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C-1.0 INTRODUCTION

This appendix presents the fish and fish habitat data collected concurrently with the collection of hydrometric data during the 2019 field study as part of the evaluation of Rascal Stream and the Rascal Stream watershed for the Back River Project (the Project). The primary task of the 2019 study was to survey fish habitat conditions during spring flows at the newly constructed bridge crossing over the lower reach (Reach 1) of Rascal Stream West (RSW), also referred to as Gander Pond Outflow.

The 2019 study of fish habitat conditions collected environmental data on the following:

- Dominant habitat types and habitat quality for Arctic Grayling in RSW Reach 1
- Physical dimensions and composition substrate of each habitat unit
- Nephelometric turbidity unit (NTUs) measurements
- Photographs of delineated habitat units and potential barriers to fish movements

The 2019 field study also collected supplemental hydrological measurements on spring flow conditions upstream of the newly construction bridge crossing to inform the evaluation of water management options related to the airstrip expansion. Hydrometric data are summarized in Appendix A of the 'Rascal Stream Fishway Hydrotechnical Assessment'.

C-2.0 RASCAL STREAM WEST - FISH HABITAT

A detailed fish habitat survey was completed at the bridge crossing on Rascal Stream West Reach 1 (RSW1) on 20 June 2019. The survey covered a 405-m section of stream extending from the outlet of Gander Pond (310 m upstream of the bridge crossing) to the confluence with Goose Lake (95 m downstream of the bridge crossing). Instream habitat was classified into distinct habitat units, corresponding to areas of similar habitat type as defined in O'Neil and Hildebrand (1986). Measurements of the physical dimensions at each habitat unit included wetted width, channel length, bank-full width and water depth. Composition substrate (based on Wentworth scale) and availability of instream cover were visually estimated as a percentage of the total area within each habitat unit. Left and right downstream bank (LDB and RDB) stability, fish habitat potential, and potential barriers to fish movement were recorded and documented by photographs. Nephelometric turbidity units (NTUs) were measured within the survey area using a LaMotte 2020; six measurements were taken downstream of the bridge crossing, one at the bridge crossing, and one measurement at a reference location upstream of the bridge crossing (locations are reported in (Table C-1). Additional *in situ* water quality variables that were measured at the bridge crossing included temperature (°C), conductivity (µS/cm), and pH. A scoping level visual assessment of a previously undescribed secondary outflow channel was also completed; the secondary channel was a 318 m section from Gander Pond to Goose Lake (Figure A-1 in Appendix A).

Table C-1: Rascal Stream West reach 1 Turbidity Measurements, 20 June 2019

Site	UTM Coordinates (13V NAD83)		NTU #1	NTU #2	NTU #3	Average
	Easting	Northing				
10 m upstream of crossing ^(a)	432845	7270046	0.4	0.43	0.42	0.42
At crossing	432844	7270064	0.45	0.51	0.45	0.47
10 m downstream of crossing	432839	7270072	0.34	0.33	0.35	0.34
RSW1 downstream	432824	7270098	0.47	0.44	0.49	0.47
RSW1/Goose Lake Confluence	432807	7270141	0.57	0.56	0.60	0.58
Goose Lake Downstream	432748	7270123	0.45	0.44	0.46	0.45
Goose Lake Downstream	432748	7270123	0.57	0.63	0.49	0.56
Goose Lake Downstream	432748	7270123	0.86	0.65	0.65	0.72

(a) Control site; all sites compared to this site.

Note: No exceedances were noted.

UTM = Universal Transverse Mercator; NTU = Nephelometric Turbidity Unit; - = not applicable.

Based on the habitat assessment, RSW1 was described as a small permanent watercourse with a neutral channel form, well-defined banks, and unconfined by valley walls. Riparian vegetation was dominated by shrubs and grasses with small areas of bare ground noted around the bridge crossing. The watercourse was in a flooded condition during the survey assessment with observations of flows over the stream banks at numerous locations (e.g., Photo C-8). Calculated discharge at the time of the survey was 2.66 m³/s. Water temperature was 3.6 °C, conductivity was 33 microseimens per centimetre (µs/cm), and pH was 5.60 at the time of the assessment. There were no obvious upstream-downstream trends in turbidity (NTU) values, which ranged from 0.34 to 0.72.

Four habitat types were present in RSW1: run, riffle, pool and cascade. The surveyed reach is suitable to provide low to moderate spawning and rearing habitat for Arctic Grayling. The detailed habitat data of the survey reach is provided in Table C-2.

Upstream of the crossing, four habitat types were present; shallow depth (<0.5 m) run, riffle, pool and cascade habitats. The stream gradient changed from a flat channel with confined flows near the Gander Pond outlet to a moderate gradient where high velocities were observed near the crossing (Photo C-8). Mean maximum water depths ranged from 0.45 m to approximately 1 m, mean wetted width ranged from 3.5 to 29 m, and bank-full width ranged from 6 to 29 m. Substrate was dominated by sand and gravel with smaller portions of cobble, boulder, and organics. Instream cover was dominated by depth and turbulence in the channel centres and submerged riparian vegetation along the banks. Stable, fully vegetated channel banks were present throughout most of the reach. A small, isolated bank area of slumping was noted in the cascade section. There is a 0.7 m drop in height at a location within the cascade section that may act as a potential barrier to upstream movements of fish during lower flows.

The bridge crossing was located over a riffle habitat unit with constricted flows and relatively high velocities (Photo C-9). Mean maximum water depth was 0.45 m, with a mean bankfull and wetted width of 2.5 m. Substrate was dominated by sand and gravel with patches of cobble in the channel centre. Instream cover was limited to depth and turbulence and patches of submerged riparian vegetation along the banks. Channel banks were partially vegetated and stabilized by boulder armouring with no visible signs of erosion. Bank height at the left downstream bank was 0.7 m and right downstream bank was 0.6 m, respectively.

Three habitat types were present downstream of the crossing: run, riffle, and pool (Photo C-10). The reach had a downward sloping gradient causing high velocities with flooding over the lower downstream bank (Photo C-11). Mean maximum water depth ranged from 0.04 to 0.7 m, wetted width ranged from 3.5 to 27 m, and bank-full width ranged from 4.5 to 27 m. Substrate was dominated by sand and gravel with smaller portions of cobble, and boulder. Instream cover was dominated by depth and turbulence in the channel centres and submerged riparian vegetation along the banks. The channel banks were fully vegetated, well-defined and stable with no noted erosion. A steep drop with a height of 0.55 m, located near Goose lake Inflow, may act as a potential barrier to fish movement under lower flows.

The Gander Pond outflow secondary channel was a small intermittent watercourse with defined banks and channelized, low flows (Photo C-12). This watercourse may dry completely after the spring freshet is complete. Average water depth was 0.2 m, with an average wetted width of less than 1 m. Upstream of the bridge crossing, substrate was dominated by cobble and boulders. Bank vegetation consisted of low-lying grass and sparse patches of shrubs. Downstream of the bridge crossing, predominate substrate was fines with patches of gravel. Instream cover included submerged and overhanging vegetation. Bank vegetation consisted mainly of shrubs.

2019

Table C-2: Rascal Stream West Reach 1 Habitat Assessment, 20 June 2019

(^a) Drop barrier (Height = 0.55 m; Length = 2.0 m; Width = 2.2 m); (^b) Drop barrier (Height = 0.7 m; Length = 2.0 m; Width = 1.5 m); (^c) D = Downstream; R = Right-of-way; C = centre line; U =

ID#	Habitat Unit Location (^c)	Habitat Unit Type (^d)	Unit Length (m)	Water Depth (m)			Wetted Width (m)			Bank-full Width (m)			Substrate (% area)					Instream Cover (% area)				
				Max	Mean Max	ΔB-W	Min	Max	Mean	Min	Max	Mean	Or	Sa	Gr	Co	Bo	SU	WD	D/T	SRV	OV
33	D	R3	31	0.46	0.04	0.04	2	37	27	2*	37	27	-	80	14	1	5	-	2	15	5	4
34(^a)	D	RF	9	0.48	0.30	0.04	12	15	13	12*	15	13	-	85	15	-	-	-	2	20		3
36	D	P3	10	0.65	0.45	0.40	7	9	8	7*	9	8	-	90	10	-	-	-	7	5	3	5
35	D	R3	6	0.54	0.48	0.50	6	8	7	9*	11	8	-	85	12	3		-	3	2	5	3
37	D	P2	8	1.00	0.70	0.50	2	7	5	4*	11	9	-	95	5	-	-	-	5	40	2	-
38	D	R2	12	0.66	0.57	0.20	3	4	3.5	4	5	4.5	-	85	13	2		-	1	-	15	1
39	R	R2	15	0.76	0.68	0.25	4	6	5	4	6.5	5.5	-	90	10	-	-	-	-	-	30	-
40	C	RF	8	0.76	0.45	0.15	2	3	2.5	2	3	2.5	-	80	15	5	-	-	-	10	7	-
41	R	R3	15	0.6	0.50	0.30	3	5	4	13	16	14	-	75	15	10	-	3	-	15	7	5
42	U	RF	9	0.54	0.50	0.30	3	4	3.5	14*	15	14.5	-	60	15	10	5	3	-	15	-	3
44	U	R3	12	0.56	0.48	0.70	8	9	8	16*	17	16	-	85	12	3	-	-	4	3	5	3
45	U	CA	29	0.72	0.55	0.20	8	10	9	11*	13	12	-	55	23	15	7	5	5	5	2	3
48	U	RF	43	0.60	0.50	0	26	34	29	26*	34	29	-	60	20	18	2	3	5	3	2	2
50(^b)	U	R3	120	0.60	0.52	0	3	37	11	3*	37	11	5	55	25	3	2	2	5	10	7	5
56	U	P2	6	1.00	0.90	0.30	5	7	6	5	7	6	-	80	10	5	5	5	-	10	3	2
58	U	R3	72	0.62	0.45	0.20	3	34	10	4	36	10	10	85	5	-	-	-	3	-	20	3

upstream; (^d) R3 = Run 3 is a shallow (<0.75 m deep) moderate velocity area with low instream cover; RF = Riffle is a shallow (<0.5 m deep), high velocity and gradient area dominated by coarse substrate; P3 = Pool 3 is a shallow (<1.0 m deep) low velocity area with low instream cover, not suitable for overwintering; P2 = Pool 2 is 1.0 – 1.5 m deep, low velocity area with high to moderate instream cover and low suitability for overwintering habitat; R2 = Run 2 is 0.75 – 1.0 m deep, moderate to high velocity area with moderate to high instream cover; CA = cascade is a extremely high gradient and velocity area with broken water surface but may be passable to fish; notes: ΔB-W = difference between bank and water; Or = organic; Sa = sand; Gr = gravel; Co = cobble; Bo = boulder; SU = substrate; WD = woody debris; D/T = depth/turbulence; SRV = submerged riparian vegetation; OV = overhanging vegetation; - = not applicable; * = flooding observed over banks



Photo C-1: View upstream towards discharge location at RS6 (20 June 2019).



Photo C-2: View downstream towards discharge location along main channel section at RS5 (21 June 2019).



Photo C-3: View downstream towards discharge location at RS7 (21 June 2019).



Photo C-4: View upstream towards discharge location at RSE4 (20 June 2019).



Photo C-5: View downstream towards discharge location at MGPS3 (21 June 2019).



Photo C-6: View downstream towards discharge location at RSW3 (20 June 2019).



Photo C-7: View downstream towards discharge location at RWS1 (20 June 2019).



Photo C-8: View of flooded area upstream of bridge crossing in riffle habitat at RSW1 (20 June 2019).



Photo C-9: View downstream towards bridge crossing in riffle habitat at RSW1 (20 June 2019).



Photo C-10: View upstream towards bridge crossing at Run 2 habitat type at RSW1 (20 June 2019).



Photo C-11: View of flooded area downstream of bridge crossing in riffle habitat at RSW1 (20 June 2019).



Photo C-12: Gander Pond outlet side channel downstream of bridge looking downstream (20 June 2019).

C-3.0 REFERENCES

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