Appendix C3

Report: *All-Weather Private Access Road (AWPAR) Fisheries Monitoring Report - 2008, Meadowbank Gold Project*

All-Weather Private Access Road (AWPAR) Fisheries Monitoring Report – 2008

Meadowbank Gold Project

Prepared for

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ACKNOWLEDGEMENTS

We gratefully thank Agnico Eagle Meadowbank Division, Vancouver, for their support of the 2008 study.

A number of people assisted with the data collection. Field studies were managed and conducted by Mr. Joe Mota and Ms. Yhana Michaluk of North/South Consultants, Winnipeg. Field assistance was provided by Mr. Kenny Avala and Mr. Derek Mikkunguwak, both of Baker Lake.

Randy Baker authored this report with review/editing by Gary Mann. Rachel Gould (AEM) also reviewed the report.

EXECUTIVE SUMMARY

This report summarizes results of the fisheries-related monitoring conducted by Azimuth Consulting Group (Azimuth) in 2008 along the All-Weather Private Access Road (AWPAR) between Baker Lake and the Meadowbank Project. The work was conducted on behalf of Agnico-Eagle Mines (AEM) to meet the requirements of the DFO *Fisheries Act* Authorization (S-08/09-1040-NU) that primarily targets stream crossings where bridge abutments encroached into stream channels. In such cases, these installations caused a 'harmful alteration, disruption or destruction of fish habitat', or HADD. Azimuth has been monitoring movements of fish along the AWPAR route since 2005. Since construction of the AWPAR started in 2007, monitoring, as per the requirements of the Authorization, has focused on determining whether Arctic grayling movements or migrations have been constrained by any of the HADD bridges and on collecting baseline information on Arctic grayling spawning productivity at Bridge R02, in advance of constructing habitat compensation.

The DFO authorization for AWPAR requires that the following components be addressed by field studies during spring migrations by fish:

- Fish passage past bridges
- Success of compensation features
- Catch results from a creel survey

Stability of crossing structures (i.e., bridges and culverts) and the future habitat compensation feature is the purview of AEM and is reported separately.

Fish Passage

AWPAR monitoring was carried out using hoop nets at R02, R06, R09 and R15 between June 18 and July 16, 2008. R19, which was initially a HADD bridge, due to road re-alignment was constructed without encroaching into the stream; only discharge data were collected here. In total, 184 Arctic grayling were captured, most moving upstream (141), with small numbers of lake trout (8 fish) and round whitefish (4 fish) captured incidentally. Although hoop nets were installed earlier than in previous years, because larval Arctic grayling were captured shortly after drift nets were set, we assumed that the majority of the upstream migration by Arctic grayling may have been missed. Only a portion of the fish captured were ripe, as most were immature or spent. Although early and rapid snowmelt caused streams to open earlier in 2008, high runoff and ice conditions along shore prevented earlier installation of nets. The majority of movements by Arctic grayling probably occurred under ice. Hoop nets were removed in mid-July when downstream movements by fish became rare or absent, or physical barriers up- or downstream of R02, R06 and R15 because of low water levels.

Maximum stream velocities measured along the AWPAR were less than 1.48 m/s at all crossings and diminished rapidly through the spring. Although discharge velocities may have been higher earlier in spring, the short distance to navigate the stream under the bridge combined with relatively low velocity near the bottom and the sides of the channel is well within the swimming ability of Arctic grayling, thus movements and migrations would not be impaired by the bridge crossings at R02, R06, R09, R15, and R19.

Recapture of previously marked fish from downstream traps (current year and 2007) in upstream traps also indicates that fish moved unimpeded within the stream channels and were not limited or impaired by the bridges.

Success of Compensation Features

Construction of the habitat compensation feature at R02 is scheduled for winter 2009. Monitoring work in 2008, as in 2007, targeted collecting baseline information on larval Arctic grayling production to support future assessments of the relative success of the enhancement effort. Between June 21 and July 16, 158 larval Arctic grayling were collected in drift traps up- and downstream of the location where the compensation feature will be constructed. A similar number were captured in 2007 (170).

Larvae were first collected on June 23, coinciding with peak drift at a water temperature of 6^{o}C. This timing confirms that Arctic grayling had migrated and spawned well in advance of installation of hoop nets. Grayling larvae had no yolk sac and were in a relatively advanced stage of development. This further suggests that mature Arctic grayling had migrated upstream and established spawning territories at R02 as early as mid-late May, prior to ice-off of the stream at water temperatures less than 4^{o}C. This confirms early movement and spawning by grayling upstream of the bridge crossing at R02 and that adult fish had navigated past the bridge at much higher flow velocities and discharge than was measured in 2008.

Creel Survey

The 2008 creel survey results confirm that the AWPAR streams were not targeted by fishers as no fishing in the vicinity of any stream was noted. Given the use of the road for hunting, its use to access nearby lakes cannot be ruled out.

1. INTRODUCTION

1.1. Background

The All-weather Private Access Road (AWPAR) between the Hamlet of Baker Lake and the Agnico-Eagle Mines (AEM) Meadowbank project, 75 km north of the hamlet was completed in 2008. This report summarizes results of fisheries-related monitoring conducted by Azimuth Consulting Group (Azimuth) in 2008 along the AWPAR on behalf of AEM to meet the requirements of the DFO *Fisheries Act* Authorization (S-08/09-1040-NU). Monitoring was focused primarily on fish-bearing stream where bridge abutments encroached into the stream channel. In such cases, these installations caused the 'harmful alteration, disruption or destruction of fish habitat', or HADD. Azimuth has been monitoring movements of fish along the AWPAR route since 2005. Since construction of the AWPAR started in 2007, monitoring has focused on determining whether Arctic grayling movements or migrations have been constrained by any of the HADD bridges and on collecting baseline information on Arctic grayling spawning productivity at Bridge R02, in advance of constructing habitat compensation (Azimuth, 2007). Construction of the habitat compensation area is scheduled for winter 2008.

The DFO authorization for AWPAR requires that the following components be addressed by field studies during spring migrations by fish:

- Fish passage past bridges
- Success of compensation features
- Catch results from a creel survey

This report documents fish passage success based on measurements of water velocity and monitoring of movements up- and downstream of HADD bridges using hoopnets and spawning success at R02 (the compensation area) using larval drift traps; stability of compensation features, bridges and culverts is the purview of AEM and is documented separately.

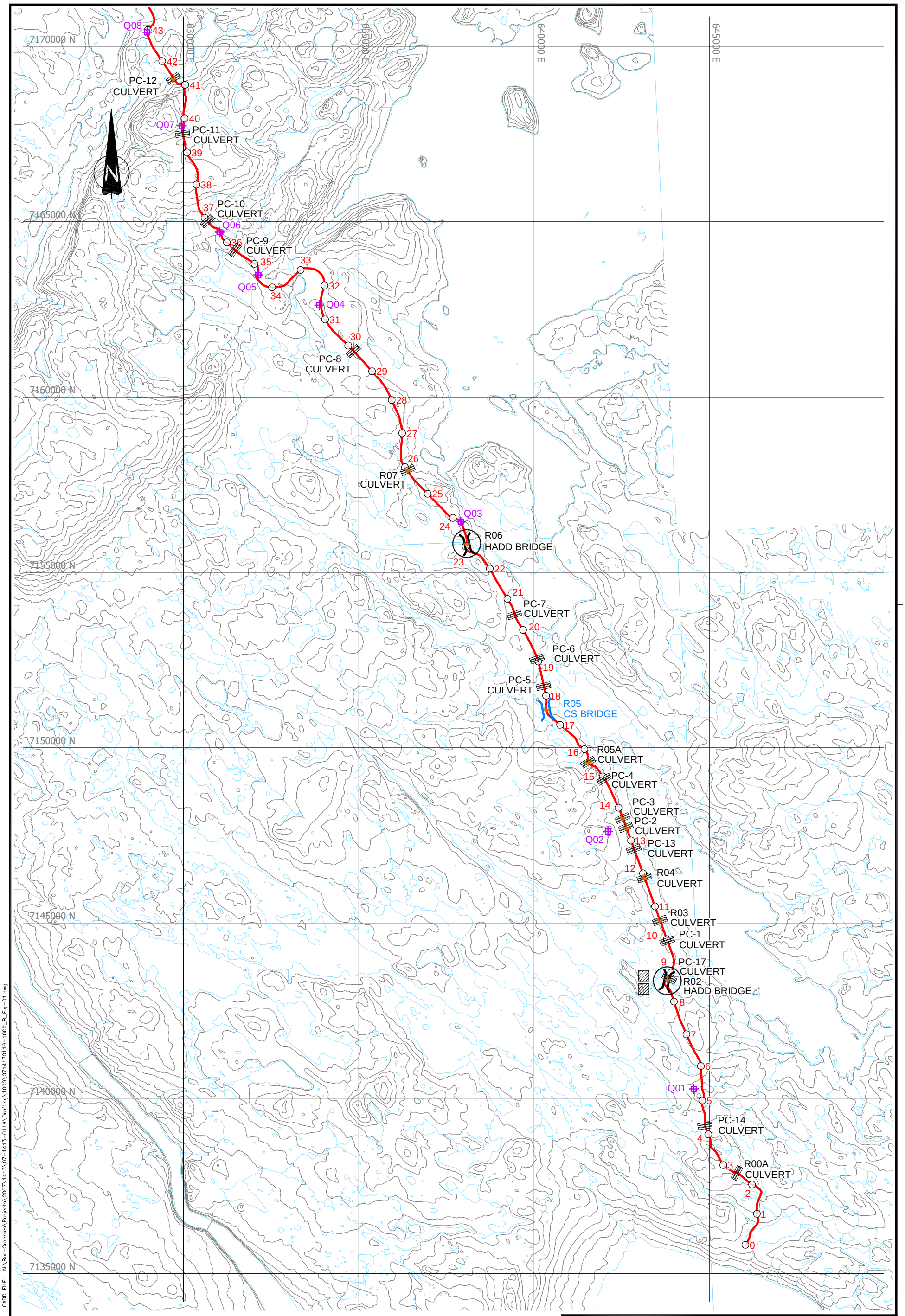
1.2. Monitoring History

The predominant water system along the road is the Prince River drainage that includes Whitehills Lake and Amarulik Lake. This system lies to the southwest of the Quoich River system, of which Third Portage Lake is in the headwaters and is connected to Tehek Lake. Three non-fish bearing crossings drain small, ephemeral streams that empty into Third Portage Lake. One non-fish bearing stream drains north to the Back River system that flows to the Arctic Ocean. All other crossings drain into the Prince River that eventually enters Baker Lake, several kilometers east of town. In 2005 and 2006,

Azimuth monitored movements of Arctic grayling (*Thymallus arcticus*) using hoop nets and larval drift traps at all potential stream crossings along the proposed AWPAR route between the Hamlet of Baker Lake and Meadowbank Mine (Azimuth, 2005; 2008a). Twenty-five crossings were monitored in 2005 (**Figure 1**) to determine presence/absence of fish and habitat use and suitability. In non-ephemeral fish-bearing streams connecting fish-bearing lakes, the magnitude and timing of migrations and movements of fish species was determined using paired hoop nets, larval drift traps and Gee minnow traps. The main species identified was Arctic grayling (*Thymallus arcticus*), which were present in 6 of the 25 proposed crossing locations, the only spring spawning species utilizing these streams as migratory corridors and spawning habitat. Lake trout (*Salvelinus namaycush*), Arctic char (*S. alpinus*) and round whitefish (*Prosopium cylindraceum*) were found in small numbers in most of the streams where grayling were present. Five streams contained only ninespine stickleback (*Pungitius pungitius*) and slimy sculpin (*Cottus cognatus*). The remaining streams were non-fish bearing and consisted primarily of ephemeral channels that connected small ponds.

Monitoring in 2006 (Azimuth, 2008a) focused on the five stream crossings (R02, R06, R09, R15, and R19) where Arctic grayling were confirmed to be present and for which bridge crossings were planned. These streams are the only locations where bridge abutments were predicted to encroach into the stream channel and might result in habitat loss. Total fish enumerated from all streams was 883 consisting primarily of Arctic grayling (779), followed by round (67), lake trout (*Salvelinus namaycush* 36) and a single Arctic char. No other species was captured, which was consistent with results from 2005.

In 2007, DFO issued a *Fisheries Act* Authorization (NU-03-0190-2) for AWPAR construction that required monitoring of non-clear span bridge crossings to determine stability and success of compensation features, fish passage past bridges and report on catch results from a creel survey. The Authorization required the preparation of a detailed monitoring plan to help guide future monitoring; this was completed by Azimuth (2007) on behalf of AEM. Five bridges were clear-span crossings (R01, R05, R13, R16 and R18), do not encroach into streams and did not require monitoring, as per DFO guidance for clear-span bridge crossings. Monitoring in 2007 (Azimuth, 2008b; submitted as Appendix K of AEM, 2008) was affected by construction of the AWPAR and timing of bridge and culvert installations. Bridges had not yet been installed at R09, R15 and R19, so open water season monitoring focused only on R02 and R06. In 2007, 294 adult or juvenile fish were enumerated, dominated by. Arctic grayling (n=279), with small numbers of lake trout and round whitefish captured. Results confirmed that Arctic grayling were able to pass beneath the bridge at maximum water velocities up to 1.7 m/s. Drift traps confirmed that spawning is successful at this crossing. Spawning was also observed on gravel introduced into the stream at the base of the bridge abutment at R06.



LEGEND

- CULVERT
- HADD BRIDGE
- CLEAR-SPAN BRIDGE
- HOOP NETS INSTALLED
- LARVAL DRIFT TRAP
- EXISTING QUARRY
- 10 KILOMETER MARKER

REFERENCES

1) ROAD ALIGNMENT, BRIDGE, CULVERT AND QUARRY LOCATIONS FROM NUNA M&T SERVICES Ltd.
2) BASE DRAWING FROM GOLDER ASSOCIATES Ltd.

PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK DIVISION

TITLE

ALL-WEATHER PRIVATE ACCESS ROAD 2008 MONITORING LOCATIONS

AZIMUTH

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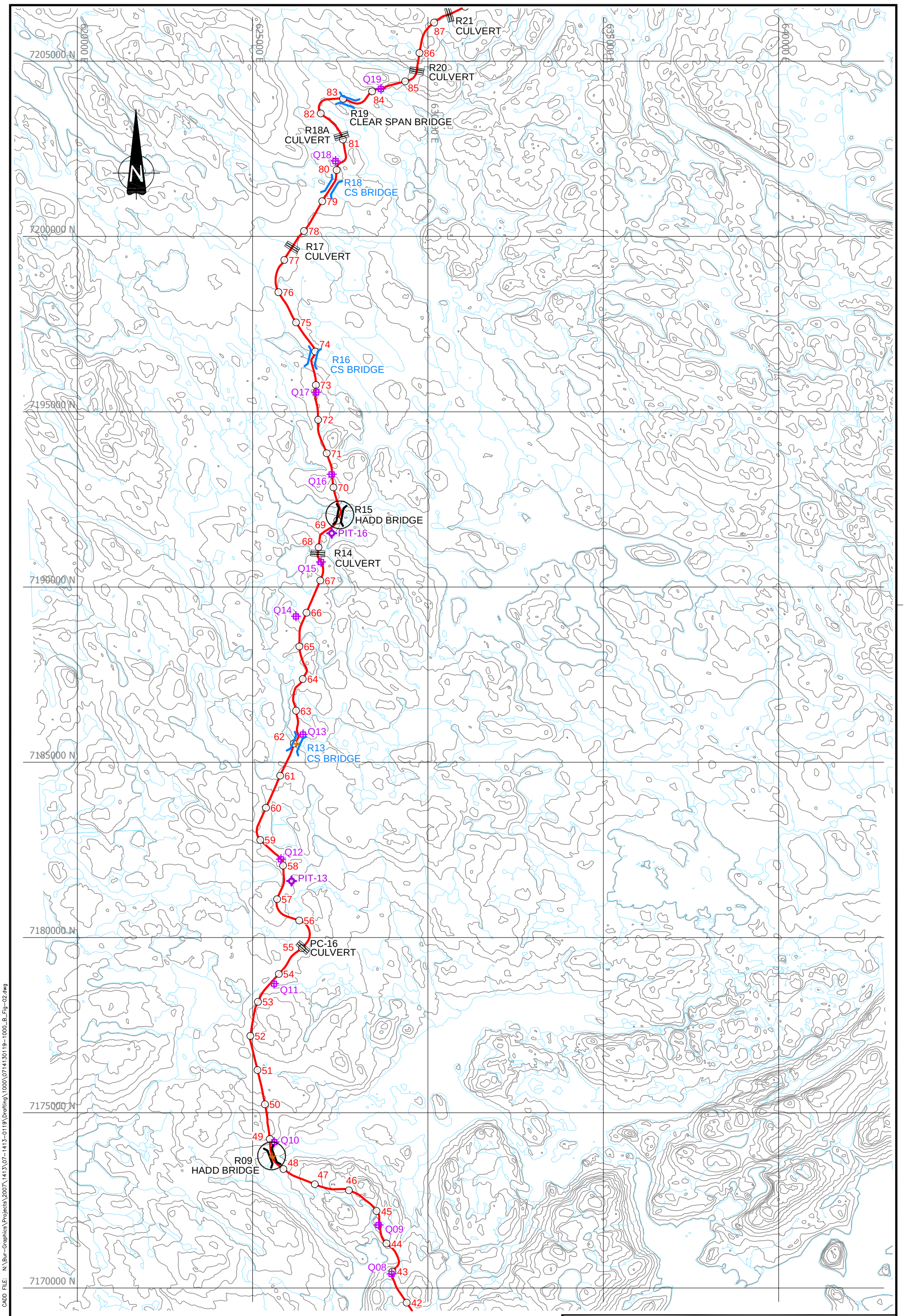

LEGEND

- CULVERT
- HADD BRIDGE
- CLEAR-SPAN BRIDGE
- HOOP NETS INSTALLED
- LARVAL DRIFT TRAP
- EXISTING QUARRY
- 10 KILOMETER MARKER

REFERENCES

1) ROAD ALIGNMENT, BRIDGE, CULVERT AND QUARRY LOCATIONS FROM NUNA M&T SERVICES Ltd.
2) BASE DRAWING FROM GOLDER ASSOCIATES Ltd.

PROJECT

AGNICO-EAGLE MINES LIMITED
MEADOWBANK DIVISION

TITLE

ALL-WEATHER PRIVATE ACCESS ROAD 2008 MONITORING LOCATIONS

AZIMUTH

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R18 CS BRIDGE
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R16 CS BRIDGE

LEGEND

- CULVERT
- HADD BRIDGE
- CLEAR-SPAN BRIDGE
- HOOP NETS INSTALLED
- LARVAL DRIFT TRAP
- EXISTING QUARRY
- 10 KILOMETER MARKER

REFERENCES

1) ROAD ALIGNMENT, BRIDGE, CULVERT AND QUARRY LOCATIONS FROM NUNA M&T SERVICES Ltd.
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PROJECT

AEM

AGNICO-EAGLE MINES LIMITED
MEADOWBANK DIVISION

TITLE

ALL-WEATHER PRIVATE ACCESS ROAD 2008 MONITORING LOCATIONS

AZIMUTH

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1.3. Objectives

Monitoring of migrations and movements of Arctic grayling was carried out during spring of 2008 under DFO Authorization S-08/09-1040-NU focused on five bridge crossings (R02, R06, R09, R15 and R19) where bridge abutments encroach into the stream channel. Monitoring of drift of larval Arctic grayling was again carried out at the candidate compensation area of R02. The abutments of four bridges (R02, R06, R09 and R15) did not encroach into the wetted stream width of the channel. These abutments have caused a minor 'harmful alteration, disruption or destruction (HADD)' of fish habitat. It is at these crossings where monitoring is required. However, due to minor re-alignment of the AWPAR during construction, the HADD bridge at R19 was constructed over a more narrow section of the stream so that the abutment did not encroach into the stream channel. Consequently, monitoring at R19 in 2008 consisted of velocity measurements only, with no direct monitoring of fish movements using hoop nets.

The three main objectives for the 2008 monitoring of the AWPAR stream crossings are:

- *Assessment of fish passage at R02, R06, R09 and R15* – The field program will continue previous years' investigations in stream migrations and include identifying, tagging and collecting biological information of fish captured in hoop nets deployed up- and downstream of the bridges. Current velocity and stream discharge (m^3/s) data were also collected.
- *Larval Drift at R02* – Habitat compensation structures are planned for implementation upstream of the bridge at R02. Additional baseline data on larval drift were collected to confirm the location of spawning activity in relation to the bridge.
- *Creel survey* – Year 2 of a creel survey to obtain information on fishing habits in the vicinity of the AWPAR and general fishing patterns by Baker Lake residents in nearby lakes. This information was gathered by the Baker Lake Hunter / Trapper Organization (HTO) and from local observations.

Assessment of sedimentation at all culvert and bridge crossings along the AWPAR were routinely visually inspected by AEM to ensure that sediment is not being inadvertently introduced to downstream water courses. Results of this assessment are reported separately by AEM. During the course of the Azimuth surveys at bridge crossings, no sediment sources were identified.

2. METHODOLOGY

2.1. Timing and Deployment Strategy

Hoop nets were set in streams as soon as ice and safety conditions would allow. The timing of gear deployment varies from year-to-year according to snow cover and timing and magnitude of freshet, amount of ice, and water depth. In 2007, nets were first set on June 20 and were left in the water until July 24 at R02 and July 29 at R06. In 2008 nets were set between June 16 (R02) and June 18 (R15). Although nets were set earlier than in 2007, freshet was underway and nets were installed at or just before peak discharge in each of the streams. Discharge was beginning to decline at the time of installation of each of the hoop nets, even further north at R15, which is typically one week behind the other streams due to colder temperatures north of Whitehills Lake.

Table 1 provides details on the date and location of installation of hoop nets at R02, R06, R09 and R15. Nets were moved from their initial set location as water levels permitted or as water levels changed throughout the spring. For example, at R02 water depth was too deep during the first few days to be set in the stream thalweg. As depth diminished, nets were moved into deeper water or to span a greater width of the stream in order to maximize stream width covered by the net wings.

Initially, nets were set to capture fish moving upstream as Arctic grayling typically move out of lakes shortly after initiation of freshet to move into connecting channels and streams to spawn. Note that grayling frequently move beneath the ice, well before breakup of the streams, so it is often difficult to determine the true magnitude of fish movements. Nets were switched to capture downstream moving fish once it was believed that upstream movements of fish had been completed and/or when capture of upstream moving fish ceased or diminished significantly.

Table 1: Date of installation, position and orientation of hoopnets set along the AWPAR, 2008.

R02				
Installation date	Gear type	UTM (14W)		Comments
		Easting	Northing	
June 16	staff gauge	643800	7143321	Staff guage installed
June 16	D/S south pier hoopnet	643800	7143305	d/s of bridge oriented to capture u/s movements
June 16	D/S mid channel hoopnet	643810	7143312	d/s of bridge oriented to capture u/s movements
June 17	U/S south pier hoopnet	643761	7143379	u/s of bridge oriented to capture u/s movements
June 17	U/S mid channel hoopnet	643734	7143415	u/s of bridge oriented to capture u/s movements
June 20	DT 1 & 2	643566	7143533	Upstream of Compensation Area
June 20	DT 3 & 4	643543	7143532	Upstream of Compensation Area
June 20	DT 5 & 6	643543	7143512	Upstream of Compensation Area
June 20	DT 7 & 8	643584	7143507	Downstream of Compensation Area
June 20	D/S mid channel hoopnet	643725	7143438	moved orientation to capture d/s movements
July 7	U/S south pier hoopnet			reoriented to capture d/s movements
July 7	U/S north pier hoopnet			oriented to capture d/s movements
July 16	DT 1 & 2			removed
July 16	DT 3 & 4			removed
July 16	DT 5 & 6			removed
July 16	DT 7 & 8			removed
July 17	U/S south pier hoopnet			removed
July 17	U/S north pier hoopnet			removed
July 17	U/S mid channel hoopnet			removed

R06				
Installation date	Gear type	UTM (14W)		Comments
		Easting	Northing	
June 17	staff gauge	638051	7155858	Staff guage installed
June 17	U/S north pier hoopnet	638055	7155859	u/s of bridge oriented to capture u/s movements
June 17	U/S south pier hoopnet	638058	7155844	u/s of bridge oriented to capture u/s movements
June 20	D/S north pier hoopnet	638107	7155848	d/s of bridge oriented to capture u/s movements
June 20	D/S south pier hoopnet	638095	7155823	d/s of bridge oriented to capture u/s movements
July 5	U/S north pier hoopnet			reoriented to capture d/s movements
July 5	U/S south pier hoopnet			reoriented to capture d/s movements
July 12	U/S mid channel hoopnet			u/s of bridge oriented to capture d/s movements
July 16	d/s orientation			removed
July 17	u/s orientation			removed

Table 1 con't: Date of installation, position and orientation of hoopnets set along the AWPAR, 2008.

R09				
Installation date	Gear type	UTM (14W)		Comments
		Easting	Northing	
June 16	staff gauge	625547	7173759	Staff guage installed
June 16	U/S hoopnet	625527	7173741	u/s of bridge oriented to capture u/s movements
June 16	D/S hoopnet	625597	7173777	u/s of bridge oriented to capture u/s movements
July 6	U/S hoopnet			reoriented to capture d/s movements
July 16	U/S hoopnet			removed

R15				
Installation date	Gear type	UTM (14W)		Comments
		Easting	Northing	
June 18	staff gauge	627417	7192110	Staff guage installed
June 18	U/S mid channel hoopnet	627403	7192106	u/s of bridge oriented to capture u/s movements
June 18	U/S north pier hoopnet	627443	7192110	u/s of bridge oriented to capture u/s movements
June 18	D/S south pier hoopnet	627497	7192053	u/s of bridge oriented to capture u/s movements
June 18	D/S north pier hoopnet	627494	7192064	u/s of bridge oriented to capture u/s movements
July 5	U/S mid channel hoopnet			u/s of bridge reoriented to capture d/s movements
July 5	U/S north pier hoopnet			u/s of bridge reoriented to capture d/s movements
July 12	D/S north pier hoopnet			reoriented to capture d/s movements
July 12	D/S south pier hoopnet			removed
July 12	U/S south pier hoopnet			u/s of bridge oriented to capture d/s movement
July 16	u/s orientation			removed
July 16	d/s orientation			removed

2.2. Equipment

2.2.1. Hoop Nets

Dimensions of hoop nets were either four-foot (1.22 m) or three-foot (0.9 m) diameter front hoops, 17 feet (4.9 m) long with a total width, including wings of either 9 m or 15 m, respectively. All hoop nets have a 25 cm square size (1 inch) mesh and are designed to capture juvenile and adult/mature fish. Hoop nets were anchored to the stream bottom with aluminum or steel poles driven between rocks. The wings of the nets were extended at least 5 m from the hoop in both directions and anchored to the bottom using poles and rocks to prevent fish from passing underneath. Hoop nets were installed in streams to maximize channel width covered, where sufficient depth allowed.

Hoop nets were set upstream and downstream of bridge crossings at streams R02, R06, R09 and R15 along the AWPAR (**Figure 1**). Typically, two nets were set both up- and downstream of the bridge and were set to cover as much of the stream as possible, depending on water depth. At R09 the stream was relatively narrow and only one net was required up- and downstream of the bridge to cover the entire channel, allowing capture of all migrating fish.

Fish were removed and evaluated from hoop nets nearly every day and identified to species, measured for fork length (+/- 1 mm) using a standard measuring board, weighed (g) and examined for external condition. Arctic grayling were examined for sexual maturity and spawning condition was assessed if possible from color and shape of the dorsal fin and from gentle palpation of the body to attempt to extrude eggs or milt. Fish were classified where possible as immature, waiting to spawn next year, ripe and spawning or spent.

Fish were inspected for Floy or spaghetti tags that were applied in 2007 or in 2008. All unmarked fish were tagged with individually numbered Floy tags prior to release. Recapture of tagged fish allows movements and changes in fish size to be determined within and between years.

Initial efforts were focused on assessing upstream migration past the bridges by setting nets in an upstream orientation immediately downstream and upstream of the bridges. Absolute confirmation of upstream migration would be achieved by catching tagged fish (i.e., those tagged in the downstream trap) upstream of the bridge.

Table 1 provides the UTM coordinates of hoop nets, number of hoop nets, orientation, timing of sets and proximity to the respective bridge structures. Ambient air and water temperature data were collected each day from each stream using a field thermometer. Stream velocity was measured every three to four days in each stream at surface, mid-water and near bottom using a pre-calibrated Swoffer Model 2100 flow meter. Stream

velocity was measured directly beneath the centerline of the bridge. Where possible, at least three velocity profiles were measured across the stream (i.e., near south bank, north bank and mid-stream). Velocity data were used to calculate stream discharge (m^3/s) combined with cross-sectional dimension of the stream at the bridge crossing where stream flow was constricted and contained. A summary of stream water temperature and minimum and maximum velocity at each stream crossing in 2008 is provided in **Table 2**.

2.2.2. Larval Drift Traps

Eight larval drift traps were deployed upstream of R02 on June 20, six traps within the compensation option area and two downstream (**Table 1**). Larval drift traps consisted of 0.5 mm nitex mesh traps attached to the back of a square, cone-shaped aluminum frame. The frame consists of a trailing net and Nalgene collection jar which was submerged into the stream and anchored between two aluminum poles. These traps passively collected drifting fish eggs, newly hatched fry and invertebrates drifting downstream.

The primary goal of setting drift traps in this location was to verify that spawning occurs in this area and the magnitude of spawning (based on drift) to gauge capacity of the candidate compensation option area to increase existing spawning habitat in this large stream. Physical information gathered from the existing spawning areas (i.e., substrate, velocity and depth) will assist in design construction design of the replacement habitat as a result of the HADD from bridge abutments.

Fish larvae were collected from traps nearly every day, preserved in 10% formalin and identified to species and enumerated. Taxonomic identification was by North/South Consultants Inc. (Winnipeg) with the use of larval taxonomic keys (Auer, 1982; Konrad, 1985). Notes on incidental capture of drifting invertebrates (e.g., Ephemeroptera, chironomid larvae) and larval stickleback and sculpin were recorded but are not reported here.

Table 2: Water temperature (°C) and minimum and maximum velocity (m/s) at HADD stream crossings, 2008.

	R02		R06		R09		R15		R19	
Date	Water Temperature	Velocity (m/s)	Water Temperature	Velocity (m/s)	Water Temperature	Velocity (m/s)	Water Temperature	Velocity (m/s)	Water Temperature	Velocity (m/s)
June 21					6.0	0.37 - 1.19	5.0	0.16 - 0.60	-	0.30 - 0.87
June 22	4.5	0.18 - 0.72	5.0	0.15 - 0.87						
June 24					6.0	0.31 - 0.90	5.0	0.18 - 0.59	-	0.30 - 0.83
June 25	6.0	0.15 - 0.76	5.0	0.23 - 1.18						
June 27					5.0	0.13 - 1.61	5.0	0.12 - 0.49	-	0.58 - 1.07
June 29	9.0	0.23 - 0.97	6.5	0.13 - 0.84						
July 2					7.0	0.17 - 1.09	5.5	0.11 - 0.76	-	0.29 - 0.80
July 3	9.0	0.16 - 0.87	6.5	0.27 - 1.0						
July 5					10.0	0.19 - 0.64	7.0	0.17 - 0.49	-	0.05 - 0.46
July 6	9.5	0.34 - 0.98	6.0	0.23 - 0.61						
July 8					14.0	0.38 - 1.02	12.0	0.12 - 0.23	-	0.08 - 0.43
July 9	12.5	0.39 - 1.16	11.0	0.15 - 0.60						
July 12					15.0	0.52 - 0.84	14.0	0.05 - 0.38	-	0.03 - 0.44
July 17	11.0	0.14 - 0.66	10.0	0 .19 - 0.73	15.0	0.29 - 0.60	14.0	0.01 - 0.27	-	-

3. RESULTS AND DISCUSSION

This section is organized to satisfy the overall objectives of the 2008 field sampling program along the AWPAR by documenting migratory and spawning behavior by the target species Arctic grayling. Successful migration and spawning must not be limited by water velocities that might be created by constriction of the stream as a result of installation of bridge abutments. In the absence of a physical barrier and by demonstrating that fish passage, both up- and downstream of the bridge crossing is possible, there should be no impact by the bridges on migratory populations of Arctic grayling.

3.1. Stability and Integrity of Stream Crossings

The AWPAR was driven nearly every day between Baker Lake and R19 between mid-June and mid-July. During this time bridge crossings R02, R06, R09, R15 and R19 were inspected for presence of erosion, instability and sedimentation. Routine observations did not identify any obvious signs of erosion and instability of bridge abutments and no sediment introductions to downstream watercourses from bridges were observed. AEM has prepared a more detailed summary of all stream crossings, including culvert crossings and reports this information separate from this document.

3.2. Stream Depth, Velocity and Discharge

Stream depth, measured daily from staff gauge measurements (**Figure 2**) and stream velocities (**Table 2**), measured every three or four days at each of the five bridge crossings (including R19 which was a clear-span crossing) were used to calculate total discharge (m^3/s) at the bridge crossings. At the onset of monitoring, freshet had been well underway. It was not possible to set hoop nets in the streams any earlier because of strong discharge, difficulty accessing the stream because of ice along the shorelines and because of drifting ice down the streams, which jeopardize integrity of the hoop net sets.

Stream elevation diminished through the spring and early summer from the onset of monitoring (June 16) to when hoop nets were removed on July 16. The net decline in stream depth over this time ranged from 23 cm (R15) to 27 cm (R02). By the time the hoop nets were pulled from the streams water depths had declined so much, either up- or downstream (or both) that there was insufficient water in the streams to allow passage by fish.

Declining stream depth correlated with declines in water velocity and therefore, total stream discharge (**Table 2**). Following is a summary of maximum water velocities measured at each of the bridge crossings. Maximum velocity was nearly always

measured just below the water surface. Stream velocity near the bottom was 30 – 60% of maximum values.

- Maximum water velocity at R02 occurred on July 9 and was measured at 1.16 m/s. With declining water level discharge had become concentrated within in the narrow channel adjacent to the south bridge abutment resulting in slightly higher water velocity than when discharge was higher and channel width was greater.

- Maximum water velocity at R06 was 0.87 m/s on June 22 with a minimum velocity of 0.15 m/s at the bottom on the same date. Velocity increased with increasing discharge to 1.18 m/s on June 25, gradually declining to 0.73 m/s on July 17, when the hoop nets were pulled.

- Maximum water velocity on June 21 at R09 was 1.19 m/s. Velocity increased to 1.61 m/s on June 27 before declining to 0.60 m/s on July 17 shortly before the hoop nets were removed.

- Maximum water velocity on June 21 at R15 was 0.56 m/s and continued to decline throughout the spring/summer to 0.27 m/s on July 17, shortly before the nets were pulled.

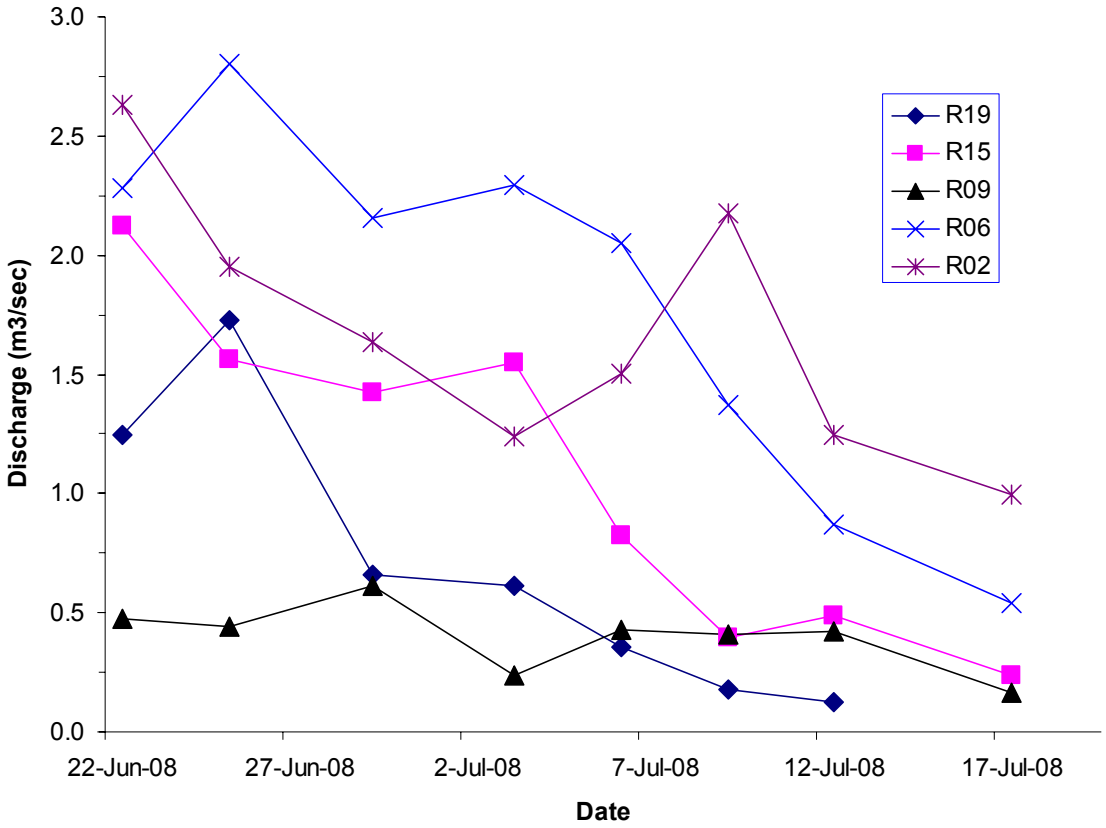
- Maximum water velocity at R19 was 1.48 m/s on June 21 at the clear span bridge. Stream velocity declined throughout the spring/summer to 0.44 m/s on July 12.

Maximum stream velocities measured along the AWPAR are below the threshold above which Arctic grayling would have difficulty navigating the channel beneath the bridges (**Table 2**). Adult Arctic grayling have a sustained swimming speed of 0.8 m/s, a prolonged speed of 0.8 - 2.1 m/s and a burst speed of 2.1 – 4.3 m/s (MOT, 2006). These speeds are defined as the ability to maintain a speed indefinitely, a speed maintained up to 200 minutes, and a speed that can be maintained for 15 seconds, respectively. Given the relatively short length of stream beneath the bridges (approximately 15 – 20 m), this distance is short enough that the current velocities measured at each of the crossings is sufficiently low that no velocity barrier should be imposed on migrating fish. Furthermore, velocities at far less than maximum were measured near the bottom and along the sides of the channel. Even if discharge velocities were higher earlier in spring (i.e., we probably did not measure peak freshet nor peak velocity), the short length under the bridge and the swimming ability of Arctic grayling is great enough to have allowed passage at higher water velocities. It is also likely that grayling moved under the ice, well before peak flow. It is our opinion that fish movements and migrations should not have been impaired by the bridge crossings.

Total stream discharge declined between late June and late July in all streams, reflecting diminished snowmelt and runoff. Discharge was highest at R02 (2.6 m^3/s) on 26 June and diminished to 0.54 m^3/s by 17 July (**Figure 2**). Peak discharge was likely much higher than this under the ice or during break-up earlier in June. R02 opens at least two weeks earlier than the other streams because it is further south (i.e., streams north of Whitehills Lake are in a colder micro-climate) and because of greater snowmelt. Snowmelt and runoff in 2008 was also earlier than in 2007 as water levels were lower in 2008 earlier in the year than when staff gauges and hoop nets were installed in 2007. Furthermore, the discharge measured here does not include discharge through the culverts on the north side of the stream crossing. These culverts pass a substantial amount of water early in freshet that was not measured by our field crew. Discharge through the culverts ceased by June 10.

Similar patterns were observed at the remaining crossings with peak discharge in late June (1.25 – 2.2 m^3/s) and low discharge (0.2 m^3/s) in mid-July. Differences in discharge are a function of watershed size and dynamics of snow melt. R02 has by far the largest drainage area and is expected to have the greatest discharge. Peak discharge was probably missed at R02 because of the earlier snowmelt at this crossing. Note that it was not possible to install hoop nets in the thalweg of the stream when the field team arrived on June 17 because it was too deep. So, discharge was not measured and would have been much higher than what was measured a week later.

Figure 2: Total stream discharge (m^3/s) at the five bridge crossings along the AWPAR, 2008.



3.3. Adult Fish Movements

Hoop nets were installed at R02, R06, R09 and R15 as soon as ice and discharge conditions would allow (**Figure 3**), which was slightly earlier than in 2007. Despite the earlier installation date, the majority of freshet had occurred because spring snowmelt was earlier in 2008 than in 2007. It is likely that the majority of upstream migration of Arctic grayling had already occurred. Stream velocity (**Table 2**) and discharge (**Figure 2**) were on the decline at the time of measurement and hoop net installation. It is noteworthy that Arctic grayling typically move as soon as streams begin to thaw, even before the ice comes off, so the majority of upstream moving fish are probably missed ever year. This same trend also occurred in 2006 as high flow and ice conditions precluded documentation of the early run of fish (Azimuth, 2007). Relatively few fish were monitored moving upstream and many of the stream channels became so shallow within 2 – 3 weeks of hoop net installation that movement by fish up- or downstream was difficult or impossible. Given that larval Arctic grayling were captured soon after drift traps were set (**Section 3.5**) means that grayling had moved upstream to spawn several weeks before we were able to install hoop nets in the streams.

Details on movements of fish within each of the four monitored stream crossings are described in the following sections. We do not review data on round whitefish or lake trout as the objective of this study was to assess whether or not constrictions of the crossings by bridge abutments created velocity barriers and to review the migratory patterns of Arctic grayling and their general biology.

3.3.1. R02

Four hoop nets were installed at R02 on June 16 and 17 (**Table 1**). Water tempertaure was 3.0^{o}C. Maximum stream velocity was 1.19 m/s and discharge was in excess of 2.5 m^{3}/s. Nets were set upstream and downstream of the bridge, to capture fish moving both in the upstream and downstream directions. Ice blocks along shore in mid-June below the bridge hampered installation of hoop nets. Despite earlier installation of hoop nets in 2008 than in 2007, fish were not captured moving up-or downstream until nearly 2 weeks later. (**Figure 3**). In all, only 34 fish (excluding fish recaptured within 2 days of mark and release) were captured in hoopnets at R02 (the largest stream along the AWPAR), 17 moving upstream and 17 moving downstream until the nets were removed on July 16. No fish were captured moving in either direction after July 12.

The pattern of fish movements in **Figure 3** suggests that the majority of the upstream migration by Arctic grayling was missed, despite deployment of the nets as soon as water and ice conditions would allow. The pattern of larval drift (see **Section 3.5** and **Figure 3**) also confirms this. In fact, larval Arctic grayling were captured in the drift traps on June 23, one week before the first adult fish was captured here. Furthermore, the larvae had no

yolk sac attached. This evidence suggests that grayling migrated and spawned upstream of the bridge at least 3 weeks earlier, probably under the ice. While it is possible that some fish may have moved downstream from the lake above R02, spawning migrations by adults typically occur in an upstream direction. According to the literature, spawning by Arctic grayling occurs when water temperatures reach 7ºC (Scott and Crossman, 1973) with young hatching within 16 – 18 days at water temperatures of 9ºC (McPhail and Lindsey, 1970), or within 8 – 32 days at water temperatures of 15.5 – 5.8ºC (Krueger, 1981). This is not the case at R02 (and the other streams). At the time of arrival of the field team water temperature was only 3.0ºC. Spawning had already occurred perhaps up to 3 weeks earlier at colder water temperatures as drifting fry (i.e., with no yolk sac) were captured in drift traps on 23 June when water temperature was only 5ºC.

The size of fish captured at R02 was relatively small, with a mean length and weight of 236 mm and 162 g respectively (**Table 3**). Condition factor was high (1.19) and similar to the other streams. The length – frequency distribution (**Figure 4**) show that most of the fish captured were 250 mm or less (mode 240 mm) and would be classified as immature. Only one sexually mature fish was identified (**Appendix A**). This is further evidence that the upstream run of sexually mature fish had occurred prior to our arrival. Fish captured were primarily juveniles that were probably feeding within the stream during spring.

Only 34 Arctic grayling were captured in hoop nets in 2008. In 2007, only 67 fish were captured, most of these (63) moving downstream (**Figure 3**). In 2006 the total number of grayling moving up- and downstream was 136 with peak upstream migration on June 24 and peak downstream migration on July 4 (Appendix K; AEM, 2008). Timing was similar in 2007, with peak migration (n=23) occurring on June 26. Despite the large size of the watershed, relatively few fish are captured here relative to the size of other watersheds. This may be a virtue of the fact that the stream is so large. R02 opens earlier than other streams allowing fish to migrate beneath the ice and shortly after ice-off before fishing gear can safely be installed in the stream. It may also be that fish avoid the hoop nets to some degree, because of the great width of the stream it is impossible to block all of the accessible routes.

Hoop nets were removed on July 16 and 17, several days after the last downstream moving fish was captured (**Figure 3**). Water temperature was 13ºC. Declining water levels also limited fish passage because of a naturally exposed boulder garden upstream of the bridge. Four round whitefish were captured in the nets as well as Arctic grayling. No other fish species were captured.

Table 3: Mean length (mm), weight (g) and condition factor (K) of Arctic grayling at R02, R06, R09 and R15.

Stream Crossing	Sample Size	Length (mm)		Weight (g)		Condition Factor (K)	
		Range	Mean	Range	Mean	Range	Mean
R02	34	192 - 340	236	75 - 375	162	0.88 - 1.76	1.19
R06	67	200 - 386	302	100 - 650	340	0.85 - 1.57	1.19
R09	59	195 - 343	257	75 - 500	230	0.77 - 1.88	1.25
R15	9	215 - 335	284	100 - 425	294	1.01 - 1.88	1.23

Figure 3: Daily in-stream movements by fish during spring/summer along the AWPAR, 2008.

			Spring/Summer Survey																																
			15-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	1-Jul	2-Jul	3-Jul	4-Jul	5-Jul	6-Jul	7-Jul	8-Jul	9-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	Cummulative Total
BRIDGE R02																																			
Tempeature (deg C)				3	3	5	5	4.5	-	4.5	5	6	6	5	5		9	7	8	9	9	10	9	9.5	10	13	12.5	15	15	15	15	14	12	13	
Staff Guage Level (cm)				73	68	66	64	62	-	60	58	56	55	59	59		58	59	58	56	55	55	53	53	53	51	50	50	47	45	44	45	44	42	
Hoopnet Set				IN																SW														OUT	
***Species* [1]**	*ARGR*	*US*		0	0	0	0	0	0	0	0	0	1	0	0	0	2	5	2	1	0	1	0	0	0	1	0	0	0	3	0	1	0	0	17
		DS		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	1	4	3	3	0	0	0	0	17
	RNWH	*US*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	3
		DS		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Larval Drift Trap									IN																									OUT	
	Fry	*Upstream*							0	0	31	17	7	1	1		4	0	4		3		2			0		0			0			0	70
		Downstream							0	0	28	4	10	8	12		20	3	2		0		1			0		0			0			0	88
BRIDGE R06																																			
Tempeature (deg C)					3	4.5	4	5	-	5	5	6	5	5	5	-	6	6	5	6	6	6.5	7	6	7	9	9	9	9.5	11	9	10	8	10	
Staff Guage Level (cm)					107	105	107	108	-	103	103	101	101	103	102	-	101	101	101	100	99	97	96	95	96	95	95	92	92	91	91	90	90	90	
Hoopnet Set					IN																				SW									OUT	
***Species* [1]**	*ARGR*	*US*			0	0	0	13	0	5	9	2	0	0	2	0	4	22	2	0	1	2	0	0	0										62
		DS																								6	0	4	0	1	0	0	0	0	11

Figure 3 con't: Daily in-stream movements by fish during spring/summer along the AWPAR, 2008.

	Spring/Summer Survey																															
	15-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	1-Jul	2-Jul	3-Jul	4-Jul	5-Jul	6-Jul	7-Jul	8-Jul	9-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	Cummulative Total
BRIDGE R09																																	
Tempeature (deg C)				4	5	-	6	5	6	6	5	6	5	-	8	7	-	7	8.5	9	10	9	10	14	12	15	15	11	15	13	13		
Staff Guage Level (cm)				77	78	-	75	73	71	70	71	71	75	-	71	71	-	70	70	69	68	68	66	67	67	65	65	64	62	62	60		
Hoopnet Set				IN																			SW								OUT		
Species [1] *ARGR* *US*				0	0	0	17	1	0	3	3	1	0	0	2	2	0	10	2	4	6	2											53
DS																							0	8	2	2	1	0	2	0	0		15
LKTR *US*				0	0	0	3	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0											5
DS																							1	1	0	0	1	0	0	0	0		3
BRIDGE R15																																	
Tempeature (deg C)				5	4.5	-	5	3.5	4	5	5	5	5		5.5	6	-	5.5	6	6	7	-	7	12	12	12	14	9	15	14	12	11	
Staff Guage Level (cm)				60	56	-	56	55	53	51	50	50	48		48	48	-	47	46	45	44	-	43	42	41	40	39	38	38	38	37	37	
Hoopnet Set				IN																		SW										OUT	
Species [1] *ARGR* *US*				0	0	0	7	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0											9
DS																							0	0	0	0	0	0	0	0	0	0	0

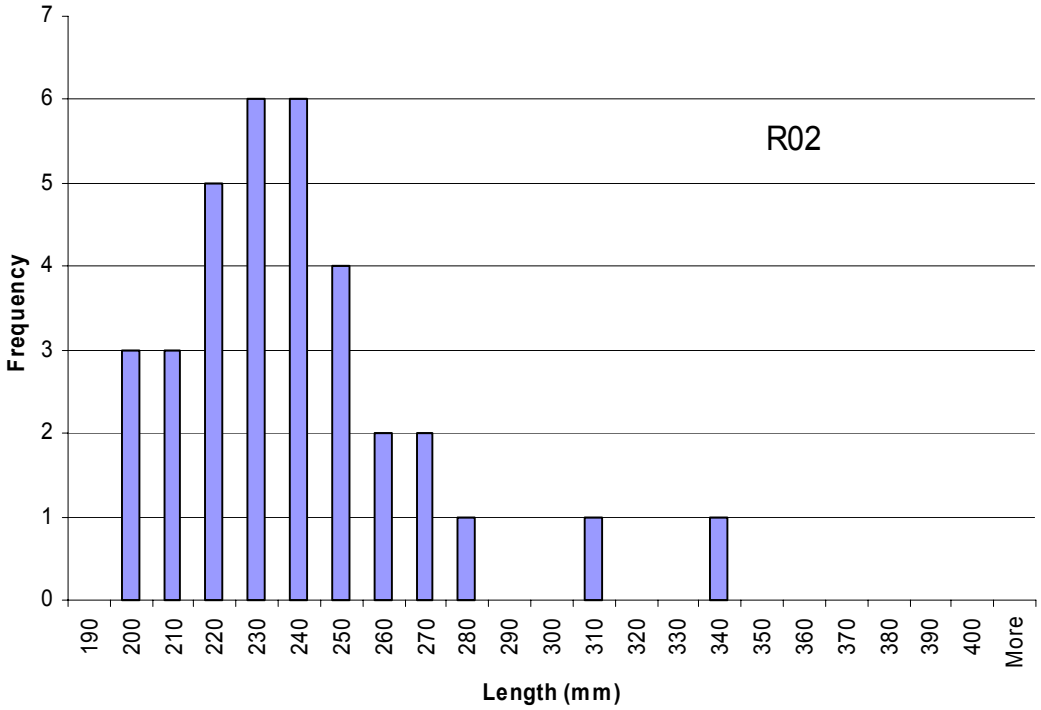
Notes:

[1] ***Acronym***	***Species Name***
ARGR	Arctic grayling
LKTR	Lake trout
RDWH	Round whitefish
US	Fish moving upstream
DS	Fish moving downstream
SW	Nets switched to capture fish moving downstream

IN OUT = Duration of net set

\- No monitoring due to vehicle breakdown or illness

Figure 4: Length – frequency distribution of Arctic grayling from R02, 2008.



3.3.2. R06

Two hoop nets were installed upstream of R06 on June 17 and two downstream on June 20 (**Table 1**). Nets were set to capture upstream moving fish. High water level delayed installation of the nets downstream of the bridge. Water tempertaure was 3.0^{o}C.

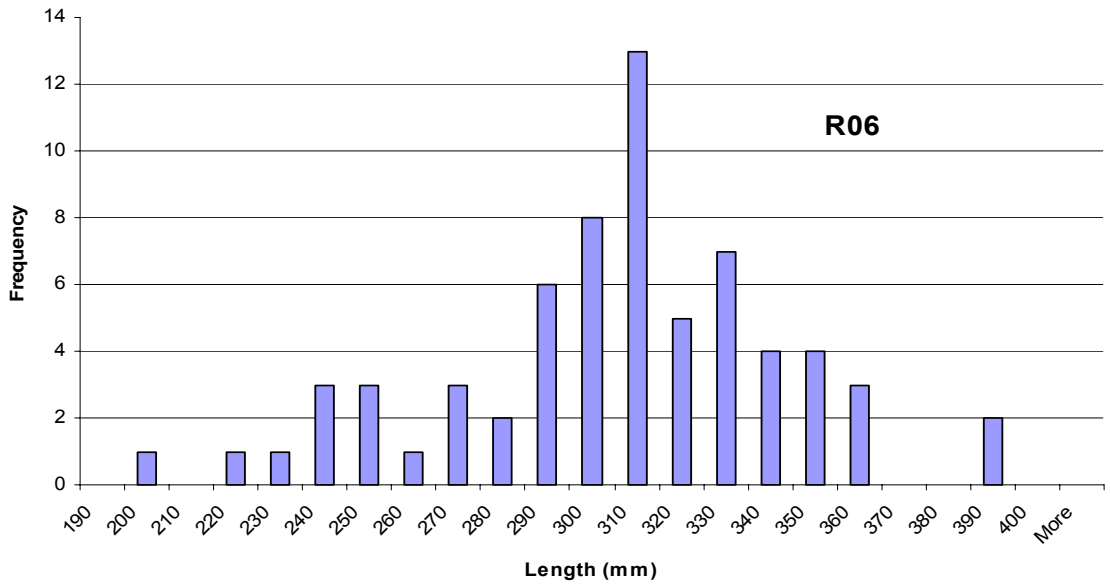
Thirteen fish were captured moving upstream on June 20. Peak upstream migration occurred on June 30 when 22 fish were captured (**Figure 3**). Of the 62 fish captured moving upstream, most were captured on these two days, with only small numbers of fish captured on other days. Nets were switched to capure downstream moving fish on July 5.

Only 11 fish were captured moving downstream before the nets were pulled on July 16 when water temperature was 10^{o}C. No downstream moving fish were captured for nearly one week prior to removal. No other species were captured in hoop nets at R06 in 2008.

The size of fish captured at R06 was considerably larger than from R02 with a mean length and weight of 302 mm and 340 g respectively (**Table 3**) with similar condition factor (1.19). The length – frequency distribution (**Figure 5**) showed that nearly all of the fish captured at R06 were larger than all of the fish captured at R02, with very few fish less than 250 mm, as the modal size was 320 mm. Most fish captured were considered sexually mature and would spawn during the current year (**Appendix A**). Note that maturity codes for females (2 and 3) and males (7 and 8) indicate current year spawners were eggs/milt were difficult or easy to extrude respectively.

In 2007, 134 Arctic grayling were captured at R06 (Appendix K; AEM, 2008). All but one fish were captured moving downstream between July 2 and 17 until nets were pulled on July 30. Mean size was 307 mm and 352 g (K = 1.17), very similar to 2008. Most of these fish were immature or spent. However, although fish were not captured in nets, grayling were observed congregating near the bridge abutment in late June, apparently defending spawning grounds near the bridge. Although these fish were not captured moving upstream they were obviously present and had likely migrated here prior to installation of nets and might explain why virtually no fish were captured moving upstream.

Figure 5: Length – frequency distribution of Arctic grayling from R06, 2008.



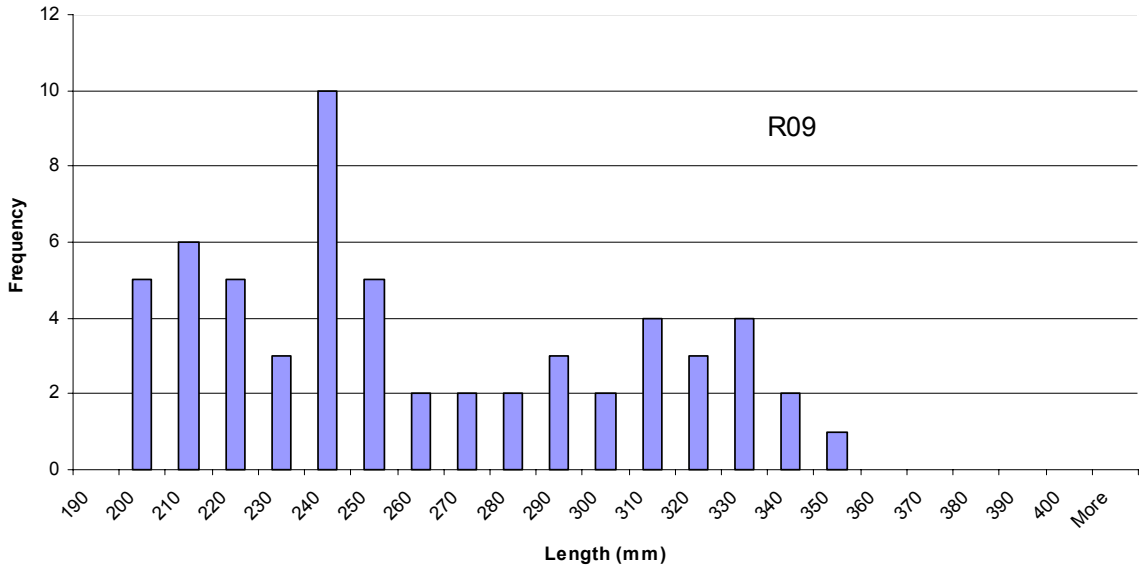
3.3.3. R09

The bridge crossing at R09 is relatively narrow and only two hoop nets were needed to entirely span the crossing to capture either up- or downstream moving fish. Hoop nets were installed up- and downstream of R09 to capture upstream moving fish, on June 18 (**Table 1**, **Figure 3**). Nets were switched to capture fish moving downstream on July 7. Water tempertaure was 4.0°C. Total stream discharge was low in mid-June (0.5 m^3/s) and continuted to decline through the summer to less than 0.2 m^3/s.

Fifty-three Arctic grayling were captured moving up R09 between June 18 and July 6 while only 15 fish were captured moving downstream. Eight lake trout were also captured incidentally over the course of the summer. Mean size of Arctic grayling at R09 was 257 mm and 230 g with a high mean condition factor of 1.25 (**Table 2**). Length – frequency distribution showed that the size range of fish captured was widely distributed with equitable numbers of both large and small fish with a modal size of 240 mm (**Figure 6**). Most of the fish less than 300 mm in size were considered immature. All fish greater than 300 mm were current year spawners (**Appendix A**). There was no discerable 'peak' of upstream movement of fish. The highest number of fish enumerated (17) was on June 21. Similarly, there was no large or concerted downstream movement of fish, with the nighest number (8 fish) on July 8. Given that the entire stream channel was blocked off, the number of fish migrating in this stream is relatively small.

R09 was not fished in 2007 as the AWPAR had not advanced as far as this crossing by late June. In 2006, 84 fish were captured with a peak upstream migration on June 25 (Azimuth, 2007). Mean size of fish (278 mm, 259 g; K = 1.13) was slightly larger in 2006 than in 2008, but this could have been due to some pre-spawning fish being captured. Larval Arctic grayling were observed in R09 about two to three weeks after the first fish were observed migrating upstream, at water temperatures of about 10°C.

Figure 6: Length – frequency distribution of Arctic grayling from R09, 2008



3.3.4. R15

Four hoop nets were installed at R15 on June 18 (**Table 1**), all orientated to capture upstream moving fish. Nets were switched to capture fish moving downstream on July 5 and pulled entirely on July 16 after a long period of no fish capture and because low water level in the stream impaired movements by fish. Water tempertaure upon installation of the hoop nets was 5.0 °C. Total stream discharge was more than 2.0 m^3/s on June 18 and declined rapidly and consistently through the summer to 0.3 m^3/s on July 18 (**Figure 1**).

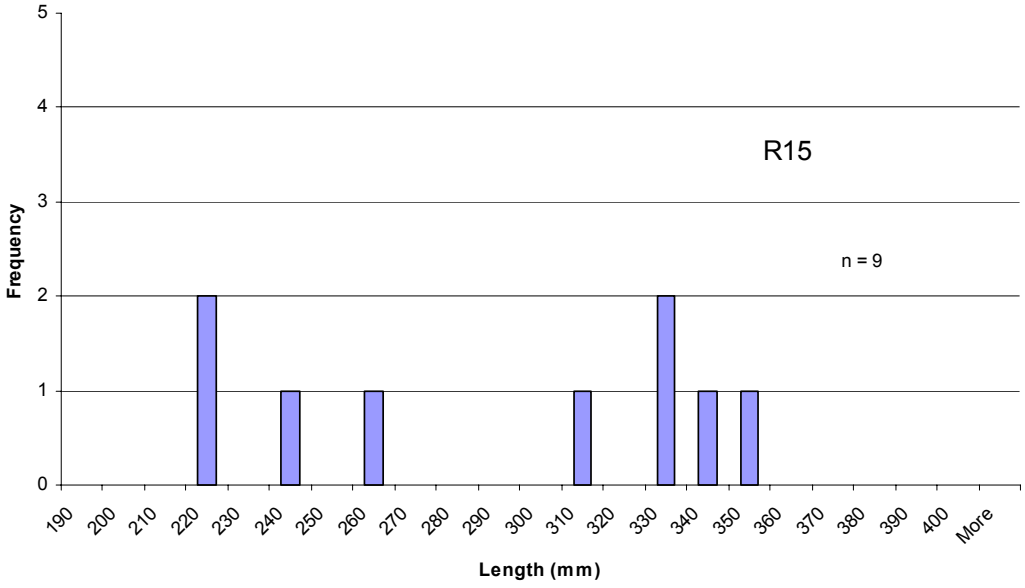
Only nine Arctic grayling were captured moving up R15 during the entire monitoring period, with most (7) on 21 June (**Figure 3**). Mean size of Arctic grayling at R15 was 284 mm and 294 g with a high mean condition factor of 1.23 (**Table 3**). No fish were cpatured moving downstream. The length – frequency distribution showed that the size range of fish captured was widely distributed with equitable numbers of both large and

small fish (**Figure 7**). Most of the fish less than 300 mm in size were considered immature. All fish greater than 300 mm were current year spawners (**Appendix A**). There was no discerable 'peak' of upstream movement of fish because of the small number of fish enumerated.

No other species was encountered in this stream.

R15 was also not fished in 2007 because the AWPAR had not advanced this far by June. The stream at R15 is a shallow diffuse channel with limited passability by fish throughout the open water season. Reconaissance monitoring of R15 in 2006 between June 24 and July 9 (AEM, 2008) captured only five Arctic grayling. Few fish were also captured here in 2005. Hoop nets a larval drift trap were set between June 28 and July 9, 2005 captured only two Arctic grayling. Although connectivity and potential for fish passage was ranked as good, very few fish were encountered now over three years. Larval Arctic grayling fry were collected on two days (July 14 and 15) which confirms that this stream is used for spawning, but the importance of this stream as spawning habitat is uncertain. Again, it is likely that because of movement under ice, the majority of the upstream migration by Arctic grayling was missed.

Figure 7: Length – frequency distribution of Arctic grayling from R15, 2008.



3.4. Recaptures of Adult Arctic Grayling

Twenty-one Arctic grayling tagged during the summer of 2008 were recaptured (**Table 4**). Most of the recaptured fish were caught moving in the same direction and the same net (i.e., upstream or downstream of the bridge) that they were originally tagged. This is likely because most of the spawning fish moving upstream had already passed by the bridges prior to installation of the hoop nets. Most of the recaptured fish were likely undertaking local movements, although many were captured several days or up to two weeks after they were first tagged. Most fish were recaptured at R09 because the entire stream is blocked off by the hoop nets because of its narrow width. Thus there is no ability for fish to avoid nets as can happen in other streams. Two of the recaptured fish at R09 were marked in the net downstream of the bridge and recaptured upstream of the bridge (**Table 4**).

Nine fish tagged in 2007 were recaptured in 2008, all from R06 (**Table 5**). All of the fish recaptured in 2008 were caught moving upstream in June, in hoop nets set up- or downstream of the bridge. Most of the fish were first tagged downstream of the bridge in 2007 and recaptured upstream of the bridge 2008. This suggests that movements of fish were not hampered by constriction of the stream by the bridge abutments as downstream/upstream recaptures were demonstrated, albeit in different years.

No fish tagged at R02 in 2007 were recaptured in 2008. This is likely because most of the migration by spawning adults had already occurred under the ice. Also, because RO2 is such a large stream, only a relatively small area of the stream can be effectively fished by the hoop nets. Many parts of the stream are too shallow to install the main body of the hoop nets but are deep enough to pass fish.

Table 4: Documentation of recaptures of current year tagged Arctic grayling at R02, R06, R09 and R15.

Crossing	Tag #	Date		Length (mm)	Weight (g)	Gender	Maturity	Capture Relative to Bridge	Direction of Movement
R02	85870	Tagged	21-Jun	233	150		1	DS	US
	85870	Recaped	4-Jul					DS	US
R02	86429	Tagged	4-Jul	235	129		1	US	US
	86429	Recaped	10-Jul					US	DS
R06	85865	Tagged	27-Jun	305	300			US	US
R06	85865	Recaped	29-Jun					US	US
R06	86871	Tagged	29-Jun	280	300			US	US
R06	86871	Recaped	30-Jun					DS	US
R06	86871	Recaped	1-Jul					DS	US
R06	86852	Tagged	23-Jun	293	300	F	2	US	US
R06	86852	Recaped	30-Jun					DS	US
R06	85191	Tagged	30-Jun	303	250			DS	US
R06	85191	Recaped	8-Jul					DS	DS
R06	85613	Tagged	8-Jul	359	500			DS	DS
R06	85613	Recaped	12-Jul					US	DS
R09	85873	Tagged	21-Jun	324	350	F	3	DS	US
R09	85873	Recaped	23-Jun					US	US
R09	85812	Tagged	21-Jun	343	500	M	7	US	US
R09	85812	Recaped	24-Jun					US	US
R09	85809	Tagged	21-Jun	296	350	M	7	US	US
R09	85809	Recaped	29-Jun					US	US
R09	86868	Tagged	29-Jun	330	450	F	2	US	US
R09	86868	Recaped	30-Jun					US	US
R09	85801	Tagged	21-Jun	239	175	Imm		DS	US
R09	85801	Recaped	2-Jul					US	US
R09	85805	Tagged	21-Jun	320	400	F	3	US	US
R09	85805	Recaped	2-Jul					US	US
R09	86432	Tagged	4-Jul	231	200	Imm		US	US
R09	86432	Recaped	5-Jul					US	US
R09	86448	Tagged	2-Jul	210	125	Imm		US	US
R09	86448	Recaped	8-Jul					US	DS
R09	86474	Tagged	30-Jun	249	200	Imm		US	US
R09	86474	Recaped	8-Jul					US	DS
R09	86426	Tagged	5-Jul	209	100	Imm		US	US
R09	86426	Recaped	8-Jul					US	DS
R09	86438	Tagged	3-Jul	225	200	Imm		US	US
R09	86438	Recaped	8-Jul					US	DS
R09	86874	Tagged	5-Jul	218	125	Imm		US	US
R09	86874	Recaped	10-Jul					US	DS
R09	86444	Tagged	2-Jul	200	100	Imm		US	US
R09	86444	Recaped	10-Jul					US	DS
R15	85870	Tagged	21-Jun	233	150	Imm		DS	US
R15	85870	Recaped	4-Jul					DS	US

Table 5: Documentation of recapture of Arctic grayling tagged in 2007 at R06.

Crossing	Year	Tag #	Date Caught	Length (mm)	Weight (g)	Gender	Maturity	Capture Relative to Bridge	Direction of Movement
R06	2007	85337	3-Jul	311	405	M	8	DS	DS
	2008	85337	20-Jun	315	375	M	7	US	US
R06	2007	85304	3-Jul	304	335	F	4	DS	DS
	2008	85304	20-Jun	309	350	F	3	US	US
R06	2007	85189	2-Jul	336	395	F	4	DS	DS
	2008	85189	22-Jun	340	400	F	2	US	US
R06	2007	85589	2-Jul	348	515	M	9	DS	DS
	2008	85589	23-Jun	355	500	M		US	US
R06	2007	85593	2-Jul	309	350	F	4	DS	DS
	2008	85593	23-Jun	310	300	F		US	US
R06	2007	85313	2-Jul	291	305	F	4	DS	DS
	2008	85313	23-Jun	305	300	F		US	US
R06	2007	85342	3-Jul	321	355	F	1	DS	DS
	2008	85342	27-Jun	330	450	F		US	US
R06	2007	85191	1-Jul	295	290	F	4	DS	DS
	2008	85191	30-Jun	303	250	F		DS	US
R06	2007	85339	1-Jul	311	305	F	4	US	DS
	2008	85339	30-Jun	315	300	F		DS	US

3.5. Larval Drift

Larval drift traps were installed at R02 on June 21, within (DT1 – DT6) and downstream (DT-7, DT8) of the designated enhancement area upstream of the bridge crossing, at a similar location as in 2007. The first larvae were captured on June 23 which is several days earlier than when larvae were first captured in 2007 (June 29). Peak drift in 2008 was 23 – 24 June and extended to June 29 at water temperatures of 6^{o}C. Peak drift in 2007 was June 30 to July 4 at Area A and June 29 – 30 at Area B when water temperatures ranged from 6^{o}C to 12^{o}C.

One-hundred fifty-eight larval grayling were collected in 2008, within (70) and downstream (88) of the enhancement area. Given that only 2 nets were set downstream of the enhancement area, the number of larvae captured per trap (44) was much higher than traps set within the compensation area (12). Larval Arctic grayling were observed at R02 shortly after hoop nets were installed at water temperatures of about 6.0C. This indicates that Arctic grayling had migrated and spawned well in advance of hoop net installation. In addition, the larvae captured did not have yolk sacs attached and were in a relatively advanced stage of development (i.e., several days post-hatch). This indicates that mature Arctic grayling had migrated upstream and established spawning territories at R02 as early as mid-late May, prior to ice-off of the stream at fairly low water temperatures, probably around 4^{o}C or less. Assuming that larvae hatch and emerge from the gravel at least two to three weeks after eggs were laid, this further suggests early movement and spawning by grayling upstream of the bridge crossing at R02. This was well in advance of initiation of the 2008 field survey and suggests that adult fish had navigated past the bridge at much higher flow velocities and discharge than was measured in 2008. This also lends support to our belief that fish moved up all of the streams well before it was possible, or safe to install fishing gear in the streams.

3.6. Creel Survey

Fish harvest information (species and locations) was collected from a large number of Baker Lake residents by AEM throughout 2008 (**Appendix C**). Consistent with previous fishing patterns in 2007, fishing effort was directed towards spring ice-fishing on several lakes north of Baker Lake, including Whitehills Lake, and early summer fishing for anadromous Arctic char near the mouth of Chesterfield Inlet.

AEM, Azimuth and North/South staff did not witness or hear of fishing activities for Arctic grayling taking place in streams along the AWPAR. The traditional knowledge survey indicated that five lake trout were captured in the vicinity of the road, north of Amarulik Lake but it is not known if these were taken from a lake or from a stream. To our knowledge, no individuals used the AWPAR to access nearby lakes to undertake fishing activities, but due to its use to access hunting grounds, this cannot be ruled out.

4. CONCLUSIONS

The 2008 DFO authorization for AWPAR required that the following components be addressed by field studies:

- Fish passage past bridges
- Success of compensation features
- Catch results from a creel survey

The 2008 results confirmed that Arctic grayling are able to successfully navigate past the bridge structures at R02, R06, R09 and R15 (and R19). Maximum water velocities measured at each crossing (**Table 2**) were lower than prolonged or maximum velocities that grayling were able to swim over the short distance between the downstream and upstream margins of the abutments. This is consistent with monitoring results in 2007 that also demonstrated successful navigation and spawning at R02 and R06. Recapture of previously marked fish (current year and 2007) also indicates that fish moved beneath the bridges and that movements were not prevented by abutment-related stream velocities. However, given that Arctic grayling moved and spawned earlier and possibly under the ice, the majority of the spawning migration was probably missed. Notwithstanding this, results from larval drift traps demonstrated that successful spawning by Arctic grayling occurred upstream of the bridge at R02 and that spawning occurred several weeks before our survey began. This further suggests that mature adults navigated upstream and spawned, probably under the ice well before hoop nets were installed. Given the early date of recapture of larval Arctic grayling, it is likely that adult spawners moved upstream under the ice. We speculate that water velocity may have been lower under the ice when streams were first opening up, than during peak freshet.

The reach of river upstream of R02 has been successfully used by Arctic grayling for spawning since monitoring was initiated in 2005. This portion f this reach with lower habitat value has been selected for enhancement to compensate for the loss of habitat from installation of bridge abutments; construction is scheduled for this winter.

5. REFERENCES

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APPENDICES

APPENDIX A

RAW AWPAR FISHERIES DATA, 2008

Appendix A Table: Daily movements of fish species up- and down- stream of R02, R06, R09 and R15, biological and recapture data along the AWPAR, 2008.

Crossing ID	Date	Staff Gauge	Water Temp	Species	u/s : d/s of bridge	Direction of Movement	Fish #	Fork Length (mm)	Weight (g)	Tag #	Sex	Maturity	Recap	Comments
R02	06/16/2008	73	3.0		D/S	U/S								installed hoopnets d/s of bridge oriented to capture
R02	06/17/2008	68	3.0		U/S	U/S								installed hoopnets u/s of bridge to capture u/s
R02	06/17/2008	68	3.0		D/S	U/S								**no catch**
R06	06/17/2008	107	3.0		U/S	U/S								installed hoopnets u/s of bridge to capture u/s
R09	06/18/2008	77	4.0		U/S	U/S								installed hoopnet u/s of bridge to capture u/s
R09	06/18/2008	77	4.0		D/S	U/S								installed hoopnets d/s of bridge oriented to capture
R15	06/18/2008	560	5.0		U/S	U/S								installed hoopnet u/s of bridge to capture u/s
R15	06/18/2008	560	5.0		D/S	U/S								installed hoopnets d/s of bridge oriented to capture
R06	06/18/2008	105	4.5		U/S	U/S								**no catch**
R02	06/18/2008	66	5.0		U/S	U/S								**no catch**
R02	06/18/2008	66	5.0		D/S	U/S								**no catch**
R15	06/19/2008	56	4.5		U/S	U/S								**no catch**
R15	06/19/2008	56	4.5		D/S	U/S								**no catch**
R09	06/19/2008	78	5.0		U/S	U/S								**no catch**
R09	06/19/2008	78	5.0		D/S	U/S								**no catch**
R06	06/19/2008	107	4.0		U/S	U/S								**no catch**
R02	06/19/2008	64	5.0		U/S	U/S								**no catch**
R02	06/19/2008	64	5.0		D/S	U/S								**no catch**
R06	06/20/2008	108	5.0	ARGR	U/S	U/S	1	315	375	85337	M	7	PYRC	
R06	06/20/2008	108	5.0	ARGR	U/S	U/S	2	309	350	85304	F	3	PYRC	
R06	06/20/2008	108	5.0	ARGR	U/S	U/S	3	348	475	85854	M	7		
R06	06/20/2008	108	5.0	ARGR	U/S	U/S	4	335	450	85855	M	8		
R06	06/20/2008	108	5.0	ARGR	U/S	U/S	5	298	325	85856	F	2		
R06	06/20/2008	108	5.0	ARGR	U/S	U/S	6	338	500	85857	M	7		
R06	06/20/2008	108	5.0	ARGR	U/S	U/S	7	325	425	85858	M	7		
R06	06/20/2008	108	5.0	ARGR	U/S	U/S	8	338	500	85859	M	7		
R06	06/20/2008	108	5.0	ARGR	U/S	U/S	9	324	425	85860	M	7		
R06	06/20/2008	108	5.0	ARGR	U/S	U/S	10	383	675	85861	M	7		
R06	06/20/2008	108	5.0	ARGR	U/S	U/S	11	305	375	85862	M	7		
R06	06/20/2008	108	5.0	ARGR	U/S	U/S	12	386	650	85863	M	8		
R06	06/20/2008	108	5.0	ARGR	U/S	U/S	13	357	600	85864	M	7		
R02	06/20/2008	62	4.5		U/S	U/S								**no catch**
R02	06/20/2008	62	4.5		D/S	U/S								**no catch**
R15	06/20/2008	-	-		U/S	U/S								**not checked**
R15	06/20/2008	-	-		D/S	U/S								**not checked**
R09	06/20/2008	-	-		U/S	U/S								**not checked**
R09	06/20/2008	-	-		D/S	U/S								**not checked**
R15	06/21/2008	56	5.0	ARGR	U/S	U/S	14	257	225	85865		IMM		
R15	06/21/2008	56	5.0	ARGR	D/S	U/S	15	325	375	85866				
R15	06/21/2008	56	5.0	ARGR	D/S	U/S	16	335	400	85867	M	7		
R15	06/21/2008	56	5.0	ARGR	D/S	U/S	17	307	350	85868				

Appendix A Table: Daily movements of fish species up- and down- stream of R02, R06, R09 and R15, biological and recapture data along the AWPAR, 2008.

Crossing ID	Date	Staff Gauge	Water Temp	Species	u/s : d/s of bridge	Direction of Movement	Fish #	Fork Length (mm)	Weight (g)	Tag #	Sex	Maturity	Recap	Comments
R15	06/21/2008	56	5.0	ARGR	D/S	U/S	18	341	425	85869	M	7		
R15	06/21/2008	56	5.0	ARGR	D/S	U/S	19	233	150	85870				
R15	06/21/2008	56	5.0	ARGR	D/S	U/S	20	325	425	85871	F	3		
R09	06/21/2008	75	6.0	LKTR	D/S	U/S	21	695	3300	85872				
R09	06/21/2008	75	6.0	ARGR	D/S	U/S	22	324	350	85873	F	3		
R09	06/21/2008	75	6.0	ARGR	D/S	U/S	23	286	275	85874				
R09	06/21/2008	75	6.0	ARGR	D/S	U/S	24	333	425	85875	M	7		
R09	06/21/2008	75	6.0	ARGR	D/S	U/S	25	239	175	85801		IMM		
R09	06/21/2008	75	6.0	ARGR	D/S	U/S	26	300	375	85802	F	3		
R09	06/21/2008	75	6.0	ARGR	D/S	U/S	27	334	400	85803	M	7		
R09	06/21/2008	75	6.0	LKTR	U/S	U/S	28	563	1525	-				too weak to tag
R09	06/21/2008	75	6.0	LKTR	U/S	U/S	29	455	1000	85804				
R09	06/21/2008	75	6.0	ARGR	U/S	U/S	30	320	400	85805	F	3		
R09	06/21/2008	75	6.0	ARGR	U/S	U/S	31	273	275	85806				
R09	06/21/2008	75	6.0	ARGR	U/S	U/S	32	200	175	85807				
R09	06/21/2008	75	6.0	ARGR	U/S	U/S	33	281	300	85808	F	2		
R09	06/21/2008	75	6.0	ARGR	U/S	U/S	34	296	350	85809	M	7		
R09	06/21/2008	75	6.0	ARGR	U/S	U/S	35	322	350	85810	M	7		
R09	06/21/2008	75	6.0	ARGR	U/S	U/S	36	234	175	85811				
R09	06/21/2008	75	6.0	ARGR	U/S	U/S	37	343	500	85812	M	7		
R09	06/21/2008	75	6.0	ARGR	U/S	U/S	38	284	300	85813				
R09	06/21/2008	75	6.0	ARGR	U/S	U/S	39	317	400	85814	M	7		
R09	06/21/2008	75	6.0	ARGR	U/S	U/S	40	309	375	85815				
R15	06/22/2008	55	3.5	ARGR	U/S	U/S	41	215	100	85816				
R15	06/22/2008	55	3.5		D/S	U/S								**no catch**
R09	06/22/2008	73	5.0	ARGR	U/S	U/S	41.5	325	500	85817				
R09	06/22/2008	73	5.0	LKTR	D/S	U/S	42	420	600	85818				
R06	06/22/2008	103	5.0	ARGR	U/S	U/S	43	340	400	85189	F	2	PYRC	
R06	06/22/2008	103	5.0	ARGR	U/S	U/S	44	325	450	85819				
R06	06/22/2008	103	5.0	ARGR	U/S	U/S	45	325	400	85820				
R06	06/22/2008	103	5.0	ARGR	U/S	U/S	46	345	500	85821	M	7		
R06	06/22/2008	103	5.0	ARGR	U/S	U/S	47	200	100	85822				
R06	06/22/2008	103	5.0		D/S	U/S								**no catch**
R02	06/22/2008	60	4.5		U/S	U/S								**no catch**
R02	06/22/2008	60	4.5		D/S	U/S								**no catch**
R15	06/23/2008	53	4.0		U/S	U/S								**no catch**
R15	06/23/2008	53	4.0		D/S	U/S								**no catch**
R09	06/23/2008	71	6.0	ARGR	U/S	U/S	48			85873	F	3	CYRC	
R09	06/23/2008	71	6.0		D/S	U/S								**no catch**
R06	06/23/2008	103	5.0		D/S	U/S								**no catch**
R06	06/23/2008	103	5.0	ARGR	U/S	U/S	49	355	500	85589			PYRC	

Appendix A Table: Daily movements of fish species up- and down- stream of R02, R06, R09 and R15, biological and recapture data along the AWPAR, 2008.

Crossing ID	Date	Staff Gauge	Water Temp	Species	u/s : d/s of bridge	Direction of Movement	Fish #	Fork Length (mm)	Weight (g)	Tag #	Sex	Maturity	Recap	Comments
R06	06/23/2008	103	5.0	ARGR	U/S	U/S	50	310	300	85593			PYRC	
R06	06/23/2008	103	5.0	ARGR	U/S	U/S	51	305	300	85313			PYRC	
R06	06/23/2008	103	5.0	ARGR	U/S	U/S	52	345	450	85823	M	8		
R06	06/23/2008	103	5.0	ARGR	U/S	U/S	53	322	400	85824				
R06	06/23/2008	103	5.0	ARGR	U/S	U/S	54	310	300	85825	F	2		
R06	06/23/2008	103	5.0	ARGR	U/S	U/S	55	295	250	86851	M	7		
R06	06/23/2008	103	5.0	ARGR	U/S	U/S	56	293	300	86852	F	2		
R06	06/23/2008	103	5.0	ARGR	U/S	U/S	57	350	450	86853	M	7		
R02	06/23/2008	58	5.0		U/S	U/S								**no catch**
R02	06/23/2008	58	5.0		D/S	D/S								mid channel net reoriented to capture d/s movements and moved closer to north pier
R02	06/23/2008	58	5.0		D/S	U/S								**no catch**
R15	06/24/2008	51	5.0		U/S	U/S								**no catch**
R15	06/24/2008	51	5.0		D/S	U/S								**no catch**
R09	06/24/2008	70	6.0	ARGR	U/S	U/S	58			85812			CYRC	
R09	06/24/2008	70	6.0	ARGR	U/S	U/S	59	315	350	86854	M	7		
R09	06/24/2008	70	6.0	ARGR	U/S	U/S	60	260	200	86855				
R09	06/24/2008	70	6.0	ARGR	U/S	U/S	61	250	200	86856				
R09	06/24/2008	70	6.0		D/S	U/S								**no catch**
R06	06/24/2008	101	6.0		D/S	U/S								**no catch**
R06	06/24/2008	101	6.0	ARGR	U/S	U/S	62	325	400	86857	F	2		
R06	06/24/2008	101	6.0	ARGR	U/S	U/S	63	300	300	86858				
R02	06/24/2008	56	6.0		U/S	U/S								**no catch**
R02	06/24/2008	56	6.0		D/S	D/S								**no catch**
R02	06/24/2008	56	6.0		D/S	U/S								**no catch**
R15	06/25/2008	50	5.0		U/S	U/S								**no catch**
R15	06/25/2008	50	5.0		D/S	U/S								**no catch**
R09	06/25/2008	71	5.0		D/S	U/S								**no catch**
R09	06/25/2008	71	5.0	ARGR	U/S	U/S	64	225	100	86859				
R09	06/25/2008	71	5.0	ARGR	U/S	U/S	65	310	400	86860	M	7		
R09	06/25/2008	71	5.0	ARGR	U/S	U/S	66	265	200	86861				
R06	06/25/2008	101	5.0		D/S	U/S								**no catch**
R06	06/25/2008	101	5.0		U/S	U/S								**no catch**
R02	06/25/2008	55	6.0		U/S	U/S								**no catch**
R02	06/25/2008	55	6.0		D/S	D/S								**no catch**
R02	06/25/2008	55	6.0	ARGR	D/S	U/S	67	280	250	86862				
R15	06/26/2008	50	5.0		U/S	U/S								**no catch**
R15	06/26/2008	50	5.0		D/S	U/S								**no catch**
R09	06/26/2008	71	6.0		D/S	U/S								**no catch**
R09	06/26/2008	71	6.0	ARGR	U/S	U/S	68	235	100	86864				
R06	06/26/2008	103	5.0		D/S	U/S								**no catch**
R06	06/26/2008	103	5.0		U/S	U/S								**no catch**

Appendix A Table: Daily movements of fish species up- and down- stream of R02, R06, R09 and R15, biological and recapture data along the AWPAR, 2008.

Crossing ID	Date	Staff Gauge	Water Temp	Species	u/s : d/s of bridge	Direction of Movement	Fish #	Fork Length (mm)	Weight (g)	Tag #	Sex	Maturity	Recap	Comments
R02	06/26/2008	59	5.0		U/S	U/S								**no catch**
R02	06/26/2008	59	5.0		D/S	D/S								**no catch**
R02	06/26/2008	59	5.0		D/S	U/S								**no catch**
R15	06/27/2008	48	5.0		U/S	U/S								**no catch**
R15	06/27/2008	48	5.0		D/S	U/S								**no catch**
R09	06/27/2008	75	5.0		D/S	U/S								**no catch**
R09	06/27/2008	75	5.0		U/S	U/S								**no catch**
R06	06/27/2008	102	5.0		D/S	U/S								**not checked**
R06	06/27/2008	102	5.0	ARGR	U/S	U/S	69	330	450	85342			PYCR	
R06	06/27/2008	102	5.0	ARGR	U/S	U/S	70	305	300	86865				
R02	06/27/2008	59	5.0		U/S	U/S								**no catch**
R02	06/27/2008	59	5.0		D/S	D/S								**no catch**
R02	06/27/2008	59	5.0		D/S	U/S								**no catch**
R15	06/28/2008	-	-		U/S	U/S								**not checked**
R15	06/28/2008	-	-		D/S	U/S								**not checked**
R09	06/28/2008	-	-		D/S	U/S								**not checked**
R09	06/28/2008	-	-		U/S	U/S								**not checked**
R06	06/28/2008	-	-		D/S	U/S								**not checked**
R06	06/28/2008	-	-		U/S	U/S								**not checked**
R02	06/28/2008	-	-		U/S	U/S								**not checked**
R02	06/28/2008	-	-		D/S	D/S								**not checked**
R02	06/28/2008	-	-		D/S	U/S								**not checked**
R15	06/29/2008	48	5.5		U/S	U/S								**no catch**
R15	06/29/2008	48	5.5		D/S	U/S								**no catch**
R09	06/29/2008	71	8.0		D/S	U/S								**no catch**
R09	06/29/2008	71	8.0	ARGR	U/S	U/S	71			85809			CYRC	
R09	06/29/2008	71	8.0	LKTR	U/S	U/S	72	440	800	86866				
R09	06/29/2008	71	8.0	ARGR	U/S	U/S	73	309	400	86867	F	2		
R09	06/29/2008	71	8.0	ARGR	U/S	U/S	74	330	450	86868	F	2		
R06	06/29/2008	101	6.0		D/S	U/S								**no catch**
R06	06/29/2008	101	6.0	ARGR	U/S	U/S	75			86865			CYRC	
R06	06/29/2008	101	6.0	ARGR	U/S	U/S	76	290	300	86869				
R06	06/29/2008	101	6.0	ARGR	U/S	U/S	77	270	250	86870				
R06	06/29/2008	101	6.0	ARGR	U/S	U/S	78	280	300	86871				
R06	06/29/2008	101	6.0	ARGR	U/S	U/S	79	310	300	86872	M	7		
R02	06/29/2008	58	9.0		D/S	D/S								**no catch**
R02	06/29/2008	58	9.0		D/S	U/S								**no catch**
R02	06/29/2008	58	9.0	ARGR	U/S	U/S	80	240	200	86873				
R02	06/29/2008	58	9.0	ARGR	U/S	U/S	81	225	200	86451				
R15	06/30/2008	48	6.0		U/S	U/S								**no catch**
R15	06/30/2008	48	6.0		D/S	U/S								**no catch**

Appendix A Table: Daily movements of fish species up- and down- stream of R02, R06, R09 and R15, biological and recapture data along the AWPAR, 2008.

Crossing ID	Date	Staff Gauge	Water Temp	Species	u/s : d/s of bridge	Direction of Movement	Fish #	Fork Length (mm)	Weight (g)	Tag #	Sex	Maturity	Recap	Comments
R09	06/30/2008	71	7.0		D/S	U/S								**no catch**
R09	06/30/2008	71	7.0	ARGR	U/S	U/S	82			86868			CYRC	
R09	06/30/2008	71	7.0	ARGR	U/S	U/S	83	219	100	86452				
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	84			85342			PYRC	second time recap
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	85	303	250	85191			PYRC	
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	86			85189			PYRC	second time recap
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	87			86871			CYRC	
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	88	315	300	85339			PYRC	
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	89			85313			PYRC	second time recap
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	90			86852			CYRC	
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	91	260	150	86453				
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	92	295	250	86454				
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	93	310	300	86455				
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	94	285	250	86456				
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	95	292	300	86458	F	2		
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	96	310	300	86459	M	7		
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	97	305	300	86460				
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	98	275	275	86461				
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	99	270	250	86462				
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	100	295	300					too weak to tag
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	101	270	250	86463	M	7		
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	102	310	400	86464				
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	103	315	350	86465				
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	104	285	300	86466				
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	105	240	200	86467				
R06	06/30/2008	101	5.0	ARGR	D/S	U/S	106	217	125	86468				
R06	06/30/2008	101	5.0	ARGR	U/S	U/S	107	310	300	86469				
R02	06/30/2008	59	7.0	ARGR	U/S	U/S	108	310	300	86470				
R02	06/30/2008	59	7.0	ARGR	U/S	U/S	109	200	100	86471				
R02	06/30/2008	59	7.0	ARGR	U/S	U/S	110	215	150	86472				
R02	06/30/2008	59	7.0	ARGR	U/S	U/S	111	230	200	86473				
R02	06/30/2008	59	7.0	ARGR	U/S	U/S	112	249	200	86474				
R02	06/30/2008	59	7.0		D/S	D/S								**no catch**
R02	06/30/2008	59	7.0		D/S	U/S								**no catch**
R15	1/7/2008				U/S	U/S								**not checked**
R15	1/7/2008				D/S	U/S								**not checked**
R09	1/7/2008				D/S	U/S								**not checked**
R09	1/7/2008				U/S	U/S								**not checked**
R06	1/7/2008	101	6.0	ARGR	D/S	U/S	113			86871			CYRC	
R06	1/7/2008	101	6.0	ARGR	D/S	U/S	114	285	250	86475				
R06	1/7/2008	101	6.0		U/S	U/S								**no catch**

Appendix A Table: Daily movements of fish species up- and down- stream of R02, R06, R09 and R15, biological and recapture data along the AWPAR, 2008.

Crossing ID	Date	Staff Gauge	Water Temp	Species	u/s : d/s of bridge	Direction of Movement	Fish #	Fork Length (mm)	Weight (g)	Tag #	Sex	Maturity	Recap	Comments
R02	1/7/2008	58	8.0		D/S	D/S								**no catch**
R02	1/7/2008	58	8.0		D/S	U/S								**no catch**
R02	1/7/2008	58	8.0	ARGR	U/S	U/S	115	340	375	86450	M	8		
R02	1/7/2008	58	8.0	ARGR	U/S	U/S	116	230	100	86449				
R15	2/7/2008	47	5.5		U/S	U/S								**no catch**
R15	2/7/2008	47	5.5		D/S	U/S								**no catch**
R09	2/7/2008	70	7.0		D/S	U/S								**no catch**
R09	2/7/2008	70	7.0	ARGR	U/S	U/S	117			85801			CYRC	
R09	2/7/2008	70	7.0	ARGR	U/S	U/S	118			85805			CYRC	
R09	2/7/2008	70	7.0	ARGR	U/S	U/S	119	210	125	86448				
R09	2/7/2008	70	7.0	ARGR	U/S	U/S	120	220	200	86447				
R09	2/7/2008	70	7.0	ARGR	U/S	U/S	121	310	450	86446				
R09	2/7/2008	70	7.0	ARGR	U/S	U/S	122	195	100	86445				
R09	2/7/2008	70	7.0	ARGR	U/S	U/S	123	200	100	86444				
R09	2/7/2008	70	7.0	ARGR	U/S	U/S	124	218	200	86443				
R09	2/7/2008	70	7.0	ARGR	U/S	U/S	125	200	100	86441				
R09	2/7/2008	70	7.0	ARGR	U/S	U/S	126	270	300	86442				
R06	2/7/2008	100	6.0		D/S	U/S								**no catch**
R06	2/7/2008	100	6.0		U/S	U/S								**no catch**
R02	2/7/2008	56	9.0		D/S	U/S								**no catch**
R02	2/7/2008	56	9.0		D/S	D/S								**no catch**
R02	2/7/2008	56	9.0	ARGR	U/S	U/S	127	235	150	86440				
R15	3/7/2008	46	6.0		U/S	U/S								**no catch**
R15	3/7/2008	46	6.0		D/S	U/S								**no catch**
R09	3/7/2008	70	8.5		D/S	U/S								**no catch**
R09	3/7/2008	70	8.5	ARGR	U/S	U/S	128	255	200	86439				
R09	3/7/2008	70	8.5	ARGR	U/S	U/S	129	208	75	86438				
R06	3/7/2008	98.5	6.5		D/S	U/S								**no catch**
R06	3/7/2008	98.5	6.5	ARGR	U/S	U/S	130	318	400	86437				
R02	3/7/2008	55	9.0		D/S	U/S								**no catch**
R02	3/7/2008	55	9.0		D/S	D/S								**no catch**
R02	3/7/2008	55	9.0		U/S	U/S								**no catch**
R15	4/7/2008	45	6.0	ARGR	D/S	U/S	131			85870			CYRC	
R15	4/7/2008	45	6.0	ARGR	U/S	U/S	132	220	200	86436				
R09	4/7/2008	69	9.0		D/S	U/S								**no catch**
R09	4/7/2008	69	9.0	ARGR	U/S	U/S	133	245	200	86435				
R09	4/7/2008	69	9.0	ARGR	U/S	U/S	134	247	200	86434				
R09	4/7/2008	69	9.0	ARGR	U/S	U/S	135	280	300	86433	M	7		
R09	4/7/2008	69	9.0	ARGR	U/S	U/S	136	231	200	86432				
R06	4/7/2008	97	7.0		U/S	U/S								**no catch**
R06	4/7/2008	97	7.0	ARGR	D/S	U/S	137	320	450	86431				

Appendix A Table: Daily movements of fish species up- and down- stream of R02, R06, R09 and R15, biological and recapture data along the AWPAR, 2008.

Crossing ID	Date	Staff Gauge	Water Temp	Species	u/s : d/s of bridge	Direction of Movement	Fish #	Fork Length (mm)	Weight (g)	Tag #	Sex	Maturity	Recap	Comments
R06	4/7/2008	97	7.0	ARGR	D/S	U/S	138	290	350	86430				
R02	4/7/2008	55	10.0		D/S	U/S								**no catch**
R02	4/7/2008	55	10.0		D/S	D/S								**no catch**
R02	4/7/2008	55	10.0	ARGR	U/S	U/S	139	235	129	86429				
R15	5/7/2008	44	7.0		D/S	U/S								**no catch**
R15	5/7/2008	44	7.0		U/S	U/S								**no catch**
R15	5/7/2008	44	7.0		U/S	D/S								upstream nets reoriented to capture d/s movements
R09	5/7/2008	68	10.0		D/S	U/S								**no catch**
R09	5/7/2008	68	10.0	ARGR	U/S	U/S	140			86432			CYRC	
R09	5/7/2008	68	10.0	ARGR	U/S	U/S	141	235	150	86428				
R09	5/7/2008	68	10.0	ARGR	U/S	U/S	142	238	175	86427				
R09	5/7/2008	68	10.0	ARGR	U/S	U/S	143	209	100	86426				
R09	5/7/2008	68	10.0	ARGR	U/S	U/S	144	240	175	86875				
R09	5/7/2008	68	10.0	ARGR	U/S	U/S	145	218	125	86874				
R09	5/7/2008	68	10.0	ARGR	U/S	U/S	146	247	225	85601				
R06	5/7/2008	96	7.0		U/S	U/S								**no catch**
R06	5/7/2008	96	7.0		D/S	U/S								**no catch**
R06	5/7/2008	96	7.0		U/S	D/S								upstream nets reoriented to capture d/s movements
R02	5/7/2008	53	9.0		D/S	D/S								**no catch**
R02	5/7/2008	53	9.0		D/S	U/S								**no catch**
R02	5/7/2008	53	9.0	RNWH	U/S	U/S	147	323	400	85602				
R15	6/7/2008				D/S	U/S								**not checked**
R15	6/7/2008				U/S	D/S								**not checked**
R09	6/7/2008	68	9.0	ARGR	D/S	U/S	148	235	175	85603				
R09	6/7/2008	68	9.0	ARGR	D/S	U/S	149	240	125	85604				
R09	6/7/2008	68	9.0		U/S	U/S								**no catch**
R09	6/7/2008	68	9.0		U/S	D/S								upstream nets reoriented to capture d/s movements
R06	6/7/2008	95	6.0		D/S	U/S								**no catch**
R06	6/7/2008	95	6.0		U/S	D/S								**no catch**
R02	6/7/2008	53	9.5	RNWH	U/S	U/S	150	294	250	85605				
R02	6/7/2008	53	9.5		D/S	U/S								**no catch**
R02	6/7/2008	53	9.5		D/S	D/S								**no catch**
														south net reoriented to capture d/s movements
R02	6/7/2008	53	9.5		U/S	D/S								
R15	7/7/2008	43	7.0		D/S	U/S								**no catch**
R15	7/7/2008	43	7.0		U/S	D/S								**no catch**
R09	7/7/2008	66	10.0		D/S	U/S								**no catch**
R09	7/7/2008	66	10.0		U/S	D/S								**no catch**
R06	7/7/2008	96	7.0		D/S	U/S								**no catch**
R06	7/7/2008	96	7.0		U/S	D/S								**no catch**
R02	7/7/2008	53	10.0		U/S	U/S								**no catch**
R02	7/7/2008	53	10.0		D/S	U/S								**no catch**

Appendix A Table: Daily movements of fish species up- and down- stream of R02, R06, R09 and R15, biological and recapture data along the AWPAR, 2008.

Crossing ID	Date	Staff Gauge	Water Temp	Species	u/s : d/s of bridge	Direction of Movement	Fish #	Fork Length (mm)	Weight (g)	Tag #	Sex	Maturity	Recap	Comments
R02	7/7/2008	53	10.0		D/S	D/S								**no catch**
R02	7/7/2008	53	10.0		U/S	D/S								**no catch**
R15	8/7/2008	42	12.0		D/S	U/S								**no catch**
R15	8/7/2008	42	12.0		U/S	D/S								**no catch**
R09	8/7/2008	67	14.0	LKTR	U/S	D/S	151	513	1450	85606				
R09	8/7/2008	67	14.0	ARGR	U/S	D/S	152			86448			CYRC	
R09	8/7/2008	67	14.0	ARGR	U/S	D/S	153			86474			CYRC	
R09	8/7/2008	67	14.0	ARGR	U/S	D/S	154			86426			CYRC	
R09	8/7/2008	67	14.0	ARGR	U/S	D/S	155			86438			CYRC	removed tag - fish dead
R09	8/7/2008	67	14.0	ARGR	U/S	D/S	156	245	125	85607				
R09	8/7/2008	67	14.0	ARGR	U/S	D/S	157	213	75	85608				
R09	8/7/2008	67	14.0	ARGR	U/S	D/S	158	235	100	85609				
R09	8/7/2008	67	14.0	ARGR	D/S	U/S	159	222	100	85610				
R06	8/7/2008	95	9.0	ARGR	D/S	D/S	160			85191			CYRC	
R06	8/7/2008	95	9.0	ARGR	D/S	D/S	161	287	300	85611				
R06	8/7/2008	95	9.0	ARGR	D/S	D/S	162	242	150	85612				
R06	8/7/2008	95	9.0	ARGR	D/S	D/S	163	359	500	85613				
R06	8/7/2008	95	9.0	ARGR	D/S	D/S	164	230	150	85614				
R06	8/7/2008	95	9.0	ARGR	D/S	D/S	165	242	200	85615				
R06	8/7/2008	95	9.0		U/S	D/S								**no catch**
R02	8/7/2008	51	13.0		D/S	D/S								**no catch**
R02	8/7/2008	51	13.0		D/S	U/S								**no catch**
R02	8/7/2008	51	13.0	ARGR	U/S	U/S	166	263	200	85616				
R02	8/7/2008	51	13.0	ARGR	U/S	D/S	167	225	100					too weak to tag
R02	8/7/2008	51	13.0	ARGR	U/S	D/S	168	217	100					too weak to tag
R02	8/7/2008	51	13.0	ARGR	U/S	D/S	169	242	175	85617				
R02	8/7/2008	51	13.0	ARGR	U/S	D/S	170	270	250	85618				
R02	8/7/2008	51	13.0	ARGR	U/S	D/S	171	245	200	85619				
R02	8/7/2008	51	13.0	ARGR	U/S	D/S	172	233	150	85620				
R15	9/7/2008	41	12.0		D/S	U/S								**no catch**
R15	9/7/2008	41	12.0		U/S	D/S								**no catch**
R09	9/7/2008	67	12.0		D/S	U/S								**no catch**
R09	9/7/2008	67	12.0	ARGR	U/S	D/S	173	201	100	85621				
R09	9/7/2008	67	12.0	ARGR	U/S	D/S	174	203	125	85622				
R06	9/7/2008	95	9.0		D/S	D/S								**no catch**
R06	9/7/2008	95	9.0		U/S	D/S								**no catch**
R02	9/7/2008	50	12.5		D/S	D/S								**no catch**
R02	9/7/2008	50	12.5		D/S	U/S								**no catch**
R02	9/7/2008	50	12.5		U/S	U/S								**no catch**
R02	9/7/2008	50	12.5	ARGR	U/S	D/S	175			85619			CYRC	
R02	9/7/2008	50	12.5	ARGR	U/S	D/S	176	211	100	85623				

Appendix A Table: Daily movements of fish species up- and down- stream of R02, R06, R09 and R15, biological and recapture data along the AWPAR, 2008.

Crossing ID	Date	Staff Gauge	Water Temp	Species	u/s : d/s of bridge	Direction of Movement	Fish #	Fork Length (mm)	Weight (g)	Tag #	Sex	Maturity	Recap	Comments
R15	10/7/2008	40	12.0		D/S	U/S								**no catch**
R15	10/7/2008	40	12.0		U/S	D/S								**no catch**
R09	10/7/2008	65	15.0		D/S	U/S								**no catch**
R09	10/7/2008	65	15.0	ARGR	U/S	D/S	177			86874			CYRC	
R09	10/7/2008	65	15.0	ARGR	U/S	D/S	178			86444			CYRC	
R06	10/7/2008	92	9.0		D/S	D/S								**no catch**
R06	10/7/2008	92	9.0	ARGR	U/S	D/S	179	247	200	85624				
R06	10/7/2008	92	9.0	ARGR	U/S	D/S	180	300	425	85625				
R06	10/7/2008	92	9.0	ARGR	U/S	D/S	181	240	225	85626				
R06	10/7/2008	92	9.0	ARGR	U/S	D/S	182	234	200	85627				
R02	10/7/2008	50	15.0		U/S	U/S								**no catch**
R02	10/7/2008	50	15.0		D/S	D/S								**no catch**
R02	10/7/2008	50	15.0		D/S	U/S								**no catch**
R02	10/7/2008	50	15.0	ARGR	U/S	D/S	183			86429			CYRC	
R02	10/7/2008	50	15.0	ARGR	U/S	D/S	184	232	150	85628				
R02	10/7/2008	50	15.0	ARGR	U/S	D/S	185	232	150	85629				
R02	10/7/2008	50	15.0	ARGR	U/S	D/S	186	206	100	85630				
R02	10/7/2008	50	15.0	RNWH	U/S	D/S	187	255	200	85631				
R15	11/7/2008	39	14.0		D/S	U/S								**no catch**
R15	11/7/2008	39	14.0		U/S	D/S								**no catch**
R09	11/7/2008	65	15.0		D/S	U/S								**no catch**
R09	11/7/2008	65	15.0	LKTR	U/S	D/S	188	544	1900	85632				
R09	11/7/2008	65	15.0	ARGR	U/S	D/S	189	210	100	85633				
R06	11/7/2008	92	9.5		D/S	D/S								**no catch**
R06	11/7/2008	92	9.5		U/S	D/S								**no catch**
R02	11/7/2008	47	15.0		D/S	D/S								**no catch**
R02	11/7/2008	47	15.0		D/S	U/S								**no catch**
R02	11/7/2008	47	15.0		U/S	U/S								**no catch**
R02	11/7/2008	47	15.0	ARGR	U/S	D/S	190	220	150	85634				
R02	11/7/2008	47	15.0	ARGR	U/S	D/S	191	224	150	85635				
R02	11/7/2008	47	15.0	ARGR	U/S	D/S	192	214	125	85636				
R15	12/7/2008	38	9.0		D/S	U/S								**no catch**
R15	12/7/2008	38	9.0		U/S	D/S								**no catch**
R15	12/7/2008	38	9.0		D/S	D/S								1 net kept d/s to capture d/s movements; other moved u/s to catch d/s movements
R09	12/7/2008	64	11.0		U/S	D/S								**no catch**
R09	12/7/2008	64	11.0		D/S	U/S								**no catch**; removed
R06	12/7/2008	91	11.0		D/S	D/S								**no catch**
R06	12/7/2008	91	11.0	ARGR	U/S	D/S	193			85613			CYRC	
R02	12/7/2008	45	11.0	ARGR	U/S	D/S	194	210	100	85637				
R02	12/7/2008	45	11.0	ARGR	U/S	D/S	195	245	175	85638				
R02	12/7/2008	45	11.0	ARGR	U/S	D/S	196	251	200	85639				

Appendix A Table: Daily movements of fish species up- and down- stream of R02, R06, R09 and R15, biological and recapture data along the AWPAR, 2008.

Crossing ID	Date	Staff Gauge	Water Temp	Species	u/s : d/s of bridge	Direction of Movement	Fish #	Fork Length (mm)	Weight (g)	Tag #	Sex	Maturity	Recap	Comments
R02	12/7/2008	45	11.0	RNWH	U/S	U/S	197	300	300	85640				
R02	12/7/2008	45	11.0	ARGR	U/S	U/S	198	192	75	85641				
R02	12/7/2008	45	11.0	ARGR	U/S	U/S	199	222	225	85642				
R02	12/7/2008	45	11.0	ARGR	U/S	U/S	200	208	75	85643				
R02	12/7/2008	45	11.0		D/S	D/S								**no catch**
R02	12/7/2008	45	11.0		D/S	U/S								**no catch**
R15	13/7/2008	38	15.0		U/S	D/S								**no catch**
R15	13/7/2008	38	15.0		D/S	D/S								**no catch**
R09	13/7/2008	65	15.0	ARGR	U/S	D/S	201	200	100					too weak to tag
R09	13/7/2008	65	15.0	ARGR	U/S	D/S	202	228	150	85644				
R06	13/7/2008	91	9.0		D/S	D/S								**no catch**
R06	13/7/2008	91	9.0		U/S	D/S								**no catch**
R02	13/7/2008	44	15.0		D/S	D/S								**no catch**
R02	13/7/2008	44	15.0		D/S	U/S								**no catch**
R02	13/7/2008	44	15.0		U/S	U/S								**no catch**
R02	13/7/2008	44	15.0	ARGR	U/S	D/S	203	200	100	85645				
R15	14/7/2008	38	14.0		U/S	D/S								**no catch**
R15	14/7/2009	38	14.0		D/S	D/S								**no catch**
R09	14/7/2010	62	15.0		U/S	D/S								**no catch**
R06	14/7/2011	90	10.0		D/S	D/S								**no catch**
R06	14/7/2012	90	10.0		U/S	D/S								**no catch**
R02	14/7/2013	45	14.0		D/S	D/S								**no catch**; removed
R02	14/7/2014	45	14.0		D/S	U/S								**no catch**; removed
R02	14/7/2015	45	14.0		U/S	D/S								**no catch**
R02	14/7/2016	45	14.0	ARGR	U/S	U/S	204	204	260	85646				
R15	15/7/2016	37	12.0		U/S	D/S								**no catch**
R15	15/7/2016	37	12.0		D/S	D/S								**no catch**
R09	15/7/2016	62	13.0		U/S	D/S								**no catch**
R06	15/7/2016	90	8.0		D/S	D/S								**no catch**
R06	15/7/2016	90	8.0		U/S	D/S								**no catch**
R02	15/7/2016	44	12.0		U/S	U/S								**no catch**
R02	15/7/2016	44	12.0		U/S	D/S								**no catch**
R15	16/7/2016	37	11.0		U/S	D/S								**no catch; removed**
R15	16/7/2016	37	11.0		D/S	D/S								**no catch; removed**
R09	16/7/2016	60	13.0		U/S	D/S								**no catch; removed**
R06	16/7/2016	90	10.0		D/S	D/S								**no catch; removed**
R06	16/7/2016	90	10.0		U/S	D/S								**no catch**
R02	16/7/2016	42	13.0		U/S	U/S								**no catch; removed**
R02	16/7/2016	42	13.0		U/S	D/S								**no catch; removed**

APPENDIX B

PHOTOGRAPHS OF BRIDGE CROSSINGS ALONG THE AWPAR, 2008

Photo 1: Bridge crossing at R02, looking north under the bridge from ice.

Photo 2: Hoopnets set at R02, upstream of bridge.

Photo 3: Upstream side of R02 showing riffle and compensation areas.

Photo 4: Bridge at R02, looking north.

Photo 5: Photo of natural rock boulder field upstream of R06.

Photo 6: Staff moving ice chunks, upstream of bridge at R06.

Photo 7: Staff checking downstream hoopnet at R06.

Photo 8: Hoop nets on upstream side of bridge at R06, showing rock barrier.

Photo 9: Bridge at R19 looking upstream, June 17th, 2008.

Photo 10: Close up of Photo 9.

APPENDIX C

CREEL SURVEY SUMMARY, 2008

Creel data collected by the Hunter Harvest Survey (aquatic component) reported that 1254 fish were captured between March 2007 and November 2008, consisting of 9 lake whitefish (*Coregonus clupeaformis*), 26 Arctic char (*Salvelinus alpinus*) and 1219 lake trout (*S. namaycush*). No Arctic grayling (*Thymallus arcticus*), the most common fish species in streams crossed by the AWPAR, were captured. Only 11 char and 197 trout were captured during the open water season – all other fish were captured under ice. No fish were captured from within the Meadowbank project lakes. The vast majority of fish were taken from Whitehills Lake and Baker Lake, with a small number of fish taken from Schultz Lake. Five lake trout were reported being captured in the vicinity of the AWPAR, perhaps near bridge R16, or at the north end of Amarulik Lake in early July 2008. The resolution was not fine enough to determine exactly where these 5 fish were taken. Daily observations made by Azimuth personnel did not record any fishing activities along the AWPAR during 2008 monitoring.