete, fish were transferred to an aerated tote for recovery prior to being released at initial capture locations.

Holding times for fish from the end of electrofishing through to release were on average 96 minutes. Holding times may have been dependent on numbers of fish captured at each site since holding times ranged from 34 minutes (one fish processed) to 133 minutes (9 fish processed). Surgery times averaged four minutes per fish with recorded recovery times (i.e. time from when fish was placed into recovery tote until it was upright and swimming) an average 21 minutes (ranging between 8 and 36 minutes).

Telemetry Surveys

Following the initial tagging event, radio-tagged fish were tracked using a combination of aerial (i.e., helicopter) and ground-based methods. Survey equipment included an H-antenna, coaxial cable, Lotek SRX 600 receiver and Trimble GPS antenna.

[2] Wagner, G.W., S.J. Cooke, R.S. Brown, K.A. Deters. 2011. Surgical implantation techniques for electronic tags in fish. Rev Fish Biol Fisheries. 21:71-81

Aerial surveys were conducted with helicopter assistance. In an effort to reduce signal interference, the H-antenna was mounted externally on the helicopter skid and receiver audio was not patched directly into the helicopter audio system. Instead, receiver audio was connected to a headset worn by the operator. To maximize signal range and reduce interference, flight speed typically ranged from 45-100 km/hr, at a height between 60 and 100 m above the watercourses depending on stream morphology and wind conditions. When potential signals were detected, the helicopter slowed, circled and/or hovered until sufficient data was collected to positively identify the tag and its location.

Ground surveys were conducted by snowmobile and required stable ice conditions on the Wapiti River to access tag locations. Ground survey locations were focused on last known tag locations identified during previous aerial surveys. Snowmobiles were driven to within ~200 m of these locations and crews then approached on foot to limit fish movement as a result of sound disturbance. The hand-held antenna was connected to the Lotek receiver unit and adjustments in gain settings were made as necessary to fine tune tag location.

While the data logging capabilities of the receiver unit was used, the crew also manually recorded telemetry information and geo-referenced tag locations during each of the surveys. Logged telemetry data included receiver settings, tag code identification, tag signal strength, coded data, UTM coordinates, and time stamps.

Data downloaded from the receiver for aerial surveys was sorted by code ID and frequency, which combine to provide a unique identifier for tagged fish. Data were examined to eliminate false or interrupted data. Tag detection was determined valid if a code ID was encountered with successive hits at specific intervals, resulting in an audible 'chirp'. The strongest signal from this code ID was used to pinpoint the tag's location.

Microhabitat Data Collection

Microhabitat data collection was tied to ground telemetry surveys and therefore occurred during periods of stable ice conditions between February and March 2015. Once the location of a tagged fish was identified during the ground survey, field crews drilled three holes to document microhabitat values. Drill holes were power augered at the identified tag location as well as in downstream and lateral (typically toward the thalweg) directions from the tag location. These additional drill holes were each located 2 m from the tag location. An underwater camera was used to confirm substrate classifications. However, visibility was limited due to poor water clarity and observations of additional habitat features and fish presence were not possible.

Microhabitat data collected at each drill hole included the following:

- In-situ water quality parameters (temperature, DO, specific conductance, and pH) using YSI Pro Plus instrument
- Depth measurements (effective water depth [depth below ice], ice thickness, and total water depth [effective + ice thickness])

- Water velocities at various depths within the water column using a Swoffer flow meter: Interval depths were determined based on ice coverage and effective water depth:

Effective Depth (m)	Ice Coverage	Interval Depth
all depths	open or ice covered	• immediately below water surface (under ice if present), and • 0.1 m above substrate
< 0.75	ice covered	• 50% of effective depth*
< 0.75	open water	• 60% of effective depth
> 0.75	open or ice covered	• 20% of effective depth, and • 80% of effective depth

* Based on methods outlined in Lane 1999[3], 50% of effective depth was measured and a coefficient of 0.88 was applied to recorded velocities

- Presence and thickness of frazil or anchor ice, and
- Substrate classification using a modified Wentworth scale for particle size and percentage abundance, confirmed visually through use of an underwater camera.

Classification	Abbreviation	Size Range (mm)
Clay/Silt	CL	<0.06
Sand	S	0.06-2.0
Small gravel	SG	2.0-16.0
Large gravel	LG	16.0-64.0
Cobble	C	64.0-256.0
Boulder	B	>256.0
Bedrock	R	-

RESULTS

Tagging Operations

Tagging operations for the winter telemetry program were conducted between October 16 and 19, 2014. In total, 128 mountain whitefish were collected within two zones located approximately 65 river kilometres apart: Wapiti Gardens and Magoo's Landing (Figure 1 in Attachment 1). Within each of these two zones, multiple site locations were sampled. All 40 radio tags were successfully implanted within suitably selected mountain whitefish (fork lengths ranged from 254 mm to 414 mm with weights between 201g and 722 g). Previous literature[4] indicated mountain whitefish would be prevalent in significant numbers within the Wapiti Gardens zone. However, fish abundance was extremely low and only seven individuals from this area

[3] Lane, R. 1999. Lesson Package No. 10.1 – Principles of Discharge Measurements. The Water Survey of Canada Hydrometric Technician Career Development Program.

[4] Portion of report provided by AESRD: Swanson, Chapter 5: Fish population parameters, pg 91-110

were implanted with tags. The remaining 33 tagged fish were collected from the area around Magoo's Landing (Table 1). Individual fish lengths and weights for tagged fish are provided in Attachment 2.

Table 1. Fish tagging sites in October 2014.

Zone	Tagging Site	Date Tagged	River Km	Tag Frequency	No. Individuals Tagged
Wapiti Gardens	W02	17-Oct-14	96.6	149.34	1
Wapiti Gardens	W03	17-Oct-14	97.4	149.34	2
Wapiti Gardens	W04	17-Oct-14	95.1	149.34	1
Wapiti Gardens	W05	17-Oct-14	94.6	149.34	3
Magoo's Landing	W01	16-Oct-14	34.2	149.34	10
Magoo's Landing	W06	18-Oct-14	33.9	148.84 and 149.34	9
Magoo's Landing	W07	18-Oct-14	33.3	148.84	3
Magoo's Landing	W08	19-Oct-14	35.1	148.84	8
Magoo's Landing	W09	19-Oct-14	36.0	148.84	3

While collection of habitat data from tagging sites was not considered a program task, generalizations on habitat characteristics can be made based on field crew observations. Overall habitat within the Wapiti River consisted of uniform riffle-glide habitat units with areas of deep pools (depths greater than 2 m). Boulder garden riffle complexes were prevalent within the Wapiti Gardens zone. Fish were routinely captured from pools with depths exceeding 2 m.

Three fish mortalities (all mountain whitefish) occurred during fish sampling and tagging operations. Two expired while in holding following sampling and one after surgery. It is anticipated the stress of capture rather than surgery protocol resulted in the third mortality since it was noticed prior to surgery that the particular individual was not recovering as well as expected from collection. Length, weight and DNA samples were collected from the mortalities, prior to the individuals being frozen whole and retained for necropsies.

Telemetry Surveys

Spatial boundaries for the first aerial telemetry flight extended 135km along the Wapiti River from the confluence of the Smoky River. Significant tributaries such as Nose Creek, Pinto Creek and Redwillow River were also included in the survey for a minimum distance of 5km from the confluence of the Wapiti River. At the downstream extent, the spatial boundary was expanded to include the Smoky River upstream and downstream of the confluence with the Wapiti River and adjacent portion of the Simonette River. Aside from one tag being located in the Redwillow River and another in the Smoky River, all other tags were located within the Wapiti River between River Km 0 and River Km 105. Based on these initial telemetry results, the spatial boundary for subsequent aerial and ground telemetry surveys was limited to these River kms and the identified tag locations within the Redwillow and Smoky rivers.

As shown in Table 2, overall tag detection during the winter monitoring program was successful, particularly for aerial surveys. Reduced tag detection during ground surveys was primarily due to poor access to previous tag locations as a result of unstable ice conditions and/or areas of open water. Significant interference and false hits were experienced during the one aerial survey in January. Possible explanations for interference and the low proportion of tags detected include:

- Overcast weather conditions with precipitation and flurries that may have resulted in ice formation on the antenna, introducing electrical interference.
- Water within open areas was occasionally observed to be turbid. Increased turbidity often results in increased water conductivity which has potential to reduce signal strength (turbid waters were not observed during the first and third aerial surveys).
- Signal strength may have been further weakened by formation of multiple layers of ice, water and snow on the river surface as a result of recent warm weather (nearly a two-week period of daily maximum temperatures exceeding 0°C[5]) and changing ice conditions.
- Warm weather conditions may also have triggered fish movement beyond the spatial boundaries of the survey.

Table 2. Tag detection success for each of the five telemetry surveys.

Telemetry Survey	Survey Type	Tag Detection (#/%)
December 29, 2014	Aerial	39 (97.5)
January 26, 2015	Aerial	19 (47.5)
February 12, 2015	Aerial	35 (87.5)
February 17-21, 2015	Ground	22 (55.0)
March 3-5, 2015	Ground	22 (55.0)

Fish Movement

Table 3 summarizes tag locations by River Kilometre (Km) for each telemetry survey conducted between December 2014 and March 2015. Fish movement during this period is also reflected in the table. Movements between current tag location and last known position are provided. Negative values reflect downstream movement from the last known position while positive values represent upstream movement. Overall, or total, distance travelled by each tagged fish throughout the program is also included in the table. Figures 2 to 6 located in Attachment 1 of this report, visually illustrate these fish movements between initial tagging locations and subsequent telemetry surveys.

[5] Environment Canada. 2015. Canadian Climate Data from Grande Prairie A Station. http://climate.weather.gc.ca/climateData/dailydata_e.html?timeframe=2&Prov=AB&StationID=51422&dlyRange=2013-09-12|2015-04-06&Year=2015&Month=1&Day=01

While few trends were readily visible within the dataset, several key observations were made:

- One fish (TagID 109) was not detected during any of the five telemetry surveys. Possible explanations may include tag failure, or fish movement beyond the limits of the study area.
- The vast majority of tagged fish (over 75%, or 31 individuals) had moved downstream between the initial tagging event in October 2014 and the first aerial flight conducted in December 2014.
- Within this initial downstream movement, 22 individuals (70%) travelled more than 5 km, with the farthest distance recorded at over 73 km (TagID 108).
- Although initial long distance movements (>15 km) were noted for individuals tagged in Wapiti Gardens and Magoo's Landing, a much larger proportion of tagged individuals moved downstream from Wapiti Gardens than Magoo's Landing (57% vs 24%, respectively) and over longer distances (combined average of 43 km vs 24 km, respectively).
- Subsequent fish movement between December 2014 and March 2015 was much less in comparison, ranging from 0.1 to 3.2 km. Exceptions to this include:
    - TagID 12: between January 26 and February 12, moved upstream over 7 km
    - TagID 29: between February 12 and the week of February 17, moved upstream 12.9 km
- One fish (TagID 110) relocated to Km 6.1 within the Redwillow River following the initial tagging event and was detected at this location during the subsequent aerial surveys. While the signal was detected in the same general location during the ground survey in February, its actual location could not be pin-pointed. Unstable ice conditions during the final survey in March precluded snowmobile access to assess whether the individual was still present at this location.
- Following the initial tagging event, TagID 12 relocated to the Smoky River 3.7 km downstream of the confluence with the Wapiti River. It was detected at this location on December 29. By February 12 it had returned to the Wapiti River and was detected at River Km 4.1. It was last detected during the February 17 ground survey at this location. Unstable ice conditions during the final survey in March precluded snowmobile access to assess whether the individual was still present at this location.

1 **Table 3. Individual fish movements during the winter telemetry study program, October 2014 to March 2015.**

Initial Tagging Event				Dec 29, 2014		Jan 26, 2015		Feb 12, 2015		Feb 17-21, 2015		Mar 3-5, 2015		Total Distance (km)
Tag_ID	Date Tagged	Tagging Site	River KM	River Km	Movement Distance	River Km	Movement Distance	River Km	Movement Distance	River Km	Movement Distance	River Km	Movement Distance	
11	18-Oct-14	W06	33.9	20.8	-13.1			20.8	0.0	20.9	0.1	21.0	0.1	13.3
12	18-Oct-14	W06	33.9	3.7	-37.6			4.1	7.8	4.0	-0.1			45.5
13	18-Oct-14	W06	33.9	33.8	-0.1			34.2	0.4	34.1	-0.1	34.1	0.0	0.6
14	18-Oct-14	W06	33.9	17.3	-16.6			17.4	0.1	17.7	0.3	17.4	-0.3	17.3
15	18-Oct-14	W06	33.9	33.9	0.0					33.7	-0.2	33.7	0.0	0.2
16	18-Oct-14	W07	33.3	34.0	0.7			37.0	3.0			33.8	-3.2	6.9
17	18-Oct-14	W06	33.9	28.9	-5.0			28.7	-0.2					5.2
18	18-Oct-14	W07	33.3	33.3	0.0			33.8	0.5	33.7	-0.1	33.8	0.1	0.7
19	18-Oct-14	W07	33.3	33.4	0.1			33.7	0.3	33.8	0.1	33.7	-0.1	0.6
20	19-Oct-14	W08	35.1	34.0	-1.1			33.8	-0.2	33.5	-0.3			1.6
21	19-Oct-14	W08	35.1	26.4	-8.7									8.7
22	19-Oct-14	W08	35.1	24.6	-10.5	25.7	1.1							11.6
23	19-Oct-14	W08	35.1	34.1	-1.0			36.0	1.9	35.8	-0.2	35.8	0.0	3.1
24	19-Oct-14	W08	35.1	22.4	-12.7			22.5	0.1			22.5	0.0	12.8
25	19-Oct-14	W08	35.1	34.6	-0.5			37.0	2.4					2.9
26	19-Oct-14	W08	35.1	24.4	-10.7			24.4	0.0					10.7
27	19-Oct-14	W08	35.1	10.1	-25.0			11.8	1.7			11.7	-0.1	26.8
28	19-Oct-14	W09	36.0	32.5	-3.5			33.7	1.2	33.6	-0.1	34.0	0.4	5.2
29	19-Oct-14	W09	36.0	20.8	-15.2			20.8	0.0	33.7	12.9			28.1
30	19-Oct-14	W09	36.0	21.1	-14.9									14.9
101	16-Oct-14	W01	34.2	25.8	-8.4	25.8	0.0	25.7	-0.1					8.5
102	16-Oct-14	W01	34.2	17.5	-16.7	17.5	0.0	17.5	0.0	17.4	-0.1	17.3	-0.1	16.9
103	16-Oct-14	W01	34.2	34.2	0.0	34.2	0.0	34.2	0.0			34.2	0.0	0.0
104	16-Oct-14	W01	34.2	34.1	-0.1			34.2	0.1	34.3	0.1	34.2	-0.1	0.4
105	17-Oct-14	W02	96.6	71.9	-24.7	71.8	-0.1	71.4	-0.4	72.0	0.6	71.8	-0.2	26.0
106	17-Oct-14	W04	95.1	95.3	0.2	97.7	2.4	97.1	-0.6	97.2	0.1	97.1	-0.1	3.4
107	17-Oct-14	W05	94.6	98.1	3.5	100.8	2.7	100.7	-0.1	100.7	0.0	100.7	0.0	6.3

Initial Tagging Event				Dec 29, 2014		Jan 26, 2015		Feb 12, 2015		Feb 17-21, 2015		Mar 3-5, 2015		Total Distance (km)
Tag_ID	Date Tagged	Tagging Site	River KM	River Km	Movement Distance	River Km	Movement Distance	River Km	Movement Distance	River Km	Movement Distance	River Km	Movement Distance	
108	17-Oct-14	W03	97.4	24.3	-73.1	24.5	0.2	25.0	0.5					73.8
109	17-Oct-14	W03	97.4											n/a
110	17-Oct-14	W05	94.6	6.1	-20.8	6.7	0.6	6.8	0.1					21.5
111	17-Oct-14	W05	94.6	37.9	-56.7	37.8	-0.1	37.9	0.1					56.9
112	18-Oct-14	W01	34.2	32.7	-1.5	32.8	0.1	32.7	-0.1	32.6	-0.1			1.8
113	18-Oct-14	W01	34.2	11.2	-23.0	11.4	0.2	11.4	0.0	11.4	0.0	11.5	0.1	23.3
114	18-Oct-14	W01	34.2	30.0	-4.2	29.8	-0.2	29.9	0.1					4.5
115	18-Oct-14	W01	34.2	25.4	-8.8	25.2	-0.2	25.4	0.2					9.2
116	18-Oct-14	W01	34.2	12.7	-21.5	12.7	0.0	12.8	0.1	12.7	-0.1	12.8	0.1	21.8
117	18-Oct-14	W01	34.2	37.9	3.7	37.3	-0.6	31.7	-5.6	31.8	0.1	31.9	0.1	10.1
118	18-Oct-14	W06	33.9	26.8	-7.1	26.8	0.0	26.9	0.1					7.2
119	18-Oct-14	W06	33.9	33.8	-0.1	33.9	0.1	33.9	0.0	34.0	0.1	33.9	-0.1	0.4
120	18-Oct-14	W06	33.9	0.4	-33.5	0.5	0.1	7.1	6.6	7.1	0.0	7.1	0.0	40.2

Notes:

1) Negative values within Movement Distance columns denote fish movement downstream, positive values denote fish movement upstream. Total Distance reflects total kilometres moved regardless of direction.
2) Mouth of the Redwillow River joins the Wapiti River at River Km 79.9
3) TagID 110 entered Redwillow River following initial tagging event. Fish was detected in Redwillow River during two subsequent tracking events but could not be confirmed during the ground surveys due to access constraints.
4) TagID 12 tagged in the Wapiti River at River KM 33.9. Detected on 29 Dec 2014 in Smoky River 3.7 km downstream of confluence with Wapiti River. Subsequent surveys also detected this fish in the Wapiti River.

Habitat Values

Tables 4 and 5 present habitat data collected at each of the tag locations during the two ground surveys conducted in February and March 2015. While the purpose of drilling three holes (tag location, downstream, and lateral) at each tag location was to identify potential habitat variability, for ease of discussion and purpose of the summary report, substrate type, effective water depths and mean column water velocities have been averaged for all three investigative holes at each tag location. Ranges have also been presented to assess variability in effective water depth and mean water column velocities among holes at each tagging location. The complete datasets for all three drill holes and velocities throughout the water column are provided in Attachment 3 and also in digital format.

There was virtually no variability of substrate material among the three drill-hole locations (i.e. consistent substrate among all three drill holes). Variability among tag locations across the river was also limited. Observed substrate at the tag locations was predominantly cobble with sand as sub-dominant substrate. This was expected since the majority of habitat within the spatial boundaries of the program was observed to consist of uniform riffle-glide/pool features with a mixture of cobble and sand or cobble and gravel substrates.

Mean water column velocities at detected tag locations throughout the ground surveys ranged from 0.02 m/s to 1.02 m/s with nearly 80% of these data between 0.2 m/s and 0.66 m/s. Based on minimum and maximum values recorded at each of the three drilled holes for each tag location, mean water column velocities showed little variability (Table 4). The average difference between minimum and maximum values across all three holes at each location was 0.04 m/s.

Effective water depths recorded for tagged fish detected during the ground telemetry surveys typically ranged between 0.25 and 1.2 m (~80% of the tagged locations). Slight variability among the three holes was observed. The average difference between minimum and maximum values across all three holes at each location was 0.12 m. Throughout the ground surveys the shallowest and deepest effective water depths recorded for all detected tags were 0.18 m (TagID18 on February 19, 2015) and 1.88 m (TagID 117 on March 3, 2015), respectively. While TagID23 was located in shallower water depth (0.09 m during the March ground survey), the tag was positioned at the exact same location during the two ground surveys, indicating possible fish mortality or shed tag. While the tag was actively search for using the underwater camera, low visibility and coarse substrate material precluded visual confirmation of the tag.

Table 4. Habitat characteristics at locations where tags were detected during ground telemetry surveys, February 17-21 and March 3-5, 2015. Mean water column velocities represent average and ranges among three drilled holes at each location.

TagID	Date	River Km	Substrate Type[1]		Mean Water Column Velocities (m/s)[2]				Water Quality[3]				
			Dom	Sub-dom	Avg.	Min.	Max.	Diff.	Temp. (°C)	DO (%)	DO (mg/L)	Cond. (uS/cm)	pH
11	21/02/2015	20.9	C	S	0.49	0.48	0.60	0.13	0.0	113.4	16.4	380	9.3
11	05/03/2015	21	C	G	0.54	0.59	0.64	0.05	0.0	134.6	20.4	360	9.4
12	18/02/2015	4	Cl	-	0.02	0.00	0.03	0.03	0.1	107.5	16.4	476	8.7
13	19/02/2015	34.1	C	G	0.56	0.00	0.00	0.00	0.1	117.8	17.5	399	8.5
13	03/03/2015	34.1	S	CL	0.04	0.00	0.10	0.10	0.1	101.7	14.7	333	8.9
14	21/02/2015	17.7	C	G	0.70	0.78	0.80	0.01	0.1	116.1	17.1	450	8.4
14	05/03/2015	17.4	C	G	0.44	0.49	0.52	0.02	0.0	101.6	14.8	344	8.5
15	19/02/2015	33.7	S	C	0.31	0.00	0.00	0.00	0.1	121.1	20.6	411	8.8
15	03/03/2015	33.7	C	G	n/a	n/a	n/a	n/a	0.0	101.5	14.8	480	9.2
16	03/03/2015	33.8	S	CL/C	0.31	0.33	0.37	0.05	0.1	103.7	15.2	323	8.9
18	19/02/2015	33.7	S	CL	n/a	n/a	n/a	n/a	0.3	115.5	16.8	403	8.1
18	03/03/2015	33.8	C	G	0.55	0.47	0.87	0.40	0.1	103.7	15.4	411	8.6
19	19/02/2015	33.8	C	S	0.37	0.36	0.39	0.03	0.1	119.3	17.6	401	8.7
19	03/03/2015	33.7	C	G	0.40	0.46	0.46	0.00	0.1	103.6	15.2	433	8.7
20	20/02/2015	33.5	CL	-	0.51	0.48	0.48	0.00	0.1	115.9	17.0	354	8.3
23	19/02/2015	35.8	C	G	n/a	n/a	n/a	n/a	1.1	113.6	16.5	399	9.1
23	03/03/2015	35.8	C	G	n/a	n/a	n/a	n/a	0.0	90.3	13.1	332	8.8
24	05/03/2015	22.5	C	G	0.56	0.50	0.71	0.21	0.1	145.9	20.5	474	8.4
27	05/03/2015	11.7	C	G	0.36	0.00	0.00	0.00	0.2	100.5	14.7	525	9.0
28	20/02/2015	33.6	S	C	0.28	0.31	0.33	0.02	0.0	115.3	16.8	357	9.1
28	03/03/2015	34	C	G	0.92	0.94	1.13	0.19	0.1	102.8	15.0	386	8.5
29	20/02/2015	33.7	C	S	0.41	0.45	0.49	0.04	0.1	117.1	17.5	407	8.3
102	18/02/2015	17.4	S	C	0.49	0.51	0.59	0.08	0.1	100.7	15.0	461	8.6
102	05/03/2015	17.3	C	G	1.02	1.14	1.19	0.06	0.1	100.5	14.8	420	9.2
103	03/03/2015	34.2	S	C	0.35	0.00	0.00	0.00	0.1	122.4	17.8	297	10.4
104	19/02/2015	34.3	C	CL	0.06	0.01	0.04	0.03	0.6	116.8	16.3	377	8.4

TagID	Date	River Km	Substrate Type[1] Dom	Sub-dom	Mean Water Column Velocities (m/s)[2] Avg.	Min.	Max.	Diff.	Water Quality[3] Temp. (°C)	DO (%)	DO (mg/L)	Cond. (uS/cm)	pH
104	03/03/2015	34.2	S	CL	0.09	0.07	0.12	0.04	0.0	103.1	15.1	394	8.4
105	20/02/2015	72	C	G	0.39	0.39	0.50	0.11	0.1	115.6	16.7	366	8.5
105	04/03/2015	71.8	C	G	0.67	0.76	0.76	0.00	0.1	71.0	10.3	280	8.9
106	17/02/2015	97.2	C	B	0.28	0.30	0.34	0.05	0.0	120.4	17.4	354	9.2
106	04/03/2015	97.1	C	B	0.53	0.50	0.50	0.00	0.1	103.5	15.1	413	8.5
107	17/02/2015	100.7	B	C	0.48	0.00	0.00	0.00	0.0	119.6	14.5	355	9.6
107	04/03/2015	100.7	C	B	0.37	0.00	0.00	0.00	0.1	103.5	15.1	375	8.9
112	19/02/2015	32.6	C	S	0.37	0.00	0.00	0.00	0.1	119.2	17.5	398	8.8
113	18/02/2015	11.4	C	G	n/a	n/a	n/a	n/a	0.0	97.9	14.3	455	8.8
113	05/03/2015	11.5	C	G	0.33	0.35	0.39	0.04	0.1	99.7	14.4	553	8.2
116	18/02/2015	12.7	C	G	0.28	0.00	0.00	0.00	0.1	105.2	14.6	451	8.3
116	05/03/2015	12.8	C	G	0.23	0.00	0.00	0.00	0.1	101.1	14.7	524	8.3
117	19/02/2015	31.8	C	G	0.36	0.00	0.00	0.00	0.1	118.6	17.0	356	8.2
117	03/03/2015	31.9	G	C	0.20	0.00	0.00	0.00	0.1	93.1	13.7	415	9.0
119	19/02/2015	34	C	G	0.66	0.00	0.00	0.00	0.1	122.0	17.1	401	8.2
119	03/03/2015	33.9	CL/S	C	0.49	0.00	0.00	0.00	0.1	103.8	15.1	311	8.7
120	18/02/2015	7.1	C	S	0.38	0.44	0.46	0.01	0.0	109.8	15.8	441	8.5
120	05/03/2015	7.1	C	G	0.23	0.25	0.28	0.03	0.2	99.2	14.6	510	8.8

1 Substrate types: Dominant (Dom); Sub-dominant (Sub-dom); Boulder (B); Clay/silt (CL); Gravels (G, including large and small); Sand (S).
2 Velocities: Average (Avg.); Minimum (Min.); Maximum (Max.); Difference (Diff) calculated as difference between minimum and maximum values; n/a = effective water depths less than 0.25m
3 Water quality: Temperature (Temp.), Dissolved oxygen (DO); Conductivity (Cond.).

Table 5. Effective water depth (m) comparisons between holes at locations where tags were detected during ground telemetry surveys, February 17-21 and March 3-5, 2015.

TagID	Date	River Km	Average	Minimum	Maximum	Difference
11	21/02/2015	20.9	0.46	0.41	0.50	0.09
11	05/03/2015	21.0	0.38	0.34	0.41	0.07
12	18/02/2015	4.0	0.95	0.83	1.03	0.20
13	19/02/2015	34.1	0.90	0.86	0.95	0.09
13	03/03/2015	34.1	0.50	0.46	0.57	0.11
14	21/02/2015	17.7	0.42	0.39	0.44	0.05
14	05/03/2015	17.4	0.54	0.52	0.57	0.05
15	19/02/2015	33.7	0.29	0.25	0.31	0.06
15	03/03/2015	33.7	0.25	0.24	0.25	0.01
16	03/03/2015	33.8	0.67	0.60	0.71	0.11
18	19/02/2015	33.7	0.25	0.18	0.29	0.11
18	03/03/2015	33.8	0.28	0.27	0.30	0.03
19	19/02/2015	33.8	0.38	0.33	0.43	0.10
19	03/03/2015	33.7	0.33	0.28	0.39	0.11
20	20/02/2015	33.5	0.95	0.69	1.10	0.41
23	19/02/2015	35.8	0.22	0.17	0.31	0.14
23	03/03/2015	35.8	0.10	0.09	0.12	0.03
24	05/03/2015	22.5	0.37	0.33	0.42	0.09
27	05/03/2015	11.7	1.04	1.02	1.05	0.03
28	20/02/2015	33.6	0.34	0.25	0.40	0.15
28	03/03/2015	34.0	0.61	0.58	0.64	0.06
29	20/02/2015	33.7	0.38	0.34	0.42	0.08
102	18/02/2015	17.4	0.64	0.62	0.66	0.04
102	05/03/2015	17.3	0.47	0.44	0.51	0.07
103	03/03/2015	34.2	1.12	1.06	1.18	0.12
104	19/02/2015	34.3	0.67	0.54	0.86	0.32
104	03/03/2015	34.2	0.89	0.79	1.08	0.29
105	20/02/2015	72.0	0.40	0.36	0.43	0.07
105	04/03/2015	71.8	0.32	0.26	0.41	0.15
106	17/02/2015	97.2	0.71	0.69	0.74	0.05
106	04/03/2015	97.1	0.92	0.71	1.07	0.36
107	17/02/2015	100.7	1.23	1.20	1.28	0.08
107	04/03/2015	100.7	1.53	1.34	1.75	0.41
112	19/02/2015	32.6	0.95	0.89	0.99	0.10
113	18/02/2015	11.4	0.26	0.23	0.31	0.08
113	05/03/2015	11.5	0.29	0.25	0.33	0.08
116	18/02/2015	12.7	1.49	1.40	1.55	0.15
116	05/03/2015	12.8	1.26	1.07	1.40	0.33

TagID	Date	River Km	Average	Minimum	Maximum	Difference
117	19/02/2015	31.8	0.87	0.87	0.87	0.00
117	03/03/2015	31.9	1.83	1.70	1.90	0.2
119	19/02/2015	34.0	0.79	0.76	0.86	0.1
119	03/03/2015	33.9	0.84	0.81	0.86	0.05
120	18/02/2015	7.1	1.01	0.93	1.14	0.21
120	05/03/2015	7.1	0.50	0.48	0.51	0.03

CONCLUSION

Findings from the Wapiti River Fish Telemetry Program appear to indicate the following:

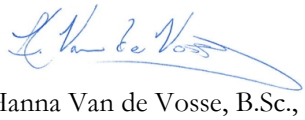
- The area around Magoo's landing (~ River Km 35) appears to be important for overwintering mountain whitefish.
- It is unclear at this time whether TagID23 represents a shed tag or fish mortality. A follow-up aerial survey may determine whether this tag is in a live fish (i.e. upstream movement from its last known position would indicate a live fish).
- During tagging events in October mountain whitefish were commonly captured in pools with depths greater than 2 m based on incidental habitat observations by the field crew. Water depths recorded from subsequent tracking events would appear to indicate that tagged mountain whitefish are utilizing areas of shallow water depths (between 0.25 and 1.2 m) for overwintering. In the event that the program is repeated, it would be advantageous to incorporate comparable habitat data collection from tagging sites and other locations within the study area to confirm whether habitat characteristics are significantly different from identified overwintering locations.

In the event that the project is repeated, the following items should be considered:

- Electrofishing effort could be altered in areas of fish abundance to limit the numbers of fish to be processed at any one time and reduce holding times. For example, conducting more numerous but shorter duration passes would result in the same effort expended but reduced catch number per pass allowing for fish to be processed more quickly.
- Aerial tracking surveys should be timed to avoid unfavorable weather conditions, wherever possible:
    - Avoid tracking during snowfall events since there is increased potential for ice formation on the antenna which can introduce electrical interference.
    - Avoid periods of unseasonably warm conditions that can generate multiple layers of ice, water and snow on the river surface further interfering with signal strength.

Yours truly,

EDI Environmental Dynamics Inc.



Hanna Van de Vosse, B.Sc., R.P. Bio
Senior Biologist

Attachments:

- Attachment 1 – Map figures illustrating initial tagging locations of fish as well as individual fish locations during each of the subsequent telemetry surveys.
- Attachment 2 – Fish data including tagged location, biological data, and telemetry data
- Attachment 3 – Microhabitat data collected during each of the ground telemetry surveys
- Attachment 4 – Digital data

Document Summary

Document Title	Date Prepared
14G0576_InterimMemo_1	3 November 2014
14G0576_InterimMemo_2	8 January 2015
14G0576_InterimMemo_3	16 February 2015
14G0576_InterimMemo_4	27 February 2015
14G0576_InterimMemo_5	6 March 2015
14G0576_InterimMemo_6	9 March 2015
rpt_final summary_150417 (draft)	17 April 2015
rpt_final summary_150430	30 April 2015

ATTACHMENT 1. MAP FIGURES

Wapiti River fish sampling sites, October 16 – 19, 2014

Legend

- Fish Sampling Site
- Kilometre Marker (Wapiti River)[1]
- Highway / Main Road
- Local Road

[1] Kilometre marker indicates the distance upstream from the Smoky River.

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Project data displayed is site specific. Data collected by EDI Environmental Dynamics Inc. (2014) was obtained using Garmin GPS technology.

This document is not an official land survey and the spatial data presented is subject to change.

0 1 2 4 6 8 10
kilometres

Map Scale: 1:200,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 11N

Drawn: LG	Checked: MK/HVV	Date: 01/04/2015	**FIGURE 1**

Grande Prairie
MAP AREA

EDI

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Radio tags located during aerial survey, December 29, 2014

Legend

- Radio Tag Detected
- Kilometre Marker (Wapiti River)[1]
- Extent of Aerial Survey

Base Data

- Highway / Main Road
- Local Road

[1] Kilometre marker indicates the distance upstream from the Smoky River.

Data sources
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0 5 10 15 20
kilometres

Map Scale: 1:300,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 11N

Drawn:	Checked:	Date:	
LG	MK/AB/HVV	01/04/2015	**FIGURE 2**

Grande Prairie
MAP AREA

EDI

Path: J:\Grande_Prairie\14_G_0576_City_Wapiti_Telem\Mapping\Finals\Fig2_Wapiti_TelemSurvey_29Dec2014.mxd

Radio tags located during aerial survey, January 26, 2015

Legend

- Radio Tag Detected
- Kilometre Marker (Wapiti River)[1]
- Extent of Aerial Survey

Base Data

- Highway / Main Road
- Local Road

[1] Kilometre marker indicates the distance upstream from the Smoky River.

Data sources
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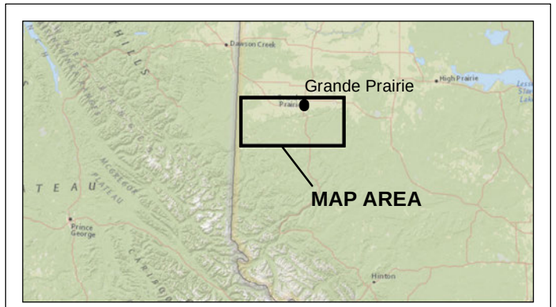
0 5 10 15 20
kilometres

Map Scale: 1:300,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 11N

Drawn:	Checked:	Date:	
LG	MK/AB/HVV	01/04/2015	**FIGURE 3**



EDI

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Radio tags located during aerial survey, February 12, 2015

Legend

- Radio Tag Detected
- Kilometre Marker (Wapiti River)[1]
- Extent of Aerial Survey

Base Data

- Highway / Main Road
- Local Road

[1] Kilometre marker indicates the distance upstream from the Smoky River.

Data sources
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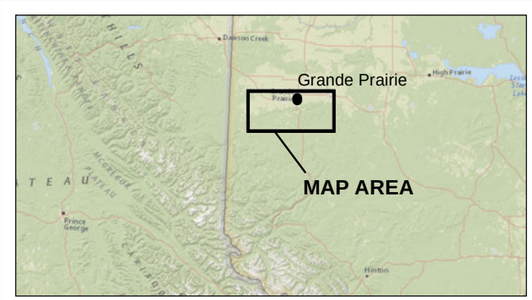
0 5 10 15 20
kilometres

Map Scale: 1:250,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 11N

Drawn:	Checked:	Date:	
LG	MK/AB/HVV	01/04/2015	**FIGURE 4**



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Microhabitat data collection sites, Wapiti River, February 17 - 21, 2015

Legend

- Tag 15 — Radio Tag Located, Microhabitat Data Collected
- Tag 24 — Radio Tag Located in Previous Aerial Survey, Not Detected or Unsafe Ice Conditions[1]
- Kilometre Marker (Wapiti River)[2]
- Extent of Ground Survey
- Area of Unsafe Ice Conditions Encountered During Ground Surveys

Base Data

- Highway / Main Road
- Local Road

[1] Tag locations are for illustrative purposes only.

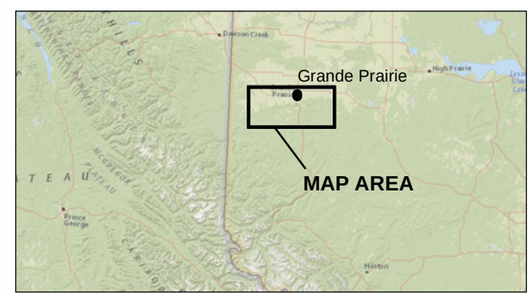
[2] Kilometre marker indicates the distance upstream from the Smoky River.

Path: J:\Grande_Prairie\14_G_0576_City_Wapiti_Telem\Mapping\Finals\Fig5_WapitiTelemSurvey_GroundFeb2015.mxd

0 5 10 15 20
kilometres

Map Scale: 1:250,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 11N

Drawn:	Checked:	Date:	
LG	MK/AB/HVV	01/04/2015	**FIGURE 5**



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Microhabitat data collection sites, Wapiti River, March 3 to 5, 2015

Legend

- Tag 15 — Radio Tag Located, Microhabitat Data Collected
- Tag 17 — Radio Tag Located in Previous Aerial Survey, Not Detected or Unsafe Ice Conditions[1]
- Kilometre Marker (Wapiti River)[2]
- Extent of Ground Survey
- Area of Unsafe Ice Conditions Encountered During Ground Surveys

Base Data

- Highway / Main Road
- Local Road

[1] Tag locations are for illustrative purposes only.

[2] Kilometre marker indicates the distance upstream from the Smoky River.

Path: J:\Grande_Prairie\14_G_0576_City_Wapiti_Telem\Mapping\Finals\Fig6_WapitiTelemSurvey_GroundMar2015.mxd

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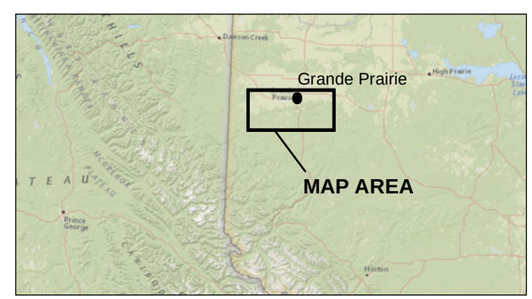
0 5 10 15 20
kilometres

Map Scale: 1:250,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 11N

Drawn:	Checked:	Date:	
LG	MK/AB/HVV	01/04/2015	**FIGURE 6**



EDI

ATTACHMENT 2. FISH MOVEMENT AND INDIVIDUAL FISH DATA

Table 1. Mountain whitefish movements during the winter telemetry program, October 2014 to March 2015.

		Intial Tagging Event						Dec 29, 2014		Jan 26, 2015		Feb 12, 2015		Feb 17-21, 2015		Mar 3-5, 2015		Total
Tag_ID	Tag Freq	Date Tagged	Zone	Site	Easting	Northing	River Km	River Km	Distance	River Km	Distance	River Km	Distance	River Km	Distance	River Km	Distance	Movement (km)
11	148.84	18-Oct-14	Magoo's Landing	W06	391132	6103584	33.9	20.8	-13.1			20.8	0.0	20.9	0.1	21.0	0.1	13.3
12	148.84	18-Oct-14	Magoo's Landing	W06	391132	6103584	33.9	3.7	-37.6			4.1	7.8	4.0	-0.1			45.5
13	148.84	18-Oct-14	Magoo's Landing	W06	391132	6103584	33.9	33.8	-0.1			34.2	0.4	34.1	-0.1	34.1	0.0	0.6
14	148.84	18-Oct-14	Magoo's Landing	W06	391132	6103584	33.9	17.3	-16.6			17.4	0.1	17.7	0.3	17.4	-0.3	17.3
15	148.84	18-Oct-14	Magoo's Landing	W06	391132	6103584	33.9	33.9	0.0					33.7	-0.2	33.7	0.0	0.2
16	148.84	18-Oct-14	Magoo's Landing	W07	391565	6103242	33.3	34.0	0.7			37.0	3.0			33.8	-3.2	6.9
17	148.84	18-Oct-14	Magoo's Landing	W06	391132	6103584	33.9	28.9	-5.0			28.7	-0.2					5.2
18	148.84	18-Oct-14	Magoo's Landing	W07	391565	6103242	33.3	33.3	0.0			33.8	0.5	33.7	-0.1	33.8	0.1	0.7
19	148.84	18-Oct-14	Magoo's Landing	W07	391565	6103242	33.3	33.4	0.1			33.7	0.3	33.8	0.1	33.7	-0.1	0.6
20	148.84	19-Oct-14	Magoo's Landing	W08	390182	6104563	35.1	34.0	-1.1			33.8	-0.2	33.5	-0.3			1.6
21	148.84	19-Oct-14	Magoo's Landing	W08	390182	6104563	35.1	26.4	-8.7									8.7
22	148.84	19-Oct-14	Magoo's Landing	W08	390182	6104563	35.1	24.6	-10.5	25.7	1.1							11.6
23	148.84	19-Oct-14	Magoo's Landing	W08	390182	6104563	35.1	34.1	-1.0			36.0	1.9	35.8	-0.2	35.8	0.0	3.1
24	148.84	19-Oct-14	Magoo's Landing	W08	390182	6104563	35.1	22.4	-12.7			22.5	0.1			22.5	0.0	12.8
25	148.84	19-Oct-14	Magoo's Landing	W08	390182	6104563	35.1	34.6	-0.5			37.0	2.4					2.9
26	148.84	19-Oct-14	Magoo's Landing	W08	390182	6104563	35.1	24.4	-10.7			24.4	0.0					10.7
27	148.84	19-Oct-14	Magoo's Landing	W08	390182	6104563	35.1	10.1	-25.0			11.8	1.7			11.7	-0.1	26.8
28	148.84	19-Oct-14	Magoo's Landing	W09	389641	6104937	36.0	32.5	-3.5			33.7	1.2	33.6	-0.1	34.0	0.4	5.2
29	148.84	19-Oct-14	Magoo's Landing	W09	389641	6104937	36.0	20.8	-15.2			20.8	0.0	33.7	12.9			28.1
30	148.84	19-Oct-14	Magoo's Landing	W09	389641	6104937	36.0	21.1	-14.9									14.9
101	149.34	16-Oct-14	Magoo's Landing	W01	390945	6103863	34.2	25.8	-8.4	25.8	0.0	25.7	-0.1					8.5
102	149.34	16-Oct-14	Magoo's Landing	W01	390945	6103863	34.2	17.5	-16.7	17.5	0.0	17.5	0.0	17.4	-0.1	17.3	-0.1	16.9
103	149.34	16-Oct-14	Magoo's Landing	W01	390945	6103863	34.2	34.2	0.0	34.2	0.0	34.2	0.0			34.2	0.0	0.0
104	149.34	16-Oct-14	Magoo's Landing	W01	390945	6103863	34.2	34.1	-0.1			34.2	0.1	34.3	0.1	34.2	-0.1	0.4
105	149.34	17-Oct-14	Wapiti Gardens	W02	342094	6094559	96.6	71.9	-24.7	71.8	-0.1	71.4	-0.4	72.0	0.6	71.8	-0.2	26.0
106	149.34	17-Oct-14	Wapiti Gardens	W04	343039	6095389	95.1	95.3	0.2	97.7	2.4	97.1	-0.6	97.2	0.1	97.1	-0.1	3.4
107	149.34	17-Oct-14	Wapiti Gardens	W05	342832	6095782	94.6	98.1	3.5	100.8	2.7	100.7	-0.1	100.7	0.0	100.7	0.0	6.3
108	149.34	17-Oct-14	Wapiti Gardens	W03	341554	6095270	97.4	24.3	-73.1	24.5	0.2	25.0	0.5					73.8
109	149.34	17-Oct-14	Wapiti Gardens	W03	341554	6095270	97.4											n/a
110	149.34	17-Oct-14	Wapiti Gardens	W05	342832	6095782	94.6	6.1	-20.8	6.7	0.6	6.8	0.1					21.5
111	149.34	17-Oct-14	Wapiti Gardens	W05	342832	6095782	94.6	37.9	-56.7	37.8	-0.1	37.9	0.1					56.9
112	149.34	18-Oct-14	Magoo's Landing	W01	390945	6103863	34.2	32.7	-1.5	32.8	0.1	32.7	-0.1	32.6	-0.1			1.8
113	149.34	18-Oct-14	Magoo's Landing	W01	390945	6103863	34.2	11.2	-23.0	11.4	0.2	11.4	0.0	11.4	0.0	11.5	0.1	23.3
114	149.34	18-Oct-14	Magoo's Landing	W01	390945	6103863	34.2	30.0	-4.2	29.8	-0.2	29.9	0.1					4.5
115	149.34	18-Oct-14	Magoo's Landing	W01	390945	6103863	34.2	25.4	-8.8	25.2	-0.2	25.4	0.2					9.2
116	149.34	18-Oct-14	Magoo's Landing	W01	390945	6103863	34.2	12.7	-21.5	12.7	0.0	12.8	0.1	12.7	-0.1	12.8	0.1	21.8
117	149.34	18-Oct-14	Magoo's Landing	W01	390945	6103863	34.2	37.9	3.7	37.3	-0.6	31.7	-5.6	31.8	0.1	31.9	0.1	10.1
118	149.34	18-Oct-14	Magoo's Landing	W06	391132	6103584	33.9	26.8	-7.1	26.8	0.0	26.9	0.1					7.2
119	149.34	18-Oct-14	Magoo's Landing	W06	391132	6103584	33.9	33.8	-0.1	33.9	0.1	33.9	0.0	34.0	0.1	33.9	-0.1	0.4
120	149.34	18-Oct-14	Magoo's Landing	W06	391132	6103584	33.9	0.4	-33.5	0.5	0.1	7.1	6.6	7.1	0.0	7.1	0.0	40.2

Notes:

1) TagID 110 entered Redwillow River following initial tagging event. Fish was detected in Redwillow River during two subsequent tracking events but could not be confirmed during the ground surveys due to access constraints. Redwillow River confluence with Wapiti River is located at River Km 79.9.

2) TagID 12 tagged in the Wapiti River at River KM 33.9. Detected downstream in Smoky River on 29 Dec 2014 3.7 km downstream of confluence with Wapiti River. Detected in Wapiti River at River KM 4.1 on Feb 12 and at River KM 4.0 during ground tracking week later.

Table 2. Individual biological data recorded from tagged mountain whitefish during the winter telemetry program, October 2014 to March 2015.

Tag_ID	Date Tagged	Zone	Tagging Site	Easting	Northing	Fish ID	Fork Length (mm)	Weight (g)	Tag Freq (Hz)
11	18-Oct-14	Magoo's Landing	W06	391132	6103584	91	341	400	148.84
12	18-Oct-14	Magoo's Landing	W06	391132	6103584	92	337	403	148.84
13	18-Oct-14	Magoo's Landing	W06	391132	6103584	93	280	231	148.84
14	18-Oct-14	Magoo's Landing	W06	391132	6103584	94	361	467	148.84
15	18-Oct-14	Magoo's Landing	W06	391132	6103584	96	262	207	148.84
16	18-Oct-14	Magoo's Landing	W07	391565	6103242	129	278	249	148.84
17	18-Oct-14	Magoo's Landing	W06	391132	6103584	101	269	268	148.84
18	18-Oct-14	Magoo's Landing	W07	391565	6103242	131	270	202	148.84
19	18-Oct-14	Magoo's Landing	W07	391565	6103242	132	314	403	148.84
20	19-Oct-14	Magoo's Landing	W08	390182	6104563	140	391	649	148.84
21	19-Oct-14	Magoo's Landing	W08	390182	6104563	141	295	266	148.84
22	19-Oct-14	Magoo's Landing	W08	390182	6104563	143	363	488	148.84
23	19-Oct-14	Magoo's Landing	W08	390182	6104563	144	278	229	148.84
24	19-Oct-14	Magoo's Landing	W08	390182	6104563	142	294	256	148.84
25	19-Oct-14	Magoo's Landing	W08	390182	6104563	145	379	382	148.84
26	19-Oct-14	Magoo's Landing	W08	390182	6104563	146	266	205	148.84
27	19-Oct-14	Magoo's Landing	W08	390182	6104563	147	368	471	148.84
28	19-Oct-14	Magoo's Landing	W09	389641	6104937	152	389	554	148.84
29	19-Oct-14	Magoo's Landing	W09	389641	6104937	153	414	722	148.84
30	19-Oct-14	Magoo's Landing	W09	389641	6104937	154	390	648	148.84
101	16-Oct-14	Magoo's Landing	W01	390945	6103863	2	375	475	149.34
102	16-Oct-14	Magoo's Landing	W01	390945	6103863	5	382	545	149.34
103	16-Oct-14	Magoo's Landing	W01	390945	6103863	4	382	560	149.34
104	16-Oct-14	Magoo's Landing	W01	390945	6103863	3	328	417	149.34
105	17-Oct-14	Wapiti Gardens	W02	342094	6094559	20	291	261	149.34
106	17-Oct-14	Wapiti Gardens	W04	343039	6095389	53	339	446	149.34
107	17-Oct-14	Wapiti Gardens	W05	342832	6095782	54	287	241	149.34
108	17-Oct-14	Wapiti Gardens	W03	341554	6095270	35	310	311	149.34
109	17-Oct-14	Wapiti Gardens	W03	341554	6095270	36	284	224	149.34
110	17-Oct-14	Wapiti Gardens	W05	342832	6095782	56	315	319	149.34
111	17-Oct-14	Wapiti Gardens	W05	342832	6095782	55	348	397	149.34

Table 2. Individual biological data recorded from tagged mountain whitefish during the winter telemetry program, October 2014 to March 2015.

Tag_ID	Date Tagged	Zone	Tagging Site	Easting	Northing	Fish ID	Fork Length (mm)	Weight (g)	Tag Freq (Hz)
112	18-Oct-14	Magoo's Landing	W01	390945	6103863	66	375	462	149.34
113	18-Oct-14	Magoo's Landing	W01	390945	6103863	68	339	432	149.34
114	18-Oct-14	Magoo's Landing	W01	390945	6103863	67	385	572	149.34
115	18-Oct-14	Magoo's Landing	W01	390945	6103863	70	374	551	149.34
116	18-Oct-14	Magoo's Landing	W01	390945	6103863	69	403	675	149.34
117	18-Oct-14	Magoo's Landing	W01	390945	6103863	71	302	295	149.34
118	18-Oct-14	Magoo's Landing	W06	391132	6103584	82	300	292	149.34
119	18-Oct-14	Magoo's Landing	W06	391132	6103584	83	254	201	149.34
120	18-Oct-14	Magoo's Landing	W06	391132	6103584	84	299	277	149.34

ATTACHMENT 3. MICROHABITAT DATA

Table 1. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: ice conditions and water depths.

TagID	Hole	Date	River Km	Easting	Northing	Ice Conditions	Depths (m) Total	Ice	Effective Water
11	Tag Location	21/02/2015	20.9	402190	6105389	Flood layer near surface - solid	1.19	0.73	0.46
11	Downstream	21/02/2015	20.9	402190	6105393	Flood layer near surface - solid	1.25	0.75	0.50
11	Lateral	21/02/2015	20.9	402186	6105389	Flood layer near surface - solid	1.14	0.73	0.41
11	Tag Location	05/03/2015	21.0	402163	6105370	Solid	0.92	0.53	0.39
11	Downstream	05/03/2015	21.0	402165	6105372	Solid	0.91	0.57	0.34
11	Lateral	05/03/2015	21.0	402165	6105369	Solid	0.95	0.54	0.41
12	Tag Location	18/02/2015	4.0	413848	6112207	Solid, flood ice about 23cm	1.74	0.76	0.98
12	Downstream	18/02/2015	4.0	413849	6112210	Solid, flood ice about 23cm	1.54	0.71	0.83
12	Lateral	18/02/2015	4.0	413849	6112205	Solid, flood ice about 23cm	1.75	0.72	1.03
13	Tag Location	19/02/2015	34.1	390984	6103824	Solid throughout	1.42	0.56	0.86
13	Downstream	19/02/2015	34.1	390987	6103819	Solid throughout	1.40	0.50	0.90
13	Lateral	19/02/2015	34.1	390980	6103823	Solid throughout	1.47	0.52	0.95
13	Tag Location	03/03/2015	34.1	390998	6103847	Solid with lots of Slush	1.04	0.56	0.48
13	Downstream	03/03/2015	34.1	390998	6103842	Solid with lots of Slush	1.13	0.56	0.57
13	Lateral	03/03/2015	34.1	390999	6103848	Solid with lots of Slush	1.01	0.55	0.46
14	Tag Location	21/02/2015	17.7	405132	6106498	Solid	1.06	0.62	0.44
14	Downstream	21/02/2015	17.7	405133	6106497	Solid	1.06	0.62	0.44
14	Lateral	21/02/2015	17.7	405130	6106499	Solid	1.03	0.64	0.39
14	Tag Location	05/03/2015	17.4	405374	6106487	Solid	0.96	0.44	0.52
14	Downstream	05/03/2015	17.4	405377	6106489	Solid	0.97	0.44	0.53
14	Lateral	05/03/2015	17.4	405373	6106485	Solid	0.98	0.41	0.57
15	Tag Location	19/02/2015	33.7	391288	6103396	Solid with few thin layers of flood ice	1.01	0.70	0.31
15	Downstream	19/02/2015	33.7	391292	6103389	Solid with few thin layers of flood ice	0.96	0.69	0.30
15	Lateral	19/02/2015	33.7	391287	6103390	Solid with few thin layers of flood ice	1.01	0.76	0.25
15	Tag Location	03/03/2015	33.7	391295	6103386	Thin layers flood ice	0.90	0.65	0.25
15	Downstream	03/03/2015	33.7	391296	6103383	Thin layers flood ice	0.86	0.63	-
15	Lateral	03/03/2015	33.7	391293	6103382	Thin layers flood ice	0.85	0.61	0.24
16	Tag Location	03/03/2015	33.8	391201	6103503	Thin flood layers	1.26	0.56	0.71
16	Downstream	03/03/2015	33.8	391202	6103502	Thin flood layers	1.30	0.61	0.69
16	Lateral	03/03/2015	33.8	391199	6103503	Thin flood layers	1.29	0.69	0.60
18	Tag Location	19/02/2015	33.7	391278	6103407	Solid, a few thin flood layers	0.93	0.64	0.29
18	Downstream	19/02/2015	33.7	391277	6103407	Solid, a few thin flood layers	0.90	0.72	0.18
18	Lateral	19/02/2015	33.7	391274	6103407	Solid, a few thin flood layers	0.96	0.71	0.29
18	Tag Location	03/03/2015	33.8	391241	6103431	Thin flood layers	0.94	0.67	0.27
18	Downstream	03/03/2015	33.8	391241	6103429	Thin flood layers	0.97	0.70	0.27
18	Lateral	03/03/2015	33.8	391238	6103430	Thin flood layers	1.00	0.70	0.30

Table 1. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: ice conditions and water depths.

TagID	Hole	Date	River Km	Easting	Northing	Ice Conditions	Depths (m) Total	Ice	Effective Water
19	Tag Location	19/02/2015	33.8	391230	6103486	Flood layers	0.88	0.55	0.33
19	Downstream	19/02/2015	33.8	391236	6103485	Flood layers	1.01	0.58	0.43
19	Lateral	19/02/2015	33.8	391233	6103485	Flood layers	0.91	0.52	0.39
19	Tag Location	03/03/2015	33.7	391304	61033	Thin flood layers	0.84	0.56	0.28
19	Downstream	03/03/2015	33.7	391306	6103374	Thin flood layers	0.92	0.53	0.39
19	Lateral	03/03/2015	33.7	391304	6103377	Thin flood layers	0.85	0.53	0.32
20	Tag Location	20/02/2015	33.5	391547	6103614	Solid	1.45	0.35	1.10
20	Downstream	20/02/2015	33.5	391549	6103609	Solid	1.41	0.36	1.05
20	Lateral	20/02/2015	33.5	391549	6103615	Solid	1.26	0.57	0.69
23	Tag Location	19/02/2015	35.8	389740	6104783	Solid throughout	1.06	0.87	0.19
23	Downstream	19/02/2015	35.8	389746	6104785	Solid throughout	1.04	0.87	0.17
23	Lateral	19/02/2015	35.8	389742	6104790	Solid throughout	1.17	0.86	0.31
23	Tag Location	03/03/2015	35.8	389738	6104787	Solid	1.05	0.96	0.09
23	Downstream	03/03/2015	35.8	389739	6104781	Solid	1.04	0.94	0.10
23	Lateral	03/03/2015	35.8	389740	6104784	Solid	1.06	0.94	0.12
24	Tag Location	05/03/2015	22.5	401146	6104255	Solid	0.86	0.51	0.35
24	Downstream	05/03/2015	22.5	401149	6104255	Solid	0.82	0.49	0.33
24	Lateral	05/03/2015	22.5	401144	6104255	Solid	0.87	0.45	0.42
27	Tag Location	05/03/2015	11.7	409322	6109152	Flood layers throughout	1.57	0.52	1.05
27	Downstream	05/03/2015	11.7	409327	6109159	Flood layers throughout	1.55	0.53	1.02
27	Lateral	05/03/2015	11.7	409322	6109154	Flood layers throughout	1.60	0.55	1.05
28	Tag Location	20/02/2015	33.6	391376	6103327	Solid	0.84	0.59	0.25
28	Downstream	20/02/2015	33.6	391379	6103325	Solid	0.94	0.54	0.40
28	Lateral	20/02/2015	33.6	391375	6103325	Solid	0.96	0.60	0.36
28	Tag Location	03/03/2015	34.0	391053	6103672	Solid	1.11	0.53	0.58
28	Downstream	03/03/2015	34.0	391055	6103665	Solid	1.21	0.57	0.64
28	Lateral	03/03/2015	34.0	391052	6103668	Solid	1.21	0.60	0.61
29	Tag Location	20/02/2015	33.7	391297	6103379	Solid	0.94	0.60	0.34
29	Downstream	20/02/2015	33.7	391300	6103379	Solid	0.96	0.58	0.38
29	Lateral	20/02/2015	33.7	391296	6103379	Solid	0.98	0.56	0.42
102	Tag Location	18/02/2015	17.4	405366	6106492	Solid with flood areas	1.16	0.50	0.66
102	Downstream	18/02/2015	17.4	405368	6106492	Solid with flood areas	1.11	0.48	0.63
102	Lateral	18/02/2015	17.4	405366	6106486	Solid with flood areas	1.10	0.48	0.62
102	Tag Location	05/03/2015	17.3	405524	6106541	Solid	0.85	0.34	0.51
102	Downstream	05/03/2015	17.3	405526	6106540	Solid	0.82	0.35	0.47
102	Lateral	05/03/2015	17.3	405524	6106542	Solid	0.81	0.37	0.44

Table 1. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: ice conditions and water depths.

TagID	Hole	Date	River Km	Easting	Northing	Ice Conditions	Depths (m) Total	Ice	Effective Water
103	Tag Location	03/03/2015	34.2	390935	6103888	Solid	1.62	0.51	1.11
103	Downstream	03/03/2015	34.2	390937	6103886	Solid	1.69	0.51	1.18
103	Lateral	03/03/2015	34.2	390934	6103884	Solid	1.59	0.53	1.06
104	Tag Location	19/02/2015	34.3	390890	6103925	Solid through	1.46	0.60	0.86
104	Downstream	19/02/2015	34.3	390893	6103921	Solid through	1.21	0.60	0.61
104	Lateral	19/02/2015	34.3	390894	6103924	Solid through	1.11	0.57	0.54
104	Tag Location	03/03/2015	34.2	390971	6103877	Solid	1.31	0.52	0.79
104	Downstream	03/03/2015	34.2	390975	6103878	Solid	1.61	0.53	1.08
104	Lateral	03/03/2015	34.2	390974	6103882	Solid	1.35	0.56	0.80
105	Tag Location	20/02/2015	72.0	358820	6101950	Solid	1.05	0.69	0.36
105	Downstream	20/02/2015	72.0	358821	6101954	Solid	1.05	0.62	0.43
105	Lateral	20/02/2015	72.0	358823	6101950	Solid	0.97	0.55	0.42
105	Tag Location	04/03/2015	71.8	358862	6102051	Flood layer near bottom	0.88	0.59	0.29
105	Downstream	04/03/2015	71.8	358865	6102053	Flood layer near bottom	0.82	0.56	0.26
105	Lateral	04/03/2015	71.8	358863	6102048	Flood layer near bottom	0.97	0.56	0.41
106	Tag Location	17/02/2015	97.2	341721	6095121	10cm ice, flood layers, solid	1.45	0.75	0.70
106	Downstream	17/02/2015	97.2	341720	6095119	10cm ice, flood layers, solid	1.46	0.77	0.69
106	Lateral	17/02/2015	97.2	341721	6095118	10cm ice, flood layers, solid	1.48	0.74	0.74
106	Tag Location	04/03/2015	97.1	341762	6095025	Abundant flood layers	1.69	0.70	0.99
106	Downstream	04/03/2015	97.1	341764	6095024	Abundant flood layers	1.71	0.64	1.07
106	Lateral	04/03/2015	97.1	341761	6095025	Abundant flood layers	1.55	0.84	0.71
107	Tag Location	17/02/2015	100.7	338877	6094148	Solid, flood layer 30 cm @ 40 cm	2.50	1.30	1.20
107	Downstream	17/02/2015	100.7	338878	6094147	Solid, flood layer 30 cm @ 40 cm	2.28	1.00	1.28
107	Lateral	17/02/2015	100.7	338876	6094150	Solid, flood layer 30 cm @ 40 cm	2.16	0.96	1.20
107	Tag Location	04/03/2015	100.7	338902	6094162	Abundant flood layers	2.50	1.00	1.50
107	Downstream	04/03/2015	100.7	338907	6094157	Abundant flood layers	2.68	0.95	1.75
107	Lateral	04/03/2015	100.7	338901	6094160	Abundant flood layers	2.34	1.00	1.34
112	Tag Location	19/02/2015	32.6	392318	6103179	Solid	1.35	0.46	0.89
112	Downstream	19/02/2015	32.6	392320	6103177	Solid	1.46	0.47	0.99
112	Lateral	19/02/2015	32.6	392318	6103183	Solid	1.45	0.48	0.97
113	Tag Location	18/02/2015	11.4	409629	6109392	Solid	1.01	0.78	0.23
113	Downstream	18/02/2015	11.4	409635	6109395	Solid	1.08	0.82	0.23
113	Lateral	18/02/2015	11.4	409630	6109397	Solid	1.01	0.70	0.31
113	Tag Location	05/03/2015	11.5	409477	6109266	Flood layers near bottom	0.92	0.67	0.25
113	Downstream	05/03/2015	11.5	409482	6109266	Flood layers near bottom	0.95	0.66	0.29
113	Lateral	05/03/2015	11.5	409480	6109263	Flood layers near bottom	0.94	0.61	0.33

Table 1. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: ice conditions and water depths.

TagID	Hole	Date	River Km	Easting	Northing	Ice Conditions	Depths (m) Total	Ice	Effective Water
116	Tag Location	18/02/2015	12.7	404409	6109479	Overflow, Flood layers about 35cm 1st layer	2.05	0.54	1.51
116	Downstream	18/02/2015	12.7	404410	6109478	Overflow, Flood layers about 35cm 1st layer	2.10	0.55	1.55
116	Lateral	18/02/2015	12.7	404409	6109481	Overflow, Flood layers about 35cm 1st layer	1.96	0.56	1.40
116	Tag Location	05/03/2015	12.8	408322	6109506	Solid, flood layer half way down	1.96	0.65	1.31
116	Downstream	05/03/2015	12.8	408321	6109505	Solid, flood layer half way down	1.74	0.67	1.07
116	Lateral	05/03/2015	12.8	408320	6109505	Solid, flood layer half way down	2.00	0.60	1.40
117	Tag Location	19/02/2015	31.8	393178	6102941	Solid	1.32	0.45	0.87
117	Downstream	19/02/2015	31.8	393180	6102941	Solid	1.32	0.45	0.87
117	Lateral	19/02/2015	31.8	393178	6102937	Solid	1.45	0.44	0.87
117	Tag Location	03/03/2015	31.9	393072	6102974	Solid	2.39	0.51	1.88
117	Downstream	03/03/2015	31.9	393074	6102972	Solid	2.31	0.61	1.70
117	Lateral	03/03/2015	31.9	393072	6102970	Solid	2.42	0.52	1.90
119	Tag Location	19/02/2015	34.0	391084	6103642	Multiple layers of flood ice	1.54	0.78	0.76
119	Downstream	19/02/2015	34.0	391084	6103639	Multiple layers of flood ice	1.64	0.78	0.86
119	Lateral	19/02/2015	34.0	391085	6103639	Multiple layers of flood ice	1.60	0.84	0.76
119	Tag Location	03/03/2015	33.9	391138	6103586	Some flood ice	1.54	0.68	0.86
119	Downstream	03/03/2015	33.9	391139	6103584	Some flood ice	1.53	0.68	0.84
119	Lateral	03/03/2015	33.9	391141	6103590	Some flood ice	1.43	0.62	0.81
120	Tag Location	18/02/2015	7.1	412468	6109974	Solid	1.40	0.47	0.93
120	Downstream	18/02/2015	7.1	412471	6109974	Solid	1.45	0.48	0.97
120	Lateral	18/02/2015	7.1	412468	6109981	Solid	1.61	0.47	1.14
120	Tag Location	05/03/2015	7.1	412451	6109937		0.98	0.48	0.50
120	Downstream	05/03/2015	7.1	412454	6109937		0.95	0.47	0.48
120	Lateral	05/03/2015	7.1	412450	6109938		0.96	0.45	0.51

Table 2. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: water velocities.

TagID	Hole	Date	River Km	Easting	Northing	Velocities in Water Column (m/s)				
						0.1 m above substrate	20% Depth	50% Depth	80% Depth	0.10 m below ice
11	Tag Location	21/02/2015	20.9	402190	6105389	0.38	-	0.59	-	0.51
11	Downstream	21/02/2015	20.9	402190	6105393	0.41	-	0.48	-	0.39
11	Lateral	21/02/2015	20.9	402186	6105389	0.45	-	0.60	-	0.58
11	Tag Location	05/03/2015	21.0	402163	6105370	0.58	-	0.61	-	0.54
11	Downstream	05/03/2015	21.0	402165	6105372	0.64	-	0.64	-	0.56
11	Lateral	05/03/2015	21.0	402165	6105369	0.56	-	0.59	-	0.51
12	Tag Location	18/02/2015	4.0	413848	6112207	0.03	0.07	0.03	0.01	-
12	Downstream	18/02/2015	4.0	413849	6112210	0.03	0.00	0.00	-	-
12	Lateral	18/02/2015	4.0	413849	6112205	0.04	0.03	0.00	0.03	-
13	Tag Location	19/02/2015	34.1	390984	6103824	0.46	0.43	-	0.61	0.43
13	Downstream	19/02/2015	34.1	390987	6103819	0.45	0.48	-	0.59	0.57
13	Lateral	19/02/2015	34.1	390980	6103823	0.60	0.54	-	0.69	0.63
13	Tag Location	03/03/2015	34.1	390998	6103847	0.28	-	0.00	-	0.00
13	Downstream	03/03/2015	34.1	390998	6103842	0.18	-	0.05	-	0.00
13	Lateral	03/03/2015	34.1	390999	6103848	0.21	-	0.10	-	0.07
14	Tag Location	21/02/2015	17.7	405132	6106498	0.61	-	0.78	-	0.52
14	Downstream	21/02/2015	17.7	405133	6106497	0.61	-	0.80	-	0.56
14	Lateral	21/02/2015	17.7	405130	6106499	0.77	-	0.79	-	0.65
14	Tag Location	05/03/2015	17.4	405374	6106487	0.43	-	0.52	-	0.29
14	Downstream	05/03/2015	17.4	405377	6106489	0.44	-	0.49	-	0.43
14	Lateral	05/03/2015	17.4	405373	6106485	0.30	-	0.50	-	0.50
15	Tag Location	19/02/2015	33.7	391288	6103396	0.15	0.01	-	-	-
15	Downstream	19/02/2015	33.7	391292	6103389	0.38	0.36	-	-	-
15	Lateral	19/02/2015	33.7	391287	6103390	0.49	0.55	-	-	-
15	Tag Location	03/03/2015	33.7	391295	6103386	0.41	-	-	-	0.47
15	Downstream	03/03/2015	33.7	391296	6103383	0.46	-	-	-	0.49
15	Lateral	03/03/2015	33.7	391293	6103382	0.51	-	-	-	0.47
16	Tag Location	03/03/2015	33.8	391201	6103503	0.33	-	0.33	-	0.34
16	Downstream	03/03/2015	33.8	391202	6103502	0.28	-	0.37	-	0.37
16	Lateral	03/03/2015	33.8	391199	6103503	0.28	-	0.37	-	0.33
18	Tag Location	19/02/2015	33.7	391278	6103407	0.15	0.21	-	-	-
18	Downstream	19/02/2015	33.7	391277	6103407	0.02	-	-	-	-
18	Lateral	19/02/2015	33.7	391274	6103407	0.03	0.01	-	-	-
18	Tag Location	03/03/2015	33.8	391241	6103431	0.57	-	0.47	-	0.52
18	Downstream	03/03/2015	33.8	391241	6103429	0.43	-	0.55	-	0.00
18	Lateral	03/03/2015	33.8	391238	6103430	0.54	-	0.87	-	0.00

Table 2. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: water velocities.

TagID	Hole	Date	River Km	Easting	Northing	Velocities in Water Column (m/s)				
						0.1 m above substrate	20% Depth	50% Depth	80% Depth	0.10 m below ice
19	Tag Location	19/02/2015	33.8	391230	6103486	0.33	0.32	-	-	-
19	Downstream	19/02/2015	33.8	391236	6103485	0.38	0.38	0.39	-	-
19	Lateral	19/02/2015	33.8	391233	6103485	0.35	0.41	0.36	-	-
19	Tag Location	03/03/2015	33.7	391304	61033	0.39	-	-	-	0.40
19	Downstream	03/03/2015	33.7	391306	6103374	0.43	-	0.46	-	0.45
19	Lateral	03/03/2015	33.7	391304	6103377	0.43	-	0.46	-	0.51
20	Tag Location	20/02/2015	33.5	391547	6103614	0.43	0.54	-	0.58	0.56
20	Downstream	20/02/2015	33.5	391549	6103609	0.53	0.51	-	0.59	0.56
20	Lateral	20/02/2015	33.5	391549	6103615	0.45	-	0.48	-	0.47
23	Tag Location	19/02/2015	35.8	389740	6104783	0.14	-	-	-	-
23	Downstream	19/02/2015	35.8	389746	6104785	0.25	-	-	-	-
23	Lateral	19/02/2015	35.8	389742	6104790	-	0.21	-	-	-
23	Tag Location	03/03/2015	35.8	389738	6104787	0.04	-	-	-	-
23	Downstream	03/03/2015	35.8	389739	6104781	0.02	-	-	-	-
23	Lateral	03/03/2015	35.8	389740	6104784	0.05	-	-	-	-
24	Tag Location	05/03/2015	22.5	401146	6104255	0.57	-	0.71	-	0.60
24	Downstream	05/03/2015	22.5	401149	6104255	0.70	-	0.70	-	0.62
24	Lateral	05/03/2015	22.5	401144	6104255	0.56	-	0.50	-	0.43
27	Tag Location	05/03/2015	11.7	409322	6109152	0.22	0.29	-	0.40	0.37
27	Downstream	05/03/2015	11.7	409327	6109159	0.30	0.32	-	0.44	0.37
27	Lateral	05/03/2015	11.7	409322	6109154	0.32	0.35	-	0.37	0.36
28	Tag Location	20/02/2015	33.6	391376	6103327	0.33	-	-	-	-
28	Downstream	20/02/2015	33.6	391379	6103325	0.36	-	0.33	-	0.27
28	Lateral	20/02/2015	33.6	391375	6103325	0.32	-	0.31	-	0.24
28	Tag Location	03/03/2015	34.0	391053	6103672	0.80	-	1.13	-	1.23
28	Downstream	03/03/2015	34.0	391055	6103665	0.66	-	1.06	-	1.18
28	Lateral	03/03/2015	34.0	391052	6103668	0.69	-	0.94	-	0.83
29	Tag Location	20/02/2015	33.7	391297	6103379	0.42	-	-	-	0.40
29	Downstream	20/02/2015	33.7	391300	6103379	0.42	-	0.49	-	0.42
29	Lateral	20/02/2015	33.7	391296	6103379	0.34	-	0.45	-	0.48
102	Tag Location	18/02/2015	17.4	405366	6106492	0.44	-	0.51	-	0.51
102	Downstream	18/02/2015	17.4	405368	6106492	0.50	-	0.57	-	0.43
102	Lateral	18/02/2015	17.4	405366	6106486	0.52	-	0.59	-	0.55
102	Tag Location	05/03/2015	17.3	405524	6106541	0.89	-	1.19	-	1.18
102	Downstream	05/03/2015	17.3	405526	6106540	0.86	-	1.16	-	1.16
102	Lateral	05/03/2015	17.3	405524	6106542	0.86	-	1.14	-	1.20

Table 2. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: water velocities.

TagID	Hole	Date	River Km	Easting	Northing	Velocities in Water Column (m/s) 0.1 m above substrate	20% Depth	50% Depth	80% Depth	0.10 m below ice
103	Tag Location	03/03/2015	34.2	390935	6103888	0.33	0.35	-	0.39	0.36
103	Downstream	03/03/2015	34.2	390937	6103886	0.35	0.36	-	0.33	0.34
103	Lateral	03/03/2015	34.2	390934	6103884	0.28	0.32	-	0.34	0.32
104	Tag Location	19/02/2015	34.3	390890	6103925	0.26	0.27	-	0.00	0.00
104	Downstream	19/02/2015	34.3	390893	6103921	0.25	-	0.04	-	0.00
104	Lateral	19/02/2015	34.3	390894	6103924	0.15	-	0.01	-	0.00
104	Tag Location	03/03/2015	34.2	390971	6103877	0.11	-	0.12	-	0.03
104	Downstream	03/03/2015	34.2	390975	6103878	0.10	0.14	-	0.09	0.09
104	Lateral	03/03/2015	34.2	390974	6103882	0.12	-	0.07	-	0.00
105	Tag Location	20/02/2015	72.0	358820	6101950	0.55	-	-	-	0.52
105	Downstream	20/02/2015	72.0	358821	6101954	0.41	-	0.50	-	0.46
105	Lateral	20/02/2015	72.0	358823	6101950	0.24	-	0.39	-	0.44
105	Tag Location	04/03/2015	71.8	358862	6102051	0.63	-	-	-	0.64
105	Downstream	04/03/2015	71.8	358865	6102053	0.45	-	-	-	0.63
105	Lateral	04/03/2015	71.8	358863	6102048	0.75	-	0.76	-	0.53
106	Tag Location	17/02/2015	97.2	341721	6095121	-	-	0.30	-	-
106	Downstream	17/02/2015	97.2	341720	6095119	-	-	0.34	-	-
106	Lateral	17/02/2015	97.2	341721	6095118	-	-	0.30	-	-
106	Tag Location	04/03/2015	97.1	341762	6095025	0.29	0.50	-	0.62	0.59
106	Downstream	04/03/2015	97.1	341764	6095024	0.39	0.49	-	0.67	0.59
106	Lateral	04/03/2015	97.1	341761	6095025	0.45	-	0.50	-	0.35
107	Tag Location	17/02/2015	100.7	338877	6094148	-	0.32	-	0.55	-
107	Downstream	17/02/2015	100.7	338878	6094147	-	0.61	-	0.59	-
107	Lateral	17/02/2015	100.7	338876	6094150	-	0.34	-	0.46	-
107	Tag Location	04/03/2015	100.7	338902	6094162	0.27	0.38	-	0.36	0.32
107	Downstream	04/03/2015	100.7	338907	6094157	0.14	0.32	-	0.35	0.33
107	Lateral	04/03/2015	100.7	338901	6094160	0.37	0.41	-	0.44	0.42
112	Tag Location	19/02/2015	32.6	392318	6103179	0.32	0.37	-	0.45	0.47
112	Downstream	19/02/2015	32.6	392320	6103177	0.21	0.31	-	0.48	0.33
112	Lateral	19/02/2015	32.6	392318	6103183	0.28	0.35	-	0.29	0.30
113	Tag Location	18/02/2015	11.4	409629	6109392	0.02	-	-	-	-
113	Downstream	18/02/2015	11.4	409635	6109395	0.04	-	-	-	-
113	Lateral	18/02/2015	11.4	409630	6109397	0.05	-	-	-	-
113	Tag Location	05/03/2015	11.5	409477	6109266	0.33	-	-	-	0.18
113	Downstream	05/03/2015	11.5	409482	6109266	0.40	-	0.35	-	0.31
113	Lateral	05/03/2015	11.5	409480	6109263	0.33	-	0.39	-	0.35

Table 2. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: water velocities.

TagID	Hole	Date	River Km	Easting	Northing	Velocities in Water Column (m/s)				
						0.1 m above substrate	20% Depth	50% Depth	80% Depth	0.10 m below ice
116	Tag Location	18/02/2015	12.7	404409	6109479	0.18	0.28	-	0.30	0.23
116	Downstream	18/02/2015	12.7	404410	6109478	0.25	0.23	-	0.29	0.24
116	Lateral	18/02/2015	12.7	404409	6109481	0.19	0.24	-	0.34	0.25
116	Tag Location	05/03/2015	12.8	408322	6109506	0.15	0.20	-	0.22	0.16
116	Downstream	05/03/2015	12.8	408321	6109505	0.19	0.21	-	0.25	0.19
116	Lateral	05/03/2015	12.8	408320	6109505	0.17	0.25	-	0.25	0.23
117	Tag Location	19/02/2015	31.8	393178	6102941	0.27	0.28	-	0.34	0.27
117	Downstream	19/02/2015	31.8	393180	6102941	0.28	0.33	-	0.37	0.39
117	Lateral	19/02/2015	31.8	393178	6102937	0.34	0.39	-	0.43	0.39
117	Tag Location	03/03/2015	31.9	393072	6102974	0.32	0.41	-	0.00	0.00
117	Downstream	03/03/2015	31.9	393074	6102972	0.35	0.45	-	0.00	0.00
117	Lateral	03/03/2015	31.9	393072	6102970	0.28	0.33	-	0.00	0.00
119	Tag Location	19/02/2015	34.0	391084	6103642	0.60	0.71	-	0.81	0.65
119	Downstream	19/02/2015	34.0	391084	6103639	0.55	0.61	-	0.72	0.76
119	Lateral	19/02/2015	34.0	391085	6103639	0.64	0.66	-	0.47	0.38
119	Tag Location	03/03/2015	33.9	391138	6103586	0.20	0.43	-	0.57	0.55
119	Downstream	03/03/2015	33.9	391139	6103584	0.39	0.47	-	0.58	0.57
119	Lateral	03/03/2015	33.9	391141	6103590	0.16	0.33	-	0.58	0.62
120	Tag Location	18/02/2015	7.1	412468	6109974	0.32	0.29	0.45	0.38	-
120	Downstream	18/02/2015	7.1	412471	6109974	0.36	0.32	0.46	0.41	-
120	Lateral	18/02/2015	7.1	412468	6109981	0.34	0.33	0.44	0.36	-
120	Tag Location	05/03/2015	7.1	412451	6109937	0.18	-	0.28	-	0.26
120	Downstream	05/03/2015	7.1	412454	6109937	0.16	-	0.26	-	0.26
120	Lateral	05/03/2015	7.1	412450	6109938	0.23	-	0.25	-	0.29

Table 3. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: substrate composition

TagID	Hole	Date	River Km	Easting	Northing	Classification and Percentage Abundance					
						Clay/Silt	Sand	Sm. Gravel	Lg Gravel	Cobble	Boulder
11	Tag Location	21/02/2015	20.9	402190	6105389	-	40	5	5	50	-
11	Downstream	21/02/2015	20.9	402190	6105393	-	40	5	5	50	-
11	Lateral	21/02/2015	20.9	402186	6105389	-	40	5	5	50	-
11	Tag Location	05/03/2015	21.0	402163	6105370	-	5	5	10	80	-
11	Downstream	05/03/2015	21.0	402165	6105372	-	5	5	10	80	-
11	Lateral	05/03/2015	21.0	402165	6105369	-	5	5	10	80	-
12	Tag Location	18/02/2015	4.0	413848	6112207	100	-	-	-	-	-
12	Downstream	18/02/2015	4.0	413849	6112210	100	-	-	-	-	-
12	Lateral	18/02/2015	4.0	413849	6112205	100	-	-	-	-	-
13	Tag Location	19/02/2015	34.1	390984	6103824	-	15	-	30	50	5
13	Downstream	19/02/2015	34.1	390987	6103819	-	15	5	30	50	-
13	Lateral	19/02/2015	34.1	390980	6103823	-	15	5	30	50	-
13	Tag Location	03/03/2015	34.1	390998	6103847	10	85	-	-	5	-
13	Downstream	03/03/2015	34.1	390998	6103842	10	85	-	-	5	-
13	Lateral	03/03/2015	34.1	390999	6103848	10	85	-	-	5	-
14	Tag Location	21/02/2015	17.7	405132	6106498	-	10	5	15	70	-
14	Downstream	21/02/2015	17.7	405133	6106497	-	10	5	15	70	-
14	Lateral	21/02/2015	17.7	405130	6106499	-	10	5	15	70	-
14	Tag Location	05/03/2015	17.4	405374	6106487	-	-	15	15	70	-
14	Downstream	05/03/2015	17.4	405377	6106489	-	-	15	15	70	-
14	Lateral	05/03/2015	17.4	405373	6106485	-	-	15	15	70	-
15	Tag Location	19/02/2015	33.7	391288	6103396	20	80	-	-	-	-
15	Downstream	19/02/2015	33.7	391292	6103389	-	60	-	-	40	-
15	Lateral	19/02/2015	33.7	391287	6103390	-	20	10	10	60	-
15	Tag Location	03/03/2015	33.7	391295	6103386	-	-	10	10	80	-
15	Downstream	03/03/2015	33.7	391296	6103383	-	-	10	10	80	-
15	Lateral	03/03/2015	33.7	391293	6103382	-	-	10	10	80	-
16	Tag Location	03/03/2015	33.8	391201	6103503	5	90	-	-	5	-
16	Downstream	03/03/2015	33.8	391202	6103502	5	90	-	-	5	-
16	Lateral	03/03/2015	33.8	391199	6103503	5	90	-	-	5	-
18	Tag Location	19/02/2015	33.7	391278	6103407	20	80	-	-	-	-
18	Downstream	19/02/2015	33.7	391277	6103407	20	80	-	-	-	-
18	Lateral	19/02/2015	33.7	391274	6103407	20	80	-	-	-	-
18	Tag Location	03/03/2015	33.8	391241	6103431	-	5	15	20	70	-
18	Downstream	03/03/2015	33.8	391241	6103429	-	5	15	20	70	-
18	Lateral	03/03/2015	33.8	391238	6103430	-	5	15	20	70	-

Table 3. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: substrate composition

TagID	Hole	Date	River Km	Easting	Northing	Classification and Percentage Abundance					
						Clay/Silt	Sand	Sm. Gravel	Lg Gravel	Cobble	Boulder
19	Tag Location	19/02/2015	33.8	391230	6103486	-	30	10	10	50	-
19	Downstream	19/02/2015	33.8	391236	6103485	-	30	10	10	50	-
19	Lateral	19/02/2015	33.8	391233	6103485	-	30	10	10	50	-
19	Tag Location	03/03/2015	33.7	391304	61033	-	-	10	10	80	-
19	Downstream	03/03/2015	33.7	391306	6103374	-	-	10	10	80	-
19	Lateral	03/03/2015	33.7	391304	6103377	-	-	10	10	80	-
20	Tag Location	20/02/2015	33.5	391547	6103614	100	-	-	-	-	-
20	Downstream	20/02/2015	33.5	391549	6103609	100	-	-	-	-	-
20	Lateral	20/02/2015	33.5	391549	6103615	100	-	-	-	-	-
23	Tag Location	19/02/2015	35.8	389740	6104783	5	-	5	20	70	-
23	Downstream	19/02/2015	35.8	389746	6104785	5	-	5	20	70	-
23	Lateral	19/02/2015	35.8	389742	6104790	5	-	5	20	70	-
23	Tag Location	03/03/2015	35.8	389738	6104787	5	5	15	15	60	-
23	Downstream	03/03/2015	35.8	389739	6104781	5	5	15	15	60	-
23	Lateral	03/03/2015	35.8	389740	6104784	5	5	15	15	60	-
24	Tag Location	05/03/2015	22.5	401146	6104255	-	10	10	10	70	-
24	Downstream	05/03/2015	22.5	401149	6104255	-	10	10	10	70	-
24	Lateral	05/03/2015	22.5	401144	6104255	-	10	10	10	70	-
27	Tag Location	05/03/2015	11.7	409322	6109152	-	15	10	10	65	-
27	Downstream	05/03/2015	11.7	409327	6109159	-	15	10	10	65	-
27	Lateral	05/03/2015	11.7	409322	6109154	-	15	10	10	65	-
28	Tag Location	20/02/2015	33.6	391376	6103327	20	40	10	10	20	-
28	Downstream	20/02/2015	33.6	391379	6103325	20	40	10	10	20	-
28	Lateral	20/02/2015	33.6	391375	6103325	20	30	10	10	30	-
28	Tag Location	03/03/2015	34.0	391053	6103672	-	-	5	15	80	-
28	Downstream	03/03/2015	34.0	391055	6103665	-	-	5	15	80	-
28	Lateral	03/03/2015	34.0	391052	6103668	-	-	5	15	80	-
29	Tag Location	20/02/2015	33.7	391297	6103379	-	40	10	10	40	-
29	Downstream	20/02/2015	33.7	391300	6103379	-	40	10	10	40	-
29	Lateral	20/02/2015	33.7	391296	6103379	-	40	10	10	40	-
102	Tag Location	18/02/2015	17.4	405366	6106492	-	40	10	10	40	-
102	Downstream	18/02/2015	17.4	405368	6106492	-	40	10	10	40	-
102	Lateral	18/02/2015	17.4	405366	6106486	-	-	-	-	-	-
102	Tag Location	05/03/2015	17.3	405524	6106541	-	-	10	30	60	-
102	Downstream	05/03/2015	17.3	405526	6106540	-	-	10	30	60	-
102	Lateral	05/03/2015	17.3	405524	6106542	-	-	10	30	60	-

Table 3. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: substrate composition

TagID	Hole	Date	River Km	Easting	Northing	Classification and Percentage Abundance					
						Clay/Silt	Sand	Sm. Gravel	Lg Gravel	Cobble	Boulder
103	Tag Location	03/03/2015	34.2	390935	6103888	10	80	-	-	10	-
103	Downstream	03/03/2015	34.2	390937	6103886	-	70	-	-	30	-
103	Lateral	03/03/2015	34.2	390934	6103884	-	70	-	-	30	-
104	Tag Location	19/02/2015	34.3	390890	6103925	40	30	-	10	20	-
104	Downstream	19/02/2015	34.3	390893	6103921	-	20	-	20	60	-
104	Lateral	19/02/2015	34.3	390894	6103924	-	20	-	20	60	-
104	Tag Location	03/03/2015	34.2	390971	6103877	45	50	-	-	5	-
104	Downstream	03/03/2015	34.2	390975	6103878	45	50	-	-	5	-
104	Lateral	03/03/2015	34.2	390974	6103882	45	50	-	-	5	-
105	Tag Location	20/02/2015	72.0	358820	6101950	-	5	15	30	50	-
105	Downstream	20/02/2015	72.0	358821	6101954	-	5	15	30	50	-
105	Lateral	20/02/2015	72.0	358823	6101950	-	-	-	-	-	-
105	Tag Location	04/03/2015	71.8	358862	6102051	-	-	10	15	75	-
105	Downstream	04/03/2015	71.8	358865	6102053	-	-	10	15	75	-
105	Lateral	04/03/2015	71.8	358863	6102048	-	-	10	15	75	-
106	Tag Location	17/02/2015	97.2	341721	6095121	-	-	-	20	60	20
106	Downstream	17/02/2015	97.2	341720	6095119	-	-	-	15	75	10
106	Lateral	17/02/2015	97.2	341721	6095118	5	-	10	25	40	20
106	Tag Location	04/03/2015	97.1	341762	6095025	-	-	5	5	85	5
106	Downstream	04/03/2015	97.1	341764	6095024	-	-	-	5	75	25
106	Lateral	04/03/2015	97.1	341761	6095025	-	-	5	5	85	5
107	Tag Location	17/02/2015	100.7	338877	6094148	5	-	5	15	35	40
107	Downstream	17/02/2015	100.7	338878	6094147	5	-	5	15	35	40
107	Lateral	17/02/2015	100.7	338876	6094150	5	-	5	15	35	40
107	Tag Location	04/03/2015	100.7	338902	6094162	-	5	5	10	50	30
107	Downstream	04/03/2015	100.7	338907	6094157	-	5	5	10	50	30
107	Lateral	04/03/2015	100.7	338901	6094160	-	-	5	5	50	40
112	Tag Location	19/02/2015	32.6	392318	6103179	20	35	-	5	40	-
112	Downstream	19/02/2015	32.6	392320	6103177	20	35	-	5	40	-
112	Lateral	19/02/2015	32.6	392318	6103183	20	35	-	5	40	-
113	Tag Location	18/02/2015	11.4	409629	6109392	2	8	20	30	40	-
113	Downstream	18/02/2015	11.4	409635	6109395	2	8	20	30	40	-
113	Lateral	18/02/2015	11.4	409630	6109397	2	8	20	30	40	-
113	Tag Location	05/03/2015	11.5	409477	6109266	-	-	20	20	60	-
113	Downstream	05/03/2015	11.5	409482	6109266	-	-	20	20	60	-
113	Lateral	05/03/2015	11.5	409480	6109263	-	-	20	20	60	-

Table 3. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: substrate composition

TagID	Hole	Date	River Km	Easting	Northing	Classification and Percentage Abundance					
						Clay/Silt	Sand	Sm. Gravel	Lg Gravel	Cobble	Boulder
116	Tag Location	18/02/2015	12.7	404409	6109479	-	20	10	20	50	-
116	Downstream	18/02/2015	12.7	404410	6109478	-	-	-	-	-	-
116	Lateral	18/02/2015	12.7	404409	6109481	-	-	-	-	-	-
116	Tag Location	05/03/2015	12.8	408322	6109506	-	10	10	20	60	-
116	Downstream	05/03/2015	12.8	408321	6109505	-	10	10	20	60	-
116	Lateral	05/03/2015	12.8	408320	6109505	-	10	10	20	60	-
117	Tag Location	19/02/2015	31.8	393178	6102941	5	5	10	10	70	-
117	Downstream	19/02/2015	31.8	393180	6102941	5	5	10	10	70	-
117	Lateral	19/02/2015	31.8	393178	6102937	5	5	10	10	70	-
117	Tag Location	03/03/2015	31.9	393072	6102974	-	5	15	40	40	-
117	Downstream	03/03/2015	31.9	393074	6102972	-	5	15	40	40	-
117	Lateral	03/03/2015	31.9	393072	6102970	-	5	15	40	40	-
119	Tag Location	19/02/2015	34.0	391084	6103642	-	5	15	20	60	-
119	Downstream	19/02/2015	34.0	391084	6103639	-	5	15	20	60	-
119	Lateral	19/02/2015	34.0	391085	6103639	-	20	-	30	50	-
119	Tag Location	03/03/2015	33.9	391138	6103586	45	45	-	-	10	-
119	Downstream	03/03/2015	33.9	391139	6103584	45	45	-	-	10	-
119	Lateral	03/03/2015	33.9	391141	6103590	45	45	-	-	10	-
120	Tag Location	18/02/2015	7.1	412468	6109974	-	20	10	10	60	-
120	Downstream	18/02/2015	7.1	412471	6109974	-	20	10	10	60	-
120	Lateral	18/02/2015	7.1	412468	6109981	-	20	10	10	60	-
120	Tag Location	05/03/2015	7.1	412451	6109937	-	-	10	10	80	-
120	Downstream	05/03/2015	7.1	412454	6109937	-	-	10	10	80	-
120	Lateral	05/03/2015	7.1	412450	6109938	-	-	10	10	80	-

Table 4. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: water quality parameters.

						Water Quality Parameters				
TagID	Hole	Date	River Km	Easting	Northing	Temp (°C)	DO (%)	DO (mg/L)	Sp. Cond (uS/cm)	pH
11	Tag Location	21/02/2015	20.9	402190	6105389	0	113.4	16.38	380	9.3
11	Downstream	21/02/2015	20.9	402190	6105393	-	-	-	-	-
11	Lateral	21/02/2015	20.9	402186	6105389	-	-	-	-	-
11	Tag Location	05/03/2015	21.0	402163	6105370	0	134.6	20.42	360	9.4
11	Downstream	05/03/2015	21.0	402165	6105372	-	-	-	-	-
11	Lateral	05/03/2015	21.0	402165	6105369	-	-	-	-	-
12	Tag Location	18/02/2015	4.0	413848	6112207	0.1	107.5	16.41	476	8.7
12	Downstream	18/02/2015	4.0	413849	6112210	-	-	-	-	-
12	Lateral	18/02/2015	4.0	413849	6112205	-	-	-	-	-
13	Tag Location	19/02/2015	34.1	390984	6103824	0.1	117.8	17.49	399	8.5
13	Downstream	19/02/2015	34.1	390987	6103819	-	-	-	-	-
13	Lateral	19/02/2015	34.1	390980	6103823	-	-	-	-	-
13	Tag Location	03/03/2015	34.1	390998	6103847	0.1	101.7	14.72	333	8.9
13	Downstream	03/03/2015	34.1	390998	6103842	-	-	-	-	-
13	Lateral	03/03/2015	34.1	390999	6103848	-	-	-	-	-
14	Tag Location	21/02/2015	17.7	405132	6106498	0.1	116.1	17.12	450	8.4
14	Downstream	21/02/2015	17.7	405133	6106497	-	-	-	-	-
14	Lateral	21/02/2015	17.7	405130	6106499	-	-	-	-	-
14	Tag Location	05/03/2015	17.4	405374	6106487	0	101.6	14.81	344	8.5
14	Downstream	05/03/2015	17.4	405377	6106489	-	-	-	-	-
14	Lateral	05/03/2015	17.4	405373	6106485	-	-	-	-	-
15	Tag Location	19/02/2015	33.7	391288	6103396	0.1	121.1	20.63	411	8.8
15	Downstream	19/02/2015	33.7	391292	6103389	-	-	-	-	-
15	Lateral	19/02/2015	33.7	391287	6103390	-	-	-	-	-
15	Tag Location	03/03/2015	33.7	391295	6103386	0	101.5	14.8	480	9.2
15	Downstream	03/03/2015	33.7	391296	6103383	-	-	-	-	-
15	Lateral	03/03/2015	33.7	391293	6103382	-	-	-	-	-
16	Tag Location	03/03/2015	33.8	391201	6103503	0.1	103.7	15.18	323	8.9
16	Downstream	03/03/2015	33.8	391202	6103502	-	-	-	-	-
16	Lateral	03/03/2015	33.8	391199	6103503	-	-	-	-	-
18	Tag Location	19/02/2015	33.7	391278	6103407	0.3	115.5	16.83	403	8.1
18	Downstream	19/02/2015	33.7	391277	6103407	-	-	-	-	-
18	Lateral	19/02/2015	33.7	391274	6103407	-	-	-	-	-
18	Tag Location	03/03/2015	33.8	391241	6103431	0.1	103.7	15.41	411	8.6
18	Downstream	03/03/2015	33.8	391241	6103429	-	-	-	-	-
18	Lateral	03/03/2015	33.8	391238	6103430	-	-	-	-	-

Table 4. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: water quality parameters.

						Water Quality Parameters				
TagID	Hole	Date	River Km	Easting	Northing	Temp (°C)	DO (%)	DO (mg/L)	Sp. Cond (uS/cm)	pH
19	Tag Location	19/02/2015	33.8	391230	6103486	0.1	119.3	17.61	401	8.7
19	Downstream	19/02/2015	33.8	391236	6103485	-	-	-	-	-
19	Lateral	19/02/2015	33.8	391233	6103485	-	-	-	-	-
19	Tag Location	03/03/2015	33.7	391304	61033	0.1	103.6	15.2	433	8.7
19	Downstream	03/03/2015	33.7	391306	6103374	-	-	-	-	-
19	Lateral	03/03/2015	33.7	391304	6103377	-	-	-	-	-
20	Tag Location	20/02/2015	33.5	391547	6103614	0.1	115.9	17	354	8.3
20	Downstream	20/02/2015	33.5	391549	6103609	-	-	-	-	-
20	Lateral	20/02/2015	33.5	391549	6103615	-	-	-	-	-
23	Tag Location	19/02/2015	35.8	389740	6104783	1.1	113.6	16.52	399	9.1
23	Downstream	19/02/2015	35.8	389746	6104785	-	-	-	-	-
23	Lateral	19/02/2015	35.8	389742	6104790	-	-	-	-	-
23	Tag Location	03/03/2015	35.8	389738	6104787	0	90.3	13.1	332	8.8
23	Downstream	03/03/2015	35.8	389739	6104781	-	-	-	-	-
23	Lateral	03/03/2015	35.8	389740	6104784	-	-	-	-	-
24	Tag Location	05/03/2015	22.5	401146	6104255	0.1	145.9	20.5	474	8.4
24	Downstream	05/03/2015	22.5	401149	6104255	-	-	-	-	-
24	Lateral	05/03/2015	22.5	401144	6104255	-	-	-	-	-
27	Tag Location	05/03/2015	11.7	409322	6109152	0.2	100.5	14.74	525	9
27	Downstream	05/03/2015	11.7	409327	6109159	-	-	-	-	-
27	Lateral	05/03/2015	11.7	409322	6109154	-	-	-	-	-
28	Tag Location	20/02/2015	33.6	391376	6103327	0	115.3	16.77	357	9.1
28	Downstream	20/02/2015	33.6	391379	6103325	-	-	-	-	-
28	Lateral	20/02/2015	33.6	391375	6103325	-	-	-	-	-
28	Tag Location	03/03/2015	34.0	391053	6103672	0.1	102.8	15.04	386	8.5
28	Downstream	03/03/2015	34.0	391055	6103665	-	-	-	-	-
28	Lateral	03/03/2015	34.0	391052	6103668	-	-	-	-	-
29	Tag Location	20/02/2015	33.7	391297	6103379	0.1	117.1	17.45	407	8.3
29	Downstream	20/02/2015	33.7	391300	6103379	-	-	-	-	-
29	Lateral	20/02/2015	33.7	391296	6103379	-	-	-	-	-
102	Tag Location	18/02/2015	17.4	405366	6106492	0.1	100.7	15.03	461	8.6
102	Downstream	18/02/2015	17.4	405368	6106492	-	-	-	-	-
102	Lateral	18/02/2015	17.4	405366	6106486	-	-	-	-	-
102	Tag Location	05/03/2015	17.3	405524	6106541	0.1	100.5	14.77	420	9.2
102	Downstream	05/03/2015	17.3	405526	6106540	-	-	-	-	-
102	Lateral	05/03/2015	17.3	405524	6106542	-	-	-	-	-

Table 4. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: water quality parameters.

						Water Quality Parameters				
TagID	Hole	Date	River Km	Easting	Northing	Temp (°C)	DO (%)	DO (mg/L)	Sp. Cond (uS/cm)	pH
103	Tag Location	03/03/2015	34.2	390935	6103888	0.1	122.4	17.8	297	10.4
103	Downstream	03/03/2015	34.2	390937	6103886	-	-	-	-	-
103	Lateral	03/03/2015	34.2	390934	6103884	-	-	-	-	0
104	Tag Location	19/02/2015	34.3	390890	6103925	0.6	116.8	16.3	377	8.4
104	Downstream	19/02/2015	34.3	390893	6103921					
104	Lateral	19/02/2015	34.3	390894	6103924					
104	Tag Location	03/03/2015	34.2	390971	6103877	0	103.1	15.14	394	8.4
104	Downstream	03/03/2015	34.2	390975	6103878	-	-	-	-	-
104	Lateral	03/03/2015	34.2	390974	6103882	-	-	-	-	-
105	Tag Location	20/02/2015	72.0	358820	6101950	0.1	115.6	16.69	366	8.5
105	Downstream	20/02/2015	72.0	358821	6101954	-	-	-	-	-
105	Lateral	20/02/2015	72.0	358823	6101950	-	-	-	-	-
105	Tag Location	04/03/2015	71.8	358862	6102051	0.1	71	10.3	280	8.9
105	Downstream	04/03/2015	71.8	358865	6102053	-	-	-	-	-
105	Lateral	04/03/2015	71.8	358863	6102048	-	-	-	-	-
106	Tag Location	17/02/2015	97.2	341721	6095121	0	120.4	17.36	354	9.2
106	Downstream	17/02/2015	97.2	341720	6095119		-	-	-	-
106	Lateral	17/02/2015	97.2	341721	6095118		-	-	-	-
106	Tag Location	04/03/2015	97.1	341762	6095025	0.1	103.5	15.12	413	8.5
106	Downstream	04/03/2015	97.1	341764	6095024	-	-	-	-	-
106	Lateral	04/03/2015	97.1	341761	6095025	-	-	-	-	-
107	Tag Location	17/02/2015	100.7	338877	6094148	0	119.6	14.51	355	9.6
107	Downstream	17/02/2015	100.7	338878	6094147	-	-	-	-	-
107	Lateral	17/02/2015	100.7	338876	6094150	-	-	-	-	-
107	Tag Location	04/03/2015	100.7	338902	6094162	0.1	103.5	15.12	375	8.9
107	Downstream	04/03/2015	100.7	338907	6094157	-	-	-	-	-
107	Lateral	04/03/2015	100.7	338901	6094160	-	-	-	-	-
112	Tag Location	19/02/2015	32.6	392318	6103179	0.1	119.2	17.49	398	8.8
112	Downstream	19/02/2015	32.6	392320	6103177	-	-	-	-	-
112	Lateral	19/02/2015	32.6	392318	6103183	-	-	-	-	-
113	Tag Location	18/02/2015	11.4	409629	6109392	0	97.9	14.3	455	8.8
113	Downstream	18/02/2015	11.4	409635	6109395	-	-	-	-	-
113	Lateral	18/02/2015	11.4	409630	6109397	-	-	-	-	-
113	Tag Location	05/03/2015	11.5	409477	6109266	0.1	99.7	14.4	553	8.2
113	Downstream	05/03/2015	11.5	409482	6109266	-	-	-	-	-
113	Lateral	05/03/2015	11.5	409480	6109263	-	-	-	-	-

Table 4. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: water quality parameters.

						Water Quality Parameters				
TagID	Hole	Date	River Km	Easting	Northing	Temp (°C)	DO (%)	DO (mg/L)	Sp. Cond (uS/cm)	pH
116	Tag Location	18/02/2015	12.7	404409	6109479	0.1	105.2	14.55	451	8.3
116	Downstream	18/02/2015	12.7	404410	6109478	-	-	-	-	-
116	Lateral	18/02/2015	12.7	404409	6109481	-	-	-	-	-
116	Tag Location	05/03/2015	12.8	408322	6109506	0.1	101.1	14.69	524	8.3
116	Downstream	05/03/2015	12.8	408321	6109505	-	-	-	-	-
116	Lateral	05/03/2015	12.8	408320	6109505	-	-	-	-	-
117	Tag Location	19/02/2015	31.8	393178	6102941	0.1	118.6	16.97	356	8.2
117	Downstream	19/02/2015	31.8	393180	6102941	-	-	-	-	-
117	Lateral	19/02/2015	31.8	393178	6102937	-	-	-	-	-
117	Tag Location	03/03/2015	31.9	393072	6102974	0.1	93.1	13.74	415	9
117	Downstream	03/03/2015	31.9	393074	6102972	-	-	-	-	-
117	Lateral	03/03/2015	31.9	393072	6102970	-	-	-	-	-
119	Tag Location	19/02/2015	34.0	391084	6103642	0.1	122	17.14	401	8.2
119	Downstream	19/02/2015	34.0	391084	6103639	-	-	-	-	-
119	Lateral	19/02/2015	34.0	391085	6103639	-	-	-	-	-
119	Tag Location	03/03/2015	33.9	391138	6103586	-	-	-	-	-
119	Downstream	03/03/2015	33.9	391139	6103584	0.1	103.8	15.11	311	8.7
119	Lateral	03/03/2015	33.9	391141	6103590	-	-	-	-	-
120	Tag Location	18/02/2015	7.1	412468	6109974	0	109.8	15.75	441	8.5
120	Downstream	18/02/2015	7.1	412471	6109974	-	-	-	-	-
120	Lateral	18/02/2015	7.1	412468	6109981	-	-	-	-	-
120	Tag Location	05/03/2015	7.1	412451	6109937	0.2	99.2	14.55	510	8.8
120	Downstream	05/03/2015	7.1	412454	6109937	-	-	-	-	-
120	Lateral	05/03/2015	7.1	412450	6109938	-	-	-	-	-

Notes:
1) DO = dissolved oxygen measured in percent saturation (%) and concentration (mg/L)
2) Sp. Cond = Specific conductance (i.e. conductivity corrected for temperature effects)

Table 5. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: field observations.

TagID	Hole	Date	River Km	Easting	Northing	Field Observations
11	Tag Location	21/02/2015	20.9	402190	6105389	Mid channel fish 29 is just US. Couldn't get - too much interference
11	Downstream	21/02/2015	20.9	402190	6105393	
11	Lateral	21/02/2015	20.9	402186	6105389	
11	Tag Location	05/03/2015	21.0	402163	6105370	5cm snow, straight stretch, DS of side bar, mid channel, 50 m DS of last hole
11	Downstream	05/03/2015	21.0	402165	6105372	
11	Lateral	05/03/2015	21.0	402165	6105369	
12	Tag Location	18/02/2015	4.0	413848	6112207	About 20m from LB, erodible sidebar nearby, possible bar nearby DS of large island about 300m lon sweaping outside bend. Lateral hole forwards midstream large woody debris, banks are all fines - less cobble - substrate feels like fines
12	Downstream	18/02/2015	4.0	413849	6112210	Measure @ 50% depth unable to record velocity at 80% due to slush and frazil ice
12	Lateral	18/02/2015	4.0	413849	6112205	
13	Tag Location	19/02/2015	34.1	390984	6103824	Close to RB about 100m DS of bridge/ Magoo's - glide section - possible lateral bar on RB
13	Downstream	19/02/2015	34.1	390987	6103819	
13	Lateral	19/02/2015	34.1	390980	6103823	
13	Tag Location	03/03/2015	34.1	390998	6103847	Near Magoo's, DS of 104 and 103 water turbid in holes. No DO - frozen
13	Downstream	03/03/2015	34.1	390998	6103842	Velocity at hole #1 and #2 at 10 cm below ice was taken through slush
13	Lateral	03/03/2015	34.1	390999	6103848	
14	Tag Location	21/02/2015	17.7	405132	6106498	Just US of 102 - 102 is still in same area, On left hand side of channel, eroding bank, straight glide section
14	Downstream	21/02/2015	17.7	405133	6106497	
14	Lateral	21/02/2015	17.7	405130	6106499	
14	Tag Location	05/03/2015	17.4	405374	6106487	10 m DS of last hole, Mid Channel, Wolf peed on last hole, Straight stretch, 10cm snow hard packed
14	Downstream	05/03/2015	17.4	405377	6106489	
14	Lateral	05/03/2015	17.4	405373	6106485	
15	Tag Location	19/02/2015	33.7	391288	6103396	18 + 15 close together just DS of 18 same conditions adjacent to island, on transition between fast and slow area mid channel glide
15	Downstream	19/02/2015	33.7	391292	6103389	
15	Lateral	19/02/2015	33.7	391287	6103390	
15	Tag Location	03/03/2015	33.7	391295	6103386	Mid channel, Right by fish 19
15	Downstream	03/03/2015	33.7	391296	6103383	
15	Lateral	03/03/2015	33.7	391293	6103382	
16	Tag Location	03/03/2015	33.8	391201	6103503	Mid Channel, depositional area
16	Downstream	03/03/2015	33.8	391202	6103502	
16	Lateral	03/03/2015	33.8	391199	6103503	

Table 5. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: field observations.

TagID	Hole	Date	River Km	Easting	Northing	Field Observations
18	Tag Location	19/02/2015	33.7	391278	6103407	18 + 15 close together just DS of 19 same conditions, mid channel feels like fines, substrate OM observed inside bend depositional adjacent to island glide
18	Downstream	19/02/2015	33.7	391277	6103407	
18	Lateral	19/02/2015	33.7	391274	6103407	
18	Tag Location	03/03/2015	33.8	391241	6103431	Mid channel - shallow island
18	Downstream	03/03/2015	33.8	391241	6103429	
18	Lateral	03/03/2015	33.8	391238	6103430	
19	Tag Location	19/02/2015	33.8	391230	6103486	On mainstem with island, mid channel, shallow, glide section DS can see cobbles? Spring? About 100m DS
19	Downstream	19/02/2015	33.8	391236	6103485	
19	Lateral	19/02/2015	33.8	391233	6103485	
19	Tag Location	03/03/2015	33.7	391304	61033	Just DS of 15. Mid Channel. DO Values for March 3rd questionable as meter froze in morning. Snow Pack 10cm. Some large cobbles
19	Downstream	03/03/2015	33.7	391306	6103374	
19	Lateral	03/03/2015	33.7	391304	6103377	
20	Tag Location	20/02/2015	33.5	391547	6103614	Side Channel trib on left side of river island, Possible outflow from Weyerhaueser. Shale bank, mid channel, fresh firm under silt, ~40m acrage
20	Downstream	20/02/2015	33.5	391549	6103609	
20	Lateral	20/02/2015	33.5	391549	6103615	
23	Tag Location	19/02/2015	35.8	389740	6104783	Just at end of open water section - can't do fish above this - closer to RB on inside of bend - possibly lateral bar along RB - not much cobble or LWD - glide section - small wood debris under ice
23	Downstream	19/02/2015	35.8	389746	6104785	
23	Lateral	19/02/2015	35.8	389742	6104790	
23	Tag Location	03/03/2015	35.8	389738	6104787	Close to open water - same spot as last time - dead? Very shallow
23	Downstream	03/03/2015	35.8	389739	6104781	
23	Lateral	03/03/2015	35.8	389740	6104784	
24	Tag Location	05/03/2015	22.5	401146	6104255	Straight Stretch before bend, Mid Channel, DS of open riffle the end didn't do this fish before shallow, 5cm snow
24	Downstream	05/03/2015	22.5	401149	6104255	
24	Lateral	05/03/2015	22.5	401144	6104255	
27	Tag Location	05/03/2015	11.7	409322	6109152	Near RB - eroded bank, slight bend outside - at end of straight stretch
27	Downstream	05/03/2015	11.7	409327	6109159	
27	Lateral	05/03/2015	11.7	409322	6109154	
28	Tag Location	20/02/2015	33.6	391376	6103327	DS of 15,18 + 119, Yesterday fish 15, 18 + 119 nearby island adjacent, mid channel
28	Downstream	20/02/2015	33.6	391379	6103325	
28	Lateral	20/02/2015	33.6	391375	6103325	
28	Tag Location	03/03/2015	34.0	391053	6103672	Near right bank, island in channel. Faster velocity
28	Downstream	03/03/2015	34.0	391055	6103665	
28	Lateral	03/03/2015	34.0	391052	6103668	

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TagID	Hole	Date	River Km	Easting	Northing	Field Observations
29	Tag Location	20/02/2015	33.7	391297	6103379	Hole marked the location of this fish yesterday - did not sample. Not in area today. Near 28, 15, 119, 18 fish same - mid channel
29	Downstream	20/02/2015	33.7	391300	6103379	
29	Lateral	20/02/2015	33.7	391296	6103379	
102	Tag Location	18/02/2015	17.4	405366	6106492	Mid Channel, really long glide section not much for woody debris - banks - fine
102	Downstream	18/02/2015	17.4	405368	6106492	
102	Lateral	18/02/2015	17.4	405366	6106486	
102	Tag Location	05/03/2015	17.3	405524	6106541	Mid Channel, Straight stretch long, 10 cm snow, surface current, open riffle just us
102	Downstream	05/03/2015	17.3	405526	6106540	
102	Lateral	05/03/2015	17.3	405524	6106542	
103	Tag Location	03/03/2015	34.2	390935	6103888	Near right bank
103	Downstream	03/03/2015	34.2	390937	6103886	
103	Lateral	03/03/2015	34.2	390934	6103884	
104	Tag Location	19/02/2015	34.3	390890	6103925	About 10m from RB Magoo's Launch - About 30m DS of bridge - first hole may be back eddy - lots of slush in holes
104	Downstream	19/02/2015	34.3	390893	6103921	
104	Lateral	19/02/2015	34.3	390894	6103924	
104	Tag Location	03/03/2015	34.2	390971	6103877	DS of 103, mid channel really turbid in holes couldn't do DO/Cond - Frozen
104	Downstream	03/03/2015	34.2	390975	6103878	Velocity at hole #3 at 10 cm below ice was taken through slush
104	Lateral	03/03/2015	34.2	390974	6103882	
105	Tag Location	20/02/2015	72.0	358820	6101950	Upstream of island adjacent to bar on right hand side of braid to side, on edge of large island and mid bar, big long glide - uniform LB. LwD + log jams DS + US RB
105	Downstream	20/02/2015	72.0	358821	6101954	
105	Lateral	20/02/2015	72.0	358823	6101950	
105	Tag Location	04/03/2015	71.8	358862	6102051	Closer to LB/ Island Eroding, 5cm of snow, Straight stretch
105	Downstream	04/03/2015	71.8	358865	6102053	
105	Lateral	04/03/2015	71.8	358863	6102048	
106	Tag Location	17/02/2015	97.2	341721	6095121	No frazil ice - solid, Elk tracks, Drilled lateral hole to bank - no water (shallow drilled towards center) Outside bend eroding banks, Gravel + cobbles in banks, bank vertical, Channel width about 70m
106	Downstream	17/02/2015	97.2	341720	6095119	
106	Lateral	17/02/2015	97.2	341721	6095118	
106	Tag Location	04/03/2015	97.1	341762	6095025	Near left bank, Dirty water, 2cm snow, Mid Channel
106	Downstream	04/03/2015	97.1	341764	6095024	
106	Lateral	04/03/2015	97.1	341761	6095025	

Table 5. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: field observations.

TagID	Hole	Date	River Km	Easting	Northing	Field Observations
107	Tag Location	17/02/2015	100.7	338877	6094148	Large woody debris on shore within 5 m of eroding bank, Recorded 3x on camera
107	Downstream	17/02/2015	100.7	338878	6094147	
107	Lateral	17/02/2015	100.7	338876	6094150	
107	Tag Location	04/03/2015	100.7	338902	6094162	Near left bank, onsight stretch, 10cm snow, eroding bank deep
107	Downstream	04/03/2015	100.7	338907	6094157	
107	Lateral	04/03/2015	100.7	338901	6094160	
112	Tag Location	19/02/2015	32.6	392318	6103179	Mid Channel, DS - flooded 500m from intake, LWD on LB
112	Downstream	19/02/2015	32.6	392320	6103177	
112	Lateral	19/02/2015	32.6	392318	6103183	
113	Tag Location	18/02/2015	11.4	409629	6109392	Mid Channel to RB side a bit - very shallow @ hole - a few SWD downhole
113	Downstream	18/02/2015	11.4	409635	6109395	
113	Lateral	18/02/2015	11.4	409630	6109397	
113	Tag Location	05/03/2015	11.5	409477	6109266	Mid Channel, 5 cm Snow, Straight stretch
113	Downstream	05/03/2015	11.5	409482	6109266	
113	Lateral	05/03/2015	11.5	409480	6109263	
116	Tag Location	18/02/2015	12.7	404409	6109479	In left stem - island main stem - hard to find fish - open water 300m DS
116	Downstream	18/02/2015	12.7	404410	6109478	
116	Lateral	18/02/2015	12.7	404409	6109481	
116	Tag Location	05/03/2015	12.8	408322	6109506	5 cm snow, Mid Channel, DS of high flood section, Frazil ice on top in some parts
116	Downstream	05/03/2015	12.8	408321	6109505	
116	Lateral	05/03/2015	12.8	408320	6109505	
117	Tag Location	19/02/2015	31.8	393178	6102941	Closest to RB - glide section and end of glide eroding RB few LWD - pretty wide channel
117	Downstream	19/02/2015	31.8	393180	6102941	
117	Lateral	19/02/2015	31.8	393178	6102937	
117	Tag Location	03/03/2015	31.9	393072	6102974	Mid Channel, 20 cm snow here, Long straight stretch, Deeper here
117	Downstream	03/03/2015	31.9	393074	6102972	Velocity at hole #1,2,3 at 80% of depth and at 10 cm below ice was taken through slush beneath ice
117	Lateral	03/03/2015	31.9	393072	6102970	
119	Tag Location	19/02/2015	34.0	391084	6103642	Main stem with island on right side near righ bank about 30m - fast surface velocity - whirpool - glide habitat - uniform section of habitat - no LWD on shore
119	Downstream	19/02/2015	34.0	391084	6103639	
119	Lateral	19/02/2015	34.0	391085	6103639	
119	Tag Location	03/03/2015	33.9	391138	6103586	Near right bank, island instream. On island LB - exposed
119	Downstream	03/03/2015	33.9	391139	6103584	
119	Lateral	03/03/2015	33.9	391141	6103590	

Table 5. Microhabitat data collected during ground surveys between February 17 and March 5, 2015: field observations.

TagID	Hole	Date	River Km	Easting	Northing	Field Observations
120	Tag Location	18/02/2015	7.1	412468	6109974	More mid Channel about 50m from LB - less ice - Lateral hole towards LB eroding bank on LB
120	Downstream	18/02/2015	7.1	412471	6109974	
120	Lateral	18/02/2015	7.1	412468	6109981	
120	Tag Location	05/03/2015	7.1	412451	6109937	Straight Stretch, Sidebar on RB, Snow 10 cm
120	Downstream	05/03/2015	7.1	412454	6109937	
120	Lateral	05/03/2015	7.1	412450	6109938	

ATTACHMENT 4. DIGITAL DATA

- Raw telemetry files
- Individual fish data
- Raw microhabitat data
- Shapefiles with metadata
- Photographs